July 31, 1951 R. P. HOLLAND, JR 2,562,789

KITE

Filed Oct. 18, 1948 2 Sheets-Sheet 1

FIG. 1.

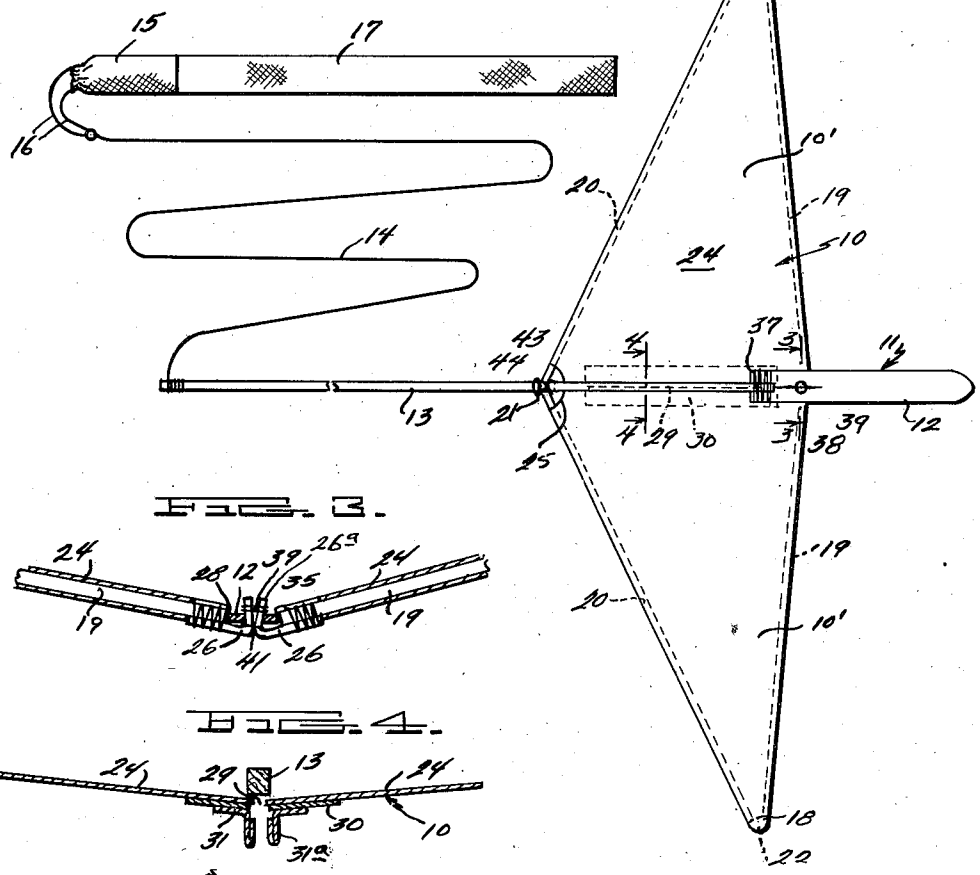
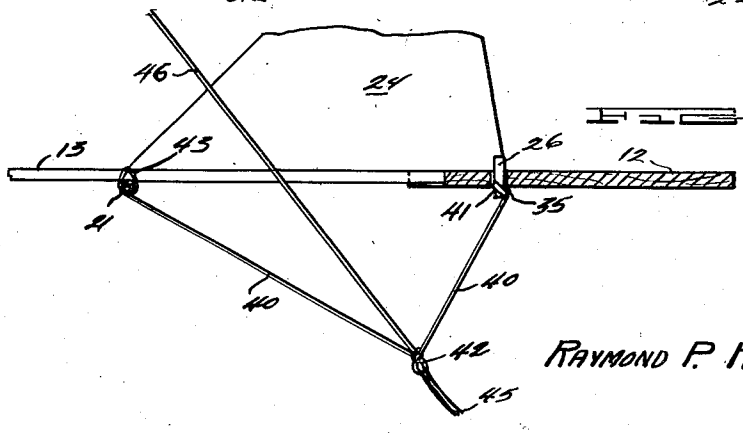


FIG. 3.

FIG. 4.

FIG. 2.



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KITE

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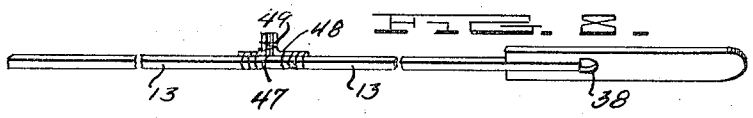


FIG. 8.

