

(19)



(11)

EP 2 789 777 A2

(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:
15.10.2014 Bulletin 2014/42

(51) Int Cl.:
E05B 15/02 (2006.01) **E05B 47/06** (2006.01)
E05B 13/00 (2006.01) **E05B 63/16** (2006.01)

(21) Application number: **14164101.9**

(22) Date of filing: **09.04.2014**

(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

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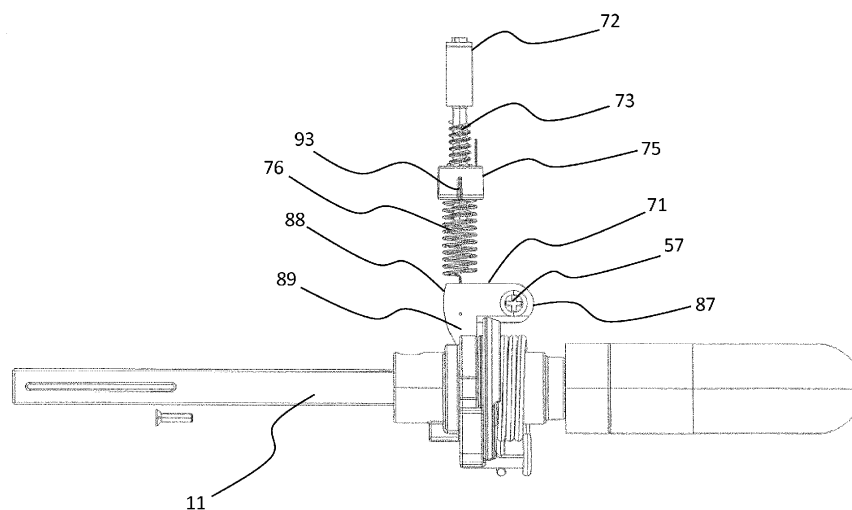
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(54) An electromechanical locking mechanism

(57) This invention relates to an electromechanical locking mechanism (1) comprising an inner escutcheon (5), an outer escutcheon (3), an inner handle (9), an outer handle (7), an inner spindle (13), an outer spindle (11), an inner spindle interlock (17), an outer spindle interlock (15) coupled to the inner spindle interlock and an electronic key reader (35) housed in the outer escutcheon. A latch (71) is mounted in the inner escutcheon (5) and is operable to releasably engage a notch (91) in the outer

spindle interlock (17) and prevent rotation of the outer spindle interlock (15) and the outer spindle (11) when the latch (71) is engaged in the notch (91). The latch (71) is pivotably mounted in the inner escutcheon and pivots to and from a locking configuration in which part of the latch is located in the notch, and a release configuration in which the latch is free of the notch. The pivoting latch (71) will require less power to operate than linearly displaceable latches.

Fig. 13**EP 2 789 777 A2**

Description

Introduction

[0001] This invention relates to an electromechanical locking mechanism comprising an inner escutcheon, an outer escutcheon, an inner handle, an outer handle, an inner spindle, an outer spindle, an inner spindle interlock, an outer spindle interlock coupled to the inner spindle interlock, and an electronic key reader housed in the outer escutcheon.

[0002] Electromechanical locking mechanisms are commonly used in hotels and other buildings on doors where it is desirable to provide a locking mechanism that requires an electronic key to open the door from the outside and only requires simple operation of the inner handle to open the door from the inside. These locking mechanisms provide a high level of security from intruders while at the same time permit fast evacuation in case of emergency.

[0003] Generally speaking, these electromechanical locking mechanisms have a pair of spindles, an inner spindle connected to an inner handle and an outer spindle connected to an outer handle, that are either releasably engageable with each other by way of a clutch mechanism, or are connected to each other permanently and their movement may be selectively restricted by a latch. By and large, electromechanical locking mechanisms that incorporate a latch rather than a clutch mechanism are simpler in construction and are easier to manufacture. The present invention relates to an electromechanical locking mechanism of the type having a latch located in the inner escutcheon of the electromechanical locking mechanism. There are numerous advantages to placing the latch in the inner escutcheon. By having the latch located in the inner escutcheon of the door, the outer escutcheon can be more compact which is desirable aesthetically speaking. Furthermore, the electromechanical locking mechanism with the latch located in the inner escutcheon will be more secure as the latch will be less accessible to intruders.

[0004] One such electromechanical locking mechanism is that described in European Patent No. EP1130195 in the name of Salto Systems S.L. This patent describes a latch mechanism for electronic locks that has a latch located in the inner escutcheon. The latch releasably engages an outer spindle tumbler to control rotation of the outer and inner spindles. When actuated by an electronic key, the latch is linearly displaceable by a motor into and out of a groove formed in the outer spindle tumbler.

[0005] There are however problems with the known electromechanical locking mechanisms that incorporate a latch. Most importantly, these electromechanical locking mechanisms tend to be quite power hungry as the latch must be moved a substantial distance in order to make the transition to and from a locked configuration and a release configuration. This transition results in a

significant draw on the battery power supply and a relatively short battery life. A short battery life will mean higher maintenance costs and equipment costs which is undesirable.

[0006] In order to obviate the problem of short battery life, it is possible to provide larger batteries in the locking mechanism however this increases the size of the inner escutcheon and increases the cost of the electromechanical locking mechanism, both of which are undesirable. Another way to circumvent the problem of short battery life is to reduce the amount of linear displacement required by the latch. However, reducing the amount of linear displacement required leads to a locking mechanism that is more susceptible to manipulation by unscrupulous individuals. Reducing the amount of linear displacement required also results in a need for very tight manufacturing tolerances, without which operation of the locking mechanism will be unreliable.

[0007] It is an object of the present invention to provide an electromechanical locking mechanism that overcomes at least some of the above-identified problems. It is a further object of the present invention to provide an electromechanical locking mechanism that is efficient in operation resulting in an extended battery life. It is a further still object of the invention to provide an electromechanical locking mechanism that provides a useful choice to the consumer.

Statements of Invention

[0008] According to the invention there is provided an electromechanical locking mechanism comprising an inner escutcheon, an outer escutcheon, an inner handle, an outer handle, an inner spindle, an outer spindle, an inner spindle interlock, an outer spindle interlock coupled to the inner spindle interlock, an electronic key reader housed in the outer escutcheon, a latch mounted in the inner escutcheon and operable to releasably engage a notch in the outer spindle interlock and prevent rotation of the outer spindle interlock and the outer spindle when the latch is engaged in the notch, a battery-operated motor housed in the inner escutcheon, coupled to the latch and responsive to the electronic key reader to actuate the latch, the inner spindle interlock and the latch having complementary cam surfaces so that rotation of the inner spindle interlock caused by operation of the inner handle will result in disengagement of the latch from the notch, and in which the latch is pivotably mounted in the inner escutcheon and pivots to and from a locking configuration in which part of the latch is located in the notch thereby preventing rotation of the outer spindle interlock, and a release configuration in which the latch is free of the notch thereby allowing rotation of the outer spindle interlock.

[0009] By having such an electromechanical locking mechanism, the latch will be pivotable to and from a locking configuration and a release configuration rather than being linearly displaceable. In this way, part of the weight of the latch will be supported by the pivot which will lessen

the burden on the motor when transitioning the latch to and from a locked configuration and a release configuration. This will allow a smaller motor to be used, if desired, with a smaller power requirement and a lower cost. Furthermore, it is envisaged that by pivotally mounting the latch, the amount of movement required transitioning the latch to and from a locked configuration and a release configuration will be reduced thereby resulting in a lower power draw from the battery but without compromising functionality or requiring tighter manufacturing tolerances.

[0010] In one embodiment of the invention there is provided an electromechanical locking mechanism in which the latch comprises an elongate arm, one end of which is dimensioned for reception in the notch and the other end of which is pivotally mounted on the inner escutcheon.

[0011] In one embodiment of the invention there is provided an electromechanical locking mechanism in which the end of the latch pivotally mounted on the inner escutcheon is provided with a through hole for reception of a transverse mounting pin.

[0012] In one embodiment of the invention there is provided an electromechanical locking mechanism in which the transverse mounting pin about which the latch pivots is arranged substantially orthogonal to the longitudinal axis of the inner spindle.

[0013] In one embodiment of the invention there is provided an electromechanical locking mechanism in which the latch is cranked intermediate its ends.

[0014] In one embodiment of the invention there is provided an electromechanical locking mechanism in which there is provided a notch in the inner spindle interlock, and in which at least portion of the latch sits in the notch in the inner spindle interlock when the latch is engaged in the notch in the outer spindle interlock. This is seen as a useful feature of the present invention as it will provide a locking mechanism that is compact in construction and reliable in operation.

[0015] In one embodiment of the invention there is provided an electromechanical locking mechanism in which at least one of the side walls of the notch in the inner spindle interlock, and the underside of the portion of the latch that is arranged to sit in the notch in the inner spindle interlock, is chamfered. By chamfering either or preferably both of the side walls of the notch in the inner spindle interlock and the underside of the portion of the latch that periodically sits in the notch in the inner spindle interlock, a more reliable, smoother mechanism will be provided.

[0016] In one embodiment of the invention there is provided an electromechanical locking mechanism in which there is provided a resiliently deformable coupling member coupling the motor to the latch. By providing a resiliently deformable coupling member intermediate the motor and the latch, the motor and the locking mechanism will be protected from known attacks consisting of repeated, rapid manipulation of the outer handle.

[0017] In one embodiment of the invention there is pro-

vided an electromechanical locking mechanism in which the resiliently deformable coupling member comprises a helical spring. This is seen as a particularly preferred embodiment of the present invention. By having a helical spring, the movement of the motor can be translated into movement of the latch in a simple and straightforward manner that is simple and inexpensive to manufacture. The connection of the helical spring to the latch and the motor will be more secure than other known arrangements and will not be as prone to slippage or disengagement over time as is the case with some of the existing mechanisms. In addition to the foregoing, the helical spring will provide a more predictable performance.

[0018] In one embodiment of the invention there is provided an electromechanical locking mechanism in which the motor comprises a wormscrew and a wormscrew nut for engagement of the resiliently deformable coupling member, the wormscrew nut being moveable in a reciprocal fashion back and forth along the wormscrew. Again, this is seen as a reliable way to connect the motor to the resiliently deformable coupling member, particularly if a helical spring is used.

[0019] In one embodiment of the invention there is provided an electromechanical locking mechanism in which there is provided a sensor operable to detect the position of the wormscrew nut relative the wormscrew and to prevent disengagement of the wormscrew nut from the wormscrew.

[0020] In one embodiment of the invention there is provided an electromechanical locking mechanism in which there is provided a wormscrew nut cover having a sensor tab extending outwardly therefrom.

[0021] In one embodiment of the invention there is provided an electromechanical locking mechanism in which the battery-operated motor is coupled to the latch at a location intermediate the ends of the latch. In this way, the motor will have to travel a shorter distance in order to remove the latch from the notch in the outer spindle interlock.

[0022] In one embodiment of the invention there is provided an electromechanical locking mechanism in which there is provided a latch guide plate having a slot for reception of the latch to limit lateral movement of the latch.

[0023] In one embodiment of the invention there is provided an electromechanical locking mechanism in which the outer spindle interlock is provided with an axial extension and the inner spindle interlock is provided with an axial bore for reception of the axial extension of the outer spindle interlock.

Detailed Description of the Invention

[0024] The invention will now be more clearly understood from the following description of some embodiments thereof given by way of example only with reference to the accompanying drawings, in which:-

Figure 1 is a perspective view of an electromechanical locking mechanism according to the invention;

Figure 2 is a front view of the locking mechanism of Figure 1;

Figure 3 is a left hand side view of the locking mechanism of Figure 1;

Figure 4 is a rear view of the locking mechanism of Figure 1;

Figure 5 is a plan view of the locking mechanism of Figure 1;

Figure 6 is a right hand side view of the locking mechanism of Figure 1;

Figure 7 is an exploded view of the locking mechanism of Figure 1;

Figure 8 is a perspective view of the locking mechanism of Figure 1 with an outer escutcheon housing removed;

Figure 9 is a perspective view of the locking mechanism of Figure 1 with the outer escutcheon and most of the inner escutcheon removed;

Figure 10 is a front view of the locking mechanism of Figure 9;

Figure 11 is a perspective view of the locking mechanism of Figure 1 with the outer escutcheon and most of the inner escutcheon removed;

Figure 12 is a front view of the locking mechanism of Figure 11;

Figure 13 is a left hand side view of the locking mechanism of Figure 11;

Figure 14 is a right hand side view of the locking mechanism of Figure 11;

Figure 15 is a rear view of the locking mechanism of Figure 11;

Figure 16 is a view similar to Figure 11 but with the outer spindle interlock removed;

Figure 17 is a front view of the locking mechanism of Figure 16;

Figure 18 is a left hand side view of the locking mechanism of Figure 16;

Figure 19 is a right hand side view of the locking

mechanism of Figure 16;

Figure 20 is a view similar to Figure 11 but with the outer spindle, inner spindle interlock and inner handle removed;

Figure 21 is a front view of the locking mechanism of Figure 20;

Figure 22 is a left hand side view of the locking mechanism of Figure 20;

Figure 23 is a view similar to Figure 18 but with the outer spindle, inner handle and nut cover removed; and

Figure 24 is a view similar to Figure 23 with the worm-screw nut removed.

