June 3, 1930. B. J. STEINMETZ 1,761,690

VARIABLE PITCH AND REVERSIBLE PROPELLER

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Fig. 1.

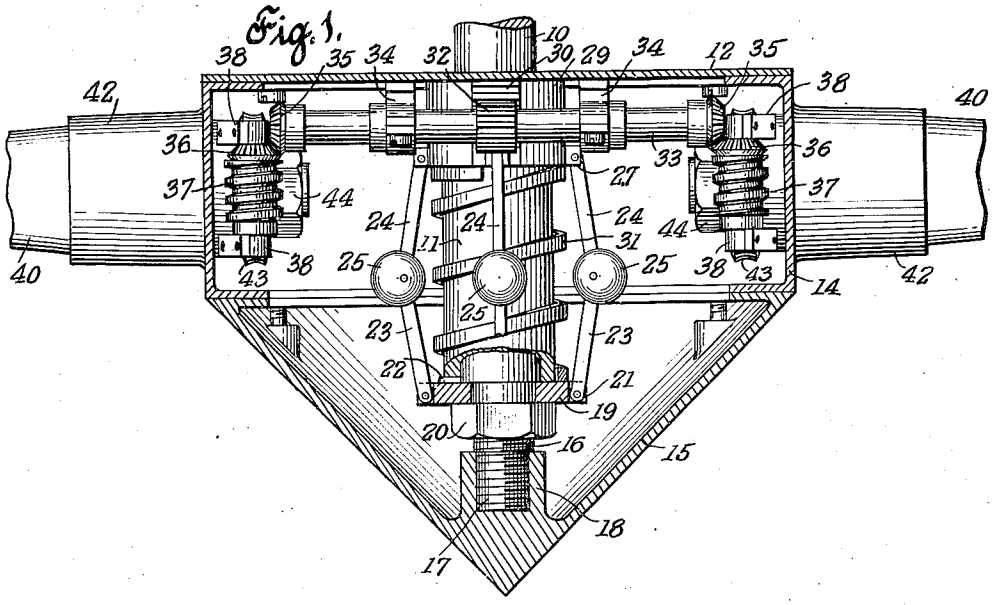
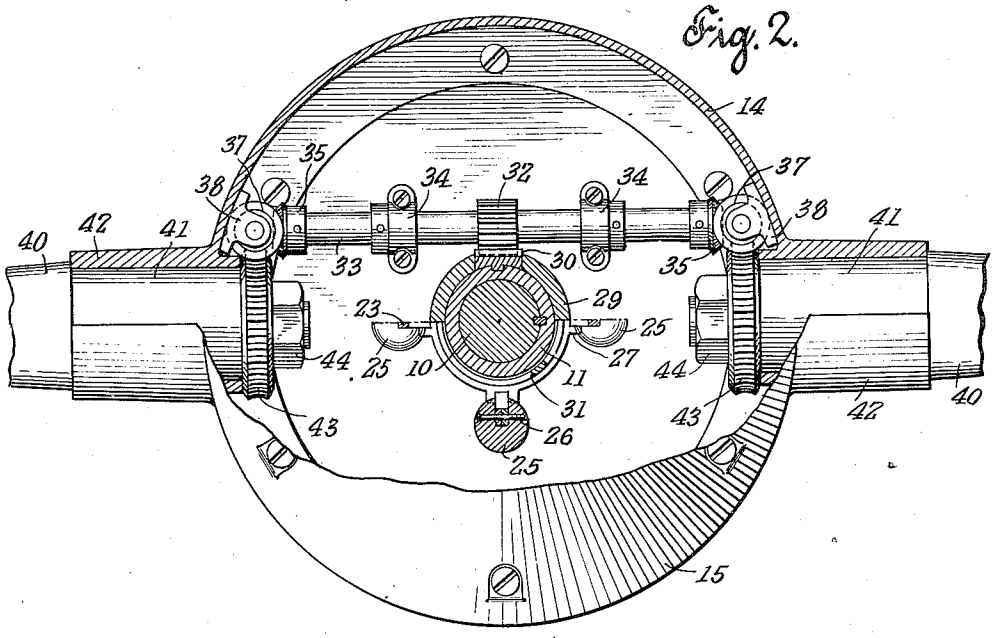



Fig. 2.




