A. MARTEL, JR.

AEROPLANE PROPELLER.

APPLICATION FILED MAY 31, 1921.

1,419,877.

Patented June 13, 1922.

2 SHEETS—SHEET 1.

Fig. 1.

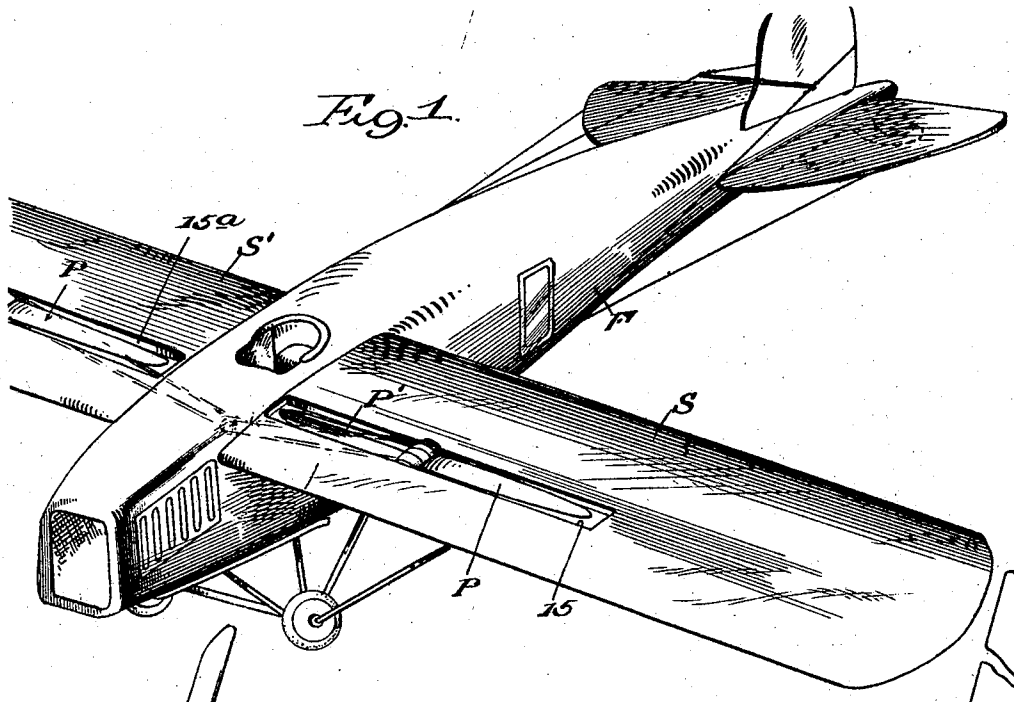


Fig. 4.

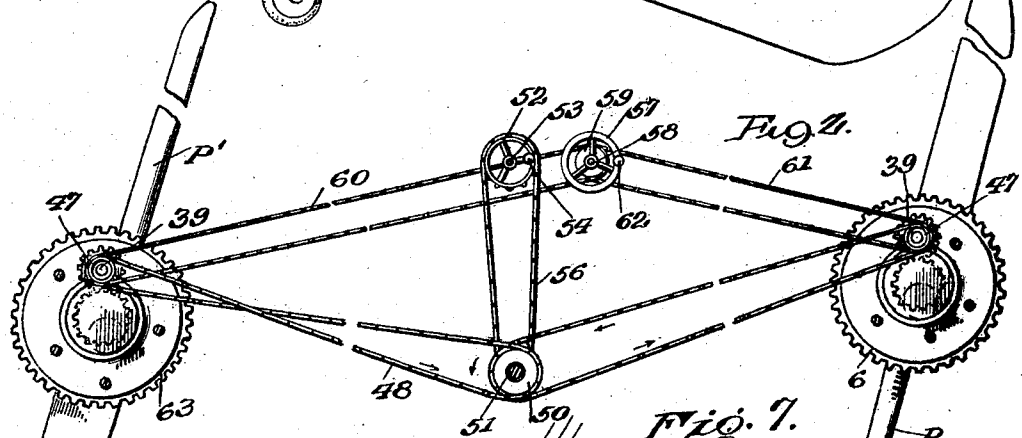


Fig. 3.

