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(54) DEVICE FOR ACTUATING AN OPENABLE AND CLOSABLE ELEMENT, A SYSTEM COMPRISING THE DEVICE AND METHODS

(57) The present invention relates to a device (100, 200, 300) for actuating an openable and closable element (61), such as a door leaf. The device (100, 200, 300) comprises: an actuator module (2, 6), and a longitudinal profile element (1) for receiving and supporting the actuator module (2, 6). The actuator module (2, 6) is configured to be mechanically connected to the openable and closable element (61) for opening and/or closing thereof. Wherein the longitudinal profile element (1) comprises four inner major support surfaces (3) defining a substantially rectangular internal cross section, the longitudinal profile element (1), at each corner (5) defined by two adjoining inner major support surfaces (3), further comprises a protrusion (7) adjoining said two adjoining inner major support surfaces (3); and wherein an internal cross section of the longitudinal profile element (1) is adapted to receive and support an actuator module (2, 6) having a circular outer cross section of a predetermined size, and/or a rectangular outer cross section of a predetermined size. A system (4) including the device (100, 200, 300) and methods involving the device (100, 200, 300) are also disclosed.

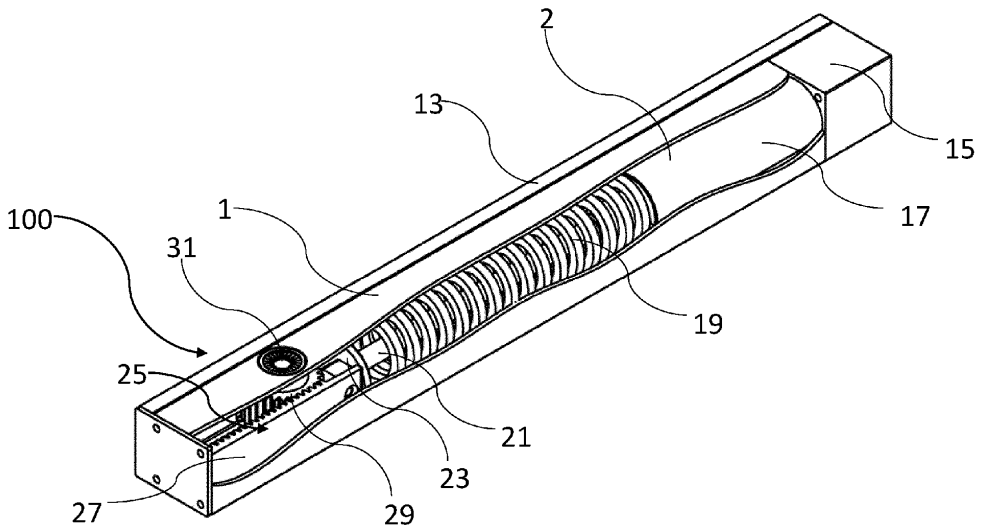


Fig. 2A

EP 4 177 430 A1

Description

Technical field

[0001] The present invention relates to a device comprising a hollow profile for receiving an actuator module such that an opener device or a closer device is provided, and a method for converting a closer device into an opener device, and vice versa.

Background

[0002] In order to automate or otherwise assist with actuation of openable and closable elements, such as door leaves or gates, actuators are used. The actuator is often an opener or a closer, i.e. it is either adapted to apply power in order to move an element from a default position, such as a closed position, or apply power and/or release power in order to move an element to a default position. When used for opening and/or closing a door leaf, the actuator is often placed above the door leaf, on the door frame.

[0003] Pertaining to the difference in size, shape and functionality of an opening actuator and a closing actuator, current practice is that openers and closers are designed independently and, naturally, requires different methods of assembly and installation. Thus, when changing from an opener to a closer or vice versa, the whole device needs to be replaced. This is not only impractical, but material inefficient and time consuming, and risks damaging or leave permanent marks in the structure in which the actuator is installed.

[0004] As such, there is a need for a device which exhibits improved versatility, and is thus easier to use and easier to install.

Summary

[0005] An object of the present invention is therefore to overcome the above problems, and to provide a solution that at least to some extent improve upon the prior art. This, and other objects, which will become apparent in the following, is accomplished by the device comprising a hollow profile for receiving an actuator module defined in the accompanying claims.

[0006] Another object is to provide such a device which is more versatile.

[0007] Another object is to provide such a device which is less time consuming to install.

[0008] Another object is to provide such a device which is more material efficient.

[0009] It is also an object to provide a cost-effective device for actuating an openable and closable element, such as a door leaf.

[0010] Another object is to provide a method for converting a closer to an opener, and vice versa, which is less time consuming and more cost-effective.

[0011] According to a first aspect of the present invention, a device for actuating an openable and closable element, such as a door leaf, is provided, the device comprising: an actuator module; and a longitudinal profile element for receiving and supporting the actuator module; wherein the actuator module is configured to be mechanically connected to the openable and closable element for opening and/or closing thereof; wherein the longitudinal profile element comprises four inner major support surfaces defining a substantially rectangular internal cross section, the longitudinal profile element, at each corner defined by two adjoining inner major support surfaces, further comprises a protrusion adjoining the two adjoining inner major support surfaces; and wherein an internal cross section of the longitudinal profile element is adapted to receive and support an actuator module having a circular outer cross section of a predetermined size, and/or a rectangular outer cross section of a predetermined size.

[0012] An actuator module may be a closing actuator or an opening actuator.

[0013] A predetermined size of a circular outer cross section or a rectangular outer cross section of an actuator module is to be understood as the cross section being dimensioned by design. As such, since the longitudinal profile element is adapted to receive and support such an actuator of predetermined size, it is to be understood that the longitudinal profile element is specifically designed for receiving and support an actuator of the predetermined size. The longitudinal profile element may as such have at least one internal cross section having a shape that is at least partially complementary to the actuator module.

[0014] That the longitudinal profile element is receiving and supporting an actuator module is to be understood as the actuator module being arranged in the longitudinal profile element with a tight fit possibly with a small tolerance, such that it is held firmly in place, but no with a press fit.

[0015] Hereby, a more versatile and easier-to-use device is provided, since it is adapted to receive actuator modules of different geometry. For example, the actuator module may be a closing actuator or an opening actuator, wherein the closing actuator has a different outer cross section than the opening actuator.

[0016] The protrusions may be uniform in size and shape. Alternatively, any protrusion may differ from the other protrusions in size and/or shape.

[0017] The actuator module may be a closer comprising a spring assembly configured to be compressed from a first state to a second state during opening of an associated openable and closable element, and wherein the actuator module may be further configured to be decompressed from the second state to the first state whereby an associated openable and closable element is closed.

[0018] Hereby, the actuator module may reuse stored energy, and an energy efficient device is provided.

[0019] The spring assembly may alternatively be configured to be compressed and/or stretched, wherein the

module is configured to be decompressed or and/or destretched from the second state to the first state.

[0020] The spring assembly may exhibit a circular outer cross section of the predetermined size and may be adapted to be received and supported by the internal cross section of the longitudinal profile element.

[0021] Hereby, the longitudinal profile element may be adapted to house at least part of the spring assembly of the actuator module. The actuator module may comprise outer cross section such that the longitudinal profile element is configured to receive and support the whole actuator module. Alternatively, the actuator module may comprise both rectangular and circular cross sections such that the longitudinal profile element is adapted to receive both cross sections of the actuator module.

