Aug. 9, 1932. F. W. CALDWELL 1,870,401

HUB FOR SMALL PROPELLERS

Filed Oct. 9, 1931

Fig. 2.

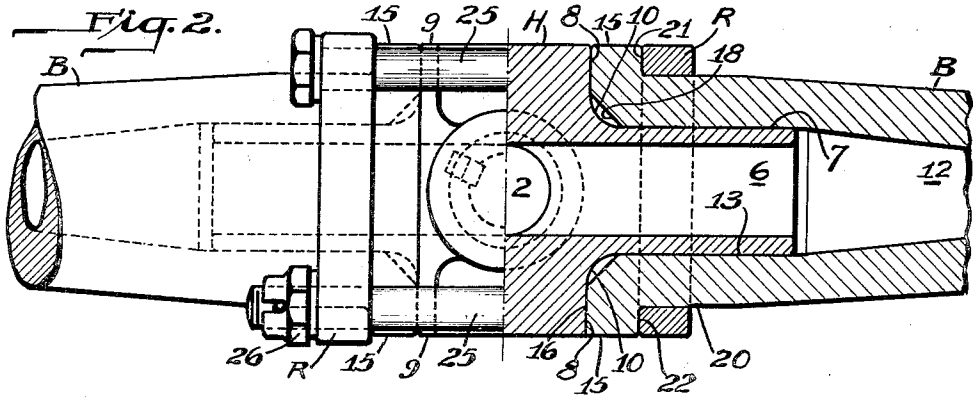


Fig. 1.

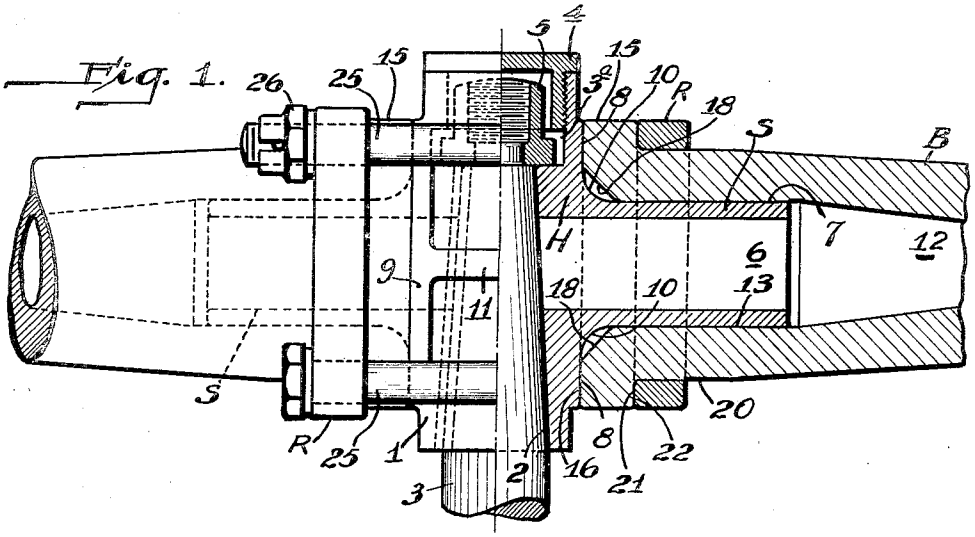
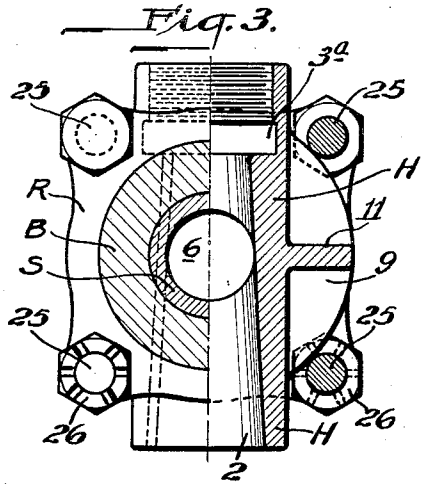


Fig. 3.



WITNESSES

A. B. Wallace.

J. Bailey Brown

Frank W. Caldwell

INVENTOR;

by Brown & Critchlow,

his attorneys.

Patented Aug. 9, 1932 1,870,401

UNITED STATES PATENT OFFICE

FRANK W. CALDWELL, OF PITTSBURGH, PENNSYLVANIA, ASSIGNOR, BY MESNE ASSIGNMENTS, TO HAMILTON STANDARD PROPELLER COMPANY, OF HOMESTEAD, PENNSYLVANIA, A CORPORATION OF PENNSYLVANIA

HUB FOR SMALL PROPELLERS

Application filed October 9, 1931. Serial No. 567,812.

This invention relates to metal aeronautical propellers.

