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Prather

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[54] **FAN-LIKE TAIL SECTION FOR MAN-POWERED GLIDER AIRCRAFT**

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[21] Appl. No.: **358,520**

Related U.S. Application Data

[62] Division of Ser. No. 188,289, Oct. 12, 1971, Pat. No. 3,750,981.

[52] **U.S. Cl.** **244/16,** 244/87
[51] **Int. Cl.** **B64c 31/04**
[58] **Field of Search** ..... 244/16, 64, 87, 88, 89, 244/75 R, 43

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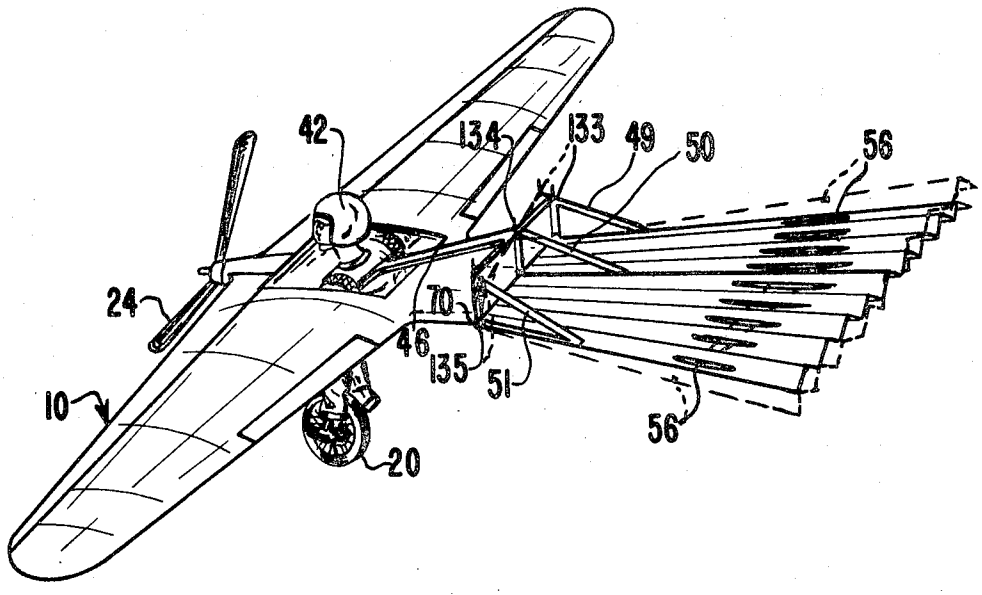
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[57] **ABSTRACT**

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 substantially 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 cambers of the side wing sections, the warping of the outer ends of these sections and the spread of the fan-like tail section.

