

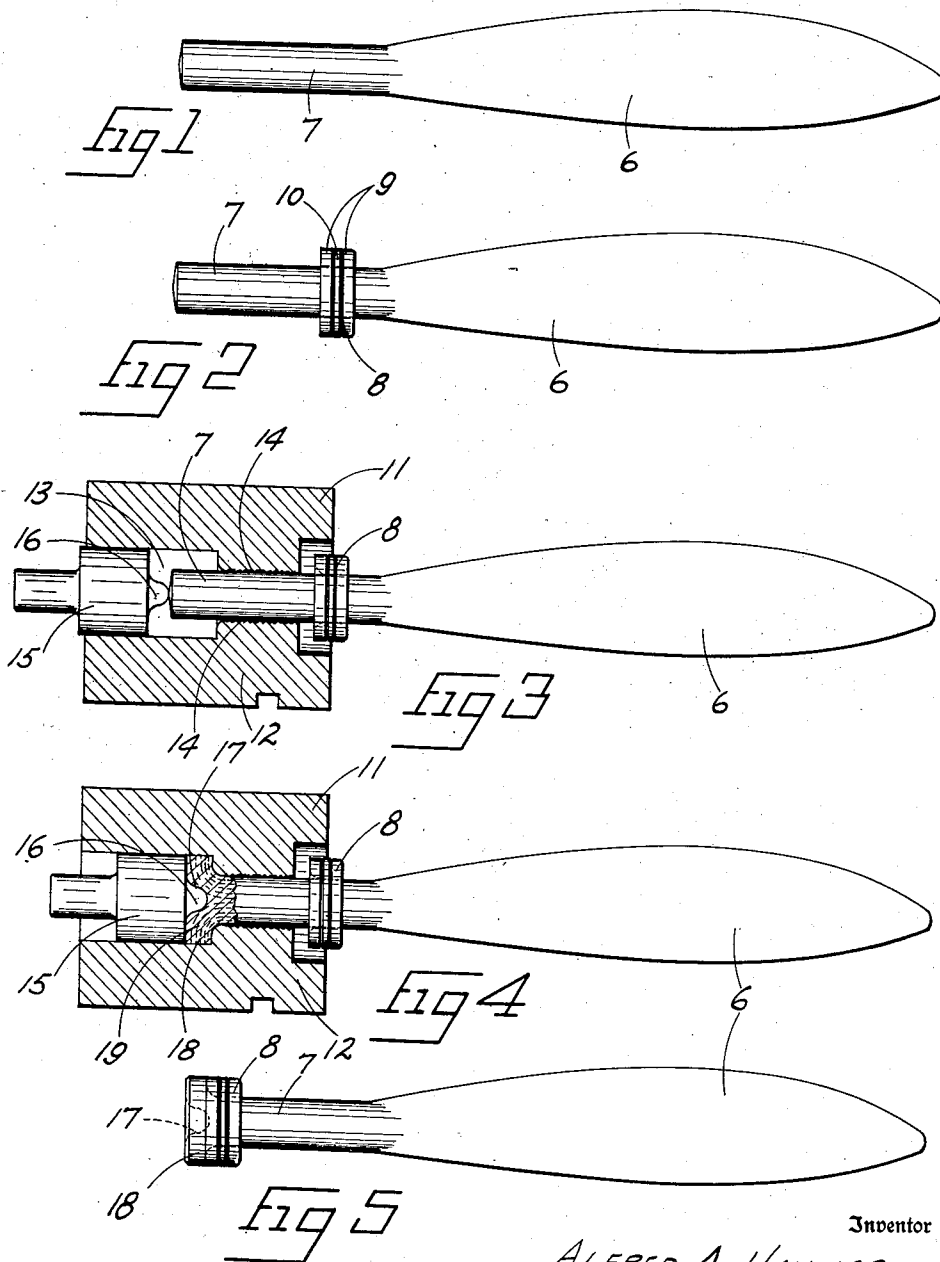
March 26, 1935.

A. A. HANDLER

1,995,451

METHOD OF MAKING VARIABLE PITCH PROPELLER BLADES

Filed July 12, 1932



Inventor

ALFRED A. HANDLER.

By

Rickey & Watts
Attorney

Patented Mar. 26, 1935

1,995,451

UNITED STATES PATENT OFFICE

1,995,451

METHOD OF MAKING VARIABLE PITCH PROPELLER BLADES

Alfred A. Handler, Cleveland, Ohio, assignor to
Aluminum Company of America, Pittsburgh,
Pa., a corporation of Pennsylvania

Application July 12, 1932, Serial No. 622,091

7 Claims. (Cl. 29—156.8)

This invention relates broadly to metallic propellers and is particularly concerned with a method of forming a thrust bearing portion or collar on the hubs of propeller blades adapted for installation in "variable pitch" propeller units.

