US008864545B2

(12) **United States Patent**
Perdomo

(10) **Patent No.: US 8,864,545 B2**
(45) **Date of Patent: Oct. 21, 2014**

(54) **RADIO FREQUENCY CONTROLLED AIRCRAFT**

(76) Inventor: **Orestes R. Perdomo**, Miami, FL (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 207 days.

(21) Appl. No.: **13/250,103**

(22) Filed: **Sep. 30, 2011**

(65) **Prior Publication Data**

US 2013/0084766 A1 Apr. 4, 2013

(51) **Int. Cl.**
A63H 27/04 (2006.01)
A63H 27/24 (2006.01)

(52) **U.S. Cl.**
CPC ***A63H 27/04*** (2013.01)
USPC **446/33**; 446/57

(58) **Field of Classification Search**
USPC 446/30, 31, 32, 33, 34, 57, 58
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

1,201,839 A		10/1916	McCoole	
2,034,298 A		3/1936	Holman	
2,061,953 A		11/1936	Sampson	
2,292,705 A		8/1942	Lohse	
2,299,582 A		10/1942	Lohse	
2,404,922 A		7/1946	Padgett	
2,409,168 A		10/1946	Walker	
2,611,213 A		9/1952	Johnson et al.	
2,624,152 A		1/1953	Sneed	
2,791,427 A		5/1957	Johnson	
2,968,119 A	*	1/1961	Glass et al.	446/33
2,968,482 A		1/1961	Gjertsen	
2,977,117 A		3/1961	Taylor	
3,080,676 A	*	3/1963	Stanzel	446/33
3,110,127 A		11/1963	Benesch	
3,222,815 A		12/1965	Struck	
3,373,505 A		3/1968	Tucker	
3,616,568 A	*	11/1971	Powell	446/50
3,705,720 A		12/1972	Nicholls	
3,731,424 A		5/1973	Meyer	
3,740,032 A		6/1973	Chang	
3,743,279 A		7/1973	Chang	
3,762,702 A		10/1973	Keele et al.	
3,857,194 A		12/1974	Guttman	

(Continued)

FOREIGN PATENT DOCUMENTS

GB 1502789 3/1978

OTHER PUBLICATIONS

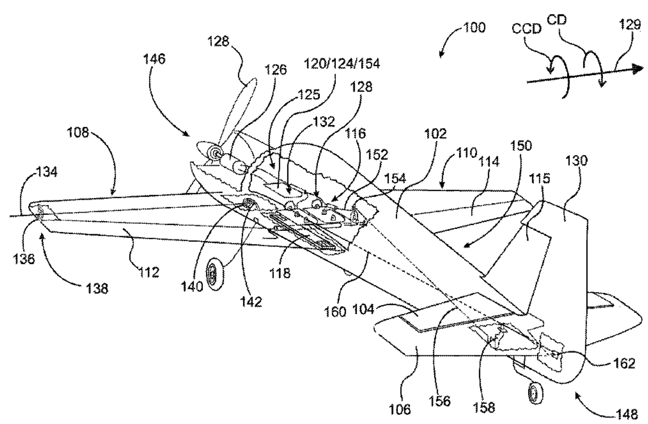
http://www.helipal.com/rc-plane_nine-eagles-airplane.html, Apr. 15, 2011.
http://www.youtube.com/watch?v=HcpK4N-Yg3A, Apr. 21, 2011.

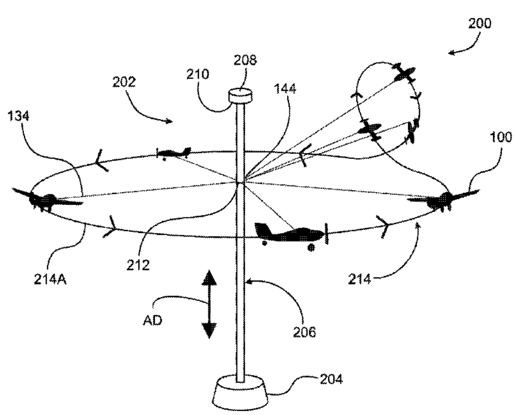
Primary Examiner — John Ricci
(74) *Attorney, Agent, or Firm* — Simpson & Simpson, PLLC

(57) **ABSTRACT**

A radio-controlled model airplane, including: a fuselage; first and second wings connected to the fuselage; and a control system including: a battery; a receiver powered by the battery and arranged to receive radio frequency signals; and a computer powered by the battery, electrically connected to the receiver, and arranged to transmit control signals in response to the received radio frequency signals. The airplane also includes a first motor powered by the battery and arranged to receive the transmitted control signals to rotate a propeller; and a single flexible wire: passing through an opening in a distal end of the first wing; with a first end fixed to a point at or near a junction of the first wing and the fuselage; and with a second end for connection to a point outside of the model airplane.

20 Claims, 6 Drawing Sheets





(56) **References Cited**

U.S. PATENT DOCUMENTS

3,957,230	A	5/1976	Boucher et al.	
3,991,512	A *	11/1976	Stanzel	446/33
4,011,684	A	3/1977	Stanzel	
4,116,432	A	9/1978	Feeney	
4,135,711	A	1/1979	Holt	
4,154,443	A	5/1979	Schmalzbauer	
4,222,558	A	9/1980	Tinguely et al.	
4,246,724	A *	1/1981	Vechot	446/32
4,981,456	A	1/1991	Sato et al.	
5,030,156	A	7/1991	Savicki, Sr.	
5,104,344	A	4/1992	Jancso, Jr.	
5,709,580	A *	1/1998	Stanzel	446/31
6,572,482	B1 *	6/2003	Lewis, Jr.	472/9

