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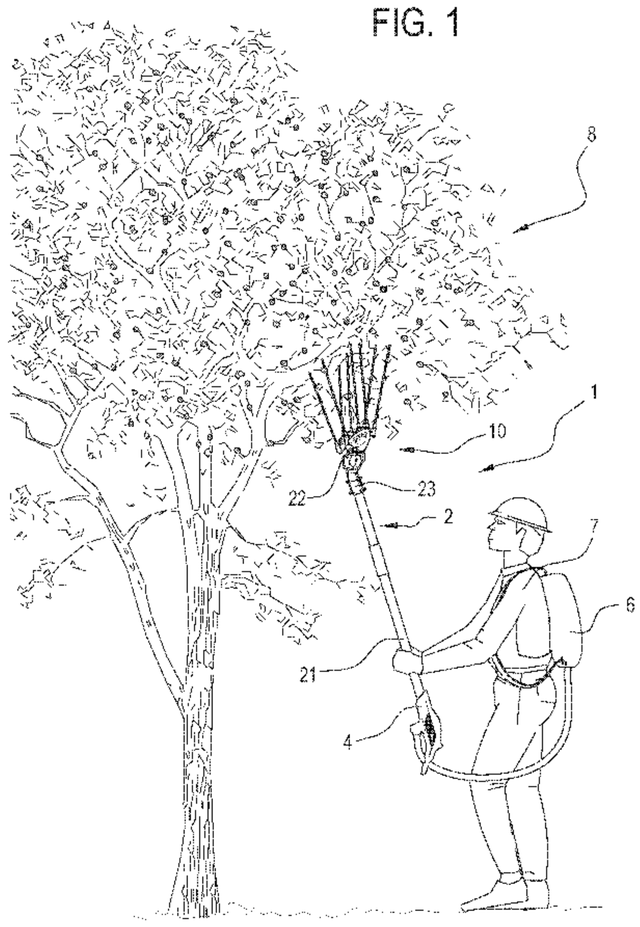
(54) Title: TOOL FOR HARVESTING OLIVES

(57) Abstract: A tool (1) for harvesting olives comprises: a frame (2) including a handgrip portion (21); a rake (3), including a plurality of prongs (300), configured to interact with the olives on an olive tree (8), wherein the rake (3) is movable relative to the frame (2) with a pivoting motion; a motor (4) associated with the frame (2); a transmission unit (5), interconnected between the motor (4) and the rake (3), wherein the motor (4) is connected to the transmission unit (5) to drive the pivoting motion of the rake (3).

FIG. 1



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DESCRIPTION

TOOL FOR HARVESTING OLIVES

Technical field

This invention relates to a tool for harvesting olives.

Background art

Olives are traditionally harvested using a portable tool known as an olive harvesters; an olive tree shaker is a power-driven tool equipped with a rake designed to sweep the branches of olive trees so as to detach the olives from them. The rake usually includes a plurality of prongs, configured to engage the olives, and moves with pivoting motion that results in a shaking action which causes the olives to be detached from the branches and to fall to the ground.

Tree shakers known in the prior art are described, for example, in patent documents WO03/030625A1, EP1795064A1, EP18183967 EP3313166B1 and EP0974257A1.

In prior art olive harvesters include transmission systems for transmitting motion from the motor to the rake. For example, EP3313166B1 discloses a transmission system of crankshaft type. These transmission systems are subject to inherent disadvantages. For example, the transmission systems may be excessively complex, creating difficulties with maintenance, or the portable object which must be carried by the operator during harvesting may be very heavy. In addition, the transmission systems may in some cases expose the operator to vibrations which not only cause discomfort but can also be harmful to health. Moreover, since the rake moves with pivoting motion involving rapid changes of direction, the transmission systems may impart excessively high accelerations to the rake itself, resulting in a particularly aggressive action on the plants.

Disclosure of the invention

The aim of this disclosure is to provide a tool for harvesting olives and a method for harvesting olives to overcome at least one of the above mentioned disadvantages of the prior art.

This aim is fully achieved by the tool and method of this disclosure as characterized in the appended claims.

Generally speaking, this disclosure addresses a tool (or shaker) for harvesting small fruits such as, for example, olives, bilberries, currants, raspberries and the like. Preferably, the tool of this disclosure is suitable for harvesting olives; the disclosure therefore refers specifically to olives; it should be noted, however, that what is described with regard to olives is also applicable to other kinds of small fruits.

The tool comprises a frame. The frame includes a handgrip portion. The handgrip portion is configured to be gripped by an operator during harvesting. Thus, the tool is a portable tool.

The tool comprises a rake that includes a plurality of prongs configured to interact with the olives of an olive tree. The rake is movable relative to the frame with pivoting motion.

The tool comprises a motor. The motor is associated with the frame.

The tool comprises a transmission unit interconnected between the motor and the rake. The motor is connected to the transmission unit to drive the pivoting motion of the rake.

It should be noted that according to an aspect of this disclosure, the transmission unit includes a slotted link device (or mechanism).

The transmission unit preferably also includes a first rod which is elongated along a first axis. The motor is (kinematically) linked to the first rod to impart rotational motion to the first rod; preferably, the rotational motion of the first rod occurs about the first axis.

Preferably, the transmission unit includes a second rod which is elongated along a second axis. More specifically, the second rod extends between a

first end and a second end. The second rod is movable to and from along the second axis with reciprocating motion. More specifically, the second rod is constrained to move along the second axis. The slotted link device is interconnected between the first rod and the second rod (specifically the first end of the second rod) to convert the rotational motion of the first rod into the reciprocating motion of the second rod. Thus, the slotted link device (or mechanism) imparts reciprocating motion to the second rod.

Preferably, the transmission unit includes a pivoting linkage. The second rod (specifically, the second end of the second rod) is kinematically linked to the rake by the pivoting linkage. Thus, the pivoting linkage is configured to convert the reciprocating motion of the second rod into the pivoting motion of the rake.

Preferably, the slotted link device includes a slotted element, defining a slot therein. The slotted element is integral with the second rod and is constrained to translate reciprocatingly along the second axis.

The slotted link device includes a rotary member which is kinematically coupled to the first rod. More specifically, the rotary member is rotatable about a third axis (along which the rotary member extends). The rotary member is kinematically coupled to the first rod by a gear mechanism (that is, a gear system) to receive from the first rod a rotational motion about a third axis.