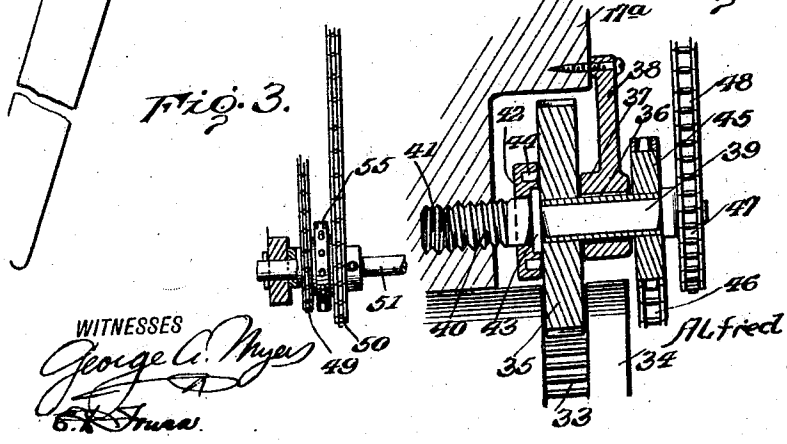


Fig. 7.

WITNESSES

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2 SHEETS—SHEET 2.

Fig. 4.

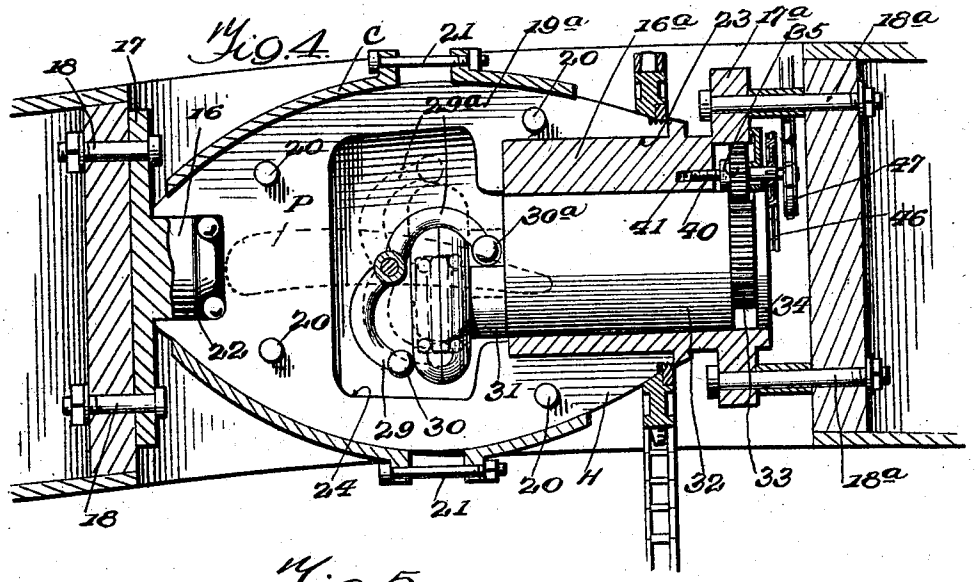


Fig. 5.

