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Liu et al.

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(54) **COLLAPSIBLE WING ASSEMBLY**

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B64C 3/56 (2006.01)
B64C 39/02 (2006.01)

(52) **U.S. Cl.**
CPC ***B64C 3/56*** (2013.01); ***B64C 39/024*** (2013.01); *B64C 2201/102* (2013.01)

(58) **Field of Classification Search**
CPC B64C 3/56
USPC ..... 244/49, 45 R, 131, 199.4
See application file for complete search history.

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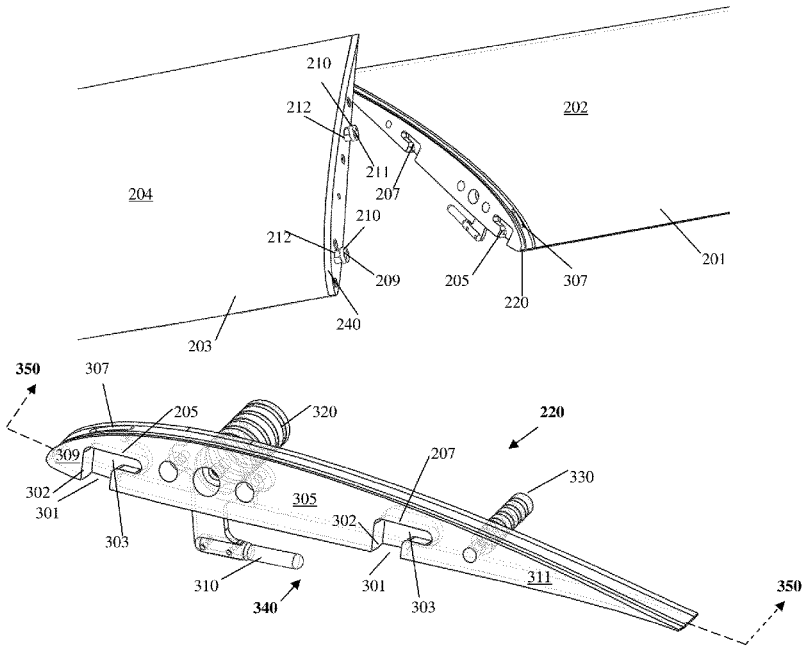
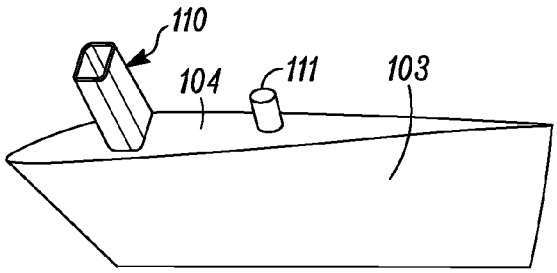
(57) **ABSTRACT**

Disclosed herein is a collapsible wing assembly of an unmanned aerial vehicle (UAV) and a method of locking and unlocking the collapsible wing assembly of an unmanned aerial vehicle (UAV). The collapsible wing assembly comprising a center wing adapted to be attached to the fuselage; and a pair of outboard wings, wherein each of the outboard edges of the center wing comprises a first attachment structure, and each of the inboard edges of the outboard wings comprises a second attachment structure, wherein the first attachment structure is operable to engage with the second attachment structure and displace the second attachment structure to a captive position towards the trailing edge of the center wing.

17 Claims, 9 Drawing Sheets





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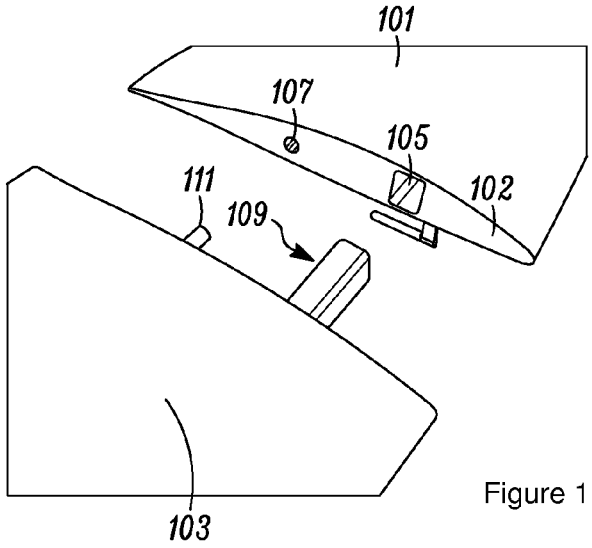


