June 15, 1965 G. T. BOSWELL 3,188,768

TOY PROJECTILE WHICH CONVERTS TO SPACE PLATFORM DURING FLIGHT

Filed May 6, 1963 2 Sheets-Sheet 1

FIG. 1

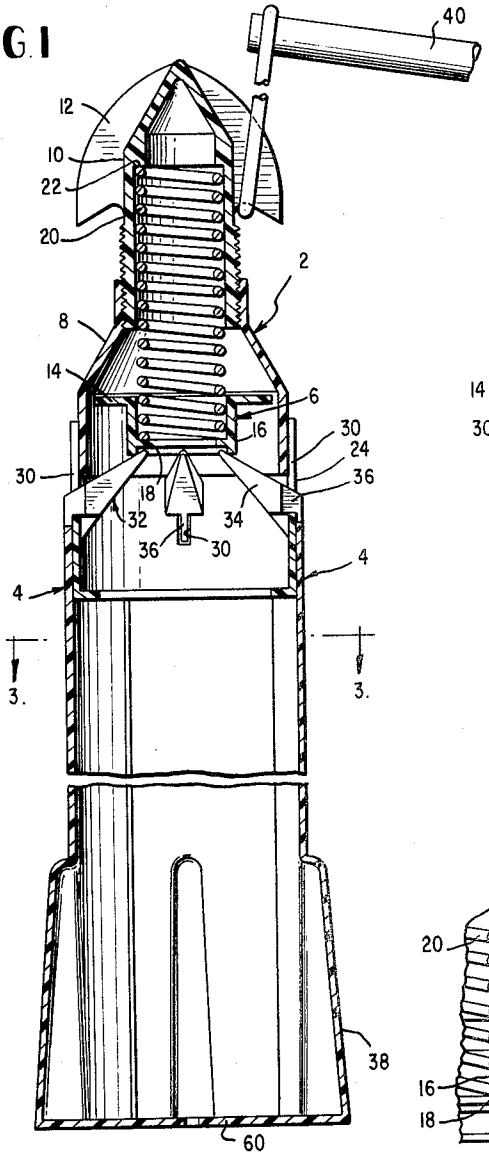
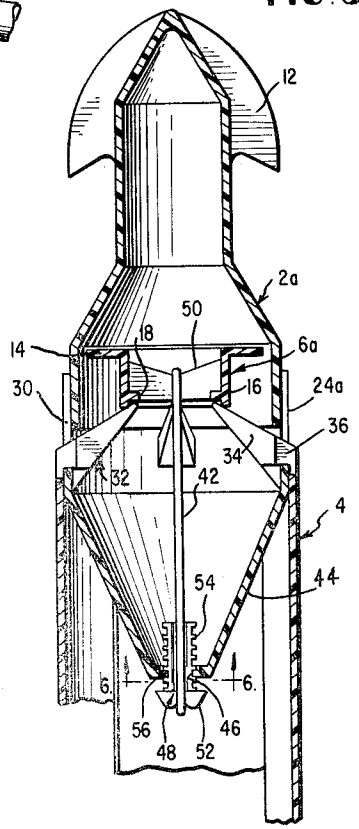


FIG. 5



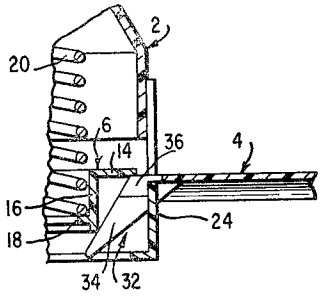


FIG. 2

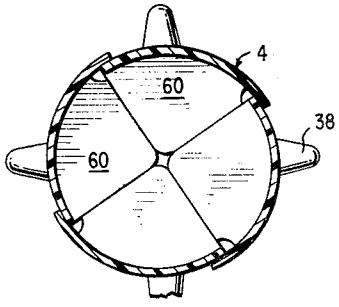


FIG. 3

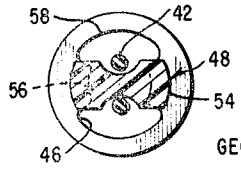


FIG. 6

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June 15, 1965 G. T. BOSWELL 3,188,768

