March 20, 1951 G. S. ROGALLO ET AL 2,546,078

FLEXIBLE KITE

Filed Nov. 23, 1948

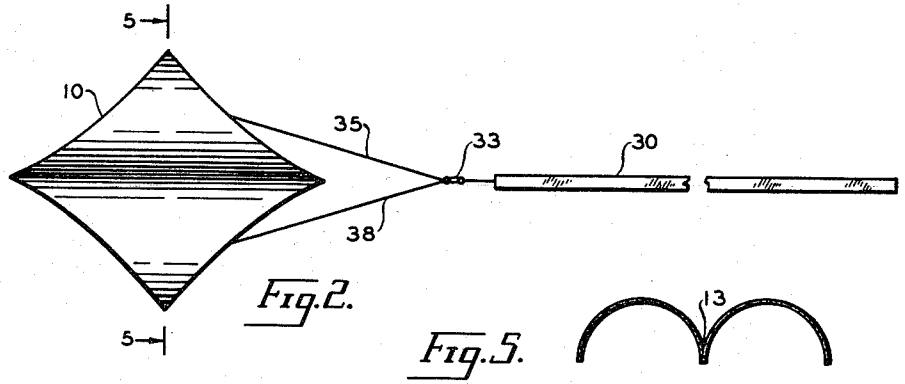

Fig. 2.

Fig. 5.

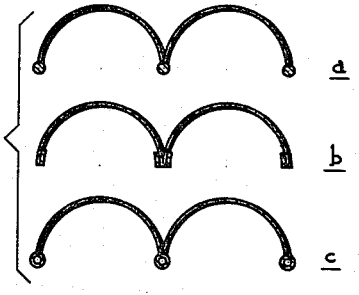

Fig. 6.

Fig. 3.

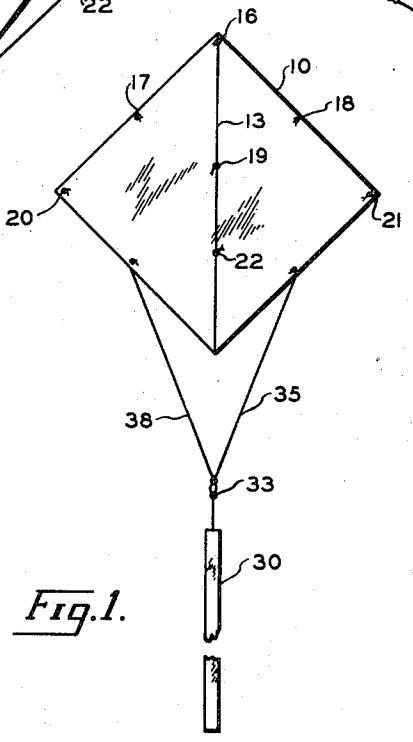

Fig. 1.

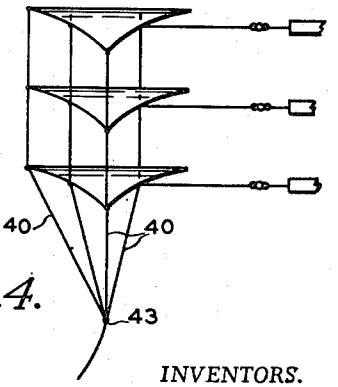

Fig. 4.

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Patented Mar. 20, 1951

2,546,078

UNITED STATES PATENT OFFICE

2,546,078

FLEXIBLE KITE

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Application November 23, 1948, Serial No. 61,702

9 Claims. (Cl. 244—153)

1

This invention relates to kites and more particularly to a kite having completely flexible surfaces.

It is an object of our invention to provide a kite of simple and economic construction and wherein the use of reinforcing members may be ordinarily eliminated.

It is another object of our invention to provide a kite which will be simple to fly and graceful in flight.

It is a further object of our invention to provide a kite structure which may be easily folded or rolled and requires a minimum of space in storage.

It is still another object of our invention to provide a structure for a kite having improved aerodynamic characteristics.

In general we achieve the above object by constructing a kite of a substantially quadrilateral piece of fabric, paper or other light and flexible material, having bridle strings attached at various points, and a tail secured to the kite when necessary, so that the stress in the strings exerted at strategic points of the kite's surface maintains the kite in proper shape and configuration to be effectively supported even in a light breeze. Owing to the fact that our kite does not require the use of stiffening members, it is considerably lighter than other kites of the same area and hence more easily flown in a light breeze.

Other objects and features of our invention will be evident from the detailed description which now follows taken in conjunction with the appended drawings in which:

Fig. 1 is a plan view of our novel type structure as it rests on a flat surface prior to flight;

Fig. 2 is a plan view of our kite in flight;

Fig. 3 is an elevation of our kite in flight showing an appropriate angle of attack;

Fig. 4 represents the manner in which a plurality of our kites may be coupled in flight;

Fig. 5 shows a section through 5—5 of Fig. 2; and

Figs. 6*a*–*c* show sections of various types of reinforcements suitable for use in conjunction with our kite, if desired.

