W. L. HUBBARD.

MECHANISM FOR ADJUSTING PROPELLER PITCH.

APPLICATION FILED DEC. 4, 1918.

1,350,312.

Patented Aug. 24, 1920.

2 SHEETS—SHEET 1.

Fig. 1.

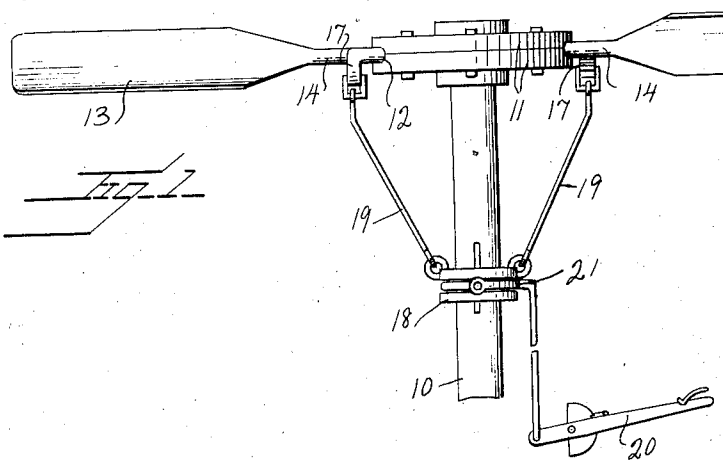


Fig. 2a.

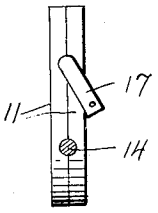


Fig. 2.

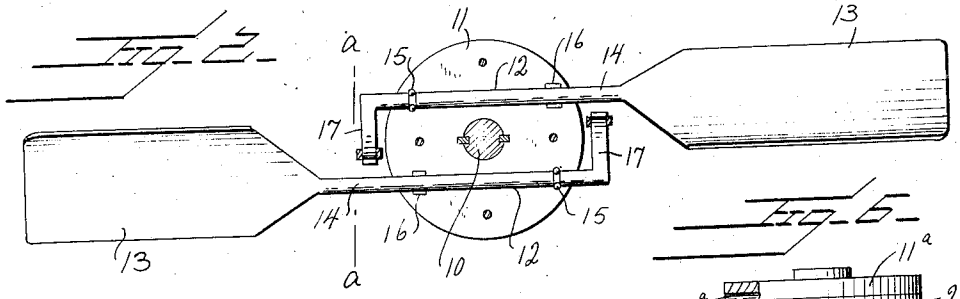


Fig. 6.

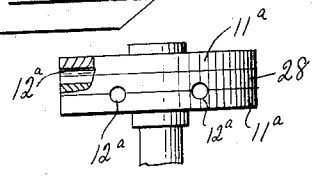


Fig. 3.

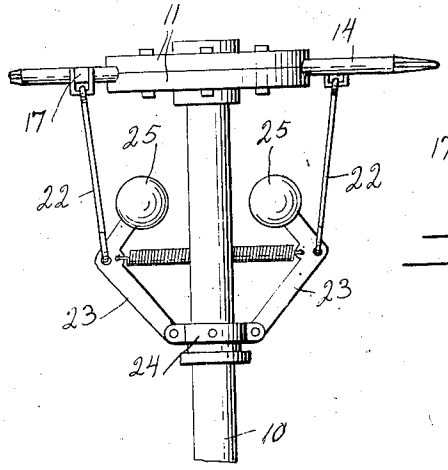


Fig. 4.

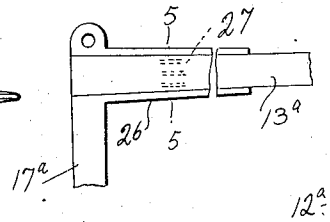


Fig. 7.

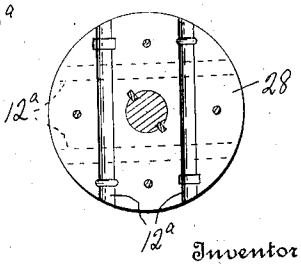
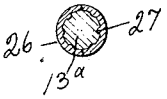


Fig. 5.



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2 SHEETS—SHEET 2.

Fig. 9.

