March 6, 1956 W. M. ALLISON 2,737,360

FLEXIBLE KITE

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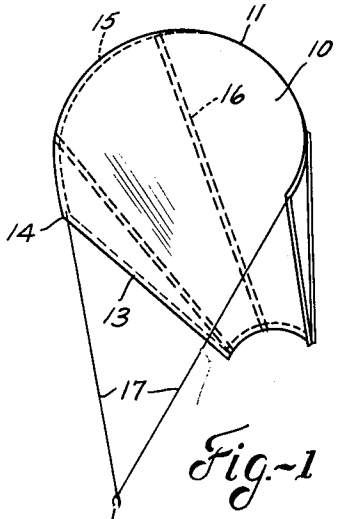

Fig.-1

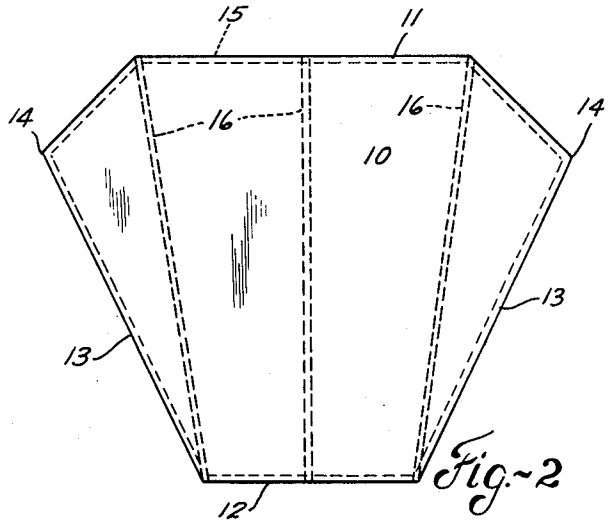

Fig.-2

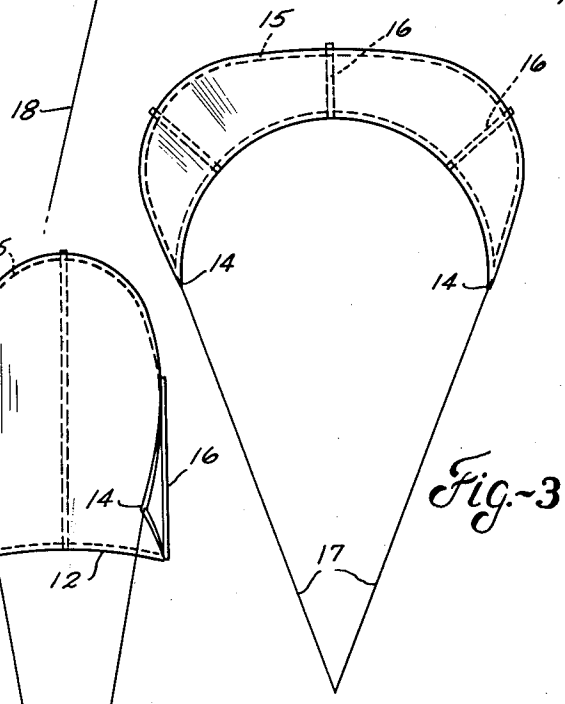

Fig.-3

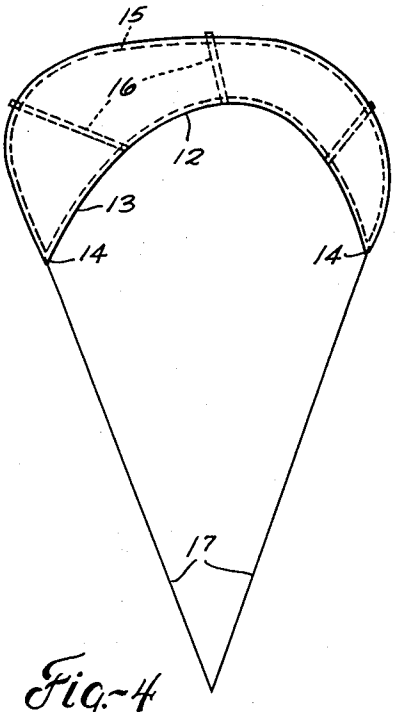

Fig.-4

Fig.-5

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FLEXIBLE KITE

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4 Claims. (Cl. 244—153)

This invention relates to kites. It proposes a novel use of aerodynamic principles to obtain flight characteristics and ease of operation heretofore unknown in kites.

A more specific object of the invention is to present a kite possessing inherent means of compensating for variations in air stream velocity and air turbulence whereby the kite may maintain a normal attitude of flight and continue to be air borne irrespective of such conditions.

Another object of the invention is to present a kite offering a minimum resistance to air flow whereby it is unlikely to be damaged and is easy to control.

