

[54] **COLLAPSIBLE PROPELLER FOR
MAN-POWERED GLIDER AIRCRAFT**

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Related U.S. Application Data

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[52] U.S. Cl. **244/16, 244/65, 416/142**

[51] Int. Cl. **B64c 31/04**

[58] Field of Search **416/142-143;**
244/16, 65

[56] **References Cited**

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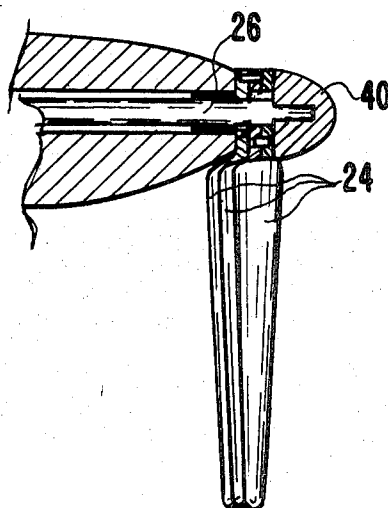
[57] **ABSTRACT**

The aircraft wings have means for varying their camber and include a fan-like tail section hinged to the rear of a rigid frame surrounding the pilot's space between the inner ends of the side wing sections, in sub-

stantially the same plane therewith, a unicycle being fixed to said rigid frame to provide a seat for the pilot. A collapsible propeller is mounted on a shaft extending forwardly from a bearing on the front of said rigid frame, and is driven by a chain or belt drive from a sprocket or pulley on the wheel of the unicycle, the blades of the propeller being keyed to the propeller shaft through limited annular slot and key connections between adjacent blade bearings, to spread the blades to their proper angular spacing whenever the shaft is driven, and to return them to a common vertical hanging position so as to reduce their drag during gliding operations whenever no power is applied.

The pilot sits on the unicycle seat, drops a yoke harness over his shoulders which is operatively connected to control the inclination and twist of the hinged tail section, whereby the shifting of his body forward, lifts the tail section to cause an increase in the angle of attack of the side wing sections, and by shifting his body rearward the tail section is lowered to decrease the angle of attack, and if he moves his body from side to side he can twist the tail section accordingly. After placing this yoke over his shoulders, the pilot inserts his arms through openings in the inner ends of said wing sections and grasps the handles of the corresponding hand control plates which are operatively connected to control the chambers of the side wing sections, the warping of the outer ends of these sections and the spread of the fan-like tail section.

