Feb. 7, 1939. H. A. BERLINER 2,146,367

PROPELLER

Filed March 7, 1936 2 Sheets-Sheet 1

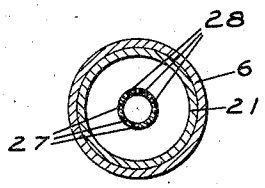

Fig. 3

Fig. 1

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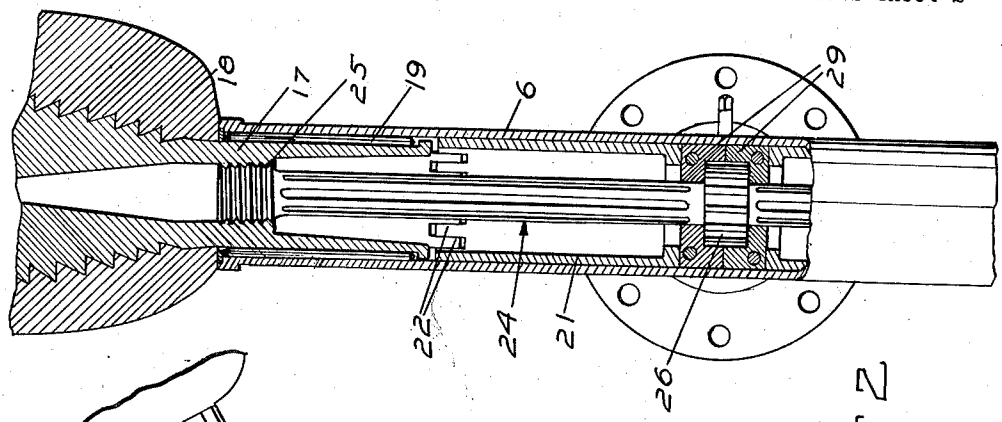

