

Sept. 18, 1945.

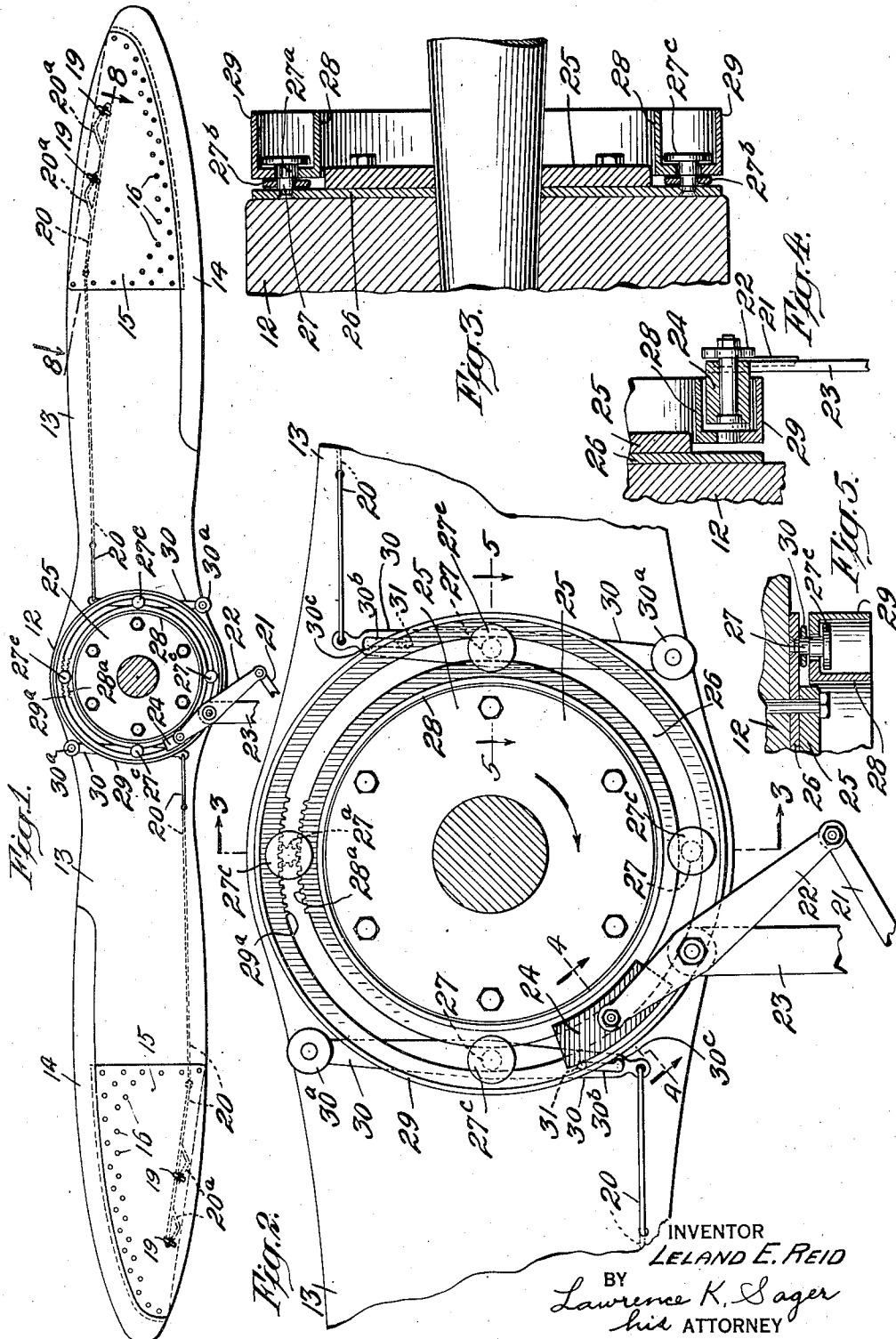
L. E. REID

2,385,028

PROPELLER

Filed Feb. 7, 1942

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Fig. 6.