1 Claim, 10 Drawing Figures



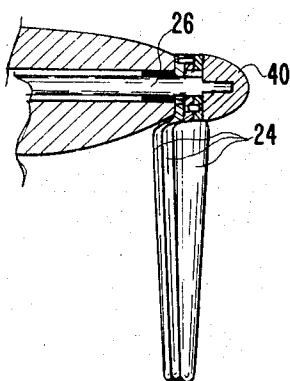


FIG. 2

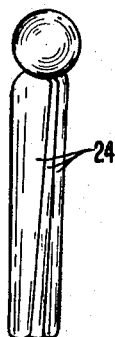


FIG. 1

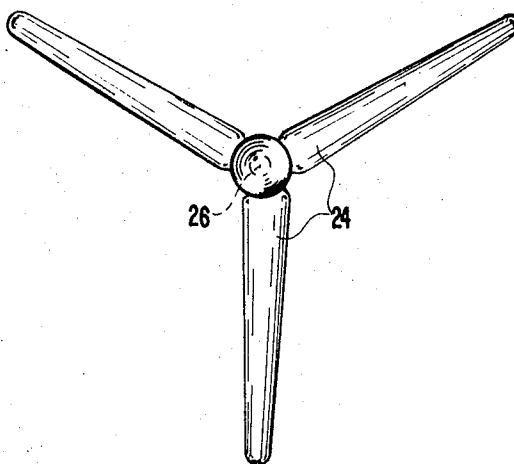


FIG. 3

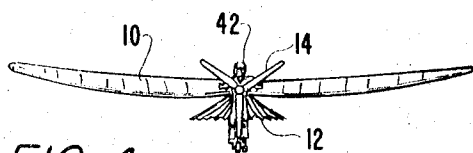


FIG. 4

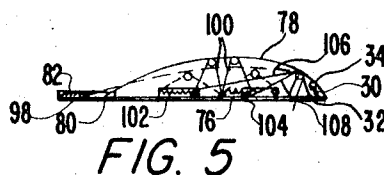


FIG. 5

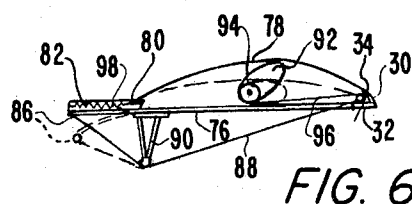


FIG. 6

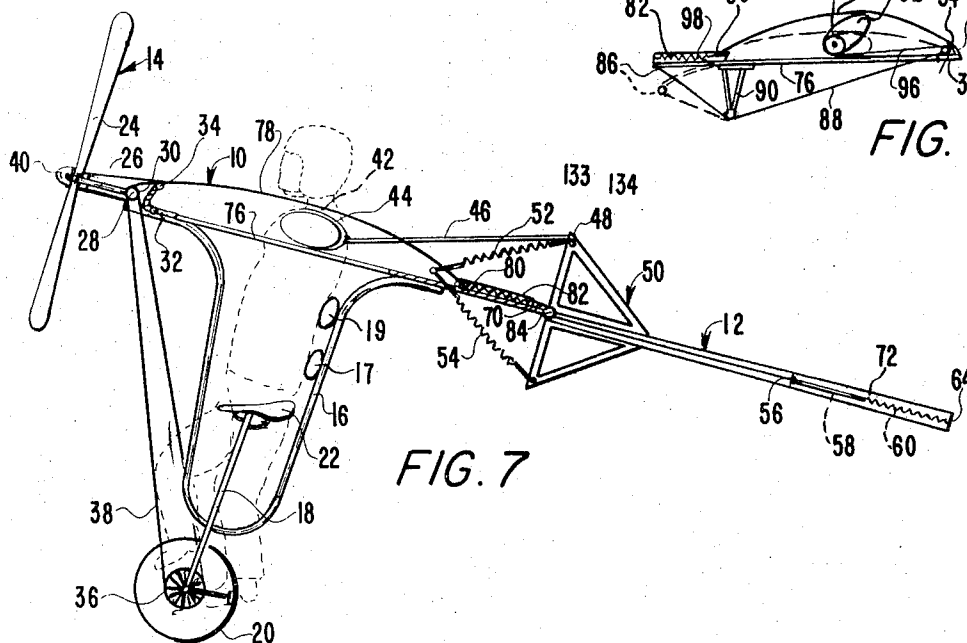


FIG. 7

SHEET 2 OF 2

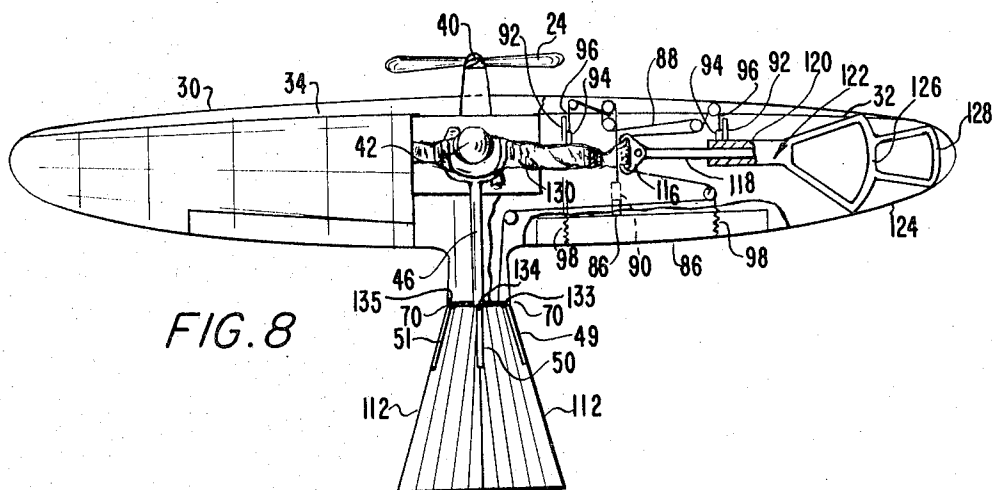


FIG. 8

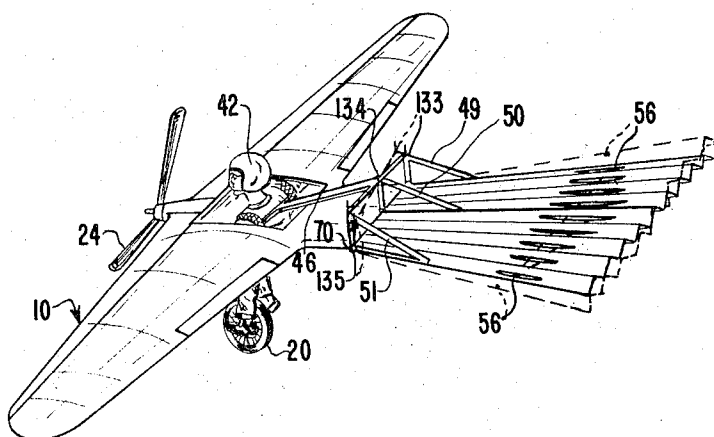


FIG. 9

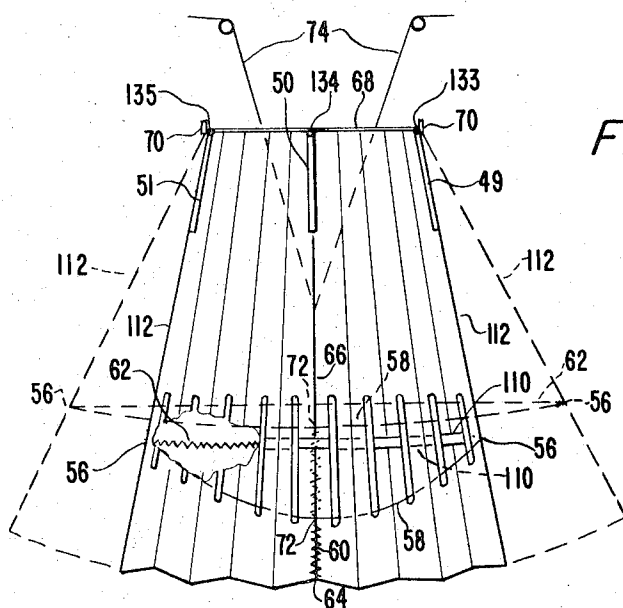


FIG. 10

COLLAPSIBLE PROPELLER FOR MAN-POWERED GLIDER AIRCRAFT

This is a division of application Ser. No. 188,289, filed Oct. 12, 1971, issued Aug. 7, 1973 as U.S. Pat. No. 3,750,981.

Various man powered glider aircraft have been developed in the past, but none have been found which have a collapsible propeller to reduce its drag when it is not being used during gliding operations, and no prior art has been found in which such aircraft uses a spreadable tail section and wings with a variable camber with simple cooperative controls for warping the tips of the wings, for varying of the spread and the inclination of the tail section and the camber of the wings and for bending the rear edges of the wings like wing flaps.

Accordingly, the main object of the present invention is to produce a man powered glider aircraft which will enable its self launching from a downwardly inclined strip of ground by means of a cycle undercarriage and the assistance of a man powered propeller, and more natural wing and tail section controls approaching those of birds in soaring flight.

A further object is to provide a collapsible propeller to reduce its drag in flight when power is not applied to it.

A further object is to provide a variable camber wing section by varying the curvature of the upper surface member thereof, or by bending the rear edge of the lower surface member, or both, the forward edges of said members being joined to a rigid nose member defining the leading edge of the wing.

A further object is to provide a spreadable as well as twistable fan-like transversely hinged tail section for aircraft, approximating the natural functions of a bird's tail in flight: for increasing lift, for assisting in steering and rolling maneuvers as well as pitching and looping, for braking the speed of flight as in landing, etc.

