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(54) OSCILLATORY HAND-HELD POWER TOOL

(57) A swing arm fixed to the spindle engages a drive eccentric to rotationally oscillate the spindle and tool attachment about the spindle axis. A compact tool is provided by arranging the spindle and motor side-by-side and the spindle and drive shaft parallel to one another avoiding the need for a motor inside a handle portion and allowing an ergonomically advantageous smaller cross section in the handle portion.

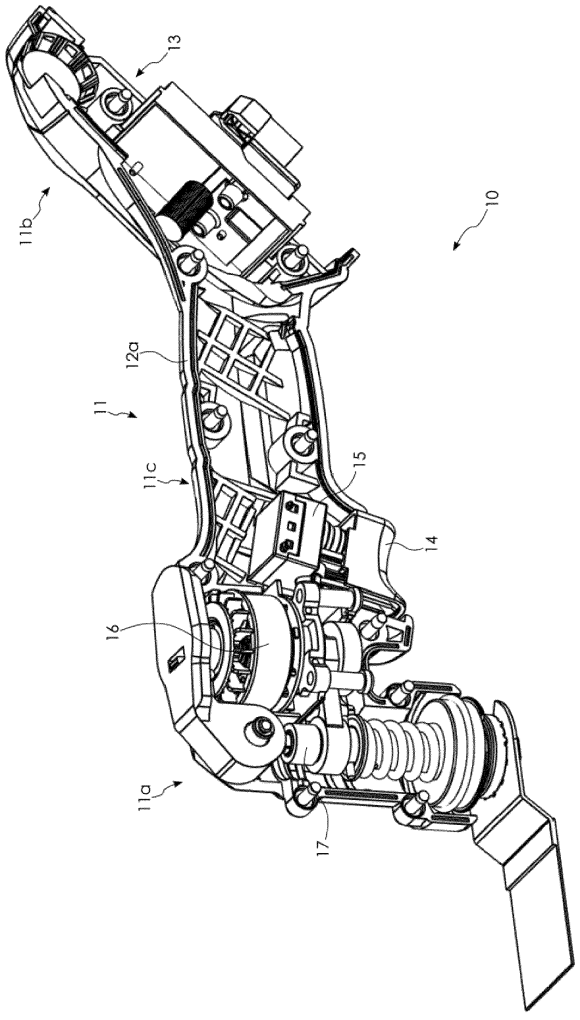

FIG 1

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Description

Technical field

[0001] The present invention relates to hand-held power tools, and more particularly to hand-held power tools of the oscillatory type.

Background of the Invention

[0002] Oscillatory hand-held power tools include a spindle motor-driven to rotate in an oscillatory manner about its axis and to which various attachments, such as saw blades, sanding discs, grinding bits, polishing pads, and the like, can be mounted to enable a wide range of machining operations. Users value these tools because of their versatility and, owing to the multitude of different applications for power tools of this type, especially for battery-powered tools, there is a particular need for compact tools with satisfactory ergonomics. It is an object of the present invention to address this need or, more generally, to provide an improved oscillatory hand-held power tool.

Disclosure of the Invention

[0003] According to one aspect of the present invention there is provided an oscillatory hand-held power tool, comprising:

a housing;

a spindle adapted to mount an attachment for rotation about a spindle axis of the spindle;

a motor disposed in the housing, the motor rotating a drive shaft about a longitudinal axis;

a drive eccentric provided at an axial end of the drive shaft;

a swing arm fixed to the spindle such that a coupler on the swing arm engages the drive eccentric to thereby rotationally oscillate the spindle about the spindle axis,

wherein the spindle and motor are located side-by-side and the spindle and drive shaft are parallel to one another.

[0004] Preferably the tool further comprises a clamping stem held in the spindle and which is displaceable along the spindle axis for clamping the attachment to the spindle.

[0005] Preferably a spring mounted coaxially with the spindle axis engages the clamping stem and applies a clamping for clamping the attachment to the spindle, a release lever includes a cam portion that acts on an outer end of the clamping stem, the release lever moveable between an engaged position in which the outer end projects and an released position in which the outer end is retracted, and wherein in the released position the lever at least in part overlies an axial end of the motor.

[0006] Preferably the housing comprises a head portion at one end in which the motor and spindle are disposed and a foot portion at an opposing end, and an elongate handle portion joins the head and foot portions, and the foot potion includes a coupling for the mounting of a battery.

[0007] Preferably the tool further comprises a trigger for controlling the motor, the trigger disposed at a head-end of the handle portion.

[0008] Preferably the drive eccentric comprises an eccentric shaft received in an annular bearing and the swing arm comprises one end fixed to the spindle and another end that is bifurcated and in which the annular bearing is received.

[0009] Preferably the spindle and motor are fixed to a transmission casing formed separately from the housing.

[0010] Preferably the spindle is mounted in inboard and outboard bearings disposed near opposite ends of the spindle and fixed in the transmission casing, and the drive eccentric is mounted in an eccentric bearing fixed in the transmission casing and at least an inboard end of the motor is fixed to the transmission casing.

[0011] Preferably the release lever is mounted to pivot on a shaft secured to the transmission casing.

[0012] Optionally, the motor includes an outer motor bearing disposed at the end of the motor opposite the drive eccentric and the outer motor bearing is fixed in the transmission casing.

[0013] Preferably the transmission casing is secured within the housing, as between two shells of the housing.

[0014] Preferably elastomeric anti-vibration mounts connect the transmission casing and the housing.

[0015] Preferably the tool further comprises a balance weight driven by the motor for countering the rotating imbalance of the drive eccentric and swing arm.

[0016] Preferably the balance weight comprises a balance arm that rotates about the spindle axis out of phase with the swing arm.

[0017] Preferably the balance arm is rotated by engagement with a balance eccentric connected to the drive shaft.

[0018] Preferably the balance eccentric is 180° out of phase with the drive eccentric.

[0019] A compact tool is provided by arranging the spindle and motor side-by-side and the spindle and drive shaft parallel to one another

[0020] This invention provides an oscillatory hand-held power tool which is effective and efficient in operational use, which minimizes manufacturing costs and provides an advantageously compact that can therefore be put to a greater variety of uses while avoiding the need for a motor inside a handle portion and allowing an ergonomically advantageous smaller cross section in the handle

portion.

Brief Description of the Drawings

[0021] Preferred forms of the present invention will now be described by way of example with reference to the accompanying drawings, wherein:

Figure 1 is a tool according to a preferred embodiment of the invention in which a part of the housing has been removed to show the internal parts;

Figure 2 is a section in an upright central plane through the head of the tool of Fig. 1;

Figure 3 is a section in plane AA of Fig. 2;

Figure 4 is a pictorial view of a transmission casing of the tool of Fig. 2;

Figure 5 is a view corresponding to Fig. 4 but showing the transmission casing of a first alternative embodiment of the tool of the invention;

Figure 6 is an exploded pictorial view of the tool of Fig. 1;

Figure 7 is a fragmentary view of a top of the transmission casing of the first alternative embodiment of the tool of Fig. 5;

Figure 8 is a pictorial view of a head assembly of a second alternative embodiment of the tool of the invention;

Figure 9 is a pictorial view of a swing arm and balance weight of the head assembly of Fig. 8;

Figure 10 is a pictorial view of an eccentric arrangement of the head assembly of Fig. 8;

Figure 11 is a sectional view in a horizontal plane of a swing arm and balance weight of the head assembly of Fig. 8, and

Figure 12 is a section in plane ZZ of Fig. 11.

