Dec. 22, 1942. O. W. MATTSON 2,306,177

PROPELLER BLADE

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Fig. 1.

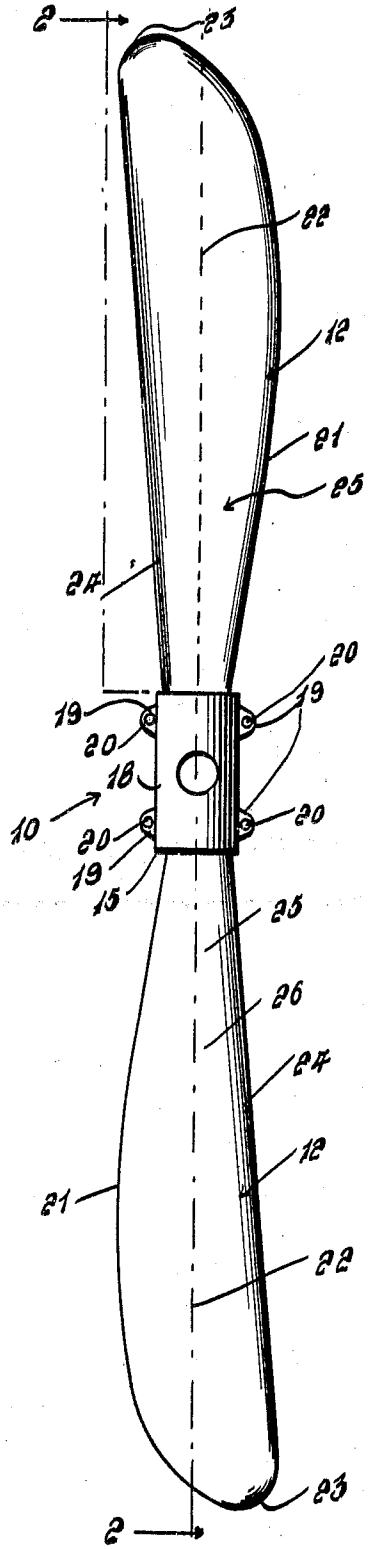


Fig. 4.

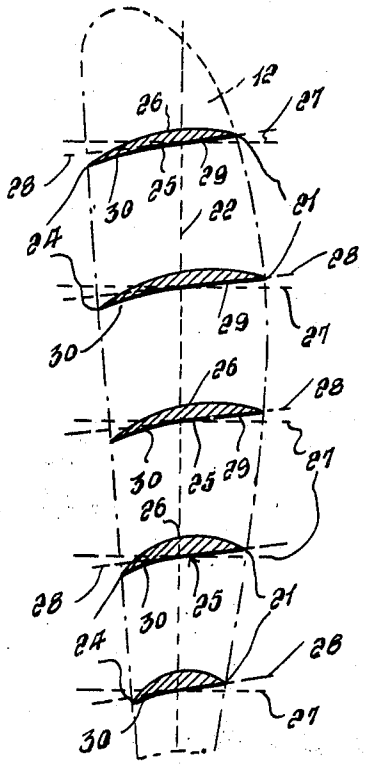
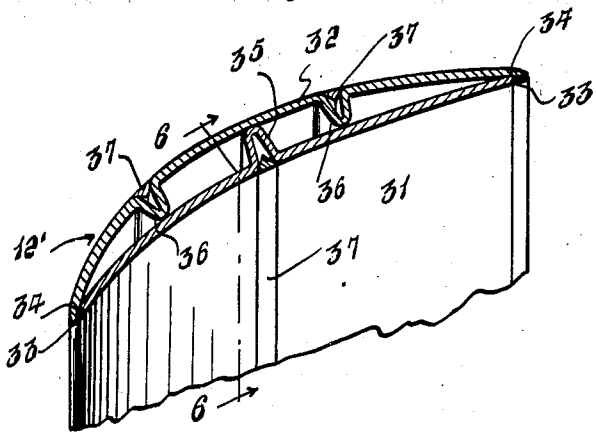


Fig. 5.



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Fig. 2.

