Robotic bird

Musters, Robert Jan

Publication date:
2021

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

(19) **World Intellectual Property Organization**
International Bureau

(43) **International Publication Date**
27 May 2021 (27.05.2021)

WIPO | PCT

(10) **International Publication Number**
WO 2021/098951 A1

(51) **International Patent Classification:**
B64C 39/02 (2006.01)

(21) **International Application Number:**
PCT/EP2019/081826

(22) **International Filing Date:**
19 November 2019 (19.11.2019)

(25) **Filing Language:** English

(26) **Publication Language:** English

(71) **Applicants: RIJKSUNIVERSITEIT GRONINGEN** [NL/NL]; Broerstraat 5, 9712 CP Groningen (NL). **ROFLIGHT** [NL/NL]; Lemselobrink 32, 7544 GD Enschede (NL).

(72) **Inventor: MUSTERS, Robert Jan**; Lemselobrink 32, 7544 GD Enschede (NL).

(74) **Agent: NEDERLANDSCH OCTROOIBUREAU**; P.O.Box 29720, 2502 LS The Hague (NL).

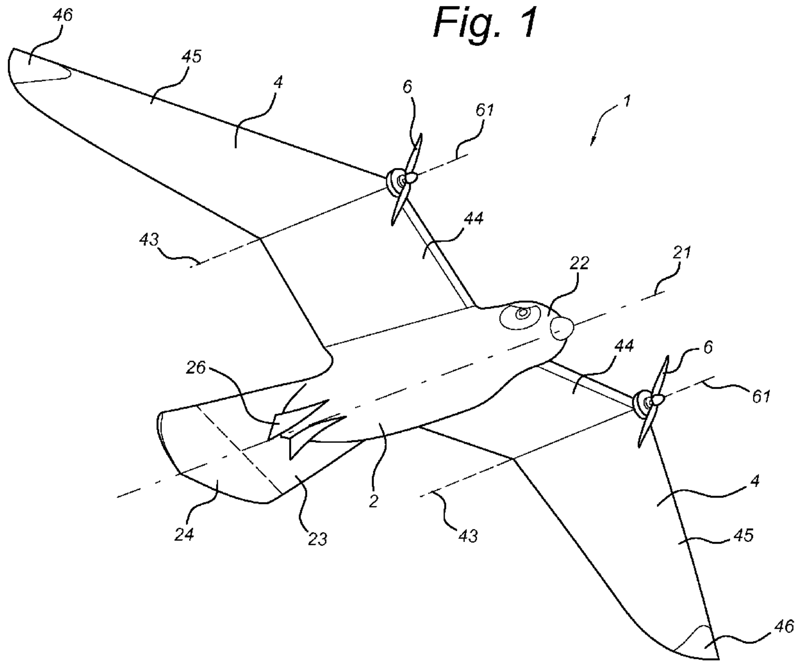
(81) **Designated States** *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, 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, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) **Designated States** *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, 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, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

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

(54) **Title:** ROBOTIC BIRD

Fig. 1



(57) **Abstract:** A robotic bird, comprising - a body, extending along a longitudinal axis between a head and a tail, - two fixed wings, connected to the body on opposite sides of the body, wherein each wing has a vertical cross-sectional shape along the longitudinal axis of the body, which gradually transforms in a direction away from the body, from a first shape which is convex at an upper side and concave at a lower side to a second shape which is convex at an upper side and convex at a lower side.

WO 2021/098951 A1

Robotic bird

Technical field

The invention relates to a robotic bird. The invention relates to a combination of such a robotic bird and a remote control device, and to a use of such robotic bird or combination for deterring birds.

Background art

Robotic birds are being used for detecting and manipulating the motion-direction of live animals, such as birds. Their shape and feather-painted colour resembles an actual bird, preferably a bird of prey. This visual appearance and the accurate control during flight of the hunting behaviour of the robotic bird ensure that live birds recognize it as their natural enemy and flee in a controlled manner; merely using a drone is not sufficient as birds get habituated rapidly. Robotic birds are particularly useful around airports, harbours, landfills and agricultural fields, because here individual birds or flocks of birds may cause serious problems. They may also be useful in film industry, animal research, surveillance or counter drone actions.

Typical robotic birds have a short flight duration, can only operate with low wind speeds, and/or have a limited manoeuvrability and controllability. An example of a robotic bird is shown in EP3398853.

It is an object of the invention to provide a robotic bird which improves on at least one of the aspects mentioned above.

Summary of the invention

According to an aspect of the invention, there is provided a robotic bird comprising:

a body, extending along a longitudinal axis between a head and a tail;

two fixed wings, connected to the body on opposite sides of the body;

wherein each wing has a vertical cross-sectional shape along the longitudinal axis of the body, which gradually transforms in a direction away from the body, from a first shape which is convex at an upper side and concave at a lower side to a second shape which is convex at an upper side and convex at a lower side.

The robotic bird may be capable of autonomous and/or semi-autonomous and/or remote-controlled flying.

The cross-sectional shape of the wings provides for a good combination of lift and manoeuvrability. This allows the bird to remain stable and controllable, even at high wind speeds of up to 6 or 7 Beaufort. An advantage of the aerodynamic shape of the wing is that it brings at the same time stability, manoeuvrability and extremely good flight characteristics even during strong winds and a vertical stoop.

Its good manoeuvrability and its low weight make the robotic bird particularly suitable for chasing small individual birds, such as starlings.

‘Fixed wings’ refer to wings which do not hinge or move with respect to each other or with respect to the body. An advantage of fixed wings is that during flight the bird is more stable and receives less shocks and, therefore, can be controlled by a non-stabilized camera and/or flight controller (auto pilot). Preferably, the wings are rigid and do not comprise any moving parts, possibly except for motors and propellers.

