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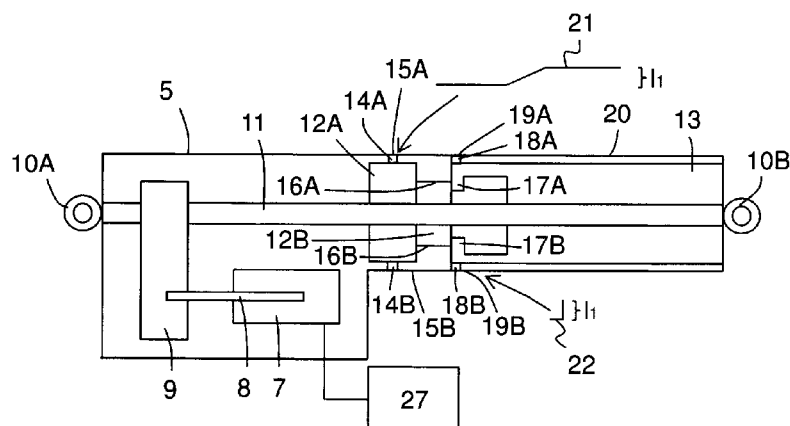


FIG. 2A

(57) Abstract: An actuator which comprises a motor, a threaded rod, a nut unit, a piston unit and a casing, the motor being arranged to drive the threaded rod via a gearbox. The actuator comprises a first means on the nut unit and a second means on the casing which perform a first guiding function for the actuator. The first means is arranged to fit with the second means so that the nut unit follows a predefined first path determined by the first means and the second means when the first means and the second means are engaged with one another and the motor drives the threaded rod. Also a method for controlling an actuator, a cab tilt device, and a vehicle.

Actuator, cab tilt device, a vehicle and a method for controlling an actuator

Field of the invention

- 5 The present invention relates to an actuator, a cab tilt device which comprises the actuator, a vehicle provided with an actuator and/or a cab tilt device, and a method for controlling an actuator.

Background to the invention

- 10 Linear actuators are currently used to effect linear movements in very many applications. A hydraulic linear actuator uses hydraulic power to provide mechanical linear motion. Another type of actuator is a pneumatic linear actuator which converts compressed air to mechanical linear motion. An electric linear actuator converts rotary motion from a motor, e.g. a low-voltage DC motor, to
15 mechanical linear motion. A linear actuator makes it possible, by simply pressing a button, to lift, adjust, tilt, push or pull objects which are heavy or difficult to access.

- An electric linear actuator usually has a motor, a gear housing and a piston rod. A
20 screw, e.g. a ball screw or worm screw, is rotated and the rotation is converted to linear motion by the piston rod. The piston rod may for example run in a cylinder or casing. The whole actuator may be surrounded by a casing, depending on the particular application and on protection requirements.

- 25 An example of an application for a linear actuator is truck cab tilting. There is sometimes a need to be able to tilt a truck cab in order to gain access to systems situated under the cab. There are currently various ways of achieving this function. An actuator with a hydraulically activated piston may for example be connected to the chassis and the cab. Cab and chassis being connected together
30 by a springing system thus leads to the tilt system having also to cater for relative movements between chassis and cab. Hydraulic cylinders with a so-called "lost motion" state, a state in which the cylinder and the piston can move relative to one

another, are currently used, but this movement results in both wear of the system and disturbing noise in the cab.

5 EP0485724 A1 describes a hydraulic system for tilting a cab, which is connected by a combination of linear movement and rotation. An accommodating element is provided with a recess which fits with an element on the cab. The motion between these elements may however result in wear of the system.

10 An object of the invention is to propose a actuator which can effect controlled rotating as well as linear movement of its piston rod and does in particular make it possible to tilt a vehicle cab.

Summary of the invention

15 In a first aspect the object described above is achieved by an actuator which comprises a motor, a threaded rod, a nut unit, a piston unit and a casing. The motor is arranged to drive the threaded rod via a gearbox. The actuator comprises a first means on the nut unit and a second means on the casing which perform a first guiding function for the actuator, the first means being arranged to fit with the second means so that the nut unit follows a predefined first path
20 determined by the first means and the second means when they are engaged with one another and the motor drives the threaded rod.

This first aspect results in an actuator which can effect controlled axial rotating of the nut unit and consequently also of the piston unit. The actuator can therefore
25 effect both a linear movement and a rotating about a centreline of the threaded rod. This may be usable in many applications and is achieved by simply activating the motor. The first guiding function serves as a form of rotation limitation between the piston unit and the casing. The casing may also take the form of a cylinder round the nut unit and the piston unit. The predefined first path
30 describes the movement required of the nut unit and/or the piston unit.

The actuator may comprise a third means on the nut unit and a fourth means on the piston unit which perform a locking function for the actuator. The third means is arranged to fit with the fourth means so that the nut unit follows a predefined locking path determined by the third means and the fourth means to a state in
5 which the piston unit is locked to the nut unit, when the nut unit follows the predefined first path. Having a locking function makes it possible for the actuator to be parted and reconnected, which means that the actuator is locked when it is reconnected so that it can be used for both lifting and pulling without coming apart. The locking function is activated by simply activating the motor. The
10 locked state may also be called positive locking.

