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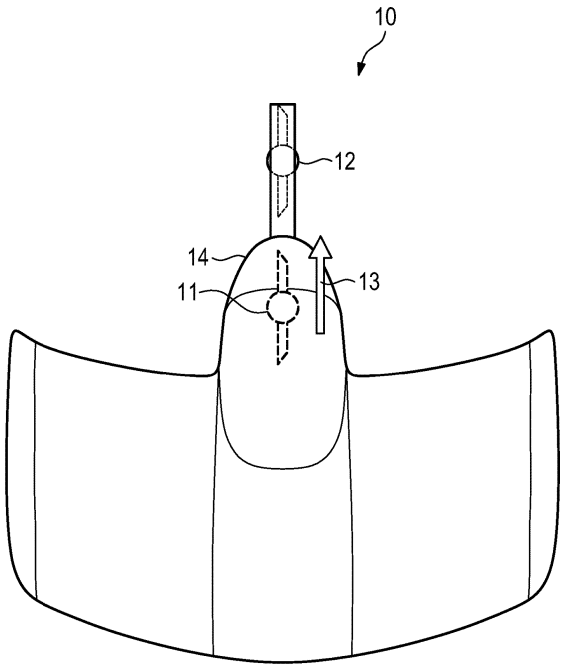
(56) Documents Cited:
WO 2018/000096 A1 **DE 020303024 U1**
US 3900176 A **US 3693910 A**
US 20100072325 A1

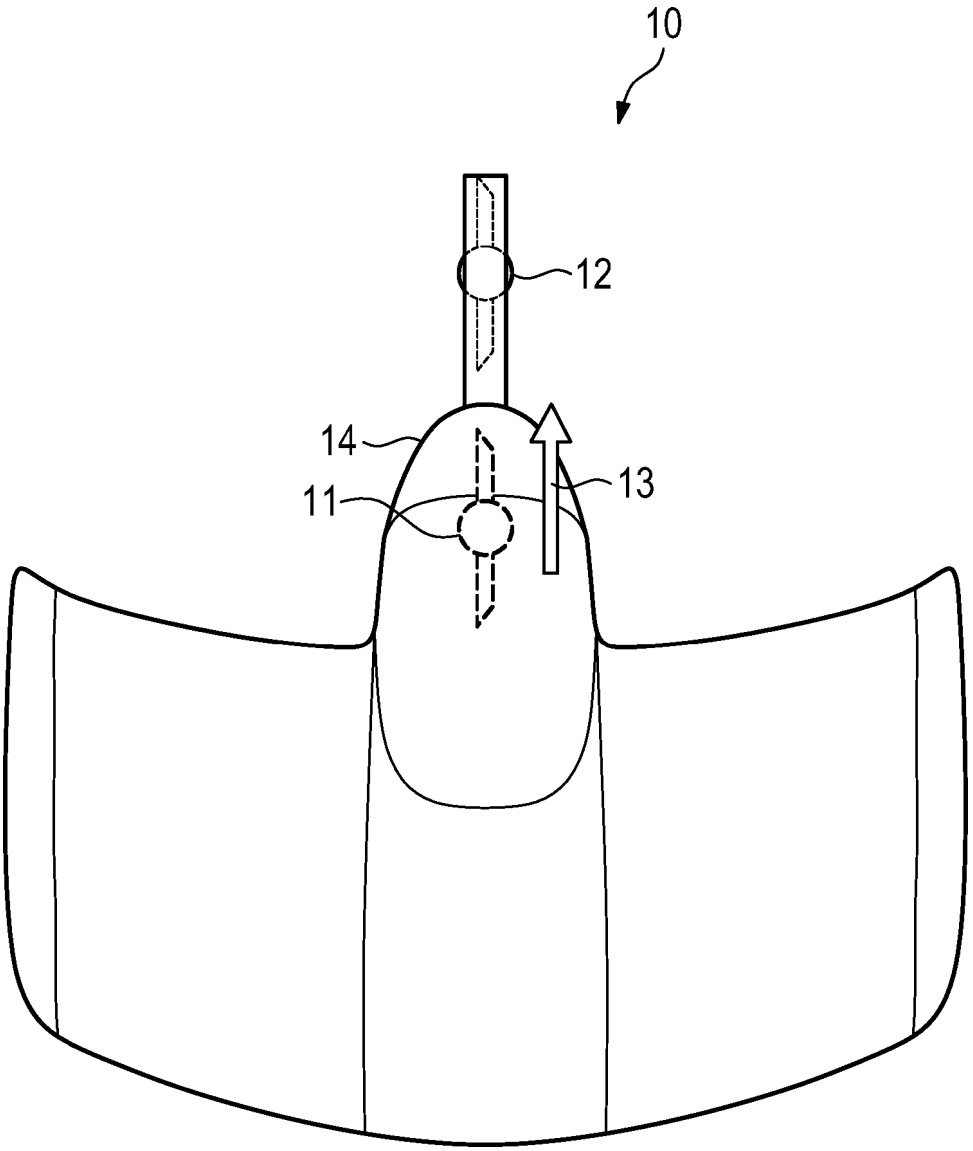
(58) Field of Search:
INT CL **B64C**
Other: **WPI, EPODOC**

