(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
21 January 2021 (21.01.2021)

(10) International Publication Number
WO 2021/010915 A1

(51) International Patent Classification:
B64C 27/28 (2006.01) *B64C 27/82* (2006.01)
B64C 29/00 (2006.01)

(21) International Application Number:
PCT/TR2020/050436

(22) International Filing Date:
20 May 2020 (20.05.2020)

(25) Filing Language: Turkish

(26) Publication Language: English

(30) Priority Data:
2019/1043 1 12 July 2019 (12.07.2019) TR

(71) Applicant: ASELSAN ELEKTRONİK SANAYİ VE TİCARET ANONİM ŞİRKETİ [TR/TR]; Mehmet Akif Ersoy Mah. 296. Cadde No: 16 Macunkdy, Ankara (TR).

(72) Inventors: ÖZYETİ§, Ender; Aselsan Elektronik Sanayi Ve Ticaret Anonim Sirketi (Mgeo Grubu) Qankrn Yolu 7 Km, Akyurt/Ankara (TR). ÖZCAN, Servet Güçlü; Aselsan Elektronik Sanayi Ve Ticaret Anonim Sirketi (Mgeo Grubu) Çankin Yolu 7 Km, Akyurt/Ankara (TR). GL̈TNER, Diinya Rauf Levent; Aselsan Elektronik Sanayi Ve Ticaret Anon¬im §irketi Çankrn Yolu 7. Km, Ankara (TR).

(74) Agent: DESTEK PATENT INC.; Konak Mahallesi İzmir Yolu Cad. Ruzi İş Merkezi No:95/l B, 161 10 Nilufer/Bursa (TR).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, WS, ZA, ZM, ZW.

(54) **Title:** A MULTI-FUNCTION UNMANNED AERIAL VEHICLE WITH TILTING CO-AXIAL, COUNTER-ROTATING, FOLDING PROPELLER SYSTEM

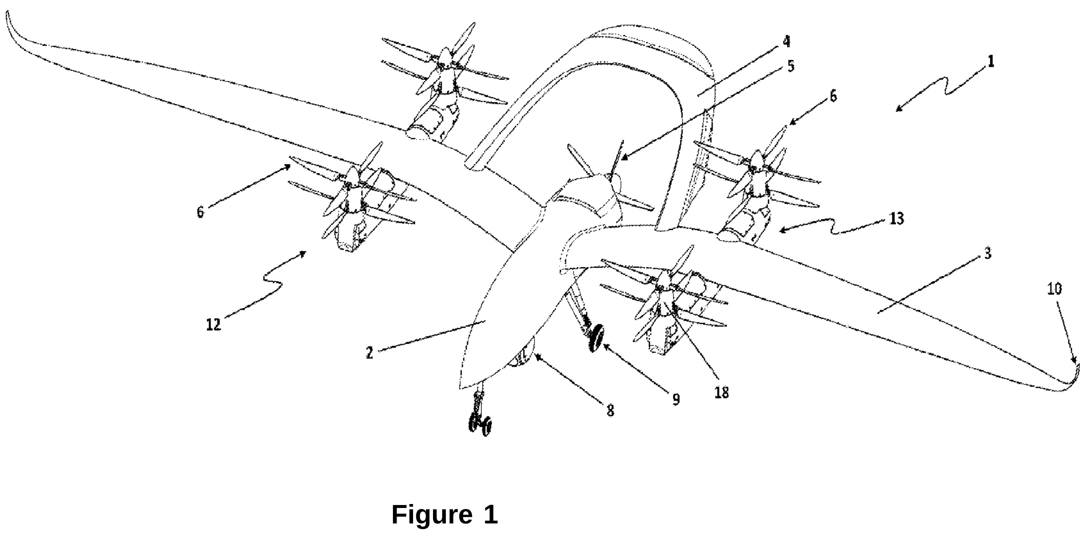

Figure 1

(57) Abstract: The invention relates to an aerial vehicle (1) with fixed wings (3), tilting coaxial, counterrotating propellers, having electric propulsion systems, a hybrid drive (electric / internal combustion), which can perform vertical take-off and landing, very short take-off and landing, and conventional take-off and landing by utilizing electric powered propulsion systems with tillable coaxial counterrotating propeller systems, Different flight modes can be performed in different situations due to wing compartments (11) with electrically driven front and rear propulsion groups (12, 13), that can be attached to and removed from the wings (3).

WO 2021/010915 A1

[Continued on next page]

(84) **Designated States** *(unless otherwise indicated, for every kind of regional protection available)* **:** ARIPO (BW, GH, GM, KE, LR, LS, MW, *ML*, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, Cl, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report (Art. 21(3))*

— *in black and white; the international application as filed contained color or greyscale and is available for download from PATENTSCOPE*

A MULTI - FUNCTION UNMANNED AERIAL VEHICLE WITH TILTING CO - AXIAL, COUNTER - ROTATING, FOLDING PROPELLER SYSTEM

Technical Field

This invention is related to a VTOL/VSTOL/CTOL capable dual hybrid (electric/internal combustion powered and fixed wing cruise vertical takeoff/landing) unmanned aerial vehicle with conventional internal combustion or electric powered silent flight capability, thanks to tiltable 4x2 coaxial counter rotating, folding propeller systems which are mounted on two removable ,pods.

Prior Art

In the current technique, there are multiple types of unmanned aerial vehicles used for vertical takeoff and landing. These may be a “helicopter type” having one or more main rotors and some form of tail rotors, “tilt rotor type” which can change the angle of engines or propellers, “tilt wing type” which changes the direction of wings together with the wing mounted engines/propellers, tail sitter type which take off vertically along longitidunal axis, whose thrust is provided by longitudinal thrust group after takeoff. . Hybrid systems have been developed in recent years with the addition of electric motors for vertical take - off at least at 3 or 4 stations to fixed - wing air vehicles in unmanned aircraft.

In helicopter type systems, flight speed, endurance and the range are low, and the mechanical failure rate is high due to the large number of fixed and moving parts involved.

Tilt - rotor type systems generally have large motors that can be tilted or propeller groups that can be tilted by means of the shaft running along the wing connected to the single motor located in the center. Tilt - rotor systems do not have an effective reverse thrust capability for very short runway landings. Due to the extra weight of the propulsion system installed in the wing in the tilt - rotor systems, and its effects on the structure of the wing and on the balance and control characteristics of the aircraft, the wing span cannot be kept wide enough.. This increases aerodynamic losses and shortens the flight time.

Tilt - wing type systems have mechanisms that can be tilted together with the wing. Wind resistance at the takeoff is relatively low. Similar to tilt - rotor type systems, They have a relatively short flight time because of the aerodynamic losses due to their short wingspan.

Tail - sitter type systems can only do vertical takeoff and landing. they have problems in terms of control and safety.

In hybrid systems, longitudinal thrust motors and vertical thrust motors are different from each other. Vertical thrust motors with at least 3 or 4 units become idle after take-off, propeller groups that remain in a position perpendicular to the direction of flight increase the drag force. In systems with 3 or 4 vertical take - off propulsion motors / propellers, if one of the vertical propulsion units fails, the mission cannot be completed so that the sortie ends with an emergency landing or loss of aircraft. Since vertical takeoff propulsion systems with electric motors are not generally used in horizontal flight, systems with internal combustion main propulsion engines are not capable of silent operation. If an electrical system is used in addition to the main propulsion engine, the range of the system and endurance decreases.

