H. KEITEL.

SCREW PROPELLER.

APPLICATION FILED APR. 9, 1913.

1,095,732. Patented May 5, 1914.

Fig. 1.

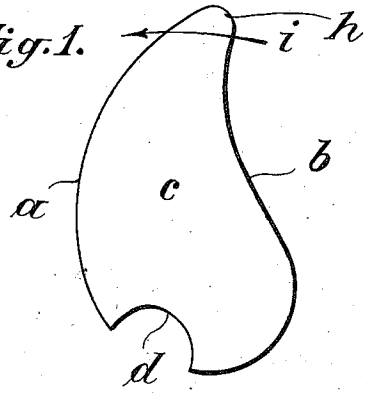


Fig. 2.

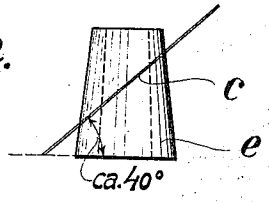


Fig. 3.

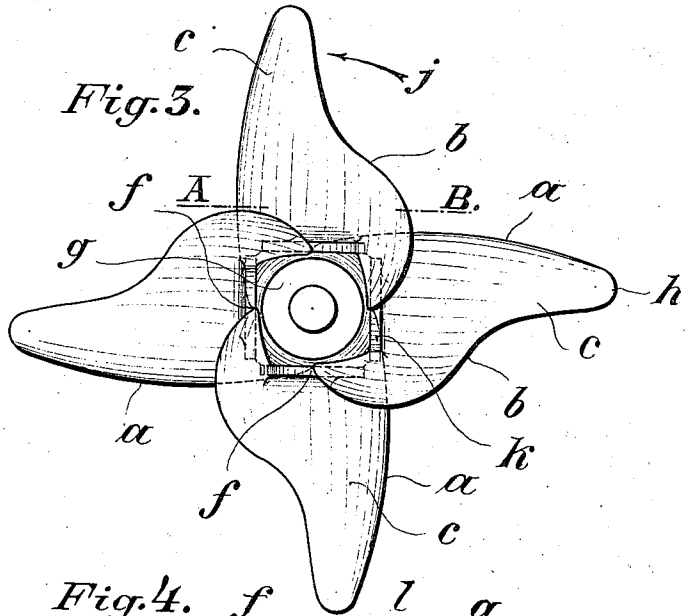
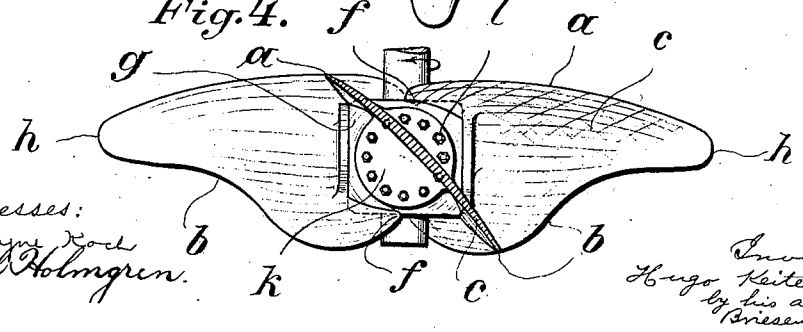


Fig. 4.



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UNITED STATES PATENT OFFICE.

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SCREW-PROPELLER.

1,095,732. Specification of Letters Patent. Patented May 5, 1914.

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To all whom it may concern:

Be it known that I, HUGO KEITEL, a citizen of the Empire of Germany, residing at 1 Grubenstrasse, Dusseldorf-Oberkassel, in the Empire of Germany, have invented a new and useful Screw-Propeller, of which the following is a specification.

My invention relates to improvements in screw-propellers, whereby an exceedingly good driving and stopping capacity is obtained, the improved screw-propeller thus combining two valuable properties in a degree hitherto not attained with the customary screw-propellers. The chief improvement consists in that each screw-blade is made to compass the nave for about half the periphery and has at the nave a width equal to about two thirds of the length or more and at the outer end a narrow width. Each blade is made either plane or slightly concave and has its front or proceeding edge curved convexly, while the rear edge is curved convexly for the inner part and concavely for the outer part. The blades may be cast in one with the nave or they may be made separate and be affixed by means of known flanges on joints of the nave. In case the blades are to be screwed on the nave by means of flanges, each blade is made to project inward from the flange so as to come on both sides in contact with the surface of the nave where each blade branch is also bolted to.

I will now proceed to describe my invention with reference to the accompanying drawing, in which—

Figure 1 is a view of an improved screw-blade alone when looked at in a direction at right angles to the blade, Fig. 2 is an upper view of the same in combination with the nave, the blade being supposed to be quite thin, Fig. 3 is a view of an improved screw-propeller with four separate blades, when looked at from the rear in the direction of the axis, and Fig. 4 is a horizontal section through the same on the line A—B in Fig. 3.

Similar letters of reference refer to similar parts throughout the several views.