[0022] The actuator module may further comprise a plurality of adjustment screws, wherein at least one adjustment screw is configured such that adjustment of the screw enables alteration of a velocity of decompression of the spring assembly, and wherein each of the plurality of adjustment screws may have a longitudinal axis, wherein the longitudinal axes of the plurality of adjustment screws may be substantially parallel with a longitudinal axis of the profile element.

[0023] By having the longitudinal axes of the plurality of adjustment screws substantially parallel with a longitudinal axis of the profile element, the longitudinal axes of the plurality of adjustment screws are consequentially substantially parallel with each other. As such, a person operating the screws may access them from the same direction. Thus, a device that may be easier to use is provide.

[0024] The actuator module may comprise a spring assembly and an electrical motor, wherein the electrical motor may be configured to transfer power to an associated openable and closable element via the spring assembly.

[0025] That the electrical motor is configured to transfer power to an associated openable and closable element implies that it is configured to transfer force, torque or any other physical quantity derivable from power by laws of physics. The transferred power may actuate the associated openable and closable element. The transferred power may close the associated openable and closable element. The transferred power may open the associated openable and closable element.

[0026] The spring assembly may comprise a spring sandwiched between a first end element displaceably attached to the spring and mechanically connected to the electric motor, and a second end element displaceably attached to the spring and configured to be mechanically connected to the openable and closable element, such that the spring may be compressed and/or decompressed by motion of the first end element independent of motion of the second end element.

[0027] When in use, the device actuates an openable and closable element, such as a door leaf. In other words, the device moves the openable and closable element in a certain direction. As an example, the device rotates a door leaf in a certain direction. If the exemplary door leaf, for any reason, would simultaneously be supplied a rotating motion in the opposite direction, e.g. that a person is trying to close the door leaf at the same time as the device is opening the door leaf, the device may be damaged. However, since the first and second end portions are able to compress or decompress the spring independently, motion opposite to what the device is providing to the openable and closable element will be picked up by the spring by compressing or decompressing the spring, instead of being translated to the electric motor of the actuator. Hereby, the actuator and the electric motor thereof may be protected.

[0028] The actuator module may comprise at least one brace fixedly attached to the first end element and arranged along a longitudinal axis of the spring assembly, wherein the at least one brace may be configured to engage with the second end element so as to allow compression of the spring assembly while defining a maximum length of extension of the spring assembly.

[0029] Hereby, a maximum length of extension of the spring assembly is defined. Furthermore, the at least one brace stabilizes and protects the spring when the actuator module is arranged in and supported by the longitudinal profile element. The at least one brace is preferably arranged on an outer surface of the spring assembly. The actuator module may comprise four braces. For example, two braces may be fixedly attached to the first end element and configured to engage with the second end element, whereas two braces may be fixedly attached to the second end element and configured to engage with the first end element. The four braces may be arranged in a way so as to define one or more rectangular outer cross sections configured to be received and support by the longitudinal profile element. The braces may be arranged to slide within the longitudinal profile element such that the spring assembly is slideably arranged in the longitudinal profile element.

[0030] The four inner major support surfaces may define a substantially rectangular first internal cross section and a substantially rectangular second internal cross section, wherein the actuator module may be adapted to be received and supported by the first and/or second rectangular internal cross section of the longitudinal profile element.

[0031] Thus, the same actuator module may be arranged in at least two different ways in the profile element. Alternatively, the actuator module may comprise an outer cross section such that it may be received and supported by both the first and the second substantially rectangular internal cross sections. Consequently, a more versatile device is provided.

[0032] The first and the second substantially rectangular internal cross sections may comprise a respective longitudinal axis, wherein the longitudinal axis of the first substantially rectangular internal cross section is perpendicular to the second substantially rectangular internal

cross section.

[0033] The first and second substantially rectangular internal cross sections may be uniform in area. Alternatively, the first and second substantially rectangular internal cross sections differ in area.

[0034] The device may further comprise a further module, wherein the internal cross section of the longitudinal profile element may be further adapted to receive and support the further module, the further module exhibiting a circular cross section of said predetermined size and/or rectangular cross section of said predetermined size, wherein the further module may be configured to mechanically connect the actuator module to an associated openable and closable element.

[0035] As such, the device may receive two different actuator modules. Hereby, a device with increased versatility is provided.

[0036] The first actuator module may comprise a main axis coinciding with the first direction, and wherein the further actuator module comprises a main axis coinciding with the second direction.

[0037] Alternatively, the device is adapted to receive more than two actuator modules.

[0038] The further module may comprise a gear rack connected to a gear, the gear comprising a rotation pin substantially arranged along an axis of rotation of the gear, wherein the gear rack may be connected to the actuator module, and wherein the rotation pin may be configured to be mechanically connected to the openable and closable element.

[0039] Hereby, the actuator module may act on the gear rack in order to translate linear motion to rotational motion of the rotation pin.

[0040] Hereby, the actuator module may act on the gear rack in order to translate linear motion to rotational motion of an associated openable and closable element via the rotation pin.

[0041] The gear rack and/or the gear may be at least partially arranged within the longitudinal profile element. For example, the gear rack and/or the gear may be completely arranged within the longitudinal profile element.

[0042] The further module may comprise a fixture and a rotation element comprising a helical groove, wherein the fixture may comprise a nut such that the helical groove (55) is meshed with the nut, wherein the fixture is connected to the actuator module, and wherein the rotation element is configured to be mechanically connected to the openable and closable element.

[0043] Hereby, the actuator module may act on the fixture in order to translate a linear motion to a rotational motion of the rotation element.

[0044] Hereby, the actuator module may act on the fixture in order to translate a linear motion to a rotational motion of an associated openable and closable element via the rotation element.

[0045] The fixture and/or the rotation element may be at least partially arranged within the longitudinal profile element. For example, the fixture and/or the rotation element may be completely arranged within the longitudinal profile element.

[0046] Alternatively, the fixture may comprise a pin arranged in the helical groove such that rotation element is meshed with the fixture.

[0047] According to a second aspect, a system is provided, the system comprising a device according to the first aspect of the present invention, a frame and an openable and closable element, such as a door leaf, pivotably hinged in the frame about an element axis of rotation, the system further comprising at least one bracket assembly fixedly arranged on the openable and closable element, wherein the actuator module of the device is mechanically connected to the openable and closable element via the bracket assembly.

[0048] Generally, the technical effects and benefits discussed in relation to the first aspect applies mutatis mutandis to the second aspect and will consequently not be repeated to avoid undue repetition.

[0049] The device may be arranged in the frame, such that it is substantially flush with at least one outer surface of the frame.

[0050] The actuator module of the device may further comprise a rotation pin having a rotational axis through which rotation pin torque is transferred from the device to the openable and closable element.

[0051] The bracket assembly may be arranged so as to co-rotate with the openable and closable element about the element axis of rotation. The rotational axis of the rotation pin may coincide with the element axis of rotation.

[0052] The element axis of rotation may be defined by hinges supporting an openable and closable element, such as a door leaf or a window.

[0053] According to a third aspect, a method for assembling and installing a device for actuating an openable and closable element, such as a door blade, is provided, the method comprising: arranging an actuator module in a longitudinal profile element comprising four inner major support surfaces defining a substantially rectangular internal cross section, the longitudinal profile element, at each corner defined by two adjoining inner major support surfaces, further comprises a protrusion adjoining said two adjoining inner major support surfaces, such that a circular and/or a rectangular cross section of the actuator module is received and supported by an internal cross section of the longitudinal profile element; and mechanically connecting the actuator module to the openable and closable element for opening and/or closing thereof.

