March 26, 1963 W. C. KNOX, JR 3,082,572

AERIAL TOY

Filed Oct. 5, 1961 2 Sheets-Sheet 1

FIG. 1

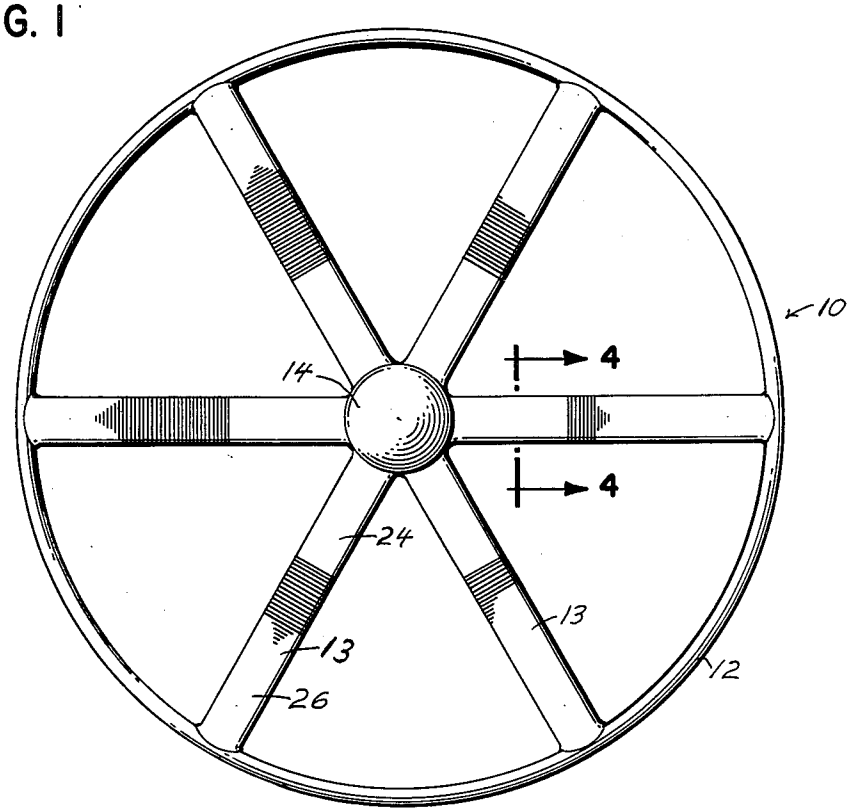
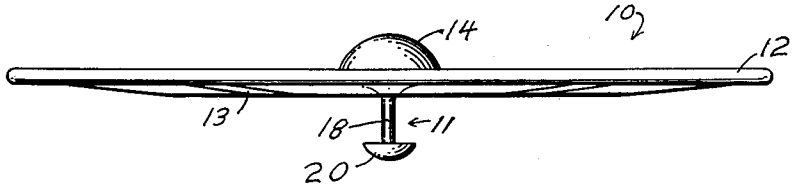


FIG. 2



INVENTOR.
WILLIAM C. KNOX JR.

BY Barnes & Seed

ATTORNEYS

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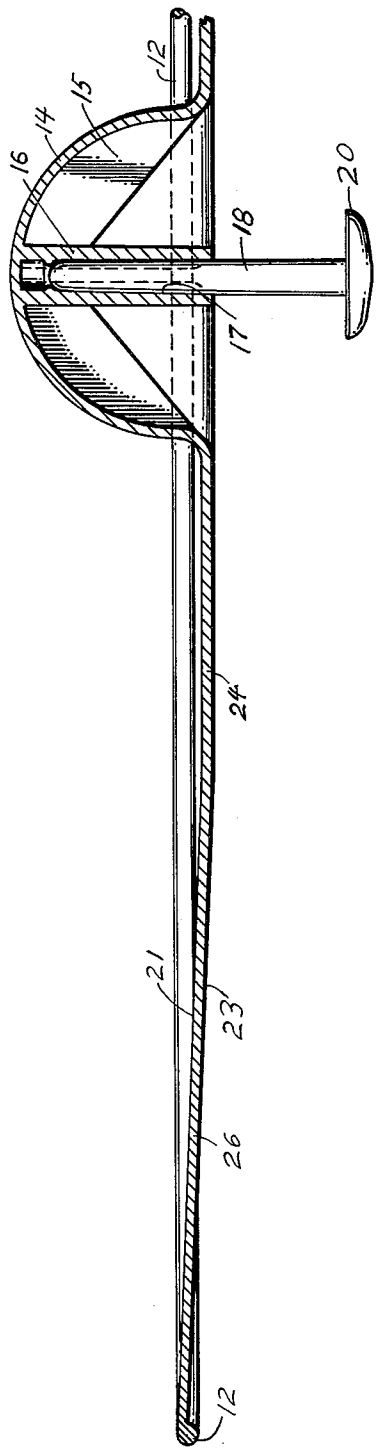