‘Concave’ means having no internal angles greater than 180 degrees. ‘Convex’ means having at least one internal angle greater than 180 degrees. Generally, both the upper and lower sides of the first and second shapes are preferably smooth and describe a continuous curve for an optimal air flow along the wings.

The bird according to the invention is extremely manoeuvrable, and is able to chase individual birds such as starlings. The bird is also able to perform vertical nosedives.

The robotic bird has a natural gliding capacity, such that without power, it will float slowly towards the ground, to avoid damage to the bird and the object or ground covering on which it lands. For example: during signal loss a fail-save, will be automatically activated to make such a safely controlled landing.

Preferably, the length from head to tail of the bird is between 200 and 800 mm (preferably between 400 and 600 mm or about 500 mm) and the width between the wings’ tips is between 300 and 1000 mm (preferably between 600 and 800 mm or about 700 mm).

In an embodiment, the wings are kinked, defining a kink axis in each wing which is substantially parallel to the longitudinal axis of the body. Preferably, the wings comprise an arm portion and a hand portion. The arm portion and hand portion may be separated by the kink axis. The arm portion and the hand portion may define an angle between one another when seen from the front side of the robotic bird, the angle being between 135 and 175 degrees, or between 145 and 165 degrees. The hand portion may thus be kinked downward between 0-5 degrees with respect to the horizontal plane, or by 5-45 degrees with respect to the arm portion. This further improves the lift and stability. The arm portion may extend upward from the body by between 0 and 45 degrees, preferably by 10-20 degrees. In an embodiment, the arm portion may be said to have an dihedral (positive v) configuration, while the hand portion has an anhedral (negative v) configuration. In an embodiment, the arm portion (as seen from the top) may be said to have a negative arrow configuration (sweeps forward). In an embodiment, the hand portion may be said to have a positive arrow configuration (sweeps backward). In an embodiment, the wings have an M-wing configuration.

In an embodiment, the robotic bird comprises a drive mechanism allowing the robotic bird to fly independently. The drive mechanism preferably comprises one or more motors and one or more propellers driven by the one or more motors. Preferably, the robotic bird comprises two propellers, mounted on either wing, preferably wherein the propellers are adapted to move in opposite directions during flying. Preferably, the propellers' axes substantially coincide with the kink axes in the wings. The domping may be 1-3 degrees.

The opposite rotation direction of the propellers make the bird more stable, since the angular momentums of the propellers cancel each other out.

The propellers are driven by motors which are preferably brushless motors and are preferably mounted at the front of the wings. In an embodiment, the motors are driven differentially, such that the bird's speed, mixed yaw and roll can be controlled. A change in the rotation speed of the propellers will also generate lift on one side of the bird, resulting in a steering movement into the direction corresponding to the desired direction. By enabling a steering movement through control of the propellers, in some embodiments the robotic bird need not comprise any ailerons. Avoiding the use of ailerons can allow for more energy efficient steering, thereby increasing the range of the robotic bird.

The propellers mounted on the wings allow for a more stable and better controllable movement of the bird, compared to propellers mounted on the body. When the propellers are mounted on the kinks, the propellers can be mounted in a predictable, well-aligned manner. This stability and controllability makes it possible to place a camera on the centre of the back or on top of the neck of the robotic bird and thus have free camera sight from the robotic birds back.

Further advantages of mounting the propellers on the kinks may include that the robotic bird is able to accelerate or decelerate without substantially ascending or descending. This may improve manoeuvrability of the robotic bird.

The locations of the propellers form an optimum between limited influence of the body onto the air flow (which requires the propellers to be a certain distance away from the body and a limited leverage effect (which requires the propellers to be not too far from the body). Preferably, the propellers are located at a distance from the longitudinal axis of between 20% and 60% of the half wing span between longitudinal axis and tip. More preferably, this is a distance of between 25% and 50% or between 30% and 40% of the half wing span between longitudinal axis and tip.

In an embodiment, the robotic bird further comprises a controller for forcing the propellers to slow down or accelerate. Preferably, the controller is adapted for individually controlling the propellers. This allows for improved control by e.g. a flight controller of the robotic bird, particularly for steering with the propellers. The controller may be a speed-controller.

In an embodiment, the robotic bird further comprises a camera mounted on the body, preferably on top of the neck. This allows for the possibility of a first-person view by the user of the robotic bird, and/or for recording images as seen by a bird. Preferably, no propeller is mounted in the field of view of the camera or on the body. This allows for a stable and unobstructed view of the camera. The camera may be a panning camera.

In an embodiment, at least one (and, preferably, each) of the wings comprises a tip which is twisted with respect to the remainder of the wings. This wing twist allows for an adjusted lift distribution along the wing, and particularly a lower angle of attack at the wing tips. This decreases drag because it contributes to keeping the body in line with the air flow.

In an embodiment, the tail comprises an elevator for controlling the robotic bird's pitch. The elevator is preferably in the form of the back side section of the tail across its full width, which is hingedly connected to the remainder of the tail.

In an embodiment, the tail comprises a stabiliser for improving stability, preferably wherein the stabiliser is transparent, for instance made of transparent plastic. The stabiliser may be in the form of a vertical fin mounted on in the middle of the end of the tail. A transparent stabiliser mitigates disturbance of the visual appearance of the robotic bird, which may otherwise be the case since most living birds do not have such a stabiliser.