[0025] Referring to Figures 1 to 6 inclusive, there is shown an electromechanical locking mechanism, indicated generally by the reference numeral 1, comprising an outer escutcheon 3, an inner escutcheon 5, an outer handle 7, an inner handle 9, an outer spindle 11 and an inner spindle (not shown).

[0026] Referring to Figure 7, there is shown an exploded view of the electromechanical locking mechanism 1. In addition to the outer escutcheon 3, the inner escutcheon 5, the outer handle 7, the inner handle 9 and the outer spindle 11, there is further provided an inner spindle 13 connected to the inner handle 9, an outer spindle interlock 15 mounted on the free end of the outer spindle 11, and an inner spindle interlock 17 mounted on the free end of the inner spindle. The outer spindle interlock 15 is provided with an axial cylindrical protrusion 19 that in use is housed inside a complementary axial bore 21 in the inner spindle interlock.

[0027] The outer escutcheon 3 comprises a multipart casing including an outer escutcheon back plate 31, an outer escutcheon housing 32 and an outer escutcheon cover 33 that are joined together to form the outer escutcheon casing. Inside the outer escutcheon 3 there is provided a main printed circuit board (PCB) 34 having an electronic key reader 35 thereon. The main PCB 34 is further provided with an accessible universal serial bus (USB) port 36 that under normal operation is hidden behind the USB cover 37. The outer escutcheon also houses a spindle sizer 38 which has an internal bore 39 dimensioned to form a snug fit around the outer spindle 11. The spindle sizer 39 sits in an outer handle return tumbler 40, which in turn is mounted in an outer handle return spring stop 41. An outer return spring 42 is fitted intermediate the outer handle return tumbler 40 and the outer handle return spring stop 41 and is operable to return the outer handle 7 back to a substantially horizontal configuration such as that shown in Figures 1 to 6 inclusive. A Euro-cylinder lock protector 43 is provided if needed. Alternatively, a suitable insert (not shown) could be

provided if the lock protector 43 is not required. A pair of LED light guides 44, 45 is provided for the PCB 34.

[0028] The inner escutcheon 5 also comprises a multipart casing including an inner escutcheon back plate 51, an inner escutcheon housing 52 and an inner escutcheon cover 53 that are joined together to form the inner escutcheon casing. Inside the inner escutcheon 5 there is provided a battery PCB 54 having a battery 55 mounted thereon. The inner escutcheon 5 houses a mechanism chassis 56 on which the latch mechanism, indicated generally by the reference numeral 70, and described in greater detail below, is mounted. The mechanism chassis 56 also carries a latch pivot pin 57 which is secured in place on the mechanism chassis 56 by a pivot pin nut 58, a sensor PCB mount 59, a handle position sensor activator 60, a sensor PCB assembly 61 and a latch guide plate. An inner handle return spring 62 is positioned intermediate the inner spindle interlock 17 and the mechanism chassis 56 which provides an inner handle return spring stop. The inner handle return spring 62 is operable to return the inner handle 9 back to a substantially horizontal configuration such as that shown in Figures 1 to 6 inclusive. The inner escutcheon 5 houses an internal bearing 63 and a screw cap 64.

[0029] The latch mechanism 70 comprises a latch 71, a motor 72 having a wormscrew 73, a wormscrew nut 74, a wormscrew nut cover 75 and a resiliently deformable coupling member, provided by way of a helical spring 76, coupling the motor 72 to the latch 71. The helical spring 76 is connected to the latch at a lower end thereof and the upper end of the helical spring 76 is connected to the wormscrew nut 74. The wormscrew nut 74 is prevented from rotating and therefore is moveable upwards and downwards in a reciprocal fashion along the wormscrew 73. The direction of travel of the wormscrew nut 74 along the wormscrew 73 will depend on the direction of rotation of the wormscrew 73.

[0030] The latch 71 comprises an elongate body cranked intermediate its ends and having a throughbore 77 located adjacent one end thereof. The pivot pin 57 passes through an aperture in the mechanism chassis, through the throughbore 77 and through a second aperture in the mechanism chassis before being secured in place by a pivot pin nut 58. The pivot pin 57 forms a close fit in the throughbore 77 to limit play from side to side of the latch 71. The operation of the electromechanical locking mechanism will be understood from the following detailed description of Figures 8 to 24.

[0031] Referring now to Figure 8, there is shown a perspective view of the electromechanical locking mechanism with the outer escutcheon housing 32 removed. The positioning of the outer handle return spring 42, the outer handle return spring stop 41 and the main PCB 34 are shown.

[0032] Referring to Figures 9 and 10, there are shown views of the locking mechanism according to the invention with the outer escutcheon and most of the inner escutcheon removed. Referring specifically to Figure 10,

the handle position sensor activator 60 is shown. The handle position sensor activator 60 comprises an arm 81 pivotably mounted about pivot point 82 intermediate its ends. A first, lower end 83 of the arm 81 is shown in contact with a protrusion 84 on the outer spindle interlock 15. A second, upper end 85 of the arm is shown in contact with a trigger switch 86. In use, when the handle 9 is in the horizontal position shown, the lower end 83 of the arm 81 will be pushed outwards by the protrusion 84 on the outer spindle interlock 15 thereby causing the upper end 85 of the arm 81 to move inwardly and contact the trigger switch. This indicates that the door handle is in this position. Once the handle is depressed, the protrusion 84 on the outer spindle interlock 15 will move away from the lower end 83 of the arm 81. The spring force of the trigger switch 86 will push the upper end 85 of the arm 81 outwardly thereby indicating that the handle 9 has been turned and that the door is not locked. This information can be used in the control of the door. For example, if the door handle has not been depressed in a predetermined period of time after the electromechanical locking mechanism has been activated using an electronic key, the motor 72 may be operated once more to lock the door once more.

[0033] Referring to Figures 11 to 15 inclusive, there are shown views of the electromechanical locking mechanism with the outer escutcheon and most of the inner escutcheon removed. In these figures, the handle position sensor activator 60 has been omitted for clarity. The latch 71 is pivotably mounted at one end 87, about a pivot pin 57 and at its other end 88, a downwardly depending hand 89 of the latch 71 is located in a notch 91 formed in the outer spindle interlock 15.

[0034] In use, when an electronic key (not shown) is presented to the electronic key reader on the outer escutcheon, a control signal is sent through to the inner escutcheon and the motor is operated to turn the wormscrew 73. As the wormscrew 73 turns, the wormscrew nut 74 will travel up along the wormscrew 73. As the wormscrew nut 74 travels upwards along the wormscrew, it will pull the helical spring 76 upwards with it. As the helical spring moves upwards, the latch 71 will move upwards also disengaging the downwardly depending hand 89 from the notch 91. The outer spindle interlock is therefore free to rotate once the hand 89 of the latch 71 has been disengaged from the notch 91. If the outer handle (not shown) is operated, the handles, the inner and outer spindles and the inner and outer spindle interlocks will rotate thereby causing the outer spindle 11 to operate a door lock (not shown) and allowing the door to be opened.

[0035] Once the handle has been returned to the horizontal position or after a predetermined period of time, the motor 72 will be operated in the opposite orientation rotating the wormscrew 73 in the opposite sense. As the wormscrew 73 turns in the opposite direction, the wormscrew nut 74 will travel downwards on the wormscrew 73 thereby pushing the helical spring 76 and in turn the latch 71 downwards. If the latch 71 and the notch 91 have

been realigned, the latch 71 will be seated once more in the notch 91, thereby preventing further rotation of the outer spindle interlock and the outer handle until a valid electronic key is presented once more to the electronic key reader.

[0036] An optical sensor (not shown), is provided and detects a sensor tab 93 mounted on the wormscrew nut cover 75. The optical sensor and the sensor tab 93 work together to brake the system in both latch open and latch closed positions and also to stop the wormscrew nut 74 binding at the top of the wormscrew or running off at the bottom of the wormscrew. The wormscrew nut cover 75 moves with the wormscrew 74. As the wormscrew nut cover 75 moves downwards on the wormscrew 72, the sensor tab will also be lowered on the wormscrew 73. The sensor tab 93 is detected by the optical sensor. When the sensor tab 93 reaches a certain lowermost point on the wormscrew, the optical sensor will detect the absence of the sensor tab and the motor 72 may be stopped from further operation in that orientation to prevent disengagement of the wormscrew nut 74 from the wormscrew 73. Similarly, when the wormscrew is being operated in the opposite orientation and the sensor tab is moving upwards along the wormscrew, the optical sensor will, after a time, detect the absence of the sensor tab. This indicates that the sensor tab has moved above the optical sensor and the latch has been disengaged in which case and the motor 72 can be prevented from further operation in the present orientation to ensure that the wormscrew nut 74 does not bind at the top of the wormscrew. It will be understood that the motor is only temporarily prevented from operating in a particular orientation and can be reset once the optical sensor has detected the sensor tab 93 once more.

[0037] Referring specifically to Figure 15, there is shown a rear view of the locking mechanism shown in Figure 11. It can be seen from the drawing, that the lower surface 95 of the latch, intermediate the end 87 and the downwardly depending hand 89 is chamfered into a substantially U-shaped cam surface 95. The inner spindle interlock 17 also comprises a notch 97 in which the U-shaped cam surface 95 sits. The sides of the notch 97 are also chamfered into cam surfaces 99, 101 for complementary engagement of the U-shaped cam surface 95 of the latch, which will be described in more detail below.

[0038] As mentioned above, a feature of the electromechanical locking mechanism 1 is that the locking mechanism must be able to be released from the inside without the use of an electronic key. Instead, it is necessary to allow simple operation of the inner handle 9 to cause the door to open. This is necessary in cases of emergency. It can be seen from Figure 15, that as the inner handle 9 is depressed, the inner spindle will begin to turn which will cause the inner spindle interlock 17 to rotate also. The inner spindle interlock 17 and the outer spindle interlock 15 are allowed a limited amount of rotation relative to each other to allow the inner spindle

interlock 17 to rotate in this manner. As the inner spindle interlock 17 rotates, depending on the direction of rotation of the handle, one of the cam surfaces 99, 101 will come into contact with the cam surface 95 on the underside of the latch 71. Further rotation of the handle 9 will cause the latch 71 to be moved upwards as the cam surface 95 moves along the cam surface 99, 101. As the latch moves upwards, the latch will be released from the notch 97 and, importantly, the downwardly depending hand 89 will be released from the notch 91. As the downwardly depending hand 89 is released from the notch 91, the outer spindle interlock 15 and hence the outer spindle 11 will be free to rotate.

[0039] Further rotation of the handle 9 will cause the arcuate protrusion 103 on the inner spindle interlock 17 to come into contact with one of the protrusions 84, 105, which will cause the outer spindle interlock 15 to rotate which in turn causes the outer spindle 11 to rotate and open a door lock (not shown). It can be seen from the foregoing construction of the protrusions 103, 84, 105 and the cam surfaces 95, 99, 101 that there is no "handedness" to the electromechanical locking mechanism and it will operate equally well with a variety of different arrangements of handles and also on either the left hand side or the right hand side of the door.

[0040] In the embodiment shown, it is envisaged that with a 10 degree turn (clockwise or anti-clockwise) of the inner handle 9, the cam (cam surfaces 99, 101) on either side of the notch on the inner spindle interlock engages with the knife-edge cam follower (cam surface 95) on the underside of the swinging pivot latch, causing disengagement of the latch from the notch in the outer spindle interlock, allowing the inner spindle interlock to engage the outer spindle interlock and continue turning both interlocks together to a further 45 degrees (allowing the spindle to turn in the lockset to open the door). Referring to Figures 16 to 19, there are shown a plurality of views of the electromechanical locking mechanism similar to Figures 11 to 14 respectively but with the outer spindle interlock 15 removed. It can be seen from Figures 16 to 19, that the only portion of the latch that engages the inner spindle interlock 17 is the cam surface 95 on the underside of the latch 71.