Fig. 2

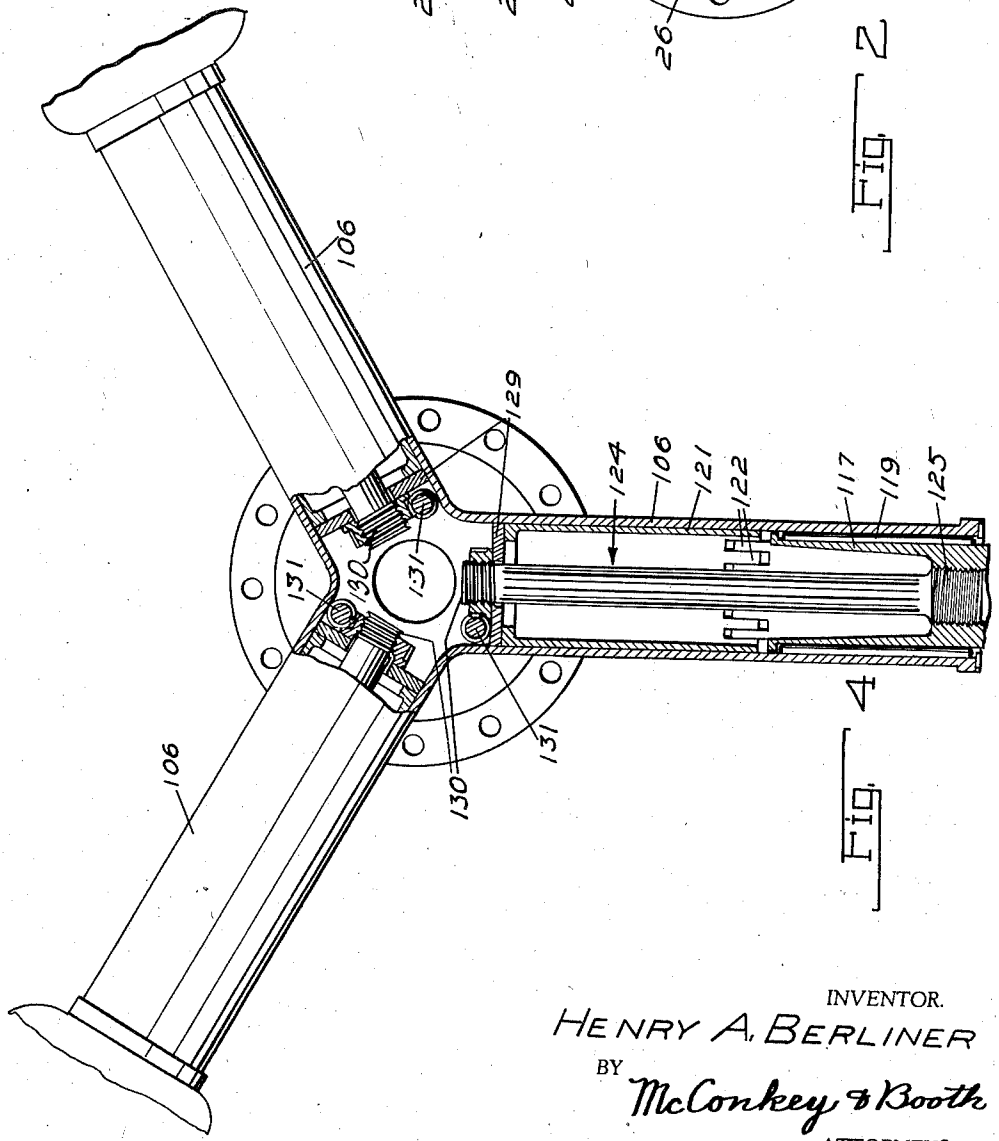

Fig. 4

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2,146,367

PROPELLER

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Application March 7, 1936, Serial No. 67,587

4 Claims. (Cl. 170—163)

This invention relates to propellers and more particularly to propellers in which the blades are separately mounted in a hub.

In propellers having separately mounted blades, and particularly in which the blades are adjustable during flight, it is necessary either to provide large heavy bearings to carry the centrifugal loads on the blades or to provide some other means to hold the blades in the hub sockets. If the blades are interconnected or are connected to the hub by means other than bearings, difficulty is encountered in providing for sufficient turning of the blades to give the desired range of pitch adjustment without causundesirable movement of the blades. It is accordingly one of the objects of the invention to provide a propeller having separately mounted blades in which the necessity for thrust bearings is eliminated and the blades can be turned through a large angle.

Another object of the invention is to provide a propeller in which the radial position of the blades can be varied to balance the propeller.

In one desirable arrangement the blades are connected to the hub or to each other by means of tubular tension members provided with a series of axial slots to form an annular series of spaced tension elements. I have found that by using a tube of minimum diameter consistent with the requisite strength, whereby the tension elements will lie relatively close to the axis of rotation, the blades may be twisted through a large angle without producing any appreciable radial movement thereof. By screw threading the tension member or members to the blades or to fastening means in the hub and by providing a mechanism for turning the tension member or the fastening means, a very simple adjustment for shifting the blades to balance the propeller is provided. The tension members may also be set to urge the blade toward its normal flight position, thereby partially or wholly balancing the centrifugal torsional force on the blade.

Other objects, advantages and novel features of the invention will be apparent from the following description when read in connection with the accompanying drawings, in which:

Figure 1 is a central section of a propeller embodying the invention;

Figure 2 is a section with parts in elevation on the line II—II of Figure 1;

Figure 3 is a section on the line III—III of Figure 1; and

Figure 4 is a partial central section of another embodiment of the invention.

As shown in Figures 1 to 3, the propeller comprises a hub 5 having a pair of oppositely facing radial sockets 6 adapted to carry the blades. The hub 5 is adapted to be drivably connected to an engine shaft or to a suitable extension of an engine shaft and has splined to its outside a sleeve 7 formed on its outer surface with a pair of cam slots. The sleeve 7 is connected through a bearing 8 with a collar 9 which is slidably mounted on a plurality of stationary rods 11 so as to be axially movable but not rotatable.

The collar 9 carries a plurality of radial pins 12 slidable in slots 13 in a collar 14 which is rotatably mounted in a fixed extension 15 which may be mounted on the engine or other part of the craft with which the propeller is used. A lever 16 extends through a suitable slot in the extension 15 and is adapted to be moved manually or through any suitable power mechanism to change the pitch of the blades, as will appear later.

A pair of blades are mounted in the sockets 6, the blades as shown being formed in the manner more particularly described and claimed in my copending application Serial No. 67,588, filed March 7, 1936, with metal spuds 17 having molded blades 18 of "Micarta" or the like formed therein. The spuds 17 have cylindrical root portions journaled in the sockets 6 through suitable bearings 19 and have reinforcing portions extending into and forming an intimate bond with the molded portions 18.

The angular position of the spuds and consequently of the blades is controlled by the mechanism described above through sleeves 21 journaled in the sockets 6 and secured to the root ends of the blades as by means of intermeshing teeth shown at 22. Rods 23 extend through suitable slots in the sockets 6 and are secured to the sleeves 21, the free ends of the rods carrying pins which are slidable in the cam slots in the sleeve 7.

To adjust the angular position or pitch of the blades, the lever 16 may be moved to rotate the sleeve 14. Due to the pin and slot connection 12, 13 this will shift the collar 9 and sleeve 7 axially, causing the ends of rods 23 to move in the cam slots in sleeve 7 and turning the sleeves 21 and the blades about their own axes in the sockets 6. While the particular mechanism shown for changing the pitch of the blades has been described in some detail, it will be apparent that any other suitable type of pitch changing mechanism might be employed.

