

Nov. 24, 1931.

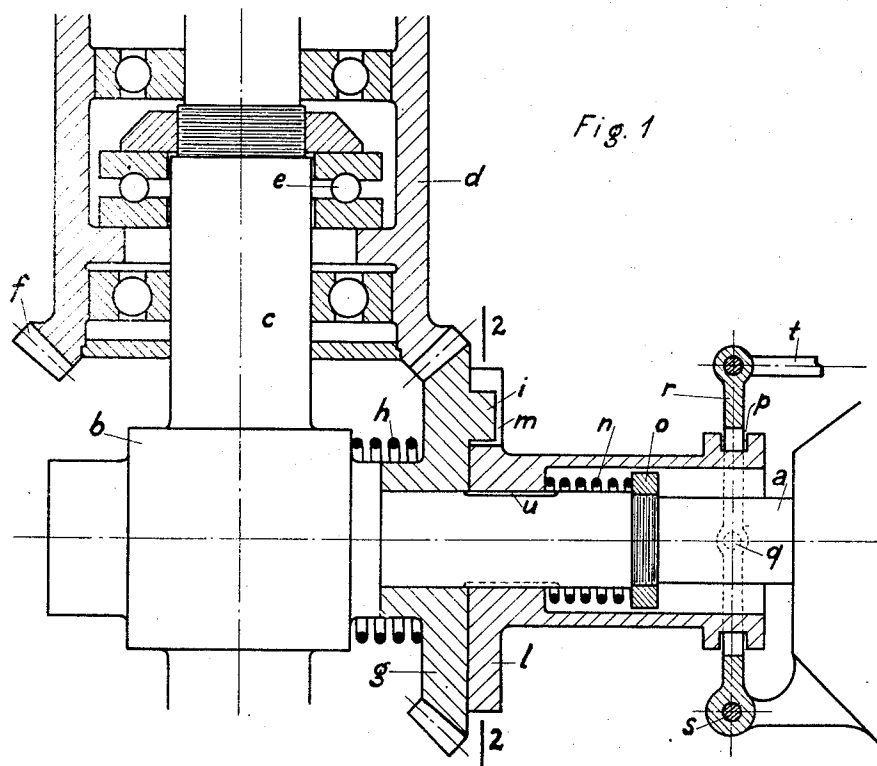
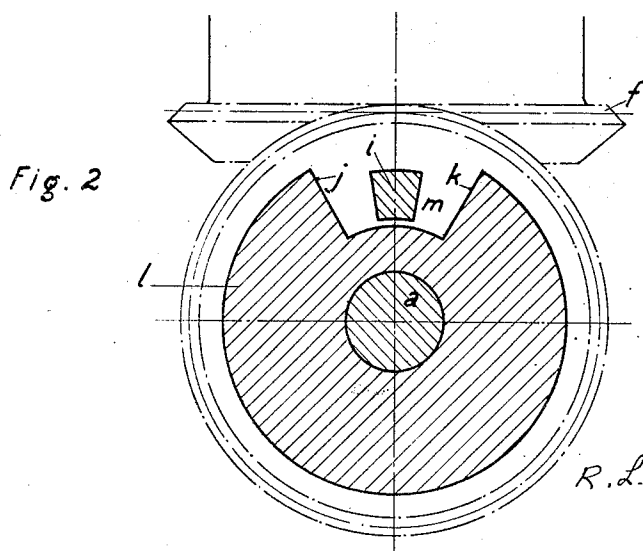
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1,833,843

