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(54) **TRI-MOTOR TOY AIRCRAFT**

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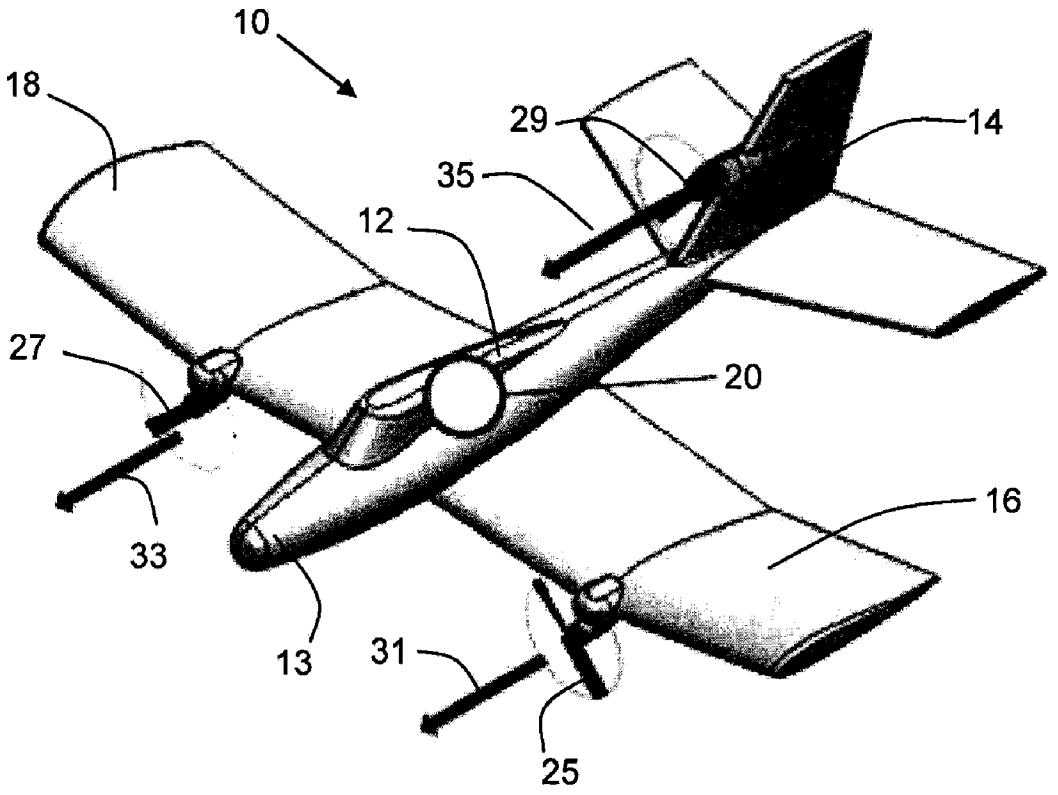
(57) **ABSTRACT**

A remote controlled tri-motor toy aircraft is provided. The tri-motor toy aircraft has two wing propellers and a tail propeller. Each propeller is controlled by a separate motor. The wing propellers provide thrust on the opposite side of the center of gravity of the toy aircraft to the thrust provided by the tail propeller, thus allowing the flight direction of the toy aircraft to be controlled by the relative thrusts of the three motors.



