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(54) **WINCH**

(57) A winch (100) comprising: a drum (2) having an axis of rotation around which the drum (2) is rotatable; a gearbox (10) comprising an at least partially hollow gearbox shaft (11); and a drum-moving device member (12) comprising: a first portion arranged within the at least partially hollow gearbox shaft (11); and a second portion

protruding from the at least partially hollow gearbox shaft (11) and coupled to the drum (2) such that the drum (2) is moveable, by the gearbox (10) via the drum-moving device member (12), along a direction substantially parallel to the axis of rotation of the drum (2).

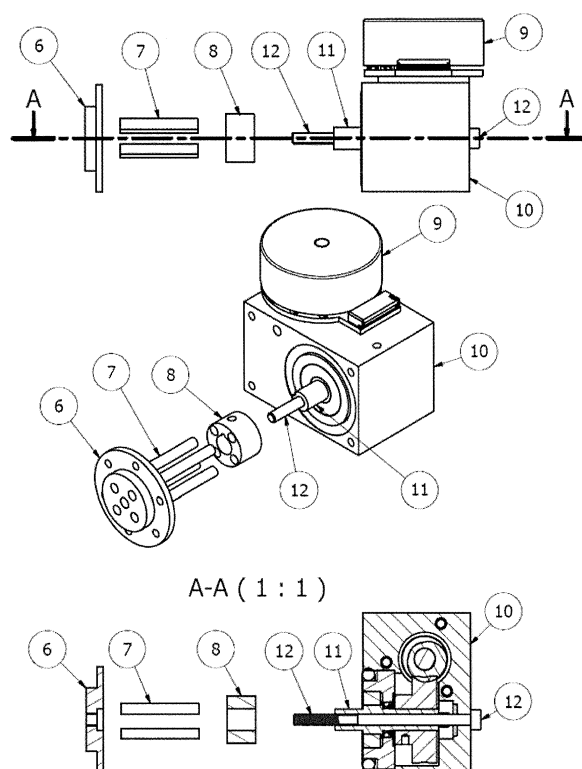


Figure 2c

## Description

### FIELD OF THE INVENTION

**[0001]** The present invention generally relates to a winch comprising a gearbox comprising an at least partially hollow gearbox shaft in which a part of a drum-moving device member is arranged.

### BACKGROUND TO THE INVENTION

**[0002]** A winch is described, for example, in US 6,520,485 B1, which generally relates to a winch system for raising and lowering theatre scenery.

**[0003]** The motorized fly system winch, drum and carriage combination of US 6,520,485 B1 for raising and lowering, for example, theatre scenery by means of cables incorporates functions for emergency breaking, for moving the drum in synchronization with relation to the carriage containing cable-guiding means and for driving of a limit switch. A feature of the system of US 6,520,485 B1 is that the cable drum assembly is used for horizontally moving the carriage together with its attached sheaves, in relation to the base, which is fixed, in synchronization with the cable back and forth travel in the drum grooves. This is accomplished by an ACME (or ball) screw, connected non-rotatably to the frame of the carriage by a fixture. A nut is non-rotatably mounted to the drum assembly brake end cap elongated hub, which hub is hollow so that the screw can pass, via the hollow hub, inside the drum, which is also hollow, where the screw is protected when the pipe batten with its attached scenery, hung from the winch, is in its up or storage position. The nut, being secured to the hub, rotates together with the drum assembly and also with respect to the screw. The pitch of the screw thread is equal to the pitch of the drum cable grooves. Therefore, the carriage is moved in synchronization with the back or forth travels of the cables in the drum grooves.

**[0004]** However, the winch system of US 6,520,485 B1 is very long in the direction in which the carriage is moved. There is therefore a need for further improvements of winches.

### SUMMARY OF THE INVENTION

**[0005]** A winch according to the present invention is set out in the independent claim. Preferred embodiments of the winch are outlined in the dependent claims.

**[0006]** We describe a winch comprising: a drum having an axis of rotation around which the drum is rotatable; a gearbox comprising an at least partially hollow gearbox shaft; and a drum-moving device member comprising: a first portion arranged within the at least partially hollow gearbox shaft; and a second portion protruding from the at least partially hollow gearbox shaft and coupled to the drum such that the drum is moveable, by the gearbox via the drum-moving device member, along a direction sub-

stantially parallel to the axis of rotation of the drum.

**[0007]** The winch as described herein may allow, for example, for a shorter and more compact construction of the winch. This may be achieved, in particular, by providing a gearbox with a gearbox shaft which is at least partially hollow such that a first portion of the drum-moving device member may be arranged within the at least partially hollow gearbox shaft. The overall length of the winch may hereby be advantageously reduced in the direction substantially parallel to the axis of rotation of the drum.

**[0008]** Moving the drum forwards and backwards, as desired, along the direction substantially parallel to the axis of rotation of the drum may allow for generally straight rope paths to be provided when operating the winch. At the same time, as outlined above, the drum driving mechanism based on the drum-moving device member being arranged partially within the at least partially hollow gearbox shaft may facilitate a compact design of the winch in the direction the drum is to be moved.

**[0009]** It will be appreciated that what is meant by the drum being moveable in a direction *substantially* parallel to the axis of rotation of the drum is that deviations from a mathematically precise movement along said axis are within the scope of the implementations of the winch as described herein. For example, the direction along which the drum is moveable may form an angle with the axis of rotation of the drum of less than 5 degrees or less.

**[0010]** The drum-moving device member may, in some examples, be a screw, a pin (which may push or pull the drum, using, for example, a hook), or other device.

