US 20200010209A1

(19) **United States**

(12) **Patent Application Publication**

Bender

(10) **Pub. No.: US 2020/0010209 A1**

(43) **Pub. Date: Jan. 9, 2020**

(54) **AIRCRAFT**

(71) Applicant: **Dr. Ing. h.c. F. Porsche Aktiengesellschaft**, Stuttgart (DE)

(72) Inventor: **Stefan Bender**, Löchgau (DE)

(73) Assignee: **Dr. Ing. h.c. F. Porsche Aktiengesellschaft**, Stuttgart (DE)

(21) Appl. No.: **16/502,331**

(22) Filed: **Jul. 3, 2019**

(30) **Foreign Application Priority Data**

Jul. 4, 2018 (DE) 102018116146.8

Publication Classification

(51) **Int. Cl.**

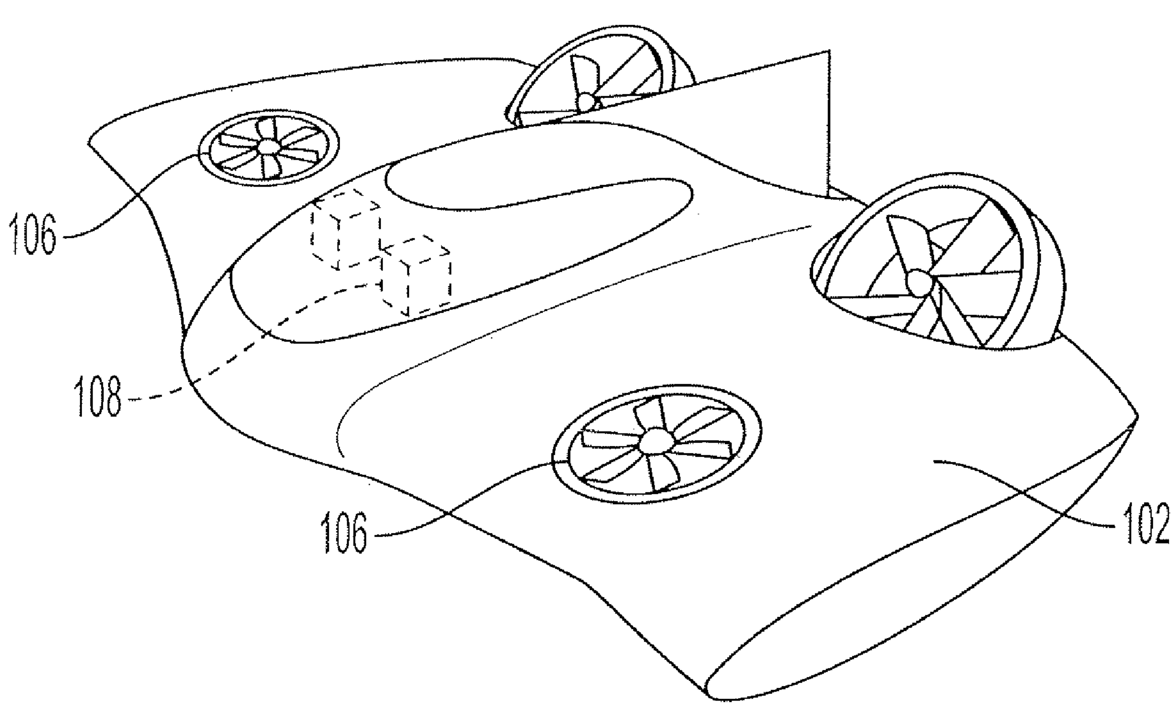
B64D 33/08	(2006.01)
B64C 3/56	(2006.01)
B64C 29/00	(2006.01)
B64C 39/02	(2006.01)
B64D 27/24	(2006.01)
F28F 21/02	(2006.01)

(52) **U.S. Cl.**

CPC ***B64D 33/08*** (2013.01); ***B64C 3/56*** (2013.01); ***B64C 29/0033*** (2013.01); ***B64C 29/0025*** (2013.01); ***B64C 39/024*** (2013.01); *B64C 2201/108* (2013.01); ***F28F 21/02*** (2013.01); *B64C 2201/141* (2013.01); *B64C 2201/06* (2013.01); *B64C 2201/088* (2013.01); ***B64D 27/24*** (2013.01)

(57) **ABSTRACT**

An aircraft includes a battery, an airfoil and heat conducting elements, and the heat conducting elements connect the battery thermally to the airfoil in such a way that heat which is produced in the battery is distributed to the airfoil.