It should be noted that the gear mechanism preferably includes a first bevel gear which is integral with the first rod and a second bevel gear which is integral with the rotary member. The third axis is (obliquely) inclined relative to the first axis. More specifically, the second axis is inclined relative to the first axis at an angle greater than 65°; preferably, the angle is less than 85°; for example, the angle may be between 70° and 80°; still more preferably, the angle is between 70° and 75°.

It should be noted that the third axis is preferably perpendicular to the second axis.

The slotted link device includes a pin which is fixed to the rotary member. More specifically, the pin is fixed eccentrically to the rotary member. The pin is slidably inserted in the slot of the slotted element.

According to an aspect of this disclosure, the rake includes a first sector, which includes a first group of prongs of the plurality of prongs, and a second sector, which includes a second group of prongs of the plurality of prongs. The first and second group of prongs form the plurality of prongs. Preferably, the first sector and the second sector are connected to the frame at respective fulcrums. Further, the first sector and the second sector are pivoting about respective pivot axes through the pivoting motion. Thus, the pivoting motion of the rake is determined by a reciprocating pivoting motion of the first and second sectors. More specifically, the first sector and the second sectors pivot towards and away from each other during the pivoting motion. Preferably, the pivot axes of the first and second sectors are perpendicular to the second axis and pass through the aforementioned fulcrums.

The pivoting linkage includes a first and a second connecting element, interconnected between the second rod and the first and the second sector, respectively. The first and the second connecting element are configured to convert the reciprocating motion of the second rod into the pivoting motion of the first and the second sector, respectively. Thus, the pivoting linkage transmits motion from the second rod to the rake. Preferably, the first and the second connecting element are connected to the first sector and to the second sector, respectively, at respective connecting points interposed between the first fulcrum and the second fulcrum.

It should be noted that the motor is preferably an electric motor; for example, the motor may be a brushless electric motor.

This disclosure also provides a method for harvesting small fruits (specifically, olives).

The method comprises a step of gripping a handgrip portion of a frame of

an olive harvesting tool, by an operator.

The method comprises a step of placing a rake of the tool in contact with the olives on an olive tree. The rake includes a plurality of prongs.

The method comprises a step of switching on a motor (of the tool) to start a step of moving the rake relative to the frame. More specifically, in the step of moving, the rake moves relative to the frame with a pivoting motion driven by a transmission unit which is interconnected between the motor and the rake. The transmission unit may have one or more of the features described in this disclosure. More specifically, the transmission unit preferably includes a slotted link device. The slotted link device receives rotational motion from the motor (through a first rod) and converts it into reciprocating motion for a second rod that is connected to the rake.

In the step of moving, the rake is moved by a pivoting linkage that is interconnected between a second rod of the transmission unit and the rake. The second rod moves with reciprocating motion along a second axis that is in turn driven by the slotted link device. In effect, in the step of moving, the slotted link device converts a rotational motion of a first rod which is kinematically linked to the motor (and which rotates about a first axis), into the reciprocating motion of the second rod.

Preferably, the rake includes a first sector and a second sector. In the pivoting motion of the rake, the first sector and the second sector pivot (or oscillate) about respective pivot axes; more specifically, the first and the second sector pivot towards and away from each other.

Brief description of the drawings

These and other features will become more apparent from the following description of a preferred embodiment, illustrated by way of non-limiting example in the accompanying drawings, in which:

- Figure 1 shows a tool for harvesting olives according to this disclosure;
- Figure 2 shows a head of the tool of Figure 1;
- Figure 3 shows the head of Figure 2 in a front cross section;

- Figures 4 and 5 show the transmission unit of the tool of Figure 1;
- Figure 6 shows the head of the tool of Figure 2, without the frame;
- Figure 6A shows a detail from Figure 6.

Detailed description of preferred embodiments of the invention

With reference to this disclosure, the numeral 1 denotes a tool for harvesting olives.

The tool 1 comprises a handgrip portion 21, mounted on a frame 2, and a head 10, fixed to the frame 2. The handgrip portion 21 can be gripped by an operator 7. More specifically, the frame 2 defines a handle, extending between a first end and a second end, and the head 10 is connected to the first end of the handle. The tool 1 also comprises a motor 4, preferably mounted at the second end of the handle.

The motor 4 is an electric motor; the electric motor 4 is connectable (operatively connected) to an electric (power) source. For example, the electric motor 4 is connected to a battery system; preferably, the battery system is housed in a backpack 6 wearable by the operator 7; alternatively, the electric motor 4 may be connected to a battery placed on the ground.

The tool 1 (more specifically, the head 10) comprises a rake 3. The rake 3 includes a first sector 31 and a second sector 32, which are movable relative to the frame 2. The first sector 31 and the second sector 32 are movable relative to the frame 2 with pivoting motion; more specifically, the first sector 31 and the second sector 32 are movable towards and away from each other so as to knock the olives on an olive tree 8 to cause them to be detached from the branches of the tree 8.

The rake 3 includes a plurality of prongs 300; the plurality of prongs 300 includes a first group of prongs 300A, mounted on the first sector 31, and a second group of prongs 300B, mounted on the second sector 32.

The tool 1 comprises a transmission unit 5, connected to the motor 4 and to the rake 3 and configured to transfer motion from the motor 4 to the rake 3.

The transmission unit 5 comprises a first rod 51 which is elongated along a

first axis A1. The first rod 51 is housed in the handle of the frame 2.

The first rod 51 has a first end, which is kinematically linked to the motor 4 to receive rotational motion about the first axis A1, and a second end, opposite to the first end. The transmission unit 5 comprises a slotted link device 50, connected to the first rod 51. The transmission unit 5 comprises a second rod 52, connected to the slotted link device 50. The slotted link device 50 receives rotational motion from the first rod 51 and transmits reciprocating motion to the second rod 52.

More specifically, the second rod 52 is elongated along a second axis A2 and is configured to slide with reciprocating motion in parallel with the second axis A2.

The slotted link device 50 comprises a rotary member 502 which is meshed with the first rod 501. The rotary member 502 extends along a third axis A3 and rotates about the third axis A3. The rotary member 502 receives rotational motion about the third axis A3 from the first rod 501.