Figure 1b

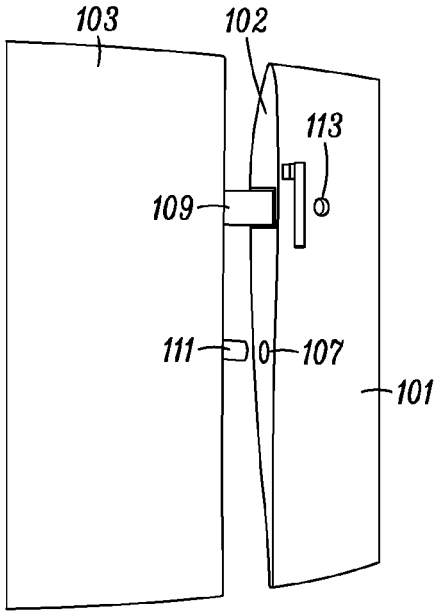


Figure 1c

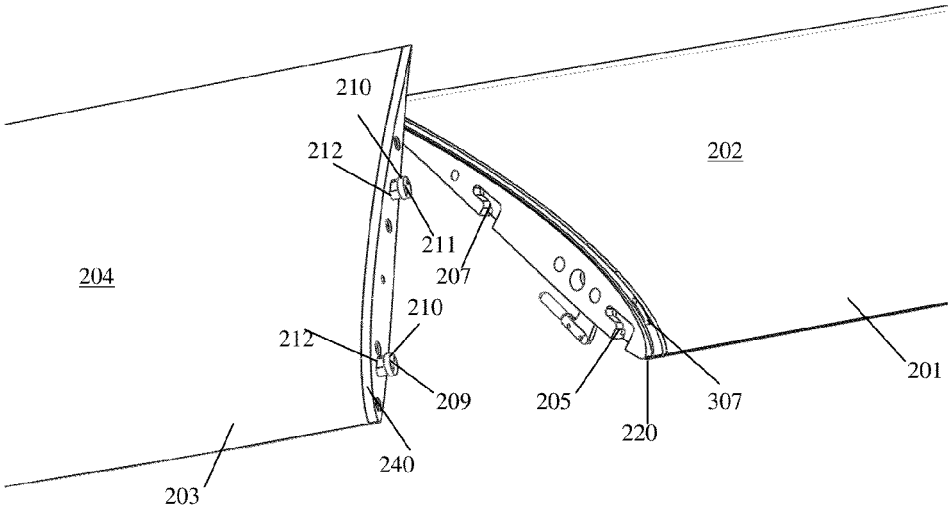
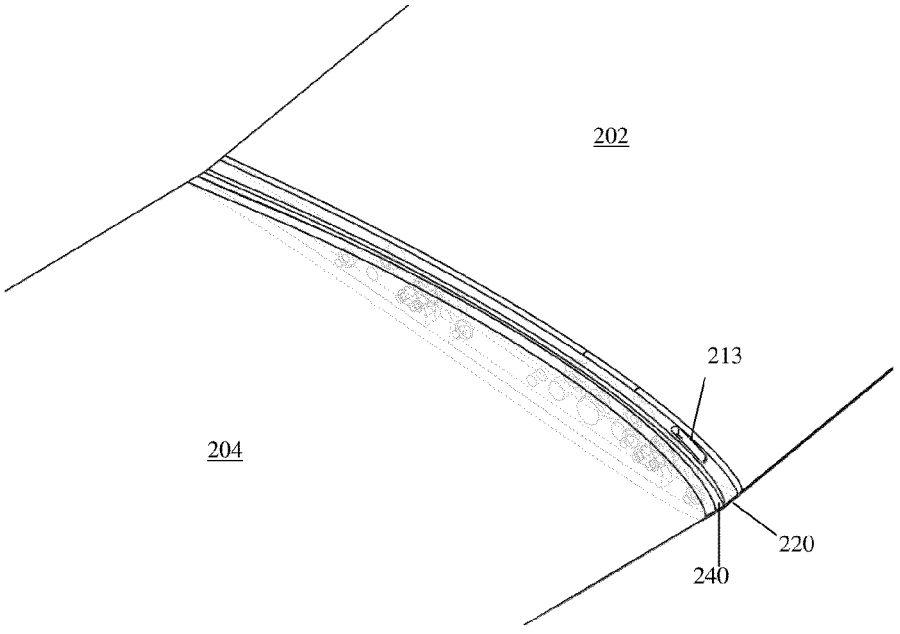


Figure 2a



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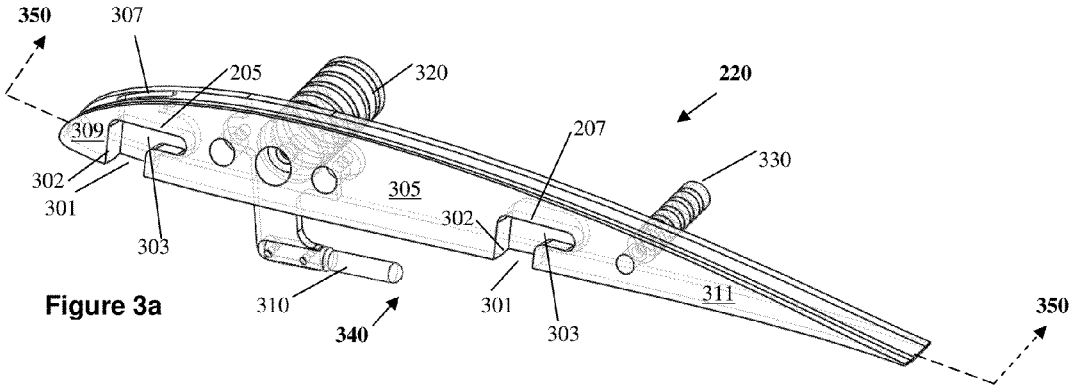


Figure 3a

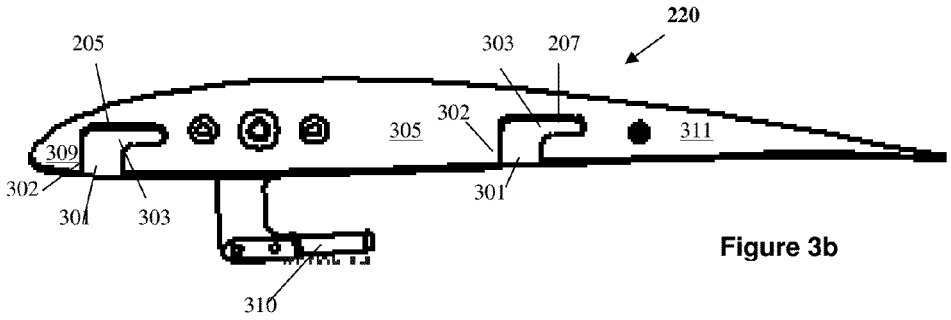


Figure 3b

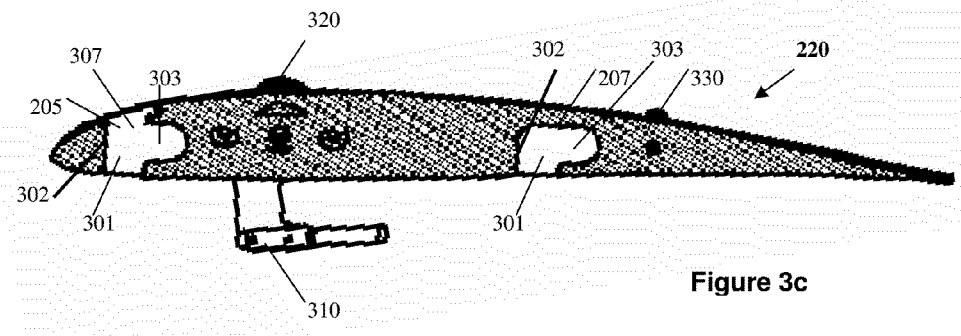


Figure 3c

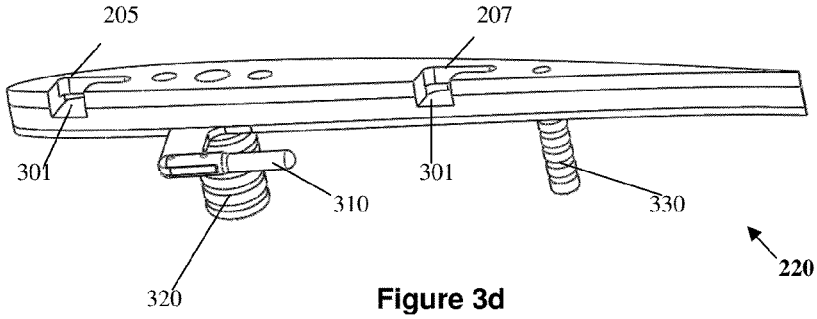
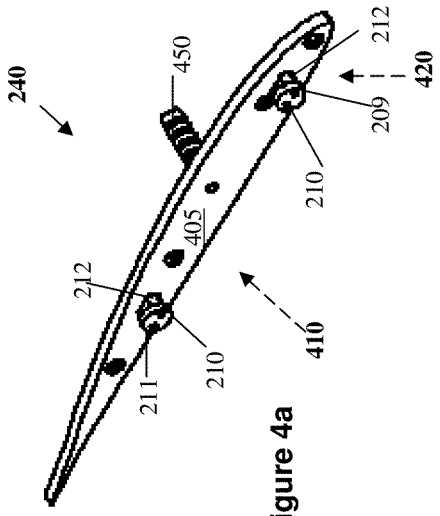