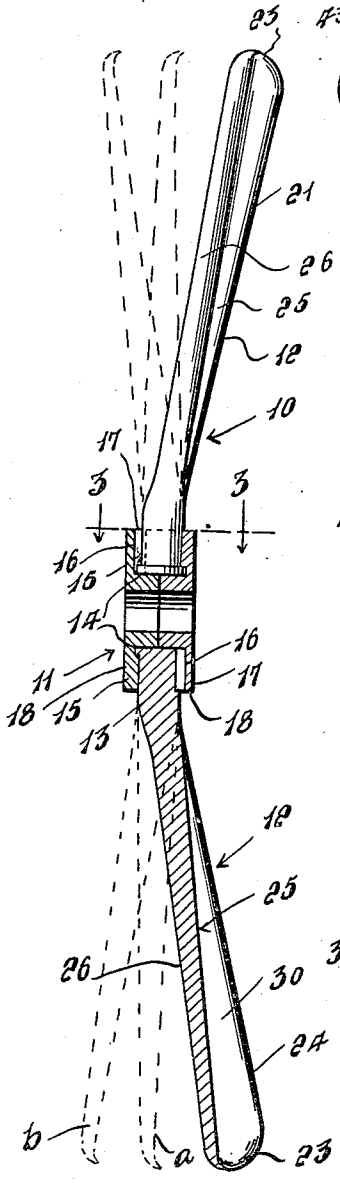


Fig. 7.

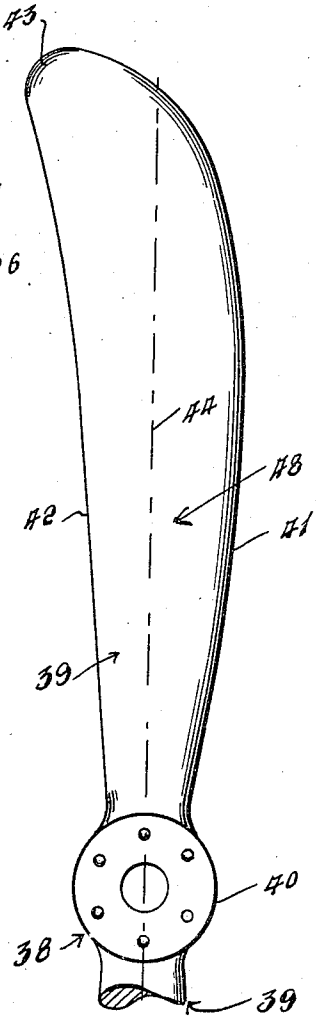


Fig. 8.

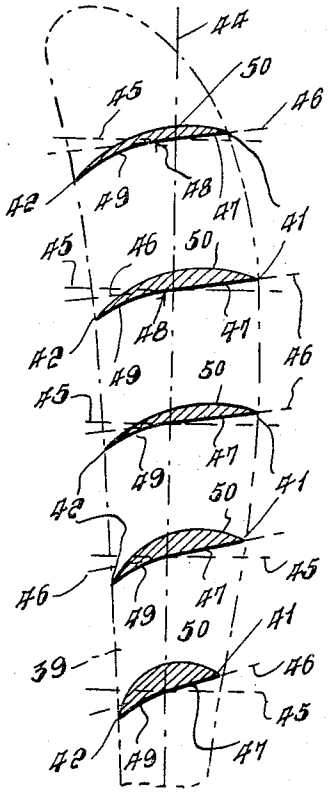


Fig. 6.

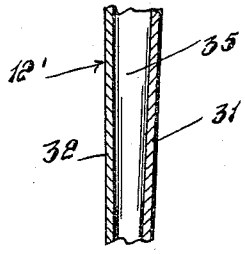
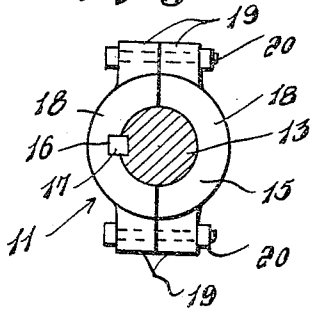


Fig. 3.



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UNITED STATES PATENT OFFICE

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PROPELLER BLADE

Otto W. Mattson, Baltimore, Md.