With respect to Figs. 1 through 3, our invention contemplates the use of a substantially square piece of fabric or paper 10 forming a body member having a diagonal fold line 13 provided therein dividing the body into symmetrical sections that may belly upwardly on both sides of the fold line to form lateral support surfaces when aloft. A series of bridle lines 16 through 22 are symmetrically attached to the kite and are brought together and secured to a main control line 26, as shown in Fig. 3.

2

The bridle lines 16, 19 and 22 are secured to the kite at the fold line 13 in any suitable manner as by punching a hole through the material just above the fold line when the kite is completely folded, and then passing strings through the holes, tying the ends thereof so as to secure the strings in their respective holes. Alternatively, adhesive patches may be utilized to hold the string ends to the kite fabric at the fold line, if desired. The bridle lines 17 and 18 are secured to the kite fabric on either side of the center line, while the lines 20 and 21 are fastened substantially at the lateral tips of the square, all of these lines being adjacent respective leading edges of the body. The particular arrangement is indicated on Fig. 1, wherein is shown exaggeratedly the string ends passing upwardly through the kite body.

The length relationships of the several lines is such as to provide any desired degree of arcuateness of the body member sections depending on the degree of wind encountered. The relationship shown is suitably proportioned for general purposes.

In strong winds we have found a tail to be essential and we prefer to utilize for this purpose a ribbon-like material of any suitable type such as cloth or aluminum foil, indicated at 30. The tail 30 is attached through a swivel joint 33 to a pair of lines 35 and 38 which are secured to respective trailing edges of the kite substantially at the mid-portions thereof, as shown in Figs. 1 and 2. Alternatively, the lines 35 and 38 could be secured to the kite substantially at the locations shown for the ends of lines 20 and 21. It will be appreciated that the particular location for the attaching ends of the tail lines may be changed to suit various conditions, such as the size and weight of the kite, the weight of the tail, the wind encountered, etc. We have found, however, as a matter of actual practice, that the location shown in Figs. 1 and 2 is suitable for general purposes.

One of the pleasing aspects found in flying our kite is the fact that in gusty air or when the string is deliberately jerked the non-rigid structure allows the shape to change in a manner suggesting a flying or swimming creature. Further, in order to enhance the attractiveness of our kite, we may construct it of transparent material, such as cellophane, or cellophane reinforced with a grid of string embedded therein and provide colored pictures of birds, rockets, etc. translucently thereon. In addition, phosphorescent

paint may be used so as to obtain a startling and pleasing effect when flying our kite at night.

In physical aspect, our kite performs very successfully when constructed of reinforced cellophane paper cut as a square with the sides thereof about eighteen inches long. The tail may be attached thereto by a single string terminating at the diagonal line 13, but we prefer the two-string arrangement, hereinabove described. The swivel joint 33 prevents the whipping tail from twisting the strings 35 and 38 about each other.

In Fig. 4 is shown a manner in which a plurality of kites, as hereinabove described, may be coupled for simultaneous flight. It will be appreciated that the kites need not be all of the same size but might be of progressively smaller area, so that the bridle strings 40 would have no angular bends therein, but would represent elements and corners of an inverted pyramid from the juncture point 43 to the points of attachment with the uppermost kite.

While we have shown but one form of the kite insofar as configuration is concerned, other forms are entirely feasible. For example, rectangular and elliptical configurations may be used. Further, while we prefer to utilize non-rigid non-reinforced lifting surfaces, it will be appreciated that reinforcements could be applied as shown in connection with Fig. 6*a* through *c*, depending upon the particular use the kite is to be put and upon the size thereof.

Fig. 6*a* represents a kite following our teaching but utilizing a reinforcement of round cross section which may be applied at the center line 13 and also at the leading and trailing edges. Fig. 6*b* shows the manner of attachment of a reinforcement of flat cross section. Fig. 6*c* is similar to Fig. 6*a* except that the reinforcement is hollow and flexible so as to be filled with compressed air, or other gas, for maintaining rigidity.

Such reinforcements might conceivably be comprised of flexible materials such as wood and even more flexible material such as soft rubber tubing or adhesive tape. In any event, the reinforcing material should not be so stiff as to prevent the leading and trailing edges from assuming proper arcuate shape as the material of the kite bellies out in flight, although a rigid reinforcement could be used at the center line, if desired. In general, the use of reinforcements reduces the required number of bridle strings and considerable latitude may be exercised in the type of reinforcement used. It should be pointed out that for large kites intended for emergency use, for military or other purposes, the reinforcements may consist of hollow fabric tubes which are open at their front ends and closed at their rear ends so as to be inflatable by the oncoming wind and maintained in shape thereby. Further, the reinforcement of each edge may consist of a number of beads strung together and secured along the edge so that their mass will provide a degree of stability due to inertia, without sacrificing flexibility.