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Filed May 6, 1963 2 Sheets-Sheet 2

FIG. 4

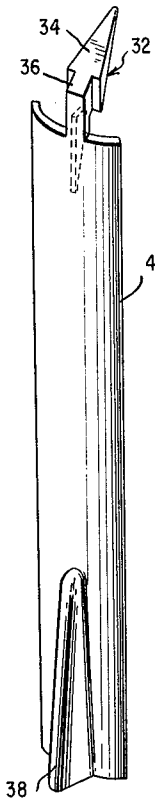


FIG. 7

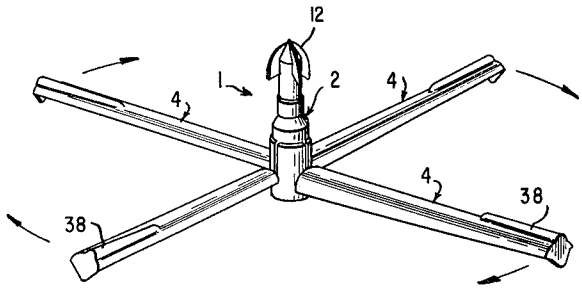


FIG. 9

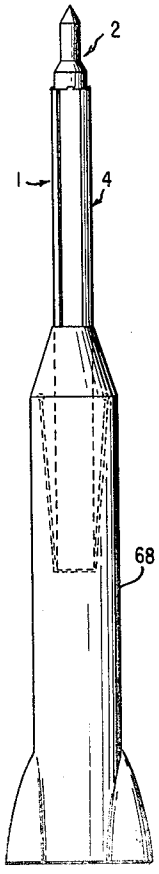


FIG. 10

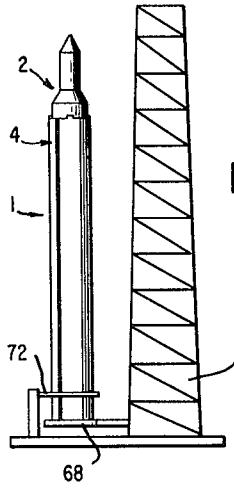


FIG. 11

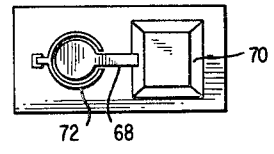
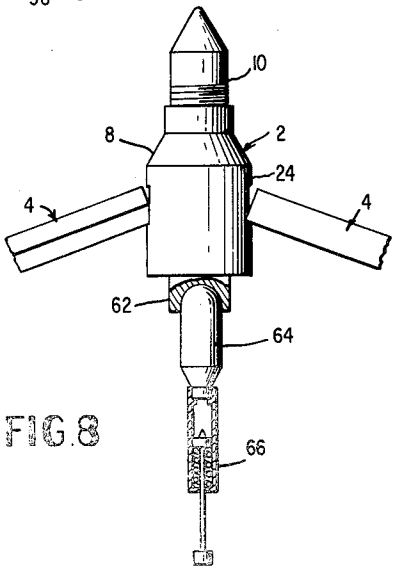


FIG. 8



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United States Patent Office

3,188,768

Patented June 15, 1965

3,188,768

TOY PROJECTILE WHICH CONVERTS TO SPACE PLATFORM DURING FLIGHT

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Filed May 6, 1963, Ser. No. 273,032

3 Claims. (Cl. 46—75)

This invention relates in general to a toy projectile and in particular to a rocket simulating toy projectile which automatically converts to a space platform type vehicle during flight.

With the increased interest now being shown in rocketry and space flights generated largely by the activities of N.A.S.A. in the United States and Russian scientific achievements in satellite launchings and interplanetary flights, there is an increasing amount of interest in toy projectiles which simulate rockets, space vehicles, satellites and space platforms.

