May 19, 1931. R. F. WOODEN 1,806,325

ADJUSTABLE AND REVERSIBLE PROPELLER FOR AEROPLANES OR OTHER AIRCRAFT

Filed March 12, 1930 3 Sheets-Sheet 1

Fig. 1.

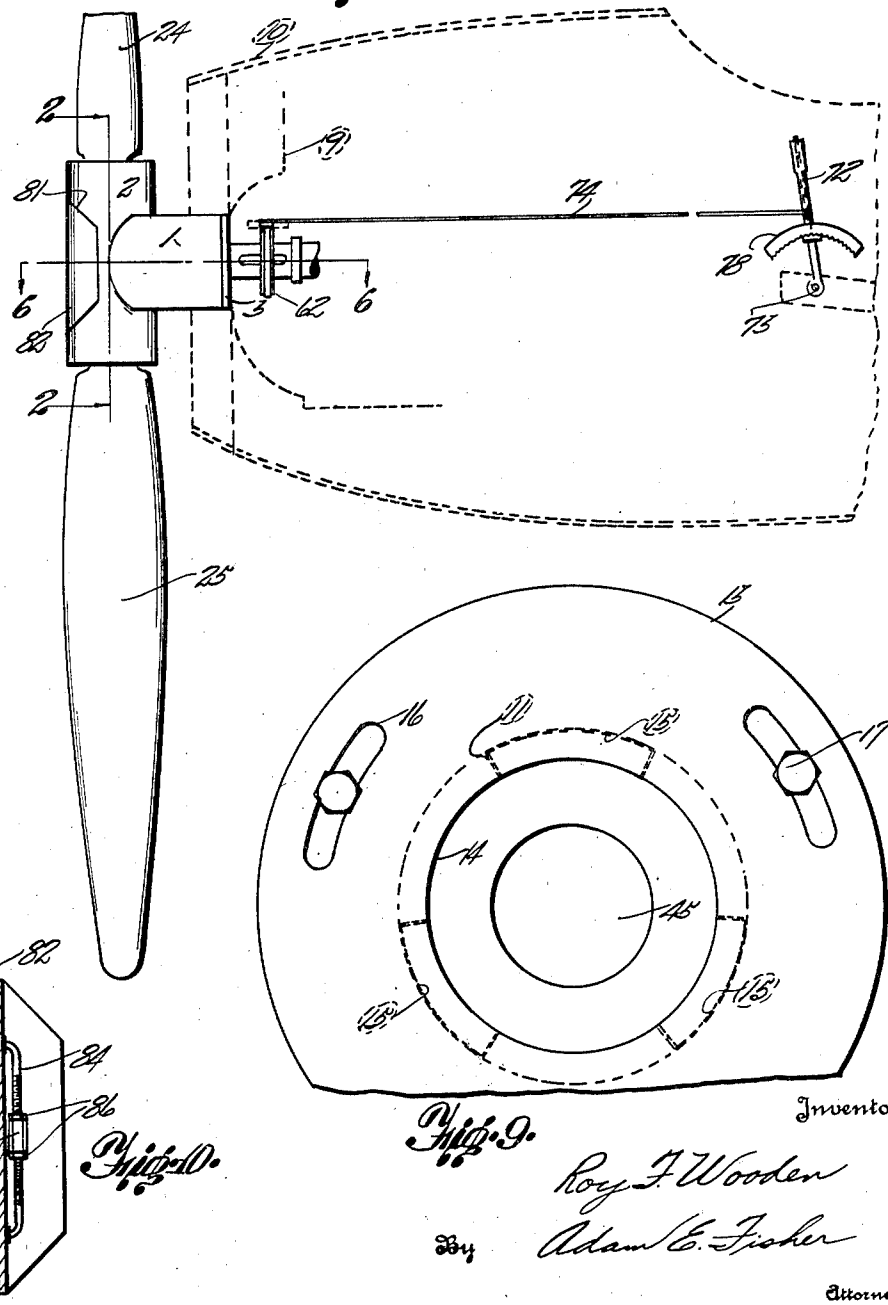


Fig. 10.