The objects of the invention are to provide a new and improved hub and blade construction, particularly adapted to the smaller sizes of metal propellers. An incidental object is to reduce weight of the blade-holding structure, to provide a hub member of one-piece construction, to provide a tension-receiving member separate from the hub member, to provide an attaching member separate from but mounted on the blades and adapted to be used to clamp the blade on the hub, and generally to improve and lighten an all metal propeller construction by providing new and simplified means for attaching the blades to each other and to the engine shaft. Many uses and advantages of the structure embodying this invention will be apparent to those familiar with the art from the following specification.

Referring to the drawing, Fig. 1 is a partial plan view and partial horizontal central section through the assembled propeller in normal operative position, the blades being partly broken away; Fig. 2 is a view similar to Fig. 1, but with the propeller axis turned through 90° to bring its forward end up, the partial horizontal section being thus taken at right angles to that of Fig. 1; and Fig. 3 shows two partial horizontal sections through the propeller with its axis horizontal but rotated 90° thereon from the position shown in Fig. 1; the section at the left half of the figure being through the blade shank, and the other half section being in the horizontal plane of the propeller axis.

The detachable-blade, adjustable-pitch, all-metal aeronautical propeller has at the present time almost displaced the older forms of propellers. The advantages of strength, accuracy of construction, adjustability of pitch, replaceability of damaged parts, standardization, adaptability to mass production manufacture, and general excellence of performance have caused this type of propeller to become standard on all planes which can stand the cost thereof.

But in very cheap planes, where the expense must be held to a minimum, the cost of detachable all metal propellers has heretofore been prohibitive, because they necessarily cost considerably more than wooden propellers. For a long time there has been continuous effort on the part of manufacturers of metal propellers to reduce cost and weight of the very small metal propellers to a point where they may be competitive with wooden propellers for small planes. By the present construction that object has in large part been attained. Except for the item of expense, the metal propeller is admittedly superior and preferable to wood.

Referring to the drawing which shows an embodiment of the present invention, the propeller comprises two blades B, retained upon a hub member H, by clamping rings R, connected by transverse bolts positioned outside and independent of the hub and blades.

The hub member itself consists of a single forging having a cylindrical body member 1, through which extends a tapered axial splined bore 2, adapted to receive the usual engine shaft 3. The smaller end of the bore 2 terminates in an enlarged nut receiving recess 3*a*, the interior wall of which is threaded to receive the usual cap nut 4 which surrounds the usual retaining nut 5 threaded down upon the end of the tapered engine shaft, to attach the propeller to the engine shaft or other driving member, in well known manner.

Extending diametrically opposite from the axis of the bore 2, which is herein referred to as the axis of the propeller, are two blade-retaining spurs S. These are hollow, having diametric bores 6 opening into the central bore 2 of the hub. The exteriors of the spurs S are circular in cross section, and may be slightly tapered towards their outer ends. The outer faces 7 of the spurs join outer annular faces 8 of flanges 9 that extend around the hub member at the base of the spurs S, by a smooth curved annular face portion 10.

The two flanges 9 at the bases of the spurs S are reinforced by cross ribs 11, on each side of the hub member, in the plane of the axes of the spurs S.

The blades B are of conventional outer blade form. They are hollow in their shank

portions only, and they are preferably formed of forged magnesium or aluminum alloys. Near the base of the blade shanks the hollows 12 therein are machined to form accurately dimensioned bores 13 adapted to fit closely over the exterior of the spurs S.

The inner terminal portions of the blade shanks are turned outward by a suitable upsetting or swaging operation to form terminal flanges 15. The inner terminal face 16 of this flange is accurately machined to fit throughout against the accurately machined annular outer face 8 of the flange 9 on the hub. The blade shanks are also machined at the inner edges of their bases to form beveled portions 18, so that the blades may be drawn up against the outer faces of the flanges 9 without interference by contact of the blade with the curved portions 10 at the junction of the spurs S and flanges 9.

Rings R are positioned upon the circular shank portions 20 of the blades, and their inner side faces 21 are accurately formed so as to make contact with the outer faces 22 of the blade flanges 15 around the entire periphery of the blade flange and ring.

Four bolts 25 pass through bores in corner extensions of the rings, as shown in Fig. 3. These bolts connect the two rings R across the main hub member, and when the nuts 26 are taken up on the bolts the ring members are drawn together, and the hollow blade shanks are drawn and held securely against the hub flanges 9. Consequently the tension force generated by centrifugal action during the operation of the propeller, tending to throw the blades away from the axis of the driving shaft is entirely carried by direct tension on the bolts and the centrifugal pull of the two blades is counterbalanced, without strain upon the hub member H.

Driving torque is transmitted to the blades entirely through the shank members and spurs S, the latter being of sufficient length to give the necessary leverage without undue strain upon the spurs or blade ends.

