A toy model aircraft aims to imitate V-22 Osprey with high emulation by being provided with flight characteristics of V-22 Osprey at a shrunk size of a toy specification. The model aircraft of the invention includes a fuselage, two fixed wings extended outwards from two sides of the fuselage and a tail wing at the tail of the fuselage. Each fixed wing includes a propeller engine installed at a distal end thereof and a rotor. The two rotors of the propeller engines rotating in opposite directions, and the propeller engines are coupled to form an integrated body through a rotary axle mechanism connecting to the wings. The fuselage holds a rotary axle driving means to drive the rotary axle mechanism to rotate and the propeller engines at two ends of the rotary axle mechanism are rotated concurrently between the vertical direction and horizontal direction.
VTOL MODEL AIRCRAFT

FIELD OF THE INVENTION

[0001] The present invention relates to a toy model aircraft and particularly to a VTOL (vertical take-off and landing) model aircraft having flight characteristics of helicopters and fixed-wing aircrafts.

BACKGROUND OF THE INVENTION

[0002] Helicopter flies through air buoyancy generated by spinning of rotors. By changing the climbing power and tilted direction of the pulling force of the rotors, flight conditions of the helicopter can be maintained or altered. It provides many advantages such as vertical take-off and landing and hover in the air. But its cruising speed is lower and safety is less desirable. On the other hand, a fixed-wing aircraft flies through air buoyancy generated by a pressure difference formed by fast airflow passing through the upper and lower sides of airfoils. By changing the angles of ailerons, elevators or rudder, it has higher cruising speed and safety, but requires longer take-off distance and cannot hover in the air. In 1950s and 1960s, some companies in U.S., Canada and Europe developed tilted rotor aircrafts that have advantages of both helicopter and fixed-wing aircraft. Bell helicopter Co. and Boeing helicopter Co. developed a V-22 Osprey multi-purpose aircraft based on the multi-purpose VTOL aircraft R&D plan (JVX plan) released by U.S. Department of Defense. It is one of few successful cases.

[0003] V-22 Osprey also is called tiltrotor aircraft. It has two rotor tilt system assemblies which are turnable between the horizontal position and vertical position respectively installed on a tip of a wing which is similar to the airfoil of the fixed-wing aircraft. When the aircraft is in vertical take-off and landing, the rotor shaft is perpendicular to the ground surface. The aircraft flies like a transverse helicopter, and also can hover in the air, or fly forwards and backwards and crab. After it has reached a certain flying speed, the rotor shaft can be tilted forwards for ninety degrees in a horizontal condition, then the rotors can serve as a pulling propeller. In such a condition, the tilted rotor aircraft can fly in higher speed for longer distance like the fixed-wing aircraft. Thus the tilted rotor aircraft is a unique rotor aircraft with abilities of the helicopter that can perform vertical take-off and landing and hover in the air, and also with abilities of a turboprop that can fly in high cruising speed.

[0004] Model aircraft has been developed following the real aircraft. As V-22 Osprey tiltrotor aircraft is a novel aircraft different from the conventional fixed-wing aircraft, to modify V-22 Osprey to a model aircraft is a great challenge. At present, most model aircraft imitating V-22 Osprey merely imitates the profile or provides merely helicopter function.

SUMMARY OF THE INVENTION

[0005] The present invention aims to provide a model aircraft with high emulation of V-22 Osprey that has same flight characteristics and can be shrunk to a toy specification.

[0006] To be a real aircraft has to take many factors into account, such as: the fuselage must have space to accommodate a certain number of passengers or cargos, strong power to carry the loads to fly at high speed; the hull must be sealed and can withstand high pressure at high altitudes; the fuselage has to arrange complex electric control circuits and wiring, etc. However, a model aircraft does not need to consider those factors. Its casing and frame can be made of light PVC material, and the interior space can be fully used for installing electric or mechanical structures without carrying people or cargos. The engine power merely has to meet flight requirement. Considering the aforesaid differences of the real aircraft and model aircraft, the present invention provides a VTOL model aircraft that includes a fuselage, two fixed wings extended outwards from two sides of the fuselage, and a tail wing at the tail of the fuselage. Each of the two wings has a distal end equipped with a propeller engine. The two propeller engines respectively have a rotor rotating in opposite directions. The invention also has a rotary axle mechanism coupled with the wings in an integrated manner. The fuselage also holds a rotary axle driving means to drive the rotary axle mechanism and the propeller engines at two ends thereof to turn concurrently between the vertical direction and horizontal direction.

