

**UNITED STATES PATENT AND TRADEMARK OFFICE**

---

**BEFORE THE PATENT TRIAL AND APPEAL BOARD**

---

SZ DJI TECHNOLOGY CO., LTD,  
Petitioner,

v.

AUTEL ROBOTICS USA LLC,  
Patent Owner

---

IPR2019-00846  
U.S. Patent No. 9,260,184

---

**PETITION FOR *INTER PARTES* REVIEW**

**Mail Stop “PATENT BOARD”**  
Patent Trial and Appeal Board  
U.S. Patent and Trademark Office  
P.O. Box 1450  
Alexandria, VA 22313-1450

## Table of Contents

I.	Introduction.....	1
II.	Mandatory Notice (37 C.F.R. § 42.8(a)(1)). .....	1
A.	Real Party-in-Interest. ....	1
B.	Notice of Related Matters. ....	2
C.	Lead and Backup Counsel.....	2
III.	Grounds for Standing (37 C.F.R. § 42.104(a)). ....	2
IV.	Identification of Challenge (37 C.F.R. § 42.204(b)). .....	3
A.	Citation of Prior Art. ....	3
B.	Grounds for Challenge. ....	3
V.	Background. ....	4
A.	Overview of the '184 patent.....	5
B.	Technological Background. ....	9
1.	Unmanned Aerial Vehicles (UAVs). ....	9
2.	The challenged claims of the '184 patent are directed to well-known connection mechanisms.....	12
C.	Level of Ordinary Skill in the Art. ....	20
D.	Claim Construction. ....	21
1.	“lock mechanism” / “clockwise lock mechanism” / “counterclockwise lock mechanism” (Claim 1). ....	21
2.	“lugs” & “notches” (Claim 1). ....	23
3.	“drive” (Claim 1). ....	25
VI.	Ground 1: The combination of Sasaki and Sokn renders claims 3 and 4 obvious.....	25
A.	The combination of Sasaki and Sokn discloses the limitations of claim 1. ....	39
1.	Sasaki discloses the UAV structural limitations recited in claim 1. ....	39
2.	The combination of Sasaki and Sokn discloses the lock mechanism limitations [1E], [1F].....	44
B.	The combination of Sasaki and Sokn renders dependent claims 3 and 4 obvious.....	50
VII.	Conclusion. ....	51

## Table of Authorities

### Cases:

*In re Clay*,  
966 F.2d 656 (Fed. Cir. 1992).....38

*In re Paulsen*,  
30 F.3d 1475 (Fed. Cir. 1994).....38

*Mars Inc. v. H.J. Heinz Co.*,  
377 F.3d 1369 (Fed. Cir. 2004).....22

### Other Authority:

MPEP 211.03 .....22

### Exhibit List

<b>DJI Exhibit No.</b>	<b>Description</b>
1001	U.S. Patent 9,260,184 to Olm <i>et al</i>
1002	U.S. Patent 9,260,184 File History
1003	Declaration of Dr. Afred Ducharme
1004	Curriculum Vitae of Dr. Afred Durcharme
1005	JP Unexamined Utility Model Application Publication H06-17511 to Ryoichi Sasaki
1006	English Language Translation of H06-17511 and Certification of Translation
1007	U.S. Patent No. 5,133,617 to Sokn
1008	U.S. Patent No. 8,052,081 to Olm
1009	Design and Construction of a Quadrotor-type Unmanned Aerial Vehicle: Preliminary Results” by Sa
1010	Design of a Four Rotor Hovering Vehicle by Nice
1011	The JAviator Quadrotor – An Aerial Software Testbed by Trummer
1012	U.S. Patent No. 135,655 to Miller <i>et al.</i>
1013	U.S. Patent No. 821,534 to Perkins
1014	Contra Rotating Propeller Drive System User Guide
1015	KitchenAid – Hand Mixer Instructions
1016	User Manual for the Microdrones md4-200, Version 2.2
1017	U.S. Patent No. 2,470,517 to Obrist

<b>DJI Exhibit No.</b>	<b>Description</b>
1018	European Patent Application EP 0 921 067 to Peter Muller
1019	IPR2019-00343, Patent Owner Preliminary Response, Paper 6
1020	American Heritage Dictionary
1021	McGraw-Hill Dictionary of Scientific and Technical Terms, Fifth Edition
1022	The New Oxford American Dictionary, Second Edition
1023	Webster's Ninth New Collegiate Dictionary

**I. Introduction.**

SZ DJI Technology Co., Ltd. (“Petitioner”) requests *Inter Partes* Review of claims 3 and 4 of U.S. Patent No. 9,260,184 (DJI-1001, “the ’184 patent”). The ’184 patent is directed to aspects of an unmanned aerial vehicle (UAV)—the basic structural components of UAV (body, arms, and rotor assembly), the operation of the UAV’s rotary assembly, and the mechanism for coupling the propellers to the driveshafts. Each of these aspects was well-known in the prior art before the earliest possible priority date of the ’184 patent. The ’184 patent itself admits that the structural components and rotary assembly were known. The claimed coupling mechanism limitations do not impart novelty. These limitations merely combine a series of well-known techniques that have been used in mechanical connections for at least a century, if not longer. Petitioner demonstrates below that claims 3 and 4 are unpatentable.

**II. Mandatory Notice (37 C.F.R. § 42.8(a)(1)).**

**A. Real Party-in-Interest.**

The real parties-in-interest are SZ DJI Technology Co., Ltd. (“Petitioner”), DJI Technology Inc., DJI Europe B.V., iFlight Technology Company Limited, DJI Japan K.K., and DJI Research LLC.

**B. Notice of Related Matters.**

Autel Robotics USA LLC (“Patent Owner”) is asserting the ’184 patent against Petitioner in *SZ DJI Tech. Co. Ltd. et al. v. Autel Robotics USA LLC et al.*, C.A. No. 16-706-LPS-CJB (D. Del.) and in *Certain Unmanned Aerial Vehicles and Components Thereof*, Inv. No. 337-TA-113 (U.S.I.T.C., instituted Sept. 26, 2018).

Petitioner filed an IPR petition challenging claims 1, 2, 5-9, and 11 of the ’184 patent (IPR2019-00343).

**C. Lead and Backup Counsel.**

Pursuant to 37 C.F.R. §§ 42.8(b)(3) and 42.10(a), Petitioner appoints **Lori A. Gordon** (Reg. No. 50,633) as its lead counsel and **Steve W. Peters** (Reg. No. 73,193) as backup counsel, both at the address: King & Spalding LLP, 1700 Pennsylvania Avenue NW, Washington, D.C. 20006, phone number (202) 737-0500 and facsimile (202) 626-3737.

Petitioner consents to electronic service by email at the email addresses: lgordon@kslaw.com, speters@kslaw.com, and DJI-PTAB@kslaw.com.

**III. Grounds for Standing (37 C.F.R. § 42.104(a)).**

The ’184 patent issued on February 16, 2016. Pursuant to 37 C.F.R. § 42.104(a), Petitioner certifies that the ’184 patent is available for *Inter Partes* Review and that Petitioner is not barred or estopped from requesting *Inter Partes* Review on the grounds identified herein.

#### **IV. Identification of Challenge (37 C.F.R. § 42.204(b)).**

##### **A. Citation of Prior Art.**

The '184 patent was filed on May 14, 2014 and claims priority to Canadian Patent Application No. 2815885, filed on May 15, 2013. Petitioner does not acquiesce that the '184 patent is entitled to claim priority benefit to this application. However, each of the references asserted in this Petition published or issued before the earliest possible priority date of the '184 patent (May 15, 2013).

**JP Unexamined Utility Model Application Publication H06-17511**, to Ryoichi Sasaki ("Sasaki"; DJI-1005) is prior art under at least 35 U.S.C. §§102(a)(1) and (2) because it published on January 14, 1991, before the Canadian Priority Application date (May 15, 2013) and is not subject to any exceptions under §§102(b)(1) or (2). A certified translation of Sasaki is provided as DJI-1006. Sasaki was not applied during prosecution of the '184 patent.

**U.S. Patent No. 5,133,617** to Sokn ("Sokn"; DJI-1007) is prior art under at least 35 U.S.C. §§102(a)(1) and (2) because it issued on July 28, 2002, before the Canadian Priority Application date (May 15, 2013), and is not subject to any exceptions under §§102(b)(1) or (2). Sokn was not applied during prosecution of the '184 patent.

##### **B. Grounds for Challenge.**

This Petition presents the following ground of unpatentability:



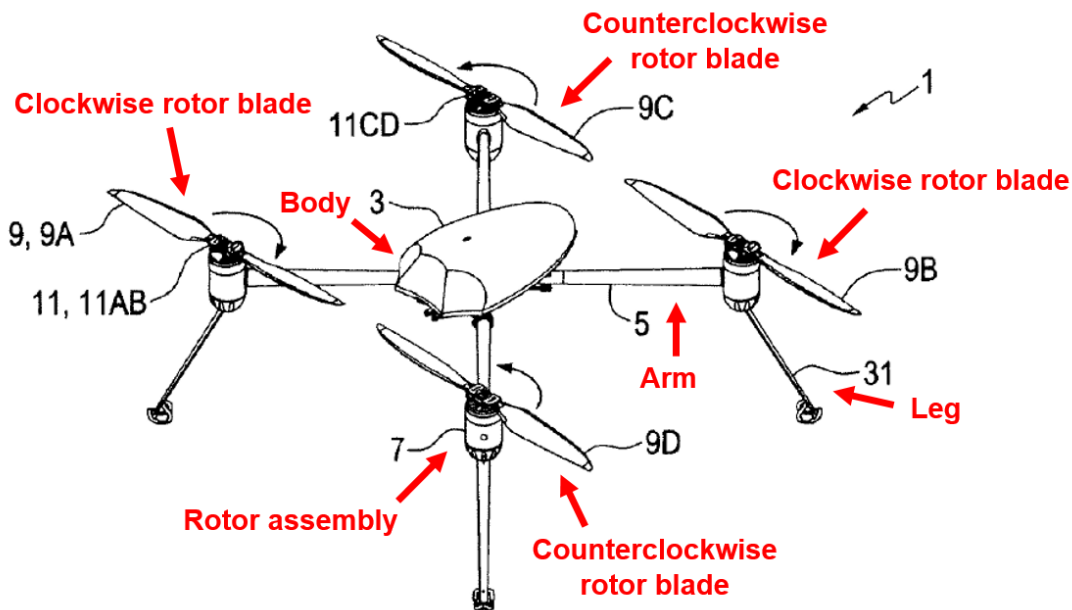
- **Ground 1:** Sasaki in combination with Sokn renders claims 3 and 4 obvious.

## **V. Background.**

The '184 patent uses well-known mechanisms to couple propellers of a UAV to their driveshafts. The sole independent claim of the '184 patent includes a set of limitations directed to the basic structure of the UAV, a limitation directed to the operation of the propulsion system, and a set of limitations defining the mechanisms for coupling the propellers to the driveshafts. (DJI-1003, Ducharme Decl., ¶23.) The basic components of a multi-rotor UAV (body, arms, and rotor assembly) and the operation of the propulsion system were well-known before the earliest possible priority date of the '184 patent (May 2013). The '184 patent itself acknowledges that these components were known. (DJI-1001, 1:18-20.) Indeed, many UAVs, including UAVs by the original assignee of the '184 patent, Draganfly, sold prior to May 2013 included these basic components. (*See* DJI-1009, p. 2 (listing Draganflyer E4, Parrot AR.Drone, and X-4 Flyer among others as existing UAV products); *see also*, DJI-1003, ¶40.) The recited coupling mechanism does not impart patentability to the claims because it merely combines several well-known concepts of mechanical connections: a keyed connection, a lug and notch connection, and a directional twist-lock connection as Petitioner details below.

