

Dec. 8, 1942.

P. DI CESARE

2,304,153

VARIABLE PITCH PROPELLER

Filed Jan. 20, 1940

3 Sheets-Sheet 1

Fig. 1

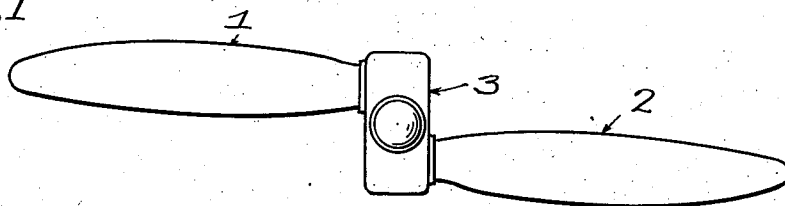


Fig. 2

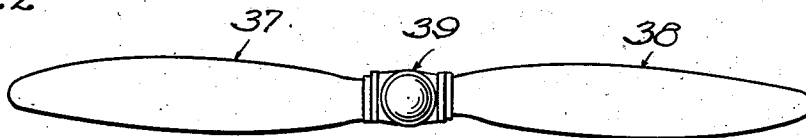
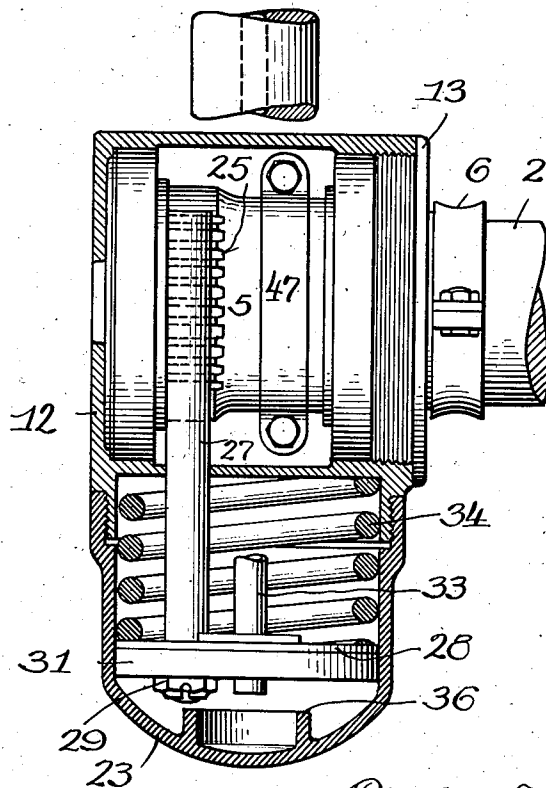


