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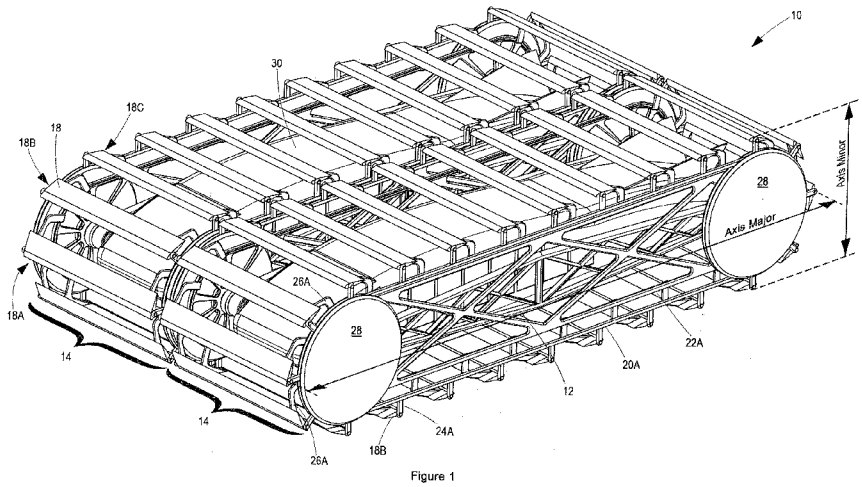


Figure 1

(57) Abstract: This invention relates to an aircraft. More specifically, the invention relates to vertical take-off and landing aircraft having a plurality of wings orbital in a substantially vertical operative plane. The aircraft includes an airframe, a primary closed loop guide, a secondary closed loop guide, a plurality of wings movable along the guides and a means for displacing leading and trailing edges of the wings thereby to vary the pitch of the wings such that the aircraft can be controlled.

AIRCRAFT

BACKGROUND OF THE INVENTION

THIS invention relates to an aircraft. More specifically, the invention relates to vertical take-off and landing aircraft having a plurality of wings orbital in a substantially vertical operative plane. It will be appreciated that although the patent specification describes an aircraft and a lift and propulsion system related thereto, that other crafts may also be fitted with such propulsion system. For example, a watercraft in the form of a submarine.

A few different types of vertical take-off and landing (VTOL) aircrafts having wings orbiting in an operative vertical plane are known. One such type was an airplane dubbed the "wingless craft" developed by Mr Bemus Johnston in the early 1900's. This airplane made use of orbiting fixed wings rotating on an endless belt. The disadvantages of this airplane, amongst others, were: (i) its use of non-symmetrical lifting section wings enabling generation of lift along only its operatively upper part; and (ii) the positioning of the wings within a fuselage thereby preventing the orbiting wings from thrusting the airplane forwardly.

Around the same era, a Professor F.K. Kirsten developed what was dubbed a "cyclocopter" making use of a cycloidal propeller configuration having symmetrical aerofoil section wings capable of generating both lift and thrust by orbiting wings about a flywheel of sorts. Although some thrust was generated by a lift force of the wings directed forwardly, much of the thrust was generated by stalled wings about an operatively lower orbital position of the wings, which in effect, pushed air backwardly to generate thrust much like a paddle is used to thrust a vessel through water under each paddle stroke. A disadvantage of the cycloidal propeller configuration is that with the operatively lower orbital position of the wings being placed in stall, lift is again generated only along an operatively upper part.

Another such type of VTOL aircraft is disclosed by IKESHIRO in US patent 7,344,106, which discloses a plurality of wings orbiting about a cabin of an aircraft within sets of tracks. Although it appears never to be the intention of the inventor, it is arguable that this patent discloses the ability of generating lift at operatively upper and lower parts.

Although this patent shows auxiliary propulsion or thrust means, it appears that at least a small amount of lift is generated at certain orbital position of the aircraft to create thrust. The disadvantage of this aircraft is that leading and trailing edges of the wings are forced to follow the same path about the cabin, thereby eliminating the ability for constantly varied pitch control of the wings.

It is therefore an object of the invention to provide a craft, more particularly an aircraft, that addresses the disadvantages of known prior art device.

SUMMARY OF THE INVENTION

According to the invention there is provided a craft including:

an airframe;

a primary closed loop guide;

a secondary closed loop guide, the primary and secondary guides being in use mounted substantially vertically on the airframe and substantially parallel to one another, wherein the guides comprise a shape having a major-to-minor axis ratio of at least 1.5:1;

a plurality of wings being movable along the guides, each wing comprising a leading edge and a trailing edge spanning substantially between two opposing terminal ends, the wings extending substantially perpendicularly from the guides and being movably connected near the leading edge to the primary guide and near the trailing edge to the secondary guide;

a means for displacing:

(i) the leading edge relative to the primary guide so as to shift the path of travel of the leading edge relative to the primary guide; and/or

(ii) the trailing edge relative to the secondary guide so as to shift the path of travel of the trailing edge relative to the secondary guide,

thereby to vary the pitch of the wings.

The shape of the guides may be elliptical- or oval-like. Alternatively, the shape of the guides may be oblong, having arcuate corners. In yet another alternative embodiment, the shape of the guides is oblong, having opposing linear major sides and opposing arcuate minor sides, the major sides being located at operatively upper and lower sides of the airframe respectively.

Generally, the craft includes a cabin contained within a length of the airframe, defined between a front end and a rear end thereof, and within a width of the airframe, defined between opposing sides of the craft extending substantially between the front and rear ends thereof. In use, orbital movement of the wings is substantially about the cabin in a direction from operatively top-to-front-to-bottom-to-rear-to-top generates lift at the top and the bottom orbital positions to enable the craft to fly, and is capable of generating lift at front and rear orbital positions to control the forward and reverse motion of the craft respectively.

Typically, the craft also includes a plurality of primary connectors, each being connected at or near one of the terminal ends of one the wings at one end, and connected to the primary guide at an opposite end. The primary connectors may be connected to the wing nearer the leading edge than to the trailing edge thereof with the wings being pivotable relative to the primary guide about a leading edge axis.

Preferably, the primary connectors are pivotally connected at or near the terminal ends of the wings, the leading edge axis passing centrally through the pivot connection. More preferably, the primary connectors are pivotally connected to the primary guide.