PROPELLER BLADE

Filed March 27, 1930

3 Sheets-Sheet 1



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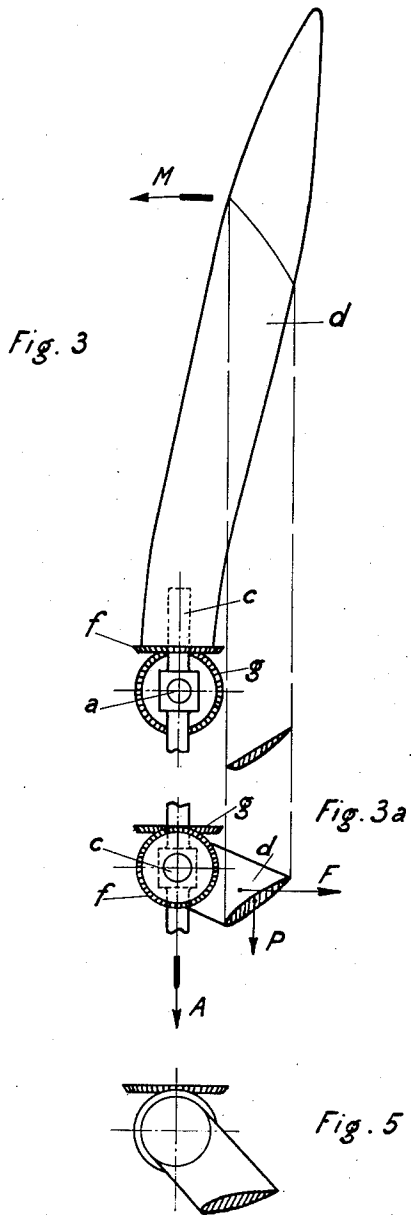
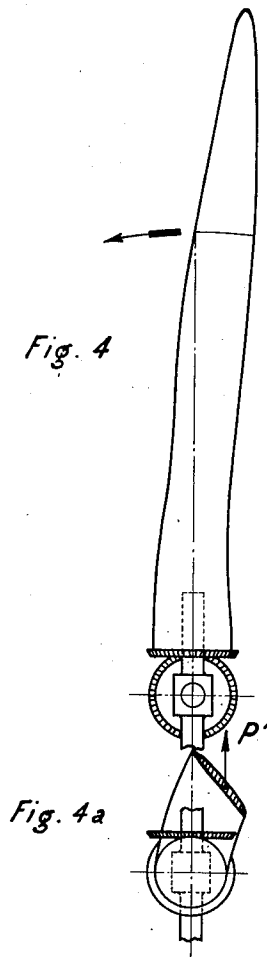
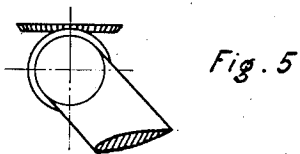
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PROPELLER BLADE

Filed March 27, 1930

3 Sheets-Sheet 2



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PROPELLER BLADE

Filed March 27, 1930

3 Sheets-Sheet 3

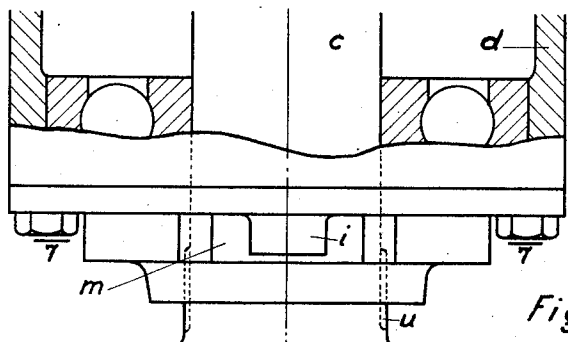


Fig. 6

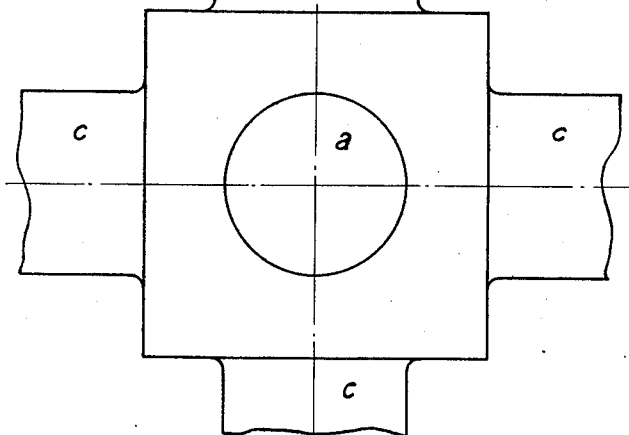
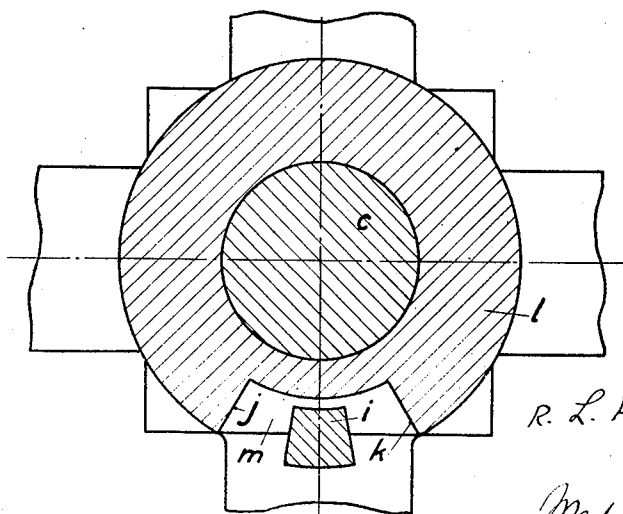


Fig. 7



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UNITED STATES PATENT OFFICE

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PROPELLER BLADE

Application filed March 27, 1930, Serial No. 439,477, and in France May 11, 1929.

