March 2, 1937. E. C. BERGER 2,072,196

AERIAL PROPELLER

Filed Sept. 25, 1935 3 Sheets-Sheet 1

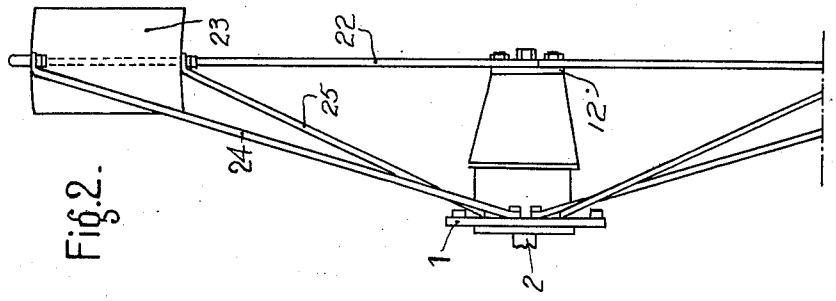


Fig. 2.

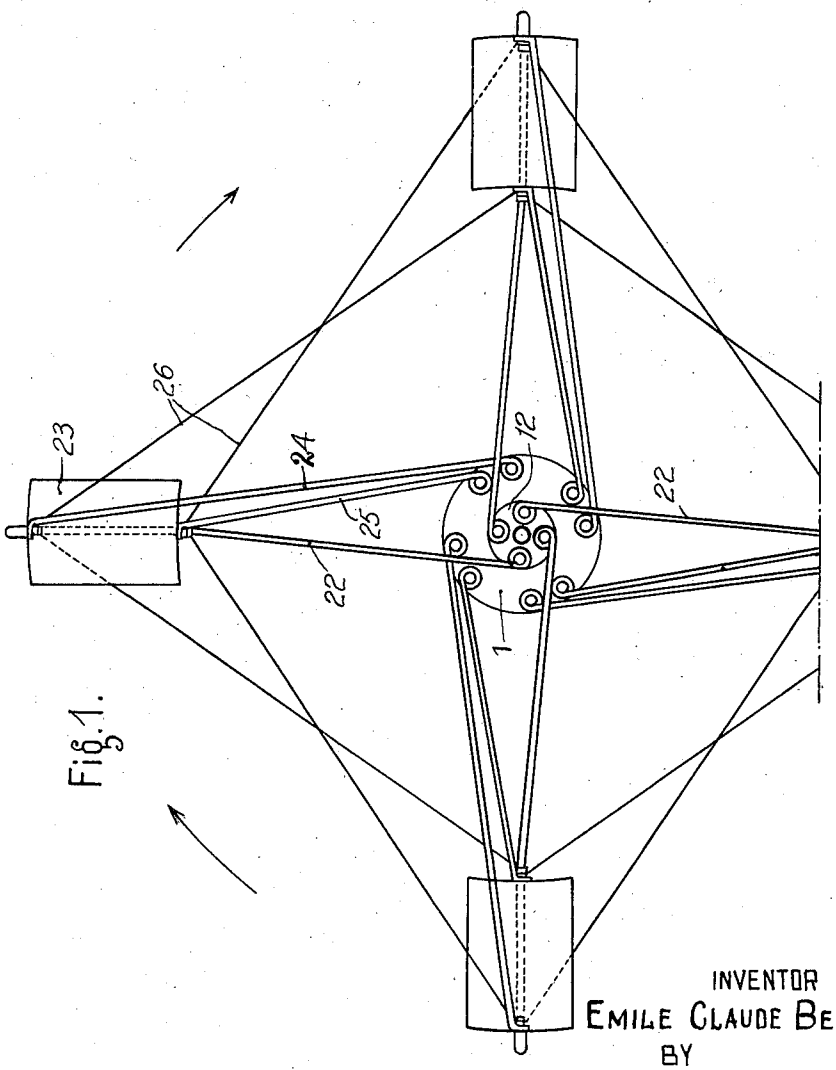


Fig. 1.