2 Claims, 10 Drawing Figures



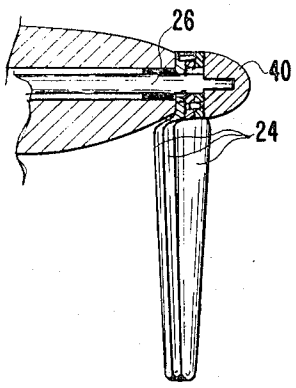


FIG. 2

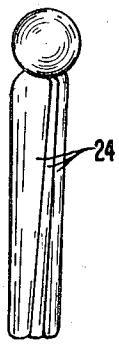


FIG. 1

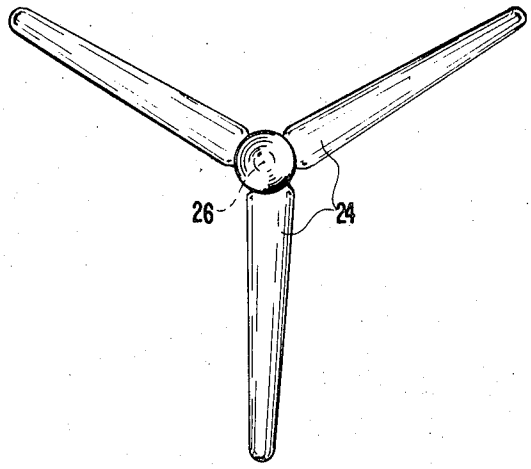


FIG. 3

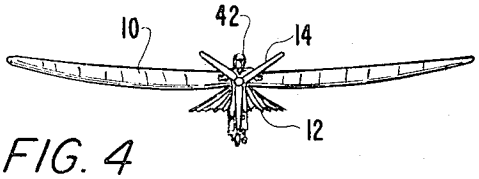


FIG. 4

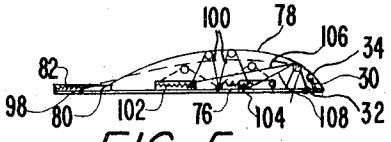


FIG. 5

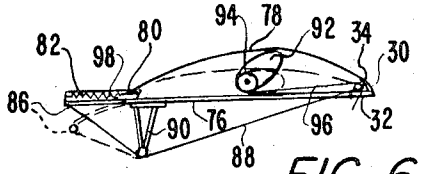


FIG. 6

FIG. 7

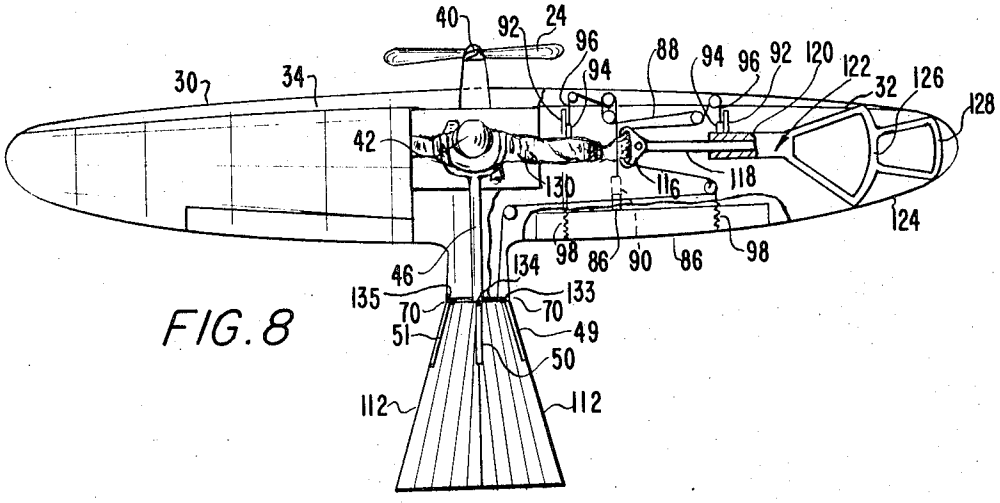


FIG. 8

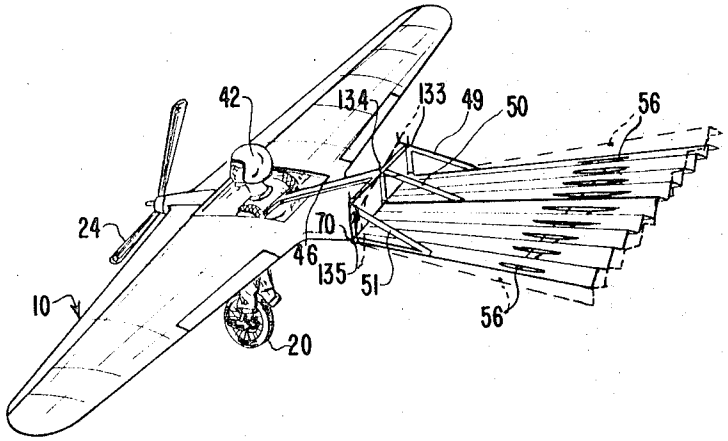


FIG. 9

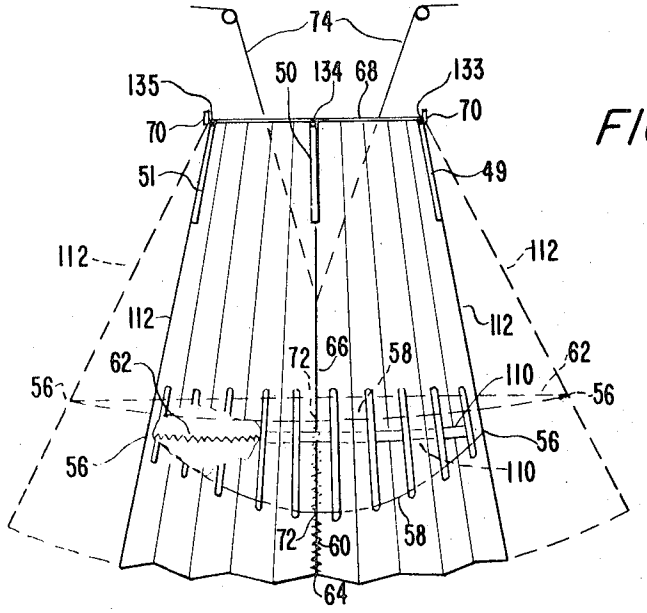


FIG. 10

FAN-LIKE TAIL SECTION FOR MAN-POWERED GLIDER AIRCRAFT

This is a division, of application Ser. No. 188,289, filed 10-12-71 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 earings **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.** Tee chord portions portions **126** and **128** of the frame meber **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 extensions **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 outer 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 plate **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 of 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 pivot at **56,** to normally hold the tail section folder 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 imdependently 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 cotrolled by turning the keyed sleeve **120,** and the camber of the wings can also be simultaneously controled 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 fan-like tail section for man-powered aircraft, having hinge means at its forward edge connected to the trailing edge of the main wing of said aircraft,

means for resiliently floating said tail section normally in substantial extension of the plane of said wing,

control means for varying the inclination of said tail section extending forwardly into said craft for manual control therefrom,

resilient means for holding said tail section normally at a minimum spread, and

control means for increasing said spread extending into said aircraft for manual operation therefrom.

2. A fan-like tail section for man-powered aircraft, having hinge means at its forward edge connected to the trailing edge of the main wing of said aircraft,

means for resiliently floating siad tail section normally in substantial extension of the plane of said wing,

control means for varying the inclination of said tail section extending forwardly into said craft for manual control therefrom,

resilient means for holding said tail section normally at a minimum spread,

control means for increasing said spread extending into said aircraft for manual operation therefrom,

said tail section being made of stiff sheet material folded in accordion fashion, said folds being held in close relation at its hinged end and in a normally limited slightly more spread relation at its rear portion defining said normal minimum spread by said resilient means in the form of a coil spring stretched between the outer side edges of said rear portion of the tail section,

said coil spring being passed through axially extending slots in the folds of said sheet material and having spacer blocks strung on it between the successive folds to limit the normal minimum spread of said tail section,

a stiffly resilient spreading wire being passed through said axially extending slots and having its ends fixed to said outer side edges adjacent to the ends of said spring, said wire being slightly longer than the maximum stretch of said spring, said wire being normally resiliently bowed rearwardly to reduce the spread of said tail section to its normal minimum, and

a line extending from the middle of said bowed wire into said aircraft to provide said control means for increasing said spread.

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