Each screw-blade *c* resembles somewhat an overt bird's wing and is made wide at the nave (*e* in Fig. 2, *g* in Figs. 3 and 4) and narrow at the outer end *h*. Normally it is to turn in the direction of the arrow *i* in Fig. 1 or *j* in Fig. 3. The front or proceeding edge *a* of any blade *c* is curved convexly, while the rear edge *b* is curved convexly for the inner part and concavely for the outer part, as is clearly shown at Fig. 1. It will be seen, that the curvature of the rear edge *b* is sharper for the inner part than for the outer part. In consequence of this the blade *c* tapers outward in a curved line. In Fig. 2 the nave *e* is supposed to be outwardly conical, so that the inner edge *d* of the blade *c* has the shape shown at Fig. 1. The blade *c* may be made plane and be placed at an angle to the axis of the propeller, as is shown at Fig. 2. Where so preferred, the blade *c* may be made slightly concave as is shown at Fig. 4. The blade *c* is made to compass the nave *e* or *g* for about half the periphery, as is shown. The width of each blade *c* is made equal to about two thirds of the length or more. For the sake of clearness the blade *c* in Fig. 2 is merely represented by a thick line, while in reality the blade is to be made sufficiently strong, as is for example shown in Fig 4.

All the blades *c* may be cast in one with the nave (*e* in Fig. 2) as usual, or they may be made separate and be affixed on the nave *g* by means of circular flanges *k* and screws *l* as shown in Fig. 4. In the latter case the two inner branches of each blade *c* projecting from the flange *k* are made to bear against the surface of the nave *g* at *f*, so that the blade actually compasses the nave for about half the periphery. It is of course not absolutely necessary, that the said two branches shall come in contact with the nave for the whole length, as a slight space may be left between the blade and the nave for a length extending from the flange to a point short of the branch end, if so preferred. The essential point is that the water be substantially prevented from escaping along the nave.

When four blades *c* are provided on the screw-propeller, as shown at Figs. 3 and 4, the consequence of the described shape of the blades will be, that in the view of the propeller as in Fig. 3 the several blades *c* overlap each other, so that deep threads closed internally by the nave surface are formed, in which the water is prevented from escaping along the nave. During the turn of the propeller in the direction of the arrow *j* for driving the ship the water forced by the blades *c* from the ends *h* toward the nave *g* into the said threads will

act exactly like a screw, since it can escape from the propeller only in the direction opposite to that of the drive. When the propeller is turned in the opposite direction for stopping the ship, the blades *c* by reason of their shape have the tendency of forcing the water outward, so that they catch the water in proximity of the nave and throw it out in the direction of the drive in a spreading jet, which is favorable for accelerating the stoppage of the ship. Preferably the ends of the blade branches are bolted directly to the nave *g* at *f*, so that the durability of the propeller is thereby increased.

By the described shape of the blades *c* their points of gravity or attack are shifted nearer to the nave *e* or *g*, whereby the vibrations of the ship are reduced to a minimum or removed altogether. Owing to the proximity of the point of gravity or attack of any blade *c* to the nave *e* or *g* the thickness of the blade can also be reduced to a minimum, whereby of course not only the passage of the water between the blades is facilitated, but also the resistance of the water to the front edges of the blades is reduced.

The several blades *c* of the propeller should make with the plane of rotation (at right angles to the axis) an angle of about 40°, as is shown at Figs. 2 and 4.

A theory was heretofore generally held, to the effect that in a propeller, the water is thrown outward on the blades by centrifugal action. This theory has been disproven by Prof. Flamm of Charlottenburg, Germany, by means of photostereoptic views of a number of ship propellers while turning in water, and also by Prof. Ahlborn (see Flamm's *Die Schiffschraube und ihre Wirkung auf das Wasser*). A centrifugal action, can not take place, for the reason among others, that the pushing effect of the driving blade surface exerted upon the water is far in excess of the centrifugal effect. The water receives, at the propeller, a considerable acceleration parallel to its shaft, while the component resulting from the centrifugal force is negligible when compared with that resulting from the pushing force, so that as a consequence the off-flowing water leaves the propeller substantially parallel to the shaft-axis. A different effect is obtained, when a propeller sprinkled with water is rotated out of water. In that case the centrifugal effect exceeds considerably the pushing effect, so that the water is thrown outward.

The notion that the propeller throws the water outwardly may be based on the observation that back of ships a water mound frequently appears, but this mound is stow-water from propeller to rudder.

With applicant's construction, the water is forced from the ends of the blades toward the hub, for the reason that the effective area of the blades increases from tip to root, and that the roots are not placed parallel or nearly parallel to the hub as heretofore, but at an angle of from 35°–40°.