Figure 3d



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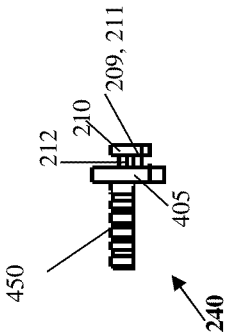
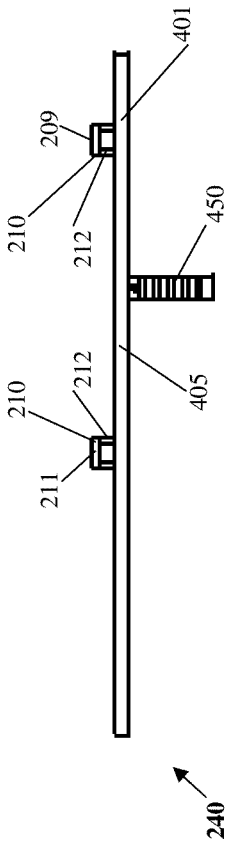


Figure 4d



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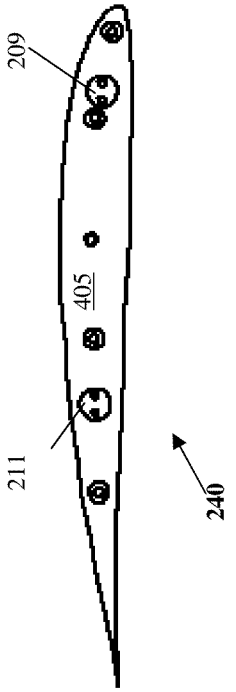


Figure 4b

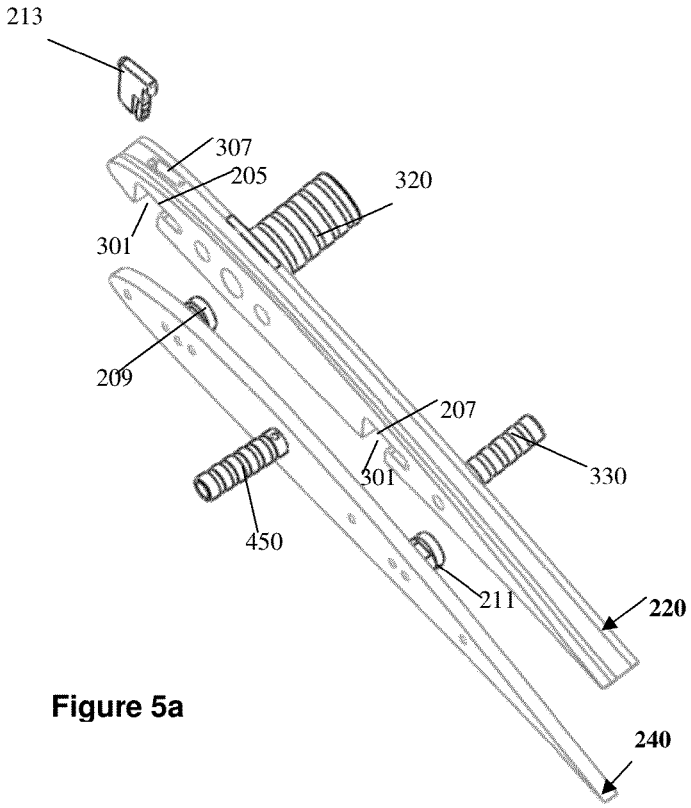


Figure 5a

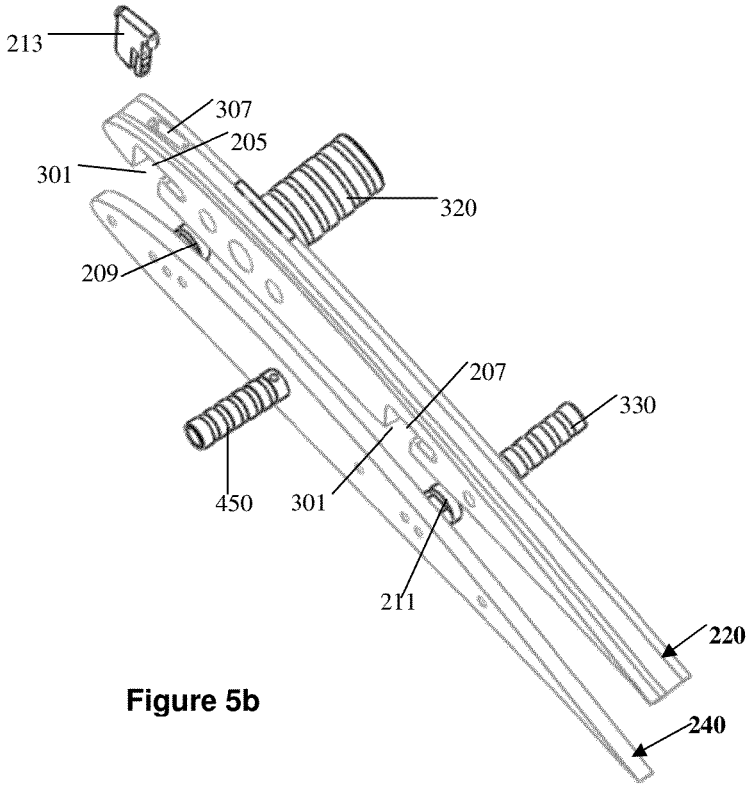
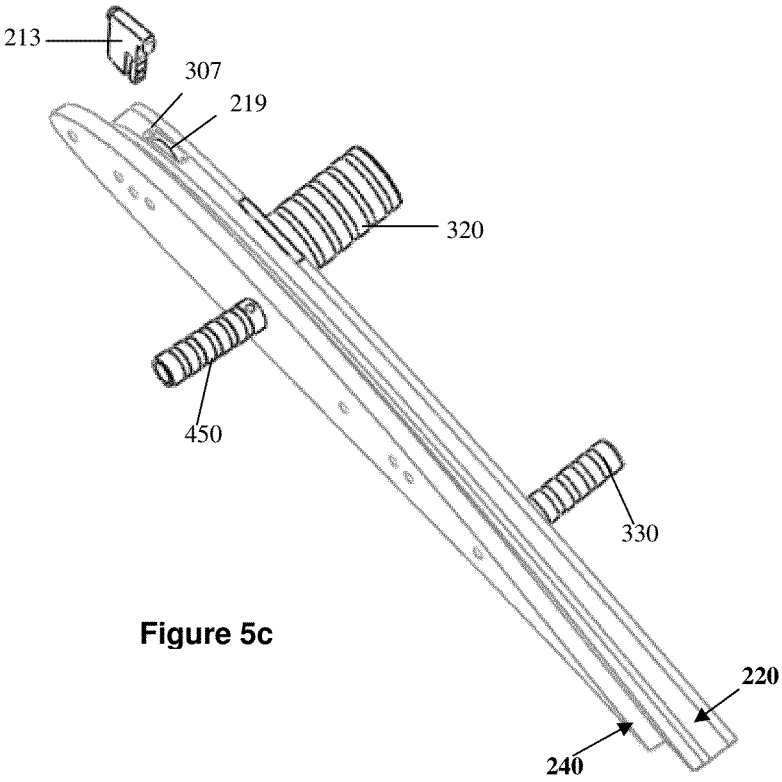