There presently exists many toy projectiles which, through various means, are actuated to convert or separate during midflight to produce parachutes, gliders and similar separated units. One toy of this kind is the elastic-launched rocket-simulating device which opens in midair to produce a gyro rotating type of winged vehicle which, after separation from the rocket simulating vehicle, rotates to produce a slow descent to earth.

It has been found that interest and attraction in a toy vehicle of the type described is a function of the time of flight or activity of that projectile. In other words, the longer a toy of this type can be made to remain airborne, the greater the interest afforded by the toy. Time of flight, especially in an auto-rotative type toy, depends on the weight of the vehicle and the area of air foil presented as a lifting surface. The larger the ratio of area of air foil to weight, generally the longer the time of flight realized in the vehicle. Many of the prior art devices utilize either separate auto-rotative devices, ejected from an air frame or, air foils which extend from a conventional air frame. In both cases, there is a large amount of wasted weight; in the former, the air frame itself falls to the ground without any flight, and in the latter case, the weight of the air frame, as a non-lifting entity, shortens the time of flight of the vehicle.

It is an object of this invention to provide a toy auto-rotative missile in which a very high lifting surface to weight ratio is achieved.

It is another object of this invention to provide a toy auto-rotative projectile in which the projectile air frame itself is utilized as the air foil structure for the auto-rotative portion of the flight.

Another object is to provide a simple but effective means for converting the projectile air frame into the air foil structure at the most opportune moment of flight and with good reliability of performance.

It is still another object of this invention to provide a rocket simulating toy projectile which converts to a gyro rotating descent vehicle.

It is a further object of this invention to provide a rocket simulating projectile which, by utilizing the structure of the vehicle itself, provides a unitary rocket ascent and gyro rotating descent device.

It is another object of this invention to provide a simple, inexpensive and reliable mechanism to provide midflight conversion of a rocket simulating device to a gyro rotating descent vehicle.

It is still a further object of this invention to provide a safe and simple toy projectile which provides a high degree of interest with a minimum of expenditure of material and effort.

It is still another object of this invention to provide a projectile-actuating mechanism suitable for use with single-stage, hand-launched toys, CO_2 propelled rockets or with multi-stage, midair separating toy rockets.

Other objects and further scope of applicability of the present invention will become apparent from the detailed description given hereinafter; it should be understood, however, that the detailed description and specific examples, while indicating preferred embodiments of the invention, are given by way of illustration only, since various changes and modifications within the spirit and scope of the invention will become apparent to those skilled in the art.

These objects are accomplished by the present invention by forming a projectile that consists primarily of a segmented, tubular rocket simulating body in which the segments are hinged and formed to provide a rocket-vehicle like configuration in the closed condition and, upon opening, provide radially disposed air foil members which operate in the manner of an autogyro or helicopter to provide gyro rotation of the vehicle for slow descent after the projectile has reached its apogee. The segmented members making up the major portion of the rocket body are elastically biased in such a manner as to cause the segments to be deployed as a blade wheel under static conditions, but may be easily folded and held in a folded condition under the normal arerodynamic forces attendant with the flight of the vehicle after launching.

Launching of the vehicle may be accomplished through use of the well-known sling shot hand launcher, CO_2 cartridges or may be accomplished by incorporation in a multi-stage toy missile such as that disclosed in my copending application Serial No. 214,049, filed August 1, 1962. In either case, the projectile is launched in an upward direction and, as long as the aerodynamic force imposed by the air flow is present on the folded segments, the projectile retains the configuration of a rocket-type missile. As the projectile decelerates under the influence of gravity and approaches the apogee of its flight, the dynamic forces imposed by air flow decrease to a point where the elastic loading causes the segments to pivotally deploy to a radially disposed position. At this point, the vehicle begins a descent towards earth and aerodynamic forces acting on the deployed segments induce rotation in the system. This rotation induces local flow over each of the individual air foils and, through principles well known in the art, imposes lift on these foils resulting in a slow rotary descent of the vehicle to earth.