[0054] The technical effects and benefits discussed in relation to the first aspect applies mutatis mutandis to the third aspect and will consequently not be repeated to avoid undue repetition.

[0055] According to a fourth aspect, a method for altering a functionality of a device according to the first aspect is provided. The device comprising a first actuator module is provided, the method comprising: removing

the first actuator module from the longitudinal profile element; and arranging a further actuator module having a different functionality in the longitudinal profile element.

[0056] The first actuator module may be an actuator module configured to close an openable and closable element and the further actuator module may be an actuator module configured to open an openable and closable element.

[0057] The first actuator module may be an actuator module configured to open an openable and closable element and the further actuator module may be an actuator module configured to close an openable and closable element.

[0058] The first actuator module may be an actuator module configured to close an openable and closable element and the further actuator module may be an actuator module configured to open and close an openable and closable element.

[0059] The first actuator module may be an actuator module configured to open and close an openable and closable element and the further actuator module may be an actuator module configured to close an openable and closable element.

[0060] Hereby, a method for easily converting a door closer into a door opener, or vice versa, is provided.

Brief description of the drawings

[0061] These and other variants of the present inventive concept will now be described in more detail, with reference to the appended drawings showing exemplary variants of the present inventive concept, wherein:

Fig. 1A is a schematic perspective view of the longitudinal profile element of the first aspect.

Fig. 1B is a schematic cross-sectional view of the longitudinal profile element in Fig. 1A.

Fig. 2A is schematic perspective view of a device according to the first aspect, in form of a closer, with a cut-out of the longitudinal profile element showing the arrangement of an actuator module and a further module therein.

Fig. 2B is a schematic perspective view of the actuator module in Fig. 2A that is adapted to be received and supported by the longitudinal profile element.

Fig. 2C is a schematic perspective view of the further module in Fig. 2A.

Fig. 3A is schematic perspective view of a device according to the first aspect, in form of an opener, with a cut-out of the longitudinal profile element showing the arrangement of an actuator module and a further module therein.

Fig. 3B is a schematic perspective view of the actuator module in Fig. 3A that is adapted to be received and supported by the longitudinal profile element.

Fig. 3C is a schematic perspective view of the further module in Fig. 3A.

Fig. 4 is a schematic view of a system according to the second aspect of the present invention.

Detailed description

[0062] In the following detailed description, some variants of the present inventive concept will be described. However, it is to be understood that features of the different variants are exchangeable between the variants and may be combined in different ways, unless anything is specifically indicated. Even though in the following description, numerous details are set forth to provide a more thorough understanding of the present inventive concept, it will be apparent to one skilled in the art that the present inventive concept may be practiced without these details. In other instances, well known constructions or functions are not described in detail, so as not to obscure the present inventive concept.

[0063] Fig. 1A is a perspective view of the longitudinal profile element 1 of a device 100, 200, 300 according to the first aspect. The longitudinal profile element 1 is configured for receiving and supporting an actuator module, which may be a closer 2 (shown in Fig. 2B) or an opener 6 (shown in Fig. 3B). As such, a closer device 100 (shown in Fig. 2A) or an opener device 200 (shown in Fig. 3A) may be provided. The longitudinal profile element 1 comprises four inner major support surfaces 3 defining a substantially rectangular internal cross section. Here, the inner major support surfaces 3 are shown as being of equal length. Alternatively, any inner major support surface 3 may be shorter or longer than an opposite facing inner major support surface 3. In Fig. 1B, two rectangular internal cross sections RCS1, RCS2 are indicated. A rectangular internal cross section RCS1, RCS2 may receive and support an actuator module 6 having a rectangular outer cross section of a predetermined size complementary to the dimensions of the longitudinal profile element 1. Here, the rectangular internal cross sections RCS1, RCS2 comprise a respective longitudinal axis. Here, the longitudinal axes are substantially perpendicular.

[0064] The longitudinal profile element 1 may be formed by an extrusion process. The longitudinal profile element 1 may be made of metal. Alternatively, the longitudinal profile element 1 may be made of a plastic material.

[0065] The longitudinal profile element 1, at each corner 5 defined by two adjoining inner major support surfaces 3, further comprises a protrusion 7 adjoining the two adjoining inner major support surfaces 3. The protrusions 7 are configured such that they may support an actuator module 2 having a circular outer cross section complementary to the dimensions of the longitudinal profile element 1. To this end, the protrusions 7 are here shown as comprising a respective bevelled surface 7A that are substantially centre facing. Alternatively, a bevelled surface 7A may be concave. Alternatively, a protrusion 7 may instead comprise a sharp edge. Here, the bevelled surfaces 7A and the inner major support surfaces 3 define a circular cross section CCS.

[0066] As such, the longitudinal profile element 1 is adapted to receive and support an actuator module having a circular outer cross section of a predetermined size, and/or a rectangular outer cross section of a predetermined size. The longitudinal profile element 1 may thus for example receive and support an actuator module 6 having both a circular outer cross section of a predetermined size and a rectangular outer cross section of a predetermined size. For example, a portion of the actuator module 6 may have a circular cross section whereas a second portion of the actuator module 6 has a rectangular cross section.

[0067] Furthermore, the main direction of extension of the internal cross section RCS1 is perpendicular to the main direction of extension of the internal cross section RCS2. Thus, the longitudinal profile element 1 is adapted to receive an actuator module having a rectangular outer cross section of predetermined size and having a main axis along a first main direction of extension, whereby the main axis coincides with the first direction and wherein the longitudinal profile element 1 is further adapted to receive the actuator module along a second main direction of extension, whereby the main axis coincides with the second direction. Alternatively, the two directions may not be perpendicular.

[0068] The longitudinal profile element 1 further comprises at least one channel 9 for receiving a fastening means, such as a screw. Moreover, the longitudinal profile element 1 comprises two slits 11 for receiving a longitudinal cap 13 (shown inter alia in Fig. 2A). The longitudinal cap 13 comprises a first and a second attachment portion (not shown) configured to be arranged and latched in a respective slit 11 such that the longitudinal cap 13 is attached to the longitudinal profile element 1. When the longitudinal cap 13 is attached to the longitudinal profile element 1, a channel (not shown) is formed. The channel (not shown) may e.g. receive an electronic component (not shown), such as a wire or a chip.

[0069] Fig. 2A shows an exemplary device 100 according to the first aspect. The depicted device 100 is configured for actuating an openable and closable element, such as a door leaf 61 (shown in Fig. 4). The device 100 comprises a longitudinal profile element 1 and an actuator module. Here, the actuator module is a closer 2. The closer 2 is shown independent from the longitudinal profile element 1 in Fig. 2B. The closer 2 comprises a main housing portion 15, a longitudinal housing portion 17, a spring assembly 19 arranged along a shaft portion 21 and an end element 23 attached to the shaft portion 21. The longitudinal housing portion 17 exhibits a circular outer cross section of a predetermined size and is supported by the internal cross section of the longitudinal profile element 1. Furthermore, the spring assembly 19 exhibits a circular outer cross section of a predetermined size and is supported by the internal cross section of the longitudinal profile element 1. The spring assembly may thus be arranged in contact with at least one of, preferably all four, of the bevelled surfaces 7A of the protrusions 7. The spring assembly may thus be arranged in contact with at least one of, preferably all four, of the major support surfaces 3 as indicated by CCS in Fig.1B.

