



(11) **EP 4 273 355 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
08.11.2023 Bulletin 2023/45

(51) International Patent Classification (IPC):
E05B 17/20 (2006.01) **E05B 47/06** (2006.01)
E05B 47/00 (2006.01) **E05B 15/04** (2006.01)

(21) Application number: **22171351.4**

(52) Cooperative Patent Classification (CPC):
E05B 47/068; E05B 17/2084; E05B 47/0012;
E05B 2015/0413; E05B 2047/0031

(22) Date of filing: **03.05.2022**

(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 MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

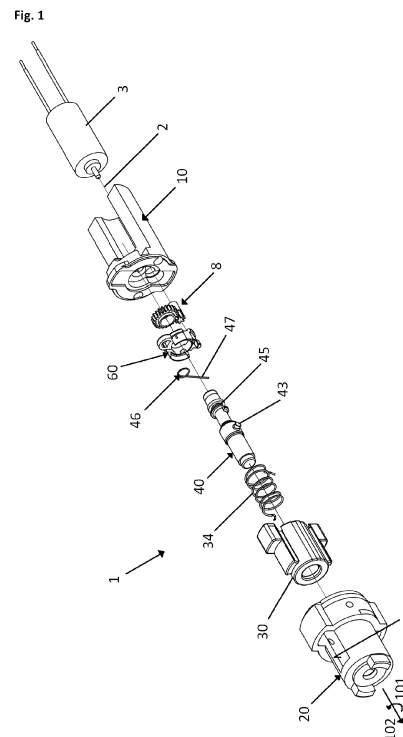
(71) Applicant: **Uhlmann & Zacher GmbH**
97297 Waldbüttelbrunn (DE)

(72) Inventor: **Lauer, Andreas**
97230 Estenfeld (DE)

(74) Representative: **Lohr, Jöstingmeier & Partner**
Junkersstraße 3
82178 Puchheim/München (DE)

(54) **CLUTCH ACTUATOR FOR A DOOR LOCK**

(57) A clutch actuator for a door lock comprises a first shaft with a longitudinal shaft axis and an azimuthal bearing surface, wherein the azimuthal bearing surface provides a first block against a rotation in a first direction, the first direction is an azimuthal direction and the first block extends in at least one second direction, the first and the second direction are linearly independent. The clutch actuator further comprises a coupling member, being movably supported relative to the shaft by the bearing surface between an open position and a closed position, wherein the coupling member has at least a first spring block and a second spring block and wherein the first spring block and the second spring blocks face in mutually opposite directions, said mutual opposite directions being parallel to a third direction. A helical spring is movably supported relative to the first shaft to enable a movement parallel to the third direction, wherein the movement parallel to the third direction is limited in the third direction by the first spring block and in the opposite direction by the second spring block and wherein the helical spring has multiple windings. A spindle is torque proof connected to a motor shaft and rotatably supported relative to the first shaft, wherein a protrusion of the spindle engages in a void between two adjacent windings of the helical spring. Safety provided by the clutch actuator against manipulation is enhanced if the coupling member has a first interlocking protrusion extending towards the spindle and if the spindle has a second interlocking protrusion extending towards the coupling member, wherein in the open position of the coupling member the second interlocking protrusion intersects the path of the first interlocking member from the open position to the closed position.



EP 4 273 355 A1

Description

Field of the invention

[0001] The invention relates to a clutch actuator for a door lock. The clutch actuator may comprise a shaft with a longitudinal axis and an azimuthal bearing surface, wherein the azimuthal bearing surface may provide a block against a rotation in an azimuthal direction and may extend in at least one other direction. The clutch actuator may further comprise a coupling member, being movably supported relative to the shaft by the azimuthal bearing surface between an open position and a closed position. The coupling member may have at least a first spring block and a second spring block, The first spring block and the second spring blocks may face in mutually opposite directions, wherein said mutual opposite directions may be parallel or anti-parallel to a third direction. A helical spring may be movably supported to enable a movement parallel to the third direction, wherein the movement of the helical spring parallel to the third direction may be limited in the third direction by the first spring block and in the opposite direction by the second spring block. The helical spring may have multiple turns. A spindle may be torque proof connected to a motor shaft and rotatably supported, wherein a protrusion of the spindle may engage in a void between two adjacent turns of the helical spring.

Description of the related art

[0002] Electronic locks ("locks" for short) become more and more popular as they allow for lean access management of infrastructure like offices, flats, hotel rooms, safes, cars, manufacturing sites, etc.. Corresponding locking systems comprise at least one user device with an electronic identification for authentication of a user. The electronic identification is transmitted from the user device to the lock and if the key is considered valid by the lock, the lock changes its state from unlocked to locked or from locked to unlocked. The electronic identification takes the function of a mechanical key in a purely mechanical locking system. Presently, most electronic locking system use so called RFID-transponders as user devices. There are numerous applications explaining different aspects of this technique (see e.g. EP 1 710 753 A2, WO 03/071060 A1, EP 2 195 767 A1, EP 1 787 241 B1 to name only a few). Alternatively keypads, fingerprint scanners, iris scanners or any other human machine interface may be used to enter a code that functions as a key to the electronic lock.

[0003] When a lock changes its state from "locked" to "unlocked" a user gains access to a building, a room, a cabinet or a drawer or something else. One possibility to provide the access is to enable a user to operate a latch and/or a dead bolt (jointly "latch" hereinafter, unless explicitly stated). This can either be done by unblocking the latch, i.e. by releasing a coupling between the latch and

a door leaf and/or a door frame. Alternatively, the latch may be coupled to a handle. In both cases a selective coupling needs to be opened and closed. Such selective couplings are as well referred to as clutches and are known from a number of publications, e.g. EP 2 473 690 A1, DE 102 35 201 A1, DE 198 54 454 A1, GB 2 262 770 A to name only very few. The initially described clutch actuator has been suggested in US 10,927,569 B2.

[0004] All these clutches have a clutch actuator mechanism. These clutch actuator mechanisms are reliable in that the motor for moving the coupling member from the closed position to the open position can be actuated without checking if the coupling member is blocked or jammed and in that the coupling member is moved in the corresponding position once the blockage or jamming is resolved due to an elastic connection between the motor's drive shaft and the coupling member being provided by the spring. The spring temporally decouples a movement of the coupling member from an actuation of the motor.

Summary of the invention

[0005] The object underlying the invention is to improve safety of a door lock with a clutch for coupling a handle shaft with a locking member shaft.

[0006] Solutions of the problem are defined by the independent claims. Advantageous embodiments are subjects of the dependent claims.

[0007] The clutch actuator according to the invention may be used to open and close a clutch for selectively coupling two preferably aligned shafts of a door lock mechanism. The clutch actuator may be integrated into at least one of the two shafts may be hence comprise a (first) shaft of these two shafts.