This invention relates to screw propellers having blades the inclination of which, to the plane of rotation may be varied about their pivotal axes automatically to vary the pitch, such as are described in the specification of Letters Patent of the United States No. 1,455,442. The object of the invention is to obviate certain inconveniences, hereinafter specified, which have been encountered in the practical operation of flying machines or other aircraft provided with such propellers and, in particular, to allow their application to apparatus of the revolving wing type.

According to this invention a stop member is employed to restrict the rotation of the blades in both directions, so as to enable the propeller to be employed in special running conditions, such as in starting, stopping and slowing down of the engine. Means may be provided for disengaging the stop member, and allowing the blades to set themselves in position automatically and at a suitable moment, to exert a powerful braking action by presenting their substantially flat surface to the air.

In the accompanying drawings which illustrate an embodiment of the invention by way of example:

Figure 1 is an axial section of the device for mounting and controlling the blades of a propeller, and Figure 2 is a section, at right angles to the axis, on the line 2—2, Figure 1. Figure 3 is an end view, and Figure 3a a plan, on a smaller scale, of a blade in the ordinary working position. Figures 4 and 4a are similar views of a blade in the braking position. Figure 5 is a plan of a blade in the starting position. Figure 6 is a plan of a variant of the device, with vertical axis, applied to an apparatus of the revolving wing type, and Figure 7 is a section on the line 7—7, Figure 6.

On the engine shaft *a* is keyed a block *b* carrying the pivotal axes *c* of the propeller blades *d*. These blades are adapted to turn on their respective axes *c*, for example on ball bearings *e*. Each blade *d* has integral therewith a bevel pinion *f* meshing with a pinion *g* which is common to all the pinions *f* and is mounted idly on the shaft *a*. A torsion

spring *h*, of spiral or other form, is coiled round the shaft *a* and abuts against an arm on the block *b*, and against the pinion *g* which conjugates the blades. This spring *h* is regulated in such a way as to tend always to bring the blades back into the position corresponding with the ordinary running of the flying machine. The displacement of each blade *d* around its axis *c* is limited, in both directions, by a lug *i*, on the pinion *g* and is adapted to be checked, in both directions, by abutments *j* and *k* at the ends of a recess *m* in a flange of a sleeve *l* carried round integrally by the engine shaft *a*. The sleeve *l* may be divided into two sleeves, each provided with an abutment.

A spring *n*, abutting against a shoulder *o* provided on the shaft *a* and housed inside the sleeve *l*, tends to keep the lug *i* always in the recess *m* of the sleeve *l*.

The sleeve *l*, which is provided with the abutments *j*, *k*—or only the sleeve carrying the abutments *k*, if the sleeve be divided—is adapted to be disengaged from the pinion *g*, in that it can be displaced longitudinally on the shaft *a*, small grooves *u* being formed in the shaft *a* parallel to the axis thereof. The sleeve *l* is formed with an annular groove *p* in which engage rollers *q* on a fork *r*, adapted to be swung on a fixed pivot *s*, attached to the engine frame, when the fork *r* is actuated by a lever *t* within reach of the pilot.

When the sleeve *l* is moved towards the left, Figure 1, under the action of the spring *n*, when the pilot releases the lever *t*, the abutments *j* and *k* lie on opposite sides of the lug *i* so as to stop it in both directions of rotation of the pinion *g*. The blade *d*, integral with the pinion *f* can turn on its pivotal axis *c* as far as these two abutments, and assume the incidence corresponding with the various forces acting upon it.

In normal running, with the flying machine travelling in the direction of the arrow A (Figures 3 and 3a) and the engine turning in the direction of the arrow A, (Figs. 3 and 3a) and the engine turbine in the direction of the arrow M, the blade *d* assumes an angle of slight inclination in relation to a

plane at right angles to the rotational axis of the engine, under the action of the normal thrust P of the air and of the centrifugal force F due to the rotational velocity of the actuating shaft a .

The blades thus adapt themselves automatically to the different conditions of running, and present a variable pitch propeller. In particular, when the flying machine mounts in the atmosphere, the reduced density of the air compels the blades to yield, more and more, to the action of centrifugal force, thus automatically increasing their pitch. It can easily be shown, by calculation, that this adaptation, which results from the value of the angle assumed by the blades in relation to their axis, can be strictly accurate for only two altitudes of flight; but, for other altitudes, it is sufficiently exact for practical requirements.

