(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 4 563 520 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
04.06.2025 Bulletin 2025/23

(21) Application number: **23213175.5**

(22) Date of filing: **29.11.2023**

(51) International Patent Classification (IPC):
B67B 3/20 *(2006.01)*

(52) Cooperative Patent Classification (CPC):
B67B 3/2073; B67B 3/208

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC ME MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA
Designated Validation States:
KH MA MD TN

(71) Applicant: **Przedsiebiorstwo Produkcyjno Handlowo Uslugowe Pablo Spolka z Ograniczona**
26-065 Piekoszów (PL)

(72) Inventor: **Pazdzierz, Pawel**
26-065 Piekoszów (PL)

(74) Representative: **JD&P Patent Attorneys Joanna Dargiewicz & Partners**
ul. Mysliborska 93A/50
03-185 Warszawa (PL)

(54) **CAPPING HEAD FOR BOTTLES WITH FEEDBACK**

(57) A screwing head for bottles with feedback, characterised in that it comprises two modules:
- a screwing head module and
- a torque measurement module;

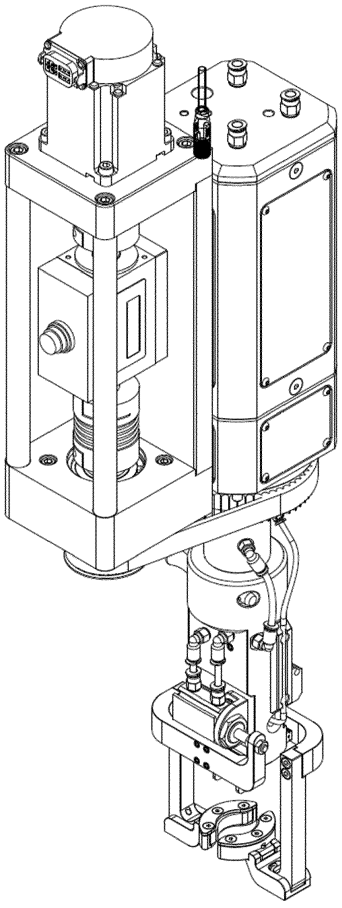

Fig. 1a

EP 4 563 520 A1

Description

[0001] The present invention relates to a screwing head suitable for bottles, with feedback system for simultaneous torque measurement of the screwing process.

[0002] Known solutions are based mainly on the use of a servo drive, allowing control over the tightening process, and the tightening force is regulated by changing the current of the screwing head servo motor, and is selected experimentally for a given batch of bottles and caps. The disadvantage of this solution is the reduced efficiency of the screwing process and the inability to correct the screwing torque in real time. A large number of activities performed by the machine operator, when making corrections, increases the amount of materials and raw materials needed to properly adjust the screwing process. The disadvantage is also low accuracy (currently accuracy on average +/-0.5 Nm) and repeatability of the screwing process, especially at high efficiency (large number of cycles).

[0003] The purpose of the present invention was to develop a screwing head with negative feedback from the force torque signal, enabling real-time control of the torsional moment of the head load, in order to maximize the efficiency and repeatability of the preset screwing torque, as well as the possibility of changing the screwing torque during the process, based on the analysis of previous cycles and taking into account the relevant deviation. The goal was also to achieve greater accuracy and repeatability of the screwing process (up to +/- 0.1 Nm per bottle).

[0004] This object has been achieved by the subject matter of the present invention.

[0005] Therefore, the present invention provides a screwing head for bottles which feedback, which comprises two modules:

- a screwing head module and
- a torque measurement module;

whereby the torque measurement module contains a torque measurement module housing which consists of three plates, a side, a top and a bottom plate, made of stainless steel;

a servo motor is attached to the top plate, which is connected to an upper clutches;

between the upper and lower clutches there is a torque sensor, which is attached to a side plate with a sheet metal, corresponding to its contact surface;

a rotary shaft of a torque sensor is attached to the clutches on both sides;

in turn, the lower clutch is attached to the shaft, which is responsible for a rotation movement of a toothed belt pulley;

rods attached to the top and bottom plates stabilize the entire torque measurement system housing;

whereby the screwing head module contains a main head body and covering head bodies;

inside the main head body there is a screwing axle, on which there is a locking nut;

underneath the housing, on the screwing axle, there are two bearings and two internal snap rings;

on the screwing axle, at the top base, there are pins of a rotary grommet, as well as plug-in connectors for a pneumatic network;

in turn, at the base of the lower screwing axle, there are mini plug-in connectors for the pneumatic network and a gear wheel;

the screwing head module also contains a lower head body, through which a mounting pin passes in the upper part;

six mini plug-in connectors and a pneumatic plug-in socket are embedded underneath;

at the underside of the head body, mounting brackets are embedded to provide attachment of mini actuators;

head brackets are attached to the same brackets, and gripper arms are attached to them,

further elements connected to the arms are gripper jaws and their mounting;

at the underside of the head body, there is a guide mounting plate, from which a rotation lock mounting plate is mounted on rods;

and the next element mounted to the rotation lock mounting plate is a rotation lock plate.

[0006] The subject of the invention is presented in the drawings, where:

Fig. 1a and 1b show a view of a screwing head structure module;

Fig. 2a and 2b show a view of a screwing torque measurement module;

Fig. 3a and 3b show a view of a screwing head

module;

Fig. 4 shows a cross-sectional view of a torque measurement module;

Fig. 5 shows a cross-sectional view of a screwing head module.

