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(54) **HELICOPTER KIT**

HUBSCHRAUBERKIT

KIT D'HÉLICOPTÈRE

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Description

[0001] The present invention relates to a kit for a helicopter.

[0002] Helicopters are known to basically comprise a fuselage, a main rotor positioned on the top of the fuselage and rotating about its own axis, and a tail rotor located at an end of the fuselage.

[0003] In greater detail, the rotor, in turn, basically comprises:

- a support casing;
- a hub rotatable about the aforesaid axis and equipped with a plurality of blades radially fastened to and projecting from the aforesaid hub; and
- a mast that can be connected to a drive member and operatively connected to the hub to drive it in rotation.

[0004] The fuselage is normally constrained to the rotor by a plurality of connecting rods and an anti-torque plate; in other words, the fuselage is "suspended" from the support casing.

[0005] In use, operation of the rotor causes the creation of high and low frequency vibrations. More specifically, low-frequency vibrations are generated by the wash separating from the blades and from the centre of the hub. This separation takes place at the centre of the hub and affects the vertical and horizontal aerodynamic tail surfaces and the tail rotor.

[0006] The rotation of the blades at high angular speeds causes, in use, the generation of further high-frequency vibrations, which are transmitted to the mast, and therefore to the fuselage, deteriorating comfort for the occupants of the fuselage.

[0007] Within the industry, it is known that the vibratory loads acting on the rotor have pulses equal to $N^*\Omega$ and multiples thereof in the reference system integral with the fuselage, where Ω is the rotation speed of the mast and N represents the number of blades of the rotor.

[0008] In other words, the hub and the mast transfer the vibratory aerodynamic load pulses acting in the plane of the blades on the aforesaid pulses.

[0009] From the foregoing, there is a clearly felt need within the industry for limiting transmission from the mast to the fuselage of vibrations with the aforementioned pulse values equal to $N^*\Omega$ and multiples thereof.

[0010] To this end, there are known passive and active damping devices.

[0011] Passive damping devices basically comprise masses elastically suspended from the mast or the hub by springs. The vibration of these suspended masses enables at least partially absorb the vibrations on the mast and the hub.

[0012] The aforementioned damping devices convert the kinetic energy in the elastically supported movement of the aforementioned masses and exert a damping force proportional to the spring modulus and the displacement of the masses.

[0013] Alternatively, active damping devices are basically actuators that exert a sinusoidal damping force on the hub or on the mast, which counters the force generated by the vibrations.

[0014] Damping devices, that work by absorbing vibration via a passive vibrating element, require the use of combinations of masses and springs in standard layouts and have minimum overall dimensions that limit flexibility of use.

[0015] Active damping devices are expensive and complex to manufacture.

[0016] A further, recently developed solution is represented by so-called "inertance" devices, known as "inerters".

[0017] These devices are interposed between a first point and a second point, and exert a force on them proportional to the difference in accelerations between the first and the second points, the acceleration components along the line joining the two points being intended.

[0018] Through opportune calibration of the inertia values, it is possible to ensure that this force reduces or cancels the transmission of vibrations with a given frequency between the first and second points.

[0019] One of the first examples of these inerter-type devices is illustrated in EP-B-1402327 and basically comprises:

- a rod connected to the first point;
- a casing connected to the second point and the rod can slide in respect thereto; and
- a flywheel connected to the rod and rotatable inside the casing as a result of the rod sliding due to vibrations on the first point.

[0020] US-A-2009/0108510 describes a further inerter-type damping device.

[0021] There is awareness in the industry of the need to have an inerter-type damping device that is easily integrable in helicopters of known type without altering the aerodynamic configuration of the helicopter.

[0022] There is also awareness in the industry of the need to have an inerter-type damping device that is particularly compact, particularly accurate and able to dampen large-amplitude vibrations.

[0023] There is also awareness in the industry of the need to have an inerter-type damping device that is long-lasting, has a high load capacity and the lowest possible friction.

[0024] JP-A-S6078130 discloses a kit according to the preamble of claim 1.

[0025] The object of the present invention is to provide a kit for a helicopter that enables satisfying at least one of the aforementioned needs in a simple and inexpensive manner.

[0026] The aforementioned object is achieved by the present invention, in so far as it relates to a kit for a helicopter according to claim 1.

[0027] For a better understanding of the present invention, a preferred embodiment is described hereinafter, purely by way of non-limitative example and with reference to the accompanying drawings, in which:

- Figure 1 is a perspective side view of a main rotor of a helicopter with a kit according to the present invention, with parts removed for clarity;
- Figure 2 is a section, on an enlarged scale, along the axis II-II of Figure 1 of a component of the kit of Figure 1, with parts removed for clarity;
- Figure 3 is a section, on an enlarged scale, along line III-III of Figure 2 of the component of Figure 2, with parts removed for clarity;
- Figure 4 is a section along the line IV-IV of Figure 3; and
- Figure 5 is a perspective view, on a highly enlarged scale, of a helicopter incorporating the kit of Figures 1 to 4.

[0028] Referring to Figure 1, the reference numeral 1 indicates a kit for a helicopter 2.

[0029] Referring to Figure 5, the helicopter 2 basically comprises a fuselage 3, a main rotor 4 positioned on the top of the fuselage 3 and rotating about an axis A, and a tail rotor located at one end of the fuselage 3 and rotating about its own axis, transversal to axis A.

[0030] In greater detail, the rotor 4 is only shown with regards to:

- a support casing 5;
- a mast 6 rotating about the axis A, coupled, in a manner not shown, with a drive unit, for example a turbine, carried by the helicopter 1 and operatively connected to a hub (not shown) on which a plurality of blades (also not shown) are hinged.

