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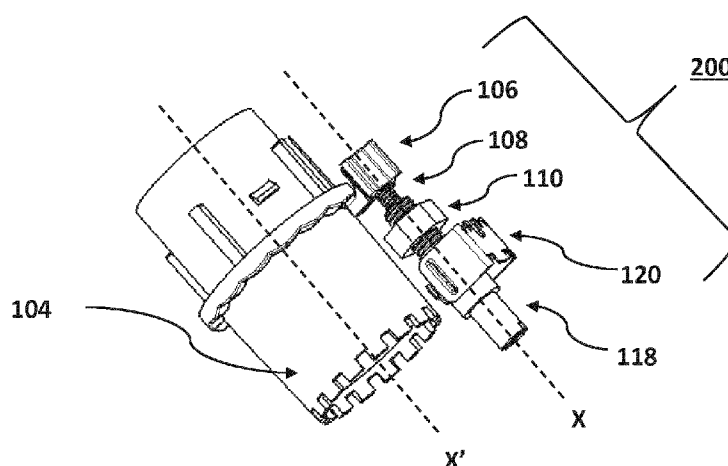


FIG. 2a

(57) Abstract: A torque calibrating mechanism and method of calibration a rotatable input member using the same is provided. The torque calibrating mechanism further comprises a calibrating device having a shaft with an adjustment member for rotating the shaft according to a range of calibration values is provided. The calibrating device further includes a plurality of teeth configured for coupling the shaft to a first locking means fixed with a housing of the rotatable input member, and an engaging means for engaging the shaft with the rotatable input member for generating a counter torque for the rotatable input member, wherein the engaging means is flexibly coupled to the shaft for adjusting the counter torque by adjusting the engagement between the shaft and the first locking means.





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A Torque Calibrating Mechanism and Method of Calibration

FIELD OF INVENTION

5 This invention broadly relates to an engineering element to maintain an installation. Specifically, this invention relates to a torque calibration mechanism and a method of calibration.

BACKGROUND OF INVENTION

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Typically, manually operable electronic modules will require an operator to provide an input command using a selection of buttons, switches or dials.

15 When an operator gives an input command via a dial, the dial is typically provided with some resistance to prevent undesired movement. Torque is used as a way of measurement to determine how much force is acting on the dial. Therefore, torque of a dial needs to be adjusted to limit the working torque range so that a balance
20 between comfort and precision is provided when the dial is in use.

Conventional knob dials possess torque limits which are manually inspected or measured during production. The torque limit of existing knob dials, in particular knob dials used in automotive
25 industry ranges between ± 30 percent to ± 60 percent. Furthermore, knob dials typically loosen after some time due to the large torque limits used in the automotive industry. Hence, it is an object of this invention to provide a calibration mechanism to improve the torque limits of dials. It is also an object of this
30 invention to improve the period of time before dials are loosened.

SUMMARY OF INVENTION

Exemplary embodiments are provided herein relate to a torque calibration mechanism and a method of calibrating torque of a rotatable input member using the same.

In a first aspect of an embodiment, a torque calibrating mechanism is provided, for a rotatable input member being coupled and placed in a housing, the torque calibrating mechanism having a calibrating device. The calibrating device comprises a shaft having an adjustment member for rotating the shaft according to a range of calibration values, a plurality of teeth configured for coupling the shaft to a first locking means; and engaging means for engaging the shaft with the rotatable input member for generating torque for the rotatable input member; wherein the engaging means is flexibly coupled to the shaft for adjusting the torque by adjusting the engagement between the shaft and the first locking means.

The advantage of the aforesaid calibration device allows a precise adjustment of the torque tolerance of a rotatable input member, for example a dial or knob dial, to a tolerance value lower than ± 10 percent of a predetermined torque value.

An upper end of the shaft may engage with the engaging means, which in turn may engage with the rotatable input member. The rotatable input member may include a cylindrical body, the cylindrical body comprise a protruding part having a plurality of grooves therebetween, for engagement with the engaging means. Upon rotation of the rotatable input member, the engaging means may be capable of flexibly traversing the protruding part having the plurality of grooves on one side to thereby cooperate with the rotation of the rotatable input member. As the engaging means also engages the shaft, the engaging means therefore provides the

cooperative link between rotation of the shaft and rotation of the rotatable input member by way of the flexible coupling.

5 The adjustment member may be configured for rotating the plurality of teeth about an axis relative to the first locking means, wherein the first locking means may be configured for snap-fitting together with the plurality of teeth. The first locking means may be configured to fit according to the circumference of the plurality of teeth, through a snapping action, 10 e.g. engaging the first locking means to fit the circumference of the plurality of teeth. Depending on the snap-fitting position of the shaft, the force for traversing the rotatable input member may be adjusted. An advantage of using the first locking means aids to reduce vibrations during calibration because the first 15 locking means is capable of holding the plurality of teeth in place during calibration. A further advantage of the first locking means is that the rotatable input member provides an operator with feedback from the plurality of teeth snap-fitting with the first locking means, thereby providing operator 20 awareness when operating the rotatable input member. The adjustment member may be positioned proximate a lower end of the shaft to allow for easier rotation of the shaft. The plurality of teeth may be positioned proximate a lower end of the shaft and above the adjustment member.

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The plurality of teeth may be positioned around the periphery of the shaft such that rotation of the adjustment member rotates the plurality of teeth. As the first locking means is configured to snap-fit, the plurality of teeth may be configured to rotate 30 relative to the fixed first locking means.

In addition, in a preferred embodiment, the adjustment member may be coaxial with the shaft and the shaft may be configured for rotating about an axis at 360 degrees. Advantageously, it may

require less force to rotate the adjustment member when the adjustment member is coaxial with the shaft.

In a preferred embodiment, the engaging means may be coaxial with the shaft. In addition, the engaging means may be configured for supplying a means for receiving a portion of the shaft. Typically, the torque of the rotatable input member may decrease after some time due to the loosening of engagement between the shaft and the housing. Advantageously, because the engaging means may be coaxial with the shaft, it is easier to maintain cooperation between the engaging means and the shaft for a longer period of time and the tolerance limit for deviation from the torque factory setting may be kept at a minimum. In other embodiments, the engaging means may be designed to not be coaxial with the shaft or be engaged perpendicularly to the shaft, but tolerance concerns may result in such embodiments.