[0007] With the head according to the present invention, the bottle screwing process is characterized by increased efficiency, repeatability of the bottle screwing torque and the possibility of torque correction. As a result of the innovative screwing head, equipped with real-time torque sensors, the technological process is significantly accelerated. There is also a reduction in operating costs for the customer, as tightening adjustments are not required in an additional process after the products have been screwed on. A reduction in the number of machine operations is achieved, as well as a reduction in handling time with less use of raw materials.

SCREWING HEAD MODULES WITH FEEDBACK - GENERAL DESCRIPTION

[0008] A screwing head structure consists of two modules: a screwing head module and a measurement module (Fig. 1).

TORQUE MEASUREMENT MODULE

[0009] Fig. 2a shows a view of a torque measurement module. The housing of the torque measurement module consists of three plates, a side (A1), a top (A2) and a bottom (A3), made of stainless steel. A servo motor (B) is attached to the top plate (A2), which is connected to an upper clutch (C1).

[0010] Between the upper (C1) and lower (C2) clutches, there is a torque sensor (D1), which is attached to a side plate (A1) by a sheet metal corresponding to its contact surface. A rotary shaft (140) of the torque sensor (D1) is attached on both sides to the clutches (C1) and (C2). In turn, the lower clutch (C2) is attached to the shaft (140), which is responsible for a rotational movement of a toothed belt pulley (F). Rods (G1) and (G2) attached to the top (A2) and bottom (A3) plates stabilize the entire torque measurement system housing.

[0011] Inside the lower base there are: an internal snap ring, four self-locking nuts and two rings - an outer and an inner ring. The outer ring is stationary and is located between two ball bearings, the inner ring is on a shaft (140) and moves together with it in a rotating motion.

SCREWING HEAD MODULE

[0012] The screwing head module [Fig. 3a] consists of a main head body (1) and covering bodies for the head, (2) and (8). Inside the main head body (1), there is a screwing axle (5) on which a locking nut (6) is located. There are two bearings (3) and (3a) and two internal snap rings (4) and (4a), underneath the housing, on the screwing axle (5).

[0013] On the screwing axle (5), at the top base, pins of a rotary grommet (50) are seated, as well as plug-in connectors (15) and (15a) for a pneumatic network. In turn, at the base of the lower screwing axle (5) there are mini plug-in connectors (10) for the pneumatic network and a gear wheel (H).

[0014] The screw head module [Fig. 3a] consists of a lower head body (A), through which a mounting pin (44) passes in the upper part. Below this, six mini plug-in connectors (45) and (45a) and a pneumatic plug-in socket (D) are embedded. At the underside of the head body (A), mounting brackets (E) are fitted to provide attachment of mini actuators (26) and (26a). Head brackets (35), (35a) and (35b), and gripper arms (36) and (36a) are attached to the same brackets (E).

[0015] Further components connected to the arms (36) and (36a) are gripper jaws (41) and (41a), together with their mountings. At the underside of the head body, a guide mounting plate is fixed, from which a rotation lock mounting plate (32) is fastened on rods (30) and (30a). The last component attached to the rotation lock mounting plate is a rotation lock plate (33).

SCREWING HEAD MODULES WITH FEEDBACK - DETAILED DESCRIPTION

TORQUE MEASURING MODULE

[0016] Fig. 4 shows a schematic of the torque measurement module in cross-sectional view. The torque measurement system at the bottom is connected by a toothed belt (100) to a gripping head assembly. Its housing consists of a side plate (A1) and rods (G1 and G2), as well as top plates (A2) and bottom plates (A3) to stabilize the torque measuring system. A plate (60) fixes the torque measurement sensor (D1) to the plate (A1).

[0017] At the bottom of the system, there are bearings (70 and 70a) with a stationary ring (80) between them. Inside the ring (80), there is a smaller movable ring (90), which is located on the shaft (140). The bearings (70 and 70a) are located between an upper internal (101) and a lower external snap ring (220). The system is also equipped with two movable clutches: the upper one (C1), driven by the servo motor (B) and the lower one (C2) located on the shaft (140).

[0018] The servo motor (B) is attached to the top plate (A2) with allen screws (160 and 160a). On the underside of the bottom plate (A3), there are allen screws (150) attaching rods (300 and 300a) to the both plates (A2 and A3), and the allen screws (150a) attaching the plate (A3) to the attaching rods (300). Allen screws (170 and 170a) together with self-locking nuts (180 and 180a) allow the torque measurement system to be bolted to a head mounting plate. The final components are the toothed belt pulley (F) and an expansion clamping bushing (200).

[0019] The principle of the torque measurement sensor is that the sensor constantly monitors the setting of the appropriate bottle screwing parameter. When the sensor detects the appropriate resistance, this will indicate that the cap has been tightened to the bottle and will deactivate the screwing system.

SCREWING HEAD MODULE

[0020] Fig. 5 shows a schematic view of the screwing head module.

[0021] The screwing head assembly consists of the main head body (1) and the covering bodies (2 and 8). In the main head body (1), there are two the bearings (3 and 3a) flanked on two sides by the two external snap rings (4 and 4a), which, together with the bearings (3 and 3a), are located on the screwing axle (5).

[0022] The screwing axle (5) is stabilized in the system by using the locking nut (6) and allen screws (7 and 7a) holding the toothed belt pulley. The upper covering body (8) houses the plug-in connectors (15 and 15a) and also houses a cable (59) for an inductive sensor (58). The inductive sensor (58) is attached to a sensor mounting plate (16) by means of an angle plate (59) via a lens bolt (62), together with a nut (61) and a washer (60). The covering bodies (2 and 8) are fixed to each other by screws (21 and 21a).