The foregoing general description will be better understood to those skilled in the art when viewed in the light of the accompanying drawings in which like numerals indicate like parts thereof throughout the figures and wherein:

FIG. 1 is a side view of a missile embodying the invention, partly in section and partly broken away;

FIG. 2 is an enlarged portion of the missile of FIG. 1 in section;

FIG. 3 is a sectional view of the missile of FIG. 1 taken along the line 3—3 in FIG. 1;

FIG. 4 is a perspective view of one of the fins of a missile embodying the features of this invention;

FIG. 5 is a side view of a portion of another missile embodying the invention, partly broken away and in cross section;

FIG. 6 is a sectional view of a portion of the missile of FIG. 5 taken along the lines 6—6 of FIG. 5;

FIG. 7 is a reduced perspective view of a missile embodying the features of this invention with the vanes thereof deployed;

FIG. 8 is a side view of a projectile embodying the invention, partly broken away and partly in section, showing a means for launching thereof;

FIG. 9 is a side view of a projectile embodying the in-

vention showing another method of launching the projectile;

FIG. 10 is a side view of a projectile embodying the invention showing still another method of launching thereof;

FIG. 11 is a plan view of the projectile and means for launching of FIG. 10.

Referring now to FIG. 1 of the drawings, the projectile is comprised of nose member indicated generally at 2, vanes 4 and vane actuating piston 6.

Nose member 2, in the embodiment of FIG. 1, is further comprised of base 8 having nose cone 10 threaded therein. Nose fins 12 are symmetrically mounted around the periphery of the nose cone.

Piston 6 consists of radial flange 14, cylindrical body 16 and inwardly extending ring 18. Compression spring 20 is coaxially mounted within nose member 2 and seats, at one end, on shoulder 22 in nose cone 10, and at the other end in the cylindrical body of piston 6 against ring 18. Spring 20 is shown in a fully compressed condition in FIG. 1, with piston 6 in its most upward position. The compressive force exerted by spring 20 may be adjusted, as desired, by threading nose cone 10 into or out of base 8.

Cylinder 24 is attached to the bottom of base member 8 and provides an attaching point for fins 4. Connection between these members may be accomplished by any suitable means such as adhesive, heat welding or press fit.

Slots 30 are provided around the periphery of cylinder 24 for purposes to be described below.

Vanes 4 are provided with angled lever members indicated generally at 32 at the top ends thereof. Referring to the perspective view of vane member 4 in FIG. 4, lever member consists of wedge-shaped body 34 and reduced neck portion 36. The neck portion is formed to slidably fit into slot 30 to form a hinge for vane 4 in cylinder 24 as shown. The upper ends of lever 32 are in contact with the base of piston 6.

Vane fins 38 may be provided at the bottom of vane 4 and serve to provide aerodynamic stability, where required, for the missile. These vane fins may be shaped as fins, or rocket motor pod simulating structure as desired.

Although this embodiment of the invention is shown having four vanes, any suitable number describing a cylinder in a closed condition may obviously be provided without varying the operation of the invention.

In operation, vanes 4 are configured in a closed condition, as shown in FIG. 1. This disposes piston 6 in an upward condition through the camming action of levers 32 and compresses spring 20. The missile is then launched by any suitable means such, for example, as sling shot 40 hooked under nose fin 12. Aerodynamic force retains vanes 4 in an essentially closed cylindrical configuration until the velocity of the missile drops off. When the aerodynamic force drops below the bias force of spring 20, piston 6 is moved downwardly under the influence of the spring force and causes vanes 4 to deploy as shown in FIG. 2, through camming action on lever 32.

Referring now to FIG. 4, it should be noted that lever 32 is disposed in an asymmetrical condition with respect to the longitudinal centerline of vane 4. This hinge point therefore describes a hinge line along the vane which is laterally displaced from the centerline thereof, and induces, under the influence of aerodynamic flow, normal to the vane when it is deployed, an unbalanced condition which causes rotation of the vane in the direction of asymmetry. One longitudinal edge of the vane is also preferably tapered with respect to the other edge, as may be seen in the vanes of FIG. 7, the chord of the vane tapering from a maximum at the hinge end to a minimum at the base end. This produces a maximum asymmetry at the hinge portion of the vane to induce rotation of the projectile, and a minimum asymmetry at

the base or tip of the vane to provide low drag at the point of highest velocity when the vane is rotating.