(54) Title of the Invention: **Aircraft**
Abstract Title: **An aircraft comprising a deployable emergency rotor**

(57) An aircraft 10 comprising an emergency rotor deployable from a rest position 11 into a use position 12. Preferably the rotor is deployed from an aircraft nose 14 by a translatory movement to assist or replace any lifting rotors in emergency landing or to counteract stalling when cruising has slowed due to malfunction. The aircraft may be fully electric and capable of taking off and/or landing vertically or at short runways, e.g. VTOL, STOL, STOVL, VTHL. The aircraft may have angled wings and a rapid-charge battery system for quick charging. The aircraft may comprise vertically fixed ducted fans for generating propulsion and horizontally fixed ducted fans for take-off and landing. Horizontal shrouded fans may be selectively covered by louvres. The aircraft may be controlled by pilot(s), or fully autonomously. The deployable rotor may be concealed in the protected rest position 11 such that bird strikes are not possible.



GB 2576248 A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Aircraft

The present invention relates to an aircraft, in particular a fully electric VTOL (*vertical take-off and landing*) aircraft.

In aerospace engineering, VTOL covers any type of airplane, drone or rocket which is capable of taking off, and landing again, essentially vertically and without any take-off and landing runways. This umbrella term will be used hereinbelow in a broad sense to include not just fixed-wing aircraft, but also rotary-wing aircraft, such as helicopters, gyrocopters and gyrodynes, and hybrids, such as compound helicopters, as well as convertiplanes. Also covered are aircraft capable of taking off and landing on particularly short runways (*short take-off and landing*, STOL), of taking off on short runways, but of landing vertically (*short take-off and vertical landing*, STOVL), or of taking off vertically, but landing horizontally (*vertical take-off and horizontal landing*, VTHL).

US7677491B2 discloses an airborne delivery system having a deployable autorotating rotor system. The rotor system makes it easier to control the descent.

A deployable rotor according to US3333643A has flexible blades and a collapsible structure for stowing in an extremely small amount of space, wherein the arrangement, once released, automatically deploys into an initial, partially open position, in which installed wings drive the rotor on account of the airstream during free fall and the rotor blades are disengaged in a step-wise manner

by a mechanism which is dependent on the rotational speed, in which case deceleration increases gradually. Once the rotor is fully deployed, its direction can be controlled and it automatically regulates the speed of descent.

A deployable rotor according to US4017043A can be used, for example, as a lifting device for an ejector seat, wherein the pitch of the rotor blades is varied in accordance with the rotational speed.

An aspect of the invention provides an aircraft, in particular a fully electric vertical take-off and landing aircraft in the above sense, as claimed in independent claim 1. The rest position of the rotor can be one in which the rotor is completely or partially within the fuselage of the aircraft

An advantage of this solution resides in the increased safety of a correspondingly equipped aircraft. During regular cruising operation, the rotor here is accommodated in a protected state in the aircraft and bird strikes are therefore not possible.

Further advantageous configurations of aspects of the invention are specified in the dependent patent claims. It is thus possible for the aircraft to be equipped, for example, with wings which are, or can even optionally be, angled. A corresponding variant increases the wing surface area which is effective during horizontal flight, without the aircraft footprint being extended.

Furthermore, the aircraft can have a rapid-charge battery system which provides the propulsion energy for vertical take-off and landing as well as horizontal flight and provides for quick charging of the aircraft when the latter is stationary.