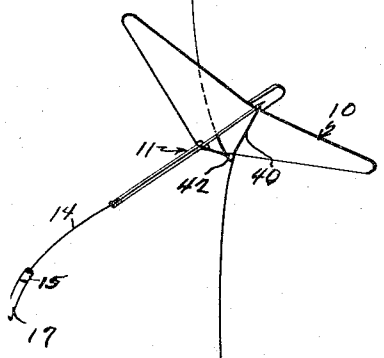


FIG. 9.

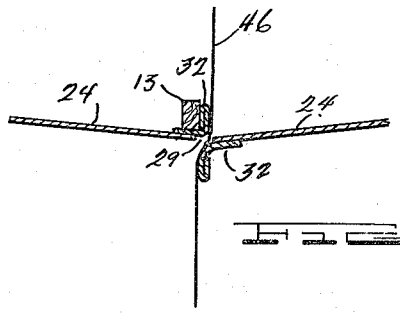
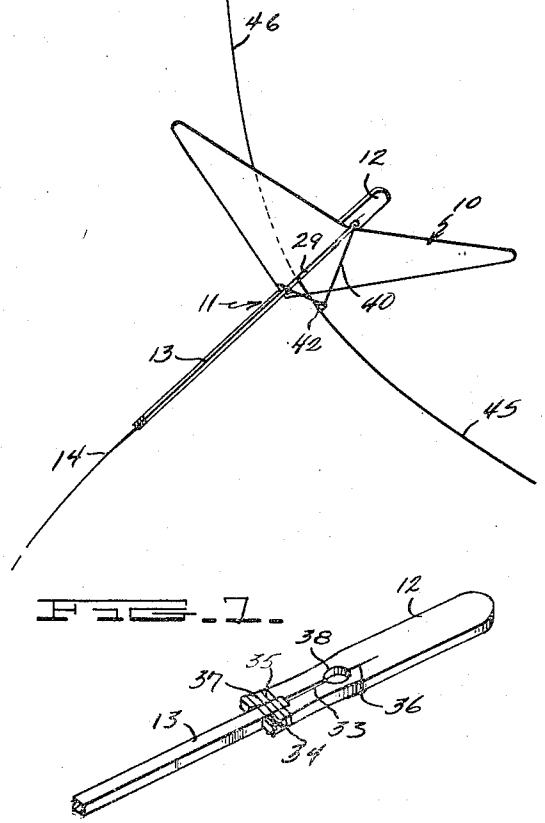


FIG. 5.



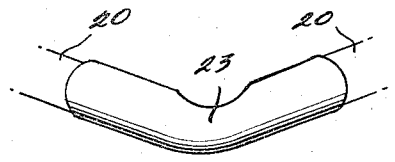


FIG. 6.

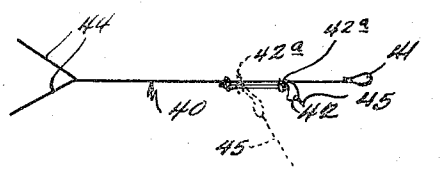


FIG. 10.

FIG. 7.

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UNITED STATES PATENT OFFICE

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KITE

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Application October 18, 1948, Serial No. 55,116

19 Claims. (Cl. 244—153)

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This invention relates to kites and has specific reference to a folding kite which has improved aerodynamic qualities and may be flown by itself, or in a multiple kite flight system.

Whereas airplane design has constantly kept pace with the increased knowledge of aerodynamics, the design of kites has changed little if any as a result of this knowledge. Heretofore no kite has been successfully designed whereby several kites may be flown, one above another in stacked relationship on a single ground cord, contrasting with conventional use of a plurality of ground cords branching out from a single cord held by the operator.

It is a primary object of this invention to apply modern principles of aerodynamics to kite design and thereby produce a kite of greater flight stability and lift, and greater maneuverability.

Another object of this invention is to provide a kite from which other kites may be flown to achieve multiple flying.

Another object of this invention is to provide a kite which has novel features of design permitting easy foolproof assembly of the kite in such manner that the require delicate balances of the structural members of the kite are attained.

Another object of this invention is to provide a kite having a novel tail structure which is readily adjustable to attain maximum flying performance under various wind conditions.

Still another object of this invention is to provide a kite of inexpensive construction which is easy to manufacture in quantity.

With these and other objects in view the accompanying drawings and detailed description of the invention are set forth for the purpose of fully explaining the various features comprising the invention and, are not to be regarded as limiting the scope and spirit of the invention except as defined in the appended claims.