**A. Overview of the '184 patent.**

The '184 patent discloses a rotary wing aircraft with arms extending from a body and a rotor assembly attached to an end of each arm as shown in annotated Figure 1 below.



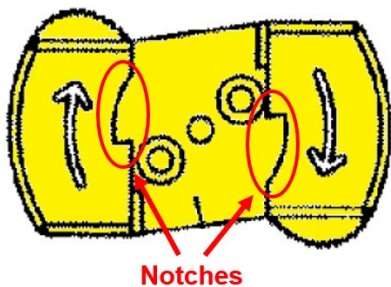
**'184 Patent, Figure 1 (annotated)**

As shown in Figure 1 above, the aircraft has a body (3), four arms (5), corresponding rotor assemblies (7) on each arm, four rotor blades (9A, 9B, 9C, 9D)—two of which rotate clockwise (9A, 9B) and two of which rotate counterclockwise (9C, 9D)—and four support legs (31).

The '184 patent describes a lock mechanism used to couple the rotor blades to their associated driveshafts. The lock mechanism disclosed by the '184 patent has at least two parts: a “shaft lock portion” attached to the driveshaft, and a “blade

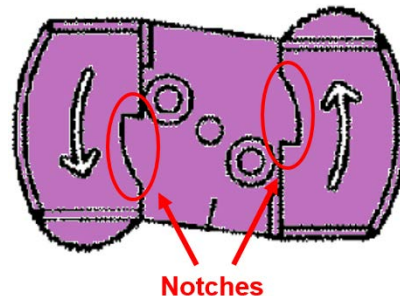
lock portion” attached to the rotor blade. (DJI-1003, ¶¶33-38.) Each clockwise-rotating driveshaft has a shaft lock portion (yellow), and each counterclockwise-rotating driveshaft has an oppositely-configured shaft lock portion (purple) as illustrated in the top figure below. (*Id.*, ¶33.) As shown in the bottom figure below, the ’184 patent discloses a clockwise rotor blade (9A, light green) with lugs on a blade lock portion (17A, dark green) specifically configured to engage the clockwise shaft lock portions, and a counterclockwise rotor blade (9C, light blue) with lugs on a blade lock portion (17C, dark blue) specifically configured to engage the counterclockwise shaft lock portions. (*See, e.g.*, DJI-1001, 4:19-23; DJI-1003, ¶¶34-35.)

**Clockwise Shaft Lock Portion**



**’184 patent, Figure 6 (annotated)**  
(mirror image of counterclockwise shaft lock portion actually depicted)

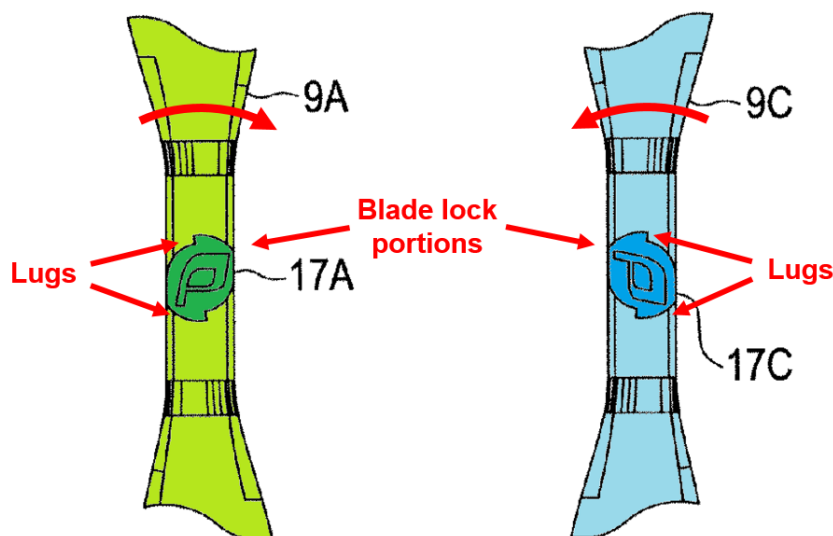
**Counterclockwise Shaft Lock Portion**



**’184 patent, Figure 6 (annotated)**

**Clockwise Rotor Blade**

**Counterclockwise Rotor Blade**



**'184 Patent, Figure 6 (portions of image cropped and rearranged)**

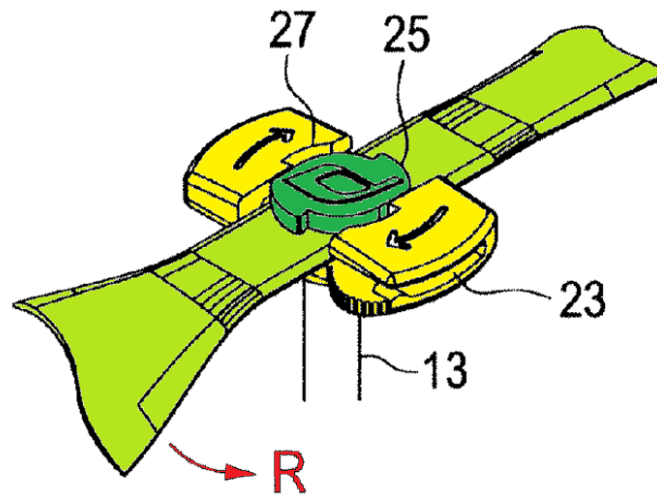
Each shaft lock portion has a center recess—in the middle, between the notches—into which the blade lock portion of the rotor blade may be inserted or “dropped” for attachment.<sup>1</sup> (See DJI-1001, Figure 6 (showing recess 21 in counterclockwise shaft lock portion).) Since the clockwise shaft lock portion has notches that are configured differently from the notches on the counterclockwise shaft lock portion, the notches of the clockwise shaft lock portion will not engage

---

<sup>1</sup> No claims specifically require the shaft lock portion to have a “center recess.”

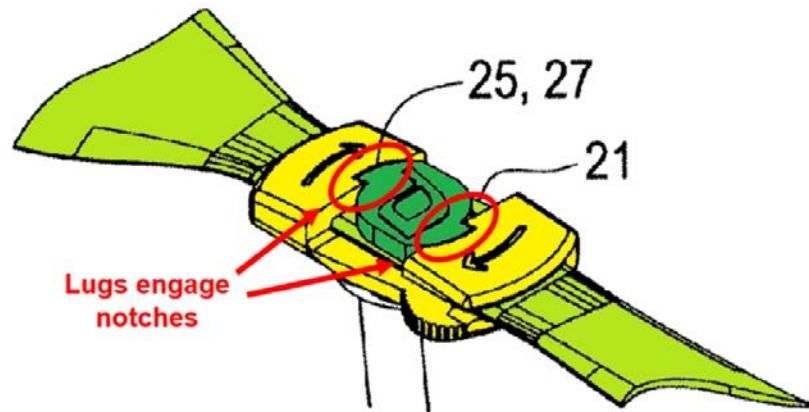
the lugs on a rotor blade that is configured to engage the notches on the counterclockwise shaft lock portion, and vice versa. (DJI-1003, ¶34.)

To attach the clockwise rotor blade, the blade lock portion (dark green) of the clockwise rotor blade (light green) is inserted into and positioned in the recess of the shaft lock portion (yellow) of the clockwise lock mechanism as shown in annotated Figure 4 below. (*see also*, DJI-1001, 4:1-4.)



**'184 Patent, Figure 4 (annotated)**

To complete the installation, the clockwise rotor blade (light green) is rotated as indicated by red-highlighted “R” and arrow in Figure 4, above. As shown and highlighted in annotated Figure 5 below, this rotation causes the lugs (25) of the blade lock portion to engage the notches (27) of the shaft lock portion, and the rotor blade to slide into slots (23) on each side of the shaft lock portion. (DJI-1001, 4:3-8.)



**'184 Patent, Figure 5 (annotated)**

## **B. Technological Background.**

### **1. Unmanned Aerial Vehicles (UAVs).**

#### **a) Basic structure of UAVs was known.**

A multi-rotor UAV (e.g., quadcopter) includes three core components: a body, two or more arms, and a rotor assembly attached to each arm (also referred to as a propulsion assembly). (DJI-1003, ¶¶41-42.) As was known in the art, a rotor assembly includes a motor, propeller, and a driveshaft coupled to both the motor and the propeller. (DJI-1003, ¶42.) The driveshaft is a mechanical component for transmitting torque and rotation from the motor to the propeller. (DJI-1003, ¶42.) The '184 patent acknowledges that this basic UAV structure was known in the prior art, explaining that a popular configuration for an existing UAV “includes a number of arms extending laterally from the aircraft body, with a rotor assembly on the end of each arm.” (DJI-1001, 1:18-20; *see also*, DJI-1003, ¶¶40-41.)

The rotor assembly (also referred to as the propulsion assembly) is an important component of a UAV because the flight of the UAV is controlled by varying the rotation speeds of the propellers. (DJI-1003, ¶¶43-45.) The optimal design for a quadrotor aircraft, for example, uses a pair of propellers that spin clockwise and an opposite pair of propellers that spin counterclockwise to cancel the propellers' torque effect. (*See* DJI-1003, ¶44; DJI-1011, p. 3; DJI-1010, pp. 2, 6.) Because two propellers rotate in the clockwise direction and two rotate in the counterclockwise direction, the clockwise propellers must have an opposite pitch (angle of attack) from the counterclockwise propellers in order to generate lift. (DJI-1003, ¶45.) That is, a quadcopter includes a pair of clockwise propellers and a pair of counterclockwise propellers. (DJI-1003, ¶44.) A propeller pitched to generate upward lift when spinning in the clockwise direction would generate downward lift when spinning in the counterclockwise direction. (DJI-1003, ¶45.) Thus, the quadrotor aircraft would not be controllable if a propeller designed for a clockwise rotation were to be inadvertently attached to a counterclockwise driveshaft. (*Id.*) Because the propellers on UAVs are removable by a user, manufacturers used techniques to “mistake proof” or key the coupling between the propeller and the driveshaft to ensure users attach the proper propellers to the proper driveshafts. (*Id.*)

In addition, manufacturers of UAVs recognized that the connection mechanism between the propeller and driveshaft had to withstand various forces during takeoff, flight, and landing which, if not accounted for, could result in separation of the propeller from the driveshaft. (DJI-1003, ¶46.) First, the design of the coupling between the driveshaft and the propeller must account for the torque generated by the rotation of the driveshaft itself. (*Id.*) When the motor rotates the driveshaft in the clockwise direction, the clockwise rotation of the drive shaft imparts a corresponding clockwise torque (“drive torque”) on the propeller coupling which causes the propeller to also rotate in the clockwise direction. (*Id.*) However, the propeller does not rotate freely through the air: there is aerodynamic drag generated by the friction between the propeller and the air as the propeller is rotating, which imparts a torque (“drag torque”) on the propeller in a direction opposite the rotation of the propeller. (DJI-1003, ¶47.) Drag torque in the counterclockwise direction is unavoidable while the UAV is in operation and the propeller is spinning and can loosen the coupling between the drive shaft and the propeller if unaccounted for. (*Id.*) The greater the drag torque is relative to the drive torque, the greater the loosening effect will be due to the imbalanced torque forces on the coupling. (*Id.*) Additionally, when the drive shaft accelerates or decelerates during takeoff, landing, or in-flight maneuvers, it imparts an additional



torque on the coupling which changes the balance of the drive torque and drag torque. (*Id.*)

**2. The challenged claims of the '184 patent are directed to well-known connection mechanisms.**

Independent claim 1 requires the coupling between the rotor blade and the driveshaft to have two characteristics. First, the claim requires the coupling be “keyed” such that “*the clockwise rotor blade is engageable only with the clockwise lock mechanism and cannot be engaged in the counterclockwise lock mechanism, and the counterclockwise rotor blade is engageable only with the counterclockwise lock mechanism and cannot be engaged in the clockwise lock mechanism.*”<sup>2</sup>

Second, the claim requires a lug and notch style coupling for at least the clockwise mechanism: “*the shaft lock portion defining notches configured to engage corresponding lugs on the blade lock portion.*” Lug and notch style couplings, including the common bayonet connection, have been used for centuries, if not millennia, to couple two components together. (DJI-1003, ¶¶29, 50-53.)