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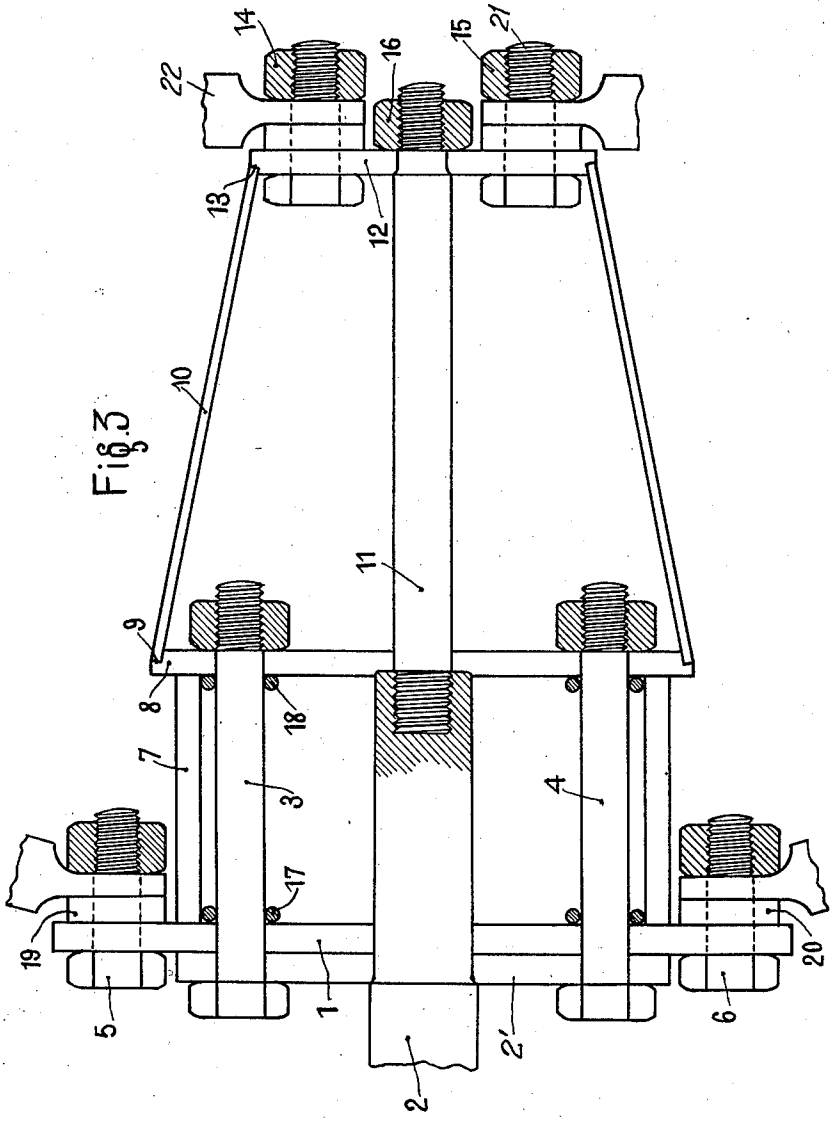


Fig. 3

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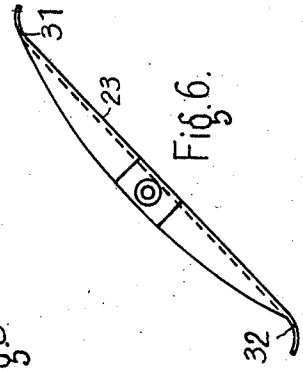


Fig. 6.