[0041] Referring to Figures 20 to 22, there are shown a plurality of views of the electromechanical locking mechanism similar to Figures 11 to 13 respectively but with the outer spindle, inner spindle interlock and inner handle removed. It can be seen from Figures 20 to 22 that the cam surface 95 extends from the end 87 to the downwardly depending hand 89 and that the only portion of the latch that engages the outer spindle interlock 17 is the downwardly depending hand 89.

[0042] Referring to Figure 23, there is shown a side view of the latch 71 resting on the inner spindle interlock 17. Furthermore, the wormscrew nut cover 75 has been removed to shown the engagement of the wormscrew nut 74 and the helical spring 76. A helical channel is formed in the side of the wormscrew nut 74 to receive

the helical spring. Referring to Figure 24, there is shown a side view similar to the view shown in Figure 23 without the wormscrew nut 74. It can be seen that the wormscrew 73 extends downwardly inside the helical spring.

[0043] In the embodiments shown, it will be understood that there will be wiring extending rearwardly from the main PCB to the inner escutcheon side of the electromechanical locking mechanism to provide the control signals to operate the latch however these are standard and have not been shown for clarity. If preferred, wireless communications could be used instead however this would require at least a wireless transmitter in the outer escutcheon and a wireless receiver in the inner escutcheon.

[0044] It will be further understood that the handles are not limiting and other types of handles could be used in their stead. Furthermore, a leaf spring, torsion spring or other spring could be used instead of the helical spring with appropriate modifications made to the engagement of the leaf spring, torsion spring or other spring and the wormscrew.

[0045] There are several advantages to using a spring and a helical spring in particular as the connection between the wormscrew and the latch. The spring creates an 'elastic' connection between the pivot latch and the micro-motor/wormscrew assembly. It is envisaged that a non-elastic (i.e. rigid) connection would cause damage to a micro-motor very quickly in normal use. Secondly, the spring acts as a shock absorber when the external handle/escutcheon is subjected to attack from an intruder. The spring suppresses pivot latch bounce and protects delicate electronic components such as the light sensor and the micro-motor. In the down (i.e. locked) position, the spring is slightly compressed providing a down force on the pivot latch. This force would not be there without the spring. Thirdly, in the open position the pivot latch hits a physical stop before the light sensor (optical sensor and sensor tab 93 arrangement) stops the motor. Therefore, after the pivot latch is stopped, the nut continues to travel a little more up the wormscrew until it reaches the stop position determined by the optical sensor. In that position, the spring will be slightly extended providing a small downward pulling force on the nut in preparation for closing after a fixed time. Fourth, the helical spring prevents the nut from rotating when the wormscrew rotates thus causing the nut to travel up and down the wormscrew.

[0046] In this specification the terms "comprise, comprises, comprised and comprising" and the terms "include, includes, included and including" are all deemed totally interchangeable and should be afforded the widest possible interpretation.

[0047] The invention is in no way limited to the embodiments hereinbefore described and may be varied in both construction and detail within the scope of the claims.

Claims

1. An electromechanical locking mechanism (1) comprising an inner escutcheon (5), an outer escutcheon (3), an inner handle (9), an outer handle (7), an inner spindle (13), an outer spindle (11), an inner spindle interlock (17), an outer spindle interlock (15) coupled to the inner spindle interlock, an electronic key reader (35) housed in the outer escutcheon, **characterised in that** there is provided a latch (71) mounted in the inner escutcheon and operable to releasably engage a notch (91) in the outer spindle interlock and prevent rotation of the outer spindle interlock and the outer spindle when the latch is engaged in the notch, a battery-operated motor (72) housed in the inner escutcheon, coupled to the latch and responsive to the electronic key reader to actuate the latch, the inner spindle interlock and the latch having complementary cam surfaces (95, 99, 101) so that rotation of the inner spindle interlock (17) caused by operation of the inner handle (9) will result in disengagement of the latch (71) from the notch (91), and in which the latch is pivotably mounted in the inner escutcheon (5) and pivots to and from a locking configuration in which part of the latch (71) is located in the notch (91) thereby preventing rotation of the outer spindle interlock (15), and a release configuration in which the latch (71) is free of the notch (91) thereby allowing rotation of the outer spindle interlock.
2. An electromechanical locking mechanism (1) as claimed in claim 1 in which the latch (71) comprises an elongate arm, one end (88) of which is dimensioned for reception in the notch (91) and the other end (87) of which is pivotably mounted on the inner escutcheon.
3. An electromechanical locking mechanism (1) as claimed in claim 1 or 2 in which the end (87) of the latch (71) pivotably mounted on the inner escutcheon (17) is provided with a through hole (77) for reception of a transverse mounting pin (57).
4. An electromechanical locking mechanism (1) as claimed in claim 3 in which the transverse mounting pin (57) about which the latch (71) pivots is arranged substantially orthogonal to the longitudinal axis of the inner spindle (13).
5. An electromechanical locking mechanism (1) as claimed in claim 2 in which the latch (71) is cranked intermediate its ends (87, 88).
6. An electromechanical locking mechanism (1) as claimed in any preceding claim in which there is provided a notch (97) in the inner spindle interlock (17), and in which at least portion of the latch (71) sits in the notch in the inner spindle interlock when the latch

is engaged in the notch in the outer spindle interlock (15).

7. An electromechanical locking mechanism (1) as claimed in claim 6 in which at least one of the side walls (99, 101) of the notch (97) in the inner spindle interlock (17), and the underside (95) of the portion of the latch (71) that is arranged to sit in the notch in the inner spindle interlock, is chamfered. 5
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8. An electromechanical locking mechanism (1) as claimed in any preceding claim in which there is provided a resiliently deformable coupling member coupling the motor (72) to the latch (71). 15
9. An electromechanical locking mechanism (1) as claimed in claim 8 in which the resiliently deformable coupling member comprises a helical spring (76). 20
10. An electromechanical locking mechanism (1) as claimed in claim 8 or 9 in which the motor (72) comprises a wormscrew (73) and a wormscrew nut (74) for engagement of the resiliently deformable coupling member (76), the wormscrew nut being moveable in a reciprocal fashion back and forth along the wormscrew. 25
11. An electromechanical locking mechanism (1) as claimed in claim 10 in which there is provided a sensor operable to detect the position of the wormscrew nut relative the wormscrew and to prevent disengagement of the wormscrew nut (74) from the wormscrew (73). 30
12. An electromechanical locking mechanism (1) as claimed in claim 11 in which there is provided a wormscrew nut cover (75) having a sensor tab (93) extending outwardly therefrom. 35
13. An electromechanical locking mechanism (1) as claimed in any preceding claim in which the battery-operated motor (72) is coupled to the latch (71) at a location intermediate the ends (87, 88) of the latch. 40
14. An electromechanical locking mechanism (1) as claimed in any preceding claim in which there is provided a latch guide plate having a slot for reception of the latch (71) to limit lateral movement of the latch. 45
15. An electromechanical locking mechanism (1) as claimed in any preceding claim in which the outer spindle interlock (15) is provided with an axial extension (19) and the inner spindle interlock (17) is provided with an axial bore (21) for reception of the axial extension of the outer spindle interlock. 50
55