More specifically, the slotted link device 50 comprises a first gear 504, fixed to the second end of the first rod 51, and a second gear 505, fixed to the rotary member 502. Preferably, the first gear 504 and the second gear 505 are bevel gears. In effect, the third axis A3 is inclined relative to the first axis A1. More specifically, the third axis A3 is inclined relative to the first axis A1 at an angle δ less than 90°. Preferably, the angle δ is between 70° and 80°. Still more preferably, the angle δ is 75°. This inclination makes harvesting easier for the operator 7.

The slotted link device 50 comprises a pin 503, fixed to the rotary member 502 eccentrically relative to the rotary member 502. In other words, the pin 503 is out of alignment with the third axis A3 about which the rotary member 502 rotates.

The slotted link device 50 comprises a slotted element 501 which defines a slot having an elongate shape. More specifically, the slot of the slotted element 501 is shaped to extend in a direction perpendicular to the third

axis A3. The pin 503 is slidably inserted in the slotted element 501 to move in the direction defined by the slot.

The second rod 52 has a first end 52A which is connected to the slotted element 501. The slotted link device 50 receives rotational motion from the first rod 51 and transmits reciprocating motion to the second rod 52.

The transmission unit 5 also comprises a gear motor, interconnected between the first rod 51 and the motor 4 to reduce and/or modify the rotation speed of the first rod 51, hence the pivoting speed of the rake 3.

The slotted link device 50 may also comprise a counterweight 506, interposed between the slotted element 501 and the second bevel gear 504.

The frame 2 comprises a shell 23 which encloses the slotted link device 50. Preferably, on an inside wall of it, the shell 23 defines a guide 231 which is oriented in parallel with the second axis A2; the slotted element 501 is slidably coupled to the guide 231. Thus, the slotted element 501 is constrained by the guide 231 to move in parallel with the second axis A2. It should be noted that the guide 231 may be provided on a pair of inside walls of the shell 23, facing each other, to constrain the slotted element 501 on two opposite sides.

The transmission unit 5 also comprises a pivoting linkage 53, connected to a second end 52B of the second rod 52, opposite to the first end 52A. The pivoting linkage 53 comprises a first connecting element 531, which is connected to the first sector 31 of the rake 3, and a second connecting element 532, which is connected to the second sector 32 of the rake 3. More specifically, at its second end 52B, the second rod 52 comprises a plate oriented transversely to the second axis A2. The first connecting element 531 is pivoted to the plate at a first pin 531A and is pivoted to the first sector 31 at a second pin 531B, spaced from the first pin 531A. Thus, the first connecting element 531 is rotatably connected both to the second rod 52 and to the first sector 31. Similarly, the second connecting element 532 is pivoted to the plate at a first pin 532A and is pivoted to the second sector

32 at a second pin 532B, spaced from the first pin 532A. Thus, the second connecting element 532 is rotatably connected both to the second rod 52 and to the second sector 32.

The frame includes a supporting element 22, fixed to the shell 23. The first sector 31 and the second sector 32 are pivotally connected to the supporting element 22 of the frame 2. More specifically, the first sector 31 is pivotally connected to the supporting element 22 at a first fulcrum F1 and the second sector 32 is pivotally connected to the supporting element 22 at a second fulcrum F2. The first sector 31 is rotatably connected (idly) to the supporting element 22 at the first fulcrum F1 to pivot with rotational motion about a first pivot axis A4; this motion is transmitted by the first connecting element 531. The second sector 32 is rotatably connected (idly) to the supporting element 22 at the second fulcrum F2 to pivot with rotational motion about a second pivot axis A5; this motion is transmitted by the second connecting element 532. It should be noted that the first and the second pivot axis A4 and A5 are parallel to each other and perpendicular to the second axis A2. The first and the second connecting element 531 and 532 are interposed between the first and the second pivot axis A4 and A5 and also rotate about axes which are parallel to the first and the second pivot axis A4 and A5.

It should be noted that the first and the second sector 31 and 32 rotate about respective pivot axes A4 and A5 in opposite rotation directions. Thus, when the second rod 52 moves upwards (away from the first rod 51), the first and the second sector 31 and 32 move away from each other and when the second rod 52 moves downwards (towards the first rod 51), the first and the second sector 31 and 32 move towards each other. This movement defines the pivoting motion of the rake 3.

That way, the pivoting linkage 53 converts the reciprocating motion of the second rod 52 into a pivoting motion of the first sector 31 and of the second sector 32.

It should be noted that the slotted link device 50, the second rod 52, the

pivoting linkage 53 and the rake 3 make up a head of the tool 1. The first rod 51 extends into the handle. Thus, one end of the handle is connected to the motor 4 and the opposite end is connected to the head; preferably, the handgrip portion 21 is interposed between the motor 4 and the head.

CLAIMS

1. A tool (1) for harvesting olives, comprising:

- a frame (2) including a handgrip portion (21);

- a rake (3), including a plurality of prongs (300), configured to interact with the olives on an olive tree (8), wherein the rake (3) is movable relative to the frame (2) with a pivoting motion;

- a motor (4) associated with the frame (2);

- a transmission unit (5), interconnected between the motor (4) and the rake (3), wherein the motor (4) is connected to the transmission unit (5) to drive the pivoting motion of the rake (3),

characterized in that the transmission unit (5) includes a slotted link device (50).

2. The tool (1) according to claim 1, wherein the slotted link device (50) includes:

- a slotted element (501), defining a slot therein;

- a rotary member (502) configured for receiving motion from the motor (4);

- a pin (503), fixed eccentrically to the rotary member (502), wherein the pin (503) is slidably inserted in the slot of the slotted element (501).

3. The tool (1) according to claim 2, wherein the transmission unit (5) includes:

- a first rod (51), elongated along a first axis (A1), wherein the motor (4) is kinematically connected to the first rod (51) to impart to the first rod (51) a rotational motion about the first axis (A1);

- a second rod (52), elongated along a second axis (A2) between a first end (52A) and a second end (52B) and movable reciprocatingly along the second axis (A2) with a reciprocating translational motion, wherein the slotted link device (50) is interconnected between the first rod (51) and the first end (52A) of the second rod (52) to convert the rotational motion of the first rod (51) into the reciprocating motion of the second rod (52),

- a pivoting linkage (53) configured to convert the reciprocating motion of

the second rod (52) into the pivoting motion of the rake (3), wherein the second end (52B) of the second rod (52) is kinematically connected to the rake (3) through the pivoting linkage (53).

4. The tool (1) according to claim 3, includes wherein the slotted element (501) is integral with the second rod (52) and is constrained to translate reciprocatingly along the second axis (A2).

