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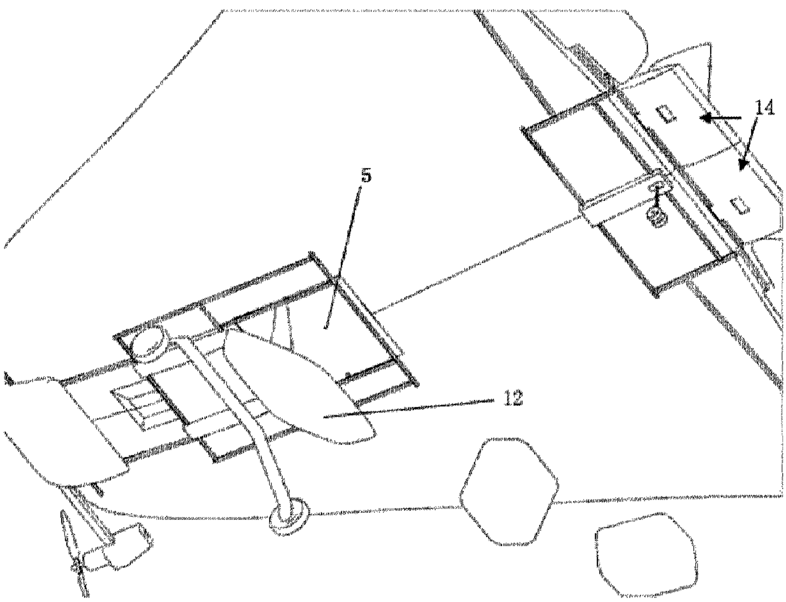

(57) Abrégé/Abstract:
In the field of aircraft, aerostats rely on lighter-than-air gas for buoyancy but have high flight resistance. An anhedral trapezoidal lifting and floating integrated aircraft is disclosed that includes an airframe and a power system. The airframe has a head with an equipment front cabin and a tail with a tail engine cabin. The head is flat-headed, the outer end of the tail adopts a forward-swept analogous anhedral trapezoid, the internal space of the airframe adopts a transverse lacing structure to form an aerofoil, and a penetrating anhedral trapezoidal empty nest is provided in the middle of the airframe as a space for accommodating load. The airframe shape and internal load storage increase the ratio of aerodynamic lift to static buoyancy and improve flight speed and wind resistance. Although the empty nest occupies inflation volume, aerodynamic performance is improved and an auxiliary airbag can be installed for high flight.

ABSTRACT

In the field of aircraft, aerostats rely on lighter-than-air gas for buoyancy but have high flight resistance. An anhedral trapezoidal lifting and floating integrated aircraft is disclosed that includes an airframe and a power system. The airframe has a head with an equipment front cabin and a tail with a tail engine cabin. The head is flat-headed, the outer end of the tail adopts a forward-swept analogous anhedral trapezoid, the internal space of the airframe adopts a transverse lacing structure to form an aerofoil, and a penetrating anhedral trapezoidal empty nest is provided in the middle of the airframe as a space for accommodating load. The airframe shape and internal load storage increase the ratio of aerodynamic lift to static buoyancy and improve flight speed and wind resistance. Although the empty nest occupies inflation volume, aerodynamic performance is improved and an auxiliary airbag can be installed for high flight.

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DIHEDRAL TRAPEZOIDAL LIFTING AND FLOATING INTEGRATED AIRCRAFT

TECHNICAL FIELD

[001] The present disclosure belongs to the technical field of aircrafts, and particularly relates to an anhedral trapezoidal lifting and floating integrated aircraft.

BACKGROUND

[002] In recent years, the emerging unmanned aerial vehicle (UAV) has been widely used by all walks of life because of its low cost, easy operation, high flexibility and ultra-low altitude flight. Most of the existing UAVs are mainly used in the fields such as scientific research, geographic exploration, agricultural plant protection, security monitoring and video shooting.

[003] Traditional aerostats, typified by airships, have the characteristics of long empty time, good safety performance and low fuel consumption rate, and are widely used in civil fields such as air transportation and communication relay, and military fields such as coastal monitoring and airborne early warning. However, the traditional aerostat mainly relies on the internal filling of gas lighter than air to generate buoyancy, and its lift is proportional to the size of the aircraft. In order to increase the load, it is necessary to increase the size of the aircraft, especially in the stratosphere with low air density. However, too large size will often increase the flight resistance, reduce the movement speed and even exceed the limit of the tension of the capsule material. According to the patent No. 201510557995 previously applied by the inventor, during the actual manufacture and flight test, it is found that the lifting and floating integrated aircraft with this structure has the problems of poor wind resistance and difficult engineering realization, so that the original scheme must be redesigned. Therefore, an anhedral trapezoidal lifting and floating integrated aircraft is disclosed.

SUMMARY

[004] In view of the problems existing in the prior art, the present disclosure aims to provide an anhedral trapezoidal lifting and floating integrated aircraft, which has greatly improved aerodynamic efficiency, flight stability, structural strength, wind resistance and the like. The aircraft is suitable for performing various tasks in various airspace domains such as low altitude

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and stratosphere, and can choose to charge helium or air to the airframe according to the needs of the task and convenience of users.

[005] The present disclosure is realized by the following technical scheme.

[006] An anhedral trapezoidal lifting and floating integrated aircraft is provided, comprising an airframe and a power system provided on the airframe, wherein the airframe has a head and a tail, the head is provided with an equipment front cabin, and the tail is provided with a tail engine cabin; in a top view, the head is flat-headed, the outer end of the tail adopts a forward-swept analogous anhedral trapezoid, the airframe is formed by heat sealing and welding eight or more adhesive tapes, the internal space of the airframe adopt a transverse lacing structure to form the airfoil of the airframe, and a penetrating anhedral trapezoidal empty nest is provided in the middle of the airframe as a space for accommodating load.

[007] According to the anhedral trapezoidal lifting and floating integrated aircraft, the airframe is made of two layers of materials, the outer layer is made of light materials with less elasticity and extensibility and better strength; the inner layer is made of air-tight material with high elasticity, and the outer layer is punched through the inner-layer material patch and then is fixed through the opening hole of the outer layer. This arrangement can effectively improve the overall flatness and puncture resistance of the airframe and solve the depression problem at the empty nest of the airframe.

[008] According to the anhedral trapezoidal lifting and floating integrated aircraft, the power system comprises engines installed at the tail and the front of the airframe, the middle of the tail of the airframe installed with an odd number of engines is a forward concave arc, and the middle of the tail of the airframe installed with an even number of engines is a straight trailing edge.

[009] According to the anhedral trapezoidal lifting and floating integrated aircraft, the longitudinal section of the airframe adopts an airfoil MT722 with large area and high efficiency at the same time. The airfoil can effectively increase the internal volume of the aircraft and further improve the static buoyancy.

[0010] According to the anhedral trapezoidal lifting and floating integrated aircraft, the equipment front cabin is in the shape of the leading edge of the airfoil, and the shape of the tail

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engine cabin is nearly conformal with the trailing edge of the airfoil. The equipment front cabin and the tail engine cabin are used to further correct the airfoil distortion caused by the deformation of the non-rigid airframe during inflation and movement.

[0011] According to the anhedral trapezoidal lifting and floating integrated aircraft, an elevator/aileron hybrid control surface with both ends protruding forward is installed at the left and right outer parts of the trailing edge of the tail of the airframe. This arrangement can reduce the influence of thick wing airframe on aerodynamic efficiency of the elevator/aileron at the tail of the aircraft, and then improve the efficiency of the control surface.

[0012] According to the anhedral trapezoidal lifting and floating integrated aircraft, the anhedral trapezoidal empty nest is formed by an erected three-dimensional foldable rigid truss structure, the truss structure comprises an upper support frame and a lower support frame, a longitudinal support frame is detachably provided between the upper support frame and the lower support frame, and the upper support frame and the lower support frame are both detachable from the airframe. The anhedral trapezoidal empty nest is provided, which can reduce the load resistance of the loading task, and its internal support frame can effectively strengthen the anti-deformation ability of the airframe.

[0013] According to the anhedral trapezoidal lifting and floating integrated aircraft, the upper part of the anhedral trapezoidal empty nest is provided with an upper cover plate, and the lower part thereof is provided with a lower hopper. The upper cover plate and the lower hopper are provided, which is convenient for loading and unloading cargo and task load and maintains the shape integrity of the airframe.

[0014] According to the anhedral trapezoidal lifting and floating integrated aircraft, a single vertical tail and a rudder are installed on the aircraft with an even number of engines, a one-piece or two-piece elevator is installed in the middle of the tail; double vertical tails are installed at the tail of the aircraft installed with an odd number of engines, and the horizontal tail and the elevator are located between the double vertical tails.