* cited by examiner

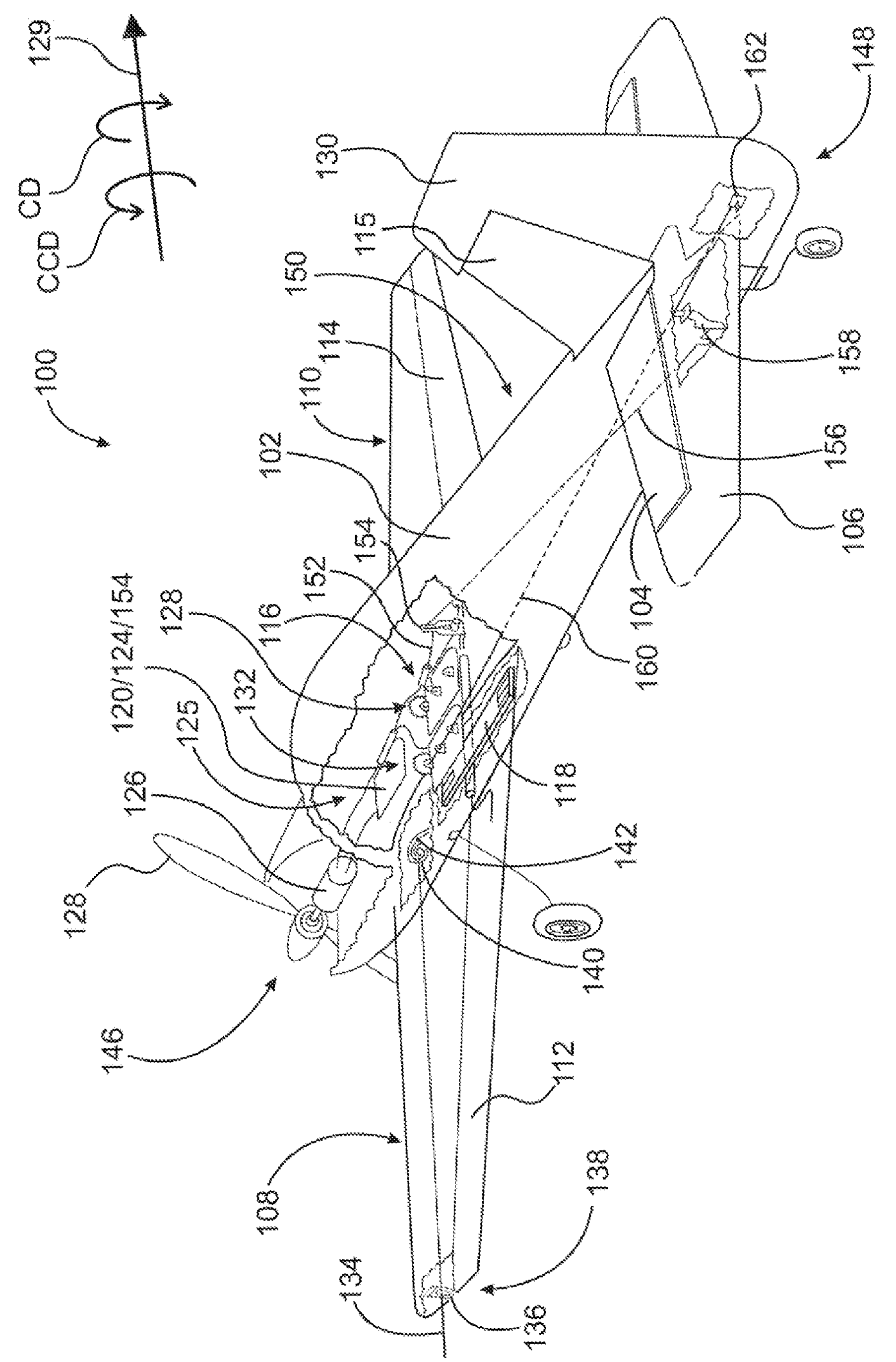

129
CD
CCD
100
130
162
148
115
150
114
110
102
158
156
106
104
160
154
152
116
128
120/124/154
132
125
118
126
142
128
140
146
112
108
138
134
136