5. The tool (1) according to claim 4, wherein the rotary member (502) is kinematically coupled to the first rod (52).

6. The tool (1) according to claim 5, wherein the rotary member (502) is kinematically connected to the first rod (51) by a gear mechanism to receive from the first rod (51) a rotational motion about a third axis (A3).

7. The tool (1) according to claim 6, wherein the third axis (A3) is perpendicular to the second axis (A2).

8. The tool (1) according to claim 6 or 7, wherein the gear mechanism includes a first bevel gear (504) integral with the first rod (51) and a second bevel gear (505) integral with the rotary member (502).

9. The tool (1) according to claim 8, wherein the third axis (A3) is inclined to the first axis (A1) at an angle (δ) of between 70° and 75°.

10. The tool (1) according to any one of claims 3 to 9, wherein the rake includes a first sector (31), including a first group of prongs (300A) of the plurality of prongs (300), and a second sector (32), including a second group of prongs (300B) of the plurality of prongs (300), wherein the first sector (31) and the second sector (32) are connected to the frame (2) at respective fulcrums (F1, F2) and are pivotable about respecting pivot axes (A4, A5) perpendicular to the second axis (A2) and passing through the fulcrums (F1, F2) through the pivoting motion.

11. The tool (1) according to claim 10, wherein the first sector (31) and the second sector (32) are pivotable towards and away from each other through the pivoting motion.

12. The tool (1) according to claim 10 or 11, wherein the pivoting linkage

(53) includes a first and a second connecting element (531, 532), interconnected between the second rod (52) and the first and the second sector (31, 32), respectively, to convert the reciprocating motion of the second rod (52) into the pivoting motion of the first and the second sector (31, 32).

13. The tool (1) according to any one of the preceding claims, wherein the motor (4) is an electric motor.

14. A method for harvesting olives, comprising the following steps:

- gripping a handgrip portion of a frame (2) of an olive harvesting tool (1), by an operator;

- placing a rake (3) of the tool (1) in contact with the olives on an olive tree, wherein the rake (3) includes a plurality of prongs;

- switching on a motor (4) to start a step of moving the rake (3) relative to the frame (2), wherein the rake (3) moves with a pivoting motion driven by a transmission unit (5) which is interconnected between the motor (4) and the rake (3),

characterized in that the transmission unit (5) includes a slotted link device (50).

15. The method according to claim 14, wherein, during the step of moving, the rake(3) is moved by a pivoting linkage (53) interconnected between a second rod (52) of the transmission unit (5) and the rake (3), wherein the second rod (52) moves with reciprocating motion and wherein the slotted link device (50) converts a rotational motion of a first rod (51), which is kinematically connected to the motor (4), into the reciprocating motion of the second rod (52).

16. The method according to claim 14 or 15, wherein the rake (3) includes a first sector (31) and a second sector (32) and wherein, during the pivoting motion of the rake (3), the first sector (31) and the second sector (32) pivot towards and away from each other about respective pivot axes.

17. The method according to any of claims 14 to 16, wherein the slotted link

device (50) includes:

- a slotted element (501), defining a slot therein;
- a rotary member (502) receiving motion from the motor (4);
- a pin (503), fixed eccentrically to the rotary member (502), wherein the pin (503) is slidably inserted in the slot of the slotted element (501).