The application numbered US20160288903A1 in the prior art refers to a system that has an aerodynamically driven propulsion steering system, capable of short - distance landing take - off, vertical landing take - off and / or conventional landing take - off. The thrust system of the application can switch between different flight modes. Thanks to its design, the system has features such as high lift capacity, low drag, low weight, good stability at low and high speeds, and low noise.

Another application CN1 06586001 A in prior art relates to the technical field of unmanned aerial vehicles and particularly relates to an unmanned aerial vehicle with a tailed flying wing configuration, which has a plurality of working modes such as vertical take - off and landing / short - distance take - off and landing / conventional take - off and landing / low - speed forward flight / high - speed forward flight and the like. The said unmanned aerial vehicle has propulsion systems consisting of two 360 - degrees rotating fans, one fixed fan which is powered by an internal combustion engine, and one fixed fan, which is positioned on the back of the aircraft, that is basically built into the air vehicle body designed as a flying wing. According to this, it provides various advantages such as the flying wing and the improved aerodynamic properties brought by the tail structure integrated with the wing attached to this structure and the high effective load factor of the conventional wing structure.

However, when both applications are examined, it can be seen that an unmanned aerial vehicle with internal combustion or electric propulsion, capable of silent flight, capable of prolonged flight, with tiltable coaxial counter - rotation propeller, with dual hybrid structure, (electric / internal combustion and fixed - wing conventional flight / vertical takeoff / landing) capable of vertical takeoff/landing (VTOL), very short runway takeoff/landing (VSTOL), conventional takeoff/landing (CTOL) and which can continue its duty in case of failure of any propulsion unit has not been revealed.

As a result, due to the above - mentioned drawbacks and the inadequacy of the existing solutions, an improvement in the technical field has been required.

The Purpose of Invention

The invention relates to an unmanned aerial vehicle with internal combustion or electric propulsion, silent flight capability, removable double pod mounted, with tilting 4x2 coaxial counterrotating, folding propeller systems, with dual hybrid (electric / internal combustion and fixed - wing flight / landing) capable of vertical take-off/landing (VTOL), very short runway take-off/landing (VSTOL), conventional take-off/landing (CTOL). With the invention, the advantages of tilt-rotor type systems and hybrid systems are combined. Thus, nine different types of flights become possible.

In the system of the present invention, the coaxial - counter - rotating propeller groups can be held in a horizontal or vertical position by a tilting mechanism, but also at a desired angle. Thus;

- When the front propeller group is placed in a horizontal position, the internal combustion engine, which produces more noise than the electric motor, is switched off and a silent flight, powered with only electricity can be made. Thus, in military applications that require silent observation, silent operation can be carried out for a certain period in the enemy region.
- Thanks to the use of solar panels and electric motor / propeller groups of it on conventional flight, electric powered flight can be made in certain parts of the flight and flight time is increased. This feature is not available in other hybrid UAV systems.
- The generator of the internal combustion motor and solar panels can charge the batteries of the electric motors. In this way, in certain parts of the flight, the internal combustion engine can be stopped and electric powered flight portion can be increased.

- In case of an internal combustion engine failure, it is possible to return to base by performing an electric powered flight for up to an hour with the front electric motors. This feature is not available in other hybrid systems that cannot tilt their engines.
- The system can perform VSTO - Very Short Take - off and very short runway landings in high altitude and hot weather conditions where vertical takeoff and landing can be difficult. For take offs, the front propeller groups are operated in horizontal position to support take off and climb. In very short runway landing, the front electric motors are closed while the rear electric motor group produces effective reverse thrust, reducing the landing distance.

Due to capability of adjustment of the positioning of the motor groups as horizontal or vertical to adopt to the streamline, the drag force encountered in horizontal flight is less than the other hybrid (fixed - wing aircraft capable of vertical takeoff / landing) systems.

The folding propeller groups were made to be opened by electric motor rotation and closed by airflow. Thus, they provide less drag force than other hybrid systems when they are placed in a horizontal streamlined position when not in use, such as in modes where the aircraft is cruising with internal combustion engine power only. Each vertical / horizontal tilting station in the system has coaxial propeller groups with counter - rotation. In this way, the system can continue to operate even if one of the electric motors or propellers is disabled or failed. If two propellers / motors are disabled, the system can continue to operate in certain combinations and can execute emergency vertical landings in each failure combination. Even if all of the electric motors (8 units) are disabled, the system can perform conventional landing on a runway.

The propeller groups with coaxial counter - rotation, provide more thrust per unit station than systems with 4 vertical propulsion groups. In addition, the counter - rotating propeller system is more compact than the propulsion systems that have the same number of single structures, without coaxial counter - rotation motors and propellers. This is advantageous by producing less aerodynamic drag force, especially when the vertical thrust units are not in use such as in cruise phase.

In order to accomplish the above - mentioned objectives, the invention is an aerial vehicle comprising at least two semi - elliptical wings extending on either side of a main body, a tail extending between the wings, a pusher type fuselage propeller positioned at the rear of the main body, a propulsion element located in the main body and powering the fuselage propeller and able to perform very short runway takeoff/landing, conventional takeoff/landing, and vertical takeoff/landing. Air vehicle is further comprising,

- wing compartments that are mounted on the wings,
- front propulsion groups located in the front part of the wing compartments, which provide forward or upward thrust depending on their positioning,
- rear propulsion groups located in the rear part of the wing compartments, which provide backward or upward thrust depending on their positioning,
- tilting mechanisms located at the tips of the wing compartment that move the front and rear propulsion groups between the vertical and horizontal axis,
- electric motors moving wing propellers in the front and rear propulsion groups(1 2, 13), located within the wing compartment,
- motor control elements controlling electric motors and tilting mechanisms,
- shafts transferring the rotational motion generated by the electric motors to the wing propellers.

The structural and characteristic features and all advantages of the invention will be understood clearly by the drawings below and in the detailed description made by referring these figures Therefore, the evaluation should be made considering these figures and detailed explanations.

Description of Figures

Figure 1 is a front perspective view of the aerial vehicle of the invention.

Figure 2 is a detailed view of the wing compartment mounted on the wings of the aerial vehicle of the invention.

Figure 3 is a detailed view of the front propulsion group in the wing compartment.

Figure 4 shows the wing compartment with the propulsion groups in the vertical position with the wing propellers open.

Figure 5 shows the condition of the front and rear propulsion groups in the case of very short runway take - off and electrically assisted climbing and cruise.

Figure 6 shows the condition of the front and rear propulsion groups in the case of very short runway landing.

Figure 7 shows the integrated wing - tail configuration and folded wings.

Figure 8 shows the solar panels placed on the wing and tail sections of the aerial vehicle.

Figure 9 is the view of the aerial vehicle with propulsion groups in horizontal position and wing propellers closed. i.e in the case of conventional take off cruise and landing phases with internal combustion engine only.

Figure 10 is the view of the aerial vehicle with propulsion groups positioned for a very short runway landing.

Figure 11 is the view of the aerial vehicle with propulsion groups positioned for very short runway take - off and electrically assisted climbing and cruise.