Fig. 9.

Inventor

Roy F. Wooden

By Adam E. Fisher

Attorney

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ADJUSTABLE AND REVERSIBLE PROPELLER FOR AEROPLANES OR OTHER AIRCRAFT

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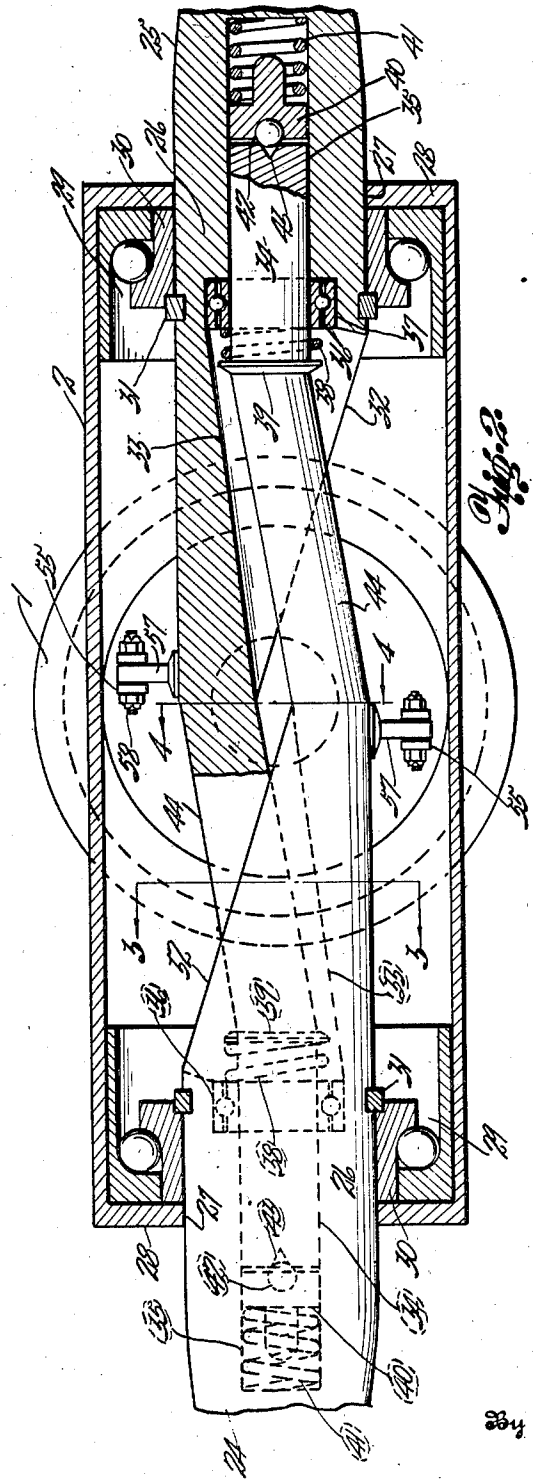


Fig. 2.

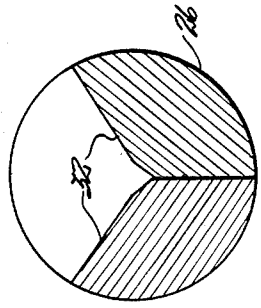


Fig. 3.

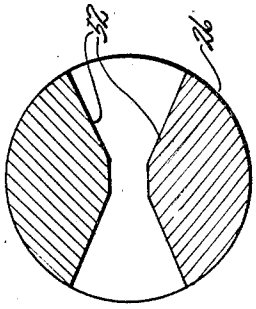


Fig. 4.

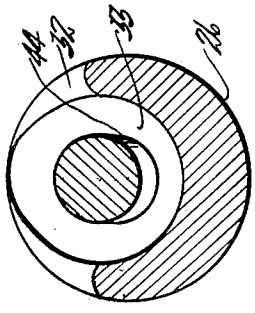


Fig. 5.