FIG. 3

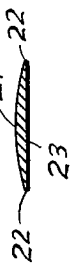


FIG. 4

INVENTOR.
WILLIAM C. KNOX, JR.

BY Barnes & Seed

ATTORNEYS

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AERIAL TOY

William C. Knox, Jr., Seattle, Wash., assignor to Knox Instruments, Inc., Seattle, Wash., a corporation of Washington

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5 Claims. (Cl. 46—82)

This invention relates generally to an educational and amusement device, and more particularly to a satellite model which can be propelled in a manner to follow a generally predetermined glide path through the atmosphere.

Plans for a "space station satellite" have been quite realistically directed to designs which provide an outer ring having facilities for a permanent living area. The satellite is to rotate about the center axis of the ring so as to create within the area of the interior of the ring a centrifugal force which simulates the earth's gravitational pull. Connecting this ring to the center hub of the satellite, will be a plurality of radially extending tubular chambers to be used for storage. The hub itself will furnish space both for machinery and an observatory for studies of outer space. Apparatus for power and for heat exchanging must be provided at a location removed from the rest of the satellite. Thus a suitable housing structure for such apparatus is spaced below the hub and connected thereto by an axially extending stem. A self-sufficient city, such a satellite is to circle the earth about once every two hours, on an orbit over a thousand miles above the earth's surface.

With this design being generally promulgated as a practical structure for an orbiting space station, it is the general object of this invention to provide a device which has the overall appearance in miniature of such a space station, and which can, with relative ease, be propelled through the air in a manner to follow an orbital glide path suggestive of that of an earth satellite, such path including a launching, an orbital flight, and a landing.

Ancillary to the above is the object of arranging this device so that its main components simulate in appearance corresponding components of the aforedescribed space station, and also serve practical physical functions which cooperate to produce the desired orbital flight path of the device.

More particularly, it is an object to provide a device which can be launched on its desired path with an easy throwing motion, this motion being such that a person, after very little practice, can launch the device on an orbital path which terminates very close to the locus of the launching.

It is a further particular object to so arrange this device that by modifying the design specification of the physical components with respect to one another, many various patterns of flight can be achieved, so that the particular requirements of the prospective user of the device can be properly satisfied.

It is a still further object to arrange the device with a depending member which, aside from aiding in the accomplishment of the foregoing objects also serves as a convenient handle by which the device may be caught upon completion of its orbital flight.

It is yet another particular object to so arrange the device that it is able to land on the ground surface with little likelihood of being damaged.

Yet a further object is to so arrange the device that as it travels in the prescribed manner, it will create gyroscopic forces along with aerodynamic and other related forces, all of which forces coact upon the device in a manner to create the desired flight path.

It is another particular object to provide a device in which the component parts are such that the device is easy and economical to manufacture, and which is of such rugged construction as to withstand rough and frequent usage.

The above and other objects and advantages in view will appear and be understood in the course of the following description and claims, the invention consisting in the novel construction and in the adaptation and combination of parts hereinafter described and claimed.

FIGURE 1 is a top plan view of an orbiting device embodying preferred teachings of my invention.

FIG. 2 is an elevational view thereof.

FIG. 3 is a fragmentary sectional view taken on a plane containing the center axis of the device; and

FIG. 4 is a sectional view taken on line 4—4 of FIG. 1.

Referring to the accompanying drawings, this device comprises a wheel **10**, having an axially depending handle **11** removably secured thereto. The wheel has an outer circular ring **12**, which, with respect to reference planes taken perpendicular to its circumference line, is of uniform circular cross-section. Extending radially at equal angular intervals from the center portion of the wheel as spokes thereof, are a plurality of blades **13**, each of which are secured at their outer ends to said ring **12**, and at their inner ends to a center hub **14**.