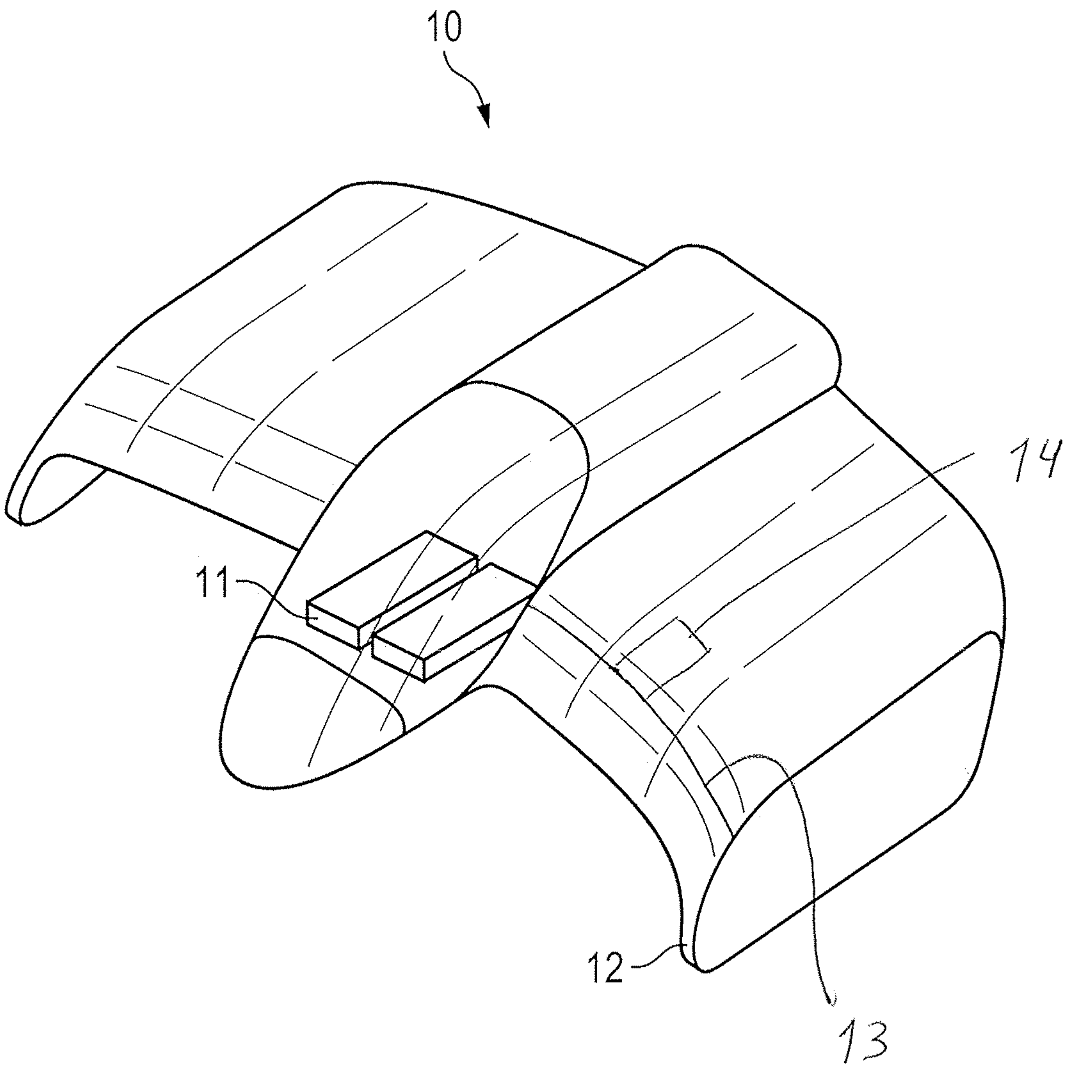


FIG. 1

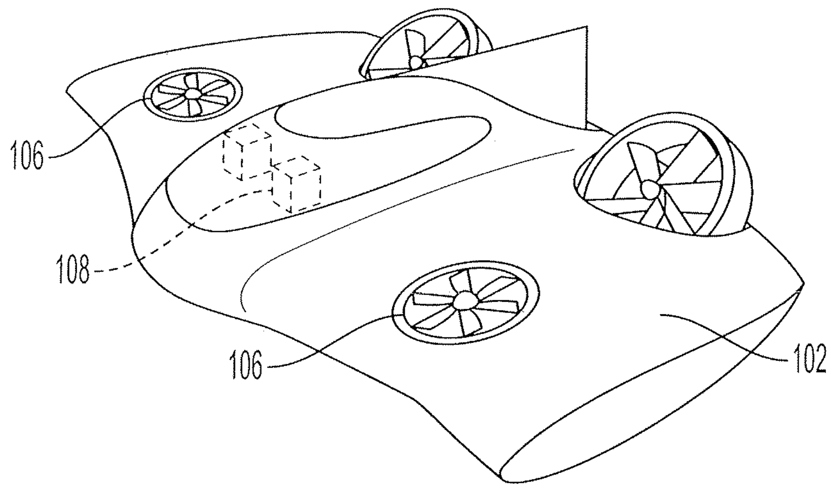


FIG. 2

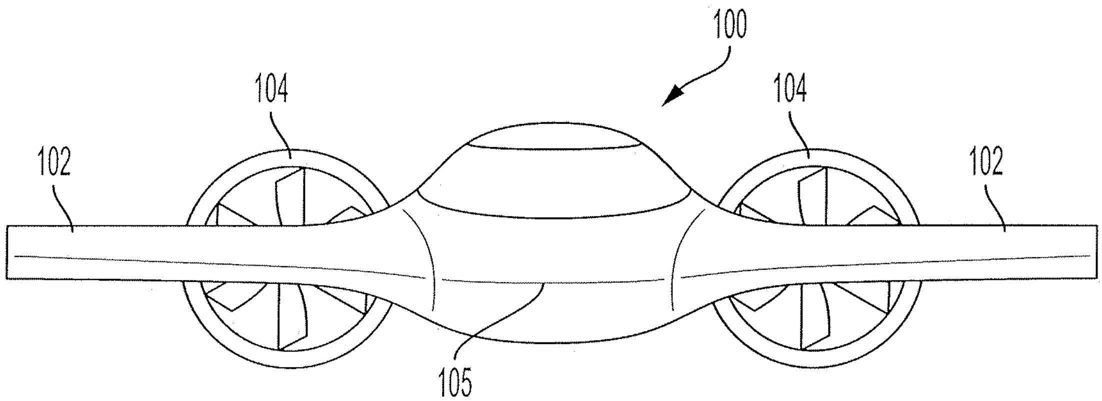


FIG. 3

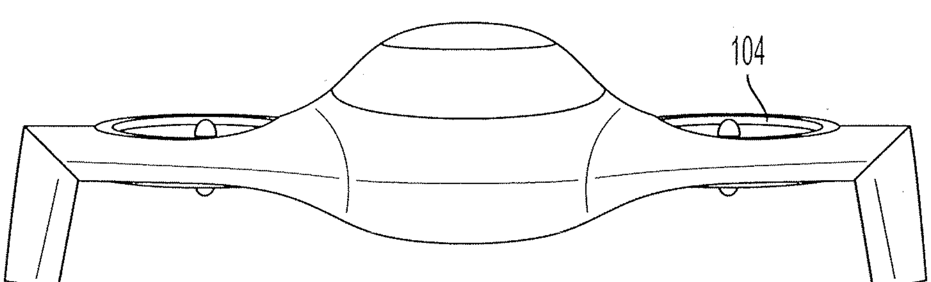


FIG. 4

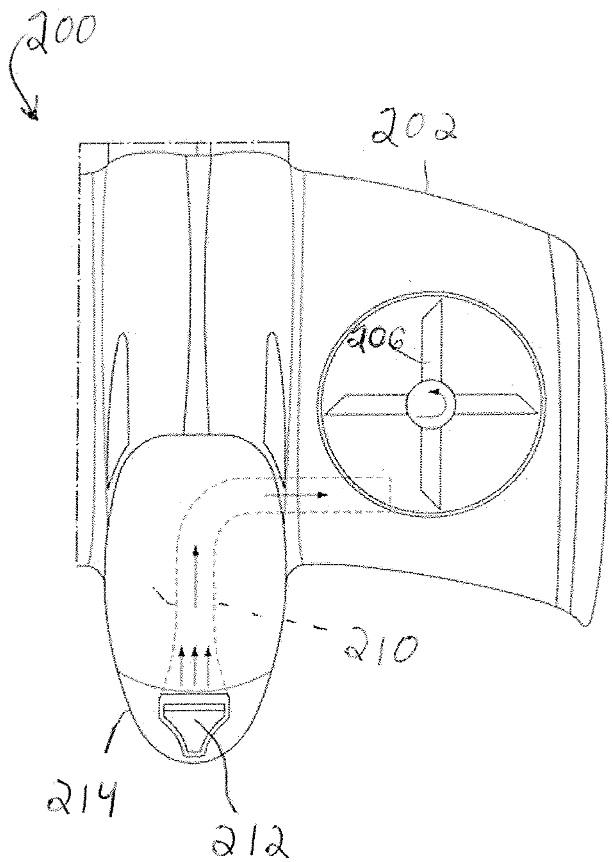


FIG. 5

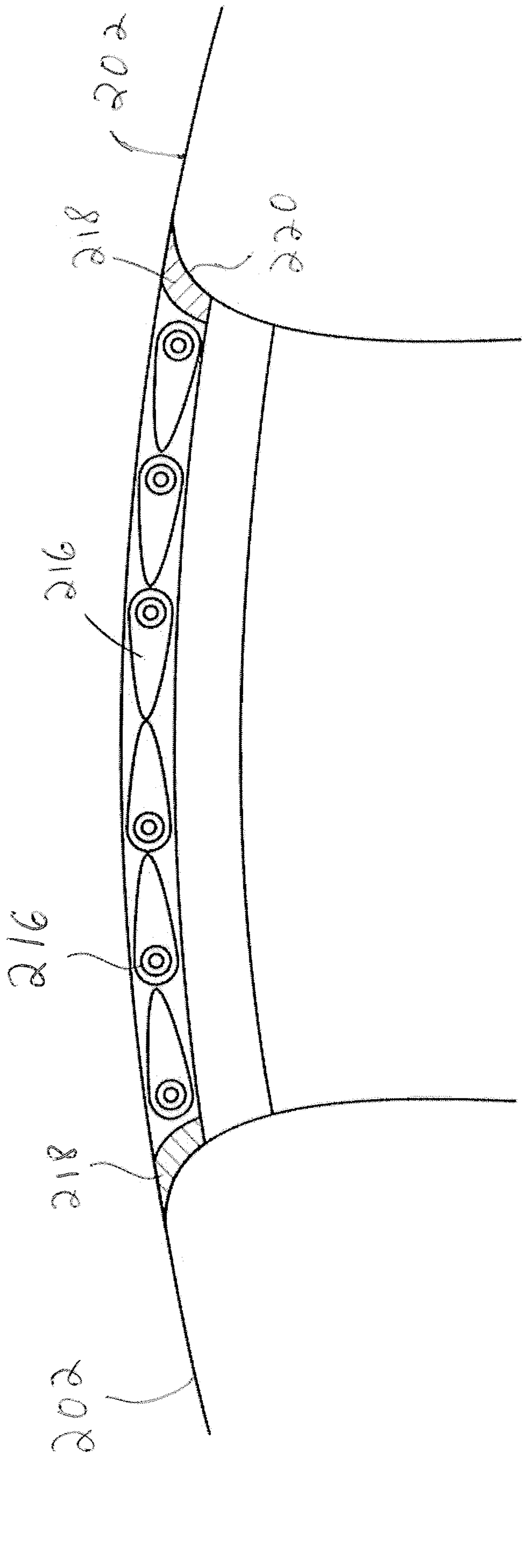


FIG. 6

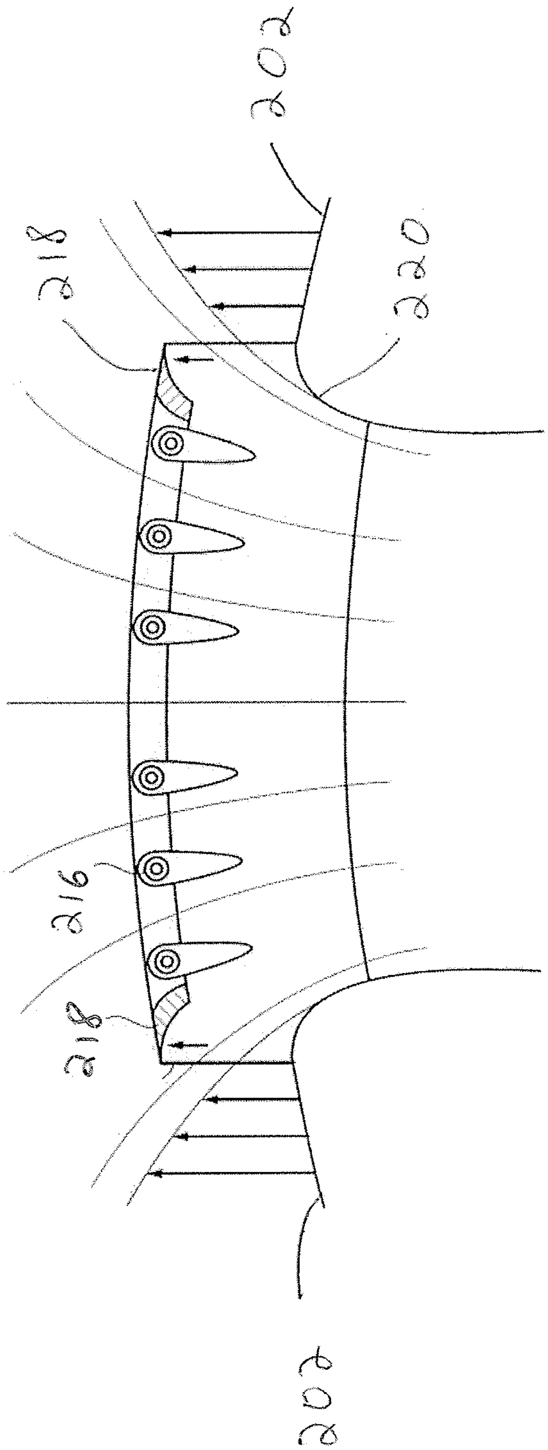


FIG 7

AIRCRAFT

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims priority to German Patent Application No. 10 2018 116 146.8, filed Jul. 4, 2018, the content of such application being incorporated by reference herein in its entirety.

FIELD OF THE INVENTION

[0002] The present invention relates to an aircraft, in particular a fully electric aircraft which is capable of taking off and landing vertically (vertical take-off and landing, VTOL).

BACKGROUND OF THE INVENTION

[0003] In aerospace technology, VTOL denotes, across all languages, any type of aircraft, drone or rocket which has the capability to take off and land again substantially vertically and without a runway. In the following text, this collective term is used in a broad sense which includes not only fixed airfoil aircraft with airfoils, but also rotary airfoil aircraft such as helicopters, gyrocopters, gyrodynes and hybrids such as compound helicopters or compound gyroplanes and convertiplanes. Furthermore, aircraft are to be included with the capability of taking off and landing in particularly short distances (short take-off and landing, STOL), taking off in short distances but landing vertically (short take-off and vertical landing, STOVL) or taking off vertically but landing horizontally (vertical take-off and horizontal landing, VTHL).

[0004] In order to cool an aircraft, U.S. Pat. No. 4,635, 709A, which is incorporated by reference herein, proposes a cooling plate below the airfoil for dissipating heat from the electronic components and cooling fins for dissipating the heat which is output by the cooling plate into the cooling air stream. In addition, a liquid coolant is provided in cavities which are configured in the cooling plate directly next to the electronic components.

[0005] Said liquid coolant evaporates at elevated temperatures when the cooling air stream is not available, in order to cool the cold plate. The steam which is released by way of the evaporation of the liquid coolant is ejected from the heat exchanging apparatus through a hydrophobic filter membrane which covers a part of the cavities. The hydrophobic membrane is impermeable for liquids, but is permeable to gas.

[0006] EP1764302A2, which is incorporated by reference herein, also discloses a passive cooling system for a wing. The passive cooling system comprises a fluid transmission chamber which is adjacent with respect to the wing. A fluid transmission element and coolant are arranged in the fluid transmission chamber. The fluid transmission element conducts a part of the coolant to the wing which dissipates the thermal energy.

[0007] Finally, US20150000523A1, which is incorporated by reference herein, describes an aircraft fuel tank flammability reduction method by way of the feeding of compressed air into an air separation module which contains an oxygen separating membrane. The method comprises bringing the separating membrane into contact with the air feed, the penetrating of oxygen from the air feed through the separating membrane, and the generating of nitrogen-enriched air from the air separating module as a consequence of the removal of oxygen from the air feed. The enriched air from the air separating module is cooled in a flow heat exchanger in the wing and is fed to the fuel tank.

SUMMARY OF THE INVENTION

[0008] Described herein is an aircraft, in particular a fully electric aircraft which is capable of taking off and landing vertically. The aircraft has a battery, an airfoil and heat conducting elements, and the heat conducting elements connect the battery thermally to the airfoil in such a way that heat which is produced in the battery is distributed to the airfoil.