[0023] Inside the covering bodies (2 and 8), there is a rotary air-permeable grommet (50) for plug-in connectors (51 and 51a), which is attached to a grommet connector (53) using grommet connector fixing screws (54 and 54a). The plug-in connectors (51 and 51a) are connected by a cable (52) and there is an inductive sensor pin (56) at the bottom of the grommet connector, which makes it possible to remove the inductive sensor easily. Attached to the rotary grommet, the plug-in connector (51a) is connected via a cable (55) to a plug-in connector (12), located on the screwing axle (5). Using allen screws (19 and 19a), polycarbonate (17 and 17a) and (18 and 18a) is fixed to the housing.

[0024] The screwing head assembly consists of the inserted into it screwing axle (5), together with plug-in connectors (9 and 9a) and a plug-in connector (10) attached to it, together with cables (57 and 57a). The mounting pin (44) is built into the screwing head, allowing the screwing head to be detached from the screwing axle. The plug-in connectors (45 and 45a) are attached to the screwing head body, and the cables (48) coming out of them connect to mini plug-in connectors (27 and 27a) located on the mini actuators (26 and 26a).

[0025] Next to the plug-in connectors (45 and 45a), there are pressure screws (46) on the diagonal. The mini actuators (26 and 26a) are mounted to the head body using an actuator mounting bracket (28 and 28a) via allen screws. The mini actuators (26 and 26a) are attached to the head brackets (35, 35a and 35b). In the head brackets there are additional mountings (43 and 43a), on which, at the head body, there are linear rails (23 and 23a) with mountings (25 and 25a), on which linear carriages (24 and 24a) move in order to adjust the corresponding length of the cap diameter.

[0026] The gripper arms (36 and 36a) are attached to the head bracket (35, 35a and 35b) with allen screws (37 and 37a). Then, at the underside of the gripper arms (36 and 36a) there are the jaw mounts (41 and 41a), and to these, via allen screws (42), the gripper is attached, the central part of which is described as silicone clamp (38), the upper part is a pressure plate (40 and 40a) and the lower part is a clamp mount (39 and 39a).

[0027] The final arrangement of the parts is a trigger rotation lock, which consists of a guide mounting plate which is fixed with allen screws (31 and 31a), to which the rotation lock mounting plate (32) is attached using rods (30 and 30a), to which the U-shaped rotation lock plate (33) is attached at the underside.

Claims

1. A screwing head for bottles with feedback, **characterised in that** it comprises two modules:

   - a screwing head module and
   - a torque measurement module;

   whereby the torque measurement module contains a torque measuring module housing, which consists of three plates, a side (A1), a top (A2) and a bottom (A3), made of stainless steel;

   on the top plate (A2) is attached a servo motor (B), which is connected to an upper clutch (C1);
   between the upper (C1) and lower (C2) clutches there is a torque sensor (D1) which is attached to the side plate (A1) by a sheet metal corresponding to its contact surface;
   a rotary shaft (140) of a torque sensor (D1) is attached on both sides to the clutches (C1) and (C2);
   in turn, the lower clutch (C2) is attached to the shaft (140), which is responsible for a rotational movement of a toothed belt pulley (F);
   rods (G1) and (G2), attached to the top (A2) and the bottom plates (A3), stabilize the entire torque measurement system housing;

   whereby the screwing head module contains a main head body (1) and covering head bodies (2) and (8);
   inside the main head body (1) there is a screwing axle (5) on which there is a locking

nut (6);
underneath the housing, on the screwing axle (5), there are two bearings (3) and (3a) and two internal snap rings (4) and (4a);
on the screwing axle (5), at the top base, pins of a rotary grommet (50) are seated, as well as plug-in connectors (15) and (15a) for a pneumatic network;
in turn, at the base of the lower screwing axle (5) there are mini plug-in connectors (10) for the pneumatic network and a gear wheel (H);
the screwing head module also contains a lower head body (A), through which a mounting pin (44) passes in the upper part;
underneath, six mini plug-in connectors (45) and (45a) and a pneumatic plug- in socket (D) are embedded;
at the underside of the head body (A), mounting brackets (E) are embedded to provide attachment of mini actuators (26) and (26a);
head brackets (35, 35a, 35b) are attached to the same brackets (E), and gripper arms (36) and (36a) are attached to them,
further elements connected to the arms (36) and (36a) are gripper jaws (41) and (41a) with their mounting;
at the underside of the head body there is a guide mounting plate from which a rotation lock mounting plate (32) is fastened on rods (30) and (30a);
and the next element attached to the rotation lock mounting plate is a rotation lock plate (33).

