

July 24, 1934.

F. BALLEW

1,967,461

VARIABLE PITCH PROPELLER

Filed Sept. 13, 1932

3 Sheets-Sheet 1

Fig. 1.

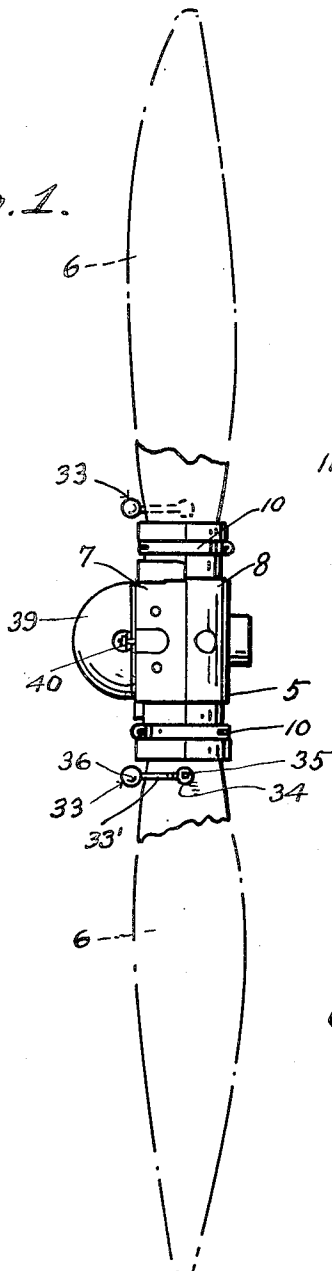


Fig. 2.

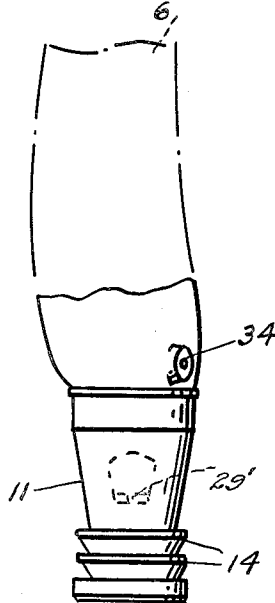


Fig. 3.

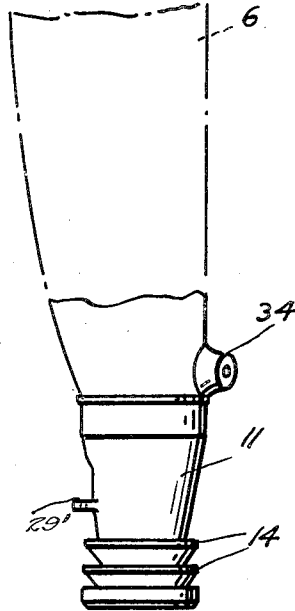
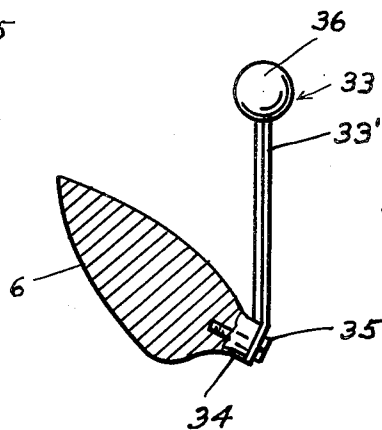


Fig. 4.



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Fig. 5.

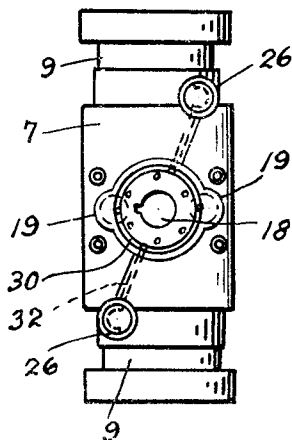


Fig. 6.