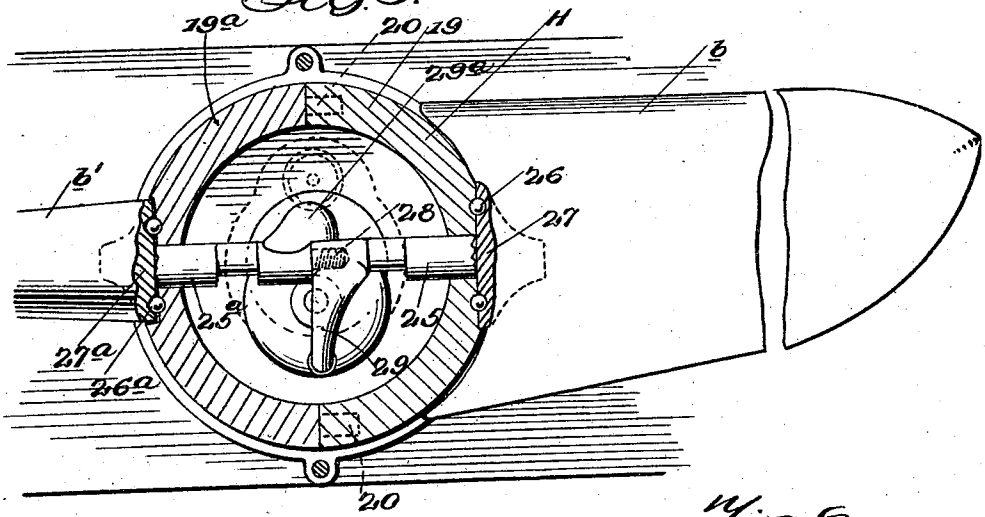
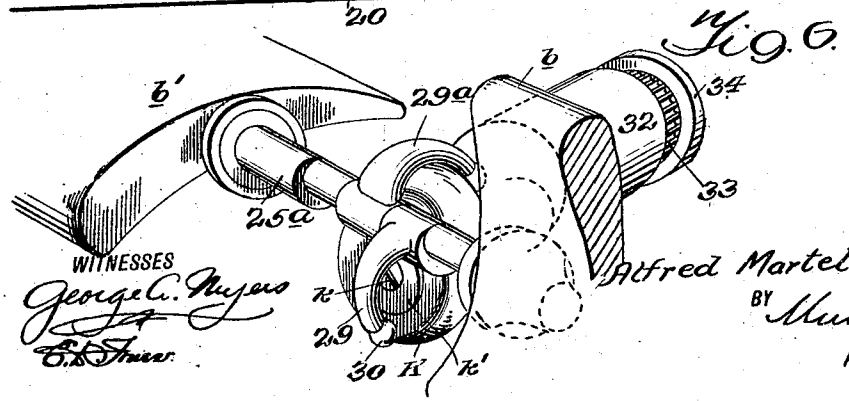


Fig. 6.



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AEROPLANE PROPELLER.

1,419,877. Specification of Letters Patent. Patented June 13, 1922.

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To all whom it may concern:

Be it known that I, ALFRED MARTEL, Jr., a citizen of the United States, and a resident of Mountain View, in the county of Santa Clara and State of California, have invented certain new and useful Improvements in Aeroplane Propellers, of which the following is a specification.

My invention relates to aeroplane propellers, and the purpose of my invention is the provision of a propeller having mechanism which is operable to effect the successive feathering of the propeller blades to simultaneously secure a lifting and propelling action, and which is manually controllable to increase or decrease both the lifting and propelling actions to discontinue the feathering action so that only a propelling force is obtained, and to vary the pitch of the blades to increase or decrease the propelling action.

I will describe one form of propeller embodying my invention and one form of aeroplane to which the propeller is applied, and will then point out the novel features thereof in claims.

In the accompanying drawings:

Figure 1 is a view showing in perspective an aeroplane having applied thereto one form of propeller embodying my invention.

Figure 2 is an enlarged detail view showing in rear elevation the two propellers shown in Figure 1 and one form of manually operable means for adjusting the propellers also embodying my invention.

Figure 3 is a fragmentary view showing in side elevation and partly in section a portion of the means shown in Figure 2.

Figure 4 is an enlarged longitudinal sectional view of the hub and adjacent mechanism of either of the propellers shown in Figure 2.

Figure 5 is a transverse sectional view taken centrally through the hub shown in Figure 4.

Figure 6 is a fragmentary perspective view of a portion of the feathering means shown in Figures 4 and 5.

Figure 7 is an enlarged vertical sectional view of a portion of the mechanism shown in Figure 4.