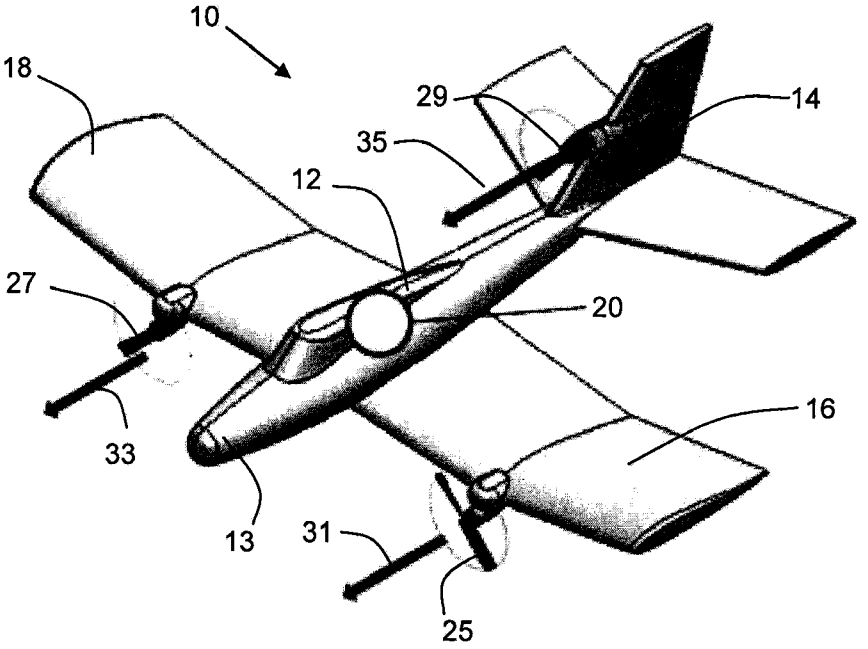


FIG. 1

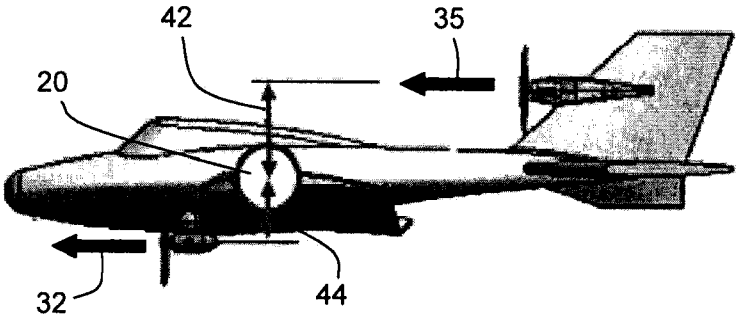


FIG. 2A

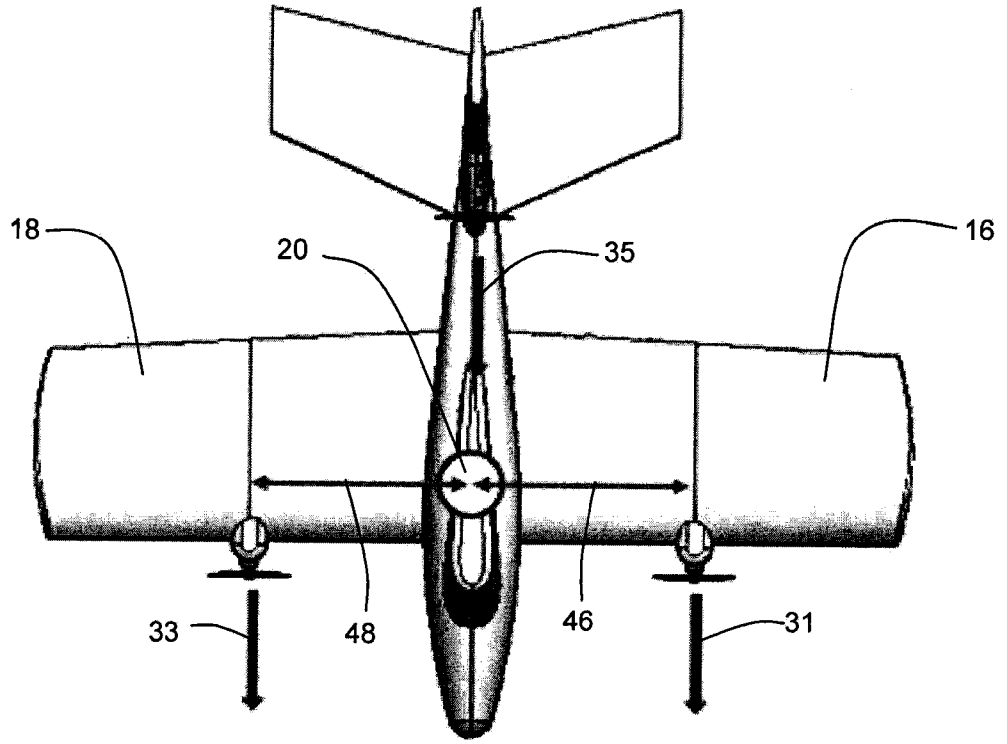


FIG. 2B

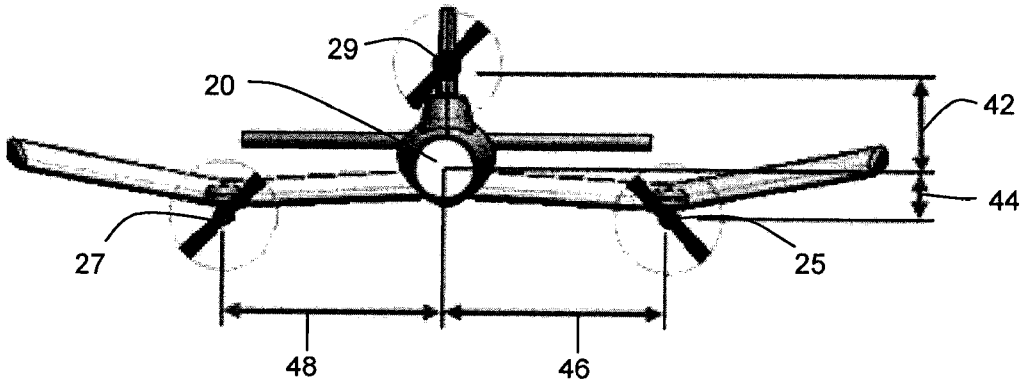


FIG. 2C

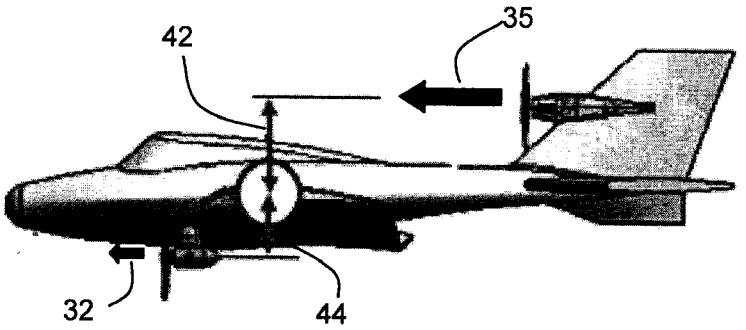


FIG. 3A

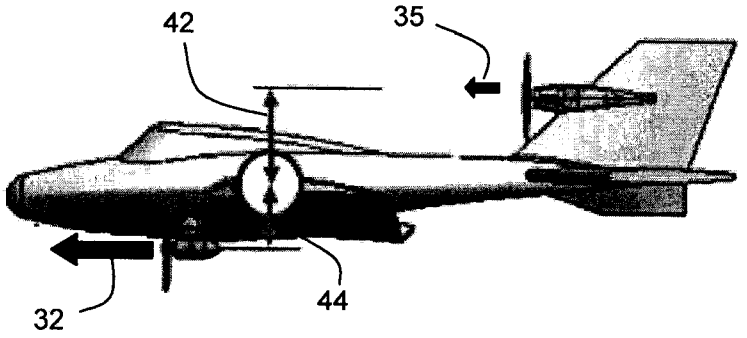


FIG. 3B

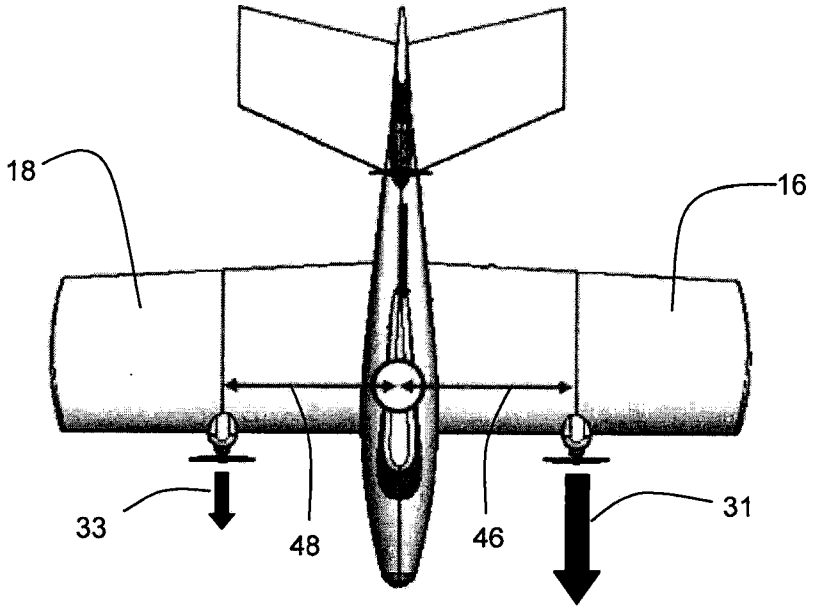


FIG. 4A

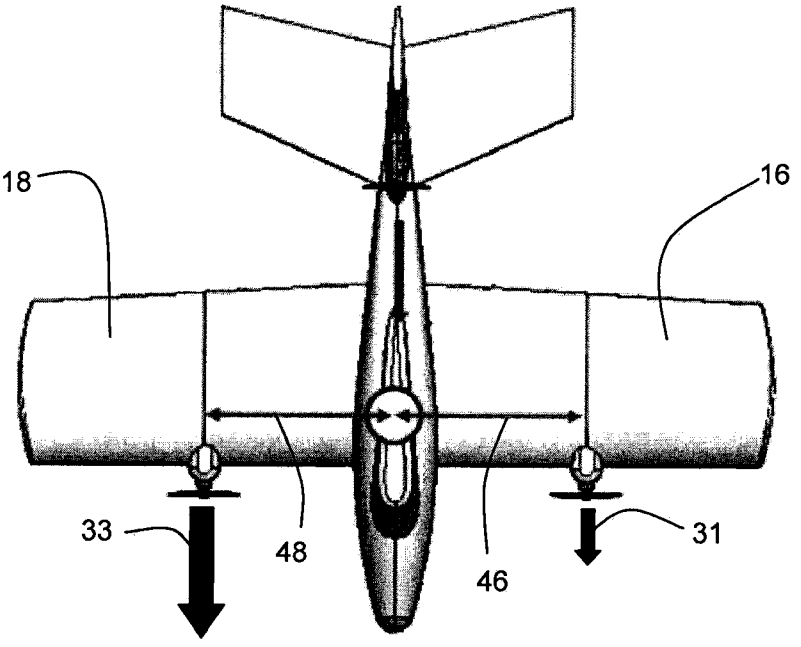


FIG. 4B

TRI-MOTOR TOY AIRCRAFT

FIELD OF THE DISCLOSURE

[0001] The present disclosure relates generally to toy aircraft, and more particularly to remote controlled toy aircraft.

BACKGROUND

[0002] A traditional aircraft is steered leftward or rightward about the vertical axis of the fuselage of the aircraft by discretely controlling a rudder on the vertical stabilizer of the tail. The aircraft turns in the same direction as