

Nov. 25, 1947.

J. H. McKEE

2,431,411

PLATE COMPONENT FOR PROPELLER BLADES

Filed July 2, 1943

2 Sheets-Sheet 1

Fig. 1.

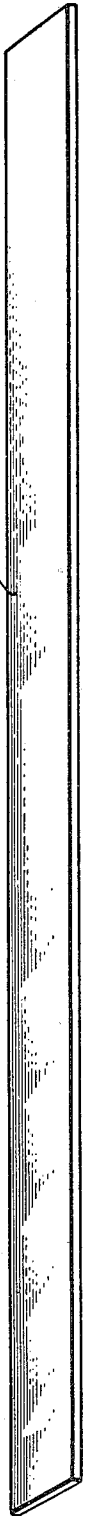


Fig. 2.

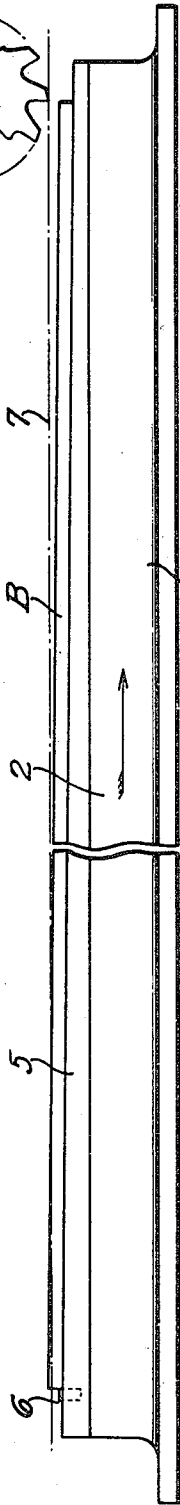


Fig. 3.

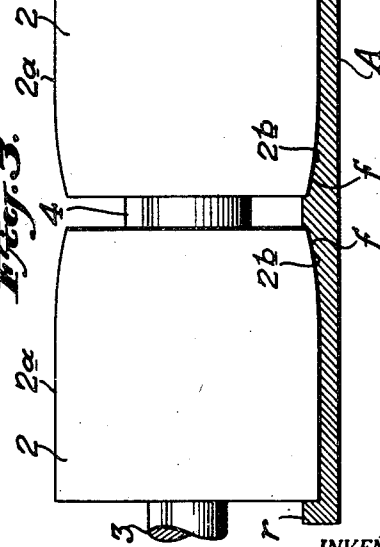
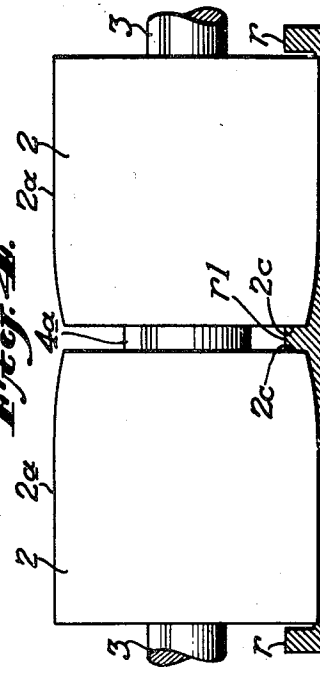


Fig. 4.