Each calibration value may be at a predetermined interval, preferably at a constant interval, within each 360° rotation. The plurality of teeth may be at least 15 and each calibration value is therefore at most 24 degrees within each 360 degrees of rotation when the calibration interval is constant. A larger number of teeth provides for a larger number of calibration values. Thus, the number of teeth may preferably be at least 15, 16, 17, 18, 19, 20, or more. An advantage of the aforesaid design is that a larger number of teeth provides the rotatable input member with a larger number of design options for a manufacturer to configure. For example, where the rotatable input member is a climate control temperature selector, 15 teeth may provide 15 temperature values for the selection by an operator of the rotatable input member. In a preferred embodiment, there are 20 teeth and each calibration value is 18° per teeth within the 360° rotation. The shaft may be configured to rotate about the axis in a clockwise direction or an anti-clockwise direction.

The means for receiving the portion of the shaft may be any means to provide mechanical resistance to the shaft and permit coupling and uncoupling of the shaft from the engaging means. For example, the means for receiving the portion of the shaft may be a detent means. The term "detent means" as used in the context of the present invention refers to a catch which is capable of releasable engagement, the catch being capable of providing a flexible force according to its longitude or axis.

The engaging means may be configured for coupling the shaft to a cylindrical body of the rotatable input member. In some embodiments, the detent means may be capable of flexibly coupling the shaft to a cylindrical body of the rotatable input member.

In an embodiment, the detent means may be a spring. The cylindrical body of the rotatable input member may extend through the housing, wherein an end of the cylindrical body is the rotatable input member used by an operator, while the other end of the cylindrical body is connected to the engaging means. The end of the cylindrical body to be connected to the engaging means may comprise a plurality of grooves therebetween. The engaging means may comprise a first end that engages with the grooves of the cylindrical body and a second end that comprises the detent means. At rest, the first end rests within a groove of the cylindrical body. Upon rotation of the rotatable input member and the cylindrical body, the engaging means is forced to compress as it moves out of the groove and past the protruding part. The compression may be provided by way of the detent means. Thus, the engaging means as a whole is capable of traversing a protruding part and into a groove. Where the detent means is capable of receiving the portion of the shaft, rotation of the cylindrical body compresses the engaging means, which in turn compresses the shaft. Thus, the engaging means is able to flexibly couple to the shaft.

The cylindrical body of the rotatable input member may have an axis parallel to an axis of the shaft, the cylindrical body being configured for rotating in an opposing direction as the shaft.

5 That is, the axis of rotation of the cylindrical body may be parallel to the axis of rotation of the shaft, but the cylindrical body and the shaft may be configured to rotate in opposing directions.

10 Preferably, rotating the shaft in a direction creates a higher torque and rotating the shaft in the opposing direction creates a lower torque. The higher torque results in a higher counter torque required for rotating the rotatable input member; and the lower torque results in a lower counter torque required for
15 rotating the rotatable input member.

In a preferred embodiment, the shaft may comprises a threaded portion configured for receiving a second locking means to maintain the torque at its predetermined calibration value.

20 Preferably, the second locking means may be advantageously operably to cooperate with the threaded portion of the shaft, thereby maintaining the torque and/or control vibrations.

Advantageously, the second locking means may work in cooperation
25 with the first locking means to maintain the torque deviation at a minimum and the torque at its predetermined calibration value.

Preferably, rotating the shaft in a direction winds the threaded
30 portion into the second locking means thereby creating a higher torque; and rotating the shaft in the opposing direction unwinds the threaded portion from the second locking means thereby creating a lower torque. The second locking means may be a lock nut or other mechanical part with similar functions.

The adjustment member may be configured for rotating at least 3, 4, 5, or more rotations about the axis to provide the highest torque. More rotations generally result in a higher torque, although it may be appreciated that the torque may be increased up to a limit. In a preferred embodiment, the adjustment member may be configured for rotating at least 3, 4 or a maximum of 5 rotations about the axis to provide the highest torque.

10 In a second aspect of this invention, a device for calibrating torque tolerance of a rotatable input member is provided. The device comprises the torque calibrating mechanism as described above, and a housing to house the torque calibrating mechanism.

15 The housing may further comprise an opening to access the adjustment member. In operation, a measuring device for rotating the rotatable input member and measuring a counter torque for rotating the rotatable input member is further provided. The measuring device may be manually operable or machine operable to
20 rotate the rotatable input member and measure the counter torque needed for rotating the rotatable input member.

The housing may further comprise an opening to access the rotatable input member.

25

Preferably, a decision unit operable to receive the counter torque measurement and calibrate the torque tolerance of the rotatable input member is provided.

30 In a third aspect of this invention, a method for calibrating torque tolerance of a rotatable input member by means of the device as described above is provided. The method further comprises the steps of (1) engaging the rotatable input member by means of the measuring device; (2) rotating the rotatable input

member and measuring a counter torque; (3) determining a deviation between the measured counter torque and a desired torque; (4) determining an adjusting value by means of the deviation for controlling the adjustment member; and (5) rotating the shaft by means of the adjustment member according to the adjusting value to achieve the desired torque.

Here, the desired torque means the desired torque of the shaft. As the calibrating device comprising, among others, the shaft provides the torque necessary to achieve the counter torque of the rotatable input member, the measured counter torque of the rotatable input member is therefore equal to the torque of the calibrating device, which may deviate from the desired torque of the calibrating device. Therefore, to achieve the counter torque of the rotatable input member at a torque tolerance value lower than ± 10 percent, the desired torque of the calibrating device is adjusted according to the adjusting value to achieve the desired torque.

It is noted that the terms "torque" and "counter torque" are relative. Thus, the calibrating device may be referred to as providing a counter torque necessary to achieve a torque of the rotatable input member. However, for consistency, the term "torque" used herein refers to the torque of the calibrating device and the term "counter torque" used herein refers to the torque of the rotatable input member. It shall further be understood the motion of achieving a torque of the rotatable input member and a counter torque of the input member corresponds to the rotational direction of the shaft, i.e. either in a clockwise or anti-clockwise direction.

Preferably, the motion of rotating the shaft in a clockwise direction yields a higher torque value, and rotating the shaft in an anti-clockwise direction yields a lower torque value.

BRIEF DESCRIPTION OF DRAWINGS

5 Objects and aspects of this invention will become apparent from the following description of embodiments with reference to the accompany drawings in which:

10 FIG. 1 shows an exploded view of a dial with a torque calibration mechanism according to a preferred embodiment of this invention.

15 FIG. 2a shows a perspective view of the torque calibration mechanism according to a preferred embodiment of this invention engaged with a component from the dial.

20 FIG. 2b shows a perspective view of the torque calibration mechanism according to a preferred embodiment of this invention.

25 FIG. 2c - 2d shows a bottom and a perspective profile view of the torque calibration mechanism engaged in a housing of a dial according to a preferred embodiment of this invention.