In the manufacture and production of variable pitch propellers the individual blades are rotatably mounted in the central hub of the propeller in such a manner that they may be adjusted angularly by remote control at the will of the pilot or operator of an airplane, to vary the pitch thereof to suit various flying and wind conditions. It is therefore essential that a dependable and durable type of thrust bearing be provided to retain the blades against dislodgment due to centrifugal force and yet permit free rotation of the blades for ready adjustment thereof.

It is also desirable in the manufacture of metallic propellers, particularly in propellers made of aluminum or other light metal alloys, that the metal be formed into propeller shape in such a manner as to obtain the maximum strength and fatigue resistance. In my prior application, Serial No. 387,017, filed August 19, 1929, I have disclosed and claimed a method of forming a billet of metal into propeller shape which produces a blade having flow lines conforming to the contour of the blade and a uniform grain structure, provides the maximum strength of the metal in the direction of the greatest stress, and eliminates stress raisers or planes of weakness which may result in failure of the propeller under repeated reversals of stress. In my Patent No. 1,957,499, issued May 8, 1934, the application for which was co-pending herewith, I have disclosed and claimed a method of increasing the diameter and strength of the hub portion of a propeller blade and at the same time eliminating stress raisers and refining the grain structure to conform to the blade by upsetting and piercing the hub end of the blade to increase the external diameter and form an axial opening in the hub end.

The purpose of the present invention is to provide a method of forming the hub end of the propeller blade which will provide adequate strength and fatigue resistance in this portion of the blade and at the same time assemble with the blade a suitable thrust bearing for permitting use of the blade with a variable pitch mechanism.

In carrying out this purpose, it is of course essential that the necessary strength be obtained with the minimum amount of metal and also in as economical a manner as possible. I have found that very satisfactory results may be obtained by forming the hub or shank of the propeller substantially cylindrical in form and

of a diameter sufficiently large to carry the stresses to which this portion of the blade is subjected, and small enough to fit within the thrust bearing, assembling the thrust bearing over the shank and moving it up toward the blade portion of the propeller so as to be out of the way, upsetting the extreme end of the hub portion of the blade to spread the metal to a large diameter and thereby form an integral abutment having a refined grain structure and flow lines continuous with the flow lines of the shank, and then moving the thrust bearing assembly back against the abutment. This operation prevents the formation of stress raisers or planes of weakness at the end of the propeller and provides a laterally projecting abutment for transmitting axial thrust to the bearing which has great resistance to the shearing action of the thrust bearing assembly. The shank is made of sufficient length so that the thrust bearing after being initially placed over the shank may be moved up toward the blade to permit gripping dies to engage about the shank behind the thrust bearing assembly and to permit heating the metal which is to be upset to a working temperature without drawing the temper of the bearing assembly. I have also found that the spreading or upsetting of the end of the hub may be most conveniently accomplished by utilizing an upsetting tool having an axial projection for forming a hollow at the end of the blade which may then be utilized as a socket for engaging with the hub structure which fixes the angular position of the blade.

These and other objects and advantages of the invention will be rendered more apparent by the detailed description in the annexed specification taken in conjunction with the drawing forming a part thereof, wherein;

Figure 1 is a plan view of a propeller blade ready for the initial step of the method;

Figure 2 is a view similar to Figure 1 showing a thrust bearing assembled on the shank of the blade previous to the upsetting operation;

Figure 3 illustrates the assembled blade of Figure 2 positioned in gripping dies, preparatory to being upset;

Figure 4 is a view similar to Figure 3 at the completion of the upsetting operation; and

Figure 5 illustrates a finished propeller blade produced in accordance with my invention.

A billet of metal is first formed into the shape of a blade 6 with an extended cylindrical shank or hub portion 7, preferably by axial rolling of the billet as disclosed and claimed in my co-pending application, Serial No. 387,017. Preparatory to the forging or upsetting operation, it is preferred to heat the entire blade to a working temperature, to prevent strains being set up in any portion thereof. A thrust bearing 8 is then placed over the shank 7 as illustrated in 60

Figure 2 and moved up along the shank into engagement with the root of the blade portion 6. The bearing 8 may be of any suitable type, but preferably consists of a pair of annular races 9 having balls or rollers carried by a retainer ring 10 disposed between the same.

The end of the shank 7 is then gripped between a pair of gripping dies 11 and 12 in an upsetting machine with a portion of the end of the shank 7 projecting through the dies into an enlarged space 13 formed in the dies, as indicated in Figure 3. The gripping surfaces of the dies 11 and 12 are preferably formed with corrugations 14 which bite into the shank and securely grip the same.

An upsetting die 15 having a projecting boss 16 is then pressed into the end of the shank 7 which extends into the space 13. Pressure is exerted on the upsetting die 15 until the metal of the end of the shank 7 is caused to flow laterally and spread to fill the die space 13 while the boss 16 of the upsetting tool forms a recess or hollow 17 in the end of the shank as indicated in Figure 4.

