Sept. 5, 1933. J. SQUIRES 1,925,854

METHOD OF MAKING PROPELLER BLADES

Filed May 20, 1930

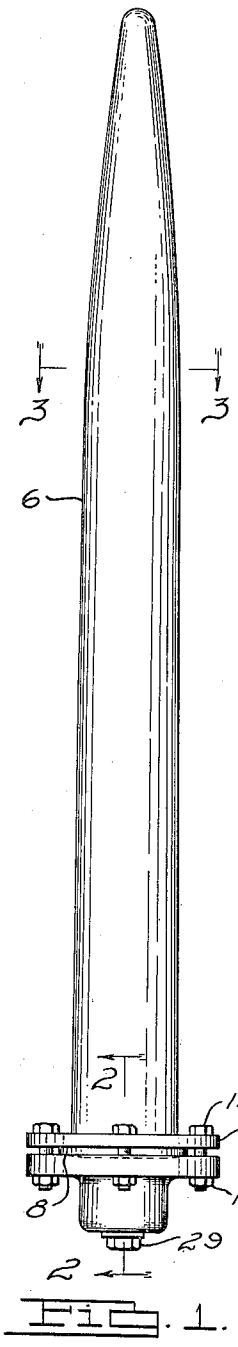


Fig. 1.

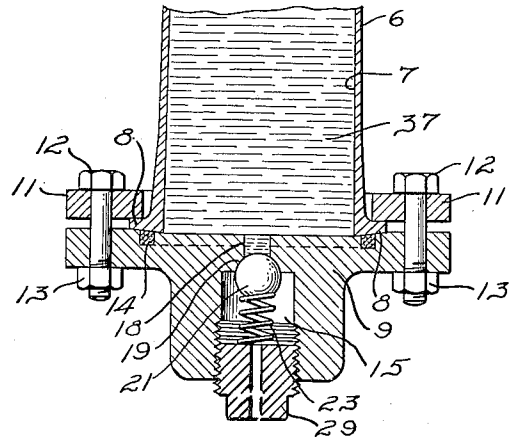


Fig. 2.

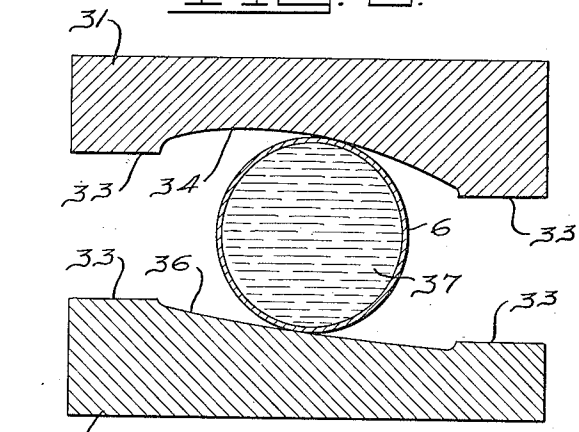


Fig. 3.

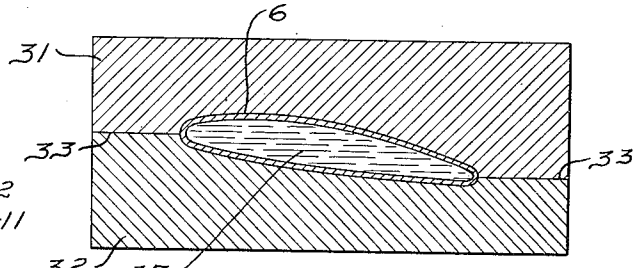


Fig. 4.

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Patented Sept. 5, 1933 1,925,854

UNITED STATES PATENT OFFICE

1,925,854

METHOD OF MAKING PROPELLER BLADES

John Squires, Hagerstown, Md.

Application May 20, 1930. Serial No. 454,134

1 Claim. (Cl. 29—156.8)

This invention relates to a method of working metal tubes and to the apparatus used to carry out this method, and particularly to making airplane propeller blades.

The main objects of this invention are to provide an improved method of forming propeller blades; to provide a method of forming a propeller blade having an airfoil cross section from a hollow metal tube; and to provide an improved method of supporting the inner walls of a metal tube while being pressed between forming dies to airfoil or other cross section.

Another object is to provide an improved method of supporting the inner walls of a metal tube against collapse and under pressure while being pressed between forming dies to a new cross section, consisting in filling the interior of such member with a substantially incompressible fluid and then squeezing said member between a pair of dies while restricting escape of said fluid whereby to cause it to assume the desired shape and section of the die depressions.

Another object is to provide, for a tube of the type described, a simple closure means having an adjustable relief valve to control the internal pressure in the tube, that may be quickly and removably attached to the tube, by the use of which the tube may be filled with fluid, and through which the fluid may emerge at a predetermined limiting pressure.

Another object is to provide unitary self-contained portable means for each object to be processed to hold fluid under pressure in the interior thereof.

Numerous other objects and features of novelty, the same consisting in certain methods, features of construction and combination of parts to be hereinafter described, will be apparent in the following specification.

In the accompanying drawing which shows an illustrative embodiment of the present invention, and in which like numerals refer to like parts throughout the several different views:—

Fig. 1 is an elevational view of a propeller blade blank and a relief valve casing and flange attached thereto embodying an illustrative form of my invention.

Fig. 2 is a fragmentary cross sectional view taken on the line 2—2 of Fig. 1, looking in the direction indicated.

Fig. 3 is a view showing the tube in place between a pair of forming dies prior to the closing of the dies, the tube being shown in section as taken on the line 3—3 of Fig. 1.