Description of the Preferred Embodiments

[0022] Referring to Fig. 1, an oscillatory hand-held power tool 10 has a housing 11 that may be an assembly comprising two shells 12a (shell 12b being absent from Fig. 1, along with a transmission casing 43 described further below with reference to Figs 4 and 5) which are connected generally at a plane (not shown) that longitudinally bisects the tool 10. The housing comprises a head portion 11a at one end in which a motor 16 and spindle 17 are disposed. A foot portion 11b at an opposing end, is joined to the head portion 11a by an elongate handle portion 11c. The foot portion 11b may include a coupler 13 for the connection of a battery pack (not shown). Compared to old tools of this type, in which the motor was disposed to extend longitudinally through the handle portion, the more ergonomically satisfactory handle portion 11c has a relatively smaller cross-section for improver grip by the user and, in particular, this allows a pistol grip, in which a trigger 14 is disposed at the head end of the handle portion 11c. The trigger 14 acts on a trigger switch 15 for controlling the motor 16.

[0023] As best seen in Figs 2 and 3, the spindle 17 may be hollow with a spindle axis 18 about which it is supported to rotate by annular bearing assemblies 19 and 20 disposed proximate its outer and inner ends respectively. A tool holder 21 may be fixed to the inner end of the spindle 17 and may include features (not shown) for positive driving engagement with attachments, such as the saw blade 22 shown. A clamping mechanism allows attachments to be readily interchanged and includes a block 23 that presses the attachment 22 against the tool holder 21. The block 23 is fixed to a clamping stem 24 held in the spindle 17 and axially moveable to apply the clamping load. The clamping stem 24 may be an assembly to which the block 23 is connected by a pin 25 and engaged with a crosshead 26 received in a transverse opening in an intermediate part of the stem 24 between its ends.

[0024] A spring 27 mounted coaxially with the spindle axis 18 about the spindle 17 may have an inner end abutting the bearing 20 and an outer end abutting the crosshead 26 which extends through longitudinally extending slots in the spindle 17. The spring 27 thus engages the clamping stem 24 via the crosshead 26 and applies a clamping load for clamping the attachment 22 to the tool holder 21 fixed on the end of the spindle 17.

[0025] To release the clamping mechanism, a release lever 28 is mounted adjacent the outer end of the spindle 17 to turn about a fulcrum shaft 29. In the engaged position shown the clamping mechanism is engaged to hold the attachment 22, the outer end of the stem 24 projects, a cam portion 30 may be spaced apart from the outer end of the clamping stem 24, and an arm portion 31 may overly an outer axial end of the motor 16. In the released position (not shown) the clamping mechanism is released to free the attachment 22, the lever 28 is rotated to abut the cam portion 30 with the outer end of the stem 24, which is thereby retracted.

[0026] A swing arm 32 may extend generally perpendicular to the spindle 17, which is received in an aperture in one end thereof, whereby the swing arm 32 is fixed to the spindle 17, as by an interference fit, to rotate with the spindle about the axis 18. The other end opposite the spindle 17 may be bifurcated to define two projecting fingers 33, 34.

[0027] An annular bearing 35 may be received between the fingers 33, 34 which form a coupler, such that diametrically opposed outer faces of the bearing 35 gen-

erally engage opposing inwardly-facing surfaces of the fingers 33, 34. A drive eccentric 36 comprises a shaft portion received in the central opening of the bearing 35 and rotated by the motor 16 moves the bearing 35 with a wobbling motion and in turn imparts a rotational oscillation to the swing arm 32 and spindle 17.

[0028] The motor 16 has a drive shaft 37 with a longitudinal axis 38 and which is supported on a chassis 39 of the motor by inner and outer bearings 40, 41. The drive eccentric 36 may be driven directly by the motor and may be provided at an axial end of the drive shaft 37. The drive eccentric 36 is supported in an eccentric bearing 42 coaxial with the axis 38. Along with the spindle bearings 19, 20, the eccentric bearing 42 may be fixed in a transmission casing 43 formed separately from the housing 11, as by a metal casting. An inboard end of the motor 16 may also be fixed to the transmission casing 43.

[0029] The tool head assembly thus mounted to the transmission casing 43 is advantageously compact measured in the longitudinal direction of the housing 11, compared to old tools, owing to the motor 16 and spindle 17 being located side-by-side and the spindle axis 18 and drive shaft axis 38 being parallel to one another. Transverse to the elongate housing 11, the head of the tool 10 also has modest dimensions, aided by the alignment of the eccentric bearing 35.

[0030] Fig. 4 shows the mounting of the inboard end of the motor 16 to the exterior of transmission casing 43 and the provision for mounting the release lever 28 (the outline of which is shown in light lines). The transmission casing 43 may include a spindle-receiving part 43a from the side of which an eccentric-receiving part 43b extends. A pair of opposing flanges 44, 45 disposed at the outer axial end of the spindle-receiving part 43a project in a cantilever manner and between them the fulcrum shaft 29 passes to mount the release lever 28.

[0031] In an alternative embodiment of the tool 110 of the invention shown in Fig. 5, the transmission casing 143 has like form to the transmission casing 43 and like reference numerals are used to refer to corresponding parts, but casing 143 further comprises an arm portion 43c disposed above, and projecting in the direction of the eccentric-receiving part 43b. Advantageously, an opening in the end of this an arm portion 43c receives the outer motor bearing 41 and thus axially opposing ends of the motor 16 are rigidly secured.

[0032] As illustrated in Fig. 6, the transmission casing 43 is secured to the tool housing 11 and this may be done by mounting the transmission casing 43 inside the head portion 11a between the shells 12a, 12b.

[0033] The transmission casing 43 is spaced apart from the shells 12a, 12b of housing 11 with elastomeric anti-vibration mounts 47 connecting the transmission casing 43 and the housing 11. The mounts 47 may have opposing faces that abut the exterior of the transmission casing 43 and the interior of the housing 11 respectively. The opposing faces may be concave for abutting the transmission casing 43 and convex for abutting the housing respectively. Advantageously the mounts 47 may have like dimensions so as to be interchangeable and may include two sets engaging the spindle-receiving part 43a, the mounts of each set 47a/47b , 47c/47d/47e spaced apart circumferentially about the spindle axis 18 and the set 47a/47b spaced apart axially from the set 47c/47d/47e. A further set of mounts 47f may be disposed on the eccentric-receiving part 43b. The transmission casing 43 may be entirely supported by the mounts 47, with no part of the housing abutting the transmission casing 43. Optionally, the mounts 47 may be located within recesses (not shown) in the housing 11, located as between internal features of the housing 11. The mounts 47 thus serve to decouple the transmission casing 43 from the housing 11 that is grasped by the user and mitigate user fatigue by reducing the propagation of vibrations to the housing 11.