This hub **14** is generally hemispherical with its convex surface rising above, and its circular base edge lying slightly below, a plane containing the ring **12**. Depending axially from the lower concave hub surface is a tubular stud **16**, braced by ribs **15**, and defining a downwardly facing socket **17** which receives in a friction fit, the stem **18** of the handle **11**. This handle is formed as an inverted mushroom, with the stem rising from the upper moderately concave surface of a concavo convex base portion **20**.

To describe the blades **13** more particularly, each, with respect to sections taken on a plane perpendicular to the length thereof, has a uniformly curved, moderately convex, upper surface **21**, each end of which meets, along a slightly rounded edge portion **22**, the flat lower surface **23** of the blade. Thus it can be seen that, with respect to air-flow directed generally parallel to the plane of the ring, and with a velocity component perpendicular to either blade edge **22**, the blade functions as an air foil, with the lift component being directed upwardly, i.e. against the flat base surface **23**. The inner portion **24** of each blade connects to the lower edge portion of the hub **14**, and is located a slight distance below a plane tangent to the lowermost points of the ring surface. The longitudinal axis of this inner blade portion **24** extends parallel to this last named plane to a point at about the midlength of the blade, from which point said blade axis slants on a dihedral angle moderately upward to form an outer blade portion **26** which joins the ring at the upper portion thereof.

To launch the device into orbital flight, the wheel **10** is positioned within the plane of the device (which plane is understood to be the plane containing the ring **12**) being vertical and parallel to the direction of launching. The wheel is grasped along a ring portion which is located, in reference with the present vertical position of the wheel, at the bottom edge of the wheel, with the handle **11** extending away from the thrower. Then with an overhand

throwing motion, the device is hurled on a line nearly horizontal and slanted slightly upward. This throwing motion imparts not only a linear velocity component to the device, but also an angular velocity component, the axis of rotation being the center axis of the ring **12**, and the direction of rotation being counter-clockwise, as viewed from a position looking toward the convex surface of the hub **14**.

The device so hurled begins its path of travel with its trajectory and position in flight being largely undisturbed. That is to say, the wheel remains vertically positioned, and the trajectory bends neither right nor left, but does bend slightly downward as would any object little affected by aerodynamic forces and trajected on such a path. After travelling in this manner for a rather substantial distance, the downward edge of the device swings upward rather abruptly so that the device almost immediately becomes nearly level. The path up to this point can be termed as the "launching" path.

At this instant the device begins a wide orbital glide path, the device initially climbing upward and then gradually descending until it returns very close to the site of launching. A person can easily catch the device by the handle **11**, or if the device is allowed to land, it will come to rest on the mushroom base **20**.

The precise manner in which the gravitational, aerodynamic, and gyroscopic forces coact on the device is rather complex. However, it can be theorized, with some justification, that some aspects of the interaction may be explained in the following manner. When the device begins its initial trajectory in a vertical position, the plane of the device is almost exactly parallel to the path of flight. Thus the outer blade portions **26** adjacent the leading edge of the ring **12** are largely shielded by the ring itself from any appreciable impact from the flow of air. However, there is some force exerted on the base surface **23** of the blade portions adjacent the leading edge of the ring, which force tends to gradually move the leading edge of the ring at right angles to the plane of the device in the direction of the lifting force exerted by the blades.

Further, the blades moving in the direction of travel, having greater relative air speed, exert a greater lift component than do the blades moving opposite the direction of travel, which blades have lesser relative velocity. This creates a force couple which tends to push the upper edge of the device in the direction of the lift components of the blades. Since the rotary motion of the device gives it considerable gyroscopic action, the resultant of this last named force couple is at right angles thereto and also acts to move the leading edge portion of the ring **12** in the direction of lift.

When the plane of the device so moves to a position which is slightly off parallel to the line of flight, a greater portion of the blade base **23** adjacent the ring's leading edge becomes exposed to the flow of air in a manner that this aforementioned force exerted on the base surface adjacent the leading edge of the ring is multiplied. Thus there is now exerted on the device a counter-clockwise force couple of some magnitude, acting on a vertical axis. Because of the aforementioned gyroscopic action, the resultant force of such last named force couple is at right angles thereto and acts to lift the lowermost edge so that the device becomes nearly level in flight. This occurs at the end of the launching path and at this point begins the gradually curving orbital glide path.