[0009] Benefits of this aircraft lie in its reduced complexity in comparison with active cooling systems and the correspondingly reduced weight of the resulting aircraft.

[0010] The aircraft can be equipped with folded or even selectively foldable airfoils. One corresponding variant enlarges the wing area which is active during horizontal flying, without increasing the footprint of the aircraft, however.

[0011] Furthermore, the aircraft may have a rapidly chargeable battery system which provides the drive energy for vertical take off and landing and horizontal flying, and makes brief charging of the aircraft at a standstill possible.

[0012] Here, in order to drive the aircraft, instead of exposed rotors, a plurality of ducted fans, even of different size, can be used, as are known away from aeronautical engineering, for instance from hovercrafts or airboats. In an embodiment of this type, the cylindrical housing which surrounds the propeller is capable of considerably reducing the thrust losses as a consequence of vortices at the blade tips. Suitable ducted fans may be oriented horizontally or vertically, may be configured such that they can be pivoted between the two positions or, for aerodynamic reasons, may be covered by way of louvers during horizontal flying. In addition, a pure horizontal thrust generation by means of stationary ducted fans is conceivable.

[0013] Finally, in addition to preferably fully autonomous operation of the aircraft, the granting of manual control to human pilots with sufficient qualifications also comes into consideration, which imparts the greatest possible flexibility in terms of handling to the apparatus according to aspects of the invention.

BRIEF DESCRIPTION OF THE DRAWING

[0014] One exemplary embodiment of the invention is shown in the drawing and will be described in greater detail in the following text.

[0015] FIG. **1** shows the perspective view of an aircraft.

[0016] FIG. **2** depicts an isometric view of an aircraft, wherein the wings are shown in an extended configuration and the rear propellers are shown in an angled orientation.

[0017] FIG. **3** depicts a front elevation view of the aircraft of FIG. **2**, wherein the wings are shown extended configuration and the rear propellers are shown in a cruising orientation.

[0018] FIG. **4** depicts another front elevation view of the aircraft, wherein the wings are shown in a folded configuration and the rear propellers are shown in a take-off/landing orientation.

[0019] FIG. **5** depicts a top plan view of a portion of an aircraft, showing an internal duct extending between a nose of the aircraft and a horizontal fan mounted to the wing.

[0020] FIG. **6** depicts moveable louvers applied on top of the horizontal fan of FIG. **5**, wherein the louvers are shown in a closed position.

[0021] FIG. **7** depicts the movable louvers of FIG. **6**, wherein the louvers are shown in an open position.

DETAILED DESCRIPTION OF THE INVENTION

[0022] The terms 'fan,' 'rotor' and 'propeller' may be used interchangeably herein.

[0023] FIG. **1** illustrates the structural features of one preferred refinement of the battery-electric aircraft **10** according to aspects of the invention, the heat management of which can be regulated via the airfoil **12** which is distributed substantially to its wings on both sides.

[0024] To this end, in addition to a high voltage battery **11** which is used for the drive, the aircraft **10** has heat conducting elements **13** which connect the battery **11** thermally to the airfoil **12** in such a way that the heat which is unavoidably produced in the battery **11** during flying operation is distributed as homogeneously as possible to the airfoil **12**. The airfoil **12** which is flowed around to a pronounced extent during flying acts as a heat exchanger in this way.

[0025] Guide plates **14**, silicone, mica, aluminum oxide or other ceramic, polyimide (Kapton®), metal foil or graphite foil may be used, for example, as heat conducting elements **13**.