30 FIG. 3 shows a profile view of a dial with the torque calibration mechanism within a housing of a dial according to a preferred embodiment of this invention.

35 FIG. 4 shows a cross sectional view of the torque calibration mechanism according to a preferred embodiment of this invention, within a housing of a dial.

40 FIG. 5 illustrates a graphical representation of a measurement of force (torque) relative to the number of rotations of the

calibration mechanism according to a preferred embodiment of this invention.

5 DESCRIPTION OF PREFFERED EMBODIMENTS

Hereinafter, exemplary embodiments of the present invention will be described in detail with reference to the accompanying drawings. The detailed description of this invention will be provided for the purpose of explaining the principles of the invention and its practical application, thereby enabling person skilled in the art to understand the invention for various exemplary embodiments and with various modifications as are suited to the particular use contemplated. The detailed description is not intended to be exhaustive or to limit the invention to the precise embodiments disclosed. Modifications and equivalents will be apparent to practitioners skilled in this art and are encompassed within the spirit and scope of the appended claims.

20

Various terms, such as "first", "second", and the like used herein may refer to modifying various different elements of various embodiments of the present disclosure, but do not limit the elements. The expressions may be used to distinguish one element from another element. For instance, "a first portion" and "a second portion" may indicate or make reference to different parts, structures or elements of a mechanical design, regardless of the order or the importance, without departing from the scope of the present disclosure.

30

The terms "torque" and "counter torque" are relative. In certain aspects of this invention, a calibrating device may be referred to as providing a counter torque necessary to achieve a torque of the rotatable input member. For clarity and consistency, the

term "torque" used herein may refers to the torque of the calibrating device and the term "counter torque" used herein may refers to the torque of the rotatable input member. It shall further be understood the motion of achieving a torque of the rotatable input member and a counter torque of the input member corresponds to the rotational direction of the shaft, i.e. either in a clockwise or anti-clockwise direction.

Turning now to the drawings, FIG. 1 shows an exploded view of a dial 100, with parts of a torque calibrating mechanism according to a preferred embodiment of this invention, and a housing 102. The torque calibrating mechanism is provided for a rotatable input member, for example a dial or knob dial, being coupled and placed in the housing 102. It will be understood by a person skilled in the art that a conventional dial may include a cylindrical body 104, for actuating an input command, and may further include other components or features such as a cap (not shown in figure). The term "rotatable input member" used herein shall be construed to be either with or without a knob cap.

The torque calibrating mechanism has a calibrating device. The calibrating device further comprises a shaft having an adjustment member 118 for rotating the shaft according to a range of calibration values. It shall be understood by the person skilled in the art that the adjustment member 118 functions like a handle for rotating the calibrating device. The calibrating device may be manually rotated, or if in a production line, automated by equipment. The calibrating device further includes a plurality of teeth 116 configured for coupling the shaft to a first locking means 120, eg. a spring lock, fixed with the housing 120. The adjustment member may be specially designed to include ridges, thereby requiring compatible tool for calibration. The shaft may further include a narrower portion 112, and a threaded portion

114. The narrower portion 112 has a diameter smaller than the threaded portion 114, and is configured to fit into a detent means 108. The detent means may be a spring or the like. Preferably, the detent means is configured to move in a longitude or latitude
5 direction.

Hereinafter, the term "calibrating mechanism" shall be construed to include the calibrating device. The term "device" shall be construed as a piece of mechanical equipment for use in conjunction with a specific mechanism, in the case, the calibrating
10 mechanism as disclosed.

An engaging means 106, eg. a plunger or the like is provided for engaging the shaft with the rotatable input member for generating a torque for the rotatable input member. The engaging means 106
15 is flexibly coupled to the shaft for adjusting the torque by adjusting the engagement between the shaft and the first locking means. The term "flexibly coupled" or "flexible coupling" shall be construed to mean the relevant parts engages with each other
20 when in operation, and minor movement, either in longitude or latitude direction may be expected. The engaging means may further include a detent means 108 and a second locking means 110.

The advantage of the aforesaid calibration mechanism allows a
25 precise adjustment of the torque tolerance of the dial to a tolerance value lower than ± 10 percent.

The adjustment member 118 is configured for rotating the plurality of teeth 116 about an axis relative to the first locking means 120, and the first locking means 120 is configured for
30 snap-fitting together with the plurality of teeth 116. The first locking means 120 is designed to be a releasable engagement with the plurality of teeth 116. The release of the engagement may occur upon an application of a force to rotate the adjustment

member 118 which causes a tooth to be released from the first locking means 120 and a next tooth to be engaged into the first locking means 120. In an example, the first locking means 120 may be a spring lock or a bracket for holding the shaft in place and/or for reducing vibration when in operation. Ideally, the adjustment member is positioned proximate a lower end of the shaft. The adjustment member 118 is coaxial with the shaft and the shaft is configured for rotating about an axis, X at 360 degrees.

Each of the calibration values corresponds to a predetermined interval, preferably at a constant interval, within each 360° rotation. The plurality of teeth 116 is at least 15 and more preferably, 20. In this example, each calibration value is at most 24 degrees or more preferably, 18 degrees within each 360 degrees of rotation. The shaft is configured to rotate about the axis in a clockwise direction or an anti-clockwise direction.

With reference to FIG. 2a, the engaging means 106 is coaxial with the shaft and configured for supplying a means for receiving a portion of the shaft. The means for receiving the portion of the shaft may be a detent means 108, eg. a spring. It shall be understood by a person skilled in the art that an equivalent of other detent means that functions in the same manner as a spring, i.e. to allow longitude or latitude movement shall be applicable.

The engaging means 106 is configured for coupling the shaft to a cylindrical body 104 of the rotatable input member. The cylindrical body 104 of the rotatable input member has an axis, X', parallel to the axis, X of the shaft, the cylindrical body 104 being configured for rotating in an opposing direction as the shaft, thereby producing a counter torque.

FIG. 2b illustrates the entire calibrating mechanism including the calibrating device 300, where the shaft body has a first portion 112 narrower in diameter compared with the other parts of the shaft body. A second portion 114 of the shaft has a plurality of threads. Ideally, the plurality of threads fulfills the ISO metric screw threads of M5, i.e. with a pitch between 0.05mm to 0.08mm. Referring back to FIG. 2a, the plurality of threads may include a second locking means 110 at the second portion 114 of the shaft.

In operation, rotating the shaft in a direction creates a higher torque and rotating the shaft in the opposing direction creates a lower torque. As shown in FIG. 2a, the engaging means is flexibly coupled to the cylindrical body of the rotatable input member. The cylindrical body comprise a protruding part having a plurality of grooves therebetween, for engagement with the engaging means. Upon rotation of the rotatable input member, the engaging means may be capable of flexibly traversing the protruding part having the plurality of grooves on one side to thereby cooperate with the rotation of the rotatable input member. As the engaging means also engages the shaft, the engaging means therefore provides the cooperative link between rotation of the shaft and rotation of the rotatable input member by way of the flexible coupling.