In an embodiment, the body may comprise a twin tail on its underside, which is preferably shaped as two retracted legs, more preferably with claws. These contribute to increasing fear in live birds. The twin tail further stabilises the robotic bird, while limiting the altering of the visual appearance with respect to a living bird.

In an embodiment, the wings and tail are made of expanded polypropylene (EPP) or fibreglass, possibly at least one of which is reinforced with carbon strips, and/or wherein the remainder of the body is made of fibreglass. This allows for a material with a low weight while still being strong.

In an embodiment, the body comprises a battery and electronic equipment for controlling flight properties, and preferably wherein the body comprises air inlets for allowing air to flow into the body to cool the battery and the electronic equipment. The air inlets may be nostrils located on the head. Alternatively, there may be air inlets on other locations of the body. The battery is for powering the electronic equipment and/or the propellers.

Preferably, the robotic bird has a weight of less than 500 grams, preferably less than 400 grams, even more preferably less than 250 grams. The weight includes the battery weight. The low weight of the bird ensures that the impact of a crash of a bird with a person, vehicle, building or aircraft is very limited. Moreover, due to its low weight the bird is capable of performing flights lasting 20 minutes or more.

In an embodiment, connections between the wings, tail and the body are rounded or smoothed to improve flight stability.

In an embodiment, the robotic bird has the visual appearance of a bird of prey, preferably a falcon, eagle or hawk. In an embodiment, the robotic bird has the visual appearance of a falcon. In an embodiment, the robotic bird has the appearance of an eagle. In an embodiment, the robotic bird has the appearance of a hawk. This visual appearance, preferably together with precise imitation of its hunting behaviour, prevents habituation by the birds to be scared away.

According to an aspect of the invention, there is provided a combination of a robotic bird as described herein and a remote control device, which is adapted for wireless communication with the robotic bird, and preferably adapted to transmit instructions to the controller. Preferably, the remote control device is configured to transmit instructions over a long range. The range may depend on weather conditions and on whether there are obstacles. In clear weather and if there are no obstacles, the range may be up to 10 kilometres.

In an embodiment, the combination further comprises a pair of virtual reality glasses or a screen or the like, wherein images recorded by the camera are in real time transmitted to the virtual reality glasses or screen or the like, such that a user can operate the robotic bird based on the recorded images which form a first-person view of the robotic bird.

According to an aspect of the invention, there is provided the use of a robotic bird or a combination as described herein, for deterring birds. The robotic bird may thus be used for clearing an area of birds, or preventing birds to enter an area, such as an airport, preferably by manipulating the direction of motion of flocks and/or chasing living birds.

The various aspects discussed in this patent can be combined in order to provide additional advantages.

Brief description of drawings

Embodiments will now be described, by way of example only, with reference to the accompanying schematic drawings in which corresponding reference symbols indicate corresponding parts.

Figure 1 shows a perspective view of a robotic bird according to an embodiment;

Figures 2 and 3 show exploded views of a wing of such a robotic bird;

Figure 4 shows a frontal view of the robotic bird;

Figure 5 shows a top view of the robotic bird;

Figure 6 shows a perspective view of a combination of a robotic bird and a remote control device according to an embodiment.

The figures are meant for illustrative purposes only, and do not serve as restriction of the scope or the protection as laid down by the claims.

Detailed description

Further advantages, features and details of the present invention will be explained in the following description of some embodiments thereof. In the description, reference is made to the attached figures.

Figure 1 shows a robotic bird 1. The robotic bird 1 is modelled after a peregrine falcon, and comprises a body 2, which is elongate and extends along a longitudinal axis 21 between a head 22 and a tail 23.In various embodiments, at least part of the body 2 comprises fibreglass. At both sides of the body 2 a wing 4 extends in a direction substantially perpendicular to the longitudinal axis 21. The wings 4 are fixed and rigid and are identical, and do not move with respect to the body 2 or to one another. The wings 4 each comprise a hand portion 45 and an arm portion 44, which are separated by a kink, defined by a kink axis 43. The kink axis is substantially parallel to the longitudinal axis 21. The arm portion 44 extends slightly upward from the body 2, and kinks downward into the hand portion 45. The tip 46 of the wings 4 is slightly twisted for extra horizontal stability. The kinked shape of the wings 4 improves on the flight properties of the bird 1.

In the wings 4, in the shown embodiment at the kink axes 43, propellers 6 are provided. In alternative embodiments the propellers may be provided elsewhere on the wing 4 or even on the body 2. The propeller axes 61 are parallel to the longitudinal axis 21 and preferably coinciding with the kink axes 43. This improves the controllability of the bird 1. The speed, acceleration and direction of the propellers 6 can be controlled individually for excellent flight control. The body 2 comprises a battery and electronic equipment inside for driving the propellers 6.An elevator 24, in the form of a pivoting end part of the tail 23, is provided to control the bird’s pitch. For improved stability, the underside of the body 2 provides a twin tail 26 shaped and coloured as two retracted legs. The depicted shape appears realistic to living birds in order to prevent habituation.

Figure 2 shows an exploded view of the wing 4 and emphasises on the cross-sectional shape of the wing. The cross-sectional shape is general understood as the shape of the cross-sectional plane through the wing which is vertical and parallel to the longitudinal axis of the body (not shown). The cross-section has a first shape 41 close or adjacent to the body, which is convex at the upper side 41b, and concave at the lower side 41a. In the figure a straight dashed line is drawn along the lower side 41a, tangential to the point where the leading edge 47 evolves into the lower side 41a and through the trailing edge 49 of the wing 4.It can be clearly seen that the lower side 41a, around the middle of the cross-sectional length, departs significantly inward with respect to the dashed line.