[0031] The helicopter 2 also comprises a plurality of rods 7, which extend along respective axes B that are oblique to the axis A and have respective ends 8 and 9 opposite each other, respectively fastened to the casing 5 and to a top portion 10 of the fuselage 3.

[0032] The rods 7 are hinged to respective anchors 12 and 13 carried by the top portion 10 and by the casing 5, respectively, about respective axes D and E.

[0033] The kit 1 comprises a plurality of devices 15 for damping vibrations transmitted to the fuselage 3 by the rotor 4.

[0034] In the case shown, there are four devices 15 associated with respective rods 7.

[0035] Referring to Figures 2 to 4, the devices 15 extend along respective axes B, are hollow and house the associated rods 7.

[0036] As the devices 15 are identical, only a single device 15 is described below.

[0037] Device 15 comprises (Figures 2 to 4):

- a female screw 21 connected to the rotor 4 and adapted to vibrate parallel to the axis B;
- a screw 20 connected to the fuselage 3, operatively connected to the female screw 21 so as to rotationally vibrate about axis B; and
- a plurality of threaded rollers 22, which have a thread 23 screwed on the screw 20 and on the female screw 21, are rotatable about their respective axes C parallel to and separate from the axis B and are also rotatable around axis B with respect to the screw 20 and the female screw 21.

[0038] In this way, the device 15 implements an inerter, namely a device capable of exerting a force on the fuselage 3 and on the casing 5 proportional to the difference in acceleration between the fuselage 3 and the casing 5.

[0039] This force enables damping the vibrations generated by operation of the rotor 4 and curbing their transmission to the fuselage 3.

[0040] In greater detail, the device 15 comprises:

- a tubular axial end lug 30 fastened to the casing 5; and
- a tubular axial end lug 31, axially opposite to the lug 30 and fastened to the top portion 10 of the fuselage 2.

[0041] The lugs 30 and 31 are hinged to respective anchors 12 and 13 about respective axes D and E.

[0042] As a consequence, lug 30 is subjected to an alternating movement of axial vibration parallel to the axis B, which is caused by the vibratory loads transmitted by the casing 5.

[0043] The device 15 also comprises, interposed between the lugs 30 and 31:

- a tubular body 32 fastened to lug 30 and defining, on the part axially opposite to lug 30, the female screw 21; and
- a tubular body 33 fastened to lug 31 and defining, on the part axially opposite to lug 30, the screw 20.

[0044] In particular, tubular body 32 comprises, in turn, at its mutually opposite axial ends:

- a cup-shaped portion 35 connected to lug 30; and
- a cup-shaped portion 36, having a larger diameter than portion 35 and defining the female screw 21.

[0045] In turn the tubular body 33 comprises:

- a cup-shaped portion 37 connected to lug 31; and
- a portion 38 having a longer length than the portion 37 and a smaller diameter than the portion 37, and defining the screw 20.

[0046] Portion 38 of tubular body 33 has a smaller diameter than portion 36 of tubular body 32.

[0047] Portion 38 of tubular body 33 is housed inside portion 36 of tubular body 32.

[0048] The screw 20 and the female screw 21 have multi-start threads.

[0049] The screw 20 and the female screw 21 are arranged radially facing each other and radially spaced apart from each other with respect to axis B.

[0050] The rollers 22 are arranged in a position radially interposed between the screw 20 and the female screw 21 in a direction radial to axis B.

[0051] The rollers 22 extend along their respective axes C and each have an external thread 23.

[0052] Thread 23 is simultaneously screwed onto the female screw 21 and onto the screw 20.

[0053] The rollers 22 extend along respective axes C and are angularly equi-spaced from each other around axis B and, in the case shown, are nine in number.

[0054] The rollers 22 are:

- rotatable about the axes C with a rotational movement; and
- simultaneously rotatable around axis B with a revolutionary movement.

[0055] Preferably, the rollers 22 are integrally movable with the female screw 21 with translation in a direction parallel to axis B.

[0056] Preferably, the thread angle of the thread 23 on the rollers 22 is equal to the thread angle of the female screw 21.

[0057] Due to the coupling between thread 23 and the screw 20, translation of the rollers 22 along axis B causes rotation of tubular body 33 about axis B.

[0058] Each roller 22 also comprises:

- two mutually opposite axial ends 27 and 28; and
- two cogwheels 45 and 46 arranged adjacent to the respective ends 27 and 28.

[0059] The threads 23 of the rollers 22 are single-start threads.

[0060] It is important to underline that the angles of the threads 23 of the rollers 22, of the screw 20 and of the female screw 21 shown in the accompanying figures are purely indicative.

[0061] The coupling between the threads 23 of the rollers 22 and the screw 20 and the female screw 21 is reversible.

[0062] The device 15 also comprises a pair of crowns 47 and 48, respectively fastened to the female screw 21 and made in one piece with the female screw 21.

[0063] The crowns 47 and 48 are coaxial with axis B and spaced out along axis B.

[0064] According to the present invention, each crown 47 and 48 has internal gear tooth 49 meshing with the respective cogwheels 45 and 46 of each roller 22.

[0065] In this way, the cogwheels 45 and 46 mesh with the gear tooth 49 (Figure 4) during rotation of the rollers 22 around axis B.

[0066] The device 15 also comprises two disc-shaped supports 25 on axis B, spaced apart from each other along axis B and rotatable with respect to the female screw 21 and the screw 20.

[0067] Each support 25 defines a plurality of seats 26 angularly equi-spaced from each other around axis B and engaged by the axial ends 27 of respective rollers 22.