In order to hold the blades in their sockets,

there is provided, according to the present invention, a tension member indicated generally at 24. The member 24 is in the form of a hollow steel tube having enlarged end portions 25 screw threaded into the root ends of the blades and an enlarged center portion 26. Between the end and center portions the tube has series of axially extending slots 27 so that it forms, in effect, a series of tension strips 28 arranged in annular array about the axis of rotation of the blades. Preferably the tube has the minimum diameter consistent with strength so that the strips 28 lie closely adjacent the blade axis. I have found that with this arrangement the blades may be twisted through a large angle without producing any appreciable shortening of the tension member and consequently without causing appreciable shifting of the blades axially of their sockets.

The enlarged center portion 26 of the tension member is held in place and centered in the hub by means of blocks 29 secured in the hub in any suitable manner and gripping the ends of the portion 26. Preferably the portion 26 is formed as a worm gear meshing with a worm 31 which is rotatably mounted in the hub and whose shaft extends through the hub so that it may be engaged by any suitable tool and turned. The portions 25 of the tension member are formed with threads of the same hand so that turning the tension member will move one of the blades radially inwardly and the other outwardly, thereby permitting the propeller to be balanced easily and quickly after it is assembled. This is an important feature since it enables a great saving in time and effort over the present methods of balancing propellers.

In the use of adjustable pitch propellers on aircraft, it is desirable to be able to turn the blades to a 90° pitch angle in order to feather the blades and at the same time to turn them to a reverse angle for braking during landing. For example, a plane with four engines, when not heavily loaded, may desire to run on two engines to effect a saving in fuel and the two idle propellers should be turned with their blades substantially parallel to reduce air resistance. When this condition is coupled with reversibility of the blades for braking, it means that the blades must be capable of turning through a total angle in the neighborhood of 110°.

Angles of this, or even of greater magnitude, are possible with the present invention, it being appreciated that the tension member can be set at approximately the center of the total arc of twist so that it must be turned or twisted only half of the total angle, or about 55° in each direction. When the tension member is so set, its natural resiliency tends to turn the blade toward or even past its normal setting for forward flight, the tension member under the conditions assumed above tending to turn the blade to a forward pitch angle of 35°. This effect is increased by the pull on the tension member due to the centrifugal force on the blades so that a very appreciable turning moment is exerted by the tension member tending wholly or partially to balance the centrifugal torsional effect on the blades tending to turn them into their plane of rotation. In order to transmit this torsional force between the tension member and the blades, the fit of the portions 25 may be made very tight or suitable set screws may be provided to lock the blades and the tension member against undesired relative rotation.

Figure 4 illustrates a three blade propeller embodying the invention and for the sake of brevity of description parts therein corresponding to like parts in Figures 1 to 3 have been designated by the same reference numbers plus 100. In this construction a separate tension member 124 is provided for each blade and the inner ends of the tension members extend through blocks 129 which are rigidly secured in the sockets 106 and which have nuts 130 screw threaded on the ends thereof. The nuts 130 are formed as worm gears and mesh with worms 131 rotatably mounted in the hub by means of which the blades can be adjusted separately to balance the propeller. It will be apparent that instead of turning the nuts 130 on the tension members, the entire tension members might be turned to effect the adjustment by means of the screw threads at 125.

While only two embodiments of the invention have been shown and described, it will be apparent that many changes might be made or that other embodiments might be devised. It is accordingly not intended to limit the scope of the invention to the forms shown or otherwise than by the terms of the appended claims.

I claim:

1. A propeller comprising a hub having a pair of oppositely facing sockets, a blade rotatably mounted in each of said sockets, means for adjusting the angular positions of the blades, and means for holding the blades in the sockets including a tubular member secured to the root ends of the blades substantially at the axis of rotation thereof and formed with a plurality of axial slots to provide an annular series of spaced tension members, means to center the tubular member in the hub, and means operable from outside of the hub to adjust the position of the blades relatively to the tension member thereby to balance the blades.

2. A propeller comprising a hub having a pair of oppositely facing sockets, a blade rotatably mounted in each of said sockets, means for adjusting the angular positions of the blades, and means for holding the blades in the sockets including a tubular member screw threaded to the root ends of the blades substantially at the axis of rotation thereof and formed with a plurality of axial slots, means to center the tubular member in the hub, and means to turn the tubular member thereby to adjust the axial positions of the blades in the hub.

3. A propeller comprising a hub having a pair of oppositely facing sockets, a blade rotatably mounted in each of said sockets, means for adjusting the angular positions of the blades, and means for holding the blades in the sockets including a tubular member screw threaded at its opposite ends into the root ends of the blades and having its center portion formed to engage oppositely facing thrust bearings in the hub to center said member, said member being formed with series of axial slots between its center portion and its opposite ends, and means to rotate said member to adjust the positions of the blades in their sockets.

4. A propeller comprising a hub having a plurality of radial sockets, blades mounted in said sockets, and means for holding each blade in its socket comprising a tension member in the hub secured to the root end of the blade, a nut in the socket screw threaded to the tension member to hold it in the socket, and means operable from outside the hub to turn said nut thereby to adjust the position of the blade in its socket.

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