At or close to the tip 46, the cross-section has a second shape 42 which is depicted separately for proper comparison to the first shape 41. The second shape 42 is convex at the upper side 42b and also convex at the lower side 42a. Generally, the wing 4 is convex over its entire upper surface and has a lower side which evolves gradually from concave near the body 2 to convex near the tip 46.

Figure 3 shows a perspective side view of the wing 4 which again highlights the first and second shapes 41, 42.

As is clear from Figures 2 and 3, in various embodiments the bird comprises downward kinked wings with a concave underside close to the body and a convex underside close to the tip.

In various embodiments, a propeller (not shown) may be mounted on the wing 4, preferably on the kink 43.

Figure 4 shows a frontal view of the bird 1. The head 22 of the bird comprises nostrils 27 for allowing air to flow into the head 22 and the body 2 to cool the battery and the electronic equipment inside. The hand portion 45 and arm portion 44 of each wing 4 defines an angle α, which is in this embodiment about 160 degrees. The angle α can be between 135 and 175 degrees, or between 145 and 165 degrees. The hand portion may thus be kinked downward between 0-5 degrees with respect to the horizontal plane, or by 5-45 degrees with respect to the arm portion. The arm portion may extend upward from the body by between 0 and 45 degrees with respect to the horizontal plane. In an embodiment, the arm portion may be said to have an dihedral (positive v) configuration, while the hand portion has an anhedral (negative v) configuration.

Figure 5 shows a top view of the bird 1, which shows the nostrils 27 and the particular shape of the wings 4: the arm portions 44 have a leading edge 47 which is substantially perpendicular to the longitudinal axis 21, while the hand portions 45 have a leading edge 48 which is oriented backwards under an oblique angle β of about 60 degrees with respect to the longitudinal axis 21. In an embodiment, the arm portions 44 may be said to have a negative arrow configuration (sweeps forward). In an embodiment, the hand portions 45 may be said to have a positive arrow configuration (sweeps backward). In an embodiment, the wings have an M-wing configuration.

Figure 6 shows another embodiment of a robotic bird 101. The bird 101 is generally identical to the previous embodiment, in particular the body 102, wings 104 and propellers 106. The bird 101 furthermore includes a camera 108 mounted on the head 122 of the bird 101. Because the propellers 106 are mounted on the wings 104, the camera's field of view is largely unobstructed and the head 122 is relatively stable in movement. Both effects contribute to a more stable view by the camera which improves control.

The body 102 furthermore comprises a battery 181 and electronic equipment 182, which includes a controller 183 for controlling the propellers' rotation. The propellers 106 and camera 108 are powered by the battery 181. The controller 183 can be instructed in a wireless manner using an antenna 185 and a remote control device 184. Video images recorded by the camera 108 are transmitted in real time to virtual reality glasses 186, which allow for a first person view from the bird 101. Alternatively, video images recorded by the camera 108 may be transmitted in real time to a screen (not shown) or the like, which also allows for a first person view from the bird 101. The present configuration allows a user for excellent natural flight control and a pleasant and convenient flying experience.

In various embodiments, the user may operate the robotic bird 101 remotely. In various embodiments, the robotic bird 101 may function autonomously without the need for intervention by a human pilot, for example, the robotic bird 101 may be configured to fly a pre-programmed trajectory, for example for the purpose of inspection. In various embodiments, the robotic bird 101 may be configured to fly in a semi-autonomous mode, for example, the robotic bird 101 may be configured with a failsafe, wherein the robotic bird 101 is configured to safely land or return to its home base when a loss of signal or other pre-programmed event occurs.

In various embodiments, the abilities of the robotic bird 101 to be remotely operated, to fly autonomously and/or to fly semi-autonomously may be combined. In an embodiment, the robotic bird is able to be remotely operated and to fly semi-autonomously. In an embodiment, the robotic bird is able to be remotely operated and to fly autonomously. In an embodiment, the robotic bird is able to fly autonomously and semi-autonomously. In an embodiment, the robotic bird is able to be remotely operated, to fly semi-autonomously and to fly autonomously.

The weight of the battery 181 is limited by the constraint that the total weight of the robotic bird 101 should preferably be limited. Preferably, the robotic bird has a weight of less than 500 grams, more preferably less than 400 grams and even more preferably less than 250 grams. The weight includes the battery weight. The weight and motor power of the model should preferably be in balance. If the power of the robotic bird is too high or too low, the robotic bird may behave unnaturally and living birds may quickly habituate.

The size of the battery 181 is limited by the constraint that the size of the robotic bird should not be too large. Preferably, the length from head to tail of the bird is between 200 and 800 mm (preferably between 400 and 600 mm or about 500 mm) and the width between the wings' tips is between 300 and 1000 mm (preferably between 600 and 800 mm or about 700 mm). If the size of the robotic bird is comparable to the size of a bird of prey, such as a falcon or peregrine falcon, the robotic bird will appear to be more realistic to living birds and may therefore be more efficient at preventing live birds to enter an area, scaring them away or manipulating the direction of motion of living birds.

In order to achieve a high range, it is preferable the capacity of the battery is at least 900 mAh, more preferably 1200 mAh and even more preferably 1500 mAh, all while meeting the constraints imposed by the size and weight of the robotic bird.

The tail 123 comprises an elevator 124, being a hinging flat portion at the back of the tail 123 and driven by a servo, for controlling the bird's pitch. The tail 123 may also comprise a stabiliser 125, made of transparent plastic, to improve the bird's stability during flight. In various embodiments, the wings and tails may comprise expanded polypropylene (EPP) of different densities. The wings 104 are reinforced using carbon strips 150.