[0068] In the embodiment shown, there is radial play between the supports 25 and portion 36.

[0069] In an alternative embodiment, elements with a low coefficient of friction can be interposed between the supports 25 and portion 26 of the female screw 21.

[0070] The device 15 also comprises:

- a flywheel 40 rotating about the axis B and angularly integral with the screw 20; and
- two bearings 41 radially interposed between portion 37 of tubular body 33 and lug 31.

[0071] In the case shown, the flywheel 40 is located at the shoulder defined by portions 37 and 38 of the body 33.

[0072] The flywheel 40 rotates together with the screw 20 following vibration of tubular body 32 along axis B.

[0073] The flywheel 40 is sized so as to achieve a desired value for the rotating masses, equal to the sum of the masses of the rollers 22, tubular body 32 and the flywheel 40. This value of the rotating masses tunes the device 15 to a predetermined vibration frequency value of the casing 5 for which it is wished to dampen transmission to the fuselage 3.

[0074] The bearings 41 enable relative rotation of tubular body 33 with respect to lug 31 about axis B, and support the axial loads transmitted by the screw 20.

[0075] The ends 8 and 9 of the rod 7 are housed inside lugs 30 and 31, respectively.

[0076] The rod 7 extends, proceeding from end 8 towards end 9 along axis B, inside lug 30, tubular body 32, tubular body 33 and lug 31.

[0077] In particular, the diameter of the rod 7 is less than the internal diameter of the screw 23.

[0078] In use, the mast 6 drives the hub and the blades in rotation about axis A.

[0079] The rotation of the hub and the blades generates aerodynamic loads on the blades and consequent vibrations, which are transmitted to the mast 6.

[0080] The rods 7 connect the fuselage 3 to the casing 5 of the rotor 4.

[0081] The operation of the helicopter 2 is illustrated hereinafter with reference to a single rod 7 and to a single device 15.

[0082] Operating the rotor 4 causes the generation of vibratory loads.

[0083] The hinging of the lug 30 about axis E prevents rotation of the female screw 21 about axis B.

[0084] Therefore, the vibratory loads cause an alternating translational vibration of lug 30, tubular body 32 and the female screw 21 parallel to axis B.

[0085] The alternating translation of the female screw 21 causes, as a result of the coupling between the thread

23 of the rollers 22 and the female screw 21, the alternating rotation of the supports 25 about axis B, and of the rollers 22 about their respective axes C.

[0086] At the same time, the rollers 22 describe an alternating revolutionary movement around axis B, because the respective cogwheels 45 and 46 mesh with the gear teeth 49 of the corresponding crowns 47 and 48.

[0087] Rotation of the rollers 22 about their respective axes C causes, as a result of the coupling between the threads 23 of the rollers 22 and the female screw 21, the alternating rotation of the screw 20, tubular body 33 and the flywheel 40 about axis B.

[0088] The bearings 41 prevent the transmission of this rotation to the fuselage 3 through lug 31, and support the axial loads transmitted by the screw 20.

[0089] The device 15 thus generates inertial vibratory torque on the flywheel 40 originating from the translational vibratory movement transmitted from the casing 5 to tubular body 32.

[0090] More specifically, this inertial vibratory torque is due to the alternating rotation of the rollers 22, the screw 20 and the flywheel 40.

[0091] Due to the alternating rotation of the rollers 22, tubular body 33, the screw 20 and the flywheel 40, the device 15 applies two equal forces on the points of constraint of the lugs 30 and 31 with the casing 5 and fuselage 3, respectively, these forces being opposed to each other and proportional to the relative acceleration between the aforementioned points of constraint.

[0092] These torque forces dampen the vibrations transmitted to the fuselage 3 because they tend to cancel the vibratory forces transmitted by the internal rod 7, thereby increasing the comfort of the occupants of the helicopter 2.

[0093] In other words, the device 15 implements an inerter.

[0094] From an examination of the kit 1 according to the present invention, the advantages that can be achieved therewith are evident.

[0095] In particular, the kit 1 comprises a plurality of inerter-type damping devices 15. The devices 15 each comprise a plurality of rollers 22 screwed on the associated screw 20 and female screw 21, and rotatable about respective axes B and C as a result of axial vibrations transmitted from the casing 5 to tubular body 32 and to the female screw 21.

[0096] Therefore, the device 15 is capable of transforming the axial vibrations of the tubular body 30 into alternating rotation of the rollers 22 about axes B and C and of the screw 20 and the flywheel 40 about the associated axes B.

[0097] This alternating rotation generates a force acting on the anchors 12 and 13 that is proportional to the relative acceleration of the anchors 12 and 13.

[0098] This force curbs the transmission of vibrations to the anchor 13, and therefore to the fuselage 3, improving perceived comfort inside the helicopter 2.

[0099] Due to the presence of the rollers 22 interposed between the respective screws 20 and female screws 21, the devices 15 of the kit 1 have low friction, high capacities and are long-lasting with respect to inerter devices of a known type and described in the introductory part of this description.

[0100] In addition, the presence of rollers 22 interposed between the screws 20 and female screws 21 makes the devices 15 particularly compact and accurate.

[0101] This makes application to the helicopter 2 particularly advantageous.

[0102] Each device 15 houses the rod 7 and is hinged to the associated anchors 12 and 13 about the same hinging axes D and E of the associated rod 7 to the anchors 12 and 13.

[0103] Consequently, the devices 15 do not require any substantial redesign of the helicopter 1 and make use of the anchors 12 and 13 already provided for fixing the rods 7 between the casing 5 and the top portion 10 of the fuselage 3.