With the vane deployed then, the projectile assumes a blade-wheel configuration (FIG. 7) and begins descent under the influence of gravity. Air flow, normal to the vanes, induces rotation thereof, as described above, the rotation providing chordwise air flow along the vanes and inducing lift therein through principles well known in the art. The induced lift retards descent of the projection and auto-rotative, helicopter type of toy is provided.

The threaded spring compression adjusting means provides adjustment of the bias urging the vanes outwardly and provides a means to vary the height of deployment of the vanes. This feature provides added interest for the toy since competitive trials may be performed for the purpose of achieving a maximum flight time or the like by suitable adjustment of the bias force.

Referring now to FIG. 5, a variation of the projectile of FIG. 1 is shown. The basic variation here is in the vane biasing structure and, as shown, piston 6*a* is provided with an elastic band 42 in tension to bias it in a downward direction. Cylinder 24*a* is provided with a frustro conical base portion 44 which includes an aperture 46 having adjusting pin shown generally at 48 mounted therein. Piston 6*a*, has web portion 50 diametrically mounted therein. The web serves as a connection point for one end of elastic band 42 while grooved head 52 of pin 48 retains the other end thereof.

Pin 48 is provided with circumferential interrupted lands 54 axially spaced along opposed sides of the shank thereof. A pair of oppositely disposed teeth 56 are provided in aperture 46 to engage lands 54 when pin 48 is suitably rotated with respect thereto as shown in FIG. 6.

Referring now to FIG. 6, a plan view of pin 48 disposed in aperture 46 is shown with teeth 56 engaging lands 54 to hold elastic band 42 at a selected elongation to provide desired tension therein. Tension in band 42 may be changed by rotating pin 48 ninety degrees from the position shown to place lands 54 in alignment with enlarged portion 58, of aperture 46, axially displacing pin 48 to a desired position, and rotating the pin ninety degrees to re-engage teeth 56 with lands 54. In this way, the biasing force for vanes 4 may be adjusted for purposes described for the embodiment of FIG. 1.

Returning to FIG. 5, nose portion 2*a* is of a similar outer configuration to nose member 2 of FIG. 1. However, since the adjustment feature of FIG. 1 is not required in the embodiment of FIG. 5, nose portion 2*a* is an integral unit. The remaining components of the embodiment of FIG. 5 are essentially identical in structure and operation to those of the embodiment of FIG. 1.

FIG. 3 is a plan view of the devices of FIG. 1 and FIG. 5 taken along the line 3—3 of FIG. 1. Vanes 4 may be formed to overlap as shown to provide greater lifting area in a given cylinder diameter. The vanes, however, may be formed to abut, if so desired, without essentially changing the operation of the device. Triangular segmental base plates 60 are provided at the base of the vanes to provide structural stability for the vanes when disposed in the cylindrical configuration. The segments are formed to abut and form a disc as shown when the vanes are fully closed. In variations where this stability is not required or desired, such as embodiments where the device is not hand launched, plates 60 may be omitted.

FIG. 7 is a device, embodying the invention, fully deployed for rotation in the direction of the arrow.

FIG. 8 depicts an alternate method of launching the device of FIG. 1. Cup extension 62 is in the base of cylinder 24 to receive CO_2 capsule 64. A CO_2 discharging device such as spring piston 66 may be used to puncture the seal in capsule 64.

In operation, capsule 64 is disposed in cup 2, as shown, and is punctured by spring piston 66. Discharge of the contents of the capsule provides thrust to project the missile

into the air. Upon exhaustion of the contents of the capsule and deceleration of the missile, vanes 4 deploy for auto-rotation as in the devices of FIGS. 1 and 5.