[0008] The first shaft (hereinafter "the shaft") has a longitudinal axis. In operation, the longitudinal axis may be the rotational axis of the shaft. The longitudinal axis implicitly defines an azimuthal direction (herein as well "the first direction"). The shaft may further comprise a first azimuthal bearing surface, wherein the first azimuthal bearing surface provides a first block against a rotation in the azimuthal direction and extends in at least one other direction. This other direction will be referred to as well as second direction. Only to avoid misunderstandings, the first and the second direction are linearly independent. The first block can thus be considered as an abutment blocking a rotation in the azimuthal direction, while allowing for a movement along the surface of the block in the second direction. The azimuthal abutment, i.e. the azimuthal bearing surface, may thus limit a rotation of a coupling member in the azimuthal direction, while allowing for a translation and/or a rotation and/or pivotal movement in at least the second direction (and of course opposite to the second direction). Thus, via the block a torque can be transferred by the coupling member in the azimuthal direction into the shaft and the coupling member can be moved, e.g. shifted, relative to the shaft from

an open position and/or orientation (jointly "open position") into a closed position and/or orientation (jointly "closed position"). In other words, the coupling member is preferably movably supported at least inter alia by the bearing surface between the open position and the closed position.

[0009] As already apparent, the coupling member preferably has a second azimuthal bearing surface, wherein the second azimuthal bearing surface provides a second block against a rotation in a direction opposite to the first direction. In case the azimuthal direction is clockwise, the opposite direction is counter clockwise and vice versa. In both cases, the second block may face towards the first block and may extend as well at least in the second direction.

[0010] Assuming the coupling member to be in its open position, the movable support of the coupling member relative to the shaft hence allows to extend at least a portion of the coupling member into a recess of a second shaft of the clutch, thereby providing a positive locking of the first shaft and the second shaft in an azimuthal direction via the coupling member. Of course, the coupling member may alternatively or in addition be extended in its closed position over at least a portion of the second shaft to provide a positive locking. In other words, a recess of the coupling member may be shifted over at least a portion of the second shaft. In both cases, a positive locking can be obtained, typically if the recess and the corresponding portion of the second shaft or the coupling member, respectively are not continuously rotationally invariant, i.e. if they have broken rotational symmetries with respect to the longitudinal axis. In addition or as an alternative to the positive locking, the coupling may as well be provided by a releasable friction connection often as well referred to as force fit. In case the force fit is an alternative, at least one of the coupling member and the corresponding portion of the second shaft can be continuously rotationally invariant.

[0011] The movable support allows as well to retract the coupling member into its open position. In the open position, the positive locking and/or the force fit of the coupling member with the second shaft is released. In the open position, the torque proof connection provided by the azimuthal block of the first shaft may be released.

[0012] The coupling member may have at least a first spring block and a second spring block. The first spring block and the second spring block may preferably face in mutually opposite directions. These mutual opposite directions are preferably parallel to a third direction. The third direction and the second direction may preferably be parallel or anti-parallel to each other. This (anti) parallelism is a preferred example as it simplifies the clutch actuator, but it is not required.

[0013] A helical spring may be movably supported to enable a movement parallel to the third direction, wherein the movement parallel to the third direction is limited in the third direction by the first spring block and in the opposite direction by the second spring block. The helical

spring may have multiple turns.

[0014] A spindle may be torque proof connected to a motor shaft and rotatably supported, wherein a protrusion of the spindle may engage in a void between two adjacent turns of the helical spring. Alternatively, the protrusion of the spindle may form a recess into which the filament forming the helical spring engages. Thus, operating the motor shifts the helical spring towards the corresponding spring block. Continued operation of the motor loads the helical spring against the corresponding spring block and - if the coupling member is not blocked or jammed - shifts the coupling member in or against the third direction. In other words, operating the motor allows to move the coupling member from its open position into its closed position and back into its open position, the latter by simply inverting the direction of rotation of the spindle.

[0015] In some embodiments, a movement in the open or in the closed direction of the coupling member may load a secondary spring. In this case, the secondary spring may push the coupling member back into the closed or open position, respectively (i.e. after the secondary spring has been loaded), respectively, if the force being applied by the helical spring is reduced by rotating the spindle in the corresponding direction. In this case, the surface of the coupling member against which the secondary spring pushes, may be considered as the first or the second spring block and the secondary spring may be considered as a portion of the helical spring, regardless of the type of the secondary spring.

[0016] In any case, the position of the coupling member is controlled by rotating the spindle. A rotation of the spindle shifts the position of the coupling member in which an equilibrium of the restoring forces of the at least one loaded spring is established (equilibrium position). If the coupling member is not blocked, it hence moves into this equilibrium position. If it is blocked it cannot move, but once the blocking is released, the coupling member will move in the direction into which it is preloaded. The spring(s) hence enable to decouple the point in time of controlling the drive which rotates the spindle and the point in time the coupling member moves as a result of the rotation of the spindle as the spring(s) store the work provided by the drive and provide it once blocking of the coupling member is released.

[0017] Preferably, the coupling member has a first interlocking protrusion. The optional first interlocking protrusion may extend towards the spindle. The spindle may have a second interlocking protrusion extending towards the coupling member. When moving the coupling member from the open position to the closed position, the first interlocking protrusion is moved along a line and the movement of the contour of the first interlocking protrusion along this line defines a surface, being given by the set of trajectories of the points defining the contour. Herein, this surface will be referred to as "the path". Assuming the contour to be closed (not being required - only selected as vivid example) and the trajectories to be straight lines, the movement of the first interlocking protrusion

from the open position to the closed position hence defines a cylinder surface (for a definition of a cylinder surface, see Bronshtein, Semendayev, Musiol, Muehlig, Handbook of Mathematics, Springer, 5th ed., Sect. 3.3.4, ISBN 978-3-540-72121-5). Of course, other trajectories are possible as well. The second interlocking protrusion intersects the path. Thus, the coupling member cannot be moved along the path unless at least one of the two interlocking protrusions is moved out of said path. An unauthorized temporal shift of the coupling member, e.g. being induced by an oscillation of the door leaf cannot cause the coupling member to move into its closed position. Even if oscillating the clutch actuator would provide the coupling member a momentum and sufficient kinetic energy to compress the helical spring to temporarily be moved into its closed position, such movement is reliably inhibited by the interaction of the first interlocking member and the second interlocking member, which simply abut each other and hence prevent the coupling member to be moved into its closed position.

[0018] Generally, the first interlocking protrusion and the second interlocking protrusion preferably have a radial overlap, wherein "radial" references to the spindle axis. Radial overlap, as usual, means that the intersecting set of the extension of the first interlocking protrusion in the radial direction and set of the extension of the second interlocking protrusion is not empty. Thus, an appropriate azimuthal alignment of the first interlocking protrusion and the second interlocking protrusion assumed, the interlocking protrusions block a movement of the coupling member from the open position towards its closed position.

[0019] On the other hand, the spindle is rotated to drive the coupling member into the closed position. With the spindle, the second interlocking protrusion rotates relative to the coupling member and thus enables the first protrusion to pass the path.

[0020] The first interlocking protrusion and the second interlocking protrusion preferably each have passage (first passage and second passage, respectively), wherein the first interlocking protrusion fits into or through the second passage and the second interlocking protrusion fits into or through the first passage, while the spindle is rotated relative to the coupling member to load the helical spring towards or against the second direction and to thereby move the coupling member from its open position into its closed position or from the closed position into the open position, respectively. The passages may be considered as recesses having an azimuthal extension allowing the corresponding other interlocking protrusion to pass the respective passage while the spindle is rotated and the coupling member moves towards its closed position. The first passage is thus between at least two surfaces that connect the two axially facing sides of the first interlocking protrusion and the second passage is in between of at least two surfaces that connect the two axially facing sides of the second interlocking protrusion, wherein axially references to the spindle axis.