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Fig. 3.

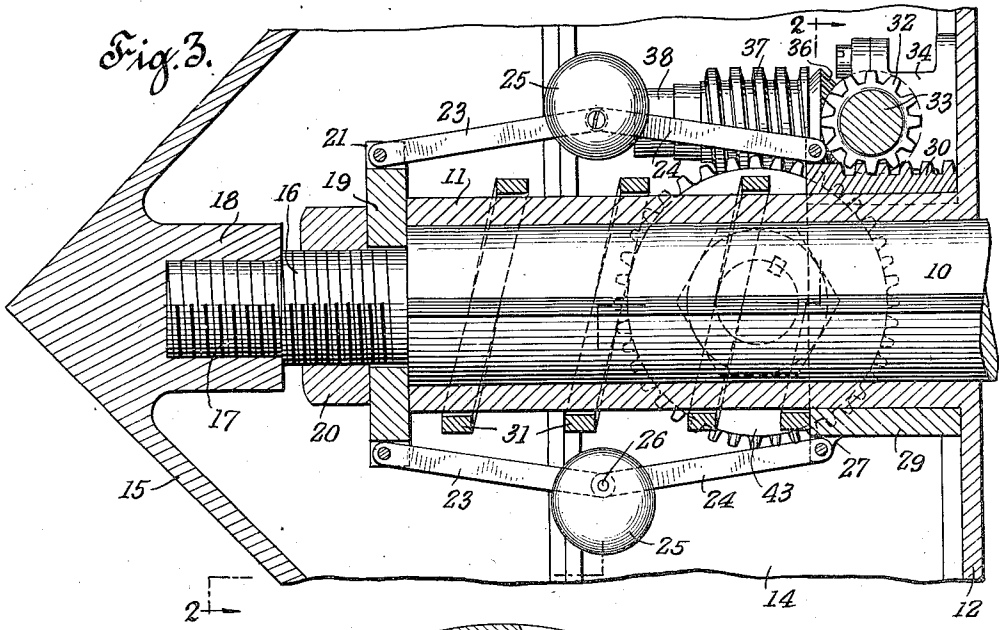
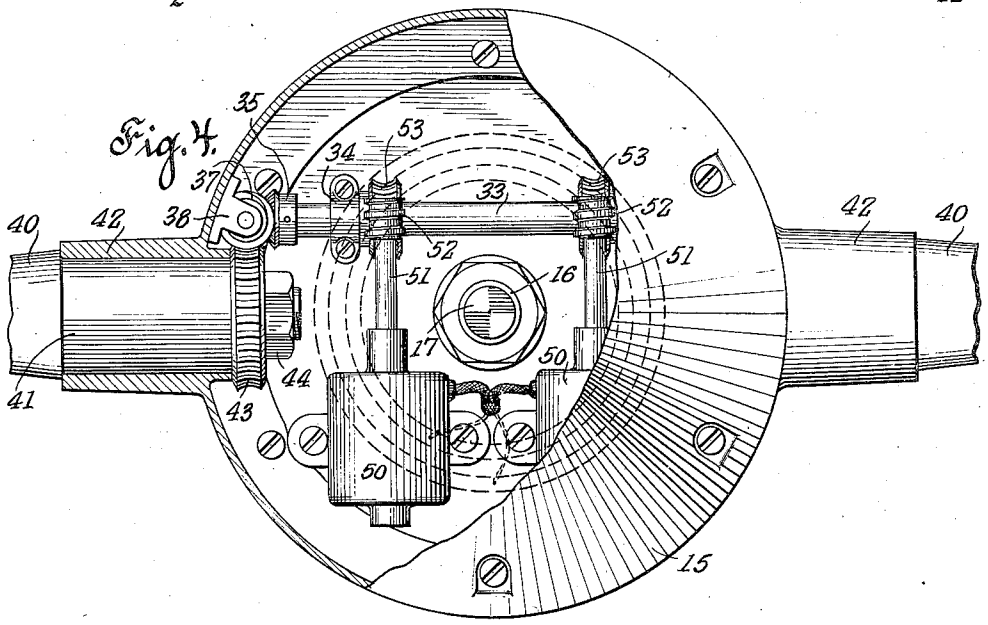



Fig. 4.