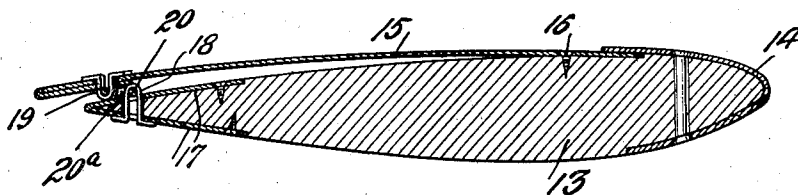


Fig. 7.

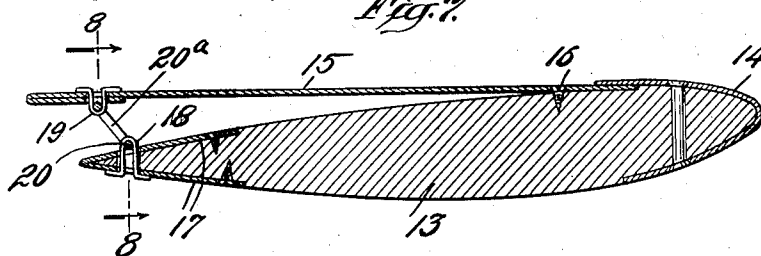


Fig. 8.

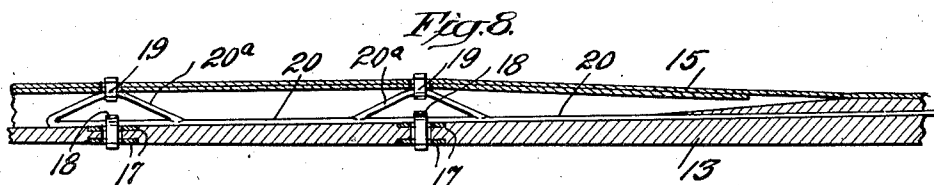


Fig. 9.

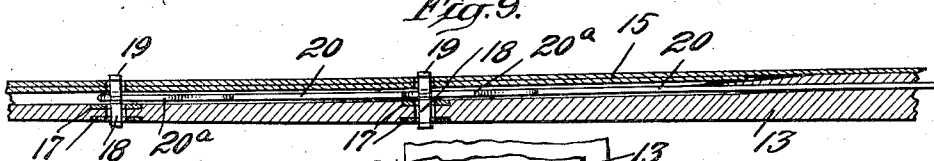


Fig. 10.

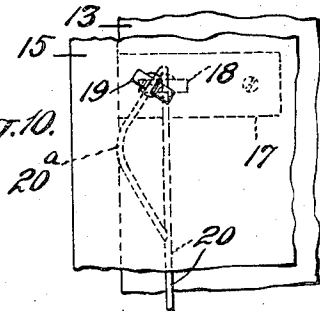
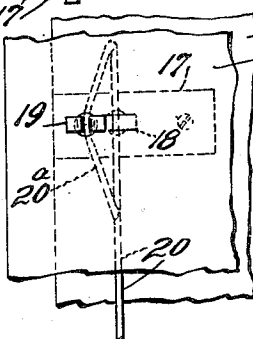


Fig. 11.