[0026] FIGS. **2-4** depict an aircraft **100**. The aircraft **100** shown in those figures may appear different from the previously described aircraft, however, many (if not all) of the details of the previously described aircraft also apply to aircraft **100**.

[0027] The aircraft **100** includes foldable wings **102**. The wings **102** are shown in a folded configuration in FIG. **4** and an extended configuration in FIG. **3**. A motor or solenoid is configured to move the wings between those configurations.

[0028] Rear propellers **104** are mounted on the trailing edge of the airfoils or wings **102** (i.e., the edge furthest from the nose **105**). Propellers **104** may be referred to as cruising propellers because they are used during the cruising operation of the aircraft (at least in one position of the propellers **104**). The propellers **104** are configured to pivot between two different positions, as shown in FIGS. **2-4**. In the vertical position of the propellers **104** shown in FIG. **3**, the propellers **104** generate maximum horizontal thrust for cruising operation of the aircraft (i.e., while the aircraft is flying through the air). In the horizontal position of the propellers **104** shown in FIG. **4**, the propellers **104** generate maximum vertical thrust for take-off and landing operations of the aircraft. A motor or solenoid is configured to move the propellers **104** between those two positions. Alternatively, the propellers **104** may be immovable and fixed in a vertical position, as shown in FIG. **2**.

[0029] Horizontally mounted propellers **106** are fixedly mounted and integrated into the wings **102**. Unlike the propellers **104**, the position of the propellers **106** is fixed, however, those skilled in the art will recognize that the propellers **106** could be modified so that they are pivotable between vertical and horizontal positions. The propellers **106** generate maximum vertical thrust for take-off and landing operations of the aircraft. The propellers **106** may also be referred to herein as lifting propellers.

[0030] The propellers **104** and **106**, which may also be referred to herein as fans, may be operated by a fully-electric drive. To that end, a battery charging system **108** including a charger, an inverter and a fast-charging battery are positioned within the fuselage of the aircraft for powering the propellers **104** and **106**. The fuselage may also be configured to carry one or more passengers.

[0031] FIGS. **5-7** depict views of an aircraft **200**. The aircraft **200** shown in those figures may appear different from the previously described aircraft **100**, however, most (if not all) of the details of the previously described aircraft **100** also apply to aircraft **200**. Only a segment of the aircraft **200** is shown in FIG. **5**. An air duct **210** extends between an opening **212** formed on the nose **214** of the aircraft **200** and the horizontally mounted propeller **206** that is fixedly mounted to the wing **202**. In operation, air is delivered to the propeller **206** via the duct **210**, as depicts by the arrows. Although not shown, air ducts that are similar to duct **210**, may extend to the propeller **206** on the opposite wing **202**, as well as any rear propellers **104** (not shown in these views). Accordingly, the propellers may be referred to as either "ducted propellers" or "ducted fans."

[0032] FIGS. **6** and **7** depict louvers **216** that are configured to selectively cover the horizontally mounted propellers **206**. It is noted that the louvers **216** are omitted from FIG. **5** for clarity purposes. Each louver **216** is rotatable about a shaft (or otherwise moveable) between a closed position (FIG. **6**) and an open position (FIG. **7**). The louvers **216**, which are flush with the top face of the wing **202**, may be moved to the closed position during the cruising operation of the aircraft **200** for aerodynamic purposes. The louvers **216** may be moved to an open position at any time during operation of the propellers **206** to permit the exit or entrance of air therethrough. A motor or solenoid is configured to move the louvers **216** between those positions. It is to noted that the louvers are shown in a closed position in FIG. **2**.

[0033] A sealing ring **218** surrounds the louvers **216** and is moveable between a retracted position (FIG. **6**) and a deployed position (FIG. **7**). The louvers **216** are mounted to the sealing ring **218** and move therewith between the retracted and deployed positions. The lower surface of the sealing ring **218** is configured to be in sealing relationship with an opening **220** formed in the wing **202**. It should be understood that the opening **220** accommodates the body of the propeller **206**. The sealing ring **218** may be moved to the retracted position, which is flush with the top face of the wing **202**, during cruising operation of the aircraft **200** for aerodynamic purposes. Alternatively, the sealing ring **218** may be moved to the deployed (i.e., extended) position at any time during operation of the propellers **206** to permit the exit or entrance of air, as depicted by the arrows in FIG. **7**. A motor or solenoid is configured to move the sealing ring **218** between those positions.

What is claimed is:

1. An aircraft comprising a battery, an airfoil and heat conducting elements, wherein the heat conducting elements thermally connect the battery to the airfoil in such a way that heat, which is produced in the battery, is distributed to the airfoil.

2. The aircraft as claimed in claim **1**, wherein the heat conducting elements comprise guide plates.

3. The aircraft as claimed in claim **1**, wherein the heat conducting elements comprise graphite foil.

4. The aircraft as claimed in claim **1**, wherein the aircraft has a fully electric drive.

5. The aircraft as claimed in claim **1**, wherein the aircraft comprises folded or foldable airfoils.

6. The aircraft as claimed in claim **1**, wherein the aircraft comprises a chargeable battery system.

7. The aircraft as claimed in claim **1**, wherein the aircraft comprises horizontally fixed ducted fans for take off and landing.

8. The aircraft as claimed in claim **7**, wherein the aircraft has louvers, and the louvers are configured to selectively cover the horizontal ducted fans.

9. The aircraft as claimed in claim **1**, wherein the aircraft comprises vertically fixed ducted fans for generating propulsion.

10. The aircraft as claimed in claim **1**, wherein the aircraft is configured to be selectively controlled in a fully autonomous manner.

* * * * *

US 20200009974A1

(19) United States
(12) Patent Application Publication
(10) Pub. No.: US 2020/0009974 A1
(43) Pub. Date: Jan. 9, 2020
Bender et al.

(54) POWER SUPPLY FOR AN AIRCRAFT AND CORRESPONDING AIRCRAFT

(71) Applicant: **Dr. Ing. h.c. F. Porsche Aktiengesellschaft**, Stuttgart (DE)

(72) Inventors: **Stefan Bender**, Löchgau (DE); **Mikel Fauri**, Ludwigsburg (DE)

(73) Assignee: **Dr. Ing. h.c. F. Porsche Aktiengesellschaft**, Stuttgart (DE)

(21) Appl. No.: **16/460,442**

(22) Filed: **Jul. 2, 2019**

(30) **Foreign Application Priority Data**

Jul. 4, 2018 (DE) 102018116164.6

Publication Classification

(51) **Int. Cl.**

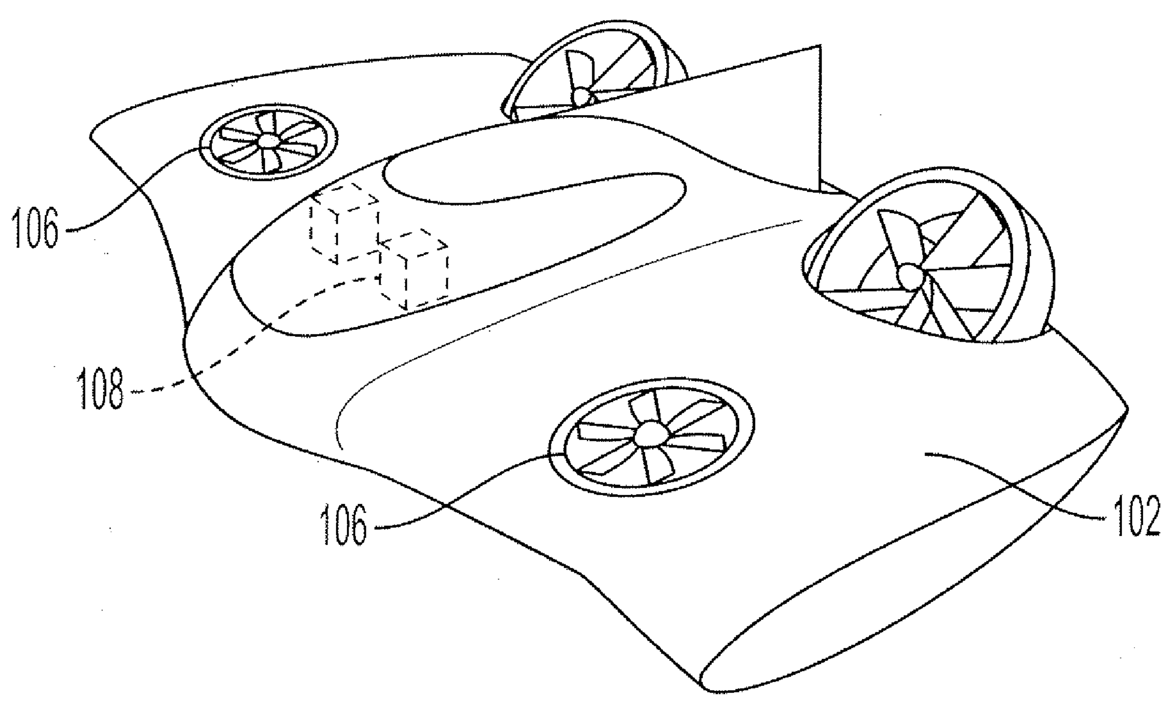
B60L 53/18	(2006.01)
B64C 39/02	(2006.01)
B64C 29/00	(2006.01)
B64C 3/54	(2006.01)
B64D 27/24	(2006.01)
B60L 53/16	(2006.01)