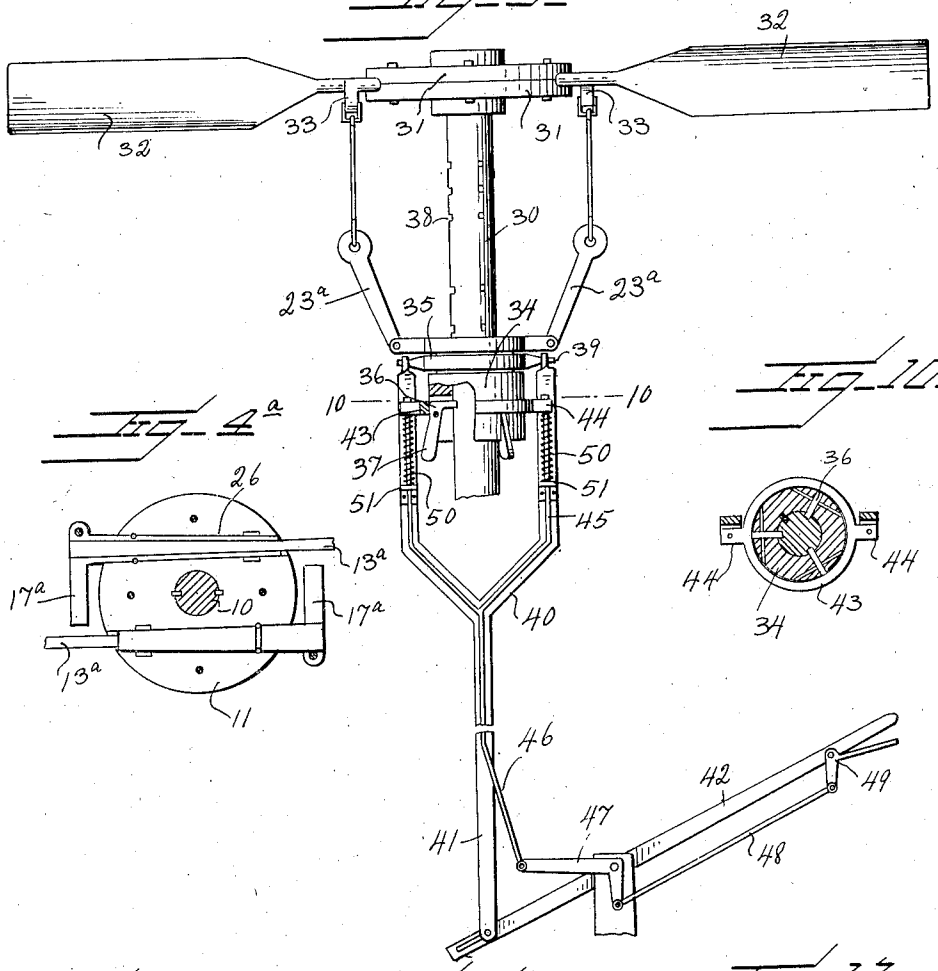


Fig. 4a.

Fig. 10.

Fig. 11.

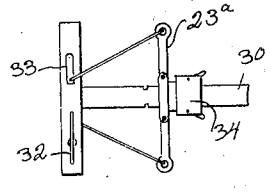


Fig. 12.

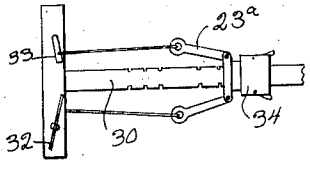


Fig. 13.

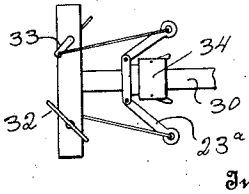
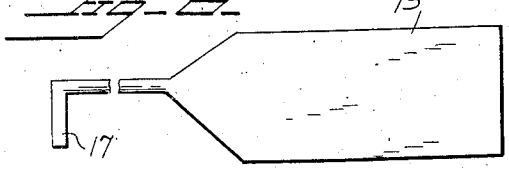


Fig. 8.



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UNITED STATES PATENT OFFICE.

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MECHANISM FOR ADJUSTING PROPELLER-PITCH.

1,350,312. Specification of Letters Patent. Patented Aug. 24, 1920.

Application filed December 4, 1918. Serial No. 265,230.

To all whom it may concern:

Be it known that I, WALTER L. HUBBARD, a citizen of the United States, residing at Ferris, in the county of Hancock and State of Illinois, have invented certain new and useful Improvements in Mechanism for Adjusting Propeller-Pitch, of which the following is a specification, reference being had to the accompanying drawings.

This invention relates to propellers, and particularly to propellers in which the pitch of the blades may be adjusted so as to increase or decrease the degree of the pitch.