Inventor

Roy F. Wooden

Adam E. Fisher

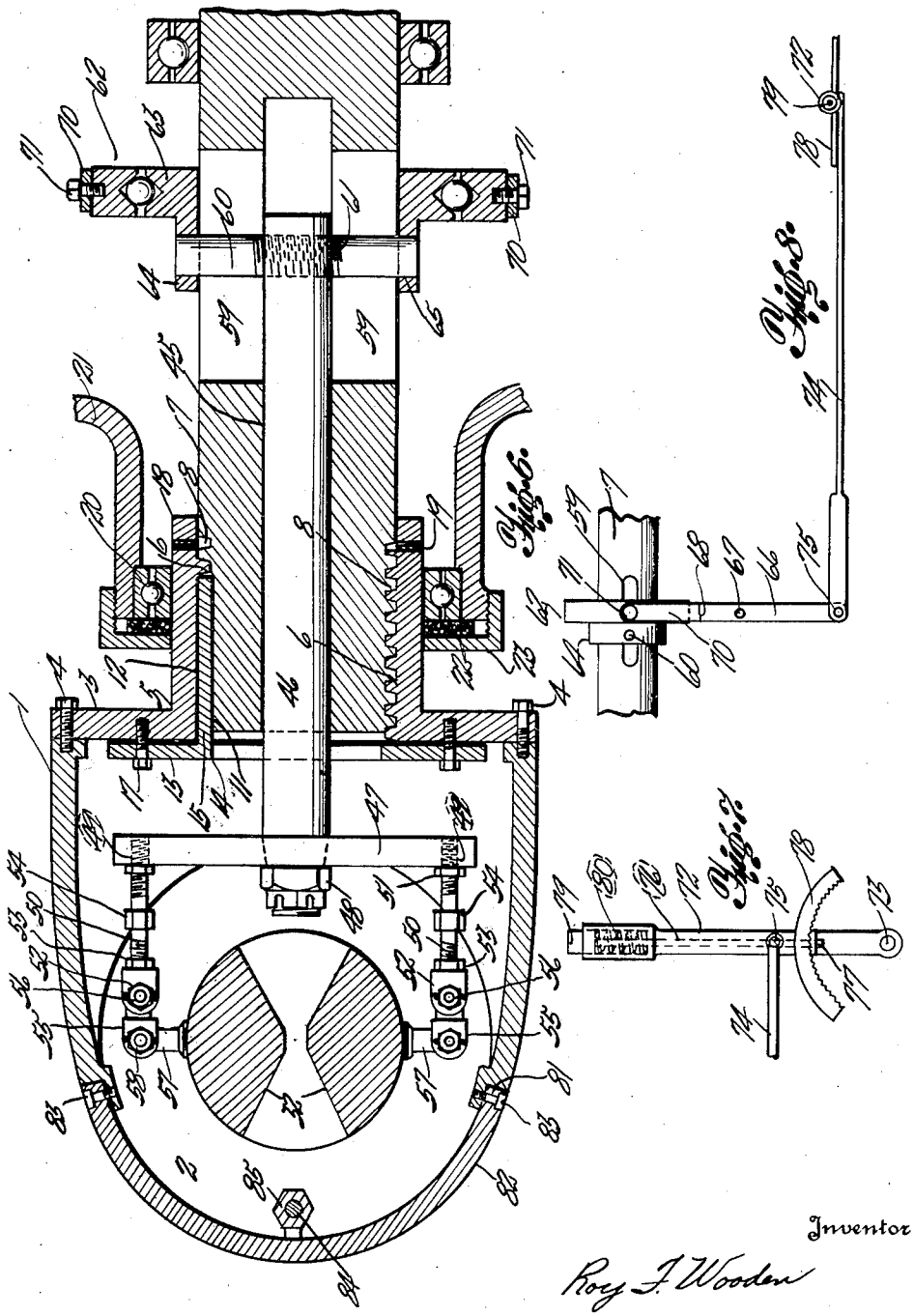
By

Attorney

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ADJUSTABLE AND REVERSIBLE PROPELLER FOR AEROPLANES OR OTHER AIRCRAFT

Filed March 12, 1930 3 Sheets-Sheet 3



Inventor

Roy F. Wooden

By Adam E. Fisher

Attorney

Patented May 19, 1931

1,806,325

UNITED STATES PATENT OFFICE

ROY F. WOODEN, OF MOUNT VERNON, ILLINOIS

ADJUSTABLE AND REVERSIBLE PROPELLER FOR AEROPLANES OR OTHER AIRCRAFT

Application filed March 12, 1930. Serial No. 435,070.