The actuator may also comprise a fifth means on the piston unit and a sixth means on the casing which perform a second guiding function for the actuator. The fifth means is arranged to fit with the sixth means so that the piston unit
15 follows a predefined second path determined by the fifth and sixth means when they are engaged with one another and the motor drives the threaded rod. The result is that the piston unit is caused to assume a desired behaviour, e.g. rotation, or locking in a certain path. This second guiding function may also be used to cause the piston unit to maintain a state in which it is locked to the nut
20 unit. The second guiding function counteracts the piston unit rotating with the threaded rod and serves as a form of rotation limitation between the piston unit and the casing. The casing round the nut unit and the piston unit may take the form of a cylinder.

25 In a second aspect the object is at least partly achieved by a cab tilt device for vehicles which comprises an actuator according to any embodiment described. The actuator is arranged to have its one end fastened to the vehicle's chassis and its other end to the vehicle's cab. The cab tilt device further comprises a control unit and/or input unit arranged to activate the tilting of the cab. This second
30 aspect makes it possible to use a single component to take care both of connecting together the actuator and the cab and of tilting the cab.

Using an actuator, e.g. a linear actuator, with internal disengagement guided by controlled axial rotating makes it possible to replace existing hydraulic devices by an electrical device which has less internal friction and therefore potentially generates less disturbing noise in the cab.

5

In a third aspect the object is at least partly achieved by a vehicle provided with an actuator according to any embodiment herein described and/or a cab tilt device.

10 In a fourth aspect the object is at least partly achieved by a method for controlling an actuator which comprises a motor, a threaded rod, a nut unit, a piston unit and a casing. The method comprises

- placing the nut unit on the threaded rod in the casing in such a way that a first means on the nut unit and a matching second means on the casing run in one another;
- 15 - driving the threaded rod so that the nut unit follows a predefined first path which is delineated by the first means and the second means.

Preferred embodiments are described in the dependent claims and the detailed description.

20

Brief description of the attached drawings

The invention is described below with reference to the attached drawings, in which:

- Fig. 1 depicts a vehicle with a cab which can be tilted by a cab tilt device.
- 25 Fig. 2A depicts an actuator according to an embodiment of the invention.
- Fig. 2B depicts an actuator according to another embodiment of the invention.
- Fig. 3 depicts a cross-sectional view of part of the actuator in Fig. 2A.
- Fig. 4 depicts an enlarged view through part of the actuator in Fig. 2A.
- Fig. 5 depicts a further cross-sectional view of part of the actuator in Fig. 2A.
- 30 Figs. 6A-6C depicts various cross-sectional views of the actuator in Fig. 2A.
- Fig. 7 depicts a flowchart according to an embodiment of the invention.

Detailed description of preferred embodiments of the invention

Fig. 1 depicts a vehicle 1 with a chassis 2, a sprung suspended driver cab 3 and two pairs of wheels 4A, 4B. The vehicle may be a utility vehicle, e.g. a truck, in which it is necessary to be able to tilt the cab 3 in order to reach components under the cab. A cab tilt device 6 has its one end fastened to the chassis 2 and its other end to the cab 3. The tilt device 6 is arranged to tilt the cab from a position of rest to a tilted position. The cab's tilted position is illustrated in broken lines. The cab may be fastened to the chassis at a fastening point about which the cab rotates when the tilt device is activated and tilts the cab. In a tilted state the cab's centre of gravity may thus be shifted outside the vehicle, subjecting the tilt device to large forces. The tilt device comprises an actuator 5 herein described. When the tilt device is not to be used, the actuator may be disengaged, e.g. when the vehicle is on the move, and thus not hinder the cab's springing. The actuator's connection and disconnection may be by appropriate rotating of components of it, as explained in more detail below.

Figs. 2A and 2B illustrate an actuator 5 which may be arranged in the cab tilt device 6. In one embodiment the actuator is a linear actuator provided with one or more functions. The actuator comprises a motor 7, e.g. an electric motor which may be brushless. Via a shaft 8 and a gearbox 9 the motor transmits rotary motion to a threaded rod 11. A nut unit 12A, 12B is situated on the threaded rod. The nut unit may for example be a ball nut. The nut unit has a first section 12A with a first diameter and a second section 12B with a second diameter. The first diameter is larger than the second diameter. When the threaded rod 11 rotates, the nut unit 12A, 12B on it will rotate, rise or sink, depending on which direction the threaded rod is rotating. So long as the nut unit is not allowed to rotate with the threaded rod, its linear movement along the threaded rod will correspond to the pitch angle on the threaded rod and how many rotates the threaded rod rotates. In one embodiment a piston unit 13 may be firmly anchored in the nut unit 12A, 12B. In another embodiment the piston unit may be disengaged from the nut unit, as described in more detail below. A casing 20 wholly or partly surrounds the parts described above. This casing may serve as protection for the

parts described above and also protect the surroundings from parts of the actuator which move. The actuator may be arranged to have its one end 10A fastened to the vehicle's chassis 2 and its other end 10B to the cab 3.