In the drawings:

Figure 1 is a top plan view of the assembled kite of this invention showing the tail attached;

Figure 2 is a fragmentary longitudinal section of the kite viewed along the central axis thereof;

Figure 3 is a fragmentary elevational view of the kite taken along the lines 3—3 of Figure 1;

Figure 4 is a fragmentary cross section of the kite taken along the lines 4—4 of Figure 1;

Figure 5 is a fragmentary cross section of the kite showing a further embodiment of string aperture in the kite wing receivng the attaching cord of the next higher kite in a series of kites in multiple flight;

Figure 6 is a fragmentary perspective view

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showing how the ends of the sticks forming the wing edges are joined at the outer tips and at the rear of the wing;

Figure 7 is a perspective view of the body member of the kite showing the details of one type of construction of the nose piece and tail piece in assembly;

Figure 8 is a fragmentary perspective view of the kite body structure as modified for factory assembly;

Figure 9 shows a plurality of kites being flown from one ground cord to accomplish multiple flying, and Figure 10 is a detailed view of the bridle.

In its broadest concept this invention embodies a kite of aerodynamic proficiency having a single long narrow wing or lifting surface which is mounted on a kite body member formed of novel tail and nose piece constructions, and having a bridle provided with an attachment for receiving a ground cord. Means are provided for forming a dihedral wing provided with a reinforced slit in the surface thereof through which the flying or ground cord may be extended for attachment with another higher flying kite. It is contemplated that several kites may be flown from one ground cord by attaching the flying cord of one kite to the bridle of a second kite beneath the first. Unique means also are provided for removably connecting the tail piece to the nose piece, and further means are provided for effecting a secondary balance in the kite through an adjustable ballast bag attached to a cord on the end of the tail extension.

Referring in particular to the drawings there is shown in Figure 1 the kite of this invention having a single lifting surface or wing 10 mounted beneath a body member generally designated as 11. The member 11 is comprised of a nose piece 12 and a tail piece 13. A leader string 14 is attached to the tail piece of the kite, and a ballast bag 15 is attached to the end of the string. Drawstrings 16 are provided for closing the mouth of the bag and for attachment to the string 14. A streamer 17 may be provided extending to the rear of the ballast bag, said members being provided for purposes to be described.

The characteristic rigidity of the wing structure is an important factor in the successful operation of the kite. In addition a sturdy wing construction is provided which does not deflect under torsion and strain incident to flight in strong winds to any degree. In accordance with the present invention, the lifting surface or wing 10 is composed of two triangular panels 10' of equal size positioned on each side of the body

member 11, the panels forming a diamond shaped flight surface converging to small outer wing tips 18. Relatively rigid structural members 19, which may be formed conveniently of wood, metal or plastic, outline the leading edges of the wing panels, as shown generally in Figure 3, and similar members shown as sticks 20 outline the trailing edges of the panels. A flexible joint 21 joins the adjacent ends of the sticks 20 forming the trailing edges of the panels, where the edges meet at the rear of the lifting surface. A similar flexible joint 22 is provided to secure the outer ends of the sticks 19 and 20 joining at the tips 18 of the wing panels. As shown in detail in Figure 6 these joints 21 and 22 may be formed of such materials as flexible rubber or plastic tubing 23, formed with open ends receiving and firmly securing the adjacent ends of the sticks 19 and 20.

A sheet of paper or other wing covering material 24 is cut to the proper shape and folded over the leading and trailing sticks 19 and 20 forming the frame. The free edges of the paper 24 may be glued in position on the frame, secured with adhesive tape, or secured in some other convenient way. An arcuate opening 25 is formed in the covering 24 at the rear of the lifting surface to permit binding of said covering 24 cleanly to the frame, and to provide access at this point to the body member for purposes to be described. It will be noted that the joints 21 and 22 employed in joining the frame sticks should preferably be formed so that they are flexed inwardly slightly in forming the frame, thus setting up a force tending to expand the cover 24 forming the lifting surface out to full, taut dimension at all times.

The leading edges 19 of the wing 10 are joined in the front by a unique member which permits folding of the wing for packaging or when not in use, and ready assembly of the kite for flying. Figure 3 shows fragments of the right and left leading edge sticks 19. A match angled member 26 is bound or otherwise secured to the inner end of each stick 19. The cover paper 24 loosely retains the match angles and the two leading edge sticks 19 in adjacent relationship. The wing covering material 24 may preferably be cut back at this point at 28 to allow the upturned ends 26*a* of the match angles 26 to protrude above the plane of the covering 24. It will be noted that the match angles are bent at such an angle that when the upturned ends 26*a* are brought together, the tips 18 of the wing 10 are raised to impart the desired dihedral conformation to the wing.

