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(54) FIXED-BODY TOY VEHICLE HAVING DIFFERENTIAL THRUST AND UNASSISTED LIFTOFF CAPABILITY

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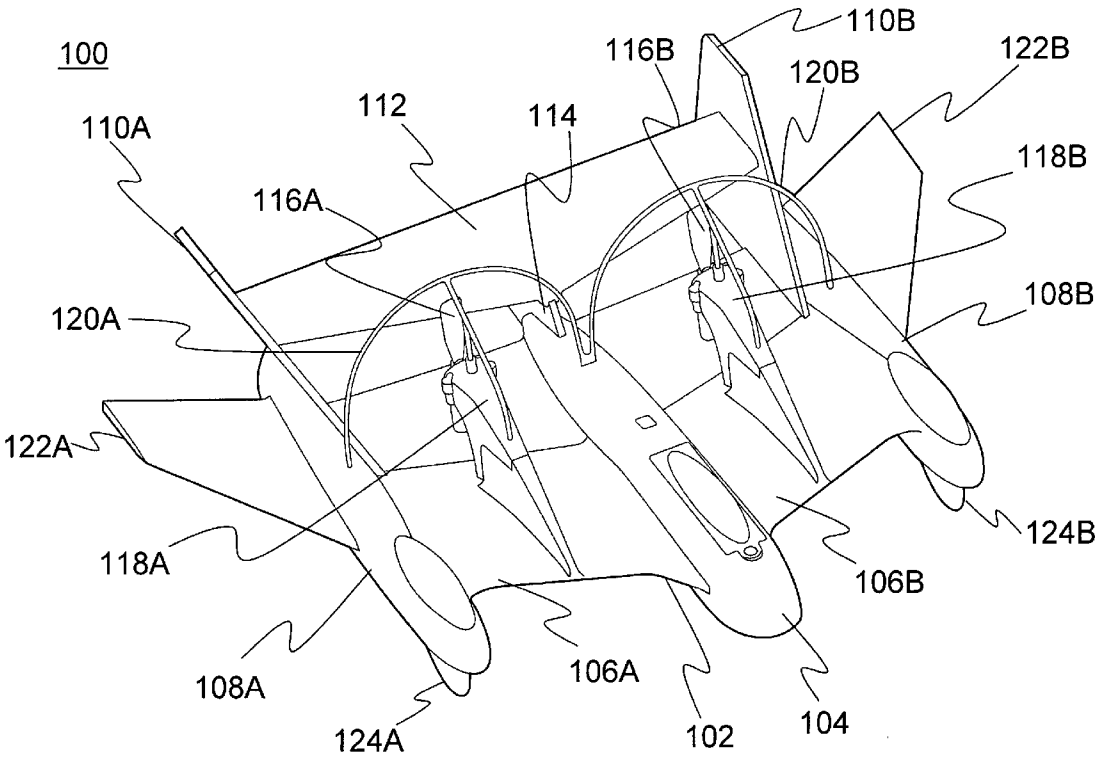
(57) **ABSTRACT**

A toy remote-controlled vehicle capable of moving along the surface and taking off into the air with ease. The vehicle has wings connected with runners supporting wheels for travel along the surface. The vehicle is powered by a propeller mounted on each wing. The vehicle has a uniquely-shaped fixed tail to facilitate lifting of the vehicle into the air once a minimum speed is achieved. The wheels also maintain the vehicle in a straight path with a degree of lift to ease takeoff into the air. The vehicle changes speed and direction using a differential thrust system between the two propellers that is controlled by a customized integrated circuit.



