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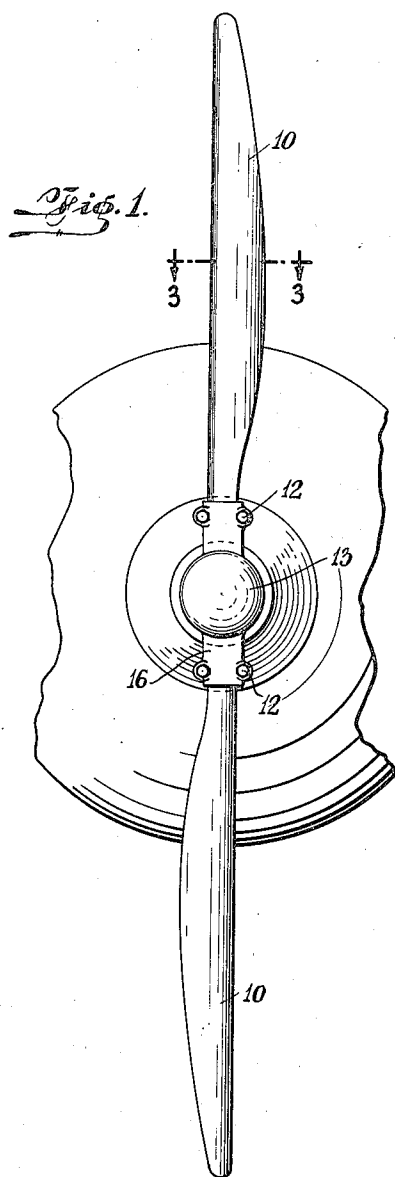
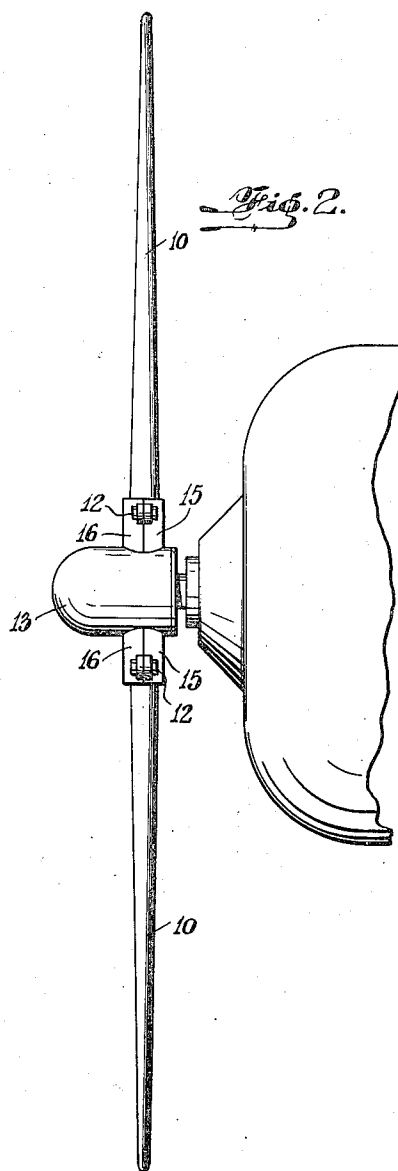
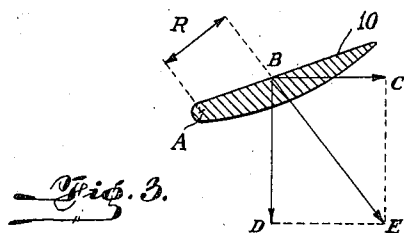
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2,452,444