The craft may further include secondary connectors, each being connected at or near the same terminal end of the same wing as the respective primary connector at one end, and connected to the secondary guide at an opposite end. The secondary connectors may be connected to the wing nearer the trailing edge than to the leading edge thereof with the wings being pivotable relative to the secondary guide about a trailing edge axis.

Preferably, the secondary connectors are pivotally connected to the terminal ends of the wings, the trailing edge axis passing centrally through the pivot connection. More preferably, the secondary connectors are pivotally connected to the secondary guide.

The primary guide may be a chain, belt or like member passing over sprockets or pulleys, the sprockets or pulleys being connected to a primary drive means for imparting motion, through the sprockets or pulleys, to the chain, belt or like member.

The secondary guide may also be a chain, belt or like member passing over sprockets or pulleys, the sprockets or pulleys being connected to the primary drive means, or a independent secondary drive means, for imparting motion, through the sprockets or pulleys, to the chain, belt or like member.

In an alternative embodiment, the primary guide and the secondary guide are tracks, wherein the respective ends of the primary and secondary connectors connected to the tracks have runners movably captured along the tracks. In this alternative embodiment, one or more of the runners of the primary and/or secondary connectors may be driven along the track by a drive means.

Generally, the primary and secondary guides are located proximate one another and, together with the plurality of the primary and secondary connectors connected respectively thereto, to form a guide set.

The primary and secondary guides of each guide set may be located proximate one another. The primary and secondary guides of each guide set may be spaced laterally relative to one another along the width of the airframe. Alternatively, the primary and secondary guides of each guide set may be substantially co-planar with one another.

Preferably, one of the primary or secondary guides of each guide set is smaller in dimension than the other, the smaller guide being located substantially within the boundary of the larger guide.

The displacing means may be in the form of variable length primary and/or secondary connectors, the variation in the length of the primary and/or secondary connectors causing displacement of the leading edge and/or trailing edge relative to one or both guides, thereby enabling a controllable variation in the pitch of the wings. The length of the connectors may be variable as a result of the connectors, for example, being telescopic, in the form of scissor-hinges, in the form of bellow or any other means.

In a preferred alternative embodiment, the displacing means is in the form of movable primary and/or secondary guides, and further wherein movement of the primary and secondary guides relative to one another causes, through consequential movement of the primary and/or secondary connectors, displacement of the leading edge and/or trailing edge relative to one or both guides, thereby enabling a controllable variation in the pitch of the wings. More preferably, the primary and/or secondary guides are movable relative to one another in at least one plane.

Generally, one of the primary or secondary guides is movable linearly or on a curved path between operatively forward and back positions, top and bottom positions and/or any intermediate positions there between.

Typically, the craft includes at least a pair of guide sets across which the wings are supported, each of the wings being movably connected at one terminal end to one of the pair of guide sets and to the other of the pair of guide sets at the opposite terminal end, the pair of guide sets being spaced laterally relative to one another along the width of the airframe and jointly with the wings movably connected there-across form a wing assembly.

The craft may further include at least a pair of wing assemblies positioned adjacently or near one another across the width of the airframe, the wing assemblies being controllable in a synchronized and/or unsynchronized manner.

Generally, up, down, forward and/or reverse movement of the craft is enabled through synchronized control of each of the displacing means of each of the wing assemblies such that the pitch of the wings on each of the wing assemblies is settable to a common, mirrored pitch angle which results in the generation of the required lift, at the required orbital position, to in use move the craft in a desired up, down, forward and/or reverse direction. It will be appreciated that the lift generated is further controllable by increasing and/or decreased the speed of orbital movement of the wings on the wing assemblies.

Typically, left and/or right banking movement of the craft is enabled through unsynchronized control of each of the displacing means of each of the wing assemblies such that the pitch of the wings on each of the wing assemblies is settable to uncommon pitch angles, in use resulting in more lift being generated by one wing assembly as compared to the lift generated by the other of the wing assemblies, causing the craft to roll about a longitudinal axis passing between its front and rear ends and consequently causing the banking of the craft towards the left or the right.

The left and/or right movement may be further controllable by setting the orbital movement of the wings of each of the wing assemblies to different speeds, resulting in use more lift being generated by one wing assembly as compared to the lift generated by the other of the wing assemblies, causing the craft to roll about its the longitudinal axis and consequently causing the banking of the craft towards the left or the right.

Each of the wings may be a neutral aerofoil section that is symmetrical about a mean camber line passing through the leading and trailing edges thereof, the neutral aerofoil section wings enabling lift generation at both operatively upper and lower sides of the aircraft and as a result, vertical take-off and landing capabilities.

It will be appreciated that the craft may be an aircraft or a watercraft, such as a submarine.

According to a second aspect of the invention there is provided a wing assembly for a craft including:

at least one guide set having:

a primary closed loop guide; and

a secondary closed loop guide, the primary and secondary guides being in use orientated substantially vertically and substantially parallel to one another, wherein the guides comprise a shape having a major-to-minor axis ratio of at least 1.5:1;

a plurality of wings being movable along the guides, each wing comprising a leading edge and a trailing edge spanning substantially between two opposing terminal ends, the wings extending substantially perpendicularly from the guides and being movably connected near the leading edge to the primary guide and near the trailing edge to the secondary guide; and

a means for displacing:

(iii) the leading edge relative to the primary guide so as to shift the path of travel of the leading edge relative to the primary guide; and/or

(iv) the trailing edge relative to the secondary guide so as to shift the path of travel of the trailing edge relative to the secondary guide,

thereby to vary the pitch of the wings.

Preferably, the wing assembly comprises at least a pair of guide sets spaced apart from one another and across which the plurality of wings are movably supported.

The shape of the guides may be elliptical- or oval-like. Alternatively, the shape of the guides may be oblong, having arcuate corners. In yet another alternative embodiment,

the shape of the guides is oblong, having opposing linear major sides and opposing arcuate minor sides, the major sides being located at operatively upper and lower sides of the airframe respectively.

In use, orbital movement of the wings along the guides may be directed in an operatively top-to-front-to-bottom-to-rear-to-top direction so as to generate lift at the operatively top and bottom orbital positions to enable a craft to which the wing assembly is in use mountable to fly, and further wherein lift generated by the wing assembly at the operatively front and rear orbital positions enables forward and reverse motion of the craft respectively.

Generally, the wing assembly includes a plurality of primary connectors, each being connected at or near one of the terminal ends of one the wings at one end, and connected to the primary guide at an opposite end. The primary connectors may be connected to the wing nearer the leading edge than to the trailing edge thereof with the wings being pivotable relative to the primary guide about a leading edge axis. Preferably, the primary connectors are pivotally connected at or near the terminal ends of the wings, the leading edge axis passing centrally through the pivot connection. More preferably, the primary connectors are pivotally connected to the primary guide.