[0007] The present invention employs the propeller engine to replace the turbine engine of the real aircraft. Because the model aircraft has a light weight and does not need to carry people or cargos, the propeller engine can provide adequate power to meet requirements of vertical take-off and landing and cruise. The fuselage of the model aircraft also does not need to leave space for accommodating people or cargos, hence the rotary axle driving means can be directly installed in the fuselage to directly drive the rotary axle mechanism and the two propeller engines to turn concurrently between the vertical direction and horizontal direction. The rotary axle mechanism is located transversely across the fuselage and wings, and provides mechanical and synchronous rotation of the propeller engines. Compared with the real aircraft that needs to install a rotor tilt system assembly on the distal end of the wing, the present invention provides a much simplified structure without complex electrical control synchronous mechanism.

[0008] When the propeller engines of the model aircraft of the invention are in the vertical condition, the pitch of the propeller can be changed to allow the aircraft to perform vertical take-off and landing, and hover in the air. By changing the tilt direction of the rotor shaft and pitch, the aircraft can fly forwards and backwards, and crab. When the propeller engines are turned to the horizontal condition and the pitch of each propeller engine can be fixed at a selected value, cruising flight can be performed. Thus the model aircraft of the invention can function and operate like a real V22 Osprey aircraft to achieve high emulation. By incorporating the characteristics of the model aircraft, the invention simplifies the driving means of the real aircraft with a novel driving structure adapted to the size of the model aircraft at a shrunk size within 0.5 to 3 meters. Compared with the conventional model aircraft that partly imitates V22 Osprey aircraft or only imitates the profile of V22 Osprey aircraft, the present invention provides a full imitation design with substantial features and outstanding improvements.

[0009] The foregoing, as well as additional objects, features and advantages of the invention will be more readily apparent from the following detailed description, which proceeds with reference to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a schematic view of the model aircraft of the invention in a vertical take-off and landing or hover condition.
FIG. 2 is a schematic view of the internal structure of the invention according to FIG. 1.

FIG. 3 is a schematic view of the invention in a cruising flight condition.

FIG. 4 is an enlarged view of a propeller engine.

FIG. 5 is an exploded view of a propeller engine.

FIG. 6 is an enlarged view of a rotary oblique plate.

FIG. 7A is a schematic view of the propeller engine according to FIG. 1 in an operating condition.

FIG. 7B is a fragmentary enlarged view according to FIG. 7A.

FIG. 8A is another fragmentary enlarged view according to FIG. 7A.

FIG. 8B is a yet another fragmentary enlarged view according to FIG. 7A.

FIG. 9 is an exploded view according to FIG. 3.

FIG. 10 is an enlarged view of the rotary axle mechanism.

FIG. 11 is an exploded view of the linkage bar mechanism.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Please refer to FIG. 1, the present invention aims to provide a model aircraft which includes a fuselage 1, two fixed wings 2 extended outwards from two sides of the fuselage 1 and a tail wing 3 located at the tail of the fuselage 1. The two wings 2 respectively have a propeller engine 4 and 5 at a distal end with a rotor 42 and 52 coupled thereof rotating in opposite directions to offset rotation of the fuselage 1. The aircraft also has wheels 6 respectively located at two sides of the bottom and below the prow. While the model aircraft is in vertical take-off and landing, or hover in the air, the propeller engines 4 and 5 are in a working condition. Seeing from the front side of the aircraft, the rotor rotates clockwise, and the other rotor 52 rotates counterclockwise as shown by the arrows in the drawings. Rotation of the rotors 42 and 52 generates an upward pulling force. By adjusting the rotating pitch of the rotors 42 and 52, the pulling force can be adjusted.