(52) **U.S. Cl.**

CPC ***B60L 53/18*** (2019.02); ***B64C 39/024*** (2013.01); ***B64C 29/0025*** (2013.01); *B60L 2210/10* (2013.01); ***B64D 27/24*** (2013.01); ***B60L 53/16*** (2019.02); *B60L 2200/10* (2013.01); ***B64C 3/546*** (2013.01)

(57) **ABSTRACT**

A power supply for an aircraft includes a drone capable of flight and including rotors, a DC-to-DC converter, a battery for driving the rotors and a locking device for securing a plug connection between the drone and the aircraft. The drone is set up to secure the plug connection by the locking device until the aircraft reaches a prescribed altitude, and the power supply is configured in such a way that the battery supplies power to the aircraft by the DC-to-DC converter as long as the plug connection exists.



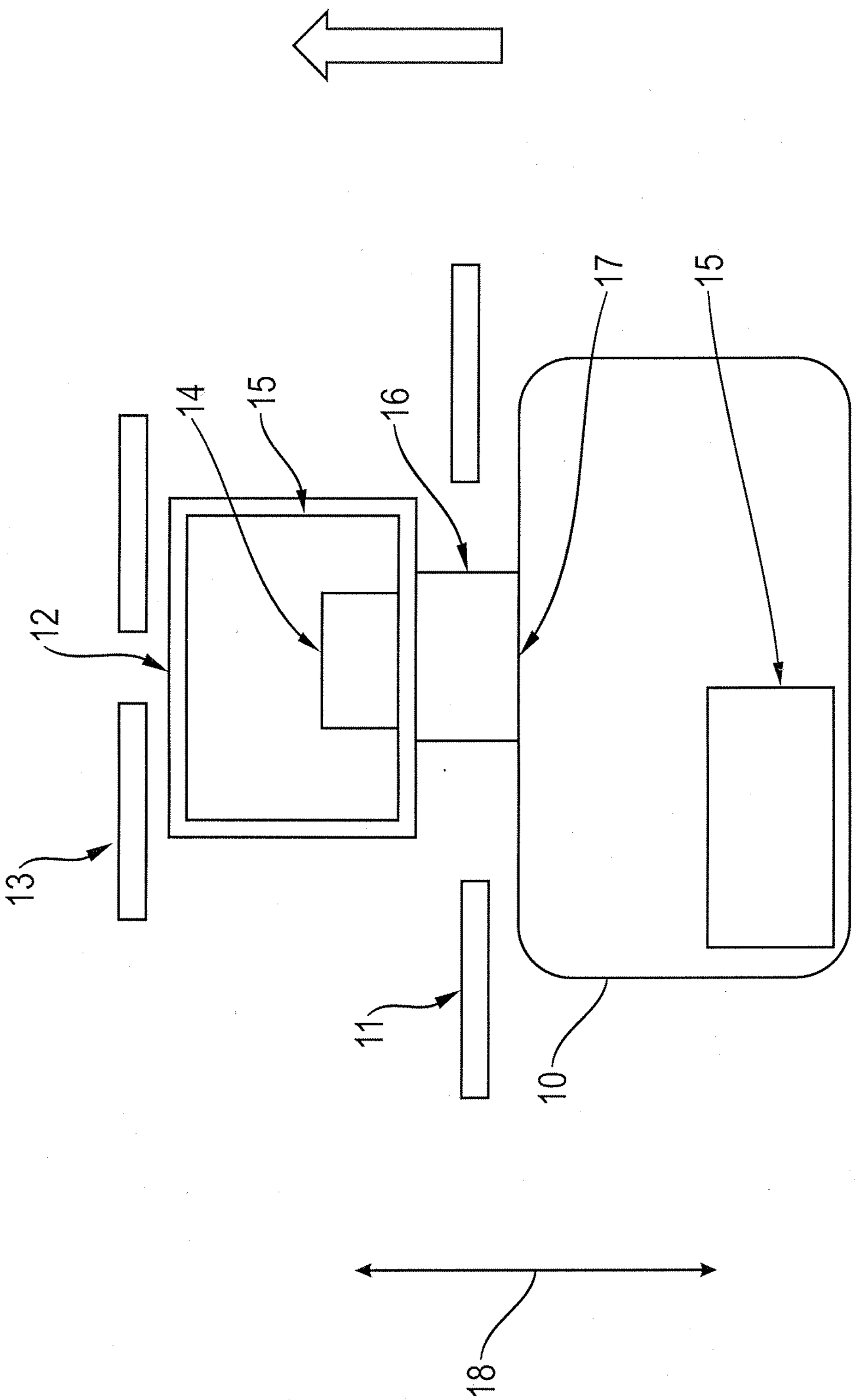


Fig. 1A

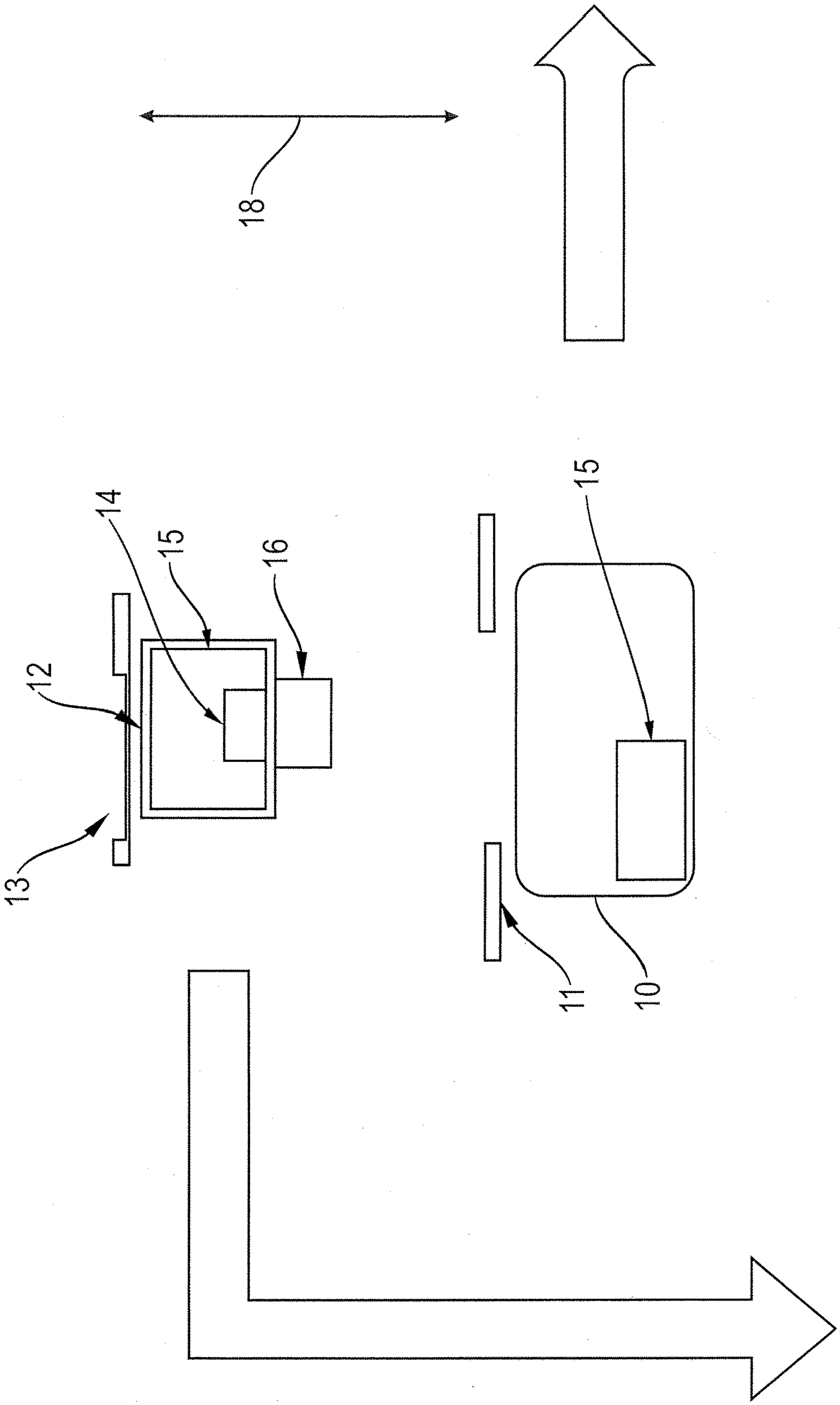


Fig. 1B

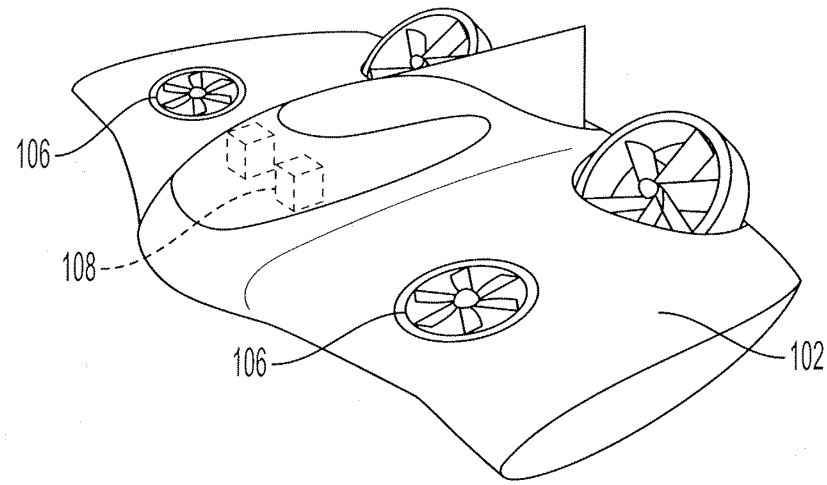


FIG. 2

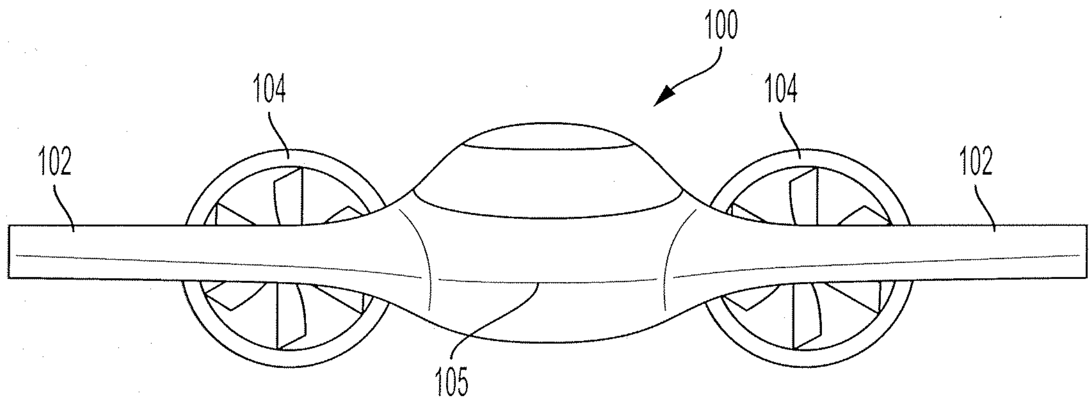


FIG. 3

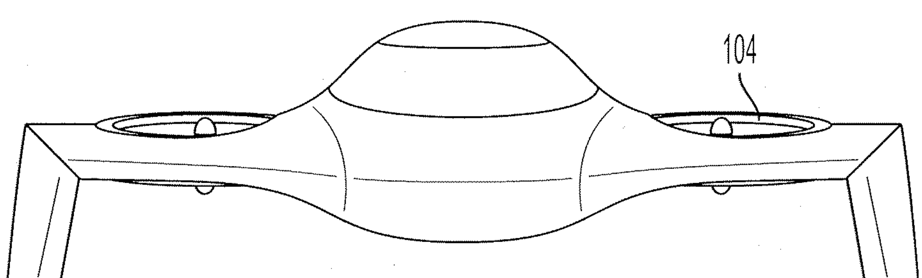


FIG. 4

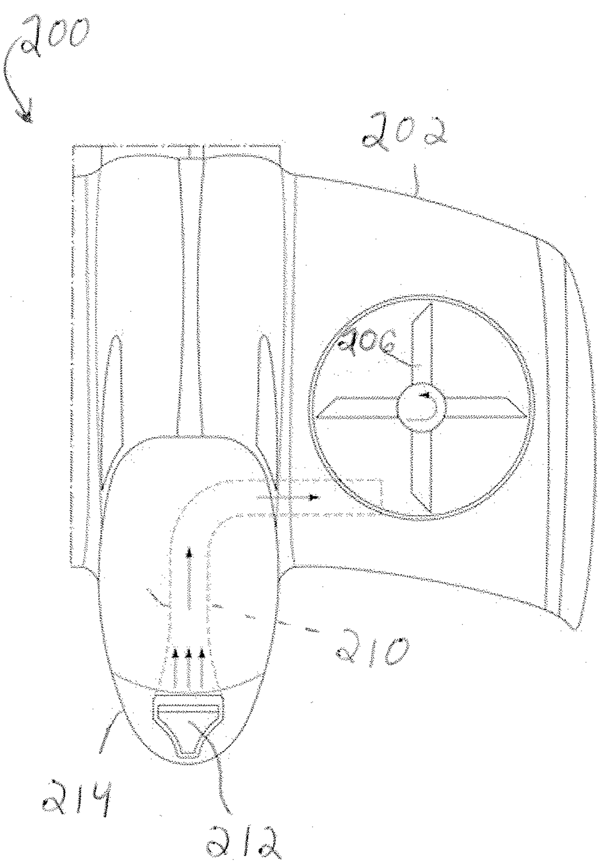


FIG. 5

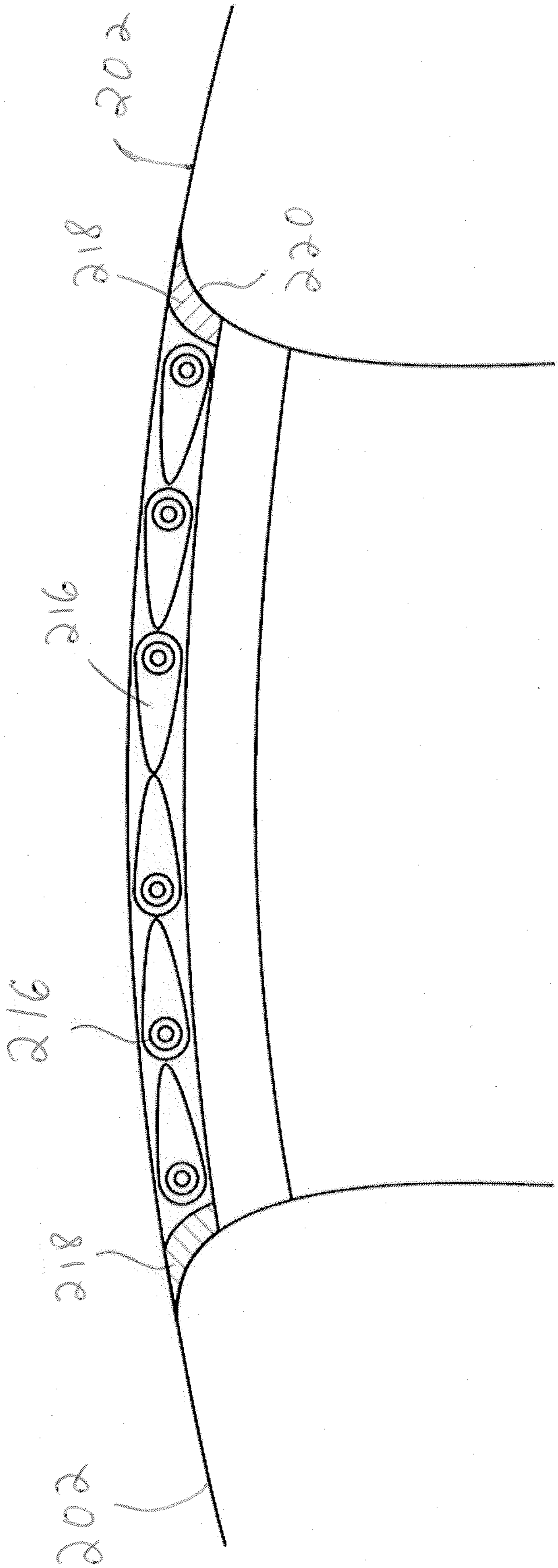


FIG. 6

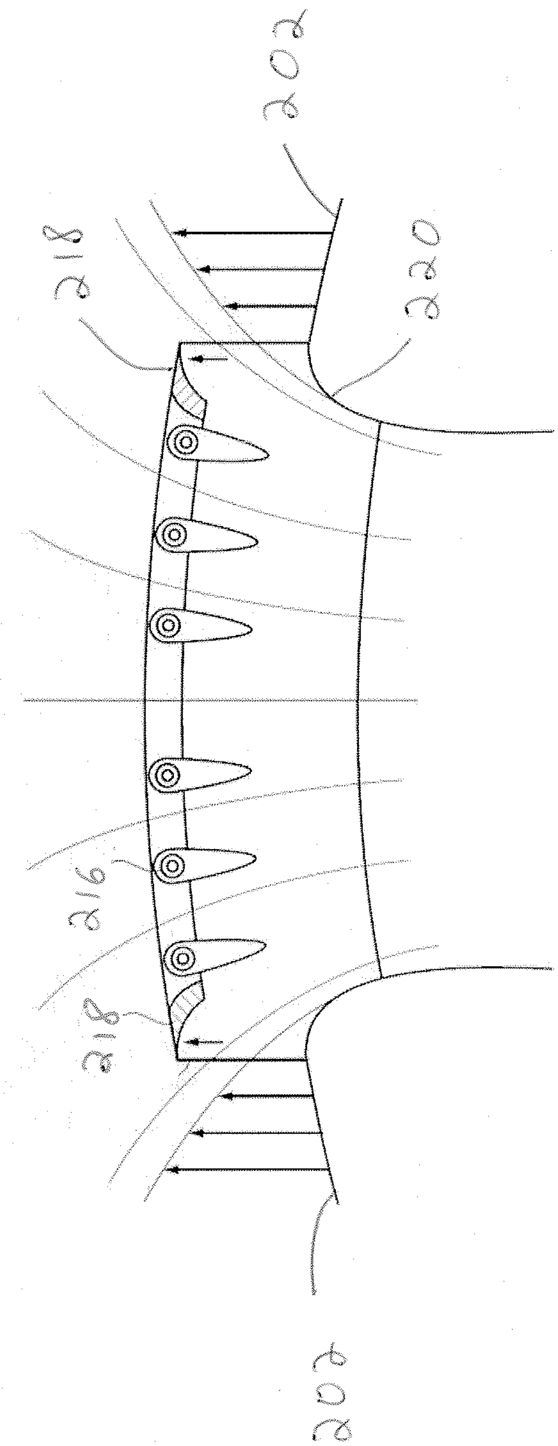


FIG. 7

POWER SUPPLY FOR AN AIRCRAFT AND CORRESPONDING AIRCRAFT

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims priority to German Patent Application No. 10 2018 116 164.6, filed Jul. 4, 2018, the content of such application being incorporated by reference herein in its entirety.

FIELD OF THE INVENTION

[0002] The present invention relates to an aircraft, in particular a fully electric vertical take-off and landing (VTOL) aircraft. The invention also relates to a corresponding power supply.

BACKGROUND OF THE INVENTION

[0003] VTOL is the cross-language name given in the aerospace industry to any type of aircraft, drone or rocket that has the capability of lifting off and landing again substantially vertically and without a runway. This collective term is used below in a further sense that includes not just fixed-wing aircraft with wings, but rather also rotary-wing aircraft such as helicopters, gyrocopters, gyrodynes and hybrids such as composite or combination helicopters and convertiplanes. Short take-off and landing (STOL) aircraft, short take-off and vertical landing (STOVL) aircraft and vertical take-off and horizontal landing (VTHL) aircraft are also included.