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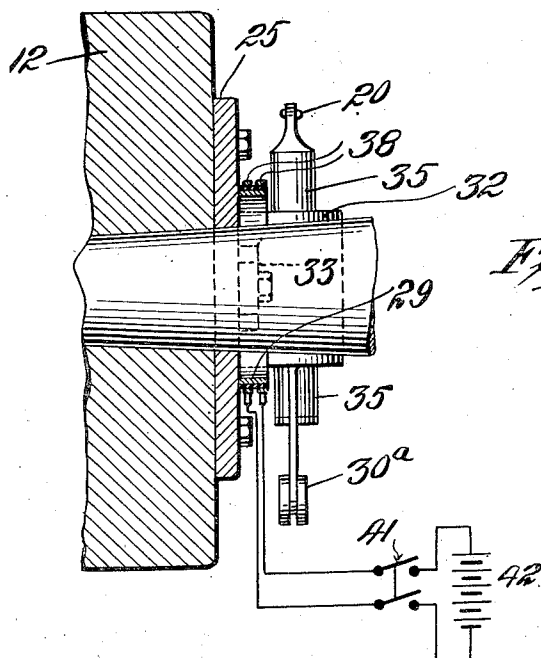
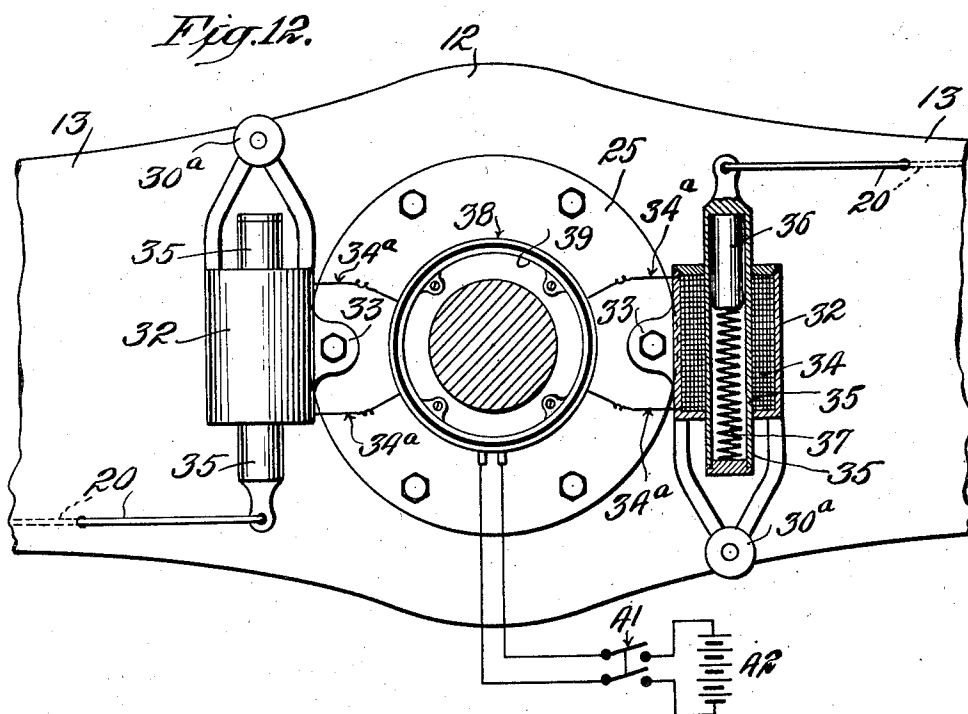
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2,385,028

PROPELLER

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Application February 7, 1942, Serial No. 429,845

9 Claims. (Cl. 170—161)

This invention relates to improvements in propellers particularly adapted for use on aeroplanes. The invention relates to means for varying the pitch of the propeller blades and to the provision of cushioning means for overcoming the undesirable effects of shocks and vibration under variations in pressure as when the air is choppy or variable or under changes in direction of the plane in its various manipulations.

This invention is an improvement over the disclosures of my prior patent granted August 16, 1938 No. 2,126,813 and my Patent No. 2,292,089 granted August 4, 1942.

The main object of this invention is to provide a simple form of structure for obtaining variable pitch and cushioning of the propeller and which may be applied to standard forms of propellers in a simple manner. Another object is to provide a form of structure which may be readily and conveniently applied to propellers at comparatively low additional expense and which will provide a steady and durable form of structure. Another object is to increase the efficiency of the propeller and by its variable control of the pitch permit adaptation of the pitch to that most desirable under the variable conditions of operation. Another object is to provide means whereby the pitch may be changed conveniently and effectively from any convenient location, such as the cockpit of the plane. Another object is to provide means for adjusting the pitch of the blade by a push-pull operating rod for securing a simpler form of control and one which may be more easily operated than a rotatable rod. Another object is to provide controlling means for varying the pitch which will offer a minimum resistance to air flow over the propeller blades. Other objects and advantages will be understood from the following description and accompanying drawings which illustrate one embodiment of the invention.