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# UNITED STATES PATENT OFFICE

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## VARIABLE PITCH AND REVERSIBLE PROPELLER

Application filed September 14, 1927. Serial No. 219,453.

This invention relates to aeroplanes and like aerial machines, whether of the heavier-than-air, self-buoyant, or other types depending for advancement upon the rotation of bladed propellers, and the invention resides more particularly in the mounting and control of such propeller blades.

Notwithstanding the great amount of thought and experimentation that is bestowed on the subject of aerial navigation, no particular advancement has been made in the propellers, designers having contented themselves with copying the earlier rigid models, making improvements only in shape and in the selection of material, all being rigidly fixed in a revoluble head, the same being in effect a hub carried on the forward end of a motor driven shaft disposed longitudinally of the machine.

It is, however, regarded as highly desirable that some feature of speed control be provided for advancement of the machine through the air, irrespective of the rate of revolution of the motor, for it is known that such motors are variable in speed, as during intervals of "racing" and also that slowing of the motor is accomplished by throttling or cutting off of the impulsive medium, thus reducing the generation of energy.

Having this subject in mind, it is the main object of the present invention to provide means for increasing or decreasing the pitch of the propeller blades whereby their propulsive force may be measurably modified without recourse to changing the speed of the motor.

A further feature is in the provision of means whereby the propeller blades will automatically assume an angle or pitch adapted to cause an increased forward movement of the machine, such arrangement being highly desirable when the machine reaches a high altitude or enters a thin or attenuated stratum of air in which the usual pitch of the blades is insufficient to properly propel the machine.

Another purpose is to produce propeller blades so mounted as to turn upon their longitudinal axes to any desired extent either controlled by an operator, or automatically as may be preferred, and which can be completely reversed to act as a brake in retarding the machine, as at landing or approaching a mooring mast.

These and other like objects, which will become apparent as the description progresses, are accomplished by the novel construction and arrangement of parts hereinafter described and illustrated in the accompanying drawings, forming a material part of this disclosure, and in which:—

Figure 1 is a top plan view of an aeroplane nose as made in accordance with the invention, the casing being in section to show the interior.

Figure 2 is a transverse sectional view of the same, the casing being partially in end elevation, the section being taken on line 2—2 of Figure 3.

Figure 3 is a partial longitudinal sectional view, taken in a plane at a right angle to Figure 1, and drawn to an enlarged scale.

Figure 4 is a partial end and transverse sectional view, similar to Figure 2, but showing a modified form of manually operated control.

Throughout the several views the numeral 10 designates a motor driven shaft extending outwardly at the front of the fuselage of a flying machine of whatever type may be used.

Tight fitted and keyed to the projecting portion of the shaft is a sleeve 11 reaching integrally outward from the rear wall 12 of a short cylindrical casing 14 disposed closely adjacent the front end wall of the fuselage, and removably attached to the open front end of the casing is a hollow conical nose 15, the attachment being made by screws or like fastenings as shown.

In the preferred form, shown in Figures 1, 2 and 3, the outer portion of the shaft is shouldered, reduced and screw threaded, as at 16, and terminates in a further reduced threaded step 17, the same being engaged in an inreaching hub 18 of the conical nose 15.

A circular plate 19 is bored to fit over the threaded portion 16 of the shaft to be firmly

held against its shoulder by a clamp nut 20, and extending from the periphery of the plate are several pairs of lugs 21.

The plate 19 also makes contact with the end of the sleeve 11, which extends coincident with the extending portion of the shaft 10, and a key 22 in the plate engages a slot in the sleeve end so that the several parts rotate as a unit.

Pivoted between each of the paired lugs 21 are links 23, their opposite ends being reduced in thickness and connected with the similarly reduced ends of another set of links 24, the connections being made in the slotted bodies of weights 25, by pins 26, the arrangement being of the well known centrifugal governor type.

The opposite, rearwardly extending ends of the links 24 are pivotally connected between lugs 27 reaching radially outward from an annulus 29 slidable on the sleeve 11, to which it is keyed to prevent relative rotation, and carried by the annulus is a spur toothed rack 30.