- 5 A control unit 27 and/or input unit 27 may be arranged to activate the actuator 5 and be in communication with the motor 7. The control unit may be arranged to be controlled by a control device, e.g. one or more buttons or levers, the position or positions of which will indicate whether the motor is intended to be off or on and its desired direction. The control unit may be provided with a more advanced
- 10 input unit which may also take a desired speed for the motor. Off and on input indicate whether the motor is intended to be running or not. Direction here means the direction in which the nut unit 12A, 12B is intended to move along the threaded rod 11, i.e. to rise or sink. Speed means how quickly the nut unit is intended to move along the threaded rod. Alternatively, the motor may itself be
- 15 provided with an input unit 27, e.g. a control device, which makes it possible to cause the motor to run or not run and to control its desired direction.

The actuator 5 further comprises a first means 14A, 14B, 14C, 14D on the nut unit 12 and a second means 15A, 15B, 15C, 15D on the casing 20 which perform a

20 first guiding function for the actuator. Fig. 2A depicts a first variant of the first means 14A, 14B and the second means 15A, 15B. In this first variant the first means 14A, 14B on the nut unit 12A, 12B takes the form of one or more spigots 14A, 14B protruding from an outside 24 (Fig. 3) of the nut unit 12. In this same first variant the second means 15A, 15B on the casing 20 takes the form of one

25 or more corresponding recesses 15A, 15B in the inside 25 (Fig. 3) of the casing.

Fig. 2B depicts a second variant of the first means 14C, 14D and the second means 15C, 15D. In this second variant the first means 14C, 14D on the nut unit 12A, 12B takes the form of one or more recesses 14C, 14D in the outside of the

30 nut unit. In this same second variant the second means 15C, 15D takes the form of one or more corresponding spigots 15C, 15D protruding from the inside 25 (Fig. 3) of the casing 20.

The first means 14A, 14B, 14C, 14D is arranged to fit with the second means 15A, 15B, 15C, 15D so that the nut unit 12 follows a predefined first path 21 determined by the first means 14A, 14B, 14C, 14D and the second means 15A, 15B, 15C, 15D when they are engaged with one another and the motor 7 drives the threaded rod 11.

The predefined first path 21 may have an extent such that the nut unit 12A, 12B is arranged to move a distance l_1 at right angles to a linear movement of the nut unit 12A, 12B when it follows the predefined first path. The predefined first path 21 is depicted schematically in Figs. 2A and 2B. The path 21 is therefore a mechanical travel which is determined and configured during the manufacture of the actuator.

In one embodiment the actuator 5 comprises a third means 16A, 16B, 16C, 16D on the nut unit 12 and a fourth means 17A, 17B, 17C, 17D on the piston unit 13 which perform a locking function for the actuator. In a first variant of this locking function, depicted in Fig. 2A, the third means 16A, 16B on the nut unit 12 takes the form of one or more recesses 16A, 16B in the outside 24 (Fig. 3) of the nut unit, and the fourth means 17A, 17B takes the form of one or more corresponding spigots 17A, 17B protruding on the outside 26 (Fig. 3) of the piston unit. In a second variant of the locking function, depicted in Fig. 2B, the third means 16C, 16D on the nut unit 12A, 12B takes the form of one or more spigots 16C, 16D protruding from the outside 24 (Fig. 3) of the nut unit, and the fourth means 17C, 17D takes the form of one or more corresponding recesses 17C, 17D in the outside 26 (Fig. 3) of the piston unit.

The third means 16A, 16B, 16C, 16D is arranged to fit with the fourth means 17A, 17B, 17C, 17D so that the nut unit 12 follows a predefined locking path 22 determined by the first means 14A, 14B, 14C, 14D and the second means 15A, 15B, 15C, 15D to a state in which the piston unit 13 is locked to the nut unit 12, when the nut unit follows the predefined first path 21.

In one embodiment the locking path 22 has an extent l_1 which is at right angles to a linear movement of the nut unit 12. In one embodiment the extent l_1 corresponds to rotating by between 80° and 100° , e.g. 90° , of the nut unit 12 or the threaded rod 11. In one embodiment the nut unit is arranged to move the
5 distance l_1 at right angles to the linear movement of the nut unit when it follows the predefined first path 21, while at the same time the nut unit moves the distance l_1 along the locking path 22 to the locked state. The locking path may comprise a first section in the direction of the linear movement of the nut unit, and a second section l_1 which is at right angles to the first section.

10

In one embodiment the piston unit 13 has its end 10B fastened to the cab 3, and during vehicle movement etc. it will not be connected to the nut unit 12A, 12B to a locked state. The piston unit may however still be inserted in the casing 20. The remaining parts of the actuator 5 are connected to the chassis 2 by the actuator's
15 other end 10A. When tilting is desired, the motor 7 is activated via a control device or other input unit 27, and the nut unit 12A, 12B will rise on the threaded rod 11. The nut unit following the predefined first path 21 and the predefined locking path 22 thus makes it possible for the actuator 5 to be connected together and for tilting to take place. The engagement is preferably made during the first
20 part of the linear movement of the actuator and by the nut unit 12A, 12B being rotated approximately 90° along the paths 21, 22. Rotating the threaded rod 11 in the opposite direction to that in which the nut unit 12A, 12B rises makes it possible for the nut unit to be lowered along the threaded rod, thereby disconnecting the actuator 5 from its locked state and releasing the piston unit 13
25 from the nut unit.