the steering direction of the rudder. The fuselage can also pitch up or down about an axis perpendicular to the longitudinal plane of symmetry of the aircraft by controlling an elevator on the horizontal stabilizer of the traditional aircraft. The aircraft dives or pitches down and climbs or pitches up when the elevator is steered downward and upward respectively.

[0003] In contrast, dual motor toy aircraft control yaw and pitch by adjusting propeller speed rather than by adjusting the angle of tail control surfaces such as a rudder or elevator. Such dual-motor toy aircraft use differential speeds of the propellers on opposing wings to yaw, i.e., to steer rightward or leftward. The speed of both propellers are increased or decreased to control the ascent and the descent of toy aircraft. For example, U.S. Pat. No. 5,087,000 describes the use of differential steering by controlling the rotational outputs of the right and left propellers of a toy aircraft. The dual-motor toy aircraft turns rightward if the left propeller spins faster causing the rotational output of the left propeller to be higher than that of the right propeller. Similarly, the dual-motor toy aircraft turns leftward if the rotational output of the right propeller is higher than that of the left propeller. In addition, the dual-motor toy aircraft ascends as the rotational outputs of both propellers continuously increase to produce more lift to climb, and descends as the rotational outputs of both propellers continuously decrease. A level flight is achieved when the rotational outputs of both propellers are kept constant at a particular percentage level of the maximum outputs.