Challenged dependent claims 3 and 4 add a further directional twist-lock requirement to each of the couplings—namely that one component (the blade lock portion) be rotated (or twisted) to effectuate the coupling: “*blade lock portion of*

---

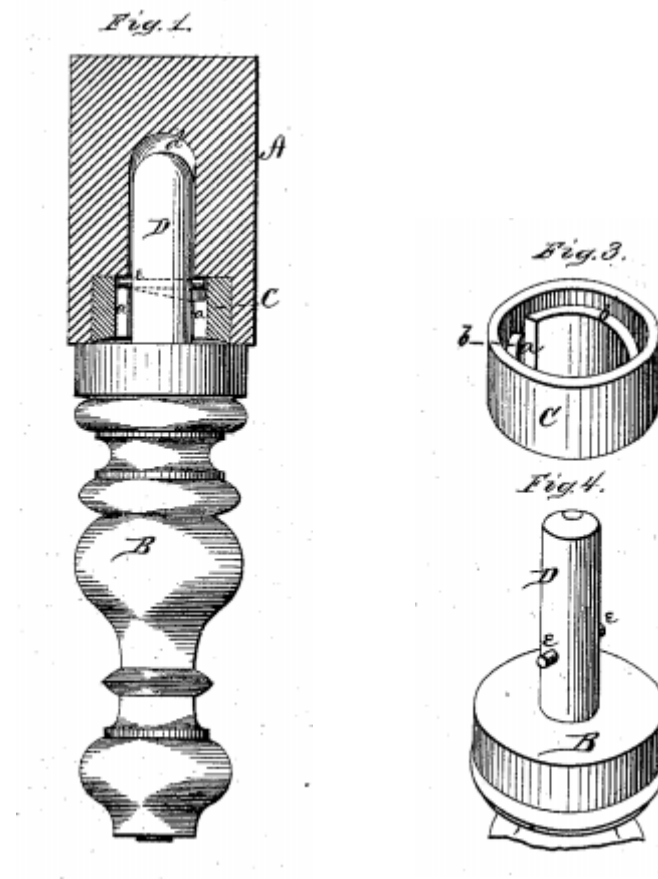
<sup>2</sup> Claim language is indicated by italics.

*the clockwise lock mechanism is rotated counterclockwise with respect to the shaft lock portion thereof to releasably attach the clockwise rotor blade to the first driveshaft*” (claim 3) and *“blade lock portion of the counterclockwise lock mechanism is rotated clockwise with respect to the shaft lock portion thereof to releasably attach the counterclockwise rotor blade to the second driveshaft”* (claim 4). Twist-lock coupling mechanisms as well as keyed connections were well-known and widely used prior to the earliest possible priority date of the ’184 patent. The claimed directionality of the coupling also does not impart novelty to the claims. (DJI-1003, ¶¶30, 49.) It was well-known that when coupling a component to a rotating component (*e.g.*, a propeller to a blade) using a twist-lock connector, the direction of “twisting” must be opposite to the rotational direction so that the forces of rotation do not release the connection. (DJI-1003, ¶¶30, 58-66.) Indeed, twist-lock connectors for blades in marine applications were designed to account for rotational forces for nearly a century. (DJI-1003, ¶¶59-63.)

**a) Twist-Lock/Lug-Notch connectors were known.**

The use of twist-lock/lug-notch connectors is not novel. Twist-lock connections (*e.g.*, bayonet connection) have been used in a wide variety of applications for over a century. U.S. Patent No. 135,655, issued in February 1873, (the “’655 patent”) describes the use of a twist-lock mechanism to easily attach and detach legs to and from tables as illustrated in Figures 1, 3 and 4 below. The ’655

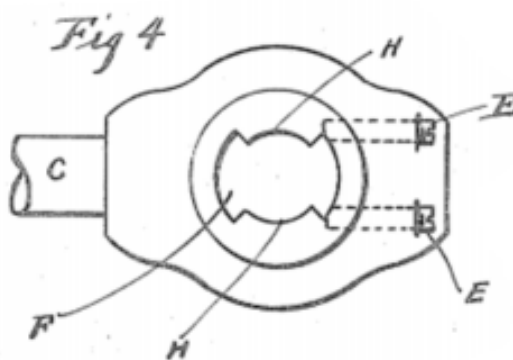
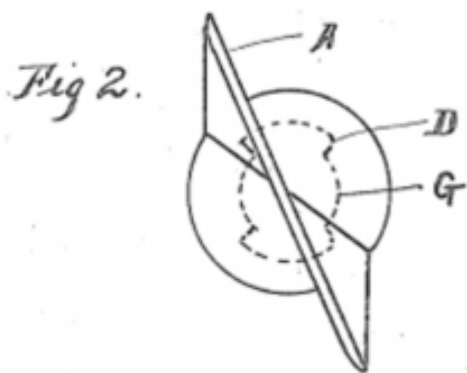
patent notes that it was not the first to use this coupling technique—the use of “incline b, with catches or lugs, **has been before used in bedsteads.**” (DJI-1012, p. 2, col. 2 (emphasis added).) Thus, even in 1873, it was acknowledged that the use of lugs and notches in twist-lock configurations was not novel. (See DJI-1003, ¶50.)



**'655 Patent, Figures 1, 3, and 4**

The use of twist-lock/lug-notch couplings expanded beyond use in furniture. U.S. Patent No. 821,534 (“Perkins”), filed on June 2, 1905, describes the use of a twist-lock connector for coupling a propeller blade to a hub. Figure 2 of Perkins,

reproduced below left, is an end view of a propeller and Figure 4, reproduced below right, is a top plan of the hub “showing the opening into which the shaft of the blade is inserted.” (DJI-1013, p. 2, lines: 21-28.) The propeller-blade, labeled A, includes a “short centrally-located portion” projecting from the end, labeled G. (DJI-1013, p. 2, lines: 58-63.) Perkins refers to this projection as a “shaft.” The end “carries a broken flange D,” two lugs extending from the circumference of the shaft.



### Perkins, Figures 2 and 4

The hub shown in Figure 4 includes an opening, labeled F, which receives the shaft of the propeller blade G. As shown in Figure 4, the hub opening is expanded at one or more places “so as to permit the flange D to pass therethrough.” (DJI-1013, p. 2, lines: 67-73.) The hub further includes a pair of adjusting or locking screws or pins, labeled E, that “are adapted to bear against the corners of

the flanges D upon the blade-shafts when the blades are in position.” (DJI-1013, p. lines: 81-87.) Thus, the blade portion has lugs and the hub of the drive shaft includes corresponding notches to receive the lugs.

To assemble, the blade is turned “so that the broken flange D will register with the openings in the broken flange H, and so will pass therethrough.” (DJI-1013, p. 2, lines: 90-94.) The blade is given “a quarter-turn or as much as may be necessary, and these two broken flanges D and H engage with each other, the flange D being under the flange H, so that withdrawal of the wheel is impossible.” (DJI-1013, p. 2, lines: 94-99.) That is, the blade is coupled to the hub via a twist-lock/lug-notch coupling.

**b) “Keyed” connection mechanisms were well-known.**

The use of a “keyed” connection mechanism is also not novel. Keyed connections have long been used in systems having components with different shapes that require specific placement in systems with multiple rotating components in close proximity to avoid interference between the rotating components. (DJI-1003, ¶54.) Keyed connection mechanisms “mistake proof” the device, ensuring that a user couples the components in the correct manner. (*Id.*) For example, keyed connections are commonly used in kitchen mixers to ensure that the beaters are properly aligned to avoid interference during operation. (*Id.*) Keyed connections are also commonly used to ensure that UAV propellers are coupled to

the proper driveshafts, as discussed in the UAV background section. (DJI-1003, ¶¶55, 57, 64; *see also*, DJI-1014, p. 3 (“[E]ach propeller is designed so that it can only fit on the front or the rear, whichever is appropriate for each propeller. This means that it is not possible to incorrectly assemble either prop.”).) A wide variety of techniques have been used to “key” a connection including keying based on size of the connecting parts, keying based on positioning of the connecting parts, and keying based on configuration of the connection components (*e.g.*, directional threading). (DJI-1003, ¶¶56-57, 64.)

For example, version 2.2 of the User Manual for the Microdrones md4-200 (“Microdrones”) teaches a “keyed” connection based on positioning of the connecting parts. (DJI-1003, ¶57.) Microdrones discloses a rotary wing aircraft (quadcopter, UAV). (*Id.*) As shown in Figure 25 below, Microdrones rotor blade has two lugs that are inserted into corresponding notches on the driveshaft. (*Id.*) Microdrones “keys” its connection mechanism by altering the positioning of the lugs on the clockwise and counterclockwise propellers. Specifically, Microdrones’ clockwise lock mechanism differs from its counterclockwise lock mechanism in that the distance between the lugs on the center bar of the rotor blade and the matching notches on the rotor mounting plate is “**individual**”<sup>3</sup> (*i.e.*, unique) and

---

<sup>3</sup> Unless otherwise noted, emphasis by bold or underlined has been added.

thus different. (DJI-1016, p. 27 (“To avoid accidental misplacement, **both directions of turning use individual distances between these knobs.**”).)



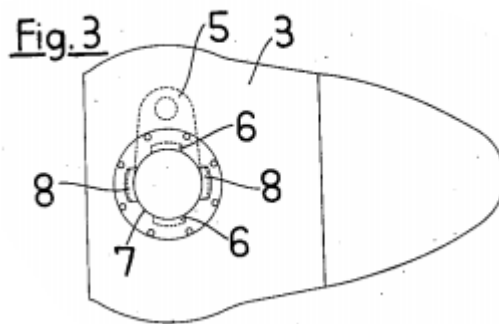
**Microdrones, Figure 25**

**c) Directionality of coupling.**

As discussed above, it was well-known, long before the '184 patent, that rotational forces impact the connection between a rotating component (*e.g.*, a driveshaft) and another component (*e.g.*, propeller or blade). (DJI-1003, ¶58.) Connection mechanisms which are twisted or turned to a position such that the connection resists the rotational forces (referred to herein as directional connection mechanisms) are commonly used in devices requiring connection with a rotating component such as marine propellers, fans, and UAVs. (DJI-1003, ¶¶58-66.)

