March 14, 1939. E. V. TELFER 2,150,299

PROPELLER

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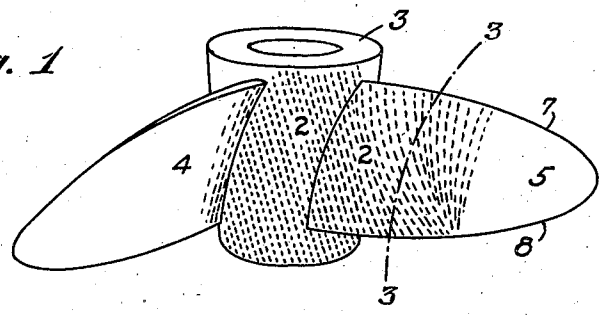
Fig. 1



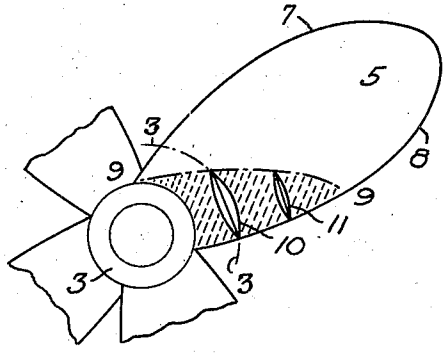


Fig. 2

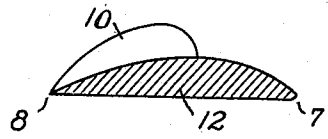


Fig. 3

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PROPELLER

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6 Claims. (Cl. 170—170)

This invention relates to propellers for ships and aircraft and has for its object to provide a construction which is simple to manufacture and more efficient in use than those heretofore proposed.

Therefore the principal object is to provide a simple means of increasing propeller efficiency, my particular purpose being to prevent the wasteful increase of torque induced by blade interference towards the hub. More particularly stated my invention comprehends a propeller provided with concentric ribs on the trailing half of each blade near to the hub to prevent flow distortion due to the mutual interference of consecutive blades.

With these and other objects in view the invention resides in the novel details of construction and combinations of parts as will be disclosed more fully hereinafter and particularly pointed out in the claims.

Referring to the accompanying drawing forming a part of this specification and in which like numerals designate like parts in all the views—

Fig. 1 is a perspective view of a propeller in which is indicated the flow paths through the propeller across the hub, on the driving face of one blade, and on the back of the next adjacent blade;

Fig. 2 is a fragmentary plan view of a propeller looking down upon the back or suction face of the blades, which face of course looks forward when the propeller is in position on a ship, one of the blades showing my invention applied thereto; and

Fig. 3 is a transverse section through a blade taken as on the line 3—3 of Fig. 2, but showing in elevation the preferred outline of a flow rib.

On cast iron propellers of conventional design which have been for some time in service I have observed a skin granulation which unmistakably indicates the path of the water over the propeller surface. Around the hub 3 this flow path is chiefly across and not along the gap between adjacent blades. The path continues over the trailing half of the blade back, following a track of quite violently increasing radius from the axis of rotation instead of the constant or slightly decreasing radius track which might be expected from simple theoretical considerations and which incidentally is actually followed by the skin granulations on the blade driving face 4 and on the leading half of the blade back 5. This direction of formation of the granulation is indicated in Fig. 1 by the dotted areas 2.

The distorted flow over the back 5 appears to be broadly confined to a zone defined in circumferential expansion by the square projection of the following blade leading edge on to the back of the preceding blade. This zone proceeds from somewhat abaft the leading edge at the hub, diagonally across to the trailing edge at about one-third to one-half of the propeller radius, depending upon the local blade width and pitch ratio.

Flow distortion as above described evidently results from the excessive rotational velocity imparted to the water when virtually churned in the gap between contiguous blade roots, such action leading to the formation of the well known hub vortex. The effect of the flow distortion upon the blade forces can be simply demonstrated. Since the actual flow path on the blade back is much longer than the constant radius path, the actual flow velocities will be higher and therefore the back suctions greater on the trailing half of the back than had the constant radius path been followed. The lift or drag of the blade sections will therefore both be increased, the net effect being chiefly to increase the transverse force across the blade, thus increasing the propeller torque and leaving the thrust practically unchanged.

Increased blade number and root blade width results in increased blade overlap, thus causing flow distortion and torque increase. Experiment shows lower efficiency with increased blade number despite the gain which must result from a more uniform slipstream velocity.