In one embodiment the actuator 5 comprises a fifth means 18A, 18B, 18C, 18D on the piston unit 13 and a sixth means 19A, 19B, 19C, 19D on the casing 20 which perform a second guiding function for the actuator. In a first variant of this second
30 guiding function the fifth means 18A, 18B takes the form of one or more spigots 18A, 18B protruding from the outside 26 of the piston unit, and the sixth means 19A, 19B takes the form of one or more corresponding recesses 19A, 19B in the

inside 15 of the casing 20. In a second variant of the second guiding function the fifth means 18C, 18D takes the form of one or more recesses 18C, 18D in the outside 27 of the piston unit, and the sixth means 19C, 19D takes the form of one or more corresponding spigots 19C, 19D protruding on the inside 25 of the casing 20.

The fifth means 18A, 18B, 18C, 18D is arranged to fit with the sixth means 19A, 19B, 19C, 19D so that the piston unit 13 follows a predefined second path 23 determined by the fifth means 18A, 18B, 18C, 18D and the sixth means 19A, 19B, 19C, 19D when they are engaged with one another and the motor 7 drives the threaded rod 11.

In one embodiment the predefined first path 21 comprises rotating by between 80° and 110°, preferably 90°, of the nut unit 12A, 12B. In another the predefined locking path 22 comprises rotating by between 80° and 110°, preferably 90°, of the nut unit 12A, 12B. The rotating of the two paths 21, 22 may be simultaneous. In one embodiment the predefined second path comprises rotating by between 80° and 110°, preferably 90°, of the piston unit 13. The rotating of all three paths may be simultaneous.

20

For clarification purposes, Figs. 3-6 depicts parts of the actuator 5 in various views which illustrate the different functions according to the first variants of these parts.

25 Fig. 3 depicts a first cross-sectional view of part of the actuator 5, showing the threaded rod 11 with the nut unit 12A, 12B arranged round it. The nut unit 12A, 12B has an outside denoted generally by ref. 24 and facing towards an inside 25 of the casing 20. The nut unit's first section 12A has two spigots 14A, 14B protruding from its outside 24. On the inside 25 of the casing 20 there are two corresponding recesses 15A, 15B into which the spigots 14A and 14B are
30 configured to fit when the nut unit 12A, 12B is correctly positioned in the casing. When the motor 7 thereafter drives the threaded rod 11, the nut unit 12A, 12B will

be forced to follow the predefined first path 21 (Fig. 2A) when the spigots 14A, 14B run in the recesses 15A, 15B.

The second nut section 12B, which has a different diameter, has two recesses 16A and 16B in its outside 24. The piston unit 13 is provided with two protruding spigots 17A and 17B, not depicted in Fig. 3, which fit into the two recesses 16A and 16B in the second nut section 12B. The piston unit is provided with a cavity 28 configured to accommodate the second nut section 12B. This cavity is a space between the piston unit 13 and the threaded rod 11. The piston unit extends round the cavity 28, and the spigots 17A, 17B are situated on the portion or portions of the piston unit which extend round the cavity. In one embodiment the spigots 17A, 17B are situated in the distal part of the portion or portions of the piston unit which extend round the cavity 28. The spigots 17A, 17B face in towards the middle of the piston unit. When the motor drives the threaded rod 11, the nut unit 12A, 12B will be forced to follow the locking path 22 (Fig. 2A) when the spigots 17A and 17B enter the recesses 16A and 16B.

Fig. 4 depicts a view through part of the actuator 5 in Fig. 2A, showing the predefined first path 21 running on the inside 25 (Fig. 3) of the casing 20 in the form of the recess 15A in which the spigot 14A protruding from the outside 24 (Fig. 3) of the nut section 12B is situated. The recess 15A makes an approximately 90° rotate a distance l_1 from a straight section of the recess 15A which extends in the direction of the nut unit's linear extent, and thereafter continues in the direction of the nut unit's linear extent, but displaced the distance l_1 . A further recess 15B in the opposite direction makes a similar rotate on the opposite side of the inside 25 of the casing 20. The recesses 15A, 15B continue thereafter along the inside 25 (Fig. 3) of the casing. The spigots 18A and 18B protruding on the outside 26 (Fig. 3) of the piston unit may run in the same recesses 15A, 15B as the spigots 14A, 14B protruding on the outside 24 of the nut section 12B. The diagram also shows the spigots 17A, 17B protruding from the piston unit 13 which extend into the cavity 28 in the piston unit. The extent of the spigots 17A, 17B is limited by the threaded rod 11.