ADJUSTABLE PITCH AIRPLANE PROPELLER

Filed April 5, 1945

2 Sheets-Sheet 1



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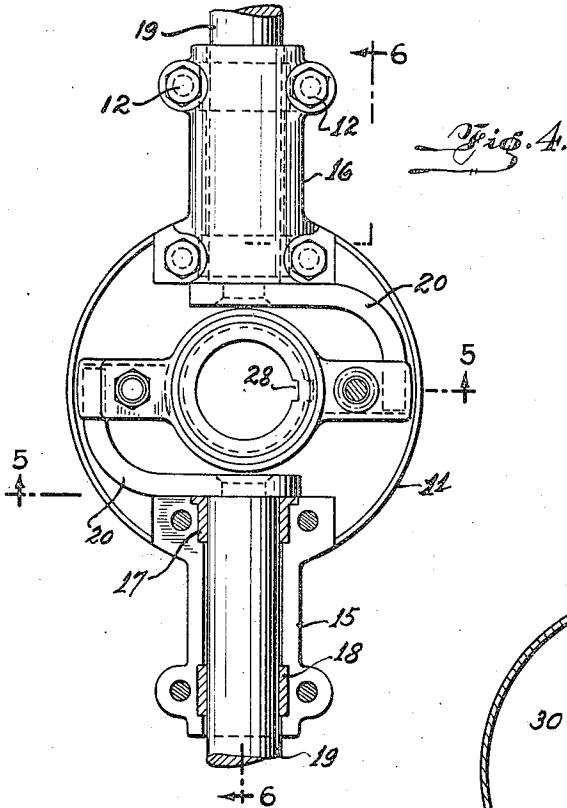
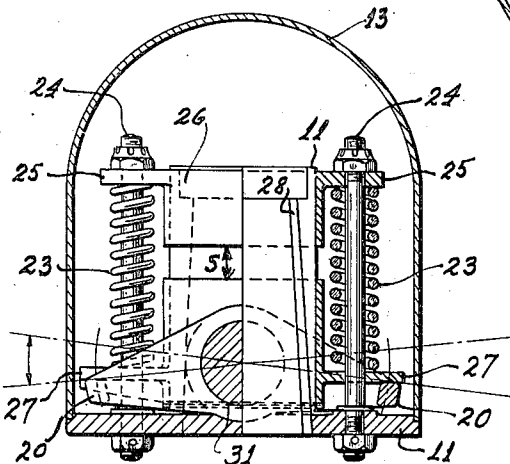
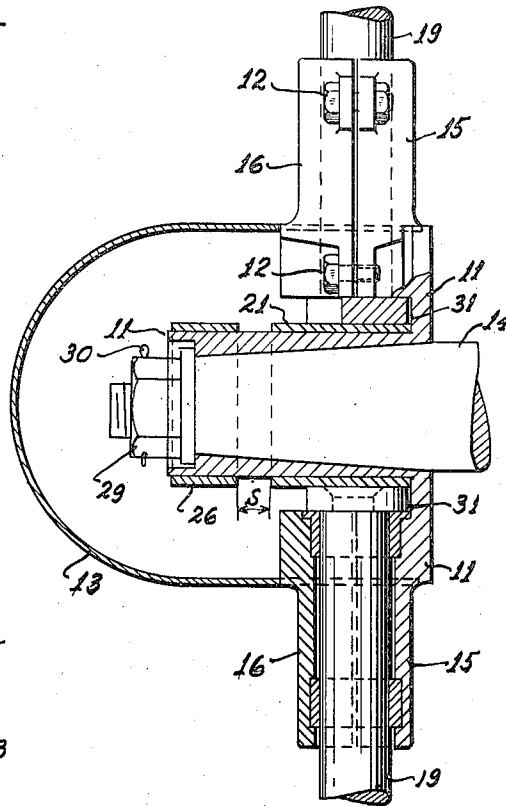
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ADJUSTABLE PITCH AIRPLANE PROPELLER

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2 Sheets-Sheet 2



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2,452,444

ADJUSTABLE PITCH AIRPLANE PROPELLER

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Application April 5, 1945, Serial No. 586,752

2 Claims. (Cl. 170-162)

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This application is a continuation in part of my application filed May 1, 1943, Serial Number 485,285 now abandoned, and relates to adjustable pitch aeroplane propellers and specifically it refers to propellers which are automatically adjustable by means of the resultant force of the thrust and torque components acting upon the propeller blades and where the propeller blades are rotatably mounted in the hub of the propeller and having spring loaded levers to control the pitch in accordance with the force exerted upon the blades by the resultant force as mentioned.