Similar reference characters refer to similar parts in each of the several views.

Referring specifically to the drawings and particularly to Figure 1, I have in the present instance shown a monoplane to which is applied the propellers embodying my invention, and with the understanding that an aeroplane of this type is shown to simplify the drawings and to illustrate only one application of the propeller. The fuselage of the monoplane is indicated at F, and extending from the opposite sides thereof adjacent its forward end are the two sections S and S′ of the main supporting plane. Each section S or S′ is formed at a point adjacent the fuselage with a longitudinally extending slot 15 or 15ª in which is arranged for rotation in a plane perpendicular to the plane of the main plane, a propeller P or P′. The mounting and adjusting means for the blades of both propellers is the same so that a description of one will suffice for both.

Referring now to Figures 4 and 5, I have here shown a hub designated at H which is mounted for rotation within the slot 15 by means of bearings 16 and 16ª having flanges 17 and 17ª secured to the side walls of the slot by means of bolts 18 and 18ª. The hub H is made up of two companion sections 19 and 19ª which are secured at their edges by means of pins 20 and held in hub formation by means of a sectional casing C, the two sections of which are secured to each other by means of bolts 21. As shown in Figure 4, the hub H is of substantially ovate formation with the casing of a corresponding contour so as to snugly embrace the two sections of the same and thus lock them against displacement. The two sections of the hub are formed at their confronting faces with cooperating depressions to provide a pocket 22 for the reception of the bearing 16, and other recesses to form a pocket 23 for the reception of the cylindrical bearing 16ª. The pocket 23 communicates with a pocket 24 formed by recessing the confronting sides of the hub sections, and extending into this pocket are shafts 25 and 25ª which are journaled in the sections of the hub in the manner clearly shown in Figure 5, and which are rigidly connected to the blades *b* and *b′* of the propeller P or P′. Ball bearings 26 and 26ª are provided between the hub and flanged heads 27 and 27ª formed on the outer ends of the shafts 25 and 25ª, respectively, with the heads extending into the blades in the manner shown. These shafts 25 and 25ª are disposed in longitudinal alinement with each other and are connected at their confronting ends by an extension 28 formed on one of the shafts and which threadedly engages the

walls of a socket formed in the other shaft, this connection permitting of the limited independent movement of one shaft with respect to the other for a purpose which will be hereinafter described.

Each shaft 25 or 25ª carries at its confronting end an arm 29 or 29ª which as shown in Figures 4 and 6 is curved in the form of an arc and preferably tapered in cross section toward its free end, with the latter terminating in a circular head 30 or 30ª. These arms when rocked are adapted to effect an adjustment of the blades *b* and *b'* through the medium of the shafts 25 and 25ª, and to this end I provide a cam K rotatably supported on the free end of a stub-shaft 31 through the medium of ball bearings as shown in dotted lines in Figure 4, with the stub-shaft sustained eccentrically upon one end of a main shaft 32 journaled in the bearing 16ª. As shown in Figure 6, the cam K is made of two sections secured together upon the extension by a screw *k* and a disc *k'*. The main shaft is provided at its outer end with a gear 33 formed in a recessed portion of the shaft so as to provide at the extreme outer end an annular flange 34. The gear 33 constantly meshes with a pinion 35 fixed to a tubular shaft 36 journaled in a bearing 37 formed in a plate 38 secured to the flange 17ª of the bearing 17. Journaled in the shaft 36 is a solid shaft 39 which projects beyond the shaft 36 at one end where it is formed with an extension 40 having screw-threaded engagement with the walls of a recess 41 formed in the bearing 16ª. To lock the pinion 35 against longitudinal movement on the tubular shaft 36, it is interposed between the bearing 37 and a ring 42 which loosely embraces the shaft 39 and abuts an annular flange 43 formed on the shaft. The pinion 35 is formed with pins 44 adapted to engage in recesses formed in the ring 42 so that the ring rotates with the pinion.