Fig. 5



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3 Sheets-Sheet 2

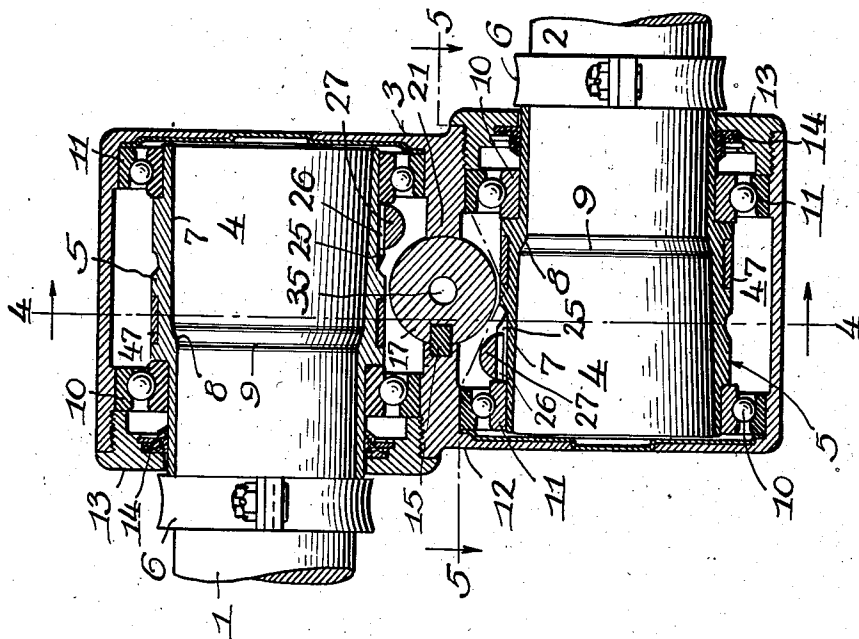


Fig. 3

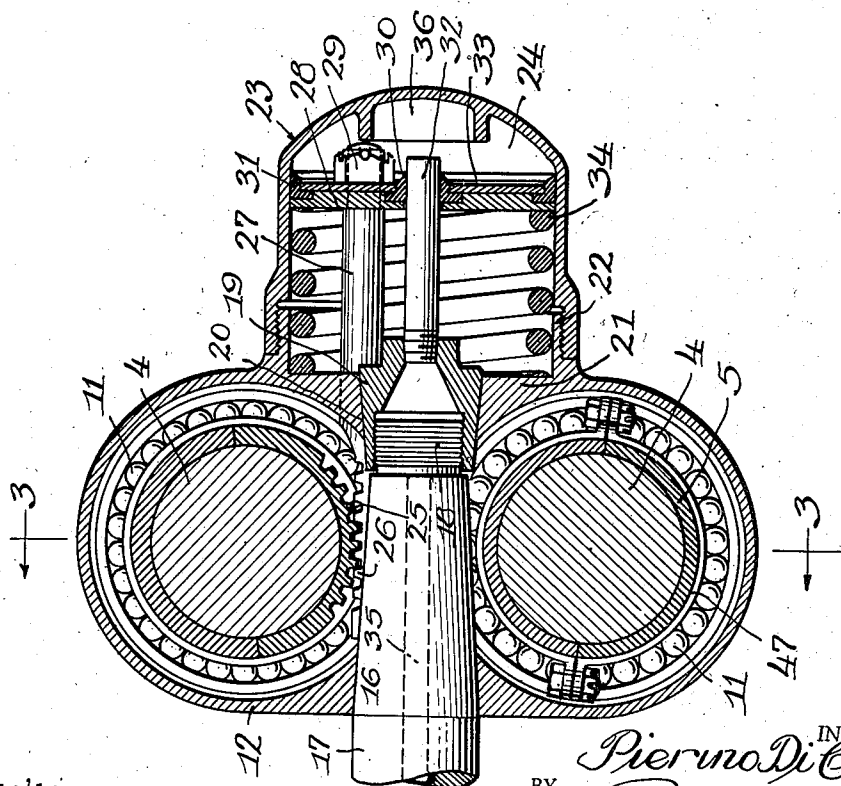


Fig. 4

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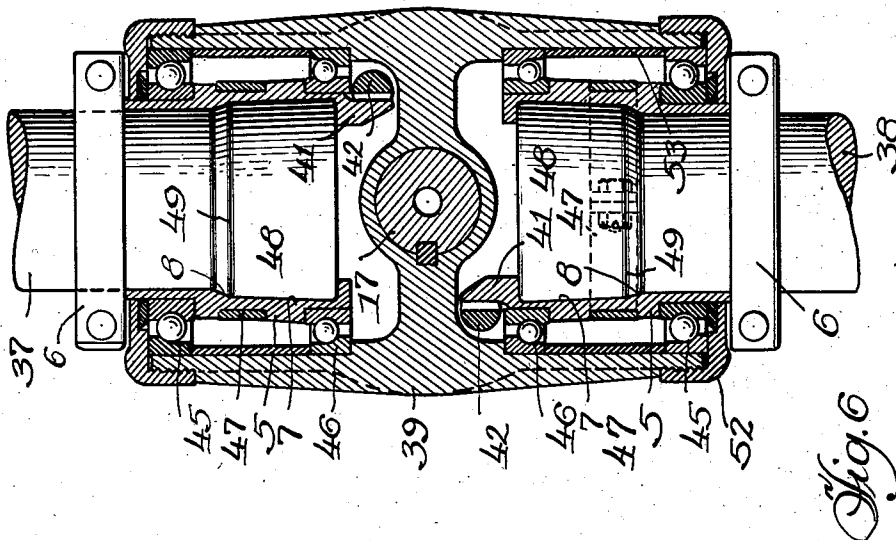
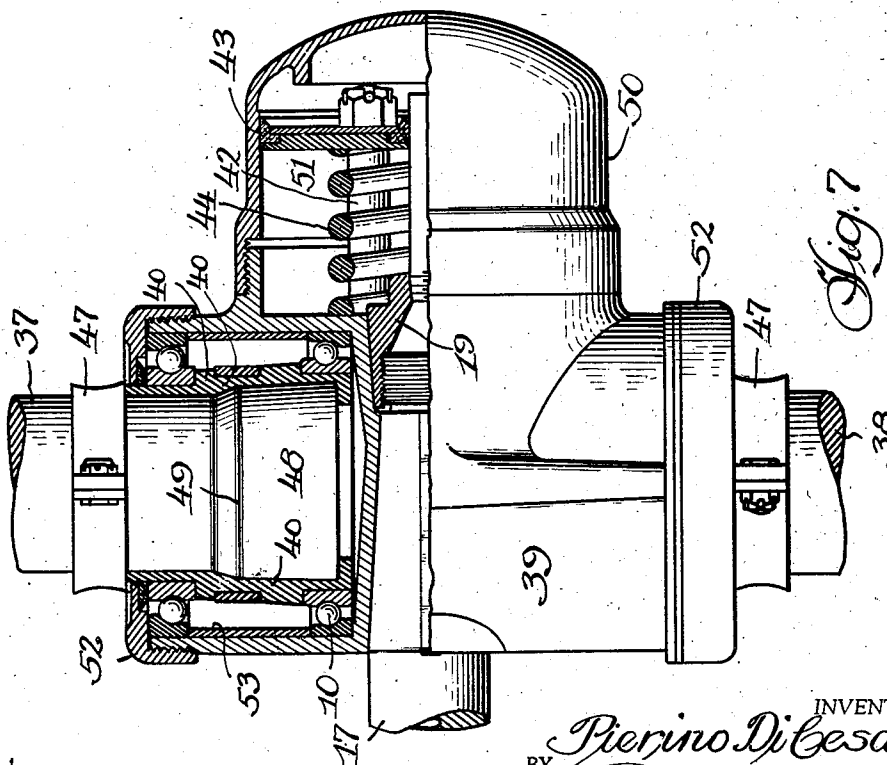
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VARIABLE PITCH PROPELLER

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3 Sheets-Sheet 3



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UNITED STATES PATENT OFFICE

2,304,153

VARIABLE PITCH PROPELLER

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Application January 20, 1940, Serial No. 314,853

2 Claims. (Cl. 170-163)

The present invention relates to variable pitch propellers especially adapted for aircraft. In the present novel embodiment of propeller hub, mechanism is provided for automatically adjusting the pitch of the blades for effecting maximum aircraft propulsion efficiency under all conditions encountered in flying.

Among the objects of the present invention is to provide a novel propeller hub construction in which the pitch of the blades is automatically adjusted during operation. In addition, novel means and mechanism is provided for hydraulically adjusting the pitch of the blades when that becomes necessary or desirable, as for example, at take-off or to obtain a greater rate of climb.

The invention further comprehends a propeller hub construction provided with novel adjusting means for automatically adjusting the pitch of the propeller blades and a novel means for anchoring the shank of each propeller blade in the hub.

Further objects are to provide a construction of maximum simplicity, efficiency, economy and ease of assembly and operation, and such further objects, advantages and capabilities as will later more fully appear and are inherently possessed thereby.

The invention further resides in the construction, combination and arrangement of parts illustrated in the accompanying drawings, and while I have shown therein a preferred embodiment, it is to be understood that the same is susceptible of modification and change, and comprehends other details, arrangements of parts, features and constructions without departing from the spirit of the invention.