Reference Numbers

1. Aerial vehicle
2. Main body
3. Wing
4. Tail
5. Fuselage propeller
6. Blade
7. Solar panel
8. Payload
9. Landing gear
10. Winglet
11. Wing compartment
12. Front propulsion group
13. Rear propulsion group
14. Power Supply (Battery)
15. Motor control element
16. Electric motor
17. Mounting point
18. Wing propeller
19. Folding mechanism

20. Shaft
21. Inner shaft
22. Tilting mechanism
23. Spring
24. Stopper

Detailed Description of the Invention

In this detailed description, preferred structures of the invention are explained only for a better understanding of the subject matter and without any restrictive effect.

The invention shown in Figure 1 is a fixed wing hybrid type (fixed wing with VTOL capability), hybrid drive (internal combustion/electric) unmanned aerial vehicle (1), which can perform vertical takeoff and landing, very short takeoff and landing, and conventional takeoff and landing, by utilizing electric powered propulsion systems with tiltable coaxial counter rotating propeller systems. In this small UAV class aerial vehicle (1), there are semi - elliptical wings (3) with a folding structure and a positive dihedral angle. Between the two wings (3) is the tail (4) part integrated into the wings (3). At the centerline of the aircraft (1), i.e. the main fuselage where the wings (3) are fixed (2) there is a propulsion element with a pusher type fuselage propeller (5) and preferably an internal combustion engine. payloads (8) such as EO / IR (electro - optical / infrared), ADS - B (automatic dependent surveillance - broadcasting), AIS (automatic identification system), etc. are carried in the main body (2). The main body (2) also has front - controlled inward - retractable landing gear (9), preferably with 3 wheels. At the ends of the wings (3), the winglets (10) are formed.

Approximately in the middle section of both wings (3) are two wing compartments (11), which are given a detail view in Figure 2 and can be mounted on the aerial vehicle (1) from the mounting point (17). The mounting point (17) on the wing compartment (11) allows the wing compartment (11) to be secured to the bottom of the wing (3). Electric - powered front and rear propulsion groups (12, 13) are available in each of these compartments (11). In one embodiment of the invention, there are two power sources (14) in one wing compartment (11) that can back up each other when needed, along with 4 motor control elements (15), 4 electric motors (16) and 4 wing propellers (18) with 4 blades. (6).

Of the total of 4 electric front and rear propulsion groups (12, 13) in the aerial vehicle (1), each consist of two consecutive BLDC (brushless direct current) electric motors (16) which drive the inner shaft (21) within the shaft (20), and 2 4 - bladed (6) wing propellers (18) that fold axially with the airflow towards the opposite direction of flight, which are driven in opposite directions by the electric motors (16). The inner shaft (21), which is connected to the the outer wing propeller (18) in the front and rear propulsion groups (12, 13), extends from the inside of the said shaft (20) Each propulsion group can be positioned vertically and horizontally according to the wing compartment (11) by means of a tilting mechanism (22). It is also possible to bring the propulsion groups to the desired angle within the specified position range.

When the co - axial counter - rotating wing propellers (18) in the propulsion groups are operated sequentially; first, the front propellers (the front and rear definitions are with respect to air vehicle (1) longitudinal axis, positive from stern to bow.) unfold (opened), and then the rear propellers are unfold (opened) under the effect of centrifugal force. When the propulsion groups are placed in a horizontal position, the electric motor (16) stops and the airflow closes first the propeller at the rear and then the propeller at the front. As shown in Figure 3, there are stoppers (24) and springs (23) between the wing propellers (18) in the same propulsion group.

As shown in Figure 4, in the case of vertical take - off of the aerial vehicle (1), all propulsion groups are open and facing up. After the take - off stage, the transition phase from four - propeller mode to fixed wing mode begins with the power of the internal drive element. When the stall speed is exceeded, the electric front and rear propulsion stations (12, 13) are moved to the horizontal position.

If, only the internal combustion engine propulsion element is to be used during the climbing phase, the front and rear propulsion groups (12, 13) are in a horizontal position while the propellers (18) in the front and rear propulsion groups (12, 13) are stopped, similar to Figure 2 and Figure 9, and the propeller blades (6) produce less drag force against the direction of flight. If additional thrust force is required during the climbing and cruise stages, the front propulsion group (12) continues to operate in a horizontal position as shown in Figure 5 and Figure 11. Thus, flight can be carried out in high altitude conditions.

In cases where silent navigation is required, the main internal combustion propulsion element is turned off, and the electric motors (16) perform a silent flight for a while with the energy provided by the power supply (14) and the solar panels (7) placed on the tail (4) and the wing (3).

If the propulsion element of the internal combustion engine fails and cannot be restarted during flight, the aerial vehicle (1) can continue flying using only the electric - powered front propulsion group (12). The aerial vehicle (1) can return to the base according to the power supply (14) and if the remaining power supply (14) is sufficient it may perform a vertical landing, but if not, a very short runway landing or conventional landing can be performed.

For vertical landing, all front and rear propulsion groups (12, 13) are operated with the front - rear order while in horizontal position and brought to the vertical position. The propulsion element can be activated when the aerial vehicle (1) is landing on a ship, in other cases it can be turned off or operated at idling.

In flight stages where only the propulsion element is used, all front and rear propulsion groups (12, 13) are folded in horizontal position. In very short runway landings, as shown in figure 6 and figure 10, the rear propulsion groups (13) produce reverse thrust, reducing the final approach speed of the aircraft (1) and the running speed on the runway in a very short time. Meanwhile, the propeller blades (6) in the front propulsion groups (12) are kept in a closed position. Conventional landing can be used when the front and rear propulsion sets (12, 13) are in horizontal position and the blades (6) are folded in case there is an appropriate length of runway and vertical landing is not possible due to various failures.

Very short runway take - off can be made with electric support by operating the front propulsion groups (12) in horizontal position. Since the thrust capacity of the vertical propulsion units is much greater than that of the main internal combustion propulsion element in the main body (2) and the propeller (5), the extra thrust provided by the front propulsion groups (12) makes it possible to perform a very short runway take - off. Conventional takeoff, conventional climbing, and conventional flight can be done in the appropriate length tracks by keeping front propulsion groups (12) closed in a horizontal position.

The aerial vehicle (1) has an avionics battery that drives avionics systems, and preferably 4 power sources (14) that drive electric motors (16) which can back each other up in pairs. The battery and power supplies (14) can be charged with a generator connected to the drive element, as well as solar panels (7) integrated into the wings (3) and tail (4). Power supplies for vertical landing (14) can be recharged in a short time according to generator capacity. In this way, the flight time can be extended by adding electric - powered silent flight phases.

The aerial vehicle (1) is able to perform vertical take - off, conventional take - off, very short runway take - off, conventional climbing, electric - assisted climbing, conventional cruise, electric - powered cruise, silent cruise, very short runway landing, conventional landing, and vertical landing modes and capabilities.

The aircraft (1) contains a folding point (19) which is formed on the wing (3) and folds correctly on its own from the tip of the wing (3) in the direction of the main body (2) in order not to take up space, while the wings (3) are kept ready for flight in restricted storage areas such as ships, etc.