[0004] The existing dual-motor remote controlled toy aircraft, however, are not capable of controlling the pitch without altering the speed of the toy aircraft. For example, they are not capable of flying fast without climbing nor are they capable of decelerating without descending. It is therefore desirable to provide a remote controlled toy aircraft that has such capabilities.

SUMMARY

[0005] The present disclosure provides a remote controlled tri-motor toy aircraft. The tri-motor toy aircraft has a fuselage having a tail, a left wing attached to a left side of the fuselage and a right wing attached to a right side of the fuselage. A left propeller is disposed on the left wing and is driven by a left motor so as to generate a fore/aft thrust on the left side of the toy aircraft, or a left thrust. Likewise, a right propeller is disposed on the right wing and is driven by a right motor so as to generate a fore/aft thrust on the right side of the toy aircraft, or a right thrust, and a tail propeller is disposed on the tail and is driven by a tail motor so as to generate a fore/aft tail thrust. The left propeller and the right propeller are vertically displaced from the center of gravity in a first direction and the tail propeller is vertically displaced from the center of gravity of the toy aircraft in a second direction opposite to the first direction. In this way, controlling the left thrust, the right thrust and the tail thrust acts to simultaneously provide yaw and pitch control to direct the flight direction of the toy aircraft.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] Further features of the present invention will become apparent from the following written description and the accompanying drawings and the appended claims in which:

[0007] FIG. **1** is a perspective view of an embodiment of the present remote controlled tri-motor toy aircraft maintaining a straight and level flight.

[0008] FIG. **2**A is a side view of the embodiment of FIG. **1**.

[0009] FIG. **2**B is a top view of the embodiment of FIG. **1**.

[0010] FIG. **2**C is a front view of the embodiment of FIG. **1**.

[0011] FIG. **3**A is a side view of the embodiment of FIG. **1** pitching down.

[0012] FIG. **3**B is a side view of the embodiment of FIG. **1** pitching up.

[0013] FIG. **4**A is a top view of the embodiment of FIG. **1** yawing rightward.

[0014] FIG. **4**B is a top view of the embodiment of FIG. **1** yawing leftward.

DETAILED DESCRIPTION

[0015] As used herein, the terms "up", "upward", "down", "downward", "above", "below", "right", "rightward", "left", "leftward", "vertical(ly)", "horizontal(ly)" and the like are intended to indicate relative directions or positions in the context of the present toy aircraft as it would be positioned in straight and level flight.

[0016] As used herein, the term "center of gravity" is intended to mean the point at which the toy aircraft would balance if it were possible to suspend the toy aircraft at that point, or the mass center of the toy aircraft.

[0017] As used herein, the term "pitch" is intended to mean the angle of rotation of the toy aircraft about an axis perpendicular to the longitudinal plane of symmetry of the toy aircraft relative to level flight. When pitch is positive, the nose of the toy aircraft is oriented upwards relative to the tail, and when pitch is negative, the nose of the toy aircraft is oriented downwards relative to the tail.

[0018] As used herein, the term "yaw" is intended to mean the angle of rotation of the toy aircraft about the vertical axis of the fuselage of the toy aircraft, relative to straight flight. When yawing right, the toy aircraft is turning right as observed while facing in the direction of forward motion of the toy aircraft, and when yawing left, the toy aircraft is turning left as observed while facing in the direction of forward motion of the toy aircraft. "Roll" is a secondary effect of yaw. As the toy aircraft yaws, its outboard wing travels faster in air than its inboard wing, thus producing more lift and causing roll. As used herein, the term "roll" is intended to mean the angle of rotation of the toy aircraft about the longitudinal axis of the toy aircraft relative to level flight. When roll is positive, the toy aircraft rotates clockwise while facing in the direction of forward motion of the toy aircraft and when roll is negative, the toy aircraft rotates counterclockwise while facing in the direction of forward motion.