Only to avoid ambiguities, the spindle axis may be at least essentially aligned with the longitudinal shaft axis, such alignment is preferred but not required.

[0021] Summarizing, the invention is, inter alia, based on the observation, that the elastic connection between the coupling member and the motor for driving the coupling member as well provides the risk, that the coupling member is shifted into its closed position by inducing an oscillation of the coupling member, e.g. by hammering against the door leaf, hitting the door lock or the like. This may in some cases allow a non-authorized person to bring the coupling member at least for short period of time into a position in which the coupling member engages with its counterpart (closed position). If in this moment the clutch is loaded by operating the handle, the coupling member is jammed by the load and the latch and/or the dead bolt can be retracted. The interaction of the first and the second interlocking protrusions, however, protects against such un-authorized movement of the coupling member into the closed position. Unauthorized access to a door having a door lock with the claimed clutch actuator can be avoided. The safety of door locks can be enhanced by the clutch actuator.

[0022] In a preferred example, at least one of the first interlocking protrusion and the second interlocking protrusion is a helical structure aligned with the spindle axis or in other words at least one of the first interlocking protrusion and the second interlocking protrusion is and/or forms a screw thread being aligned with the spindle axis, while the respective other interlocking member is configured to temporarily engage and travel through the voids between turns of the helical structure while the spindle is rotated. In a first example, the first interlocking member is a pin and the second interlocking protrusion is a helical structure. In a second example, the first interlocking protrusion is a helical structure and the second interlocking protrusion is a pin. In a third example, the first interlocking protrusion and the second interlocking protrusion are both helical structures. In all these three examples, the void between the turns of at least one helical structure provides a helical passage for the respective other interlocking protrusion. In the example, in which an interlocking protrusion is a radially or an anti-radially extending pin, the passage provided by said radially or an anti-radially extending pin is formed by the azimuthal void connecting the two azimuthally facing sides of the pin.

[0023] In case an interlocking protrusion is a pin, it is preferred if the pin is elastically supported. For example, the pin may be a leg of a torsion spring. Such elastic bearing of the pin increases reliability and reduces wear of the clutch actuator.

[0024] Preferably, the length of the helical structure measured parallel to the spindle axis is shorter than the distance between the open position and the closed position. This measure increases reliability of the clutch actuator.

[0025] Preferably, the second interlocking protrusion is in the first half, first third, first fourth and/or first sixth

of the path the first interlocking protrusion is moved if the coupling member is moved from the open position to the closed position.

[0026] Thereby, a potential engagement of the first interlocking protrusion and the second interlocking protrusion is released, well before the coupling member reaches its closed position and blocking of the spindle by a jammed or blocked coupling member is reliably avoided, because the spindle and the coupling member are connected only via the helical spring.

[0027] Preferably, the sum of the widths of the first interlocking protrusion and the second interlocking protrusions measured parallel to the third direction is smaller than the distance the coupling member is moved in the third direction by n or less than n revolutions of the spin-

dle, wherein $n \in \{5, 4, 3, 2, 1, \frac{3}{4}, \frac{1}{2}, \frac{1}{4}\}$. This ensures, that the interlocking of the interlocking protrusions is released reliably after the corresponding number of n

turns. In particular if $n = 1$ or $1 \geq n \geq \frac{1}{4}$ the passages do not need to be helical (but may be).

[0028] The second direction and/or the third direction may be at least essentially parallel to the longitudinal axis of the first shaft. In this case, the coupling member moves forth and back parallel to the first shaft's axis. In a preferred example of this embodiment, the first shaft and the coupling member are two parts of a telescopic shaft. Alternatively, the second direction (and hence as well the third direction) may be the radial (including anti-radial) direction, relative to the first shaft's axis. In this alternative the coupling member is moved radially inwardly and outwardly to open or close the clutch. Superpositions of these preferred directions are as well possible. The first and the second directions are assumed to match herein, but this is not required. They can be linearly independent, e.g. if one transforms a movement along the azimuthal bearing surface e.g. by a lever in another direction.

[0029] Preferably, the coupling member has a groove that extends longitudinally. Or in other words, the optional groove has a longitudinal groove direction, wherein the longitudinal groove direction is preferably parallel to the third direction and/or to the second direction. At least one of the ends of the helical spring may engage into said groove, thereby blocking a rotation of the helical spring, while allowing for an axial movement of the corresponding end of the helical spring.

[0030] The clutch actuator may be integrated in a door lock clutch. The corresponding door lock thus comprises the clutch actuator and a second shaft with a second azimuthal abutment. If the coupling member in its open position, there is no azimuthal overlap of the coupling member and the second block. No overlap means in this case, that a rotation of the coupling member around the first shaft axis is not blocked by the second block. In less vivid but as well less functional wording one may say that the contour of a body being formed by rotating the cou-

pling member around the first shaft's axis does not intersect the contour of the second shaft. In the closed position of the coupling member, there is preferably such azimuthal overlap to thereby provide a positive locking between the coupling member and the second shaft in the azimuthal direction. In the less preferred case of an only frictional connection based coupling, there is of course no such overlap. In this case the coupling member is simply pressed against the second shaft.

[0031] A door handle may comprise at least a clutch having an input shaft and an output shaft. The door handle can be, e.g., a lever type door handle or a door knob to provide only two examples. Such door handles typically have an output shaft that can be coupled to a transmission of a door lock. Wherein the transmission may convert a rotation of the handle portion of the door handle into a movement of the latch and/or the dead bolt to thereby convert actuation of the handle portion into a retraction and/or extension of at least one of a latch and a dead bolt. Actuating the door handle may hence cause a retraction of the latch and/or the dead bolt. Only for simplicity we will not distinguish herein between a door lever and a door knob or any other type of door handle. The handle lever is considered as a handle portion of a door handle being configured to be pivoted and/or rotated or translated manually by a person opening or closing a door.

[0032] The handle lever is preferably being torque proof connected to the input shaft of the clutch, wherein the first shaft of the clutch actuator may be the input shaft of the door lever and the second shaft of the door lock clutch may be the output shaft of the door handle or at least torque proof connected to the output shaft. In other words, two torque proof connected shafts shall be considered as a single shaft. The torque proof connection may be provided by any kind of torque coupling. In another example, the second shaft of the clutch actuator may be the input shaft of the door lever and the first shaft of the door lock clutch may be the output shaft of the door handle or at least torque proof connected to the output shaft. Again, in this context, two torque proof connected shafts shall be considered as a single shaft.

[0033] A door lock comprising a latch bolt and/or a dead lock may in addition comprise the door lock clutch as described above. For example, the first shaft or the second shaft of the door lock clutch may be coupled via a transmission to a latch bolt and/or a dead lock. The respective other shaft may be configured to be driven by an operator, e.g., by a handle portion of a key or by a door handle. Thus, if the door lock clutch is closed, operating the handle portion may retract and/or extend a latch or a dead bolt or the door lock.