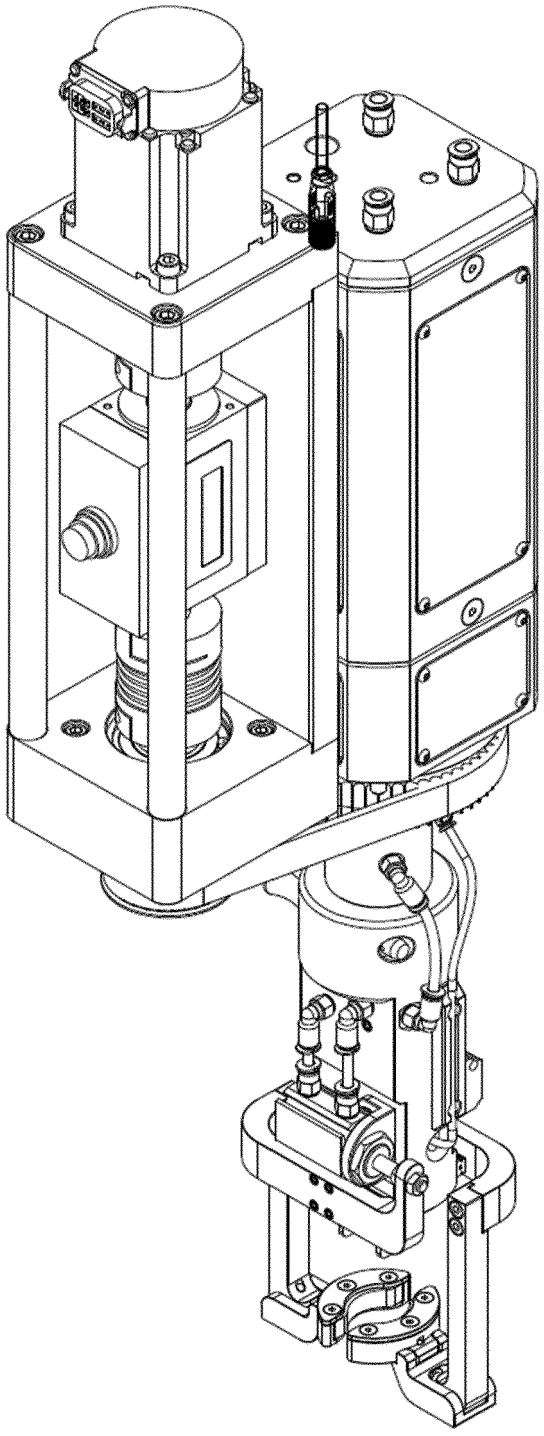

Fig. 1a

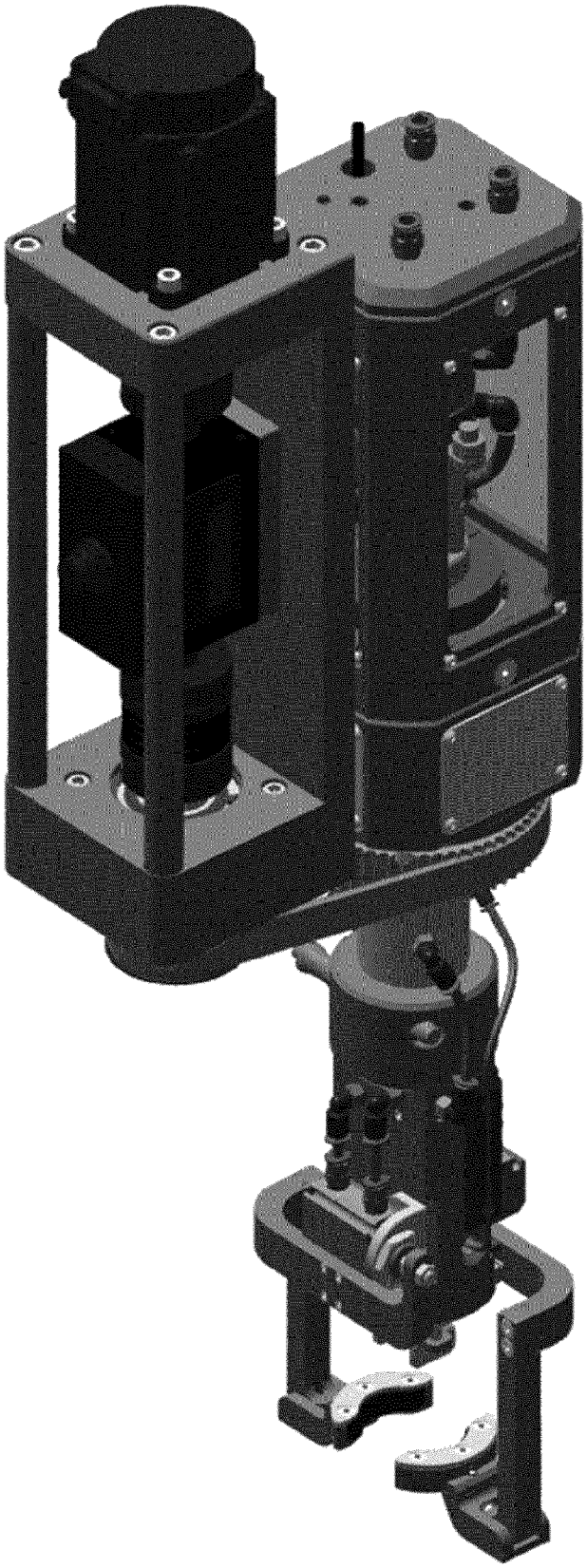

Fig. 1b