The present invention may be embodied in other specific forms without departing from its spirit or essential characteristics. The described embodiments are to be considered in all respects only as illustrative and not restrictive. The scope of the invention is, therefore, indicated by the appended claims rather than by the foregoing description. It will be apparent to the person skilled in the art that alternative and equivalent embodiments of the invention can be conceived and reduced to practice. All changes which come within the meaning and range of equivalency of the claims are to be embraced within their scope.

CLAIMS

1. A robotic bird, comprising
   - a body, extending along a longitudinal axis between a head and a tail,
   - two fixed wings, connected to the body on opposite sides of the body,

   wherein each wing has a vertical cross-sectional shape along the longitudinal axis of the body, which gradually transforms in a direction away from the body, from a first shape which is convex at an upper side and concave at a lower side to a second shape which is convex at an upper side and convex at a lower side.

2. Robotic bird according to claim 1, wherein the bird is configured to fly autonomously and/or semi autonomously and/or by a remote control device.

3. Robotic bird according to any one of the preceding claims, wherein the wings comprise an arm portion and a hand portion, which are at an angle between one another when seen from the front side of the robotic bird, and wherein the angle is between 135 and 175 degrees.

4. Robotic bird according to any of the preceding claims, wherein the wings are kinked, defining a kink axis in each wing which is substantially parallel to the longitudinal axis of the body and located between the arm portion and the hand portion.

5. Robotic bird according to any one of the preceding claims, further comprising two propellers, mounted on either wing, preferably wherein the propellers are adapted to move in opposite directions during flying.

6. Robotic bird according to claim 5, wherein the propellers’ axes substantially coincide with kink axes in the wings.

7. Robotic bird according to any one of the preceding claims, further comprising a controller for forcing the propellers to slow down or accelerate, and preferably wherein the controller is adapted for individually controlling the propellers.

8. Robotic bird according to any one of the preceding claims, further comprising a camera mounted on the body, preferably on top of the neck, and preferably wherein no propeller is mounted in the field of view of the camera or on the body.

9. Robotic bird according to any one of the preceding claims, wherein the wings each have a tip which is twisted with respect to the remainder of the wings.

10. Robotic bird according to any one of the preceding claims, wherein the tail comprises an elevator for controlling the robotic bird's pitch.

11. Robotic bird according to any one of the preceding claims, wherein the tail comprises a stabiliser, preferably wherein the stabiliser is transparent, for instance made of transparent plastic.

12. Robotic bird according to any one of the preceding claims, wherein the body comprises a stabilizing twin tail on its underside, which is preferably shaped as two retracted legs.

13. Robotic bird according to any one of the preceding claims, wherein the wings and tail are made of expanded polypropylene (EPP) or fibreglass, reinforced with carbon strips, and/or wherein the remainder of the body is made of fibreglass.

14. Robotic bird according to any one of the preceding claims, wherein the body comprises a battery and electronic equipment for controlling flight properties, and preferably wherein the body comprises air inlets for allowing air to flow into the body to cool the battery and the electronic equipment.

15. Robotic bird according to any one of the preceding claims, wherein the robotic bird has a weight of less than 500 grams, preferably less than 400 grams, more preferably less than 250 grams.

16. Robotic bird according to any one of the preceding claims, wherein connections between the wings, tail and the body are rounded or smoothed to improve flight stability.

17. Robotic bird according to any one of the preceding claims, wherein the robotic bird has the visual appearance of a bird of prey, preferably a falcon, hawk or eagle.

18. Combination of a robotic bird according to any one of the preceding claims and a remote control device, which is adapted for wireless communication with the robotic bird, and preferably adapted to transmit instructions to the controller.

19. Combination according to the preceding claims, further comprising a pair of virtual reality glasses or a screen, wherein images recorded by the camera are in real time transmitted to the virtual reality glasses or the screen, such that a user can operate the robotic bird based on the recorded images which form a first-person view of the robotic bird.