One of the objects of the invention is the provision of a very simple construction to this end wherein the propeller blades are connected to the shaft of the propeller in such manner that the blades may rotate upon their own axes, provision being made whereby the blades may be so rotated either automatically under the control of the governor or by hand as the operator may desire to adjust the blades.

A further object is to provide a propeller of the character above stated wherein the blades are rotated automatically in accordance with the horse power of the motor and load to be carried so as to increase the pitch of the blade as the load is reduced or the power increased, and decrease the pitch of the blade if the power is decreased.

A further object is to provide mechanism for automatically adjusting the blades as to pitch in correspondence with the speed of rotation of the propeller shaft, and to provide manually actuatable means whereby the governor may be shifted into or out of a neutral position or to reverse position.

A further object is to provide a mounting for these axially rotatable blades which will be thoroughly strong and will secure a full bearing for the blades, the mounting being adapted to support any number of pairs of blades.

A further object is to provide means whereby wooden blades may be rotatably supported in said mounting.

Other objects will appear in the course of the following description.

My invention is illustrated in the accompanying drawings, wherein:—

Figure 1 is an elevation of a propeller constructed in accordance with my invention;

Fig. 2 is a sectional view of the propeller illustrated in Fig. 1 in a plane transverse to the shaft, one of the disks 11 being removed;

Fig. 2ª is a detail view of the blade shanks of the propeller disposed in the mounting illustrated in Fig. 1;

Fig. 3 is an elevation showing a governor controlled propeller;

Fig. 4 shows a preferably form of mounting for the blade shank of the propeller;

Fig. 4ª is a face view of one of the propeller carrying sections showing the wooden shanks of the propellers disposed in the mounting illustrated in Fig. 4;

Fig. 5 is a section on the line 5—5 of Fig. 4;

Fig. 6 is a line partly in section of a modified form of blade support;

Fig. 7 is a face view of the blade support shown in Fig. 6 with one of the sections 11ª removed, the shaft and attaching bolts being in section;

Fig. 8 is a face view of one of the propeller blades detached from its mountings;

Fig. 9 is an elevation partly broken away of a propeller provided with a governor and the mechanism for manually controlling the governor;

Fig. 10 is a section on the line 10—10 of Fig. 9; and

Figs. 11, 12 and 13 are diagrammatic views showing various positions of the hand controlled governor.

Referring to Figs. 1 to 7, 10 designates the propeller shaft of either an aeroplane, a motor boat or any other vehicle designed to be propelled by a screw, this propeller shaft carrying upon its extremity a plurality of disks illustrated in Fig. 1 as two in number, these disks being keyed, splined or otherwise connected to the shaft to rotate therewith and held from longitudinal movement upon the shaft. If the disks 11 are to support a pair of propeller blades, as illustrated in Fig. 1, then the confronting faces of the disks are formed with shaft passages 12 which extend tangentially to a circle of which the axis of the shaft is the center, the confronting faces of the disks being cut away to form each one-half of the shaft passage so that when the disks are brought into contact a complete pair of shaft passages will be formed.

The propellers 13 are provided with spindles 14 which are disposed through the shaft passages 12 and which are rotatably

mounted in these passages in any desired bearing and I have illustrated a ball bearing 15 and a roller bearing 16 for each one of the propeller spindles 14. Each spindle at its end opposite the blade 13 has an angularly directed arm 17.

Slidingly mounted upon the propeller shaft 10 is a sleeve or collar 18 which is rotatable with the shaft 10 and which is connected by any suitable links 19 to the arms 17, these links 19 being of course pivoted to the collar 18 and to the ends of the arms 17. It will now be obvious that by sliding the collar 18 along the shaft 10 in one direction or the other the propeller blades will be rotated an equal amount to change the pitch of these blades and that the blades may be readily brought therefore from a neutral position where both blades are paralled to the plane of their rotation, to a position where the blades are to a greater or less extent inclined to this plane and that the blades may be shifted to an inclination on either side of the neutral plane of the blades so that if the propeller is used for boats or the like, the propeller may be easily reversed to cause a reverse movement of the vehicle without reversing the motion of the drive shaft 10.