Fig. 1 is a front view of the pressure face of the propeller; Fig. 2 is an enlarged view of the propeller hub and controlling parts for changing the pitch; Fig. 3 is a section on the line 3—3 of Fig. 2; Fig. 4 is a section on the line 4—4 of Fig. 2; Fig. 5 is a section on the line 5—5 of Fig. 2; Fig. 6 is an enlarged section across a portion of one of the blades showing the sheathing in the position for obtaining a low pitch of the blade; Fig. 7 is a similar section showing the sheathing in the position for obtaining a high pitch of the blade; Fig. 8 is an enlarged section along line 8—8 of Fig. 1 showing the sheathing in the position for obtaining a high pitch of the blade; Fig. 9 is a view similar to Fig. 8 showing the sheathing in the po-

sition for obtaining a low pitch of the blade; Fig. 10 is an enlarged face view of a portion of the blade showing the cam action by the controlling push rod and with the sheathing in the position of low pitch; Fig. 11 is a view similar to Fig. 10 with the sheathing in the position of high pitch; Fig. 12 is a side view of the propeller hub partly in section and partly diagrammatic showing a modified form for controlling the push-pull rods; and Fig. 13 is a vertical section thereof.

Referring to Fig. 1 the propeller is shown having the hub 12 provided with two oppositely extending solid blades 13. The usual metal sheathing or tipping 14 is shown provided on the leading edge of each of the blades. Mounted on the pressure face of each blade and at the outer portion thereof is a thin sheathing 15. This is preferably of metal and flexible. It preferably extends from the tipping 14 to and somewhat beyond the trailing edge of the blade and is fastened to the blade by screws or rivets 16 along the edge adjoining the tipping 14 and along the inner edge of the sheathing 15 and to its outer portion; but the region where it overlaps the trailing edge of the blade is not fastened to the blade and is free to be flexed towards and from the blade for cushioning purposes and it is also raised or lowered from the blade by controlling means for varying the pitch. The sheathing 15 may extend under the edge of the tipping 14, as shown in Figs. 6 and 7, or may be otherwise related thereto. At the trailing edge the sheathing is folded over inwardly on itself, as shown in Figs. 6 and 7 for stiffening that portion of the sheathing.

On the trailing edge of the blade and spaced from each other, as shown in Figs. 6 to 11, are located metal strips 17 which are bent over the trailing edge and secured in place by screws or otherwise. These strips reinforce the edge of the blade at their spaced locations for supporting eyelets 18 on the pressure face near the trailing edge. The eyelets are shown as formed of metal strips which have portions extending from the loop of the eyelet through the blade and bent over the opposite face of the blade, although any other suitable form of support having an opening may be used. Similarly the sheathing is provided with eyelets 19 spaced from each other near the edge of the sheathing and at positions corresponding to the locations of the eyelets 18. However, the eyelets 19 are positioned to one side of the eyelets 18 respectively and in the drawings the eyelets 19 are shown displaced from the eyelets 18 outwardly towards the trailing edge.

The push-pull rod 20, as well shown in Fig. 8,

extends along the blade near the trailing edge so as to pass through the eyelets 18 and is provided with looped portions 20a which pass through the eyelets 19. The sides of the loops 20a diverge from each other from the eyelets 19 to engage the rod 20 at spaced positions; forming in effect loops of generally triangular form. When the rod 20 is in the position shown in Fig. 8, the apexes of the loops 20a engage the eyelets 19 and thereby hold the sheathing in a displaced position from the body of the blade, as shown in Figs. 7 and 8 which increases the pitch. When the rod 20 is pulled toward the hub of the propeller, the loops 20a are pulled through the eyelets 19 which results in a cam action causing the eyelets 19 to take positions on the loops at the outer ends thereof. This results in drawing the sheathing towards the body of the blade from the positions shown in Figs. 7, 8 and 11 to that shown in Figs. 6, 9 and 10. During this action there is a simultaneous rotation of the rod 20 in the eyelets 18 as pivots, from the angular position shown in Fig. 7 to the position shown in Fig. 6. When the rod 20 is pushed outwardly from the hub, the eyelets 19 are forced to travel along the inclined or looped portions of the rod which results in raising the sheathing by a reverse action to that occurring when the rod is moved toward the hub of the propeller. The same action could be obtained by causing the inner portions of the loops 20a to pass through the eyelets 19 but in that case the sheathing would be moved toward the blade by an outward movement of the rod 20 and be raised from the blade by an inward movement of the rod 20. It is obvious that by adjustment of the rod 20 the sheathing may be given any intermediate position between the two limiting positions.

