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(54) ELECTRONICALLY OPERATED DOOR LOCK COMPRISING A CLUTCH

(57) This disclosure relates to an electronically operated door lock (2) comprising a cylinder assembly (11) in turn comprising a housing (15), a cylinder (16) rotatably mounted in the housing (15) and provided with a cam (19) to drive a bolt (8; 9), e.g. a bolt (8; 9) in a lock case (3), an electromechanical actuator (40) to rotate the cylinder (16) and cam (19), and a door knob (17) to manually rotate the cylinder (16) and cam (19). The lock comprises a clutch (50, 51) that by manual rotation of the door knob (17) disengages the electromechanical actuator (40) from the cylinder (16) and engages the door knob (17) and the cylinder (16) or, if the two are already engaged, maintains engagement between the door knob (17) and the cylinder (16).

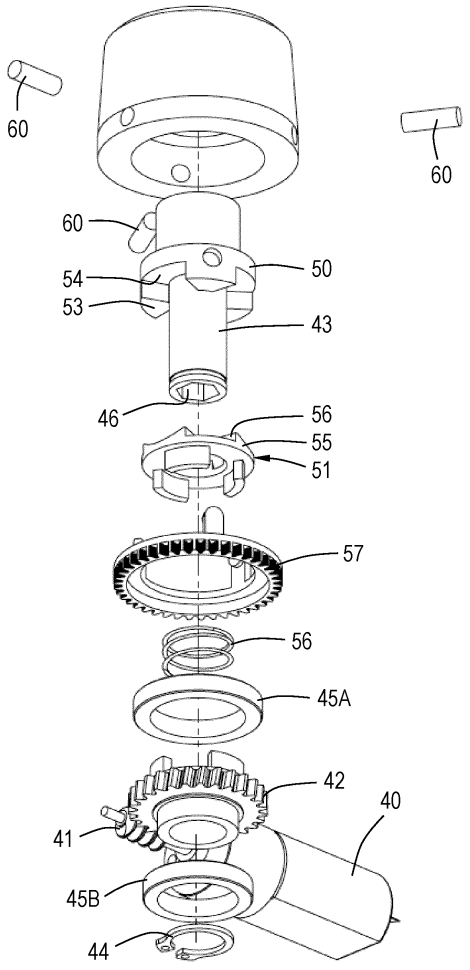

Fig. 6

EP 3 995 650 A1

Description

[0001] The present invention relates to an electronically operated door lock comprising a cylinder assembly in turn comprising a housing, a cylinder rotatably mounted in the housing and provided with a cam to drive a bolt, e.g. a bolt in a lock case, an electromechanical actuator such as an electric motor or solenoid, preferably located on the side of the lock case facing the inside of a room or building (also referred to as the interior side or the safe side), to rotate the cylinder and cam, typically to move the locking bolt from the door into the door frame or backwards, thereby locking or unlocking the door, and a door knob, preferably on the same side as the electromechanical actuator, to manually rotate the cylinder and cam.

[0002] Keyless entry systems conveniently allow a person to access an area, such as his home, without having to insert a key into a lock.

[0003] GB 2 524 718 relates to a lock assembly comprising an external handle coupled to an inner shaft (indicated by reference number 5A in the Figures of GB 2 524 718) rotatable within an outer sleeve (5F) that may be coupled to an interior handle. Rotation of the outer sleeve drives a lock bolt or latch, e.g. via cam (5E) of a cylinder lock. An electrically movable element selectively couples inner shaft and outer sleeve such that outer handle may be uncoupled from outer sleeve. Figures 1 and 2 of GB 2 524 718 show a "fixing screw 3 [that] screws into a fixing point 5C and so fixes the outer faceplate 2 to the cylinder assembly 5. Although not always required and not shown, for higher protection against vandalism a further fixing screw can be used to prevent forced rotation of the outer faceplate 2 though this would mark the door 4."

[0004] WO 2020/123573 relates to a door lock that includes a clutch mechanically arranged between a drive motor and a lock drive with the clutch having a clutch gear that is movable between engaged and disengaged positions to selectively couple and uncouple the drive motor from the lock drive from the drive motor. The clutch gear may be movable along a pathway between engaged and disengaged positions, e.g., in a direction perpendicular to a rotation axis of the clutch gear. The clutch gear may selectively couple and uncouple the drive motor from the lock drive based on movement of the drive motor.