[0019] The present remote controlled tri-motor toy aircraft has a fuselage having a tail, a left wing attached to a left side of the fuselage and a right wing attached to a right side of the fuselage. A left propeller is disposed on the left wing and is

driven by a left motor so as to generate a left thrust. Likewise, a right propeller is disposed on the right wing and is driven by a right motor so as to generate a right thrust, and a tail propeller is disposed on the tail and is driven by a tail motor so as to generate a tail thrust. Because each of the three propellers is driven by a different motor, the thrust of each propeller can be controlled independently.

[0020] In at least one embodiment, the right, left and tail motors are each independently controlled by a user-manipulated remote control unit, by methods well known in the art, including but not limited to transmission of infrared control signals and radio frequency control signals between the remote control unit and the toy aircraft. In at least one embodiment, the remote control unit can control one or more microprocessors on the toy aircraft. Each microprocessor can be programmed with instructions so as to control one or more of the right, left and tail motors independently, in response to signals sent from the remote control unit.

[0021] The left propeller and the right propeller are vertically displaced from the center of gravity in a first direction and the tail propeller is vertically displaced from the center of gravity of the toy aircraft in a second direction opposite to the first direction. In at least one embodiment, the left propeller and the right propeller are located below the center of gravity of the toy aircraft and the tail propeller is located above the center of gravity. In at least one other embodiment, the left propeller and the right propeller are located above the center of gravity of the toy aircraft and the tail propeller is located below the center of gravity.

[0022] The direction of flight, including the yaw and the pitch of the tri-motor toy aircraft is controlled by the magnitude and direction of thrusts from each of the left, the right and the tail motors relative to the center of gravity of the toy aircraft, as will be explained in more detail below. The vector sum of thrusts generated from the three motors controls the forward speed and direction of the tri-motor toy aircraft. In at least one embodiment, each of the left, the right and the tail motors can be operated so as to generate a forward thrust or a reverse thrust. By manipulating the magnitude and direction of thrusts of the left, right and tail motors relative to the center of gravity of the toy aircraft, the speed and direction of flight of the toy aircraft can be controlled.

[0023] The present tri-motor toy aircraft is capable of performing various manoeuvres including but not limited to increasing or decreasing speed while maintaining a straight and level flight, pitching up and down, and yawing. Through manipulation of thrusts from the three motors of the tri-motor toy aircraft as described herein and as will be apparent to the person of skill in the art, the present remote controlled tri-motor toy aircraft is also capable of diving to the ground or pulling up before hitting the ground. Moreover, it is capable of performing well-known stunts such as inside loops, spins, chandelle, barrel roll and the like.

[0024] An embodiment of the present remote controlled tri-motor toy aircraft is shown in FIG. **1**. Here, the tri-motor toy aircraft **10** has a fuselage **12**; a nose **13**, a tail **14**; a left wing **16**; a right wing **18**; a left propeller **25** disposed on the left wing **16** and below the center of gravity **20** of toy aircraft **10**, and driven by a left motor (not shown); a right propeller **27** disposed on the right wing **18** and below the center of gravity **20** of toy aircraft **10**, and driven by a right motor (not shown); and a tail propeller **29** disposed on the tail **14** and above the center of gravity **20** of toy aircraft **10**, and driven by a tail motor (not shown).

