Dec. 22, 1931. H. C. EUSTIS 1,837,318

CHANGEABLE PITCH PROPELLER

Filed March 20, 1931 2 Sheets-Sheet 1

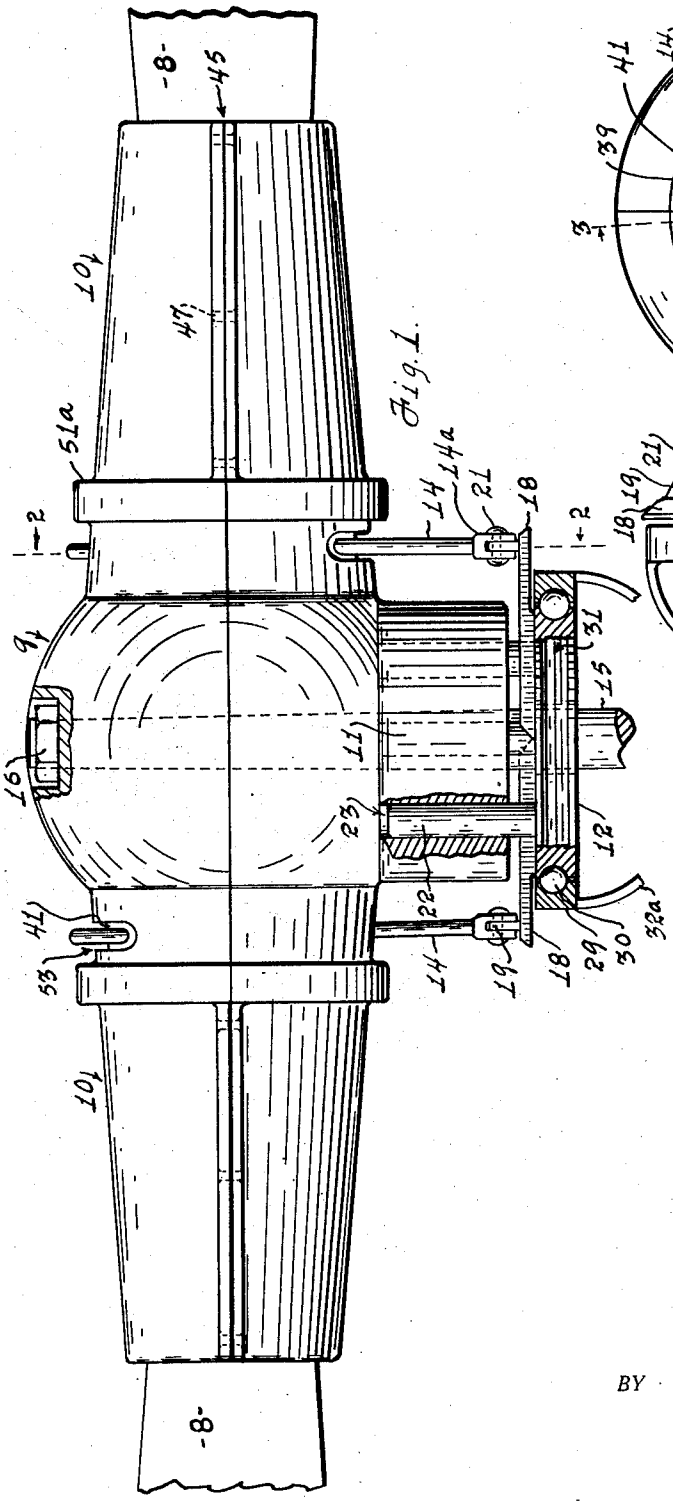


Fig. 1.

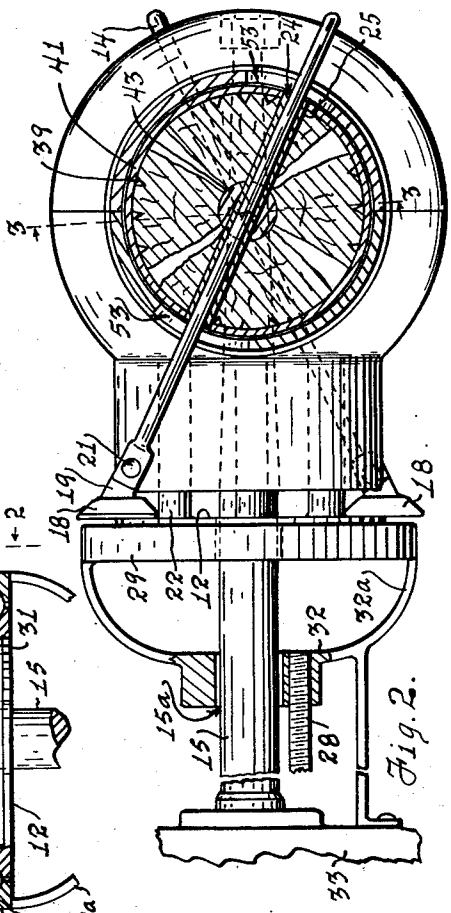


Fig. 2.