[0005] EP 3 597 843 relates to an electronically operated door lock comprising a lock case (reference number 3 in EP 3 597 843) accommodated in a mortice (4), i.e. a pocket, in the lock stile (5) of the door and external and internal door fittings (6, 7) on the external (E) and internal (I) sides of the door. The lock case (3) houses a spring bolt (8) or latch and a dead bolt (9) and has a throughhole (10) for accommodating a cylinder assembly (11), having e.g. a Euro Profile and comprising a housing (15) and a cylinder (16) rotatably mounted in the housing. The cylinder (16) is provided with a knob (17) on one end (18) and a cam (19) near its other (distal) end to drive a bolt (8, 9) in the lock case (3).

[0006] It is an object of the present invention to provide an improved electronically operated door lock.

[0007] To this this end, the lock according to the present invention is characterized by a clutch that by manual rotation of the door knob disengages the electromechanical actuator from the cylinder and engages the door knob and the cylinder or, if the two are already engaged, maintains engagement between the door knob and the cylinder.

[0008] As a result, the lock can be opened manually, typically from the inside of e.g. a room or building, even in case of e.g. empty batteries or an electronic malfunction, and in principle requires no additional operation, such as rotating a lever or pushing a button, to cancel blocking or friction induced by the electromechanical actuator or its transmission. Further, the present invention enables safe use of self-locking transmission, such as a worm drive, between the electromechanical actuator and the cylinder. Such transmissions are robust and provide a very high reduction ratio which allows for a compact motor.

[0009] In an embodiment, the door knob comprises a rotatable shaft, preferably located in the center of the door knob, and at least part of the clutch is slidably positioned on the shaft.

[0010] In another embodiment, the clutch comprises first and second parts that are slidable relative to each other along the shaft, i.e. at least one of the parts of the clutch is slidable along and in the axial direction of the shaft, between at least an engaged position and a disengaged position. Arranging the clutch about the shaft enhances a compact and/or robust design.

[0011] In an embodiment, in the engaged position, the first and second parts interlock, thus providing a positive lock, as opposed to a friction lock, which allows reliable engagement even at small axial forces on the clutch.

[0012] In an embodiment, the first and second parts comprise an annular portion mounted over the central shaft.

[0013] In a refinement, the first and second parts comprise protrusions and recesses that, in the engaged position of the clutch, interlock, thus enabling transmission of torque between the parts, in particular from the part of the clutch coupled to the electromechanical actuator to the other part of the clutch.

[0014] In an embodiment, one part of the clutch is part of or fixed in position to the central shaft and another part of the clutch is, when the clutch is disengaged, both slidable and rotatable along resp. around the shaft. The latter part is preferably coupled to the electromechanical actuator.

[0015] Another embodiment comprises at least one element, preferably at least two, e.g. three or four, elements, extending in radial direction and between the first and second parts of the clutch, which at least one element is movable, preferably rotatable, between at least a (first) position wherein the first and second parts of the clutch engage and a (second) position wherein the at least one

element disengages the first and second parts of the clutch. In an embodiment, by rotating the door knob the at least one element pushes the parts of the clutch apart over distance sufficient to cause te parts to disengage.

[0016] In an embodiment, the element is attached, preferably directly, to the door knob. In an embodiment, the at least one element extends radially from an inner wall of the door knob. It is preferred that, in a position where the at least one element disengages the first and second parts of the clutch, the at least one element (still) engages at least one of the parts, such that that part can be rotated by manual rotation the door knob.

[0017] In an embodiment, at least one of the top surfaces on the protrusions of one of the parts of the clutch is concave and wherein, when the clutch is engaged, the at least one element is located in the concavity.

[0018] In another embodiment, the first and second parts are biased, preferably by means of a passive element such as a spring, towards the engaged position. Thus, when the electromechanical actuator is disengaged from the from the cylinder, e.g. after the door knob has been operated, and the clutch was left in the disengaged position, the clutch will automatically engage when the electromechanical actuator is activated to turn one of the parts of the clutch relative to the other.

[0019] In another embodiment, the clutch provides an overrunning clutch between the door knob and the electromechanical actuator, preferably in both rotational directions, clockwise and counterclockwise.

[0020] In an embodiment, the clutch is at least partially accommodated inside the door knob.

[0021] In a further embodiment, the door lock comprises a lock case in turn comprising a through-hole for accommodating the cylinder assembly, such that at least one bolt in the lock case can be operated by the cylinder assembly.

[0022] In another embodiment, the door knob and the electromechanical actuator are located on the same side of the lock case, preferably on the inside, and wherein an electronic module for controlling the electromechanical actuator is located on the other side of the lock case.