The higher torque results in a higher counter torque required for rotating the rotatable input member and conversely, the lower torque results in a lower counter torque required for rotating the rotatable input member.

FIG. 2c shows a bottom view of the calibrating device engaged with the cylindrical body (not shown) of the dial, the calibrating device within a housing of the dial. The plurality of teeth 116 is releasably engaged or snap-fitted with the first locking means

120. The adjustment member 118 is not coupled or attached to any other means. The adjustment member may be configured outside of the housing. It shall be understood by a person skilled in the art, this arrangement is necessary for the rotating the shaft of the calibrating device. In a production line, a separate equipment may be necessary for rotating the adjustment member 118 for calibration purposes.

FIG. 2d shows a top view of the calibrating device engaged with the cylindrical body 104. The plurality of teeth 116 is releasably engaged or snap-fitted with the first locking means 120.

Referring back to FIG. 2a, the detent means 108 comprises a second locking means 110 and the shaft further comprises a threaded portion 114 (as shown in FIG. 2b) for receiving the second locking means 110 to maintain the detent means 108 in place. The second locking means 110 is connected to the threaded portion 114 of the shaft for maintaining the torque at its predetermined calibration value.

In a preferred embodiment, rotating the shaft in a direction winds the threaded portion 114 into the second locking means 110 thereby creating a higher torque; and rotating the shaft in the opposing direction unwinds the threaded portion from the second locking means 110 thereby creating a lower torque. The second locking means 110 may be a lock nut or the like.

The adjustment member 118 may be configured for rotating at least 3 rotations about the axis to provide the highest counter torque. Referring to FIG. 5, a graphical representation 500 of a measurement of force (torque) relative to the number of rotations of the calibration mechanism according to a preferred embodiment of this invention is provided.

As shown in FIG. 5 here, the readings are relative to a rotation of 3 times clockwise and 3 times anti-clockwise. By way of an example, at 0 degrees, the force acting on the detent means or spring is approximately 1.5N. Rotating the calibrating mechanism in a clockwise direction, compresses the detent means or spring, thereby achieving a higher force acting on the detent means or spring. Ideally, the force adjustment per rotation, or 360 degrees of the calibrating mechanism yields approximately 0.35N. On the other hand, rotating the calibrating mechanism in an anti-clockwise direction decompresses the detent means or spring, thereby achieving a lower force acting on the detent means or spring. The detent means or spring is configured to move in a longitude or latitude direction. On the same note, the force adjustment per rotation, or 360 degrees of the calibrating mechanism yields approximately -0.35N.

Each of the calibration value is at a predetermined interval, preferably at a constant interval, within each 360° rotation. The plurality of teeth 116 may be at least 15 and each calibration value is therefore at most 24 degrees within each 360 degrees of rotation when the calibration interval is constant. A larger number of teeth provides for a larger number of calibration values. Thus, the number of teeth may preferably be at least 15, 16, 17, 18, 19, 20, or more. In a preferred embodiment, there are 20 teeth and each calibration value is 18° per teeth within the 360° rotation. The shaft is configured to rotate about the axis in a clockwise direction or an anti-clockwise direction.

In a second aspect of this invention, a device for calibrating torque tolerance of a rotatable input member is provided. The device comprises the torque calibrating mechanism as described above, and a housing to house the torque calibrating mechanism.

The housing 102 further comprises an opening to access the adjustment member. In operation, a measuring device (not shown in figures) for rotating the rotatable input member and measuring a torque for rotating the rotatable input member is further provided. It shall be understood by a person skilled in the art such a measuring device are known in the art and easily available, such as a dial gripper. Ideally, the dial gripper is capable of measuring a torque of preferably 0.0175Nm.

FIG. 3 illustrate a cross-sectional profile view of the calibrating mechanism within a dial with housing. FIG. 4 shows a cross sectional view of the calibrating mechanism within a housing 102 of the dial. As shown here in both FIG. 3 and FIG. 4, the engaging means 106 is flexibly coupled to a cylindrical body 104, the cylindrical body 104 having a protruding part 401 that allows the flexible coupling. The protruding part 401 may have a plurality of grooves on one side (not shown) therebetween. The engaging means 106 comprises a first end that engages with the plurality of grooves of the protruding part 401 of the cylindrical body 104 and a second end configured for a detent means 108. The detent device 108 is further capable for receiving first portion 112 of the shaft body of the calibrating device 300. At rest, the first end of the engaging means 106 rests within a groove of the cylindrical body 104. Upon rotation of the cylindrical body 104, the first end of the engaging means 106 is forced to compress as it moves out of the groove and past the protruding part 401. The compression is provided by way of the detent means 108 at the second end of the engaging means 106. Thus, the engaging means 106 as a whole is capable of traversing a protruding part 401 and into at least one of the plurality of grooves of the cylindrical body 104. The first portion 112 of the shaft body, being fixedly received in the detent means 108, therefore also compresses along with the detent means 108 and engaging means 106 to settle in the next groove. Thus, the

engaging means 106 is able to flexibly couple to the shaft. The second locking means 110 or a compatible lock nut is screwed on or winded together with the second portion 114 of the shaft having a plurality of threads. The shaft has a further portion, or third
5 portion, with plurality of teeth which is releasably engaging or snap fit with the first locking means 120, eg. a spring lock. As shown here in FIG. 3, the housing 102 of the dial has an opening 302 showing the adjustment member 118 of the calibrating device 300. The aforesaid setup allows rotating the adjustment member
10 118 for calibrating the torque of the dial.

When in operation, for example in a production line, a decision unit (not shown in figures) may be used to receive the counter torque measurement and calibrate the torque tolerance of the
15 rotatable input member is provided. The decision unit is capable of benchmarking the measurement of the torque tolerance of the rotatable input member against a predetermined value, eg. a predetermined nominal torque value to execute a desired calibration value and send a command to rotate the torque calibrating
20 mechanism 200.

The term "decision unit" or "control unit" shall be construed to refer to a hardware device that includes a memory and a processor. The memory is configured to store a database of calibration
25 values, including a predetermined nominal torque value for benchmarking purposes and the processor is specifically configured to execute a decision based on readings of the measuring device, to perform one or more processes described above.