Fig. 1

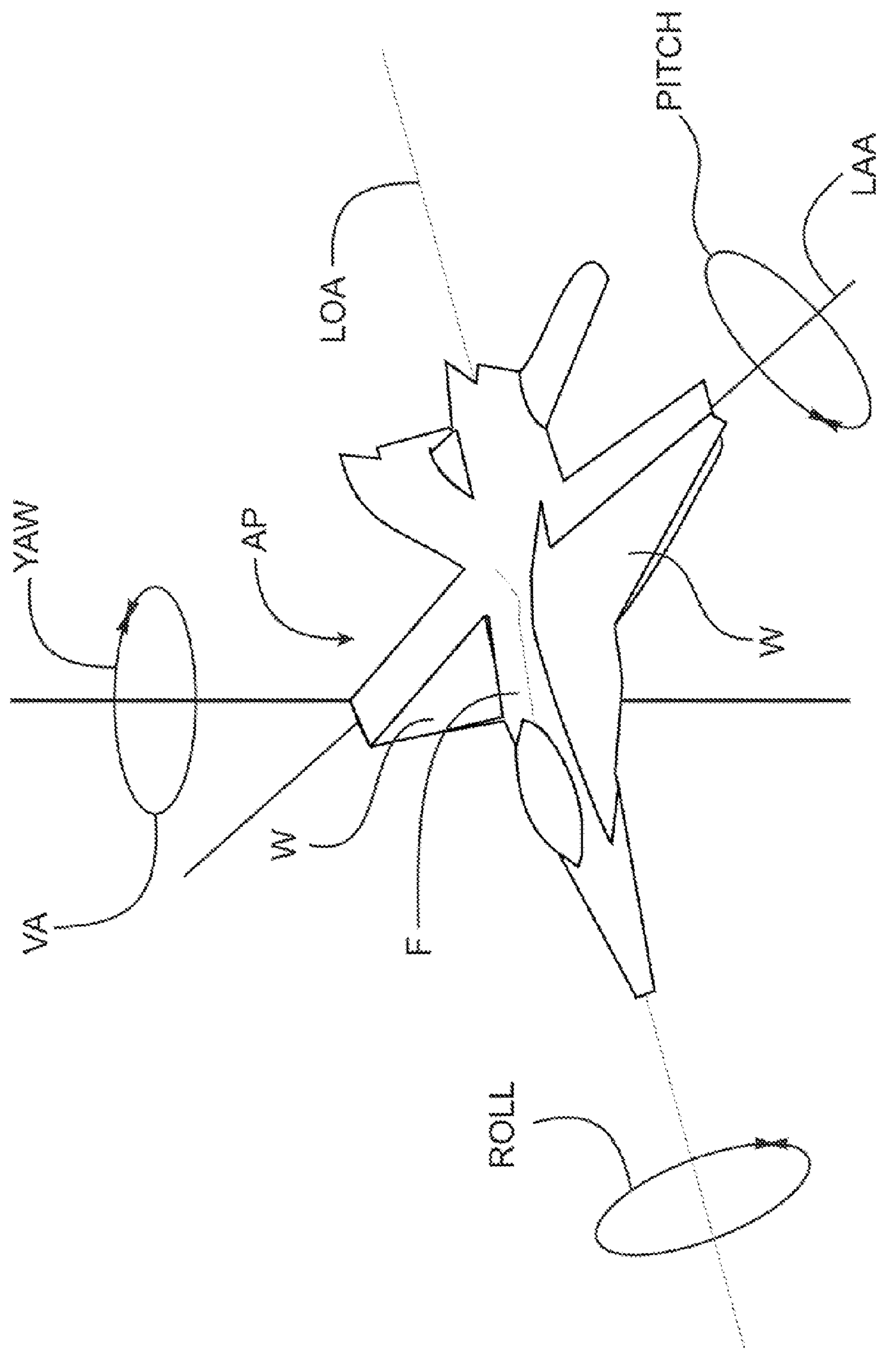


Fig. 2

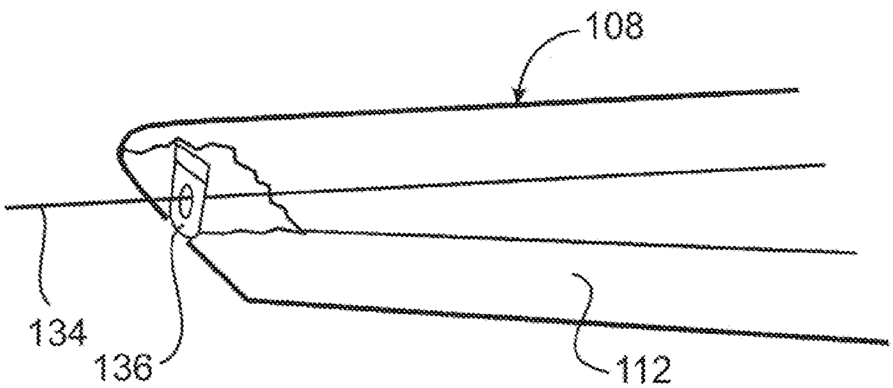


Fig. 3A

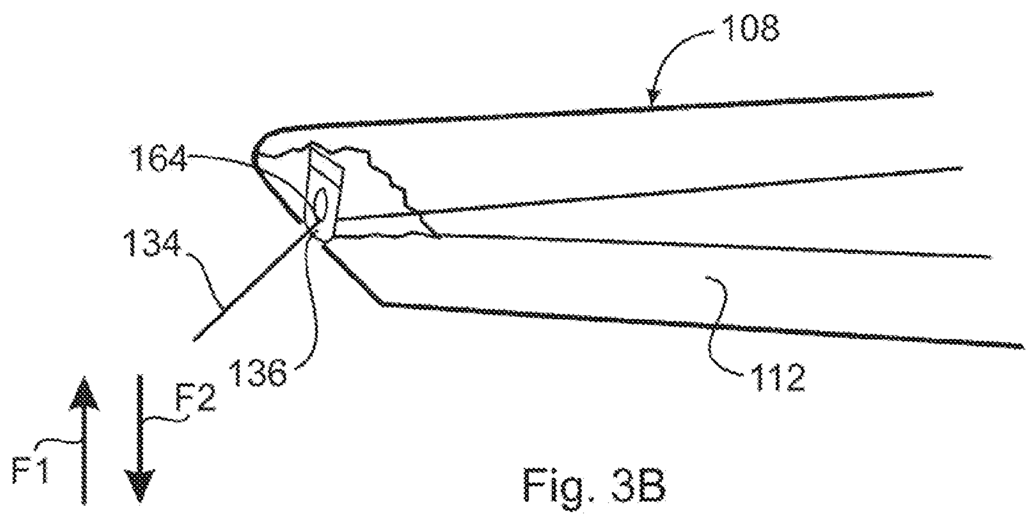


Fig. 3B

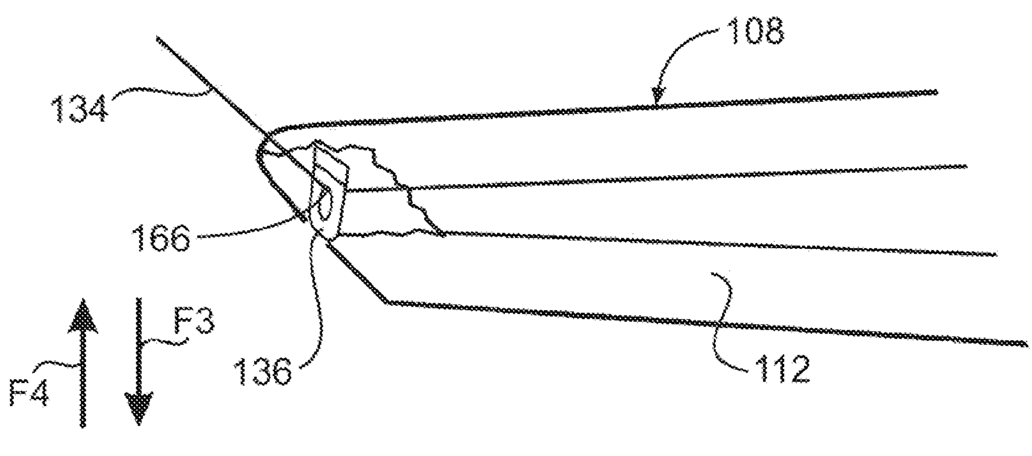


Fig. 3C

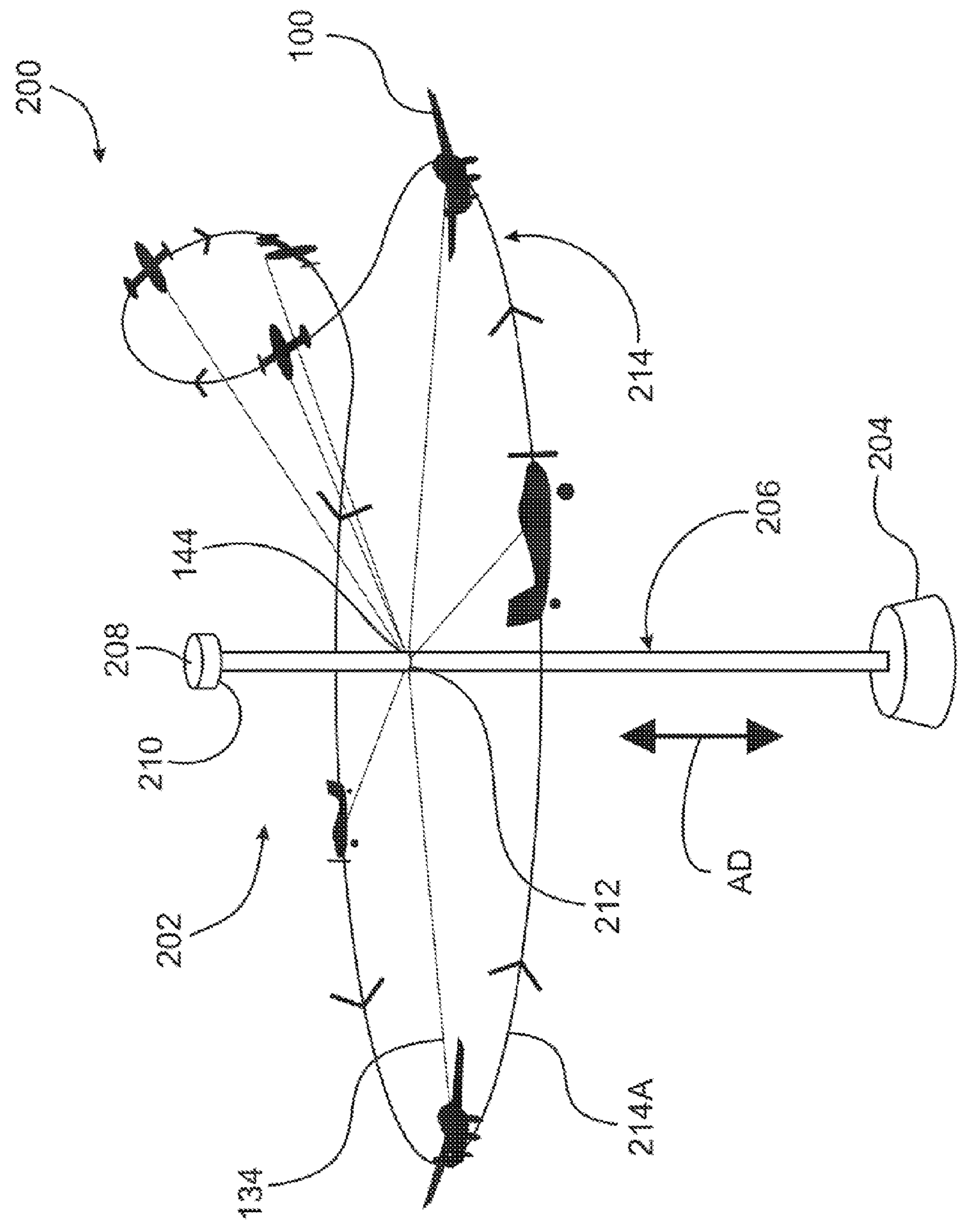


Fig. 4

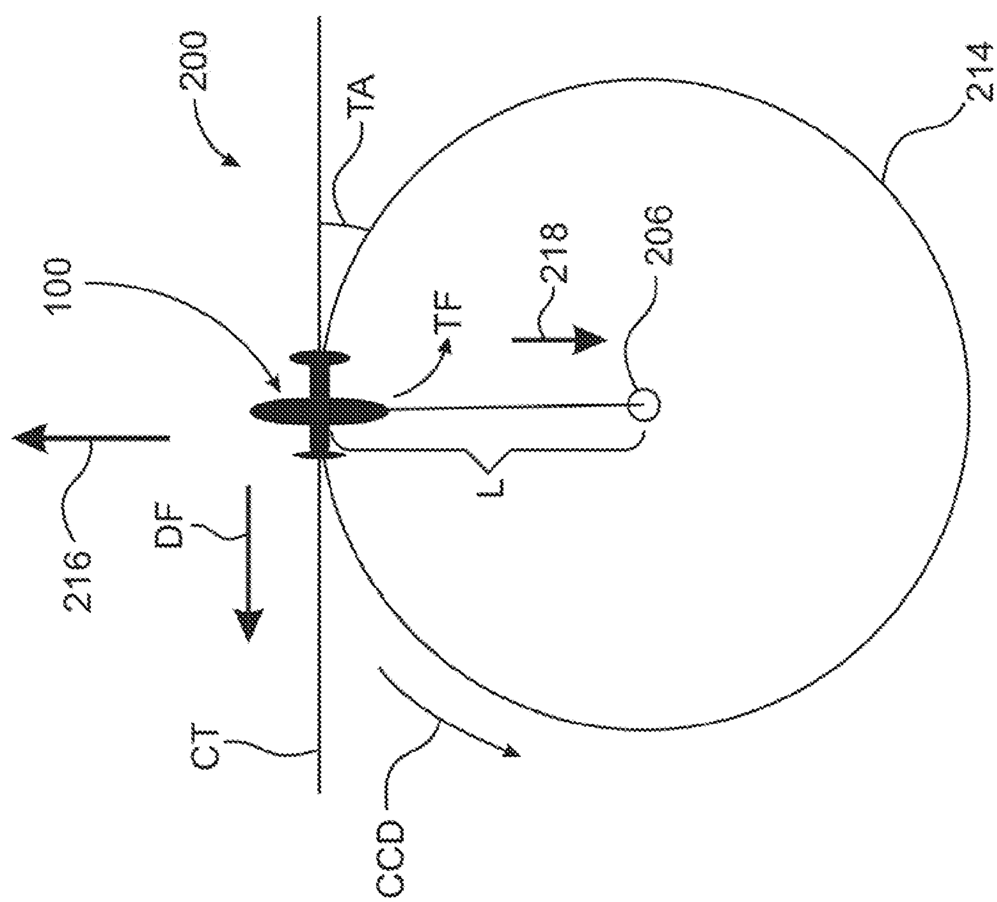
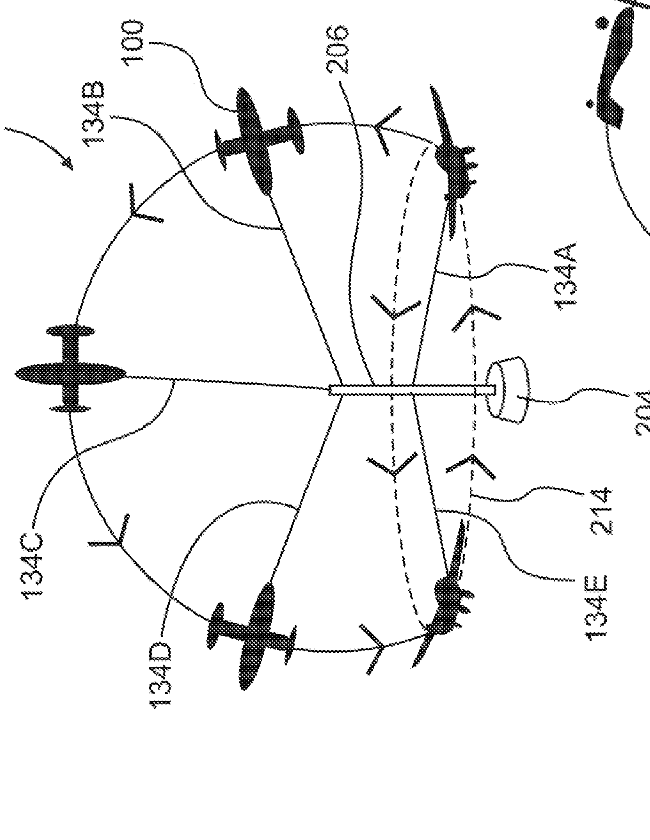


Fig. 5

Fig. 6


200
134B
100
206
134A
204
214
134C
134E
134D

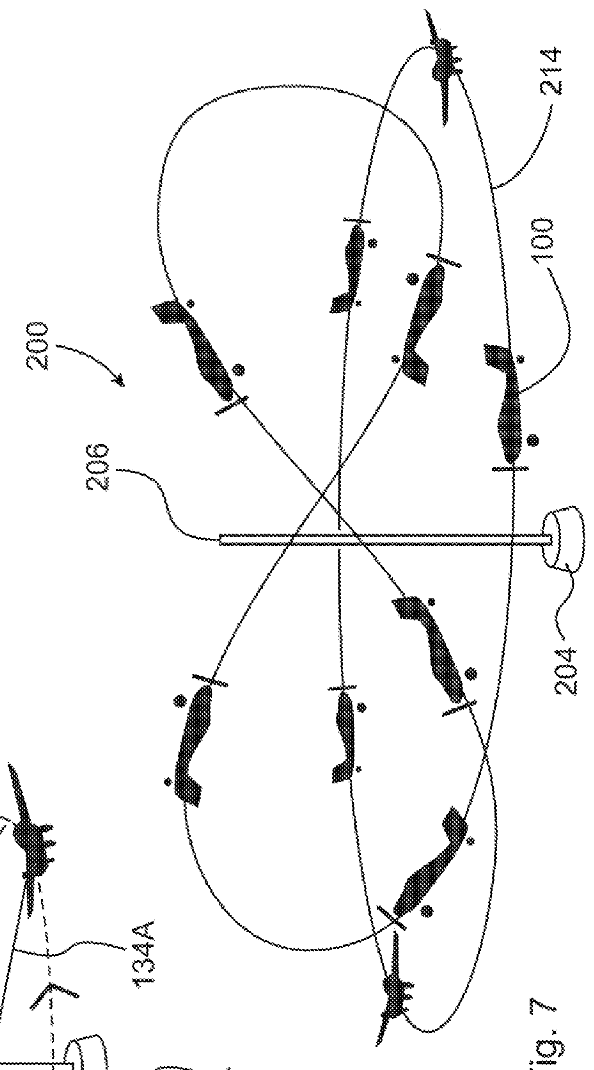

214
100
200
206
204

Fig. 7

RADIO FREQUENCY CONTROLLED AIRCRAFT

FIELD OF THE INVENTION

The invention relates generally to a radio-controlled model airplane and system, in particular, a model airplane and system using a flexible guide wire.

BACKGROUND

U.S. Pat. No. 4,116,432 teaches a model aircraft with an on-board gasoline engine connected to a post by a three-point connection to cable connected to a rotatable and vertically displaceable ring placed about the post. Feeney does not teach any control of the aircraft. The aircraft starts on the ground, flies upward until the cable reaches an end point of the post and then flies in this position until the engine runs out of gasoline.

U.S. Pat. No. 2,292,705 teaches a model aircraft with an on-board engine with a wire connected to a wing tip and to a post. The post includes a spiral configuration by which the wire is able to move up and down the post. The spiral configuration severely limits the type of movement possible for the aircraft.

Patent GB 1502789 teaches model airplanes connected with respective wires to fixed points on a post. The wire is connected to the wing of an airplane and provides electrical power for an engine in the airplane. U.S. Pat. No. 4,135,711 teaches model airplanes connected to a post by wires supplying electrical power for on-board motors. The wires are connected to the fuselage without touching the wing.

It is known to use a solid, non-flexible rod to connect a model airplane to a central post. In some instances the airplane includes an on-board motor receiving power via the rod and in some instances the airplane does not have an on-board motor and the rod rotates to propel the airplane.

SUMMARY

According to aspects illustrated herein, there is provided a radio-controlled model airplane, including: a horizontal stabilizer with a controllable rear elevator hingedly connected to the horizontal stabilizer; first and second wings including first and second controllable flaps hingedly connected to the first and second wings, respectively; and a control system including: a battery; a receiver powered by the battery and arranged to receive radio frequency signals; and a computer powered by the battery, electrically connected to the receiver, and arranged to transmit control signals in response to the received radio frequency signals. The airplane also includes: a first motor powered by the battery and arranged to receive the transmitted control signals to rotate a propeller; and a second motor powered by the battery and arranged to receive the transmitted control signals to: swivel, with respect to a same frame of reference, the first and second flaps in a clockwise direction and to swivel the rear elevator in a counter clockwise direction; or swivel, with respect to the same frame of reference, the first and second flaps in the counterclockwise direction and the rear elevator in the clockwise direction.