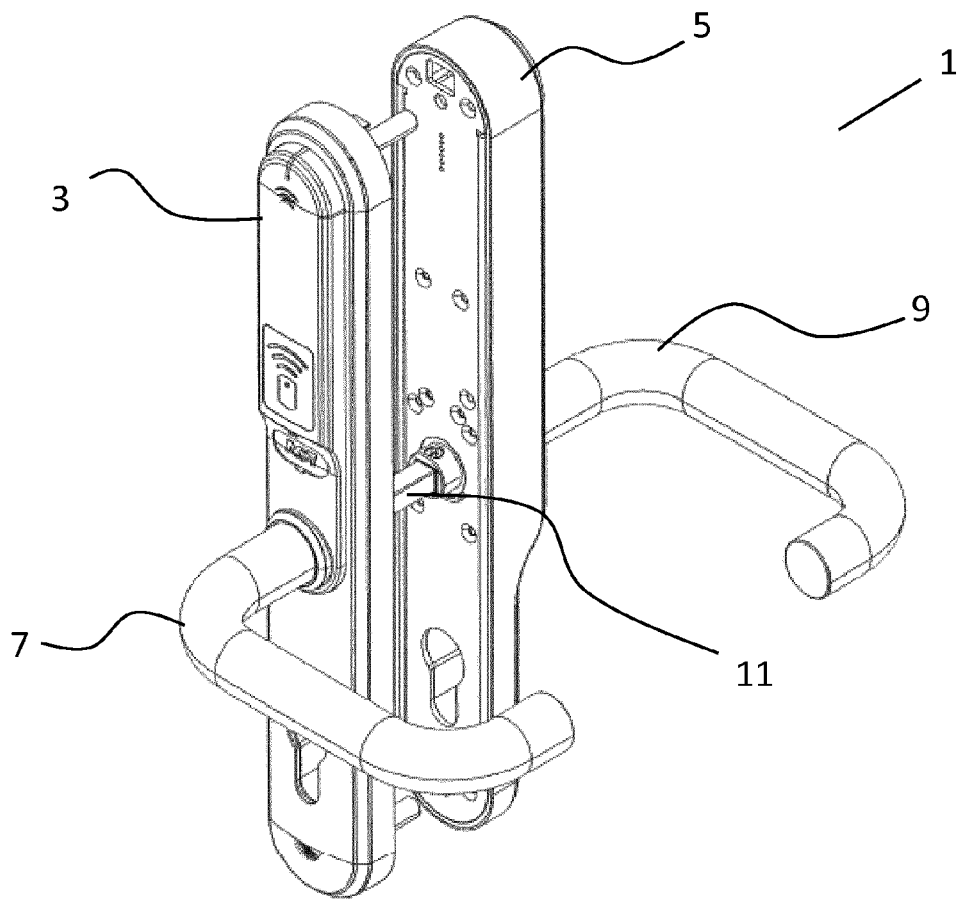


Fig. 1

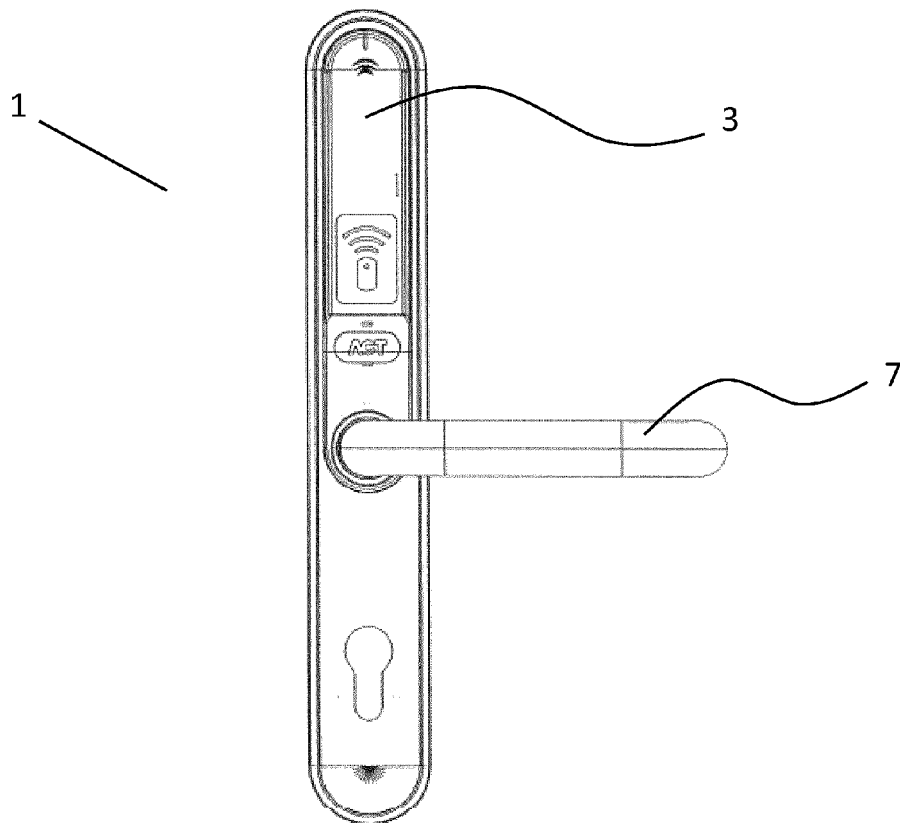


Fig. 2

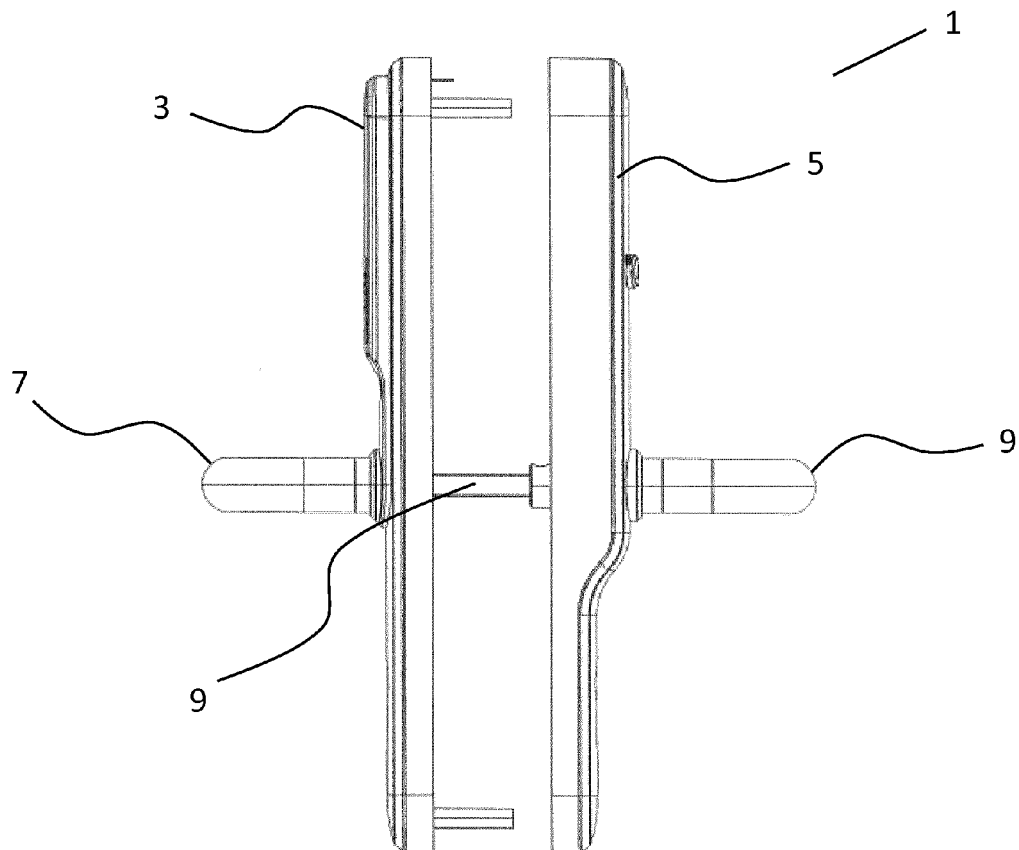


Fig. 3

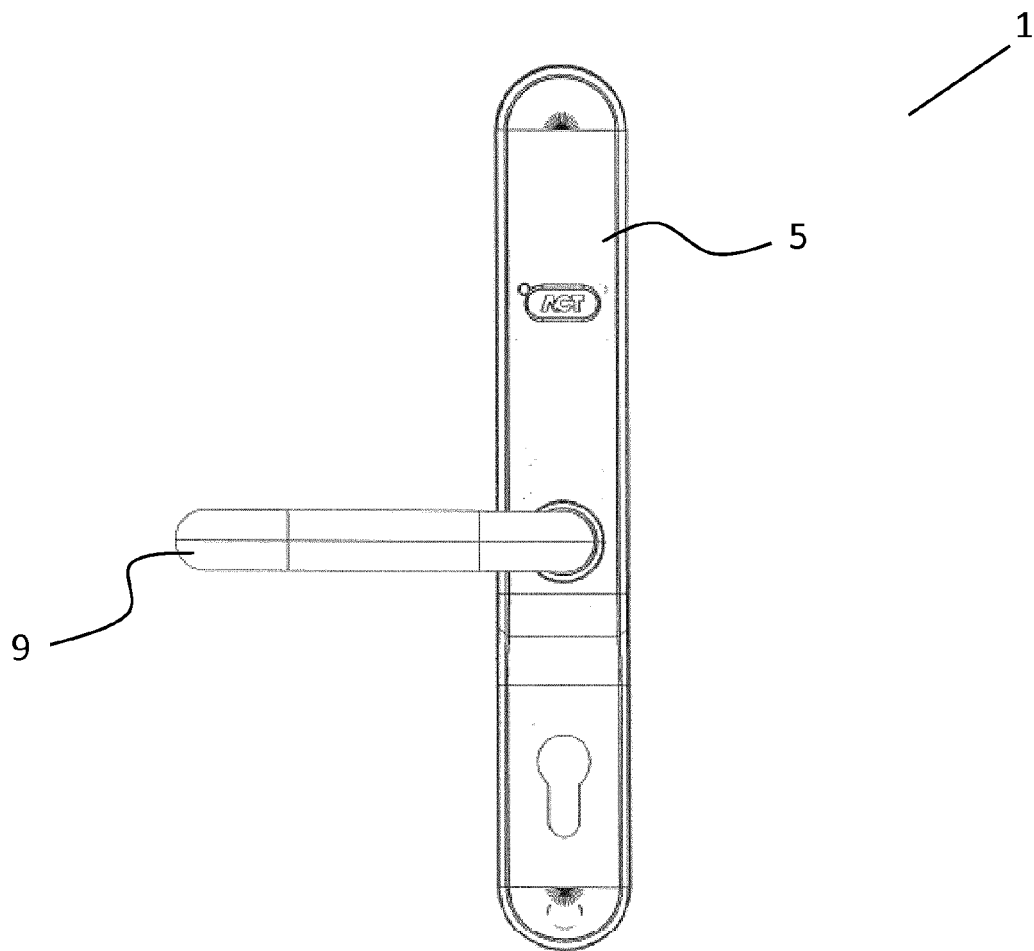


Fig. 4

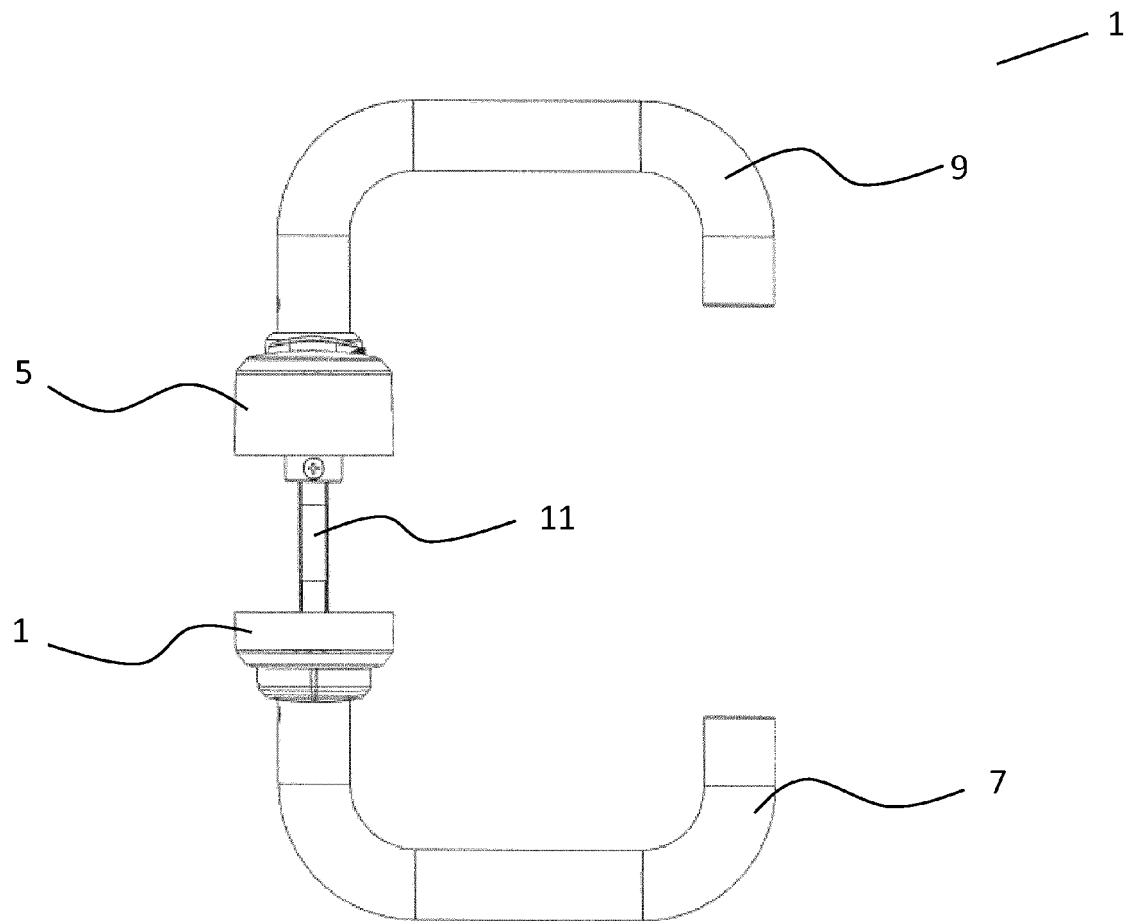


Fig. 5

