C. A. HIRTH.

PROPELLER.

APPLICATION FILED DEC. 17, 1913.

1,163,010. Patented Dec. 7, 1915.

Fig. 2.

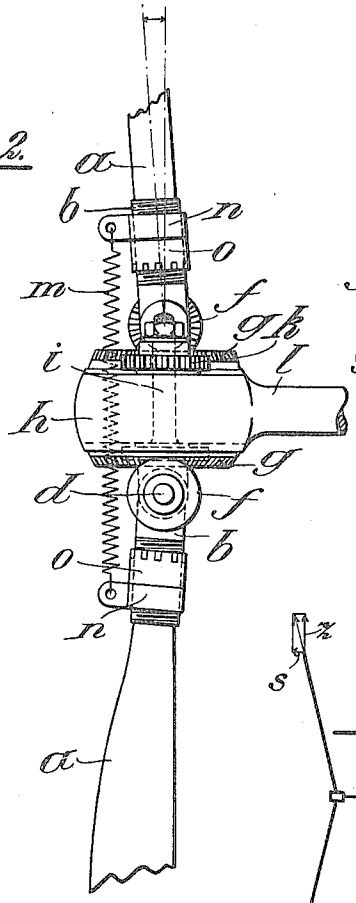


Fig. 3.

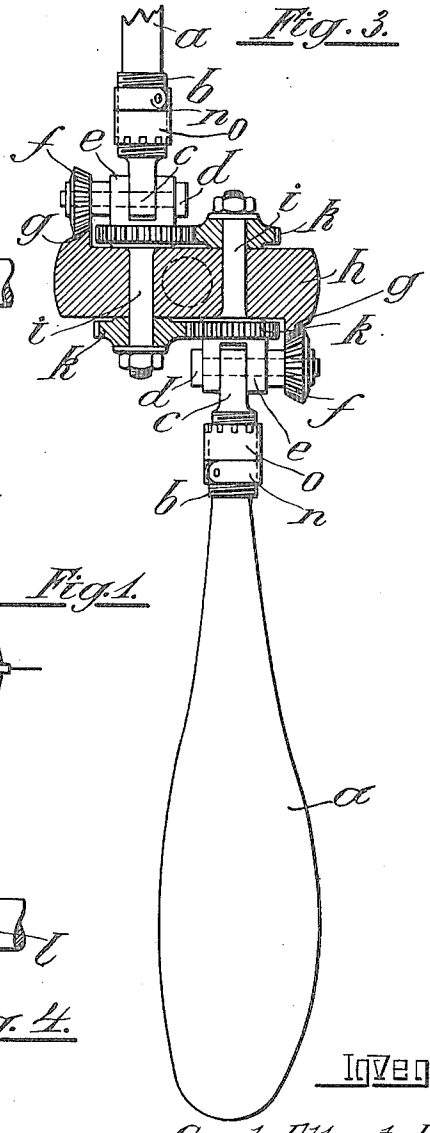


Fig. 1.

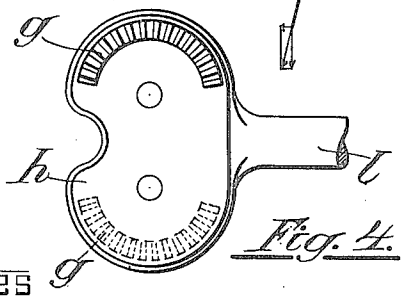


Fig. 4.

Witnesses

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UNITED STATES PATENT OFFICE.

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PROPELLER.

1,163,010. Specification of Letters Patent. Patented Dec. 7, 1915.

Application filed December 17, 1913. Serial No. 807,343.

To all whom it may concern:

Be it known that I, CARL ALBERT HIRTH, a subject of the German Emperor, residing at Cannstatt-Stuttgart, in the Empire of Germany, have invented certain new and useful Improvements in and Relating to Propellers, of which the following is a specification.

It has already been recognized that the greatest efficiency can be obtained from a flying machine, or rather a flying machine engine, if the pitch of the propeller blades can be varied with the speed of revolution of the propeller and the suggestion has therefore been made to make the pitch of the propeller blades directly dependent on the number of revolutions of the propeller. No satisfactory result has however been obtained as it was overlooked that the most favorable adjustment of the pitch of the blades is in no way dependent only on the number of revolutions of the propeller but that the relative speed of the travel of the propeller through the air (the speed of the flight) has also a substantial influence thereon. The same is the case with other suggestions which only allow of the adjusting of the propeller blades relatively to the tractive effort of the motor and the thrust of the air on the blades, while the effect of the speed of revolution which is dependent not only on the tractive effort of the motor but also on its control and the like, was neglected.