20. The use of a robotic bird or a combination according to any one of the preceding claims, for deterring birds.

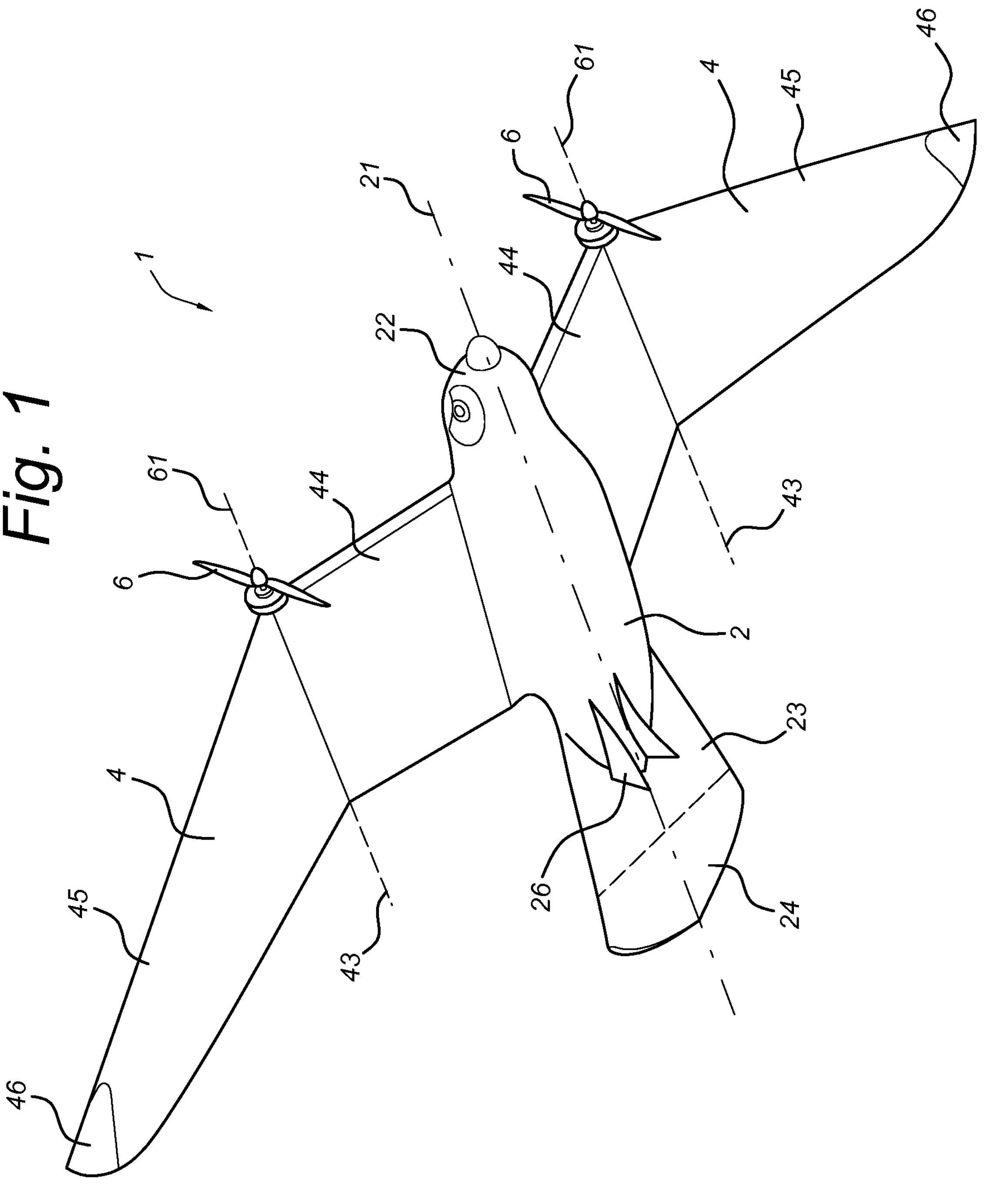


Fig. 1

Fig. 2