The means for controlling the push-pull of the rods 20 of the two blades, as shown in Figs. 2 to 5, is provided by an arm 21 which is operable from the cockpit of the plane or from any other desired location. This arm or rod is connected to one end of a lever 22 which is pivotally mounted at about its center on a fixed support 23 which may be mounted on any portion of the frame near the hub of the propeller. The end of the lever 22 opposite the operating rod 21 carries a brake shoe 24 which is pivotally mounted on the end of the arm 22. On one side of the propeller hub and within the end plate 25 is secured a sheet metal circular plate 26. This extends beyond the plate 25 and supports a plurality of studs 27, four of these being utilized in the present instance, as shown in Fig. 2. On one of the studs, as shown at the top of Fig. 2, is mounted a freely rotatable pinion 27a. A cylindrical metal element 28 with an outwardly extending flange at its inner end is provided with teeth 28a at a portion of the periphery of the flange which mesh with the pinion 27a. Another cylindrical element 29 is provided with an inwardly extending flange having teeth 29a at a portion of its periphery which mesh with the pinion 27a on the opposite side thereof from the teeth 28a. The cylindrical elements 28 and 29 are free to turn in their engagement with the pinion 27a on bearings formed by the studs 27 and washers 27b and enlarged heads 27c of the studs. The cylindrical elements 28 and 29 form brake drums and in the trough between them is positioned the brake shoe 24 but the brake shoe does not engage any portion of the trough unless it is actuated by the lever 22 against the inner or outer side of the trough. The outwardly extending toothed flange of the element 28 is in the same plane as the inwardly extending toothed

flange of the element 29, being in a plane at right-angles to the propeller shaft. The structure is such as to occupy small space in the axial direction of the propeller shaft which is particularly advantageous in propeller installations.

The two opposite studs 27 on the center line of the propeller have levers 30 rotatably mounted thereon respectively back of the elements 28 and 29 and one end of each of these levers is pivotally connected to the push-pull rods 20 respectively. The other ends of the levers 30 are suitably counter-balanced by weights 30a. Near the end of each lever 30 where it is connected to the rod 20 is a longitudinal slot 30b. A pair of pins 31 are fixed to the inner side of the element 29 and project respectively within the two slots 30b.

The rods 20 instead of passing along the outside of the blades for the purpose of controlling their respective sheathings, are concealed within the blade, as shown in Fig. 1. At a short distance from their connections to the arms 30 they pass into small long openings through the blade until they reach the sheathings 15, as particularly shown in Figs. 8 and 9. The blade is thinner at its outer portions under the sheathing and permits the rods 20 to pass out from within the thicker portions of the blades in the region where the sheathings are located. This concealment of the rods 20 thus avoids the air resistance which would occur if the rods were outside the blades. It also tends to reduce possible breakage and permits convenient replacement in case the rods or any of their parts be broken. The connections at the ends of the rods to the arms 30 are sufficiently loose to permit the small turning movement of the rods already referred to which occur during adjustments of the sheathings.

Normally the parts are in the position shown in Fig. 2, the counter-weights 30a being such that the rotation of the propeller will cause the rods 20 to be pushed outwardly and raise the sheathings to give the maximum pitch for normal operations. If it be desired at any time to decrease the pitch, the control rod 21 is pushed to cause the shoe 24 to engage the braking element 29. Assuming the direction of rotation of the propeller to be clockwise, as indicated by the large arrow in Fig. 2, the engagement of the shoe 24 with the outer brake drum 29 will retard its movement somewhat and thereby cause the pins 31 to move along the slots 30b toward the outer ends of the levers 30 and thereby force the rods 20 inwardly. This will draw the sheathings toward the propeller blades and thereby reduce the pitch. The outer ends of the slots 30b are provided with notched portions 30c on the inner sides of the slots; and when the pins 31 reach the outer ends of the slots they seat in the notched portions against the pull of the rods 20 and retain the parts in the low pitch position. This permits the brake shoe to be moved away from the outer brake drum and positioned between the drums without engaging either of them and thereby avoiding any dragging effect on the propeller. When it is desired to change from the low pitch condition to the high pitch condition, the control rod 21 is pulled to cause the shoe 24 to engage the inner braking element 28 and thereby cause it to be retarded somewhat with reference to the other parts. This causes the pinion 27a to be turned on its stud in a clockwise direction which shifts the outer element 29 in a clockwise direction with reference to the other parts sufficiently to force the pins 31 from their notches 30c to the inner ends of the slots. This forces