**[0011]** In some example implementations of the winch, the drum-moving device member comprises a screw, wherein the second portion comprises a thread of the screw, and wherein the drum is moveable, by the gearbox via the thread of the screw, along the direction substantially parallel to the axis of rotation of the drum.

**[0012]** By providing a screw for moving the drum in the direction substantially parallel to the axis of rotation of the drum, the design of the winch may be relatively simplistic, which may be advantageous, for example, when manufacturing or operating the winch.

**[0013]** As will be appreciated, the screw, or generally the drum-moving device member, may hereby be directly or indirectly (via other components of the winch) coupled to the drum so as for the drum to be moveable along the direction substantially parallel to the axis of rotation of the drum.

**[0014]** In some variants, a center portion of the drum may hereby comprise a drum winding complementary to the thread of the screw for moving the drum along the direction substantially parallel to the axis of rotation of the drum. In some example implementation, the gearbox may cause the screw to rotate while the screw is in a fixed position along a direction substantially parallel to the axis of rotation of the drum. The rotating screw may transfer some force to the drum via the drum winding of the center portion of the drum. This may cause the drum

to move forwards or backwards, depending on the rotation direction of the screw, along the direction substantially parallel to the axis of rotation of the drum.

**[0015]** Example implementations in which the center portion of the drum may comprise a drum winding complementary to the thread of the screw may be particularly advantageous in view of a simple design of the winch as no further components of the winch may be required for moving the drum along the direction substantially parallel to the axis of rotation of the drum given the direct coupling of the screw to the drum. The screw may hereby penetrate the center portion of the drum with a portion which comprises the screw thread.

**[0016]** In some variants of the winch, the center portion is comprised of a drum plate removable from the drum. This may allow, for example, for manufacturing a drum plate separate from other parts of the drum. The drum plate may hereby, for example, be replaced, separately from other parts of the drum, after abrasion of the winding of the drum plate to a certain degree due to extended usage.

**[0017]** In some further example implementations of the winch, the drum is fixed to a drum-moving device, which comprises the drum-moving device member, by one or more drum fixing screws. This may allow for simple replacement of the drum, for example when a different pitch of the drum rope grooves is desired.

**[0018]** In some further variants of the winch, the gearbox shaft is hollow along its entire length along the direction substantially parallel to the axis of rotation of the drum. This may be particularly advantageous as the drum-moving device member may penetrate the hollow gearbox shaft to a larger extent or in some example implementations entirely. This may facilitate an even shorter and more compact design of the winch in the direction substantially parallel to the axis of rotation of the drum. Furthermore, a particularly stable arrangement of the drum-moving device member may be achieved, in particular when moving the drum forth and back.

**[0019]** In some variants, a head of the screw may be anchored on a first surface of the gearbox opposite a second surface of the gearbox which faces the drum, and wherein the screw penetrates the entire hollow gearbox shaft. The portion of the screw which comprises a thread may hereby protrude at least partially from the gearbox shaft from the side of the gearbox which faces the drum. This may ensure that the drum is moveable via the screw thread exerting a force onto the complementary winding of the drum center portion.

**[0020]** By anchoring the screw head on a first surface of the gearbox opposite the surface which faces the drum, the screw may be fixed to the gearbox in a particularly strong manner, while the winch is maintained very compact in the direction substantially parallel to the axis of rotation of the drum.

**[0021]** In some example implementations, the drum is coupled to the gearbox via one or more slide shafts and a slide holder. The one or more slide shafts and the slide

holder may provide for a guided movement of the drum in the direction substantially parallel to the axis of rotation of the drum. This may, for example, enhance stability during movement of the drum in said direction.

## BRIEF DESCRIPTION OF THE DRAWINGS

**[0022]** These and other aspects of the invention will now be further described, by way of example only, with reference to the accompanying figures, wherein like reference numerals refer to like parts, and in which:

Figure 1a shows a front view of a schematic illustration of a winch according to some example implementations as described herein;

Figure 1b shows a side view of a schematic illustration of a winch with a rope wound around a drum according to some example implementations as described herein;

Figure 1c shows a side view of a schematic illustration of a winch with a rope wound out of a drum according to some example implementations as described herein;

Figure 2a shows side and perspective views, respectively, of a schematic illustration of a drum, a drum-moving device, a gearbox and a motor according to some example implementations as described herein;

Figure 2b shows an exploded view of the side view schematic illustration of Figure 2a with the drum being separated from the drum-moving device according to some example implementations as described herein;

Figure 2c shows side, perspective and cross-sectional views of parts of the winch according to some example implementations as described herein in a dismantled state; and

Figure 3 shows side views of schematic illustrations of parts of the winch in different operating states according to some example implementations as described herein.

## DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

**[0023]** Figure 1a shows a front view of a schematic illustration of a winch 100 according to some example implementations as described herein.

**[0024]** In this example, the winch 100 comprises a winch base 1, on which is mounted a drum 2 with a rope 3 arranged thereon.

**[0025]** In this example an object 14 is attached to the

winch 100, which object 14 is, in this example, to be lowered or raised, as desired.

**[0026]** Parts of the winch 100 which are shown in Figure 1a will be further described in more detail below.

**[0027]** Figure 1b shows a side view of a schematic illustration of the winch 100 with a rope 3 wound around the drum 2 according to some example implementations as described herein.

**[0028]** As can be seen in Figure 1b, a motor 9 and a gearbox 10 are arranged on a surface of the winch base 1, whereby said surface faces away from the drum 2.

**[0029]** Figure 1c shows a side view of a schematic illustration of the winch 100 with the 3 rope wound completely out of the drum 2 according to some example implementations as described herein.