A further object of the invention is to present a kite which can be economically and easily made.

Still another object of the invention is to present a kite which can be compactly folded when not in use and which is at all times ready to be released for flight.

A further object of the invention is to provide a kite of the character described having the advantageous structural features and the inherent meritorious characteristics and mode of operation hereinafter set forth.

The inventive concept making possible achievement of the above objects is that of polymorphic kite, that is one capable of assuming many shapes, all as may be dictated or required by fluctuations of the air stream. According to this conception of the invention, a kite comprises a flexible air foil panel capable of lateral arching for inflation by the air stream but braced against longitudinal flexing, and tethers connected to side edges of the panel and joined together to form a bridle attachable to a flight line. The tethers provide a transverse axis of restraint about which the air foil panel may bodily oscillate to vary the angle of incidence of the panel relative to such line of restraint and the angle of attack thereof relatively to the air stream, which axis is lengthened or shortened in response to variations in the degree of inflation of the panel. According to the construction and mode of operation of the kite compensatory adjustments in the angle of incidence of the air foil panel and in the degree of inflation of the panel and in the shape of the inflated arch make possible the maintenance of a favorable attitude of flight under substantially any conditions of air velocity and turbulence.

With the above primary and other incidental objects in view as will more fully appear in the specification, the invention intended to be protected by Letters Patent consists of the features of construction, the parts and combinations thereof, and the mode of operation, as hereinafter described or illustrated in the accompanying drawings, or their equivalents.

In the drawing, wherein is illustrated the preferred but obviously not necessarily the only form of embodiment of the invention:

Fig. 1 is a view of a kite in accordance with the instant invention, tethered to a flight line and in an attitude of flight like that assumed during ascent;

Fig. 2 is a view in front elevation of the air foil panel;

Fig. 3 is a view of the kite in flight attitude as it appears under conditions of high air stream velocity and with the center or inflationary and flight sustaining lines of effort in line with the longitudinal axis of the kite, the air foil panel being at a minimum angle of attack and maximum inflation, with the inflation being equal over the surface of the panel;

Fig. 4 is a view similar to Fig. 3 with the center of effort shifted to the right, as may result from air turbulence; and

Fig. 5 is a view similar to Fig. 3 showing the kite at the opposite end of its operational range, the air foil panel thus being at maximum attack and minimum inflation.

Like parts are indicated by similar characters of reference throughout the several views.

Referring to the drawing, and particularly to Figs. 1 and 2, a kite in accordance with the instant invention may comprise an air foil panel **10** made of any light material relatively impervious to the passage of air, for example, paper. The shape of the air foil panel is approximately an isosceles trapezoid, there being present the essential elements of an isosceles trapezoid including a base **11**, an apex **12** and interconnecting sides **13** of equal length. The base angles are cropped, as well as the apex **12**, to define an irregular hexagonal figure and lateral extremities **14** longitudinally spaced from the base **11**. The marginal area of the air foil panel **10** is folded back upon and adhesively bonded to the surface of the panel to define a reinforced perimeter **15** whereby the panel presents a relatively strong, thin edge to flowing air currents. Extending longitudinally of the air foil panel **10**, from base **11** to apex **12**, is a plurality of substantially rigid members **16**. Made of thin, light weight, strips of wood or metal tubing and adhesively bonded or otherwise secured to the panel **10**, the members **16** are arranged centrally of the panel and in interconnecting relation to the ends of the base and apex thereof.

Connected to the lateral extremities **14**, as by insertion into the reinforced perimeter **15**, are elongated tethers **17** of equal predetermined length. At their free ends the tethers **17** are joined together to form a bridle attachable, as shown in Fig. 1, to a flight line **18**. Such bridle is of a yielding nature so that the ends or extremities **14** may move in approaching and withdrawing directions relatively to one another.

In considering the structure of the kite, it will be noted that while the members **16** function as longitudinal braces, substantially to preclude flexing or arching of the panel about a transverse axis, there is an absence of lateral rigidity. When not in use, therefore, the kite may be folded lengthwise and in use may flex or arch in inflationary manner about a longitudinal line.

The effect of attachment of the tethers **17** to the lateral extremities **14** is to enable the kite to be maintained in an attitude of flight and also to establish stress points defining a lateral line of restraint from which tension forces can radiate across the air foil panel when inflated. Further, such line of restraint serves as a pivot for longitudinal bodily shifting of the kite, the surface of the panel **10** assuming various angles of incidence with respect to such lateral line of restraint as effected and controlled by the air stream.