the rods 20 outwardly thereby raising the sheathings and increasing the propeller pitch. The brake shoe 24 may then be moved from engagement with the inner brake drum to its non-engaging position and the parts will then remain in the high pitch position owing to the relation of the centrifugal forces acting on the levers 30 being such as to maintain the parts normally in this position. If desired, additional notches may be formed on the inner sides of the slots 30b spaced from each other and similar to the notches 30c for retaining the parts in intermediate positions of adjustment between the maximum and minimum pitch of the propellers.

In Figs. 12 and 13, a different form of means is provided for controlling the position of the rods 20, this being accomplished electrically. For this purpose a pair of solenoid magnets are provided having frames 32 of iron or steel pivotally supported by extensions 33 on oppositely located end plate clamping bolts. Each of these magnets encloses an exciter winding 34 and within the winding is positioned a sleeve 35 of non-magnetic material in which the magnetic plunger or core 36 is freely movable. A compression spring 37 is also enclosed within the sleeve 35 for normally forcing the plunger 36 toward the end of the pivoted frame to which the rod 20 is connected. A pair of conducting collector rings 38 insulated from each other are supported on a cylindrical bracket 39 which is fixed to the end plate 25. The terminals of each of the two windings 34 are connected respectively to the rings 38 by the lead wires 34a. A pair of brushes are suitably supported in fixed position for respectively engaging the rings 38, as shown at the lower portion of the rings in Figs. 12 and 13. The brushes are connected through a switch 41 to any suitable source of energy indicated as a battery 42. Only one collector ring and one brush would be required if one lead from each winding and one terminal of the battery were grounded to the frame.

Fig. 12 shows the parts in their normal operating positions with the rods 20 in their outer positions for securing a high pitch of the propeller. The parts are suitably weighted and counter-balanced so that when the windings 34 are not energized, the relation of the centrifugal forces acting on the parts will be such as to maintain the condition of high pitch. Whenever it is desired to reduce the pitch, the operator will close the switch 41 and thereby energize the windings 34. This will attract the plungers 36 within the windings 34 against the pressure of the springs 37. This shifting of the plungers will change the relationship of the centrifugal forces acting upon the magnets and connecting parts and result in the forces acting upon the portions of the magnets near the counter-weights 30a overcoming the centrifugal forces of the parts on the opposite side of the pivotal supports and thereby force the rods 20 inwardly to reduce the pitch. Whenever the windings 34 are deenergized by opening the switch 41, the springs 37 will force the plungers 36 to the position shown in Fig. 12 which will change the relationship of the centrifugal forces acting on the pivoted magnets and thereby force the rods 20 outwardly for adjusting the sheathings to their high pitch position. Thus while the switch 41 is maintained closed, the centrifugal forces will act to maintain the condition of low pitch and whenever the switch is open the parts automatically assume the condition of high pitch.

The sheathings serve to cushion abrupt changes in air pressure in any position of the sheathings

and thereby tend to reduce undesirable vibrations of the blades. The position of the sheathings is readily controlled by a simple form of mechanism which may be applied readily to the standard forms of propellers. The controlling parts are well protected and may be easily repaired or replaced. Although a preferred embodiment of the invention has been disclosed, various changes and modifications may be made for adaptation to particular requirements without departing from the scope of the invention.