As shown by the dotted lines near the body member in Figure 1, special provision is made in the wing to permit a flying cord to pass through the wing cover for attachment of a second kite to the first kite, flying one kite above another. Figure 4 shows one embodiment of this construction including as the main elements the tail piece 13 with the wing 10 disposed below it. The central portion of the wing cover 24 is cut lengthwise to form a slit 29, extending longitudinally of the cover for sufficient length so that fore and aft movement of a kite flying above the kite shown will not affect the longitudinal stability and balance of the lower kite to which it is attached. A reinforcement for the cover 24 adjacent the slit 29 such as paper or fabric tape 30, is affixed on each side of the slit to prevent tearing. The edges of the cover 24 defining the slit may be further reinforced by provision of a covering or closing strip of relatively stiff tape 31 on the undersurface of the cover having depending parallel projections 31*a*, which minimize the wind leakage through the slit 29.

Figure 5 shows a further embodiment of this feature of the invention, wherein reinforcing sealing members 32 are affixed to the edges of the slit 29 on opposite sides of the cover 24. The members 32 normally overlap to seal the slit 29, preventing the passage of air through the slit 29. When a string forming an attachment for an overhead kite is passed through the slit, however, the overlapping members 32 are forced back as shown, to receive the string indicated as 46. At other points along the slit 29, the edges 32 remain in overlapping relationship, thereby minimizing the size of the aperture 29 in the flight surface of the wing. Other means such as straps or groups of cord slung beneath the slit are contemplated for protecting and covering the slit 29.

The preferred construction of the body member of the kite is disclosed in detail in Figure 7. The tail piece 13 may be formed as a stick of wood, plastic or other suitable material of sufficient length to impart a definite leverage to the lifting surface of the kite through the action of the ballast bag 15. The nose piece 12 is formed as a flat piece of light wood having a narrow slot 33 at its rear end opening into a wider slot 34 defined by squared shoulders 35 of the nosepiece 12. A narrow slot 36 extends further up along the nose piece so that the nosepiece is capable of exerting a clamping action on the front end of the tail piece 13 when inserted in the slot 34. The tail piece 13 is assembled with the nose piece 12 by forcing the forward end of the tail piece home in the slot 34. The positive clamping action of the nosepiece may be reinforced by binding the shoulders 34 of the nosepiece together with a rubber band 37 or other convenient means securing the tail piece positively in position. Where a permanent assembly of the nosepiece and tail piece is desired the tail piece 13 may be glued in the slot 34, in which case the narrow slots 33 and 36 may be dispensed with in a construction to be described more in detail.

A transverse aperture 38 is cut into the nose piece 13 between the slots 33 and 36 to receive the upper ends of the match angles 26 on the sticks 19 forming the leading edge of the wing. In Figure 3 the match angles 26 are passed through the aperture 38 and then bound as by a rubber band 39 to raise the wing tips to a desired dihedral flight position. It will be noted that the correct dihedral angle is achieved automatically by the use of the match angle construction at the centerline point of the wing sticks. When the rubber band 39 is in place, the diameter of the binding assembly is somewhat larger than the aperture 38, and thus secures the sticks 19 in place on the front piece 12. The rearward part of the wing 10 is secured to the tail piece 13 at the rear joint 21 of the wing sticks 20 in such manner that the wing 10 is hinged at this point to swing freely rearwardly beneath the body member 11 when the wing is not attached to the front piece 12, a preferred hinge construction being described hereinafter.

In the construction of kites according to this invention, the center of gravity of the kite is determined by the degree of forward extension of the nose piece 12 relative to the length of the tail piece 13, the center of gravity of the kite being determined with the tail cord removed. The forwardly extending nose piece 12 protruding well beyond the wing 10, is an essential factor relative to the improved performance of the kite,

for the overall design necessitates that the center of gravity, exclusive of the ballast bag, be located forward at least to the region of the center point of the wing 10. As normally constructed, the kite of this invention is formed with the tail piece 13 preferably extending approximately twice the width of the center of the lifting surface or wing 10 to the rear of the lifting surface. It is important that the nose piece 12 then be formed to bring the enter of gravity of the kite forward at least to the region of the middle of the lifting surface or wing 10. For this reason, it is preferred to construct the nose piece 12 after the other details of construction have been worked out, to ensure that the nose piece is formed in length meeting the balance requirements of the kite.