FIG. 1

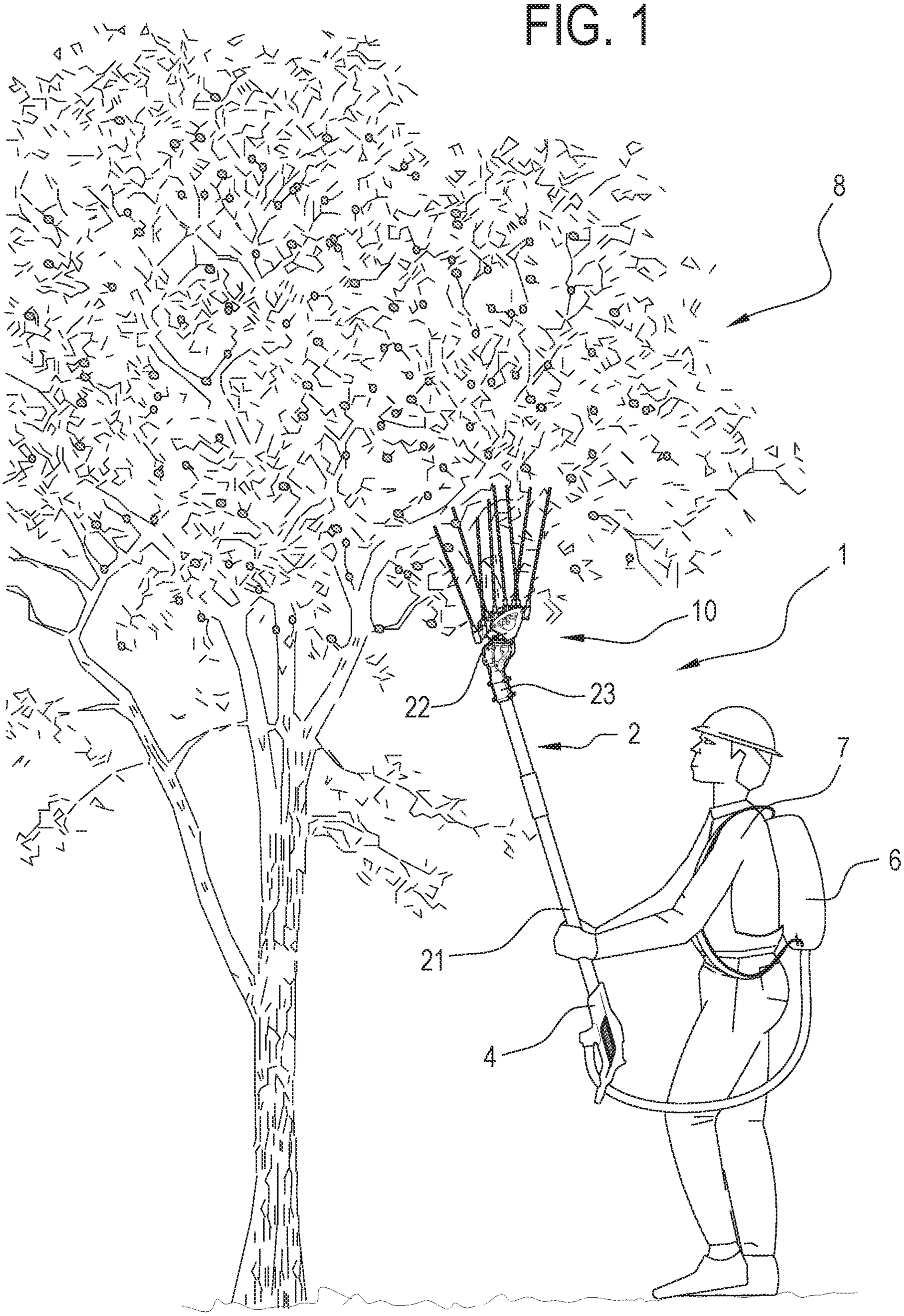


FIG. 2

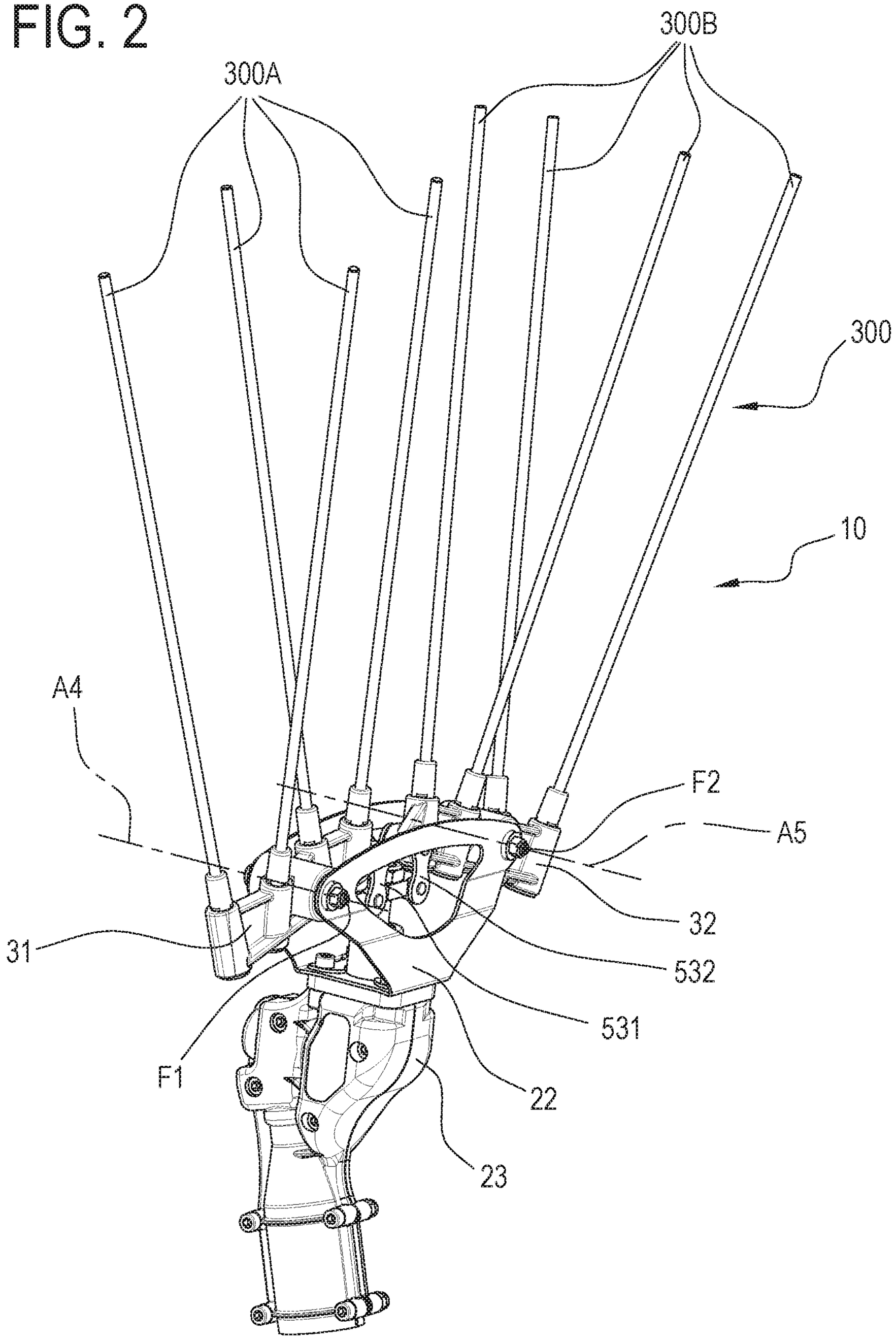
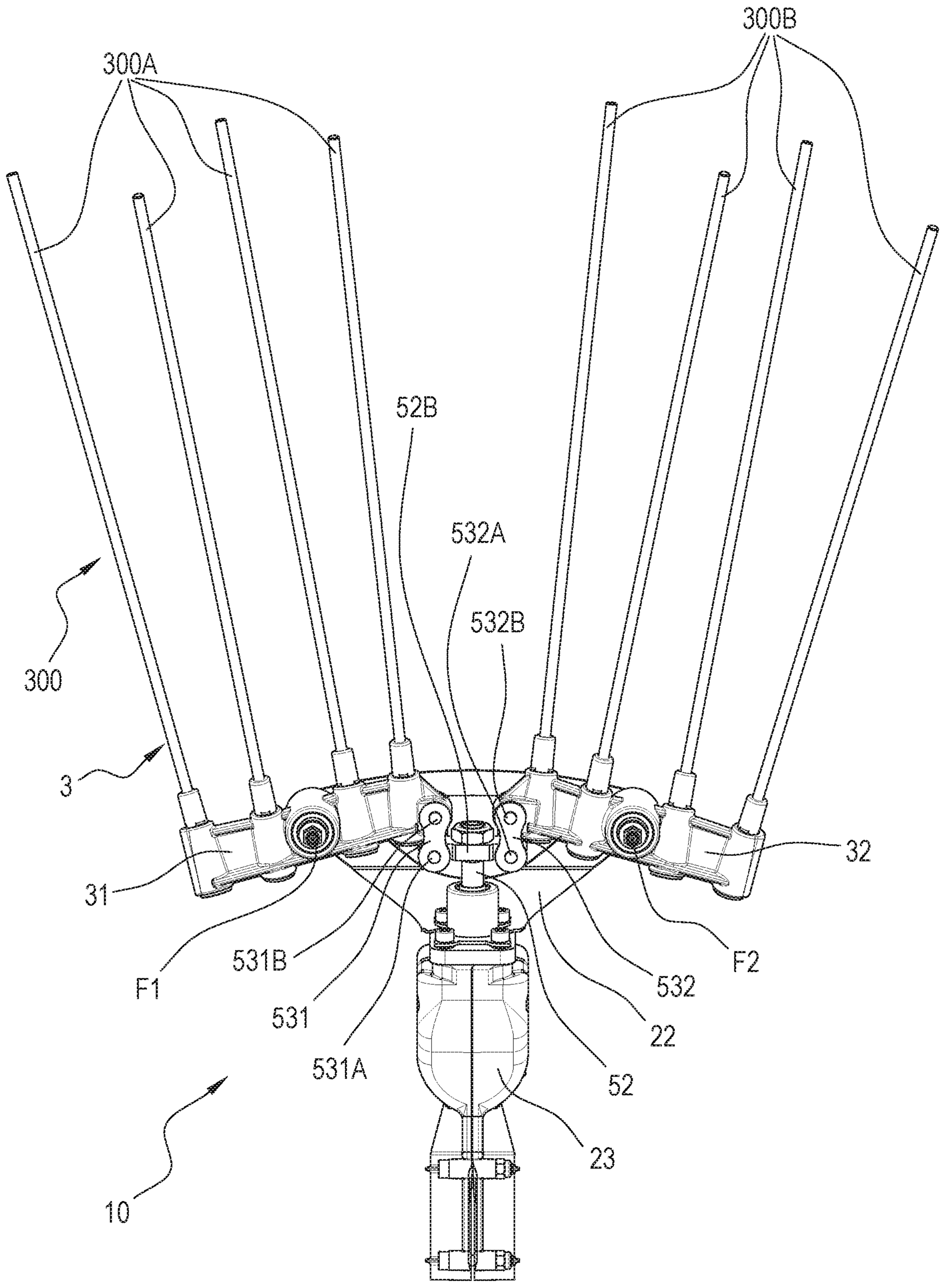