30 In a third aspect of this invention, a method for calibrating torque tolerance of a rotatable input member by means of the device as described above is provided. The method further comprises the steps of (1) engaging the rotatable input member 304 by means of the measuring device; (2) rotating the rotatable

input member 304 and measuring a counter torque; (3) determining a deviation between the measured counter torque and a desired torque; (4) determining an adjusting value by means of the deviation for controlling the adjustment member 118; and (5) rotating the shaft by means of the adjustment member according to the adjusting value to achieve the desired torque.

The motion of rotating the shaft in a clockwise direction yields a higher counter torque value, and rotating the shaft in an anti-clockwise direction yields a lower counter torque value.

Patent claims

1. A torque calibrating mechanism (200) for a rotatable input member (304) being coupled and placed in a housing (102),
5 the torque calibrating mechanism (200) having a calibrating device (300), the calibrating device (300) comprising,

a shaft having an adjustment member (118) for rotating the shaft according to a range of calibration values, a
10 plurality of teeth (116) configured for coupling the shaft to a first locking means (120); and

engaging means (106) for engaging the shaft with the rotatable input member (304) for generating torque for the rotatable input member (304);

15 wherein the engaging means (106) is flexibly coupled to the shaft for adjusting the torque by adjusting the engagement between the shaft and the first locking means (120).

2. The mechanism of Claim 1, wherein the adjustment member (118) is configured for rotating the plurality of teeth (116) about an axis relative to the first locking means (120), wherein the first locking means (120) is configured for snap-fitting together with the plurality of teeth (116).
20

3. The mechanism of any of the preceding claims, wherein the adjustment member (118) is coaxial with the shaft and the shaft is configured to rotate about an axis at 360 degrees.
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4. The mechanism of claim 3, wherein each calibration value is at a predetermined interval, preferably at a constant interval, within each 360° rotation.
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5. The mechanism of claim 4, wherein the plurality of teeth (116) is at least 15 and each calibration value is at most 24° within each 360° rotation.
- 5 6. The mechanism of any of the preceding claims, wherein the shaft is configured to rotate about the axis in a clockwise direction or an anti-clockwise direction.
- 10 7. The mechanism of any of the preceding claims, wherein the engaging means (106) is coaxial with the shaft and configured for supplying a means for receiving a portion of the shaft.
- 15 8. The mechanism of claim 7, wherein the means for receiving the portion of the shaft is a detent means (108).
- 20 9. The mechanism of any of the preceding claims, wherein the engaging means (106) is configured for coupling the shaft to a cylindrical body (104) of the rotatable input member (304).
- 25 10. The mechanism of claim 9, wherein the cylindrical body (104) of the rotatable input member (304) has an axis parallel to an axis of the shaft, the cylindrical body (104) being configured for rotating in an opposing direction as the shaft.
- 30 11. The mechanism of any of the preceding claims, wherein rotating the shaft in a direction creates a higher torque and rotating the shaft in the opposing direction creates a lower torque.
12. The mechanism of claim 11, wherein the higher torque results in a higher counter torque required for rotating

the rotatable input member; and the lower torque results in a lower counter torque required for rotating the rotatable input member (304).

- 5 13.The mechanism of any of the preceding claims, wherein the shaft comprises a threaded portion (114) configured for receiving a second locking means (110) to maintain the torque at its predetermined calibration value.
- 10 14.The mechanism of claim 13, wherein rotating the shaft in a direction winds the threaded portion into the second locking means (110) thereby creating a higher torque; and rotating the shaft in the opposing direction unwinds the threaded portion (114) from the second locking means (110)
- 15 thereby creating a lower torque.
- 15.The mechanism of any of claims 13-14, wherein the second locking means (110) is a lock nut.
- 20 16.The mechanism of any of the preceding claims, wherein the adjustment member (118) is configured for rotating at least 3 rotations about the axis to provide the highest torque.
- 25 17.A device for calibrating torque tolerance of a rotatable input member (304), the device comprising the torque calibrating mechanism (200) of any one of the preceding claims and a housing (102) to house the torque calibrating mechanism (200).
- 30 18.The device of Claim 17, wherein the housing (102) comprises an opening (302) to access the adjustment member (118).
- 19.The device of any of claims 17 - 18, further comprising a measuring device for rotating the rotatable input member

(304) and measuring a counter torque for rotating the rotatable input member (304).

20. The device of claim 19, further comprising a decision unit operable to receive the counter torque measurement and calibrate the torque tolerance of the rotatable input member (304).

21. A method for calibrating torque tolerance of a rotatable input member (304) by means of the device according to any of claims 18-21, the method comprising the steps of:

engaging the rotatable input member by means of the measuring device

rotating the rotatable input member and measuring a counter torque

determining a deviation between the measured counter torque and a desired torque

determining an adjusting value by means of the deviation for controlling the adjustment member (118)

rotating the shaft by means of the adjustment member according to the adjusting value to achieve the desired torque.

22. The method of Claim 21, wherein rotating the shaft in a clockwise direction yields a higher torque value and rotating the shaft in an anti-clockwise direction yields a lower torque value.

