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T. MIDDLETON

METAL PROPELLER FOR AEROPLANES, DIRIGIBLES, BALLOONS, AND THE LIKE

Filed Feb. 18, 1921

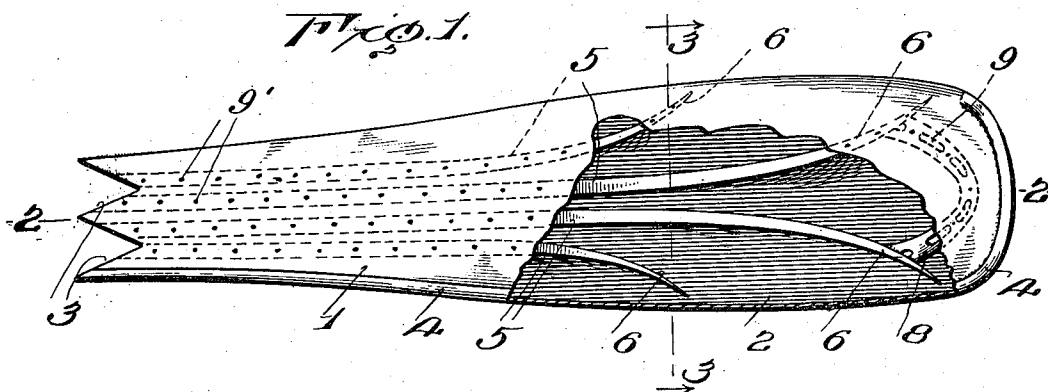
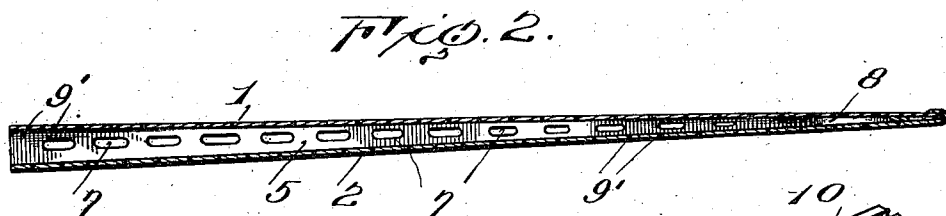


Fig. 5.

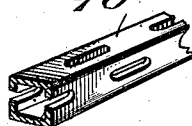
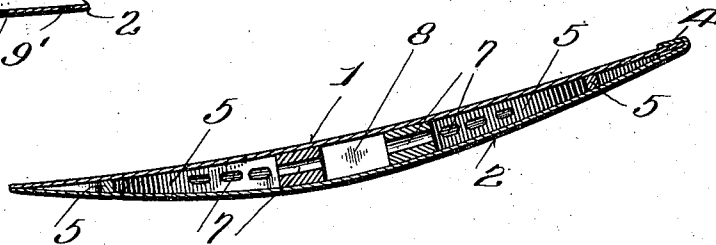


Fig. 3.

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METAL PROPELLER FOR AEROPLANES, DIRIGIBLES, BALLOONS, AND THE LIKE.

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To all whom it may concern:

Be it known that I, THOMAS MIDDLETON, a citizen of the United States, residing at Schenectady, in the county of Schenectady and State of New York, have invented certain new and useful Improvements in Metal Propellers for Aeroplanes, Dirigibles, Balloons, and the like, of which the following is a specification.

10 This invention relates to propellers.

The primary object of the present invention resides in the production of a metal propeller for aeroplanes, dirigibles, balloons and other air machines.