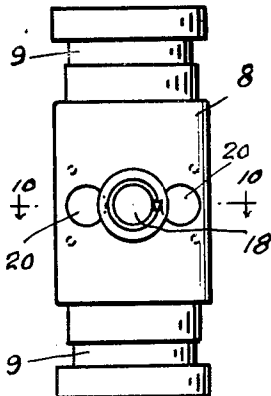


Fig. 7.

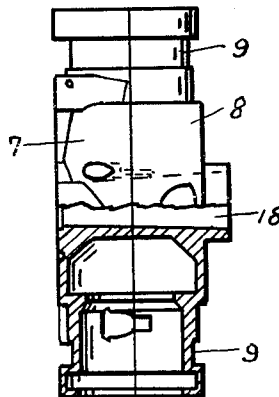


Fig. 8.

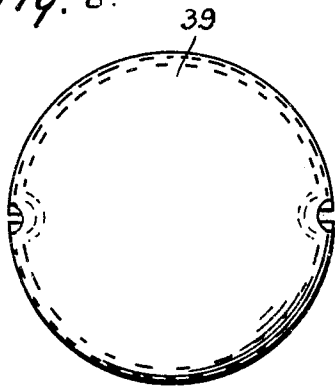


Fig. 9.

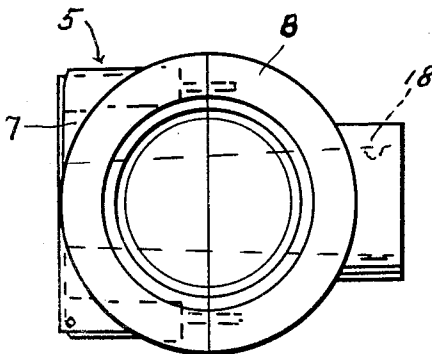


Fig. 11.

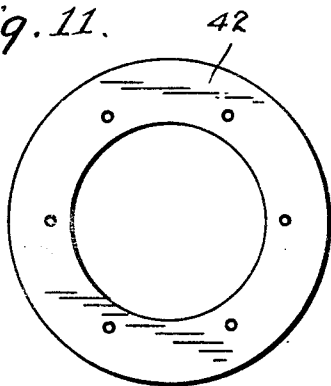
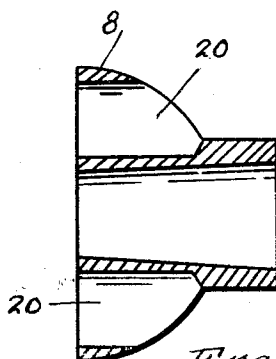


Fig. 10.



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Fig. 12.

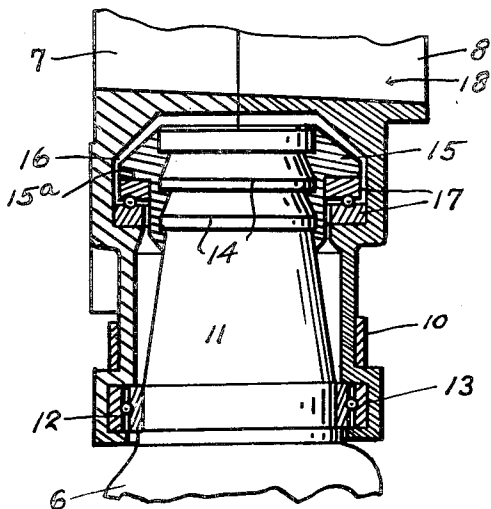


Fig. 13.

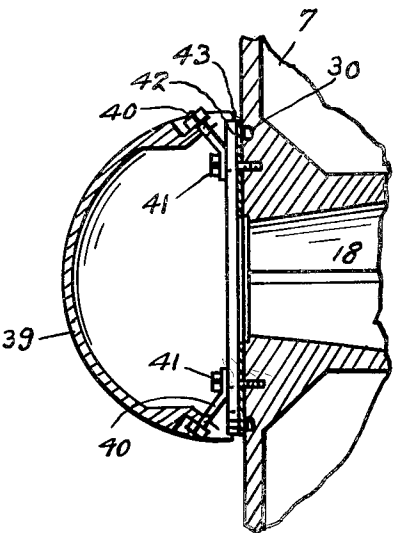


Fig. 14.