U.S. Patent 2,470,517 to Obrist (“Obrist”), filed in 1945, describes a directional twist-lock coupling mechanism for a variable-pitch marine propeller. In

Obrist, the root of the blade includes two projections 6 arranged opposite to one another. (DJI-1017, 2:28-32.) The propeller hub includes two recesses 8 that are slightly larger than the projections 6. (DJI-1017, 2:38-42.) The lugs are introduced through recesses 8, the blade root is turned about 90° so that “the lugs 6 are displaced from the recesses 8 through which they entered, and engage an arcuate seat formed therefore on the internal face of the hub” as shown in Figure 3 of Obrist below. (DJI-1017, 2:44-54.)



**Obrist, Figure 3**

Obrist notes that “[i]n this position the projections 6 act as a **lock** with regard to the centrifugal forces exerted on the correlated blade 1 in that they rest directly against the inner surface of the hub 3.” (DJI-1017, 2:55-3:4 (emphasis added).) Thus, in Obrist the lug/notch connection is configured to twist so that the connection remains locked when system is exposed to centrifugal forces. (DJI-1003, ¶60.) European Patent Application EP 0921067 to Muller (“EP067”) also



discusses a bayonet connection which is twisted in a specific direction such that “the reaction force in rotation of the propeller [] maintains the respective projection against the stop.” (DJI-1018, ¶[0011]; DJI-1003, ¶¶61-63.)

Threaded screws are also an extremely common and well-known type of directional fastening mechanism. (DJI-1003, ¶64.) A screw has a thread which is a helical structure (protrusion wrapped around a cylinder in the form of helix). (*Id.*) The helix of a thread can twist in two possible directions—right (or right-handed) and left (or left-handed). (*Id.*) With a right-hand thread, turning the screw clockwise inserts or tightens the screw; turning the screw counterclockwise loosens or removes the screw. (*Id.*) A screw has a corresponding hole or socket (*e.g.*, nut) with corresponding threads. (*Id.*) For example, a screw with right-handed male threads has a hole or socket (*e.g.*, nut) with right-handed female threads and a screw with left-handed male threads has a hole or socket (*e.g.*, nut) with left-handed female threads. (*Id.*) Therefore, threaded connections are also “keyed”—a right-handed screw cannot be used with a left-handed hole, and vice versa. (*Id.*) Sasaki, discussed in detail in Ground 1, describes the use of directionally threaded screw fasteners in its UAV. (*see, e.g.*, DJI-1003, ¶66.)

### **C. Level of Ordinary Skill in the Art.**

A person having ordinary skill in the art (“POSITA”) at the time of the alleged invention would have had at least an undergraduate degree in mechanical

engineering, or equivalent education, training, or experience, with at least two years of experience with UAVs. (DJI-1003, ¶72.)

**D. Claim Construction.**

In inter partes review proceedings filed on or after November 13, 2018, claim terms are construed using the same standard used in district courts. 37 C.F.R. § 42.100(b) (as amended Nov. 13, 2018); *Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005) (en banc). Petitioner proposes the following constructions under the *Phillips* standard. *See Vivid Techs., Inc. v. Am. Sci. & Eng'g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999) (holding that “only those terms need be construed that are in controversy, and only to the extent necessary to resolve the controversy”).

**1. “lock mechanism” / “clockwise lock mechanism” / “counterclockwise lock mechanism” (Claim 1).**

Independent claim 1 recites that “*each rotor assembly compris[es] a rotor blade releasably attached to a driveshaft by a **lock mechanism**,*” that “*a clockwise rotor blade is releasably attached to the first driveshaft by engagement in a **clockwise lock mechanism**,*” and that a “*counterclockwise rotor blade is releasably attached to the second driveshaft by engagement in a **counterclockwise lock mechanism**.*” Claim 1 also recites that “*the **clockwise lock mechanism** comprises a shaft lock portion...and a blade lock portion,*” and claim 2 recites that “*the*

*clockwise lock mechanism comprises a shaft lock portion...and a blade lock portion.”*

Petitioner proposes construing these terms to clarify that the recited “lock mechanisms” may include components other than those specifically recited in the claims to releasably attach the rotor blades. Nothing in the claims or specification restricts the recited locking mechanisms to consisting of only the recited “shaft lock portion” and “blade lock portion.” Rather, the claims recite that the “[clockwise / counterclockwise] lock mechanism **comprises** a shaft lock portion...and a blade lock portion,” leaving open the possibility that the lock mechanism may consist of other components that enable releasable attachment of the rotor blades. Indeed, the ’184 patent’s lock mechanism also includes at least slots 23 on the shaft lock portion, which help to achieve the releasable attachment of the rotor blades. (See DJI-1001, Figure. 9, 4:1-8; DJI-1003, ¶78.)

It is a well-established principle that the transitional term “comprises” is “synonymous with ‘includ[es],’ ‘contain[es],’ or ‘characterized by,’ [and] is inclusive or open-ended and **does not exclude additional, unrecited elements** or method steps.” MPEP 211.03 (citing *Mars Inc. v. H.J. Heinz Co.*, 377 F.3d 1369 (Fed. Cir. 2004) (“[L]ike the term ‘comprising,’ the terms ‘containing’ and ‘mixture’ are open-ended.”)). The specification also uses the open-ended term “comprises” when describing components that make-up the clockwise and

counterclockwise lock mechanisms. (*See* DJI-1001, 3:55-62.) Thus, a POSITA would understand that a “lock mechanism” for a rotor blade could potentially include multiple components used to attach the blade. (DJI-1003, ¶79.)

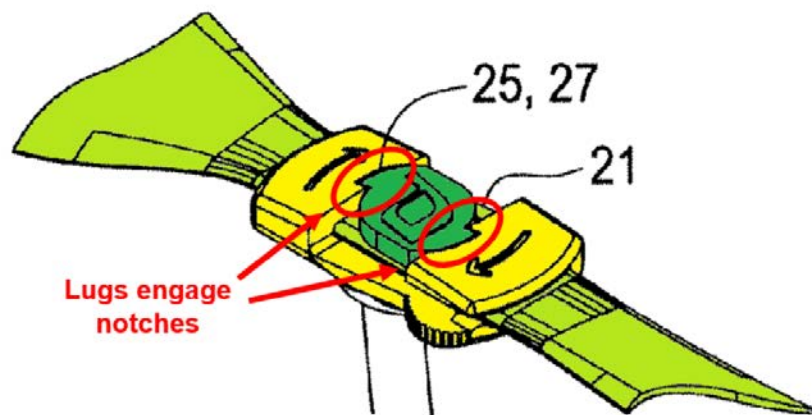
This understanding aligns with the definition of a “mechanism.” (*See* DJI-1020, p. 843 (defining “mechanism” as “[t]he arrangement of connected parts in a machine” and a “system of parts that operate or interact like those of a machine”).)

Therefore, the meaning of “lock mechanism” / “clockwise lock mechanism” and “counterclockwise lock mechanism” is “one or more components that enable a [clockwise / counterclockwise] rotor blade to be releasably attached.” (DJI-1003, ¶¶77-82.)

## 2. “lugs” & “notches” (Claim 1).

Claim 1 recites “the shaft lock portion defining **notches** configured to engage corresponding **lugs** on the blade lock portion.”

Construction of these terms is necessary to avoid confusion about their meaning in the mechanical context. The ’184 patent teaches that the blade lock portion (dark green) has “lugs” (25), which are simply projections that engage “notches” (27) on the shaft lock portion (yellow), as shown in annotated Figure 5 below. (DJI-1001, 4:3-6 (“[L]ugs 25A on the blade lock portion 17A engage notches 27A defined by the shaft lock portion as seen in FIG. 5.”))



**'184 Patent, Figure. 5 (annotated)**

A POSITA would understand that “lugs” are projections that, together with the notches, serve to ensure proper fitting or alignment of an object. This understanding is consistent with contemporaneous dictionary definitions of the noun “lug.” (See DJI-1021, p. 1177 (defining “lug” as a “projection or head on a metal part to serve as a cap, handle, support, or fitting connection”); DJI-1020, p. 806 (defining “lug” as “a handle or projection used as a hold or support” and a “projection that helps provide traction”). A POSITA would further understand that “notches” are simply indentations, which, in view of claim 1, would be designed to “engage” the “lugs.” (See *e.g.*, DJI-1022, p. 1163 (defining “notch” as “an indentation or incision on an edge or surface”); *see also* DJI-1003, ¶86.)

Therefore, “lugs” are “projections”; and “notches” are “indentations.”

These constructions comport with the usage of these terms in the '184 patent, where the “the shaft lock portion defin[es] **notches [(i.e., indentations)]** to

engage corresponding **lugs [(i.e., projections)]** on the blade lock portion.” (DJI-1003, ¶¶83-87.)

### 3. “drive” (Claim 1).

Claim 1 recites “a **drive** rotating the driveshaft.” As “drive” is a broad term typically used in verb form, Petitioner proposes a construction to clarify its meaning in the context of the patent and claims. The ’184 patent teaches a “drive” may be “**an electric motor**, rotating the driveshaft.” (DJI-1001, 3:20-21.) A POSITA would thus understand “drive” to be a component, such as an electric motor, that can impart a force to cause motion.

This understanding is consistent with contemporaneous dictionary definitions of the term “drive.” (*See* DJI-1023, p. 384 (defining “drive” as “to impart a forward motion to by physical force”); DJI-1021, p. 616 (defining “drive” as “[t]he means by which a machine is given motion or power..., or by which power is transferred...”).)

Therefore, “drive” is a “component that imparts motion.” (DJI-1003, ¶¶89-91.)

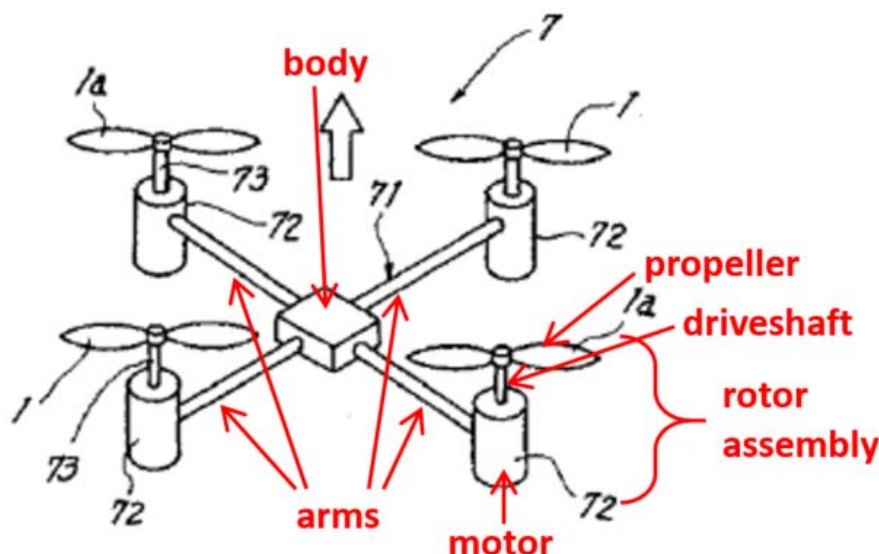
## VI. **Ground 1: The combination of Sasaki and Sokn renders claims 3 and 4 obvious.**

The present petition challenges dependent claims 3 and 4 which depend from independent claim 1. Therefore, Petitioner establishes that the combination of

Sasaki and Sokn teaches or suggests each limitation of independent claim 1 as well as the subject matter of claims 3 and 4.