[0070] The spring assembly 19 is configured to be compressed from a first state to a second state during opening of an associated openable and closable element, such as a door leaf 61, to which the device 100 is configured to be mechanically connected. The spring assembly 19 is further configured to be decompressed from the second state to the first state whereby an associated openable and closable element is closed. The closer 2 further comprises a plurality of adjustment screws 20 arranged in the main housing portion 15. Adjustment screws are known in the art, and are configured to alter the characteristics of the closer 2. The adjustment screws 20 are as normally configured to adjust kick, high speed, low speed and opening brake. As such, at least one adjustment screw 20 is configured such that actuation of the screw 20 enables alteration of the velocity of decompression of the spring assembly 19. Each of the plurality of adjustment screws 20 has a longitudinal axis. Here, the longitudinal axes of the plurality of adjustment screws 20 are substantially parallel with a longitudinal axis of the profile element. Thus, the adjustment screws 20 are substantially parallel to each other. Thus, the adjustment screws 20 are accessible form the same direction.

[0071] The device 100 comprises a further module. Here, the further module is a gear assembly 25. The gear assembly 25 is shown independent from the longitudinal profile element 1 in Fig. 2C. The gear assembly 25 exhibits a rectangular cross section of a predetermined size such that it is supported by one of the internal rectangular cross sections RCS1, RCS2 of the longitudinal profile element 1. The gear assembly 25 comprises a gear rack 27 connected to a gear 29. The gear rack 27 is connected to the end portion 23 of the closer 2 such that force may be translated between the gear rack 27 and the end portion 23. The gear 29 comprises a rotation pin 31 substantially arranged along an axis of rotation of the gear 29. The rotation pin 31 of the gear 29 is configured to be mechanically connected to the openable and closable element. As such, the gear assembly 25 mechanically connects the closer 2 to an associated openable and closable element. Hereby, rotational motion of the rotation pin 31 translates to linear motion of the gear rack 27, which in turn translates to linear motion of the end element 23 and compression/decompression of the spring assembly 19 of the closer 2, and vice versa.

[0072] Fig. 3A shows an exemplary device 200 according to the first aspect. The device 200 is configured for actuating an openable and closable element, such as a door leaf 61 (shown in Fig. 4). The device 200 comprises a longitudinal profile element 1 and an actuator module. Here, the actuator module is an opener 6. The opener 6 is shown independent from the longitudinal profile element 1 in Fig. 3B. The opener 6 comprises an electric motor 33, a connection housing 35, an actuation screw 37 and a spring assembly 39. The connection housing

35 exhibits two rectangular outer cross sections of a predetermined size and is supported by the internal cross section of the longitudinal profile element 1. The electrical motor 33 is configured to provide power to the connection housing 35, which in turn is configured to drive the actuation screw 37 which provides linear motion to the spring assembly 39. The linear motion of the spring assembly 39 is in turn translated to the associated openable and closable element. As such, the electrical motor 33 is configured to transfer power to an associated openable and closable element via the spring assembly 39.

[0073] The spring assembly 39 comprises a spring 41 sandwiched between a first and a second end element 43, 45 such that the spring 41 is configured to be compressed and/or decompressed by motion of the first end element 43 independent of motion of the second end element 45. The first end element 43 may as such move along a longitudinal extension of the spring assembly 39 independent of motion of the second end element 45. As such, the spring 41 of the spring assembly 39 may be compressed by the first end element 43 opposite to the overall motion of the spring assembly 39. This allows for protection of the electric motor 33 of the opener 6. In an example, the device rotates a door leaf 61 in a certain direction. If the door leaf 61, for any reason, would simultaneously be supplied rotating motion in the opposite direction, e.g. that a person is trying to close the door leaf at the same time as the device 200 is opening the door leaf 61, the device 200 may be damaged. However, since the first and second end elements 43, 45 are able to compress or decompress the spring 41 independently, motion opposite to what the device is providing the openable and closable element will be picked up by the spring 41, instead of being translated to the electric motor 33.

[0074] The opener 6 further comprises four braces 47. Two braces 47 are fixedly attached to the first end element 43 and configured to engage with the second end element 45, whereas two braces 47 are fixedly attached to the second end element 45 and configured to engage with the first end element 43. The four braces 47 are arranged in a way so as to define two rectangular outer cross sections supported by the longitudinal profile element 1. The braces 47 are arranged to slide within the longitudinal profile element 1 such that the spring assembly 39 is slideably arranged in the longitudinal profile element 1. The braces 47 are arranged on the outside of the spring 41 and compressing the spring 41 in a radial direction. As such, the spring 41 is effectively smaller in radius. As such, the spring 41 may be made to fit inside the longitudinal profile element 1.

[0075] The device 200 comprises a further module. Here, the further module is a fixture assembly 49. The fixture assembly 49 is shown independent from the longitudinal profile element 1 in Fig. 3C. The fixture assembly 49 exhibits a rectangular cross section of a predetermined size such that it inter alia is supported by one of the internal rectangular cross sections RCS1, RCS2 of the longitudinal profile element 1. The fixture assembly 49 comprises a fixture 51 and a rotation element 53 arranged in and meshed with the fixture 51. To this end, the rotation element 53 comprises a helical groove 55. The fixture comprises a nut such that the helical groove 55 is meshed with the nut. The rotation element further comprises a rotation pin 57 having a main axis of rotation. The fixture 51 is configured to be connected to the actuator module, here the opener 6. The fixture 51 is configured to be connected to the opener 6 via the connection element 54. As such, linear motion of the fixture 51 along the rotation axis of the rotation pin 57, e.g. originating from the opener 6, is translated into a rotational motion of the rotation element 53, and thus the rotation pin 57, around the rotational axis. The rotation pin 57 is configured to be mechanically connected to the openable and closable element 61 such that it may translate rotational motion thereto.

[0076] It should be clear that the longitudinal profile element 1 of the exemplary devices 100 and 200 is configured to receive and support a variety of modules. Therefore, a variety of combinations of actuator modules and further modules is possible. For example, an opener 6 may be combined with a gear assembly 25 and closer 2 may be combined with a fixture assembly 49. Thus, actuator modules and further modules are readily interchangeable. Therefore, according to the fourth, a method for altering a functionality of a device 100, 200 is provided. The method comprises removing the actuator module from the longitudinal profile element 1, and arranging a further actuator module in the longitudinal profile element 1. If the actuator module is a closer 2, the further actuator module is an opener 6. If the actuator module is an opener 6, the further actuator module is an closer 2.

[0077] Fig. 4 shows a system 4 according to the second aspect. The system comprises a device 300. The device 300 may e.g. be a device as seen in Fig. 2A or in Fig. 3A. The device 300 is further arranged in a door frame 59. The system 4 further comprises an openable and closable element, here shown to be a door leaf 61, pivotably hinged in the door frame 59 about an element axis of rotation (not shown). The door leaf 61 is pivotably hinged in the door frame 59 via door leaf bracket 63. The door leaf brackets 63 are typically hinges. The door leaf brackets 63 are typically defining the element axis of rotation. The system 4 further comprising at least one bracket assembly 65 fixedly arranged on the door leaf 61 so as to co-rotate with the door leaf 61 about the element axis of rotation (not shown). The device 300 is mechanically connected to the door leaf 61 via the bracket assembly 65. Thus, the element axis of rotation (not shown) coincides with an axis of rotation of the device 300, such as an axis of rotation of the rotation pin 31 of the device 100 in Fig. 2A. However, the bracket assembly 65 may be arranged in any other way so that the element axis of rotation does not coincide with an axis of rotation of the device 300. To this end, a link arm linking the axis of rotation of the device 300 and the element axis of rotation may be used.