Figure 5b



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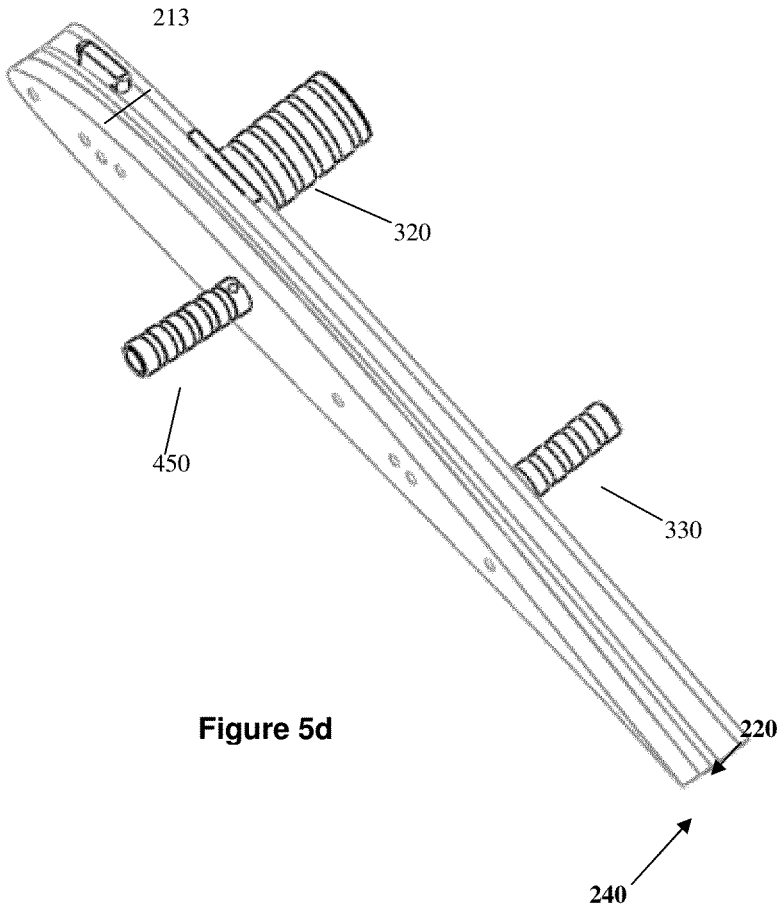

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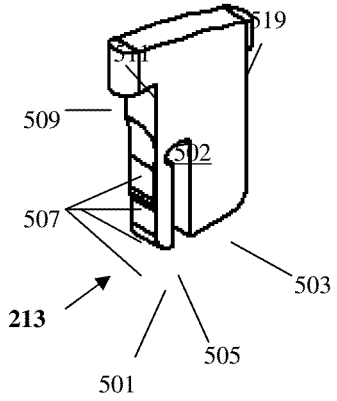

Figure 6a

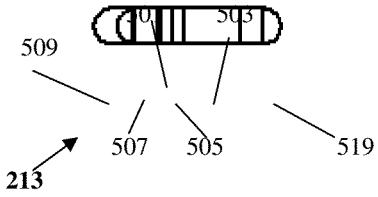

Figure 6b

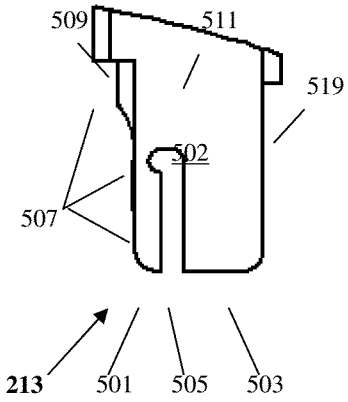

Figure 6c

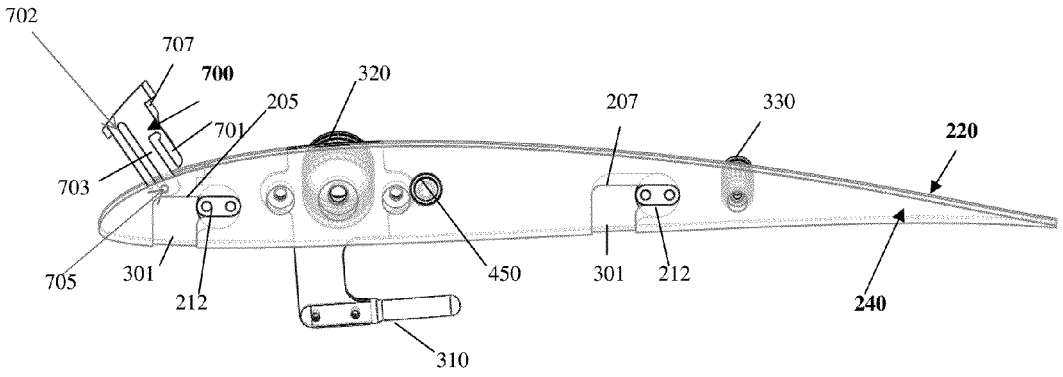

Figure 7a

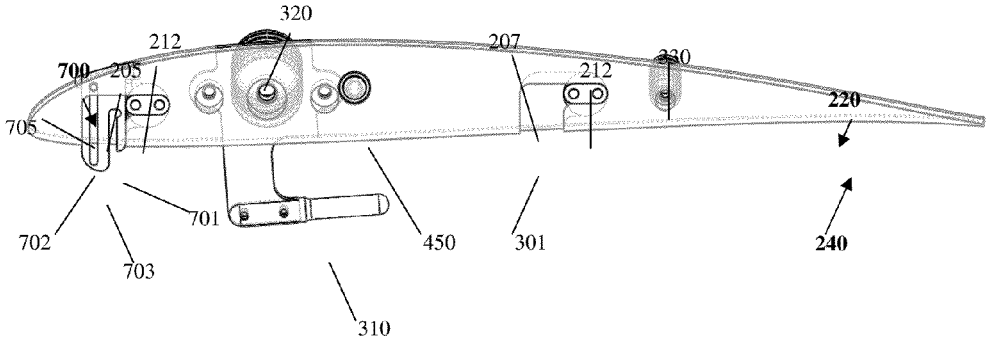

Figure 7b

COLLAPSIBLE WING ASSEMBLY

FIELD OF INVENTION

Embodiments of the present invention relate to a collapsible wing assembly of an unmanned aerial vehicle (UAV)

BACKGROUND

A main wing of an UAV may comprise a plurality of segments that can be assembled. As shown in FIGS. **1***a* to **1***c*, currently, the main wing of an UAV comprises a centre wing **101** attached to the fuselage of the aircraft, and a pair of outboard wings **103** that can be attached to the outboard edges **102** of the centre wing **101**.