Sasaki discloses an apparatus which it refers to as a “flying toy.” As shown in Figure 7, Sasaki’s “flying toy” includes a body with four arms extending therefrom. Each arm includes a rotor assembly comprising a propeller, a motor, and a driveshaft coupled to both the propeller and motor. Thus, Sasaki’s “flying toy” is a UAV and more specifically a quadcopter. (*See* DJI-1003, ¶93.) Sasaki’s quadcopter includes each of the claimed UAV structural limitations, limitations that the ’184 patent itself admits were known in the prior art. (*See* DJI-1001, 1:18-20; 3:32-37.)

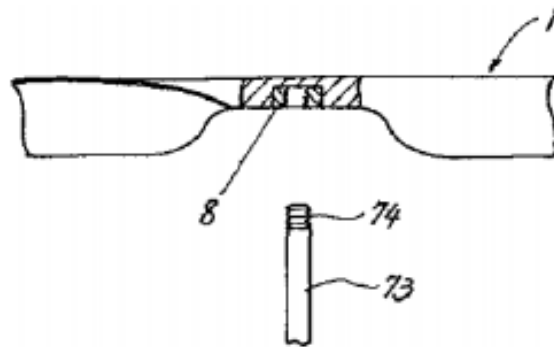
Sasaki teaches that two of its propellers rotate in the clockwise direction and two rotate in the counterclockwise direction: “[o]ne group of propellers (1) facing diagonally rotates in the direction opposite to the direction of rotation of the other group of propellers (1a), and the reaction force occurring due to the rotation of each set of propellers (1) (1a) is canceled by one another so that the flying toy can fly.” (DJI-1006, 4:8-14.)



**Sasaki, Figure 7 (annotated)**

Sasaki explains that “[t]he propellers (1) (1a) are each **detachably attached** to a top end of the upward rotating shaft (73) of the motor (72).” (DJI-1006, 4:27-29.) Sasaki describes a prior art technique used to “detachably attach” the propeller to the rotating shaft—a threaded nut and screw coupling. (DJI-1003, ¶95.) Figure 8 (reproduced below) depicts the threaded screw coupling mechanism described in Sasaki. Specifically, a nut is buried “in the central portion of the propeller (1)” (a socket) and a screw shaft (74) is “formed at a top end of a rotating shaft (73).” (DJI-1006, 1:49-2:4.) To couple the propeller to the shaft, the propeller/nut is rotated to screw the propeller to the screw shaft portion of the shaft (73). (DJI-1003, ¶95.)





**Sasaki, Figure 8**

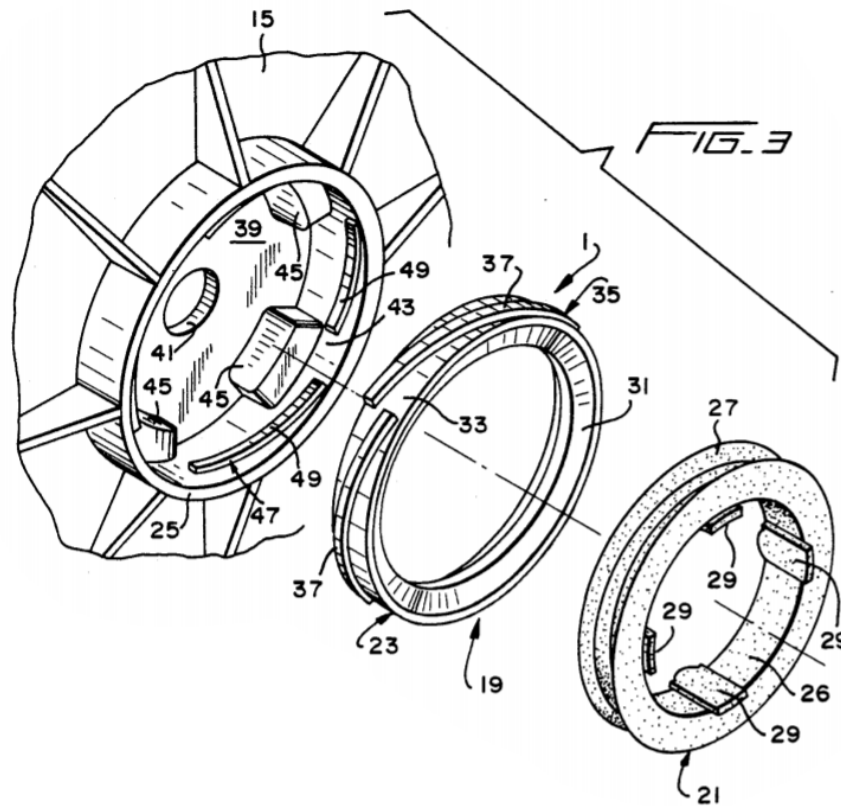
Sasaki teaches that with the threaded screw coupling mechanism, the clockwise propellers use a clockwise lock mechanism—a left screw and associated nut. (DJI-1006, 2:5-7; DJI-1003, ¶96.) Thus, to couple the clockwise propeller to the base, the propeller is twisted (screwed) in a counterclockwise direction. (DJI-1003, ¶96.) Sasaki also teaches that the counterclockwise propellers use a counterclockwise lock mechanism—a right screw and associated nut. (DJI-1006, 2:7-8; DJI-1003, ¶96.) To couple the counterclockwise propeller to the base, the propeller is twisted in a clockwise direction. (DJI-1003, ¶96.) Because of this directional threading, the clockwise propeller cannot be used on the counterclockwise driveshaft and vice versa. (*Id.*) That is, Sasaki’s directionally threaded coupling mechanism is “mistake-proof.” (*Id.*)

With this directionally threaded coupling mechanism, “the nut (8) and the rotating shaft (73) receive a force in the tightening 10 direction due to the rotation of the propeller.” (DJI-1006, 2:9-11.) Sasaki recognized that these forces can cause

the nut and rotating shaft of the propeller to be “tightened more than necessary” making the propeller more difficult to remove. Sasaki discloses a fixture to address the overtightening problem. However, Sasaki’s fixture is non-directional, meaning that the same coupling mechanism can be used with both the clockwise and counterclockwise propellers. (DJI-1003, ¶100.) Therefore, Sasaki’s coupling fixture no longer ensures that the user cannot place a propeller on the wrong driveshaft. (*Id.*) Moreover, Sasaki’s fixture has more components than the two components required in a directionally threaded coupling mechanism and, as a result, is more complicated to manufacture and to use in the field. (*Id.*) Thus, a POSITA would have been motivated to replace Sasaki’s directionally-threaded mechanism with a mechanism that does not suffer from the overtightening problem, is easy to use, and maintains the “mistake-proofing” of the prior art. (*Id.*) Sokn provides such a connection mechanism.

Sokn describes a mechanism for mounting a fan motor to a fan housing using a segmented threaded connection “to provide precise alignment” between the components. (DJI-1007, 1:9-11.) Sokn’s locking mechanism is a modification of the threaded locking mechanism of Sasaki. (DJI-1003, ¶101.) As illustrated in Figure 3 below, Sokn’s locking mechanism includes a mounting ring assembly 19 comprised of an internal ring 21 supported within an external ring 23 and a cylindrical socket 25. (DJI-1007, 2:59-64.) Internal ring 21 is mounted onto the

hub of the motor and includes an inner peripheral surface 26 and an outer peripheral surface 27. (DJI-1007, 3:10-15.) External ring 23 also includes an inner peripheral surface 31 and an outer peripheral surface 33. (DJI-1007, 3:16-19.) The outer peripheral surface 27 of the inner ring 21 is of opposite configuration to the inner peripheral surface 31 of ring 23, permitting the inner ring 21 to be coaxially positioned within ring 19. (DJI-1007, 3:19-24.) The outer surface 33 of external ring 23 is provided with a first engagement portion having a raised helical thread defined by a plurality of circumferentially spaced thread segments 37 and notches therebetween as shown in Figure 3 below. (DJI-1007, 3:28-34; DJI-1003, ¶103.)



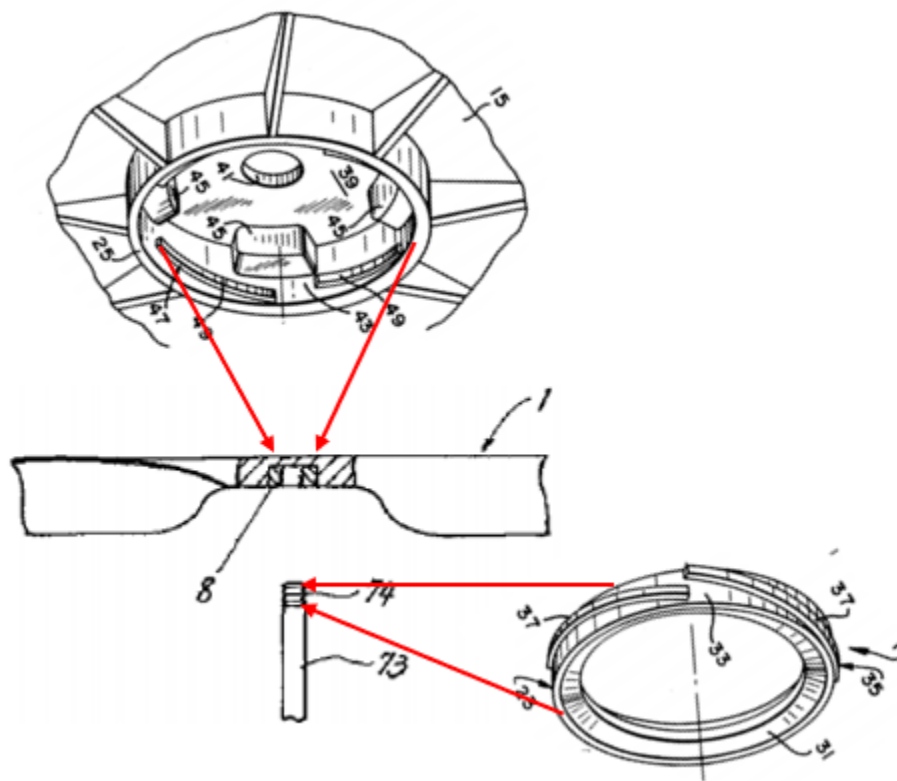
**Sokn, Figure 3**

Socket 25 includes a second engagement portion 47 on inner cylindrical surface 43 having a thread configuration corresponding to that of the first engagement portion 35. Second engagement portion 47 is defined by a plurality of protruding thread segments 49 which extend inwardly from the inner cylindrical surface 43. (DJI-1007, 3:49-52.) Socket 25 further includes a plurality of stop members 45 equally and circumferentially spaced around surface 43. (DJI-1007, 3:40-42.) The protruding thread segments 49 are spaced forwardly of stop members 45. (DJI-1007, 3:52-53.) Sokn explains that “[t]hrough this arrangement,

a large and easily alignable target area is established between the mounting ring assembly 19 and socket 25 so that ring assembly 19 may be easily aligned and inserted within socket 25.” (DJI-1007, 3:53-57.) During the mounting process, ring assembly 19 is rotated 90° with respect to socket 25, resulting “in a secure and aligned interlock connection.” (DI-1007, 3:57-59.) “In this position, ring assembly 19 is disposed in abutting engagement against stop members 45, thus assuring a secure attachment between assembly 19 and socket 25 which will not become accidentally loosened or disconnected during operation of motor 3.” (DI-1007, 3:60-65.) Sokn further notes that “[i]t is of course possible to configure first and second engagement portions 35 and 47, and also stop members 45 in order to provide a predetermined orientation for the engagement and interlock connection between ring assembly 19 and socket 24.” (DJI-1007, 3:66-4:2.) To unmount (or disassemble), ring assembly 19 is rotated 90° in the opposite direction. (DJI-1003, ¶105.)