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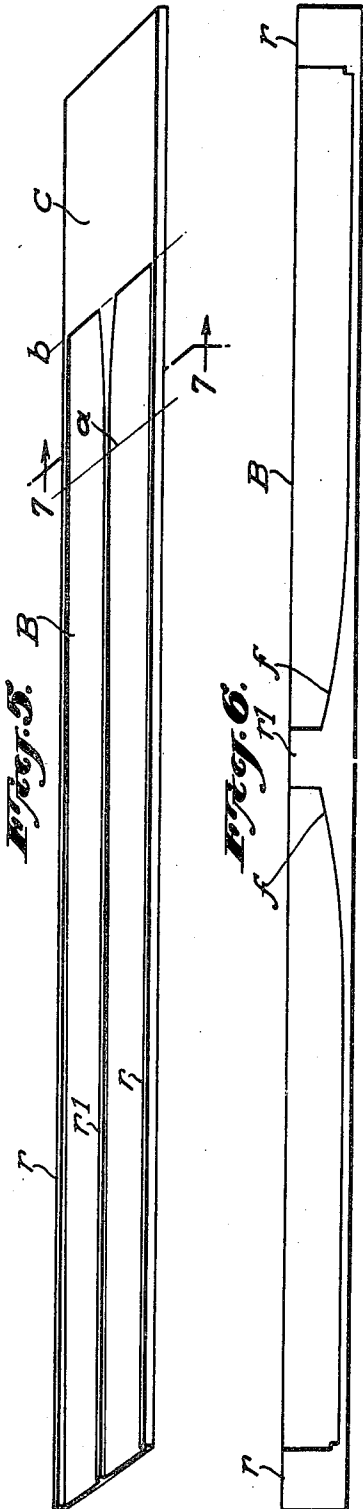
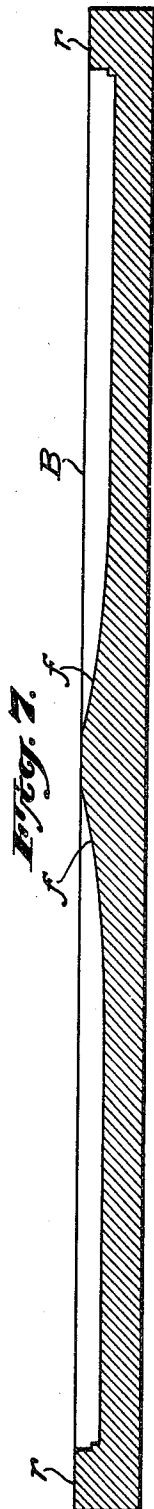
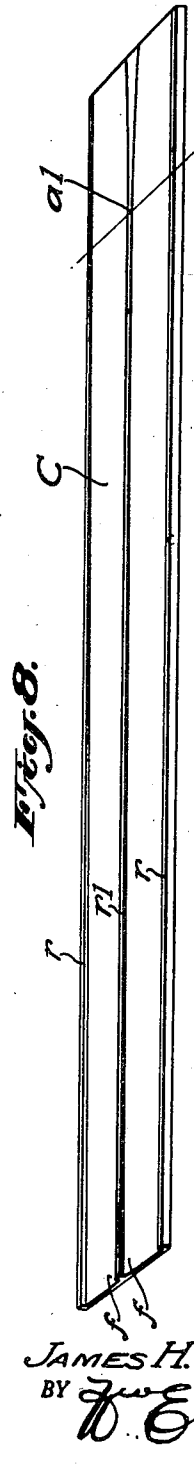
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PLATE COMPONENT FOR PROPELLER BLADES

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2 Sheets-Sheet 2



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PLATE COMPONENT FOR PROPELLER
BLADESJames H. McKee, North Caldwell, N. J., assignor
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Application July 2, 1943, Serial No. 493,314

3 Claims. (Cl. 29—190)

1 My invention relates to plates or plate constructions, a pair of said plates, when completed, serving as the camber and thrust plates of a hollow propeller blade.

In accordance with my invention, the contour of one surface of a blank plate is changed to remove material therefrom and form a rib between the edges thereof; more particularly, the plate contour is changed by action of a milling cutter on said blank plate.

My invention has particular reference to a plate having opposite surfaces of plane and tapered configuration, respectively, the tapered surface having a rib projecting therefrom between the edges of said plate and formed integrally therewith.

Various other objects, advantages and features of my invention will become apparent from the following detailed description.

My invention resides in the novel plates or plate constructions and features of the character hereinafter described and claimed.

For an understanding and an illustration of my invention, reference is to be had to the accompanying drawings, in which:

Figure 1 is a perspective view of a blank plate destined to form a propeller plate;

Fig. 2 is an elevational view illustrating the milling operation of my invention;

Figs. 3 and 4 are enlarged elevational views, partly in section, further illustrative of the milling operation of my invention;

Fig. 5 is a perspective view showing one form of novel plate of my invention;

Fig. 6 is an end view of the plate shown in Fig. 5;

Fig. 7 is a transverse sectional view taken on the line 7—7 of Fig. 5; and

Fig. 8 is a perspective view showing another form of novel plate of my invention.

Referring to Fig. 1, I have shown a blank plate A as known in the propeller manufacturing art, said plate A, after the performance of suitable operations, forming a partially completed propeller plate or plate construction B as shown in Fig. 5. The plate A is formed from steel or other suitable metal and is of uniform thickness throughout the area thereof. It has parallel edge and end surfaces, the top and bottom surfaces thereof being of plane configuration.

In Fig. 2, I have illustrated the bed 1 of a milling machine which, as understood in the art, is movable horizontally in both directions. As shown in Figs. 2, 3 and 4, the milling machine comprises a cutter arrangement formed, prefer-

ably but not necessarily, from two cutters 2, 2 secured to the same horizontal shaft 3, facing surfaces of said cutters 2, 2 being separated from each other to the desired extent by a washer 4 detachably carried by the shaft 3. For a purpose hereinafter to be described, the overall length of the cutters 2, 2 and the separating washer 4 is somewhat less than the width of the blank plate A.