CLAIMS

1. An aerial vehicle (1) comprising at least two semi - elliptical wings (3) extending on either side of a main body (2), a tail (4) extending between the wings (3), a fuselage propeller (5) positioned at the rear of the main body (2), a propulsion element located in the main body (2) and rotating the fuselage propeller (5) and able to perform very short runway takeoff and landing, conventional takeoff and landing, and vertical takeoff and landing, characterized by further comprising;

- wing compartments (11) that can be mounted on the wings (3),
- front propulsion groups (12) located in the front part of the wing compartments (11), which perform forward or upward movement depending on their positioning,
- rear propulsion groups (13) located in the rear part of the wing compartments (11), which perform backward or upward movement depending on their positioning,
- tilting mechanisms (22) located at the tips of the wing compartment (11) that moves the front and rear propulsion groups (12, 13) at a 90 - degree angle between the vertical and horizontal axis,
- electric motors (16) moving wing propellers (18) in the front and rear propulsion groups (12, 13), located within the wing compartment (11),
- motor control elements (15) controlling electric motors (16) and tilting mechanisms (22),
- shafts (20) transferring the rotational motion generated by the electric motors (16) to the wing propellers (18).

2. The aerial vehicle (1) according to claim 1, wherein; comprising a folding point (19) which is formed on the wing (3) and folds correctly on its own from the tip of the wing (3) in the direction of the main body (2).

3. The aerial vehicle (1) according to claim 1, wherein; comprising a mounting point (17) on the wing compartment (11) allows the wing compartment (11) to be secured to the bottom of the wing (3).

4. The aerial vehicle (1) according to claim 1, wherein; comprising solar panels (7) integrated into the wings (3) and tail (4).

5. The aerial vehicle (1) according to claim 1, wherein; the front and rear propulsion groups (12, 13) comprise two both - sided wing propellers (18).

6. The aerial vehicle (1) according to claim 5, wherein; comprising inner shaft (21), which is connected to the outer wing propeller (18) and shaft (20) which is connected to the inner wing propeller (18) in the front and rear propulsion groups (12, 13), where inner shaft (21) extends from the inside of the said shaft (20) and transfers the rotational motion of the shaft (20) to the outer wing propeller (18).