[0034] In the alternative embodiment of the tool 110 of the invention shown in Figs 5 and 7, the mounts 47 may further comprise a set including mounts 47g disposed on opposing sides of the arm portion 43c. The mounts 47g may have a generally rectangular prismatic form. The mounts 47 may further comprise a set including mounts 47h disposed on an outer end of the arm portion 43c and having an annular form for spanning between and abutting opposing annular faces on the arm portion 43c and internal surface of the housing 11.

[0035] Referring to Figs 8-12, the tools 10, 110 of the invention may further comprise a balance weight 46 driven by the motor 16 for countering the rotating imbalance of the assembly comprising the drive eccentric 36 and swing arm 32. The balance weight 46 may have the form of an elongate arm disposed adjacent the swing arm 32, as axially inboard of the wing arm 32. The balance weight 46 may have one end 46a mounted to rotate about the spindle axis 18, and may for instance be connected by a bearing (not shown) to the spindle 17 to rotate independently of the spindle 17. An opposing end 46b may include an opening 49 slotted in the longitudinal direction to receive an annular bearing 50 free to move longitudinally therein. A eccentric 48 rotated by the drive shaft 37 may comprises a drive eccentric shaft portion 51 received in the eccentric bearing 42 in the above-described manner to oscillate the swing arm 32 and attached spindle 17, and balance eccentric shaft portion 52. The balance eccentric shaft portion 52 is received in the bearing 50 and opening 49 to thereby oscillate the balance weight 46 about the axis 18. The eccentric dimensions 53 and 54 of the drive eccentric shaft portion 51 and balance eccentric shaft portion 52 respectively, may be the same and their respective axes may be coplanar with the drive shaft axis 38 such that the balance eccentric shaft portion 52 is 180° out of phase with the drive eccentric shaft portion 51.

[0036] Aspects of the present invention have been described by way of example only and it should be appreciated that modifications and additions may be made thereto without departing from the scope thereof.

Claims

1. An oscillatory hand-held power tool, comprising:

   a housing;
   a spindle adapted to mount an attachment for rotation about a spindle axis of the spindle;
   a motor disposed in the housing, the motor rotating a drive shaft about a longitudinal axis;
   a drive eccentric provided at an axial end of the drive shaft;
   a swing arm fixed to the spindle such that a coupler on the swing arm engages the drive eccentric to thereby rotationally oscillate the spindle about the spindle axis,
   wherein the spindle and motor are located side-by-side and the spindle and
   drive shaft are parallel to one another.

2. The tool of claim 1 further comprising a clamping stem held in the spindle and which is displaceable along the spindle axis for clamping the attachment to the spindle.

3. The tool of any one of the preceding claims, further comprising a spring mounted coaxially with the spindle axis engages the clamping stem and applies a clamping for clamping the attachment to the spindle, a release lever includes a cam portion that acts on an outer end of the clamping stem, the release lever moveable between an engaged position in which the outer end projects and an released position in which the outer end is retracted, and wherein in the released position the lever at least in part overlies an axial end of the motor.

4. The tool of any one of the preceding claims wherein the housing comprises a head portion at one end in which the motor and spindle are disposed and a foot portion at an opposing end, and an elongate handle portion joins the head and foot portions, and the foot potion includes a coupling for the mounting of a battery.

5. The tool of claim 4 further comprising a trigger for controlling the motor, the trigger disposed at a head-end of the handle portion.

6. The tool of any one of the preceding claims wherein the drive eccentric comprises an eccentric shaft received in an annular bearing and the swing arm comprises one end fixed to the spindle and another end that is bifurcated and in which the annular bearing is received.

7. The tool of any one of the preceding claims wherein the spindle and motor are fixed to a transmission casing formed separately from the housing.

8. The tool of claim 7 wherein the spindle is mounted in inboard and outboard bearings disposed near opposite ends of the spindle and fixed in the transmission casing, and the drive eccentric is mounted in an eccentric bearing fixed in the transmission casing and at least an inboard end of the motor is fixed to the transmission casing.

9. The tool of claim 7 or claim 8 wherein the release lever is mounted to pivot on a shaft secured to the transmission casing.

10. The tool of any one of claims 7 to 9 wherein the motor includes an outer motor bearing disposed at the end of the motor opposite the drive eccentric and the outer motor bearing is fixed in the transmission casing.

11. The tool of any one of claims 7 to 10 wherein the transmission casing is secured within the housing, as between two shells of the housing.

12. The tool of any one of claims 7 to 11 wherein elastomeric anti-vibration mounts connect the transmission casing and the housing.

13. The tool of any one of the preceding claims wherein the tool further comprises a balance weight driven by the motor for countering the rotating imbalance of the drive eccentric and swing arm.

14. The tool of claim 13 wherein the balance weight comprises a balance arm that rotates about the spindle axis out of phase with the swing arm.

15. The tool of claim 14 wherein the balance arm is rotated by engagement with a balance eccentric connected to the drive shaft.