A POSITA would have been motivated to replace Sasaki’s directionally threaded screw coupling mechanism with Sokn’s modified threaded coupling mechanism. (DJI-1003, ¶106.) Specifically, a POSITA would have been motivated to replace the screw shaft (74) formed at the top of Sasaki’s rotating shaft (73) with Sokn’s first engagement portion 35 provided on the outer peripheral surface of Sokn’s external ring. (DJI-1003, ¶107.) The resulting portion of the coupling

mechanism on the shaft includes a plurality of circumferentially spaced thread segments 37 and notches defined therebetween as illustrated in the figure below. (*Id.*) Additionally, a POSITA would have been motivated to replace Sasaki's nut buried "in the central portion of the propeller (1)" (socket) with Sokn's stop members 45 and second engagement portion 47. (*Id.*) The resulting portion of the coupling mechanism on the propeller blade has plurality of helical thread segments 49 spaced forwardly of stop members 45 as illustrated in the figure below. (*Id.*)



### Combination of Sasaki and Sokn

A POSITA would also appreciate that Sokn's coupling components can be scaled down to use with Sasaki's quadcopter. (DJI-1003, ¶108.) Such scaling is a

matter of mechanical design well within the capabilities of a POSITA as of the earliest possible priority date of the '184 patent. (*Id.*) A POSITA would recognize that the required scaling can be achieved by selecting the proper materials and tolerances for the parts. (*Id.*) In addition, the feasible maximum lift of the Sasaki/Sokn coupling mechanism would be equivalent to the Sasaki coupling mechanism, provided the materials are the same and the total surface area of the engagement portions were the same. (*Id.*) In general, a higher surface area could be achieved with Sokn's coupling components with little added expense or added weight. (*Id.*) In addition, larger surface area and choice of stronger materials could enable Sokn's coupling mechanism to achieve much higher lift capacity than Sasaki's coupling mechanism. (*Id.*)

Sokn's thread segments 37 and corresponding notches of the shaft portion are helical. (*See* DJI-1007, 3:28-34; DJI-1003, ¶109.) Because Sokn's second engagement portion has a thread configuration corresponding to the first engagement portion 35, the thread segments 49 of the blade portion are also helical. (*See* DJI-1007, 3:45-47; DJI-1003, ¶109.) Sokn further teaches that the first and second engagement portions and stop members can be configured to provide a predetermined orientation for engagement and interlock connection. (DJI-1007, 3:66-4:2.) Based on this explicit teaching of Sokn and the teachings of Sasaki regarding directionality of threading in the clockwise and counterclockwise

coupling mechanisms, a POSITA would have been motivated to orient the thread segments and corresponding notches for the clockwise coupling mechanism of the clockwise propeller in a left helical direction (similar to a left screw). (DJI-1003, ¶109.) With this orientation, the rotation force during operation is in the locking direction. (*Id.*) The stops prevent overtightening by restricting further rotation. (*Id.*) The orientation further prevents disassembly during operation. (*Id.*) Thus, in the combined UAV of Sasaki and Sokn, to couple the clockwise propeller to the shaft, the protruding thread segments 49 of the blade portion are placed in the notches between the thread segments 37 of the shaft portion. (DJI-1003, ¶109.) The propeller is then rotated in a counterclockwise direction until the thread segments 37 engage stop members 45 of the blade portion. (DJI-1003, ¶109.)

Similarly, a POSITA would have been motivated to orient the thread segments and corresponding notches for the counterclockwise coupling mechanism of the counterclockwise propeller in a right helical direction (similar to a right screw). (DJI-1003, ¶110.) Thus, in the combined UAV of Sasaki and Sokn, to couple the clockwise propeller to the shaft, the protruding thread segments 49 of the blade portion are placed in the notches between the thread segments 37 of the shaft portion. (DJI-1003, ¶110.) The propeller is then rotated in a counterclockwise direction until the thread segments 37 engage stop members 45 of the blade portion. (DJI-1003, ¶110.) Disassembly of Sokn requires rotation of the rotor blade



in opposite direction of operation. (DJI-1003, ¶110.) The engagement portions in the combined system would then release like a screw but require fractional rotation rather than multiple rotations to fully disengage the components. (DJI-1003, ¶110.)

A POSITA would have been motivated to modify the coupling mechanism of Sasaki to use the coupling mechanism of Sokn for a variety of reasons. (DJI-1003, ¶111.) First, Sokn's coupling mechanism maintains the "mistake-proofing" of Sasaki's prior art directionally threaded screw fastener without suffering from overtightening. (*Id.*) Sokn's use of a plurality of protruding thread segments, rather than continuous threads, in combination with stop members 45 provides a secure interlock connection without the risk of overtightening. (*Id.*) Specifically, the stop members prevent any further rotation of ring assembly after installation. (*Id.*) In normal operation, the stop members resist all the rotational force of the motor against the rotor blade while the helical thread engagement surface resists the lift and thrust forces. (*Id.*) In this way, Sokn's connector used with Sasaki's driveshaft is not subject to overtightening. (*Id.*)

Second, a POSITA would have been motivated to use Sokn's connection mechanism to provide increased design flexibility. (DJI-1003, ¶112.) Sokn's connection mechanism can be used with a wider range of aircraft than Sasaki's threaded connection. (DJI-1003, ¶112.) For example, if the size of the quadcopter increases, Sasaki's connection would require the size of the shaft and engaging

surface to increase (*e.g.*, longer screw with greater diameter) to withstand the lift of quadcopter. (DJI-1003, ¶112.) Increased motor shaft diameter and length will increase relative weight which is a driving design factor of all aircraft. (*Id.*) In addition, as rotor blades get larger, mounting them using Sasaki's threaded mechanism would be difficult to achieve without increased potential for "cross-threading" and damaging the mechanism. (*Id.*) Cross-threading occurs when two treaded components are engaged without properly aligning the threads. The misaligned threads cut into each other and cause irreparable damage. (*Id.*)

Third, a POSITA would have been motivated to use Sokn's locking mechanism to improve useability. (DJI-1003, ¶113.) As explained by Sokn, its locking arrangement provides a "large and easily alignable target area" so that ring assembly 19 (shaft lock portion) can be easily aligned and inserted with socket 25 (blade lock portion). (*Id.*) When implemented in Sasaki's quadcopter, a user can assembly and disassemble the propellers with only ½ turn as compared with 3-4 turns with the threaded connection disclosed in Sasaki. (*Id.*) The improved efficiency is beneficial for quadcopter design, particularly because quadcopters are used outdoor, often in remote areas. Additionally, Sokn's connection mechanism has improved mechanical alignment. (*Id.*) Sasaki's threaded connection is subject to cross-threading issue where the user misaligns the screw thread with the

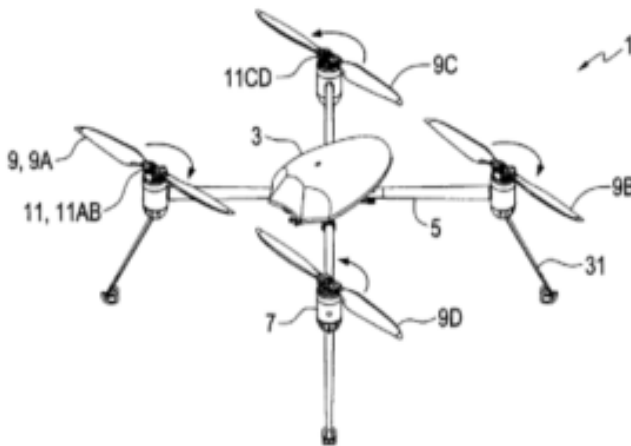
embedded nut threads. (*Id.*) Sokn's lug/notch style (segmented threading) is easily aligned and does not have a cross-threading issue. (*Id.*)

Although Sokn is primarily directed to mounting a fan motor to a fan housing, Sokn is analogous art because it is "reasonably pertinent to the particular problem with which the inventor is involved." *See In re Paulsen*, 30 F.3d 1475, 1481-82 (Fed. Cir. 1994). As discussed above, one of the issues addressed and claimed by the inventors of the '184 patent is a mechanism for precise and secure connection of two components (propeller and driveshaft). (DJI-1003, ¶114.) This was not only a problem for multi-rotor copters such as the quadcopter but for any system requiring a precise and secure connection of one component to another component, such as the system described in Sokn. (*Id.*) Therefore, given the nature of the problem being addressed, a POSITA would have consulted references describing coupling mechanisms for other systems subject to similar forces and would have been led to Sokn which includes a motor and multiple rotating driveshafts. (*Id.*) *See, e.g., In re Paulsen*, 30 F.3d at 1482; *In re Clay*, 966 F.2d 656, 659 (Fed. Cir. 1992) ("A reference is reasonably pertinent if, even though it may be in a different field of endeavor, it is one which, because of the matter with which it deals, logically would have commended itself to an inventor's attention in considering his problem.").

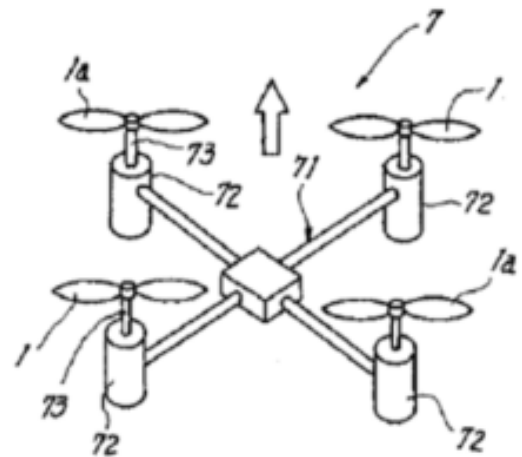
**A. The combination of Sasaki and Sokn discloses the limitations of claim 1.**

**1. Sasaki discloses the UAV structural limitations recited in claim 1.**

Figure 7 (reproduced below right) depicts Sasaki's quadcopter (referred to as a "flying toy") (7). Sasaki's quadcopter (7) has a similar structure to the "rotary wing aircraft apparatus 1" of the '184 patent as highlighted by the side-by-side comparison of Figure 7 of Sasaki (below right) and Figure 1 of the '184 patent (below left).