Fig. 5 depicts a further cross-sectional view of part of the actuator 5 in Fig. 2A. Fig. 6A depicts a cross-section along F-F of the actuator in Fig. 5, Fig. 6B a cross section along G-G of the actuator in Fig. 5, and Fig. 6C a cross-section along H-H of the actuator in Fig. 5. The cross-section along F-F depicts the two recesses 15A and 15B on the inside 25 (Fig. 3) of the casing 20, the nut section 12A and the threaded rod 11. The cross-section along G-G likewise depicts the two recesses 15A and 15B on the inside 25 (Fig. 3) of the casing 20 and the threaded rod 11, but this time depicts the nut section 12B, which has the recesses 16A and 16B in its outside 24. As may be seen in the diagram, these recesses 16A and 16B extend along about 90° of the outside 24 (Fig. 3) of the second nut portion. The length of the respective extents of the recesses 16A and 16B is l_1 along the cross-section. The cross-section along H-H depicts the inward spigots 17A, 17B on the piston unit 13, and the outward spigots 18A, 18B on the outside 26 of the piston unit (Fig. 3). These outward spigots 18A, 18B run in recesses 19A, 19B on the inside 25 of the casing 20.

The invention relates also to a method for controlling the actuator 5 illustrated in Figs. 1-6C. Fig. 7 depicts a flowchart illustrating the method, which will now be explained with reference to this diagram. The method comprises placing the nut unit 12A, 12B on the threaded rod 11 in the casing 20 in such a way that a first means 14A, 14B, 14C, 14D on the nut unit 12 and a matching second means 15A, 15B, 15C, 15D on the casing 20 run in one another (A1). Thereafter the threaded rod 11 is driven so that the nut unit 12A, 12B follows a predefined first path 21 which is delineated by the first means 14A, 14B, 15C, 15D and the second means 15A, 15B, 15C, 15D (A2). In one embodiment the method comprises effecting a state in which the piston unit 13 is locked to the nut unit 12A, 12B by having the nut unit follow a predefined locking path 22 which is delineated by a third means 16A, 16B on the nut unit 12A, 12B and a matching fourth means 17A, 17B on the piston unit 13, while at the same time the nut unit 12A, 12B follows the predefined first path 21.

The present invention is not restricted to the embodiments described above.

Sundry alternatives, modifications and equivalents may be used. The aforesaid embodiments therefore do not limit the invention's scope, which is defined by the attached claims.

Claims

1. An actuator (5) which comprises:
- 5 - a motor (7);
- a threaded rod (11);
- a nut unit (12);
- a piston unit (13);
- a casing (20), the motor (7) being arranged to drive the threaded rod (11) via a
10 gearbox (9), c h a r a c t e r i s e d in that the actuator (5) comprises a first
means (14A, 14B, 14C, 14D) on the nut unit (12) and a second means (15A, 15B,
15C 15D) on the casing (20) which perform a first guiding function for the actuator
(5), the first means (14A, 14B, 14C, 14D) being arranged to fit with the second
15 means (15A, 15B, 15C 15D) so that the nut unit (12) follows a predefined first
path (21) determined by the first means (14A, 14B, 14C, 14D) and the second
means (15A, 15B, 15C, 15D) when the first means (14A, 14B, 14C, 14D) and the
second means (15A, 15B, 15C, 15D) are engaged with one another and the motor
(7) drives the threaded rod.
- 20 2. The actuator (5) according to claim 1, in which the first means (14A,
14B) on the nut unit (12) takes the form of one or more spigots (14A, 14B)
protruding from the outside (24) of the nut unit, and the second means (15A, 15B)
takes the form of one or more corresponding recesses (15A, 15B) in the inside
(25) of the casing (20).
- 25 3. The actuator (5) according to claim 1, in which the first means (14C,
14D) on the nut unit (12) takes the form of one or more recesses (14C, 14D) in
the outside of the nut unit (12), and the second means (15C, 15D) takes the form
of one or more corresponding spigots (15C, 15D) protruding from the inside (25)
30 of the casing (20).

4. The actuator (5) according to any one of the foregoing claims, in which the predefined first path (21) has an extent such that the nut unit (12) is arranged to move a distance l_1 at right angles to a linear movement of the nut unit (12) when it follows the predefined first path (21).

5

5. The actuator (5) according to any one of the foregoing claims, which comprises a third means (16A, 16B, 16C, 16D) on the nut unit (12) and a fourth means (17A, 17B, 17C, 17D) on the piston unit (13) which perform a locking function for the actuator (5), the third means (16A, 16B, 16C, 16D) being arranged to fit with the fourth means (17A, 17B, 17C, 17D) so that the nut unit (12) follows a predefined locking path (22) determined by the third means (16A, 16B, 16C, 16D) and the fourth means (17A, 17B, 17C, 17D) to a state in which the piston unit (13) is locked to the nut unit (12), when the nut unit (12) follows the predefined first path (21).

15

6. The actuator (5) according to claim 5, in which the third means (16A, 16B) on the nut unit (12) takes the form of one or more recesses (16A, 16B) in the outside (24) of the nut unit, and the fourth means (17A, 17B) takes the form of one or more corresponding spigots (17A, 17B) protruding on the outside of the piston unit.