According to aspects illustrated herein, there is provided a radio-controlled model airplane, including: a fuselage; first and second wings connected to the fuselage; and a control system including: a battery; a receiver powered by the battery and arranged to receive radio frequency signals; and a computer powered by the battery, electrically connected to the receiver, and arranged to transmit control signals in response to the received radio frequency signals. The airplane also includes a first motor powered by the battery and arranged to receive the transmitted control signals to rotate a propeller; and a single flexible wire: passing through an opening in a distal end of the first wing; with a first end fixed to a point at or near a junction of the first wing and the fuselage; and with a second end for connection to a point outside of the model airplane.

According to aspects illustrated herein, there is provided a radio-controlled model airplane, including: a fuselage; a horizontal stabilizer with a controllable rear elevator connected to the horizontal stabilizer; first and second wings connected to the fuselage and including first and second controllable flaps hingedly connected to the first and second wings, respectively; and a control system including: a battery; a receiver powered by the battery and arranged to receive radio frequency signals; and a computer powered by the battery, electrically connected to the receiver, and arranged to transmit control signals in response to the received radio frequency signals. The airplane also includes: a first motor powered by the battery and arranged to receive the transmitted control signals to rotate a propeller; and a single flexible wire: passing through an opening in a distal end of the first wing; with a first end fixed to a point at or near a junction of the first wing and the fuselage; and with a second end for connection to a point outside of the model airplane. The airplane also includes a second motor powered by the battery and arranged to receive the transmitted control signals to: swivel, with respect to a same frame of reference, the first and second flaps in a clockwise direction and to swivel the rear elevator in a counter clockwise direction; or swivel, with respect to the same frame of reference, the first and second flaps in the counterclockwise direction and the rear elevator in the clockwise direction.

According to aspects illustrated herein, there is provided a model airplane system, including: an anchoring system including: a base; a pylon fixedly secured to the base; a ring disposed about the pylon, rotatable about the pylon, and displaceable along a length of the pylon; a single flexible wire with a first end connected to the ring; and a cap at a distal end of the pylon to prevent the ring from displacing past the distal end. The system also includes a radio-controlled model airplane including: a horizontal stabilizer with a rear elevator connected to the horizontal stabilizer; first and second wings including first and second flaps connected to the first and second wings, respectively; and a control system including: a battery; a receiver powered by the battery and arranged to receive radio frequency signals; and a computer powered by the battery, electrically connected to the receiver, and arranged to transmit control signals in response to the received radio frequency signals. The airplane includes: a first motor powered by the battery and arranged to receive the transmitted control signals to rotate a propeller; and a second motor powered by the battery and arranged to receive the transmitted control signals to: swivel, with respect to a same frame of reference, the first and second flaps in a clockwise direction and to swivel the rear elevator in a counter clockwise direction; or swivel, with respect to the same frame of reference, the first and second flaps in the counterclockwise direction and the rear elevator in the clockwise direction.

According to aspects illustrated herein, there is provided a model airplane system, including: an anchoring system including: a base; a pylon fixedly secured to the base; a ring disposed about the pylon, rotatable about the pylon, and displaceable along a length of the pylon; a single flexible wire with a first end connected to the ring; and a cap at a distal end of the pylon to prevent the ring from displacing past the distal end. The system also includes a model airplane including: a fuselage; first and second wings connected to the fuselage; and a control system including: a battery; a receiver powered by the battery and arranged to receive radio frequency signals; and a computer powered by the battery, electrically connected to the receiver, and arranged to transmit control signals in response to the received radio frequency signals. The airplane includes a first motor powered by the battery and arranged to receive the transmitted control signals to rotate a propeller. The single flexible wire passes through an opening in a distal end of the first wing and a second end of the single flexible wire is fixed to a point at or near a junction of the first wing and the fuselage.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a prospective cut-away view of a radio-controlled model airplane;

FIG. **2** is a representation of reference axes for an aircraft;

FIGS. **3**A-C are details of a distal end of a wing for the airplane shown in FIG. **1**;

FIG. **4** is a perspective view of a model airplane system;

FIG. **5** is a plan view of the model airplane system of FIG. **4** showing the airplane of FIG. **1** flying at a constant tangent;

FIG. **6** is a perspective view of the model airplane system of FIG. **4** showing the airplane of FIG. **1** flying above the cap of the pylon; and,

FIG. **7** is a perspective view of the model airplane system of FIG. **4** showing the airplane of FIG. **1** performing a figure 8.

DETAILED DESCRIPTION

At the outset, it should be appreciated that like drawing numbers on different drawing views identify identical, or functionally similar, structural elements of the invention. While the present invention is described with respect to what is presently considered to be the preferred aspects, it is to be understood that the invention as claimed is not limited to the disclosed aspects.

Furthermore, it is understood that this invention is not limited to the particular methodology, materials and modifications described and as such may, of course, vary. It is also understood that the terminology used herein is for the purpose of describing particular aspects only, and is not intended to limit the scope of the present invention, which is limited only by the appended claims.

Unless defined otherwise, all technical and scientific terms used herein have the same meaning as commonly understood to one of ordinary skill in the art to which this invention belongs. Although any methods, devices or materials similar or equivalent to those described herein can be used in the practice or testing of the invention, the preferred methods, devices, and materials are now described.

FIG. **1** is a prospective cut-away view of a radio-controlled model airplane, or aircraft, **100**. In the description that follows, the terms airplane and aircraft are used interchangeably. Airplane **100** includes fuselage **102**, horizontal stabilizer **104** with controllable rear elevator **106** connected, for example, hingedly connected, to the horizontal stabilizer, and wings **108** and **110** including controllable flaps **112** and **114** connected, for example, hingedly connected, to the first and second wings, respectively. The airplane also includes tail fin **115** and control system **116** including battery **118**, and receiver **120** powered by the battery and arranged to receive radio frequency signals from a transmitter (not shown), and computer **124** powered by the battery, electrically connected to the receiver, and arranged to transmit control signals in response to the received radio frequency signals. In an example embodiment, the receiver operates at 2.4 GHz; however, it should be understood that other frequencies are possible. In an example embodiment, the receiver and computer are on single electronic board **125**; however, it should be understood that other configurations are possible. Motor **126** is powered by the battery and arranged to receive the transmitted control signals to rotate propeller **128**. That is, the propeller provides the force to launch and sustain the airplane in flight according to signals received by the receiver and transmitted by the computer.

Aircraft **100** is not restricted to any particular configuration or shape, except as needed to implement the configurations and functions described below. Receiver **120** and computer **124** can be any receiver and computer known in the art. In an example embodiment, computer **124** is a microprocessor. Motor **126** can be any motor known in the art. Receiver **120** can receive signals from any radio frequency transmitter known in the art. The battery can be any battery known in the art, for example, including, but not limited to, a rechargeable and replaceable LiPO battery of 3.7 volts with a capacity of 150 MAH

In an example embodiment, the airplane includes motor **128** powered by the battery and arranged to receive the transmitted control signals to swivel elevator **106** or flaps **112** and **114**. For example, motor **128** is arranged to perform the following operations:

1. Swivel, with respect to a same frame of reference (indicated by arrow **129**), flaps **112** and **114** in clockwise direction CD and to swivel the rear elevator in counter clockwise direction CCD; or,
2. Swivel, with respect to the same frame of reference, flaps **112** and **114** in direction CCD and the rear elevator in the direction CD.

Thus, using a single motor **128** and a linkage system described below, computer **124** is able to control flaps **112** and **114** and flaps **106** simultaneously. Motor **128** can be any motor known in the art. In an example embodiment, motor **128** is a servo-motor.