15 Certain difficulties are experienced in the manufacture of such sheet metal propellers as have been designed, in that the supporting frame work arranged between the plates forming the blade has not been relatively proportioned, located or effectively secured

20 It is an object of the present invention to produce a propeller consisting of metal sheets or plates shaped to form the contour of the blade and joined together by an interior support or framing of associated bracing ribs each proportioned, located and secured to the respective metal plates for effectively sustaining the working pressure

25 The present invention further contemplates the method of producing metal propellers which consists in spot welding the metal sheets or plates at intervals to an interior support and further welding the edges of the plates, the relative close location of the spot welds together with the particular arrangement of accurately proportioned supporting or bracing elements materially entering into the method of building up the propeller.

30 Another object of the invention is to provide a metal propeller having a flange formed on a portion of the respective blades, thereby reducing the wind slip.

35 A further object of the invention is to provide a sheet metal propeller possessing advantages of perfect balance, lightness, durability and working efficiency as well as comparative low cost in manufacture and repair.

Other objects will in part be obvious.

40 In the accompanying drawings illustrating an embodiment of my invention for purposes herein:

Fig. 1 is a face or plan view of my improved propeller with parts broken away as shown;

Fig. 2 is a longitudinal sectional view on the line 2—2 of Fig. 1;

Fig. 3 is a transverse sectional view on the line 3—3 of Fig. 1;

Fig. 4 is a detail sectional view illustrating the spot weld; and

Fig. 5 is a detail perspective view showing a modified form of bracing rib.

The present invention has been designed to take the place of the wooden propellers now used, serious difficulty often being experienced in both the manufacture and use of the wooden type of air screw. For example, the manufacture of wooden propellers depends largely upon skilled workmen who are required by tedious hand operations to carefully finish and balance the blades. In use the climatic conditions of heat and moisture also affect the blades; and when any of the blades are broken or injured the whole propeller is rendered useless and must be scrapped.

It is to overcome these difficulties that I have produced a metal propeller the construction of which permits of quantity production, accuracy in shape and balance, and readiness in repair, should one of the blades be injured.

Generally stated, the propeller comprises a plurality of blades each formed of metal plates or sheets joined together by an intermediate frame work of novel construction. Each blade is secured to a hub section as will be understood, and is given the proper contour according to the requirements desired. The plates are preferably pressed between dies, the accuracy of which can be definitely obtained. Large quantities therefore of accurately formed plates can be produced as compared with the highly skilled labor required in the tedious manufacture of laminated wooden propellers. The supporting or reinforcing framework interposed between the plates can be also accurately formed according to the desired location between the plates, and large quantities of these bracing elements can be inexpensively manufactured.

Referring to the drawings each blade of

the propeller is formed of sheet metal plates 1 and 2, the former for purposes herein being designated the working face of the propeller and the latter constituting the back thereof. The plates are preferably of sheet steel but it will be understood that other metals may be used. The inner ends of the sheets are serrated or notched to form the V-shaped portions 3 adapted to fit into corresponding notches or serrations formed on the hub of the propeller (not shown). This construction of joint serves to prevent any tendency of the sheet to rip or tear. Various forms of mating serrations or notches may be used. Other securing means, such as bolts, for example, are also provided for detachably affixing the blades to the hub as will be understood.

Provided on a portion of the edge of each blade is a flange 4. This flange is formed as shown herein by bending an extending portion of one of the blades around the edge of the other blade and lapping the same a suitable distance upon the face of said other blade. By this construction, the usual wind slip is reduced, the flange serving to sustain the pressure against the working face of the blade. It will be understood that the flange 2 may be formed in any other manner, for example by extending the same upwardly from one or both of the blades or affixing the same in any approved manner.

The interposed supporting and bracing elements for the respective plates 1 and 2, consist of ribs 5, each tapered proportionately according to its location between the plates, and slightly flared as at 6 for their more effective positioning toward the outer end and side edges of the blade.

Each rib is provided with a series of openings 7 preferably elongated as shown, thereby providing for lightness. These openings can be varied throughout the length of the rib and can be altered in size for accurately apportioning the weight of the blade and obtaining perfect balance.