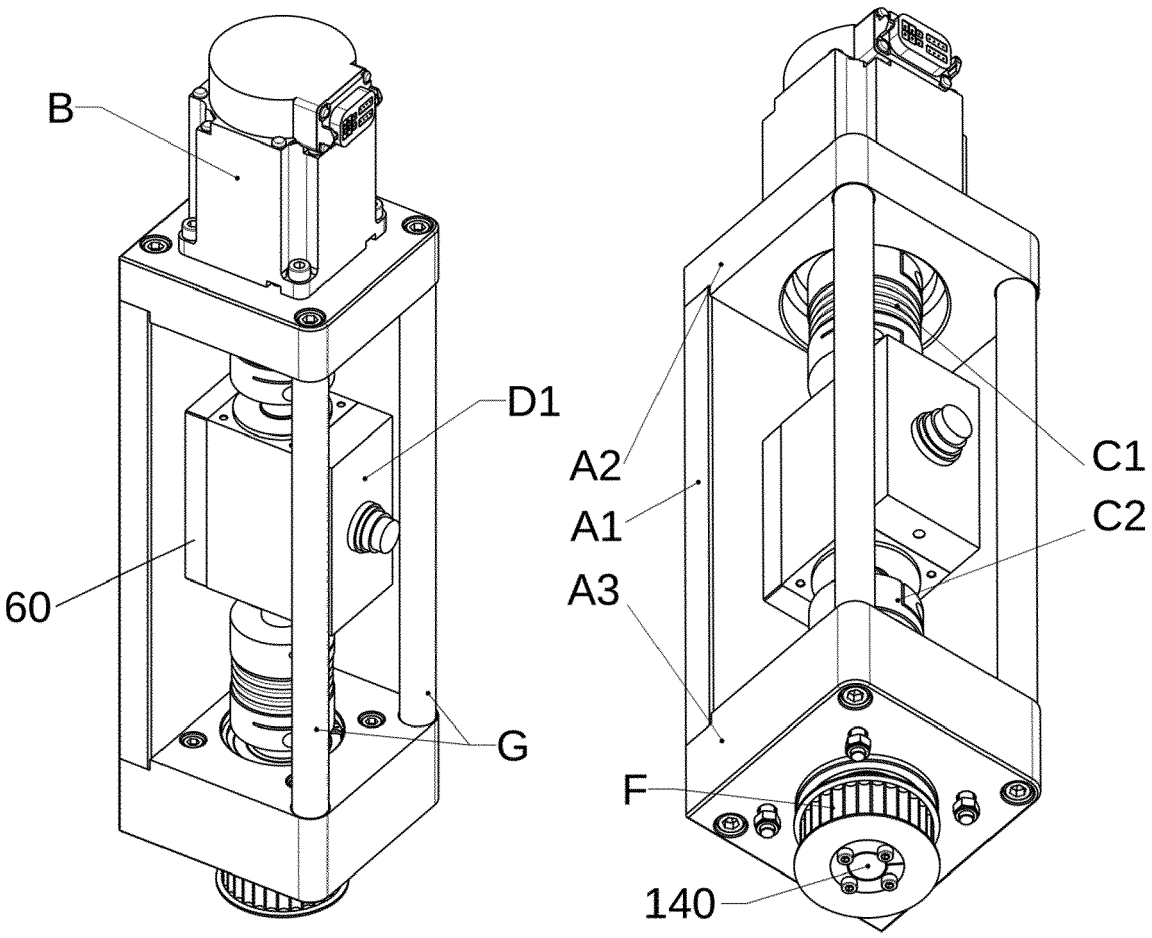

Fig. 2a

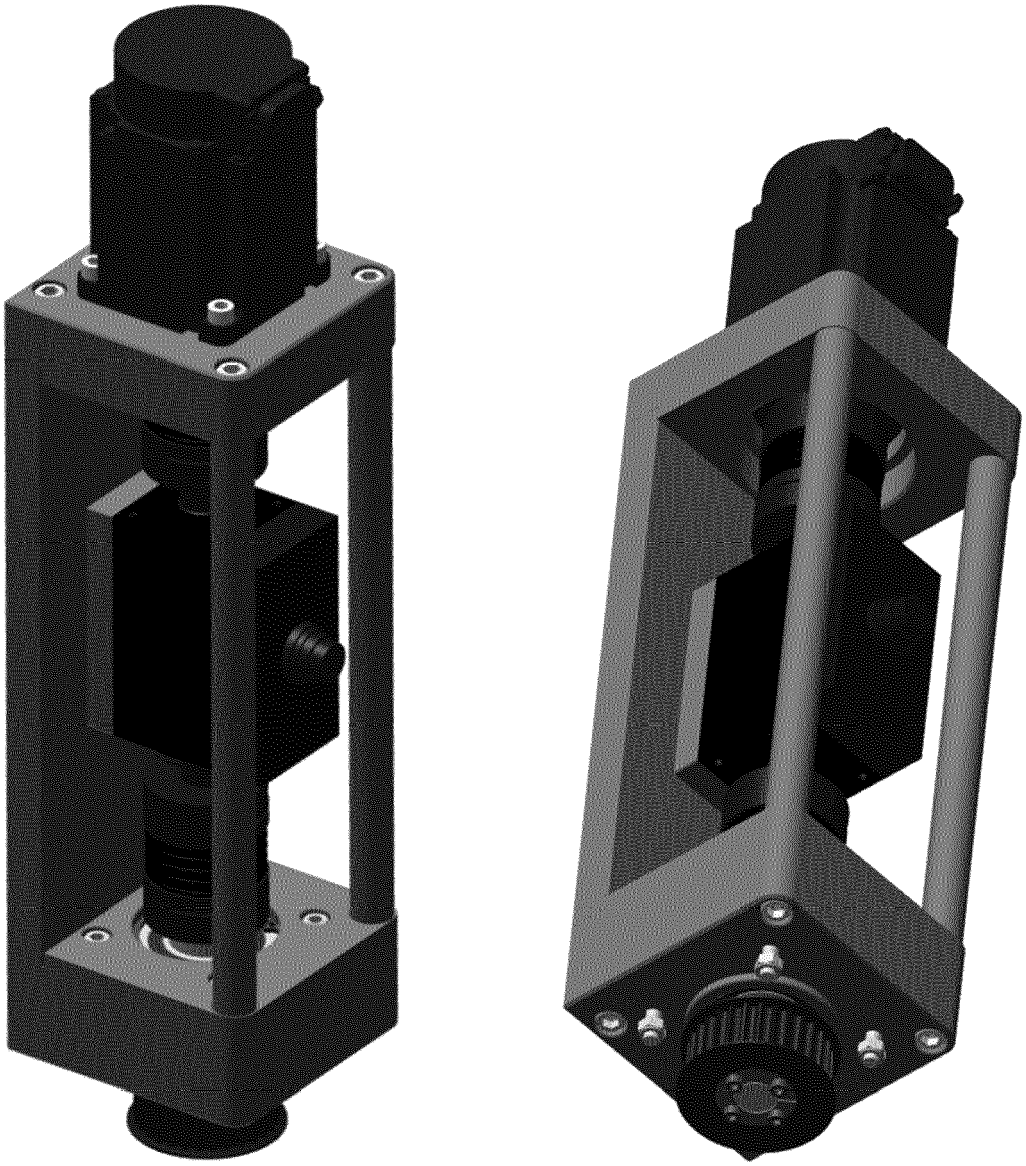

Fig. 2b

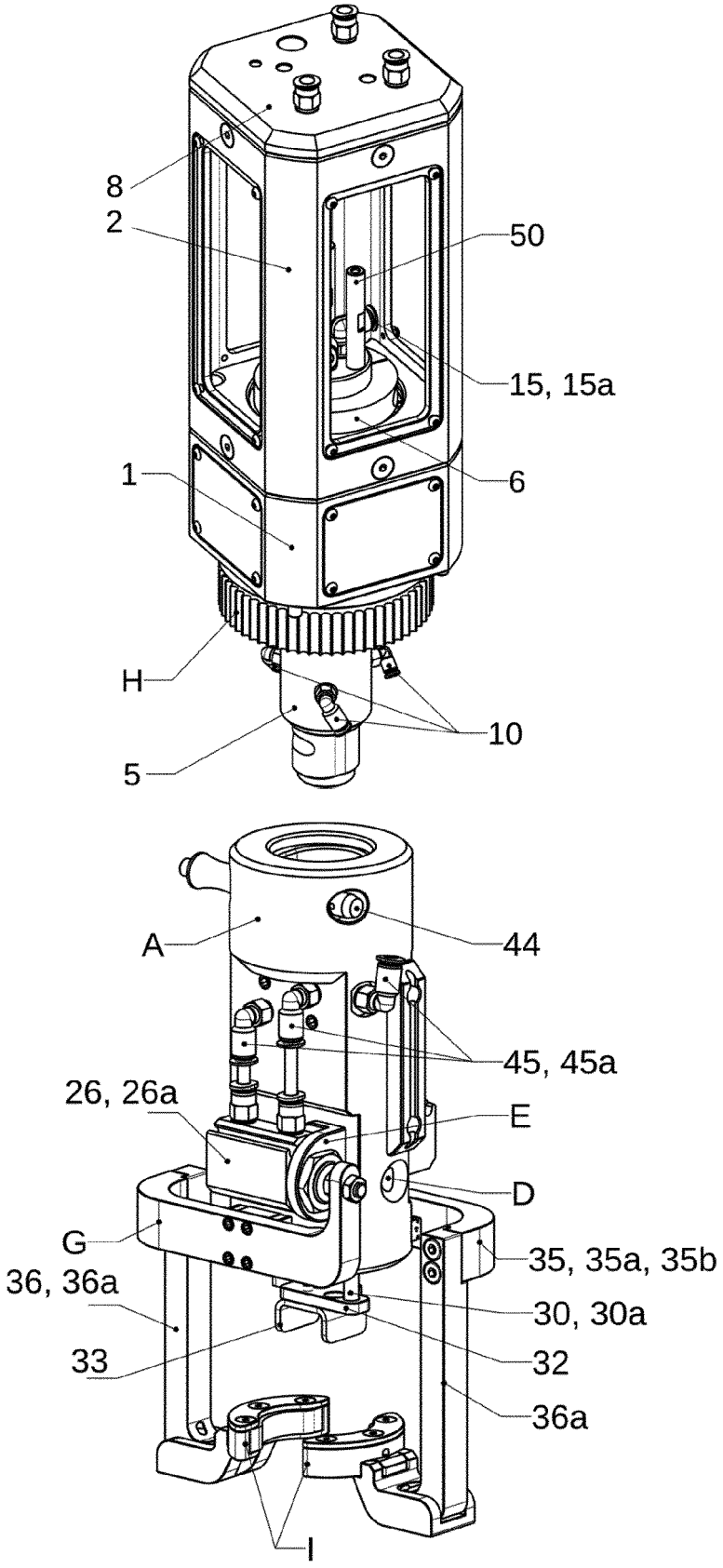
8
2
50
15, 15a
1
6
H
10
5
A
44
45, 45a
26, 26a
E
D
G
35, 35a, 35b
36, 36a
30, 30a
33
32
36a
I