[0025] Referring to FIGS. **1** and **2**A to **2**C, the left motor drives the left propeller **25** to produce a left thrust, i.e., a thrust on the left side of the toy aircraft, indicated by arrow **31**; the right motor drives the right propeller **27** to produce a right thrust, i.e., a thrust on the right side of the toy aircraft, indicated by arrow **33**, and the tail motor drives the tail propeller **29** to produce a tail thrust, indicated by arrow **35**. Left thrust **31** acts with a right yaw moment arm, indicated by arrow **46**, and right thrust **33** acts with a left yaw moment arm, indicated by arrow **48**, as seen in FIG. **2**B. Therefore, by controlling the relationship between left thrust **31** and right thrust **33**, the yaw of the tri-motor toy aircraft can be controlled. Thus, as seen in FIG. **2**B, when left thrust **31** is balanced by right thrust **33**, the toy aircraft will maintain straight flight. As seen in FIG. **4**A, the tri-motor toy aircraft **10** yaws right, in the direction of the right wing **18**, when left thrust **31** is increased and/or right thrust **33** is decreased. Furthermore, as seen in FIG. **4**B, the tri-motor toy aircraft **10** yaws left, in the direction of the left wing **16**, when left thrust **31** is decreased and/or right thrust **33** is increased.

[0026] In addition, as seen in FIG. **2**A, because tail thrust **35** is above the center of gravity **20** of toy aircraft **10**, tail thrust **35** acts with a downward pitching moment arm, indicated by arrow **42**. Likewise, because left thrust **31** and right thrust **33** are below the center of gravity **20**, their combined thrust, indicated by arrow **32**, acts with an upward pitching moment arm, indicated by arrow **44**. When tail thrust **35** is balanced by combined left and right thrust **32**, the toy aircraft will maintain level flight. As seen in FIG. **3**A, when tail thrust **35** increases and/or combined left and right thrust **32** decreases, the toy aircraft **10** will pitch down, as will be understood by the skilled person. Furthermore, as seen in FIG. **3**B, the tri-motor toy aircraft **10** pitches up when tail thrust **35** decreases and/or combined left and right thrust **32** increases.

[0027] Because tail thrust **35** is disposed on the opposite side of the center of gravity of the present tri-motor toy aircraft to the left thrust **31** and right thrust **33**, the toy aircraft can increase or decrease its forward speed without pitching up or down respectively. As long as tail thrust **35**, left thrust **31** and right thrust **33** are maintained in a relationship that permits level flight, and the flight speed is sufficient for the wings to produce enough lift to balance the weight of the toy aircraft, the combined thrust of the tail motor, left motor and right motor can be increased or decreased to accelerate or decelerate the tri-motor toy aircraft respectively. In this way, the tri-motor toy aircraft is able to maintain a straight and level flight even if speed is increased or decreased.

[0028] The embodiments of the present invention described herein are intended to be illustrative and are not intended to limit the scope of the present invention. Various modifications consistent with the description as a whole and which are readily apparent to the person of skill in the art are intended to be included. The appended claims should not be limited by the specific embodiments set forth, but should be given the broadest interpretation consistent with the description as a whole.

We claim:

1. A remote controlled tri-motor toy aircraft having a center of gravity, the tri-motor toy aircraft comprising:

a fuselage having a tail;

a left wing attached to a left side of the fuselage;

a right wing attached to a right side of the fuselage;

a left propeller disposed on the left wing, the left propeller being driven by a left motor so as to generate a left thrust;

a right propeller disposed on the right wing, the right propeller being driven by a right motor so as to generate a right thrust; and

a tail propeller disposed on the tail, the tail propeller being driven by a tail motor so as to generate a tail thrust;

wherein the left propeller and the right propeller are vertically displaced from the center of gravity in a first direction and the tail propeller is vertically displaced from the center of gravity of the toy aircraft in a second direction, the second direction being opposite to the first direction, the right motor, the left motor and the tail motor each being independently controlled by a controller remote from the toy aircraft such that controlling the left thrust, the right thrust and the tail thrust acts to control flight direction of the toy aircraft.

2. The tri-motor toy aircraft of claim **1**, wherein the left propeller and the right propeller are below the center of gravity and the tail propeller is above the center of gravity.

3. The tri-motor toy aircraft of claim **1**, wherein the left propeller and the right propeller are above the center of gravity and the tail propeller is below the center of gravity.

4. The tri-motor toy aircraft of claim **1**, wherein each of the left thrust, the right thrust and the tail thrust is independently selected from a forward thrust and a reverse thrust.

5. The tri-motor toy aircraft of claim **1**, wherein each of the left thrust, the right thrust and the tail thrust is a forward thrust.

* * * * *