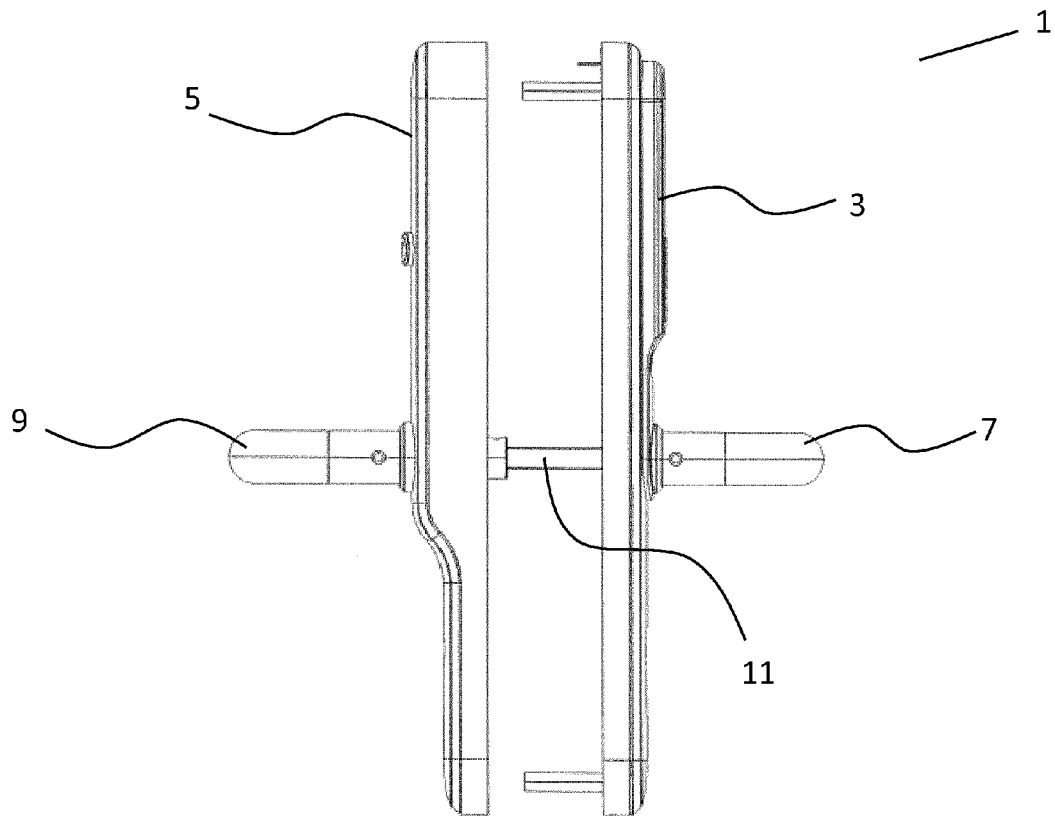


Fig. 6

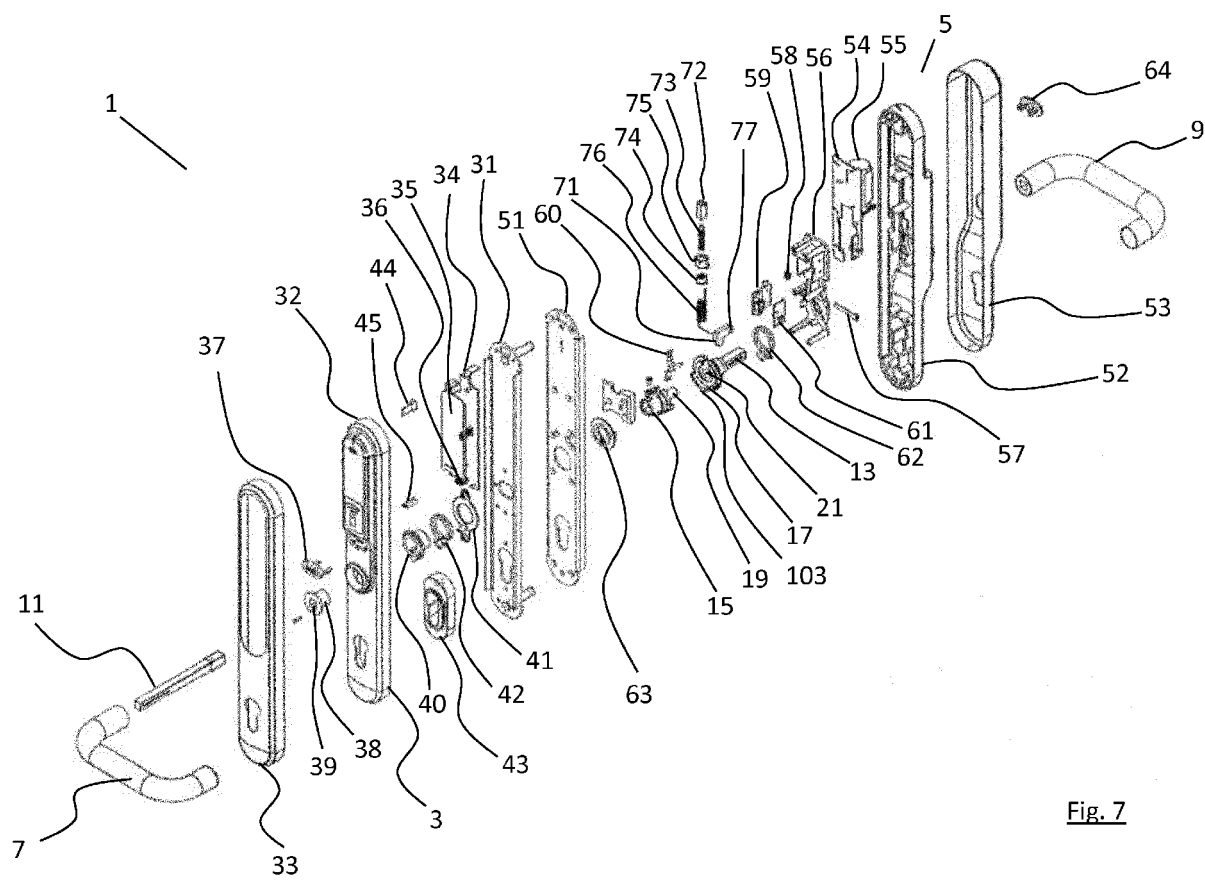


Fig. 7

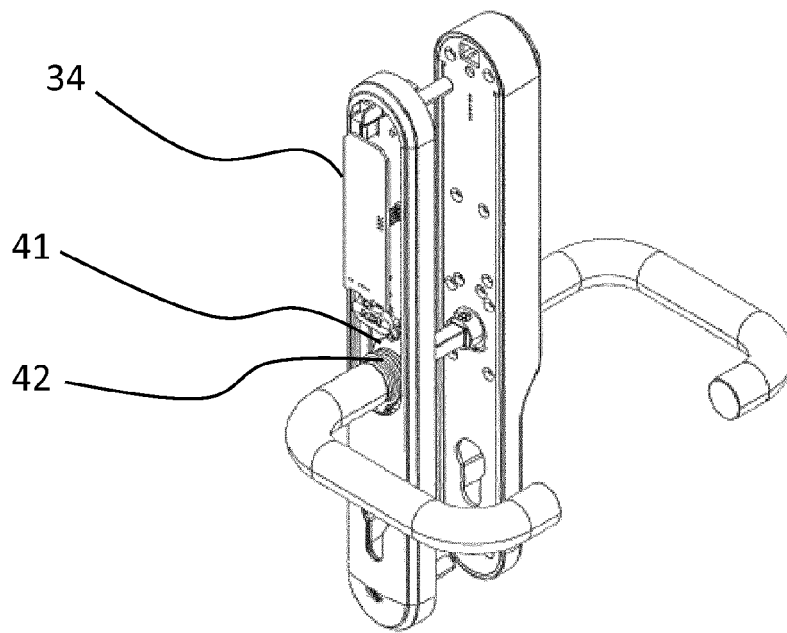


Fig. 8

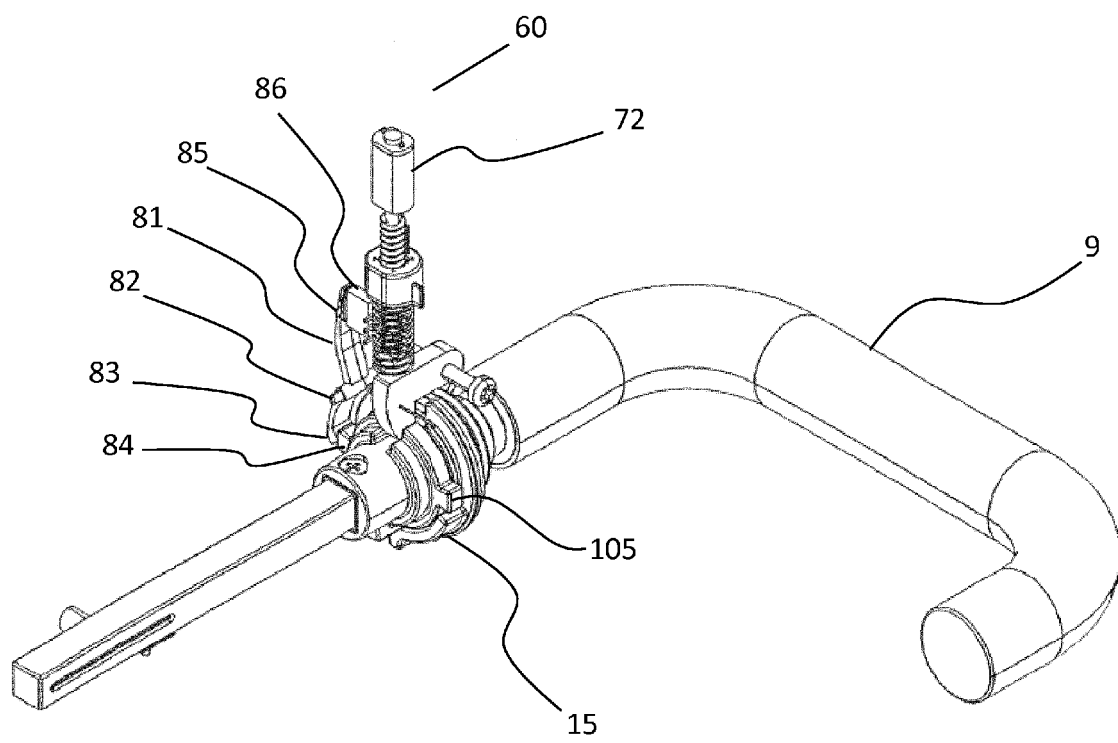


Fig. 9

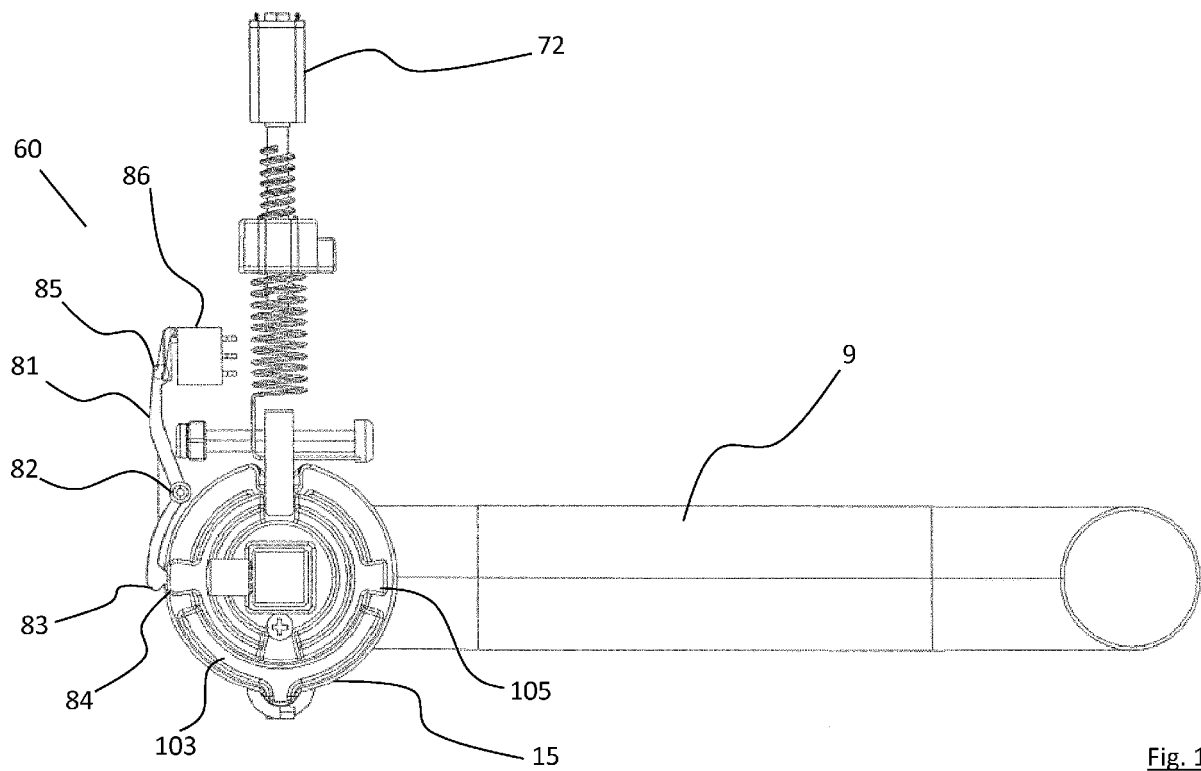


Fig. 10