For purposes of flight control, a bridle 40 of twine is attached below the body member of the kite as shown in Figures 2 and 10. This bridle 40 is designated and constructed to accurate dimensions so that a flying cord will exert pull on the kite at the proper angle when attached to the bridle. Thus the critical balance factors of the bridle 40 as well as the kite body member and lifting surface or wing 10, without which stable flight is impossible, are inherent throughout the construction. The forward end of the bridle is provided with a loop 41 which is fitted over the match angles 26 before the wing 10 is attached to the nose piece 12, assisting the cover 24 in retaining the match angles together at the base. A fixed flying cord attachment 42 is placed on the bridle 40 at a point which is forward of the perpendicular through the center of gravity of the kite, thereby ensuring that the flying cord always will be secured in the proper position on the bridle. The bridle 40 is secured to the tail piece 13 at 43 and two free ends 44 of the bridle string may be used conveniently to bind the rear of the wing 10 to the tail piece 13, forming the desired wing hinge point mentioned previously. The hinge is formed conveniently by crossing the string ends 44 over the body member and knotting, as shown in Figure 1. A ground cord 45 is tied to the bridle attachment 42.

A sliding ring 42*a* which may be formed of wire, rubber or other material may be positioned around the bridle 40 and the attachment 42. The ring 42*a* improves the ease of launching of the kite, as well as the flight characteristics at high elevations. As shown in Figure 10, with the ring 42*a* in forward position as shown by the solid lines, the ground cord 45 angles well forward. As the kite ascends the cord 45 angles more to the perpendicular, the string tension on the ring 42*a* moves the ring rearward to the dotted line position, thereby automatically adjusting the position of attachment of the cord 45 to the bridle 40 to the most favorable position for the characteristic of flight of the kite. The ring 42*a* should be of restricted diameter fitting snugly over the bridle and attachment so as to move only under tension exerted thereon by the ground cord.

In the multiple flying of kites, a second flying cord 46 is tied to the bridle 40 of the first kite at the attachment 42 and passed upward through the slit 29 in the wing 10 of the first kite for attachment to the bridle of a second kite flying at a higher altitude, as shown in Figure 9. In this way practically all forces exerted by the cord 46 are absorbed by the ground cord 45, preventing disturbance of the flight performance of the lower kite. It is to be noted that the flying cord 46 of the higher kite usually is pitched at a steeper angle to the perpendicular for it is able to exert more lift since the upper kite has less flying cord length to carry. Thus, it is possible to fly the upper kites of a flight series out of sight by stringing up or stacking the kites in this manner. Also a great deal of lifting power can be generated which would be useful in the carrying of scientific instruments, for the added kites increase the preponderance of lift over drag.

The kite of this invention is constructed so that it may be folded into a small bundle when not in use and rapidly assembled for flight in a simple operation. To fold the kite, the rubber band 39 is removed from the match angles 26 in the nose piece 12 and the match angles are pushed out of the nose piece aperture 38. The tips of the wing 10 are folded downwardly underneath the body member 11 in contact with one another and the entire wing 10 swung on its rear hinge 44 up under the tail piece 13. The leading edges 19 of the wing 10 are then pressed up against the trailing edges 20 with the cover paper 24 folded to one side to prevent undue creasing. The nose piece 12 is removed from the tail piece 13, placed beside the tail piece, and the whole assembly including the ballast bag and bridle, is wrapped up and secured with the tail cord 14 in a slender bundle.

Another body member 11 construction is shown in Figure 8, which permits folding of the body structure of the kite into a short bundle without disassembly. In this embodiment, the tail piece 13 is cut into two parts at 47 just behind the usual point of attachment of the rear part of the wing 10. Match angles 48 are secured to the adjacent ends of the tail piece 13 by binding or otherwise, and secured by a rubber band 49 to form a continuous straight tail piece 13. In this construction, the forward end of the tail piece 13 preferably is glued into the slot 34 at the rear of the nose piece 12, there being no slot extending forward of the aperture 38. In folding the kite up, the rubber band 49 is removed from the match angles 48 and the outer portion of the tail piece 13 is folded up against the nose piece 12.