Application May 22, 1941, Serial No. 394,700

3 Claims. (Cl. 170—159)

This invention relates to an improved construction of propeller blade, particularly adapted for use on aircraft, and also adapted for use on boats, fans, and other devices employing propelling blades.

It is a particular aim of the invention to provide a novel construction of propeller blade so designed that the propelling power thereof is increased relatively to conventional propelling blades now in use by varying the pitch, position and shape of the blade.

Still a further aim of the invention is to provide a propeller blade so constructed that the pitch of the pressure or back surface of the blade is greater adjacent its trailing edge than at its leading edge to form a pocket which is so constructed that the air will be compressed therein and directed longitudinally from the root toward the tip so that the extent to which the air will be compressed will be increased from the root to the tip of the blade to thereby prevent the air slipping off the trailing edge, laterally thereof.

Still another aim of the invention is to provide a propeller blade having a rearwardly flared tip for holding the air in the outer end of the pocket formed in the pressure surface of the blade.

Still a further aim of the invention is to provide a proller blade which is substantially wider adjacent its tip than at its root, and wherein the longitudinal axis of the blade passes through the leading edge thereof, adjacent the tip of the blade so that the entire tip portion of the blade is disposed adjacent the trailing edge thereof.

Still another aim of the invention is to provide a propeller blade wherein the trailing edge is inclined away from the longitudinal axis of the blade, from its root towards its tip, so that the pocket formed in the pressure side of the blade will be substantially wider adjacent the tip, where the air is compressed to the greatest extent, than adjacent the root of the blade.

Still a further aim of the invention is to provide a propeller blade which is tilted rearwardly so that the tilt thereof will combine with the pocket in the pressure surface of the blade to increase the extent to which the pocket will function for holding and retaining the air compressed therein.

Other objects and advantages of the invention will hereinafter become more fully apparent from the following description of the drawings, which illustrate preferred embodiments of the invention, and wherein—

Figure 1 is a rear elevational view looking toward the pressure surfaces of the blades of a propeller,

Figure 2 is a longitudinal sectional view, partly in side elevation, taken substantially along the plane of the line 2—2 of Figure 1, showing the propeller blades in a preferred position in full lines, relatively to the hub, and in alternate positions in dotted lines,

Figure 3 is an enlarged cross sectional view taken substantially along the plane of the line 3—3 of Figure 2,

Figure 4 is a fragmentary view showing a portion of one of the blades of Figure 1 in dotted lines, and showing various parts of the blade in cross section as they would appear looking toward the root end of the blade, said cross sectional portions of the blade being located in their correct positions in the dotted outline of the blade,

Figure 5 is a cross sectional view of a similar blade formed of hollow, metal construction,

Figure 6 is a longitudinal sectional view taken substantially along the plane of the line 6—6 of Figure 5,

Figure 7 is a fragmentary rear elevational view of a slightly modified construction of the blade, mounted on a different type of hub, and

Figure 8 is a view similar to Figure 4 of the modified propeller blade as shown in Figure 7.

Referring more particularly to the drawings, wherein like reference characters designate like or corresponding parts throughout the different views, and referring particularly to Figures 1 to 4, 10 designates generally an aeroplane propeller including a hub 11 and corresponding blades 12 which project therefrom in opposite directions.

As seen in Figure 2, the blades 12 are provided with roots 13 having enlarged or flanged terminal ends 14. The hub 11 is provided with outwardly opening sockets 15 at its ends shaped to snugly receive the blades 12 and said roots 13 and sockets 15 are provided with registering grooves 16 for receiving keys 17 by means of which the blades 12 are keyed to the hub 11 so that they cannot turn on their longitudinal axes. As seen in Figure 3, the hub 11 is formed of corresponding sections 18 having apertured outwardly projecting ears 19 for receiving bolts of nut and bolt fastenings 20, by means of which the blades are removably mounted in the hub.

Each of the blades 12 is provided with a leading edge 21 which is outwardly bowed relatively to the longitudinal axis of the blade, as indicated by the line 22 and which crosses the longitudinal axis of the blade adjacent the tip of the blade, designated 23. The trailing edge 24 of the blade

12 is substantially straight and is inclined away from the longitudinal axis of the blade, from its root 13 to its tip 23.