Typically, the wing assembly includes a plurality of secondary connectors, each being connected at or near the same terminal end of the same wing as the respective primary connector at one end, and connected to the secondary guide at an opposite end. The secondary connectors may be connected to the wing nearer the trailing edge than to the leading edge thereof with the wings being pivotable relative to the secondary guide about a trailing edge axis. Preferably, the secondary connectors are pivotally connected to the terminal ends of the wings, the trailing edge axis passing centrally through the pivot connection. More preferably, the secondary connectors are pivotally connected to the secondary guide.

The primary guide may be a chain, belt or like member passing over sprockets or pulleys, the sprockets or pulleys being connected to a primary drive means for imparting motion, through the sprockets or pulleys, to the chain, belt or like member.

The secondary guide may be a chain, belt or like member passing over sprockets or pulleys, the sprockets or pulleys being connected to the primary drive means, or a independent secondary drive means, for imparting motion, through the sprockets or pulleys, to the chain, belt or like member.

Alternatively, the primary and secondary guides are tracks, the ends of each of the primary and secondary connectors connected to the tracks having runners movably captured along the respective track. Generally, one or more of the runners of the primary and/or secondary connectors are driven along the track by a drive means.

Typically, the primary and secondary guides are located proximate one another and, together with the plurality of the primary and secondary connectors connected respectively thereto, form the guide set.

The primary and secondary guides of each guide set may be located proximate one another. Furthermore, the primary and secondary guides of each guide set may be spaced laterally relative to one another along the width of the airframe. Alternatively, the primary and secondary guides of each guide set are substantially co-planar with one another.

In a preferred embodiment, one of the primary or secondary guides of each guide set may be smaller in dimension than the other, the smaller guide being located substantially within the boundary of the larger guide.

The displacing means may be in the form of variable length primary and/or secondary connectors, the variation in the length of the primary and/or secondary connectors causing displacement of the leading edge and/or trailing edge relative to one or both guides, thereby enabling a controllable variation in the pitch of the wings.

Alternatively, the displacing means may be in the form of movable primary and/or secondary guides, and further wherein movement of the primary and secondary guides relative to one another causes, through consequential movement of the primary and/or secondary connectors, displacement of the leading edge and/or trailing edge relative to one or both guides, thereby enabling a controllable variation in the pitch of the wings.

Generally, the primary and/or secondary guides are movable relative to one another in at least one plane. Typically, one of the primary or secondary guides is movable linearly or on a curved path between operatively forward and back positions, top and bottom positions and/or any intermediate positions there between.

Preferably, each of the wings has a neutral aerofoil section that is symmetrical about a mean camber line passing through the leading and trailing edges thereof, the neutral aerofoil section wings enabling lift generation at both the operatively top and bottom orbital positions, thereby enabling vertical take-off and landing capabilities of the craft to which the wing assembly is mountable.

It will be appreciated that the wing assembly, and consequently the craft to which one or more wing assemblies are in use mountable, is controllable by having pilot controls for controlling orbital speed and the displacing means.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will now be described in more detail, by way of example only, with reference to the accompanying drawings in which:

Figure 1 is a perspective view of an aircraft in accordance with the present invention;

Figure 2 is a perspective view of a wing assembly of the aircraft of figure 1;

Figure 3 is a side view of the wing assembly of figure 2 orientated in a first position; and

Figure 4 is a side view of the wing assembly of figure 2 orientated in a second position.

DETAILED DESCRIPTION OF THE DRAWINGS

An aircraft according to a preferred embodiment of the invention is designated generally in Figure 1 with reference numeral 10. The aircraft 10 comprises an airframe 12 and a pair of wing assemblies 14, each having a plurality of wings movable thereabout to provide lift, propulsion and directional control.

Although the aircraft 10 is referred to herein, it will be appreciated that the wing assemblies 14 may be applied to any craft, for example, a submarine. It will be appreciated further that although the illustrations show the aircraft 10 with a pair of wing assemblies 14, any number of wing assemblies may be applied to the aircraft 10.

With reference now also to Figure 2, each wing assembly 14 includes a pair of guide sets 16 across which a plurality of wings 18 are supported across such that the wings 18 are substantially perpendicular to the guide sets 16. To provide the wings 18 with sufficient travel to generate lift, it is preferable that the wing assemblies have a major axis-to-minor axis ratio ($AXIS_{major}$: $AXIS_{minor}$) of at least 1.5 : 1. Although the wing assemblies may take many shapes, it is preferably that the shape is oblong having substantially linear opposing major side and arcuate opposing minor sides as illustrated in the accompanying figures.

Although a pair of guide sets is illustrated in the accompanying figures, it will be appreciated that the pair of guide sets may be substituted by a single guide set with cantilevered wings supported therefrom.

Each guide set 16 comprises a primary closed loop guide 20A,20B and a secondary closed loop guide 22A,22B typically mounted on the airframe in close proximity with respect to one another and such that in use, the primary and second closed loop guides 20A,20B,22A,22B are substantially vertical and parallel with respect to one another.

Each of the wings 18 are movable along the guides 20A,20B,22A,22B, riding on primary connectors 24A,24B and secondary connectors 26A,26B supported in or on the primary and second closed loop guides 20A,20B,22A,22B respectively.

The primary connectors 24A,24B are connected at one end towards a leading edge 18A of the wing 18 and at an opposite end to the primary closed loop guide 20A,20B. The ends of the primary connectors 24A,24B are pivotally connected at each opposing terminal end 18B of the wings 18 such that the wings are pivotal relative to the primary connectors 24A,24B about a leading edge axis (not shown).

Similarly, the secondary connectors 26A,26B are connected at one end towards a trailing edge 18C of the wing 18 and at an opposite end to the secondary closed loop guide 22A,22B. The ends of the secondary connectors 26A,26B are pivotally connected at the opposing terminal ends 18B of the wings 18 such that the wings are pivotal relative to the secondary connectors 26A,26B about a trailing edge axis (not shown).