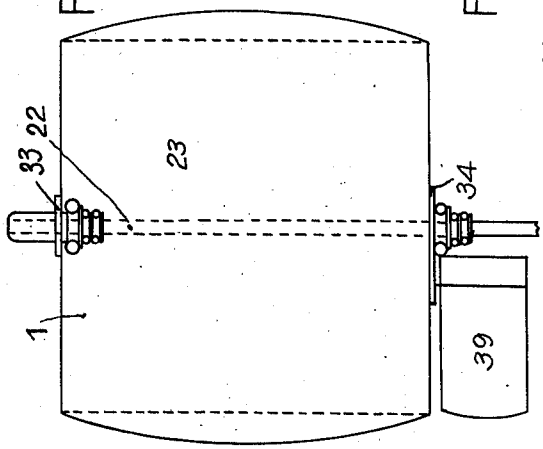


Fig. 5

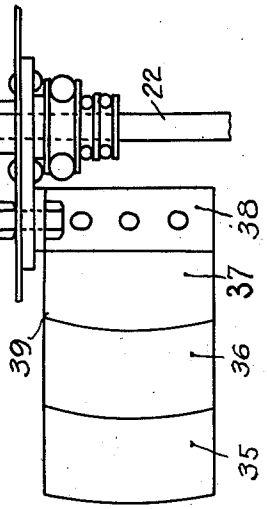


Fig. 8

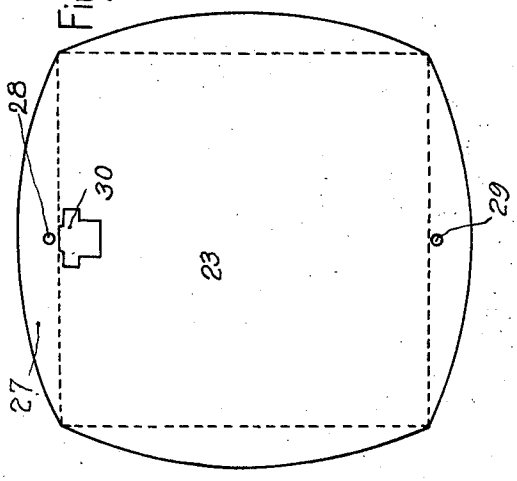


Fig. 4

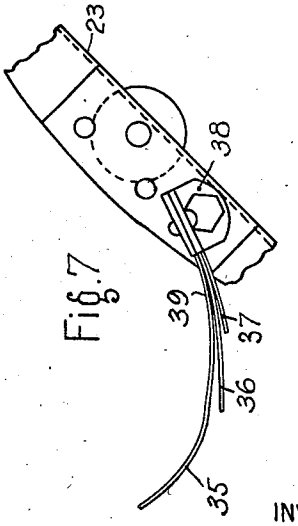


Fig. 7

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2,072,196

UNITED STATES PATENT OFFICE

2,072,196

AERIAL PROPELLER

Emile Claude Berger, Orsay, France

Application September 25, 1935, Serial No. 42,135
In France November 9, 1934

3 Claims. (Cl. 170—167)

The present invention is directed to propellers and more particularly has reference to aerial propellers capable of being adapted either for use as a traction propeller or as a sustaining propeller.

An object of this invention is to provide an aerial propeller having blades of variable pitch and equipped with means for varying the pitch of the blades.

Another object of this invention is to provide an aerial propeller having a hub structure comprising two rigidly connected co-axial rings of different diameter axially spaced from each other, a plurality of rigid blades of substantially rectangular shape arranged equidistant from the hub and with uniform peripheral distribution, arms extending from the smaller hub ring and pivotally supporting the blades, flexible rudder means on each blade for individually and automatically controlling the angle of incidence of the blade, pairs of crossed braces connecting the arms at the inner and outer edges of adjacent blades, and a pair of stays connecting the periphery of the larger hub ring with each arm at the inner and outer edges of the blade thereon.

With these and other important objects in view, which may be incident to my improvements, the invention resides in the parts and combinations to be hereinafter set forth and claimed, with the understanding that the several necessary elements comprising my invention may be varied in construction, proportions and arrangement, without departing from the spirit and scope of the appended claims.

In order to make the invention more clearly understood, there is shown in the accompanying drawings means for carrying the same into practical effect without limiting the improvements in their useful applications to the particular constructions which, for the purposes of explanation, have been made the subject of illustration.