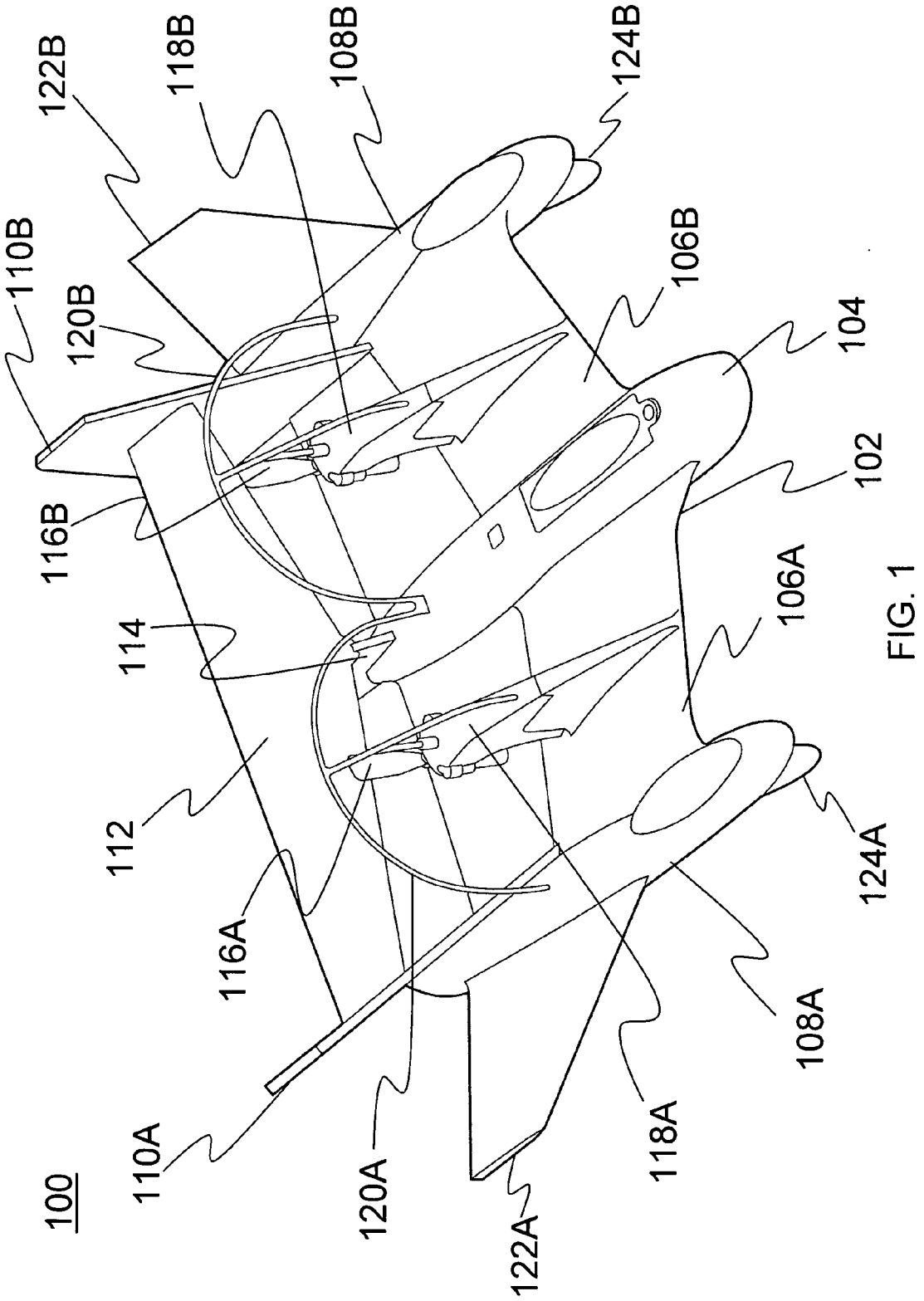

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FIG. 1

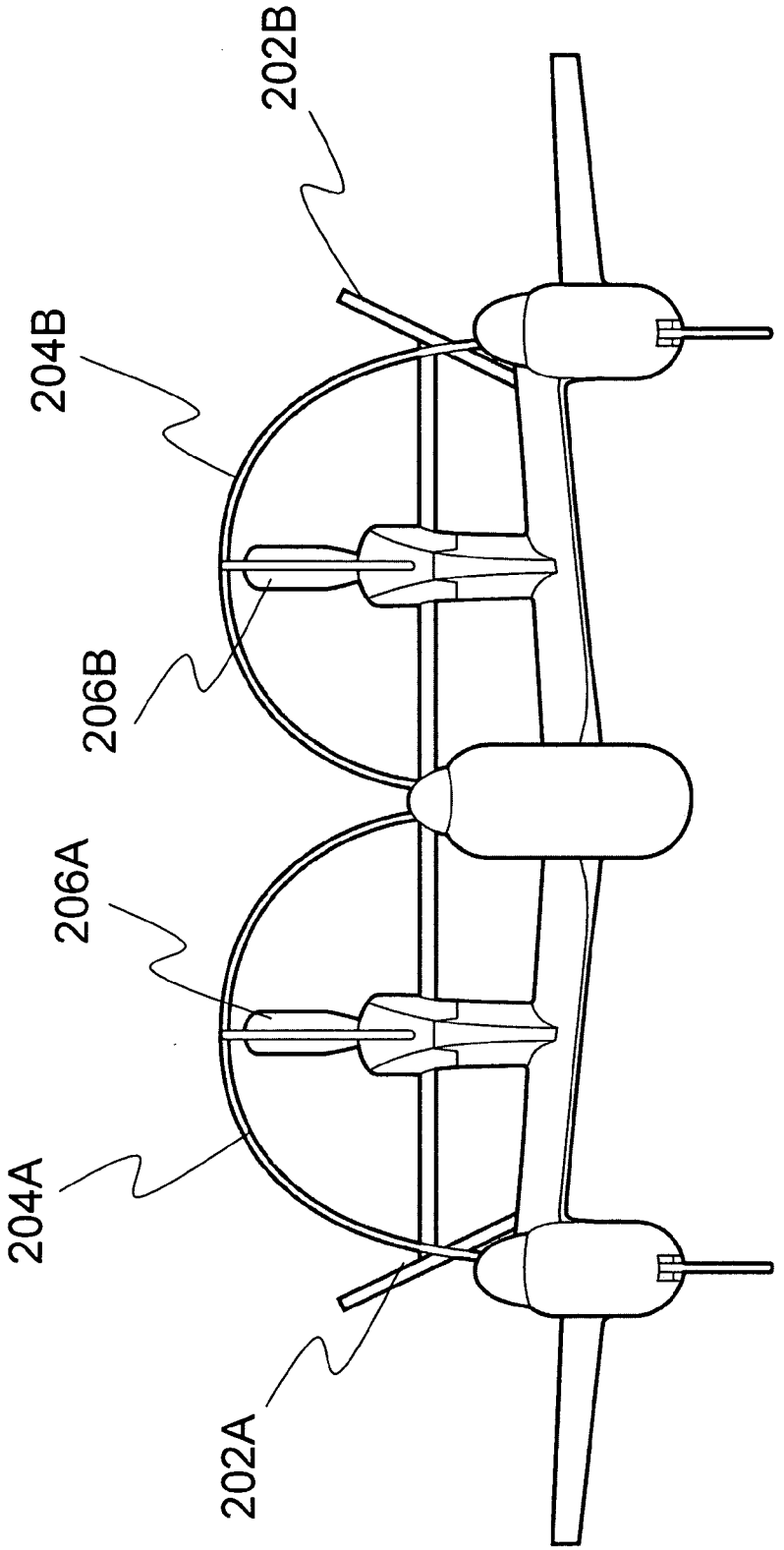

FIG. 2

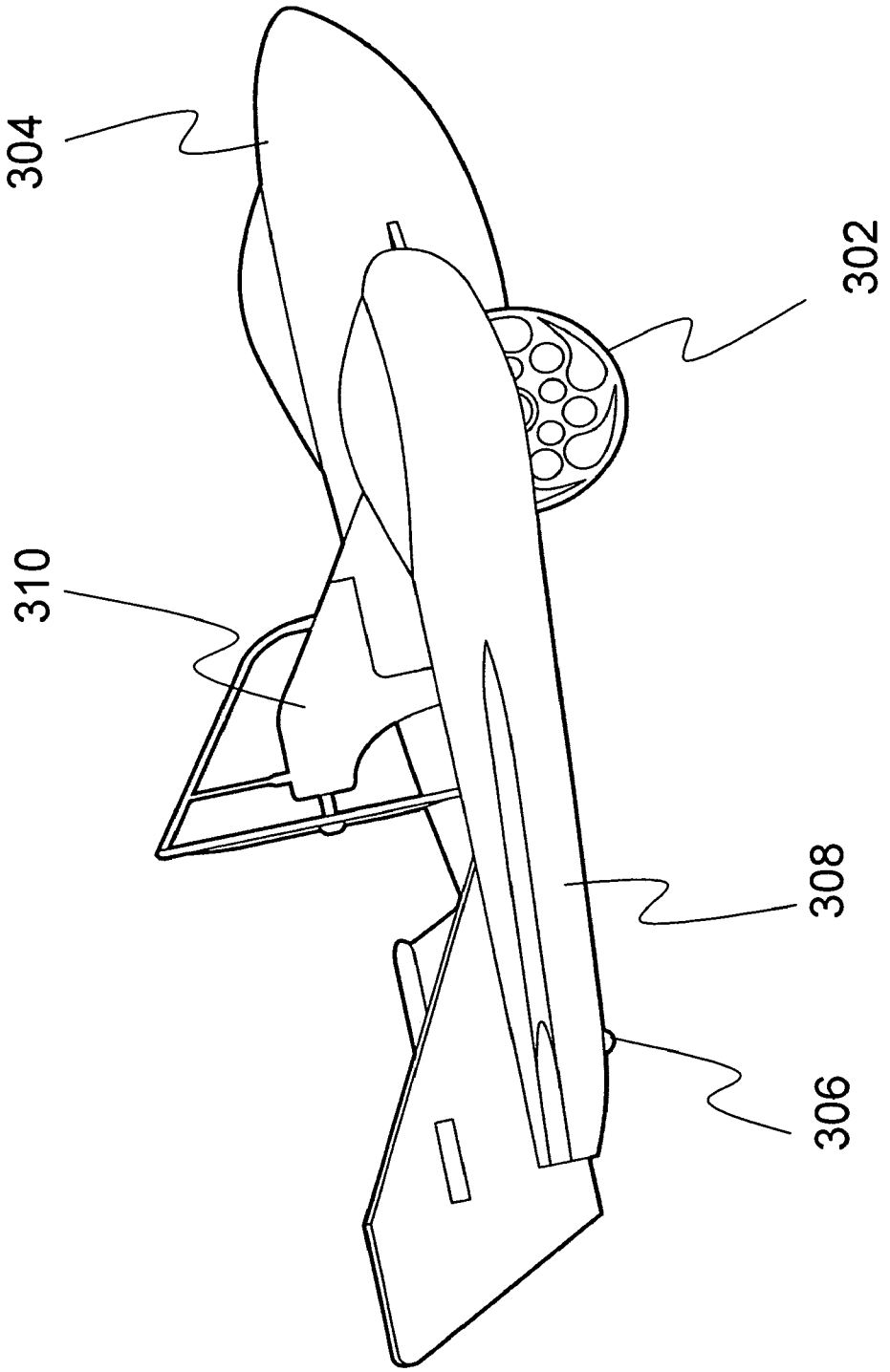

FIG. 3

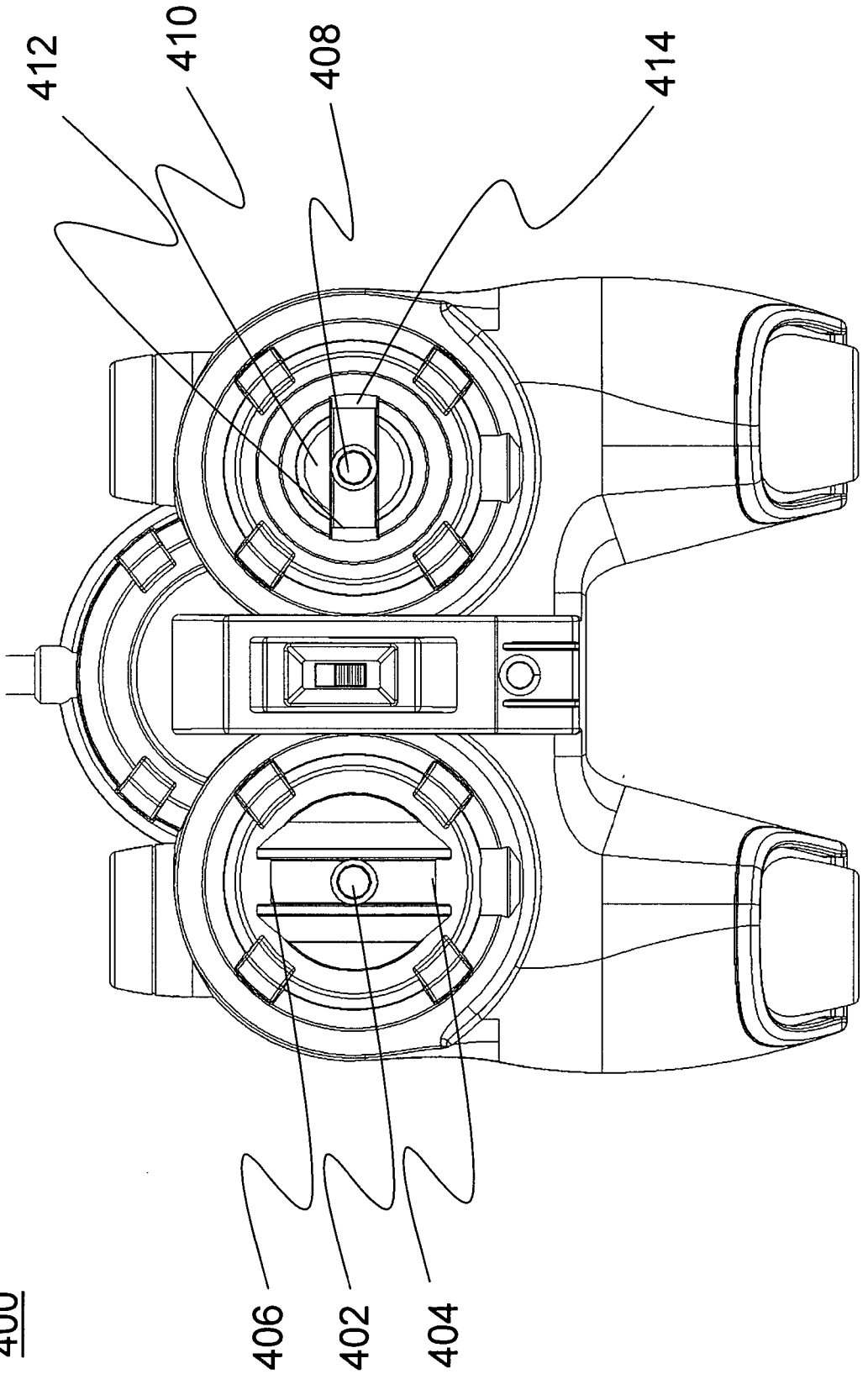

FIG. 4

FIXED-BODY TOY VEHICLE HAVING DIFFERENTIAL THRUST AND UNASSISTED LIFTOFF CAPABILITY

BACKGROUND OF THE INVENTION

[0001] (1) Technical Field

[0002] The present invention relates to toy remote-controlled vehicles, and more specifically to toy vehicles that can be operated on a surface and in the air.

[0003] (2) Background

[0004] Radio-controlled ("RC") toy cars and airplanes are well-known in the art. Existing RC cars can perform numerous stunts and functions, and usually operate by motor-powered wheels running on batteries. When a user needs to turn the car, a left or right turn command can be sent from a remote transmitter to the receiver in the RC car, causing one set of the wheels on the car to turn to the left or right, much like a regular car.