I claim:

1. A propeller blade comprising a solid blade body, a yieldable sheathing on the pressure face of said solid body, said sheathing being rigidly secured to the solid body of the blade at portions of the sheathing and movable at the trailing edge of the blade toward and from the body, a rod slidable in a direction along the length of the blade, and means between the movable portion of the sheathing and the blade actuated by said slidable movement of said rod for adjusting said sheathing toward and from the body for changing the pitch of the blade.

2. A propeller blade comprising a solid blade body, a yieldable sheathing on the pressure face of said solid body, said sheathing being rigidly secured to the solid body of the blade at portions of the sheathing and movable at the trailing edge of the blade toward and from the body, a rod slidable in a direction along the length of the blade, and means between the movable portion of the sheathing and the blade actuated by said slidable movement of the rod and angularly related to said rod for adjusting said sheathing toward and from the solid body for changing the pitch of the blade.

3. A propeller blade comprising a solid blade body, a yieldable sheathing on the pressure face of said solid body, said sheathing being rigidly secured to the solid body of the blade at portions of the sheathing and movable at the trailing edge of the blade toward and from the body, and means between the sheathing and the body and slidable in a direction along the length of the blade for adjusting said sheathing towards and from the body for changing the pitch of the blade, said means comprising an element slidably engaging the sheathing and body and having an inclined portion for adjusting the sheathing.

4. A propeller blade comprising a solid blade body, a yieldable sheathing on the pressure face of said solid body, said sheathing being rigidly secured to the solid body of the blade at portions of the sheathing and movable at the trailing edge of the blade toward and from the body, and means between the sheathing and the body and slidable in a direction along the length of the blade for adjusting said sheathing towards and from the body for changing the pitch of the blade, said means comprising a slidable element extending along and passing through said body of the blade.

5. A propeller blade comprising a solid blade body, a yieldable sheathing on the pressure face of said solid body, said sheathing being rigidly secured to the solid body of the blade at portions of the sheathing and movable at the trailing edge of the blade toward and from the body, and means between the sheathing and the body for adjusting said sheathing towards and from the body for changing the pitch, said means comprising an actuating element passing through

said body of the blade along the length of the blade.

6. A propeller blade comprising a blade body, a yieldable sheathing on the pressure face of said body, said sheathing being secured to the body of the blade at portions of the sheathing and movable at other portions toward and from the body, and means between the sheathing and the body and slidable in a direction along the length of the blade for adjusting said sheathing towards and from the body for changing the pitch of the blade, said means comprising a slidable rod extending along the length of the blade having an inclined portion and slidably engaging the sheathing and body at portions displaced with reference to each other in a direction across the blade.

7. A propeller blade comprising a blade body, a yieldable sheathing on the pressure face of said body, said sheathing being secured to the body of the blade at portions of the sheathing and movable at other portions toward and from the body, and means between the sheathing and the body and slidable in a direction along the length of the blade for adjusting said sheathing towards and from the body for changing the pitch of the blade, said means comprising a slidable rod extending along the length of the blade and engaging the body under the sheathing and having an inclined portion engaging the sheathing at a location displaced in a direction across the blade from the engagement of the rod with the body.

8. A propeller blade comprising a solid blade body, a yieldable sheathing on the pressure face of said solid body, said sheathing being rigidly secured to the solid body of the blade at portions of the sheathing and movable at the trailing edge of the blade toward and from the body, a rod slidable in a direction along the length of the blade, and pivotally mounted means between the movable portion of the sheathing and the blade actuated by said slidable movement of said rod for adjusting said sheathing toward and from the body for changing the pitch of the blade.

9. A variable pitch propeller comprising a solid blade body, a yieldable sheathing on the pressure face of said solid body, said sheathing being rigidly secured to the solid body of the blade at portions of the sheathing and movable at the trailing edge of the blade toward and from the body, a control element extending along the length of the blade and slidable in opposite directions along the length of the blade, means between the movable portion of the sheathing and the blade actuated by movement of said control element in opposite directions for adjusting said sheathing toward and from the solid body for changing the position of the blade, means mounted on the propeller for actuating said element in opposite directions by the rotation of the propeller, and a manually operated element for controlling said means to cause said actuation in opposite directions.

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