[0034] The method according to the invention may comprise operating the above described clutch actuator. The method may comprise at least one of the following steps: An optional method step is moving a coupling member being movably but torque proof connected to a first shaft with respect to a first direction, which first di-

rection is an azimuthal direction relative to the first shaft's axis, from an open position in a second and/or a third direction towards a second shaft of a door lock clutch. In the example of the above described clutch actuator, this may be obtained by powering the motor to thereby drive the spindle.

[0035] Prior to or while said moving, the method may comprise rotating a first interlocking protrusion of the coupling member through a passage in a second interlocking protrusion and the second interlocking protrusion through a passage of the first interlocking member. In the above described example, this is accomplished by driving the spindle as well. But the rotating step can as well be controlled by operating a different actuator.

[0036] As already apparent, the step of moving the coupling member may comprise loading a first spring, wherein the first spring is force transmittingly connected to the coupling member towards the second and/or the third direction, i.e. towards the closed position of the coupling member, to thereby apply a force in the second direction to the coupling member. Opening the coupling member may be accomplished by reversing the method: namely by moving the coupling member from its open position towards its closed position and while said moving or after said moving rotating the first interlocking protrusion of the coupling member through the passage in the second interlocking protrusion and the second interlocking protrusion through the passage of the first interlocking protrusion at least until the two interlocking protrusions provide mutually interlocking blocks preventing a movement of the coupling member into the closed position without again rotating the interlocking protrusions relative to each other as already explained above.

[0037] As usual in the technical field, "parallel" and is not to be understood in an exact mathematical sense, but in that two lines are considered parallel even if there exists a deviation from perfect parallelism if the angle $\pm \alpha_{dp}$ of deviation from perfect parallelism is smaller or equal to α_p , i.e. $|\alpha_{dp}| \leq \alpha_p$ and $\alpha_p \in \{30^\circ, 20^\circ, 10^\circ, 5^\circ, 2.5^\circ, 1^\circ, 0^\circ\}$. Smaller angles α_p are preferred. Similarly, "radial" and "anti-radial" shall be considered to include deviations from the perfect (anti) radial direction if the angle of deviation $\pm \alpha_{dr}$ from the perfect (anti-) radial direction is smaller or equal to α_r , i.e. $|\alpha_{dr}| \leq \alpha_r$ and $\alpha_r \in \{30^\circ, 20^\circ, 10^\circ, 5^\circ, 2.5^\circ, 1^\circ, 0^\circ\}$.

[0038] As usual, the term friction connection describes that two parts are force and/or torque transmittingly connected, wherein the force and/or torque transmission between the parts is due to frictional forces between the two parts. A positive locking in contrast provides for a force and/or torque transmission by complementary abutments. Of course, these two types of connection can be combined.

[0039] There is no substantial difference between a door and a pivotable or slideable window. The term "door" shall thus include the notion of "window" as well. The door lock clutch actuator may thus as well be used to selectively couple a window handle with a window twist-

lock or any other locking mechanism of a window. Similarly, the door handle may as well be a window handle and the door lock may be a window lock.

5 Description of Drawings

[0040] In the following the invention will be described by way of example, without limitation of the general inventive concept, on examples of embodiment with reference to the drawings.

Figure 1 shows an exploded view of a clutch actuator.

Figures 2A and 2B show sectional views of the clutch actuator in the open position.

Figure 3A and 3B show sectional views of the clutch actuator in an intermediate position.

Figure 4A and 4B show sectional views of the clutch actuator in the closed position.

Figure 5A and 5B show a front view and a perspective view, respectively, of an alternative second section of a coupling member.

[0041] In FIG. 1, a first embodiment of a clutch actuator 1 is shown. The clutch actuator 1 may comprise a first shaft 10, 20 that may comprise one or more shaft sections. In Fig. 1 two shaft sections, namely a first shaft section 10 and a second shaft section 20 are depicted, but any other integer number is possible. The shaft 10, 20 may comprise, as shown, at least one azimuthal bearing surface 22. In this example the shaft has four of these azimuthal bearing surfaces 22, but only a single one is visible in Fig. 1. Other numbers are as well possible. At least two azimuthal bearing surfaces 22 facing in opposite azimuthal directions are preferred. Reference numeral 101 indicates one of these two azimuthal directions, which is referred to as "first direction", as well.

[0042] As shown, the azimuthal bearing surface(s) 22 extend, i.a., parallel to the longitudinal axis in a second direction, being indicated as 102.

[0043] The clutch actuator 1 may further comprise a coupling member 30. The coupling member 30 may as well comprise azimuthal bearing surfaces 32 that may extend in the second direction. The azimuthal bearing surfaces 32 provide for a torque proof bearing of the coupling member 30 with the first shaft 10, 20 while allowing to move the coupling member 30 parallel and antiparallel to the second direction 102 relative to the first shaft 10, 20. The coupling member 30 may further comprises a first section (see ref. numeral 30), a second section 60 and a torsion spring 46. A leg 47 of the torsion spring 46 may provide a first interlocking protrusion 47 extending as pin 47 towards a spindle 40 (see Fig. 2A to 4B)

[0044] The clutch actuator 1 may further comprise at least one of a helical spring 34 and the spindle 40, pref-

erably both. The spindle 40 may have a protrusion 43 (preferably a radial protrusion) which may extend in a void between two adjacent turns of the helical spring 34. In FIG. 2A the protrusion 43 compresses the helical spring 34 towards the open direction (antiparallel to the second direction 102). In FIGs. 3A and 4A the protrusion has been rotated to compress the helical spring towards the second direction 102.

[0045] The spindle may be driven by a motor 3 which may be coupled by a transmission 8 to the spindle 40.

[0046] FIG. 2A and 2B show the assembled clutch actuator 1 in the open position, i.e. the coupling member 30 is in its open position. The housing 10, 20 may provide a radial and an axial bearing for the spindle 40, and accordingly the spindle 40 is preferably rotatably supported relative to the shaft 10, 20. In this example, the longitudinal axis 2 of the shaft 10, 20, the spindle axis and the helical spring axis and the coupling member 30 are essentially aligned. As can be seen in FIG. 2A the free ends of the helical spring 34 extend through a longitudinally extending groove 39 of the coupling member 30 and as well into a longitudinally extending groove 19 of the shaft 10, 20. The helical spring 34 is thus axially movable in the shaft 10, 20 and as well in the coupling member 30, but a rotation of the helical spring 34 is blocked by the boundary walls of the longitudinal grooves 19, 39. The movement of the helical spring 34 parallel and antiparallel to the second direction is preferably limited by a first spring block 37 and a second spring block 38. As can be seen best in FIG. 2B, in the open position, the first interlocking protrusion 47 may be located at the "open" side of the second interlocking protrusion 45. Open side means here the side of the second interlocking protrusion 45 which faces against the second direction 102 or in other words the side which faces in the direction the coupling member 30 is moved when being moved towards its open position. Thus, an externally applied force on the coupling member 30 cannot shift the coupling member in the second direction 102 towards its closed position. A movement of the coupling member 30 towards the closed position (without driving the spindle 40) is blocked by the interaction of the first interlocking protrusion 47 with the second interlocking protrusion 45.