[0078] The person skilled in the art realizes that the present invention by no means is limited to the variants described above. The features of the described variants may be combined in different ways, and many modifications and variations are possible within the scope of the appended claims. In the claims, any reference signs placed between parentheses shall not be construed as limiting the claim. The word "comprising" does not exclude the presence of other elements or steps than those listed in the claim. The word "a" or "an" preceding an element does not exclude the presence of a plurality of such elements.

Claims

1. A device (100, 200, 300) for actuating an openable and closable element (61), such as a door leaf, the device comprising:

   an actuator module (2, 6); and
   a longitudinal profile element (1) for receiving and supporting the actuator module (2, 6);
   wherein the actuator module (2, 6) is configured to be mechanically connected to the openable and closable element (61) for opening and/or closing thereof;
   wherein the longitudinal profile element (1) comprises four inner major support surfaces (3) defining a substantially rectangular internal cross section, the longitudinal profile element (1), at each corner (5) defined by two adjoining inner major support surfaces (3), further comprises a protrusion (7) adjoining said two adjoining inner major support surfaces (3); and
   wherein an internal cross section of the longitudinal profile element (1) is adapted to receive and support an actuator module (2, 6) having a circular outer cross section of a predetermined size, and/or a rectangular outer cross section of a predetermined size.

2. Device (100, 200, 300) according to claim 1, wherein the actuator module is a closer (2) comprising a spring assembly (19) configured to be compressed from a first state to a second state during opening of an associated openable and closable element (61), and wherein the spring assembly (19) is further configured to be decompressed from the second state to the first state whereby the associated openable and closable element (61) is closed.

3. Device (100, 200, 300) according to claim 2, wherein the spring assembly (19) exhibits a circular outer cross section of said predetermined size and is adapted to be received and supported by the internal cross section of the longitudinal profile element (1).

4. Device (100, 200, 300) according to claim 2 or 3, wherein the actuator module (2) further comprises a plurality of adjustment screws (20), wherein at least one adjustment screw (20) is configured such that adjustment of the screw (20) enables alteration of a velocity of decompression of the spring assembly (19), and wherein each of the plurality of adjustment screws (20) has a longitudinal axis, wherein the longitudinal axes of the plurality of adjustment screws (20) are substantially parallel with a longitudinal axis of the profile element (1).

5. Device (100, 200, 300) according to claim 1, wherein the actuator module is an opener (6) comprising a spring assembly (39) and an electrical motor (33), wherein the electrical motor (33) is configured to transfer power to an associated openable and closable element (61) via the spring assembly (39).

6. Device (100, 200, 300) according to claim 5, wherein the spring assembly (39) comprises a spring (41) sandwiched between a first end element (43) displaceably attached to the spring and mechanically connected to the electric motor (33), and a second end element (45) displaceably attached to the spring (41) and configured to be mechanically connected to the openable and closable element (61), such that the spring (41) is compressed and/or decompressed by motion of the first end element (43) independent of motion of the second end element (45).

7. Device (100, 200, 300) according to claim 6, wherein the actuator module (6) comprises at least one brace (47) fixedly attached to the first end element (43) and arranged along a longitudinal axis of the spring assembly (39), wherein the at least one brace (47) is configured to engage with the second end element (45) so as to allow compression of the spring assembly (39) while defining a maximum length of extension of the spring assembly (39).

8. Device (100, 200, 300) according to any one of the preceding claims, wherein the four inner major support surfaces (3) are defining a substantially rectangular first internal cross section (RCS1) and a substantially rectangular second internal cross section (RCS2), wherein the actuator module (2,6) is adapted to be received and supported by the first and/or second rectangular internal cross section (RCS1, RCS2) of the longitudinal profile element (1).

9. Device (100, 200, 300) according to any one of the preceding claims, comprising a further module (25, 49), wherein the internal cross section of the longitudinal profile element (1) is further adapted to receive and support the further module (25, 49), the further module (25, 49) exhibiting a circular cross section of said predetermined size and/or rectangu-

lar cross section of said predetermined size, wherein the further module is configured to mechanically connect the actuator module (2,6) to an associated openable and closable element (61).

10. Device (100, 200, 300) according to claim 9, wherein the further module (25) comprises a gear rack (27) connected to a gear (29), the gear (29) comprising a rotation pin (31) substantially arranged along an axis of rotation of the gear (29), wherein the gear rack (27) is connected to the actuator module (2,6), and wherein the rotation pin (31) is configured to be mechanically connected to the openable and closable element (61).

11. Device (100, 200, 300) according to claim 9, wherein the further module (49) comprises a fixture (51) and a rotation element (53) comprising a helical groove (55), wherein the fixture (51) comprises a nut such that the helical groove (55) is meshed with the nut, wherein the fixture (51) is connected to the actuator module (2,6), and wherein the rotation element (53) is configured to be mechanically connected to the openable and closable element (61).

12. System (4) comprising a device (100, 200, 300) according any one of the claims 1-11, a frame (59) and an openable and closable element (61), such as a door leaf, pivotably hinged in the frame (59) about an element axis of rotation, the system further comprising at least one bracket assembly (65) fixedly arranged on the openable and closable element (61), wherein the actuator module (2,6) of the device (100, 200, 300) is mechanically connected to the openable and closable element (61) via the bracket assembly (65).

13. System according to claim 12, wherein the actuator module (2,6) of the device further comprises a rotation pin (31, 57) having a rotational axis through which rotation pin torque is transferred from the device (100, 200, 300) to the openable and closable element (61).

14. Method for assembling and installing a device (100, 200, 300) for actuating an openable and closable element (61), such as a door leaf, the method comprising:

arranging an actuator module (2, 6) in a longitudinal profile element (1) comprising four inner major support surfaces (3) defining a substantially rectangular internal cross section, the longitudinal profile element (1), at each corner (5) defined by two adjoining inner major support surfaces (3), further comprises a protrusion (7) adjoining said two adjoining inner major support surfaces (3), such that a circular and/or a rectangular cross section of the actuator module (2, 6) is received and supported by an internal cross section of the longitudinal profile element (1); and

mechanically connecting the actuator module (2, 6) to the openable and closable element (61) for opening and/or closing thereof.

15. Method for altering a functionality of a device (100, 200, 300) according to claim 1, the device (100, 200, 300) comprising an actuator module (2, 6) according to claim 2 or claim 5, the method comprising:

removing the actuator module (2, 6) from the longitudinal profile element; and

arranging a further actuator module (2) according to claim 2, if the actuator module (6) is one according to claim 5, or a further actuator module (6) according to claim 5, if the actuator module (2) is one according claim 2, in the longitudinal profile element (1).