FIG. 3


300A
300B
52B
532A
532B
300
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32
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531A
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F2
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23
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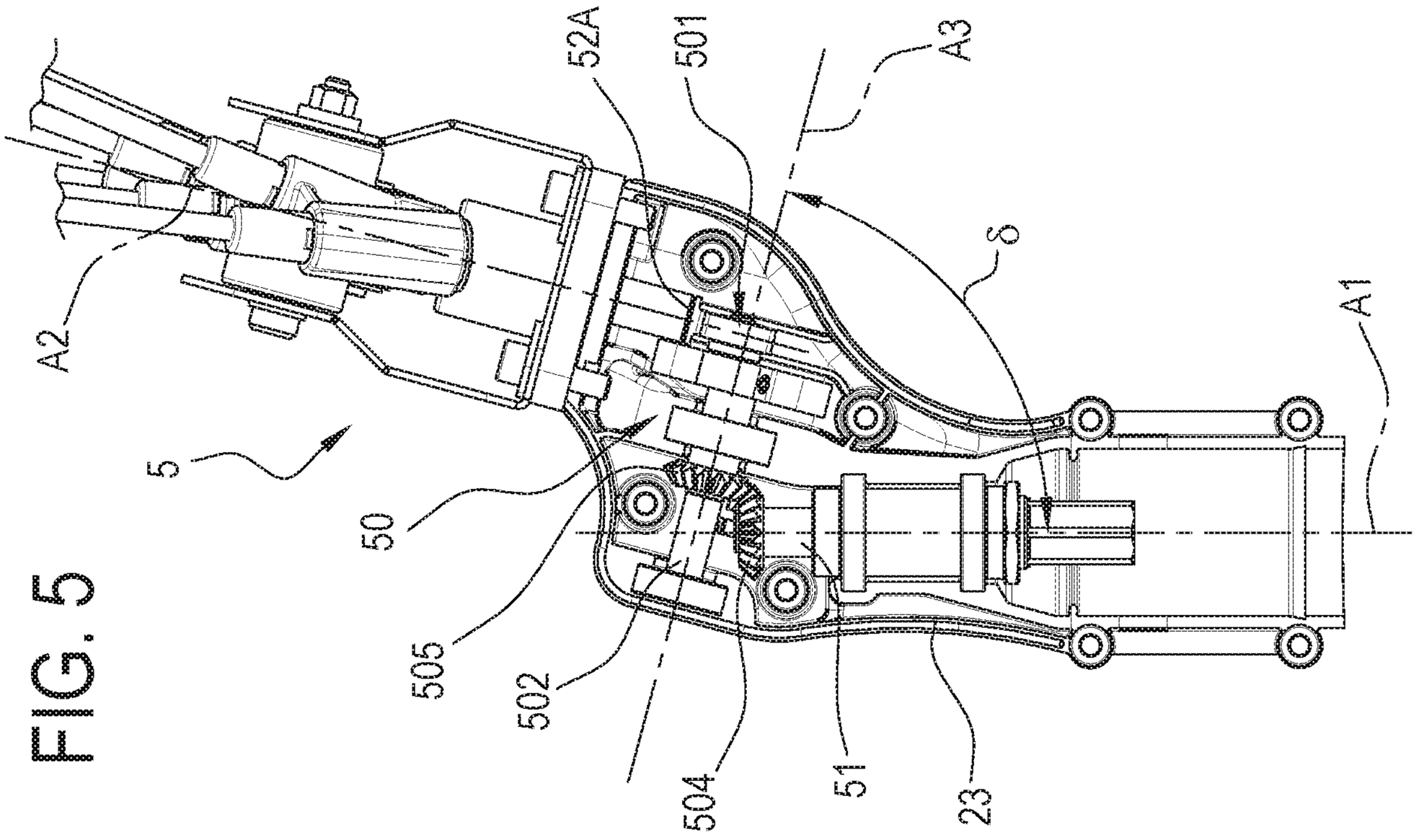
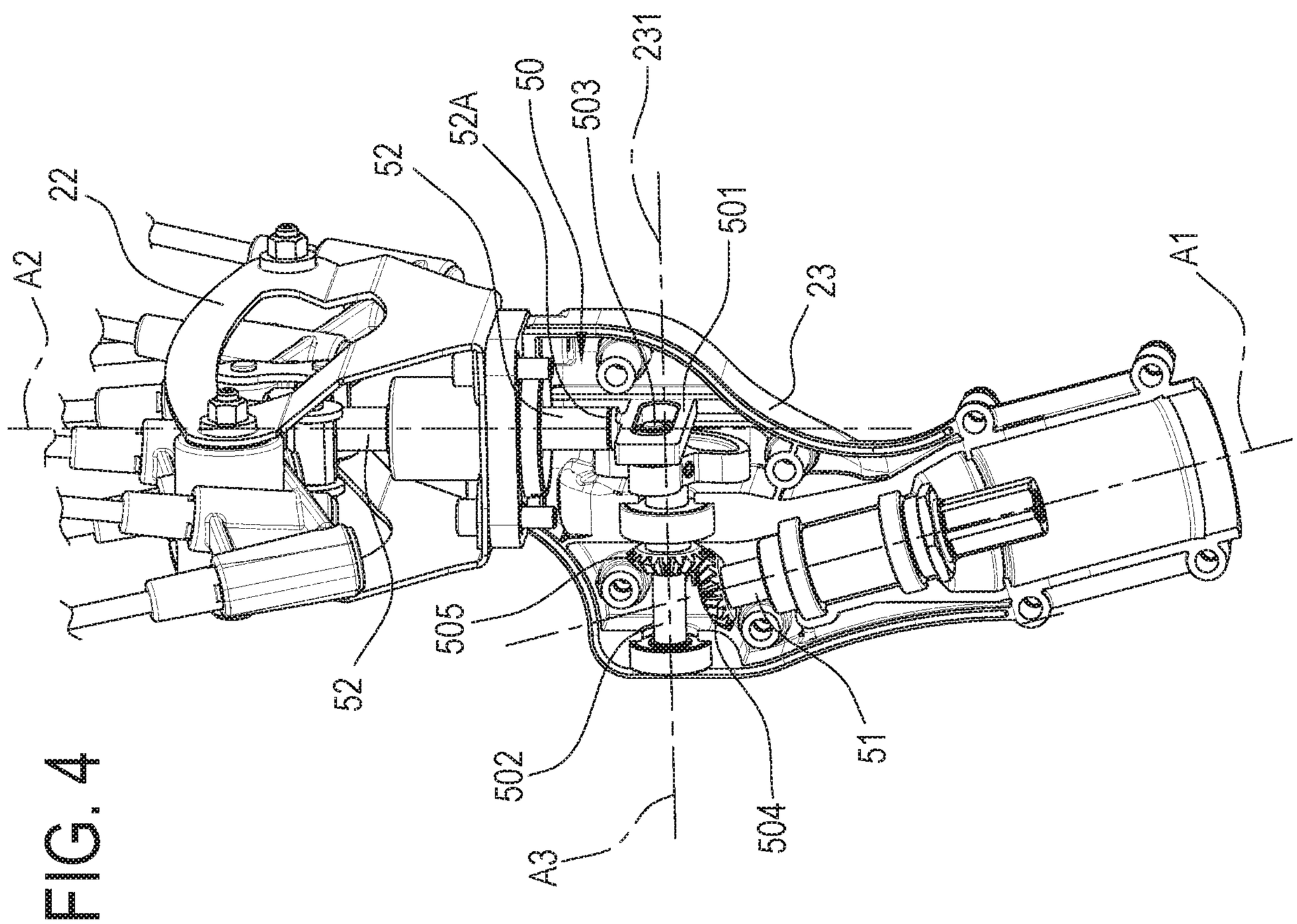