7. The aerial vehicle (1) according to claim 1, wherein; the said propulsion element is an internal combustion engine.

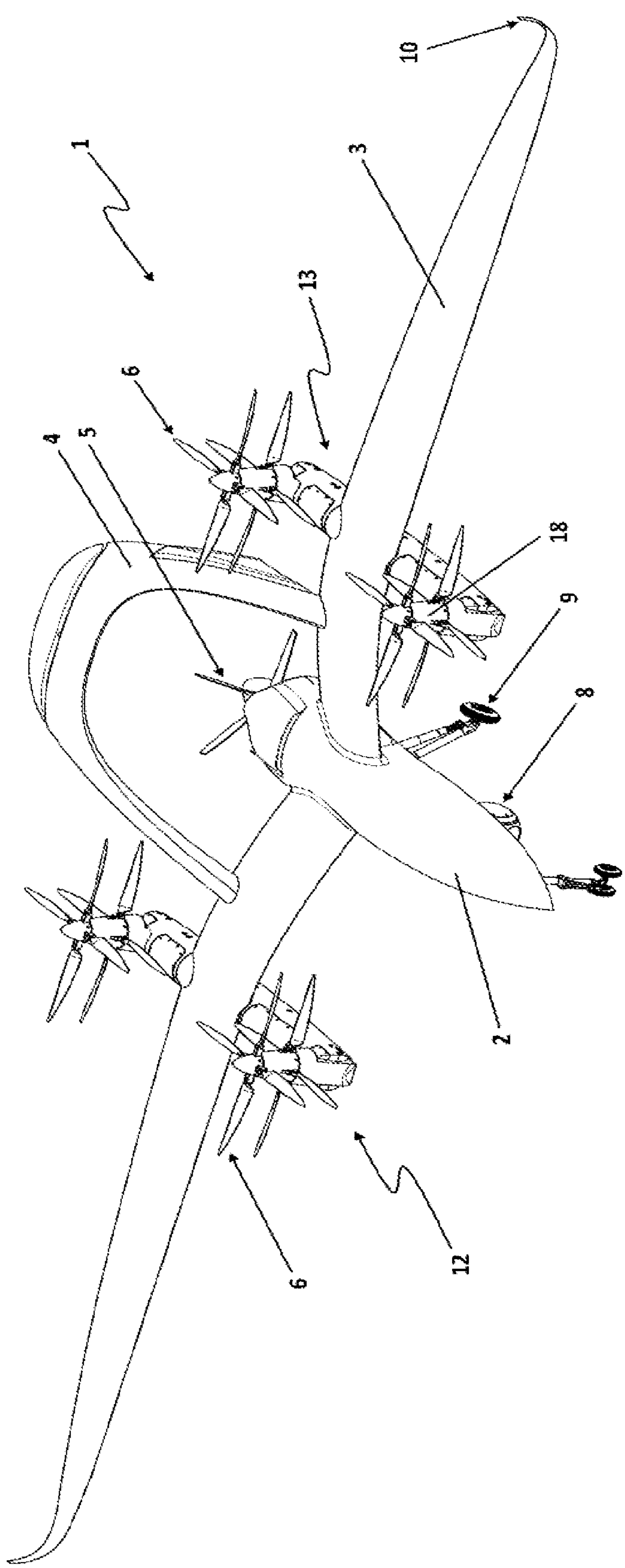

Figure 1

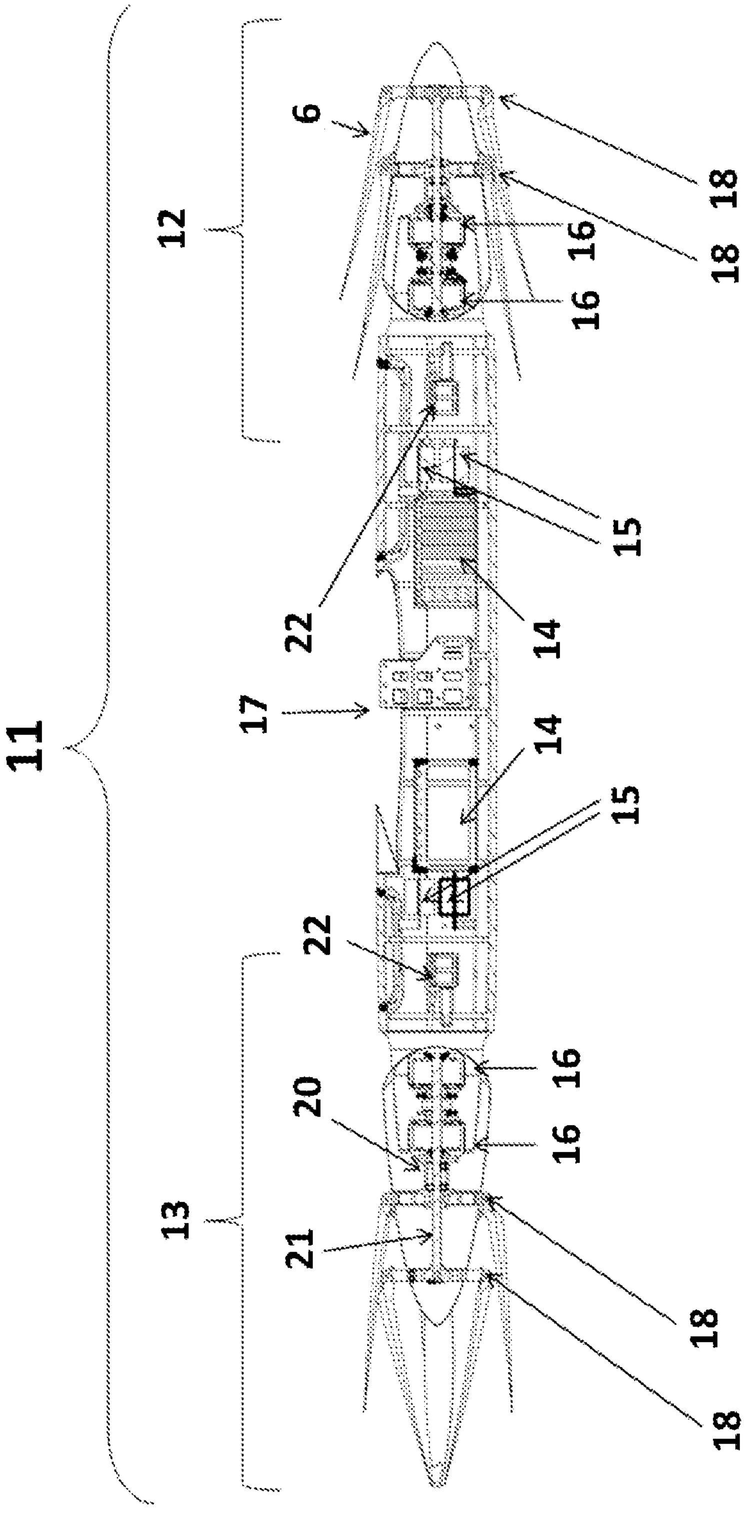

Figure 2

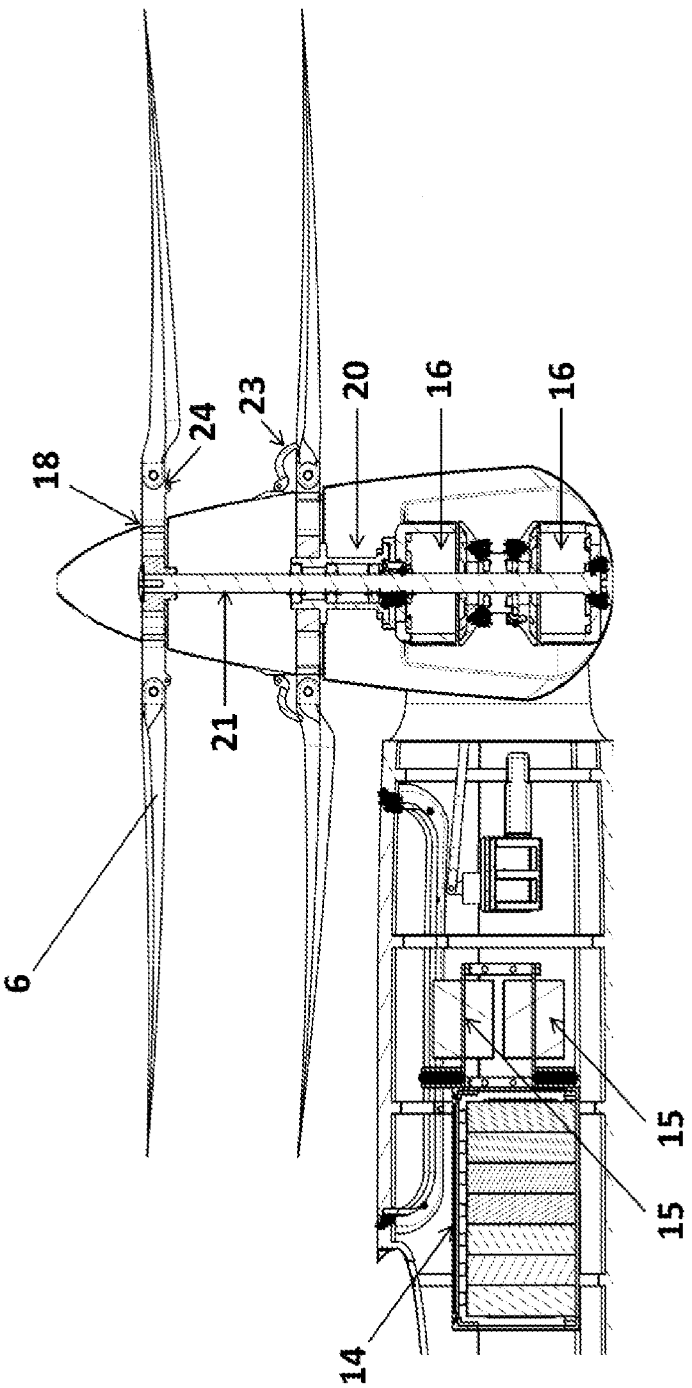

Figure 3

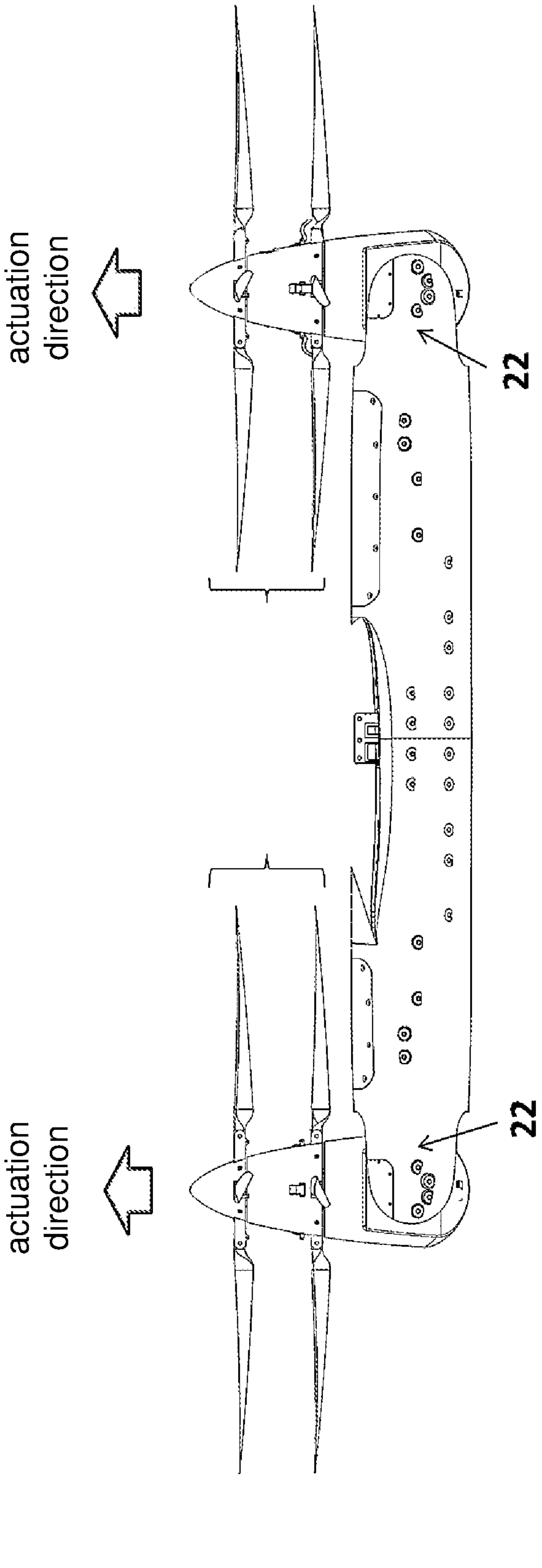

Figure 4

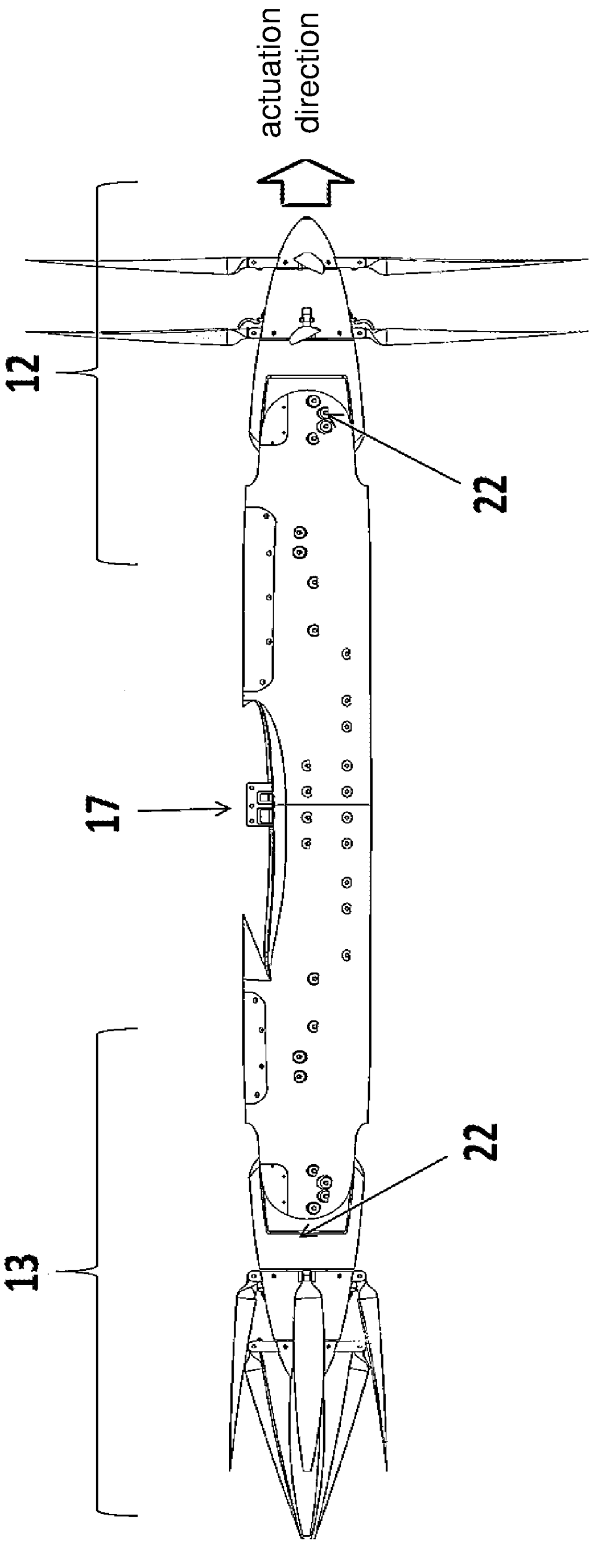

Figure 5

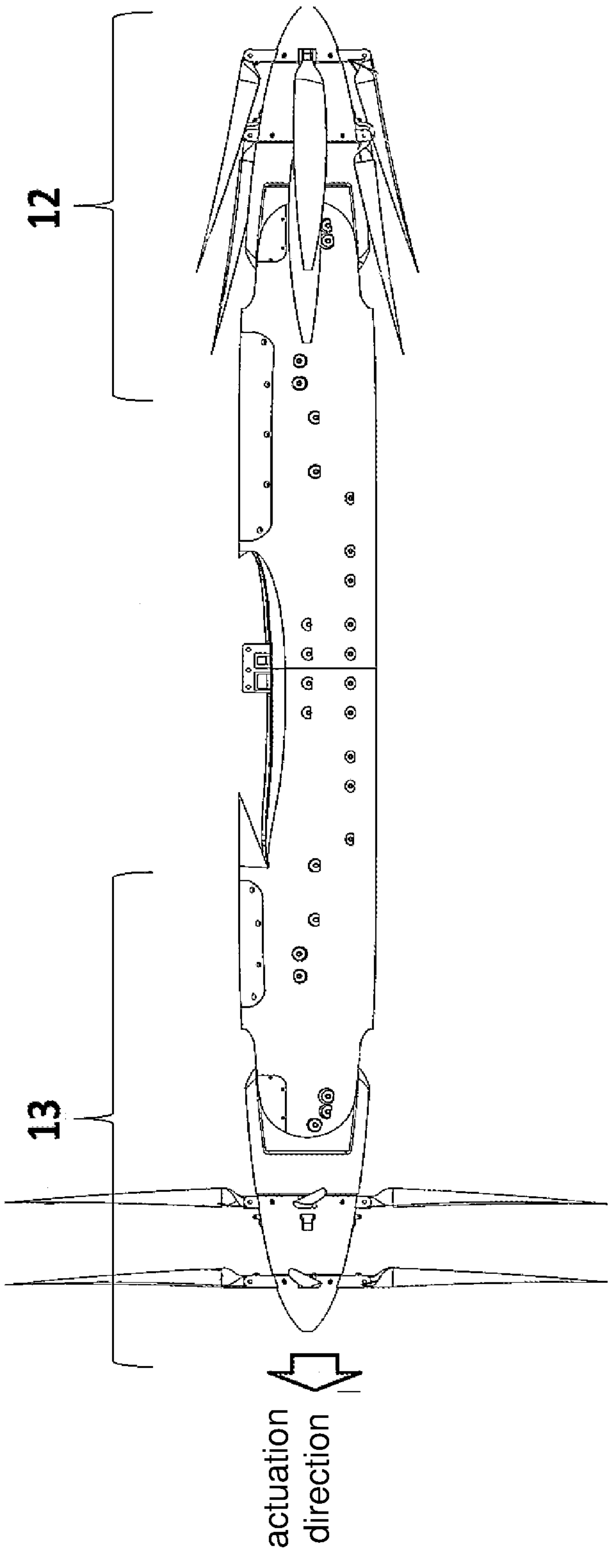

Figure 6

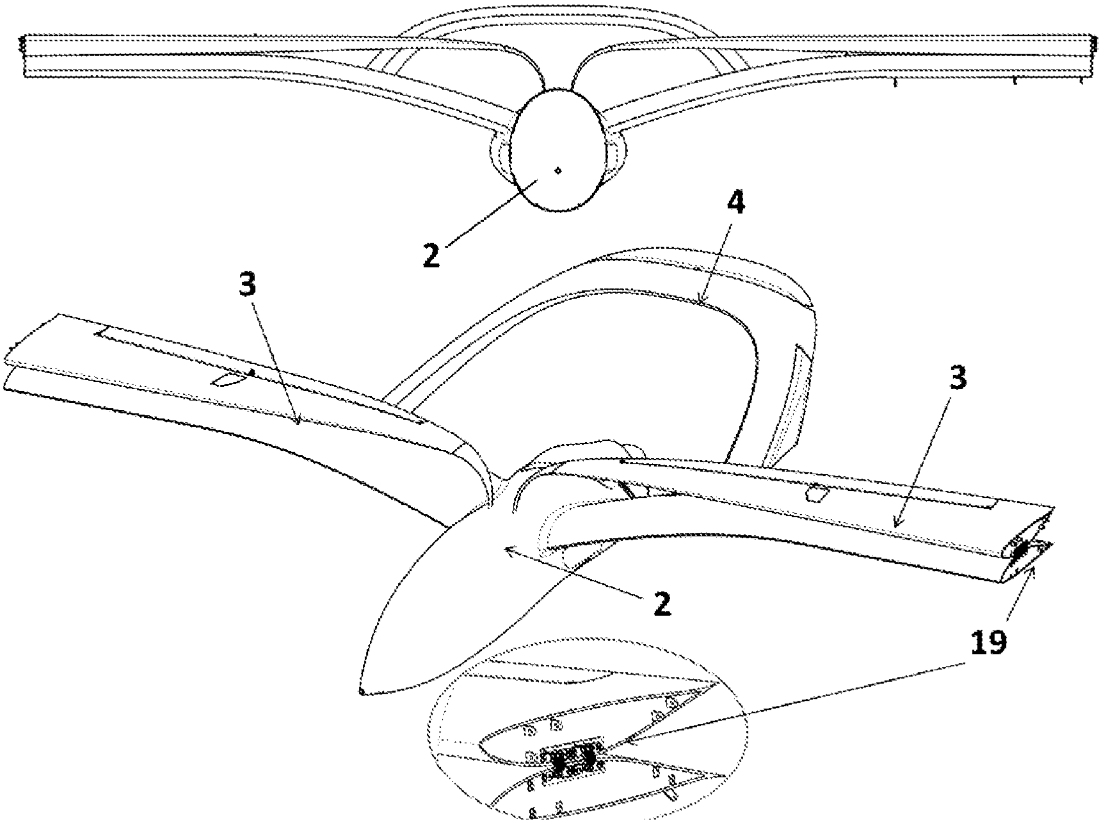

Figure 7

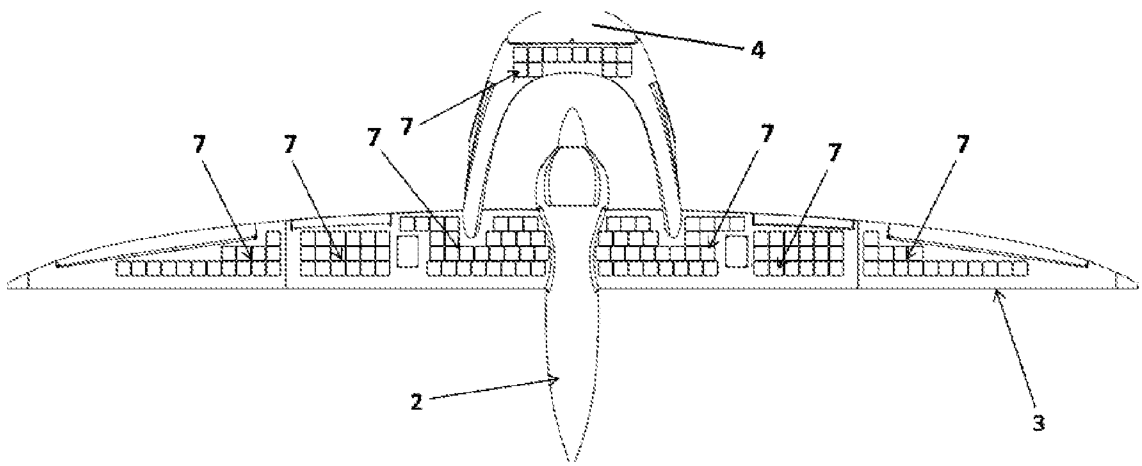

Figure 8

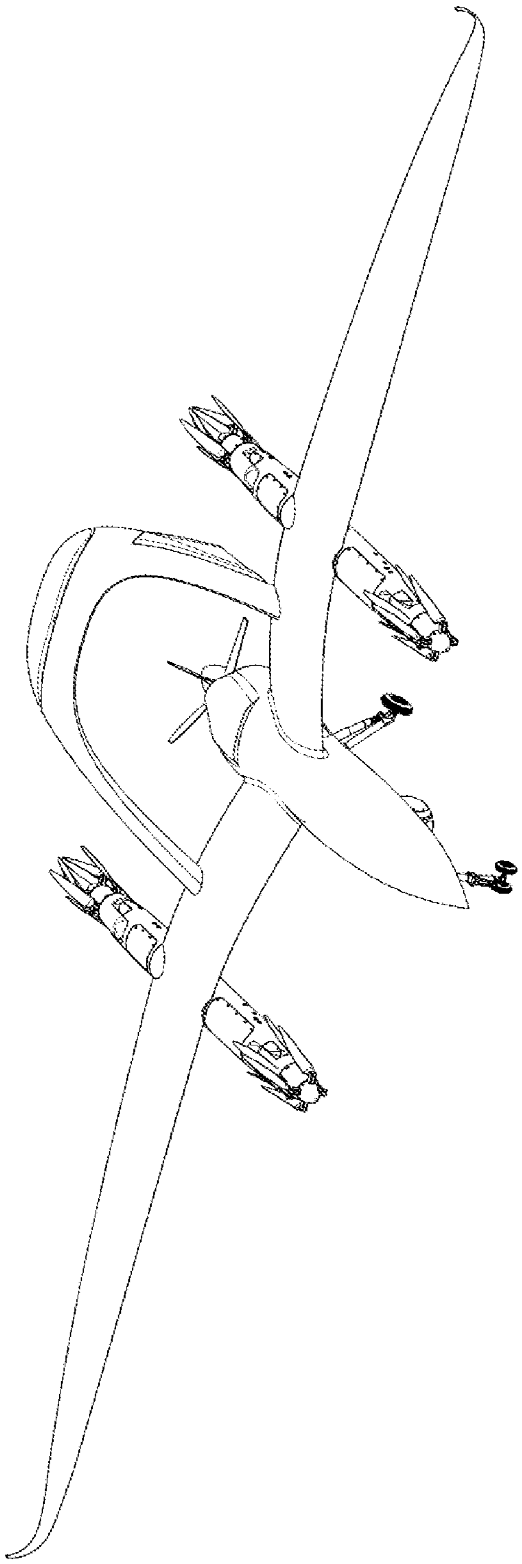

Figure 9

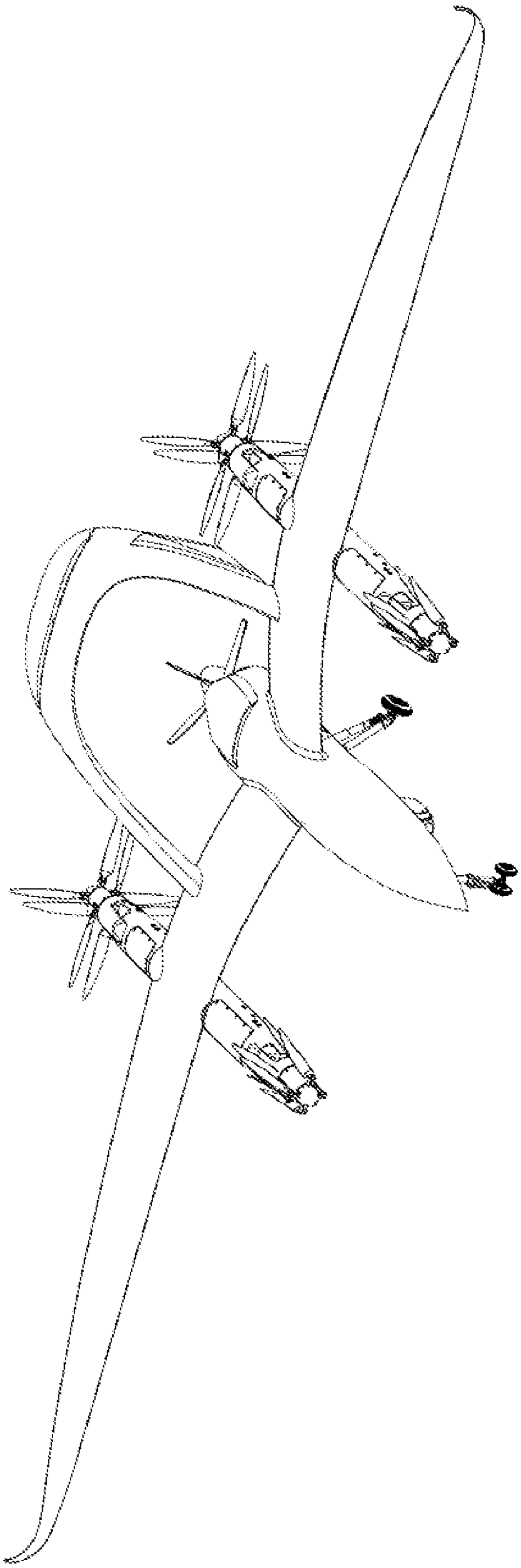