In the drawings:

Fig. 1 is a view in front elevation of the novel propeller construction with the blades offset in the hub.

Fig. 2 is a similar view of a standard type of propeller blades.

Fig. 3 is a view in vertical cross section taken on the line 3-3 of Fig. 4 but showing the blade shanks in side elevation.

Fig. 4 is a view in vertical cross section taken on the line 4-4 of Fig. 3.

Fig. 5 is a view in horizontal cross section taken on the irregular line 5-5 of Fig. 3.

Fig. 6 is a view in vertical cross section similar to Fig. 3 but taken through the form of propeller shown in Fig. 2.

Fig. 7 is a view part in horizontal cross section and part in top plan view of the hub structure shown in Fig. 2.

Referring more particularly to Figs. 1, 3, 4 and 5, the drawings disclose a novel embodiment of my invention in which the blades 1 and 2 are offset with relation to the hub 3 thereby affording the maximum effective area. The blades may be of any material suitable for the purpose such as laminated wood preferably treated to withstand the rigors of flying conditions and strains imposed upon the blades, or it may be of metal if desired. In either case, the shank 4 of the blade is suitably tapered and so contoured as to be rigidly locked and retained in an encompassing split sleeve 5 and split lock collar 6 detachably mounted upon the blade at the end of the sleeve. The sleeve 5 is shown as tapered at 7 with an annular shoulder or abutment 8 against which a complementary shoulder 9 of the shank seats to thereby prevent centrifugal force from dislodging the blade from its retaining sleeve 5 and its mounting in the hub.

The periphery of each sleeve 5 is so contoured as to receive and be rotatably mounted in spaced ball bearing rings 10 and 11 which are pressed into the housing 12 of the hub, with the blades, sleeves and ball bearings locked in position by an end cap 13 threaded into the casing or housing 12. In order to prevent any possible leakage of lubricant or hydraulic fluid, each end cap is provided with an annular oil seal 14 having a continuous wiping contact with the external surface of the sleeve 5.

The hub is keyed at 15 upon the tapered end 16 of the drive propeller shaft 17. The forward end of this shaft is threaded at 18 to receive a lock nut 19 having its external surface tapered at 20 to be received within an opening formed in a connecting web or plate 21 and having a contour complementary to that of the lock nut, these tapered surfaces aligning and maintaining the alignment of the propeller shaft. This connecting web or plate is provided with an exteriorly threaded collar 22 adapted to receive the hub cap 23 and to form therewith a cylindrical chamber 24.

The invention further comprehends novel means and mechanism for automatically adjusting the pitch of the propeller blades during operation as clearly shown in Figs. 3, 4 and 5. This comprises forming a portion of each sleeve 5 with spaced teeth 25 adapted to be maintained in continuous mesh with the teeth 26 of a rack bar 27. The positioning and arrangement of each of these rack bars is more clearly shown in Fig. 3 while the mounting of the outer end is shown more clearly in Figs. 4 and 5, in which

this end is shown as projecting through a piston plate 28 and locked therein by a suitable lock nut 29. This piston plate is provided at its inner and outer diameters with an annular recess adapted to receive inner and outer, substantially L-shaped fluid seals 30 and 31 having a wiping contact with a passage or duct 32 and the inner surface of the hub cap 23, respectively. These fluid seals may be of synthetic rubber, leather or any other material suitable for the purpose and are locked against the piston blade 28 by an annular washer or ring 33. A relatively heavy compression spring 34 is mounted within the cylindrical chamber in such a way as to tend to force the piston plate 28 outwardly to thereby retract the rack bars and rotate the blades in the desired direction.