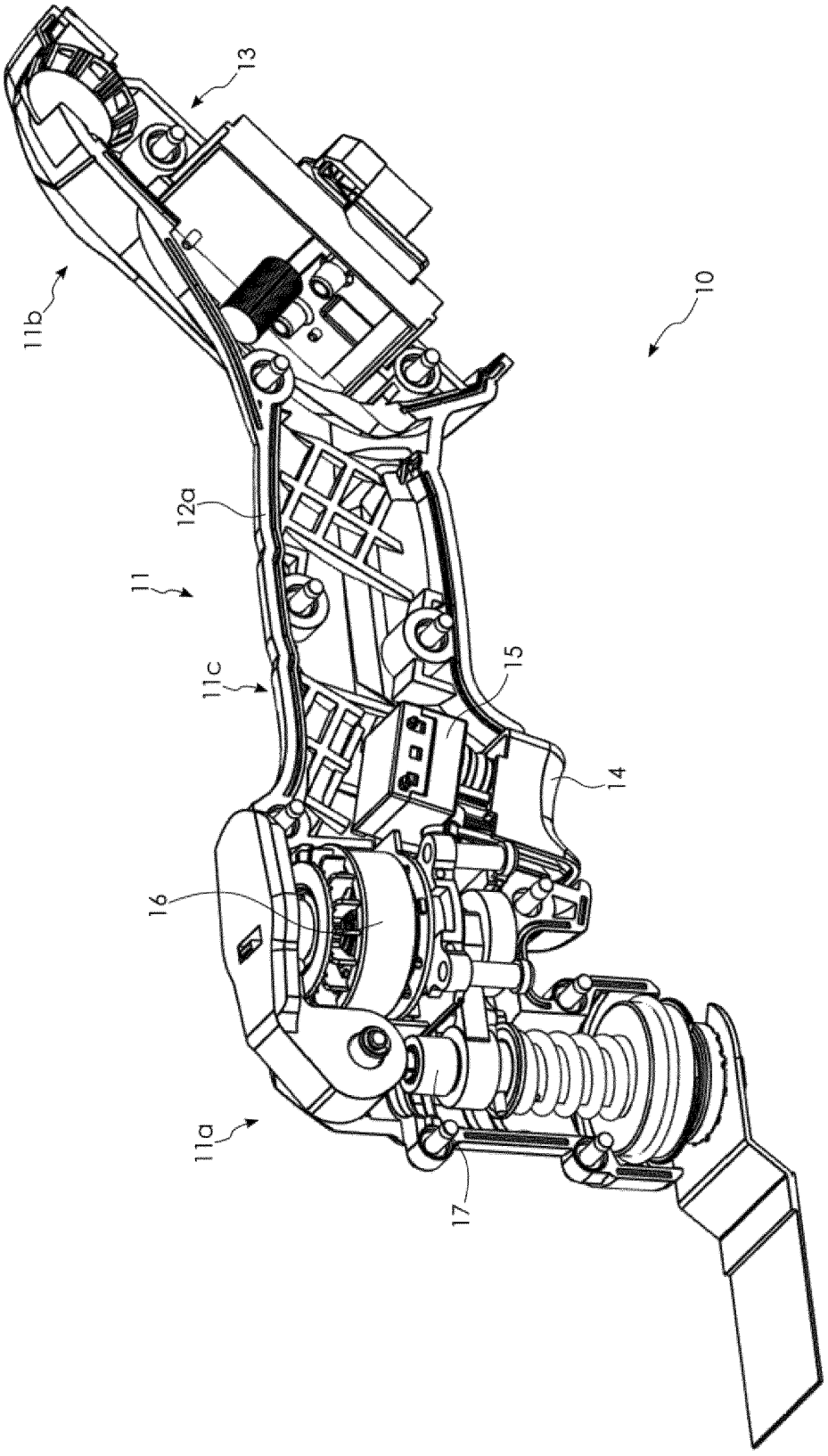

FIG 1

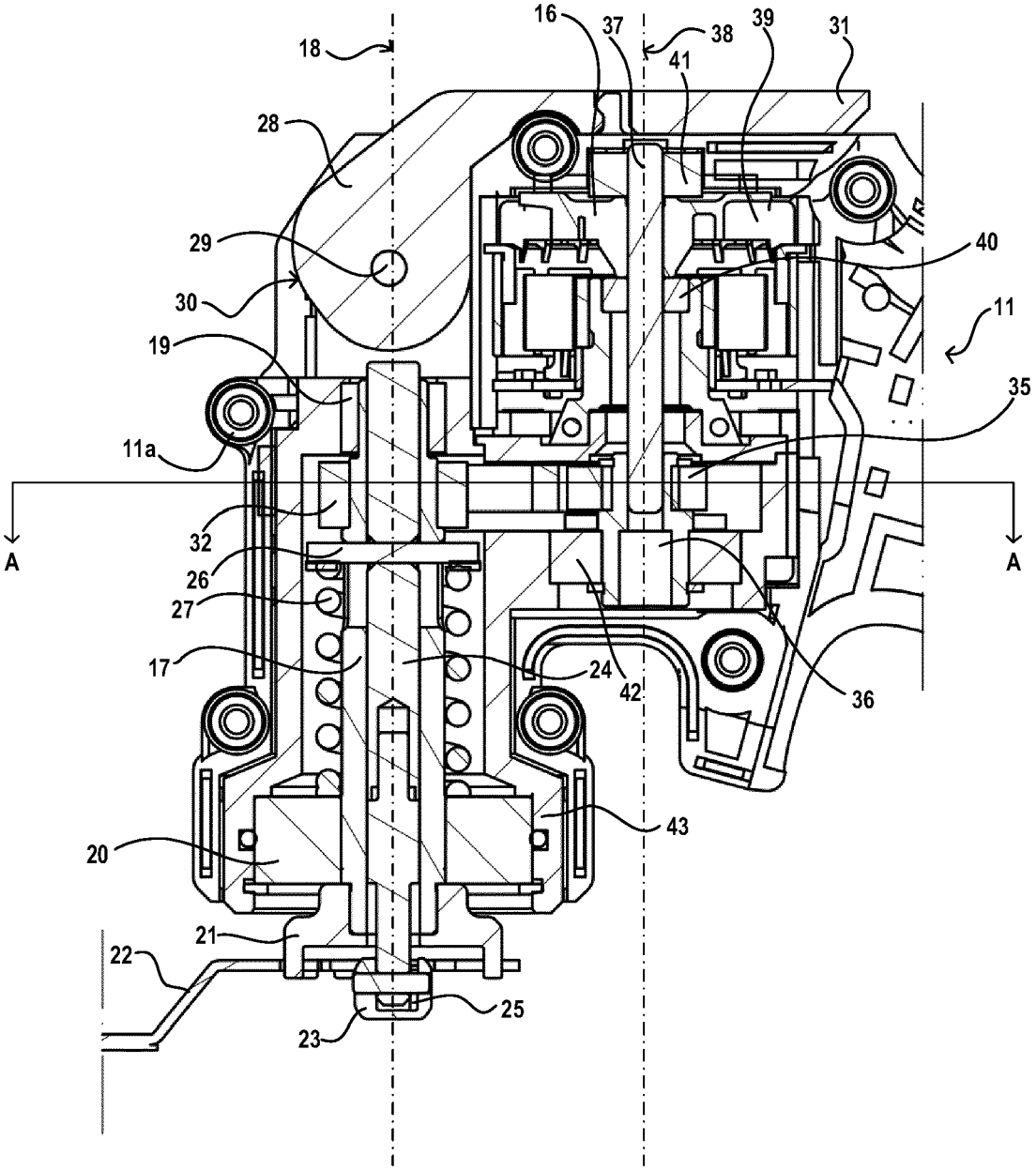
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FIG 2