[0004] The power requirement during the take-off and landing phase of a VTOL is high. The battery of an electrically driven VTOL according to the prior art therefore has to meet extremely high requirements not only in terms of its capacity but also in terms of its power density.

[0005] WO 2010/031384 A2, which is incorporated by reference herein, discloses a method for launching a drone by means of a launching catapult, which applies the launching energy, in such a way that the launching catapult is first aligned before the launch. Here, the launching catapult is covered by means of a screen, which is removed only after the alignment and immediately before the launch. DE10 2016 219 473 A1, which is incorporated by reference herein, relates to a drone for docking onto a vehicle. In this case, the drone comprises an energy storage element and a docking device for docking the drone onto the vehicle. Furthermore, the drone comprises at least one communication unit for communication with the vehicle and/or with an external device of a user of the vehicle as well as at least one position identification unit for detecting a position of the user of the vehicle. In this case, the drone is designed, after a predeterminable trigger able to be detected by the communication unit, to identify the position of the user by way of the position identification unit, to undock from the vehicle, to return to the user of the vehicle according to the detected position and to follow said user automatically.

[0006] DE10 2007 003 458 A1, which is incorporated by reference herein, describes a device for automatically supplying energy to a small battery-operated aerial vehicle in order to ensure a virtually uninterrupted use of the aerial vehicle and to avoid constantly providing an operator. For this purpose, a landing and loading platform is provided, which is assigned a battery magazine or underneath which a charging device is provided.

SUMMARY OF THE INVENTION

[0007] To solve the problem outlined above, an alternative energy source that does not contribute to the overall weight of the aircraft is proposed. This proposal is based on the following knowledge: the aircraft equipped with an on-board battery has a mass $M_{eVTOL}+M_{Batt}$ and a rotor surface A_{eVTOL}. For the power $P_{eVTOL/Batt}$ required for lift-off, the following holds true