[0005] RC airplanes, on the other hand, operate using a completely different system. Existing RC toy airplanes usually operate with a tail rudder for steering the plane and a tail or wing elevator for adjusting the plane's altitude. Propellers are typically used solely to provide thrust to the plane. However, newer methods of steering RC planes have been developed. U.S. Pat. No. 5,087,000 to Suto (hereinafter "the Suto patent") discloses a twin propeller airplane that uses differential thrust to steer the plane. Instead of a rudder, the speed of the motors can be independently varied to turn the plane. For example, when the speed of the left motor is decreased while maintaining the speed of the right motor, the plane turns to the left. U.S. Pat. No. 6,612,893 to Rehkemper et al. (hereinafter "the Rehkemper patent") further improves on the differential thrust model by adding a microprocessor to the control circuitry in the plane. The microprocessor provides programmability to an RC plane, enabling complex flying modes by a user or permitting flying essentially directed by a computer. However, the plane disclosed in the Rehkemper patent has several limitations. The plane is incapable of taking off from the ground; instead, it must be manually launched into the air to initiate flight. The plane taught by the Rehkemper patent also does not provide for landing gear or movement along the ground, limiting it to in-air use only. Once the plane descends to the ground, it must be retrieved by the user and re-launched. Furthermore, the process of launching the plane into the air while simultaneously operating the remote transmitter is difficult and usually requires two people. Finally, the addition of a microprocessor is expensive and can require complex knowledge of flying in order to properly operate.