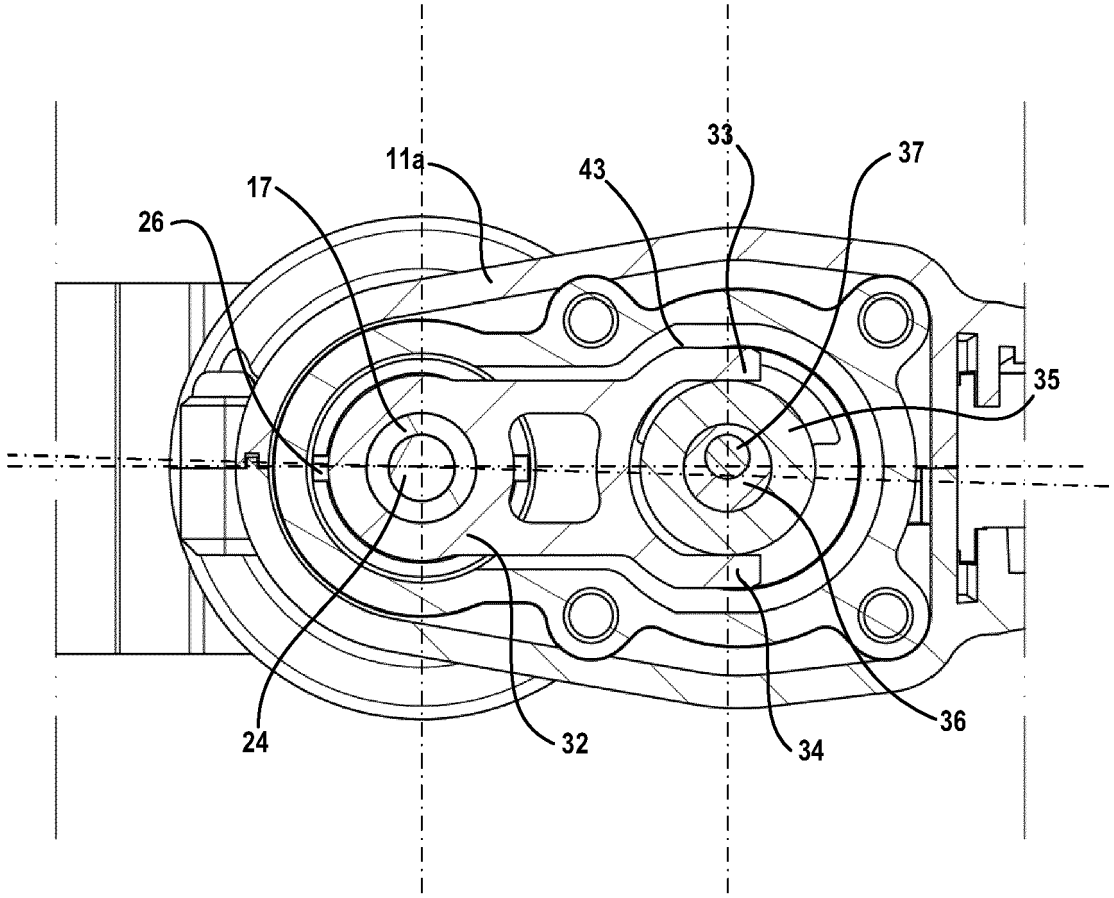

FIG 3

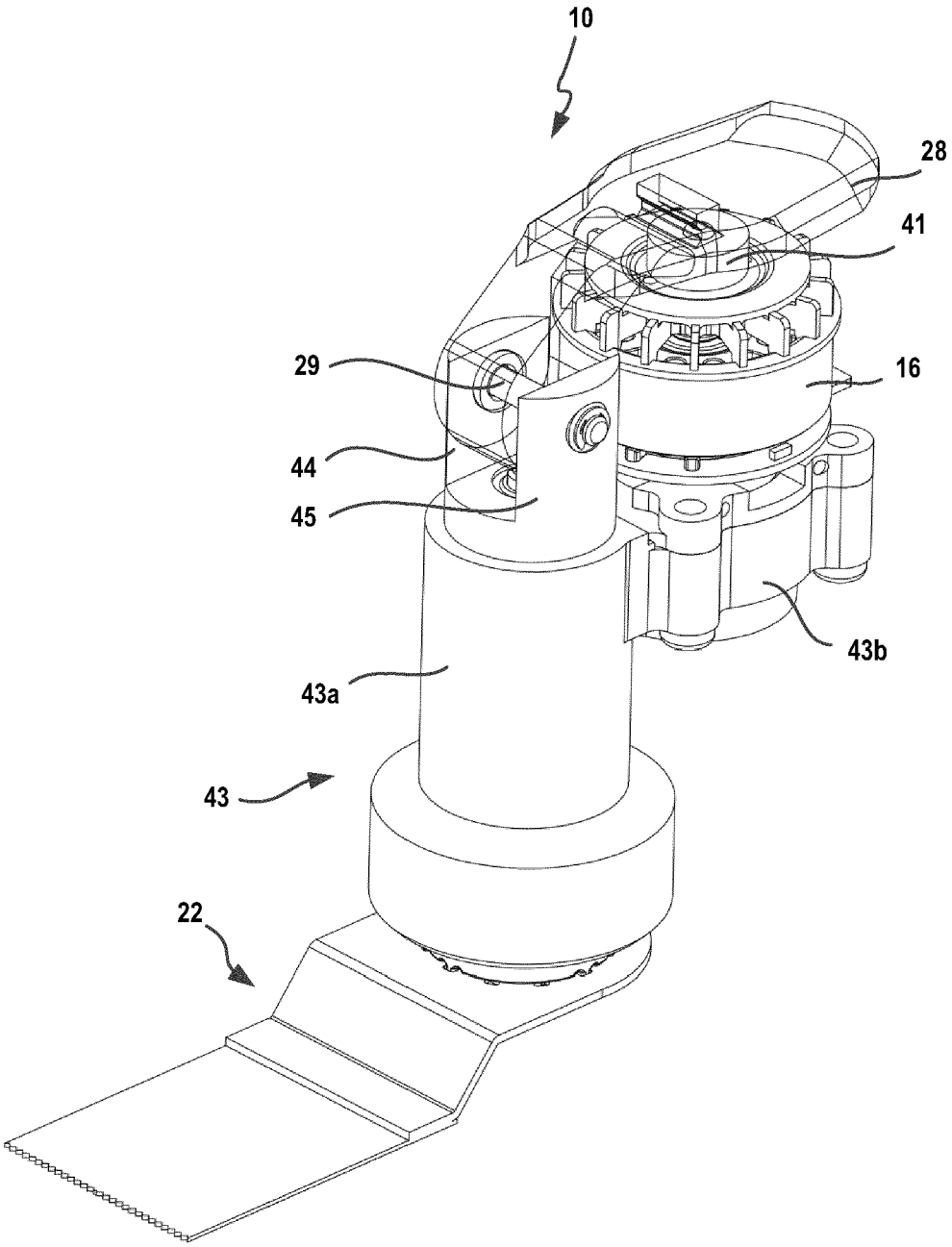

FIG 4

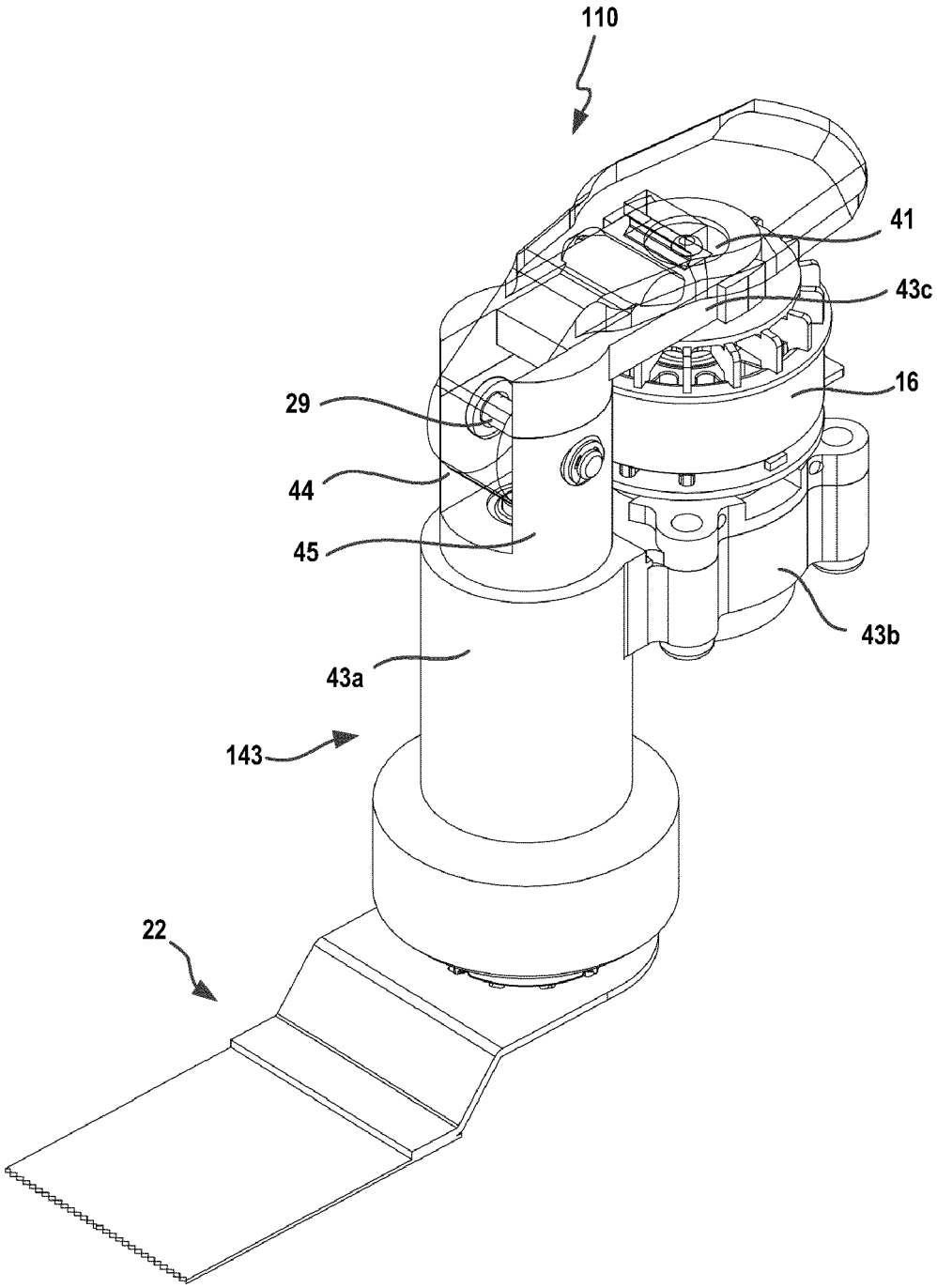

FIG 5

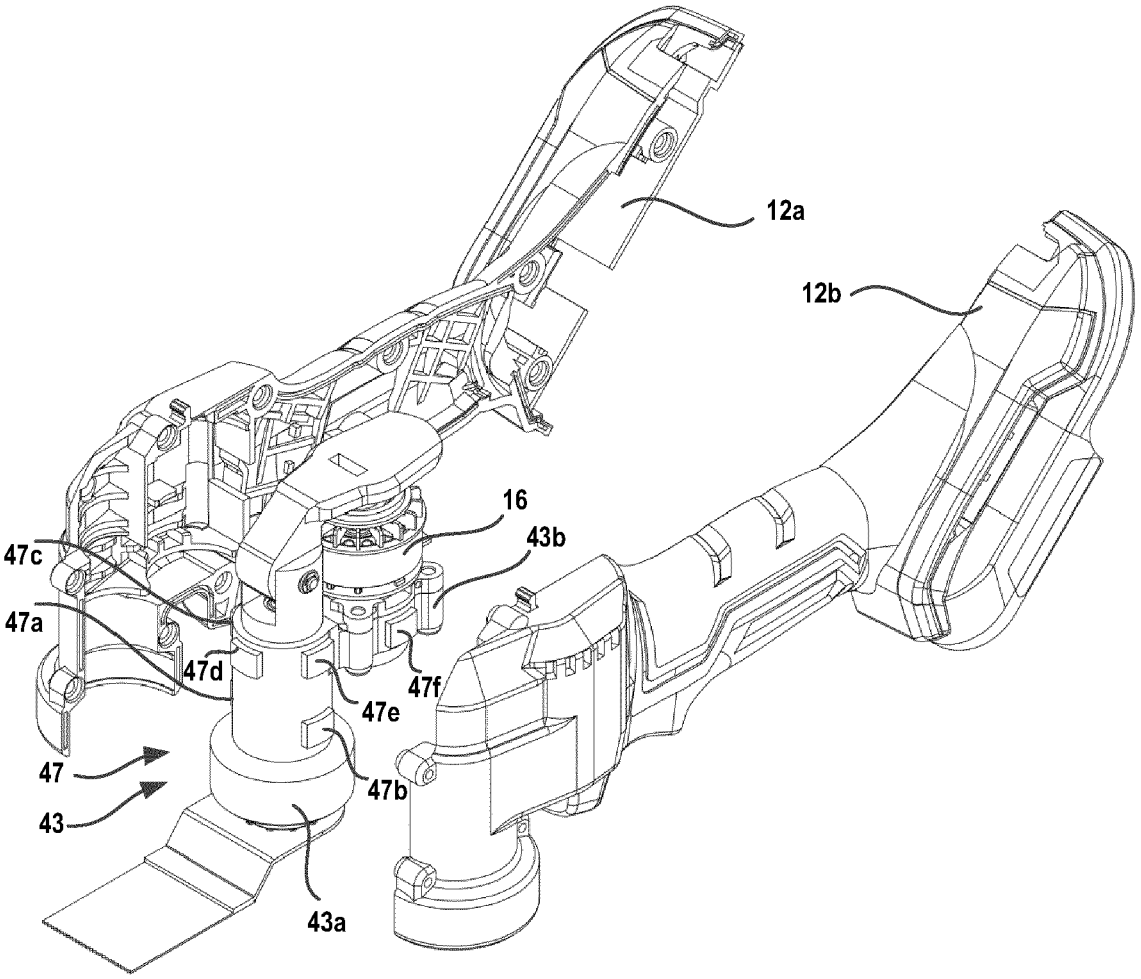

FIG 6