Further and more specific objects will become apparent in the following detailed description of the invention, as illustrated in the accompanying drawings, wherein:

FIG. 1 is a front view of the propeller in its collapsed position,

FIG. 2 is a side view of this collapsed propeller showing a sectional view of its mounting,

FIG. 3 is a front view of the propeller when power is applied to it.

FIG. 4 is a front view of the glider aircraft on take-off,

FIG. 5 is a substantially diagrammatic cross sectional view of a wing section, showing one form of cam means for varying its camber,

FIG. 6 is a similar view of another form of cam means, and pull string means for bending the rear edge downwardly,

FIG. 7 is a substantially diagrammatic axial cross sectional view of the aircraft,

FIG. 8 is a plan view of the aircraft with most of the upper surface of the right wing section broken away,

FIG. 9 is a perspective view of the aircraft, and

FIG. 10 is a detail plan view of the tail section.

The specific form of this invention, as illustrated in the drawings, has a pair of side wing sections 10 having a common leading edge beam forming the rigid nose portion of the wings and extending across the space between the inner ends of said wing sections to form the

front frame portion of the opening through which the pilot's bust 42 normally extends.

The aircraft illustrated has the rear portions of the inner ends of the side wing sections faired into a tail hinge section which has a hinge rod 84 mounted in side bearings 70 at its rear edge, on which the forward edge 68 of the tail section 12 is rotatably mounted for angular adjustment relative to the plane of the tail hinge section. The tail section 12 has central brackets 50 extending above and below the forward edge thereof. The springs 52 and 54 which are connected to pins at the upper and lower ends of said brackets are adjusted to normally resiliently hold the tail section in substantial alignment with the plane of said side wing sections for level flight.

A rigid strap 46 is fixed at its forward end by means of shoulder straps 44 to the back of the pilot 42, and its rear end has a sleeve mounted rotatably on the rod 48 which is pivoted to pins 133, 134 and 135 at the tops of the brackets 49, 50 and 51 respectively, so that by moving his body from side to side, the pilot can control the twist in the tail section accordingly. For example, if the pilot moves his body to the left, rod 48 is pivoted about pin 134 to its dotted line position shown in FIG. 9 and moves the brackets 49 and 51 in opposite directions about hinge pin 84, thus lowering the left side and raising the right side of the tail section to provide a corresponding twist therein. By moving his body forwardly or to the rear, the tail section may be angularly raised or lowered.

While thus controlling the pitch angle and twist of the tail section, the pilot has a hand controlled pull string 66 connected through lines 74 which are directed over pulleys to one side edge of each hand plate 116 which is pivoted to a rod 118 slidably keyed in an axially rotatable sleeve 120 which is a part of the frame member 122 in the flexible wing tip portion 124 extending rearwardly from the rigid nose beam 30 of the wing sections 10. The chord portions 126 and 128 of the frame member 122 are formed to provide the contour of the wing tip portions over which a flexible cover is stretched. The stiffly resilient rear edge member 124 provides a resiliently flexible rear edge for said wing tip portions.

Turning the hand plate 116 axially of sleeve 120 causes the frame member 122 to turn, thus warping the wing tip portion correspondingly. The controls in the other side wing section, although not shown in FIG. 8, are exactly the same as in the right side wing section, except that they are in reverse relation with respect to the aircraft axis.

The other side edge of the pivoted hand plate 116 is connected by lines 88 and their extension 96 to the rear edge 86 and the camber increasing pulleys 94 respectively, to simultaneously bend the rear edges 86 downwardly and increase the camber of the upper surfaces of the wing sections when that side edge of the hand plate 116 is drawn toward the pilot by pulling the hand plate 116 straight, or also twisting and turning it in accordance with the desired effect on the other controls. The camber cams 92 are fixed to the sides of their respective pulleys 94, and are normally resiliently held down in the reduced camber positions for high speed streamlining, by the assistance of tension springs 82 stretched between the rear edge 86 of the lower wing surface sheet 76 and the rear edge 80 of the upper surface sheet 78. Guideways 98 are provided for slidably

guiding the rear edges 80 over the top surface of the sheets 76.