[0104] Moreover, this makes the kit 1 retro-fittable in a particularly simple and inexpensive manner on already existing helicopters 2 equipped with rods 7.

[0105] To this end, it is sufficient to hinge the device 15 to the already existing anchors 12 and 13 about axes D and E.

[0106] The flywheel 40 enables tuning the force generated by the associated device 15 to a particular vibration frequency value to be dampened. In fact, it is sufficient to increase or reduce the rotational moment of inertia of the flywheel 40 to vary the frequency of vibrations mainly dampened by the associated device 15.

[0107] The crowns 47 and 48 enable rotation of the rollers 22 around the associated common axis B via the meshing between the respective gear teeth 49 and the cogwheels 45 and 46 of the rollers 22.

[0108] The support 25 of each device 1 keeps the respective rollers 22 angularly spaced out around axis B.

[0109] Finally, it is clear that modifications and variants can be made to the kit 1 described and illustrated herein without departing from the scope defined by the claims.

[0110] In particular, the female screw 21 could be connected to the fuselage 3 by lug 31 and the screw 20 could be connected to the casing 5 by lug 30.

[0111] Furthermore, in addition to revolving around axis B with respect to the screw 20, the rollers 22 could also be axially free to translate with respect the female screw 21 parallel to axis B.

[0112] In addition, the devices 15 could be housed inside the respective rods 7 or connected to further respective structural elements interposed between the top portion 10 of the fuselage 3 and the casing 5.

[0113] Furthermore, the kit 1 could comprise only one support 25 and only one crown 47 or 48.

[0114] Finally, the tubular elements 32 and 33 of each device 15 could be directly fastened to the associated rod 7.

Claims

1. A kit (1) for a helicopter (2), said helicopter (2) comprising a fuselage (3) and a rotor (4); the kit (1) comprising at least one device (15) adapted to dampen the vibrations transmitted from said rotor (4) to said fuselage (2) and to be interposed between said fuselage (2) and said rotor (4);
said device (15), in turn, comprising:

   - a first threaded element (21; 20) operatively connectable to said rotor (4) and adapted to, in use, vibrate parallel to a first axis (B);
   - a second threaded element (20; 21) operatively connectable to said fuselage (4) and operatively connected to said first threaded element (21; 20) so as to, in use, rotationally vibrate about said first axis (B); and
   - a plurality of threaded rollers (22), which are screwed on said first and second threaded elements (21, 20; 20, 21);

   said rollers (22) being rotatable about their respective second axes (C) parallel to and separate from said first axis (B) with respect to said second threaded element (20; 21); said rollers (22) also being rotatable about said axis (B) with respect to said first threaded element (21; 20) and to said second threaded element (20; 21);
   characterised in that it comprises at least one crown (47) fastened to said second threaded element (20; 21);
   said crown (47) comprising a gear tooth (49) facing said first axis (B) and engaged by a plurality of gear teeth (45, 46) carried by respective rollers (22).

2. The kit according to claim 1, wherein said rollers (22) are integrally movable with said first threaded element (21; 20) with translation in a direction parallel to said first axis (B).

3. The kit according to claim 1 or 2, wherein said device (15) is an inerter.

4. The kit according to any one of the preceding claims, wherein said rollers (22) and said first threaded element (21; 20) have the same thread angles; and/or in that said rollers (22) comprise a first single-start thread (23); and/or in that said first threaded element and second threaded element (21, 20; 20, 21) comprise a second and a third multi-start thread, respectively.

5. The kit according to claim 4, wherein it comprises:

   - a constraint element (31) to constrain said second threaded element (20; 21) to said fuselage (2); and
   - a bearing (41) interposed between said first threaded element (21; 20) and said constraint element (30), so as to enable the relative rotation of said second threaded element (20; 21) with respect to said constraint element (30) about said first axis (B).

6. The kit according to any one of the preceding claims, wherein it comprises a flywheel (40) rotatable about said first axis (B) and operatively connected to said rollers (22) and said second threaded element (20; 21).

7. The kit according to claim 6, wherein said flywheel (40) is angularly integral with said second threaded element (20; 21).

8. The kit according to any one of the preceding claims, wherein it comprises a support element (25) defining a plurality of seats (26) engaged by said respective rollers (22) in an angularly fixed manner; said support element (25) being angularly movable around said first axis (B) with respect to said first threaded element (21; 20) and said second threaded element (20; 21).

9. A helicopter comprising:

   - said fuselage (2);
   - said rotor (4);
   - a support casing (5) of said rotor (4); and
   - a plurality of connecting rods (7) interposed between said fuselage (2) and said support casing (5);

   wherein it comprises, for each said rod (7), a kit (1) according to any one of the preceding claims; said damping device (15) being interposed between said casing (5) and said fuselage (2).

10. The helicopter according to claim 9, wherein said first threaded element (21; 20) and second threaded element (20; 21) are constrained to the associated said rod (7) .

11. The helicopter according to claim 9 or 10, wherein at least one said rod (7) and said respective device (15) are hinged to said fuselage (2) about the third axes (D) coincident with each other; said at least one rod (7) and said respective device (15) being hinged to said rotor (4) about the same respective fourth axes (E) coincident with each other.

12. The helicopter according to any one of claims 9 to 11, wherein one of said rod (7) and said device (15) is housed inside the other of said rod (7) and said device (15) .