$$P_{eVTOL/Batt} \sim \frac{1}{A_{eVTOL}} \sim \sqrt{(M_{eVTOL} + M_{Batt})^3}.$$

[0008] When the battery is removed from the aircraft, for the power P_{eVTOL} required for the lift-off thereof, the following holds true

$$P_{eVTOL} \sim \frac{1}{A_{eVTOL}} \sim \sqrt{M_{eVTOL}^3}.$$

[0009] A battery with its own rotors would have a mass $M_{Batt}+M_{overhead}$ and a rotor surface A_{Batt}. In this case, for the power required for lift-off, the following holds true

$$P_{Batt} \sim \frac{1}{A_{Batt}} \sim \sqrt{(M_{Batt} + M_{overhead})^3}.$$

[0010] When the following equation is satisfied, the power required overall for hovering is therefore reduced, with the result that an electrically driven VTOL having a coupled, autonomous flight battery would be advantageous:

$$\frac{A_{eVTOL} + A_{Batt}}{A_{eVTOL}} > \frac{(M_{eVTOL} + M_{Batt} + M_{overhead})^3}{(M_{eVTOL} + M_{Batt})^3}$$

[0011] In view of the foregoing, described herein is an aircraft, in particular a fully electric vertical take-off and landing aircraft in the above sense, and a power supply for such an aircraft according to the independent claims.

[0012] Further advantageous configurations of the invention are specified in the dependent patent claims. The aircraft may thus be equipped for instance with bent or even selectively bendable wings. A corresponding variant increases the effective wing surface in horizontal flight, without however increasing the footprint of the aircraft.

[0013] The aircraft may furthermore have a fast-charging battery system that provides the drive energy for vertical take-off and landing and horizontal flight and allows quick charging of the aircraft when stationary.

[0014] In this case, instead of free-moving rotors, a plurality of ducted fans, including of different sizes, may be used to drive the aircraft, as are known outside of the aerospace industry, for instance for hovercraft or fanboats. The cylindrical housing surrounding the fan may considerably reduce thrust losses caused by vortexes at the blade tips in such an embodiment. Suitable ducted fans may be aligned horizontally or vertically, designed so as to pivot between both positions or be covered by louvers during horizontal flight for aerodynamic reasons. Pure horizontal thrust generation using fixed ducted fans is additionally conceivable.