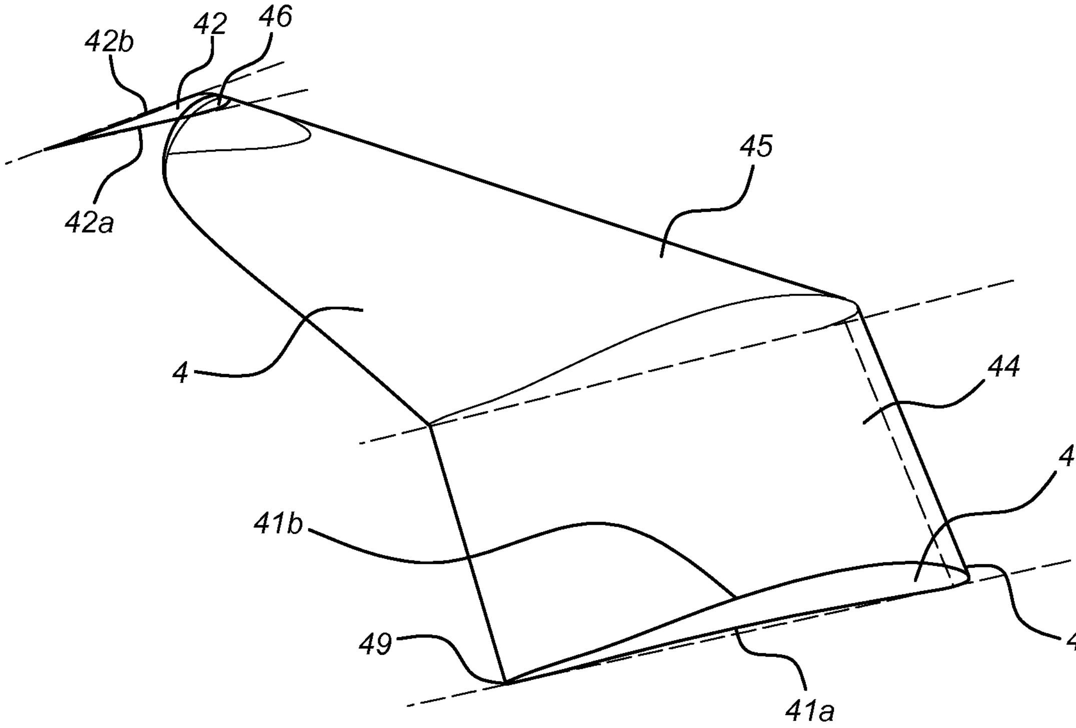


Fig. 3

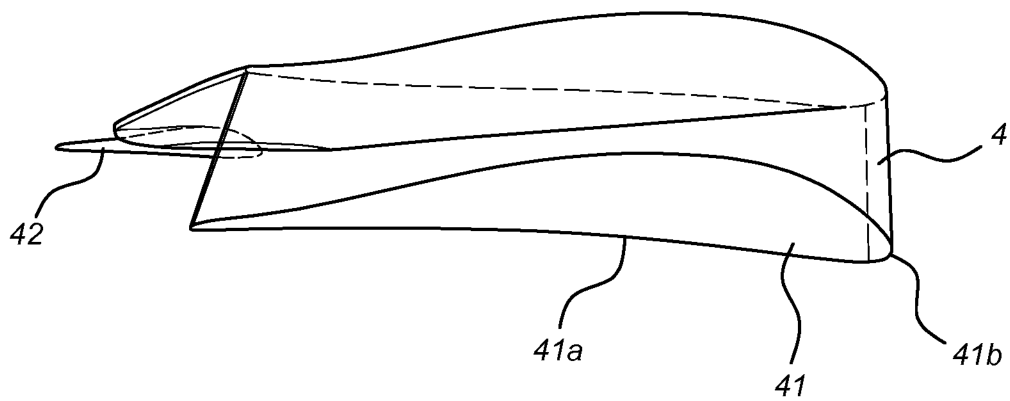


Fig. 4

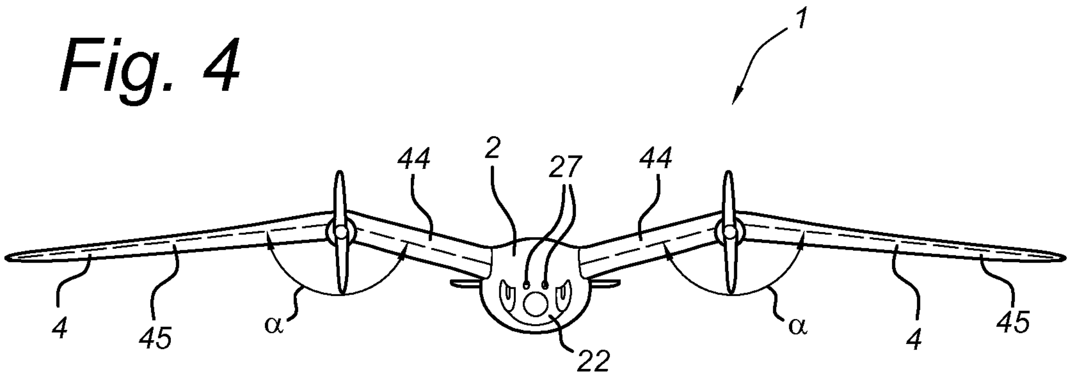
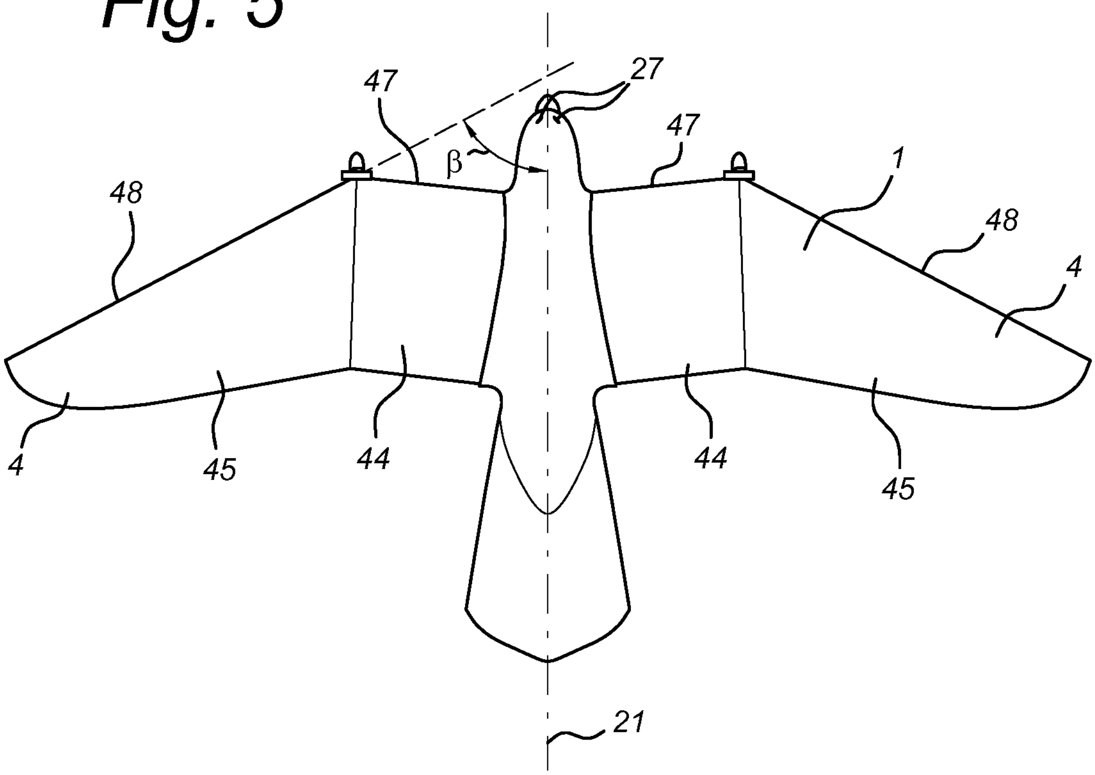