When the pulling force is greater than the gravity of the aircraft, the aircraft can take off vertically. When the pulling force is equal to the gravity the aircraft can hover in the air, and when the pulling force is smaller than the gravity the aircraft can be controlled to land steadily.

Refer to FIG. 2 for the internal structure of the aircraft. The propeller engines 4 and 5 include respectively a rotary nacelle 41 and 51 with the rotor 42 and 52 at the front end. The rotary nacelles 41 and 51 hold a driving mechanism and a pitch control means of the rotors 42 and 52, and are coupled to form an integrated body through a rotary axle mechanism 8 connected to the wings 2. The rotary axle mechanism 8 transversely stretches over the fuselage 1 which holds a rotary axle driving means 9 to drive the rotary axle mechanism 8 to rotate so that the propeller engines 4 and 5 at the two ends thereof can be turned concurrently between the vertical direction and horizontal direction. The arrows in the drawings indicate that the propeller engines 4 and 5 are rotated from the vertical direction to the horizontal direction.

When the propeller engines 4 and 5 are rotated to the horizontal direction as shown in FIG. 3, the aircraft is in a cruising flight condition, and the rotors 42 and 52 are latched at a selected pitch. The pulling force generated by the rotation is changed to forward thrust force to drive the aircraft to fly in the cruising flight condition. In such a condition, like an ordinary fixed-wing model aircraft, flight condition is controlled through ailerons, an elevator and rudders. As shown in the drawings, an aileron 21 is located at the rear edge of the fixed wing 2 to control transverse manipulation of the aircraft. The tail wing 3 includes a horizontal tail 31 and vertical tails 32 at two ends of the horizontal tail 31. The horizontal tail 31 has an elevator 311 at an upper rear edge. The two vertical tails 32 respectively have a rudder 321 at a rear edge. The aileron 21, elevator 311 and rudder 321 are controlled respectively through independent cruising control steering engines 73, 72 and 71.

In addition to the two types of flight conditions mentioned above, the propeller engines 4 and 5 also can be rotated to a selected angle relative to the vertical direction, such as between 10° and 80° in the forward or reverse direction so that desired pitch of the rotors 42 and 52 can be adjusted to generate desirable pulling force to realize forward or backward flying of the aircraft.

Please refer to FIGS. 4 and 5 for the detailed structure of the propeller engine, the propeller engine 5 is taken as an example. It includes the rotary nacelle 51 and rotor 52 at the front end of the rotary nacelle 51. The rotor 52 includes a central hub 521, three rotor blades 524 and three blade clips 523 which are coupled with the central hub 521 through three radial rotary shafts 522 which are evenly spaced from each other on the circumference of the central hub 521. Each blade clip 523 has a front end clamping one rotor blade 524 and is turnable about the radial rotary shaft 522 to alter the pitch of the rotor 52. The central hub 521 also has a rotor shaft 513 extended to the rotary nacelle 51. The driving mechanism includes a motor 511 and a gear set 512, and is installed on a distal end of the rotor shaft 513. The pitch control means includes a pitch control steering engine 514, a rotary oblique plate 53 and a plurality of pulling rods located in the middle of the rotor shaft 513.

Referring to FIG. 6, the rotary oblique plate 53 includes an upper plate 532 and a lower plate 531 that are interposed by a coil spring 533 to connect with the rotor shaft 513 through a spherical hinge 534 in an inclined manner. The coil spring 533 is wedged among the upper plate 532, lower plate 531 and spherical hinge 534. The lower plate 531 has two turnable nodes 535 on the periphery at the same straight line and a tilt control node 536 perpendicular to the straight line where the turnable nodes 535 are located. The turnable nodes 535 are held on a rotary seat consisting of two bracing plates 541. The tilt control node 536 is connected to the pitch control steering engine 514 through a lower pulling rod 542. The upper plate 532 has pitch control nodes 537 on the circumference evenly spaced from one another at a number mating the rotor blades. The blade clip 523 has an eccentric control end 526 on one side. The pitch control nodes 537 and the eccentric control end 526 are connected through upper pulling rods 543 with a mating number. Refer to FIG. 7A for the assembly structure and FIG. 7B for the coupling structure after rotated.