[0015] The present disclosure has a novel structure and a reasonable design. The matching arrangement of various structural components can improve the lifting and floating resistance ratio and wind resistance; the transverse lacing is provided, which not only can reduce the weight of the airframe and increase the structural strength of the airframe, but also simplify the engineering realization process.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016] FIG. 1 is a schematic diagram of the overall structure of an airframe of double vertical tails according to the present disclosure;

[0017] FIG. 2 is a structural schematic diagram of different sides of FIG. 1;

[0018] FIG. 3 is a structural schematic diagram of an airframe of a single vertical tail according to the present disclosure;

[0019] FIG. 4 is a structural schematic diagram of different sides of FIG. 3;

[0020] FIGS. 5-6 are schematic diagrams of partial internal structures;

[0021] FIG. 7 is an unfolded structural diagram of an outer layer of an airframe;

[0022] FIG. 8 is an unfolded structural diagram of an inner layer of an airframe;

[0023] FIGS. 9-10 are structural schematic diagrams of transverse lacings provided on an airframe;

[0024] FIGS. 11-12 are structural schematic diagrams of a truss;

[0025] FIGS. 13-14 are structural schematic diagrams of expansion models in different directions;

[0026] FIG. 15 is a schematic diagram of airflow attached to a conventional delta wing;

[0027] FIG. 16 is a schematic diagram of airflow attached to a delta wing after end cropping;

[0028] FIG. 17 is a flight state diagram of an aircraft with a thick airfoil at a large elevation angle;

[0029] FIGS. 18-19 are flight state diagrams of an aircraft at an angle of attack of 40 degrees;

[0030] FIG. 20 is a schematic diagram of a connecting structure of inner-layer and outer-layer materials of an airframe.

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DETAILED DESCRIPTION

[0031] The present disclosure will be described in further detail with reference to the attached drawings of the specification, and gives specific embodiments.

[0032] The whole mechanism of an anhedral trapezoidal lifting and floating integrated aircraft of the present disclosure is as shown in FIG. 1-FIG. 4. The aircraft comprises an airframe 1 and a power system provided on the airframe. The airframe has a head and a tail. The head is provided with an equipment front cabin, and the tail is provided with a tail engine cabin. In a top view, the airframe 1 is flat-headed. The outer end of the tail adopts the shape of a forward-swept anhedral trapezoid airframe. In a front view, the airframe 1 adopts s two-side anhedral design, as shown in FIGS. 2 and 4. The middle of the tail of the airframe installed with an odd number of engines is a forward concave arc 6, as shown in FIG. 1 and FIG. 2. The middle of the tail of the airframe installed with an even number of engines is a straight trailing edge, as shown in FIG. 3 and FIG. 4. The longitudinal section of the airframe adopts an airfoil MT722 with relatively large thickness and high efficiency, as shown in FIG. 2 and FIG. 4, which increases the ratio of aerodynamic lift and static buoyancy, improves flight speed, flight stability and wind resistance, and reduces resistance. The equipment front cabin is conformal with the leading edge of the airfoil, and the tail engine cabin is conformal with the trailing edge of the airfoil. The equipment front bin 2 and the tail engine bin 3 are used to correct airfoil distortion caused by deformation of non-rigid airframe during inflation and movement. The equipment task front bin is in the shape of the leading edge of the airfoil and is installed at the front of the airframe. The tail engine bin is in the shape close to the trailing edge of the airfoil and is installed at the tail of the airframe. Because the thick airfoil airframe has a great influence on the aerodynamic efficiency of the elevator/aileron at the tail of the aircraft, in order to improve the efficiency of the control surface, an elevator/aileron hybrid control surface 7 with both ends protruding forward is installed at the left and right outer parts of the trailing edge, as shown in FIG. 2 and FIG. 4. A single vertical tail 13 and a rudder are installed on the aircraft with an even number of engines. A one-piece or two-piece elevator 14 is installed in the middle of the tail. Double vertical tails 15 are installed at the tail of the aircraft installed with an odd number of engines, and the horizontal tail and the elevator are located between the double vertical tails.

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[0033] As shown in FIG. 5-6, in order to reduce the load resistance and strengthen the anti-deformation ability of the airframe, a penetrating inner trapezoidal empty nest 5 is provided in the middle of the airframe as a space for accommodating load, as shown in FIG. 5 and FIG. 6, and a new three-dimensional foldable rigid truss structure erected in the middle is used to enhance the rigidity of the whole aircraft, as shown in FIGS. 10-12. In order to improve the flatness and puncture resistance of the airframe and solve the depression problem at the empty nest 5 of the airframe, the airframe consists of two layers of different materials, the outer layer is made of light materials with less elasticity and extensibility and better strength, and the inner layer is made of air-tight material with high elasticity, as shown in FIGS. 6-10.

[0034] In order to simplify the molding process of the airframe, the airfoil of the airframe is formed in the structure of a transverse lacing 4, and the shape of the airframe is formed by heat sealing and welding eight or more adhesive tapes, as shown in FIG. 8 to FIG. 10. A penetrating anhedral trapezoidal empty nest is provided in the middle of the airframe as a space for accommodating load. The anhedral trapezoidal empty nest 5 is formed by an erected three-dimensional foldable rigid truss structure. The truss structure comprises an upper support frame 8 and a lower support frame 9. A longitudinal support frame 10 is detachably provided between the upper support frame 8 and the lower support frame 9. The upper support frame 8 and the lower support frame 9 are both detachable from the airframe 1. In order to facilitate loading and unloading of cargo and task loads and maintain the shape integrity of the airframe, the upper part of the empty nest 5 is provided with an upper cover plate 11, and the lower part thereof is provided with a lower hopper 12.

[0035] In order to adapt to different levels of users and different application scenarios, the anti-trapezoidal lifting and floating integrated aircraft adopts the modular design concept, forming a serial expansion model with most modules interchangeable, as shown in FIG. 13 to FIG. 14, including installing a boat chassis 16 on an inflatable airframe to form an amphibious airfoil, and installing a cross-flow fan 17 at the trailing edge of the lifting and floating integrated aircraft to further improve the aerodynamic lift, especially to significantly improve the airflow separation phenomenon of the upper wing surface at a high angle of attack.

[0036] The lifting and floating integrated aircraft is a hybrid aircraft that combines aerodynamic lift and aerostatic buoyancy in motion. In order to make the aircraft have strong dynamic lift effect and the internal volume of the airframe generating static buoyancy as large as possible, so as to obtain better overall lift effect with smaller volume compared with the traditional airship and better low-speed flight performance compared with the fixed wing, the airframe and overall aerodynamic shape design should not only have better aerodynamic performance, but also have a larger airframe surface area ratio. After CFD simulation and calculation and actual flight test, and considering the requirements of improving the structural strength-to-weight ratio and simplifying the actual processing technology, the system optimization design is carried out, and the shape design scheme of the airframe that in a top view, the head is flat-headed, and the outer end of the tail is forward-swept. The overall shape is as shown in FIG. 1 and FIG. 3.

[0037] Model selection of an airframe

[0038] In order to improve the volume ratio of the aircraft, the aircraft adopts a lifting body (the fuselage and the aerofoil are integrated into a whole) scheme and adopts the thick airfoil MT722. In order to ensure the dynamic lift performance of the airframe, it is necessary to improve the integrity of the airfoil along the span-wise direction as much as possible. At the same time, in order to combine the airframe shape with as few pieces of materials as possible, the top view shape of the airframe is flat-headed (refer to FIG. 1 and FIG. 3). The rear part of the whole MT722 airfoil lifting body is thin, which leads to poor rigidity in the vertical cross-section direction, and it is easy to swing up and down at both ends of the wing. Therefore, the trailing edge of the airframe adopts a forward-swept design to form a triangular rigid support installation and reinforcement area at the rear part of the airframe (refer to FIG. 1, FIG. 2, FIG. 3, FIG. 4 and FIG. 11). The airframe and the rigid support are fixed by patches. The whole airframe forms an anhedral trapezoid. At the same time, it also brings the benefit of improving the floor area ratio of the airframe, which can improve the buoyancy and reduce the area of materials used, thus reducing the weight of the airframe.

[0039] The principle of improving aerodynamic performance by the shape of anhedral flat-headed lifting and floating integrated airframe is as follows.

[0040] In fact, the shape of the anhedral flat-headed lifting and floating integrated airframe is similar to that of the end-cropping (root-cutting) delta wing. The principle that the root-cutting delta wing has better lift-drag ratio than the delta wing at lower speed is also applicable here.

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[0041] Why does the lift-drag ratio increase at subsonic speed after cutting the root (end) of the delta wing? This starts with the characteristics of the delta wing. Under the pressure, the airflow under the delta wing rolls over to the upper surface, forming many weak vortex bundles. At low angles of attack, leading-edge airflow separation occurs. If the air flow attaches to the leading edge, it will produce leading-edge suction, which is equivalent to reducing the resistance. However, the delta wing is prone to leading-edge airflow separation, which actually reduces the leading-edge suction and increases the resistance. Moreover, the leading-edge airflow separation vortex also produces a great induced resistance, which is also the unfavorable side of the delta wing, as shown in FIG. 15.

[0042] In order to solve the problems of large subsonic induced resistance and low lift-drag ratio of the delta wing, one method is to fix the torsion and improve its pressure span-wise distribution (such as J10). The second method is to configure the leading-edge flap and the trailing-edge flap so that the airfoil becomes a variable curvature airfoil. These two methods are difficult to process and form the flexible airframe, which cannot be adopted.

[0043] The third method is to cut the root (end). By reducing the sweepback angle of the root (end), the separation can be delayed, while the leading-edge suction can be maintained and the resistance can be reduced. Then the cruise lift-drag ratio can be improved, as shown in FIG. 16. It can be seen that the middle region keeps the complete airfoil shape along the span-wise direction, and the airflow passing through this region can produce a better lift effect. In addition, the external anhedral design not only achieves better rolling stability, but also reduces the thickness of the airfoils at both ends, which is more beneficial to further reduce induced resistance. At the same time, it also brings the benefit of improving the floor area ratio of the airframe, which can improve the buoyancy and reduce the area of the materials used, thus reducing the weight of the airframe.