The upsetting tool 15 is then withdrawn, the die blocks 11 and 12 are separated and the propeller is removed from the machine. After the end of the shank has cooled it is finished by any suitable machining operation and the thrust bearing assembly 8 is moved back until it abuts against the enlarged portion 18 which has been formed on the end of the shank. The completed propeller is shown in Figure 5. The flow lines of the metal at the end of the shank are indicated by the dotted lines 19 in Figure 4, and it will be seen that these flow lines constitute continuations of the flow lines initially formed in the shank 7 and conform to the contour of the enlarged portion 18 on the end of the shank so that axial stresses are transmitted directly from the cylindrical portion of the shank to the enlarged portion 18 without danger of this enlarged portion shearing off.

The metal of the end of the shank 7 is worked and caused to flow by the upsetting operation in a uniform manner so that the grains of the metal are refined uniformly through the enlarged portion and the integral connection between the enlarged portion, thereby preventing excessive grain size contrast which might result in undesirable grain growth and the formation of a plane of weakness at the enlarged portion of the shank.

Although an application of the invention has been described in considerable detail it will be understood that various modifications and rearrangements of the steps may be resorted to without departing from the scope of the invention as defined in the following claims. For example, it may not be desirable to heat or preheat the entire blade, the shank or the end thereof only being heated to a working temperature, and the bearing placed on the shank before or after heating.

I claim:

1. In the manufacture of propellers, the process which consists of forming a blade with a substantially cylindrical shank, assembling a thrust bearing over the shank, and spreading the end of the shank by an upsetting operation to form an enlarged abutment on the end of the shank for engagement with the thrust bearing.

2. In the manufacture of variable pitch propeller blades, the process which consists of forming

a blade with a substantially cylindrical shank portion, assembling a thrust bearing over the shank portion and moving the same along the shank away from the end thereof, confining the end of the shank within an enlarged die space and upsetting the end of the shank into the die space to form an integral enlargement on the end of the shank to abut the thrust bearing.

3. In the manufacture of variable pitch propellers, the process which consists of forming a propeller blade with a substantially cylindrical elongated shank, assembling a thrust bearing over the shank and moving the same away from the end thereof, confining the end of the shank in an enlarged die space, and spreading the metal of the end of the shank radially outward into the enlarged die space to form a recess in the end of the shank and an integral enlargement surrounding the recess to serve as an abutment for the thrust bearing.

4. In the manufacture of variable pitch propeller blades, the process which consists of forming a blade with a substantially cylindrical shank portion, assembling a thrust bearing over the shank portion, and moving the same along the shank away from the end thereof, heating the end of the shank to a working temperature, confining the end of the shank within an enlarged die space and upsetting the end of the shank into the die space to form an integral enlargement on the end of the shank to abut the thrust bearing.

5. In the manufacture of variable pitch propellers, the process which consists of forming a propeller blade with a substantially cylindrical elongated shank, assembling a thrust bearing over the shank and moving the same away from the end thereof, heating the end of the shank to a working temperature, confining the end of the shank in an enlarged die space, and spreading the metal of the end of the shank radially outward into the enlarged die space to form a recess in the end of the shank and an integral enlargement surrounding the recess to serve as an abutment for the thrust bearing.

6. In the manufacture of variable pitch propellers, the process which consists of forming a propeller blade with a substantially cylindrical elongated shank, heating the entire blade to a working temperature, assembling a thrust bearing over the shank and moving the same away from the end thereof, confining the end of the shank in an enlarged die space, and spreading the metal of the end of the shank radially outward into the enlarged die space to form a recess in the end of the shank and an integral enlargement surrounding the recess to serve as an abutment for the thrust bearing.

7. In the manufacture of variable pitch propeller blades, the process which consists of forming a blade with a substantially cylindrical shank portion, heating the entire blade to a working temperature, assembling a thrust bearing over the shank portion, and moving the same along the shank away from the end thereof, confining the end of the shank in an enlarged die space and spreading the metal of the end of the shank radially outward into the enlarged die space to form an integral enlargement on the end of the shank to abut the thrust bearing.

ALFRED A. HANDLER.

DISCLAIMER

3

1,995,451.—*Alfred A. Handler*, Cleveland, Ohio. METHOD OF MAKING VARIABLE PITCH PROPELLER BLADES. Patent dated March 26, 1935. Disclaimer filed March 1, 1938, by the assignee, *Aluminum Company of America*.

Hereby disclaims from claim 1 of said patent all processes except those wherein the step of spreading the end of the shank by an upsetting operation as recited in said claim is performed by turning the metal of the end of the shank outwardly so that the flow lines therein are turned radially outward without interrupting the continuity of such flow lines.

[*Official Gazette March 29, 1938.*]