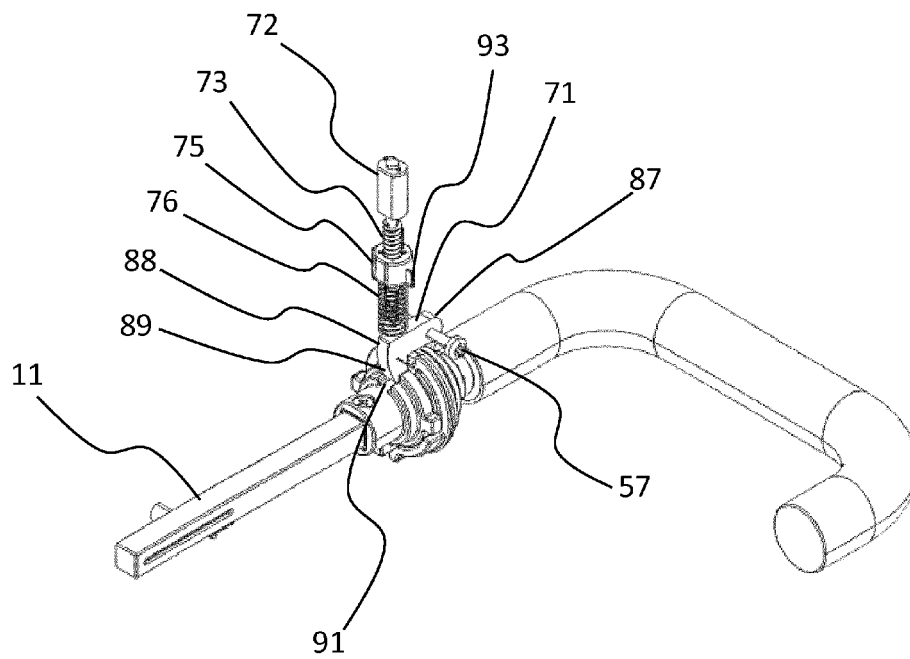


Fig. 11

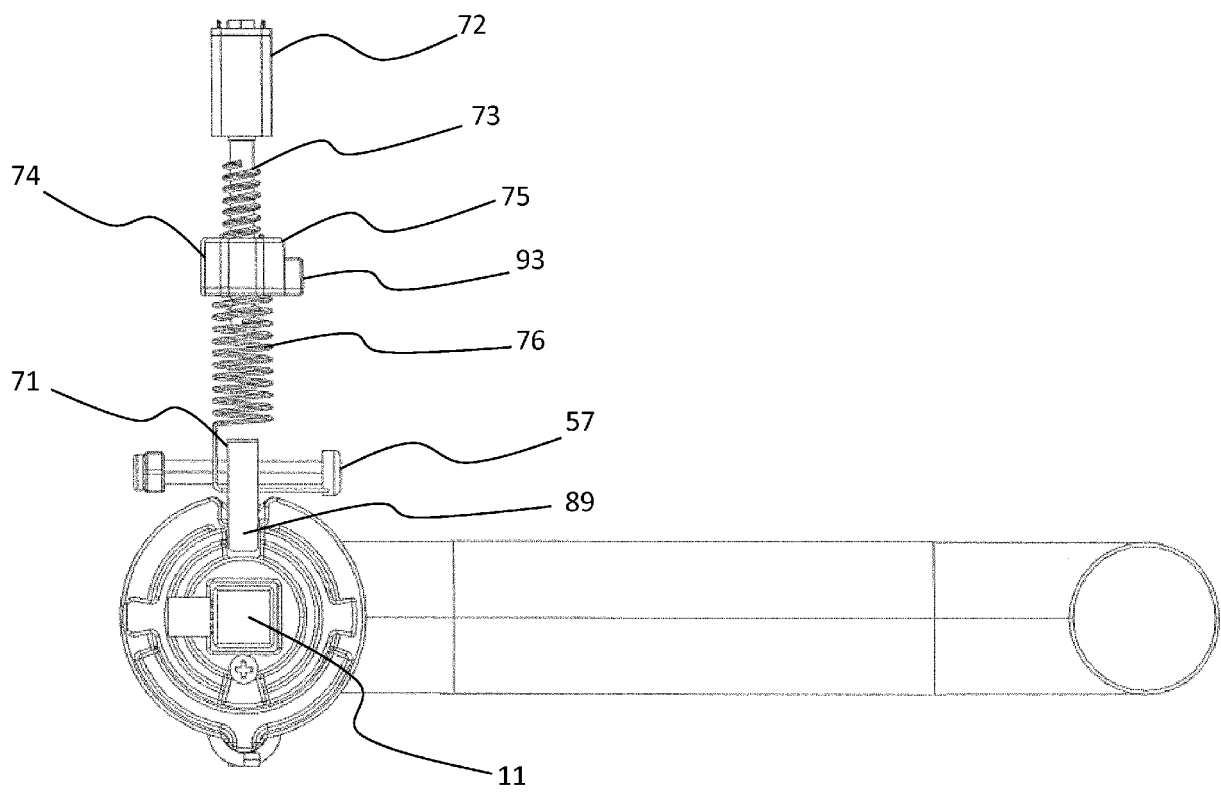


Fig. 12

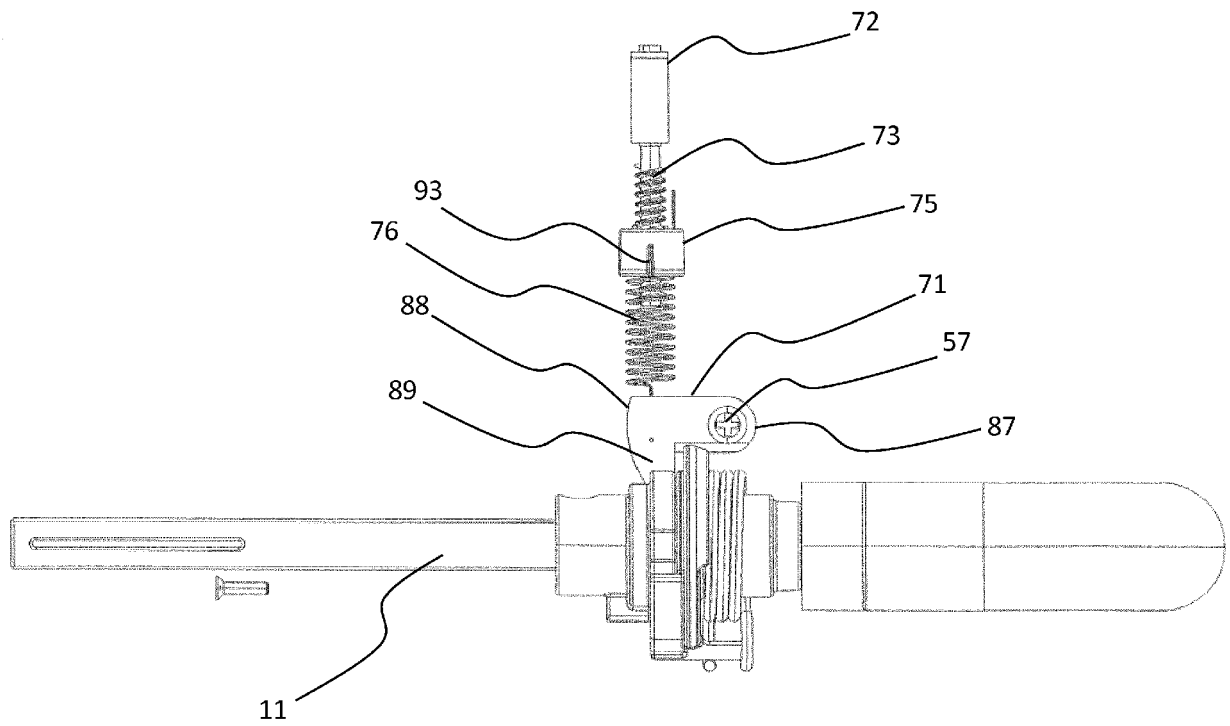


Fig. 13

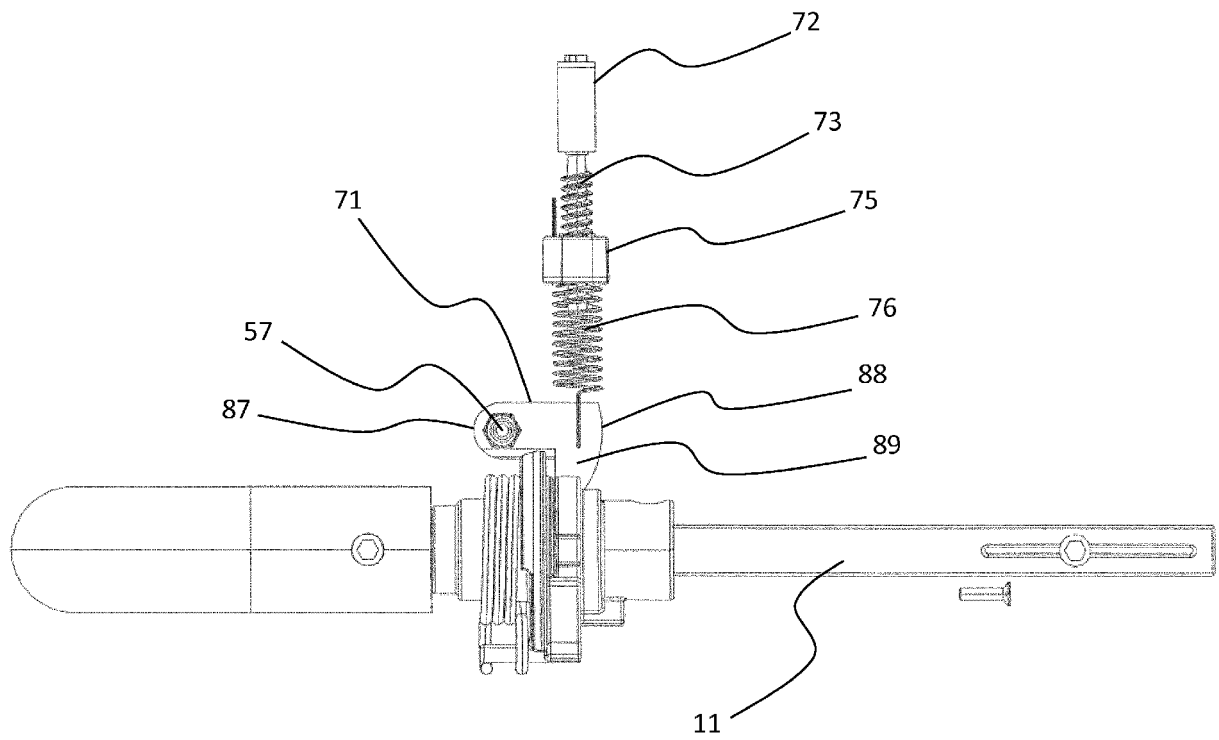


Fig. 14

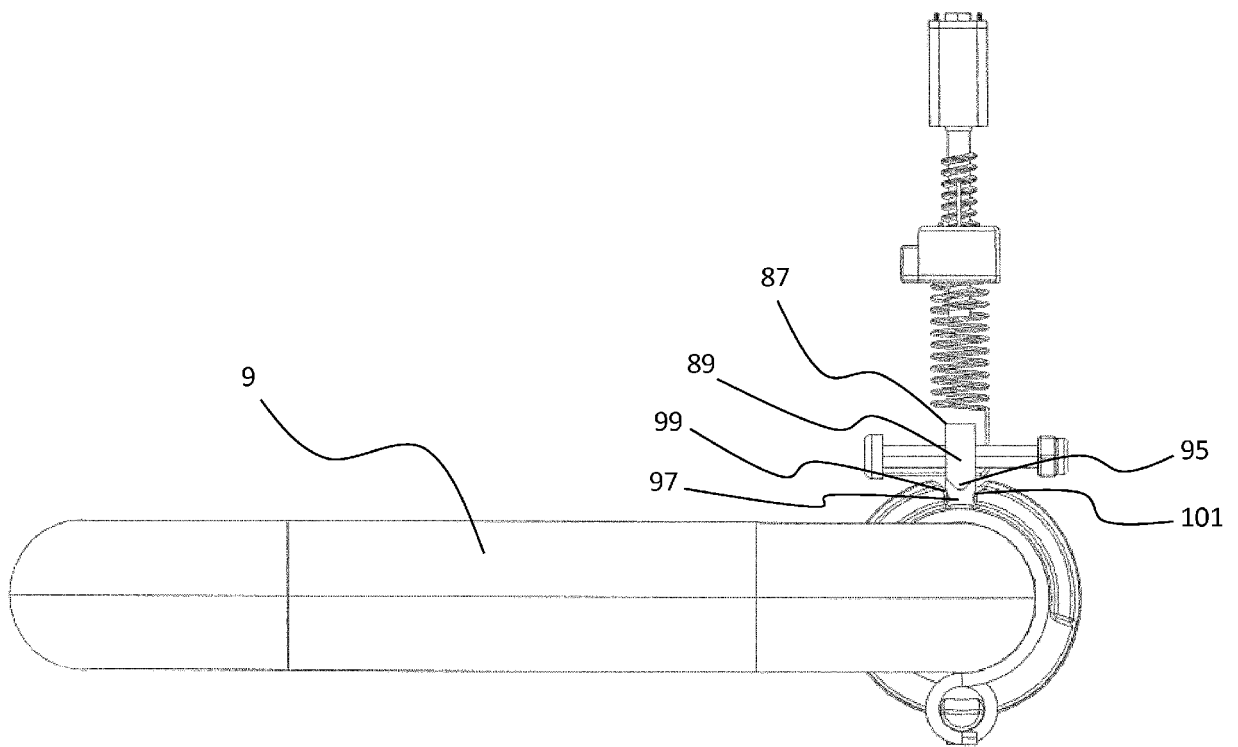


Fig. 15