[0044] Airframe forming:

[0045] It is a difficult task to ensure the flexible airframe to form a good aerodynamic shape. The anhedral trapezoid is selected, which greatly simplifies the forming and processing difficulty. The airtight surface of the airframe is welded by 8 pieces of airtight materials, as shown in FIG. 8. B3 is welded with B1, A2 is welded with A1, and A1 is welded with the front or tail of B1. After the

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corresponding lacing 4 is welded up and down, C1 is welded with A2 and B3, respectively, and finally the tail or front seal is welded.

[0046] In order to form a good aerodynamic shape, besides the shape of the airframe, it is more important to make the airframe section with as few flexible materials as possible to conform to the selected airfoil shape. Here, the airfoil shape of the airframe section is realized by means of internal lacing 4, as shown in FIG. 10. However, after inflation, the flexible airframe tends to be spherical with less lacing. The convex spherical surface of the airframe will become larger, and the distortion and deformation will be larger. If the lacing is too dense, it will increase the weight. In addition, the arrangement density and direction of lacing will affect the cross-section forming of the airframe.

[0047] Here, "Non-dominated Sorting Algorithm (NSGA_II)" is adopted to optimize the realization method of airfoil forming.

[0048] Initial structural modeling of an inflatable airfoil

[0049] First, the area between two adjacent lacings is defined as a unit, and the number of lacings 4 is set as N.

[0050] In the two-dimensional plane reference system, the initial horizontal coordinate value of each center of the circle is given, in which the coordinate origin is set at the forefront of the airfoil profile. Then, according to the tangent position relationship between the arc and the airfoil baseline, the ordinate and the radius value can be calculated.

[0051] However, the coordinate value of the initial center of the circle is limited in a limited range, so that two adjacent circles with tangent relationship can definitely intersect, and these circles cover the area of the inflatable airfoil section as much as possible.

[0052] The elevator/aileron hybrid control surface with both ends protruding forward

[0053] In order to improve the floor area ratio, the airframe adopts a thicker airfoil. The thicker airfoil will block the tail. Especially when flying at a high angle of attack, the lifting body (wing) with a large chord length will cause airflow separation, which will greatly reduce the control efficiency of the elevator/aileron hybrid control surface 2, as shown in FIG. 17.

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[0054] The elevator/aileron hybrid control surface with both ends protruding forward is adopted, and its two ends are extended to the outside of the left and right ends of the airframe, so that the control surface directly faces the airflow, which significantly improves the control efficiency, as shown in FIG. 16 and FIG. 7. At the same time, the control surface protruding forward also plays the role of balancing the control torque of the control surface.

[0055] Design and implementation of a load bin in the middle of an airframe

[0056] In order to reduce the load resistance of the loading task, strengthen the anti-deformation ability of the airframe, and disperse the acting force of the load on the airframe, it will only change from bearing load on the bottom of the airframe to bearing the loading force up and down simultaneously. A penetrating inner trapezoidal empty nest is provided in the middle of the airframe as a space for accommodating load, as shown in FIG. 5, FIG. 6 and FIG. 10, and a new three-dimensional foldable rigid truss structure erected in the middle is used to enhance the rigidity of the whole aircraft, as shown in FIGS. 10-12. In order to facilitate loading and unloading of cargo and task loads and maintain the shape integrity of the airframe, the upper part of the empty nest is provided with an upper cover plate 11, and the lower part thereof is provided with a lower hopper 12.

[0057] One advantage of the lifting and floating integrated aircraft is that it can realize large loads with the same power. If the large loads are loaded in external storage or in specially designed external stores, the aerodynamic shape of the whole airframe will be destroyed, resulting in a significant increase in resistance, a significant decrease in lift, and an increase in structural weight and processing cost. Therefore, it is very necessary to design an empty nest cabin for airframe load. Although the empty nest in the middle of the airframe will occupy the inflation volume, the loss of aerodynamic performance will have a much smaller impact on the overall performance compared with the external storage mode. In addition, when the application scenario requires a high flying height, the empty nest cabin can be used as a reserved position for installing an auxiliary airbag.

[0058] The empty nest is designed as a trapezoidal structure with a small top and a large bottom, as shown in FIG. 5, FIG. 6, FIG. 8 and FIG. 10, because the small top can minimize the large upper opening so as not to affect the shape of the upper surface of the airframe, and the large

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bottom can maximize the size of the loadable task load, while the trapezoidal structure is also conducive to more stable installation of the internal support. Refer to FIG. 12 and FIG. 13 for the support, which can play the following roles.

[0059] 1) It can be used as a load bearing structure, and the force of the load simply acting on the bottom of the airframe can be changed into the upper and lower surfaces of the airframe to be stressed at the same time through the support.

[0060] 2) The support can change the rigid support skeleton of the whole airframe from being two-dimensional to being three-dimensional, thus increasing the anti-deformation ability of the whole airframe.

[0061] The empty nest is formed by welding four adhesive tapes to each other and then to the airframe, and the support is connected with the airframe through patches, as shown in FIG. 8. The airframe is made of two layers of materials. The outer layer is made of light materials with less elasticity and extensibility and better strength; the inner layer is made of air-tight material with high elasticity, and the outer layer is punched through the inner-layer material patch and then is fixed through the opening hole of the outer layer, as shown in FIG. 20.

[0062] In the present disclosure, two layers of the airframe materials are adopted to solve the problems of the airframe flatness, improvement of puncture resistance strength and depression in the empty nest of the airframe, etc. The airframe consists of two layers of different materials, the outer layer of the airframe is made of material with less elasticity, and the inner layer is made of airtight material with greater elasticity, as shown in FIG. 6 to FIG. 10.

[0063] Flatness problem of the airframe

[0064] It can be seen from the above that in order to form the airfoil shape of the airframe, it is necessary to restrain the deformation of the airframe caused by inflation by means of lacing, etc., so as to form an ideal airframe (airfoil) profile. By making lacing according to the above algorithm and welding the lacing in the fuselage, the airframe profile shape close to the ideal airfoil can be formed with as little material as possible, but it is difficult to fundamentally eliminate the wavy undulations on the airframe surface, as shown in FIG. 10, which will lead to

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the increase of the airframe resistance. The external light material with less elasticity and extensibility can act as a bridge across the depression, so that the airframe becomes smooth.

[0065] Improvement of puncture resistance

[0066] A lifting and floating integrated aircraft needs to keep a certain pressure of gas inside the airframe to maintain a certain buoyancy and shape of the airframe. If the airframe comes into contact with sharp objects in the event of collision or scratching, it may cause perforation or tearing of the airframe, resulting in gas leakage inside the airframe, resulting in a decrease in buoyancy and a change in shape, making it difficult to continue flying or even crashing. It will be very beneficial to adopt the protection measures of external light materials with less elasticity, extensibility and better strength.

[0067] Depression in the empty nest of the airframe

[0068] As described above, the airframe of the present disclosure adopts the empty nest design in the middle. The edge of the empty nest will form a depression when inflating, as shown in FIG. 10, which will seriously affect the airfoil shape of the airframe, and then cause the aerodynamic performance to deteriorate. For this reason, the external light material with less elasticity and extensibility can also act as a bridge across the depression. In order to facilitate the installation of the internal support and the debugging of the task load, two holes are formed in the external airframe material. Because the lower part has a rigid hatch cover, the external airframe material has a hole in the lower part of the empty nest with the same size as the bottom of the empty nest.

[0069] The external airframe material is not directly connected with the internal airframe, but a pair of holes are formed at both ends of the patch position where the support is connected with the internal airframe, so that the support can pass through and clamp the internal and external airframe materials at the same time.

[0070] The cutting size of external airframe material determines the size enlargement ratio of external airframe material according to the difference of elasticity and extensibility between external and internal airframe materials under certain gas pressure.

[0071] Forming a serial expansion model by installing different modules

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[0072] In order to adapt to different levels of users and different application scenarios, the anhedral trapezoidal lifting and floating integrated aircraft can be filled with helium or air, and adopts a modular design concept to form a serial model with most modules interchangeable, as shown in FIG. 13 to FIG. 14, including installing a boat chassis 16 on an inflatable airframe to form an amphibious airfoil, and installing a cross-flow fan 17 at the trailing edge of the lifting and floating integrated aircraft to further improve the aerodynamic lift, especially to significantly improve the airflow separation phenomenon of the upper wing surface at a high angle of attack.

[0073] FIGS. 18-19 show the flow field distribution of the aircraft at an angle of attack of 40 degrees when the embedded cross-flow fan is turned off and on. In FIG. 18, the airflow separation obviously causes stall, while in FIG. 19, there is no stall.

[0074] The cross-flow fan has been used in many fields, such as air conditioning, etc. In foreign countries, aircrafts have used cross-flow fans, but the cross-flow fan has not been applied to the lifting and floating integrated aircraft, as shown in FIG. 13.

[0075] The connection of the cross-flow fan to the lifting and floating integrated aircraft can also be the same as other component modules, which are first connected with the support, and then the support is connected with the airframe through patches.

[0076] In order to meet the needs of fishing and tourism in the ocean and Great Lakes of North America, a ship-type cabin can be installed at the lower part of the airframe, as shown in FIG. 13 and FIG. 14. The connection mode is the same as other components, which are connected to the airframe through supports and patches. Because the airframe itself is an inflatable airframe, the buoyancy on the water is very large, and there is enough safe buoyancy reserve.

