Jan. 13, 1970 D. G. M. SCOTT 3,488,882

TOY AIR CUSHION VEHICLE

Filed Dec. 28, 1966 2 Sheets-Sheet 1

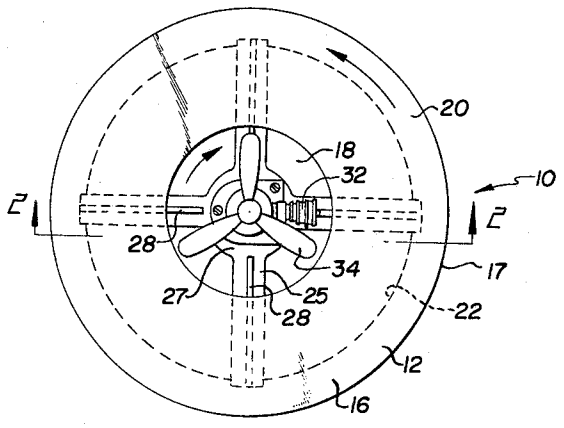


Fig. 1.

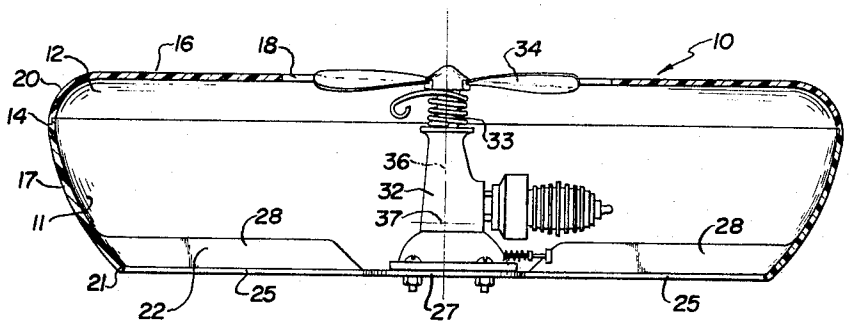


Fig. 2.

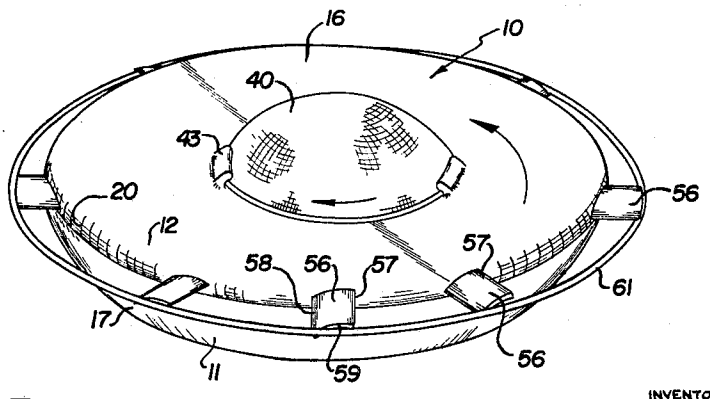


Fig. 4.

INVENTOR
DAVID G.M. SCOTT
BY
Fetherstonhaugh & Co.
ATTORNEYS

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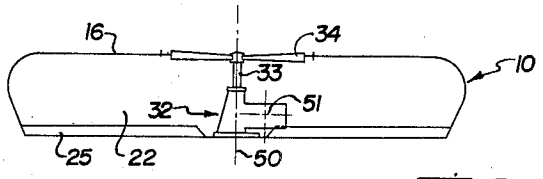


Fig. 8.

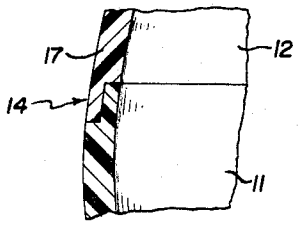


Fig. 3.

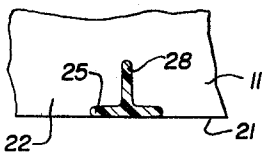


Fig. 4.