[0006] Although the plane taught by the Rehkemper patent lacks ground operating capabilities, the plane taught in the Suto patent does include a pair of wheels mounted underneath the fuselage for taking off from the ground. However, the plane does not provide for any other use on the ground. Additionally, the positioning of the wheels in the plane taught by Suto—close together underneath the fuselage of the plane—makes landing difficult without the plane tipping over, and additionally limits maneuverability of the plane on the ground.

[0007] Therefore, what is needed is a multi-use RC toy vehicle that can be used as a toy vehicle on a surface such as the ground and also as a plane in the air. What is also needed is the ability to launch the plane in the air directly from the surface. The toy vehicle should be lightweight, inexpensive to manufacture, easy for children to use, and require only a simple circuit design to control the vehicle and not necessarily a microprocessor.

SUMMARY OF THE INVENTION

[0008] The present invention provides an apparatus that overcomes the aforementioned limitations and fills the aforementioned needs by providing a radio-controlled ("RC") toy vehicle capable of travel on a surface and in the air. The vehicle is easy to use and inexpensive to manufacture due to its simple differential thrust twin propeller propulsion system and fixed body that does not require a movable rudder or tail elevator. The vehicle has a wide body with runner supports on its outer edges for increased stability during the takeoff and landing procedures. Two wheels mounted under the runner supports permit easy movement along the surface and guide the vehicle in a straight, upward direction during the takeoff action. The vehicle body is made of a lightweight foam that is durable, inexpensive and safe for use by children. Finally, a controller is used to receive a set of fixed signals from a remote transmitter which then controls the velocity and direction of the toy vehicle.

[0009] In one embodiment of the present invention, the toy flying vehicle comprises a fixed body having a forward portion and a rear portion, a fuselage, a left wing, a right wing, and a tail, whereby the vehicle is capable of taking off into the air while moving along a surface; a left runner and a right runner connected with the left wing and right wing, respectively; a left motor and a right motor connected with the left wing and right wing, respectively; a left propeller and a right propeller connected with and powered by the left motor and right motor, respectively; and a controller contained in the body and configured to control the power to the left motor and the right motor; thereby controlling the speed and direction of the toy flying vehicle.

[0010] In another embodiment of the present invention, the tail further comprises a left fixed vertical tail and a right fixed vertical tail.

[0011] In another embodiment of the present invention, the controller is a customized integrated circuit.

[0012] In another embodiment of the present invention, the toy vehicle further comprises a battery contained in the fuselage and connected with the controller.

[0013] In another embodiment of the present invention, the runners further comprise a wheel mounted within each respective left runner and right runner.

[0014] In another embodiment of the present invention, the wheels are disposed toward the forward portion of the fixed body.

[0015] In another embodiment of the present invention, the wheels provide an upward tilt to the toy vehicle for easing the ability of the vehicle to takeoff into the air.

[0016] In another embodiment of the present invention, the height of the wheels can be adjusted to increase or decrease the upward tilt of the toy vehicle.

[0017] In another embodiment of the present invention, the toy vehicle further comprises horizontal winglets mounted to an outer edge of each respective runner.

[0018] In another embodiment of the present invention, the toy vehicle further comprises a propeller cage surrounding the propellers for protecting a user from touching the propellers during operation.

[0019] In another embodiment of the present invention, the left motor and right motor are surrounded by a left motor

housing and a right motor housing, respectively, connected with the left wing and right wing, respectively.

[0020] In another embodiment of the present invention, the left fixed vertical tail and right fixed vertical tail protrude substantially vertically from the left runner and right runner, respectively.

[0021] In another embodiment of the present invention, the fixed horizontal tail is connected between the left fixed vertical tail and right fixed vertical tail.

[0022] In another embodiment of the present invention, the fixed horizontal tail is further connected with a central vertical tail, the central vertical tail connected with the fuselage.

[0023] In another embodiment of the present invention, the customized integrated circuit is configured to receive a signal from a remote transmitter and translate the signal into a command that alters the power to at least one of the left motor and right motor.

[0024] In another embodiment of the present invention, the customized integrated circuit uses a set of logic gates to translate the signal from the remote transmitter into a command that alters the power to at least one of the left motor and right motor.

[0025] In another embodiment of the present invention, a method of making a toy flying vehicle comprises the acts of: forming a fixed body having a forward portion and a rear portion, a fuselage, a left wing, a right wing, and a tail, whereby the vehicle is capable of taking off into the air while moving along a surface; connecting a left runner and a right runner with the left wing and right wing, respectively; connecting a left motor and a right motor with the left and right wing, respectively; connecting a left propeller and a right propeller with the left motor and right motor, respectively, such that the motors power the propellers; and placing a controller in the fuselage, wherein the controller is configured to control the power to the left motor and the right motor; thereby controlling the speed and direction of the toy flying vehicle.

[0026] In another embodiment of the present invention, the act of forming a tail further comprises the act of forming a left fixed vertical tail and a right fixed vertical tail.

[0027] In another embodiment of the present invention, the act of forming a the controller comprises the act of forming the controller from a customized integrated circuit.

BRIEF DESCRIPTION OF THE DRAWNGS

[0028] The objects, features and advantages of the present invention will be apparent from the following detailed descriptions of the preferred aspect of the invention in conjunction with reference to the following drawings, where:

[0029] FIG. **1** is a perspective view of the toy flying vehicle body including the right runner and left runner, fixed vertical tails and fixed horizontal tail, right wheel and left wheel, and right winglet and left winglet;

[0030] FIG. **2** is a front view of the toy flying vehicle showing the right propeller and left propeller, right propeller cage and left propeller cage, and vertical tail wings;

[0031] FIG. **3** is a side view of the toy flying vehicle depicting the right wheel contained within a portion of the right runner, a motor housing surrounding the right motor, and a right skid support for supporting the flying vehicle on the surface; and

[0032] FIG. **4** is a front view of a remote transmitter including a first control stick and a second control stick.

