

CONTROL DEVICE FOR AN ELLIPSOIDAL-SHAPED WING

The wing described in patent EP-a-0202271 in the name of the present applicant is generally a soft wing of ellipsoidal form generally in the shape of a spherical gore connected by ropes to a load, generally with the aim of moving it. Its profile is aerodynamically efficient resembling to an airplane wing or a boat sail.

In addition to its sail, the wing comprises an inflatable frame made up of a leading edge strut in the shape of a crescent and struts laid out in the profile way.

This wing has as a characteristic, thanks to its strongly arched anhedral shape, to be able to fly without rigid material add neither such as composites or metal spars nor complex networks of bridles, contrary to the generally known wings. It is retained by two lines fixed at the distal ends of the wing. In sustained flight, the whole traction is exerted on these two lines. The distal ends of the wing are consequently exactly in the prolongation of the flying lines.

The range of angle of attack of the wing is a few degrees. If its angle of attack is too high, the wing will tend to fall down. If the wing has a too weak angle of attack, its lift will be definitely low. The required angle corresponds roughly to the maximum Lift/Drag ratio of the wing.

On most soft wings, the optimal angle of attack is obtained by adjustment of the bridle. On the wing described above, whose two flying lines end at its distal ends, it is the wing itself which must be regulated when designed, in order to fly to its optimum angle of attack. The location of the distal ends corresponds to the point of optimum center of the wing.

The patent application n° FR.9214731 of the applicant describes a control device for ellipsoidal wing where, additionally to the two flying lines fixed at the distal ends in the shape of points of the wing, control lines are installed on the leading edge or the trailing edge to allow a better directional control of the wing.

This system makes it possible episodically to regulate the angle of attack of the profile by simultaneous action either on the two lines of leading edge or on the two lines of trailing edge. However it appeared with use that it was wished for security reasons, handiness and effectiveness that the pilot can, at will, regulate the power developed by the wing, in other words the angle of attack of the profile, during the flight. Two disadvantages of the previous system were the high number of lines, six, necessary to a complete control of the wing, and the difficulty of acting efficiently on these six lines.

The system which is the subject of this patent cures these disadvantages. It consists in fixing at each distal end of the wing two lines being used at the same time to retain the wing, to direct it and control its angle of attack: a line in front of the point of optimum center of the wing, the other behind.

In this configuration, the distal ends of the wing must have a minimum cord, therefore an outline shape excluding any termination as a point, except placing this one ahead or behind of the point of optimum center of the wing. The wing having always a strongly arched anhedral shape, the inflatable strut forming leading edge keeps its crescent shape but cut at the ends.

The wing is particularly used in power kite applications, where the pilot directly controls its wing with his arms. A convincing way to direct the wing and to regulate its angle of attack consists in using a bar at the ends of which the back lines are fixed, the front lines being fixed in the middle of the bar or on the mobile to be pulled. Directional control is obtained by inclining the bar while the control of the angle of attack is obtained by pulling on the back lines or by slackening the front lines.

A preferred mode of realization of this control device consists of a rectilinear bar at the ends of which the back lines are fixed, the front line being fixed either at a harness or any other device which the pilot wears, or directly on the mobile to be pulled. The bar slides along the front line and is provided with a device making it possible to block it at the desired height, for example by rotation of the bar. For the security, the fact of releasing the bar is enough to free it, and thus to cancel the lift of the wing.

Figure 1 shows the general principle of the invention on a wing side view

Figure 2 represents a wing, side view, whose location of the distal ends in the shape of points is modified, compared to the point of optimum center of the wing,

Figure 3 represents various outlines of the distal ends of the wing, side view,

Figure 4 represents various outlines of the sail,

Figure 5 shows the general working of the control bar according to a mode of preferred realization,

Figure 6 shows an example of full realization of the control device, in perspective.

According to figure 1, the wing is equipped with four lines, two at each distal end of the wing, one (1) in front of the point of optimum center (2), the other one (3) behind.

The control of the angle of attack thus obtained is full, it means that one can, if it is wished and according to the location of the attachment points of the lines (1) and (3) on the wing, to gradually decrease the angle of attack of the wing until it is close to zero: it then falls under the effect of its own weight.

So that the distal ends (4) remain in tension, one can modify the wing in at least two ways:

-Figure 2 shows a wing according to the patents n° EP-a-0202271 and FR.9214731 but whose geometry is modified, distal ends (4) in the shape of points not coinciding any more with the point of optimum center (2).

-Figure 3 shows various alternatives of modification of the distal ends (4) on a wing whose geometry is not modified. Many alternatives are possible. The use of soft materials of reinforcement, rigid parts or any other means making it possible at the distal ends to work effectively is possible.

-Figure 4 represents the various possible general shapes of the wing. To simplify the manufacturing, the shape generally consists of straight segments rather than curves.

-Figure 5: the four lines leave from the wing towards the load to be moved. With an aim of simplification of the bridle, the two front lines (1) can meet before in a central line (6) between the wing and the load, forming a Y (forking).

One of the possible control devices of the wing by the pilot according to the invention includes a bar (7) inclining along its main axis to direct the wing and sliding along the central line (6) in order to increase or to decrease the angle of attack. In this case the central line (6) is fixed on the pilot by the mean of a device (8) such as a harness, or directly on the mobile to be moved.

-Figure 6: a blocking system (9) of the bar (7) on the central line (6) maintains the bar with the desired height. Thanks to this system, one can direct the wing of one hand if it is wished and decrease its angle of attack by simply slackening his influence on the bar (7). In the event of loss of control of the wing, when the pilot falls for example, the fact of releasing the bar (7) of the hands makes it possible to cancel whole or part of the power of the wing, according to the selected adjustment.

This device increases the security of the pilot as well as the range of use and the effectiveness of wings mainly used for traction.

CLAIMS

1) System of control of the angle of attack and the direction of the wing in the shape of a spherical gore and with inflatable frame described in patent EP-a-0202271, comprising four lines starting from the wing, two from each distal end (4), wherein one of the two lines (1) is fixed ahead of the point of optimum center (2) of the wing while the other line (3) is fixed behind that point; and wherein the shape of the wing is modified consequently, the distal ends having a very weak cord.

2) System of control according to claim 1 wherein the shape of the wing is modified by displacement of its distal ends (4) in the shape of tips apart from the point of optimum center (2).

3) System of control according to claim 1 wherein the shape of the wing is modified by total or partial suppression of the distal ends (4) in the shape of tips, the leading edge (5) made of an inflatable strut having a shape of crescent, cut at its ends.

4) System of control according to claim 1 comprising a control bar in its low part wherein this control bar (7) slides along the central line (6) fixed on the harness (8) that carries the pilot or on the mobile itself.

5) System of control according to claim 4 wherein a device (9) allows the blocking of the bar (7) along the central line (6).