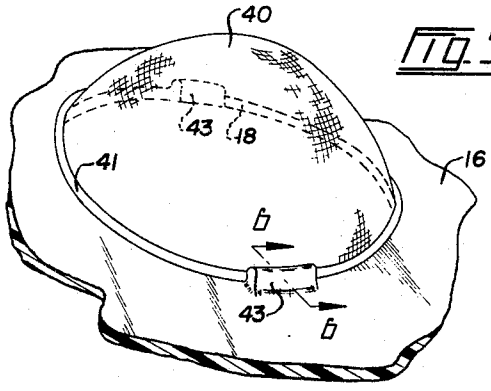


Fig. 5.

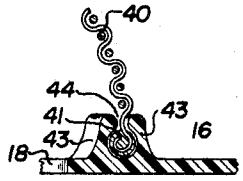


Fig. 6.

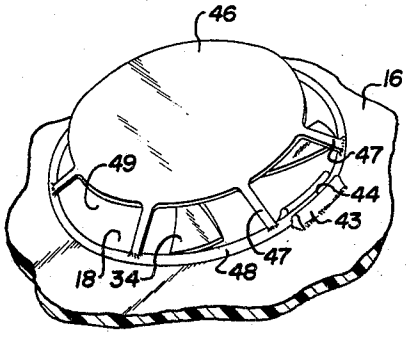


Fig. 7.

INVENTOR
DAVID G.M. SCOTT
BY
Fetherstonhaugh & Co.
ATTORNEYS

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TOY AIR CUSHION VEHICLE

David G. M. Scott, 354 Tempe Crescent, North Vancouver, British Columbia, Canada

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Int. Cl. A63h 27/06
U.S. Cl. 46—74 3 Claims

ABSTRACT OF THE DISCLOSURE

A flying toy having a body in the form of an inverted bowl in which a centrally disposed opening is formed. A power driven propeller is mounted within the body to draw air in through the opening and provide a lifting cushion of air between the body and a supporting surface. Propeller torque is utilized to spin the hovering body and impart stability to the toy.

BACKGROUND OF THE INVENTION

This invention relates to an aerial toy and more particularly to a toy vehicle capable of supporting itself on a self produced cushion of air.

Attempts to make small scale or model replicas of air cushion vehicles, or ground effect machines as they are sometimes referred to, have not been too successful in the past due perhaps to the many aerodynamic problems inherent in this type of machine. One of the difficulties encountered is that of designing a miniature toy vehicle which will actually hover rather than take off into vertical and uncontrolled flight. Another major difficulty is the problem of building into the miniature vehicle, the necessary static and dynamic stability to hover over a supporting surface and to move across said surface while maintaining substantially level flight.

SUMMARY OF THE INVENTION

The present invention overcomes the problem of stability by the design of the body of the vehicle and by imparting to the toy vehicle, a spinning motion about a central vertical axis. To achieve this spinning motion, the top utilizes the reaction of the rotating parts of the engine and particularly the propeller. The spinning vehicle operates on the gyroscopic principle of a spinning top and tends to resist any movement likely to tilt or change the axis of rotation. While spinning, the vehicle has a reservoir of energy which, when the toy contacts another object, is converted to tangential motion. Thus, the toy is capable of moving about in a series of random darting movements which give the device at least some of the flight characteristics popularly associated with flying saucers and as a result the toy is more entertaining to operate than the conventional model airplane for example.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGURE 1 is a plan view of the invention,

FIGURE 2 is an enlarged section taken on the line **2—2** of FIGURE 1,

FIGURE 3 is a detail view of the joint between the dome and shell of the body,

FIGURE 4 is a section taken on the line **4—4** of FIGURE 2,

FIGURE 5 is a perspective view of a portion of a modified form of the invention,

FIGURE 6 is an enlarged section taken on the line **6—6** of FIGURE 5,

FIGURE 7 is a view similar to FIGURE 5 and showing another modification,

FIGURE 8 is a schematic view of a further modification, and

FIGURE 9 is a perspective view of a still further modification.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to FIGURES 1 to 4 of the drawings, the numeral **10** indicates the hollow body of the top air cushion vehicle. The body **10** is formed of a tough lightweight material such as polystyrene, which plastic material is relatively inexpensive and is readily molded into the inverted bowl-like shape required for said body. Preferably the body **10** is made up on a lower shell **11** and an upper dome **12**, see FIGURES 2 and 3. The abutting edges of the shell **11** and dome **12** are connected together by a suitable joint **14** which may be glued or otherwise secured against separation. The body of the machine need not be circular although this is the preferred shape for the toy. For example, the body can be elliptic or square or of an irregular shape.