10 In accordance with the invention, each of the milling cutters 2 comprises a cylindrical cutting surface 2a merging into a curved fillet-producing surface 2b of suitable configuration as will be understood, each cutting surface 2b merging into a vertical cutting surface 2c, the cutting surfaces 2c facing each other. As shown, the curved cutter surfaces 2b are adjacent each other while the cylindrical surfaces 2a form the outer ends of the cutter arrangement.

20 As shown in Fig. 2, the bed 1 carries a plate 5 having greater thickness at the end thereof toward the left than at the right. The blank plate A, during the milling operation, rests upon the plate 5 and the end thereof toward the left engages suitable stop members 6. By reason of the described thickness characteristic of the plate 5, it results that the thereby-supported blank plate A is inclined somewhat as indicated in Fig. 2 by the broken line 7 which represents a horizontal plane.

30 With the parts arranged substantially as shown in Fig. 2, adjustment is effected to cause the cutters 2, 2 to remove material from the upper surface of the blank plate A to the desired depth. Thereupon, the bed 1 is moved from left to right while the cutters 2, 2 are rotated in a clockwise direction, Fig. 2. Due to the inclined relation of the plate A, engagement between the upper surface thereof and the cutters 2, 2 does not occur until after the bed 1 has moved a substantial distance toward the right, Fig. 2. At the start of the operation, material is removed from the plate A to a minimum depth and, as the operation proceeds, the depth of the cut constantly increases, this being true by reason of the inclination of said plate A. Therefore, the upper surface of said plate A is caused to have generally a tapered configuration.

45 As hereinbefore stated, the length of the cutters 2, 2 is somewhat less than the width of the blank plate A. When the latter is initially positioned on the plate 5, it is symmetrically related to the cutters 2, 2 so that, during the milling operation, integral edge ribs r, r of equal thickness or substantially so are formed at the respective edges

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of the plate A simultaneously as the described tapering operation proceeds.

Further, during continuance of the cutting operation described above, the curved cutter surfaces 2b, 2b produce the plate fillets f, f which are disposed at the respective sides of a rib r1 produced during the cutting operation, said rib r1 being formed integrally with and extending longitudinally of the plate A. It will be understood that this rib r1 is formed by reason of the fact that the space between the cutting surfaces 2c, 2c is a non-cutting area. Accordingly, during the milling operation, the plate material forming the rib r1 remains in situ and is not disturbed. Hence, the thickness or height of the rib r1 increases progressively in a direction extending longitudinally along the propeller blade toward the tip thereof. The same is true as regards the edge ribs r, r.

After completion of the first milling cut, the bed 1 is returned to its original position whereupon another adjustment is effected so that the cutters 2, 2 will remove another layer of material from the upper surface of the plate A. Thereupon, the bed 1 is moved from left to right, Fig. 2, to thereby remove such additional layer of material, this causing the tapered section and fillets f, f to be extended along the plate A, further deepening of the plate tapered section and further development of the edge ribs r, r and the center rib r1.

Depending upon the settings between the milling cutters 2, 2 and the plate A, this second milling operation may result in the production of the plate B shown in Fig. 5. As regards this plate, the thickness thereof at the tapered end, i. e., the end toward the left in Fig. 5, should correspond with that of propeller plates as previously formed without the central rib r1. One end of the central rib r1 terminates at the end of the plate B toward the left, Fig. 5, and, depending upon the character of the fillet-producing surfaces 2b, the other end of said rib r1 terminates at or in the vicinity of the location a, Fig. 5, whereas the edge ribs r, r and the tapered configuration terminate at a line b which is spaced from the end of the plate B toward the right, Fig. 5, a sufficient distance to provide a plate section c which has not been subjected to a milling operation. This plate section c should have such length, as will be understood by those skilled in the art, that it may subsequently be shaped into tubular configuration to form the shank of the completed propeller.

If the second milling operation described above does not result in the production of a plate B as shown in Fig. 5, it will be understood that the employment of one or more subsequent milling operations results in the production of a plate of the character described and illustrated in said Fig. 5.

In Fig. 4, it will be noted that the cutters 2, 2 are separated by a washer 4a having less thickness than the washer 4. Accordingly, in Fig. 4, the cutters are shown as somewhat closer together than in Fig. 3. It is desirable that the arrangement of Fig. 4 be utilized for the last milling operation, the longitudinal rib r1, at this time, having its thickness decreased substantially to its intended value by the cutting surfaces 2c, 2c and the fillets f, f being given substantially their final shape by the cutting surfaces 2b, 2b.