Capsule 64 may be slip-fitted into cup 62 so that it will drop away when its contents are exhausted. A parachute or other suitable device may be provided to lower the capsule if desired. The projectile, as shown, is launched with vanes 4 open, relying on aerodynamic drag to close them. Spring piston 66 may be provided, however, with an extension to allow launching with vanes 4 in a closed position. It is intended, of course, that vanes 4 be provided without base plates 60 (FIG. 3) in this embodiment.

FIG. 9 depicts another method of launching the projectile. The projectile is slidably fitted into first stage 68 of a toy missile system and is projected therefrom after launching of first stage 68 by any suitable means. It is specifically contemplated that systems disclosed in my copending application Serial No. 214,049, filed August 1, 1962, may be used to accomplish the launching and projection of the components of FIG. 9.

FIG. 10 shows another launching means for the device in which the projectile, shown generally at 1, is mounted on launching pedal 68 which is attached to gantry 70. The gantry contains an elastic-loaded launcher also described in more detail in the above-referred to copending application. A structure, such as interrupted ring 72, may be provided to hold vanes 4 closed until launching. Pedal 68 may alternately be provided with walls to provide a cup-like member for retaining vanes 4 until projectile 1 is launched.

The projectile may be fabricated of any suitable material such, for example, as high-impact styrene or the like. The elastic band may be made from any suitable elastomeric material, while the spring should preferably be fabricated from spring steel or the like.

What is claimed and desired to be protected by Letters Patent of the United States is:

1. A toy projectile comprising a hollow nose cone having an axis of symmetry therethrough, a plurality of blades hingedly depending from said nose cone and pivotal between a closed position parallel to said axis in an open position perpendicular to said axis, said blades defining a hollow tubular body in said closed position and a radially extending blade-wheel in said open position, a lever member on each of said blades proximate the hinged point thereof and extending into said nose cone, said lever being pivotal with said blade between a position essentially perpendicular to said axis when said blade is in the closed position to a position essentially parallel to said axis when said blade is in the open position, a piston coaxially mounted in said nose cone for reciprocation therein, said piston adapted to engage the ends of said lever extending into said nose cone, and means to elastically bias said piston toward the base of said nose cone to bias said blades in the open position.

2. A toy projectile comprising a hollow body having a base thereto, a plurality of air foils hingedly connected to the base of said body and pivotal between a closed position and an open position perpendicular to the longitudinal axis of said body, a lever member connected to each of said air foils proximate the hinged connection to said body and extending into the interior of said body, the pivotal arc described by each of said air foils being coplanar with the longitudinal axis of said body, said air foils describing an essentially hollow tube in said closed position, a reciprocal piston coaxially mounted in said body in engagement with said lever members, said piston movable between a forward position away from said base and a rearward position towards said base, elastic means to bias said piston in said rearward position, said lever members being so formed as to dispose said piston in said forward position when said air foils are in said closed position and to provide displacement of said piston to said rear position under the influence of said elastic means when said air foils are in said open position, said elastic means being of suitable strength to provide displacement of said piston to the rearward position when aerodynamic flow over said body is substantially absent, the camber and disposition of said air foils in said open position being such that auto-rotation about the longitudinal axis of said body is induced in said projectile under the influence of gravity during the descent of said projectile.

3. A toy projectile capable of being launched skyward simulating a nose-coned missile which converts automatically upon reaching its flight apogee into a helicopter which descends to earth with its nose-cone pointing skyward which comprises a nose cone having a longitudinal axis therethrough, a plurality of substantially identical vanes hingedly connected to said nose cone for pivoting between a closed condition parallel to said axis forming a tubular body coaxial with said nose cone extending rearwardly of the nose cone and a deployed condition radially extended perpendicular to said axis forming a gyro-rotational blade-wheel helicopter, piston means to simultaneously move all said vanes from said closed condition into said deployed condition and resilient means biasing said piston means toward the vane deploying position with a biasing force insufficient to radially extend the vanes against the air stream passing over the vanes immediately subsequent to launching of the toy projectile and sufficient to radially extend the vanes as the toy projectile approaches is flight apogee.

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RICHARD C. PINKHAM, *Primary Examiner.*