Now by this invention the possibility is afforded of utilizing in a practically thoroughly satisfactory way all the influences which come in question in the adjustment and displacement of the pitch of the propeller blades, by the blades being flexibly connected with the propeller shaft in such a way that their angle to the axis of rotation can alter according to the direction of the resultants of the centrifugal force acting on the blades (*z*, Fig. 1) and the thrust (*s*, Fig. 1). The rotary and oscillatory movement, thus rendered possible is also brought into dependence on a further rotary movement which alters the angle of pitch of the blades.

It is particularly important that by this invention the adjustment of both blades of the propeller is brought into compulsory dependence on one another, namely is kept equal. As the blades in their rotation are exposed to varying forces or resistances, by a compulsory coupling of the blades one to the other, each periodic change is avoided, as soon as they are in a given simple ratio to the actual number of pendulum oscillations of the blades, which would set the blades in disadvantageous resonance oscillations.

The invention will be more particularly described with reference to an example of construction illustrated in the accompanying drawings, in which:—

Figure 1 is a diagram of the forces acting on the blades; Fig. 2, a side view; and Fig. 3, a front view of a propeller arranged in accordance with this invention, the head of the propeller shaft being in section; Fig. 4 is an elevation of the hub of the propeller shaft which carries the adjusting device.

The propeller blades *a* are held in sockets *b* which carry lugs *c* connected to link pins *d* which are pivotally mounted in forks *e*. The pins *d* are firmly connected with the lugs *c* of the sleeves or sockets *b*, so that when the blades *a* rotate about the axis of the bolts *d*, the latter must turn with them. Bevel wheels *f* are carried on the bolts *d* and are in engagement with toothed segments *g* on the hub *h* of the propeller shaft. On the pins *d* turning, the toothed wheels *f* travel along the racks or toothed segments *g* and thus rotate the propeller blades about the pins *i* of the fork *e* on the hub *h* of the propeller shaft. Preferably, although not absolutely necessary, a toothed wheel or toothed ring *k* is also mounted on each pin *i*, and these two racks have an equal number of teeth and are brought into engagement with one another. For this object the two blades are arranged at the side of the propeller shaft *l*. If this coupling be not adopted the blades may of course stand diametrically opposite one another and their axis may intersect the axis of the propeller shaft.

The action of the arrangement described is as follows:—When the propeller shaft 1 is rotated at a given speed, the blades follow the forces acting upon them, more particularly centrifugal force, and thrust, which are both variable and do not entirely depend one on the other. Consequently the blades adjust themselves to a smaller or larger angle or setting relatively to the propeller shaft, and this automatic adjustment through the planet wheels *f* which then travel along the toothed segments *g*, gives a suitable adjustment of the angle of pitch of the blades

by turning these about the pins *i*. The coupling by means of the toothed wheels *k* insures a uniform adjustment of the two vanes.

Now it is easily evident that the adjustment of the blades is not absolutely the same at every speed of the propeller shaft, so that the blades would be given the same pitch immaterially whether they rotate with the engine running free or in full flight, but that in the adjustment of the pitch of the blades the thrust makes its influence felt which when the engine is running free has a totally different value to what is the case when in full flight. The adjustment of the pitch of the blades is of course done by more pitch being given the blades the more they tend to be upright or to erect themselves.

A spring *m* is preferably employed for suitably adjusting and influencing the forces acting on the blades, and this spring may be preferably arranged in the manner shown in Fig. 2. A common spring *m* engages two rings *n* loosely displaceable on the sockets *b* of the blades. Beneath the rings, nuts *o* are provided, which can be screwed up on an external thread provided on the socket *b*, so that thereby the tension of the spring can be suitably adjusted. The arrangement described has also further advantages in addition to the advantages already mentioned, in that the blades when the motor is stationary or shut off are to a certain extent folded up, so that they are less likely to encounter obstacles, for example when landing.

In detail the application can be carried out in various ways. The compulsory connection of the two rotary movements used for adjusting the blades can be carried out in a different way than that shown. For example the two crossed axes of rotation may be replaced by a suitable thrust cam guide. The position of the coupling elements to the axes of rotation may also be exchanged; instead of planet wheels, push rods may be employed and so forth. The constructive formation also requires some further precautions which are not here further explained as not directly belonging to the invention, such for example as means for equalizing or rendering entirely inoperative the moving of the point at which the thrust acts, which movement arises when the blades are erected, transversely over the blades and its influence causing a rotation of the blades on the pins *i*. A simple means for this purpose is, for example to insert the blade shanks eccentrically in the blade sockets.

I declare that what I claim is:—

1. A screw propeller consisting of a hub, a plurality of blades, stub spindles carrying said blades and arranged at right-angles to the axes of said blades, inter-connection means between said stub spindles and the hub so that as the spindles rotate about their axes they are also constrained to move about axes at right-angles, and means inter-connecting said blades whereby each one is constrained to move similarly to the others.

2. A screw propeller consisting of a hub, a plurality of blades, stub spindles carrying said blades and arranged at right-angles to the axes of said blades, gear wheels on said stub spindles, rack teeth on the hub engaging said gear wheels so that as the spindles rotate about their axes they are also moved about axes at right-angles, and means interconnecting the blades whereby each one is constrained to move similarly to the others.