[0023] It is preferred that at least one of the shape of the through-hole in the lock case, the shape of the opening in the door fitting, and the cylinder is in accordance with the Euro Profile lock standard, an Oval lock standard, such as a UK Oval lock standard, Scandinavian Oval lock standard or Australian Oval lock standard, or the Swiss profile, Knobset, Rim or Screw-in standard, for example in accordance with one or more of the following standards: DIN 1303, NEN-EN 1303, DIN 18250, DIN 18251 and DIN 18252.

[0024] Within the framework of the present invention the door knob is typically a rotationally symmetrical body, optionally provided with at least one roughened area and/or with recesses and/or protrusions to improve grip. Manual rotation refers to the door knob being operated by a natural person, typically using his or her hand (manus).

[0025] Aspects of this disclosure will be explained in greater detail by reference to exemplary embodiments shown in the drawings in which:

Figure 1 schematically show an electronically operated lock according to the present invention installed in an outside door.

Figure 2 is an exploded view of the electronic lock shown in Figure 1.

Figure 3 is a side view of the door knob, cylinder assembly, and electric motor of the lock shown in Figures 1 and 2.

Figure 4 is a side view of the door knob and electric motor also shown in Figure 3.

Figure 5 is a cross-section of the doorknob shown in Figure 4.

Figure 6 is an exploded view of the door knob shown in Figures 3 to 5.

Figures 7A to 7C show how the door knob is disengaged from the electric motor by rotating the knob.

[0026] Figures 1 and 2 show a door 1 provided with an electronically operated lock 2. The lock comprises a lock case 3 accommodated in a mortice 4, i.e. a pocket, in the lock stile 5 of the door and external and internal door fittings 6, 7 on the external (E) and internal (I) sides of the door. The lock case 3 houses a spring bolt 8 or latch and a dead bolt 9 and has a through-hole 10 for accommodating a cylinder assembly 11, shown in Figures 2 and 3. The door comprises openings 12 that have the same shape as the through-hole 10 and that are in register with the through-hole when the lock case 3 is properly located in the mortice 4.

[0027] The cylinder assembly 11 has e.g. a Euro Profile and comprises a housing 15 and a cylinder 16 rotatably mounted in the housing. The cylinder 16 is provided with a knob 17 on one end 18 and a cam 19 near its other (distal) end to drive a bolt 8, 9 in the lock case 3. The housing 15 comprises a recess 25 that enables the cam 19 to pass when the cylinder 16 is being rotated and, just below the recess 25, a threaded bore 26 for a retaining screw (not shown; known in itself).

[0028] The end 15A of the housing 15 opposite the knob 17 rotatably carries and covers the other (distal) end of the cylinder 16 but is otherwise solid. In this example, this part 15A of the housing 15, preferably the entire housing, is made of a hardened metal. The external door fitting 6 comprises a face plate 30 carrying a door handle 31 and is provided with an opening 32 shaped to accommodate a cylinder assembly having, in this example, a Euro Profile. An electronic module 33 for controlling the electromechanical actuator is mounted over the opening 32 by means of a metal or plastic block 34. For further details on these aspects of the lock reference is made EP 3 597 843.

[0029] The internal door fitting 7 carries the rotary knob 17 for manually operating the lock and contains an electromagnetic actuator for automatically operating the lock.

Details of the internal door fitting 7 and door knob 17 are shown in Figures 3 to 7C. Figures 3 to 5 show an electric motor 40 provided with a worm 41 that intermeshes with a worm wheel 42 that is mounted about a central shaft in the shaft 43 and held in place by means of a circlip 44. The shaft is provided with bearings 45A, 45B to mount the door knob 17 in the internal door fitting 7. The cylinder assembly 11 is coupled to the shaft 43, i.c. via the hexagonal head 18 at the proximal end of the cylinder 16 that fits inside a channel 45 having a hexagonal cross-section in the central shaft 43. The connection between the cylinder and the central shaft is not material to the present invention and can be configured in many different ways. Alternatively, the cylinder is an integral part of the central shaft.