The body **10** has a horizontal top wall **16** and a downwardly turned peripheral wall **17**, both of which are thin as can be made consistent with strength. The top wall **16**, which is circular as shown in FIGURE 1, has a centrally disposed opening **18**. In FIGURE 2 it will be seen that the body **10** has a rounded upper edge **20** and that the peripheral wall **17** inclines inwardly from said rounded upward edge to a lower rim **21**. The rim **21** defines an air discharge opening **22** which, like the opening **18**, is concentric to the wall **17**.

The body **10** is fitted with engine supports **25** which are molded integrally with the wall **17** and are disposed near the rim **21**. Supports **25** consist of two flat diametral strips of the plastic material which cross at the center of the body to provide a small platform **27**. Medial ribs **28**, see particularly FIGURE 4, are formed on the upper surfaces of the supports **25** to reinforce the engine supporting structure and give added strength and rigidity to the body.

Mounted on the platform **27** is a small internal combustion engine **32** of the type used to power model airplanes and the like. The engine **32** has a vertically disposed drive shaft **33** which extends upwardly through the center of the opening **18**. A propeller **34** is fitted to the shaft **33**, the propeller desirably having three blades which rotate parallel and in close proximity to the top surface of the wall **16**. The propeller **34** rotates about an axis which is indicated by the chain dotted line **36** of FIGURE 2. The axis **36** extends through a point **37** which represents the center of gravity of the several parts of the toy. In this particular embodiment of the toy, the center of gravity also coincides with the center of pressure or lift viz. the point at which all the lift forces are presumed to act. However, if the body of the toy is made non-circular, it is possible for the center of lift to be offset from the axis of rotation while still being coincident with the center of gravity. If desired, the present craft can be powered with other types of motors, i.e. a battery powered electric motor will serve the purpose or a spring or an elastic can be used to drive the propeller.

The toy air cushion vehicle is operated as a free flying or untethered aircraft and the machine can be flown indoors or over any reasonably flat surface of land, water, snow or ice. To operate the device, the engine **32** is fueled and the propeller **34** is turned in the usual way to start the engine. The operator holds the body **10** with the rim **21** in contact with the floor of a room or other surface over which the craft is to fly and, when the propeller **34** reaches full operating speed, the operator releases the device so that it can become airborne. Air is drawn in through the opening **18** by the rapidly rotating propeller **34** and pressure is built up within the body **10** to form a

lifting cushion of air. This air cushion fills the body **10** and occupies the space between the rim **21** and the supporting surface over which the toy hovers. Air does escape from the discharge opening **22**, since the rim **21** is then spaced above the supporting surface, but this air loss is at a slower rate than the air input so that the air cushion is maintained and the craft continues to hover as long as the propeller is rotating at normal operating speed.

The height at which the toy hovers is dependent on its shape and diameter of the body **10**, the ratio of the propeller diameter to the diameter of the body or the cushion of air and the power output of the engine as well as other factors. Generally speaking, the hover height has been found to vary between $\frac{1}{10}$th and $\frac{1}{25}$th of the diameter of the air cushion at the rim **21**. The toy always remains in ground effect. If the toy has a non-circular body, the hover height can be calculated in much the same manner. The cushion diameter which would then be used is that of a circle of the same area encompassed by the non-circular body under consideration.

As the propeller **34** of the hovering vehicle rotates in one direction, torque reaction causes the body **10** to rotate rapidly in the opposite direction. The spin velocity increases from the moment the vehicle becomes airborne until a high rate of spin is developed. Because of the shape of the body **10**, the location of the center of gravity **37** with respect to the axis of rotation **36**, and the spinning motion of the body about the rotational axis, the spinning and hovering toy possesses static stability viz. the toy tends to return to level flight of its own accord. Also the different forces acting on the machine are balanced in such a way that the toy has dynamic as well as static stability. This tendency of the spinning body **10** to maintain the direction of the axis of rotation is similar to the action of a toy spinning top. The gyroscopic principle of a top is quite well known but briefly stated, if a rapidly spinning body is forced to turn or precess about an axis which is perpendicular to the axis of spin, a restoring movement is set up perpendicular to the spin axis and in the same plane as the disturbing force. Thus, the toy air cushion vehicle will resist any tendency to tip it over or change the direction of the axis **36**.