The trailing tail 15 of the kite comprises one adjustable feature of the assembled kite which functions in a different way from that on a conventional kite. Normally the equilibrium in pitch of conventional kites is secured by the bridle and the tension in the flying string, which create a stable system in opposition to the aerodynamic forces. When these aerodynamic forces lessen as during a lull in the wind, the tension in the flying string also lessens, the pitching restraint exercised by the bridle lessens, and the weight of the kite acting at the center of gravity, previously a minor item, becomes a major influence.

The center of gravity must not be too far forward relative to the lifting surface area or the kite will dip its nose and glide forward slacking the flying string, perhaps circling as it glides, with the consequence that a resumption of wind will find the kite divorced from the string action, and unlikely to regain steady flight as a kite—neither may the center of gravity be too far aft, for then in spite of the normal restraint of the bridle the kite will oscillate nose up and nose down in gusty air as it seeks to move as a free dynamic body, pivoting about its center of gravity.

The rearward center of gravity is especially troublesome in its directional and lateral effects

for the reason that no restraining bridle exists in these planes. The conventional kite shows this when on the verge of instability by swinging and rocking pendulum fashion. The next step in the development of its instability is lateral autorotation.

These instabilities are dynamic in origin, and damping is needed to overcome them. In the conventional kite, the damping is provided by means of a rag tail attached to the lower extremity of the body stick. This is effective in itself, but since it adds mass in a rearward position, it defeats its own purpose to a considerable extent. Therefore the rag tails must be very long. The length supplies the desired quantity of damping and it also isolates much of the mass of the rag tail from the dynamic system of the kite proper—long rag tails have the disadvantage however that their air resistance is very great. They carry the kites downwind and make high flights impossible.

In the kite of this invention a novel tail is used as part of the means of curing these stability and performance difficulties. This novel tail is so effective that even conventional kites are able to fly much higher and much steadier when using it. It provides a downward and rearward pull on the rearward tip of the tail stick, always to make the kite angle upward, without introducing the undesirable dynamic effects which would exist if a fixed weight were used on the tail for the same purpose. This is accomplished by the ballast bag **15**, remotely connected to the tip of the tail stick by the long cord **14**. When flight is steady this tail exerts a steady force, but at other times the bag **15** is unable to follow the short quick rotations which take place about the center of gravity of the kite proper. The action of the tail is then intermittent and delayed, but always occurring before a sufficient time interval has elapsed to permit the kite to depart very far from its equilibrium position. Further, the aerodynamic drag of this tail is very small, enabling high flights to be performed with ease.

The kite of this invention is better suited to the action of this novel tail than is a conventional kite because it is slower than is a conventional kite to depart from its equilibrium attitude when restraints are temporarily removed. This inert character is due in part to the small narrow wing. By its narrowness, the wing closely limits the fore and aft extent over which the aerodynamic forces may act on the kite, and thus assures that the resultant force will always lie at a short moment arm (in absolute dimension, not relative to chord dimension) from the center of gravity. By its small size the wing assures that the distributing force will be small. Therefore the disturbing moments on the kite will be correspondingly small. The steadiness of the kite is also due in part to the nose and tail sticks extending fore and aft, and the long wings extending sideways. These assure large moments of inertia and corresponding reluctance to angular acceleration. The long wing serves in still another way by creating a large amount of aerodynamic damping in roll. Also the wing system has little fore and aft camber and correspondingly little tendency to pitch. Due to these features, this kite with string tail attached is able to preserve both its equilibrium and flight efficiency in strong gusty winds.

The streamer **17** on the ballast bag **15** is used to provide a small degree of damping of movement of the bag **15**, thereby stabilizing the kite and

enabling use of a shorter tail cord **14**. In particular the streamer assists in keeping the ballast weight from being thrown higher than the kite during maneuvering flight in a gusty wind. The streamer is not essential to satisfactory operation of the kite however, and can be readily dispensed with if a longer tail cord **14** is provided.

The ballast bag **15** serves primarily as a convenient means for the attachment of ballast to the end of the kite tail cord. The smooth, tapered form of the bag **15** makes it less likely that the bag **15** will snag on the ground in take-offs and offers less drag in the air. It may be filled with varying numbers of pebbles, stones, etc., the precise number employed depending on the wind and height of flight desired. As the operator becomes skilled in flying the kite he will be able to select the proper amount of ballast to be used, depending on the flight characteristic desired.

Variations in the details of construction of the invention will be apparent to one skilled in the art. Accordingly, the invention is to be limited in scope only as defined in the appended claims.