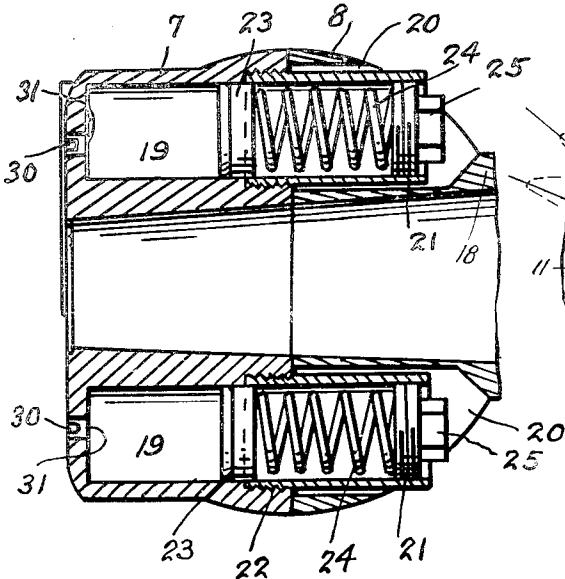
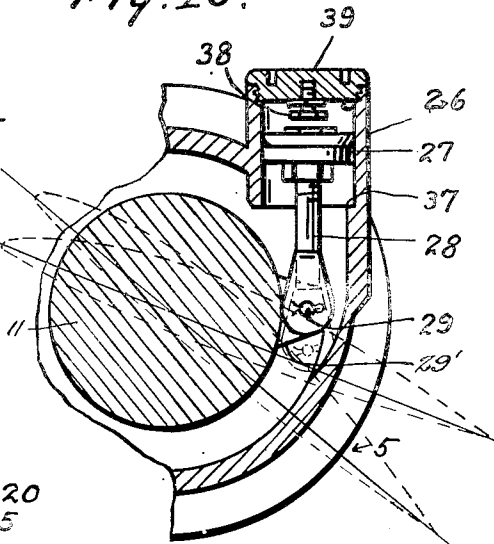


Fig. 15.



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UNITED STATES PATENT OFFICE

1,967,461

VARIABLE PITCH PROPELLER

Frank Ballew, Detroit, Mich., assignor of forty-seven and one-half per cent to Casimir A. Domzalski and five per cent to Curtis Bates, both of Detroit, Mich.

Application September 13, 1932, Serial No. 632,989

3 Claims. (Cl. 170—163)

This invention relates to propellers having reference to a propeller that is especially designed for use on aeroplanes.

The primary object of this invention is to provide a variable pitch propeller having means associated therewith whereby the pitch of the blade may be automatically varied.

Further in accordance with the present invention, each blade of the propeller is so designed that the center of pressure is always to the rear of the radial axis about which the blade is free to rotate, so that when the blade is in motion the aerodynamic force thus tends to reduce the pitch angle of the blade under all conditions, the twisting moment produced by the centrifugal force on the blade being in the same direction as that produced by the air force.

The invention together with its numerous objects and advantages will be best understood from the following description taken in connection with the accompanying drawings wherein:

Figure 1 is a side view of the propeller.

Figure 2 is an elevational view of the root of one of the propeller blades.

Figure 3 is a view similar to Figure 2 with the blade rotated about ninety degrees.

Figure 4 is a transverse sectional view through the propeller blade showing the means for mounting the centrifugal balance thereon.

Figure 5 is a front elevational view of the propeller hub.

Figure 6 is a rear elevational view of the hub.

Figure 7 is a view taken substantially at right angles to Figure 6, certain parts being broken away and shown in section.

Figure 8 is a plan view of a cover plate.

Figure 9 is an enlarged end elevational view of the hub.