**[0030]** Based on a comparison between the states of the winch 100 in Figures 1b and 1c, respectively, it can be seen that the drum 2 is moveable in a direction substantially parallel to the axis of rotation around which the drum 2 is rotatable. This ensures that straight rope paths are maintained between the drum 2 and a further wheel 15 of the winch 100 when the rope 3 is wound or unwound. In this example, wheel 15 may be used to ensure that the rope 3 extends from the wheel 15 to the object in a straight manner, i.e. generally parallel to a direction of the gravitational force.

**[0031]** Figure 2a shows side and perspective views, respectively, of a schematic illustration of the drum 2, a drum-moving device 4, the gearbox 10 and the motor 9 according to some example implementations as described herein.

**[0032]** The drum 2 may, in this example, be moved by the gearbox 10 and the motor 9 via the drum-moving device 4 in a direction substantially parallel to the axis around which the drum 2 is rotatable, as will be further outlined below.

**[0033]** Figure 2b shows an exploded view of the side view schematic illustration of Figure 2a with the drum 2 being separated from the drum-moving device 4 for illustrative purposes.

**[0034]** In this example, the drum 2 is fixed to the drum-moving device 4 using screws 5. Holes may hereby be provided in the drum 2 to sandwich the drum 2 between the heads of the screws 5 and the drum-moving device 4.

**[0035]** Figure 2c shows side, perspective and cross-sectional views of parts of the winch 100, according to some example implementations as described herein, in a dismantled state. For simplicity, only some parts of the winch 100 are depicted in Figure 2c.

**[0036]** In this example, the winch 100 comprises a drum plate 6 which may be used to fix the drum 2 to the drum-moving device 4.

**[0037]** Furthermore, slide shafts 7 and a slide holder 8 are arranged in the drum-moving device 4 between the drum plate 6 and the gearbox 10.

**[0038]** In this example implementation, the drum-moving device 4 comprises a screw 12 arranged partially within the hollow gearbox shaft 11. As outlined above, the

screw 12 may be used to move the drum 2, in this example, via the drum plate 6 along a direction substantially parallel to the axis of rotation around which the drum 2 may rotate.

**[0039]** As can be seen from the cross-sectional side view of Figure 2c (lowermost figure in Figure 2c), in this example, the gearbox shaft 11 is hollow throughout the entire gearbox 10. This allows for the screw 12 to be arranged in the gearbox 10 such that the screw head is anchored on one surface of the gearbox 10, while the other end of the screw 12, which comprises the screw thread, protrudes from the gearbox shaft 11. The screw 12 hereby penetrates throughout the entire hollow gearbox shaft 11. The design of the winch 100 may therefore be facilitated in a more compact manner in a direction substantially parallel to the axis around which the drum 2 is rotatable. Furthermore, the screw 12 is arranged in the gearbox 10 in a particularly stable manner as the screw 12 penetrates the hollow gearbox shaft 11 with a substantial portion of its entire screw length. This may result in a more stable and potentially smoother movement of the drum along the direction generally parallel to the axis around which the drum is rotatable.

**[0040]** The slide shafts 7 and the slide holder 8 may further enhance stability when the drum 2 is moved forth and back using the drum-moving device 4.

**[0041]** Figure 3 shows side views of schematic illustrations of parts of the winch 100 in different operating states according to some example implementations as described herein.

**[0042]** In the upper image of Figure 3, the drum plate 6 is moved to be close to the slide holder 8 of the drum-moving device 4. In this example, as depicted in the lower image of Figure 3, the drum plate 6 may be moved away from the slide holder 8 by a distance L. In this example, as can be seen when comparing the two images of Figure 3, the screw 12 is in a fixed position in a direction generally parallel to the axis of rotation of the drum 2. It is, in this example, merely the drum plate 6 (or generally the drum 2) which moves forth and back in the direction as indicated in Figure 3, i.e. the direction generally parallel to the axis of rotation of the drum 2.

**[0043]** The two images in Figure 3 relate to the drum 2 being in a wound and an unwound state, respectively. By moving the drum 2 with a distance L between the two states, the rope 3 may be maintained in a straight path between the drum 2 and the wheel 15. At the same time, the hollow gearbox shaft 11, as outlined above, allows for the screw 12 to be arranged partially within the gearbox shaft 11 (or in some example implementations to completely penetrate the gearbox shaft 11), such that a particularly compact and stable design of the winch 100 may be provided.

**[0044]** No doubt many other effective alternatives will occur to the skilled person. It will be understood that the invention is not limited to the described embodiments and encompasses modifications apparent to those skilled in the art and lying within the scope of the claims

appended hereto.

8. A winch (100) as claimed in any preceding claim, wherein the drum (2) is coupled to the gearbox via one or more slide shafts (7) and a slide holder (8).

## Claims

1. A winch (100) comprising:

a drum (2) having an axis of rotation around which the drum (2) is rotatable;  
a gearbox (10) comprising an at least partially hollow gearbox shaft (11); and  
a drum-moving device member (12) comprising:

a first portion arranged within the at least partially hollow gearbox shaft (11); and  
a second portion protruding from the at least partially hollow gearbox shaft (11) and coupled to the drum (2) such that the drum (2) is moveable, by the gearbox (10) via the drum-moving device member (12), along a direction substantially parallel to the axis of rotation of the drum (2).

2. A winch (100) as claimed in claim 1, wherein the drum-moving device member (12) comprises a screw, wherein the second portion comprises a thread of the screw, and wherein the drum (2) is moveable, by the gearbox (10) via the thread of the screw, along the direction substantially parallel to the axis of rotation of the drum (2).