This invention relates to adjustable and reversible propellers for aeroplanes or other aircraft.

The main object of the invention is to provide a means whereby the blades of a propeller may be axially shifted without interfering with their rotation so as to increase their pitch when taking off or flying in high altitudes or decrease their pitch when landing or warming the engine and reverse their pitch to serve as a brake when landing.

Another object is to provide a novel and very efficient mounting for the propeller blades in which they are connected and journaled together at relatively widely separated points in such manner that they may freely rotate on their axis for adjustment of pitch but cannot move out of their proper longitudinal alignment under the strains brought about by the rapid rotation of the propeller in flight.

A further object is to provide a simple and efficient remotely controlled means for shifting the blades to vary their pitch.

The foregoing and other objects of the invention together with means whereby the same may be carried into effect will best be understood from the following description of a preferred embodiment of the invention taken in connection with the accompanying drawings wherein:

Figure 1 is a side elevation of the propeller and the blade adjusting mechanism as installed on an aeroplane, the latter being shown in dotted lines.

Figure 2 is an enlarged section along the line 2—2 in Figure 1.

Figure 3 is an enlarged section along the line 3—3 in Figure 2.

Figure 4 is an enlarged section along the line 4—4 in Figure 2.

Figure 5 is a view similar to Figure 4 but illustrating the blades in a different position or set at a different pitch.

Figure 6 is an enlarged section along the line 6—6 in Figure 1.

Figure 7 is an elevation of the blade shifting lever.

Figure 8 is a plan view of a portion of the blade shifting mechanism and lever.

Figure 9 is an enlarged front elevation of the wedging plate for securing the propeller hub to the propeller shaft, the latter being also shown in end elevation in this view.

Figure 10 is an enlarged cross section through the hub cover plate as detached from the hub.

In carrying out the invention I provide a hollow hub 1 having an elongated cylindrical shell or receptacle 2 extended at right angles across its end, the said shell 2 communicating with the hub 1 to provide a housing for the inner ends of the propeller blades and their operating mechanisms which will be hereinafter described. An end plate 3 is secured by bolts 4 over the end of the hub 1 and an annulus 5 is extended from this end plate outwardly of the hub, threads being provided inside this annulus 5 as shown at 6. The end of the engine drive shaft or propeller shaft 7 is externally threaded as shown at 8 for the reception of this annulus 5 thereby providing a connection between the hub 1 and the engine, a portion of which is shown in Figure 1 in the dotted lines 9. The engine 9 may be of any suitable and conventional form and is mounted within the nose 10 of the aeroplane (also shown in dotted lines) in the usual manner. Segments of the threads 8 on the shaft 7 are cut away longitudinally of the shaft as shown at 11 and complementary segments are cut from the threads 6 in the annulus 5 as shown at 12. A circular fastening plate 13 is provided, the same having a central opening 14 around the margin of which are provided spaced keys or wedges 15 extended outwardly at right angles from the face of the plate. Slots 16 are provided through the plate 13 for the passage of bolts 17 by means of which the plate may be secured to the inside of the end plate 3. In mounting the hub 1 on the engine shaft 7 the annulus 5 is threaded thereon a substantial distance and the cut away segments 11 and 12 of the threads 6 and 8 are brought into alignment or registry. The wedges 15 are then inserted into the slots thus provided as shown in Figure 6 of the drawing and the bolts 17 are tightened driving the said wedges home and forming a rigid connection between the hub

and shaft. A stop ring 18 is secured on the shaft 7 and spacing washer 19 may be placed between this ring and the end of the annulus 5 to facilitate the rigid connection of these elements the annulus 5 being screwed down against these washers as shown. As shown in Figure 6 the annulus 5 is journaled in a ball bearing 20 provided in the crank case 21 of the engine 9 and a packing washer 22 is secured over this bearing by the gland 23 to prevent the escape of oil from the crankcase but this assembly will of course vary according to the type of engine used.