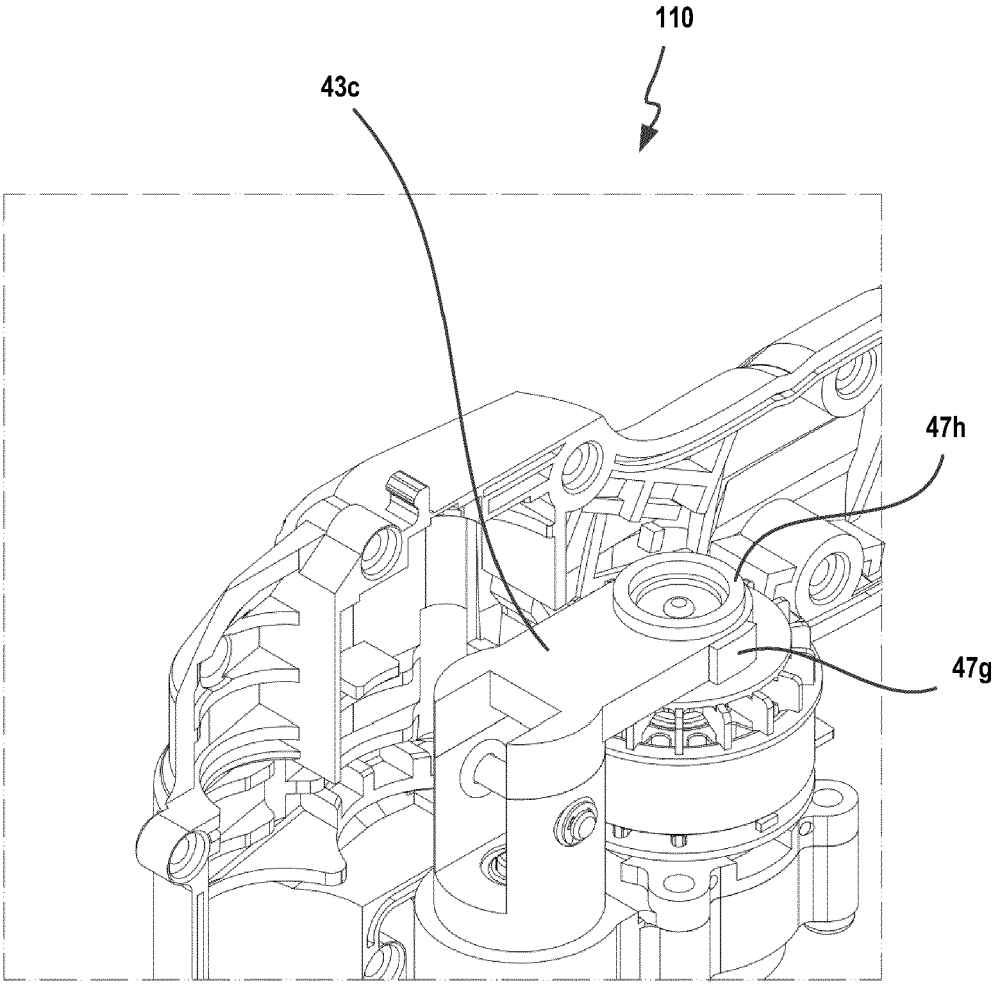

FIG 7

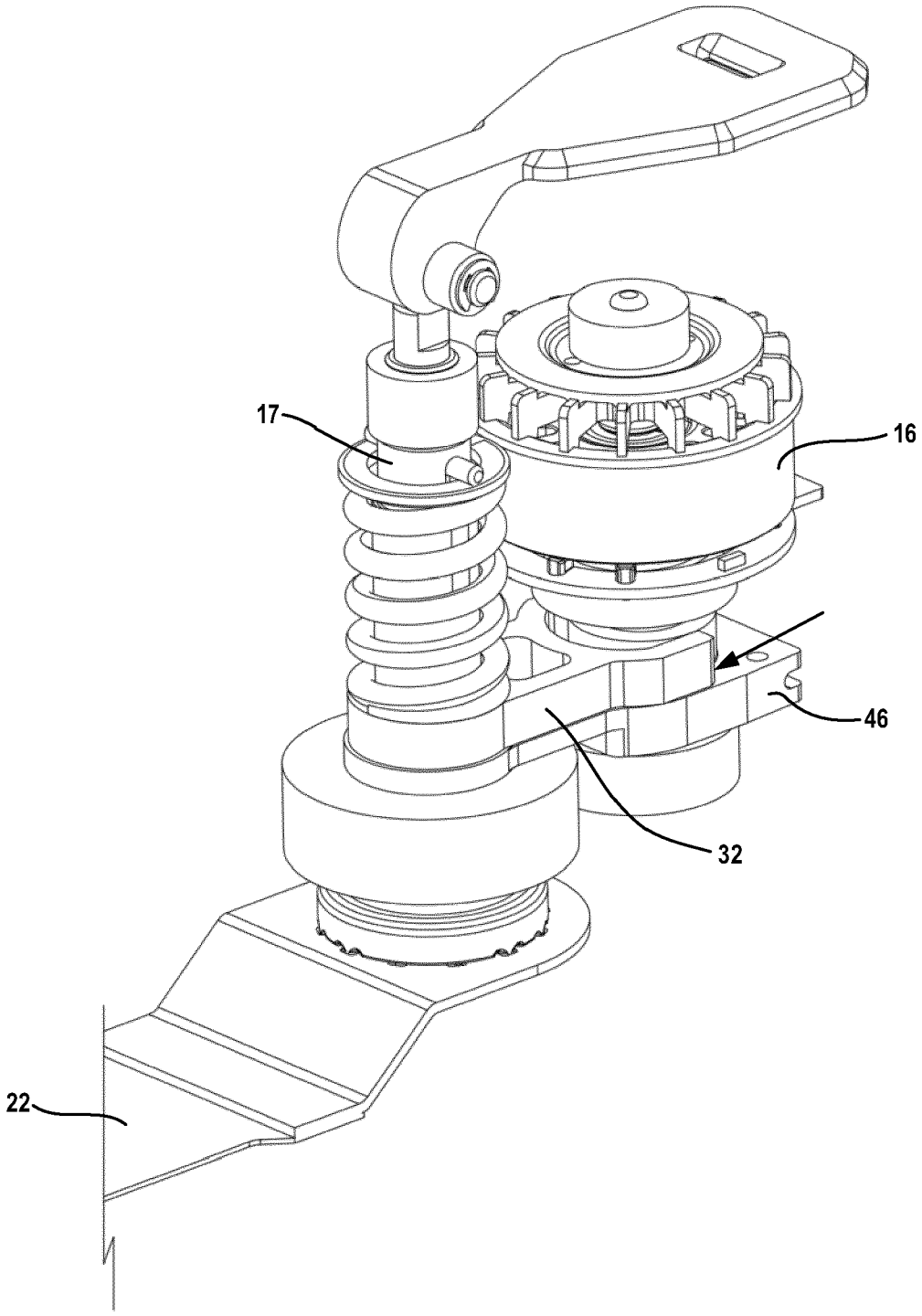

FIG 8

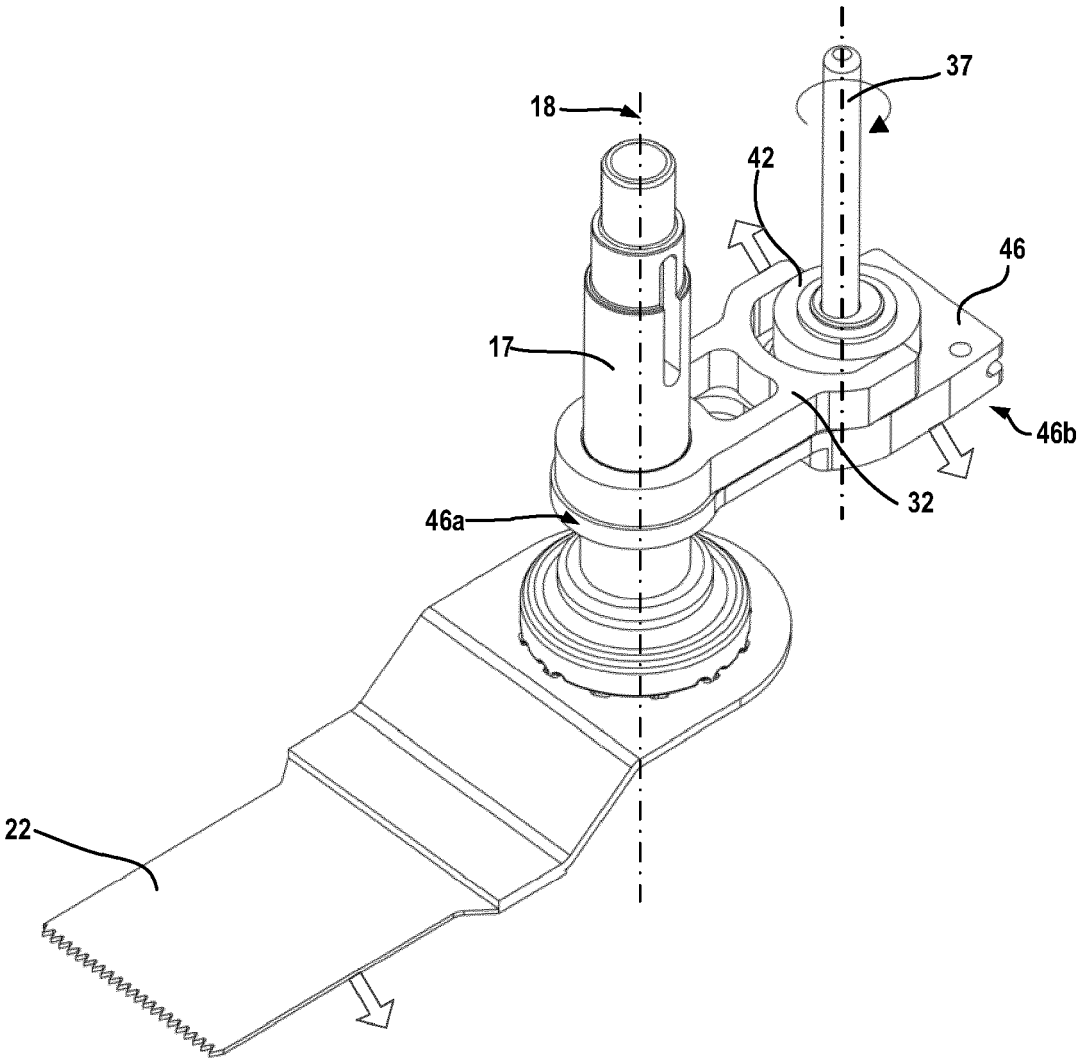

FIG 9

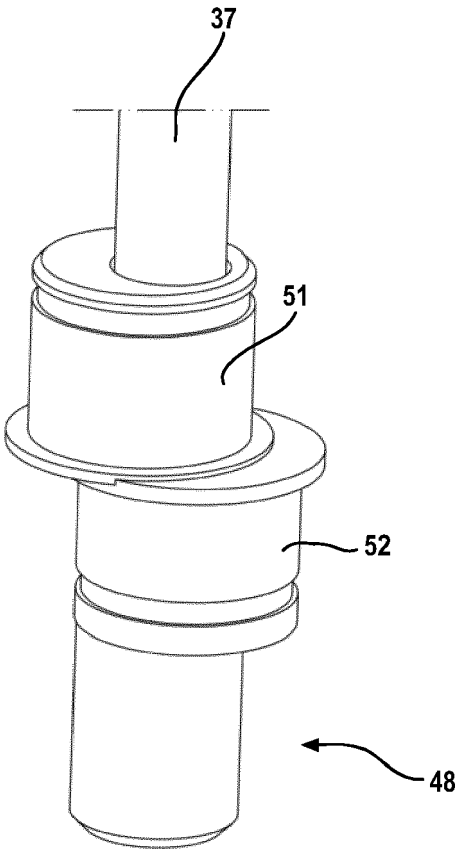

FIG 10

FIG 12