Figure 10

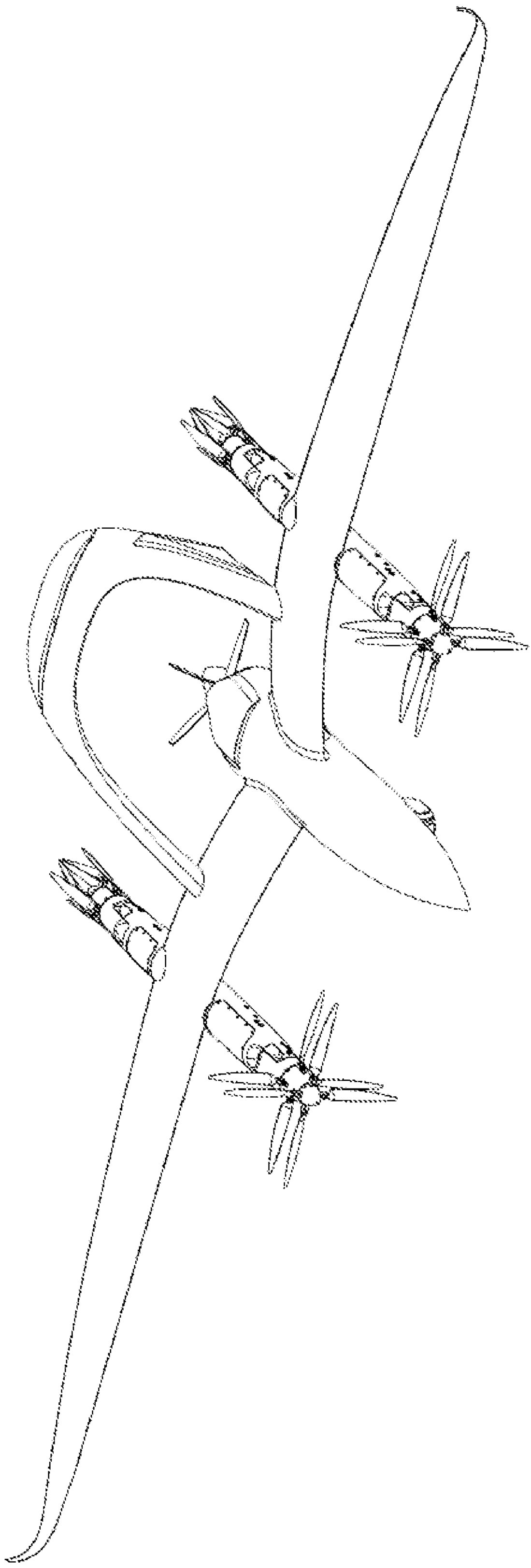

Figure 11

INTERNATIONAL SEARCH REPORT

International application No
PCT/TR2020/050436

A. CLASSIFICATION OF SUBJECT MATTER
INV. B64C27/28 B64C29/00 B64C27/82
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B64C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2019/109622 A1 (GUANGDONG KANG YUN TECH LIMITED [CN]) 13 June 2019 (2019-06-13) abstract; figures 1, 2 paragraphs [0028], [0029] -----	1-7
A	KR 2016 0116736 A (SAMCO CO LTD [KR]) 10 October 2016 (2016-10-10) abstract; figures 1-3 -----	1,5,6