WHAT IS CLAIMED IS:

1. An anhedral trapezoidal lifting and floating integrated aircraft, comprising an airframe (1) and a power system provided on the airframe (1), wherein the airframe (1) has a head and a tail, the head is provided with an equipment front cabin (2), and the tail is provided with a tail engine cabin (3); in a top view, the head is flat-headed, an outer end of the tail adopts a forward-swept analogous anhedral trapezoid, the airframe (1) is formed by heat sealing and welding eight or more adhesive tapes, an internal space of the airframe (1) adopts a transverse lacing (4) structure to form an airfoil of the airframe, and a penetrating anhedral trapezoidal empty nest (5) is provided in a middle of the airframe (1) as a space for accommodating load.

2. The anhedral trapezoidal lifting and floating integrated aircraft according to claim 1, wherein the airframe (1) is made of two layers of materials, an outer layer is made of light materials with less elasticity and extensibility and better strength; an inner layer is made of air-tight material with high elasticity, and the outer layer is punched through an inner-layer material patch and then is fixed through an opening hole of the outer layer.

3. The anhedral trapezoidal lifting and floating integrated aircraft according to claim 1, wherein the power system comprises engines installed at the tail and a front of the airframe, a middle of the tail of the airframe installed with an odd number of engines is a forward concave arc (6), and a middle of the tail of the airframe installed with an even number of engines is a straight trailing edge.

4. The anhedral trapezoidal lifting and floating integrated aircraft according to claim 1, wherein a longitudinal section of the airframe (1) adopts an airfoil MT722.

5. The anhedral trapezoidal lifting and floating integrated aircraft according to claim 1, wherein the equipment front cabin (2) is conformal with the airfoil and its shape is a leading edge of the airfoil, and the tail engine cabin (3) is also conformal with the airfoil and its shape is close to a trailing edge of the airfoil.

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6. The anhedral trapezoidal lifting and floating integrated aircraft according to claim 1, wherein an elevator/aileron hybrid control surface (7) with both ends protruding forward is installed at a left and right outer parts of a trailing edge of the tail of the airframe (1).

7. The anhedral trapezoidal lifting and floating integrated aircraft according to claim 1, wherein the anhedral trapezoidal empty nest (5) is formed by an erected three-dimensional foldable rigid truss structure, the erected three-dimensional foldable rigid truss structure comprises an upper support frame (8) and a lower support frame (9), a longitudinal support frame (10) is detachably provided between the upper support frame (8) and the lower support frame (9), and the upper support frame (8) and the lower support frame (9) are both detachable from the airframe (1).

8. The anhedral trapezoidal lifting and floating integrated aircraft according to claim 1, wherein an upper part of the anhedral trapezoidal empty nest (5) is provided with an upper cover plate (11), and a lower part thereof is provided with a lower hopper (12).

9. The anhedral trapezoidal lifting and floating integrated aircraft according to claim 1, wherein a single vertical tail (13) and a rudder are installed with an even number of engines, a one-piece or two-piece elevator (14) is installed in a middle of the tail; double vertical tails (15) are installed at the tail and are installed with an odd number of engines, and a horizontal tail and the one-piece or two-piece elevator are located between the double vertical tails.

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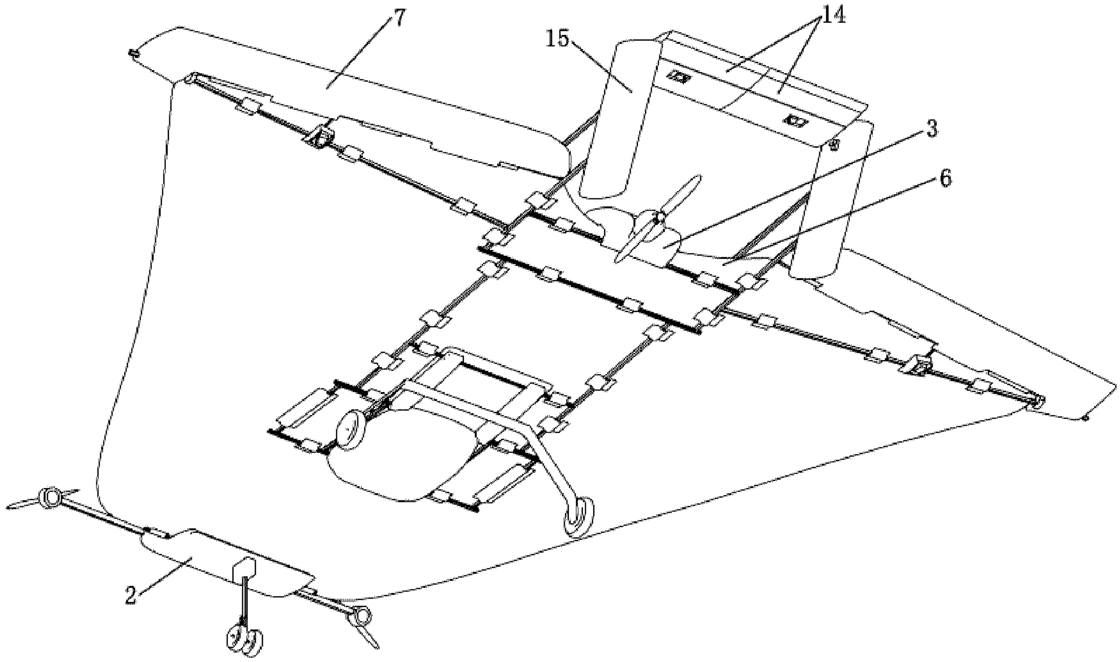