It should be noted that the effect of gravitational pull on the handle **11** is to keep the device level, with the handle extending downward. Thus with the plane of the device vertical, the handle does have a counterbalancing effect with respect to the aerodynamic action of the forward moving blades, while in level flight the force component exerted by the pull of the handle passes nearly through the center of gravity of the device, and thus has very little tilting effect.

As the device becomes nearly level and begins its orbital glide path, the various forces interact so that the leading edge portion and side ring portion moving in the direction of flight are somewhat higher than their diametrically opposed ring portions. In this aspect of flight, the force components resulting from aerodynamic and gyroscopic effects become nearly balanced.

The spinning of the device tends to cause a gradually curving path, the physical effect being similar to the forces which causes a spinning baseball to curve. Beyond this, with the forces acting on the device tending to slant it slightly off level, this slanted aspect reinforces the curving motion, in somewhat the same manner that an airplane will tend to follow a curved path if banked to one side or the other.

It is to be understood, of course, that the precise manner of the interaction of the various forces involved will vary, depending on the wind velocity, the manner in which the device is thrown, etc. Also slight changes in such things as the relative weight distribution, etc., can be utilized to vary the flight characteristics without departing from the teachings of the invention. Thus any discussion of the interaction must, of necessity, be replete with generalities.

This device readily lends itself to be molded from plastic in one piece, with the handle **11** being secured to the side of the hub **14**. When the device is to be assembled, the handle is snapped off at the root end and inserted into the socket **17** in the bottom of the hub **14**.

It is thought that the invention will have been clearly understood from the foregoing detailed description of the illustrated preferred embodiment. Minor changes will suggest themselves and may be resorted to without departing from the spirit of the invention, wherefore it is my intention that no limitations be implied and that the hereto annexed claims be given a scope fully commensurate with the broadest interpretation to which the employed language admits.

What I claim is:

1. An aerial toy comprising an outer circumferential ring and a hub located at the center axis of said ring, blades secured to said hub and extending radially therefrom, said blades being secured at their outer ends to said ring, said blades having the configuration of airfoils with respect to flow directed generally parallel to a plane containing said ring, said airfoils producing lift components directed in approximately the same direction, said direction being generally upward and parallel to the center axis of said ring, said blades sloping inwardly from said ring moderately downward to a level below that of the ring.

2. The device as recited in claim 1, wherein there is a counterbalancing handle depending from said hub generally along the center axis of said ring.

3. The device as recited in claim 2, wherein said hub rises in dome-like fashion above a plane containing said ring.

4. An aerial toy comprising an outer circumferential ring and a hub located at the center axis of said ring, blades secured to said hub and extending radially therefrom, said blades being secured at their outer ends to said ring, said blades having the configuration of airfoils with respect to flow directed generally parallel to a plane containing said ring, said airfoils producing lift components directed in approximately the same direction, said direction being generally upward and parallel to the center axis of said ring, a counterbalancing handle secured to the lower side of said hub and depending axially therefrom, said hub having a convex upper surface extending above a plane containing said ring, said blades each having an inner portion and an outer portion, said inner portion of each blade lying slightly below a plane containing the lower edge of said ring, said outer portion of each blade sloping moderately upward to the point where it joins said ring, said ring being sufficiently thick on a vertical axis, so that with respect to air-flow parallel to

a plane containing said ring, said outer blade portions adjacent the leading edge of said ring are largely shielded from any appreciable impact from said air-flow.

5. The device as recited in claim 1, wherein said air-foils are semi-elliptical.

References Cited in the file of this patent

UNITED STATES PATENTS

100,466 Taylor ---------- Mar. 11, 1870
693,328 Morgan ---------- Feb. 11, 1902
1,040,702 Lee ---------- Oct. 8, 1912
1,573,527 Simonek ---------- Feb. 16, 1926
1,907,815 Hough ---------- May 9, 1933
2,816,764 Gleason ---------- Dec. 17, 1957
2,972,481 Shapiro ---------- Feb. 21, 1961
3,036,832 Ellman et al. ---------- May 29, 1962