Fig. 5



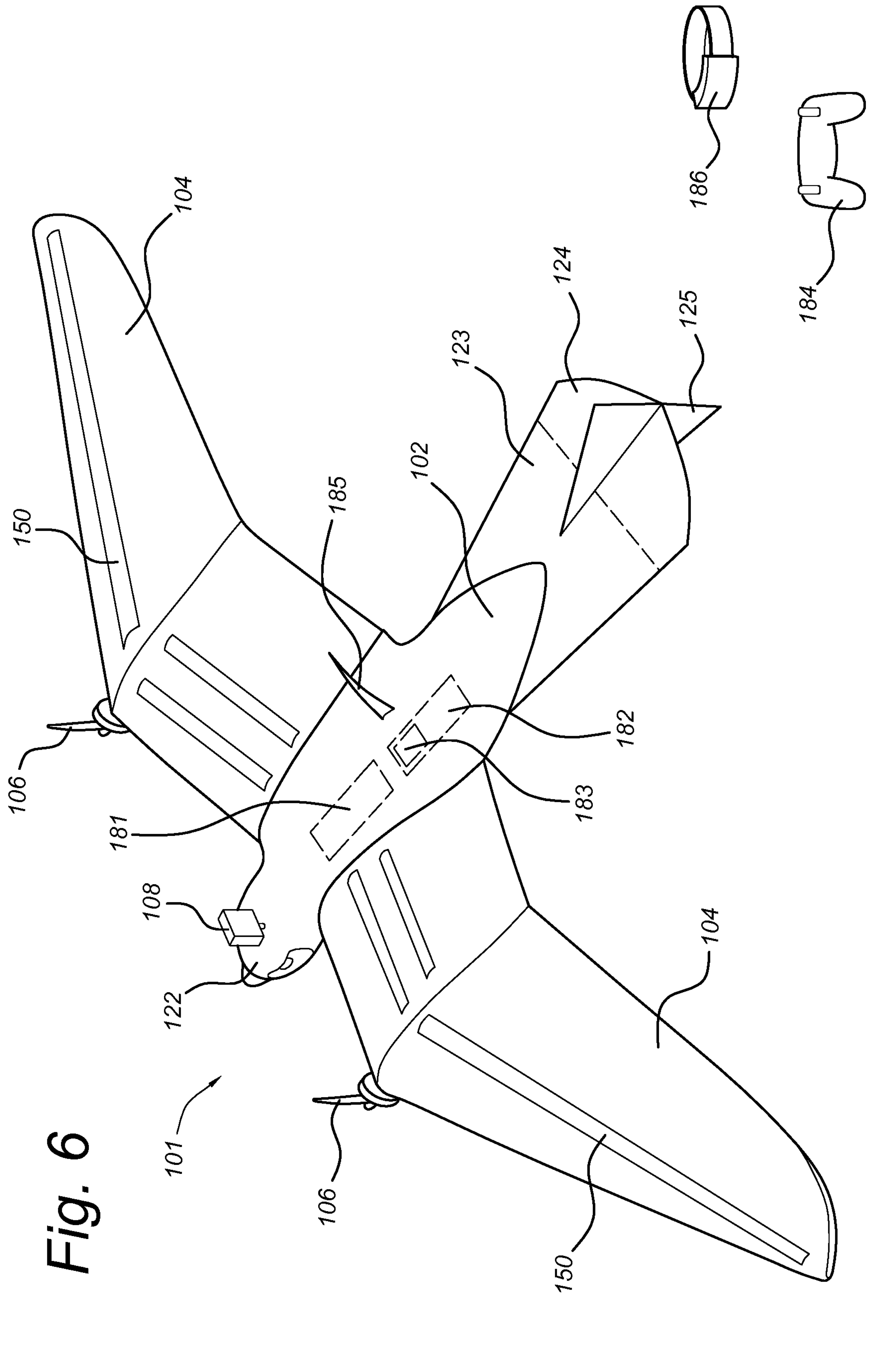

104
186
184
124
125
123
150
185
102
182
106
183
181
108
104
122
101
106
150

Fig. 6

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2019/081826

A. CLASSIFICATION OF SUBJECT MATTER
INV. B64C39/02
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.
Y	EP 3 398 853 A1 (CONSEJO SUPERIOR INVESTIGACION [ES] ET AL.) 7 November 2018 (2018-11-07) cited in the application paragraphs [0001], [0015], [0019], [0024], [0025], [0026]; claims 1,10,14; figures 1,2,3,7 -----	1-20
A	ES 2 457 690 A1 (MORENTE SANCHEZ FRANCISCO JUAN [ES]) 28 April 2014 (2014-04-28) the whole document -----	1-20
Y	FR 639 488 A (SOLDENHOFF ALEXANDER) 22 June 1928 (1928-06-22) the whole document -----	1-10, 12-20
	-/--	

[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
23 July 2020	03/08/2020

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	Cuiper, Ralf

1

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	David Crane: "Prioria Robotics Maveric Flexible-Wing Mini-UAS (Mini-Unmanned Aircraft System) at SOFIC 2011: Manpackable, Throwable SUAV (Small Unmanned Aerial Vehicle) with Flexible/Bendable Wing! (Photos and Video!) - DefenseReview.com (DR): An online tactical technology and military defense technology magazine", , 23 May 2011 (2011-05-23), XP055715811, Retrieved from the Internet: URL:https://www.defensereview.com/prioria-robotics-maveric-uas-unmanned-aircraft-system-at-sofic-2011-manpackable-throwable-suav-small-unmanned-aerial-vehicle-with-flexiblebendable-wing/ [retrieved on 2020-07-17] the whole document -----	11
A	FR 32 687 E (GOURDOU CHARLES-EDOUARD-PIERLESEURRE JEAN-ADOLPHE) 15 February 1928 (1928-02-15) the whole document -----	1

1

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/EP2019/081826

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 3398853 A1	07-11-2018	AR 107888 A1 EP 3398853 A1 ES 2613310 A1 UY 36959 A WO 2017068224 A1	28-06-2018 07-11-2018 23-05-2017 30-12-2016 27-04-2017
ES 2457690 A1	28-04-2014	NONE	
FR 639488 A	22-06-1928	NONE	
FR 32687 E	15-02-1928	NONE	