**'184 Patent, Figure 1**



**Sasaki, Figure 7**

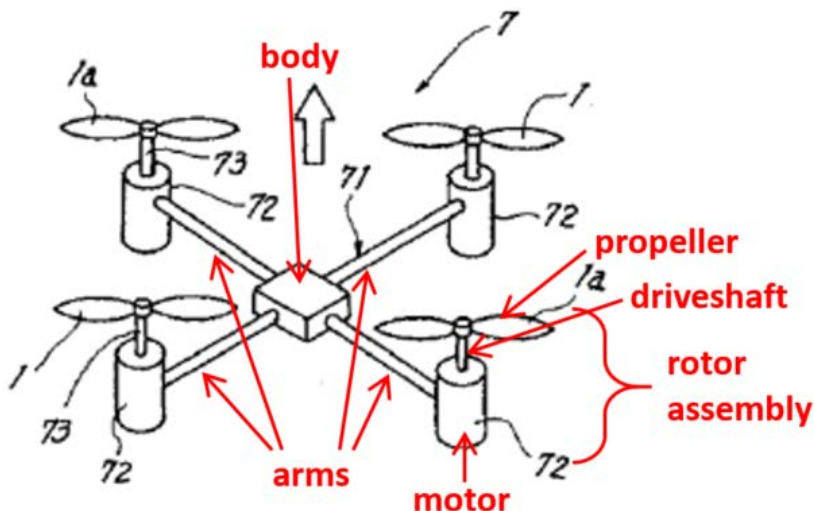
**a) Sasaki discloses a "rotary wing aircraft apparatus" [1P].**

Sasaki's quadcopter is a "rotary wing aircraft apparatus" [1P]. (DJI-1003, ¶¶117-118.) In Sasaki's quadcopter, "motors which are rotationally controlled by a pulse voltage are disposed independently of each other at four symmetrical positions around the quadcopter body (71), and a propeller (1) is rotatably

connected to each motor in a horizontal plane.” (DJI-1006, 4:3-7.) Sasaki explains that each propeller “has a plurality of wing pieces (23) integrally formed from a narrow mounting portion (21) of the central portion.” (DJI-1006, 4:36-39.)

**b) Sasaki discloses “a body” [1A] and “a plurality of arms extending laterally from the body” [1B.1] and “a rotor assembly attached to an outside end of each arm” [1B.2].**

Sasaki’s quadcopter (7) includes a body having four arms extending laterally from the body as illustrated in Figure 7 below. (*see also*, DJI-1006, 4:3-7.) Accordingly, the quadcopter of the combination of Sasaki and Sokn includes “a body” [1A] and “a plurality of arms extending laterally from the body” [1B.1]. (DJI-1003, ¶119.)



**Sasaki, Figure 7 (annotated)**

In Sasaki’s quadcopter, motors 72 “are disposed independently of each other at four symmetrical positions around the flying toy body (71).” (DJI-1006, 4:3-6.)

A propeller is “detachably attached to a top end of the upward **rotating shaft (73)** of the **motor (72)** by a fixture (4).” (DJI-1006, 4:27-29.) As shown in Figure 7 above, each of the four motors is coupled to a shaft 73 which is in turn coupled to a propeller. Although Sasaki does not use the term “rotor assembly,” a POSITA would understand that a rotor assembly includes a motor, a driveshaft, and a propeller.<sup>4</sup> (DJI-1003, ¶120; *citing* “Design and Construction of a Quadrotor-type Unmanned Aerial Vehicle: Preliminary Results,” Section II.B.) Thus, the combination of Sasaki and Sokn discloses “*a rotor assembly attached to an outside end of each arm*” [1B.2]. (DJI-1003, ¶120.)

- c) **Sasaki discloses “*each rotor assembly comprising [1C.1] a rotor blade releasably attached to [1C.2] a driveshaft by [1C.3] a lock mechanism, and [1C.4] a drive rotating the drive shaft.*”**

As discussed above, Sasaki’s quadcopter includes a rotor assembly attached to an outside end of each arm comprised of a propeller, a driveshaft and a motor. The term “propeller” is often used interchangeable with “blade” or “rotor blade.” (DJI-1003, ¶121.) Therefore, each of Sasaki’s propellers is the recited “*rotor*

---

<sup>4</sup> The ’184 patent acknowledges that a rotary assembly includes a rotor blade attached to a driveshaft which is driven by a motor.

*blade.*” Sasaki discloses that each motor<sup>5</sup> in its rotor assembly “drives” the rotation of the driveshaft, explaining that each propeller “is **rotatably connected** to each motor.” (DJI-1006, 4:6-7.) Therefore, Sasaki’s rotating shaft (72) is the claimed “*driveshaft*” [1C.2] and motor (72) is the claimed “*drive rotating the driveshaft*” [1C.4]. (DJI-1003, ¶121.)

The coupling mechanism in the combined system of Sasaki and Sokn is also releasable. Sasaki explains that “[t]he propellers (1) (1a) are each **detachably attached** to a top end of the upward rotating shaft (73) of the motor (72) by a fixture (4).” (DJI-1006, 4:27-29.) The “*rotor assembly*” of combined UAV of Sasaki and Sokn includes a coupling mechanism (“*lock mechanism*”) having two portions—a portion located on the blade in the socket at the central portion of the propeller (“*blade lock portion*”) and a portion located at the end of the rotating shaft (73) (“*shaft lock portion*”). The rotor blade is coupled to the driveshaft by engaging the two portions and rotating the propeller relative to the driveshaft (rotating shaft). (DJI-1003, ¶122.) The rotor blade is removed from the driveshaft by rotating the propeller in the opposite direction. (DJI-1003, ¶122.) Thus, the combination of Sasaki and Sokn discloses that “*each rotor assembly compris[es] a*

---

<sup>5</sup> The ’184 patent states that a drive is “typically an electric motor.” (DJI-1001, 3:20-21.)

*rotor blade releasably attached to a driveshaft by a lock mechanism” [1C.1]-*  
[1C.3]. (DJI-1003, ¶122.)

**d) The combination of Sasaki and Sokn discloses that “a first driveshaft rotates in a clockwise direction and a second driveshaft rotates in a counterclockwise direction” [1D].**

It was well-known that adjacent propellers in a quadrotor-type UAV such as disclosed by Sasaki rotate in opposite directions as discussed in the Technology Background section above. (DJI-1003, ¶123; *citing* “Design and Construction of a Quadrotor-type Unmanned Aerial Vehicle: Preliminary Results, Section II.B.) Indeed, the ’184 patent acknowledges that unmanned rotary aircrafts with two clockwise rotating propellers and two counterclockwise rotating propellers were known prior to the earliest possible priority date of the ’184 patent. (DJI-1001, 1:24-31, 3:31-37.) Sasaki also teaches this well-known concept, explaining that “[o]ne group of propellers (1) facing diagonally rotates in the direction opposite to the direction of rotation of the other group of propellers (1a), and the reaction force occurring due to the rotation of each set of propellers (1) (1a) is canceled by one another so that the flying toy can fly.” (DJI-1006, 4:8-14.) Thus, the combination of Sasaki and Sokn discloses “*wherein a first driveshaft rotates in a clockwise direction and a second driveshaft rotates in a counterclockwise direction*” [1D]. (DJI-1003, ¶123.)



**2. The combination of Sasaki and Sokn discloses the lock mechanism limitations [1E], [1F].**

**a) The combination of Sasaki and Sokn discloses the directional locking mechanism limitations.**

As discussed above, Sasaki describes directional locking mechanisms. (DJI-1003, ¶¶95-96.) Specifically, Sasaki teaches that its clockwise propellers use a clockwise lock mechanism and its counterclockwise propellers use a counterclockwise lock mechanism. (DJI-1006, 2:5-8.) Thus, Sasaki teaches “*a clockwise rotor blade is releasably attached to the first driveshaft by engagement in a clockwise lock mechanism*” [1E.1] and “*a counterclockwise rotor blade is releasable attached to the second driveshaft by engagement in a counterclockwise lock mechanism*” [1F.1]. (DJI-1003, ¶¶96, 124.)

As discussed above, the combined UAV of Sasaki and Sokn uses modified threaded structure for the locking mechanism on its clockwise rotor blade/driveshaft and counterclockwise rotor blade/driveshaft. Specifically, in the combined system, the thread segments and corresponding notches are oriented in the same direction as the continuous thread of Sasaki. (DJI-1003, ¶¶109, 110, 125, 126.) That is, the locking mechanism in the combined UAV uses a thread segments and notches in a left helical direction for the clockwise rotor blade/driveshaft and thread segments and notches in a right helical direction for the counterclockwise rotor blade/driveshaft. (DJI-1003, ¶¶109, 110, 125, 126.)

Thus, the combined UAV of Sasaki and Sokn discloses that “*a clockwise rotor blade is releasably attached to the first driveshaft by engagement in a clockwise lock mechanism*” [1E.1] and “*a counterclockwise rotor blade is releasable attached to the second driveshaft by engagement in a counterclockwise lock mechanism*” [1F.1].<sup>6</sup> (DJI-1003, ¶124.)

Sasaki teaches that “[o]ne group of propellers (1) facing diagonally rotates in the direction opposite to the 10 direction of rotation of the other group of propellers (1a), and the reaction force occurring due to the rotation of each set of propellers

---

<sup>6</sup> Patent Owner contended in its Patent Owner Preliminary Response in IPR2019-00343 that “[b]ecause the ’184 patent claims and specification make clear that the shaft lock portion and blade lock portion must form a lock mechanism, the claims do not cover devices where these claim requirements are evaded or where additional components – other than the shaft lock portion and blade lock portion – serve the function of attaching the rotor blade to the driveshaft.” (DJI-1019, pp. 19-20.) The combination of Sasaki and Sokn discloses the “lock mechanism” limitations under Patent Owner’s improperly narrow interpretation of the limitation because the combined device does not use components other than a shaft portion or blade portion to attach the rotor blade to the driveshaft. (See DJI-1003, ¶125.)

(1) (1a) is canceled by one another so that the flying toy can fly.” (Sasaki, 4:8-14.)

As described in the Technological Background section, the rotating propellers generate lift. (See DJI-1003, ¶¶44-45.) Thus, the combination of Sasaki and Sokn also discloses that the “*clockwise rotor blade ... generates a vertical lift force when rotated in the clockwise direction*” [1E.2] and the “*counterclockwise rotor blade ... generates a vertical lift force when rotated in the counterclockwise direction*” [1F.2]. (DJI-1003, ¶126.)

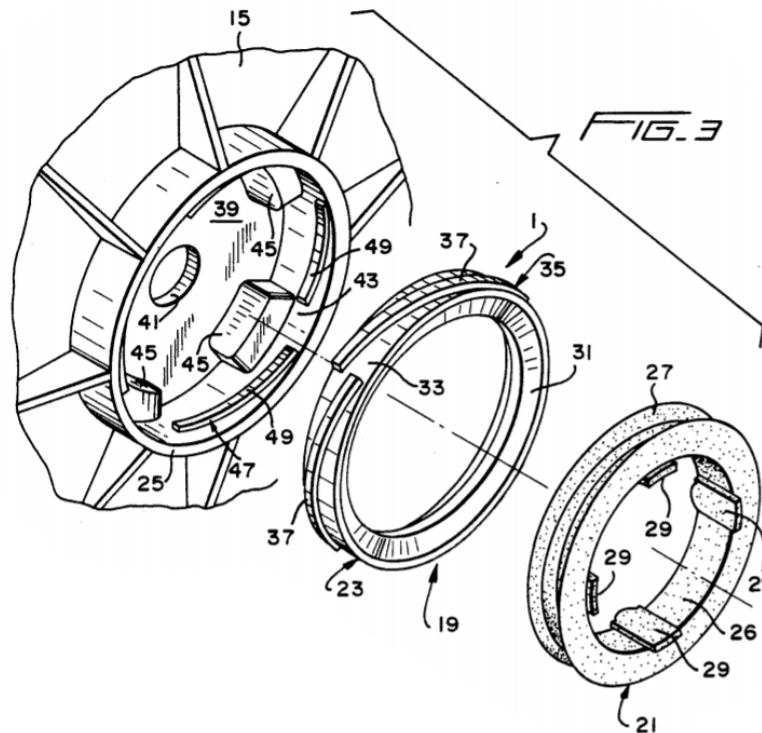
**b) The combination of Sasaki and Sokn discloses the keyed connection limitations.**

Sasaki teaches that the connections of its propellers to the driveshafts are keyed. Sasaki’s clockwise propellers use a clockwise lock mechanism—a left screw and associated nut. (DJI-1006, 2:5-7.) Thus, to couple the clockwise propeller to the base, the propeller is twisted in a counterclockwise direction. (DJI-1003, ¶126.) Sasaki’s counterclockwise propellers use a counterclockwise lock mechanism—a right screw and associated nut. (DJI-1006, 2:7-8.) To couple the counterclockwise propeller to the base, the propeller is twisted in a clockwise direction. (DJI-1003, ¶127.) Because the combined UAV retains the directional nature of Sasaki’s threading, the clockwise propeller cannot be used on the counterclockwise driveshaft. (DJI-1003, ¶127.)