20

7. The actuator (5) according to claim 5, in which the third means (16C, 16D) on the nut unit (12) takes the form of one or more spigots (16C, 16D) protruding from the outside (24) of the nut unit, and the fourth means (17C, 17D) takes the form of one or more corresponding recesses (17C, 17D) in the outside of the piston unit.

25

8. The actuator (5) according to any one of claims 5 to 7, in which the locking path (22) has an extent l_1 which is at right angles to a linear movement of the nut unit (12).

30

9. The actuator (5) according to claims 4 and 8, in which the nut unit (12) is arranged to move the distance l_1 at right angles to the linear movement of the nut unit (12) when it follows the predefined first path (21), while at the same time the nut unit (12) moves the distance l_1 along the locking path (22) to the
5 locked state.

10. The actuator (5) according to any one of the foregoing claims, which comprises a fifth means (18A, 18B, 18C, 18D) on the piston unit (13) and a sixth means (19A, 19B, 19C, 19D) on the casing (20) which perform a second guiding
10 function for the actuator, the fifth means (18A, 18B, 18C, 18D) being arranged to fit with the sixth means (19A, 19B, 19C, 19D) so that the piston unit (13) follows a predefined second path (23) determined by the fifth means (18A, 18B, 18C, 18D) and the sixth means (19A, 19B, 19C, 19D) when the fifth means (18A, 18B, 18C, 18D) and the sixth means (19A, 19B, 19C, 19D) are engaged with one another
15 and the motor (7) drives the threaded rod.

11. The actuator (5) according to claim 10, in which the fifth means (18A, 18B) takes the form of one or more spigots (18A, 18B) protruding from the outside of the piston unit, and the sixth means (19A, 19B) takes the form of one or more
20 corresponding recesses (19A, 19B) in the inside (25) of the casing (20).

12. The actuator (5) according to claim 10, in which the fifth means (18C, 18D) takes the form of one or more recesses (18C, 18D) in the outside of the piston unit, and the sixth means (19C, 19D) takes the form of one or more
25 corresponding spigots (19C, 19D) protruding on the inside (25) of the casing (20).

13. The actuator (5) according to any one of the foregoing claims, in which the predefined first path (21) comprises rotating of the nut unit (12) by between 80 and 110°, preferably 90°.

30

14. A cab tilt device for a vehicle (1), which comprises an actuator (5) according to any one of the foregoing claims, in which the actuator (5) is arranged

to have its one end (10A) fastened to the vehicle's chassis (2) and its other end (10B) fastened to the vehicle's cab (3), which tilt device further comprises a control unit (27) and/or input unit (27) arranged to activate the tilting of the cab (3).

5 15. A vehicle provided with an actuator according to any one of claims 1 to 13 and/or a cab tilt device according to claim 14.

16. A method for controlling an actuator which comprises a motor (7), a threaded rod (11), a nut unit (12A, 12B), a piston unit (13) and a casing (20),
10 which method comprises
- placing the nut unit (12A, 12B) on the threaded rod (11) in the casing (20) in such a way that a first means (14A, 14B, 14C, 14D) on the nut unit (12A, 12B) and a matching second means (15A, 15B, 15C, 15D) on the casing (20) run in one another;
15 - driving the threaded rod (11) so that the nut unit (12) follows a predefined first rotated path (21) which is delineated by the first means (14A, 14B, 14C, 14D) and the second means (15A, 15B, 15C, 15D).

17. A method according to claim 16, which further comprises:
20 - effecting a state of the piston unit (13) in which it is locked to the nut unit (12) by having the nut unit (12) follow a predefined locking path (22) which is delineated by a third means (16A, 16B, 16C, 16D) on the nut unit (12A, 12B) and matching fourth means (17A, 17B, 17C, 17D) on the piston unit (13), while at the same time the nut unit (12A, 12B) follows the predefined first path (21).

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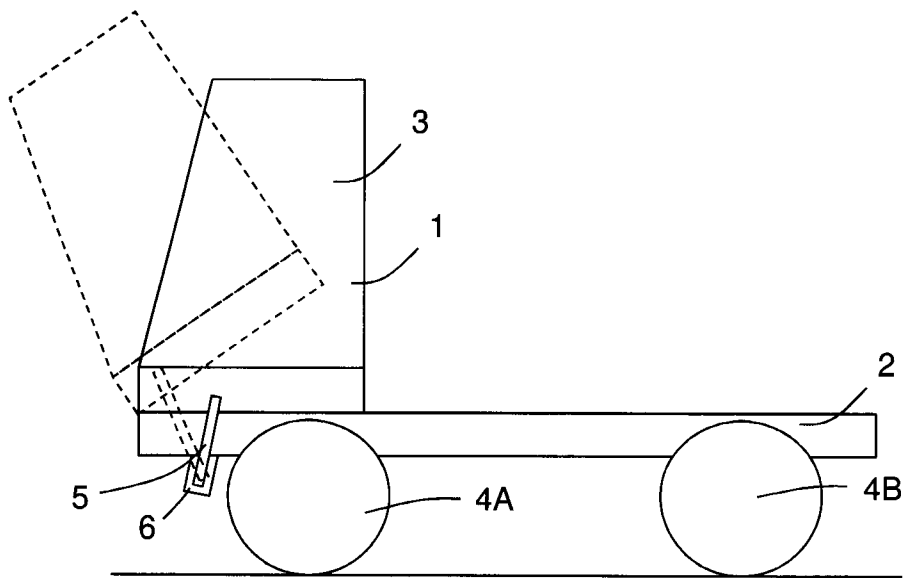