[0047] FIG. 3A and 3B show the assembled clutch actuator 1 in an intermediate position between the open and the closed state. Assuming the open state as the starting point, the spindle has been rotated. Hence the first protrusion 43 has been moved through a void being formed by a turn of the second interlocking protrusion 45, which may like in this example be a helical structure. As well due to the rotation, the spindle's protrusion 43 rotated through the winding of the helical spring 34, thereby shifting the helical spring 34 in the second direction 102. The helical spring 34 thus preloads the coupling member 30 towards its closed position. In FIGs. 3A and 3B it is assumed that the coupling member 30 is blocked in the intermediate position, but only for illustrative purposes.

[0048] Once the assumed blockage is removed, the coupling member 30 is shifted by the energy being stored in the compressed spring 34 in the closed position being shown in FIG. 4A and 4B. A non-rotationally invariant portion 31 of the coupling member 30 now extends radially from the corresponding portion of the first shaft 10, 20 and may engage in corresponding recess of a second shaft. The clutch is now closed. Opening the clutch can be accomplished by simply rotating the spindle 40 in the other direction. The spindle 40 now loads the helical spring 34 in the open direction (opposite to the second direction 102) until the first interlocking protrusion 47 abuts the second interlocking protrusion 45. Continuing to drive the spindle 40 will cause the first interlocking protrusion 47 to pass the passage of the second interlocking protrusion 45 until the coupling member reaches again the open position as depicted in FIG. 2A and 2B.

[0049] FIG. 5A and 5B show another example of the second portion 60 of the coupling member 30 as shown in Fig. 1. The second portion 60 of the coupling member 30 as shown in FIG. 5A and 5B may replace the second portion 60 of the coupling member 30 of the example being shown in FIG. 1 to 4B.

[0050] The second portion 60 of the coupling member 30 supports a pin 47 and can hence as well be referred to as pin support 60. In this example, the pin support has a first ring segment 61 and a segment ring segment 61 being centered relative to the longitudinal axis 2. In between of the two ring segments 61, 62 is a slot with a width w_{60} . An elastic pin 47 having a width w_{47} extends through the slot and is configured, i.e. located, to abut axially against the second interlocking protrusion 45 if pushed in the corresponding direction. The two ring segments 61 and 61 are supported by a flange portion 66.

[0051] As shown in FIG. 5A and 5B, the first interlocking protrusion 47 ("the pin 47") may be a free leg of an elastic wire. The free leg 47 may be attached to fixed leg 48, which may as well be referred to as attachment leg 48. The attachment leg 48 may be located in a groove in the outer surface of the second ring segment 62, and if the pin support 60 is mounted, the attachment leg is located in between of the peripheral surface of the second ring surface 62 and the inner surface of the first portion of the coupling member 30. A pivotal movement of the pin 47 parallel to the longitudinal axis 3 is limited by the flange portion 66 of the pin support 60 and by the frontal side of the first portion of the coupling member 30. In the radial direction, a pivotal movement of the pin 47 is limited by the width w_{60} to a few degrees or more precisely to an angle of $\pm \alpha$, wherein $\alpha \in \{20^\circ, 15^\circ, 10^\circ, 5^\circ, 2.5^\circ, 1^\circ, 0^\circ\}$.

List of reference numerals

[0052]

- | | |
|---|-------------------|
| 1 | clutch actuator |
| 2 | longitudinal axis |

3	motor	
10	first shaft portion / first housing portion	
19	longitudinal groove	
20	second shaft portion / second housing portion	
30	coupling member	5
31	non-rotationally invariant portion of the coupling member 30	
32	azimuthal bearing surface	
39	longitudinal groove	
34	helical coil spring	10
37	first spring block	
38	second spring block	
39	longitudinal groove	
40	spindle	
43	protrusion	15
45	second interlocking protrusion, e.g. helical structure	
46	helical torsion spring (part of coupling member)	
47	first interlocking protrusion / pin / free leg of helical torsion spring	20
48	attachment leg / attachment portion of first interlocking protrusion	
60	pin support (part of coupling member)	
61	first ring segment	
62	second ring segment	25
66	flange portion	
101	first direction	
102	second direction	30

Claims

1. A clutch actuator (1) for a door lock, the clutch actuator (1) comprising:

- a first shaft (10, 20) with a longitudinal shaft axis (2) and an azimuthal bearing surface (22), wherein

- the azimuthal bearing surface (22) provides a first block against a rotation in a first direction (101),
- the first direction (101) is an azimuthal direction and
- the first block extends in at least one second direction (102)
- the first and the second direction are linearly independent;

- a coupling member (30), being movably supported relative to the first shaft (10,20) by the bearing surface (22) between an open position and a closed position, wherein the coupling member (30) has at least a first spring block (37) and a second spring block (38) and wherein the first spring block (37) and the second spring block (38) face in mutually opposite directions, said mutual opposite directions being parallel to

a third direction;

- at least one helical spring (34) is movably supported relative to the first shaft (10, 20) to enable a movement parallel to the third direction, wherein the movement parallel to the third direction is limited in the third direction by the first spring block (37) and in the opposite direction by the second spring block (38) and wherein the helical spring (34) has multiple windings;

- a spindle (40), wherein the spindle (40) is torque proof connected to a motor shaft and rotatably supported relative to the first shaft (10,20), wherein a protrusion (43) of the spindle (40) is configured to engage in a void between two adjacent turns of the helical spring (34);

characterized in that

(i) the coupling member (30) has a first interlocking protrusion (47) extending towards the spindle (40),

(ii) the spindle (40) has a second interlocking protrusion (45) extending towards the coupling member (30),

(iii) in the open position of the coupling member (30) the second interlocking protrusion intersects (45) the path of the first interlocking protrusion (47) when the coupling member (30) is moved from the open position to the closed position.

2. The clutch actuator of claim 1,

characterized in that

at least one of the first interlocking protrusion (47) and the second interlocking protrusion (45) is a helical structure aligned with a spindle axis.

3. The clutch actuator of claim 1 or 2,

characterized in that

one of the first interlocking protrusion (47) and the second interlocking protrusion (45) is a pin.

4. The clutch actuator of claim 3,

characterized in that

the pin (47) is or comprises a leg (47) of a torsion spring (46).

5. The clutch actuator of one of claims 1 to 4,

characterized in that

the sum of the widths of the first interlocking protrusion (47) and the second interlocking protrusions (45) measured parallel to the second direction (102) is smaller than the distance the coupling member is moved in the third direction by four revolutions of the spindle (40).

