June 22, 1943. H. A. FRAZIER 2,322,352

AIRPLANE BLADE PITCH-CONTROL

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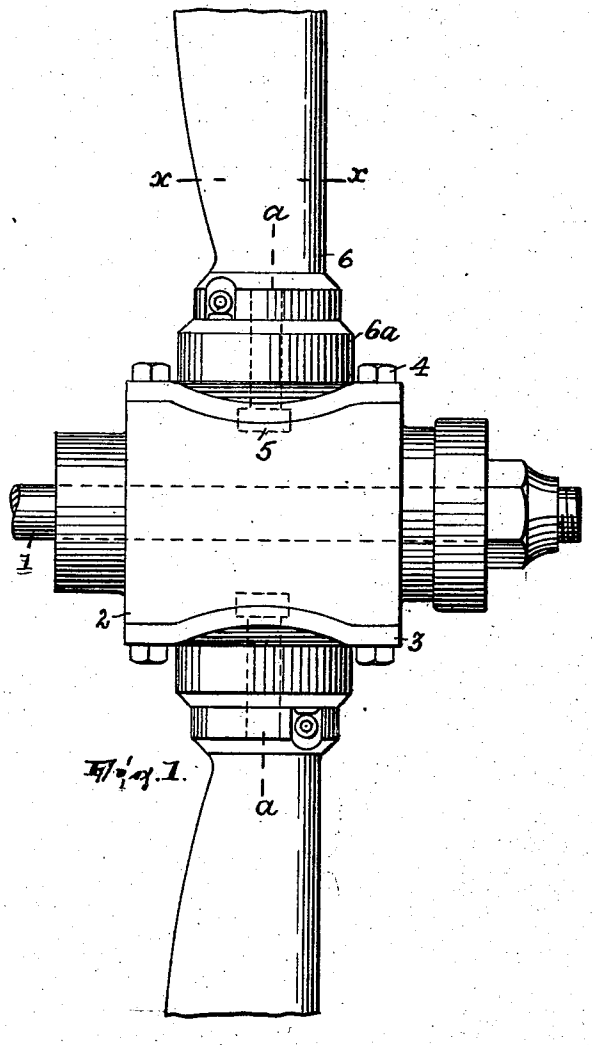


Fig. 1.

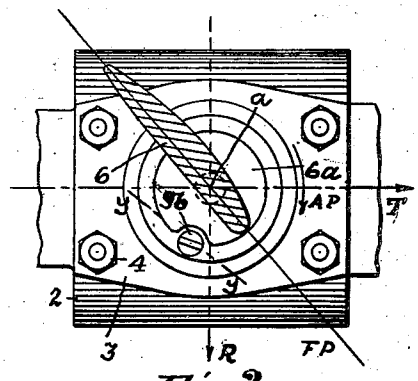


Fig. 2.

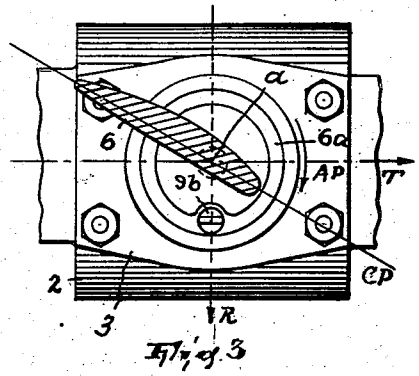


Fig. 3.

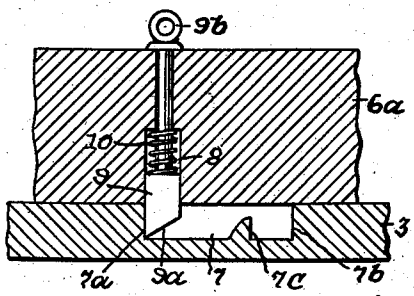


Fig. 4.

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AIRPLANE BLADE PITCH-CONTROL

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7 Claims. (Cl. 170—162)

Under different conditions in the operation of an airplane screw propeller it is desirable to provide for changing the pitch of the propeller blades. For instance, when the propeller is rotated at high speed for taking off from the ground the pitch of the blades should be finer—or at a more acute angle to the plane in which the propeller rotates—than when the plane assumes the desired height and the propeller is slowed down to the levelling-off speed; in short, the conditions are analogous to those in the operation of an automobile where the drive is in low gear on starting and high gear for travel at the normal speed. Various expedients for effecting change in the pitch of the blades have been proposed, some being dependent for the setting of the blades to a changed position on a manual operation and some being automatically operative; but all, so far as I know, require equipment which, if it does not extravagantly add to the cost of the more expensive types of airplanes, would do so if applied to the cheaper class, as those used for practice or for pleasure and sold at low prices.

In the case of any plane it is at least desirable to have the propeller blades' pitch change from fine, as when taking off, to coarse, as when the plane attains the required height from the ground and the engine and hence the propeller speed is slowed down. According to my invention, therefore, the construction is generally as follows, omitting, be it noted, parts which are expensive, complicated or of uncertain dependability: The blade's rotation in the direction to reduce its pitch in response to centrifugal torsion or turning moment incident to its rotation around the propeller axis may be limited, to wit, at the required fine pitch. In any event when, in response to some force (as inertia augmented by aerodynamic pressure) acting on it when the rotation of the propeller is retarded, as on throttling the engine for levelling off the plane, it turns to the required coarse-pitch position it is definitely confined against return from the latter position—in the present example by a latch and keeper. To insure effective and certain displacement of the blade to the coarse-pitch position when the propeller is slowed down I prefer to pivot the blade on an axis which, extending generally lengthwise thereof, is so disposed that the blade has its more ponderous mass relatively aft of said axis, whereby the inertia of such mass becomes a factor in causing the blade to assume the coarse-pitch position when the propeller is slowed down.