The blade shanks may be machined to give an almost exact fit on the spurs S, or they may be tapered and machined slightly smaller than the spurs, and drawn inward over the tapered spurs by compressive action due to take-up of the clamping bolts. Or the blades may be machined slightly smaller than the exterior of the spurs S, and may be applied thereto and turned to the proper pitch setting by first dipping the bases of the shanks in hot oil to expand them to increase the diameter of their bores. When the blades shrink they will then be seated in tight relation on the spurs S. The clamping rings and bolts insure maintenance of this tight pitch adjusted position on the hub member.

The rings R are positioned upon the blade shanks by slipping them thereover before the flanges 15 are formed thereon. To permit this the blade shanks are made either cylindrical, or slightly tapered away from their bases, so that the rings may be slipped on, and down the shanks for a substantial distance from the inner terminal ends. Then the inner ends of the blade shanks are heated sufficiently to permit formation of the flanges 15 thereon without affecting the rings R. After the flanges are formed the rings are moved back to the position shown in the drawing, being thus locked in slidably mounted position on the blade shanks.

While bolt holes could be formed in flanges 15 to receive bolts 25, it is preferable to use separate ring members R. The use of separate rings permits the use of alloy steel of maximum strength. It also facilitates machining operations both on the ring and hub. The bolts are also preferably of alloy steel.

I claim:

1. A metal aeronautical propeller comprising a hub, blades adapted to be detachably mounted thereon in fixed pitch-adjusted position, and means to clamp the blades on the hub, the hub consisting of a one-piece member having a longitudinal axial bore for receiving an engine shaft and having radial lateral spurs adapted to receive hollow blade shanks telescoped thereon, blades having hollow shanks adapted to fit over said spurs, said shanks having outwardly extending terminal flanges, ring members slidably mounted on the blade shanks behind the flanges and adapted to seat on the outside of the flanges, and bolts adapted to extend through the rings to draw the rings toward each other and so to clamp the blades on the hub and to receive the tension moment between the blades resulting from centrifugal force in flight.

2. A metal aeronautical propeller comprising a one-piece hub in fixed pitch-adjusted position, blades adapted to be detachably mounted thereon, and separate means to clamp the blades on the hub, the hub comprising a one-piece member having a longitudinal axial bore for receiving an engine shaft and having lateral spurs adapted to receive hollow blade shanks telescoped thereon, blades having hollow shanks adapted to fit over said spurs, said shanks having outwardly extending terminal flanges adapted to abut the hub member, an annular faced flange on the hub adapted to furnish an abutment for the blade shanks, ring members mounted on the blade shanks behind the flanges and adapted to seat on the outside of the flanges, and bolts adapted to extend through the rings on diametrically positioned blades, said bolts and rings being adapted to clamp the blades on the hub and to receive the tension moment between the blades resulting from centrifugal force in flight.

3. An aeronautical propeller comprising a hub, blades adapted to be detachably mounted

thereon in fixed pitch adjusted position, and means to clamp the blades on the hub, the hub having a longitudinal bore for receiving an engine shaft and having lateral spurs adapted to receive hollow blade shanks telescoped thereon, blades having hollow shanks adapted to fit onto said spurs, said shanks having outwardly extending terminal flanges adapted to abut the hub member, ring members slidably and permanently mounted on the blade shanks behind the flanges and adapted to seat on the outside of the flanges, and means to draw the rings toward each other and so to clamp the blades on the hub.

4. An aeronautical propeller comprising a hub, blades adapted to be detachably mounted thereon in fixed pitch-adjusted position, and means to clamp the blades on the hub, the hub comprising a one-piece member having a longitudinal bore for receiving an engine shaft and having hollow lateral spurs adapted to receive a hollow blade shank telescoped thereon, blades having hollow shanks adapted to fit on said spurs, said shanks having outwardly extending terminal flanges, ring members mounted on the blade shanks behind the flanges and adapted to abut the outside of the flanges, and bolts adapted to extend through the rings outside the blades and hub, said bolts being adapted to draw the rings toward each other and so to clamp the blades on the hub and to receive the tension moment between the blades resulting from centrifugal force in flight.

5. A metal aeronautical propeller comprising a hub, blades, adapted to be detachably mounted thereon, and means to clamp the blades on the hub in fixed pitch-adjusted position, the hub consisting of a one-piece member having a longitudinal axial bore for receiving an engine shaft and having hollow radial lateral spurs adapted to receive hollow blade shanks telescoped thereon, blades having hollow shanks adapted to fit over said spurs, said shanks having outwardly extending terminal flanges machined on both sides to form accurate annular interior and exterior faces, ring members slidably mounted on the blade shanks behind the flanges and having machined inner faces adapted to seat on the outside faces of the said flanges, and means independent of the hub to draw the rings toward each other and so to clamp the blades on the hub and to receive the tension moment between the blades resulting from centrifugal force in flight.

In testimony whereof, I sign my name.

FRANK W. CALDWELL.