Patentansprüche

1. Kit (1) für einen Hubschrauber (2), wobei der Hubschrauber (2) einen Rumpf (3) und einen Rotor (4) umfasst;
wobei das Kit (1) mindestens eine Vorrichtung (15) umfasst, die geeignet ist, die von dem Rotor (4) auf den Rumpf (2) übertragenen Schwingungen zu dämpfen und zwischen dem Rumpf (2) und dem Rotor (4) angeordnet zu werden;
wobei die Vorrichtung (15) wiederum umfassend:

    - ein erstes Gewindeelement (21; 20), das betriebsmäßig mit dem Rotor (4) verbindbar ist und dazu ausgelegt ist, im Betrieb parallel zu einer ersten Achse (B) zu schwingen;
    - ein zweites Gewindeelement (20; 21), das betriebsmäßig mit dem Rumpf (4) verbindbar ist und mit dem ersten Gewindeelement (21; 20) wirkverbunden ist, so dass es im Betrieb um die erste Achse (B) rotierend schwingt; und
    - mehrere Gewinderollen (22), die auf das erste und zweite Gewindeelement (21, 20; 20, 21) aufgeschraubt sind;

    wobei die Rollen (22) um ihre jeweiligen zweiten Achsen (C) parallel zu und getrennt von der ersten Achse (B) in Bezug auf das zweite Gewindeelement (20; 21) drehbar sind;
wobei die Rollen (22) auch um die Achse (B) in Bezug auf das erste Gewindeelement (21; 20) und auf das zweite Gewindeelement (20; 21) drehbar sind;
dadurch gekennzeichnet, dass es mindestens eine Krone (47) umfasst, die an dem zweiten Gewindeelement (20; 21) befestigt ist;
wobei die Krone (47) einen Zahnradzahn (49) umfasst, der der ersten Achse (B) zugewandt ist und mit mehreren Zahnradzähnen (45, 46) in Eingriff steht, die von entsprechenden Rollen (22) getragen werden.

2. Kit nach Anspruch 1, wobei die Rollen (22) integral mit dem ersten Gewindeelement (21; 20) mit Verschiebung in einer Richtung parallel zu der ersten Achse (B) beweglich sind.

3. Kit nach Anspruch 1 oder 2, wobei die Vorrichtung (15) ein Inerter ist.

4. Kit nach einem der vorhergehenden Ansprüche, wobei die Rollen (22) und das erste Gewindeelement (21; 20) die gleichen Gewindewinkel aufweisen; und/oder
dadurch gekennzeichnet, dass die Rollen (22) ein erstes eingängiges Gewinde (23) umfassen; und/oder
dadurch gekennzeichnet, dass das erste Gewindeelement und das zweite Gewindeelement (21, 20; 20, 21) ein zweites bzw. ein drittes mehrgängiges Gewinde umfassen.

5. Kit nach Anspruch 4, umfassend:

    - ein Einspannelement (31), um das zweite Gewindeelement (20; 21) an dem Rumpf (2) zu einzuspannen; und
    - ein Lager (41), das zwischen dem ersten Gewindeelement (21; 20) und dem Einspannelement (30) angeordnet ist, um so die relative Drehung des zweiten Gewindeelements (20; 21) in Bezug auf das Einspannelement (30) um die erste Achse (B) zu ermöglichen.

6. Kit nach einem der vorhergehenden Ansprüche, wobei das Kit ein Schwungrad (40) umfasst, das um die erste Achse (B) drehbar ist und mit den Rollen (22) und dem zweiten Gewindeelement (20; 21) wirkverbunden ist.

7. Kit nach Anspruch 6, wobei das Schwungrad (40) in einem Winkel einstückig mit dem zweiten Gewindeelement (20; 21) ausgebildet ist.

8. Kit nach einem der vorhergehenden Ansprüche, wobei das Kit ein Stützelement (25) umfasst, das mehrere Aufnahmen (26) definiert, in die die jeweiligen Rollen (22) winkelfest eingreifen;
wobei das Stützelement (25) um die erste Achse (B) in Bezug auf das erste Gewindeelement (21; 20) und das zweite Gewindeelement (20; 21) winkelbeweglich ist.

9. Hubschrauber, umfassend:

    - den Rumpf (2);
    - den Rotor (4);
    - ein Stützgehäuse (5) des Rotors (4); und
    - mehrere Verbindungsstangen (7), die zwischen dem Rumpf (2) und dem Stützgehäuse (5) angeordnet sind;

    worin es für jede Stange (7) ein Kit (1) nach einem der vorhergehenden Ansprüche umfasst;
wobei die Dämpfungsvorrichtung (15) zwischen dem Gehäuse (5) und dem Rumpf (2) angeordnet ist.

10. Hubschrauber nach Anspruch 9, wobei das erste Gewindeelement (21; 20) und das zweite Gewindeelement (20; 21) an der zugehörigen Stange (7) eingespannt sind.

11. Hubschrauber nach Anspruch 9 oder 10, wobei mindestens eine der Stangen (7) und die entsprechende Vorrichtung (15) am Rumpf (2) um die dritten miteinander zusammenfallenden Achsen (D) gelenkig angebracht sind;

wobei die mindestens eine Stange (7) und die jeweilige Vorrichtung (15) am Rotor (4) um die gleichen jeweiligen vierten miteinander zusammenfallenden Achsen (E) gelenkig angebracht sind.

12. Hubschrauber nach einem der Ansprüche 9 bis 11, wobei eine der jeweiligen Stange (7) und Vorrichtung (15) im Inneren der anderen jeweiligen Stange (7) und Vorrichtung (15) untergebracht ist.