DETAILED DESCRIPTION

[0033] The toy vehicle of the present invention is a radio-controlled ("RC") vehicle capable of traveling along a surface such as land or water and taking off into the air, and is constructed to be lightweight, easy to use, safe for children, and inexpensive to manufacture. The vehicle has a central fuselage, two wings connected with the fuselage, and runners attached to the outer edges of both wings. The runners provide balance to the toy vehicle when in the air and during the takeoff and landing process to prevent the toy vehicle from crashing. The runners also house a set of wheels in the front section for easing travel of the toy vehicle on the surface. The wheels also provide a slight lift angle to the toy vehicle to aid in takeoff and help maintain a straight direction of travel when liftoff into the air is desired. The toy vehicle has twin-propellers mounted on each wing and powered by separate motors. The toy vehicle uses a differential thrust system to control the speed and direction of the plane, eliminating the use of a movable rudder or elevator. The toy vehicle is therefore easy and inexpensive to manufacture, as the body can be made from one piece of material that does not have any moving parts. The toy vehicle is made from a lightweight foam that is inexpensive to manufacture and durable for use by children or novice users that may crash the vehicle frequently. Furthermore, the vehicle contains a simple customized integrated circuit within the fuselage that receives a fixed set of control signals from a remote transmitter and independently adjusts the speed of the propellers accordingly.

[0034] The following description, taken in conjunction with the referenced drawings, is presented to enable one of ordinary skill in the art to make and use the invention and to incorporate it in the context of particular applications. Various modifications, as well as a variety of uses in different applications will be readily apparent to those skilled in the art, and the general principles defined herein may be applied to a wide range of embodiments. Thus, the present invention is not intended to be limited to the embodiments presented, but is to be accorded the widest scope consistent with the principles and novel features disclosed herein. Furthermore it should be noted that, unless explicitly stated otherwise, the figures included herein are illustrated diagrammatically and without any specific scale, as they are provided as qualitative illustrations of the concept of the present invention.

[0035] In the following detailed description, numerous specific details are set forth in order to provide a more thorough understanding of the present invention. However, it will be apparent to one skilled in the art that the present invention may be practiced without necessarily being limited to these specific details. In other instances, well-known structures and devices are shown in block diagram form, rather than in detail, in order to avoid obscuring the present invention.

[0036] The reader's attention is directed to all papers and documents which are filed concurrently with this specification and which are open to public inspection with this specification, and the contents of all such papers and documents are incorporated herein by reference. All the features disclosed in this specification, (including any accompanying claims, abstract, and drawings) may be replaced by alternative features serving the same, equivalent or similar purpose,

unless expressly stated otherwise. Thus, unless expressly stated otherwise, each feature disclosed is one example only of a generic series of equivalent or similar features.

[0037] Furthermore, any element in a claim that does not explicitly state "means for" performing a specified function, or "step for" performing a specific function, is not to be interpreted as a "means" or "step" clause as specified in 35 U.S.C. Section 112, Paragraph 6. In particular, the use of "step of" in the claims herein is not intended to invoke the provisions of 35 U.S.C. Section 112, Paragraph 6.

[0038] Please note, if used, the labels "left," "right," "front," "back," "top," "bottom," "forward," "reverse," "clockwise" and "counter-clockwise" have been used for convenience purposes only and are not intended to imply any particular fixed direction. Instead, they are used to reflect relative locations and/or directions between various portions of an object.

[0039] One embodiment of the RC toy vehicle of the present invention is shown in FIG. **1**. The vehicle **100** has a basic fixed body **102** with a fuselage **104**, left wing **106**A and right wing **106**B, and left runner **108**A and right runner **108**B. Extending substantially vertically from each of the left and right runners **108**A and **108**B are two vertical tail supports **110**A and **110**B that add additional stability to the vehicle. The vertical tail supports **110**A and **110**B are connected by a large fixed horizontal tail **112**. The horizontal tail **112** is further supported by a central tail support **114** extending vertically from the fuselage **104** and connected with the horizontal tail **112** at its midpoint. The two vertical tail supports **110**A and **110**B, although fixed in place, are angled vertically from the plane body **102** and slightly away from the fuselage **104**, as can be better seen in FIG. **2**, **202**A and **202**B. Both the vertical tail supports **110**A and **110**B and the horizontal tail **112** are fixed in place and do not adjust or rotate. The lack of movable tails significantly reduces manufacturing costs and makes the vehicle less likely to break when crashed. The horizontal tail **112** is fixed at a specific angle such that once the toy vehicle **100** accelerates to a minimum speed enough lift is generated to elevate the toy vehicle **100** into the air. FIG. **1** also shows the positioning of a left and right propeller **116**A and **116**B on each respective left wing **106**A and right wing **106**B. The propellers **116**A and **116**B are raised from the surface of the wings **106**A and **106**B and supported by motor housings **118**A and **118**B to prevent the propellers from striking the surface of the wings when rotating. The motor housings **118**A and **118**B also function as housings for the electric motors (not pictured) that power the propellers **116**A and **116**B. The propellers **116**A and **116**B are protected by propeller cages **120**A and **120**B, which, in one embodiment, are single wires shaped around the rotational diameter of the propellers **116**A and **116**B. The propeller cages **120**A and **120**B are primarily safety features to prevent a user from coming in contact with the spinning propellers, but also function to protect the propellers if the toy vehicle should land upside down. Also extending horizontally from the left and right runners **108**A and **108**B are winglets **122**A and **122**B that provide added stability to the toy vehicle while in the air. The right and left runners **108**A and **108**B also house a pair of wheels **124**A and **124**B disposed to a forward section of the runners **108**A and **108**B that aid the vehicle **100** in traveling along the surface. Additionally, the wheels **124**A and **124**B have very small surface areas and are not directionally adjustable so that they tend to guide the toy vehicle **100** in a forward direction. The fixed wheels **124**A and **124**B aid in the ability of the vehicle to liftoff into the air at a faster rate, whereas a vehicle sliding along the surface on large runners or skids would tend to waver in direction, requiring more power and skill to lift the toy vehicle into the air during takeoff.