The propeller blades 24 and 25 are conventional in form except for their inner end portions 26 which are rounded and journaled through apertures 27 provided in the ends 28 of the receptacle 2 for this purpose. Ball thrust bearings 29 are provided within the receptacle 2 and these inner ends 26 of the propeller blades are secured to the inner races 30 of these bearings 29 and held against longitudinal displacement therein by locking rings 31 seated in the blades and bearing races 30 as shown. The propeller blades 24 and 25 are angularly cut away at 32 and channeled or grooved at 33 within the bearings 29 and adjacent thereto and are then tapered and rounded as shown at 44 and extended angularly inward toward their axis to terminate in axially extended journals 34. The blades are also provided with bores 35 extended axially outward from the channels 33 for the reception of the journals 34. The journal 34 of each blade is inserted in the bore 35 of the other blade thus connecting the blades together and at the same time allowing them to rotate independently upon their axis. The channel 33 of each blade receives the inwardly extending portion 44 of the other blade and allows the same to rotate as will be understood. Ball bearings 36 are seated in enlarged mouths 37 provided at the inner ends of the bores 35 and the said journals 34 are mounted through these bearings. Expansion coil springs 38 are braced between fixed collars 39 on the journals 34 and the bearings 36 to hold the latter in place. The bores 35 are considerably longer than the journals 34 and thrust bearing carriers 40 are slidably mounted in these bores and normally urged inward into engagement with the ends of the journals by the expansion coil springs 41 which are braced between the said carriers and the end of the said bores. The carriers 40 carry ball bearings 42 which seat in sockets 43 provided for this purpose in the ends of the journals 34. By the foregoing construction it will be readily apparent that the propeller blades 24 and 25 are securely mounted within the receptacle 2 and cannot vibrate or chatter due to their rapid rotation in use, yet, at the same time the blades may be freely and independently rotated on their axis to change their pitch.

The forward end of the engine shaft 7 is provided with a central longitudinally extended bore 45 opening out through the end of the shaft and a slide rod 46 is slidably mounted in this bore as shown in Figure 6. An arm or yoke 47 is bolted as shown at 48 across the forward end of the slide rod 46 and is provided with threaded apertures 49 adjacent its ends. Connecting or adjusting rods 50 are provided and the same have their ends oppositely threaded as shown, one end of each rod being threaded in the aforesaid apertures 49 in the arm 47 and locked by a lock nut 51. Forks or links 52 are threaded on the free ends of the rods 50 and locked by lock nuts 53 and a square or angular enlarged shoulder 54 is provided on these rods 50 intermediate their ends so that the distance between the forks 52 and the arm 47 may be varied as will be understood. End forks or links 55 are pivotally mounted at 56 in the clefts in the forks 52 as shown. Attaching studs or ears 57 are secured to the outer faces of the inner ends 26 of the propeller blades 24 and 25 at points substantially at the junction of the channeled sections 33 and the tapered rounded portions 44 of these blades as shown. The end forks 55 are pivotally connected to these studs 57 by the bolts 58, the said studs entering into the clefts of the forks for this purpose as shown. It will now be understood that a longitudinal or axial shifting of the slide rod 46 in the bore 45 will cause the propeller blades 24 and 25 to be shifted to vary their pitch. For this purpose diametrically opposite and longitudinally extended slots 59 are provided in the engine shaft 7 adjacent the inner end of the bore 45 and in communication therewith thus providing a slideway for a pin 60 which is threaded diametrically through the slide rod 46 near its end as shown at 61. A ball bearing 62 is loosely mounted on the shaft 7 and its inner race 63 carries an annulus 64 which is provided with apertures 65 for the reception of the ends of the pin 60, the said bearing and slide rod 46 being thus connected together. An operating arm 66 is fulcrumed at 67 to any suitable part of the aeroplane or engine (not shown) and has one end bifurcated at 68 and adapted to embrace the outer race 69 of the ball bearing 62 to which race the forks 70 of this arm are pivoted by means of the bolts 71. A hand lever 72 is provided and the same is pivoted at 73 to any suitable part of the plane within the cock pit and handy to the pilot's hand. A link 74 is pivotally attached at its ends as shown at 75 to the free end of the arm 66 and to the hand lever so that a swinging movement of the latter will bring about a shifting of the bearing 62 and slide rod 46 to vary the pitch of the propeller blades 24 and 25 as will be understood. A rod 76 is slidably mounted lengthwise in the hand lever 72 and carries at its lower end a pawl 77 adapted to engage