[0030] As best seen in Figure 6, the lock comprises a clutch having first and second parts 50, 51 that are mounted on and about the shaft 43. In this example, the clutch has a first part 50 that is mounted over the proximal end of shaft, i.e. the end closest to a person operating the door knob, and fixed to the shaft, e.g. by welding, an adhesive or, as in this example, a locking screw 52. A second part 51 of the clutch is slidably mounted about the shaft, i.e. it is slidable along and in the axial direction of the shaft, between at least an engaged position and a disengaged position. The first part comprises a plurality, e.g. three, protrusions 53 extending in the direction of the second part and defining recesses 54 between them. The second part 51 has a corresponding number of protrusions 55 that, in the engaged position of the clutch / second part, slidingly fit in the protrusions 54 on the first part 50. A spring 56 is provided between the worm wheel 42 and the second part 51 of the clutch to bias the second part towards the first part of the clutch.

[0031] The other side of the second part 51 engages the worm wheel 42. In this example, the connection is similar to the connection between the clutch parts in that the second part is slidable in axial direction relative to the worm wheel to allow it to engage and disengage the first part of the clutch. However, the protrusions on the worm wheel and the second part of the clutch permanently intermesh, i.e. will not disengage, to ensure that rotation and torque can be transmitted from the motor to the second part of the clutch.

[0032] A gear wheel 57 is attached to the first part 50 of the clutch, to drive an encoder wheel 58 (Figure 4), which enables the controller of the lock to establish the rotational position of the shaft 43 and the cylinder 16.

[0033] The clutch further has a plurality, e.g. three or four, elements, in this example pins 60, extending in radial direction and between the first and second parts of the clutch. The pins in this example have a circle cylindrical cross-section and are secured in the inner wall of the (outer housing of) the knob. The pins have a diameter that exceeds the height of the protrusions on the first part of the clutch.

[0034] Further, the top surfaces 61 on the protrusions 55 of the second part 51 of the clutch are concave, as shown in Figures 7A to 7C. The effect is that, when the knob and thus the pins are rotated (Figure 7B), clockwise or, in this example, counterclockwise, the pins 60 and thus the first part 50 of the clutch are urged (lifted) in axial direction, away from the second part 51 of the clutch and the protrusions 55 on the first part are pulled out of the recesses 56 in the second part 51. When the pins 60 reach one of the ends of the concave surfaces, the protrusions on the first part have been withdrawn completely from the recesses in the second part, i.e. the first and second parts are disengaged, and, preferably simultaneously, the pins engage the side walls of the protrusions on the first part. Thus, after rotations over a relatively small angle, e.g. 30°, the pins, the first part of the clutch, the central shaft and the cylinder of the lock can be rotated by means of the knob housing essentially without interference or blocking form the electric motor to lock on unlock the door.

[0035] The invention is not restricted to the embodiments described above and can be varied in numerous ways within the scope of the claims.

Claims

1. Electronically operated door lock (2) comprising
a cylinder assembly (11) in turn comprising a housing (15), a cylinder (16) rotatably mounted in the housing (15) and provided with a cam (19) to drive a bolt (8; 9), e.g. a bolt (8; 9) in a lock case (3),
an electromechanical actuator (40) to rotate the cylinder (16) and cam (19), and
a door knob (17) to manually rotate the cylinder (16) and cam (19),
characterized by
a clutch (50, 51) that by manual rotation of the door knob (17) disengages the electromechanical actuator (40) from the cylinder (16) and engages the door knob (17) and the cylinder (16) or, if the two are already engaged, maintains engagement between the door knob (17) and the cylinder (16).

2. Door lock according to claim 1, wherein the door knob (17) comprises a rotatable shaft (43), preferably located in the center of the door knob (17), and wherein at least part of the clutch (50, 51) is slidably positioned on the shaft (43) .

3. Door lock according to claim 2, wherein the clutch comprises first and second parts (50, 51) that are slidable relative to each other along the shaft (43), i.e. at least one of the parts of the clutch (50, 51) is slidable along and in the axial direction of the shaft (43), between at least an engaged position and a disengaged position.

4. Door lock according to claim 3, wherein, in the engaged position, the first and second parts (50, 51)

interlock.

5. Door lock according to claim 4, wherein the first and second parts (50, 51) comprise an annular portion mounted over the central shaft (43).

6. Door lock according to claim 4 or 5 wherein the first and second parts (50, 51) comprise protrusions (53, 55) and recesses (54, 56) that, in the engaged position of the clutch (50, 51), interlock.

7. Door lock according to any one of the preceding claims, wherein one part (50) of the clutch (50, 51) is part of or fixed to the central shaft (43) and another part (51) of the clutch (50, 51) is, when the clutch (50, 51) is disengaged, both slidable and rotatable along resp. around the shaft (43).