FIG. 1

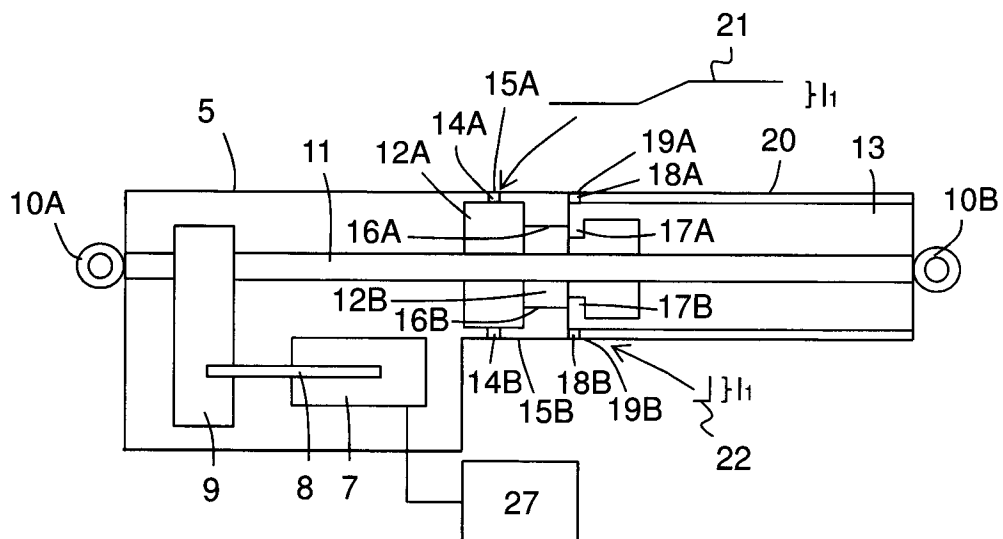


FIG. 2A

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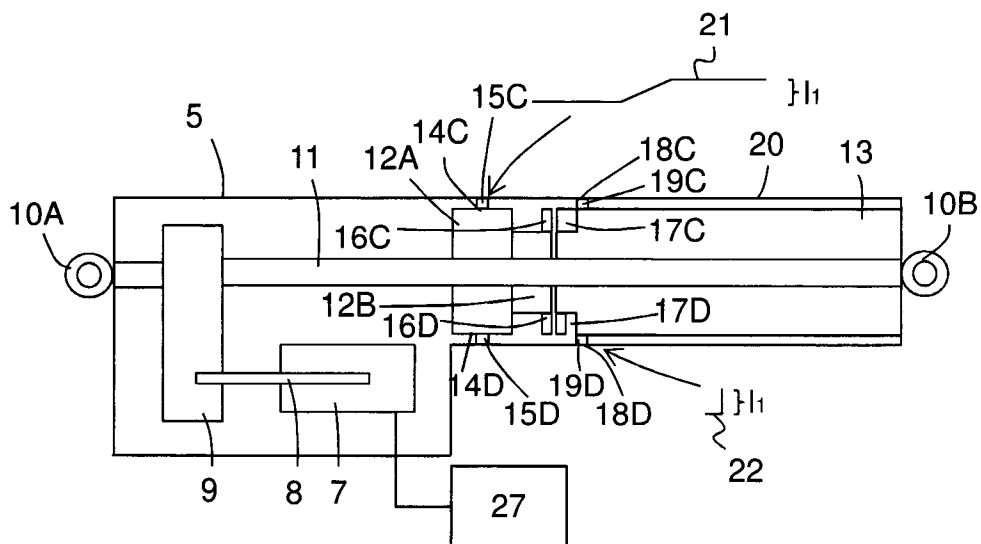