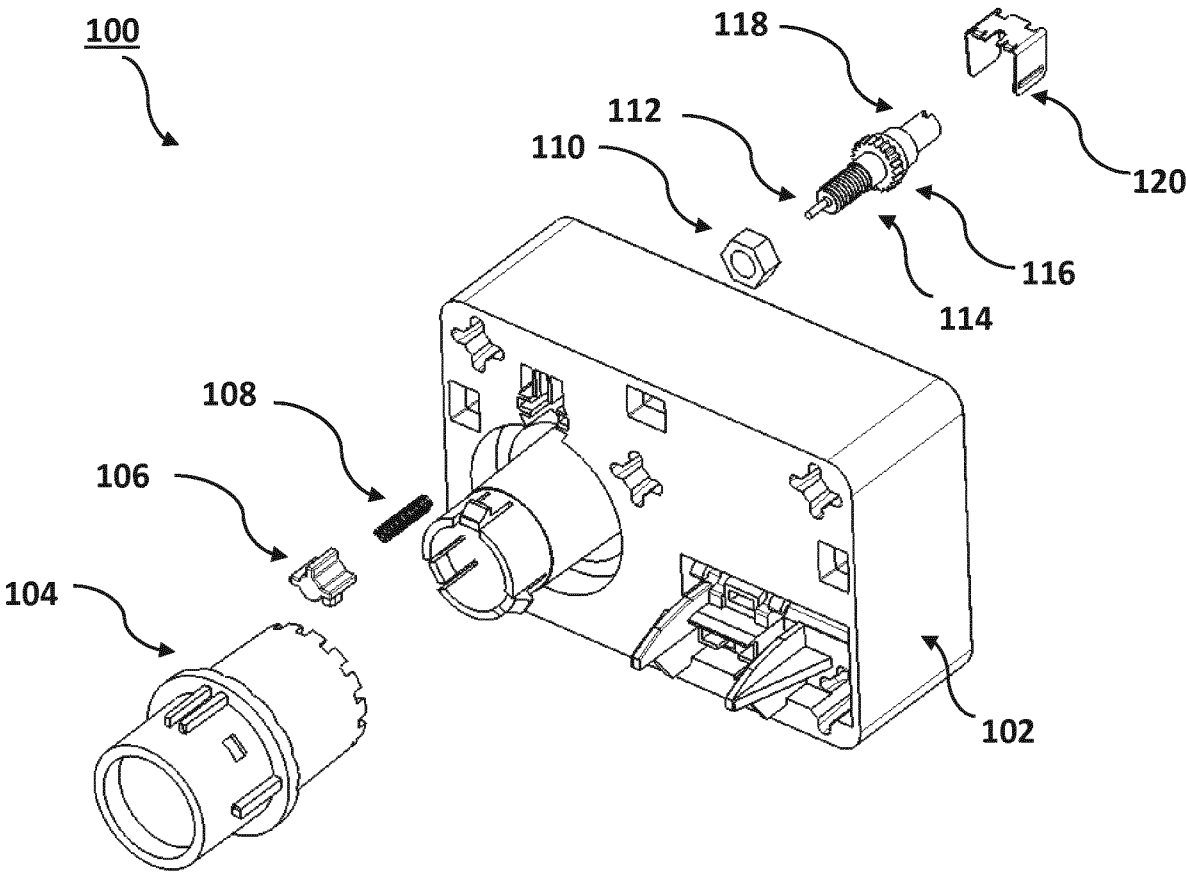


FIG. 1

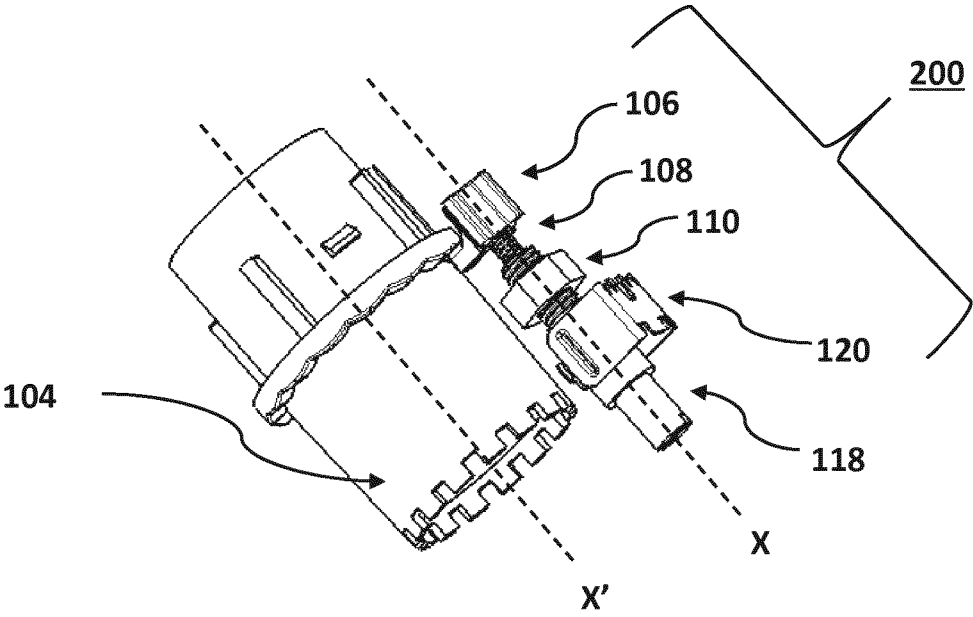


FIG. 2a

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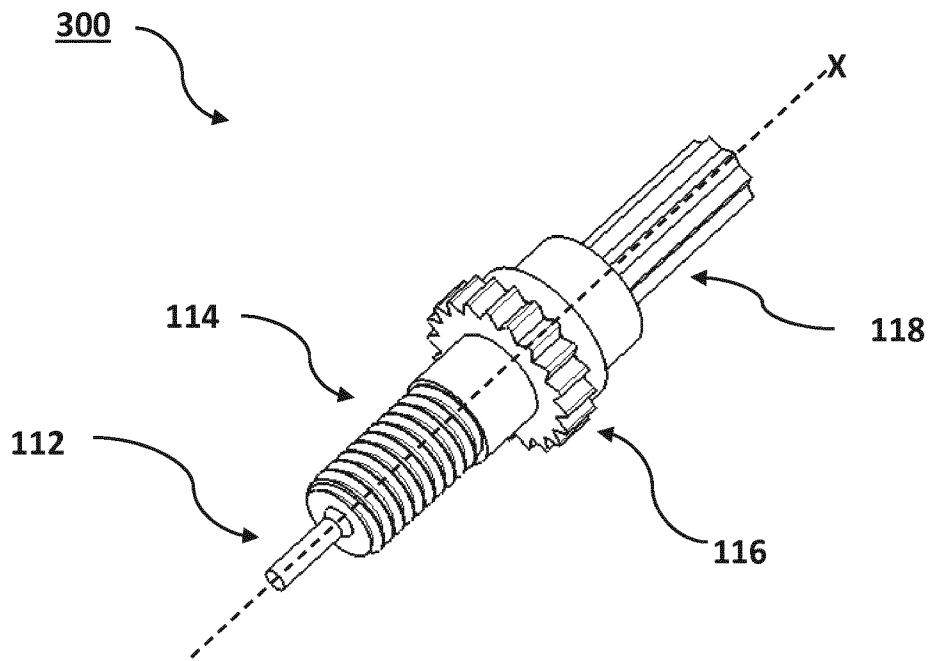