I claim:

1. A kite comprising a lifting surface, a body member carrying the lifting surface and having a tail piece and nose piece, said tail piece extending beyond the lifting surface for a distance greater than the average width of the lifting surface, said nose piece extending forward of the lifting surface sufficient to bring the center of gravity of the kite forward at least to the region of the center of gravity of said surface, a flying cord, a bridle attached to the body member well forward of the trailing end of the tail piece and extending below said lifting surface, and an attachment on the bridle for connecting the flying cord thereto forward of a perpendicular through the center of gravity of the kite.

2. A kite comprising a lifting surface, a body member carrying the lifting surface and including a nose piece and tail piece, said tail piece being relatively rigid and of greater length than the average width of the lifting surface, said nose piece extending forward of the lifting surface to a distance sufficient to bring the center of gravity of said kite forward at least to the region of the center of gravity of the lifting surface, a single tail cord attached to the end of the tailpiece exerting a minimum of drag on the tailpiece, and a ballast bag at the end of said cord.

3. A kite comprising a lifting surface, a body member carrying the lifting surface and including a nose piece and tail piece, said tail piece being relatively rigid and of greater length than the average front to rear dimension of the lifting surface, said nose piece extending forward of the lifting surface a distance sufficient to bring the center of gravity of said kite forward at least to the region of the center of gravity of the lifting surface, a tail cord attached to the end of the tail piece the cord exerting a minimum of drag on the tail piece, a ballast bag at the end of said cord, and a streamer attached to the end of said ballast bag.

4. A kite comprising a body member, a lifting surface on the body member having an aperture therein, a flying cord attached to the body member and a second flying cord attached to the said member and extending through the aperture in the lifting surface for securing a second kite both flying cords being attached to the body member at a point forward of a perpendicular through the center of gravity of the kite.

5. A kite comprising a body member having a tail piece, a lifting surface on the body member having an aperture therein, a first flying cord, a member on the lifting surface for attachment to the first flying cord, a second flying cord attached to said member and extending through the aperture in the lifting surface for securing a second kite, a thin tail cord on the tail piece, and a ballast member on the end of the tail cord.

6. A kite comprising a body member, a lifting surface attached to said body member and having an aperture therein, a flying cord, a bridle below said lifting surface for attaching the kite to the flying cord, and a second flying cord attached to said bridle and extending upward through said aperture for carrying a second kite the flying cord attachments being forward of a perpendicular through the center of gravity of the kite.

7. A kite comprising a body member, a lifting surface attached to said body member and having a longitudinal aperture in the center portion thereof, a member on the surface edges defining said aperture to minimize wind leakage, a first flying cord, a bridle below said surface for attaching the kite to the flying cord, and a second flying cord attached to said bridle and extending upward through said aperture in the lifting surface for attachment to a second kite.

8. A kite comprising a body member, a single lifting surface attached to said body member and having a longitudinal aperture in the center portion thereof, reinforcing members on the surface edges defining the aperture, closing members adjacent the said surface on both sides of the aperture to minimize the wind leakage through the aperture, a flying cord, a bridle below said surface for attaching the kite to the flying cord, and a second flying cord attached to said bridle and extending upward through said aperture for attachment to a second kite.

9. A kite comprising a body member, a single lifting surface having leading and trailing edges attached to said body member and having a longitudinal aperture in the center portion thereof, a flying cord, a bridle suspended below said lifting surface between the points on the kite where the leading and trailing edges of the lifting surface intersect the body member, a fixed attachment on the bridle positioned between the points of suspension of the bridle under the lifting surface, for attaching said flying cord, and a second flying cord attached to said bridle at said fixed attachment and extending upward through said aperture for carrying a second kite.

10. A kite comprising a body member, a single lifting surface having rigid leading and trailing edges and attached to said body member so as to center said lifting surface over said body member, said surface having a longitudinal aperture in the center portion thereof, a flying cord, a bridle attached to the body member below said surface for attaching the kite to the flying cord, and a second flying cord attached to said bridle and extending upward through said aperture in the lifting surface for carrying a second kite.

11. A kite comprising a body member, a single lifting surface centered on said body member, rigid members in the leading and trailing edges of the lifting surface, tubular expansible joints joining the leading and trailing edge members, said lifting surface having a longitudinal aperture in the center portion thereof, a flying cord, a bridle positioned below said lifting surface, and a fixed attachment on the bridle to connect the flying cord to the bridle forward of a perpendicular through the center of gravity of the kite.