3. A winch (100) as claimed in claim 2, wherein a center portion of the drum (2) comprises a drum winding complementary to the thread of the screw for moving the drum (2) along the direction substantially parallel to the axis of rotation of the drum (2).

4. A winch (100) as claimed in claim 3, wherein the center portion is comprised of a drum plate (6) removable from the drum (2).

5. A winch (100) as claimed in any preceding claim, wherein the drum (2) is fixed to a drum-moving device (4), which comprises the drum-moving device member (12), by one or more drum fixing screws (5).

6. A winch (100) as claimed in any preceding claim, wherein the gearbox shaft (11) is hollow along its entire length along the direction substantially parallel to the axis of rotation of the drum (2).

7. A winch (100) as claimed in claim 6, wherein a head of the screw is anchored on a first surface of the gearbox (10) opposite a second surface of the gearbox (10) which faces the drum (2), and wherein the screw penetrates the entire hollow gearbox shaft (11).

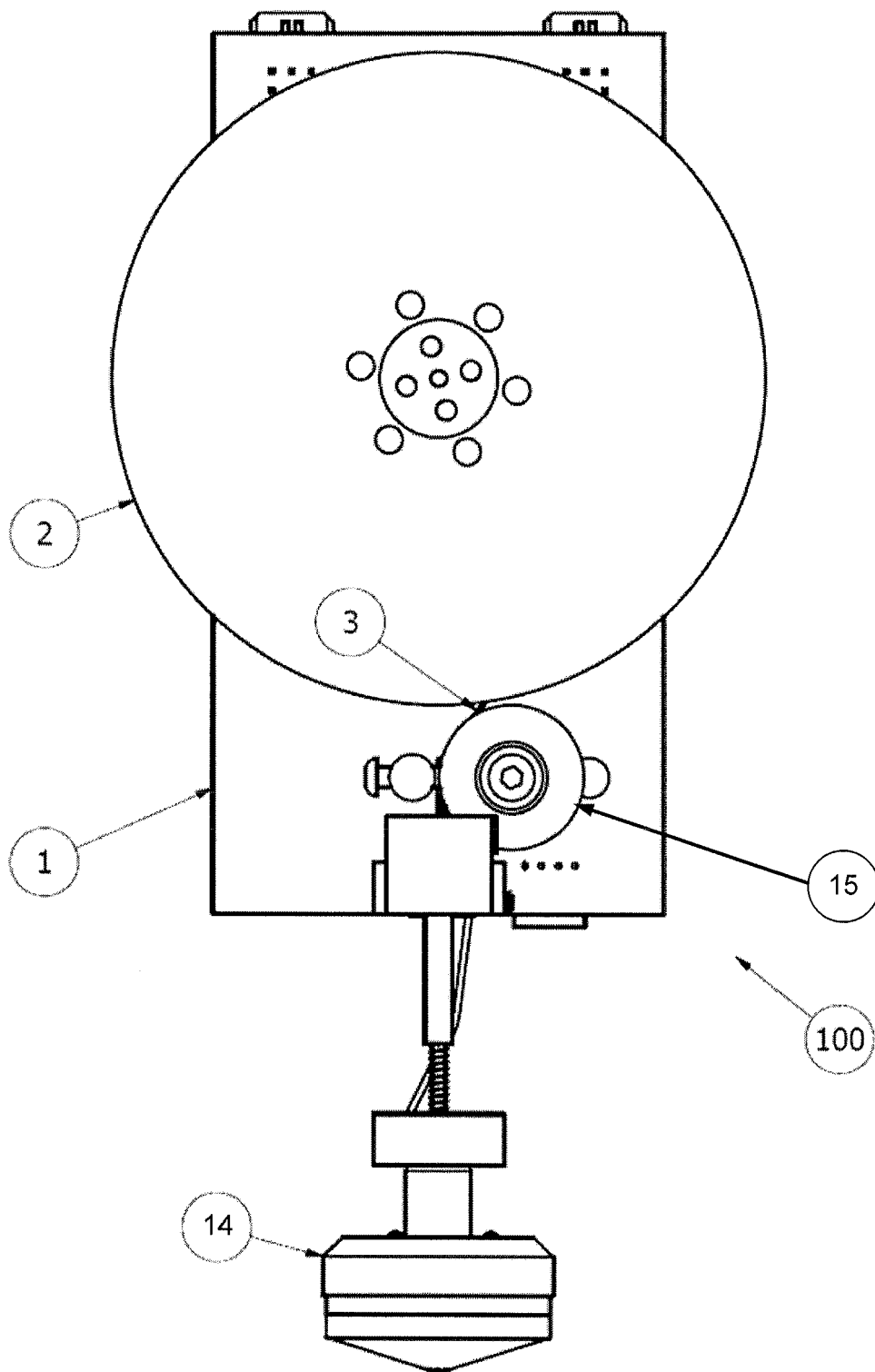


Figure 1a

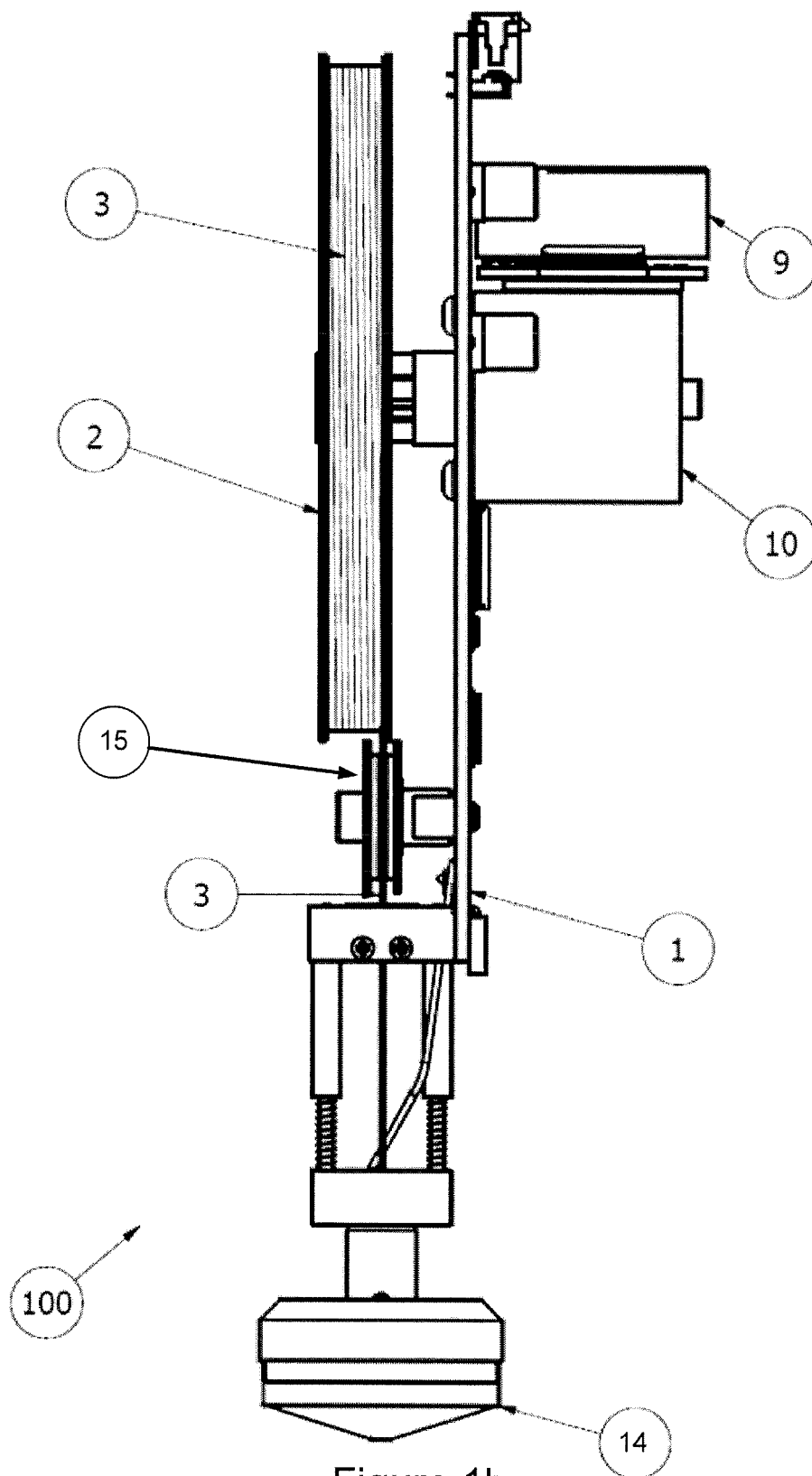


Figure 1b

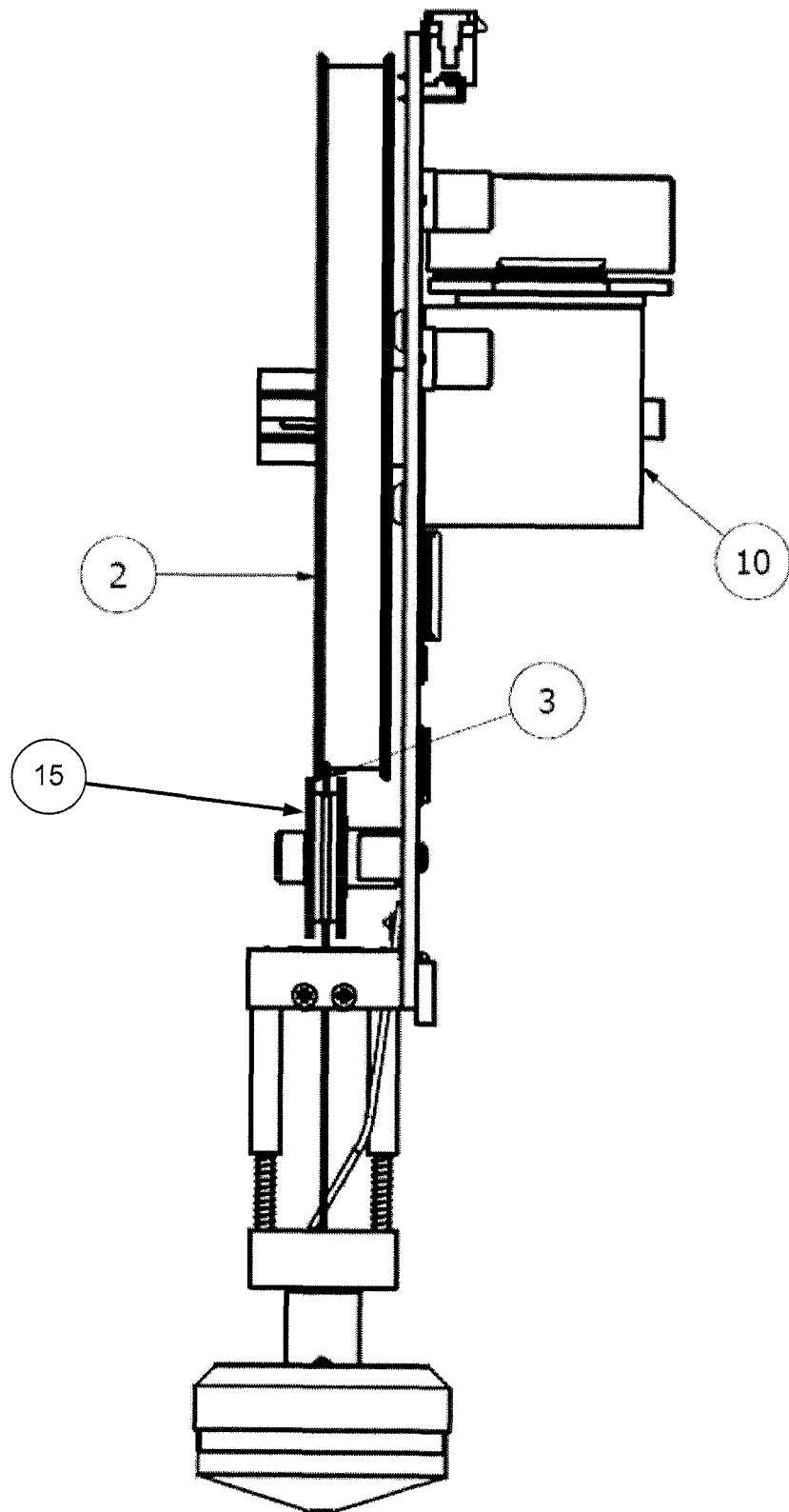


Figure 1c



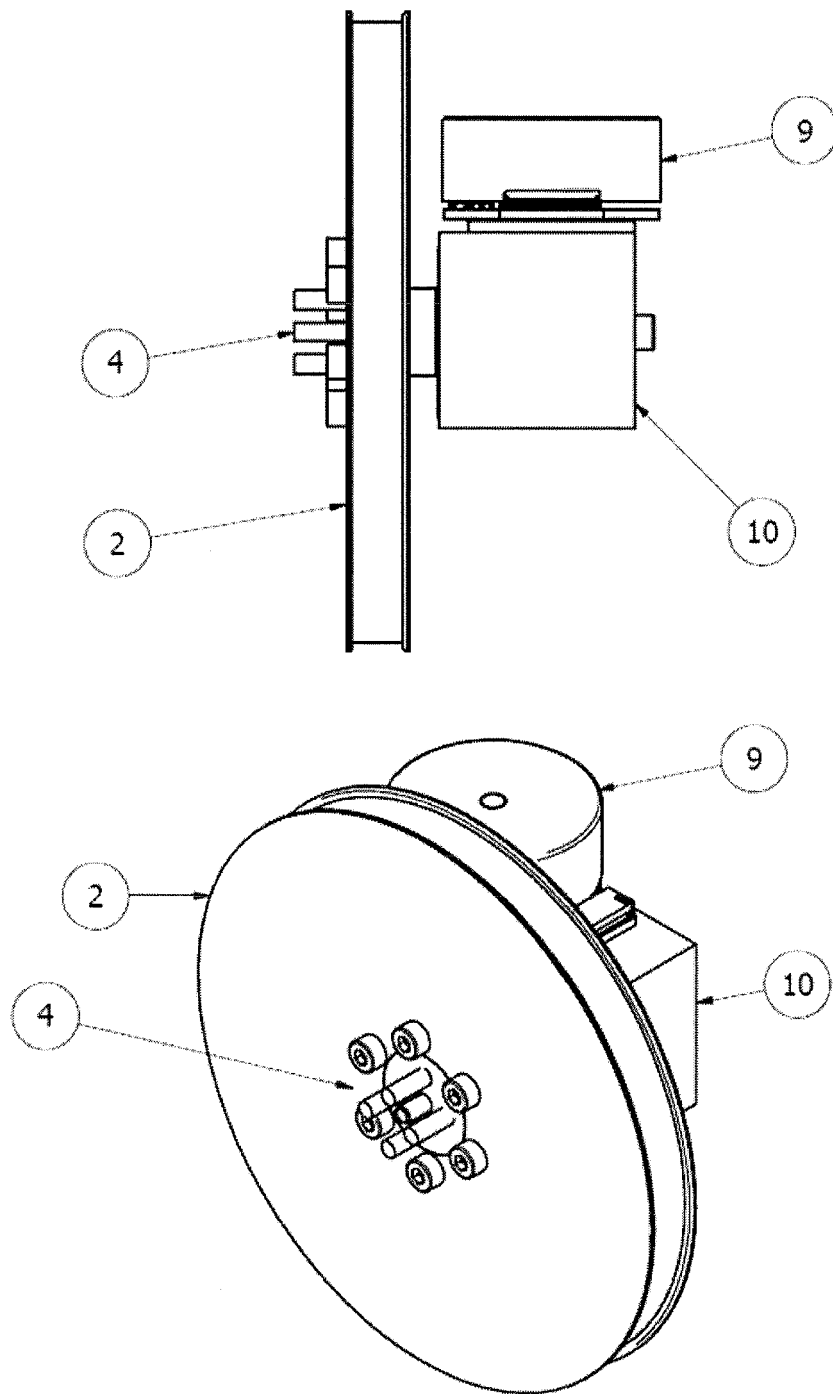


Figure 2a

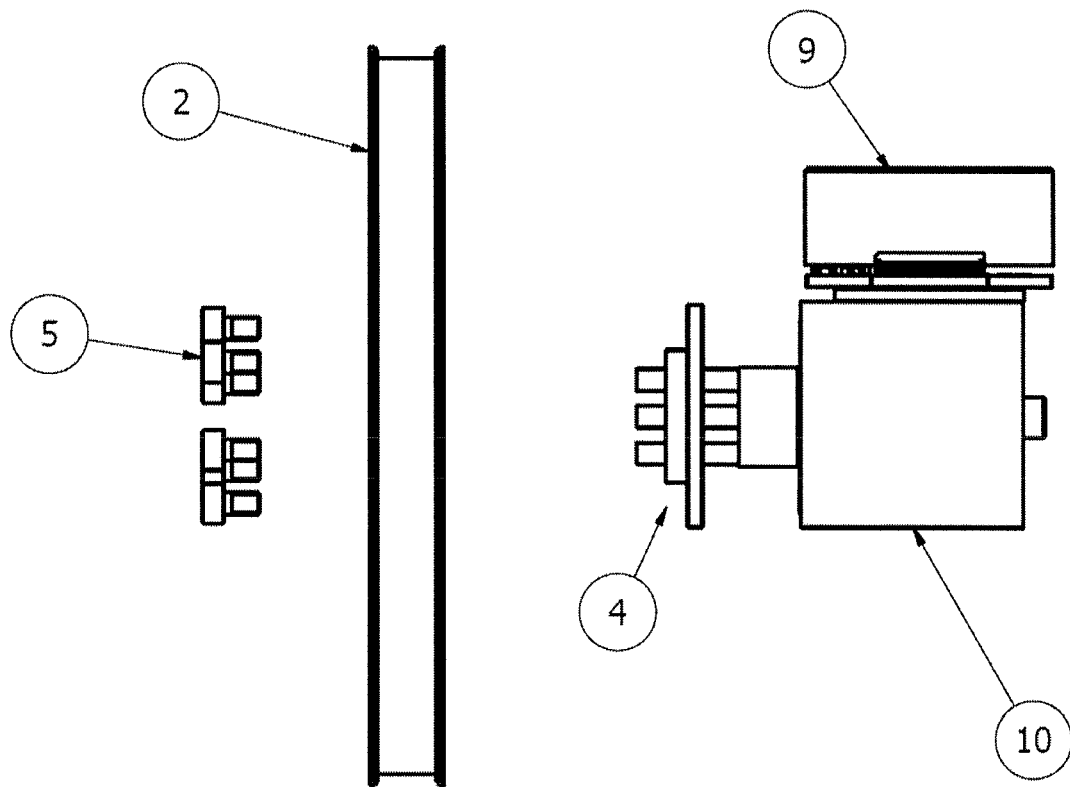


Figure 2b

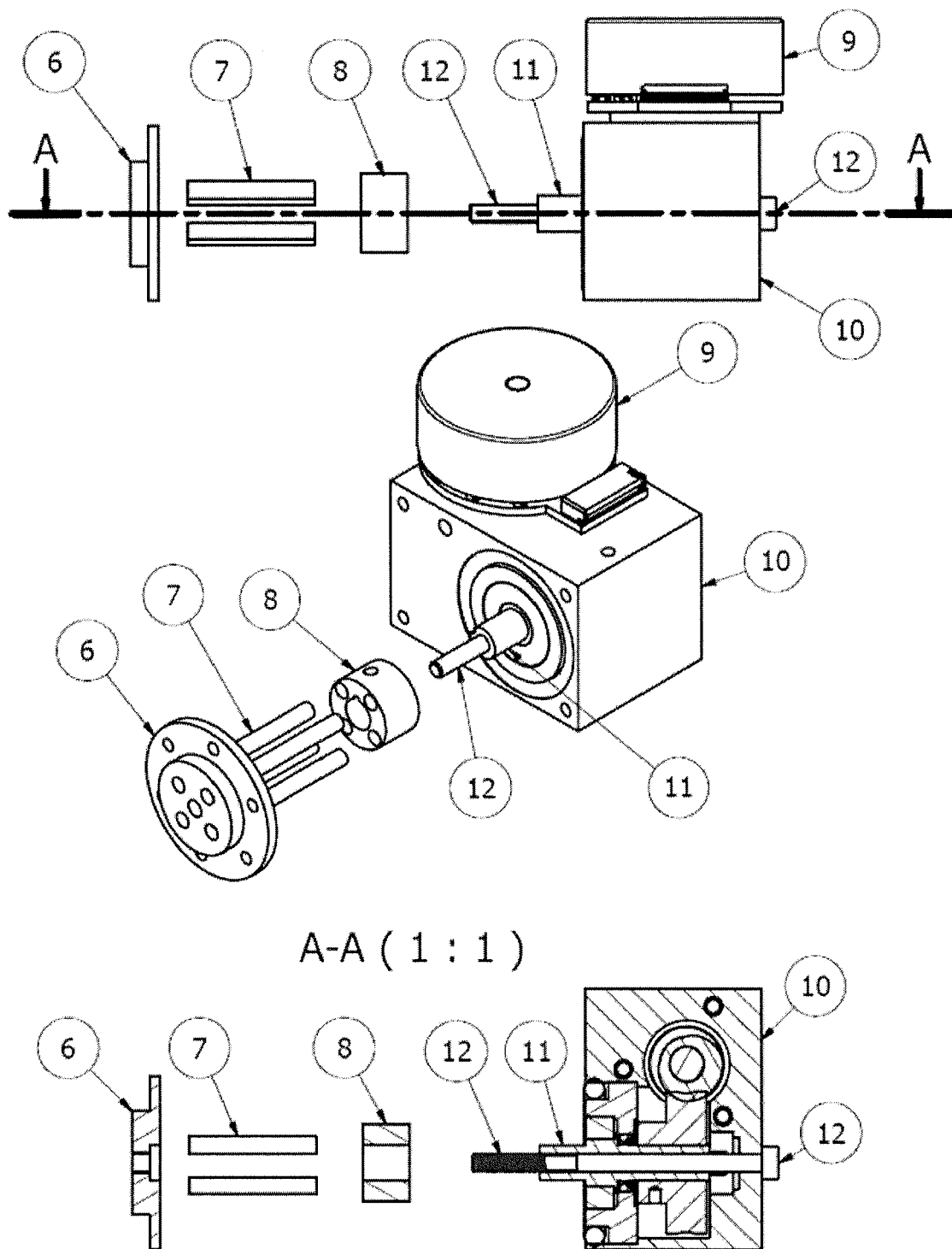


Figure 2c

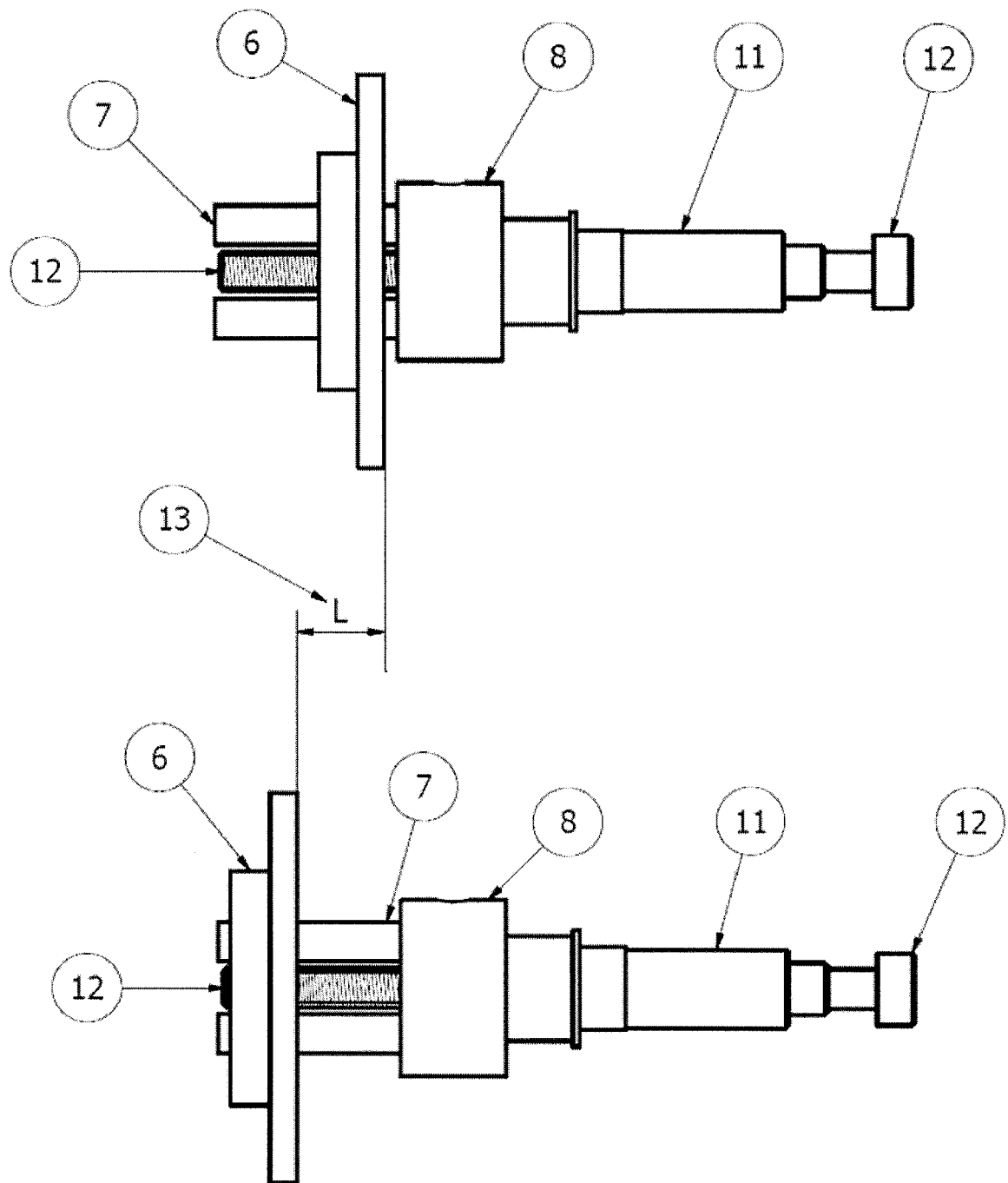


Figure 3



## EUROPEAN SEARCH REPORT

Application Number  
EP 17 19 7438

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	JP S49 133357 U (N.A.) 15 November 1974 (1974-11-15) * figure 2 *	1-3,6-8	INV. B66D1/39
X	----- CN 106 986 277 A (CHINA UNIV OF PETROLEUM) 28 July 2017 (2017-07-28) * figures 3,4 *	1-5,8	
X	----- JP S48 70671 U (N.A.) 6 September 1973 (1973-09-06) * figure 4 *	1	
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			TECHNICAL FIELDS SEARCHED (IPC)
			B66D
The present search report has been drawn up for all claims			
Place of search <b>The Hague</b>		Date of completion of the search <b>13 March 2018</b>	Examiner <b>Serôdio, Renato</b>
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			

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**REFERENCES CITED IN THE DESCRIPTION**

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**Patent documents cited in the description**

- US 6520485 B1 [0002] [0003] [0004]