Fig. 1A

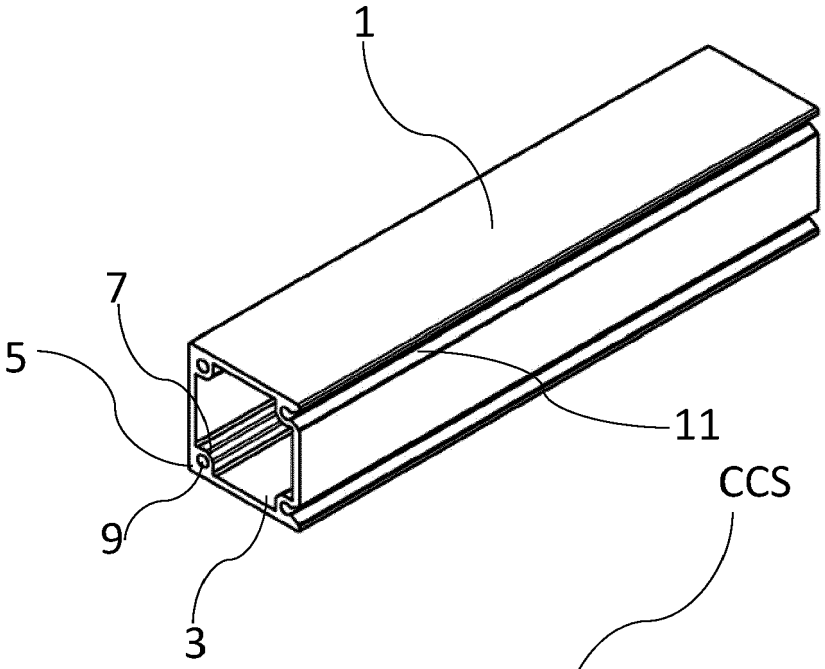
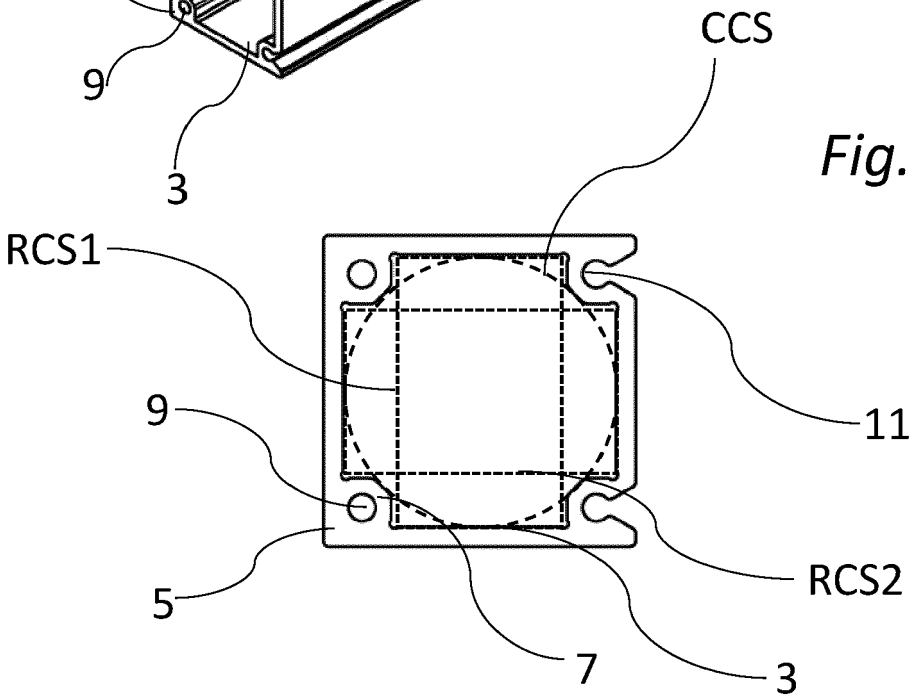