The purpose of the present invention is to prevent this flow distortion and thus provide a means of improving propeller efficiency. This is accomplished by placing, within the distortion zone, a streamlined rib or ribs such as 10 and 11 on the trailing half of each blade back. In Fig. 2 this distortion zone is defined by the dot and dash line 9—9 and the trailing edge 8 of a blade, this zone having the dash line shading to represent the reduced pressure region on the back of a blade due to the partial vacuum caused by the next preceding blade, 7 representing the leading edge of the blade. By arranging each rib substantially on a cylindrical section through the blade or parallel to the hub taper, its own resistance is a minimum, and the rib 10 has been illustrated as disposed on such a cylindrical section, said section being represented by the dot and dash line 3—3; any auxiliary ribs will be disposed on other but corresponding sections. This rib is shown substantially spanning said reduced pressure region and provided with an up-

per edge which slopes gradually toward and merges into the blade surface at the trailing edge of the blade, the leading portion of said upper edge curving relatively sharply toward the blade surface, thereby producing quick entry of the rib into the water, and a gradual easement in the trailing portion upon rotation of the propeller; the fish or streamline form of the rib in its cross-section taken parallel to the face of the blade, further reduces its resistance to the water. One rib, of height about equal to the local blade thickness, is likely to be enough to prevent flow distortion, and actual model tests of such an arrangement have shown the propeller torque to be reduced by six per cent at constant revolutions and thrust as compared with the same propeller without ribs. When the distortion zone is relatively large, as with high pitch ratios and very wide blades, an additional rib such as 11, serving as an auxiliary to the primary rib such as 10, may be usefully adopted to prevent any stalling of the primary rib corrective flow. The adoption of a multiplicity of ribs, however, fitted partially or wholly across the blade on both faces over the whole blade would give no additional corrective flow control and would merely, by their added frictional resistance, uselessly increase the propeller torque and reduce the thrust and efficiency.

In the manufacture of my improved propeller the ribs may be cast integral with the blades or separately attached in any suitable manner. Such improved propellers may be made of any of the usual materials such as brass, cast steel, cast iron, etc. and may include the use of such surface protections as vulcanizing etc. for the prevention of blade erosion and corrosion.

Summarizing the constructions illustrated in the drawing, in Fig. 1 dotted loci or areas 2 are shown on which is indicated the flow paths through the propeller across the hub 3, on the driving face 4, and on the back 5; by way of contrast the dot and dash line 3—3 illustrates a path concentric with the shaft axis from the leading edge 7 to the trailing edge 8. In Fig. 2 the same line 3—3 is shown and the dot and dash line 9—9 represents the approximate limit of the reduced pressure region (indicated by the dash lines) from the trailing edge 8 of the blade; 10 represents a primary rib located on the concentric path 6—6, while 11 represents an auxiliary rib. In Fig. 3 the blade is shown in transverse section at 12, taken as on the line 3—3 of Fig. 2, and the preferred outline of the primary and auxiliary ribs is indicated by the elevational showing of rib 10, with 7 and 8 representing respectively the leading and trailing edges of the propeller blade.

It is obvious that those skilled in the art may vary the details of construction and arrangements of parts without departing from the spirit of this invention and therefore it is desired not to be limited to the exact foregoing disclosure except as may be demanded by the claims.

What is claimed is:

1. A propeller provided with overlapping blades, each blade having on its suction face a rib disposed substantially concentric with the propeller axis, said rib being of a longitudinal length from the trailing edge to span the reduced pressure region on that blade induced by the next preceding blade.

2. A propeller provided with overlapping blades, each blade having on its suction face a rib disposed substantially concentric with the propeller axis, said rib extending from the trailing edge a distance substantially equal to the amount of the reduced pressure region on that blade induced by the next preceding blade.

3. A propeller provided with overlapping blades, each blade having on its suction face a rib disposed substantially concentric with the propeller axis, said rib being of a longitudinal length from the trailing edge to span the reduced pressure region on that blade induced by the next preceding blade, said rib having an elevation above the blade surface which is of the order of the thickness of the blade at the rib location.

4. A propeller provided with overlapping blades, each blade having on its suction face a rib disposed substantially concentric with the propeller axis, said rib extending from the trailing edge a distance substantially equal to the amount of the reduced pressure region on that blade induced by the next preceding blade, said rib having an elevation above the blade surface which is of the order of the thickness of the blade at the rib location.

5. A propeller provided with overlapping blades, each blade having on its suction face a rib disposed substantially concentric with the propeller axis, said rib being disposed over the trailing portion of the blade and substantially within the reduced pressure region on that blade induced by the next preceding blade.

6. A propeller provided with overlapping blades, each blade having on its suction face a rib disposed substantially concentric with the propeller axis, said rib extending from the trailing edge a distance substantially equal to the amount of the reduced pressure region on that blade induced by the next preceding blade, the upper edge of said rib sloping gradually toward and merging into the blade surface at the trailing edge of said blade, the leading portion of said rib having the upper edge thereof curving relatively sharply toward the blade surface.

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