Figure 10 is a sectional view taken substantially on the line 10—10 of Figure 6.

Figure 11 is a plan view of an oil groove cover plate.

Figure 12 is a fragmentary sectional elevational view showing the manner of rotatably mounting the blade on the hub.

Figure 13 is a sectional elevational view through the forward end portion of the hub showing the manner of attaching the cover plate and oil groove plate in position on the hub.

Figure 14 is a sectional elevational view through the propeller hub showing the pressure cylinder assembly and spring tension adjustment.

Figure 15 is a sectional view showing the assembly of one of the actuating cylinders, the means for limiting the range of action and means of attaching the piston connecting links to the lug on the blade root, the relative positions of the blade and the piston associated therewith, at cer-

tain stages of operation, being also herein illustrated.

Referring more in detail to the drawings, it will be seen that the propeller comprises essentially a hub 5 and blades 6 rotatably mounted on the hub.

In accordance with the present invention the hub 5 is split longitudinally to provide two half sections 7, 8.

Adjacent each end thereof the hub 5 is provided with a groove 9 accommodating a clamping ring 10 whereby the sections of the hub are secured in assembled relation.

Each blade 6 includes a root or shank portion 11 journaled in one end of the hub 5, and at the largest end of the root, the same is cylindrical and is journaled in a bearing 12 mounted in an annular chamber 13 provided at the terminal of the hub.

At its inner, smallest, or base end, the root 11 is provided with a series of retaining ribs 14 which are engaged with annular internal shoulders provided on a split retaining ring 15 arranged within an annular recess 16 provided in the hub inwardly from the end thereof.

Also fitted within the recess 16 is a thrust bearing 17, and the ring 15 is provided with an annular external shoulder 15a bearing against one end of the thrust bearing as shown in Figure 12. It will thus be seen that suitable means is provided for rotatably mounting each propeller on the hub.

The hub 5 is provided intermediate its ends with a tapered bore 18 to receive the tapered end of the propeller shaft (not shown) and any suitable means may be provided for securing the hub to said shaft. On relatively opposite sides of the bore 18 the section 7 of the hub is provided with pressure cylinders 19, there being one pressure cylinder for each propeller blade. The section 8 is provided with transverse apertures or recesses 20 extending therethrough and alining with the cylinders 19.

Sleeves 21 are arranged in the openings 20, and have one end threaded within the open end of a cylinder 19 as at 22. Constrained to shift longitudinally within each cylinder 19 is a piston 23 that is normally urged inwardly of its cylinder 19 through a coil spring 24 housed within a sleeve 21. The spring 24 is also engaged with a tensioning nut 25 threaded within the free end of the sleeve 21, and obviously through the medium of the nut 25 tension of the spring 24 may be adjusted as found desirable.

Section 7 also has formed integral therewith actuating cylinders 26, there being one cylinder 26 for each propeller blade. Constrained to reciprocate in each cylinder 26 is a piston 27 provided with a rod 28 that is pivoted as at 29 to a lug 29' provided on the root of a propeller blade 6.

Connection between the cylinders 26 and 19 is established through the medium of an oil groove or passage 30 that is provided on the hub section 7, and is in communication with the cylinders 19 through the medium of ports or apertures 31. The groove 30 is connected with the cylinders 26 through the medium of oil bores or passages 32 also provided in the propeller hub section 7.

From the description of the invention thus far it will be seen that the tendency of the blades to assume zero pitch due to air pressure and centrifugal force will actuate the pistons 27 for urging the same inwardly of the cylinders 26 thus releasing fluid pressure on the pistons 23, with the result that under action of springs 24 the pistons 23 will move toward the left in Figure 14, thus forcing the oil in the cylinders 19 therefrom through openings 31, grooves 30 and oil passages 32 into the cylinders 26 for exerting a pressure on the pistons 27 at such time as the aero-dynamic force becomes such as to permit an increase in the pitch angle of the blades.