Fig. 1B



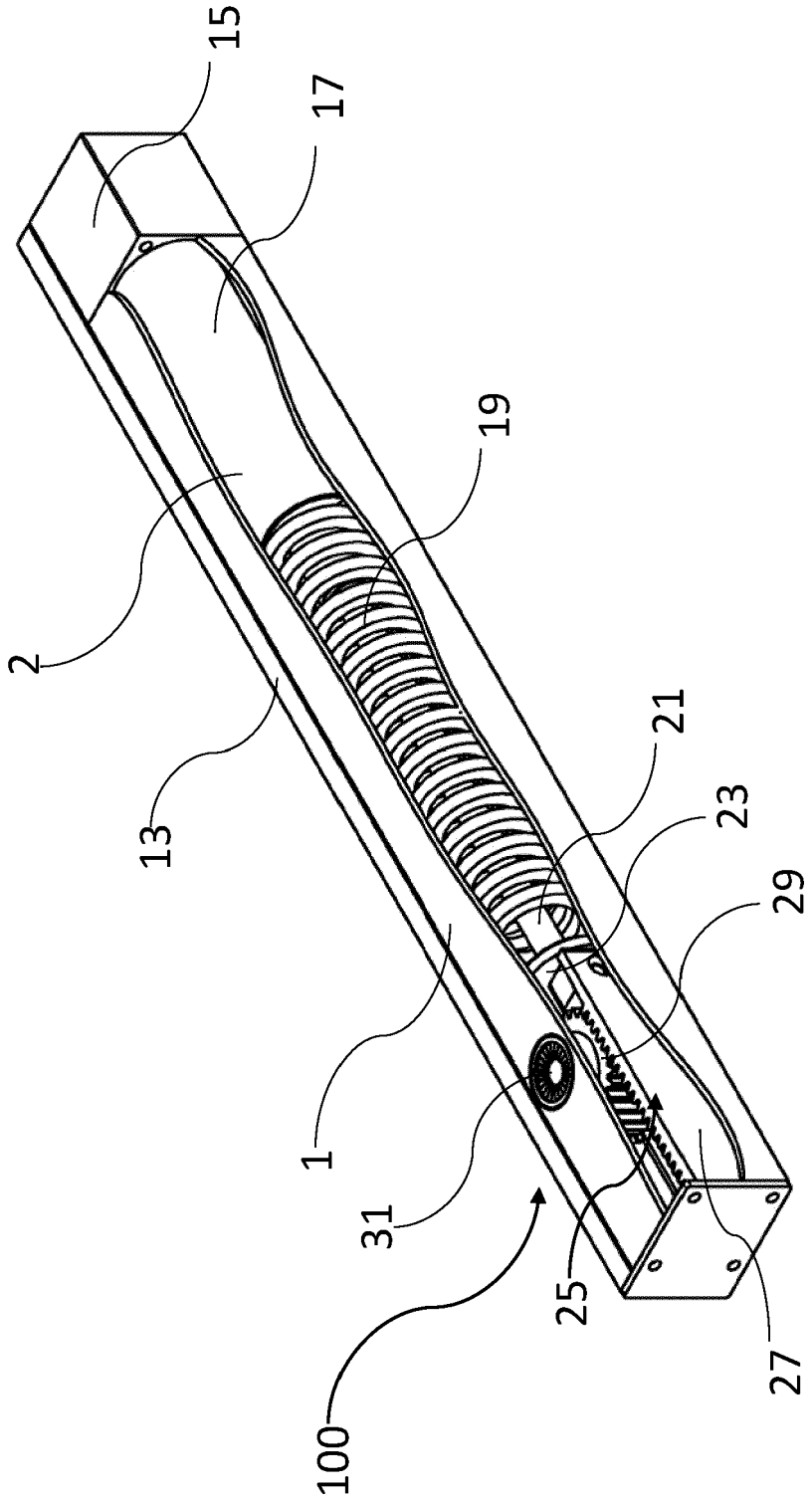


Fig. 2A

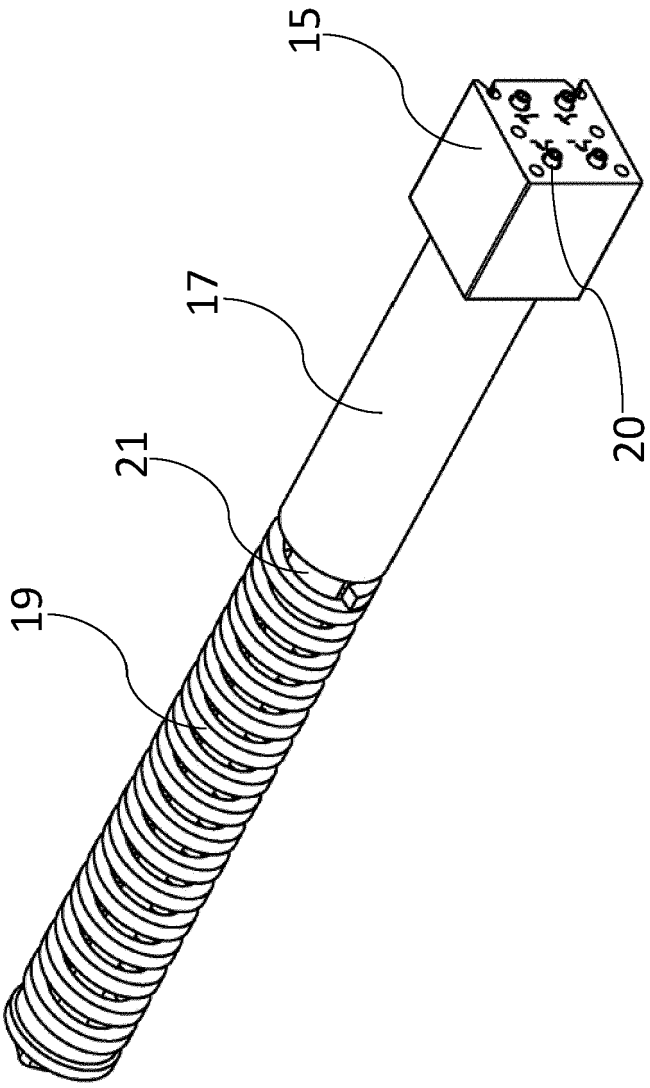


Fig. 2B

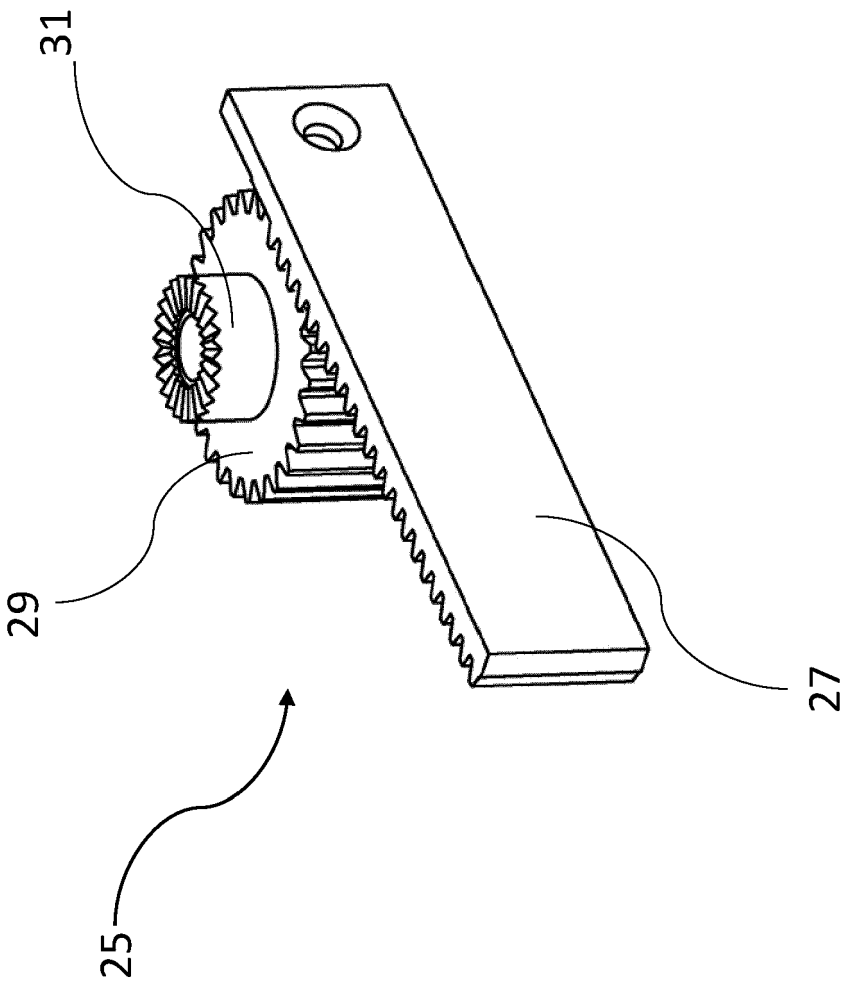


Fig. 2C

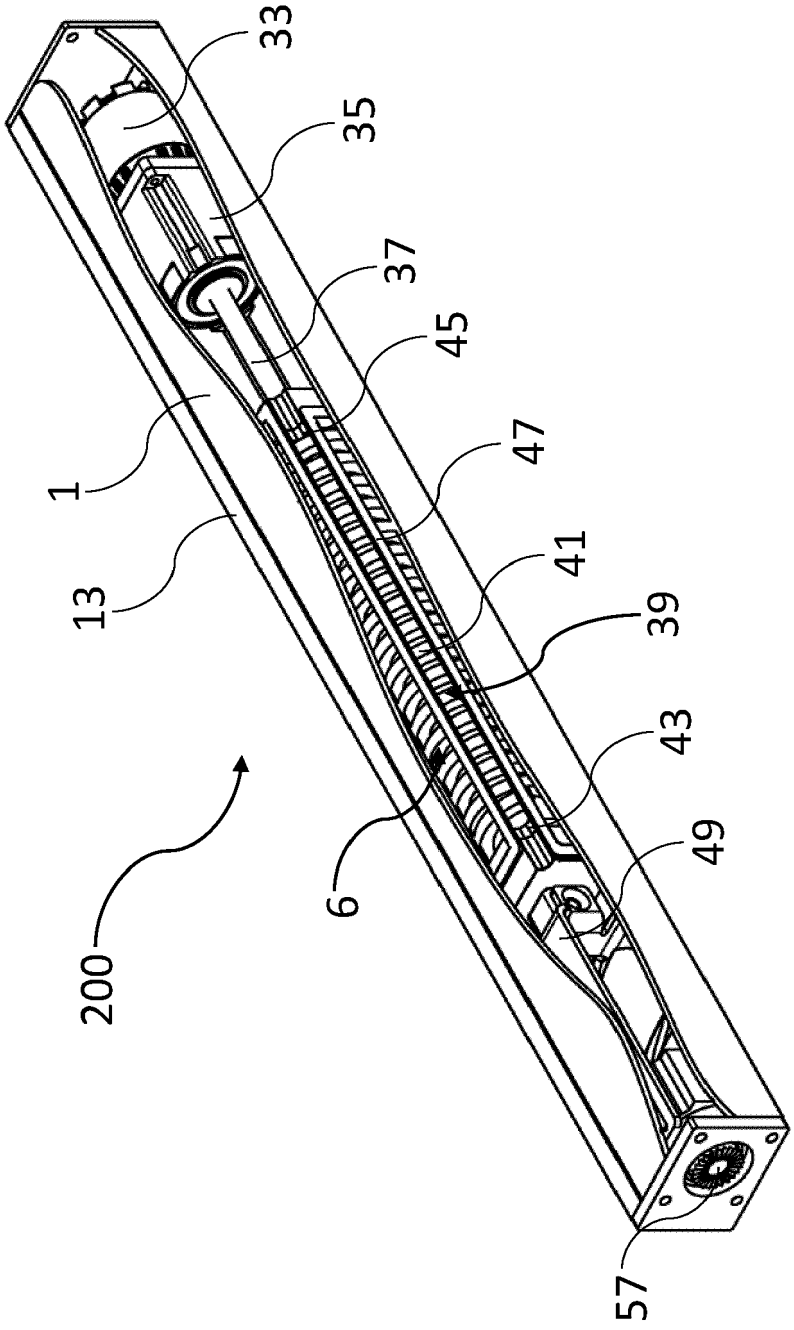


Fig. 3A

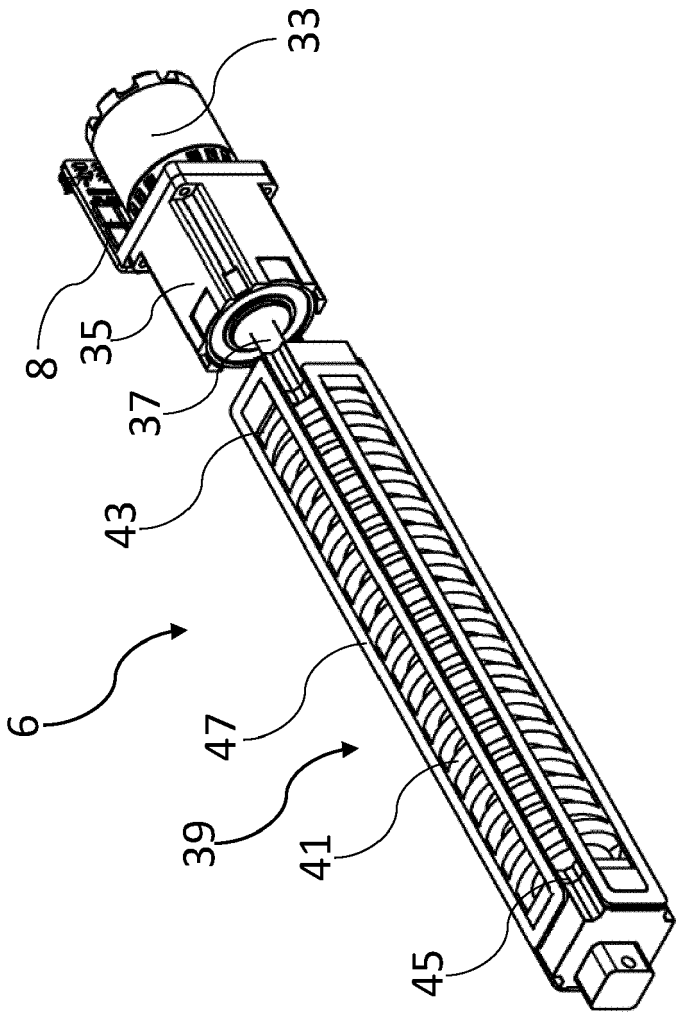


Fig. 3B

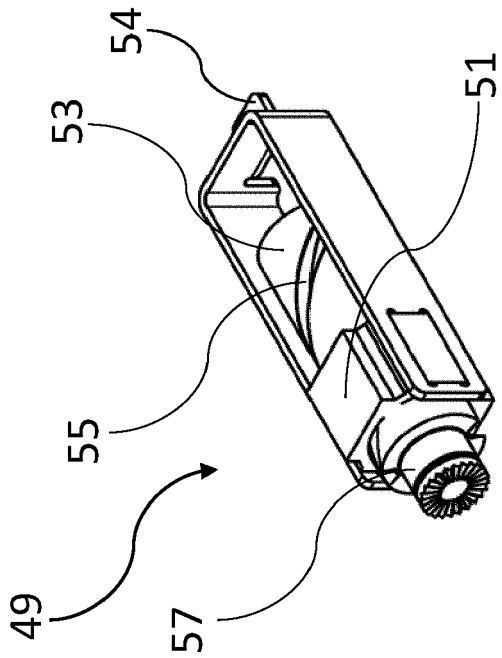