Revendications

1. Kit (1) pour un hélicoptère (2), ledit hélicoptère (2) comprenant un fuselage (3) et un rotor (4) ; le kit (1) comprenant au moins un dispositif (15) adapté pour amortir les vibrations transmises depuis ledit rotor (4) audit fuselage (2) et pour être interposé entre ledit fuselage (2) et ledit rotor (4) ;
ledit dispositif (15), à son tour, comprenant :

- un premier élément fileté (21 ; 20) pouvant être relié opérationnellement audit rotor (4) et adapté pour, pendant son utilisation, vibrer parallèlement à un premier axe (B) ;
- un second élément fileté (20 ; 21) pouvant être relié opérationnellement audit fuselage (4) et relié opérationnellement audit premier élément fileté (21 ; 20) de manière à, pendant son utilisation, vibrer de manière rotative autour dudit premier axe (B) ; et
- une pluralité de rouleaux filetés (22), qui sont vissés sur lesdits premier et second éléments filetés (21, 20 ; 20, 21) ;

lesdits rouleaux (22) étant rotatifs autour de leurs deuxièmes axes (C) respectifs parallèles et distincts dudit premier axe (B) par rapport audit second élément fileté (20 ; 21) ;
lesdits rouleaux (22) étant également rotatifs autour dudit axe (B) par rapport audit premier élément fileté (21 ; 20) et audit second élément fileté (20 ; 21) ;
caractérisé en ce qu'il comprend au moins une couronne (47) fixée audit second élément fileté (20 ; 21) ;
ladite couronne (47) comprenant une dent d'engrenage (49) faisant face audit axe (B) et mise en prise par une pluralité de dents d'engrenage (45, 46) portées par des rouleaux (22) respectifs.

2. Kit selon la revendication 1, dans lequel lesdits rouleaux (22) sont mobiles d'un seul tenant avec ledit premier élément fileté (21 ; 20) avec une translation dans une direction parallèle audit premier axe (B).

3. Kit selon la revendication 1 ou 2, dans lequel ledit dispositif (15) est un dispositif d'inertie.

4. Kit selon l'une quelconque des revendications précédentes, dans lequel lesdits rouleaux (22) et ledit premier élément fileté (21 ; 20) ont les mêmes angles de filetage ; et/ou
lesdits rouleaux (22) comprennent un premier filetage à un seul point de départ (23) ; et/ou
lesdits premier élément fileté et second élément fileté (21, 20 ; 20, 21) comprennent, respectivement, un deuxième et un troisième filetage à plusieurs points de départ.

5. Kit selon la revendication 4, dans lequel il comprend :

- un élément de contrainte (31) pour contraindre ledit second élément fileté (20 ; 21) vers ledit fuselage (2) ; et
- un palier (41) interposé entre ledit premier élément fileté (21 ; 20) et ledit élément de contrainte (30), de manière à permettre la rotation relative dudit second élément fileté (20 ; 21) par rapport audit élément de contrainte (30) autour dudit premier axe (B).

6. Kit selon l'une quelconque des revendications précédentes, dans lequel il comprend un volant (40) rotatif autour dudit premier axe (B) et relié opérationnellement auxdits rouleaux (22) et audit second élément fileté (20 ; 21).

7. Kit selon la revendication 6, dans lequel ledit volant (40) est angulairement solidaire dudit second élément fileté (20 ; 21).

8. Kit selon l'une quelconque des revendications précédentes, dans lequel il comprend un élément de support (25) définissant une pluralité de sièges (26) mis en prise par lesdits rouleaux (22) respectifs d'une manière fixe angulairement ;
ledit élément de support (25) étant mobile angulairement autour dudit premier axe (B) par rapport audit premier élément fileté (21 ; 20) et audit second élément fileté (20 ; 21).

9. Hélicoptère comprenant :

- ledit fuselage (2) ;
- ledit rotor (4) ;
- un carter de support (5) dudit rotor (4) ; et
- une pluralité de bielles (7) interposées entre ledit fuselage (2) et ledit carter de support (5) ;

dans lequel il comprend, pour chaque dite bielle (7), un kit (1) selon l'une quelconque des revendications précédentes ;
ledit dispositif d'amortissement (15) étant interposé entre ledit carter (5) et ledit fuselage (2).

10. Hélicoptère selon la revendication 9, dans lequel lesdits premier élément fileté (21 ; 20) et second élément fileté (20 ; 21) sont contraints sur ladite bielle (7) associée.

11. Hélicoptère selon la revendication 9 ou 10, dans lequel au moins une dite bielle (7) et ledit dispositif (15) respectif sont articulés sur ledit fuselage (2) autour des troisièmes axes (D) coïncidant l'un avec l'autre ;
ladite au moins une bielle (7) et ledit dispositif (15) respectif étant articulés sur ledit rotor (4) autour des mêmes quatrièmes axes (E) respectifs coïncidant l'un avec l'autre.

12. Hélicoptère selon l'une quelconque des revendications 9 à 11, dans lequel l'un parmi ladite bielle (7) et ledit dispositif (15) est logé à l'intérieur de l'autre dudit rotor (7) et dudit dispositif (15).