It will be appreciated that it is the fact that the wings 18 are pivotal relative to the connectors 24A,24B,26A,26B and the guides 20A,20B,22A,22B rather than how they are pivotal. For example, instead of being pivotal, the wings could be supported on the connectors on a flexural joint allowing sufficient flex to enable pivotal movement. Also, the pivotal connections between the connectors and the wings could in fact be supplemented, or altogether replaced, by pivotal connections at opposite ends of the connectors, i.e. between the connectors and the guides.

Furthermore, the guides 20A,20B,22A,22B may take many different forms. In the preferred embodiment illustrated in the accompanying figures, the primary guide 20A,20B is a closed loop length of belt or chain movably support about pulleys 28. The secondary guide 20A,20B is preferably a closed loop track along which the respective ends of the secondary connectors 26A,26B are movable, for example, on runners movably captured within the track.

The aircraft 10 may be configured such that a drive means (not shown) drives the primary connectors 24A,24B and/or the secondary connectors 26A,26B. In the preferred embodiment, the drive means drives one or more of the pulleys 28, thereby transmitting drive to the primary 24A,24B and, as a result of being indirectly connected to the secondary connectors 26A,26B through the wings 18, causing the secondary connectors 26A,26B to be pulled along the tracks 20A,20B.

The aircraft 10 further includes a means of displacing the wings 18. More particularly, the displacing means causes displacement of the leading edges 18A of the wings 18 relative to the primary guide 20A,20B and displacement of the trailing edges 18C of the wings 18 relative to the second guide 22A,22B so as to shift the path of travel of the leading and trailing edges about the guides, thereby enabling a pilot to vary the pitch of the wings.

More specifically, and with reference now to figures 3 and 4, the displacing means is, together with corresponding co-operation with other components described herein, the ability of the secondary guides or tracks 22A,22B to move relative to the primary guides or belt/chain 20A,20B. Movement of the secondary guides or tracks 22A,22B relative to the primary guides or belt/chain 20A,20B pulls and/or pushes the trailing edge 18C of the wings 18 closer to and/or further away from the primary guides or belt/chain 20A,20B. By doing so the pitch of the wings 18 is variable. It will be appreciated that the secondary guides or tracks 22A,22B is akin to a swash plate on a helicopter.

Referring now to figure 3, with the secondary guides or tracks 22A,22B moved upwardly "U" and forwardly "F" relative to the primary guides or belt/chain 20A,20B, the wings 18 are pitched such a downward "lift" force is generated by the wings 18 in both the upper forward path P_F and lower reverse path P_R of the orbital movement of the wings 18 about the primary and second guides so as to cause the aircraft 10 to fall in a controlled fashion. Furthermore, the wings 18, as they rise and pass over the rearward pulley 28, generate greater lift than the wings 18 falling and passing over the forward pulley 28, thereby generating a propulsion force in a reverse direction "R".

Similarly, and with reference now to figure 4, the secondary guides or tracks 22A,22B are movable downwardly "D" and rearward "R" relative to the primary guides or belt/chain 20A,20B causing the pitch of the wings 18 to vary. At this pitch, the wings 18 generate an upward lift force in both the upper forward path P_F and lower reverse path P_R of the orbital movement of the wings 18 so as to cause the aircraft 10 to rise in a controlled fashion. Furthermore, the wings 18, as they fall and pass over the forward pulley 28, generate greater lift than the wings 18 rising and passing over the rearward pulley 28, thereby generating a propulsion force in a forward direction "R".

As a result, pilot control of the pitch of the wings 18 through control of the movement of the secondary guides or tracks 22A,22B relative to the primary guides or belt/chain 20A,20B enables the pilot to control upward, downward, forward and rearward direction of the aircraft 10. It will be appreciated that it is not necessary that the secondary guides or tracks 22A,22B are movable relative to the primary guides or belt/chain 20A,20B as illustrated in the preferred embodiment, just that the secondary guides or tracks 22A,22B and the primary guides or belt/chain 20A,20B are movable relative to one another.

Turning now also to Figure 1, it will be appreciated that the aircraft 10 will roll about its longitudinal axis, that is the axis passing centrally through the operative front and rear ends of the aircraft 10, by setting the pitch of the wings 18 differently on each of the pair of wing assemblies 14. Aircraft roll causes the aircraft 10 to bank either to the left or to the right. As such, the pilot can further steer the aircraft 10 by controlling the same wings used to provide lift and forward-reverse propulsion.

It is envisaged that a cabin and/or cockpit 30 will be contained within the airframe 12 from which a pilot may control the aircraft 10. To generate lift along both the upper forward and lower reverse paths P_F, P_R it is preferably that the wings 18 are neutral aerofoil sections, symmetrical about a mean camber line passing through the leading and trailing edges 18A,18C.

With the wings 18 configured as described herein, the aircraft is capable of taking off and/or landing vertically. Although lift, propulsion and banking is controlled mainly by the pitch of the wings 18, directional control is further enabled by varying the orbital speed of the wings 18 about the primary and secondary guides.

Although the invention has been described above with reference to preferred embodiments, it will be appreciated that many modifications or variations of the invention are possible without departing from the spirit or scope of the invention. For example, the displacing means may be in the form of variable length primary and/or secondary connectors rather than displaceable primary and secondary guides. It will be appreciated further that the invention extends to the wing assemblies 14 and guide sets 16 independently of being mounted to a craft.

CLAIMS

1. A craft including:

an airframe;

a primary closed loop guide;

a secondary closed loop guide, the primary and secondary guides being in use mounted substantially vertically on the airframe and substantially parallel to one another, wherein the guides comprise a shape having a major-to-minor axis ratio of at least 1.5:1;

a plurality of wings being movable along the guides, each wing comprising a leading edge and a trailing edge spanning substantially between two opposing terminal ends, the wings extending substantially perpendicularly from the guides and being movably connected near the leading edge to the primary guide and near the trailing edge to the secondary guide;

a means for displacing:

(i) the leading edge relative to the primary guide so as to shift the path of travel of the leading edge relative to the primary guide; and/or

(ii) the trailing edge relative to the secondary guide so as to shift the path of travel of the trailing edge relative to the secondary guide,

thereby to vary the pitch of the wings.

2. A craft according to claim 1, wherein the shape of the guides is elliptical- or oval-like.

3. A craft according to claim 1, wherein the shape of the guides is oblong, having arcuate corners.

4. A craft according to claim 1, wherein the shape of the guides is oblong, having opposing linear major sides and opposing arcuate minor sides, the major sides being located at operatively upper and lower sides of the airframe respectively.