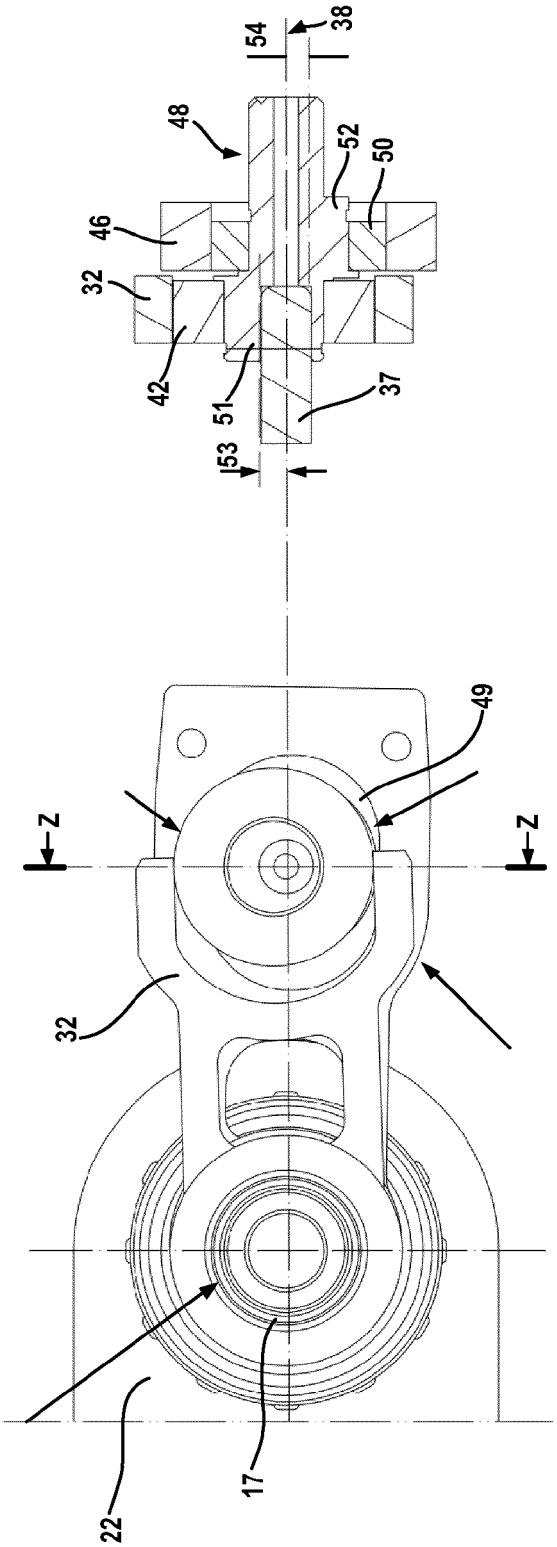

FIG 11

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EUROPEAN SEARCH REPORT

Application Number
EP 21 21 1764

DOCUMENTS CONSIDERED TO BE RELEVANT

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B24B
B24D
B28D
B27B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	14 June 2022	Matzdorf, Udo

CATEGORY OF CITED DOCUMENTS

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