12. A kite comprising a nose piece and a tail piece held in longitudinal engagement to form a body member, and a single lifting surface having leading and trailing edges attached to said body member, said tail piece extending to the rear of the lifting surface to a distance greater than the average front to rear dimension of said surface, said nose piece extending beyond the leading edge of said surface to a distance sufficient to bring the center of gravity of the kite forward at least to the region of the center of gravity of the lifting surface.

13. A kite comprising a tail piece having a forward end, a nose piece having a slot to receive the forward end of the tail piece, a binding material securing the joined ends of the nose and tail pieces to form a body member, a single lifting surface having leading and trailing edges attached to said body member, said tail piece extending to the rear of the lifting surface to a distance greater than the average width of said surface and said nose piece extending beyond the leading edge of said surface to a distance sufficient to bring the center of gravity of the kite forward at least to the region of the longitudinal center of the lifting surface.

14. A kite comprising a tail piece, a nose piece having a slot at the rear thereof to receive the forward end of the tail piece in longitudinal extension of the nose piece, to form a body member, said nose piece having a slit extending forward of said slot to allow expansion of the nose piece defining said slot for receiving the tail piece, a binding material clamping the ends of the nose and tail pieces together, a single lifting surface having leading and trailing edges attached to said body member, said tail piece extending to the rear of the lifting surface to a distance greater than the average width of said surface and said nose piece extending beyond the leading edge of said surface to a distance sufficient to bring the center of gravity of the kite forward at least to the region of the longitudinal center of the lifting surface.

15. A kite comprising a tail piece, a nose piece having a slot at the rear thereof to receivably engage the forward end of the tail piece in longitudinal extension to form a body member, said nose piece having an aperture disposed forward of said slot, a lifting surface having a leading edge, match angles fixed to the leading edge of the lifting surface for insertion through the nose piece aperture, and a securing member to bind said match angles together where they protrude through said aperture, to detachably secure the leading edge of the lifting surface to the body member.

16. A kite comprising a tail piece, a nose piece arranged in longitudinal extension to form a body member, said nose piece having an aperture, a single lifting surface, rigid members in the lifting surface forming right leading and trailing edges and left leading and trailing edges, the rigid members forming said right and left trailing edges being flexibly joined and attached for hinged movement on the tail piece, a match angle fixed to the inner end of each rigid member forming the leading edges and having an up turned extension to be inserted through the nose piece aperture and extend above the surface of the nose piece, said match angles being formed at such an angle that when placed with the up turned extensions in adjacent relationship a di-

hedral angle is imparted to the lifting surface, and a binding member for securing the upturned ends of the match angles together, said binder being of greater diameter than the nose piece aperture whereby the leading edge of the lifting surface is detachably secured to the body member.

17. In combination, a plurality of kites for flight in stacked relationship with a single ground cord, comprising a first kite, comprising a body member, a single lifting surface attached to said body member, said surface having an aperture in the center portion thereof, a ground cord, a bridle below said surface for attaching the ground cord to the first kite, a second kite above the first kite and a flying cord attached to said bridle of the first kite and extending upward through said aperture in the lifting surface of the first kite for attachment to the second kite, whereby the lifting power of the second kite is imparted directly to the ground cord of the first kite.

18. A kite comprising a body member, a lifting surface having an aperture formed therein, closing members adjacent the aperture to minimize wind leakage, a flying cord in connection with the body member, and a second flying cord in connection with the first cord and extending upwardly through the aperture for attachment to a second kite.

19. A kite comprising a body member, a lifting surface having leading and trailing edges attached to the body member, the body member extending rearwardly of the trailing edge of the lifting surface a distance greater than the average width of said lifting surface, the body member extending forwardly of the lifting surface forming a nose piece beyond the leading edge a distance bringing the center of gravity of the kite forward to the region of the longitudinal center of the lifting surface, and means for detachably securing the leading edge of the lifting surface to the body member.

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Publication: "The Use of Kites in the Exploration of the Upper Air," by C. F. Marvin. Page 211, Figures 57 and 58.

Certificate of Correction

Patent No. 2,562,789 July 31, 1951

RAYMOND P. HOLLAND, JR.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows:

Column 1, line 26, for "require" read *required*; line 53, for "receivng" read *receiving*; column 5, line 10, for "enter" read *center*; line 21, for "designated" read *designed*; column 7, line 58, for "distributing" read *disturbing*; and that the said Letters Patent should be read as corrected above, so that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 2nd day of October, A. D. 1951.

[SEAL]

THOMAS F. MURPHY,
Assistant Commissioner of Patents.