While the adjustment of the blades may be secured by means of a lever 20, connected to a shipper ring 21 mounted on the collar 18 and thus the adjustment of the blades controlled entirely by the hand of the operator, yet it is also possible with my invention to connect the blades to a governor so that the pitch of the blades will be regulated by the governor and thus the vehicle be driven at a maximum speed. To this end, as illustrated in Fig. 3, the arms 17 may be connected by links 22 to governor arms 23 pivoted upon a collar 24 which in this case is fast upon the shaft 10. This collar 24 is the equivalent of the collar 18. The governor arms carry the governor balls 25 and it is obvious now that with the arrangement illustrated in Fig. 3, that centrifugal action will throw the governor balls outward against the force of springs or like devices and that the outward movement of the arms 23 will cause a rotation of the blades 13 from a position where the pitch is not steep relative to the plane of rotation to a position where the blades have a greater pitch relative to the plane of rotation so as to thereby automatically control the speed of the machine and cause an increase in the R. P. M. of the shaft 10 to cause an increase in the speed. As soon as the speed of the engine decreases, the governor arms will be shifted inward by the springs in the usual and well known manner, and the pitch of the blades will be decreased correspondingly.

While I have heretofore illustrated the blades 13 and the blade spindles 14 as if they were made of one piece and of metal, it will be obvious that in aeroplanes the blades will be made of wood and that it will be necessary therefore to mount the shanks of these wooden blades within metallic spindles as illustrated in Figs. 4 and 4ª, wherein the metallic spindle is designated 26. This metallic spindle is preferably cast in two sections formed with ears or like means whereby they may be drawn together, the two sections being slightly corrugated as at 27 upon their inner faces, and slightly tapered from the end carrying the arm 17ª to the opposite end so that the shank 13ª of the blade 13 may be clamped securely in place against any chance of disengagement. Of course this metallic tubular member is mounted in anti-friction bearings upon the disk 11 in precisely the same manner as heretofore described.

Where the propeller is to be made with four blades it is constructed on the same principle as heretofore described except that an intermediate disk 28 is disposed between the disks 11ª, one face of the disk having grooves 12ª extending in one direction and the other face of the disk having grooves extending at right angles to the grooves 12ª. The disks 11ª are of course formed with grooves confronting the grooves in the opposite face of the disks 28. These grooves or passages 12ª, are, of course, provided with the anti-friction bearings heretofore referred to and the construction of the remainder of the propeller is the same as that heretofore described. A propeller with six blades or even eight blades can be formed by using the corresponding number of disks 28 and 11ª on the principle illustrated in Figs. 5, 6 and 7 and it will be observed that where more than two blades are used, the blades will be disposed in different planes so that one set of blades will not rotate through the "dead" air of another set of blades.

In Fig. 8 I illustrate a blade such as I prefer to use on this propeller wherein about 65% of the resistive surface of the blade is on the same side as the short radial arm 17 of the blade. In other words, these blades are nearly balanced, but not quite. As a consequence of this unbalanced condition of the blade it will tend to turn into a neutral position, that is, a position wherein the blade will be parallel with its plane of rotation. When such a blade as this is used, the springs illustrated in Fig. 3 need not be used but this tendency of the blades to return to a neutral position will take the place of the springs in returning the governor to its neutral position.

In Figs. 9 and 10, I illustrate a reversible governor control, that is, a propeller in which the blades are governor controlled as well as hand controlled and wherein the

blades are reversible. In these figures, 30 designates the propeller shaft and 31 the two disks within which the shanks of the propeller blades 32 are rotatably mounted in the manner heretofore described, each shank being provided with the radial arm 33 as heretofore described. Slidingly mounted upon the propeller shaft, is a sliding collar 34 having therein a groove for a shipper ring 35. The collar 34 is slotted at a plurality of points, as illustrated in Fig. 10 and pivotally mounted in these slots are the latches 36 having downwardly and outwardly extending terminal portions 37. The shaft 30 is provided with a plurality of notches or circumferential grooves 38 with which the latches 36 are adapted to engage. I have shown three of these latches though more may be used. The collar 34 is splined upon the shaft 30 so as to rotate therewith.

The shipper ring 35 has a pair of laterally projecting ears 39 and to these ears is connected a yoke 40 providing two arms which extend on either side of the propeller shaft and extend to these ears. The arms of the yoke 40 are connected to form a rod 41 which constitutes part of the yoke, which in turn is pivoted to an actuating lever 42. In order to engage and disengage the latches 37 from the notches 38 I mount upon the collar 34 the sliding ring 43 which has oppositely extending ears 44 through which pass rods 45 which are mounted in suitable guides in the yoke 40, these rods joining each other, then extending downward as a single rod, as at 46 and then being connected to a bell crank lever 47 mounted upon any suitable support, as for instance the pivotal support for the lever 42, this bell crank lever having a linked connection 48 to a hand grip 49 of the usual form.