As described above, in the combined UAV of Sasaki and Sokn, the clockwise lock mechanism uses left oriented helical segments and notches and the counterclockwise lock mechanism uses right oriented helical segments and notches. (DJI-1003, ¶¶127-128.) Because the combined UAV retains the directional nature of the threading in Sasaki, the counterclockwise propeller cannot be used on the clockwise driveshaft. (DJI-1003, ¶¶127-128.) Thus, the combination of Sasaki and Sokn discloses that “*the clockwise rotor blade is engageable only with the clockwise lock mechanism and cannot be engaged in the counterclockwise lock mechanism*” [1G] “*and the counterclockwise rotor blade is engageable only with the counterclockwise lock mechanism and cannot be engaged in the clockwise lock mechanism*” [1H]. (DJI-1003, ¶¶127-128.)

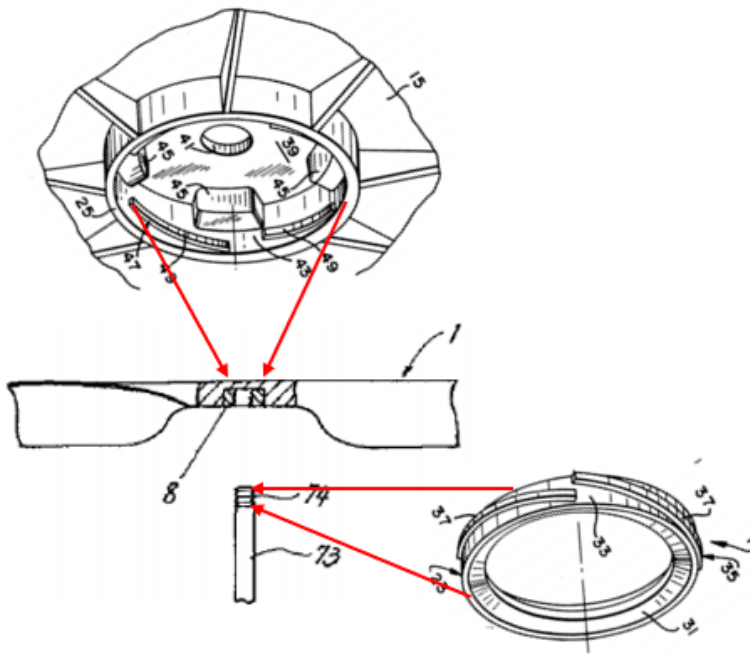
**c) The combination of Sasaki and Sokn discloses the lug/notch limitation.**

In the combined UAV of Sasaki and Sokn, the screw shaft (74) formed at the top of Sasaki’s rotating shaft (73) is replaced with Sokn’s first engagement portion 35. (DJI-1003, ¶129.) The resulting structure at the end of the rotating shaft (73) is the claimed “*shaft lock portion attached to the first driveshaft.*” As illustrated in Figure 3 of Sokn below, the first engagement portion 35 includes a plurality of circumferentially spaced thread segments 37 and notches (indentations) defined therebetween. (DJI-1003, ¶129.)



**Sokn, Figure 3**

In the combined system, Sasaki's nut buried "in the central portion of the propeller (1)" (socket) is replaced with Sokn's stop members 45 and second engagement portion 47. (DJI-1003, ¶130.) The resulting structure in the socket of the propeller is the recited "*blade lock portion attached to the...rotor blade.*" The blade lock portion has plurality of protruding helical thread segments 49 spaced forwardly of stop members 45 as illustrated in Figure 3 below. (DJI-1003, ¶130.) Both the clockwise and counterclockwise lock mechanisms use a similar two-part arrangement; the core difference between the clockwise and counterclockwise lock mechanisms is the direction of the thread segments and notches. (DJI-1003, ¶130.)



## Combination of Sasaki and Sokn

Thus, the combination of Sasaki and Sokn discloses that “*the clockwise lock mechanism comprises a shaft lock portion attached to the first driveshaft and a blade lock portion attached to the clockwise rotor blade.*”

As illustrated in Figure 3 above, the first engagement portion (shaft lock portion) includes a plurality of helical thread segments 37 that define indentations/notches therebetween. (DJI-1003, ¶131.) The indentations between the thread segments 37 are the recited “*notches*.” The second engagement portion of the blade lock portion includes a plurality of protruding thread segments 49. (DJI-1003, ¶131.) The protruding thread segments 40 are the recited “*corresponding lugs*.” Sokn explains that the first engagement portion is aligned and inserted into

the second engagement portion. (DJI-1007, 3:53-57.) Specifically, the lugs of the blade lock portion are aligned and inserted into the corresponding notches of the shaft lock portion. (DJI-1003, ¶131.) When insertion is accomplished, the shaft lock portion is rotated relative to the blade lock portion, resulting in “a secure and aligned interlock connection” therebetween. (DJI-1007, 3:57-59.) The blade is twisted (rotated) in the direction required by the orientation of its threads until the thread segment of the shaft lock portion abuts against the stop of the blade lock portion. (DJI-1003, ¶131.)

Thus, the combined UAV of Sasaki and Sokn discloses that “*the shaft lock portion defining notches configured to engage corresponding lugs on the blade lock portion.*”

**B. The combination of Sasaki and Sokn renders dependent claims 3 and 4 obvious.**

As discussed above, the combined UAV of Sasaki and Sokn uses a clockwise lock mechanism with its clockwise propellers—specifically, left oriented helical thread segments and associated notches. (DJI-1006, 2:5-7.) Thus, to couple the clockwise propeller to the clockwise driveshaft, the propeller is twisted in a counterclockwise direction. (DJI-1003, ¶132.) To release the propeller, the rotor blade is rotated in the opposite direction of operation. (DJI-1003, ¶132.) The engagement portions would then release like a screw but require fractional rotation

rather than multiple rotations to fully disengage the components. (DJI-1003, ¶132.)

The combination of Sasaki and Sokn therefore discloses that “*the blade lock portion of the clockwise lock mechanism is rotated counterclockwise with respect to the shaft lock portion thereof to releasably attach the clockwise rotor blade to the first driveshaft*” as recited in dependent claim 3.

The combined UAV of Sasaki and Sokn also uses a counterclockwise lock mechanism with its clockwise propellers—specifically, right oriented helical thread segments and associated notches. (DJI-1006, 2:5-8.) To couple the counterclockwise propeller to the base, the propeller is twisted in a clockwise direction. (DJI-1003, ¶133.) To release the propeller, the rotor blade is rotated in the opposite direction of operation. (DJI-1003, ¶133.) The engagement portions would then release like a screw but require fractional rotation rather than multiple rotations to fully disengage the components. (DJI-1003, ¶133.) Therefore, the combination of Sasaki and Sokn also discloses that “*the blade lock portion of the counterclockwise lock mechanism is rotated clockwise with respect to the shaft lock portion thereof to releasably attach the counterclockwise rotor blade to the second driveshaft*” as recited in dependent claim 4.

## **VII. Conclusion.**

For the grounds specified above, *Inter Partes* Review of claims 3 and 4 of U.S. Patent No. 9,260,184 is respectfully requested.



Respectfully submitted,

KING & SPALDING LLP

/Lori A. Gordon/

Lori A. Gordon, Reg. No. 50,633  
1700 Pennsylvania Avenue NW  
Suite 200  
Washington, D.C. 20006  
(202) 737-0500

March 19, 2019

## **APPENDIX – LISTING OF CHALLENGED CLAIMS**

**[1P]** A rotary wing aircraft apparatus comprising:

**[1A]** a body;

**[1B.1]** a plurality of arms extending laterally from the body,

**[1B.2]** and a rotor assembly attached to an outside end of each arm;

**[1C]** each rotor assembly comprising **[1C.1]** a rotor blade releasably attached to **[1C.2]** a driveshaft by **[1C.3]** a lock mechanism, and **[1C.4]** a drive rotating the driveshaft;

**[1D]** wherein a first driveshaft rotates in a clockwise direction and a second driveshaft rotates in a counterclockwise direction;

**[1E.1]** wherein a clockwise rotor blade is releasably attached to the first driveshaft by engagement in a clockwise lock mechanism

**[1E.2]** and generates a vertical lift force when rotated in the clockwise direction,

**[1F.1]** and a counterclockwise rotor blade is releasably attached to the second driveshaft by engagement in a counterclockwise lock mechanism

**[1F.2]** and generates a vertical lift force when rotated in the counterclockwise direction;

**[1G]** wherein the clockwise rotor blade is engageable only with the clockwise lock mechanism and cannot be engaged in the counterclockwise lock mechanism, and

**[1H]** the counterclockwise rotor blade is engageable only with the counterclockwise lock mechanism and cannot be engaged in the clockwise lock mechanism; and

**[1I]** wherein the clockwise lock mechanism comprises a shaft lock portion attached to the first driveshaft and a blade lock portion attached to the clockwise rotor blade, the shaft lock portion defining notches configured to engage corresponding lugs on the blade lock portion.

3. The apparatus of claim 1 wherein the blade lock portion of the clockwise lock mechanism is rotated counterclockwise with respect to the shaft lock portion thereof to releasably attach the clockwise rotor blade to the first driveshaft.

4. The apparatus of claim 3 wherein the blade lock portion of the counterclockwise lock mechanism is rotated clockwise with respect to the shaft lock portion thereof to releasably attach the counterclockwise rotor blade to the second driveshaft.

**CERTIFICATION OF WORD COUNT**

The undersigned hereby certifies that the portions of the above-captioned **PETITION FOR *INTER PARTES* REVIEW** specified in 37 C.F.R. § 42.24 have 9,246 words, in compliance with the 14,000 word limit set forth in 37 C.F.R. § 42.24. This word count was prepared using Microsoft Word.

Respectfully submitted,

KING & SPALDING LLP

/Lori A. Gordon/

Lori A. Gordon  
Registration No. 50,633  
Attorney for Petitioner

Date: March 19, 2019

KING & SPALDING LLP  
1700 Pennsylvania Avenue N.W.  
Washington, DC 20006-4707  
(202) 737-0500

**CERTIFICATE OF SERVICE**

The undersigned hereby certifies that the foregoing **PETITION FOR  
*INTER PARTES REVIEW***, DJI's Power of Attorney, and all supporting exhibits were served via overnight mail on March 19, 2019, in their entirety on the following:

LADAS & PARRY LLP  
224 South Michigan Avenue  
Suite 1600  
Chicago, IL 60604

KING & SPALDING LLP

/Lori A. Gordon/

Lori A. Gordon  
Registration No. 50,633  
Attorney for Petitioner

Date: March 19, 2019

KING & SPALDING LLP  
1700 Pennsylvania Avenue N.W.  
Washington, DC 20006-4707  
(202) 737-0500