While there are numerous types of adjustable pitch aeroplane propellers in use at the present time, all of these are complicated, costly and only suitable for large expensive aeroplanes. There is, however, a demand for an adjustable pitch aeroplane propeller for smaller aircraft, particularly for civilian use. This is due to the fact that it is highly desirable to have a low pitch propeller for takeoff, while it is equally desirable to have a high pitch propeller for cruising speed or cross-country flights. If a low pitch propeller is used for take-off, it is possible to get in the air quicker, and with a shorter runway than would be possible with a high pitch propeller. Take-offs are made with the throttle wide open, which produce the greatest engine torque. This torque, together with the great thrust, caused by the great angle of attack (due to the slow speed of the plane) increase the moment $BE \times R$ (see Fig. 3) which reduces the blade angle to an efficient angle of attack. After the proper altitude has been reached, the engine is throttled down to the specified number of revolutions per minute for proper cruising speed and it is then highly desirable to have a high pitch propeller to obtain the best possible propeller efficiency at this speed.

My present invention has solved this problem by mounting the propeller blades rotatably in the hub and by placing a suitable spring loaded lever on the end of each blade inside the hub. By proper stops and adjustment of the spring pressure it is thus possible to obtain definite propeller pitches at take-off and at cruising speed. It is obvious too that due to the spring action, there will be a number of intermediate pitches between low pitch used at take-off and the high pitch used on cruising speed. This adjustment is thus entirely automatic and is proportional to the speed of the engine.

An important object of the invention is, therefore, to provide an automatically adjustable variable pitch propeller for air craft.

A further object of the invention is to provide

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an adjustable pitch aeroplane propeller which will give a definite low pitch for take-off and another preselected high pitch for cruising speed.

Another object of my invention is to provide an automatically adjustable variable pitch propeller for air craft which can be manufactured at low cost and which is simple and reliable in operation.

Other objects and advantages of the invention will be apparent during the course of the following description:

In the accompanying drawings, forming a part of this specification, and in which like numerals are employed to designate like parts throughout the same,

Figure 1 is a front elevation of a propeller embodying my invention,

Figure 2 is a side elevation of the propeller shown in Figure 1,

Figure 3 is a force diagram illustrating the action of the thrust and torque components of the wind pressure with the propeller in operation, taken along line 3-3 in Figure 1,

Figure 4 is a front elevation of the propeller hub with the hub cap removed,

Figure 5 is a section taken along line 5-5 in Figure 4, and

Figure 6 is a sectional elevation taken along line 6-6 in Figure 4.

In the drawings, wherein for the purpose of illustration is shown a preferred embodiment of my invention, the numeral 10 designates the propeller blades, which are identical with one another but mounted in the proper opposite relation. The blades 10 are mounted in the propeller hub 11, and are rotatably secured in same by means of bolts 12. The inner hub mechanism is protected by the hub cap 13 which is removably mounted upon the hub 11 so as to make possible the inspection and lubrication of the hub mechanism. The hub 11 is keyed upon the propeller shaft 14, as shown in Figures 4, 5 and 6 and has a plurality of spokes 15 which are split, and which together with the members 16, secured to arms 15 by means of bolts 12, provide a rigid support for the bearings 17 and 18 in which the inner cylindrical portions 19 of the propeller blades 10 are rotatably mounted.

The inner cylindrical ends 19 of the propeller blades 10 extend through the bearings 17 and 18 and are rotatable in same, as mentioned supra. At the point where the cylindrical portion 19 extends through bearing 17, there are fastened levers 20, one to each of the shanks 19 of the propeller blades 10. The levers 20 are securely fas-

tened to the shanks 19 and are turnable with same. The ends of levers 20 are bent at right angles as shown in Figure 4 and are thus brought in operable engagement with the spring loaded sleeve 21, see Figures 5 and 6. The sleeve 21 is slideably mounted upon the hub 11 and is loaded by springs 23 which are held by bolts 24. Bolts 24 extend through the rear wall of hub 11 with one end and through the lugs 25 of the sleeve 26 with the other end. Sleeve 26 is slideably mounted upon the front end of hub 11 while the sleeve 21 with lugs 27 is slideable upon the same hub, see Figures 5 and 6. The hub 11 is secured to propeller shaft 14 by means of the key in slide 28, see Figure 4, as well as by nut 29, see Figure 6. The nut 29 is furthermore, secured by a cotter pin 30.