5. A craft according to any one of claims 1 to 4, including a cabin contained within a length of the airframe, defined between a front end and a rear end thereof, and within a width of the airframe, defined between opposing sides of the craft extending substantially between the front and rear ends thereof, wherein in use, orbital movement of the wings substantially about the cabin in a direction from operatively top-to-front-to-bottom-to-rear-to-top generates lift at the top and the bottom orbital positions to enable the craft to fly, and is capable of generating lift at front and rear orbital positions to control the forward and reverse motion of the craft respectively.

6. A craft according to claim 5, including a plurality of primary connectors, each being connected at or near one of the terminal ends of one the wings at one end, and connected to the primary guide at an opposite end, the primary connectors being connected to the wing nearer the leading edge than to the trailing edge thereof with the wings being pivotable relative to the primary guide about a leading edge axis.

7. A craft according to claim 6, wherein the primary connectors are pivotally connected at or near the terminal ends of the wings, the leading edge axis passing centrally through the pivot connection.

8. A craft according to claim 6 or claim 7, wherein the primary connectors are pivotally connected to the primary guide.

9. A craft according to claim 6, claim 7 or claim 8, including a plurality of secondary connectors, each being connected at or near the same terminal end of the same wing as the respective primary connector at one end, and connected to the secondary guide at an opposite end, the secondary connectors being connected to

the wing nearer the trailing edge than to the leading edge thereof with the wings being pivotable relative to the secondary guide about a trailing edge axis.

10. A craft according to claim 9, wherein the secondary connectors are pivotally connected to the terminal ends of the wings, the trailing edge axis passing centrally through the pivot connection.

11. A craft according to claim 9 or claim 10, wherein the secondary connectors are pivotally connected to the secondary guide.

12. A craft according to claim 11, wherein the primary guide is a chain, belt or like member passing over sprockets or pulleys, the sprockets or pulleys being connected to a primary drive means for imparting motion, through the sprockets or pulleys, to the chain, belt or like member.

13. A craft according to claim 11 or claim 12, wherein the secondary guide is a chain, belt or like member passing over sprockets or pulleys, the sprockets or pulleys being connected to the primary drive means, or a independent secondary drive means, for imparting motion, through the sprockets or pulleys, to the chain, belt or like member.

14. A craft according to claim 11, wherein the primary guide is a track, the ends of each of the primary connectors connected to the track having a runner movably captured along the track.

15. A craft according to claim 11 or claim 14, wherein the secondary guide is a track, the ends of each of the secondary connectors connected to the track having a runner movably captured along the track.

16. A craft according to claim 14 or claim 15, wherein one or more of the runners of the primary and/or secondary connectors are driven along the track by a drive means.

17. A craft according to any one of claims 13 to 16, wherein the primary and secondary guides are located proximate one another and, together with the plurality of the

primary and secondary connectors connected respectively thereto, form a guide set.

18. A craft according to claim 17, wherein the primary and secondary guides of each guide set are located proximate one another.

19. A craft according to claim 18, wherein the primary and secondary guides of each guide set are spaced laterally relative to one another along the width of the airframe.

20. A craft according to claim 18, wherein the primary and secondary guides of each guide set are substantially co-planar with one another.

21. A craft according to claim 19 or claim 20, wherein one of the primary or secondary guides of each guide set is smaller in dimension than the other, the smaller guide being located substantially within the boundary of the larger guide.

22. A craft according to any one of claims 18 to 21, wherein the displacing means is in the form of variable length primary and/or secondary connectors, the variation in the length of the primary and/or secondary connectors causing displacement of the leading edge and/or trailing edge relative to one or both guides, thereby enabling a controllable variation in the pitch of the wings.

23. A craft according to any one of claims 18 to 21, wherein the displacing means is in the form of movable primary and/or secondary guides, and further wherein movement of the primary and secondary guides relative to one another causes, through consequential movement of the primary and/or secondary connectors, displacement of the leading edge and/or trailing edge relative to one or both guides, thereby enabling a controllable variation in the pitch of the wings.

24. A craft according to claim 23, wherein the primary and/or secondary guides are movable relative to one another in at least one plane.

25. A craft according to claim 24, wherein one of the primary or secondary guides is movable linearly or on a curved path between operatively forward and back positions, top and bottom positions and/or any intermediate positions there between.

26. A craft according to any one of claims 22 to 25, wherein the craft includes at least a pair of guide sets across which the wings are supported, each of the wings being movably connected at one terminal end to one of the pair of guide sets and to the other of the pair of guide sets at the opposite terminal end, the pair of guide sets being spaced laterally relative to one another along the width of the airframe and jointly with the wings movably connected there-across form a wing assembly.

27. A craft according to claim 26, wherein the craft includes at least a pair of wing assemblies positioned adjacently or near one another across the width of the airframe, the wing assemblies being controllable in a synchronized and/or unsynchronized manner.

28. A craft according to claim 27, wherein up, down, forward and/or reverse movement of the craft is enabled through synchronized control of each of the displacing means of each of the wing assemblies such that the pitch of the wings on each of the wing assemblies is settable to a common, mirrored pitch angle which results in the generation of the required lift, at the required orbital position, to in use move the craft in a desired up, down, forward and/or reverse direction.

29. A craft according to claim 28, wherein the lift generated is further controllable by increasing and/or decreased the speed of orbital movement of the wings on the wing assemblies.

30. A craft according to claim 27 or claim 28, wherein left and/or right banking movement of the craft is enabled through unsynchronized control of each of the displacing means of each of the wing assemblies such that the pitch of the wings on each of the wing assemblies is settable to uncommon pitch angles, in use resulting in more lift being generated by one wing assembly as compared to the lift generated by the other of the wing assemblies, causing the craft to roll about a

longitudinal axis passing between its front and rear ends and consequently causing the banking of the craft towards the left or the right.

31. A craft according to claim 30, wherein left and/or right movement is further controllable by setting the orbital movement of the wings of each of the wing assemblies to different speeds, resulting in use more lift being generated by one wing assembly as compared to the lift generated by the other of the wing assemblies, causing the craft to roll about its the longitudinal axis and consequently causing the banking of the craft towards the left or the right.

32. A craft according to any one of the preceding claims, wherein each of the wings has a neutral aerofoil section that is symmetrical about a mean camber line passing through the leading and trailing edges thereof, the neutral aerofoil section wings enabling lift generation at both operatively upper and lower sides of the aircraft and as a result, vertical take-off and landing capabilities.