FIG. 1

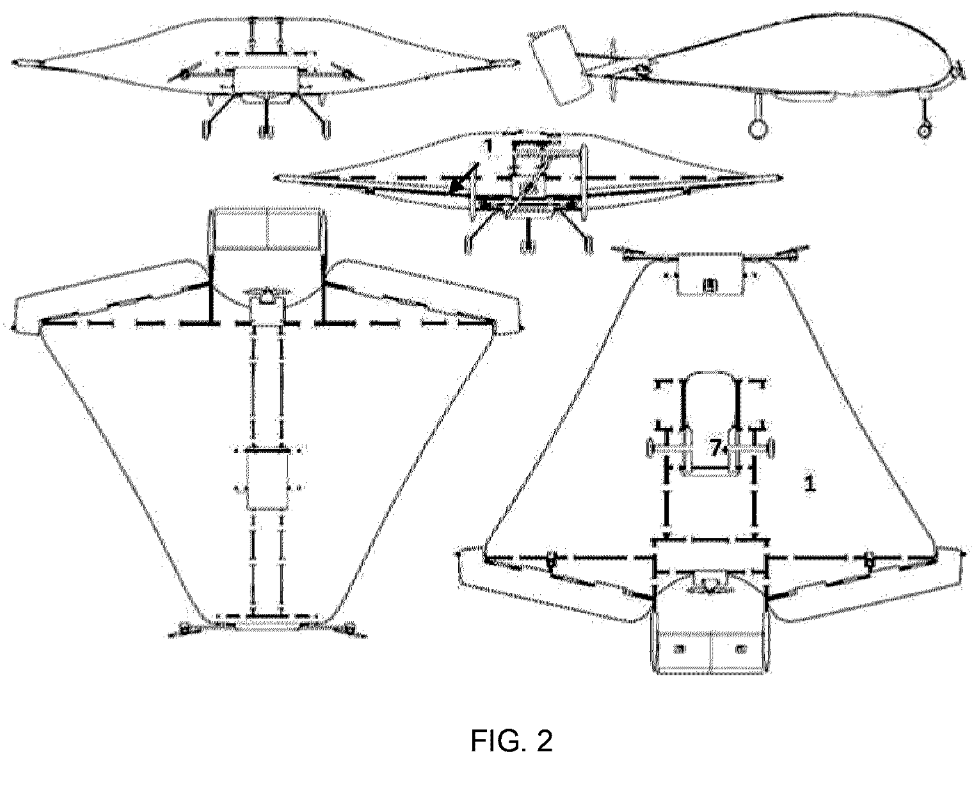

FIG. 2

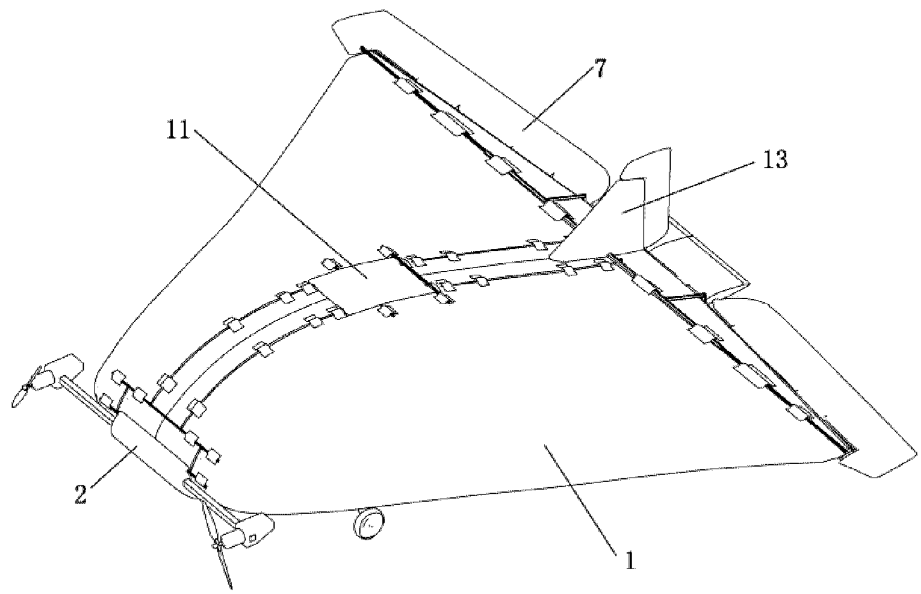

FIG. 3

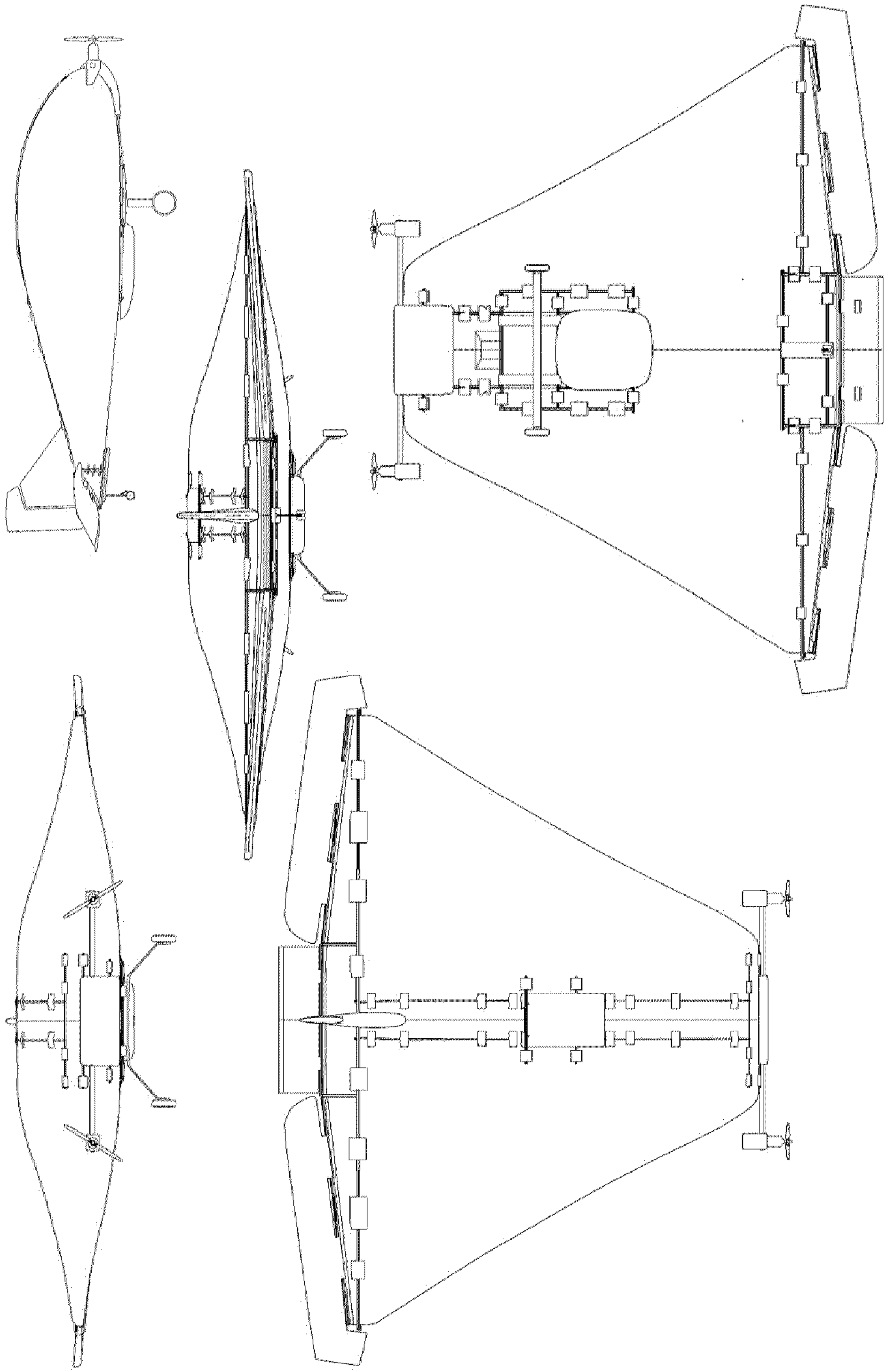

FIG. 4

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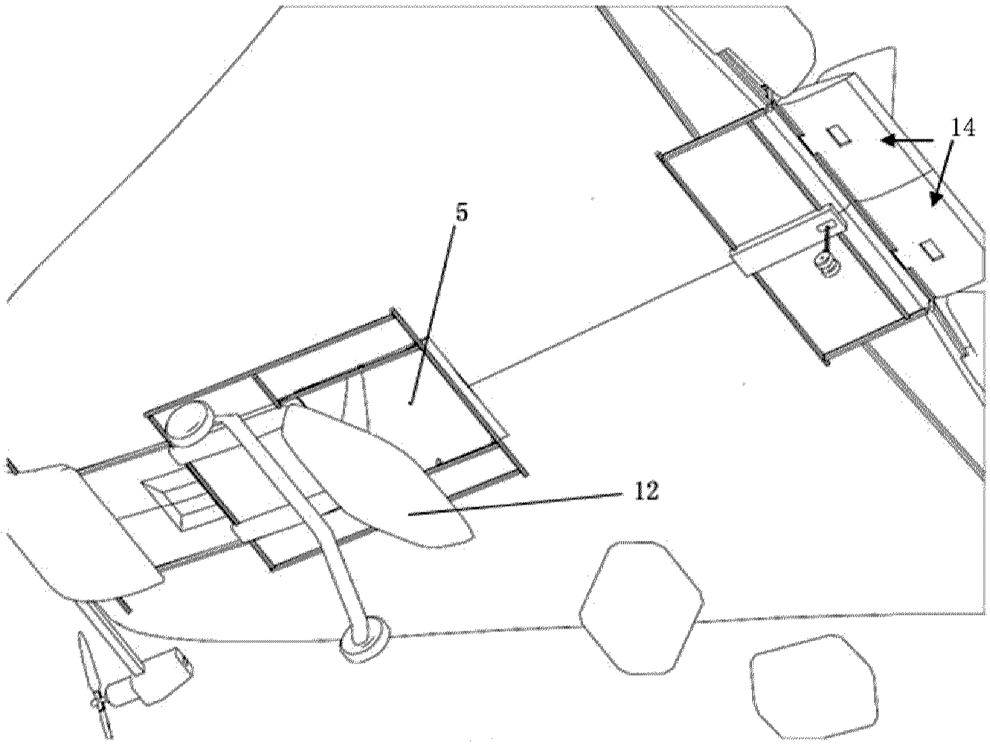