Surrounding the rods 45 are the coiled compression springs 50, which bear at their lower ends against brackets 51 on the yoke 40 and at their upper ends bear against the ears 44. It will be seen that these springs 50 act to urge the ring 43 to a position where the ring closely surrounds the latches 36 and forces these latches inward, but that if the hand grip 49 be operated this ring 43 will be drawn longitudinally on the collar 34 and will engage the outer ends 37 of the latches, raising the latches out of engagement with the notches 38. Then the collar 34 may be shifted longitudinally on the shaft by means of the lever 42 or like mechanism.

The operation of the construction illustrated in Figs. 9 and 10 is as follows: Assuming that the collar 34 is so adjusted that the governor arms 23^a are at right angles to the driving shaft, as illustrated in Fig. 11, then the blades of the propeller will be turned parallel to the plane of their rotation and will offer the least possible resistance to rotary motion. A rapid rotation of the shaft, under these circumstances, will not of course cause the governor to change its position because the governor arms are already at right angles to the shaft and are in neutral position.

The resistance of the air to a plane at starting is many times greater than when it is in full flight. If, now, the engine is started with the governor arms at neutral position, that is, as shown at Fig. 11, then when it is desired to start the machine the collar 34 is pulled back toward the operator to the position shown in Fig. 12. This movement will shift the propeller blades to the position shown in Fig. 12 and engage the propeller blades with the resistance of the air. As the resistance of the air to the movement of the blade will be greater at starting than at any other time, the unbalanced blades will naturally assume the position shown in Fig. 12 and will cause the blades to hold the governor arm close to the shaft, but as the plane gains speed the resistance of the air to the plane grows less, that is, the load on the engine is less, more power is therefore transmitted to the propeller shaft, the speed of the propeller shaft is increased and the governor automatically draws the propeller blades to a steeper angle so that they may still engage with the air through which they are traveling so rapidly. In other words, when the load on the engine is relatively great, that is, in starting the plane, the speed of the propeller shaft is naturally less and at this time the blades will be given but a relatively slight inclination relative to their plane of rotation, but as the speed of the propeller shaft increases, in other words, as the plane gains headway, the governor arms will be thrown outward which will automatically shift the blades to a position where their pitch is greater and where, therefore, they can secure the maximum pull or push on the air.

If the collar 34 be placed in neutral position when the machine is in full flight, the propeller blades will automatically swing to a position where they will offer the least resistance to the air and the governor arms will exert but little force, if any, on the blades because the centrifugal force causes the governor arms to take a position at right angles to the shaft. There is a stop carried by the ears on which the governor arms are mounted limiting this movement of the governor arms so that they cannot move outward beyond a plane at right angles to the plane of rotation, while in this position the engine should be kept running slowly. Again, if it was desired to slow down quickly to make observation or to make a landing, the blades may be thrown to a reverse position by pushing the collar 34 forward as illustrated in Fig. 13, which will slow up the movement of the plane while the engine is working.

With this construction it is obvious that

the blades may be manually controlled and automatically controlled. It will be seen that with the construction described, the blades may be very readily adjusted to increase or decrease their pitch and that by doing this the full horse power of the motor may be used without causing the motor to race.

While I have illustrated a construction which I believe to be particularly effective and which is very simple, yet it will be obvious that many minor changes may be made in the construction of the parts without departing from the spirit of the invention as defined in the appended claims.

I claim:—

1. A propeller having a propeller shaft, confronting disks mounted upon the shaft and mutually grooved to provide spindle passages extending tangentially to a circle concentric to the axis of the shaft, propellers having spindles rotatably mounted in said passages and extending entirely across the disks and beyond the disks on each side, means for rotating said spindles, the extremities of the spindles opposite the blades being formed with angularly extending arms, means connected to said arms whereby the spindles may be rotated to thereby control the pitch of the blades, and means detachably engaging the disks with each other.

2. A propeller including a shaft, confronting disks mounted on the shaft and rotatable therewith, the confronting faces of the disks being tangentially grooved to provide spindle passages extending entirely across the faces of said disks, blades having shanks, and metallic sleeves disposed in said passages and rotatably mounted therein and engaged with the shanks of the blades, each of said sleeves carrying at its end remote from the blade and beyond the edges of the disks an angularly projecting arm, and controllable means operatively engaged with said arms whereby the sleeves and attached blades may be rotated around their axes.