Each outboard edge **102** of the centre wing **101** has a square shaped slot **105** and a circular slot **107** that are made of metal. An inboard edge **104** of each outboard wing **103** has a square shaped insert **109** and a circular guide **111** that are made of metal. In use, the slot **105** receives the insert **109** and the slot **107** receives the guide **111**. A spring lock **110** is provided on one face of the insert **109** to lock the insert **109** to a hole **113** provided on an underside of the of the centre wing **101**.

In order to assemble the main wing, the insert **109** and the guide **111** located on the inboard edge **104** of each outboard wing **103** are inserted into the respective slots **105**, **107** located on the outboard edge **102** of the centre wing **101**. Once positive connection has been established, the spring lock **110** engages and locks onto the hole **113** found on the underside of the centre wing **101**.

In order to detach the outboard wings **103** on site, a special tool e.g. a pin is required so as to pierce through the hole **113** on the centre wing **101** and unlock the spring lock **110**.

Due to stringent tolerances between the insert **109** and the slot **105**, it is difficult to execute a smooth connecting action.

Furthermore, since a portion of the insert **109** is exposed, it is prone to damages which may further deteriorate the engaging or disengaging action of the wings **101**, **103**.

Since the insert **109** and the slot **105** are the only point of engagement between the centre wing **101** and the outboard wing **101**, when the wings **101**, **103** are subjected to high launching load, the trailing edge of joint between the centre wing **101** and the outboard wing **103** tends to twist outward in a span wise direction of the wings **101**, **103**.

Furthermore, the dihedral angle of the outboard wing **103** depends on the molded dihedral angle of both the centre wing **101** and the outboard wing **103**. i.e. the angles at which the outboard edges **102** of the centre wing **101** and the inboard edges **104** of the outboard wing **103** are molded, determine the dihedral angle. Therefore, the centre wing **101** and outboard wing **103** are custom built for a particular dihedral angle.

There is thus a need to provide a collapsible wing that seeks to address one or more of the above disadvantages.

SUMMARY

According to a first aspect of the present invention, there is provided a collapsible wing assembly of an unmanned aerial vehicle (UAV) having a fuselage, the assembly comprising: a centre wing adapted to be attached to the fuselage; and a pair of outboard wings, wherein each of the outboard edges of the centre wing comprises a first attachment structure, and each of the inboard edges of the outboard wings comprises a second attachment structure, wherein the first attachment structure is operable to engage with the second attachment structure and displace the second attachment structure to a captive position towards the trailing edge of the centre wing.

The first attachment structure may comprise at least a pair of L-shaped profile locks, and the second attachment structure comprises at least a pair of locking pins, wherein each of the L-shaped profile lock is operable to engage with a respective locking pin and displace the locking pin to a captive position towards the trailing edge of the centre wing.

The centre wing may comprise a body and a centre wing adaptor mounted to an outboard edge of the body, and wherein the outboard wing comprises a body and an outboard wing adaptor mounted to an inboard edge of the body of the outboard wing, wherein the first attachment structure is provided on an end face of the centre wing adaptor, and the second attachment structure is provided on an end face of the outboard wing adaptor.

The airfoils of the centre wing adaptor and outboard wing adaptor matches respectively to the body of the centre wing and the outboard wing.

The centre wing adaptor and the outboard wing adaptor may be removably mounted respectively to the centre wing and the outboard wing.

One of the L-shaped profile lock maybe located proximate to the leading edge of the centre wing adaptor and the other may be located proximate to the trailing edge of the centre wing adaptor, wherein one of the locking pin may be located proximate to the leading edge of the outboard wing adaptor and the other may be located proximate to the trailing edge of the outboard wing adaptor, wherein each of the L-shaped profile lock may be operable to engage with a respective locking pin and displace the locking pin to a captive position towards the trailing edge of the centre wing.

Each of the L-shaped profile lock may comprises a hollow channel formed on an end face of the centre wing adaptor, wherein the hollow channel comprises a first arm pointing towards the bottom surface of the centre wing adaptor, and a second arm, inclined to the first arm, pointing towards the trailing edge of the centre wing. The first arm may be substantially perpendicular to the second arm.

The bottom surface of the centre wing adaptor may have a pair of openings corresponding to the respective openings of the first arm.

The top surface of the centre wing adapter may have a slot, positioned above the first arm of the L-shaped profile lock, for receiving a locking key to lock any relative movement of the centre wing and outboard wing in the captive position.

The dimension of a head of the locking pin matches with that of the opening of the first arm of the L-shaped profile lock, and the dimension of a stem of the locking pin matches with that of the hollow channel of the second arm of the L-shaped profile lock.

An opposing face of the centre wing adaptor and outboard wing adaptor may comprise one or more anchors for mounting the centre wing adaptor and outboard wing adaptor respectively to an outboard edge of the centre wing and an inboard edge of the outboard wing.

The locking key may comprise a head and a base, wherein the top surface of the head has an inclination to match the top surface of the centre wing adaptor, wherein the base has a slit and a resilient arm, the resilient arm comprises a stepped portion comprising a plurality of inclined steps terminating at the head.

In a locked position, the stepped portion may be operable to grip the stem of the an adjacent locking pin in order to lock any relative movement of the centre wing and the outer wing, and the base of the locking key locks with the opening found on the bottom surface of the centre wing adaptor.

The body of the locking key may comprise a slot for inserting a securing pin in order to secure the locking pin to the centre wing adaptor.

According to a second aspect of the present invention, there is provided a method of locking a collapsible wing assembly of an unmanned aerial vehicle (UAV) having a fuselage, the method comprising the steps of: providing a centre wing adapted to be attached to the fuselage; providing a pair of outboard wings; providing a first attachment structure to each outboard edges of the centre wing; providing a second attachment structure to each inboard edges of the outboard wings; engaging the first attachment structure with the second attachment structure; and displacing the second attachment structure to a captive position towards the trailing edge of the centre wing.

In the above method, the first attachment structure may comprise at least a pair of L-shaped profile locks, and the second attachment structure comprises at least a pair of locking pins, wherein each of the L-shaped profile lock is operable to engage with a respective locking pin and displace the locking pin to a captive position towards the trailing edge of the centre wing.

In the above method, the centre wing may comprise a body and a centre wing adaptor mounted to an outboard edge of the body, and wherein the outboard wing comprises a body and an outboard wing adaptor mounted to an inboard edge of the body of the outboard wing, wherein the first attachment structure is provided on an end face of the centre wing adaptor, and the second attachment structure is provided on an end face of the outboard wing adaptor.

The method may further comprise a step of inserting a locking key into a slot provided on the centre wing adaptor to lock the relative movement of the centre wing and the outboard wing.