6. The clutch actuator of one of claims 1 or 2,

characterized in that

- the first interlocking protrusion (47) has a first passage and the second interlocking protrusion (45) has a second passage, wherein the first interlocking protrusion (47) fits into the second passage and the second interlocking protrusion (45) fits into the first passage. 5
7. The clutch actuator (1) of one of the previous claims **characterized in that** the first spring block (37) faces against the second direction and the second spring block (38) faces in the third direction 10
8. The clutch actuator (1) of one of the previous claims, **characterized in that** the second direction is parallel to the longitudinal axis (2) or parallel to the radial direction. 15
9. The clutch actuator (1) of one of the previous claims, **characterized in that** the third direction is parallel to the second direction (102). 20
10. The clutch actuator of one of the previous claims, **characterized in that** that the first shaft (10, 20) and the coupling member (30) are two parts of a telescopic shaft. 25
11. The clutch actuator (1) of one of the previous claims, **characterized in that** the coupling member (30) has a groove (39) having a longitudinal groove direction, wherein the longitudinal groove direction is parallel to the third direction. 30
12. The clutch actuator of one of claims 11, characterized that the at least one of the ends of the helical spring (34) engages into the longitudinal groove (39) 35
13. A door lock clutch, **characterized in that** it comprises the clutch actuator (1) of one of the previous claims and a second shaft with a second azimuthal abutment and **in that** the coupling member when in its open position does azimuthally overlap with the second abutment and when in its closed position the coupling member azimuthally overlaps with a portion of the coupling member. 40
14. A door handle comprising at least: 45
- a clutch having an input shaft and an output shaft,
 - a handle lever being torque proof connected to the input shaft **characterized in that** the clutch is the clutch of claim 13 and **in that** 50
- (i) the first shaft (10, 20) is the input shaft and the second shaft is the output shaft, or 55
 - (ii) **in that** first shaft (10, 20) is the output shaft and **in that** the second shaft is the input put shaft.
15. A door lock comprising a latch bolt and/or a dead lock, **characterized in that** the first shaft or the second shaft of the clutch of claim 13 is coupled via a transmission to a latch bolt and/or a dead lock and the respective other shaft is configured to be driven by an operator.
16. A method for closing a door lock clutch, comprising:
- (i) moving a coupling member (30) being movably but torque proof connected to a first shaft (10, 20) with respect to a first direction (101), which first direction (101) is an azimuthal direction of a longitudinal axis (2) of the first shaft, from an open position in a second direction (102) towards a second shaft of the door lock clutch,
 - (ii) prior to or while said moving: rotating a first interlocking protrusion (47) of the coupling member (30) through a passage in a second interlocking protrusion (45) and the second interlocking protrusion (45) through a passage of the first interlocking member (47).
17. The method of the previous claim, **characterized in that** moving the coupling member (30) comprises loading a first spring (34) being force transmittingly connected to the coupling member (30) towards the third direction to thereby apply a force in the third direction to the coupling member (30).