52A
501
A3
A2
δ
A1
5
50
505
502
504
51
23

FIG. 5


231
50
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52
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501
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A1
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502
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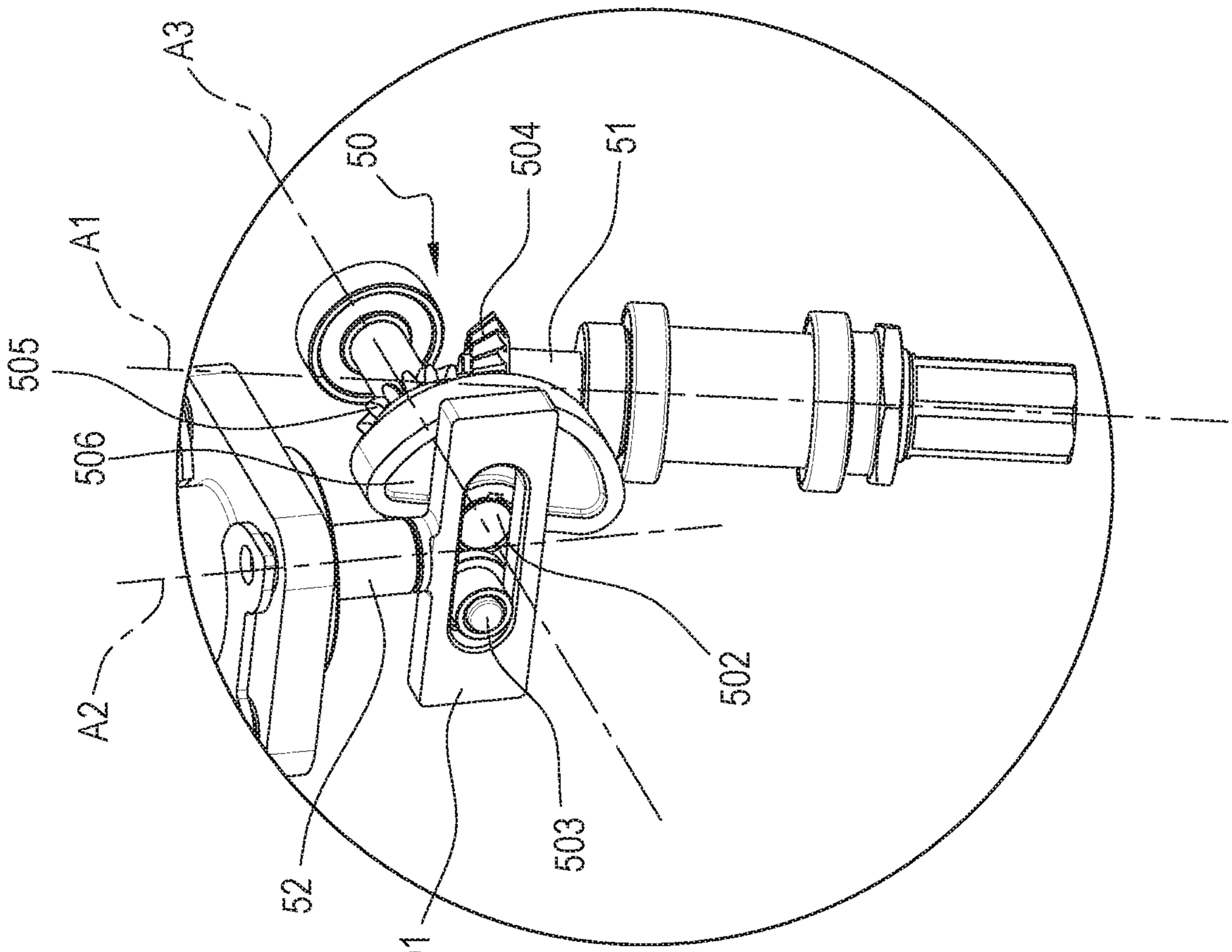
51
504
A3