3. A propeller comprising a power operated propeller shaft, blades rotatably mounted thereon and independently rotatable around their own axes, a member slidably mounted upon the shaft, governor arms pivotally mounted on said member, said governor arms being operatively connected to the propeller blades to cause the axial rotation of said propeller blades when the governor arms are moved under the action of centrifugal force, and manually adjustable means for shifting said governor arm supporting member longitudinally on the shaft to thereby lessen or increase the distance between the governor arm supporting member and the blades.

4. The combination with a power operated shaft, of a movable governor controlled member, a governor support slidably mounted on the shaft, centrifugally actuated governor arms pivoted to said support, operative connections between the governor arms and said movable member, and manually controlled means for shifting the support toward or from said first named member to thereby control the position of the governor arms without affecting said movable member.

5. The combination with a power operated shaft, and radial propeller blades mounted on the shaft for rotation therewith and for independent rotation around their own axes, the axis of rotation of each blade being disposed at one side of its center, of a manually shiftable supporting member slidably mounted on the shaft, centrifugally actuated governor arms pivoted upon said supporting member and operatively connected to said blades to cause the rotation of the blades on their own axes upon an inward or outward movement of the governor arms under the action of centrifugal force, and manually operable means for shifting said member.

6. The combination with a power operated propeller shaft and a propeller mounted thereon having radial blades rotating with the propeller and each blade being independently rotatable around its own axis and each blade having a radially projecting arm, a longitudinally shiftable, manually controlled member mounted upon the shaft, governor arms pivoted to said member, and links connecting the free ends of the governor arms with the arms on the propeller blade, the longitudinal movement of the supporting member acting to shift the governor arms into or out of neutral position without affecting the propeller blades.

7. A propeller comprising a power operated propeller shaft, radial blades rotatably mounted on the shaft and rotatable therewith, the axis of each blade being disposed to one side of its center, a longitudinally shiftable collar mounted for rotation upon the propeller shaft and having centrifugally actuated governor arms operatively connected to the blades to cause the rotation of said blades as the governor arms are shifted outward under centrifugal action, and manually operable means for shifting said collar along the propeller shaft and holding it in its shifted position.

8. A propeller comprising a power operated propeller shaft, radial blades rotatably mounted upon the shaft and rotatable therewith, a collar slidably mounted upon the shaft and rotatable therewith, a plurality of governor arms pivoted to the collar and weighted at their extremities, links operatively connecting the governor arms to the propeller blades whereby to shift the pro-

peller blades as the arms are shifted outward under the action of centrifugal force, and manually controlled means for longitudinally shifting said collar and locking it into shifted position.

9. A propeller comprising a power operated propeller shaft, radially disposed propeller blades mounted on the propeller shaft for rotation therewith, the propeller blades being individually rotatable around their own axes and having radially extending arms, a collar slidingly mounted on the propeller shaft, centrifugally actuated governor arms pivoted to the collar, links connecting the free ends of the governor arms to the arms of the propeller blades, a shipper ring loosely engaging the collar, a manually actuatable yoke connected to said shipper ring to shift it, latches mounted upon the collar, the propeller shaft having notches in which said latches are adapted to engage, a ring mounted upon the collar and shiftable therealong, said ring in one position holding the latches shifted inward and in the other position holding the latches shifted outward, and manually actuatable means for shifting said ring and the latches and mounted in connection with the means for shifting the collar.

10. A propeller comprising a power operated propeller shaft, radially extending blades mounted on the shaft for rotation therewith, the blades having shanks rotatably supported upon the shaft, said shanks being disposed to one side of the middle axis of the blades whereby the blades are unbalanced, each of said shanks having a radially extending arm, a collar mounted upon the shaft for sliding movement thereon but for rotation with the shaft, governor arms pivoted upon the collar for outward swinging movement under centrifugal action, links operatively connecting the governor arms to said arms on the shank whereby to rotate the blades and increase the pitch of the blades as the governor arms are thrown outward the unbalanced blades tending as they are rotated against the pressure of air to draw said governor arms inward into parallel relation to the propeller shaft, and manually operable means for shifting the collar along the shaft and to lock the collar in any shifted position.

In testimony whereof I hereunto affix my signature in the presence of two witnesses.

WALTER L. HUBBARD.

Witnesses:
F. N. CASBURN,
W. E. THOMPSON.