In Figure 3 is illustrated the various diagrams as it occurs when the propeller is in motion. The propeller section is taken along the line 3—3 in Figure 1. The center of rotation of the propeller blade is at the point designated "A" while the center of pressure is at "B." The wind pressure exerted upon the propeller when same is in motion consists of two components, first BC which is the torque component and BD which is the thrust component. The resultant force of these two components is represented by BE. The resultant force has a leverage R upon the point of rotation "A," and the moment exerted by the resultant BE is therefore, $BE \times R$. It is obvious, therefore, that the resultant force BE will always tend to turn the propeller blade, 10 in a clockwise direction as shown in Figure 3.

It is obvious from the above that it is possible to pre-adjust the limiting positions of the propeller blades, that is, extreme low pitch and extreme high pitch. This adjustment is easily accomplished by placing shims 31 between sleeve 21 on the hub 11. The low pitch position is adjusted by means of bolts 24 by increasing or decreasing the distance marked "S" between sleeves 21 and 26, see Figures 5 and 6.

The operation of my invention is as follows:

As described supra, the resultant of the torque component and of the thrust component will always exert a certain rotary momentary upon the propeller blades when the propeller is in motion. The moment of the resultant force BE as shown in Figure 3 is balanced by the two springs 23 working against levers 20. Accordingly the resultant force will compress springs 23 until the moment created by same upon levers 20 is equal to the moment of the component $BE \times$ the arm R. When, therefore, the engine is running with open throttle the propeller will have maximum speed and the moment $BE \times R$ will also be a maximum and the springs 23 will receive a maximum deflection. At any lower speed, the moment will be less and the pitch of the propeller will have changed accordingly by the fact that the moment $BE \times R$ is equalized by the moment of the springs 23 working against levers 20. The springs 23 are dimensioned so as to give a suitable pressure which is also adjustable by means of the bolts 24. The necessary pressure for a given minimum pitch

can be pre-determined both mechanically and by calculation and the tension of springs 23 is, therefore, adjusted accordingly. In this manner, it is possible to obtain a definite low pitch for take off and a suitable high pitch for cruising as mentioned supra. It should be noted that the centrifugal force acting on the blades has a pitch decreasing effect as well as the thrust. By properly designing the propeller blades, however, and by the use of counterweights or materials of different specific gravity, it is possible to decrease the pitch decreasing effect of the centrifugal force to an almost negligible amount. This is, furthermore, so because the present propellers are intended only for small planes with 100 horsepower motors or less and it is then not too difficult to design the blades of the propellers so that the centrifugal force will be concentrated in a different axis and will not affect the pitch.

It is to be understood that the form of my invention herein shown and described is to be taken as a preferred example of the same and that various changes in the shape, size, and arrangement of parts may be resorted to, without departing from the spirit of my invention or the scope of the sub-joined claims.

Having thus described my invention I claim:

1. An automatically adjustable pitch aeroplane propeller comprising a hub suitable for mounting on a standard propeller shaft, said hub having a plurality of split radial bearings; a plurality of propeller blades rotatably mounted in said radial bearings; a lever fastened to the inner end of each of said propeller blades, said lever being bent in 90 degrees; an inner sleeve slidably mounted upon said hub, said sleeve having a plurality of lugs engageable with the ends of said levers; an outer sleeve slidably mounted upon said hub, said outer sleeve having a plurality of lugs; a plurality of bolts placed through holes in said lugs in said sleeves and fastened at one end in the rear wall of said propeller hub; a spring placed over each of said bolts with its ends engaged between said lugs of said sleeves whereby the torque developed by said propeller blades reduce the pitch of same against said spring pressure.

2. A variable pitch aeroplane propeller of the character described in claim 1 where shims are placed between said hub and inner sleeve whereby a preadjustment of the pitch is possible.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,404,403	Parker	Jan. 24, 1922
2,023,684	Hubbell	Dec. 10, 1935

FOREIGN PATENTS

Number	Country	Date
7,084	Great Britain	Mar. 24, 1909
614,716	France	Dec. 21, 1926