According to a third aspect, there is provided a method of unlocking the above collapsible wing assembly locked by the above method, the method comprising the steps of: releasing the locking key; holding the centre wing and moving the outboard wing towards the leading edge of the centre wing; and moving the outboard wing downward to release the outboard wing.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will now be described with reference to the enclosed drawings, in which:

FIGS. **1***a* to **1***c* are partial perspective views of a centre wing and outboard wing of a conventional UAV;

FIG. **2***a* is a partial perspective view of a centre wing and outboard wing (in an open position) of an UAV in accordance with an embodiment of the present invention;

FIG. **2***b* is a partial perspective view of a centre wing and outboard wing (in a locked position) of FIG. **2***a;*

FIG. **3***a* is a perspective view of a centre wing adaptor in accordance with an embodiment of the present invention;

FIG. **3***b* is an end view of the centre wing adaptor of FIG. **3***a;*

FIG. **3***c* is a sectional view of the centre wing adaptor of FIG. **3***a;*

FIG. **3***d* is a bottom view of the centre wing adaptor of FIG. **3***a;*

FIG. **4***a* is a perspective view of an outboard wing adaptor in accordance with an embodiment of the present invention;

FIG. **4***b* is an end view of the outboard wing adaptor of FIG. **4***a;*

FIG. **4***c* is a top view of outboard wing adaptor FIG. **4***a;*

FIG. **4***d* is a side view of the outboard wing adaptor of FIG. **4***a;*

FIGS. **5***a* to **5***d* are exemplary views to illustrate a method of locking the centre wing adaptor with the outboard wing adaptor;

FIG. **6***a* is a perspective view of a locking key in accordance with an example embodiment;

FIG. **6***b* is a bottom view of the locking key of FIG. **6***a;*

FIG. **6***c* is a front view of the locking key FIG. **6***a*; and

FIGS. **7***a* and **7***b* are exemplary views to illustrate a locking key in an alternative embodiment.

DETAILED DESCRIPTION

Embodiments of the present invention eliminate the need for any special tool for detaching outboard wings and centre wing of an UAV, which is advantageous for operational deployment.

Embodiments of the present invention provide a smooth and positive engagement of the outboard wings and centre wing of an UAV by employing a "profile lock" concept.

Embodiments of the present invention provide centre wing and outboard wings that are operable to be attached and locked with each other.

By employing a dual locking system, embodiments of the present invention provide a seamless joint between the outboard wings and centre wing of an UAV even when the wings are subjected to a high launching load.

In embodiments of the invention, substantial portion of the profile lock are embedded inside the outboard wings and centre wing. The embedded feature of the profile lock increases the lifespan of the UAV.

Embodiments of the present invention provide flexibility to alter the wing dihedral angle of an UAV by swapping an adaptor attached to the centre wing and/or outboard wings.

FIG. **2***a* is a partial perspective view of a centre wing **201** and outboard wing **203** (in an open position) of an UAV in accordance with an embodiment of the present invention.

Each of the outboard edge of the centre wing **201** and the inboard edge of the outboard wing **203** has an attachment structure for attaching the outboard wing **203** to the centre wing **201**.

The centre wing **201** has a body **202** and a centre wing adaptor **220** attached to an outboard edge of the body **202**. The centre wing adaptor **220** forms the outboard edge of the centre wing **201**. The airfoil of the centre wing adaptor **220** matches with that of the body **202** of the centre wing **201**.

The attachment structure of the centre wing **201** consists of two L-shaped profile locks **205**, **207**. The first L-shaped profile lock **205** is located on the centre wing adaptor **220**, proximate to the leading edge of the centre wing adaptor **220**. The second L-shaped profile lock **207**, substantially identical to the profile lock **205**, is located proximate to a trailing edge of the centre wing adaptor **220**.

The outboard wing **203** has a body **204** and an outboard wing adaptor **240** attached to an inboard edge of the body **204**. The outboard wing adaptor **240** form the inboard edge of the outboard wing **203**. The airfoil of the outboard wing adaptor **240** matches with that of the body **204** of the outboard wing **203**.

The attachment structure of the outboard wing **203** consists of two locking pins **209**, **211**. The first locking pin **209** is located proximate to the leading edge of the outboard wing adaptor **240**. The second locking pin **211**, substantially identical to the locking pin **209**, is located proximate to the trailing edge of the outboard wing adaptor **240**. The locking pins **209**, **211** comprise a circular head **210** and a stem **212**. The dimen-

sions of the head **210** and stem **212** are designed to match the openings of the L-shaped profile locks **205**, **207** in order to engage and lock a locking pin **209**, **211** with a respective L-shaped profile lock **205**, **207**.

The adaptors **220**, **240** can be fabricated for example with a tough and scratch-resistant material such as ABS plastic, delrin, aluminium or steel by e.g. an injection moulding or diecast process.

Each of the L-shaped profile lock **205**, **207** is operable to engage with a respective locking pin **209**, **211** and displace the locking pin **209**, **211** to a captive position towards the trailing edge of the centre wing **201** (Refer to FIGS. **5***a* and **5***d*).

A substantially flat locking key **213** is shown inserted into a slot **307** (refer FIG. **3***a*) on a top surface of the centre wing adaptor **220** in order to provide an additional rigid and positive lock that can avoid any relative movement between the centre wing **201** and the outboard wing **203**. When inserted, the base of the locking key **213** is hidden within the opening **301** (refer FIG. **3***a*) located on the underside of the centre wing adaptor **240**. The base of the locking key **213** is designed to allow a user to push up the locking key **213** via the opening **301** while unlocking.

FIG. **2***b* is a partial perspective view of a centre wing **201** and outboard wing **203** (in a closed position) of an UAV in accordance with an embodiment of the present invention. It can be appreciated, in a locked position, there is substantially minimum gap between the centre wing adaptor **220** and the outboard wing adaptor, whereby a smooth joint between the centre wing **201** and outboard wing **203** is achieved.

FIG. **3***a* is a perspective view of a centre wing adaptor **220** in accordance with an embodiment of the present invention. The centre wing adaptor **220** has an airfoil-shaped body with a substantially flat end face **305**.

The end face **305** of the centre wing adaptor **220** has a locking structure consisting two L-shaped profile locks **205**, **207**. The first L-shaped profile lock **205** located near the leading edge **309** of the centre wing adaptor **220**. The second L-shaped profile lock **207**, identical to the profile lock **205**, is located near the trailing edge **311** of the centre wing adaptor **220**.

Each of the L-shaped profile locks **205**, **207** comprise a hollow channel. The hollow channel is formed by lacking a material during a moulding process and the dimensions are appropriate to receive a locking pin **209**, **211**.

A first arm **302** of each L-shaped profile lock **205**, **207** has an opening **301** that points towards the bottom surface of the centre wing adaptor **220**, while a second arm **303**, substantially perpendicular or inclined to the first arm **302**, points towards the trailing edge of the centre wing **201** and terminates into a captive position in the body of the centre wing adaptor **220**.