Pulley brackets 90 are provided under the sheets 76 for the pull lines 88 to draw the rear edges 86 downwardly.

Any other camber camming means may be used besides the oval cams 92. As shown in FIG. 5, two pairs of folding legs 100 may be pivoted to the lower sheet 76 at a common pivot and extend in opposite fore and aft directions. The other ends of each pair are biased to the left in FIG. 5, by tension springs 102 and 104. When line 106 is pulled and line 108 released, a high camber position of their upper hinges is assumed as shown, and when line 108 is pulled and line 106 released the legs are stretched to a low camber position of their upper hinges.

The lines 74 being connected to the corresponding side edges of their hand plates 116, control the spread of the tail section, the line 66 being connected at 72 to the middle of the stiffly resilient member 58 which is normally bowed back by springs 60 and 62, the rear end or spring 60 being fixed to the rear edge of the tail section at 64. The ends of the bowed member 58 are fixed pivotally to the opposite sides of the tail section at 56, and a tension spring 62 is fastened at its ends to the same pivots at 56, to normally hold the tail section folded at its minimum spread as limited by spacers 110 on spring 62.

When line 74 is pulled against the tension of spring 60, the bowed member 58 is made straighter, causing its ends to spread the tail section to the dotted line positions of the sides 112, as shown in FIG. 10, the spring 62 and the bowed member 58 being passed through slots in the fan folds of the tail section so as to keep them in the plane of the tail section in any of its twisted positions. Thus the tail section can be spread independently of the other controls by pivoting the hand plate 116 about the point at its opposite side edge to which the line 88 is connected, as the slidable rod 118 allows the pivot of the hand plate to be correspondingly pulled out. If desired, the wing tip flexure can at the same time be controlled by turning the keyed sleeve 120, and the camber of the wings can also be simultaneously controlled by pivoting the handplate about the side edge to which the line 74 is connected.

Whenever it is necessary to increase the relative wind speed, this glider aircraft is provided with a man-powered propeller 14, driven by a chain or belt 38 between the sprocket or pulley 36 on the wheel 20 of a unicycle 18 which is fixed to the frame 16 under the pilot's space frame, and the drive sprocket or pulley 28

of the propeller drive shaft 26 which is mounted in bearing supports on the nose beam 30 between the inner ends of the side wing sections 10. At the same time, the unicycle seat 22 provides a seat for the pilot, and lower and upper back rests 17 and 19 may be provided on the frame 16, while the pilot's arms are passed through armholes in the inner ends of the side wing sections so that he may grasp the hand control plates 116 inside the wing structure for manipulating the various controls either independently or in various combined control movements in a way to more closely simulate the natural bird's wing and tail controls in soaring flight and in turning rolling, pitching, landing, and other maneuvers.

The collapsible propeller shown, has three blades 24 on the propeller shaft 26, one blade bearing being keyed to the shaft, the other blade bearings being connected to their adjacent bearing by 120 degree annular slot and pin lost motion drives, so as to provide their proper spacing whenever power is supplied to the propeller shaft. Whenever the shaft is left free, it will tend to stop with the keyed propeller blade hanging downwardly, while the other blades will tend to continue turning with the aid of the slip stream until their 120 degree lost motion drive connections are taken up to bring them adjacent the keyed blade in its hanging position, where the blades will overlap to some extent and will be in a less exposed position, to reduce their air resistance to a minimum.

Many obvious modifications in the details and arrangement of the parts illustrated may be made without departing from the spirit and scope of the present invention.

What is claimed is:

1. A collapsible propeller for a man-powered glider aircraft having a shaft and a plurality of propeller blades, each blade having a bearing mounted on said shaft,

the innermost of said blade bearings on said shaft being keyed thereto,

annular lost motion slot and pin drive connections between successively adjacent blade bearings, to provide the proper angular spacing between the blades when said shaft is turned in forward drive, and to collapse the propeller when said shaft is stopped with the keyed blade hanging downwardly therefrom and by means of the airstream supporting the glider aircrafts in flight driving the other blades into adjacently hanging positions.

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