In operation, the kite is launched simply by releasing it into the wind. The passage of air through the loose folds of the air foil panel **10** causes distension or inflation of the panel into a lateral arch. At the same time, the kite assumes a high deflective angle with respect to the air stream, as for example as seen in Fig. 1, wherein the apex end **12** points downwind and toward the ground. The thrust of the air will rather quickly rock the kite to a more generally horizontal position which it maintains in flight. Facing endwise into the wind, with base **11** as the leading edge and apex **12** as the trailing edge, the kite is borne by the flow of air across its curved

under surface. In such position, it offers but slight resistance to the air flow, there being only the thin edge of panel **10**, the diameter of tethers **17** and the small ends of brace members **16** to oppose passage of the air. In response to diminishing and increasing air currents there is a corresponding adjustment both in the angle of attack of the panel to the air stream and in the curvature of the panel. Thus, a diminishing air current velocity will allow the trailing end **12** of the panel to drop downward and at the same time will reduce the tension tending to spread apart the lateral extremities **14**. These extremities will accordingly approach more closely together and increase the curvature of the air foil panel. The position of the kite in a minimum aspect of inflation and maximum angle of attack is shown in Fig. 5. In Fig. 3 is shown the opposite extreme of the operational range, achieved in response to increasing air current velocity. In this position of the kite, the angle of attack to the air stream is at a minimum while inflation of the kite is at a maximum. An infinite number of automatic adjustments between these operational extremes may be made in compensation for increase and decrease in air stream velocity to maintain in the kite continuous stability in flight.

In a turbulent air stream, the action of fluctuating, non-uniform pressures on the surface of the air foil tend to force the kite out of its normal flight attitude. If generally vertical in nature, these pressures will merely cause the kite to gain or lose altitude. If horizontal, however, a compensating action of the panel **10** is required if the kite is to maintain its flight attitude and not progress into a dive. Such action is enabled by the lateral flexibility of the panel which permits it to change shape eccentrically and so cause the center of inflationary efforts to shift. Comparing Figs. 3 and 4, for example, in Fig. 4 the center of inflationary effort has shifted rightward from the longitudinal axis of the kite resulting in a relatively greater inflation of the right hand side of the panel than the left. Excess air currents applied to the right of the panel accordingly may spill over the edge thereof. At the same time the left side of the panel presents a broadly curved surface utilizing all available air to maintain a state of balance with the right side. In the operation of the kite, therefore, the inflationary and flight sustaining lines of effort radiate from a center which is a variable having no physical connection with the kite but restricted to a range of movement within the lateral dimension of the panel **10**.

From the above description it will be apparent that there is thus provided a device of the character described possessing the particular features of advantage before enumerated as desirable, but which obviously is susceptible of modification in its form, proportions, detail construction and arrangement of parts without departing from the principle involved or sacrificing any of its advantages.

While in order to comply with the statute the invention has been described in language more or less specific as to structural features, it is to be understood that the invention is not limited to the specific features shown, but that the means and construction herein disclosed comprise but one of several modes of putting the invention into effect.

Having thus described my invention, I claim:

1. A kite, including a flexible air foil panel presenting a relatively broad base defining the leading edge thereof and an opposite smaller end defining the trailing edge, tethers connected to the side edges of said panel adjacent said leading edge and joined together at their opposite ends to form a bridle, and means for bracing said panel against longitudinal flexure, said panel being capable of rocking bodily against the restraint of said tethers and of inflating laterally whereby changes in the velocity of the air streams may be compensated for by automatic adjustments in the angle of attack of the panel to the air stream and in the degree of inflation thereof.

2. A kite, including a flexible air foil panel flat in cross section and preventing leading and trailing edges, longitudinal stiffening means precluding material flexing of the panel in a fore and aft direction, there being an absence of lateral rigidity enabling inflation of the panel by the air stream, and a bridle connected to the opposite sides of said panel at aligned points intermediate said leading and trailing edges, said panel responding to changing air stream velocity by a bodily adjustment about said points and by an increase or decrease in inflation.

3. A kite, including a flexible air foil panel flat in cross section and presenting leading and trailing edges, longitudinal stiffening means precluding material flexing of the panel in a fore and aft direction, there being an absence of lateral rigidity enabling inflation of the panel by the air stream, and a yielding connection between aligned points at the sides of said panel to establish a transverse line of restraint variable in length with variations in the degree of inflation of the panel and about which the panel is bodily adjustable to vary the angle of attack to the air stream, said panel having an operational range represented at one extreme by a maximum angle of attack and a minimum inflation and at the other extreme by a minimum angle of attack and maximum inflation.

4. A kite comprising an airfoil member of flexible material capable of being arched by a supporting airstream and being shaped so as to effect a conical arch of the surface thereof transversely across the airfoil member, the crest of said arch being the longitudinal axis of said airfoil member, and bridle strings attached to said airfoil member on opposite sides of the longitudinal axis serving to guide and control said kite and present the surface thereof at a suitable angle of attack.

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