33. A craft according to any one of the preceding claims, wherein the craft is an aircraft or a watercraft.

34. A wing assembly for a craft including:

at least one guide set having:

a primary closed loop guide; and

a secondary closed loop guide, the primary and secondary guides being in use orientated substantially vertically and substantially parallel to one another, wherein the guides comprise a shape having a major-to-minor axis ratio of at least 1.5:1;

a plurality of wings being movable along the guides, each wing comprising a leading edge and a trailing edge spanning substantially between two opposing terminal ends, the wings extending substantially perpendicularly from the

guides and being movably connected near the leading edge to the primary guide and near the trailing edge to the secondary guide; and

a means for displacing:

(iii) the leading edge relative to the primary guide so as to shift the path of travel of the leading edge relative to the primary guide; and/or

(iv) the trailing edge relative to the secondary guide so as to shift the path of travel of the trailing edge relative to the secondary guide,

thereby to vary the pitch of the wings.

35. A wing assembly according to claim 34, wherein the wing assembly comprises at least a pair of guide sets spaced apart from one another and across which the plurality of wings are movably supported.

36. A wing assembly according to claim 34 or claim 35, wherein the shape of the guides is elliptical- or oval-like.

37. A wing assembly according to claim 34 or claim 35, wherein the shape of the guides is oblong, having arcuate corners.

38. A wing assembly according to claim 34 or claim 35, wherein the shape of the guides is oblong, having opposing linear major sides and opposing arcuate minor sides, the major sides being located at operatively upper and lower sides of the airframe respectively.

39. A wing assembly according to any one of claims 34 to 38, wherein in use, orbital movement of the wings along the guides is directed in an operatively top-to-front-to-bottom-to-rear-to-top direction so as to generate lift at the operatively top and bottom orbital positions to enable a craft to which the wing assembly is in use mountable to fly, and further wherein lift generated by the wing assembly at the

operatively front and rear orbital positions enables forward and reverse motion of the craft respectively.

40. A wing assembly for a craft according to claim 39, including a plurality of primary connectors, each being connected at or near one of the terminal ends of one the wings at one end, and connected to the primary guide at an opposite end, the primary connectors being connected to the wing nearer the leading edge than to the trailing edge thereof with the wings being pivotable relative to the primary guide about a leading edge axis.

41. A wing assembly according to claim 40, wherein the primary connectors are pivotally connected at or near the terminal ends of the wings, the leading edge axis passing centrally through the pivot connection.

42. A wing assembly according to claim 41, wherein the primary connectors are pivotally connected to the primary guide.

43. A wing assembly according to claim 40, claim 41 or claim 42, including a plurality of secondary connectors, each being connected at or near the same terminal end of the same wing as the respective primary connector at one end, and connected to the secondary guide at an opposite end, the secondary connectors being connected to the wing nearer the trailing edge than to the leading edge thereof with the wings being pivotable relative to the secondary guide about a trailing edge axis.

44. A wing assembly according to claim 43, wherein the secondary connectors are pivotally connected to the terminal ends of the wings, the trailing edge axis passing centrally through the pivot connection.

45. A wing assembly according to claim 43 or claim 44, wherein the secondary connectors are pivotally connected to the secondary guide.

46. A wing assembly according to claim 45, wherein the primary guide is a chain, belt or like member passing over sprockets or pulleys, the sprockets or pulleys being

connected to a primary drive means for imparting motion, through the sprockets or pulleys, to the chain, belt or like member.

47. A wing assembly according to claim 45 or claim 46, wherein the secondary guide is a chain, belt or like member passing over sprockets or pulleys, the sprockets or pulleys being connected to the primary drive means, or a independent secondary drive means, for imparting motion, through the sprockets or pulleys, to the chain, belt or like member.

48. A wing assembly according to claim 45, wherein the primary guide is a track, the ends of each of the primary connectors connected to the track having a runner movably captured along the track.

49. A wing assembly according to claim 45 or claim 46, wherein the secondary guide is a track, the ends of each of the secondary connectors connected to the track having a runner movably captured along the track.

50. A wing assembly according to claim 48 or claim 49, wherein one or more of the runners of the primary and/or secondary connectors are driven along the track by a drive means.

51. A wing assembly according to any one of claims 46 to 50, wherein the primary and secondary guides are located proximate one another and, together with the plurality of the primary and secondary connectors connected respectively thereto, form the guide set.

52. A wing assembly according to claim 51, wherein the primary and secondary guides of each guide set are located proximate one another.

53. A wing assembly according to claim 52, wherein the primary and secondary guides of each guide set are spaced laterally relative to one another along the width of the airframe.

54. A wing assembly according to claim 52, wherein the primary and secondary guides of each guide set are substantially co-planar with one another.

55. A wing assembly according to claim 53 or claim 54, wherein one of the primary or secondary guides of each guide set is smaller in dimension than the other, the smaller guide being located substantially within the boundary of the larger guide.

56. A wing assembly according to any one of claims 52 to 55, wherein the displacing means is in the form of variable length primary and/or secondary connectors, the variation in the length of the primary and/or secondary connectors causing displacement of the leading edge and/or trailing edge relative to one or both guides, thereby enabling a controllable variation in the pitch of the wings.

57. A wing assembly according to any one of claims 52 to 55, wherein the displacing means is in the form of movable primary and/or secondary guides, and further wherein movement of the primary and secondary guides relative to one another causes, through consequential movement of the primary and/or secondary connectors, displacement of the leading edge and/or trailing edge relative to one or both guides, thereby enabling a controllable variation in the pitch of the wings.