The toy air cushion vehicle will hover over any supporting surface which is flat and horizontal. If the supporting surface is flat but also sloping, even to a very slight extent, the toy tends to travel in the direction of the slope. The lift and weight components which act on the toy over a sloping surface produce a resultant force which causes the vehicle to move parallel to said surface.

When the spinning and forward moving body **10** contacts a surface such as the wall of a room, said body will spin off the wall and move away in another direction. Once the toy moves away from the object contacted, the original spin momentum is restored and is maintained until another object is touched whereupon the toy again changes direction. The vehicle operates in this manner with occasional pauses followed by a series of rapid changes in direction. This change in speed and direction of flight continues on a decreasing scale until the motor **32** runs down and the toy settles back to the supporting surface.

The tendency of the toy to move horizontally is apparent over other supporting surfaces as well i.e. a field which may have a slightly uneven surface. When the toy vehicle hovers over a shallow depression or the like, this causes an uneven escape of air from beneath the rim **21**. As a result, the device will tilt slightly and move in the direction of tilt and thus move at random about the field.

In the modification shown in FIGURES 5 and 6, the toy is constructed as above described except for the additional use of a hood **40**. The hood **40** is made of a lightweight mesh screen and a bead **41** is formed on the lower rim of said hood. The top wall **16** is provided with cleats **43** which are spaced apart to define short slots **44**. These cleats can be formed integrally with the wall **16** on opposite sides of the opening **18** to secure the hood **40** to the body **10**. The bead **41** is forced between the cleats **43** which are sprung slightly to allow said bead to enter the slots **44**. Hood **40** is easily removed from the body **10** if it is necessary to have access to the propeller **34**. The hood **40** prevents the propeller from being bent or otherwise damaged and also protects the fingers of the operator. In addition, the hood **40** is intended to simulate the appearance of the cabin of a flying saucer. Since the hood is formed of mesh material it is extremely pervious to air and, due to this porous construction, said hood does not detract to any appreciable extent from the efficiency of the propeller.

FIGURE 7 shows a modified toy having a cover **46** which preferably is formed of the same polystyrene material as the body **10**. The cover **46** is a thin circular disc which is fitted with supporting legs **47**. A ring **48** connects the lower end of the legs **47**. Cover **46** is attached to the top wall **16** by means of the cleats **43**. To accomplish this, the ring **48** is formed into the slots **44** provided by the cleats whereupon the disc-like cover **46** is supported by the legs **47** above the air intake opening **18** and in suitably spaced and parallel relation to the top wall **16**. A gap **49** is defined between the cover **46** and the wall **16**, which gap permits the propeller **34** to perform effectively even though shielded by said cover. The cover **46** protects the propeller **34** and the operator of the air cushion vehicle almost as well as the hood **40** of the FIGURE 5 embodiment and also gives the toy an appearance somewhat like a flying saucer.

FIGURE 8 illustrates a further modification of the invention wherein the toy air cushion vehicle has substantially the same construction as in the main embodiment. However, in this modification, the propeller **34** has an axis of rotation **50**. As before, all the lift forces which act on the body **10** when the machine is in flight are assumed to act upwardly along the axis **50**. The several parts of the craft are arranged to give a center of gravity **51** which is offset from the axis **50** or the center of lift. Alternatively, the modified toy can be constructed as a statically balanced vehicle in the same manner as the main embodiment and later, small weights can be added to give the required unbalanced condition. The centers of lift and gravity can both be offset from the axis **50** as might be the case if the body was non-circular. When the modified vehicle is in powered flight this disalignment of the center of lift and the center of gravity **51** gives a moment which tends to tilt the body **10**. The propeller **34** and the body **10** counter rotate as before and this additional tendency of the body to tilt is responsible for the unusually lively action of the modified toy. The toy skims over the supporting surface with a wobbling action which is interesting to witness and which adds to the entertainment value of the toy. As the body **10** rotates about the axis **50**, which in this instance is also the center of lift, the center of gravity **51** orbits about said axis and it is the combination of these two motions which causes the wobbling action. Since the escape of air from the discharge opening **22** varies to such a great extent, there is a strong tendency for the machine to move horizontally over the supporting surface. The result is a series of quick darting movements which occur continuously and at random and which combine with the peculiar wobbling motion to simulate the type of flight usually associated with flying saucers.