In the drawing,

Fig. 1 is a fragmentary side elevation of the propeller-including system of an airplane, the same being constructed in accordance with my invention;

Figs. 2 and 3 are sectional views on line *x*—*x*, Fig. 1, showing the corresponding blade in its fine-pitch and coarse-pitch positions, respectively; and

Fig. 4 is a fragmentary sectional view on the line *y*—*y*, Fig. 2.

1 designates the propeller shaft having fast thereto a hub, the particular form of which is not material but here includes, with the hub proper 2, plates 3 held thereto by screws 4 in diametrically opposite relation to each other. To the plates are pivoted at 5 the sockets 6*a* forming the inner terminal portions of the blades 6. The showing of these parts and of the manner of pivoting the sockets is but schematic, the invention not being concerned with any specific form of the parts or specific manner of pivoting. The blades are preferably formed with the longitudinal segment of each aft of its pivoting axis *a*, as by such segment being wider than the segment forward of such axis.

Figs. 2 and 3 show a blade in the fine-pitch and coarse-pitch positions as respectively indicated by the lines FP and CP, R being the direction of rotation of the propeller and T the direction of travel of the plane. As indicated, in the fine-pitch position, it is to be held against turning (clockwise) around axis *a* as per arrow AP in response to centrifugal torsion acting on it, and when in response to some force acting on it, as inertia and aerodynamic pressure, when the rotation of the propeller is retarded, it turns to the coarse-pitch position it is to be confined against return and preferably in the latter position. Hence in the example herein shown the construction is as follows with respect to each blade:

The hub (here the plate 3 corresponding to each blade) has in the face thereof adjoining the end face of the terminal 6*a* of the blade a groove 7 which at its ends, as at 7*a* and 7*b*, provides abutments and at 7*c* is formed with an upstanding abutment or keeper.

The said terminal has a bore 8 open downwardly and opposed to the groove and in this is a latch 9 which is normally held with its beveled end protruding downwardly from the blade and into the groove and which has its cam-face 9*a* facing in the anti-clockwise direction. The latch is normally held depressed by a spring 10

and it may have an extension 9b protruding upwardly from the blade terminal so as to be accessible for manually retracting the latch.

Assume the plane is on the ground. To take off, the engine and hence the propeller is driven at high speed. At this time each blade is in the FP position, its latch engaged with abutment 7a, the blade being thereby held against clockwise rotation in response to centrifugal torsion. When the plane leaves the ground and has assumed the required height for levelling off and the engine and hence the propeller is slowed down the blade may turn in response to any force then acting on it and dominating over centrigular torsion. In so turning its latch passes the keeper 7c and becomes confined thereby between the keeper and abutment 7b, leaving the blade locked in its changed or CP position, or the position appropriate for level flight.

Preferably, as noted, each blade has its more ponderous mass aft of its pivoting axis a, as by forming the longitudinal segment thereof which is aft of said axis the wider, whereby the indicated forces (inertia and aerodynamic pressure) become effective in definitely causing the blade to turn from the FP to the CP position when the speed is slowed down.

According to my invention the means which determines the pitch of each blade according to the rotary speed of the propeller is contained wholly within the latter, thus avoiding resort to manually or mechanically operative accessory controlling means which would exorbitantly add to the cost of the less expensive type of airplane. So much is not broadly new in view of the patent to Welman, No. 2,075,682, wherein the structure which supports the blades is formed as two parts, a shaft and a hub, the latter being rotative relatively to the shaft and thereby made cooperative therewith in determining the pitch of the blades. According to my invention the hub and its axial support, as shaft 1, are confined against relative rotation, as by the hub being keyed as usual to the shaft, and the means which determines the pitch of the blades is wholly independent of any coaction between them.

Having thus fully described my invention, what I claim is:

1. An airplane propeller comprising in combination, with a rotary unitary structure including a hub, a blade extending from and pivoted to and free to turn in the hub in either direction around an axis crossing the axis of rotation of said structure, said structure and blade respectively having, wholly within themselves, means directly coactive with each other to oppose re-rotation of such blade when turned in the direction to increase its pitch and one of which means is movable and normally urged in the direction so to coact with the other.

2. An airplane propeller comprising in combination, with a rotary unitary structure including a hub, a blade extending from and pivoted to and free to turn in the hub in either direction around an axis crossing the axis of rotation of said structure, said structure and blade respectively having, wholly within themselves, means directly coactive with each other to limit the turning of the blade in the direction to reduce its pitch and also to oppose re-rotation of such blade when turned in the opposite direction and one of which means is movable and normally urged in the direction to coact with the other to oppose the rerotation of the blade during such turning of the latter in said opposite direction.

3. An airplane propeller comprising in combination, with a rotary unitary structure including a hub, a blade extending from and pivoted to and free to turn in the hub and in either direction around an axis crossing the axis of rotation of said structure, said structure and blade respectively having, wholly within themselves, means directly coactive with each other to limit the turning of the blade in the direction to reduce its pitch and also to oppose rotation of the blade in either direction when it is turned in the opposite direction and one of which means is movable and normally urged in the direction to coact with the other to oppose the re-rotation of the blade during such turning of the latter in said opposite direction.

4. The propeller set forth in claim 1 characterized by the more ponderous mass of the blade being within the longitudinal segment thereof relatively aft of its pivot.

5. The propeller set forth in claim 2 characterized by the more ponderous mass of the blade being within the longitudinal segment thereof relatively aft of its pivot.

6. The propeller set forth in claim 1 characterized by the second-named means including a latch in one and a keeper on the other of the parts formed by said structure and blade.

7. The propeller set forth in claim 2 characterized by the second-named means including a latch in one and a keeper on the other of the parts formed by said structure and blade.

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