In the drawings:

Figure 1 is a fragmentary front elevational view of a propeller embodying the present invention.

Fig. 2 is a side view of the propeller shown in Fig. 1.

Fig. 3 is an enlarged sectional view of the propeller hub.

Fig. 4 is a plan view of a plate from which the propeller blade is made.

Fig. 5 is a plan view of a completed propeller blade.

Fig. 6 is an end view of the blade shown in Fig. 5.

Fig. 7 is a detailed end view of the blade rudder.

Fig. 8 is a plan view of the rudder.

As shown in the drawings, the hub of the propeller comprises a disc 1 having a central aperture by means of which said disc is mounted on the motor shaft 2. A plate 2' is affixed to shaft 2 and is connected to disc 1 by means of bolts 3 and 4 passing through corresponding apertures in the plate and disc. In addition to the apertures for the shaft 2 and bolts 3 and 4, disc 1 is also provided with apertures for bolts 5 and 6, the purpose of which will be described hereinafter.

Shaft 2 has an extension shaft 11 threaded in the free end thereof. The extension shaft carries discs 8 and 12. Disc 8 lies against the end of shaft 2 and is spaced from disc 1 by a drum 7. Drum 7 is centered by means of rings 17 and 18 associated with bolts 3 and 4.

Discs 8 and 12 are spaced by a frusto-conical drum 10, one end of which is received in a peripheral groove 9 in disc 8 and the other end of which is received in peripheral groove 13 of disc 12.

It will be realized that drum 7 will be held between discs 1 and 8 by bolts 3 and 4 and that drum 10 is held between discs 8 and 12 by the nut 16 on shaft 11. After or during assembly, the various parts may be soldered to prevent accidental disassembly.

Disc 12 is provided with bolts 21 which carry wire stays or arms 22 on the free ends of which the blades 23 are pivoted. Two tractive stays 24 and 25 extend from bolts 5 and 6 to points at the outer and inner ends of the blades, respectively, as clearly shown in Figs. 1 and 2 of the drawings. It will be noted from Fig. 1 that stays 24 and 25 are under tension when the propeller is rotated in its correction direction, as indicated by the arrows.

Braces 26 serve to rigidify the assembled structure. These braces extend from the outer end of the carrier of one blade to a point on the adjacent blade carrier near the inner end of the blade carried thereby. Thus, each stay or blade carrier 22 is connected by two crossed braces 26 with each adjacent blade carrier.

The supporting stays of the propeller are constituted preferably of piano wire. The exceptional strength of this kind of steel permits of loading these supports at 120 kilos per square millimeter of section (see "Calculation and Construction of Light Aircraft", 3rd vol. by Engineer H. G. Desgrandschamps).

These blades 23 may be made: by casting or by bending.

If the first process is chosen, there will be given to the outer part of the blades, as also to the inner part, a curvilinear shape (Figures 1 and 2) the center of each of the circumferences being that of the propeller.

In the second or bending process, a thin plate of light metal is used, out of which is cut a disc 27 (Figure 4) and in which is bored holes 28, 29 and 30. At the outer and at the inner sides, the metal is bent backward at right-angles (Figure 5).

In order to facilitate the entry and exit, in the air, of the blade when revolving, its lateral edges will have small curved portions 31 and 32 (Figure 6).

Enclosed over the whole of its outline by curved or bent-over parts, the blade will be reinforced against deformation by the pressure of the air.

Examination of Figure 1 shows that each blade is balanced at its center on the carrier 22.

Small reinforcing plates 33 and 34 (Figure 5) are secured to the outer and inner sides of the blade. They prevent any enlargement of the hole through which the carrier 22 passes.

In order that the rotation of the propeller may always produce the maximum pressure on the air, compatible with the force of the motor, each blade is provided with an automatic rudder 39 (Figures 7 and 8).

The latter is substantially constructed of a number of flexible sheets or blades of tempered steel; these flexible blades being of different lengths, curvatures and thickness.