FIG. 5

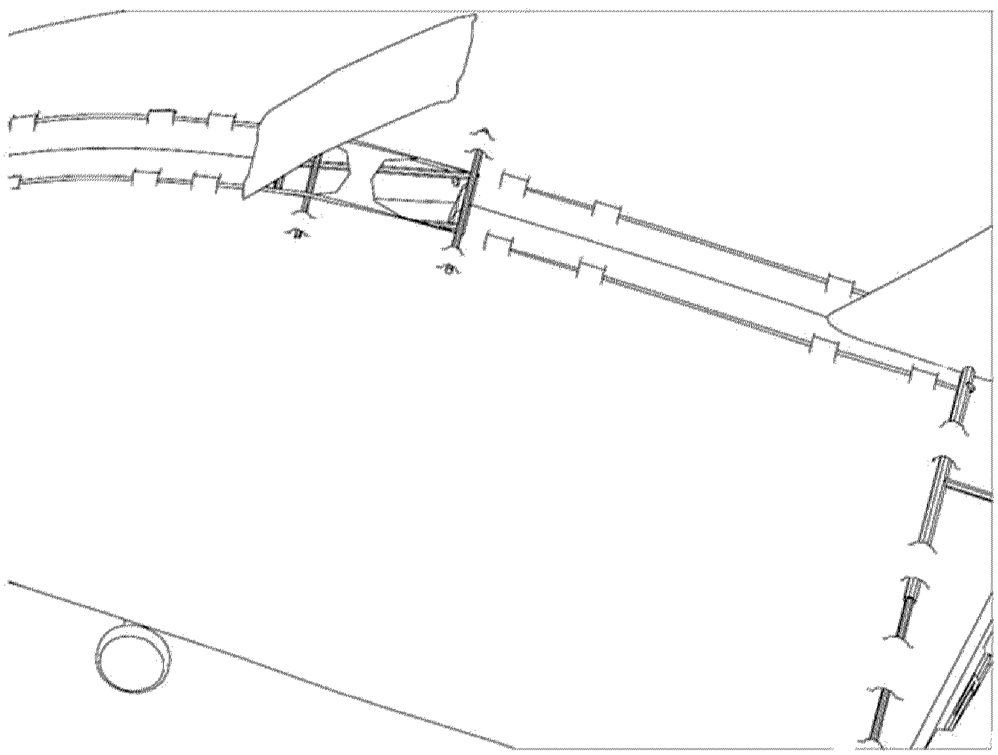

FIG. 6

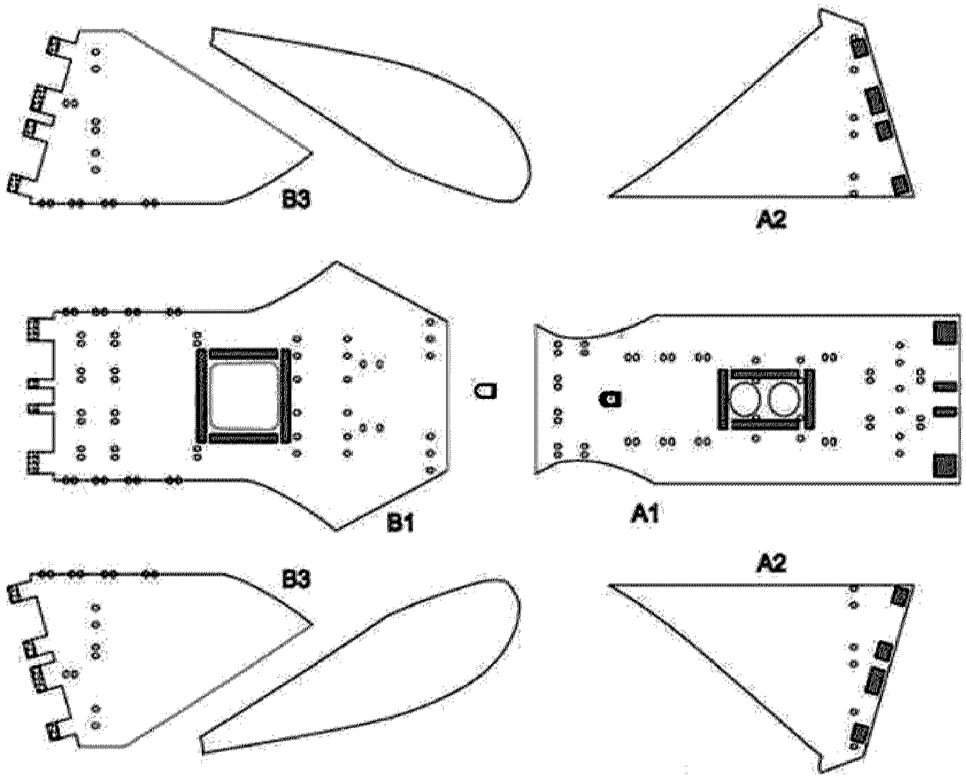
B3
A2
B1
A1
B3
A2

FIG. 7

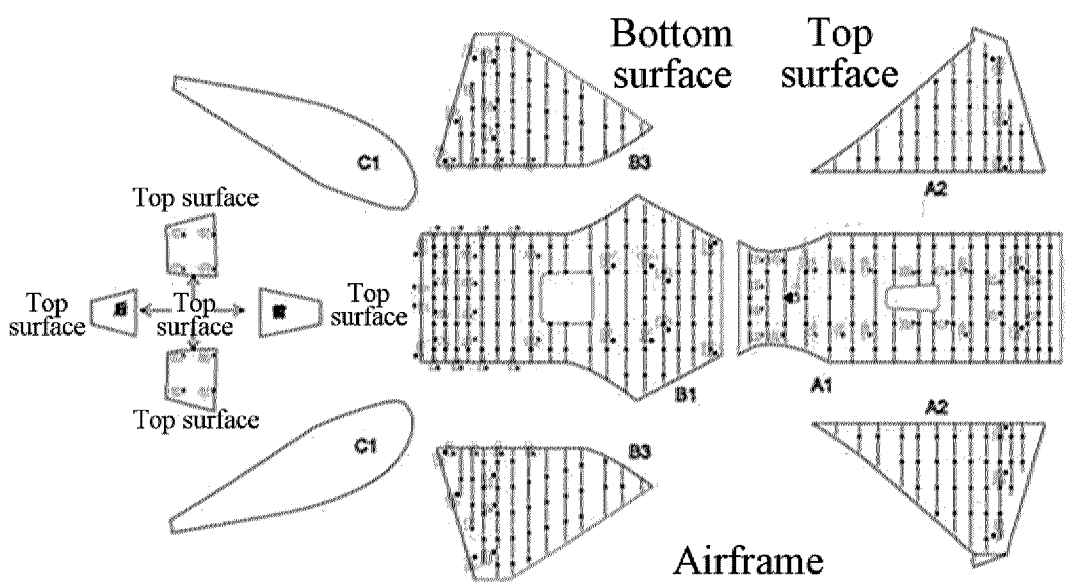
Bottom surface
Top surface
C1
B3
A2
Top surface
Top surface
Top surface
Top surface
Top surface
B1
A1
C1
B3
A2
Airframe