Fig. 3C

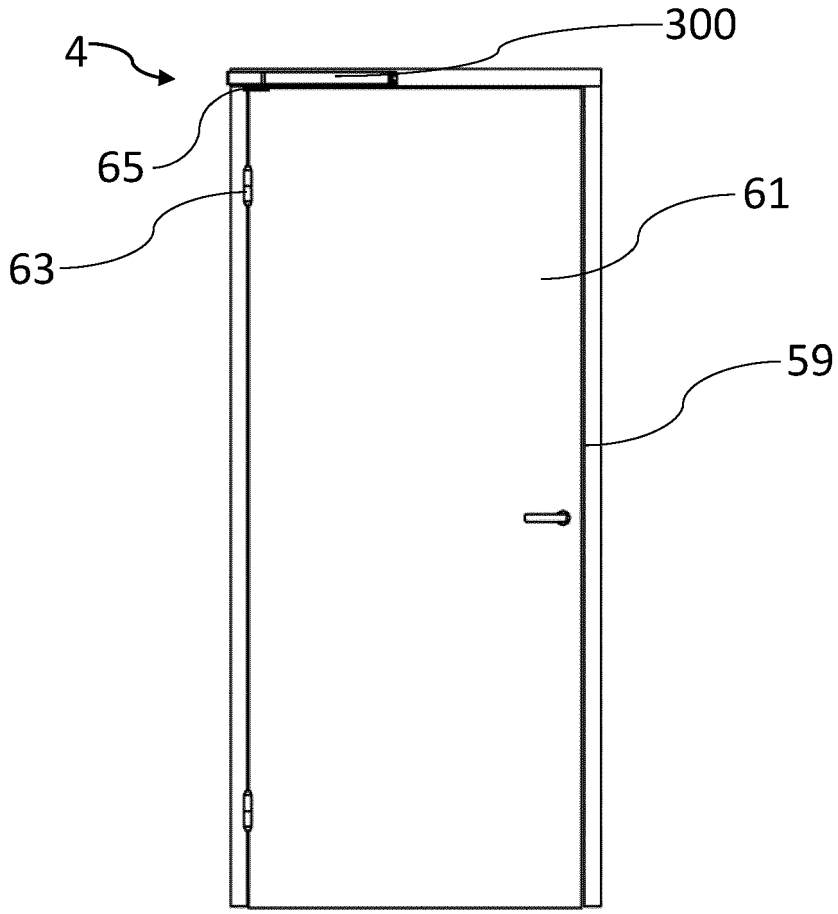


Fig. 4

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EUROPEAN SEARCH REPORT

Application Number
EP 21 20 6545

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The Hague	28 March 2022	Klemke, Beate

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