The opposing face of the centre wing adaptor **220** has a pair of anchors **320**, **330** for mounting the centre wing adaptor **220** to an outboard edge of the centre wing **201**. Attached to the anchor **320**, is a launching pin **310**, which extends below the bottom surface of the centre wing adaptor **220**. The launching pin **310** is used for launching the UAV.

The bottom surface of the centre wing adaptor **220** has a pair of openings **301** corresponding to a respective opening **301** of the first arm **302**.

The top surface of the centre wing adaptor **220** has a slot **307** positioned above the first arm **302** of the L-shaped profile lock **205**. The slot **307** is designed to accommodate a substantially flat locking key **213** (refer FIG. **2**, FIGS. **6***a*-**6***c*) in order to provide an additional locking to any relative movement between the centre wing **201** and the outboard wings **203**.

FIG. **3***b* is an end view of the centre wing adaptor **220** of FIG. **3***a* in a direction of **340** showing the relative positioning of the profile locks **205**, **207** and the launching pin **310**.

FIG. **3***c* is a sectional view of the centre wing adaptor **220** of FIG. **3***a* in a direction of **350** showing the slot **307** for accommodating the locking key **213** and inner dimensions of the arms **302**, **303** of the L-shaped profile lock **205**, **207**.

FIG. **3***d* is a bottom view of the centre wing adaptor of FIG. **3***a* clearly showing the openings **301** of the L-shaped profile locks **205**, **207**.

FIG. **4***a* is a perspective view of an outboard wing adaptor **240** in accordance with an embodiment of the present invention.

The outboard wing adaptor **240** also has an airfoil-shaped body with a substantially flat end face **405**. A locking pin **209** is located proximate to the leading edge of the outboard wing adaptor **240**. Another locking pin **211**, identical to the locking pin **209**, is located proximate to the trailing edge of the outboard wing adaptor **240**. The locking pins **209**, **211** comprise a circular head **210** and a stem **212**.

Each of the L-shaped profile lock **205**, **207** is operable to engage with a respective locking pin **209**, **211** and displace the locking pin **209**, **211** to a captive position towards the trailing edge of the centre wing **201**.

The dimension of the heads **210** matches with that of the openings **301** of the L-shaped profile locks **205**, **207**. Furthermore, the dimension of the stem **212** matches with that of the openings **303** of the L-shaped profile locks **205**, **207**. The terminal portion of the arm **303** of the profile locks **205**, **207** is towards the trailing edge of the wings **201**, **203**, such that the L-shaped profile lock **205**, **207** engages with a respective locking pin **209**, **211** and displaces the locking pin **209**, **211** to a captive position towards the trailing edge of the centre wing **201**.

An opposing face of the outboard wing adaptor **240** has an anchor **450** for mounting the outboard wing adaptor **240** to an inboard edge of the outboard wing **203**. The bottom surface **401** (refer FIG. **4***b*) of the outboard wing adaptor **240** is substantially flat.

FIG. **4***b* is an end view of the outboard wing adaptor **240** of FIG. **4***a* in a direction of **410** showing the relative positioning of the locking pins **209**, **211** on the end face **405**.

FIG. **4***c* is a bottom view of the outboard wing adaptor **240** of FIG. **4***a* in a direction of **420** showing the relative positioning of the locking pins **209**, **211** and the anchor **450**.

FIG. **4***d* is a side view of the outboard wing adaptor **240** of FIG. **4***a* showing the locking pins **209**, **211** and the anchor **450**.

FIGS. **5***a* to **5***d* are exemplary views to illustrate a method of locking the centre wing adaptor **220** with the outboard wing adaptor **240**.

As shown in FIGS. **5***a* and **5***b*, the outboard wing **203** and centre wing **201** are brought closer such that the locking pins **209**, **209** of the outboard wing adaptor **240** are aligned directly below the openings **301** on the underside of the centre wing adaptor **220**.

Subsequently, as shown in FIG. **5***c*, the locking pins **209**, **211** are inserted into a respective opening **301** of the centre wing adaptor **220** and the outboard wing **203** is moved upward into the centre wing **201** such that the locking pins **209**, **211** reach the upward limit of the arm **302** of the L-shaped profile locks **205**, **207**.

After this, as shown in FIG. **5***d*, the centre wing **201** is firmly held by a user and the outboard wing **203** is moved rearward into the centre wing **201** until the lateral limit of the L-shaped profile locks **205**, **207** is reached. i.e. at the captive position.

Thereafter, a locking key **213** is inserted into the slot **307** located on the top surface of the centre wing adaptor **220**. The locking key **213** is pushed downwards until the base of the locking key locks into the opening **301**. After locking, the locking key **213** cannot be unlocked by any vibrations or when the UAV is in operation.

In order to unlock, an operator of the UAV can push up the locking key **213** by applying a force using his/fingers into the opening **301** on the underside of the centre wing adaptor **220** whereby the head of the locking key **511** (refer FIG. **6***a*) pops out of the slot **307**. The locking key **213** is then removed out of the slot **307**.

In order to unlock the outboard wing **203** and the centre wing **201**, the operations shown in FIGS. **5***a*-**5***d* are reversed. i.e. the centre wing **201** is firmly held by a user and the outboard wing **203** is moved forward followed by a clockwise twisting action to dislodge the outboard wing **203** from the centre wing **201**.

FIG. **6***a* is a perspective view of a locking key **213** in accordance with an example embodiment.

The locking key **214** comprises a substantially flat body **502** having a substantially flat head **511** and a base **503**. The top surface of the head **511** has an inclination to match the outer surface of the centre wing adaptor **220**. Furthermore, the head also has arcuate ends **509**, **519** that match with the corresponding arcuate portion of the slot **307**. The base **503** has a slit **505** and a resilient arm **501**. The resilient arm **501** has a stepped portion **507** which terminates at the head **511**. The locking key **213** is designed to be received into the slot **307** on the centre wing adaptor **220**.

While insertion, the stepped portion **507** faces the trailing edge **311** of the centre wing adaptor **220**. After insertion, the locking key **213** is pushed downward until the base **503** and the arm **501** locks with the opening **301** on the underside of the centre wing adaptor **220** such that the head **511** is flush with the surface of the centre wing adaptor **220**. The stepped portion **507** grips with the stem **212** of the locking pin **209** in order to lock the relative movement of the centre wing adaptor **220** and the outer wing adaptor **240**.

FIG. **6***b* is a bottom view of the locking key **213** of FIG. **6***a* showing the two arcuate ends **509**, **519** of the head **511**, the base **503**, the slit **505**, the resilient arm **501** and the stepped portion **507**.

FIG. **6***c* is a front view the locking key **213** of FIG. **6***a* showing the inclination of the top surface **511** and its arcuate ends **509**, **511**, the stepped portion **507**, the resilient arm **501**, the slit **505** and the base **503**.

FIGS. **7***a* and **7***b* are exemplary views to illustrate a locking key **700** in an alternative embodiment whereby the locking key **700** is prevented from being detached away from the centre wing adaptor **220**. In order to exemplify, a stem **212** of the locking pin **209** is positioned into the end of the profile lock **205**.