For the drive of the aircraft, it is possible here, instead of free-moving rotors, to use a plurality of ducted fans, even ones of different sizes, as are known outside aerospace engineering, for example in relation to hovercraft or airboats. In such an embodiment, the cylindrical housing which encloses the propeller can significantly reduce the thrust-related losses as a result of turbulence at the blade tips. Suitable ducted fans can be oriented horizontally or vertically, can be pivoted between two positions or, for aerodynamic reasons, can be covered by louvers during horizontal flight. Pure horizontal-thrust generation by means of fixed ducted fans is conceivable in addition.

Finally – alongside preferably fully autonomous operation of the aircraft – it is possible for human pilots, if sufficiently qualified, to be allowed to control the aircraft manually, which gives the apparatus according to aspects of the invention the greatest possible degree of flexibility in terms of handling.

An exemplary embodiment of the invention will be described in more detail hereinbelow and is illustrated in the drawing, in which:

figure 1 shows the plan view of an aircraft.

The single figure illustrates the design features of a preferred configuration of the aircraft (10) according to the invention.

As is evident on its nose (14), the aircraft (10) has an emergency rotor, (11, 12), which can be deployed upward, as seen in relation to the figure, and therefore counter to the cruising direction. Whereas this narrow emergency rotor (11, 12), in its rest position (11), is integrated in an essentially concealed state in an extremely small amount of installation space in the fuselage of the aircraft (10), it can be moved if required, by a translatory movement approximately one and a half times its diameter, into a use position (12), in which it projects forwards, in front of the cockpit, out of the body of the aircraft. In this end position, it is possible for the emergency rotor (11, 12) to assist, or replace, any lifting rotors in the event of an emergency landing or to counteract stalling when cruising has been slowed down as a result of malfunction.

Patent Claims

1. An aircraft comprising an emergency rotor, which can be deployed from a rest position into a use position.

2. The aircraft as claimed in claim 1, wherein the emergency rotor can be deployed in a direction which is counter to a cruising direction of the aircraft.

3. The aircraft as claimed in claim 1 or 2, wherein the emergency rotor is arranged on a nose of the aircraft.

4. The aircraft as claimed in any one of claims 1 to 3, wherein the aircraft has a fully electric drive.

5. The aircraft as claimed in any one of claims 1 to 4, wherein the aircraft comprises wings which are, or can be, angled.

6. The aircraft as claimed in any one of claims 1 to 5, wherein the aircraft comprises a rapid-charge battery system.

7. The aircraft as claimed in any one of claims 1 to 6, 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 can be selectively covered by means of the louvers.

9. The aircraft as claimed in any one of claims 1 to 8, wherein the aircraft comprises vertically fixed ducted fans for generating propulsion.

10. The aircraft as claimed in any one of claims 1 to 9, wherein the aircraft can be selectively controlled fully autonomously.

Intellectual Property Office

Application No:	GB1909480.4	**Examiner:**	Mr Ilya Gribanov
Claims searched:	1-10	**Date of search:**	29 November 2019

Patents Act 1977: Search Report under Section 17

Documents considered to be relevant:

Category	Relevant to claims	Identity of document and passage or figure of particular relevance
X	1-3, 5, 7, 9	WO 2018/000096 A1 (BAILIE) - see the figures and page 21 lines 9-28 in particular
X	1, 5	US 2010/0072325 A1 (SAMBELL) - see the figures and paragraph [0032] in particular
X	1, 5	US 3693910 A (ANGELO) - see the figures and column 1 lines 18-23, column 3 lines 9-17 in particular
X	1, 5	US 3900176 A (EVERETT) - see figures 1, 12 and column 1 lines 62-64, column 2 lines 33-42, column 5 lines 19-29
X	1, 5	DE 20303024 U1 (HINUEBER) - see the figures and paragraph [0042] in particular

Categories:

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.

Field of Search:

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC^{X} :

Worldwide search of patent documents classified in the following areas of the IPC

B64C

The following online and other databases have been used in the preparation of this search report

WPI, EPODOC

Intellectual Property Office

International Classification:

Subclass	Subgroup	Valid From
B64C	0027/52	01/01/2006
B64C	0027/22	01/01/2006
B64C	0027/28	01/01/2006
B64C	0029/00	01/01/2006