8. Door lock according to any one of the claims 3-7, comprising at least one element (60), preferably at least two, e.g. three or four, elements (60), extending in radial direction and between the first and second parts of the clutch (50, 51), which at least one element (60) is movable, preferably rotatable, between at least a (first) position (Figure 7A) wherein the first and second parts of the clutch engage and a (second) position (Figure 7C) wherein the at least one element (60) disengages the first and second parts of the clutch (50, 51).

9. Door lock according to claim 8, wherein the element (60) is attached, preferably directly, to the door knob (17).

10. Door lock according to claim 8 or 9, wherein, in a position where the at least one element (60) disengages the first and second parts of the clutch (50, 51), the at least one element (60) engages at least one of the parts.

11. Door lock according to any one of the claims 8-10, wherein at least one of the top surfaces (61) on the protrusions (55) of one of the parts of the clutch (50, 51) is concave and wherein, when the clutch (50,51) is engaged, the at least one element (60) is located in the concavity.

12. Door lock according to any one of the claims 3-11, wherein the first and second parts of the clutch (50, 51) are biased, preferably by means of a passive element such as a spring, towards the engaged position.

13. Door lock according to any one of the preceding claims, wherein the clutch (50, 51) provides an overrunning clutch between the door knob (17) and the electromechanical actuator (40), preferably in both rotational directions, clockwise and counterclockwise.

14. Door lock according to any one of the preceding claims, comprising a lock case (3) in turn comprising a through-hole (10) for accommodating the cylinder assembly (11), such that at least one bolt (8; 9) in the lock case (3) can be operated by the cylinder assembly (11).

15. Door lock according to any one of the preceding claims, wherein the door knob and the electromechanical actuator are located on the same side of the lock case, preferably on the inside, and wherein an electronic module for controlling the electromechanical actuator (33) is located on the other side of the lock case (3).