FIG. 8

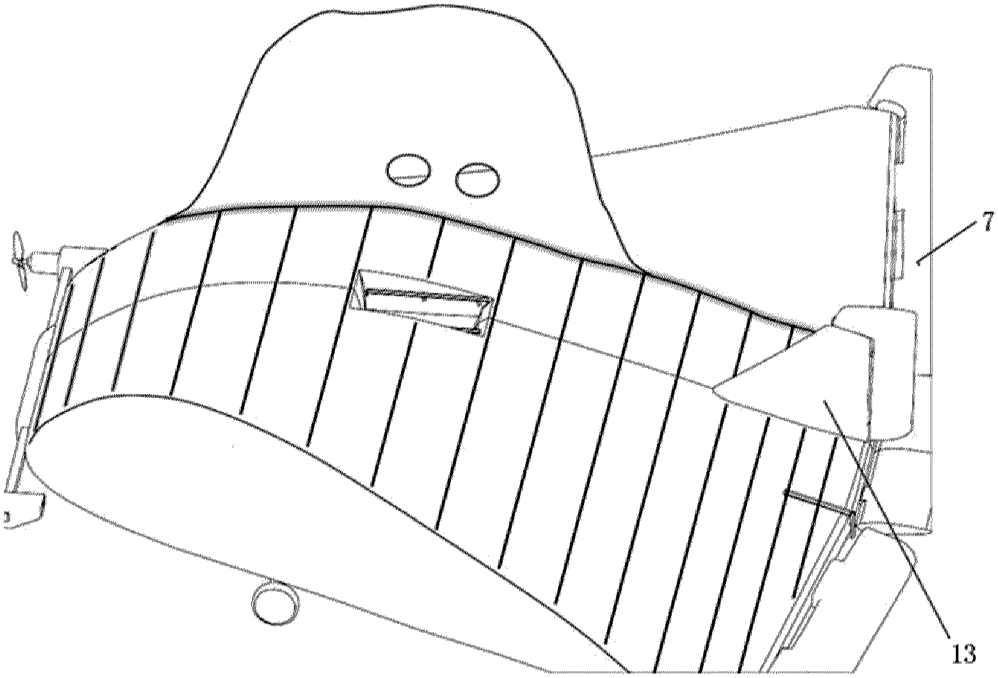

FIG. 9

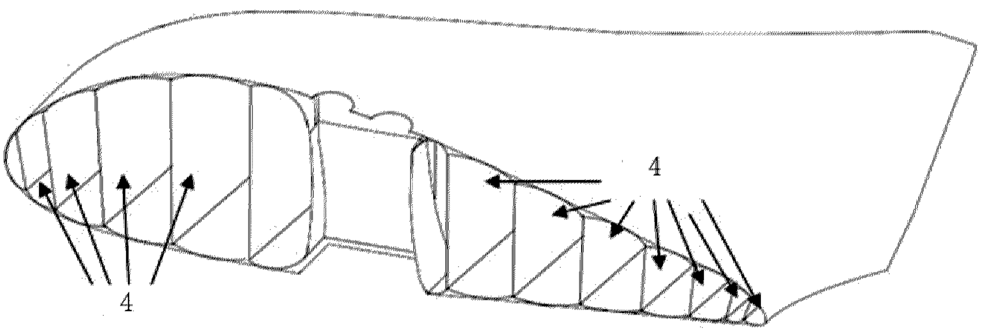

FIG. 10

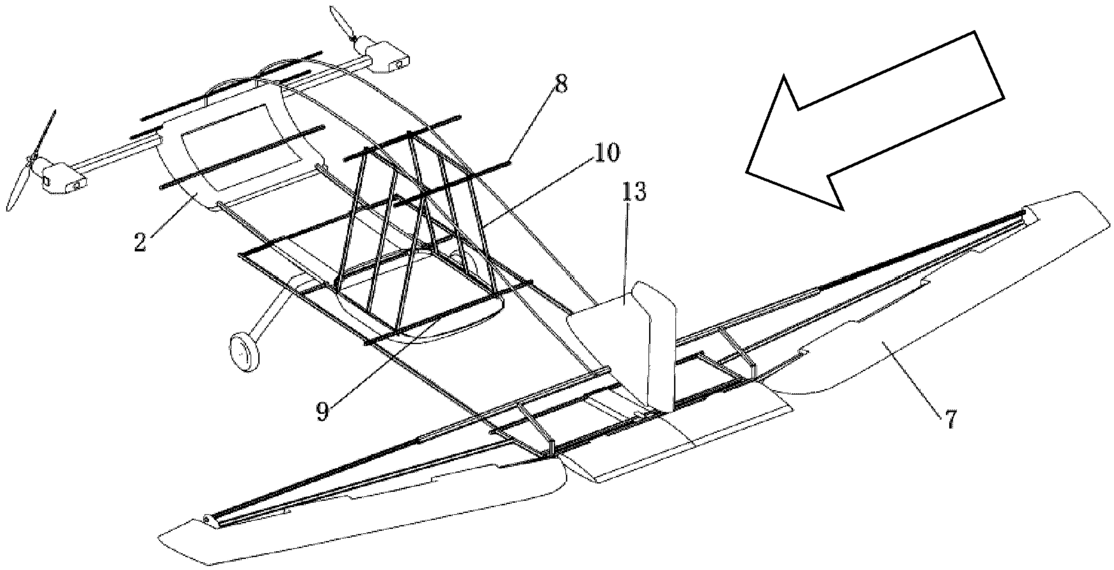

FIG. 11

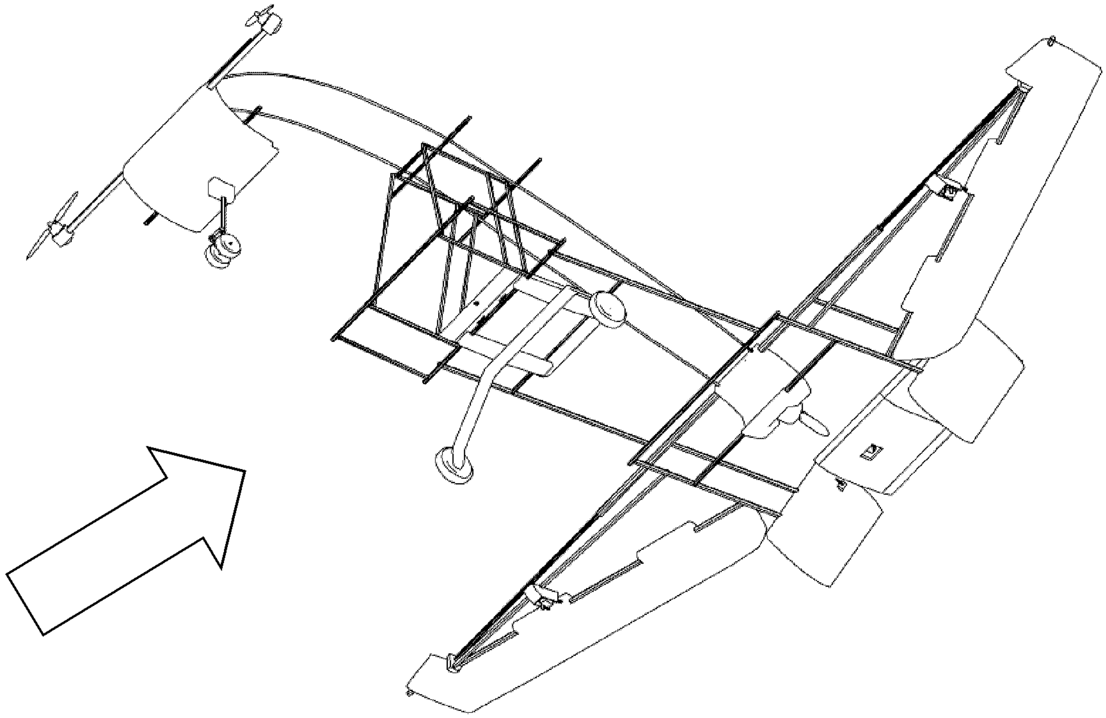

FIG. 12

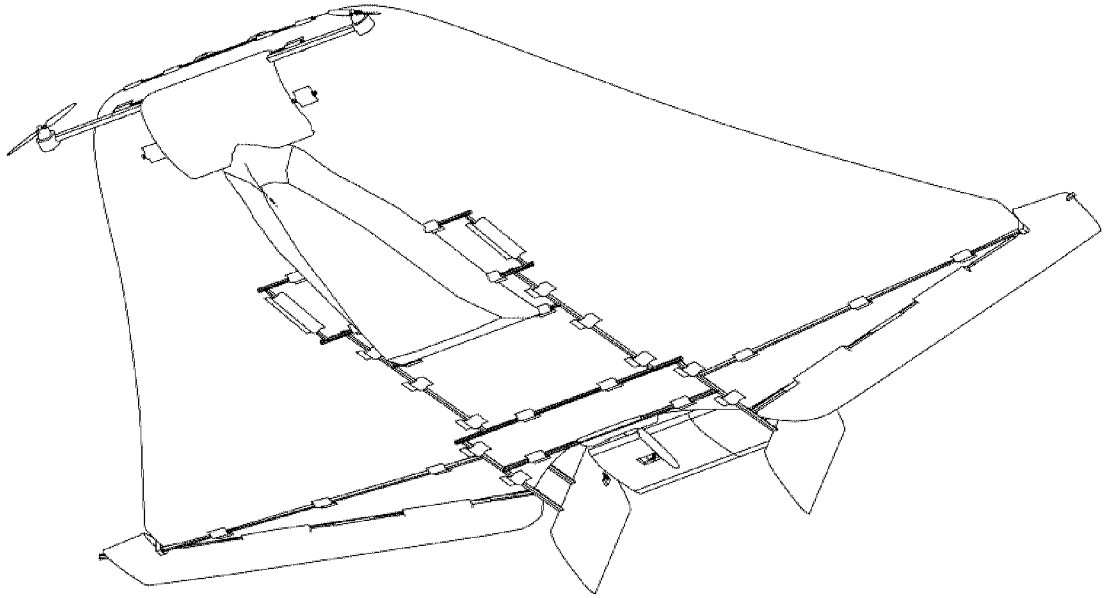

FIG. 13

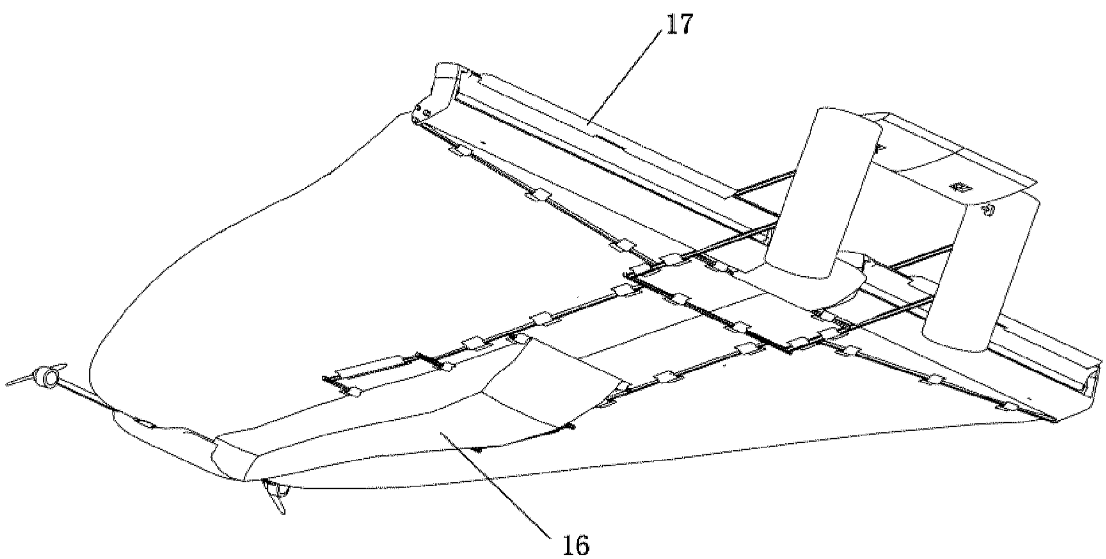

FIG. 14

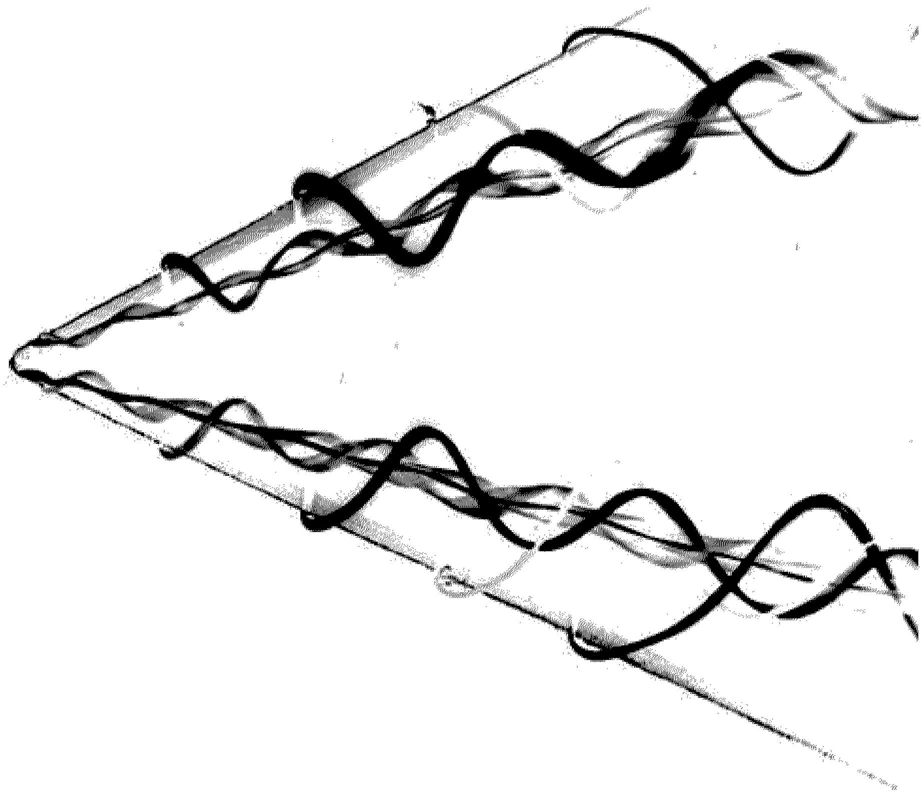

FIG. 15