The blade 35, for example will have a thickness of $\frac{1}{10}$ m/m., the blade 36 a thickness of $\frac{3}{10}$ m/m., the blade 37 a thickness of $\frac{5}{10}$ mm. It is understood that all these figures are given by way of example to explain the characteristics of the mounting.

A simple examination of Figure 7 shows that the blade 35 is in opposition to blades 36 and 37. As soon as the propeller commences to rotate, the pressure of the air tends to force the spring blades one against the other. Blade 35 obviously gives way first, since it is thinner and longer. The direction of the blade thus moves from 45° to 40° and then to 35° and continues to progressively diminish its angle of incidence.

The blades 35, 36 and 37 are secured at their common base to a small plate of light metal 38 (Figures 7 and 8) which, in turn, is secured on the inner end of the blade 23.

The speed of the translation of the aircraft has also an influence on the blade 23, but obviously less than the peripheral speed. The pressure which is exerted on the rudders 39, from the fact of the rectilinear translation, is favorable to the aircraft since it tends to increase the speed.

In operation, the torque of the motor tends to flex the arm or carrier 22, but the centrifugal force, much more powerful than the effect of the motor, not only counteracts the flexing effect of the latter but transforms into traction the stress in the arm.

Although specially designed for aeroplane traction, the propeller of this invention may also be used as a supporting propeller.

For this latter purpose, there must nevertheless be made the following modifications in its construction.

In order to prevent the flattening of the propeller on landing, it will be necessary to give a certain descending slope to the stays or carriers 22 (Figures 1 and 2). It will be sufficient to this end to double the length of the central body, giving of course exactly the preceding length and inclination to the stays or carriers 22.

Also, in the case of a sustaining screw, since the speed of rotation is to be much slower, the surface of the blades must be much larger.

The propeller described would also be useful in the case of fans having to rotate at a very high speed. The rudder 39 which, in this case, becomes useless, would be dispensed with; the blades would be given a permanent orientation of 90°.

Because of the arrangements which have just been described, the propeller is almost silent, which constitutes a great advantage for the comfort of commercial aircraft, and gives an incontestable superiority to aircraft or dirigibles of war.

I claim as my invention:

1. An aerial propeller of the kind described, having a hub structure comprising two rigidly connected co-axial rings of different diameter axially spaced from each other, a plurality of rigid blades of substantially rectangular shape arranged equidistant from the hub and with uniform peripheral distribution, arms extending from the smaller hub ring and pivotally supporting the blades, flexible rudder means on each blade for individually and automatically controlling the angle of incidence of the blade, pairs of crossed braces connecting the arms at the inner and outer edges of adjacent blades, and a pair of stays connecting the periphery of the larger hub ring with each arm at the inner and outer edges of the blade thereon.

2. An aerial propeller of the kind described, having a hub structure comprising two rigidly connected co-axial rings of different diameter axially spaced from each other, a plurality of rigid blades of substantially rectangular shape arranged equidistant from the hub and with uniform peripheral distribution, arms extending from the smaller hub ring and pivotally supporting the blades, means on each blade for individually and automatically controlling the angle of incidence of the blade, pairs of crossed braces connecting the arms at the inner and outer edges of adjacent blades, and a pair of stays connecting the periphery of the larger hub ring with each arm at the inner and outer edges of the blade thereon, said incidence control means comprising a series of superposed spring blades of different length, curvature, and stiffness exposed to air pressure.

3. An aerial propeller of the kind described, having a hub structure comprising two rigidly connected co-axial rings of different diameter axially spaced from each other, a plurality of rigid blades of substantially rectangular shape arranged equidistant from the hub and with uniform peripheral distribution, arms extending from the smaller hub ring and pivotally supporting the blades, pairs of crossed braces connecting the arms at the inner and outer edges of adjacent blades, a pair of stays connecting the periphery of the larger hub ring with each arm at the inner and outer edges of the blade thereon, and multileaved curved resilient rudders associated with the blades for controlling the incidence angle of the blades.

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