As the aerodynamic force becomes such as to force a decrease in the pitch angle of the blades, said blades in decreasing the pitch angle will of course rotate, moving the pistons 27 towards the outer ends of the cylinders 26, and forcing the oil from the cylinders 26 back into the cylinders 19. Thus provision is made for the automatic increase or decrease in the angle pitch of the propeller blades.

In this connection, it is to be noted that the blade of the propeller is so designed that the center of pressure is always to the rear of the radial axis about which the blade is free to rotate. When the blade is in motion the aerodynamic force must tend to reduce the pitch angle of the blade under all conditions. There is also a twisting moment produced by the centrifugal force on the blade, and this moment is in the same direction as that produced by the air force. This centrifugal twisting moment is nearly balanced by means of a centrifugal balance 33, but is left sufficiently unbalanced to augment the action of the air force by a certain desired amount.

As will be apparent, the sum of this unbalance and the moment produced by the air force is always equal to the moment produced by the actuating piston 27 when the proper position is attained. The centrifugal balance 33 can be adjusted to give almost any desired condition of unbalance.

As shown, each propeller blade is provided with a balance 33, and in this connection the propeller blade adjacent the root thereof is provided with a boss 34 to which is secured a rod 33', through the medium of a fastening element 35. Rod 33' forms part of the balance 33, and on the free end of the rod 33' is a ball or weight 36.

To limit the rotative movement of a propeller blade in either direction, each piston 27 is limited in its movement towards the inner end of its cylinder 26 through the medium of a stop shoulder 37 provided at the inner end of the cylinder 26, and in its movement in an opposite direction, through the medium of a suitable stop device 38 extending inwardly of the cylinder from a plug or cap 39 provided for the outer end of the cylinder.

The blades of the propeller, when stationary, assume their maximum pitch angle as determined by the stop or shoulders 37. When the engine for driving the propeller is started, the blades are forced to a lower pitch angle by the action of the aerodynamic and centrifugal forces, as explained above.

The springs 24 are so tensioned and the balance members 33 so adjusted, that under all conditions of flight the propeller will absorb the desired engine power at the desired engine speed.

Referring to the construction of the propeller, it will be seen that for the front of the propeller there is provided a substantially semi-spherical head or cover member 39, and this head or cover member is secured in position on the section 7 at the front of the propeller, through the medium of angular lugs 40 engaged with the cover member, and also with screws or similar fastening elements 41 that are used to secure in position between the inner ends of the head or cover member 39, and the front section of the propeller, a ring or plate 42 that serves as a covering for the oil groove 30.

Also interposed between the plate 42 and the front of the hub section 7 is a suitable gasket 43.

Even though I have herein shown and described the preferred embodiment of the invention, it is to be understood that the same is susceptible of further changes, modifications and improvements coming within the scope of the appended claims.

I claim:

1. In a variable pitch propeller, the combination of a hub, blades rotatably mounted on the hub, actuating and pressure cylinders respectively mounted on the hub, a piston arranged to reciprocate in each cylinder, fluid passages connecting the pressure cylinders with the actuating cylinders, and means operatively connecting said blades with the pistons in the actuating cylinders.

2. In a variable pitch propeller, the combination of a hub, blades rotatably mounted on the hub, actuating and pressure cylinders respectively mounted on the hub, a piston arranged to reciprocate in each cylinder, fluid passages connecting the pressure cylinders with the actuating cylinders, spring means engaged with the pistons in the pressure cylinders for normally urging said pistons in one direction, tensioning means for said spring means, and motion transmitting means connecting said blades with the pistons in the actuating cylinders.

3. In a variable pitch propeller, the combination of a hub, blades rotatably mounted on the hub, actuating and pressure cylinders respectively mounted on the hub, a piston arranged to reciprocate in each cylinder, fluid passages connecting the pressure cylinders with the actuating cylinders, spring means engaged with the pistons in the pressure cylinders for normally urging said pistons in one direction, tensioning means for said spring means, motion transmitting means connecting said blades with the pistons in the actuating cylinders, and balance weights mounted on said blades.

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