Fig. 3a

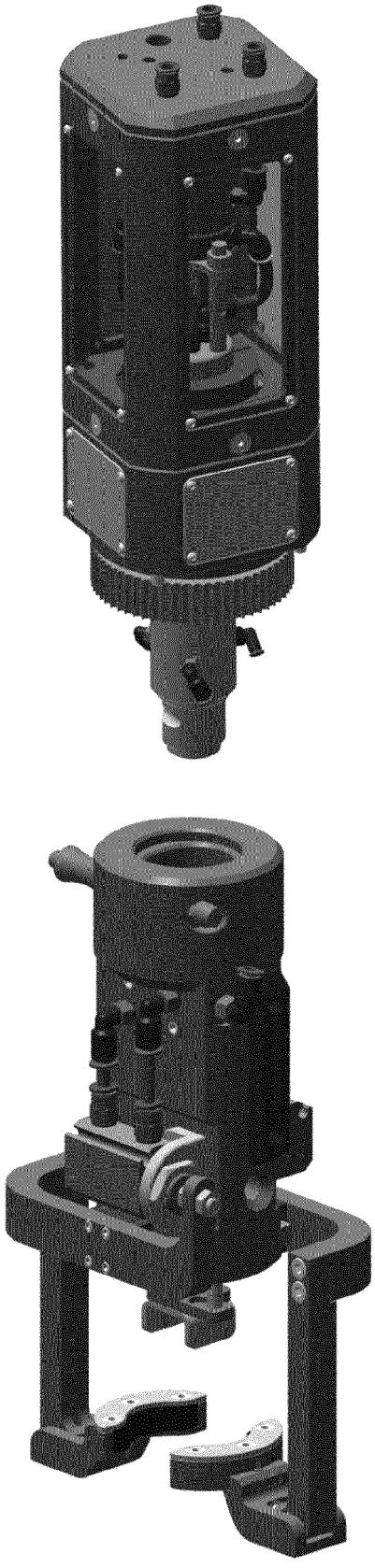

Fig. 3b

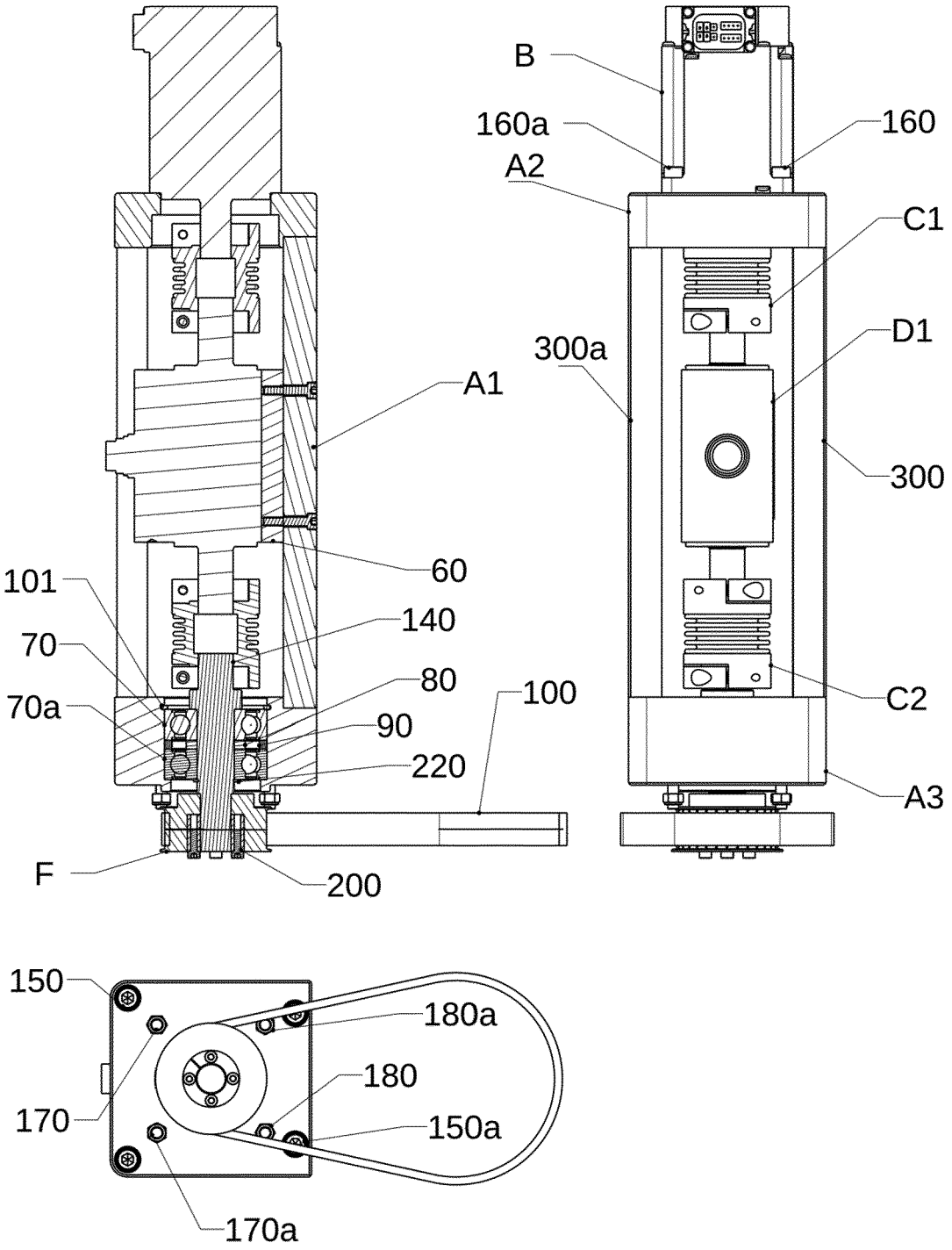
B
160a
160
A2
C1
D1
300a
A1
300
60
101
140
70
80
100
70a
90
C2
220
A3
F
200
150
180a
180
170
150a
170a