Rotation of the pinion 35 is effected through the medium of a sprocket wheel 45 fixed to the outer end of the shaft 36 and about which is trained a chain 46. Rotation of the pinion 35 obviously effects rotation of the shaft 32 through the medium of the gear 33, and with rotation of the main shaft, bodily rotation of the cam K is secured. The cam K can also be shifted laterally in either direction by the longitudinal shifting of the shaft 32. This is effected by rotation of the shaft 39 in one direction or the other. When the shaft 39 is rotated in one direction, the threaded extension effects a longitudinal movement of the shaft as will be understood, and with the pinion engaging the gear 33 between the main body of the shaft 32 and the flange 34, it will be clear that the pinion will engage the main shaft to cause a longitudinal movement thereof in one direction. Conversely, when the shaft 39 is rotated in the opposite direction the pinion 35 is moved laterally to effect a movement of the main shaft in the opposite direction. The shaft 39 is rotated in either direction by means of a sprocket wheel 47 about which is trained a chain 48.

Referring now to Figure 2 I have here shown manually operable means for effecting rotation of the shafts 36 and 39 of both of the propellers P and P' in one direction or the other to cause circumferential and lateral adjustments of both of the cams K. The means for rotating the shaft 39 comprises sprocket wheels 47, one for each of the shafts 39, and chains 48 one for each of the sprockets 47. The chains 48 in addition to being trained about the sprockets 47 are also trained about sprockets 49 and 50 fixed to a shaft 51 as clearly shown in Figure 3. As shown in Figure 2 one of the chains 48 is crossed so that the rotation of the corresponding sprocket wheel is in the direction opposite to the direction of rotation of the other sprocket wheel, all as clearly indicated by the arrows. The shaft 51 is adapted to be rotated in one direction or the other by a sprocket wheel 52 mounted on a shaft 53 and provided with a handle 54 for manually operating the same. A sprocket 55 is fixed to the shaft 51 between the wheels 49 and 50, and this sprocket is operatively connected with the sprocket 52 by a chain 56. The sprocket 52 is disposed above the shaft 51 so as to be in convenient position for manipulation by the operator of the aeroplane.

Operation of the tubular shafts 36 is obtained by means of a wheel 57 fixed to a shaft 58, and fixed to this same shaft are sprocket wheels 59 one of which is operatively connected to one of the sprocket wheels 45 by a chain 60, while the other is operatively connected to the other sprocket wheel 45 by a chain 61. This arrangement causes the rotation of the two shafts 36 in the same direction when the wheel 57 is rotated by means of a handle 62.

In the operation of the propellers P and P', when within the sections of the main plane as shown in Figure 1, the hubs thereof are driven by large sprocket wheels 63 operatively connected to the motor through suitable mechanism (not shown) and in such manner that the two propellers rotate in opposite directions. During rotation of either propeller, the arms 29 and 29ª rotate about the hub axis as a center at the same time maintaining engagement with the cam K. With the cam in the position shown in Figures 4 to 6, which is one of its extreme positions, the arms are caused to oscillate during rotation thereby effecting a feathering of the blades *b* and *b'*. Because of the contour and eccentric mounting of the cam with respect to the axis of the shaft 32, it is capable of occupying two extreme

positions and numerous intermediate positions between the two extreme positions. These adjustments are obtained by rotation of the main shaft 32 as has been described. The cam is shown in one extreme position in solid lines and in the other extreme position in dash lines, both in Figures 4 and 5. In one extreme position of the cam its axis is disposed the greatest possible distance from the axis of the hub H, while in the other extreme position its axis is coincident with the axis of the hub.

By observing the position of the arms 29 and 29^a in Figure 4, it will be clear that with the cam in one extreme position the arms will, during one complete revolution of the propeller, oscillate through an arc of substantially 90°, with one arm moving in an opposite direction to the movement of the other arm. By this operation, the blades b and b' are caused to oscillate through the same arc and in the same direction, thereby effecting the feathering action. This position is therefore termed the feathering position of the cam. When moving the cam from this feathering position toward the other extreme position, the arcs described by the arms are naturally reduced, resulting in a decreased feathering action of the blades until finally, when the cam reaches the extreme position, the feathering action is completely discontinued. This other extreme position is therefore termed the non-feathering position. In the non-feathering position of the cam, the blades of the propeller are at intersecting angles of substantially 45°, which is the normal position of propeller blades.