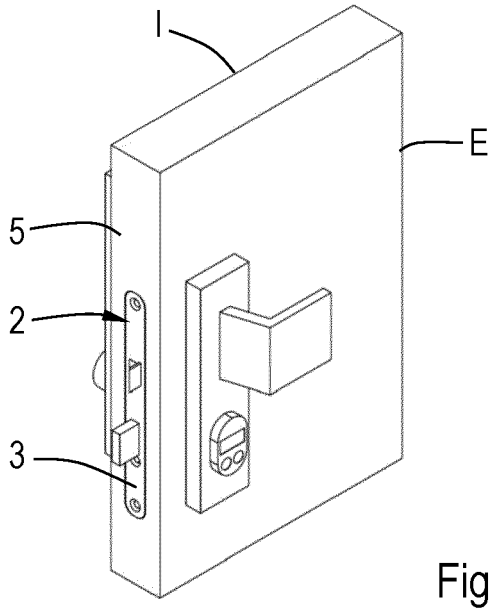

Fig. 1

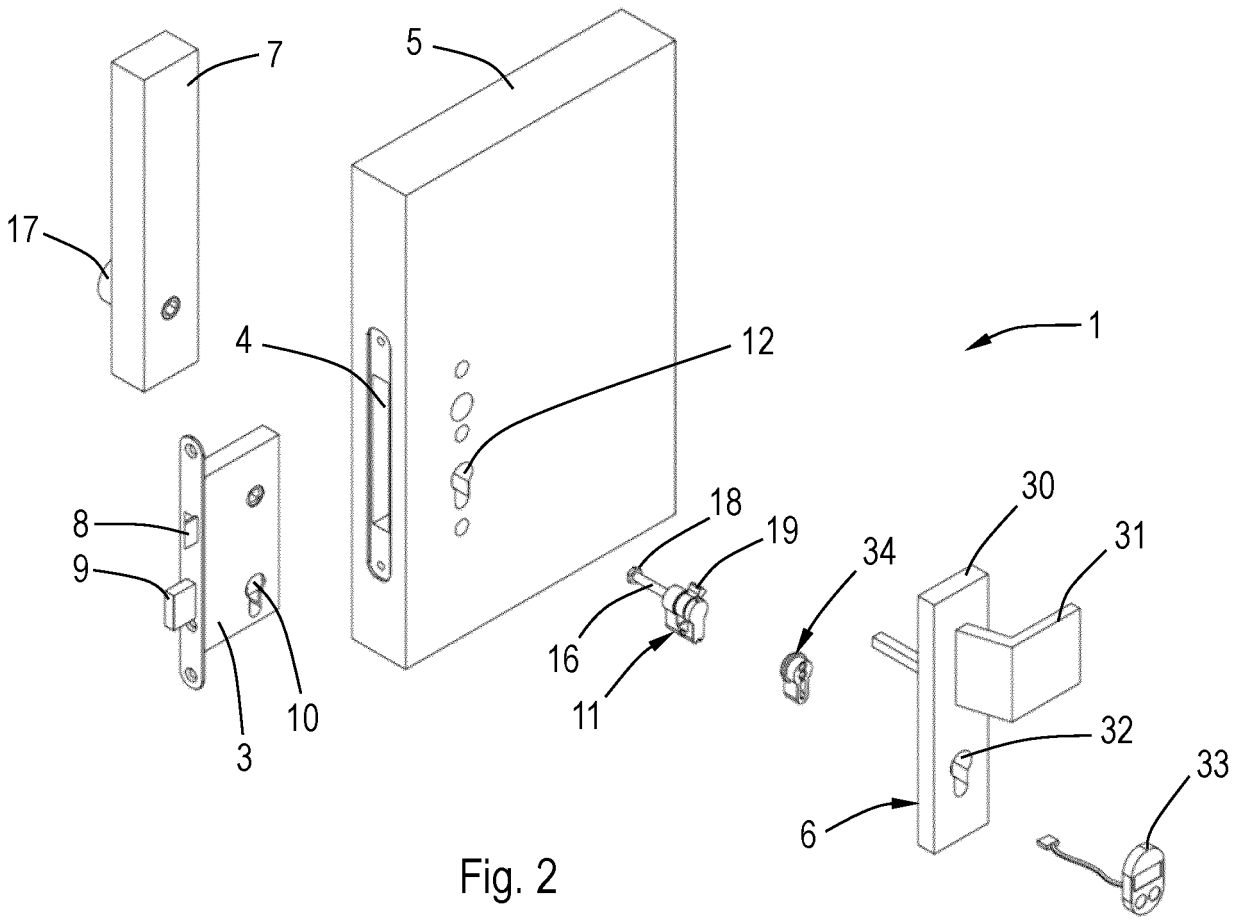

Fig. 2

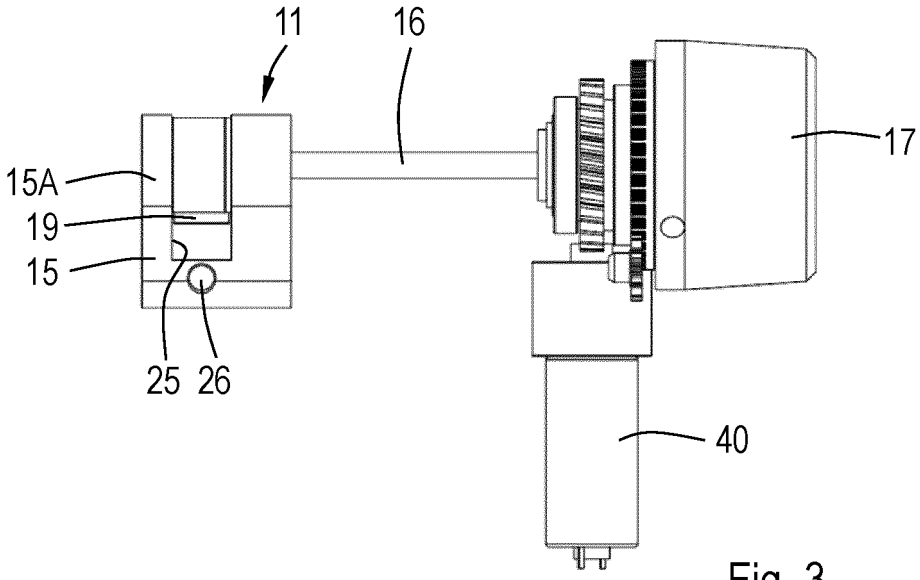

Fig. 3

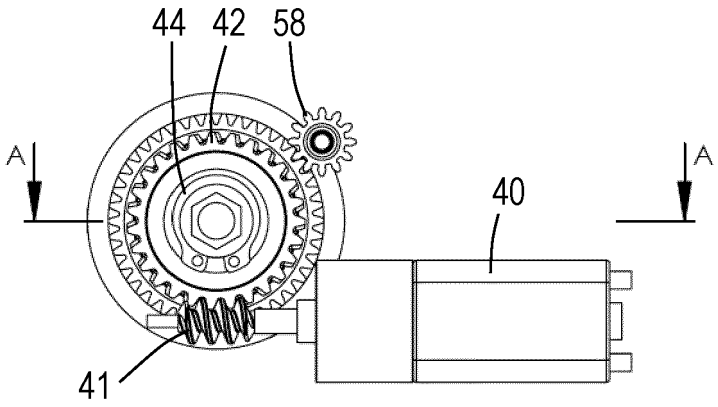

Fig. 4

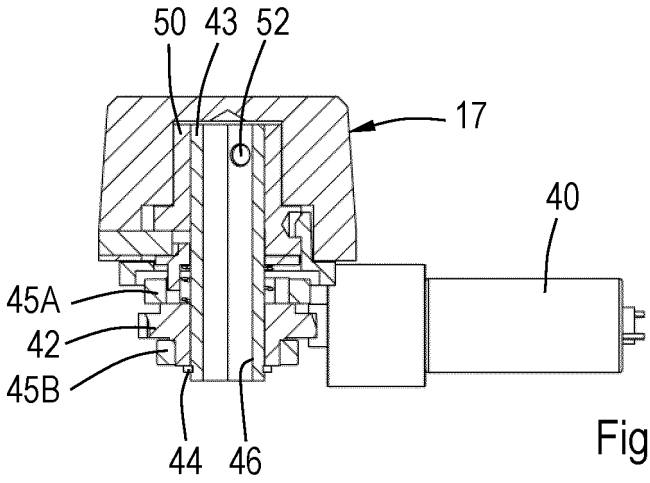

Fig. 5

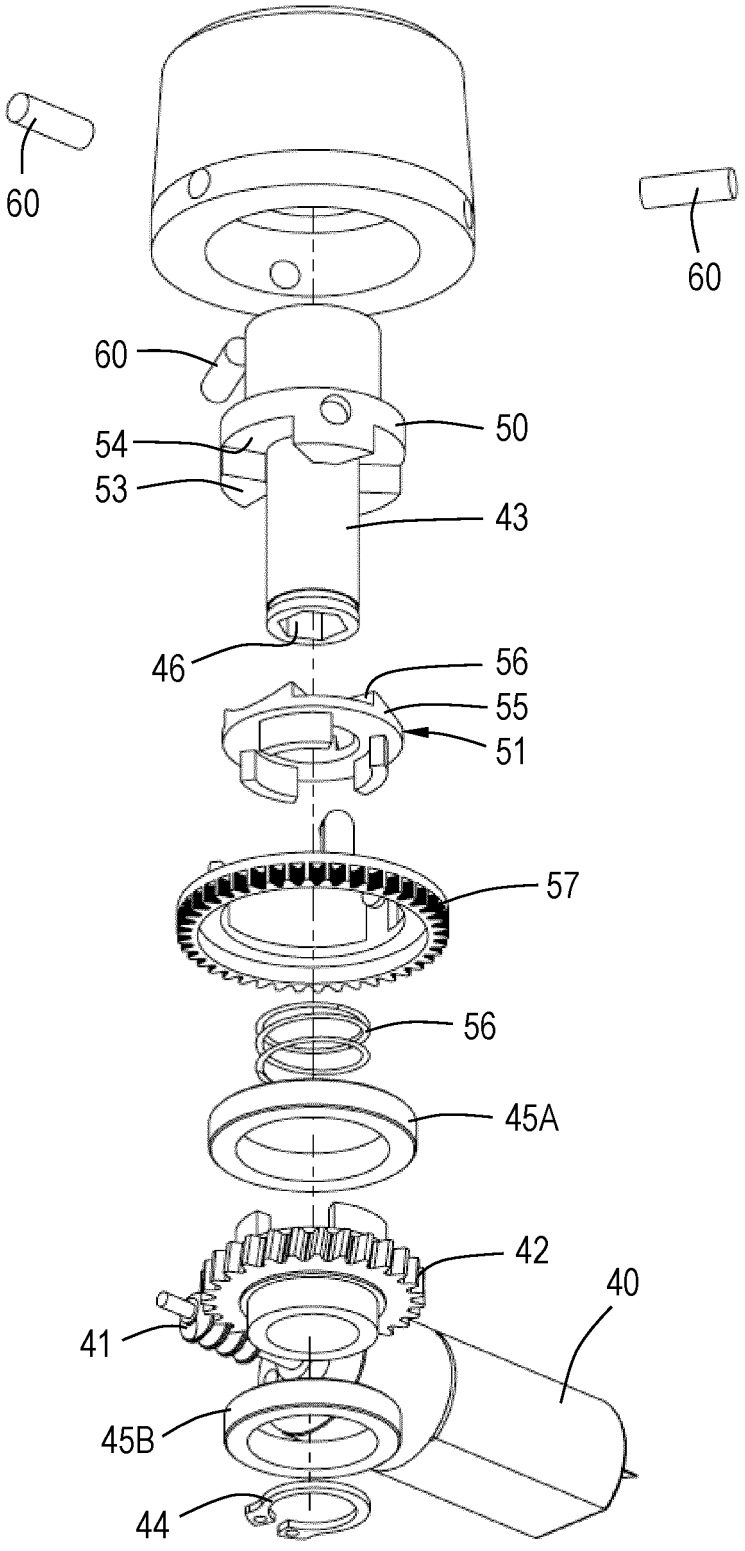

Fig. 6

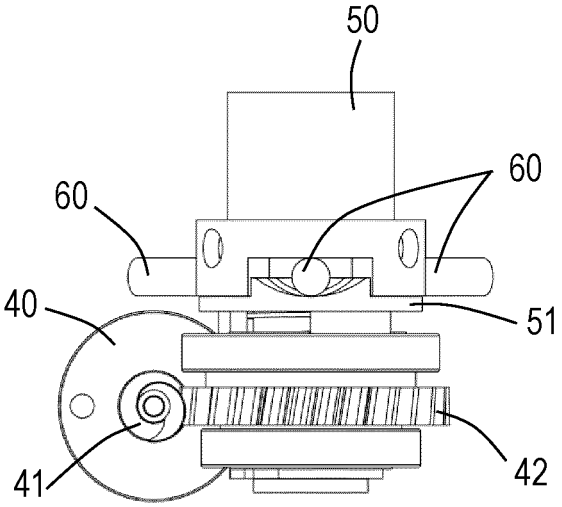

Fig. 7A

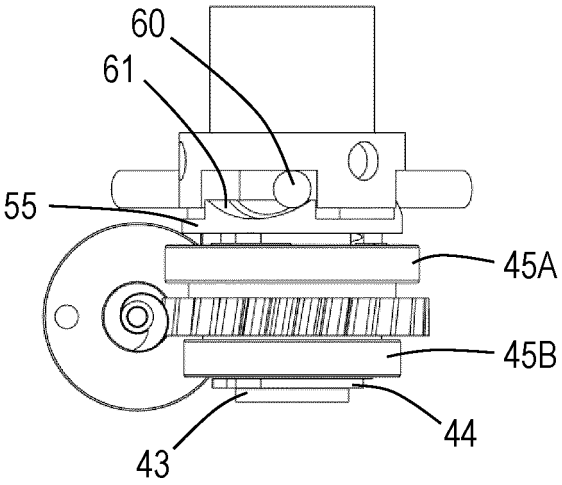