In an example embodiment, the tail fin includes rudder **130** which is fixed with respect to the tail fin. For example, the rudder is in a "zero" position of maximum alignment with the tail fin, or the rudder is at a fixed angle with respect to the tail fin, for example, to maintain tension on the guide wire noted below. In an example embodiment, rudder **130** is displaceable, for example, the rudder is hingedly connected to the tail fin, and the airplane includes motor **132** powered by the battery and arranged to receive the transmitted control signals. Motor **132** is arranged to swivel the rudder in response to the control signals from the computer. Motor **132** can be any motor known in the art. In an example embodiment, motor **132** is a servo-motor. In an example embodiment, the computer is arranged to transmit the control signals to simultaneously control motors **128** and **132**.

Airplane **100** includes single flexible wire **134** passing through opening **136** at distal end **138** of one of the wings, for example, the wing pointing inward as the plane traverses a circular path. As shown in the figures, airplane **100** is oriented to fly in a counterclockwise direction (looking down from above the airplane); therefore, opening **136** is located on wing **108**. If airplane **100** is oriented to fly in a clockwise direction (looking down from above the airplane); opening **136** is located on wing **110**. End **140** of the wire is fastened to point **142** at or near a junction of the fuselage and the wing, for example, wing **108**, upon which opening **136** is located. In an example embodiment, the wire passes through an internal space in the wing from opening **136** to point **142**. Second end **144** of the wire, not shown in FIG. **1**, but shown in FIG. **4** below, is arranged for connection to a point outside of the model airplane. The single flexible wire is used solely to guide the airplane and restrain the airplane to a circular flight path as further described below. However, the flexibility of the wire enables the airplane to fly within the circular flight path as further described below. The wire is not used to transmit power or control signals to the model airplane.

FIG. **2** is a representation of reference axes for aircraft AP. It should be understood that the location of the axes in FIG. **2** is substantially applicable to airplane **100**. Longitudinal axis LOA passes through fuselage F of airplane AP, substantially from tail to nose. "Roll" is movement or rotation about LOA. Lateral axis LAA passes through wings W and fuselage F and is perpendicular to LOA. "Pitch" is movement or rotation about LAA. Vertical axis VA passes through F and is perpendicular to LOA and LAA. "Yaw" is movement or rotation about VA. As in known in the art, the exact locations and intersects of the axes depends on the specifics of a particular airplane, for example, the configuration and propulsion system of the airplane.

The following should be viewed in light of FIGS. **1** and **2**. Advantageously, the presence of wire **134** and the positioning of opening **136** and point **142** enable desirable stability of airplane **100** while in flight, combined with optimal sensitivity to control commands. In an example embodiment, the location of point **142** is selected through careful analysis of the structure, configuration, and flight characteristics of airplane **100** such that when flaps **112** and **114** are at a position of greatest alignment with wings **108** and **110**, respectively, and flaps **106** are at positions of greatest alignment with the horizontal stabilizer, the model airplane is arranged to fly with LOA horizontal. That is, airplane **100** flies in a steady horizontal plane without "pitch." The respective positions of greatest alignment described above for flaps **112** and **114** and flaps **106** are referred to as "zero positions" in the art. For example, swiveling the flaps out of the zero positions causes some type of pitch. Without the careful placing of point **142** undesirable pitch occurs. For example, if point **142** is too close to nose **146** of airplane **100**, the nose pitches downward and if point **142** is too close to tail **148** of airplane **100**, the nose pitches upward.

As further described below, wire **134** has a length defining a circular flight path for the model airplane. In an example embodiment, the location of opening **136**, in particular with respect to LOA, is selected through careful analysis of the structure, configuration, and flight characteristics of airplane **100** such that when the rudder is in a position of greatest alignment with the tail fin, the model airplane is arranged to fly at a constant tangent with respect to the circular path. That is, airplane **100** flies without undesirable yaw. For example, nose **146** does not point too far inward of the circular path or too far outward of the circular path. The position of greatest alignment described above for the rudder is referred to as "zero position" in the art. For example, swiveling the rudder out of the zero positions causes yaw. Without the careful placing of opening **136** undesirable yaw occurs. For example, if point **142** is too close to nose **146** of the airplane, the nose yaws inward of the flight path and if opening **136** is too close to tail **148** of the airplane, the nose yaws outward of the flight path.

The location of point **142** influences the handling characteristics of airplane **100**. For example, is point **142** is too close to nose **146** the response of airplane **100** to control is undesirably sluggish, and if point **142** is too close to tail **148** the response of airplane **100** to control is undesirably sensitive and unstable.

Airplane **100** includes linkage system **150** connecting motors **128** and **132** to flaps **106** and flaps **112** and **114**, and the rudder, respectively. In an example embodiment, system **150** includes pushrod **152** connected to motor **128** and control horn **154** in order to actuate the swiveling of flaps **112** and **114**. Control horn **154** transmits this motion through pushrod **156** to control horn **158** connected to flaps **106**. Thus, the linkage system enables the synchronized motion of flaps **112** and **114** and elevator **106** noted above. Thus, motor **128** provides a linear movement through pushrods **152** and **156** to control horns **154** and **158** in order to move flaps **112** and **114** and elevator **106** in tandem. Therefore, a single motor is used to execute two mechanical commands (flaps **112** and **114** and elevator **106**, respectively), eliminating the need for a second motor, which advantageously reduces the weight of aircraft **100**. The reduction in weight increases performance, and provides the operator with more precise control of aircraft **100**. Via the aerodynamic principle of moving flaps **112** and **114** and elevator **106** in unison and in opposite directions, the aircraft is able to optimally create moment and lift at the same time allowing the operator of the model aircraft to generate sharper turns (corners) and loops which in turn allows for better performance indoors and in smaller space environments.

In an example embodiment, system **150** includes pushrod **160** connected to motor **132** and control horn **162** in order to actuate the swiveling of the rudder. It should be understood that system **150** is not limited to the components and configuration shown and that other components and configurations are possible.

FIGS. **3**A-C are details of a distal end of a wing for airplane **100**. The presence of the wire in wing **108** or wing **110** also enables desirable flight characteristics and a desirable flight path for airplane **100**. The following description is with respect to wing **108**; however, it should be understood that the description also is applicable to wing **110**. In general, as airplane **100** flies in the circular path noted above and wire **100** is substantially taut, forces exerted by the wire, in particular at distal end **138**, urge wing **108** upward or downward such that end **140** of the wire, opening **136**, and the other end of the wire are in a straight line, that is, are aligned, as shown in FIG. **3**A. If end **138** rolls upward too far, as shown in FIG. **3**B, bottom edge **164** of opening **136** contacts the wire and exerts force F**1** on the wire so that the ends of the wire are no longer aligned through opening **136**. However, the wire reacts to F**1** with opposite force F**2**, pushing end **138** down so that the configuration shown in FIG. **3**A is attained. If end **138** rolls downward too far, as shown in FIG. **3**C, top edge **166** of opening **136** contacts the wire and exerts force F**3** on the wire so that the ends of the wire are no longer aligned through opening **136**. However, the wire reacts to F**3** with opposite force F**4**, pushing end **138** up so that the configuration shown in FIG. **3**A is attained. Thus, wire **134** provides automatic stabilization with respect to roll about LOA. The operation of wire **134** is further described below.

FIG. **4** is a perspective view of model airplane system **200**. Model airplane system **200** includes anchoring system **202** and airplane **100**. System **200** is shown with a single airplane **100**; however, it should be understood that system is not limited to a single airplane **100** and that a plurality of airplanes **100** can be used in system **200**. Further, it should be understood that if a plurality of airplanes **100** are used in system **200**, different types of airplanes **100** can be used. By different types of airplanes **100** we mean that the shape and configurations of the airplanes can vary as long as the airplanes include the applicable structure and function described above and below for airplane **100**. System **202** includes base

204, pylon **206** fixedly secured to the base, cap **208** at distal end **210** of the pylon, and ring **212** disposed about the pylon, rotatable about the pylon, and displaceable along a length of the pylon. That is, ring **212** fits loosely enough about the pylon such that the ring can rotate around the pylon and be moved up and down along the pylon in direction AD. Base **204** can be a hollow reservoir base to be filled with water, sand or gravel in order to add weight to stabilize the centrifugal force created by the aircraft, and the pylon can be fixed in the middle of the base. The pylon can be made of multiple segments to allow for height adjustment. The ring or rings fit loosely about the pylon to allow the aircrafts to fly around the pylon at variable speeds. Since the rings slide vertically, the rings adapt themselves to the desired altitude of the aircraft as the operator controls the aircraft via flaps **106** and flaps **112** and **114**. The cable is thin and flexible and has any desired length in order to fit enclosed indoor spaces or outdoors. The only function of the cable is to tether the aircraft to the ring and pylon.