In addition to securing the feathering action of the blades, they are also capable of being varied in pitch so as to vary the angle of attack. This is accomplished by effecting a lateral shifting of the cam K through a longitudinal shifting of the main shaft 32 in the manner previously described. By a consideration of Figures 4 and 6 and assuming that the cam K is in neutral position, it will be clear that when the cam is moved to the right the arms will be actuated to increase the pitch of the blades b and b', while when moved to the left the arms will be moved to decrease the pitch of the blades. It is to be understood that the variance in pitch of the blades of the propeller only occurs when the cam K is in neutral position, or in other words, when the axis of the cam coincides with the axis of the hub, and there is no feathering action of the blades.

In practice, the two cams of the propellers P and P′ normally occupy the feathering position in which the feathering action of the blades is at a maximum. This condition exists when the aeroplane is making a take-off or landing, and it is desired to secure a maximum lifting action and a minimum propelling action. After the machine rises from the ground and the desired altitude is obtained, the cams are gradually moved to a non-feathering position thereby gradually reducing the feathering action of the blades and consequently reducing the lifting action of the propellers. With the reduction of the lifting action, it will be clear that there is a corresponding increase of the propelling action so that when the cams are in non-feathering position the propelling action is at a maximum. If it is desired to increase or decrease the propelling action this can be obtained by a lateral adjustment of the cam as has been described.

From the foregoing operation taken in conjunction with the accompanying drawings, it will be manifest that I have provided simple and efficient mechanism by means of which the blades of a propeller can be feathered to any degree or varied in pitch within the will of the operator during flight so as to completely control both vertical and horizontal movements of the aeroplane. It is to be particularly noted that because of the connection between the shafts 25 and 25^a they are locked to each other for rotation in one direction so that during the feathering action of the blades each blade assists the other.

Although I have herein shown and described only one form of aeroplane propeller embodying my invention, it is to be understood that various changes and modifications may be made herein without departing from the spirit of the invention and the spirit and scope of the appended claims.

What I claim is:

1. A propeller comprising a hub mounted for rotation, shafts journaled in the hub and extending diametrically of the same, blades carried by said shafts, arms fixed to said shafts, means engageable with the arms for effecting oscillatory movement thereof when the hub is rotated to cause a feathering of the blades, said means being adjustable to increase or decrease the oscillatory movement of the arms to vary the feathering action of the blades, and manually operable means for actuating the same.

2. A propeller comprising a hub mounted for rotation, shafts journaled in the hub and extending diametrically of the same, blades carried by said shafts, arms fixed to said shafts, means engageable with the arms for effecting oscillatory movement thereof when the hub is rotated to cause a feathering of the blades, said means being adjustable to increase the feathering action of the blades and to decrease such action to a point wherein there is no feathering action of the blades, and means for actuating said first means to vary the pitch of the blades.

3. A propeller comprising a hub mounted for rotation, shafts journaled in the hub,

blades carried by said shafts, arms fixed to said shafts within the hub, a member engageable with the arms and movable to occupy two extreme positions whereby when said hub is rotated the member operates the arms to effect a feathering of the blades when in one extreme position and to discontinue the feathering operation when in the other extreme position, and means for actuating said member to any of its positions.

4. A propeller comprising a hub mounted for rotation, shafts journaled in the hub, blades carried by said shafts, arms fixed to said shafts within the hub, a member engageable with the arms and movable to occupy two extreme positions whereby when said hub is rotated the member operates the arm to effect a feathering of the blades when in one extreme position and to discontinue the feathering operation when in the other extreme position, said member being also capable of adjustments whereby the arms are caused to occupy various positions to increase or decrease the normal pitch of the blades, and means for actuating said member.

