March 23, 1926. 1,577,996

R. WISHON

METHOD OF PRODUCING PROPELLERS

Original Filed Jan. 6, 1921

Fig. 1

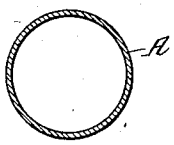


Fig. 2

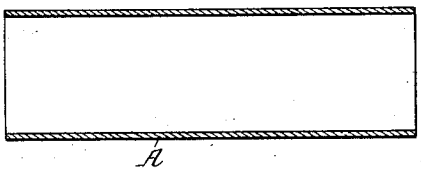


Fig. 3

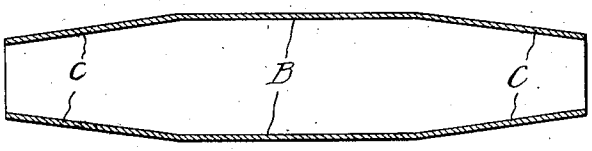


Fig. 5

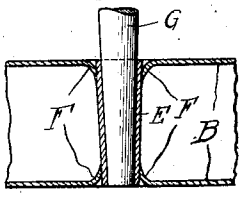


Fig. 4

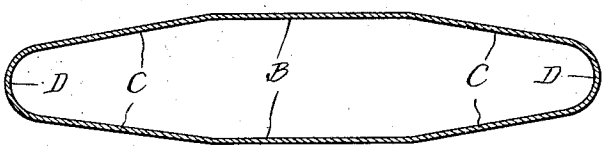


Fig. 6

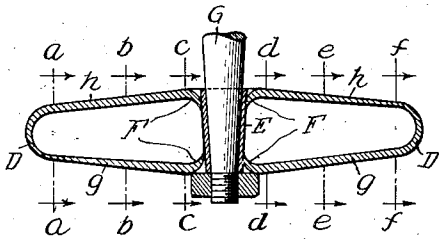


Fig. 6a Fig. 6b Fig. 6c Fig. 6d Fig. 6e Fig. 6f

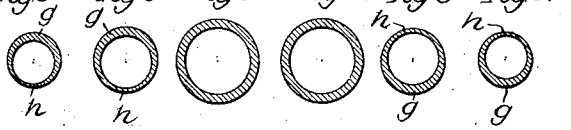


Fig. 7

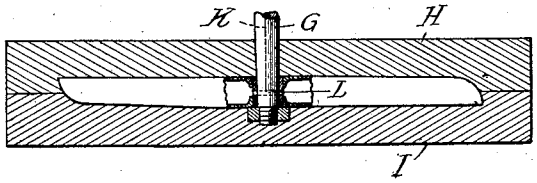
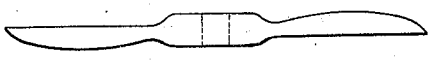


Fig. 8



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UNITED STATES PATENT OFFICE.

RALPH WISHON, OF SAN FRANCISCO, CALIFORNIA.

METHOD OF PRODUCING PROPELLERS.

Application filed January 6, 1921, Serial No. 435,376. Renewed October 17, 1925.

To all whom it may concern:

Be it known that I, RALPH WISHON, a citizen of the United States, residing at San Francisco, in the county of San Francisco and State of California, have invented certain new and useful Improvements in Methods of Producing Propellers, of which the following is a specification.

This invention relates to the manufacture of propellers, and finds its best application in the production of propellers for aeroplanes, although it may be used for the production of propellers for other purposes.

The principal object of the invention is to produce a propeller with thin metal walls, preferably left hollow, and so to dispose the metal of the walls that at least each blade in itself, and preferably two blades with the connecting hub portion, will constitute one integral metal structure, and one in which maximum strength is secured with minimum weight, and avoiding the use of separate parts assembled by welding, riveting, or other means, which experience has shown to be precarious and uncertain owing to warping out of shape, breaking, disturbance of balance, and other effects.