the serrated face of a quadrant 78 which is secured to the plane adjacent the lever 72 thereby securing the lever in any adjusted position. The rod 76 is operated to engage or disengage the pawl 77 by a finger button 79, and the said pawl is normally held in engagement with the quadrant 78 by means of a coil spring 80 arranged as shown.

In order to allow access to the mechanism in the receptacle 2 the front wall thereof is provided with an aperture 81 normally closed by a plate 82 secured in place by screws 83. This plate 82 carries on its inner face a threaded bar 84 upon which is threadedly mounted the counter weight 85 and lock nuts 86 so that the propeller may be balanced as will be understood. After the propeller is balanced the counterweight 85 is secured in its adjusted position by the lock nuts 86.

While I have herein set forth a certain preferred embodiment of my invention it is understood that I may vary from the same in minor details so as best to construct a practical device for the purpose intended, not departing from the spirit of the invention and within the scope of the appended claims.

I claim:

1. In a device of the kind described, a hub, an elongated cylindrical shell transversely mounted on the hub, a pair of propeller blades with rounded inner end portions journaled in the said shell, the said rounded inner end portions having channels in one side and having bores opening out into the said channels, journals on the same ends of the said propeller blades, the journal of each blade being journaled in the bore of the other blade, and means for rotating the blades on their longitudinal axis.

2. In a device of the kind described, a hub, an elongated receptacle transversely mounted on the hub, a pair of propeller blades, the inner end portion of each blade being rounded and journaled through the ends of the said receptacle, the said inner rounded ends of the blades within the receptacle having angular channels a part of their length, the remainder of the blades being rounded and extended angularly inward toward the axis of the blades to terminate in axially extended journals, the said blades also having axially extended bores opening out into the said channels for the reception of the journals of the oppositely disposed blades, and means whereby the blades may be independently rotated on their longitudinal axis to vary their relative pitch.

3. In a device of the kind described, in combination with the drive shaft of an engine, a hub mounted on the said drive shaft, an elongated cylindrical receptacle transversely mounted on the said hub, propeller blades journaled in the ends of the said receptacle, each of the said blades having an axially aligned journal and bore for reception of the bore and journal respectively of the opposite blade.

4. In a device of the kind described, in combination with the drive shaft of an engine, the said drive shaft having a longitudinal bore opening out through its end and having diametrically opposite slots through its wall, near the inner end of the said bore and opening thereinto, a hub mounted on the drive shaft, an elongated cylindrical receptacle transversely mounted on the hub, propeller blades journaled in the ends of the receptacle, studs secured to the said blades within the receptacle, a slide rod slidably mounted in the said bore in the drive shaft, an arm secured across the outer end of the said slide rod, connecting rods adjustably secured to the ends of the arm, forks connecting the said connecting rods to the studs on the propeller blades, a bearing slidably mounted on the said drive shaft over the slots therein, the inner race of the said bearing being connected to the inner end of the slide rod through the said slots, and manually operable means for shifting the said bearing longitudinally on the drive shaft without interfering with its rotation.

5. In a device of the kind described, a pair of mated propellers including the shanks and blades, the inner end of each shank being cut away and formed with an axially aligned journal at its extremity and a bearing bore spaced from the said journal, the intermediate portion of each shank being channeled and cut out longitudinally and angularly so as to permit the two said opposed journals of the radially assembled propellers, to enter the two said opposed bores, whereby the two propellers may oscillate independently upon their axis to vary their pitch, and yet will mutually support one another against torque.

In testimony whereof I affix my signature.

ROY F. WOODEN.