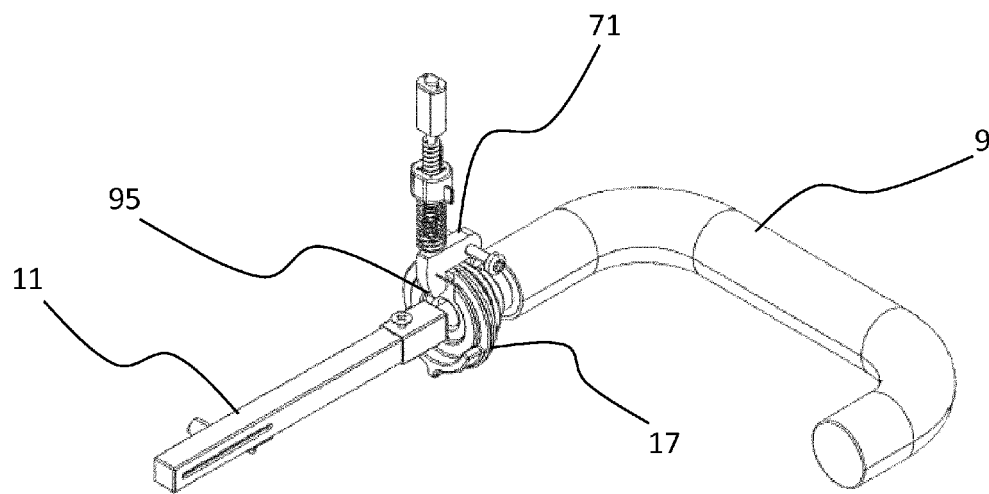


Fig. 16

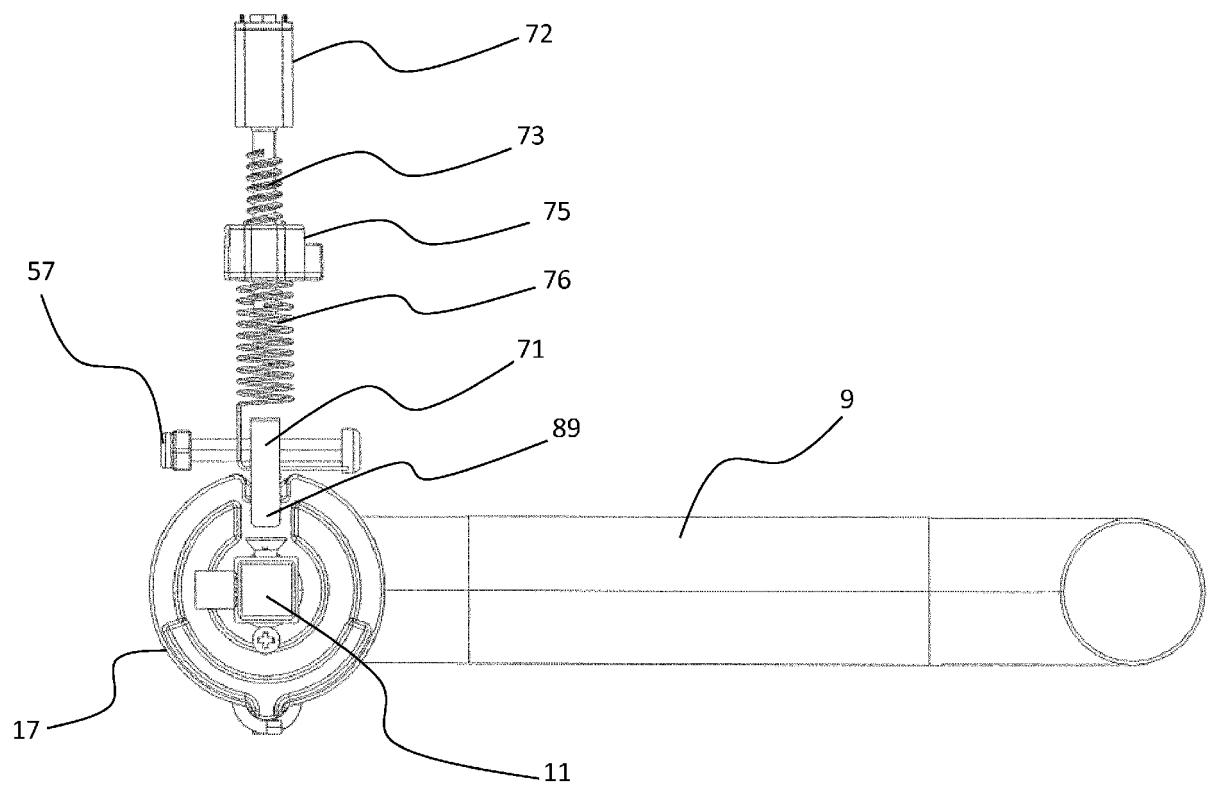


Fig. 17

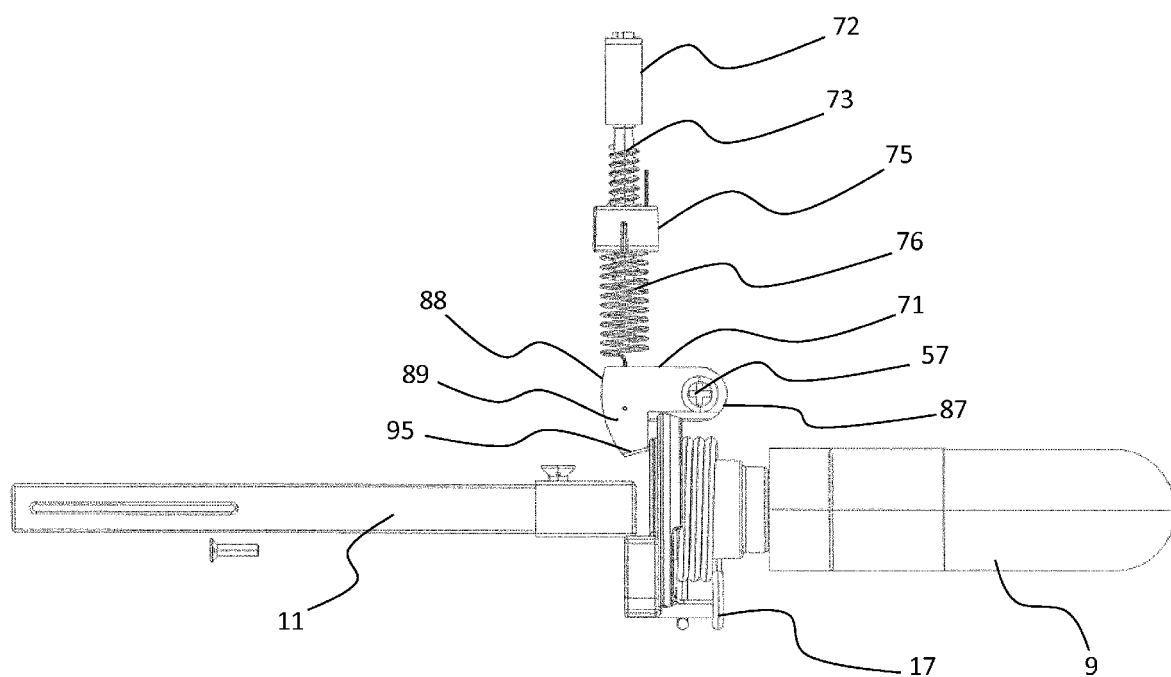


Fig. 18

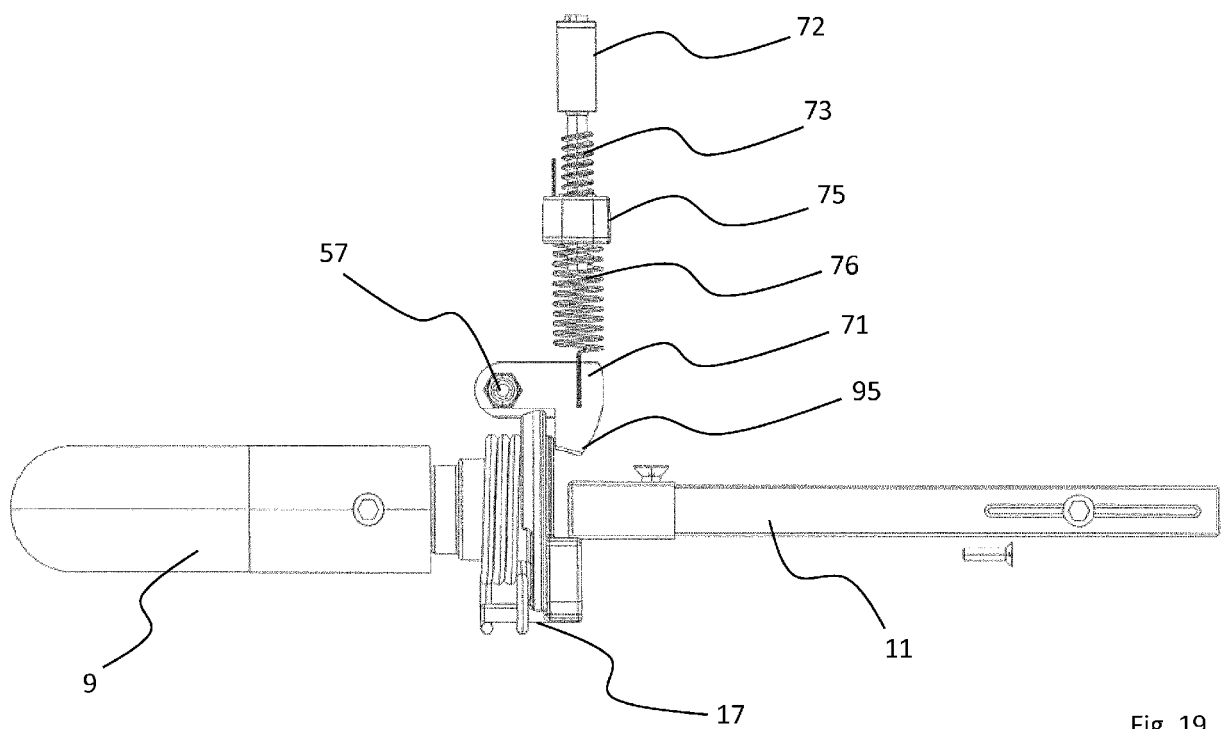


Fig. 19

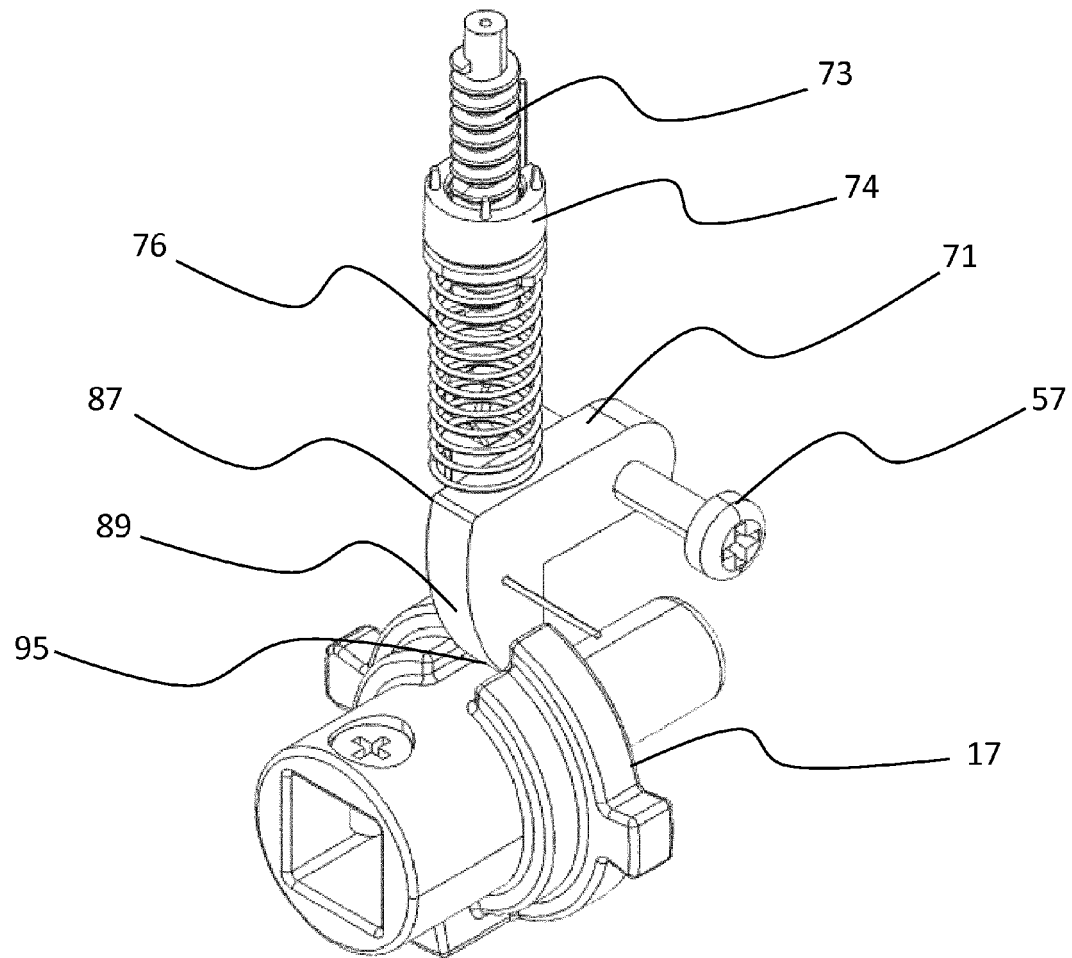


Fig. 20