Refer to FIG. 7A for the operation principle of the propeller engine. The motor 511 drives the rotor shaft 513 to rotate through the gear set 512, and the rotor shaft 513 further drives the three rotor blades 524 at the front end thereof to rotate to provide power for take-off, landing, hovering and cruising of the aircraft. When the propeller engines 4 and 5 are not in the horizontal condition, i.e. during take-off, landing, forward or backward fly or crab, the pitch of the propeller engines 4 and 5 has to be changed to adjust the pulling force...
of the engines for the aircraft to balance the gravity thereof and to alter the flight condition. Alteration of the pitch of the propeller engines is controlled through the pitch control steering engine 514 as shown in FIG. 7A. The pitch control steering engine 514 pulls the lower plate 531 braced by the bracing plate 541 through the lower pulling rod 542 as shown in FIG. 8A. The lower plate 531 is tilted to drive the upper plate 532 to tilt also, and the upper plate 532 pulls the eccentric control end 526 on the one side of the blade clip 523 through the upper pulling rod 543 to change the pitch of the rotor blade 524 clamped by the blade clip 523. When the propeller engines 4 and 5 are in the horizontal condition, i.e. the aircraft is in the cruising flight condition, the pitch control steering engine 514 controls the pitch of the rotor blade 524 at a selected value without changing.

[0030]

To ensure that the upper plate 532 is tilted upwards only in one direction, the invention further provides a positioning node 538 on the circumference of the upper plate 532 corresponding to the tilt control node 536 of the lower plate. The positioning node 538 is coupled on the rotor shaft 513 through an anchor seat turnable synchronously with the rotor shaft 513. The anchor seat includes a coupling member 544 and a holding clip 545 that are coupled in a turnable manner. The assembled structure is shown in FIG. 8B. The anchor seat and the lower pulling rod 542 are located on the same plane. The anchor seat confines the upper plate 532 from tilting to the left and right sides.

[0031]

Refer to FIG. 9 for the exploded view of the invention. The fuselage 1 includes a main body consisting of an upper structure 13, a middle structure 14 and a lower structure 15. The main body has a front end coupled with a prop casing 11 through a front frame 12, and a rear end coupled with the tail wing 3 through a rear frame 16. The lower structure 15 has a battery box 18 with a lid 17. The prop casing 11 holds a wireless receiving module 19 and its related circuit structures. The rotary axle mechanism 8 and rotary axle driving means 9 are installed on the middle structure 14. Detailed structure can be seen in FIG. 10. The rotary axle mechanism 8 includes a rotary axle 81 transversely running through the two fixed wings 2, a gear set 82 in the middle mating the rotary axle driving means 9, and a bracing tube 84 to support rotation of the rotary axle 81. The rotary axle 81 has two bearings 85 at two ends. The gear set 82 has a potentiometer 83 located thereon to measure turning angle of the rotary axle 81. When changing the angle of the propeller engines 4 and 5, the rotary axle driving means 9 drives a screw 91 to rotate, then the screw 91 also drives the rotary axle 81 to rotate through the gear set 82, so that the rotation angle of the propeller engines 4 and 5 coupled on two ends of the rotary axle 81 can be adjusted. The potentiometer 83 can accurately measure the rotation angle of the rotary axle 81. The measured rotation angle is fed back to a control circuit to control the rotary axle driving means 9 to precisely position the rotation angle of the propeller engines 4 and 5.

[0032]

The cruising control steering engines 73, 72 and 71 are connected to the aileron 21, elevator 311 and rudder 321 through a linkage bar mechanism shown in FIG. 11. The linkage bar mechanism includes a swing bar 74, an extended pulling rod 75 and a clip sheet 76. The extended pulling rod 75 has two ends, one end is coupled with the clip sheet 76 and another end is coupled with the swing bar 74 through spherical hinges. The swing bar 74 has another end connected to the cruising control steering engine. The clip sheet 76 is connected to the aileron 21, elevator 311 or rudder 321. The aforesaid structure controls vertical take-off and landing and veer of the aircraft during cruising flight.