Fig. 4

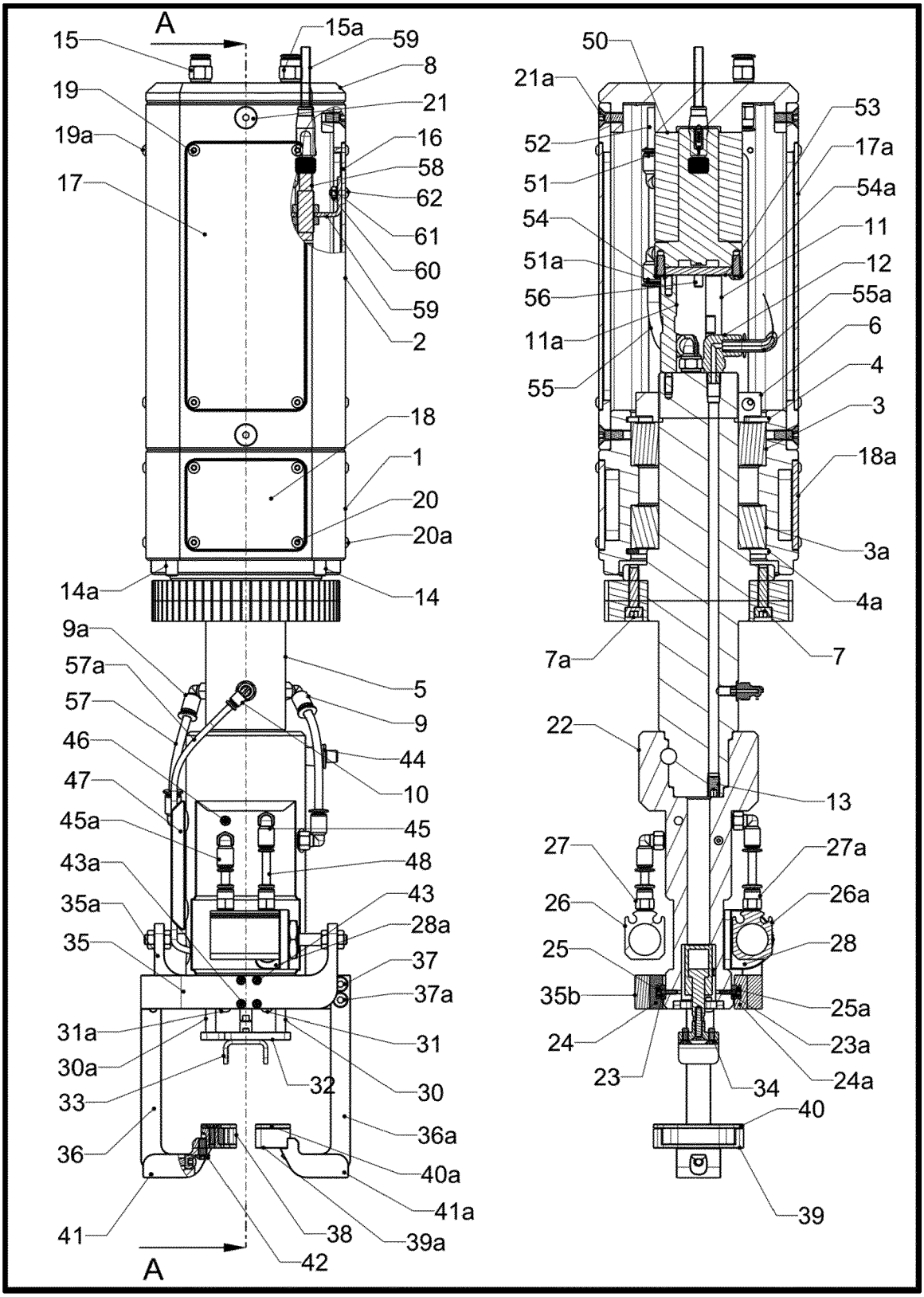
A
15
15a
59
8
19
21
19a
16
58
17
62
61
60
59
2
18
1
20
20a
14a
14
9a
57a
5
57
9
46
44
47
10
45a
45
48
43a
43
35a
28a
35
37
37a
31a
31
30a
32
30
33
36a
36
40a
41a
41
38
39a
42
A
50
21a
53
52
17a
51
54a
54
11
51a
12
56
55a
11a
6
55
4
3
18a
3a
4a
7a
7
22
13
27
27a
26
26a
25
28
35b
25a
24
23a
23
34
24a
40
39

Fig. 5

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 23 21 3175

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	CN 113 735 034 A (SUZHOU BEAUTY STAR CO LTD) 3 December 2021 (2021-12-03) * the whole document *	1	INV. B67B3/20

TECHNICAL FIELDS SEARCHED (IPC)

B67B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	21 May 2024	Wartenhorst, Frank

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 23 21 3175

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

21-05-2024

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
CN 113735034 A	03-12-2021	NONE	

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82