End **144** of wire **134** is fixedly connected to the ring. The cap prevents the ring from displacing past the distal end, that is, the ring cannot slide over the cap. Any base, pylon, cap, or ring known in the art can be used. It should be understood that other configurations are possible, with the general understanding that a ring is rotatable about and axially displaceable along a fixed element such as a pylon that is securely anchored. As described above, end **140** of the wire is connected to point **142** in airplane **100**.

As noted above, the location of point **142** is selected through careful analysis of the structure, configuration, and flight characteristics of airplane **100** such that when flaps **112** and **114** are at a position of greatest alignment with wings **108** and **110**, respectively, and elevator **106** are at a position of greatest alignment with the horizontal stabilizer, the model airplane is arranged to fly with LOA horizontal. In portion **214**A of the circular flight path, airplane **100** is flying with LOA horizontal.

FIG. **5** is a plan view of system **200** showing airplane **100** flying at a constant tangent. The following should be viewed in light of FIGS. **1** through **5**. As noted above, wire **134** has length L defining circular flight path **214** for the model airplane. L is not restricted to any particular value. L can be relatively short, for example, 8 feet, to enable use of system **200** within a room or L can be longer for use of system **200** outdoors. As noted above, the location of opening **136**, in particular with respect to LOA, is selected through careful analysis of the structure, configuration, and flight characteristics of airplane **100** such that when the rudder is in a position of greatest alignment with the tail fin, the model airplane is arranged to fly at constant tangent CT with respect to the circular path. That is, angle TA between CT and **214** remains constant and airplane **100** flies without undesirable yaw. The operation of airplane **100** in FIG. **5** can be explained as follows. The airplane flies in direction CCD and force DF acts to keep the airplane moving in direction CCD. Centrifugal force **216** pushes the plane outward and centripetal force **218** pulls the plane inward (with respect to the pylon). The key to the stability and the ability of the airplane to maintain the constant tangent is tension force TF generated by the wire in reaction to the direction force. When point **144** is properly selected, the combination of forces results in the airplane maintaining the constant tangent.

If the guide wire does not pass through the wing and is only attached to the fuselage, undesirable yaw of the nose occurs, for example, inward or outward of the flight path. As a result, the airplane assumes an undesirable orientation, for example, LOA of the airplane crosses the circular flight path (the nose points more toward or more away from a center point for the circular path) rather than being tangential to the circular flight path. If opening **136** is improperly placed undesirable yaw also occurs, for example, if the opening is too close to tail **148** of the airplane, the nose yaws outward of the flight path.

The use of a single flexible guide wire in conjunction with the positioning of the guide wire and the controllability of elevator **106**, flaps **112** and **114**, and the rudder enable a wide-ranging and complex set of maneuvers for airplane **100**. For example, returning to FIG. **4**, the airplane is shown performing an internal loop. In this case, elevator **106** and flaps **114** and **114** are swiveled to enable the loop and the guide wire and the positioning of the guide wire enable the airplane to remain stable during the loop.

FIG. **6** is a perspective view of model airplane system **200** showing airplane **100** flying above the cap on the pylon. The use of a single flexible guide wire in conjunction with the positioning of the guide wire and the controllability of elevator **106**, flaps **112** and **114**, and the rudder also enable the airplane to fly above the cap. This capability increases the vertical maneuvers possible in system **200**. Approximate sequential positions of wire **134** in the sequence of FIG. **6** are shown by numerals **134**A-E.

FIG. **7** is a perspective view of model airplane system **200** showing airplane of **100** performing a figure 8. Since guide wire **134** is flexible, airplane **100** is able to fly within circular flight path **214**. For example, the rudder can be used to move the airplane inward of path **214**. Thus, as shown in FIG. **7** a complicated figure 8 pattern, which requires the airplane to fly above the cap, perform loops, and fly inward of path **214** is accomplished. To clarify the view of FIG. **7**, the guide wire has not been shown.

Thus, airplane **100** is a totally wirelessly radio controlled tethered model scale airplane able to take off, land, climb, accelerate, dive, perform loops, vertical flight, knife flight, Cuban eight, stalls, inverted flight, flips, regular eight, square loops, and many three dimensional flight maneuvers while the operator is situated remotely outside the flight circumference. The preceding motion occurs within flight paths that are prescribed in an outward direction by flight path **214** and length L of the wire which form a dome-capped right angle cylinder. However, as noted above, for example, as shown in FIG. **7**, flight within the cylinder is possible.

In general, the centrifugal force created by the airplane will tend to tense the guide wire as this force urges the airplane away from the pylon. However, through the use of the controllable rudder, the airplane also can fly inside the circumference of the cylinder.

In an example embodiment, the RPM of motor **126** are regulated by electronic speed control (ESC) **154**, which is also located in the aircraft, for example, associated with computer **124**. This arrangement enables the operator to regulate the speed of the aircraft. To accomplish this control wirelessly, the aircraft used the radio frequency control signals noted above. Computer **124** transmits control signals to the ESC that open or close the throttle of motor **126** to regulate the speed of airplane **100** and converts the radio frequency control signals into an electronic signal in order to command motors **128** and **132** which in turn convert these electronic commands into lineal mechanical commands to actuate elevator **106**, flaps **112** and **114**, and the rudder.

Thus, it is seen that the objects of the invention are efficiently obtained, although changes and modifications to the invention should be readily apparent to those having ordinary skill in the art, without departing from the spirit or scope of the invention as claimed. Although the invention is described by reference to a specific preferred embodiment, it is clear that variations can be made without departing from the scope or spirit of the invention as claimed.

What is claimed is:

1. A radio-controlled model airplane, comprising:
a horizontal stabilizer with a controllable rear elevator hingedly connected to the horizontal stabilizer;
first and second wings including first and second controllable flaps hingedly connected to the first and second wings, respectively;
a control system including:
a battery;
a receiver powered by the battery and arranged to receive radio frequency signals; and,
a computer powered by the battery, electrically connected to the receiver, and arranged to transmit control signals in response to the received radio frequency signals;
a first motor powered by the battery and arranged to receive the transmitted control signals to rotate a propeller; and,
a second motor powered by the battery and arranged to receive the transmitted control signals to:
swivel, with respect to a same frame of reference, the first and second flaps in a clockwise direction and to swivel the rear elevator in a counter clockwise direction; or,
swivel, with respect to the same frame of reference, the first and second flaps in the counterclockwise direction and the rear elevator in the clockwise direction.

2. The model airplane of claim 1 further comprising:
a third motor powered by the battery and arranged to receive the transmitted control signals; and,
a rudder hingedly connected to a tail fin, wherein the third motor is arranged to swivel the rudder in response to the control signals from the computer.

3. The model airplane of claim 2 wherein the control signals are arranged to simultaneously control the second and third motors.

4. The model airplane of claim 1 further comprising:
a fuselage to which the first and second wings and the horizontal stabilizer are attached; and,
a single flexible wire:
passing through an opening at the distal end of the first wing;
with a first end fastened to a point at or near a junction of the first wing and the fuselage; and,
a second end arranged for connection to a point outside of the model airplane, wherein the single flexible wire is not used to transmit power or control signals to the model airplane.