FIG. 2b

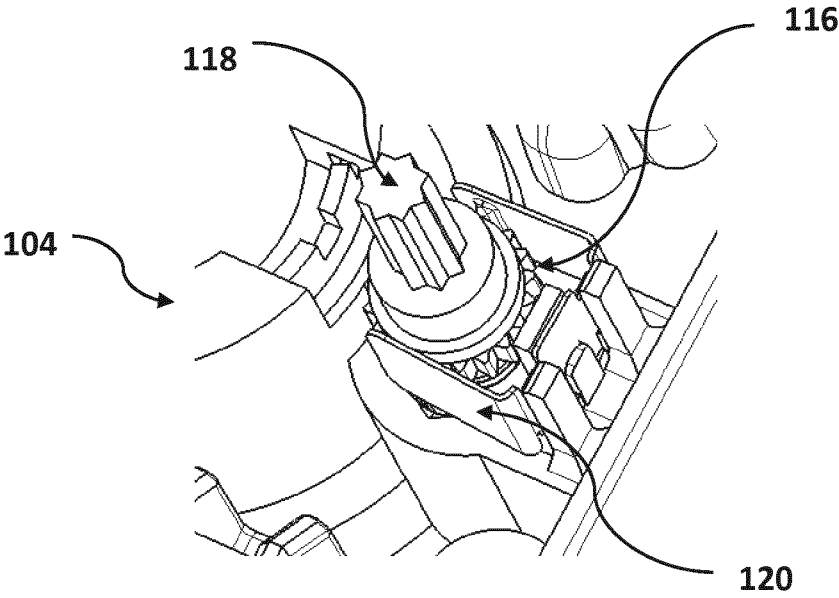


FIG. 2c

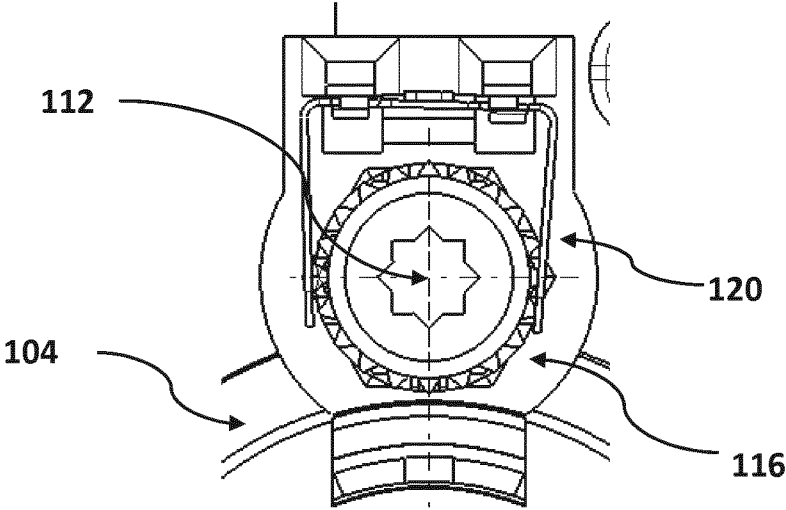


FIG. 2d

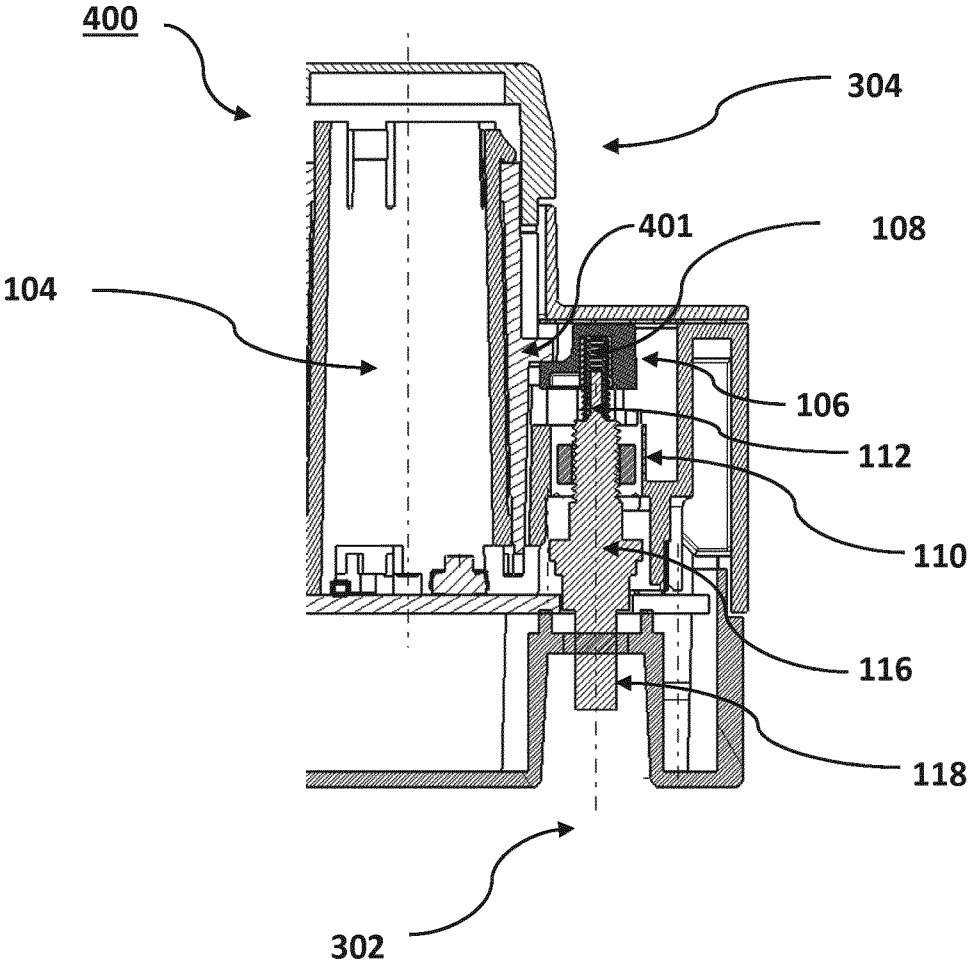


FIG. 3

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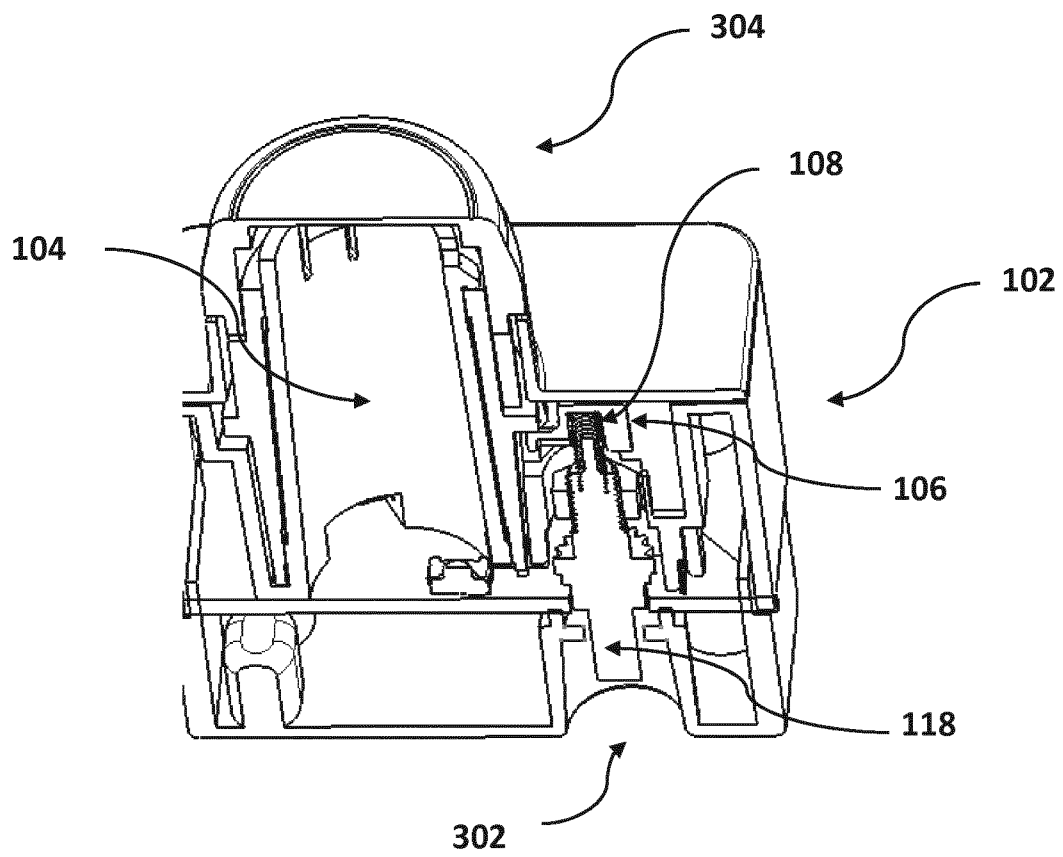


FIG. 4

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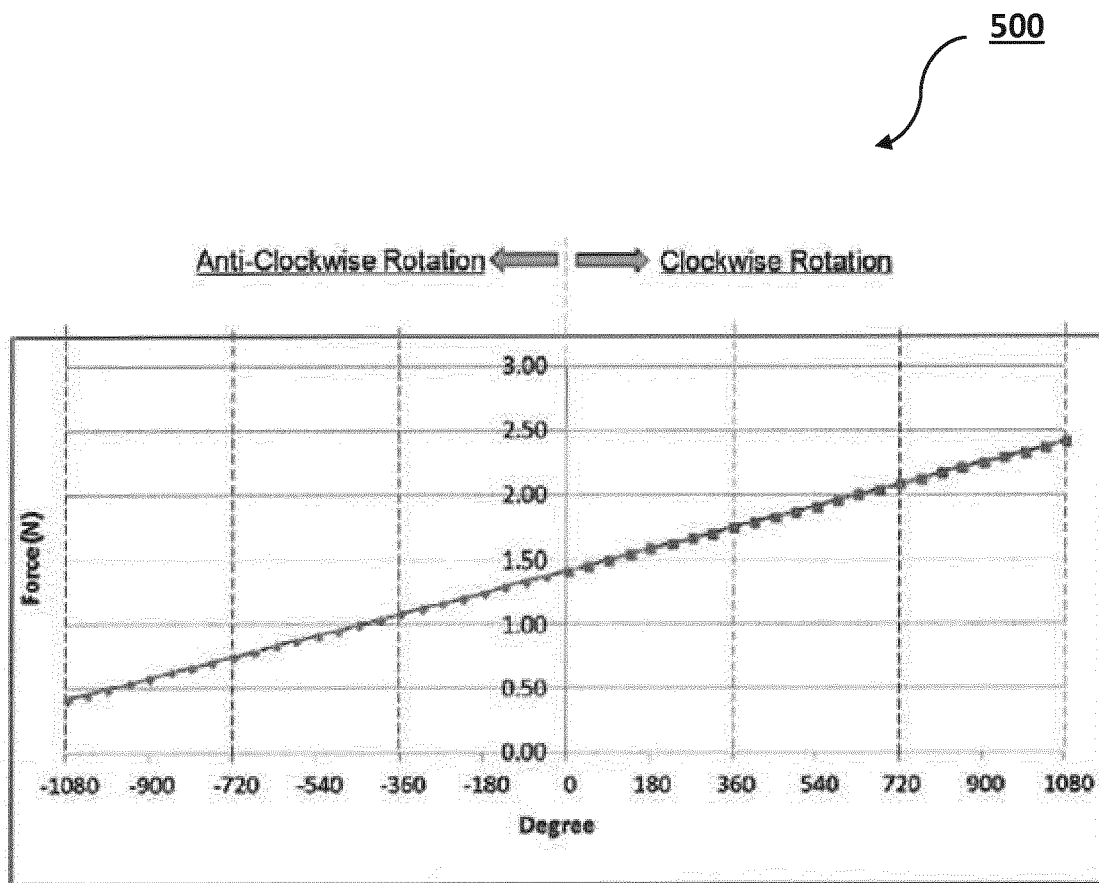


FIG. 5

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2017/060149

A. CLASSIFICATION OF SUBJECT MATTER
INV. G05G1/08 G01L25/00 H01H3/50 H01H11/00
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)
G05G H01H G01L

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	Anonymous: "HANDLES / KNOBS / SCREW CLAMPS, KNURLED KNOBS & SCREW CLAMPS, Swivel Head Screws :: Carr Lane Manufacturing Co.", 23 December 2015 (2015-12-23), XP055443208, Retrieved from the Internet: URL:https://web.archive.org/web/20151223043609/http://www.carrlane.com:80/catalog/index.cfm/27825071F0B221118070C1C513E111D081B0006280B1713050245221E0107070F1A3C3B2853524158 [retrieved on 2018-01-22] the whole document ----- -/-	1-3,6,7, 13-19



Further documents are listed in the continuation of Box C.



See patent family annex.

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"&" document member of the same patent family

Date of the actual completion of the international search

30 January 2018

Date of mailing of the international search report

09/02/2018

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Authorized officer

Schambach, Philip

INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2017/060149

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2014/144615 A1 (KOSTAL OF AMERICA [US]) 18 September 2014 (2014-09-18) figures 1-3 paragraphs [0010] - [0014] -----	1,2,6, 9-12,17, 19-22
X	DE 100 22 612 A1 (KOSTAL LEOPOLD GMBH & CO KG [DE]) 29 November 2001 (2001-11-29) figures 1-18 paragraphs [0027], [0031] -----	1,3-8,16

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2017/060149

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2014144615	A1	18-09-2014	CN 105210000 A 30-12-2015
			DE 112014001481 T5 10-12-2015
			US 2016020045 A1 21-01-2016
			WO 2014144615 A1 18-09-2014

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