The preferred location or arrangement of the ribs between the plates is best shown in Fig. 1, although it will be understood that various changes in the positioning of the ribs may be resorted to without departing from the spirit of this invention. As shown the ribs are positioned substantially longitudinally of the blade; and in slightly spaced and flaring relation to one another. The ends of the ribs are further flared outwardly toward the sides and end of the blade, thereby carrying to the extreme outer edges a substantial degree of support or internal bracing.

An intermediate bracing or rib 8 is positioned across the outer end of the blade and serves to connect the outer reduced and flared ends of the ribs 5. This rib 8 may also be provided with openings 9 for fur-

ther increasing the lightness of the blade, without, however, impairing its working strength.

The manner of associating the several foregoing parts in their relation one toward another constitutes a heretofore unknown method of producing metal propellers.

The present method of assembling and securing the sheet metal plates 1 and 2 to the ribs 5 involves a spot welding operation in which the respective plates are welded at intervals to the ribs and further welded to each other at the edges. The location of the spot welds may be relatively close, the same being indicated by the numeral 9' in the detail Figure 4. They may be arranged alternately upon each side of the rib or otherwise located with relation to the openings formed in the rib, or to each other. It is desirable to extend the spot welds throughout substantially the entire length of the rib, the intermediate portion of the ribs between the welds being in continuous contact with the inner opposed faces of the plates 1 and 2. This association of ribs or braces with the inner opposed face of the sheets or plates forms a direct support between the plates throughout the length of the ribs or bracing elements. It will be seen that the cross-sectional area of the rib together with its taper serves to insure this even and continuous contact with the opposite plates. A nicety of proportion in supporting strength, weight and balance can be obtained by the use of this relatively heavy and tapered rib.

In practice the ribs are arranged in associated relation with one of the plates of the blade and spot welded thereto by any one of the known welding processes. The electrical process is preferred, although it will be understood that other processes, for example the oxy-acetylene, or the thermic, as well as any other welding process, may be employed. I do not limit the invention to any particular process or apparatus which may be used to effect the spot and other welding operations.

When one plate has been welded to one side of the bracing ribs, the other plate is now placed in position and spot welded to the opposite side of the ribs. In welding the plates and ribs together suitable supports or holding tables may be provided, and these together with suitable centering and locating devices serve to insure the correct and related positioning of the ribs and plates as will be understood. The respective plates are also spot welded to the connecting brace 8 which in turn may also be welded to the ribs between which it is interposed.

The edges of the plates are now welded together in any suitable manner to complete the blades. This weld may be a seam, lap, spot, or other weld, and any process as

hereinbefore mentioned may be used. If spot welded, the location of the welds is relatively close so as to insure a substantially continuous joint as will be understood.

5 When the wind slip flange 4 is formed integral with one of the metal sheets or plates, it is bent over and welded in any manner to the face of the other plate, the extent of the lap being sufficient to insure an effective
10 flange. If applied separately the flange may also be welded to the blade as will be understood.

In Fig. 5 a hollow metallic supporting rib 10 is shown wherein a series of openings
15 can be provided in any one of its side walls for further lightening the structure.

While I have shown four longitudinal and one transverse bracing elements, it will be understood that a greater or less number
20 of each kind may be utilized, and I do not limit myself to either the number or the exact arrangement herein shown. Various shape propellers will necessitate different arrangements and relative positioning of the
25 several parts and the disclosure herein is for purposes of more clearly understanding the invention, reference being had to the following claims for ascertaining the definite limits of my invention.

30 I claim:

1. A propeller comprising relatively thin metal plates shaped to form the blades of the propeller, and a series of hollow tapered ribs interposed between the aforesaid plates
35 and having their outer ends flared toward the opposite side edges of the plates for forming an interior support.

2. A propeller comprising relatively thin metal plates shaped to form the blades of the
40 propeller, and a series of relatively thick bracing elements, each of said elements having all of its sides tapered to a point and shaped so that their cross sectional area forms the direct support between the said
45 plates throughout the length of the bracing elements.