From the old construction it resulted that the water at the hub would be rotated by the propeller-roots in a circle, so that the blades would at this zone exercise no pushing force. In this way this zone would represent not only an actual loss of power, but it would act in the manner of a brake, because the energy of the propeller would be in part expended to force the water in the shape of a cylinder around the hub. This cylinder will, corresponding to the number of propeller revolutions, and owing to its inherent centrifugal force, be thrown outward in the form of a hollow cylinder, while behind the hub are formed hollow vacuum spaces. The latter exercise a suction on the hub and consequently on the shaft and thus produce a negative power component. It is therefore not possible, with these propellers, to carry the water to the hub, inasmuch as the compressed water cylinder occupies this space and thus prevents the blades from pressing the water inwardly. This objection is entirely obviated by my construction, by which all the blade elements effect a screw propulsion, and there is no zone in which the water idly circles.

The screw-propeller can be varied without departing from the spirit of my invention.

Thus the water which has once been caught by the entering blade-edge, can obviously not escape from the blade-surface, until it has reached the outgoing blade edge. The angular velocity is during the rotation of the propeller, the same at all points of the blade, be it at the outer circumference or directly at the hub. Now the blade is widest at the hub, and narrowest by far at the circumference. Each blade therefore presses longest at that point upon the water quantum grasped by it, where its surface is widest. In consequence thereof and owing to the equal angular velocity at each point of the blade, the water will receive its greatest acceleration where the greatest quantity of water comes into contact with the pressure surface of the blade, during the same time unit, that is at the broadest blade-portion, directly at the hub. The off-flowing water which is here greatly accelerated, and leaves the propeller with greater velocity, exerts a pronounced suction upon the surrounding water, even at the propeller itself, according to the principle of an injector. This suction draws the water from the outer parts of the blades toward the hub to be thrown by the wide propeller faces here provided with great velocity behind the propeller in a direction parallel to the hub-axis.

During backing, the action of the propel-

ler blades upon the water is as follows: The water greatly accelerated by the wide blade surfaces, is by the sudden change of rotation, caught by the now in-cutting blade edge, and is similar to the operation during the forward movement, now during backing greatly accelerated by the broad blade surfaces next to the hub. This accelerated body of water at the hub is with great force driven against the water still flowing toward the propeller (the ships still moving forward). In this way there takes place, behind, (*i. e.* now in front of the propeller) a heavy stowage of water, by which the water is driven asunder conically, whereby a particularly effective stopping action is obtained.

The operations described can only be effected, by the wide blade surfaces around the hub, and because these broad surfaces are set at such an angle to the plane of rotation, that the propeller also exerts a pushing action on the water at and around the hub, and thus here materially accelerates the motion thereof.

I claim:

1. A screw-propeller comprising a nave and blades, each blade compassing the nave for about half the periphery and having at the nave a width equal to about two thirds of the length or more and at the outer end a narrow width.

2. A screw-propeller comprising a nave and blades, each blade compassing the nave for about half the periphery and having at the nave a width equal to about two thirds of the length or more and at the outer end a small width, the front edge of each blade being curved convexly and the rear edge being curved convexly for the inner part and concavely for the outer part.

3. A screw-propeller comprising a nave with joints and separate blades with flanges fitting said joints, each blade compassing the nave for about half the periphery and having at the nave a width equal to about two thirds of the length or more and at the outer end a narrow width, and each blade being adapted to be bolted to the nave not only in the joints but also in the branches projecting from the flange.

4. A screw-propeller comprising a nave with joints and separate blades with flanges fitting said joints, each blade compassing the nave for about half the periphery and having at the nave a width equal to about two thirds of the length or more and at the outer end a narrow width, and each blade being adapted to be bolted to the nave not only in the joints but also in the branches projecting from the flange, the front edge of each blade being curved convexly and the rear edge being curved convexly for the inner part and concavely for the outer part.

5. A screw-propeller comprising a nave and blades overlapping each other in the view in the direction of the axis, each blade compassing the nave for about half the periphery and having at the nave a width equal to about two thirds of the length or more and at the outer end a narrow width, and the blade parts at the nave forming therewith threads for the water.

6. A screw-propeller comprising a nave and blades overlapping each other in the view in the direction of the axis, each blade compassing the nave for about half the periphery and having at the nave a width equal to about two thirds of the length or more and at the outer end a small width, the front edge of each blade being curved convexly and the rear edge being curved convexly for the inner part and concavely for the outer part, and the blade parts at the nave forming therewith threads for the water.

7. A screw-propeller comprising a nave with joints and separate blades with flanges fitting said joints, each blade compassing the nave for about half the periphery and having at the nave a width equal to about two thirds of the length or more and at the outer end a narrow width, each blade being adapted to be bolted to the nave not only in the joints but also in the branches projecting from the flange, the blades overlapping each other in the view in the direction of the axis and the blade parts at the nave forming therewith threads for the water.

8. A screw-propeller comprising a nave with joints and separate blades with flanges fitting said joints, each blade compassing the nave for about half the periphery and having at the nave a width equal to about two thirds of the length or more and at the outer end a narrow width, each blade being adapted to be bolted to the nave not only in the joints but also in the branches projecting from the flange, the front edge of each blade being curved convexly and the rear edge being curved convexly for the inner part and concavely for the outer part, the blades overlapping each other in the view in the direction of the axis and the blade parts at the nave forming therewith threads for the water.

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