FIG. **7***a* shows the locking key **700** in an open position. The body of the locking key **700** has an oval shaped slot **702** cut along a height of a base **703** of the locking key **700**. A securing pin **705** is inserted into the slot **703** in order to secure the locking pin to the centre wing adaptor **220**. As in the previous embodiment the resilient arm **701** has a stepped portion **707**.

FIG. **7***b* shows the locking key **700** in a closed position. Once the centre wing adaptor **220** is locked with the outboard wing adaptor **240**, the secured locking key **700** can be easily inserted into the slot **307** of the centre wing adaptor **220**. The locking pin **700** is then pushed downward **703** until the base **703** and the arm **701** locks with the opening **301** on the underside of the centre wing adaptor **220** such that the head of the locking pin **700** is flush with the surface of the centre wing adaptor **220**. The stepped portion **707** grips with the stem **212** of the locking pin **209** in order to lock the relative movement of the centre wing adaptor **220** and the outer wing adaptor **240**. In order to unlock, a user pushes up the base **703** using a finger via the opening **301** until the head of the locking key **700** pops out for removing the locking key **700**.

It will be appreciated by a person skilled in the art that numerous variations and/or modifications may be made to the present invention as shown in the specific embodiments without departing from the scope of the invention as broadly described. The present embodiments are, therefore, to be considered in all respects to be illustrative and not restrictive.

For instance, the number of locking pins **209**, **211** and the L-shaped profile locks **205**, **207** can be more than two. The outboard wing adaptor **240** can be integral with the outboard wing **203**. The centre wing adaptor **220** can be integral with the centre wing **201**. The locking pins **209**, **211** can be provided on the centre wing **201** and the L-shaped profile locks **205**, **207** can be provided on the outboard wing with changes to the direction of locking.

Embodiments of the present invention can provide flexibility to alter the wing dihedral angle by merely swapping the centre wing adaptor **220** and/or the outboard wing adaptor **240**.

The invention claimed is:

1. A collapsible wing assembly of an unmanned aerial vehicle (UAV) having a fuselage, the assembly comprising:

a centre wing adapted to be attached to the fuselage; and

a pair of outboard wings,

wherein each of the outboard edges of the centre wing comprises a first attachment structure having at least a pair of L-shaped profile locks, and each of the inboard edges of the outboard wings comprises a second attachment structure having at least a pair of locking pins,

wherein each of the L-shaped profile locks comprises a hollow channel having a first arm pointing towards a bottom surface of the centre wing, and a second arm, inclined to the first arm, pointing towards a trailing edge of the centre wing,

wherein each of the L-shaped profile locks of the first attachment structure is operable to engage with a respective locking pin of the second attachment structure and displace the locking pin to a captive position towards the trailing edge of the centre wing.

2. The assembly of claim **1**, wherein the centre wing comprises a body and a centre wing adaptor mounted to an outboard edge of the body, and wherein the outboard wing comprises a body and an outboard wing adaptor mounted to an inboard edge of the body of the outboard wing, wherein the first attachment structure is provided on an end face of the centre wing adaptor, and the second attachment structure is provided on an end face of the outboard wing adaptor.

3. The assembly of claim **2**, wherein airfoils of the centre wing adaptor and outboard wing adaptor match respectively to those of the bodies of the centre wing and the outboard wing.

4. The assembly of claim **2**, wherein the centre wing adaptor and the outboard wing adaptor are removably mounted respectively to the centre wing and the outboard wing.

5. The assembly of claim **2**, wherein one of the L-shaped profile locks is located proximate to a leading edge of the centre wing adaptor and the other is located proximate to a trailing edge of the centre wing adaptor,

wherein one of the locking pins is located proximate to the leading edge of the outboard wing adaptor and the other is located proximate to the trailing edge of the outboard wing adaptor.

6. The assembly of claim 1, wherein the first arm is substantially perpendicular to the second arm.

7. The assembly of claim 1, wherein the bottom surface of the centre wing has a pair of openings corresponding to respective openings of the first arm.

8. The assembly of claim 1, wherein a top surface of the centre wing has a slot, positioned above the first arm of the L-shaped profile lock, for receiving a locking key to lock any relative movement of the centre wing and outboard wing in the captive position.

9. The assembly of claim 7, wherein the dimension of a head of the locking pin matches with that of the openings of the first arm of the hollow channel of the L-shaped profile lock, and the dimension of a stem of the locking pin matches with that of the second arm of the hollow channel of the L-shaped profile lock.

10. The assembly of claim 2, wherein an opposing face of the centre wing adaptor and outboard wing adaptor comprises one or more anchors for mounting the centre wing adaptor and outboard wing adaptor respectively to an outboard edge of the centre wing and an inboard edge of the outboard wing.

11. The assembly of claim 8, wherein the locking key comprises a head and a base, wherein the top surface of the head has an inclination to match the top surface of the centre wing, wherein the base has a slit and a resilient arm, the resilient arm comprising a stepped portion comprising a plurality of inclined steps terminating at the head.

12. The assembly of claim 11, wherein in a locked position, the stepped portion is operable to grip the stem of the an adjacent locking pin in order to lock any relative movement of the centre wing and the outer wing, and the base of the locking key locks with the opening found on the bottom surface of the centre wing.

13. The assembly of claim 9, wherein the body of the locking key comprises a slot for inserting a securing pin in order to secure the locking pin to the centre wing.

14. A method of locking a collapsible wing assembly of an unmanned aerial vehicle (UAV) having a fuselage, the method comprising the steps of:

providing a centre wing adapted to be attached to the fuselage;

providing a pair of outboard wings;

providing a first attachment structure to each outboard edges of the centre wing, the first attachment structure having at least a pair of L-shaped profile locks, wherein each of the L-shaped profile locks comprises a hollow channel having a first arm pointing towards a bottom surface of the centre wing, and a second arm, inclined to the first arm, pointing towards a trailing edge of the centre wing;

providing a second attachment structure to each inboard edges of the outboard wings, the second attachment structure having at least a pair of locking pins;

engaging each of the L-shaped profile locks of the first attachment structure with a respective locking pin of the second attachment structure; and displacing the locking pin to a captive position towards the trailing edge of the centre wing.

15. The method of claim 14, wherein the centre wing comprises a body and a centre wing adaptor mounted to an outboard edge of the body, and wherein the outboard wing comprises a body and an outboard wing adaptor mounted to an inboard edge of the body of the outboard wing, wherein the first attachment structure is provided on an end face of the centre wing adaptor, and the second attachment structure is provided on an end face of the outboard wing adaptor.

16. The method of claim 15, further comprising a step of inserting a locking key into a slot provided on the centre wing adaptor to lock the relative movement of the centre wing and the outboard wing.

17. A method of unlocking the collapsible wing assembly locked by the method of claim 16, the method comprising the steps of:

releasing the locking key;

holding the centre wing and moving the outboard wing towards the leading edge of the centre wing; and

moving the outboard wing downward to release the outboard wing.

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