[0040] FIG. **2** illustrates a front view of the toy vehicle more clearly depicting the outward angle of the vertical tails **202**A and **202**B. The propeller cages **204**A and **204**B are also better viewed in their position surrounding the rotational diameter of the propellers **206**A and **206**B.

[0041] The toy vehicle also generates lift by the angle at which the entire vehicle sits on the surface, as shown in FIG. **3**. The wheel **302** acts to raise the height of the front of the vehicle body **304** so that the vehicle travels on the surface at a slight tilt of approximately 10 degrees. When the vehicle is moved in a forward direction, the angle of the horizontal tail (not pictured) produces lift to launch the toy vehicle into the air, whereas lift might not occur if the vehicle rested flatly against the surface. To protect the back end of the vehicle from damage as it glides along the surface, a skid support **306** can be formed on a rear portion of the fuselage **308**. One skilled in the art will appreciate that the wheels could have adjustable height positions to alter the height of the front of the vehicle body **304**, thereby adjusting the minimum speed required to achieve takeoff. A user interested in using the toy vehicle more as a surface vehicle could lower the wheel height to increase the minimum speed required and make it more difficult for the vehicle to liftoff at greater speeds. Conversely, a user interested in using the toy vehicle more as an air vehicle could raise the wheel height to decrease the minimum speed required and make it easier for the vehicle to liftoff at lower speeds.

[0042] Inside the fuselage of the toy vehicle is a controller configured to receive one of a few fixed commands from a remote transmitter that controls the speed and direction of the toy vehicle. The controller, in one embodiment, is a customized integrated circuit ("IC"). The customized IC interprets the signal from a user operating the remote transmitter and then sends a command to one or both of the motors driving the propellers. For example, when a user sends a signal from the remote transmitter for a left turn, the customized IC receives the signal and translates it into a power drop for the left motor, which causes the vehicle to turn to the left.

[0043] A radio signal receiver (not pictured) contained within the fuselage and connected with the customized IC receives the signal from the remote transmitter and passes it on to the customized IC. The motors are housed in separate motor housings **310** protruding from the left and right wings, respectively. A battery contained within the central fuselage powers the customized IC and both motors. The battery must be lightweight but hold a significant charge to power the vehicle for a prolonged period of time. In one embodiment, the battery is a lithium ion battery and is rechargeable.

[0044] The toy RC vehicle can be formed from a foam such as an expanded polypropylene (EPP) foam which is durable, lightweight, and easy to manufacture in specific shapes. Additionally, the foam is soft enough to avoid damaging any object hit by the toy vehicle and is safe enough for children. The body of the toy vehicle including the fuselage, wings, runners, and tail can all be manufactured as a single piece of EPP foam with no moving parts, which reduces manufacturing costs. The EPP foam is light enough for the toy vehicle to float on water as well.

[0045] The motors used in one non-limiting example are simple 7.4 volt DC motors weighing approximately 8 grams each. The specific motor used is model QX-FK-N30-18048 from the QX Motor Co, Ltd. (3 Salisburg Road, T.S.T. Kowloon, Hong Kong, China). However, one skilled in the art will appreciate that the motor can vary as long as the size and weight do not impede the flying abilities of the vehicle. In another non-limiting example, the motors are electric-brushed motors.

[0046] The use of two propellers is, for obvious reasons, the minimum amount required for a differential thrust vehicle. However, additional propellers and motors can be added to increase speed and control, if desired. As an optional control mechanism, a rotatable motor could be used to change the direction of the propellers to achieve tighter turns or faster takeoffs and slower landings.

[0047] In one non-limiting example, the remote transmitter has two primary control sticks to power the toy vehicle. One embodiment of the controller **400** is shown in FIG. **4**. A first control stick **402** adjusts the power provided to both motors equally. This first control stick **402** controls only the forward speed and has a resting position **404** for zero speed and a forward position **406** for maximum speed, with midpoints of power in between both positions. When the speed is increased to a certain amount, the toy vehicle will cease to move along the surface and instead takeoff into the air. A second control stick **408** is the differential thrust system which adjusts the power proportionally between each motor in order to execute a directional change. This second control stick **408** has a central position **410** indicating no change in direction, a left position **412** for executing a left turn, and a right position **414** indicating a right turn. As with the first control stick, midpoints positions for lesser degrees of turning exist in between each position.