[0015] Finally, in addition to preferably fully autonomous operation of the aircraft, it is also possible to consider granting manual control to human pilots if they are sufficiently qualified, which gives the device according to aspects of the invention the greatest possible flexibility in terms of handling.

BRIEF DESCRIPTION OF THE DRAWING

[0016] One exemplary embodiment of the invention is illustrated in the drawings and will be described in more detail below.

[0017] FIG. **1**A shows the lift-off of an aircraft according to aspects of the invention.

[0018] FIG. **1**B shows the aircraft before its transition to cruising flight.

[0019] FIG. **2** depicts an isometric view of an aircraft, wherein the wings are shown in an extended configuration and the rear propellers are shown in an angled orientation.

[0020] FIG. **3** depicts a front elevation view of the aircraft of FIG. **2**, wherein the wings are shown extended configuration and the rear propellers are shown in a cruising orientation.

[0021] FIG. **4** depicts another front elevation view of the aircraft, wherein the wings are shown in a folded configuration and the rear propellers are shown in a take-off/landing orientation.

[0022] FIG. **5** depicts a top plan view of a portion of an aircraft, showing an internal duct extending between a nose of the aircraft and a horizontal fan mounted to the wing.

[0023] FIG. **6** depicts moveable louvers applied on top of the horizontal fan of FIG. **5**, wherein the louvers are shown in a closed position.

[0024] FIG. **7** depicts the movable louvers of FIG. **6**, wherein the louvers are shown in an open position.

DETAILED DESCRIPTION OF THE INVENTION

[0025] The terms 'fan,' 'rotor' and 'propeller' may be used interchangeably herein.

[0026] FIGS. **1**A and **1**B, when considered together, illustrate the design features and functional features of a preferred embodiment of the aircraft **10** according to aspects of the invention.

[0027] During the launch illustrated in FIG. **1**A, the rotor systems **11**, **13** that are coordinated with one another by means of a communication connection **18** between the aircraft **10** and the drone **12** lift off together. A locking device **17** secures a plug connection **16** between the drone **12** and the aircraft **10**.

[0028] In this case, the aircraft **10** is the master and the drone **12** equipped with its own battery **15** is the slave. Both batteries **15** are connected to one another and supply power to both the aircraft **10** and the rotors **13** of the drone **12**. A DC-to-DC converter **14** on board the drone **12** ensures that the voltages match and controls the flow of energy.

[0029] When the transition altitude is reached, the autonomous battery drone **12** is released and flies back to the ground. The aircraft **10** then continues the flight exclusively using its own on-board battery **15**.

[0030] FIGS. **2**-**4** depict an aircraft **100**. The aircraft **100** shown in those figures may appear different from the previously described aircraft **10**, however, most (if not all) of the details of the previously described aircraft **10** also apply to aircraft **100**.

[0031] The aircraft **100** includes foldable wings **102**. The wings **102** are shown in a folded configuration in FIG. **4** and an extended configuration in FIG. **3**. A motor or solenoid is configured to move the wings between those configurations.

[0032] Rear propellers **104** are mounted on the trailing edge of the airfoils or wings **102** (i.e., the edge furthest from the nose **105**). Propellers **104** may be referred to as cruising propellers because they are used during the cruising operation of the aircraft (at least in one position of the propellers **104**). The propellers **104** are configured to pivot between two different positions, as shown in FIGS. **2**-**4**. In the vertical position of the propellers **104** shown in FIG. **3**, the propellers **104** generate maximum horizontal thrust for cruising operation of the aircraft (i.e., while the aircraft is flying through the air). In the horizontal position of the propellers **104** shown in FIG. **4**, the propellers **104** generate maximum vertical thrust for take-off and landing operations of the aircraft. A motor or solenoid is configured to move the propellers **104** between those two positions. Alternatively, the propellers **104** may be immovable and fixed in a vertical position, as shown in FIG. **2**.

[0033] Horizontally mounted propellers **106** are fixedly mounted and integrated into the wings **102**. Unlike the propellers **104**, the position of the propellers **106** is fixed, however, those skilled in the art will recognize that the propellers **106** could be modified so that they are pivotable between vertical and horizontal positions. The propellers **106** generate maximum vertical thrust for take-off and landing operations of the aircraft. The propellers **106** may also be referred to herein as lifting propellers.

[0034] The propellers **104** and **106**, which may also be referred to herein as fans, may be operated by a fully-electric drive. To that end, a battery charging system **108** including a charger, an inverter and a fast-charging battery are positioned within the fuselage of the aircraft for powering the propellers **104** and **106**. The fuselage may also be configured to carry one or more passengers.

[0035] FIGS. **5**-**7** depict views of an aircraft **200**. The aircraft **200** shown in those figures may appear different from the previously described aircraft **100**, however, most (if not all) of the details of the previously described aircraft **100** also apply to aircraft **200**. Only a segment of the aircraft **200** is shown in FIG. **5**. An air duct **210** extends between an opening **212** formed on the nose **214** of the aircraft **200** and the horizontally mounted propeller **206** that is fixedly mounted to the wing **202**. In operation, air is delivered to the propeller **206** via the duct **210**, as depicts by the arrows. Although not shown, air ducts that are similar to duct **210**, may extend to the propeller **206** on the opposite wing **202**, as well as any rear propellers **104** (not shown in these views). Accordingly, the propellers may be referred to as either “ducted propellers” or “ducted fans.”

[0036] FIGS. **6** and **7** depict louvers **216** that are configured to selectively cover the horizontally mounted propellers **206**. It is noted that the louvers **216** are omitted from FIG. **5** for clarity purposes. Each louver **216** is rotatable about a shaft (or otherwise moveable) between a closed position (FIG. **6**) and an open position (FIG. **7**). The louvers **216**, which are flush with the top face of the wing **202**, may be moved to the closed position during the cruising operation of the aircraft **200** for aerodynamic purposes. The louvers **216**

may be moved to an open position at any time during operation of the propellers **206** to permit the exit or entrance of air therethrough. A motor or solenoid is configured to move the louvers **216** between those positions. It is noted that the louvers are shown in a closed position in FIG. **2**.

[0037] A sealing ring **218** surrounds the louvers **216** and is moveable between a retracted position (FIG. **6**) and a deployed position (FIG. **7**). The louvers **216** are mounted to the sealing ring **218** and move therewith between the retracted and deployed positions. The lower surface of the sealing ring **218** is configured to be in sealing relationship with an opening **220** formed in the wing **202**. It should be understood that the opening **220** accommodates the body of the propeller **206**. The sealing ring **218** may be moved to the retracted position, which is flush with the top face of the wing **202**, during cruising operation of the aircraft **200** for aerodynamic purposes. Alternatively, the sealing ring **218** may be moved to the deployed (i.e., extended) position at any time during operation of the propellers **206** to permit the exit or entrance of air, as depicted by the arrows in FIG. **7**. A motor or solenoid is configured to move the sealing ring **218** between those positions.

What is claimed is:

1. A power supply for an aircraft, comprising:

a drone configured for flight, said drone comprising rotors, a DC-to-DC converter, a battery for driving the rotors and a locking device for securing a plug connection between the drone and the aircraft, wherein the drone is configured to secure the plug connection by means of the locking device until the aircraft reaches a prescribed altitude; and

wherein the power supply is configured in such a way that the battery supplies power to the aircraft by means of the DC-to-DC converter as long as the plug connection exists.

2. The power supply as claimed in claim **1**, wherein the drone is further configured to automatically return to ground level after the prescribed altitude has been reached.

3. The power supply as claimed in claim **1**, wherein the drone is further configured to enter into a communication connection with the aircraft in order to adjust a common flight behavior.

4. The power supply of claim **1** further comprising the aircraft, wherein the aircraft comprises the power supply and a fully electric drive.

5. The aircraft as claimed in claim **4**, wherein the aircraft comprises bent or bendable wings.

6. The aircraft as claimed in claim **4**, wherein the aircraft comprises a fast-charging battery system.

7. The aircraft as claimed in claim **4**, wherein the aircraft comprises horizontally fixed ducted fans for take-off and landing.

8. The aircraft as claimed in claim **7**, wherein the aircraft has louvers, and the horizontal ducted fans are configured to be selectively covered by the louvers.

9. The aircraft as claimed in claim **4**, wherein the aircraft comprises vertically fixed ducted fans for generating a propulsion.

10. The aircraft as claimed in claim **4**, wherein the aircraft is configured to be selectively controlled in a fully autonomous manner.

* * * * *