25 designates generally the pressure surface of each of the blades 12, and, as seen in Figure 4, 26 designates the forward or non-pressure surface of the blade 12 and which is convex and curved so as to offer the minimum of resistance to the rotation of the blade. In Figure 4, the line 27 indicates the plane of the blade 12, and it will be apparent that the portion of the forward surface 26, between the leading edge 21 and the longitudinal axis 22 of the blade, is arranged relatively to its plane 27 so that it will offer practically no resistance to the rotation of the blade, while the portion of the surface 26, between the trailing edge 24 and the longitudinal axis line 22, is curved rearwardly and will offer no resistance.

The lines 28, Figure 4, represent the pitch of different parts of the leading portion 29 of the pressure surface 25, which portion is disposed between the leading edge 21 and the longitudinal axis 22, and it will be apparent that the pitch of the portion 29, adjacent the root 13 and tip 23 is greater than the pitch of the portion 29 intermediate of the ends of the blade. Likewise, the portion 29 is substantially flat or slightly concave. The portion 30 of the pressure surface 25, which is disposed between the longitudinal axis 22 of the blade 12 and its trailing edge 24 is concave and rearwardly curved to form a longitudinally extending pocket which increases in width from the root 13 to the tip 23. As best seen in Figure 2, the tip 23 is flared rearwardly to form the outer end of the pocket and as the width of the portion 30 increases toward the tip 23 it will be apparent that the trailing edge 24, adjacent the tip 23 is disposed a greater distance to the rear of the plane 28 of the blade 12 than it is adjacent the root so that the depth of the pocket is greater near the tip than near the root, for a purpose which will hereinafter become apparent.

As seen in Figure 2, the roots 13 are preferably disposed at an angle to the remainder of the blades 12 and are so arranged that the blades 12 are tilted rearwardly, as seen in full lines in Figure 2, to thereby increase the effectiveness of the pockets, formed by portions 30 and tips 23, for holding the air. However, blades 12 may project straight from the hub 11, as seen in dotted lines at *a*, or may be tilted forward, as seen in dotted lines at *b*.

The blades 12, illustrated in Figures 1 to 4, are of solid construction. In Figures 5 and 6, a portion of a blade, designated generally 12′ is illustrated. The shape of the blade 12′ corresponds to that of the blade 12, but the blade 12′ is formed of hollow construction including two elongated metal plates 31 and 32. The plate 31 forms the pressure side of the blade 12′ and the plate 32 forms its opposite, forward side. The longitudinal edges of the plate 32 project beyond the longitudinal edges of the plate 31. The longitudinal edges of the plate 31 bear against the inner side of the plate 32, which is grooved, as seen at 33 therebeyond for receiving welding 34 which connects the plates 31 and 32, adjacent their longitudinal edges. The plate 31, intermediate of its longitudinal edges is provided with an inwardly pressed portion forming a rib 35 which bears against the intermediate portion of the inner side of the plate 32. Plate 32 is provided with two similar ribs 36 which are disposed one on either side of the rib 35 and which project inwardly from the plate 32 and bear against the inner side of the plate 31. The ribs 35 and 36 form braces for reinforcing and holding the plates 31 and 32 in properly spaced apart relationship relatively to one another. The grooves in the outer sides of the plates 31 and 32, formed by the ribs 35 and 36 are sealed by means of strips 37 which are secured therein in any suitable manner, not shown, and which are disposed flush with the outer sides of the plates 31 and 32.