5. A propeller comprising a hub mounted for rotation, shafts journaled in the hub, blades fixed to said shafts, arms fixed to said shafts within the hub, and means supported upon the hub and engaging said arms to effect an oscillatory movement thereof when the hub is rotated.

6. A propeller comprising a hub mounted for rotation, shafts journaled in the hub and extending diametrically of the same, blades fixed to said shafts, arms fixed to said shafts, a main shaft mounted in the hub and having its axis disalined with the axis of the hub, a cam mounted eccentrically on the main shaft and interposed between said arms, said main shaft being rotatable to effect a circumferential adjustment of said cam and movable longitudinally to effect a lateral adjustment of said cam for the purposes described, and manually operable means for actuating said shaft.

7. A propeller comprising a hub mounted for rotation, shafts journaled in and arranged diametrically of the hub, blades fixed to said shafts, curved arms fixed to said shafts, a main shaft mounted in the hub with its axis disalined with the axis of the hub, a cam sustained on the main shaft and eccentrically of the hub axis, said cam having a rounded periphery and engageable with said arms to control the positions thereof, means for rotating the main shaft to effect a circumferential adjustment of the cam, and means for shifting said main shaft longitudinally to effect a lateral adjustment of said cam.

8. A propeller comprising a hub mounted for rotation, shafts journaled in and arranged diametrically of the hub, blades fixed to said shafts, curved arms fixed to said shafts, a main shaft mounted in the hub with its axis disalined with the axis of the hub, a cam sustained eccentrically on the main shaft, said cam having a rounded periphery and engageable with said arms to control the positions thereof, means for rotating the main shaft to effect a circumferential adjustment of the cam, comprising a gear of a diameter less than the diameter of the shaft fixed to one end of the shaft, a flange secured to said gear, a pinion meshing with said gear, means for rotating said pinion, and means for laterally shifting said pinion in one direction or the other whereby it is caused to engage the end of said shaft or said flange to effect longitudinal movement of the main shaft in one direction or the other whereby the lateral adjustment of said cam is effected.

9. A propeller comprising a sectional hub mounted for rotation, shafts journaled in the hub and arranged diametrically of the same, blades fixed to said shafts, arcuately curved arms fixed to said shafts, a main shaft journaled in the hub and having its axis disalined with the axis of the hub, an extension eccentrically positioned on one end of the main shaft, a cam rotatably mounted on said extension, said cam having its periphery rounded to conform to the curvature of said arms and engageable with said arms for positioning the latter, means for rotating the main shaft whereby an adjustment of the cam is effected in the plane of the cam, and means for shifting the main shaft longitudinally to effect a lateral adjustment of said cam.

10. A propeller comprising a hub formed of sections recessed at their confronting sides to provide bearing receiving pockets, and a pocket medially of the ends of the hub which communicates with one of the bearing pockets, a pair of shafts journaled diametrically in the hub and extending into the medial pocket, blades fixed to said shafts, arms fixed to said shafts within said pocket, a bearing in one of the pockets, a main shaft journaled in said bearing and having the axis thereof disalined with the axis of said hub, an extension eccentrically sustained on the main shaft, a cam carried by said extension and interposed between said arms, means for rotating the main shaft, and means for shifting the main shaft longitudinally in either direction.

11. A propeller comprising a hub mounted for rotation, shafts extending diametrically of the hub and arranged in alinement with each other, means for connecting the confronting ends of said shafts to permit dependent or independent rotation of the shafts, blades fixed to said shafts, arms fixed

to said shafts, a cam mounted for bodily movement in a circle, the axis of which is eccentric with respect to the axis of the hub, said cam also being capable of lateral adjustment in either direction, all for the purpose described.

12. A propeller comprising a hub mounted for rotation, shafts journalled in the hub, blades fixed to said shafts, arms fixed to said shafts within the hub, and means supported upon the hub and engaging said arms to effect an oscillatory movement thereof when the hub is rotated, said means being movable relatively to the arms to vary the extent of oscillatory movement of the latter.

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