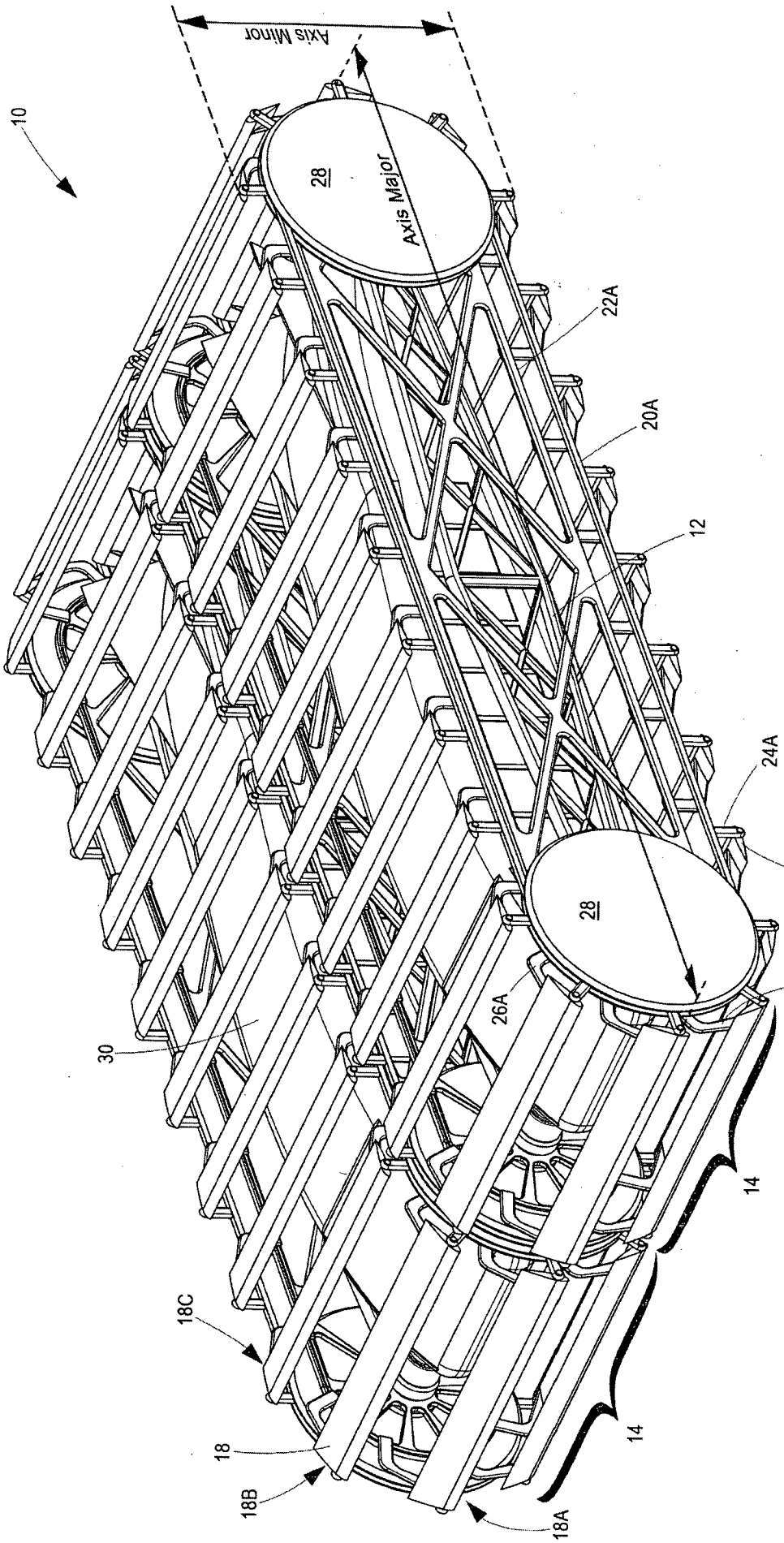
58. A wing assembly according to claim 57, wherein the primary and/or secondary guides are movable relative to one another in at least one plane.

59. A wing assembly according to claim 58, wherein one of the primary or secondary guides is movable linearly or on a curved path between operatively forward and back positions, top and bottom positions and/or any intermediate positions there between.

60. A wing assembly according to any one of claims 34 to 59, wherein each of the wings has a neutral aerofoil section that is symmetrical about a mean camber line passing through the leading and trailing edges thereof, the neutral aerofoil section wings enabling lift generation at both the operatively top and bottom orbital positions, thereby enabling vertical take-off and landing capabilities of the craft to which the wing assembly is mountable.

61. A craft according to any one of claims 1 to 33, having pilot controls for controlling orbital speed and the displacing means.

62. A wing assembly according to any one of claims 34 to 60, having pilot controls for controlling orbital speed and the displacing means.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Axis Major
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18B
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14
14