Additional means is provided for moving the piston against the compression of the spring 34. This is preferably manually controlled by the pilot from the cockpit and comprises forcing hydraulic fluid through the opening 35 in the propeller shaft 17, through the hollow lock nut 19 and thence through the passage or duct 32 into the interior of the chamber to the front of the piston 28. The hydraulic fluid is exhausted through the same members. This hydraulic pressure moves the piston to the left as shown in Fig. 4 so as to compress the spring and to move the rack bars 27 to the left thereby rotating the blades in a clockwise direction when viewed from the inner end of the blades. This hydraulic pressure is generally merely applied at take-off or to increase the rate of climb; at other times, the blades are automatically adjusted. In order to limit the movement of the piston 28 in the direction in which it is moved under compression of the spring when under no load, a stop member 36 is provided. This member is shown in Fig. 4 in the form of an annular boss or projection extending inwardly from the nose of the hub cap.

Figs. 2, 6 and 7 show a similar arrangement of parts for mounting and varying the pitch of blades 37 and 38 of a standard type propeller. In this structure, the hub 39 is differently contoured with the blades adapted to be received in split bearing sleeves 40, each having an inner extension 41 formed with spaced teeth arcuately arranged and meshing with the teeth of a rack 42 actuated by a piston 43 against the compression of a spring 44.

As in the offset form, each bearing sleeve 40 is locked on its blade and rotates in bearing rings 45 and 46, and is formed with a split locking collar 4. Also each blade has a tapered shank 48 and shoulder 49 with complementary surfaces on each sleeve. The hub cap 50 forms with the hub 39, a cylinder 51 for reciprocating movement of the piston, actuated automatically and by the hydraulic fluid manually controlled and ejected through the propeller shaft 17 in the same manner as in the offset form.

A removable end cap 52 locks the ball bearings and blades in position, with a spacer ring 53 being provided between the ball bearings 45 and 46.

From the above description and the disclosure in the drawings, it will be evident that the invention comprehends a novel variable pitch propeller construction. In this form of construction, at take-off the throttle is opened wide at the start of the run, and the blades, actuated by the increased thrust, move against the pressure of the compression spring. At the same time, the pilot may force hydraulic fluid into the chamber provided in the forward end of the hub. This fluid moves the piston and rack bars to the left and additionally rotates the blades to a minimum pitch angle resulting in an increased engine R. P. M. The pilot may in a similar manner obtain a greater rate of climb. Thereafter, the fluid may be exhausted.

As the aircraft reaches cruising speed, reduction in propeller thrust advances the blade pitch to an angle resulting in obtaining normal cruising air speed at a lower engine R. P. M., thus assuring economical operation and maximum efficiency.

Having thus disclosed the invention, I claim:

1. A variable pitch propeller for aircraft, comprising in combination a hub construction keyed upon the propeller shaft, bearing members rotatably mounted in said hub, a blade mounted in each bearing member with the longitudinal axis of each blade offset with respect to the axis of the propeller shaft, a reciprocable rack bar for each blade mounted in the hub, a gear segment formed on each bearing member and adapted to mesh with the teeth on the rack bar, a member slidable in said hub and carrying said rack bars, and a compression spring bearing against said member, said blades, bearing members and rack bars being so constructed and arranged that the pitch of the blades is automatically varied in accordance with the propeller thrust, and hydraulically actuated means at the disposal of the pilot for actuating said member and rack bars for additionally adjusting the pitch of the blades.

2. In a variable pitch propeller, the combination with a drive shaft, of a hub splined to the shaft for rotation therewith, blades having shank portions rotatably mounted in said hub and means for rotating the shank portions whereby to vary the pitch of the blades, said means comprising a sleeve rigidly mounted on each shank portion, teeth provided on each sleeve, a reciprocable rack bar in meshing engagement with the teeth on each sleeve, a chamber provided in the hub, a piston slidably mounted in the chamber and forming a support and mounting for the rack bars, a compression spring seating between said piston and a portion of the hub tending to move said member and its associated rack bars forwardly and resist rotation of the blades, and hydraulic means for additionally adjusting the pitch of the blades including a passage for hydraulic fluid to the forward end of the chamber to hydraulically actuate the piston and rack bar to vary the pitch of the blades by the pilot during take-off and to obtain a greater rate of climb.

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