The modified vehicle shown in FIGURE 9 is constructed substantially in the same manner as the toy illustrated in FIGURES 5 and 6. In addition, this particular embodiment of the invention is provided with a plurality of vanes or blades **56**. The blades **56** project radially outwards from the rounded upper edge **20** and are regularly spaced apart about the circumference of the body **10**. Preferably the blades **56** are formed of short lengths of thin but high impact resistant, and resilient plastic material. Each blade **56** has a leading edge **57**, a trailer edge **58**, a squared-off tip **59** and is suitably shaped to provide

an airfoil section. A rim **61** of a similar plastic material is secured to the tips **59** to protect the blades from damage.

The FIGURE 9 modification has many of the flight characteristics of the other embodiments of the invention as well as tendency to move vertically as well as horizontally. As the propeller **34** rotates in a clockwise direction, as before, the body **10** rotates counter clockwise. The spinning action of the body **10** moves the blades **56** through the air with sufficient speed to generate a lifting force which increases the height at which the vehicle normally hovers above a supporting surface. This increased lift is imparted when the body **10** is spinning at or near maximum speed. Since the rate of spin is not constant i.e., it is monentarily slowed when the vehicle contacts a wall or the like, the modified vehicle tends to hop about in a manner which adds to the interest of the toy. If desired, the center of lift can be offset from the center of gravity as in the FIGURE 8 embodiment to provide a combination of flight characteristics.

What I claim is:

1. A toy air cushion vehicle comprising a circular body having a horizontal top wall and a downwardly and inwardly turned peripheral wall, a rounded upper edge at the junction of the top wall an the peripheral wall, said top wall having a centrally disposed air intake opening, said peripheral wall having a rim defining an air discharge opening, said air intake opening and aid discharge opening being concentric with the peripheral wall, diametral supports mounted on the rim, an internal combustion engine mounted on the diametral supports below the air intake opening, said engine having a vertical drive shaft, a propeller mounted on the drive shaft for rotation in the vicinity of the air intake opening, said propeller being adapted to be rotated in one direction upon operation of the engine to provide a cushion of air upon which the body will hover above a supporting surface and to rotate said body in the opposite direction at a speed proportionate to the speed of said propeller whereby the counter rotating body and propeller lend stability to the vehicle in flight.

2. A toy air cushion vehicle as claimed in claim **1**, wherein the aforementioned parts have a center of gravity disposed in close proximity to the diametral supports and the cushion of air has a center of lift offset from the center of gravity whereby to give a wobbling action to the vehicle in flight.

3. A toy air cushion vehicle comprising a circular body having a horizontal top wall and a downwardly and inwardly turned peripheral wall, a rounded upper edge on the junction of the top wall and the peripheral wall, said top wall having a centrally disposed air intake opening, said peripheral wall having a rim defining an air discharge opening, said air intake opening and air discharge opening being concentric with the peripheral wall, diametral supports mounted on the rim, an internal combustion engine mounted on the diametral supports below the air intake opening, said engine having a vertical drive shaft, a propeller mounted on the drive shaft for rotation in the vicinity of the air intake opening, said propeller being adapted to be rotated in one direction upon operation of the engine to provide a cushion of air upon which the body will hover above a supporting surface, said body being adapted to rotate in the opposite direction in response to rotation of the propeller, and a plurality of radially disposed blades extending outwardly from the circular body to provide a lifting force as said body rotates.

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ROBERT PESHOCK, Primary Examiner

C. R. WENTZEL, Assistant Examiner