In carrying out the invention, a seamless tube of metal or other suitable material is taken and treated to modify its circumferential dimensions between its ends to correspond with perimeters to be insured at different points in its length, and also to vary the section of its walls in different transverse planes to correspond to differences in thickness between the leading edges and the trailing edges of the blades; the outer end or ends of the tube being treated, for instance, by spinning or equivalent process, to develop thereon an integral closure or closures; and the intermediate portion of the tube (when two blades are made integral, or the inner end of the tube when the blades are made separate) being fashioned to develop a suitable hub portion, or to adapt the blades for assembly with a hub, as the case may be. In making both blades and the hub portion as an integral structure, which is preferred, and by which the advantages of the invention are most fully realized, the metal which is to ultimately constitute front and rear faces of the propeller is displaced inwardly in a manner to provide a hub lining to receive a shaft or a bushing through which the propeller is connected with its shaft.

In addition to these general features characterizing the method of procedure and the resultant propeller, certain special features or steps in the procedure are hereinafter taught, whereby the described changes in wall section may be developed symmetrically and with accuracy, and with uniformity in the two blades so that perfect balance is assured; also where the walls may be ultimately developed with certainty and to a smooth form and accurate outline.

An illustrative procedure embodying the features of the invention will now be described in detail.

In the accompanying drawings—

Figures 1 and 2 are, respectively, a cross section and a longitudinal section of a steel tube which is used as a blank in making a propeller in accordance with the present invention.

Figure 3 shows the blank after treatment to vary its circumferential dimensions.

Figure 4 shows the same blank after its ends have been closed.

Figure 5 is a detail view representing the step of developing the hub.

Figure 6 shows the blank after it has been dressed to taper the thickness of its walls, both longitudinally of the blank and circumferentially of various transverse sections thereof.

Figures 6^a to 6^f, inclusive, are sections taken, respectively, on the lines *a*, *a*, to *f*, *f*, inclusive, of Figure 6.

Figure 7 represents the final step of truing the propeller by internal hydraulic pressure while the propeller is confined in the accurately formed cavity of a heavy metal mold; and

Figure 8 represents the finished article.

Numerous attempts have been made to produce propellers for aeroplanes from steel, but these have generally involved the use of pieces of sheet steel formed into the desired shapes, with thickness uniform from hub to tip, or with attempts at variation which have been exceedingly difficult to attain. But welding together or other methods of connecting two or more formings to make up a complete propeller have been sources of weakness and added weight, and have caused trouble in the operation of the propeller. These troubles are particularly manifest at the extreme high speeds at which aeroplane propellers are required to work. They have resulted thus far in

complete failure of propellers that have been so constructed, so that the only successful propellers produced for aeroplanes up to the present time have been those made of wood, or those made of molded material reinforced with wires, or otherwise.

In producing the tubular propeller in accordance with the present invention, any one of several machine methods may be employed, although I prefer the method involving the use of a lathe with a suitable tail stock center adapted to be thrown over sufficiently to produce the necessary taper and to offset the center in the blank to produce circumferentially tapered walls, and with the drive from the opposite end of the tube or the center taken care of in some flexible manner to allow for misplacement of the tail stock center.

After the blank A (Figures 1 and 2) is obtained, it is spun or otherwise treated to give it the desired longitudinal profile, as suggested in Figure 3, where it has the intermediate cylindrical portion B and reduced ends C. This blank is then taken and treated to provide the closed ends D (Figure 4). The middle of the closed tube is next located on opposite sides and two holes, say, one-quarter of an inch in diameter, are drilled at opposite ends of a middle diameter thereof. The tube is now heated at the middle, and a sharp tapered punch or drift is revolved at high speed and simultaneously forced into first one and then the other of the aforesaid diametric bores, until an opening is formed of sufficient diameter to receive the hub-lining or bushing E which will adapt the propeller to be placed upon the shaft which is to carry it, a suitable key-way being also cut, if desired, in the wall of the hole thus formed. In using the tapered punch or drift the displaced metal of the walls of the tube will be projected inwardly to provide inwardly extending flanges or cylindrical walls F of the opening formed, and serve to secure the hub-lining or bushing E in position after the hub or lining is fitted in the opening provided as described. A number of holes may be drilled and tapped into the joint between the hub-lining and the surrounding walls, and close fitting screws introduced thereinto and finished off flush with the surface. If necessary, these joints can be brazed in addition. A short arbor G is next fitted to the bore of the hub for use in locating the leading and trailing edges and aerofoil sections.