5. A radio-controlled model airplane, comprising:
a fuselage;
first and second wings connected to the fuselage;
a control system including:
a battery;
a receiver powered by the battery and arranged to receive radio frequency signals; and,
a computer powered by the battery, electrically connected to the receiver, and arranged to transmit control signals in response to the received radio frequency signals;
a first motor powered by the battery and arranged to receive the transmitted control signals to rotate a propeller; and,
a single flexible wire:
passing through an opening in a distal end of the first wing;
with a first end fixed to a point at or near a junction of the first wing and the fuselage; and,
with a second end for connection to a point outside of the model airplane.

6. The radio-controlled model airplane of claim 5, further comprising:
a second motor powered by the battery; and,
a rear elevator connected to a horizontal stabilizer, wherein:
the first and second wings include first and second flaps, respectively; and,
the second motor is arranged to receive the transmitted control signals to swivel the first and second flaps or the rear elevator.

7. The radio-controlled model airplane of claim 6, further comprising:
a longitudinal axis passing through the fuselage; and,
a lateral axis, perpendicular to the longitudinal axis, passing through the fuselage and the first and second wings, wherein the point at or near the junction of the first wing and the fuselage is positioned so that when the first and second flaps are at a position of greatest alignment with the first and second wings, respectively, and the rear elevator is at a position of greatest alignment with the horizontal stabilizer, the model airplane is arranged to fly with the longitudinal axis horizontal.

8. The radio controlled model airplane of claim 5 further comprising:
a second motor powered by the battery and arranged to receive the transmitted control signals; and,
a rudder connected to a tail fin, wherein:
the single flexible wire has a length defining a circular flight path for the model airplane;
the second motor is arranged to swivel the rudder in response to the transmitted control signals; and,
the opening in the distal end of the first wing is positioned so that when the rudder is in a position of greatest alignment with the tail fin, the model airplane is arranged to fly at a constant tangent with respect to the circular path.

9. The radio-controlled model airplane of claim 5, wherein when the model airplane is being propelled by the first motor a force exerted by the single flexible wire urges the model airplane to fly such that the opening in the distal end of the wing and the first and second ends of the wire are aligned.

10. A model airplane system, comprising:
an anchoring system including:
a base;
a pylon fixedly secured to the base;
a ring disposed about the pylon, rotatable about the pylon, and displaceable along a length of the pylon;
a single flexible wire with a first end connected to the ring; and,
a cap at a distal end of the pylon to prevent the ring from displacing past the distal end; and,
a radio-controlled model airplane including:
a horizontal stabilizer with a rear elevator connected to the horizontal stabilizer;
first and second wings including first and second flaps connected to the first and second wings, respectively;
a control system including:
a battery;
a receiver powered by the battery and arranged to receive radio frequency signals; and,
a computer powered by the battery, electrically connected to the receiver, and arranged to transmit control signals in response to the received radio frequency signals;

a first motor powered by the battery and arranged to receive the transmitted control signals to rotate a propeller; and,

a second motor powered by the battery and arranged to receive the transmitted control signals to:

swivel, with respect to a same frame of reference, the first and second flaps in a clockwise direction and to swivel the rear elevator in a counter clockwise direction; or,

swivel, with respect to the same frame of reference, the first and second flaps in the counterclockwise direction and the rear elevator in the clockwise direction.

11. The model airplane system of claim **10** wherein:

the model airplane includes:

a third motor powered by the battery and arranged to receive the transmitted control signals;

a rudder hingedly connected to a tail fin; and,

the third motor is arranged to swivel the rudder in response to the control signals from the computer.

12. The model airplane system of claim **11** wherein the control signals are arranged to simultaneously control the second and third motors.

13. The model airplane system of claim **10** wherein:

the model airplane includes a fuselage to which the first and second wings and the horizontal stabilizer are attached;

the single flexible wire passes through an opening at the distal end of the first wing; and,

a second end of the single flexible wire is fastened to a point at or near a junction of the first wing and the fuselage.

14. A model airplane system, comprising:

an anchoring system including:

a base;

a pylon fixedly secured to the base;

a ring disposed about the pylon, rotatable about the pylon, and displaceable along a length of the pylon;

a single flexible wire with a first end connected to the ring; and,

a cap at a distal end of the pylon to prevent the ring from displacing past the distal end; and,

a model airplane including:

a fuselage;

first and second wings connected to the fuselage;

a control system including:

a battery;

a receiver powered by the battery and arranged to receive radio frequency signals; and,

a computer powered by the battery, electrically connected to the receiver, and arranged to transmit control signals in response to the received radio frequency signals; and,

a first motor powered by the battery and arranged to receive the transmitted control signals to rotate a propeller, wherein:

the single flexible wire passes through an opening in a distal end of the first wing; and,

a second end of the single flexible wire is fixed to a point at or near a junction of the first wing and the fuselage.

15. The model airplane system of claim **14** wherein:

the model airplane includes:

a second motor powered by the battery; and,

a rear elevator connected to a horizontal stabilizer;

the first and second wings include first and second flaps, respectively; and,

the second motor is arranged to receive the transmitted control signals to swivel the first and second flaps or the rear elevator.

16. The model airplane system of claim **15** wherein:

the model airplane includes:

a longitudinal axis passing through the fuselage; and,

a lateral axis, perpendicular to the longitudinal axis, passing through the fuselage and the first and second wings; and,

the point at or near the junction of the first wing and the fuselage is positioned so that when the first and second flaps are at a position of greatest alignment with the first and second wings, respectively, and the rear elevator is at a position of greatest alignment with the horizontal stabilizer, the model airplane is arranged to fly with the longitudinal axis horizontal.

17. The model airplane system of claim **14** wherein:

the model airplane includes:

a rudder connected to a tail fin; and,

a second motor powered by the battery and arranged to receive the transmitted control signals;

the single flexible wire has a length defining a circular flight path for the model airplane about the pylon;

the second motor is arranged to swivel the rudder in response to the transmitted control signals; and,

the opening in the distal end of the first wing is positioned so that when the rudder is in a position of greatest alignment with the tail fin, the model airplane is arranged to fly at a constant tangent with respect to the circular path.

18. The model airplane system of claim **14** wherein when the model airplane is being propelled by the first motor a force exerted by the single flexible wire urges the model airplane to fly such that the opening in the distal end of the wing and the first and second ends of the wire are aligned.

19. The model airplane system of claim **14** wherein:

the model airplane includes:

a longitudinal axis passing through the fuselage; and,

a lateral axis, perpendicular to the longitudinal axis, passing through the fuselage and the first and second wings; and,

when the model airplane is being propelled by the first motor such that the point on the fuselage is aligned with a line perpendicular to the pylon, a force exerted by the single flexible wire urges the model airplane to fly such that the lateral axis is horizontal.

20. A radio-controlled model airplane, comprising:

a fuselage;

a horizontal stabilizer with a controllable rear elevator hingedly connected to the horizontal stabilizer;

first and second wings connected to the fuselage and including first and second controllable flaps hingedly connected to the first and second wings, respectively;

a control system including:

a battery;

a receiver powered by the battery and arranged to receive radio frequency signals; and,

a computer powered by the battery, electrically connected to the receiver, and arranged to transmit control signals in response to the received radio frequency signals;

a first motor powered by the battery and arranged to receive the transmitted control signals to rotate a propeller;

a single flexible wire:

passing through an opening in a distal end of the first wing;

with a first end fixed to a point at or near a junction of the first wing and the fuselage; and,

with a second end for connection to a point outside of the model airplane; and, a second motor powered by the battery and arranged to receive the transmitted control signals to:

swivel, with respect to a same frame of reference, the first and second flaps in a clockwise direction and to swivel the rear elevator in a counter clockwise direction; or,

swivel, with respect to the same frame of reference, the first and second flaps in the counterclockwise direction and the rear elevator in the clockwise direction.

* * * * *