The plate or plate construction B shown in Fig. 5, when completed, is known in the art as a camber plate. In Fig. 8, I have illustrated a plate or plate construction C which, when com-

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pleted, is known as a thrust plate and it is connected to the plate B to form a propeller blade. As shown, the plate C is not provided with a non-milled section such as the section c of the plate B although it does comprise edge ribs r, r and is of tapered configuration throughout its length. The longitudinal rib r1 of the plate C extends from the thin end thereof and terminates at or in the vicinity of the location a1, Fig. 8, whereas the edge ribs r, r of said plate C terminate at the end thereof toward the right, Fig. 8. As known in the art and as indicated on the drawing, the length of the plate C is somewhat less than that of a plate B with which it is later to be associated, the width and the thickness of said plate C being somewhat less than the corresponding respective dimensions of said plate B. In accordance with the invention, the plate C is given the configuration illustrated in Fig. 8 by two or more milling operations performed thereon in the same general manner as described with respect to the plate B.

It will be recognized by those skilled in the art that the plates of Figs. 5 and 8 are partially completed propeller plates. Subsequently, each propeller plate is subjected to a milling operation in the same general manner as described in U. S. Letters Patent No. 2,263,425, the cutter arrangement of said Letters Patent, due to the presence on each plate of the longitudinal rib r1, being formed from two cutters of the same general character as hereinbefore described. The milling operation last named is the final milling operation and, at that time, each plate is given its required degree of thinness and each rib r1 is given its final width.

During a subsequent trimming operation, each plate is given the configuration required by a propeller blade and, at this time, the edge ribs r, r are eliminated. Thereafter, each of the plates is given its proper convex configuration and has the proper twist imparted thereto in a shaping die which is provided with a slot for the reception of the longitudinal rib r1. Finally, during the welding operation, when the two completed propeller plates are associated to form a propeller blade, the welding mandrel is provided with a slot for the reception of the respective longitudinal ribs r1. Except for the slot above referred to, the forming die and the welding mandrel may be identical with and operated in the same manner as is the prior art apparatus of this character.

Each longitudinal rib r1 of the completed plate, since it is an integral part of the propeller plate, serves to stiffen the same to prevent or decrease deformation or vibration thereof when it forms a part of a propeller on a flying aircraft. In addition, each longitudinal rib r1 may serve as a base or a supporting structure for a reinforcing member should it become desirable to connect the same between and to the two plates of a hollow metal propeller. The fillets f, f merge into the longitudinal rib r1 from the tapered plate surface and, as will be understood, they serve as a reinforcement for the longitudinal rib r1.

Although the longitudinal ribs r1 described above are shown as located midway between the edges of the respective plates B and C, it shall be understood that the invention is not to be thus limited. If desirable, any rib r1 may be located nearer one edge of the plate than the other and, furthermore, the milling cutter, or equivalent, may be of such character that two or more ribs are formed in the plate. Still fur-

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ther, in a broader aspect, the ribs of my invention may extend transversely or obliquely to the longitudinal plate axis.

While the invention has been described with respect to a certain particular preferred example which gives satisfactory results, it will be understood by those skilled in the art after understanding the invention, that various changes and modifications may be made without departing from the spirit and scope of the invention and it is intended therefore in the appended claims to cover all such changes and modifications.

What is claimed as new and desired to be secured by Letters Patent is:

1. A plate component for a propeller blade comprising a single homogeneous metallic plate characterized by an upper surface of uniform, waved cross-profile throughout the length of plate, said waved cross-profile comprising a central rib homogeneous with the plate, along the longitudinal center line of said plate, said profile comprising fillets blending the lateral surfaces of said rib into the profile surface of the plate, the opposite, lower, surface of said plate being planar, the plate, between said profile surface and the lower surface tapering substantially uniformly in thickness from one end to the other and the rib increasing in height with the decrease in said thickness.

2. A plate component for a propeller blade comprising a single homogeneous metallic plate characterized by a uniform cross-profile raised in the center and curvedly tapering to a lower level toward its lateral margins, on its upper side, and characterized by being flat on its lower side, the thickness of said plate increasing substantially uniformly from one end to the other and with the raised center portion decreasing in height with the increasing plate thickness.

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3. A plate component for a propeller blade comprising a single homogeneous metallic plate characterized by a uniform cross-profile raised in the center and curvedly tapering to a lower level toward its lateral margins, on its upper side, and characterized by being flat on its lower side, the thickness of said plate increasing substantially uniformly from one end to the other, the raised portion of said upper cross-profile comprising a rib homogeneous with the plate of decreasing height with increasing plate thickness.

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