Fig. 1

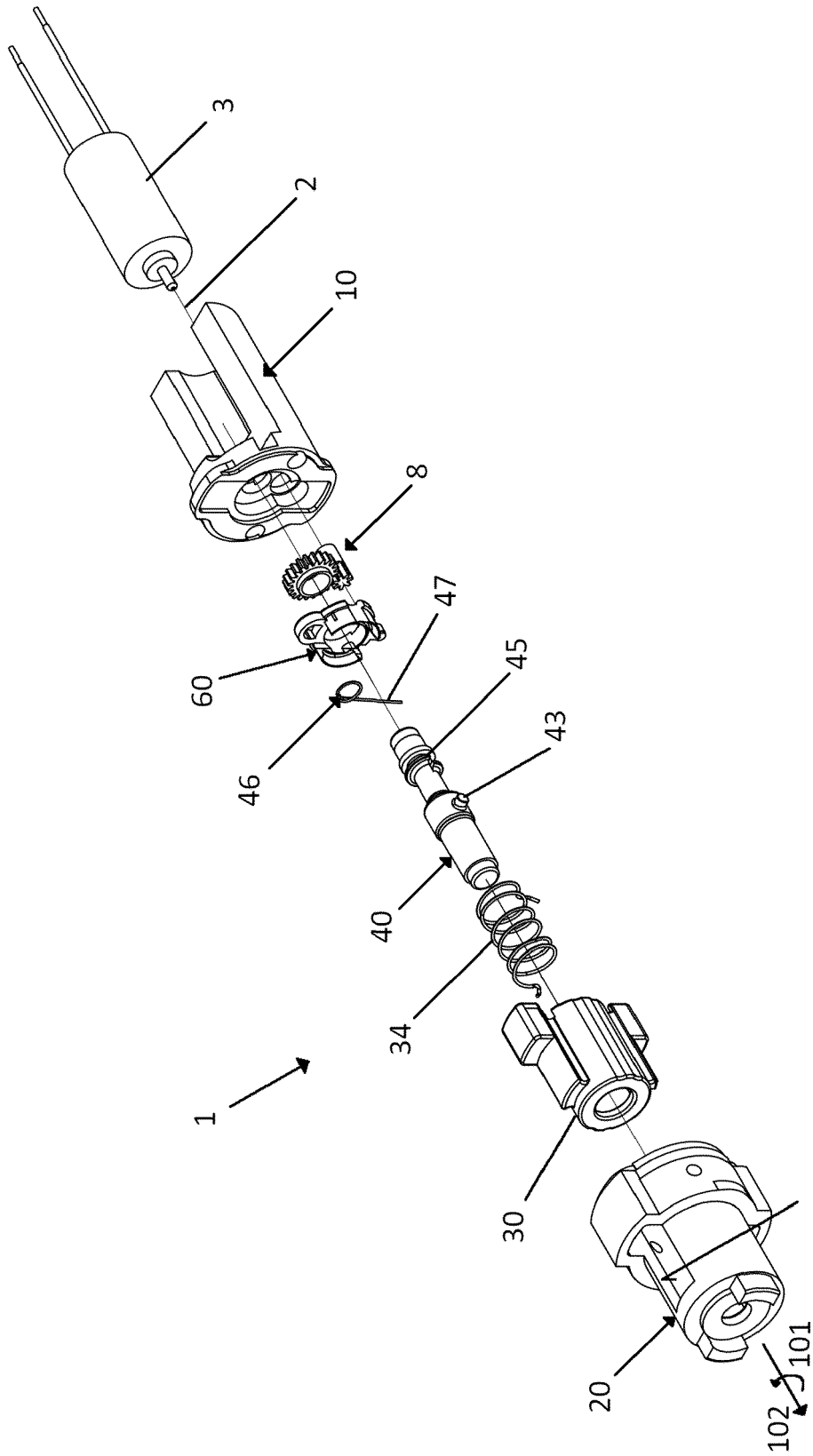


Fig. 2A

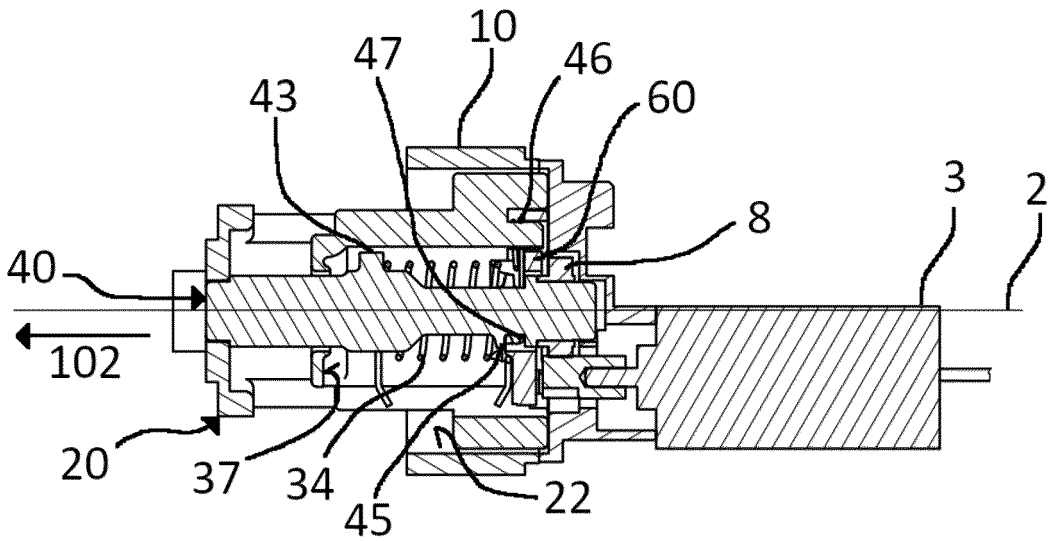


Fig. 2B

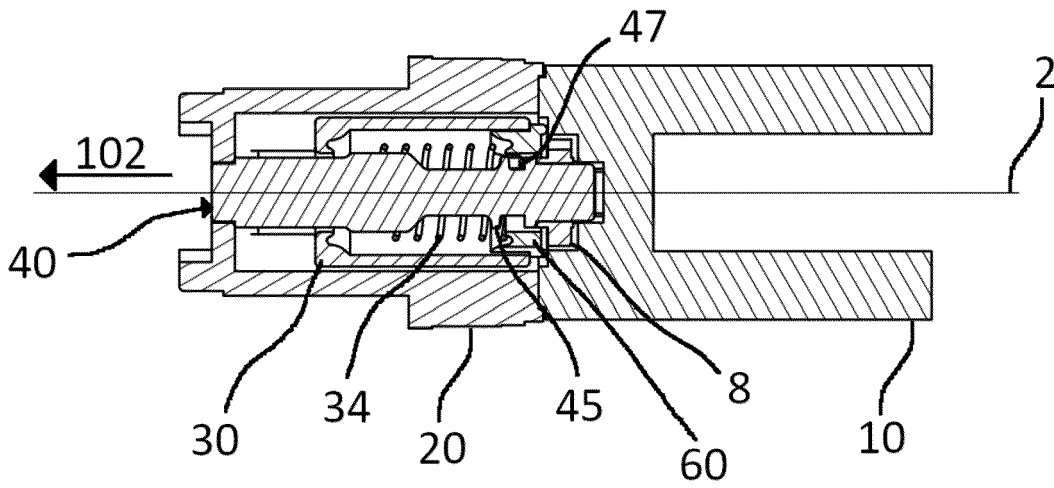


Fig. 3A

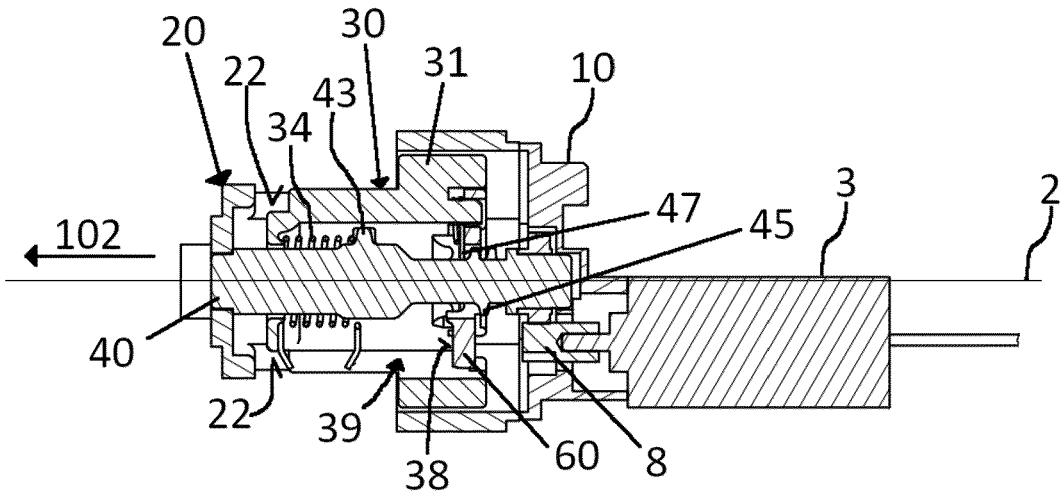


Fig. 3B

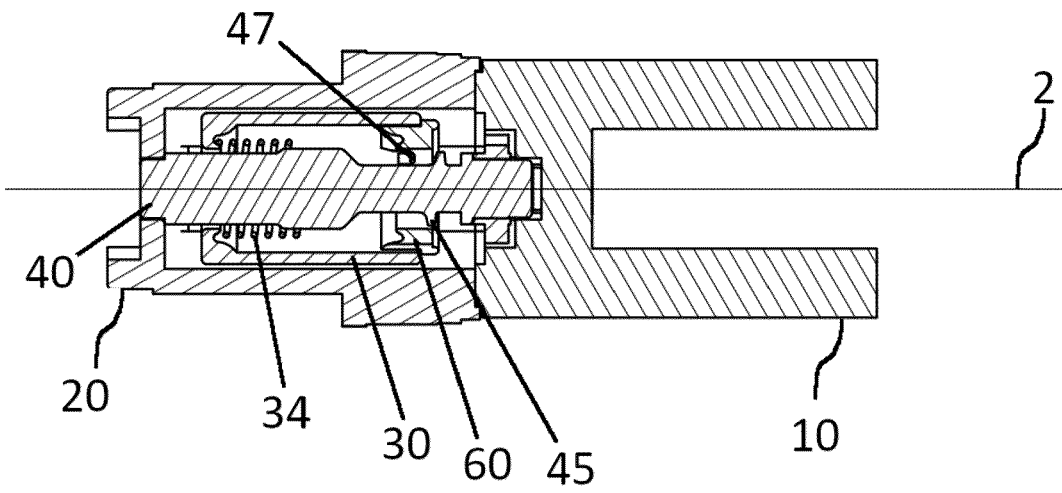


Fig. 4A

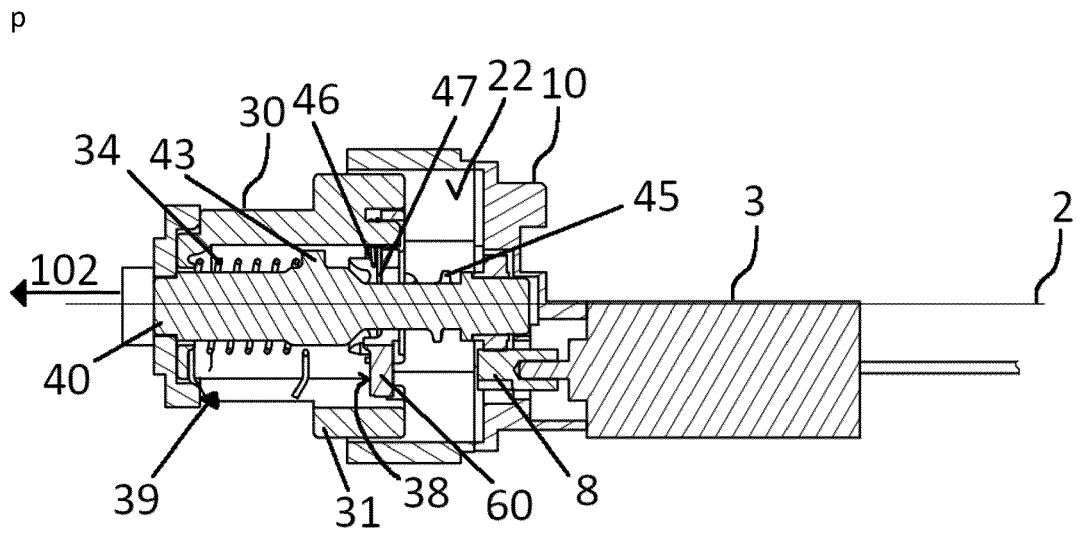


Fig. 4B

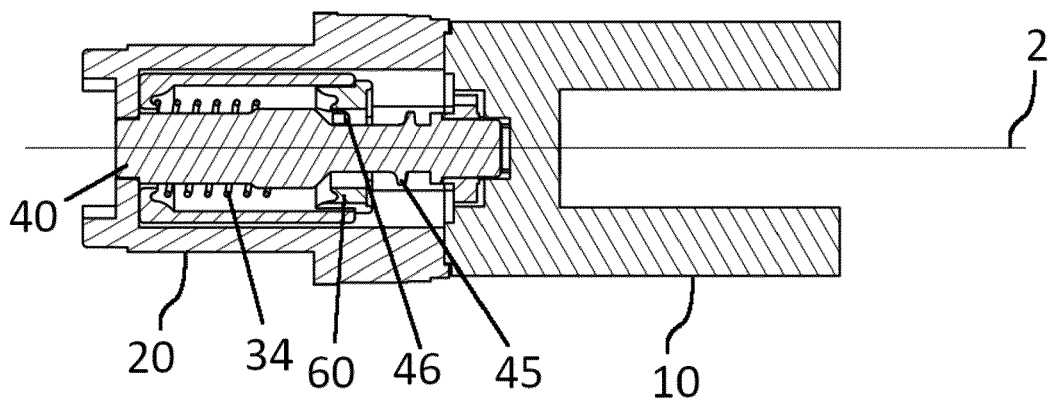


Fig. 5A

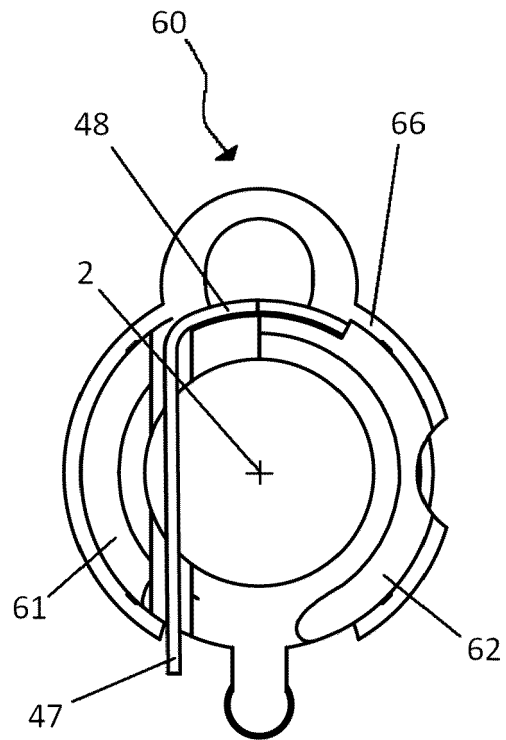
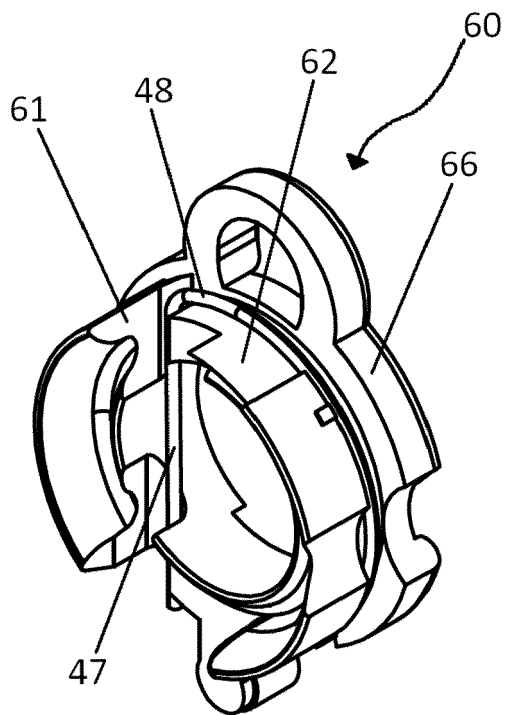


Fig. 5B





EUROPEAN SEARCH REPORT

Application Number
EP 22 17 1351

5

10

15

20

25

30

35

40

45

50

55

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	WO 98/15703 A1 (LUCKY LOCK LTD [IL]; GONEN SHMUEL [IL]) 16 April 1998 (1998-04-16) * page 5, line 2 - page 8, line 7 * * figures 1-4 *	1-17	INV. E05B17/20 E05B47/06
A	US 9 181 730 B1 (PENG FU-CHANG [TW]) 10 November 2015 (2015-11-10) * column 3, line 36 - column 5, line 26 * * figures 1-14 *	1-17	ADD. E05B47/00 E05B15/04
A	EP 2 860 331 A1 (ASSA AB [SE]) 15 April 2015 (2015-04-15) * paragraph [0051] - paragraph [0063] * * figures 1-5c *	1-17	
			TECHNICAL FIELDS SEARCHED (IPC)
			E05B
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 19 October 2022	Examiner Antonov, Ventseslav