A coiled expansion spring 31, here shown of rectangular cross section, encircles the sleeve 11, its ends abutting the plate 19 and annulus 29 respectively, thus normally pressing the rack carrying annulus rearwardly, but yielding under the centrifugal force exerted through the links by the weights when the device is rapidly rotated.

Meshed with the rack 30 is a pinion 32 fixed on a shaft 33, rotatably mounted in bearings 34 secured on the casing plate 12 and extending equally in both directions, at a right angle to and above the drive shaft 10.

Fixed on the ends of the shaft 33 are bevel gears 35 to mesh with mating gears 36 rigid with worms 37 having pintles rotatable in bearings 38 secured in opposite sides of the casing 14. As shown, the shaft 33 is disposed in an offset plane parallel to the blade axes and to prevent undesirable vibration that would result from such construction, it is understood that a suitable counterbalance of weight equalling that of said shaft and disposed a distance equal to that of the shaft and on the opposite side of said plane, is to be provided in the finished device.

The propeller blades used in connection with this invention are provided with cylindrical hubs 40 at their inner ends, having reduced bearing portions 41 housed in outwardly extending housings 42 integral with the casing 14 and arranged in diametrically opposite relation.

The inner extending ends of the blades carry worm wheels 43, held rigidly by keys and clamp nuts 44, to be engaged by the worms 37, the arrangement being such that the propeller blades are firmly held in their bearings and prevented from endwise movement, but permitted to partially rotate on their longitudinal axis at such time and to the extent of the governor control action, returning to their original position whenever an excess speed is reduced to normal.

In the modification shown in Figure 4 the ball or centrifugal governor is dispensed with and the shaft 33 actuated by another method under the immediate control of an operator.

This method consists of the use of one or more small electric motors 50, suitably mounted in the casing 14, their shafts 51 having fixed worms 52 meshing with worm wheels 53 fixed on the shaft 33.

These motors are adapted to run in either direction, under control of an operator, as is also the duration or time period of their rotation.

The foregoing disclosure is to be regarded as descriptive and illustrative only, and not as restrictive or limitative of the invention, of which obviously an embodiment may be constructed including many modifications without departing from the general scope herein indicated and denoted in the appended claims.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent, is:—

1. A flying machine having a propeller shaft, an acutely pointed conical casing on the extending end thereof, opposed radial propeller blades journalled to rotate in said casing, worm wheels fixed directly on the inner ends of said blades, train gears operatively engaging the worm wheels, a centrifugal governor in said casing and rack and pinion means controlled by the action of said governor to actuate said train gears.

2. A flying machine having a propeller shaft, a casing on the extending end thereof, a sleeve on said casing fixed on the shaft, a collar keyed to slide on said sleeve, a spring encircling the sleeve to press said collar rearwardly against a stop, a centrifugal governor in said casing to move said sleeve against the action of said spring upon attaining an abnormally high speed, a pair of propeller blades journalled in said casing, a transverse shaft geared to the inner ends of said blades, and positive means actuated by the movement of said collar to transmit rotary motion to said transverse shaft.

3. A flying machine having diametrically opposed variable pitch propellers, worm wheels fixed to the inner ends of the propellers, positive worm and gear connections to modify the pitch of said blades while the machine is in motion, a single rotatable shaft to operate said connections, and means to rotate said shaft in either direction.

4. In an aerial machine, the combination with a frame having radial propeller blades rotatably journalled therein to rotate on longitudinal axes, of a single shaft disposed in an offset plane parallel to the blade axes,

worm and gear connections between the outer ends of said shaft and the inner ends of said blades to cause semi-rotation of said blades on their axes, and controllable means to actuate said shaft, said means being mechanically operated within said frame.

5. In a flying machine having a propeller shaft, a drive head having a conical point fixed thereon, propeller blades extending radially from said head, said blades being rotatable on their longitudinal axes, means wholly contained in said head for rotating said blades on their longitudinal axes to change the pitch thereof, said means comprising a sleeve slidable on the propeller shaft, a rack carried by said sleeve, a centrifugal governor to actuate said sleeve, a shaft having a pinion meshed with said rack, and positive geared connections between said shaft and the inner ends of said propeller blades to cause rotation of the same when the machine is in motion.

In testimony whereof I affix my signature.

BENJAMIN J. STEINMETZ.