Figure 1

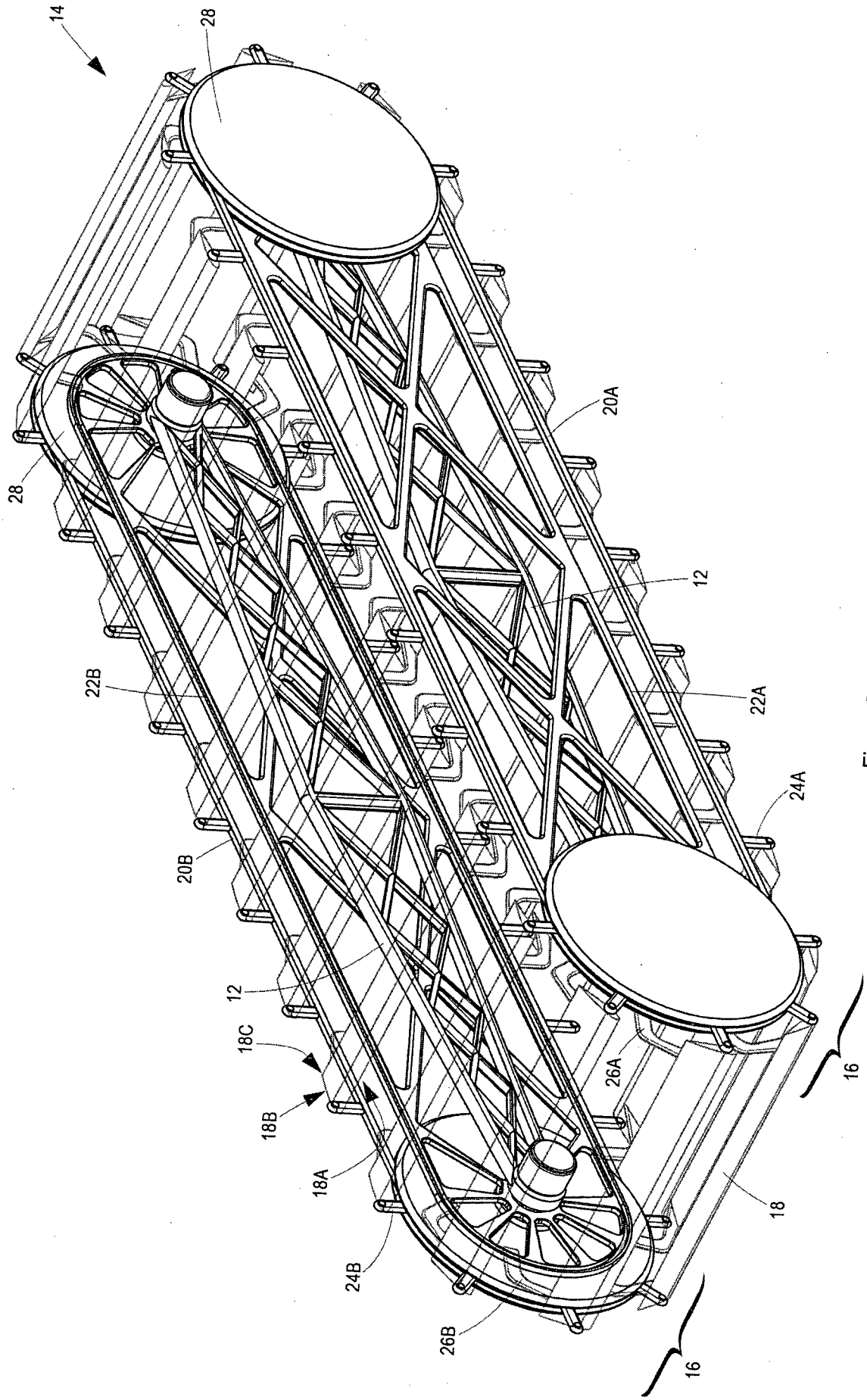

Figure 2

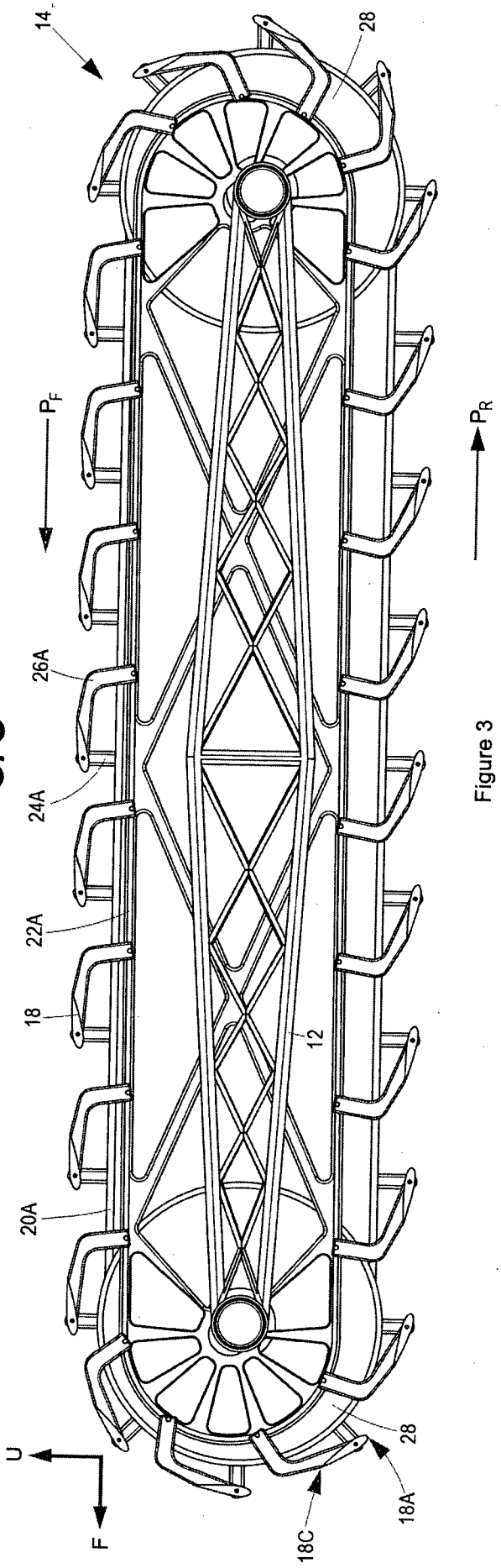

Figure 3

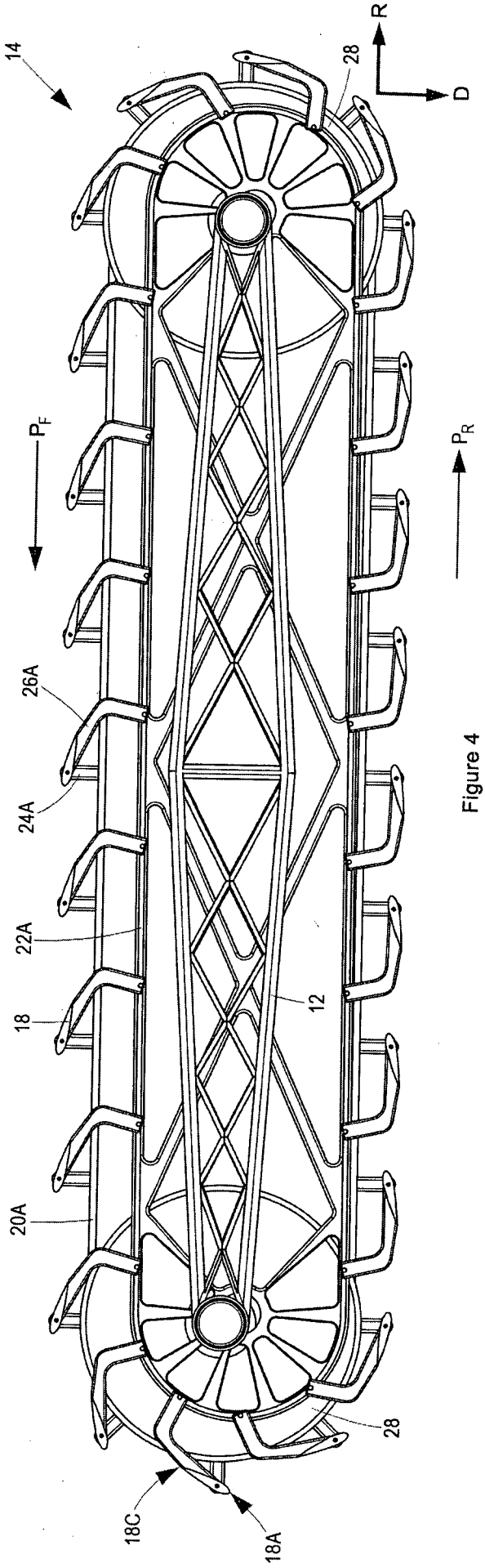

Figure 4