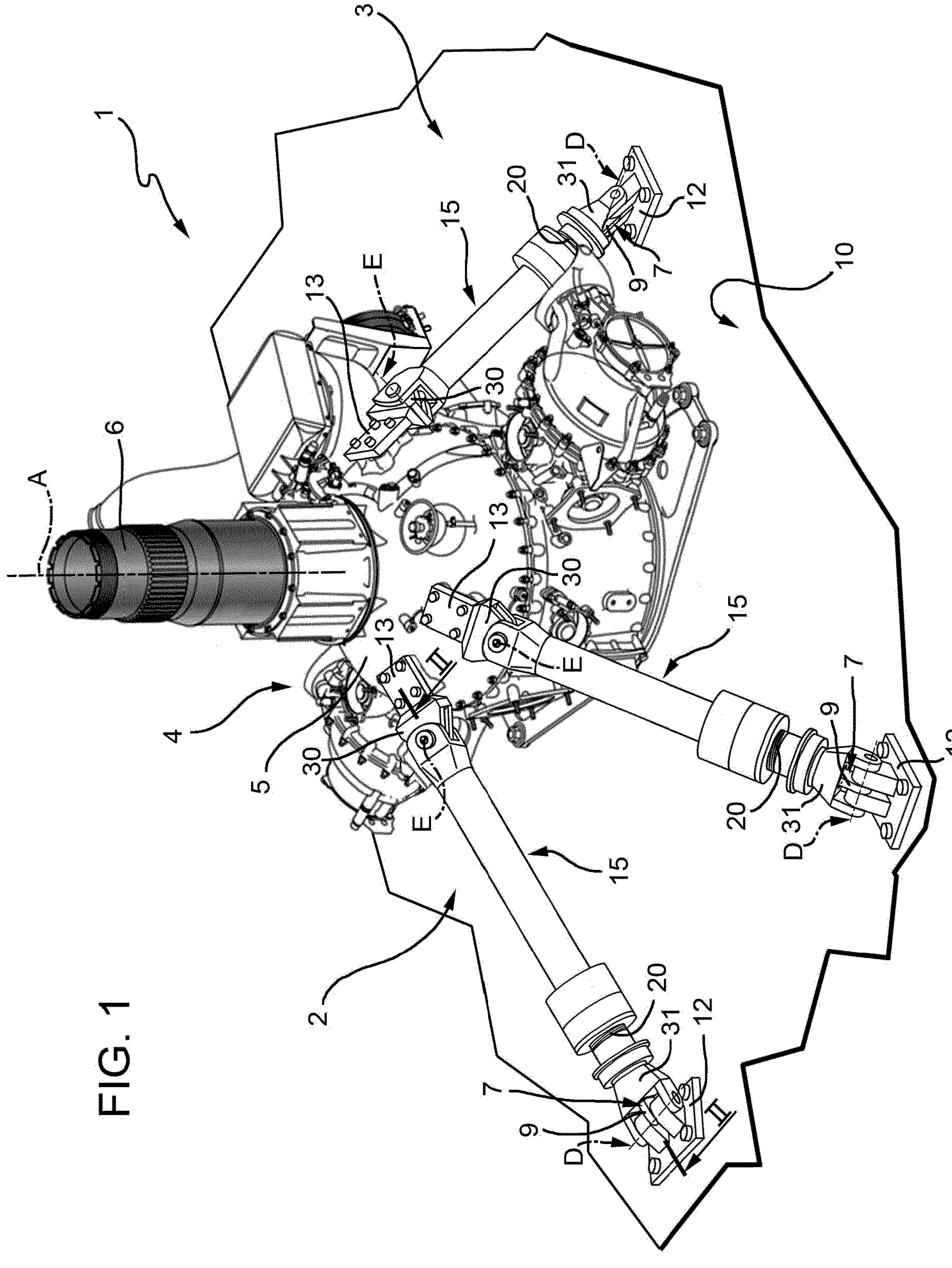

FIG. 1

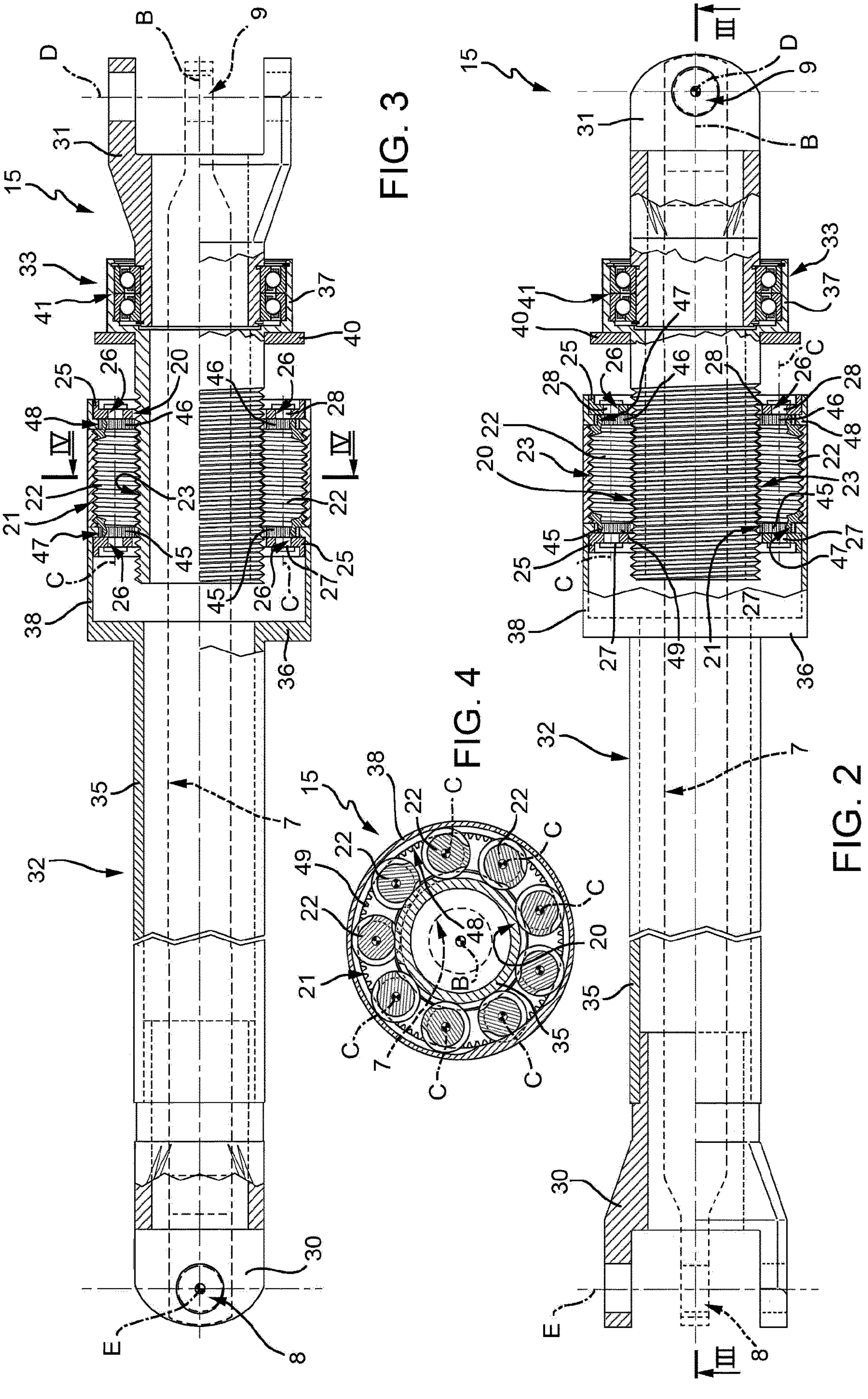

FIG. 3

FIG. 4

FIG. 2

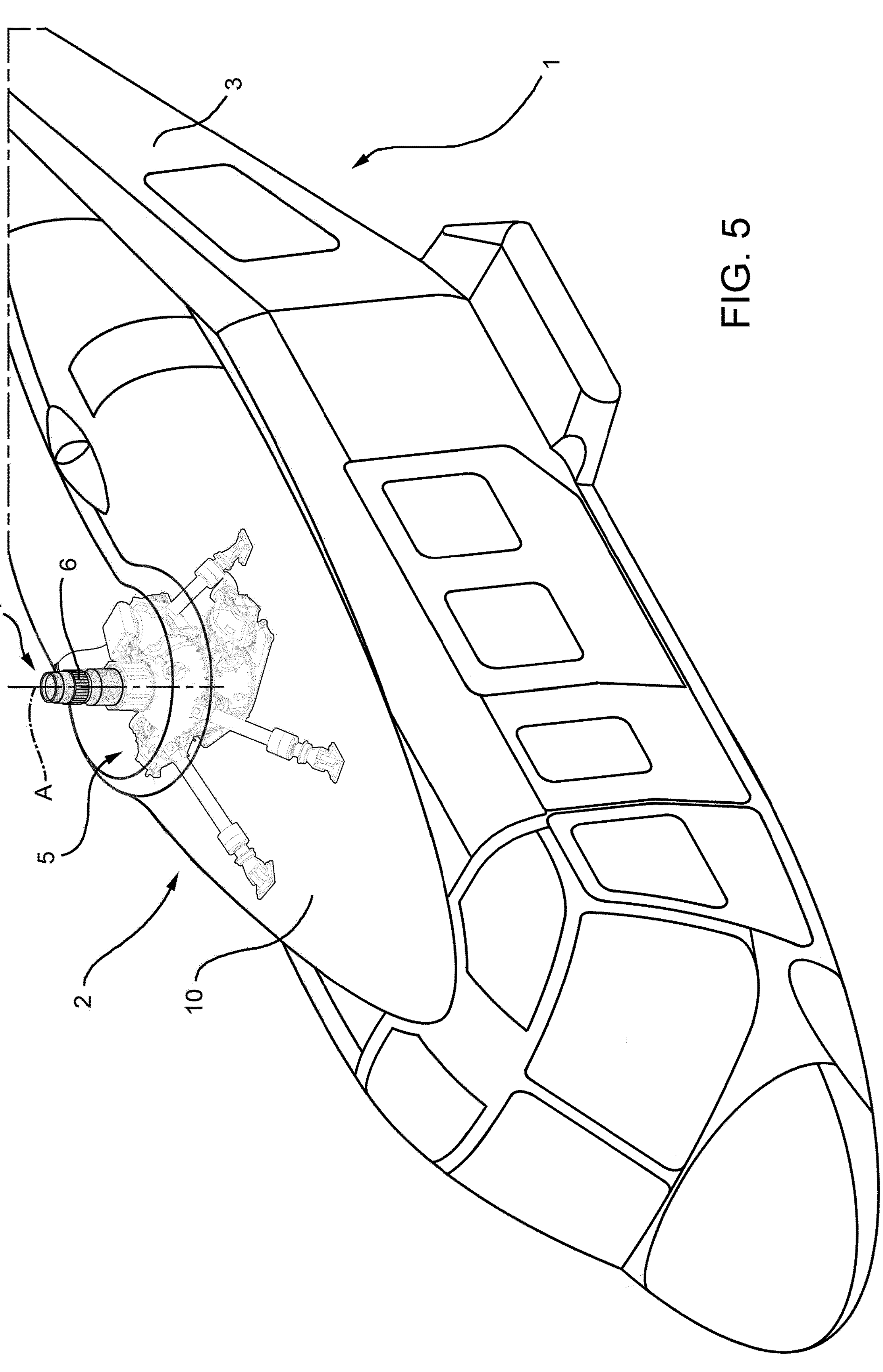

FIG. 5

REFERENCES CITED IN THE DESCRIPTION

Patent documents cited in the description

- EP 1402327 B **[0019]**
- US 20090108510 A **[0020]**
- JP S6078130 A **[0024]**