Fig. 4 is a view similar to Fig. 3 after the forming dies have been brought together.

The method described in this application for patent is particularly useful in connection with working of forming propeller blades from elongated, tubular, seamless metal closed end tubes or blanks which are preferably constructed in accordance with the disclosure set forth in my copending application executed December 16, 1929, Serial No. 415,028, filed December 18, 1929.

However, the method is equally applicable for use in connection with the forming of any type of hollow body wherein the cross-sectional shape of the hollow body is to be changed by compressing the article between forming dies.

Considerable difficulty is met in forming any hollow body to a different cross-section by compressing the body because the body tends to crumple or buckle up rather than take the shape of the forming dies.

It has heretofore been suggested that internal pressure be applied to a hollow metallic propeller blade after it has been pressed to the desired shape and while still maintained between the dies so as to force the metal of the blade out into contact with the die depression in order to obtain exact conformance of the blade shape to the die depression. I have, myself, previously suggested maintaining the blank under pressure while being pressed by the dies to the desired shape in order to effect the same result. However, in either one of these methods as heretofore disclosed it has been necessary to connect the blade or the blank, as the case may be, by suitable conduit, to a source of pressure while they are positioned between the dies.

This necessitates the connection of each blank or blade by a conduit with the source of pressure and the disconnection of such blank or blade with the source of pressure each time a blank or blade is inserted in or removed from the dies. This not only involves a relatively great amount of labor but it tends toward confusion and disorder about the machine or the operation that is being undertaken.

In accordance with the present invention I provide a simple and efficient means for placing the blank under internal pressure while being modified in cross sectional shape between a pair of dies, and which means does not necessitate the connection of a conduit to the blank nor the presence of a supply of fluid under pressure. Specifically, the means provided herein is to fill the interior of the blank with a substantially incompressible fluid, close the interior of the blank

against the escape of such fluid, except at a predetermined high pressure, and then place the blank between a pair of dies and modify its cross section thereby. In thus modifying the section of the blank its internal volume is decreased and the fluid therein is thus placed under pressure which effectively maintains the walls of the blank in intimate contact with the surfaces of the die depression, and results in a finished product which is exteriorly in exact conformance to the shape of the die depression.

Referring to the drawing, I show a tubular metallic blank 6 of a shape suitable for forming a propeller blade. One end of this blank is tapered and closed and the opposite end of the blank is provided with an outturned radial flange 8 and is normally open. The open end is closed by a cap member 9 seating against the flange 8 and drawn into intimate contact therewith by means of the ring 11 received over the blank 6 against the upper surface of the flange 8, the bolts 12 and the nuts 13.

In order to derive the benefits of the present invention to its fullest extent it is desirable that the cap 9 be sealed to the flange 8 and in order to effect this result the cooperating services may be a ground fit or a suitable gasket such as 14 may be employed.

The cap 9 is provided with an enlarged central bore 15 therein connected with the interior of the tube 6 by a smaller passage 18 forming a shoulder 19 at the point of junction with the passage 15. A ball 21 is pressed against this shoulder by means of a coil spring 23 held under compression between the ball 21 and the apertured plug 29 threadably received in the bore 15. As will be apparent, this structure affords a check valve of conventional construction and the tension of the spring 23 determines the pressure which must be built up within the interior of the tube 6 before any fluid therein may escape therefrom.

In practice the tube 6 is placed in inverted position and is filled with water or some other suitable and substantially incompressible fluid. The cap 9 is then applied as described and securely fixed in place. The tube 6 thus filled and with the cap 9 attached, is then placed between a pair of die halves 31 and 32 provided with matching depressions 34 and 36 of the desired shape and contour of the finished blade, and the die halves 31 and 32 are then brought together from the position indicated in Fig. 3 to the position indicated in Fig. 4.

When the die halves 31 and 32 are thus brought together it will be apparent that the interior volume of the blank 6 is considerably reduced and in being reduced the liquid within the tube 6 is placed under pressure and this pressure would become almost infinite if the tube 6 were strong enough to withstand the same and if there were no means for the liquid to escape. However, by suitably adjusting the tension of the spring 23, the liquid within the tube may be allowed to reach a predetermined high limit, for instance 500 pounds per square inch, before it is allowed to escape, and this pressure will be sufficient to press every portion of the tube 6 out into contact with the complementary surface of the die depression during the pressing operation, so that the contour of the finished product will conform exactly to the contour of the surfaces of the die depression.

It will thus be apparent that by this apparatus and method of operation a simple, cheap and effective method of placing the interior of the blank under internal pressure during the pressing operation is provided, and this without the necessity of supplying various conduits and sources of pressure as heretofore suggested. For these reasons the present invention affords a cheaper, equally efficient and highly practical method of obtaining the desired result.

Formal changes may be made in the specific embodiment of the invention described without departing from the spirit or substance of the broad invention, the scope of which is commensurate with the appended claim.

What I claim is:—

The method of making an airplane propeller blade comprising forming an elongated tubular metal blank of substantially uniform cross sectional contour having one end thereof materially smaller than the other end thereof and closed by an integral part thereof, and having an outwardly directed integral flange at the open end thereof, filling said blank with a liquid, closing the open end of said blank by securing to said flange a closure having an opening therethrough and a restricting means for said opening, placing said blank between dies having complementary depressions of substantially the exact size, shape and contour of the desired finished blade, and then bringing said dies together on said blank, whereby the restriction set up by said means to the escape of said liquid from said blank tends to internally and yieldingly support said blank against undesirable collapse during the pressing operation.

JOHN SQUIRES.