Like all kites, our kite obtains its lift from the action of the wind blowing past it. The kite is maintained at an inclined attitude relative to the wind, as shown in Fig. 3, by the bridle lines and the weight of the tail. The static pressure of the air on the lower surface of the kite is increased by the airflow and that on the upper surface is decreased, the pressure difference between upper and lower surfaces thereby providing a lift force perpendicular to the wind which supports the kite. This same pressure difference between upper and lower surfaces, in conjunction with the tension in the lines holds our kite in proper shape to efficiently utilize the air current. It is in this latter aspect that our kite distinguishes from those of the prior art, namely, the combination of a suitably flexible body and suitably proportioned bridle lines to effect a degree of arcuateness requisite to effective flight under widely varying wind conditions.

It is interesting to note the comparison between the principle of our kite and that of the conventional parachute. Both structures hold their shapes because of air pressure on a concave surface, but a parachute does not develop lift, it develops only drag, i. e. a force in the direction of the relative wind. Our structure, on the other hand, develops lift, i. e. a force perpendicular to the relative wind due to the wing-like shape in which the kite sections are maintained by the wind and the bridle lines. Further, we believe the principle described herein may be applied to man carrying devices, such as airplanes, parachutes and gliders, and in such event stabilizing and control surfaces could be added. We further believe that our principle could be utilized in the construction of a toy glider or airplane, and we have met with some experimental success by attaching a weight in place of the control string 26 and reflexing the trailing edge by means of a piece of string between the two ends of the center line. In this connection it should be noted that whatever structure or framework for supporting weights, motors, etc., might be utilized in conjunction with our device, such structure would be hung from the kite body and not secured to it in a manner which would tend to make the lifting surface rigid.

An additional phase of utility of our invention would be the construction of a kite embodying our principle but made of metal foil, either to serve as an antenna or as a radar target.

It will be appreciated that our invention is subject to many modifications without departing from the spirit thereof and we do not regard ourselves as limited to the specific illustration herein, except as set forth in the appended claims:

We claim:

1. In a device of the class described the combination of a body of flexible non-rigid material having a center line extending longitudinally thereof, and comprising wing-like sections extending transversely on either side of said center line, wherein said center line is effected by a crevice at the juncture of said sections and extends longitudinally the length of said body, and a plurality of bridle strings secured to said sections.

2. A kite comprising a body of non-rigid flexible material having a center line effected by the crevice at the juncture of symmetrical sections of said body, said sections extending outwardly and transversely to form a wing on each side of the center line, including a plurality of bridle lines secured to said sections and symmetrically disposed with respect to said center line, wherein said bridle lines are connected to each other at a common juncture and are relatively proportioned to effect transverse concavity of said wings in flight, said juncture being disposed relative said wings in flight so as to effect a glide angle therefor.

3. A kite comprising a substantially quadrilateral member of flexible non-rigid material having a center line extending diagonally thereacross, there being a leading edge and a trailing

edge on each side of said center line, and a plurality of bridle lines symmetrically disposed with respect to said center line and secured to respective edges of said quadrilateral member.

4. A kite comprising a substantially quadrilateral member of flexible non-rigid material having a center line extending diagonally thereacross, and a plurality of bridle lines symmetrically disposed with respect to said center line and secured to respective edges of said quadrilateral member, including at least one bridle string secured to said quadrilateral member at said center line.

5. In a device as set forth in claim 3, including a tail member secured to said quadrilateral member and comprising a ribbon-like element having a pair of lines extending therefrom to substantially the mid-points of the trailing edges of said quadrilateral member.

6. A kite comprising a wind supportable body of flexible non-rigid material shaped as a square and having a center line extending diagonally thereacross to divide said body into symmetrical wing-like sections, each having a leading and trailing edge, including bridle lines symmetrically disposed and secured to said edges, and a plurality of bridle lines in spaced relation and secured to said body at said center line, said bridle lines having a common juncture at their lower ends whereby a pull may be simultaneously exerted on all bridle lines, the structure being such that in flight the sections are maintained in arcuate shapes substantially symmetrical with respect to the center line due to pressure of the wind acting on their surfaces in conjunction with tensile force exerted on said bridle lines.

7. A kite comprising a body member of flexible non-rigid material and having a center line effected by juncture of symmetrical sections of said

body extending transversely with respect to the direction of oncoming wind, including a plurality of bridle lines secured to said symmetrical sections and to said body at said center line and having a common juncture, certain of said lines being attached to the outermost portions of said sections, whereby symmetrically arcuate sustaining surfaces are formed in said body member by oncoming wind acting against said sections in conjunction with tensile stress exerted thereon by said bridle lines.

8. In a device as set forth in claim 7, including a tail for said kite, comprising a ribbon-like material and a pair of lines secured to said body member symmetrically on opposite sides of said center line, including a swivel joint between said lines and said ribbon-like material.

9. In a device as set forth in claim 7, including reinforcements at the edges of said body member and at the center line thereof, said reinforcements being comprised of a yieldable non-rigid material capable of flexure during flight to a lesser degree than said body material.

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