Harry C. Eustis,
INVENTOR.

BY J. W. Shelley
ATTORNEY.

Dec. 22, 1931. H. C. EUSTIS 1,837,318

CHANGEABLE PITCH PROPELLER

Filed March 20, 1931 2 Sheets-Sheet 2

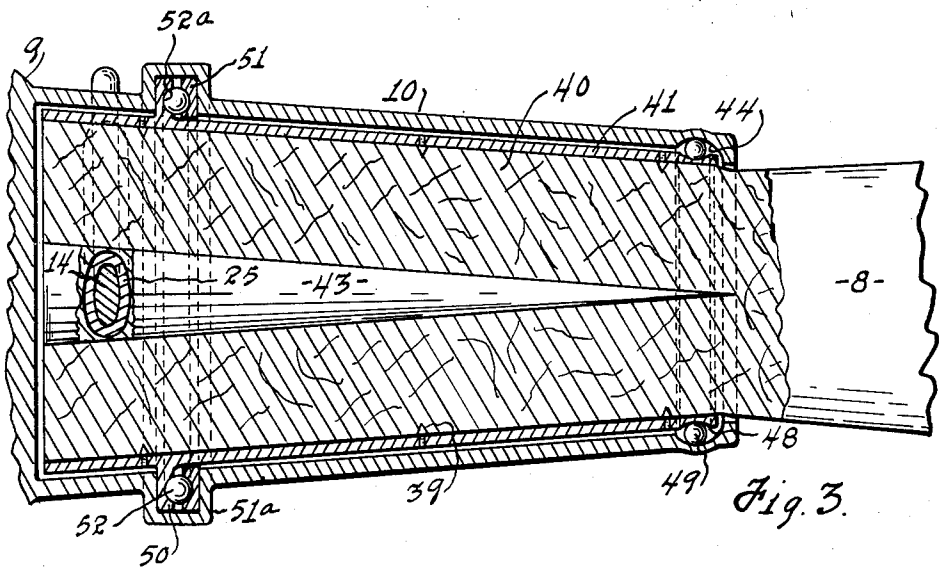


Fig. 3.

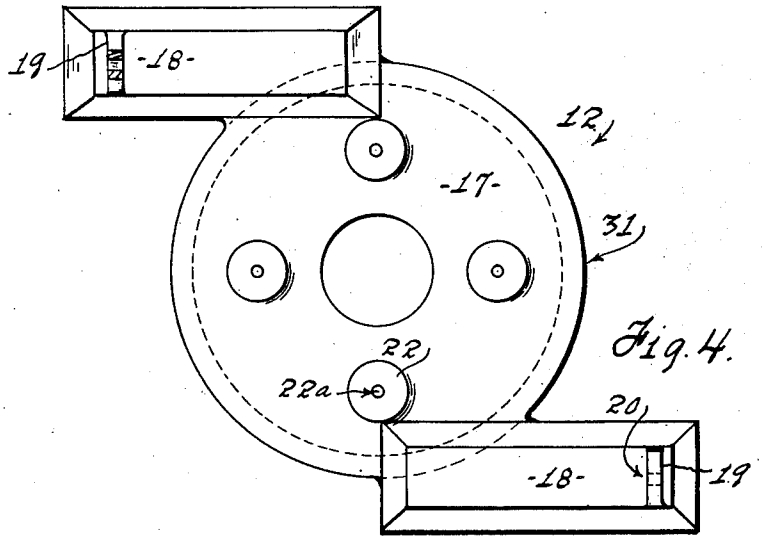


Fig. 4.

Harry C. Eustis,
INVENTOR.

BY J. W. Sheeley

ATTORNEY.

Patented Dec. 22, 1931 1,837,318

UNITED STATES PATENT OFFICE

HARRY C. EUSTIS, OF ELIZABETH, NEW JERSEY, ASSIGNOR OF ONE-HALF TO ROBERT H. McADAMS AND ONE-FOURTH TO WILLIAM I. BEATTY, BOTH OF ELIZABETH, NEW JERSEY

CHANGEABLE PITCH PROPELLER

Application filed March 20, 1931. Serial No. 524,161.

The present invention relates to airplane propellers, and pertains more particularly to changeable pitch propellers and improved mechanism for operating and locking same.

The invention has for its principal object the provision of changeable pitch propellers of more sturdy construction, particular attention being given to the provision of means for securely holding the blades or tips in place against centrifugal action.

Another object of the invention is to provide a changeable pitch propeller in which the blades are securely held against centrifugal force while capable of being turned, to change the pitch of the propeller, with minimum energy and strain.