3. A sheet metal propeller comprising relatively thin metal plates shaped to form the blades of the propeller, and an interior support formed of ribs extending in diverging directions from the hub to the outer end and side edges respectively of the blade and arranged in continuous contact throughout their length with the aforesaid metal plates.

50 4. A sheet metal propeller comprising relatively thin metal plates shaped to form the blades of the propeller, and relatively thick bracing elements flaringly arranged between the plates and adapted to extend to the side and end edges thereof, said bracing elements being shaped so that their cross sectional areas forms the direct support between the said plates throughout the length of the
60 bracing element.

5. A sheet metal propeller comprising relatively thin metal plates shaped to form the
65 blades of the propeller, relatively thick and tapered bracing elements flaringly arranged in continuous contact throughout their length with the aforesaid metal plates, and a relatively thin bracing element interposed between the first mentioned bracing
70 elements.

6. A sheet metal propeller comprising relatively thin metal plates shaped to form the
75 opposite sides of the blades of the propeller, one of said plates having a projecting edge adapted to overlap a portion only of the other of said plates to form a wind slip retaining edge, the remaining edge portions of
80 said plates being relatively smooth and adapted to form the air cleavage edge.

7. The method of producing metallic propellers which consists in securing metal plates or sheets to the opposite sides of a supporting frame by spot welding the inner opposed
85 faces of said sheets or plates to the outer sides of the supporting frame.

8. The method of producing metallic propellers which consists in securing relatively
90 thin metal plates or sheets to a relatively heavy supporting frame by spot welding the inner opposed faces of said plates or sheets at intervals to the supporting frame.

9. The method of producing metallic propellers which consists in securing metal
95 plates or sheets to an interior supporting frame by spot welding the inner opposed faces of said plates or sheets to the outer faces of the supporting frame and welding
100 the respective edges of the plates or sheets to each other.

10. The method of producing metallic propellers which consists in securing metal plates or sheets to an interior support by spot welding
105 the inner faces of the plates or sheets to the support and seam welding the respective edges of the plates or sheets to each other.

11. The method of producing metallic propellers which consists in securing metal
110 plates or sheets to a series of separate interior supports by spot welding the faces of said sheets or plates at relatively close intervals to each support.

12. The method of producing metallic propellers which consists in securing metal
115 plates or sheets to a series of separate, interior supports by spot welding the faces of said sheets or plates at relatively close intervals to each support and seam welding
120 the edges of the respective plates or sheets to each other.

13. The method of producing metallic propellers which consists in spot welding the inner opposed faces of relatively thin metal
125 sheets to the opposite outer sides of a series of separate supports.

14. The method of producing a metallic

propeller blade which consists in spot welding the faces of thin metal sheets, and further welding the edges thereof.

15. The method of producing a metallic propeller blade which consists in spot welding the inner opposed faces of thin metal sheets to spaced interior supports and securing the edges of the sheets to each other by further welding.

10 16. A sheet metal propeller comprising relatively thin metal plates shaped to form the blades of the propeller and having their inner hub ends interrupted by notches, serrations, or the like.

15 17. A metallic supporting rib for sheet metal propeller blades formed of a relatively heavy body portion comprising spaced integrally united side walls and a gradually tapered and light end portion.

18. A metallic supporting rib for sheet metal propeller blades formed with a body portion of relatively thick metal and having a series of openings extending throughout said body portion and arranged at intervals therein, and a tapered end of relatively thin metal.

19. A hollow metallic supporting rib for sheet metal propeller blades formed of tapered side walls, all of said walls being integrally united to each other throughout their length.

20. A hollow metallic supporting rib for sheet metal propeller blades having tapered side walls integrally united to each other throughout their length and a series of openings formed in certain of said side walls.

In testimony whereof I affix my signature.

THOMAS MIDDLETON.