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 22 17 1351

5 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.

19-10-2022

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 9815703	A1	16-04-1998	AU 4395597 A
			WO 9815703 A1
			05-05-1998
			16-04-1998
US 9181730	B1	10-11-2015	NONE
EP 2860331	A1	15-04-2015	AU 2014333993 A1
			CA 2924384 A1
			CN 104812978 A
			DK 2860331 T3
			EA 201690647 A1
			EP 2860331 A1
			ES 2600925 T3
			HK 1206088 A1
			JP 6386545 B2
			JP 2016532793 A
			KR 20160105381 A
			NZ 717903 A
			PL 2860331 T3
			UA 117034 C2
			US 2016251876 A1
			WO 2015052102 A1
			ZA 201601885 B
			28-04-2016
			16-04-2015
			29-07-2015
			28-11-2016
			29-07-2016
			15-04-2015
			13-02-2017
			31-12-2015
			05-09-2018
			20-10-2016
			06-09-2016
			27-03-2020
			31-01-2017
			11-06-2018
			01-09-2016
			16-04-2015
			28-06-2017

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- EP 1710753 A2 [0002]
- WO 03071060 A1 [0002]
- EP 2195767 A1 [0002]
- EP 1787241 B1 [0002]
- EP 2473690 A1 [0003]
- DE 10235201 A1 [0003]
- DE 19854454 A1 [0003]
- GB 2262770 A [0003]
- US 10927569 B2 [0003]

Non-patent literature cited in the description

- **BRONSHTEIN ; SEMENDAYEV ; MUSIOL ; MUEHLIG.** Handbook of Mathematics. Springer [0017]