3. A screw propeller consisting of a hub, a plurality of blades, stub spindles carrying said blades and arranged at right-angles to the axes of said blades, gear wheels on said stub spindles, segmental rack teeth integral with the hub, engaging said gear wheels so that as the spindles rotate about their axes they are also moved about axes at right-angles, and means inter-connecting the blades whereby each one is contrained to move similarly to the others.

4. A screw propeller consisting of a hub, a plurality of blades, stub spindles carrying said blades and arranged at right-angles to the axes of said blades, bevel gear wheels on said stub spindles, toothed sector racks on the hub engaging said gear wheels so that as the spindles rotate about their axes they are also moved about axes at right-angles, and means inter-connecting the blades whereby each one is constrained to move similar to the others.

5. A screw propeller consisting of a hub, a plurality of blades, stub spindles carrying said blades and arranged at right-angles to the axes of said blades, sockets carrying said spindles, inter-engaging gear wheels on said sockets and inter-connection means between said stub spindles and the hub so that as the spindles rotate about their axes they are also constrained to move about axes at right-angles, and means inter-connecting said blades whereby each one is constrained to move similarly to the others.

6. A screw propeller consisting of a hub, a plurality of blades, stub spindles carrying said blades and arranged at right-angles to the axes of said blades, bevel gear wheels on said stub spindles, toothed sector racks on the hub and engaging with said bevel gear wheels, sockets carrying said spindles, inter-engaging gear wheels on said sockets and inter-connecting means between said stub spindles and the hub so that as the spindles rotate about their axes they are also constrained to move about axes at right-angles, and means interconnecting said blades whereby each one is constrained to move similarly to the others.

7. A screw propeller consisting of a hub, a plurality of blades, stub spindles carry-

ing said blades and arranged at right angles to the axes of said blades, sockets carrying said spindles, a pair of gear wheels on each socket directly inter-meshing with a corresponding pair of an adjacent socket, interconnection means between said stub spindles and the hub so that as the spindles rotate about their axes they are also constrained to move about axes at right-angles, and means inter-connecting said blades whereby each one is constrained to move similarly to the others.

8. A screw propeller consisting of a hub, a plurality of blades, gear wheel connections between the shafts of said blades, controlling means on said blades whereby when a blade is turned about its axis its inclination is similarly altered, and springs arranged between the shafts of said blades.

9. A screw propeller consisting of a hub, a plurality of blades, stub spindles carrying said blades and arranged at right-angles to the axes of said blades, bevel gear wheels on said stub spindles, toothed sector racks on the hub engaging said gear wheels so that as the spindles rotate about their axes they are also moved about axes at right-angles, means inter-connecting the blades whereby each one is constrained to move similarly to the others, and springs arranged between the shafts of said blades.

10. A screw propeller consisting of a hub, a plurality of blades, stub spindles carrying said blades and arranged at right-angles to the axes of said blades, sockets carrying said spindles, a pair of gear wheels on each socket directly inter-meshing with a corresponding pair of an adjacent socket, interconnection means between said stub spindles and the hub so that as the spindles rotate about their axes they are also constrained to move about axes at right-angles, means inter-connecting said blades whereby each one is constrained to move similarly to the others, and springs arranged between the shafts of said blades.

11. A screw propeller consisting of a hub, a plurality of blades, gear wheel connections between the shafts of said blades, controlling means on said blades whereby when a blade is turned about its axis its inclination is similarly altered, springs arranged between the shafts of said blades, and means for adjusting the tension of said springs.

12. A screw propeller consisting of a hub, a plurality of blades, stub spindles carrying said blades and arranged at right-angles to the axes of said blades, sockets carrying said spindles, a pair of gear wheels on each socket directly inter-meshing with a corresponding pair of an adjacent socket, interconnection means between said stub spindles and the hub so that as the spindles rotate about their axes they are also constrained to move about axes at right-angles, means inter-connecting said blades whereby each one is constrained to move similarly to the others, springs arranged between the shafts of said blades, and means for adjusting the tension of said springs.

13. A screw propeller consisting of a hub, a plurality of blades, stub spindles carrying said blades and arranged at right-angles to their axes, bevel gear wheels on said stub spindles, toothed racks on the hub engaging said bevel wheels whereby when the spindles rotate about their axes they are also moved about axes at right-angles, sockets carrying said spindles, shafts on said sockets passing through said hub, pairs of gear wheels on said shafts one on each side of the hub and intermeshing with corresponding pairs on adjacent shafts, screwed sleeves adjustable along the blades, lugs on said sleeves and tension springs connecting said lugs.

In witness whereof, I have hereunto signed my name this 1st day of December, 1913, in the presence of two subscribing witnesses.

CARL ALBERT HIRTH.

Witnesses:
FRIDA BLARBER,
PAULINE MÜLLER.