A	US 2019/009895 A1 (TU HAOFENG [US]) 10 January 2019 (2019-01-10) abstract; figures 1-4 paragraph [0114] -----	1,7
A	US 9 783 288 B1 (MOORE ROBERT WAYNE [US] ET AL) 10 October 2017 (2017-10-10) abstract; figure 1 -----	1-7

-/--

[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
11 September 2020	28/09/2020

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Podratzky, Andreas

INTERNATIONAL SEARCH REPORT

International application No

PCT/TR2020/050436

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2018/178899 A1 (HAR DONGSOO [KR] ET AL) 28 June 2018 (2018-06-28) abstract; figures 1-3, 5-7 -----	1-7

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/TR2020/050436

Patent document cited in search report		Publication date	Patent family member(s)		Publication date
WO 2019109622	A1	13-06-2019	CN	108341050 A	31-07-2018
			WO	2019109622 A1	13-06-2019
KR 20160116736	A	10-10-2016	NONE		
US 2019009895	A1	10-01-2019	CN	110267876 A	20-09-2019
			US	2019009895 A1	10-01-2019
			WO	2018208596 A1	15-11-2018
US 9783288	B1	10-10-2017	CN	110225862 A	10-09-2019
			EP	3551535 A1	16-10-2019
			US	9783288 B1	10-10-2017
			WO	2018106382 A1	14-06-2018
US 2018178899	A1	28-06-2018	KR	20180076278 A	05-07-2018
			US	2018178899 A1	28-06-2018