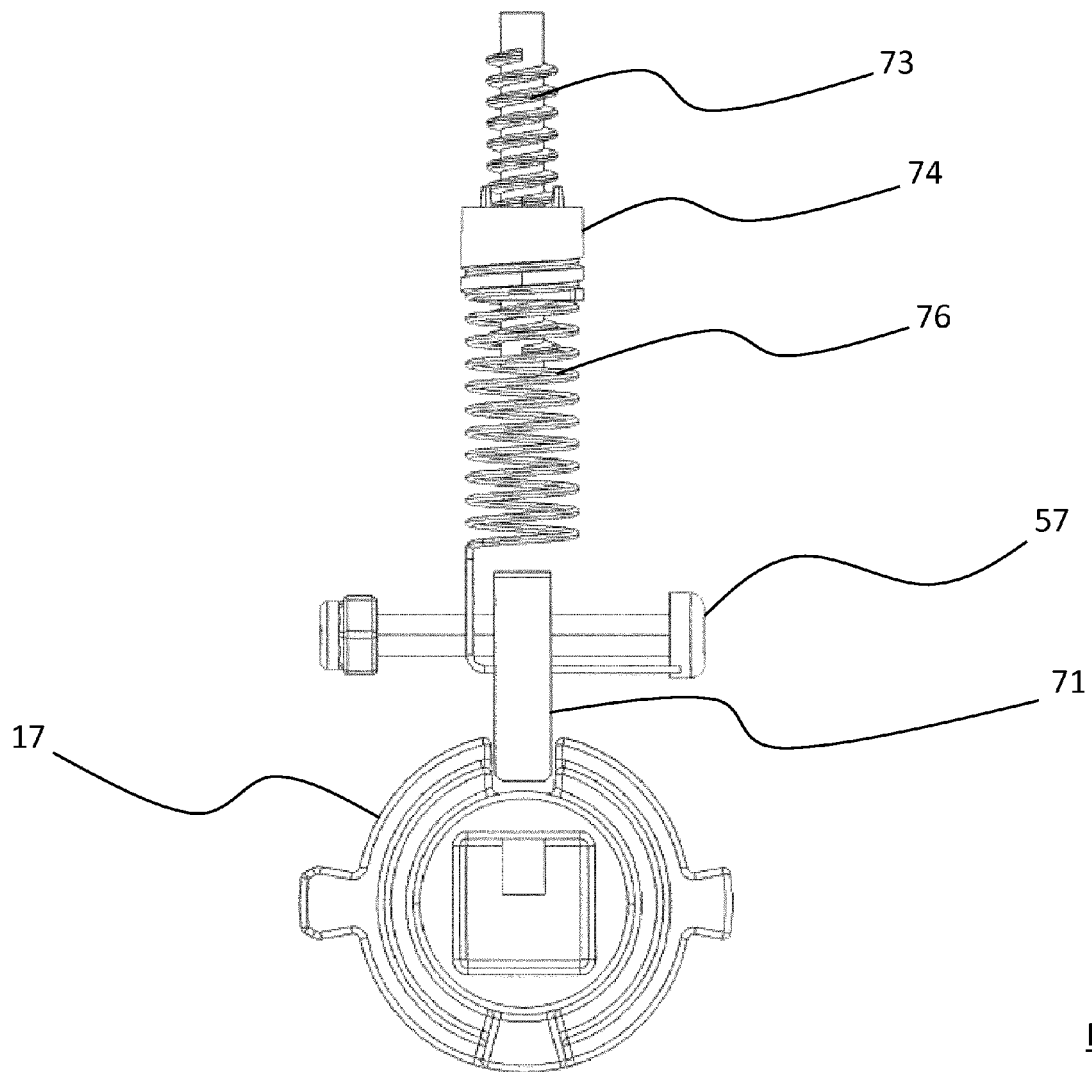


Fig. 21

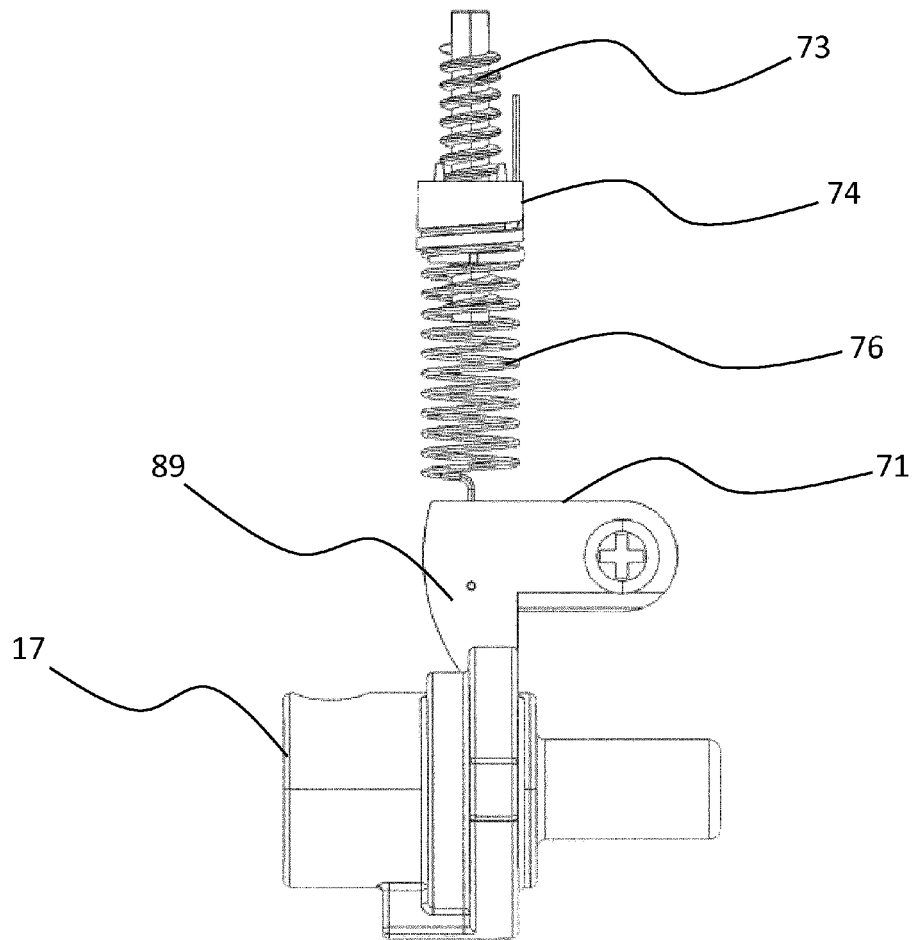


Fig. 22

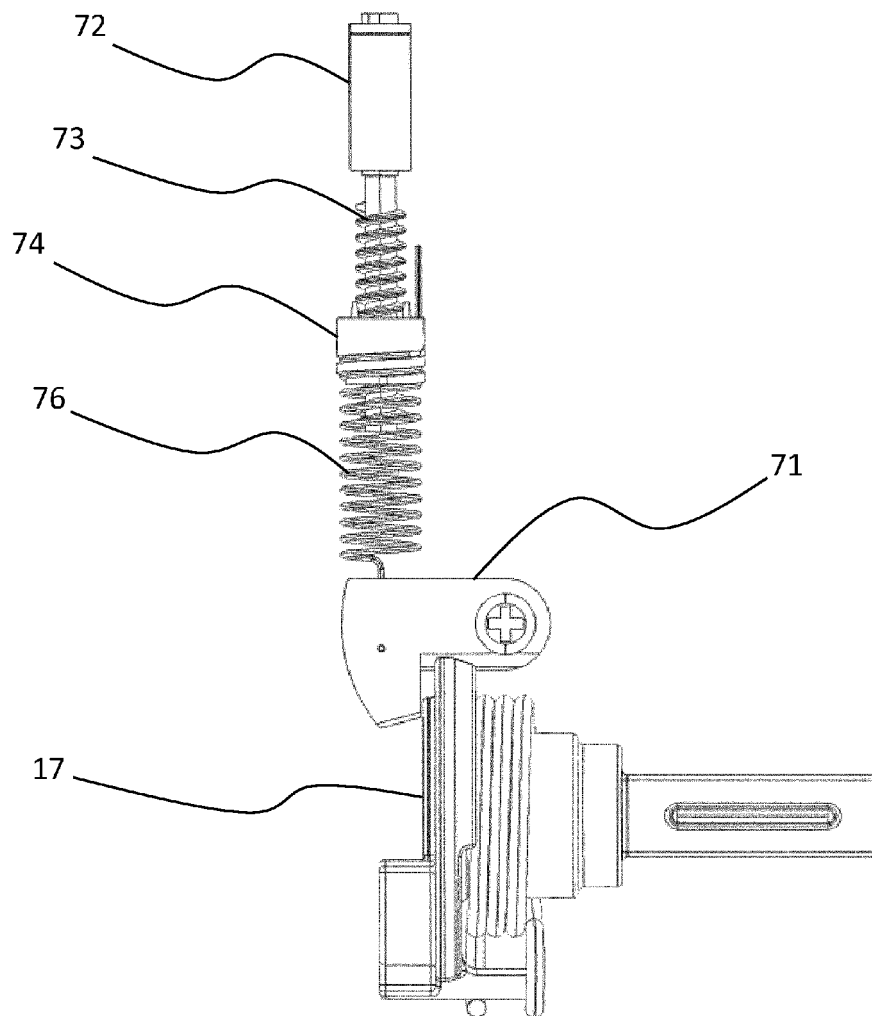


Fig. 23

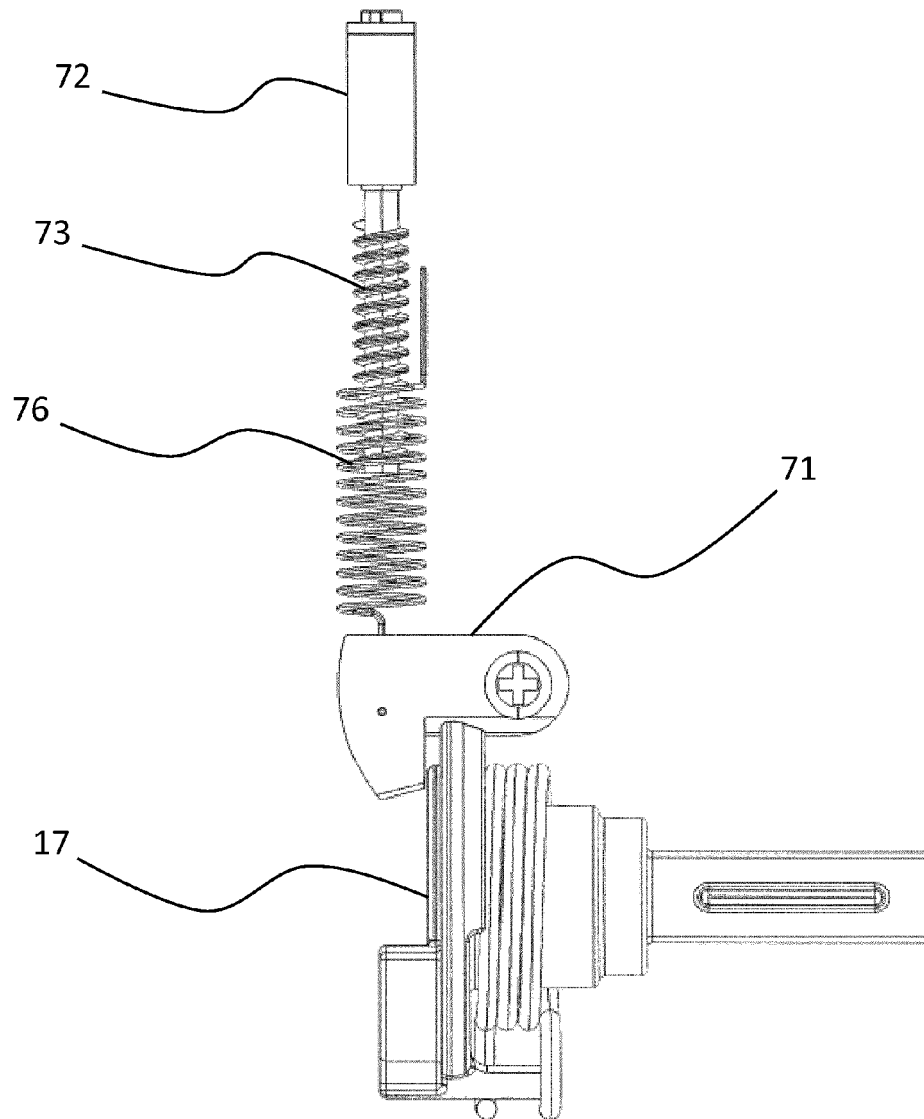


Fig. 24

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- EP 1130195 A [0004]