What is claimed is:

1. A vertical take-off and landing model aircraft, comprising a fuselage, two fixed wings extended outwards from two sides of the fuselage and a tail wing at a tail of the fuselage, wherein:
each of the two fixed wings includes a propeller engine at a distal end, the propeller engine being coupled with a rotor, the two rotors rotating in opposite directions, the two propeller engines being coupled with a rotary axle mechanism connecting to the wings to form an integrated body, the fuselage holding a rotary axle driving means to drive the rotary axle mechanism to rotate and drive the propeller engines at two ends of the rotary axle mechanism to rotate concurrently between a vertical direction and a horizontal direction.

2. The vertical take-off and landing model aircraft of claim 1, wherein each propeller engine includes a rotary nacelle and the rotor at a front end of the rotary nacelle, the rotary nacelle holding a driving mechanism and a pitch control means of the rotor.

3. The vertical take-off and landing model aircraft of claim 2, wherein the rotor includes a central hub, at least three rotor blades and a plurality of blade clips mating the number of the rotor blades, the blade clip being coupled with the central hub through radial rotary shafts evenly spaced on the circumference of the central hub to clamp the rotor blades to rotate to change pitch of the rotor; the central hub including a rotating shaft extended into the rotary nacelle, the driving mechanism including a motor and a gear set located on a distal end of the rotor shaft, the pitch control means including a pitch control steering engine, a rotary oblique plate and a plurality of pulling rods located in the middle of the rotor shaft.

4. The vertical take-off and landing model aircraft of claim 3, wherein the rotary oblique plate includes an upper plate and a lower plate that are coupled with the rotor shaft through a spherical hinge in the center in an inclined manner, the lower plate including two turnable nodes on the circumference located on a same straight line and a tilt control node perpendicular to the straight line where the turnable nodes located, the turnable nodes being held on a rotary seat, the tilt control node being coupled with the pitch control steering engine through a lower pulling rod; the upper plate including pitch control nodes evenly spaced on the circumference thereof mating the number of the rotor blades, the blade clip including an eccentric control end on one side, each pitch control node being connected to the eccentric control end through upper pulling rods with a mating number.

5. The vertical take-off and landing model aircraft of claim 4, wherein the upper plate includes a positioning node on the circumference corresponding to the tilt control node of the lower plate, the positioning node being coupled on the rotor shaft through an anchor seat turnable synchronously with the rotor shaft, the anchor seat confining the upper plate from tilting to left and right sides.

6. The vertical take-off and landing model aircraft of claim 1, wherein the rotary axle mechanism includes a rotary axle transversely running through the two fixed wings and a gear set located in the middle of the rotary axle mating the rotary axle driving means, and a bracing tube coupled on two sides of the rotary axle to support rotation of the rotary axle.
7. The vertical take-off and landing model aircraft of claim 6, wherein the gear set includes a potentiometer to measure rotation angle of the rotary axle.

8. The vertical take-off and landing model aircraft of claim 1, wherein each fixed wing includes an aileron at a rear edge thereof to control transverse manipulation of the aircraft, the tail wing including a horizontal tail and vertical tails at two ends of the horizontal tail, the horizontal tail including an elevator, the two vertical tails respectively including a rudder at a rear edge thereof, the aileron, the elevator and the rudders being controlled by independent cruising flight control steering engines.

9. The vertical take-off and landing model aircraft of claim 8, wherein the cruising flight control steering engines are connected to the aileron, the elevator and the rudders through a linkage bar mechanism, the linkage bar mechanism including a swing bar, an extended pulling rod and a clip sheet, the extended pulling rod including two ends coupled with one end of the clip sheet and one end of the swing bar through spherical hinges, the swing bar including another end connected to the cruising flight control steering engine, the clip sheet being connected to the aileron, the elevator or the rudder.

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