FIG. 4

FIG. 6A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A1
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506
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52
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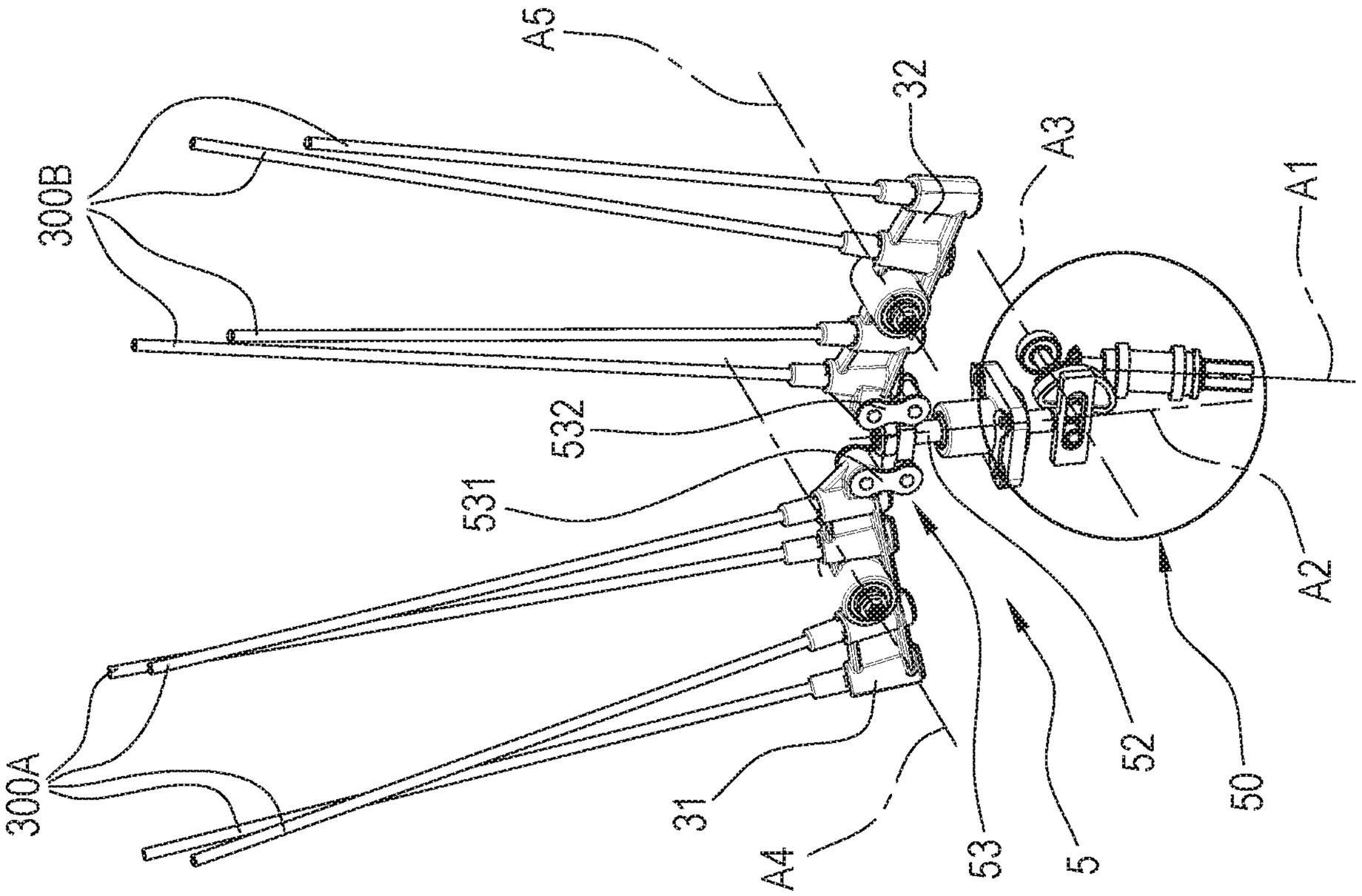
50

FIG. 6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50

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2021/050092

A. CLASSIFICATION OF SUBJECT MATTER
INV. A01D46/26
ADD.

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
A01D

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

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 3 313 166 A1 (AI MA AUTOMAZIONE INDUSTRIALE & MACCH AGRICOLE S R L [IT]) 2 May 2018 (2018-05-02)	1,13-16
A	figures 5, 12 paragraph [0001] paragraph [0044] -----	2-12,17
X	EP 0 974 257 A1 (ELEXSO SORTIERTECH GMBH [DE]) 26 January 2000 (2000-01-26) figures 1-4 paragraph [0018] - paragraph [0019] -----	1,14
A	EP 1 417 878 A1 (HISPAES S A [ES]) 12 May 2004 (2004-05-12) figure 8 paragraph [0044] -----	2-12,17

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

[X] See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
15 March 2021	19/03/2021
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Authorized officer Holtermann, Timm

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INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2021/050092

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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A	CN 105 325 123 A (UNIV NORTHWEST A&F) 17 February 2016 (2016-02-17) figures 1-3 -----	2-12,17

INTERNATIONAL SEARCH REPORT

Information on patent family members

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