Since the swaging operation in developing the longitudinal taper in the blank and closing the ends has increased the thickness of the swaged sections, whereas it is desirable to have the thickness gradually reduced from the middle toward the ends and also to have it greater in the portion which is to form the leading edge of the blade and gradually reduced toward the trailing edge thereof, the blank shown in Figure 4 is next put into a lathe and turned to bring it to the proportion shown in Figure 6, in which it will be seen that the walls taper from the section *c*, *c*, through the section *b*, *b*, to the section *a*, *a*, and from the section *d*, *d*, through the section *e*, *e*, to the section *f*, *f*. It will also be seen from Figure 6, compared with the several sectional Figures 6^a to 6^f, that each blade beyond the middle tapers from a side *g* which will ultimately constitute the leading edge of the blade to the side *h* which will constitute the trailing edge; such edges being in the blank, as in the ultimate propeller, on opposite sides of the two blades.

For convenience in accurately performing the turning operation to regulate the thickness and distribution of the metal of the walls, the tube of Figure 4 may be mounted in a steady rest at the middle of the blank, while each end is successively off-centered to receive the tail stock center, so that on being revolved it will have an eccentric swing around its true axis, and more stock will be taken from the trailing edge than from the leading edge, and the latter will be left the thicker. The tail stock is also off-centered toward the cutting tool for the purpose of removing more stock at the tip than at the hub portion, where little or none need be removed. The blank may be conveniently driven in the lathe by mounting it in a tube of considerably larger diameter secured to the face plate or large chuck of the lathe, and driving the work at a point near the middle or hub portion by suitable flexible driving means. By this method the free end of the blank next to the head stock would be able to follow its own eccentric path due to the double offsetting at the tail stock end. When the tube is properly mounted in the lathe a single cut is taken starting at the tip with a heavy cut and running out to nothing, or clearing the blank entirely on reaching the points *c*, *c*, or *d*, *d*, of the middle or hub portion. This operation is repeated, as stated, by reversing the blank and off centering the opposite end, care being taken to either advance or retard the setting according to whether the propeller is to be for right hand or left hand drive.

After removing the surplus stock from the blank, the latter is removed from the lathe and placed in a heavy two-part metal molding die, H, I, being located therein by means of the short temporary arbor G introduced into its hub opening. The cavity of this die has the precise shape of the ultimate propeller to be produced. The two parts H and I of the dies are brought together upon the blank by suitable pressure apparatus, the blank being heated if necessary, and a suitable fluid pressure medium being in-

troduced into the hollow blank at sufficient pressure to cause its walls to conform snugly to the cavity of the die and assume the precise shape desired; admission of the fluid being provided for through a channel K in the arbor, registering with port L previously drilled in the hub, or by other suitable means, or by steam or expanding filler.

I claim:

1. The art of producing a propeller blade, which consists in spinning the metal of a tube to close the end thereof at approximately the end of the blade to be formed, varying the perimetrical dimensions of the tube to correspond with those of the blade to be formed, and pressing the resultant work-piece into the shape to be given the blade.

2. The art of producing a propeller blade, which consists in closing the end of a tube at a point corresponding approximately to the length of the propeller blade to be formed, varying the thickness of the tube circumferentially at different portions of said tube toward its outer end to correspond with the thickness of the wall of the blade to be produced, and then pressing said end into the shape of blade desired, with the thick and thin portions of the walls corresponding to the leading and trailing edges of the blade.

3. The improvement in the art of constructing a blade for a propeller, which consists in spinning the metal of a tube to close an end thereof at a point corresponding approximately to the end of the blade to be produced, dressing the metal of the tube to taper it from its inner end toward its outer end and also to vary the thickness of its wall circumferentially, and pressing the resultant work-piece into form corresponding to the blade to be produced, with the thick and thin portions of the wall corresponding to the leading and trailing edges of the blade.

4. The improvement in the art of constructing blades for propellers, which consists in flowing the metal of a tube to close an end thereof at a point corresponding to the end of the blade to be produced, dressing the metal of the tube to taper it from its inner end toward its outer end, and about an axis displaced from the longitudinal axis of the tube to taper the metal of the wall from the part thereof which is to form the leading edge of the blade to the part thereof which is to constitute its trailing edge, and pressing the resultant work-piece into form corresponding to the blade to be produced.

Signed at San Francisco, California, this 6th day of November, 1920.

RALPH WISHON.