However, if the blades were entirely free to turn, as is the case in a previously known device, the propeller could not be used.

In fact, it presents the following inconveniences:

In starting the engine—even assuming the precaution having been taken to set the blades approximately in good position—the inertia and kinetic energy generally cause the blades to assume the position shown in Figures 4 and 4a. The result is to cause the propeller to exert a thrust in the direction of rearward flight of the flying machine.

If, in exceptional cases, the blades do not turn back completely, it is known that the thrust exerted by the air at a stationary point is twice as great as during flight. Under these conditions, the blades incline too much towards the front (Figure 5), which results in an excessive diminution of their pitch, and does not enable the full power of the engine to be utilized when running at normal speed.

When the flying machine is descending, the engine running at reduced speed, the reaction of the air on the blades changes in direction, thus compelling them to turn progressively in order to occupy the position already indicated (Figures 4 and 4a). This results from the torque, due to the thrust of the air, being far greater than that resulting from centrifugal force.

This condition is particularly serious, because this turned back position of the blades, out of control by the pilot, may—during flight, and at an inopportune moment—set up such a powerful braking action on the flying machine as to cause it to crash. Moreover, it is impossible to bring the blades back into good position while in flight. In fact, accelerating the engine causes the negative thrust to increase as the square of the rotational velocity and the centrifugal force as well. Since, in this position, the two resultant torques balance each other in slowing down, they continue to counteract one another,

without modifying the position of the blades, at all engine speeds.

These inconveniences are obviated by the stop devices provided in accordance with the present invention.

The lug i , by coming into contact with the abutment k , limits the rotation of the blade in the direction of increased pitch as far as the position in which the blades are in the eye of the relative wind.

In starting the flying machine, the blade turns on its axis, in the direction of diminishing the pitch, until the lug i comes into contact with the abutment j .

During flight, or in landing, the pilot, by pulling the lever t , can move the sleeve l towards the right (Figure 1), and disengage the lug i in relation to the abutment k of maximum pitch. In this manner, the pilot obtains, at the opportune moment, a powerful braking action by the propeller, the blades of which assume the turned-back position indicated in Figure 5, which affords the advantage of utilizing the substantially flat face of the blade to receive the more powerful reaction of the air and benefit by a more efficacious braking.

The spring h , which acts against the rotation of the blades in the direction of increased pitch returns the blades automatically to their original position after stopping or merely the slowing-down of the engine and flying machine.

The present invention is also applicable, as a revolving wing, to apparatus of the autogyro or helicopter type. In this case the device for conjugating the blades is omitted, and each blade is provided with independent abutments, which cannot be disengaged.

According to Figures 6 and 7 for example, the root of each blade d is directly provided with the lug i , which is able to move in the recess m in the sleeve l . This latter is then mounted on the axis c , the grooves u serving merely to regulate the angular position of the sleeve l .

This arrangement offers the advantage of taking into account the circumstance that a blade, of the supporting propeller which is moving forward in the same direction as the aircraft, has a higher velocity, in relation to the air, than that of the opposite blade moving in the reverse direction in relation to the aircraft. In the case of ordinary propellers, the difference in the velocities causes considerable differences in the thrust. The present arrangement enables the propeller to be utilized advantageously, through the possibility of conferring on the blades the faculty of modifying their incidence, and thus balancing the difference in thrust, the incidence of the forwardly moving blade decreasing automatically, whilst the incidence of the opposite blade is increased.

The various foregoing devices have been indicated solely by way of example, and may be modified in embodiment. In particular, the abutments may be replaced by any equivalent means, and the springs by any counteracting members, such as those based on the action of a fluid or of masses exposed to centrifugal force.

What I claim is:—

10 1. A variable pitch propeller having blades inclined on their pivotal axis, a propeller shaft fixed with the axis, a sleeve slidably keyed on the propeller shaft and having spaced abutments carried thereby, a lug associated with the propeller shaft and engageable between the abutments, and means for sliding the sleeve to cause the lugs to engage or disengage the abutments.

20 2. A variable pitch propeller having blades inclined on their pivotal axis, a propeller shaft fixed to the axis, a sleeve slidably keyed on the propeller shaft, said sleeve having a recess therein, the sides of which constitute abutments, a driving member for the propeller blades mounted on the propeller shaft and having a lug thereon normally engaged in said recess and between the abutments, and means for sliding the sleeve on the propeller shaft to move the
30 abutments from the path of movement of the lug.

In testimony whereof I affix my signature.

ROBERT LÉON AUGUSTE LEPARMENTIER.

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