In changeable pitch propellers, each blade or tip is mounted in a hub, so that it may be partially turned around its longitudinal axis while revolving with the hub. Inasmuch as such arrangement of blades requires that each blade be mounted independently of the other, difficulties have been experienced in holding the separate blades to the hub against the extreme centrifugal force to which they are subjected.

It is another object of the invention to employ such centrifugal force so that it actually aids in holding the blades in place, rather than to throw them out of the hub.

Another object of the invention is to provide for properly housing and enclosing all the moving parts against exposure to the elements and without possible clogging with foreign matter.

Another object of the invention is to provide for simplified manufacture of the parts which I employ for carrying out the object of my invention.

Still another object of the invention is to provide simple and efficient means for holding the blades whereby the complete propeller is stronger than all other usual propellers, as well as being capable of rapid and easy assembly or disassembly.

Still other objects and advantages of my invention will appear hereinafter.

I have illustrated my invention by the accompanying drawings in which:

Figure 1 is a plan view of one practical embodiment of my invention.

Figure 2 is a view in section thereof seen on a line 2—2 of Figure 1.

Figure 3 is a view in section on a line 3—3 of Figure 2.

Figure 4 is a view in end elevation of a part known as the sliding member.

More specifically, my improved propeller, shown complete in Figure 1, except for the extreme outer ends of the blades or tips 8, includes a hub 9, a pair of diametrically opposed radially projecting tip casings 10 carried by the hub, a large central rearwardly extending boss 11 integral with the hub, the sliding member 12 movable toward and away from the boss 11, and the pitch rods 14 connecting the sliding member with the tips for operation of the said tips.

Any usual construction may be employed for the hub, and same is pressed on the engine shaft 15 and held by means of the usual nut 16. The sliding member is in the form of a disc 17 having integral tangentially projecting arms 18 which carry integral lugs 19; said lugs each projecting from the arms toward the blades at slightly obtuse angles to the corresponding arm. Said lugs are each provided with a pivot-pin aperture 20 for receipt of a pivot pin 21.

The sliding member includes integral projecting pins 22, which extend into corresponding bores 23 provided in the boss of the hub. Said pins act as guides and torque arms for the sliding member, so that the sliding member will revolve positively with the propeller hub while being capable of movement with regard thereto longitudinally along the axis of the shaft 15. The pins 22 are each provided with a small through bore 22*a* which prevents the compression of air between the end of the pin and the bottom of the corresponding bore; said bores each being closed at the inner end.

Each blade is provided with a diametrical through bore 24 adjacent the butt end thereof, and when the blades are in normal position, each bore is obliquely disposed. Each bore is lined with a metal bushing 25. For each bore 24, there is provided a pitch rod

which is slidable in the corresponding bore and which is also revoluble in the said bore. Each pin has a forked end whereby the corresponding one of pivot pins 21 connects the corresponding arm of the sliding member to a corresponding pitch rod. One rod passes through the corresponding blade butt at the top and extends through at the bottom, while the other pitch rod enters the corresponding bore at the under side of the blade butt and passes out at the upper side, thus the two pitch rods are crossed with, or angularly opposed to, each other.

It will be apparent now that, if the sliding member is moved toward the hub, the right hand rod (viewed from the rear) will be rotated slightly around its longitudinal axis anti-clockwise, while the other blade will be moved clockwise. Thus the pitch of the propeller is changed, as will be understood by those skilled in the art. The movement necessary to give the usual ranges of pitch change is comparatively slight when expressed in the matter of degrees of a circle, and the peculiar angular arrangement of the pitch rods, and the disposition of the arms of the sliding member with regard to the line of travel of the said member, is such that appreciable movement of the sliding member is necessary to give a slight change of pitch to the blades. Thus ample leverage is provided for easy movement of the blades. The wind forces which might act to turn the blades to accidentally change the pitch, are opposed by such arrangement of the rod and sliding member, and the blades become automatically locked at whatever position they are set. Such tendency of the blades to turn sets up a thrust of the pins of the traveling member against the margins of the corresponding bores, and, therefore, I provide an ample number of such pins, of large diameter, to properly hold against such thrust. The inward and outward movement of the traveling member is controlled by a screw 28, which is threaded into a yoke 29. Said yoke encompasses the traveling member and is held thereto by intermediate balls 30, running in a ball race 31. The ball race is provided between the traveling member and the yoke, so that the traveling member is revoluble in the yoke while the yoke is stationary. Likewise the yoke may be moved longitudinally of the shaft to advance or retract the sliding member. The screw is extended through a fixed bracket 32 which prevents the yoke from turning; said bracket being fixed to a part 33 of the engine (not shown), or to any other fixed member. It is understood that suitable controls run from the screw to a control crank or lever (not shown), such as is commonly employed for operating changeable pitch propellers in airplanes. The yoke is of course free from the engine shaft in every respect, and merely encompasses same in spaced relationship thereto.