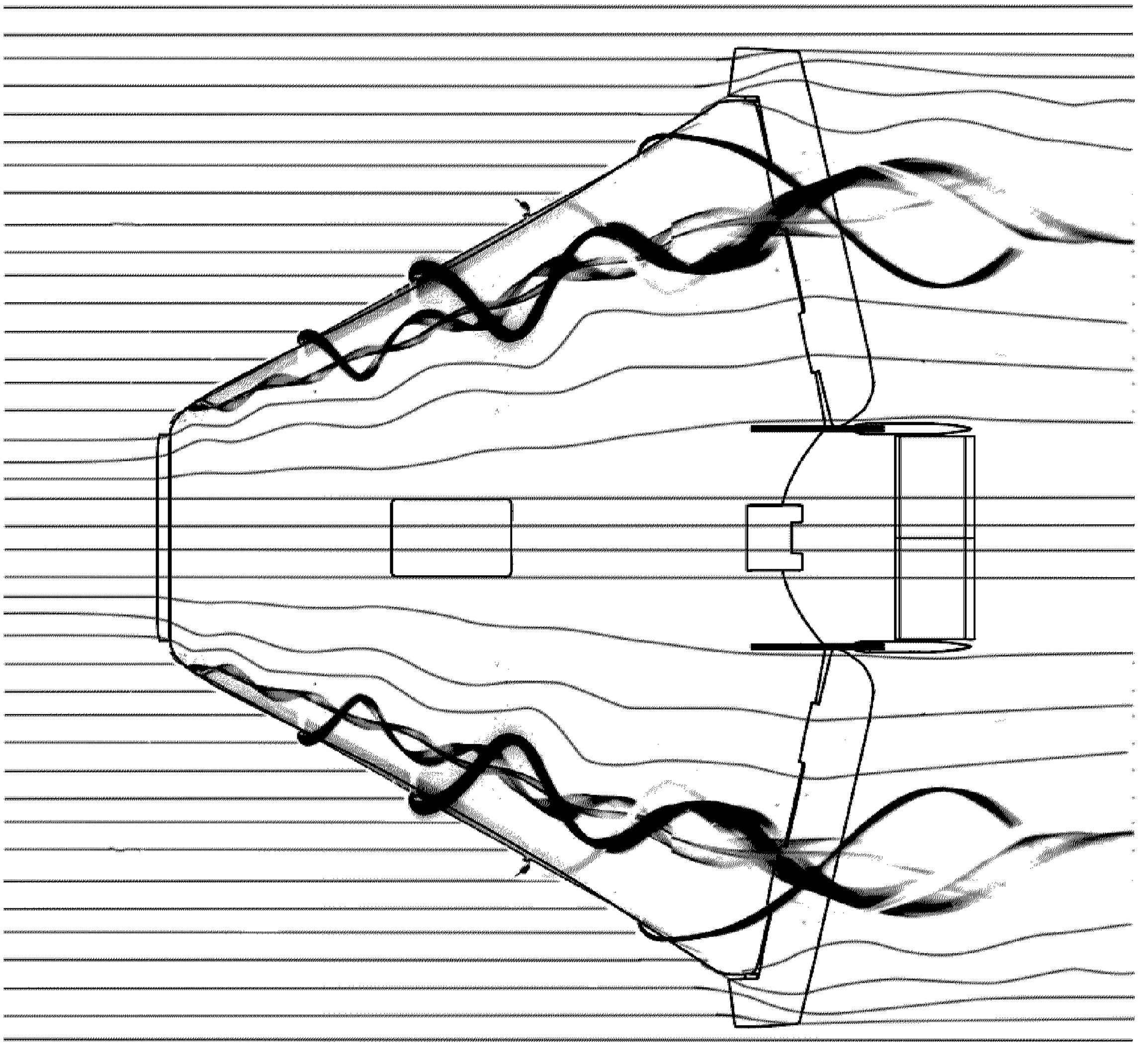

FIG. 16

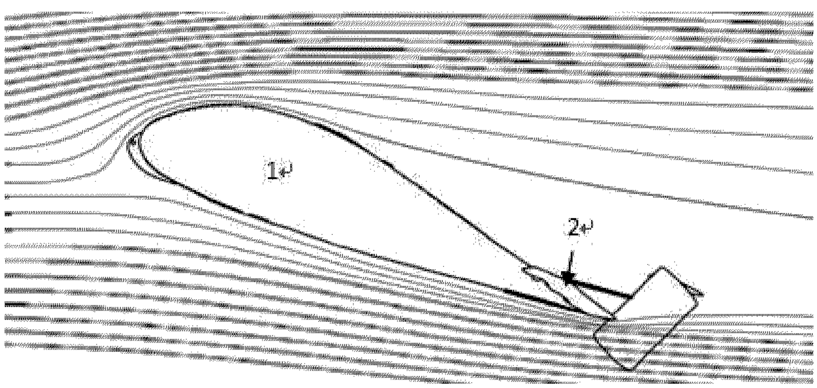

FIG. 17

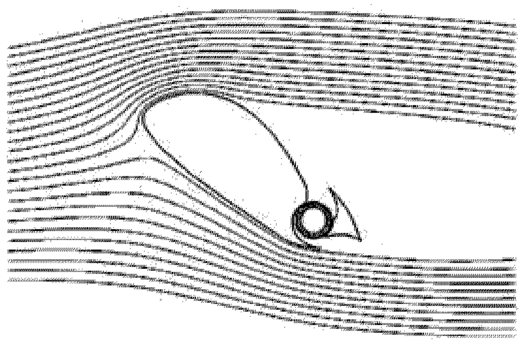

FIG. 18

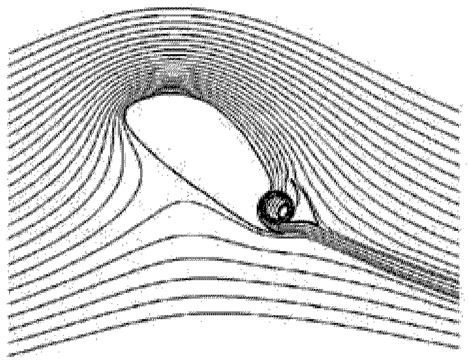

FIG. 19

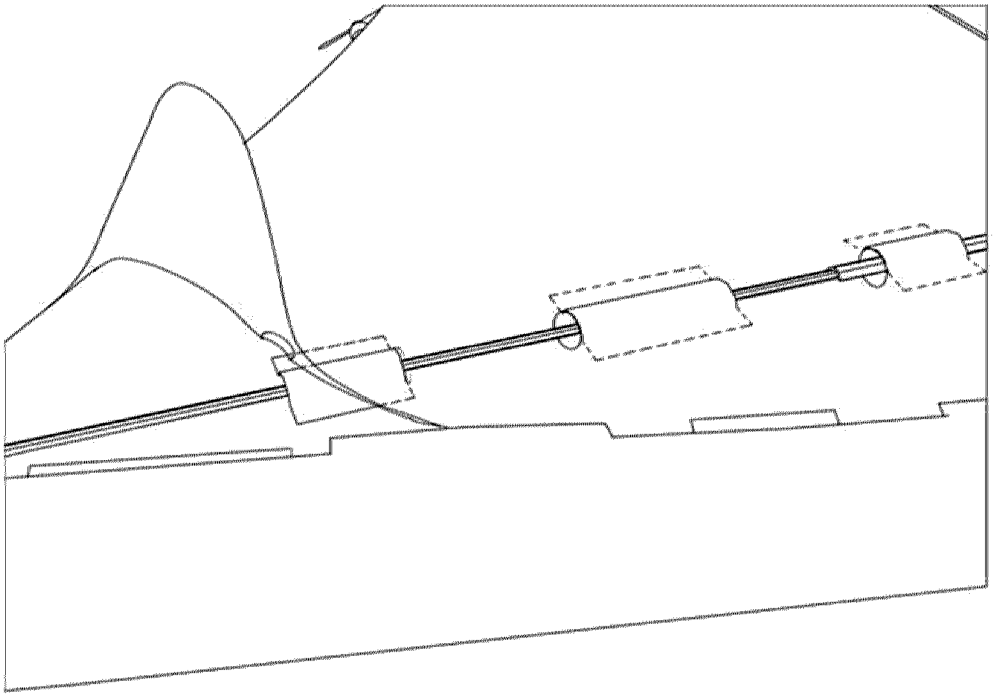

FIG. 20

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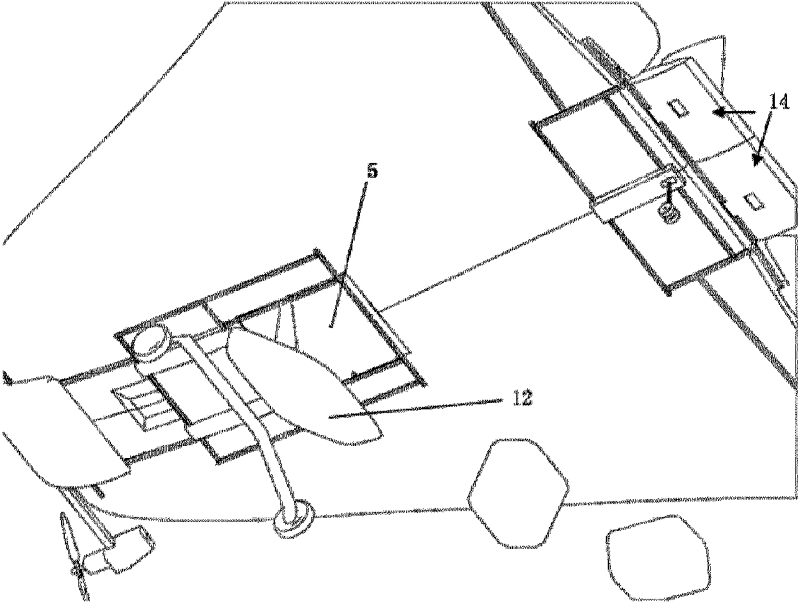

14
5
12