What is claimed is:

1. A toy flying vehicle comprising:

a fixed body having a forward portion and a rear portion, a fuselage, a left wing, a right wing, and a tail, whereby the vehicle is capable of taking off into the air while moving along a surface;

a left runner and a right runner connected with the left wing and right wing, respectively;

a left motor and a right motor connected with the left wing and right wing, respectively;

a left propeller and a right propeller connected with and powered by the left motor and right motor, respectively; and

a controller contained in the body and configured to control the power to the left motor and the right motor; thereby controlling the speed and direction of the toy flying vehicle.

2. The toy flying vehicle of claim **1**, wherein the tail further comprises a left fixed vertical tail and a right fixed vertical tail.

3. The toy flying vehicle of claim **1**, wherein the controller is a customized integrated circuit.

4. The toy flying vehicle of claim **1**, further comprising a battery contained in the fuselage and connected with the controller.

5. The toy flying vehicle of claim **1**, wherein the runners further comprise a wheel mounted within each respective left runner and right runner.

6. The toy flying vehicle of claim **5**, wherein the wheels are disposed toward the forward portion of the fixed body.

7. The toy flying vehicle of claim **6**, wherein the wheels provide an upward tilt to the toy vehicle for easing the ability of the vehicle to takeoff into the air.

8. The toy flying vehicle of claim **7**, wherein the height of the wheels can be adjusted to increase or decrease the upward tilt of the toy vehicle.

9. The toy flying vehicle of claim **1**, further comprising horizontal winglets mounted to an outer edge of each respective runner.

10. The toy flying vehicle of claim **1**, further comprising a propeller cage surrounding the propellers for protecting a user from touching the propellers during operation.

11. The toy flying vehicle of claim **1**, wherein the left motor and right motor are surrounded by a left motor housing and a right motor housing, respectively, connected with the left wing and right wing, respectively.

12. The toy flying vehicle of claim **2**, wherein the left fixed vertical tail and right fixed vertical tail protrude substantially vertically from the left runner and right runner, respectively.

13. The toy flying vehicle of claim **12**, wherein the fixed horizontal tail is connected between the left fixed vertical tail and right fixed vertical tail.

14. The toy flying vehicle of claim **13**, wherein the fixed horizontal tail is further connected with a central vertical tail, the central vertical tail connected with the fuselage.

15. The toy flying vehicle of claim **3**, wherein the customized integrated circuit is configured to receive a signal from a remote transmitter and translate the signal into a command that alters the power to at least one of the left motor and right motor.

16. The toy flying vehicle of claim **15**, wherein the customized integrated circuit uses a set of logic gates to translate the signal from the remote transmitter into a command that alters the power to at least one of the left motor and right motor.

17. A method of making a toy flying vehicle, the method comprising acts of:

forming a fixed body having a forward portion and a rear portion, a fuselage, a left wing, a right wing, and a tail, whereby the vehicle is capable of taking off into the air while moving along a surface;

connecting a left runner and a right runner with the left wing and right wing, respectively;

connecting a left motor and a right motor with the left and right wing, respectively;

connecting a left propeller and a right propeller with the left motor and right motor, respectively, such that the motors power the propellers; and

placing a controller in the fuselage, wherein the controller is configured to control the power to the left motor and the right motor; thereby controlling the speed and direction of the toy flying vehicle.

18. The method as set forth in claim **17**, whereby the act of forming a tail further comprises the act of forming a left fixed vertical tail and a right fixed vertical tail.

19. The method as set forth in claim **17**, further comprising the act of forming the controller from a customized integrated circuit.

20. The method as set forth in claim **17**, further comprising the act of inserting a battery in the fuselage and connecting the battery with the controller.

21. The method as set forth in claim **17**, further comprising the act of mounting wheels within each respective runner.

22. The method as set forth in claim **21**, further comprising the act of mounting the wheels toward the forward portion of the fixed body.

23. The method as set forth in claim **22**, further comprising the act of providing an upward tilt to the forward portion of the toy vehicle with the wheels.

24. The method as set forth in claim **23**, further comprising the act of adjusting the height of the wheels to increase or decrease the upward tilt of the toy vehicle.

25. The method as set forth in claim **17**, further comprising the act of mounting horizontal winglets to an outer edge of each respective left runner and right runner.

26. The method as set forth in claim **17**, further comprising the act of connecting a propeller cage with the fuselage, left runner, and right runner to surround the propellers for protecting a user from touching the propellers during operation.

27. The method as set forth in claim **17**, further comprising the act of surrounding the left motor and right motor with a left motor housing and a right motor housing, respectively, and further comprising the act of connecting the left motor housing and right motor housing with the left wing and right wing, respectively.

28. The method as set forth in claim **18**, further comprising the act of extending the left fixed vertical tail and right fixed vertical tail vertically from the left runner and right runner, respectively.

29. The method as set forth in claim **28**, further comprising the act of connecting the fixed horizontal tail with the left fixed vertical tail and right fixed vertical tail.

30. The method as set forth in claim **29**, further comprising the act of connecting the fixed horizontal tail with a central vertical tail, the central vertical tail connected with the fuselage.

31. The method as set forth in claim **19**, further comprising the act of receiving a signal from a remote transmitter to the customized integrated circuit and translating the signal into a command that alters the power to one or both of the left motor and right motor.

32. The method as set forth in claim **31**, further comprising the act of using a set of logic gates within the customized integrated circuit to translate the signal from the remote transmitter into a command that alters the power to one or both of the left motor and right motor.

* * * * *