A slightly modified form of the invention is shown in Figures 7 and 8, wherein a propeller 38 is provided with two corresponding blades 39, the roots of which are formed integral with the periphery of a circular hub 40. The leading edge 41 of each of the blades 39, only one of which is fully shown, is outwardly bowed similar to the leading edge 21 of the blade 12, and the trailing edge 42 of the blade 39 is inwardly bowed or bowed in the same direction as the leading edge 41. The trailing edge 42 is also curved from the root of the blade 39 toward its tip 43 in a direction away from the longitudinal axis of the blade 39, as indicated by the line 44. The lines 45, in Figure 8, indicate the plane of the blade 39 and the lines 46 indicate the pitch of the different parts of the forward portion 47 of the pressure side 48 of the blade 39. The portion 47, of the blade 39, corresponds to the portion 29 of the blade 12, and said portion 47 is substantially flat and of different widths. The trailing portion 49 of the pressure surface 48, which corresponds to the portion 30 of the blade 12, is curved rearwardly and is concave and pitched to a greater extent than the portion 47 to form a longitudinally extending pocket which increases in width toward the tip 43. As seen in Figure 7, the tip 43 is flared rearwardly to form the outer end of the pocket. The forward or non-pressure side 50 of the blade 39 is curved similarly to the side 26 of the blade 12. In view of the detailed description of the propeller 10, a further description of the construction of the details of the propeller 38 is considered unnecessary.

In both the blades 12 and 39, the surfaces or portions 30 and 49, respectively, as previously stated, form pockets which catch the air from the portions 29 and 47, respectively, and this air is directed centrifugally toward the tips 23 and 43 and is compressed to an increased extent, as it approaches the tips of the blades from where the air is thrown back into the slipstream with a maximum force to afford the maximum of efficiency of operation of the blades. The blade 39, if desired, can also be tilted rearwardly similarly to the blade 12, as illustrated in Figure 2, and when thus tilted, as previously stated the effectiveness of the pockets in the blades formed by the portions 30 and 49 is increased to prevent escape of the air from the pressure surfaces of the blades to give greater pulling power to the propeller and to also materially reduce the noise and vibration created by the propeller. Likewise, the rearwardly inclined trailing edges 24 and 42 also tend to prevent the air from escaping therefrom and act to cause the air to move toward the tips of the blades. By providing propeller blades which are wider near their tips than near their roots, the effectiveness of the blades is increased, as the portions of the pressure surfaces, adjacent the tips of the blades, afford a greater propelling force than the portions of the blades adjacent the roots, so that by increasing the width of the tip portion of the blade and especially of the pocket part thereof, formed by either

the outer part of portions 30 or 48, the effectiveness of the blades 12 and 39 is further increased.

The invention has been described in conjunction with a propeller blade, but it is to be understood that it is equally as well adapted for fans, ship propellers and the like.

Various modifications and changes are contemplated and may obviously be resorted to as only preferred embodiments of the invention have been disclosed.

I claim as my invention:

1. A propeller blade, the rear or pressure face of said blade being pitched, the pitch of said pressure face varying at different points between the root and tip of the blade, said pressure face being substantially flat between the longitudinal axis of the blade and its leading edge, and said pressure face being concave and rearwardly curved from its longitudinal axis to its trailing edge to provide a longitudinally extending pocket in the pressure face of the blade and adjacent the trailing edge thereof, the width of the flat, leading portion of the pressure face of the blade diminishing toward the tip and root, and the width of the trailing, rearwardly curved and concave portion of the pressure face of the blade increasing in width from its root to its tip.

2. A propeller blade, the rear or pressure face of said blade being pitched, the pitch of said pressure face varying at different points between the root and tip of the blade, said pressure face being substantially flat between the longitudinal axis of the blade and its leading edge, and said pressure face being concave and rearwardly curved from its longitudinal axis to its trailing edge to provide a longitudinally extending pocket in the pressure face of the blade and adjacent the trailing edge thereof, said blade being formed of elongated metal plates connected along their longitudinal edges, said plates converging or tapering from their longitudinal centers toward their longitudinal edges, said plates having inwardly pressed ribs, intermediate of their longitudinal edges, the rib of each plate engaging against the inner side of the other plate to provide longitudinally extending braces, and means for sealing the grooves formed in the outer sides of said plates by said ribs.

3. A propeller blade formed of elongated metal plates connected along their longitudinal edges, said plates converging from their longitudinal centers towards their longitudinal edges, said plates having inwardly pressed ribs, intermediate of their longitudinal edges, the rib of each plate engaging against the inner side of the other plate to provide longitudinal extending braces, and means for closing the grooves formed in the outer sides of the plates by said ribs.

OTTO W. MATTSON.