Fig. 7B

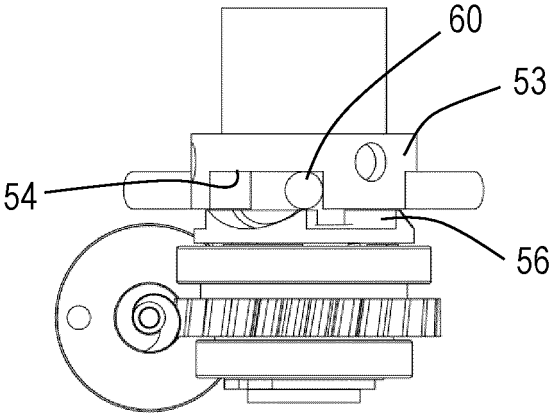

Fig. 7C

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EUROPEAN SEARCH REPORT

Application Number
EP 20 20 6821

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X Y	US 2018/320413 A1 (WONG WAI P [US]) 8 November 2018 (2018-11-08) * paragraphs [0040] - [0047]; figures 1-8 * -----	1-7, 12-15 8-11	INV. E05B47/00 E05B47/06 ADD. E05B9/04
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A	US 2013/167671 A1 (HUANG LIEN-HSI [TW] ET AL) 4 July 2013 (2013-07-04) * figures 17, 18 * -----	1-15	

TECHNICAL FIELDS SEARCHED (IPC)

E05B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	22 April 2021	Cruyplant, Lieve

CATEGORY OF CITED DOCUMENTS

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