It will be apparent now that I have provided different ways and means for taking care of the turning thrust of the blades and for causing the blades to become locked in any position in which they are set. As mentioned hereinbefore, the blades are revoluble in the casings and I will now describe my improved means for holding the blades in place against the high centrifugal force to which they are subjected.

The butt end of each blade is tapered as at 40, so that it increases in diameter inwardly, while the housing of each blade butt is also tapered to increase in diameter toward the hub. The blade butt is provided with a metal sheath 41 of conforming conical shape; said sheath being preferably of a seamless tubular construction.

In the manufacture of the blades, the butt is turned in a lathe until round and of constant diameter throughout. Then the round butt is placed in the sheath. Now a wedge 43 is driven into the butt causing same to expand and fill the conical sheath. Prior to setting the butt of the blade in the sheath, the said sheath is provided with inwardly projecting prongs, and when the blade butt is expanded in the sheath, the prongs firmly hold the butt and sheath together. The smaller end of the sheath is provided with an integral ball race 44. The casing is split as at 45, and is connected with the hub as at 46, by bolts 47. To attach the blades to the hub, each casing is fitted around the corresponding sheathed end of the butt and bolted together, after which the casings are bolted to corresponding sides of the hub. The casings each provide a ball race 48 which coacts with the corresponding race 44, to retain balls 49.

Toward the inner or larger end of each sheath, I provide an annular enlargement 50, and the casing is provided with a large corresponding annular groove 51 of enlarged diameter. One margin 51*a* of this groove is spaced from the enlargement 50 so that a complete annular end thrust ball bearing 52 is retained therebetween.

It will be apparent now that said ball bearing, in each casing, takes the end thrust set up by centrifugal force and securely holds the blade in place while providing for its being turned quite readily. The construction shown is, of course, suitable for holding separate blades in a hub assembly even if it is not desired to have changeable pitch blades. Obviously, a sheathed tip may be quickly replaced by removing and opening the split casing which holds it.

While I have shown and described a specific embodiment of my invention, I do not limit myself thereto, and I may employ any construction and arrangement of parts which

come within the scope of the appended claims.

What is claimed is:

1. In an airplane propeller, a tapering casing, a sheath rotatable in the casing, a blade having a butt end in the sheath, a wedge forced longitudinally into said blade so that it is expanded to increasing diameter toward the butt thereof and against the interior of the sheath, short internal projections in said sheath embedded in said butt; said projections being sufficiently short to permit of inserting said butt into said sheath before said butt is expanded by said wedge, an external annular enlargement to said sheath forming a thrust collar, said casing being formed with an annular groove in which said thrust collar is disposed; said casing being divided longitudinally.

2. In a changeable pitch propeller, a casing having a hollow interior space of decreasing diameter outwardly; said casing being divided longitudinally, a tubular sheath revolubly mounted in said casing having its external diameter decreasing outwardly to closely conform to the outwardly decreasing internal diameter of said casing, and a blade having an end expanded into said sheath, said casing being supported and retained on the sheath by a thrust bearing disposed near the radially inward ends thereof, and another bearing supporting the radially outward end of the casing upon the sheath.

3. In an aeroplane propeller construction, a tapering casing, a sheath rotatable in the casing, a blade having a butt end in the sheath, a wedge forced longitudinally into said butt so that it is expanded to increasing diameter toward the butt terminal thereof, and against the interior of the sheath, short interior projections in said sheath embedded in said butt, said projections being sufficiently short to permit of inserting said butt into said sheath before said butt is expanded by said wedge, an external annular enlargement on said sheath forming a thrust collar, said casing being formed with an annular channel, a bearing in the channel in which said thrust collar is disposed, said casing being divided longitudinally and said casing and sheath being provided near their radially outward ends with facing annular grooves confining another bearing.

4. In an aeroplane propeller construction, a tapering casing, a tapering sheath rotatable in the casing, a propeller blade having a butt end inserted in the sheath, a wedge forced longitudinally into said butt so that it is expanded to increasing diameter toward its radially inward terminus, and thereby snugly engaged with the interior of the sheath, short interior projections being sufficiently short to permit of inserting said butt into said sheath before said butt is expanded by said wedge, an external annular enlargement on said sheath forming a thrust collar, said casing being formed with an annular channel carrying a bearing in which said thrust collar is disposed, said casing being divided longitudinally, and anti-friction means between said thrust collar and a corresponding margin of said groove, and another bearing supporting the casing upon the sheath at the radially outward end portions thereof.

In testimony whereof I affix my signature.

HARRY C. EUSTIS.