FIG. 2B

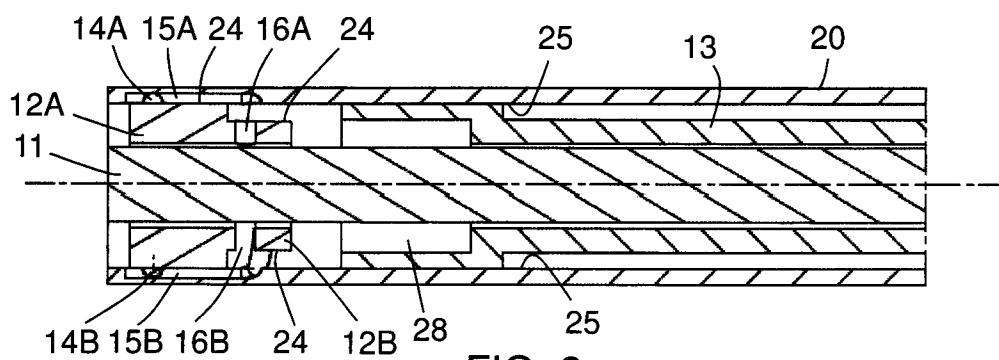


FIG. 3

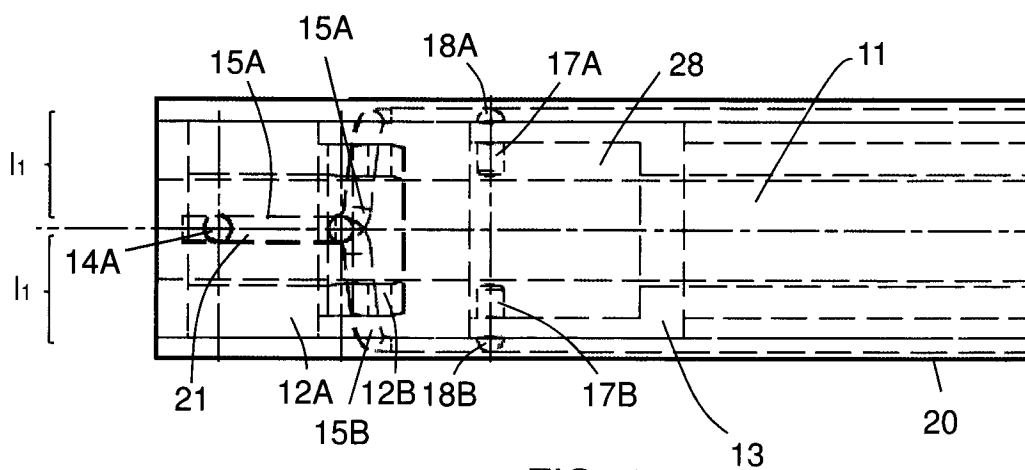


FIG. 4

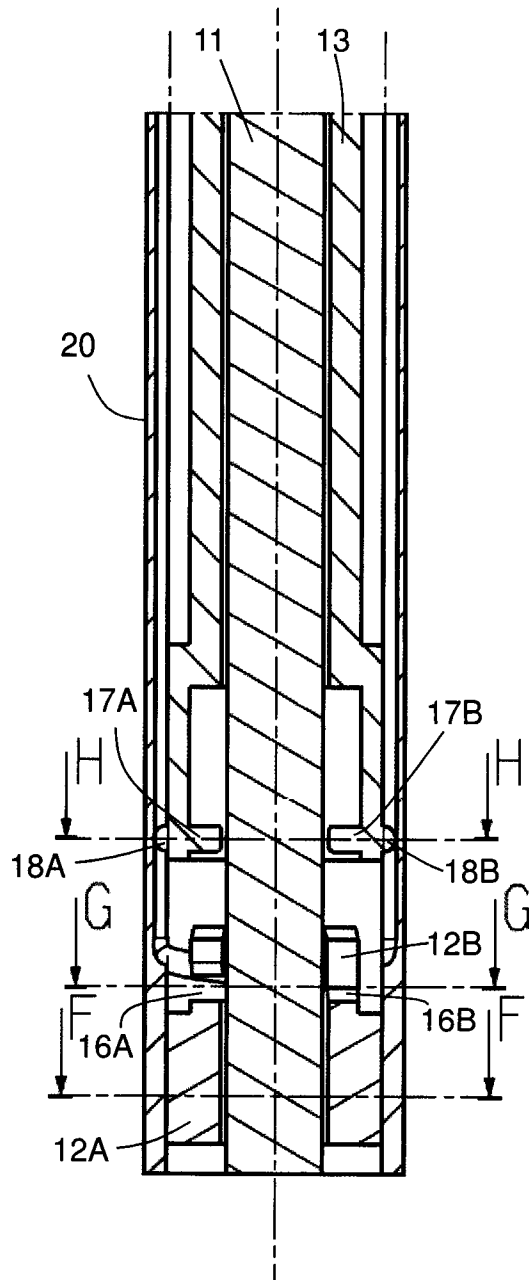


FIG. 5

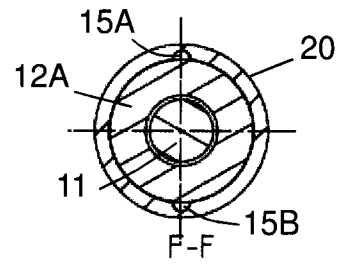


FIG. 6A

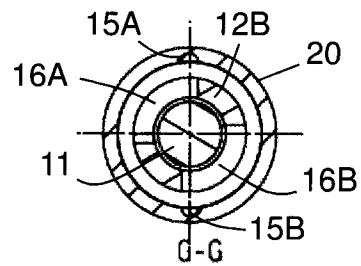


FIG. 6B

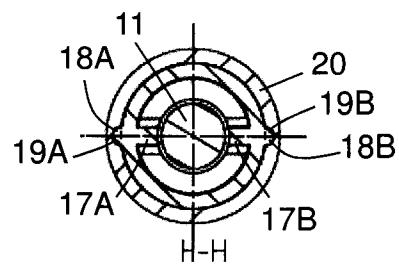


FIG. 6C

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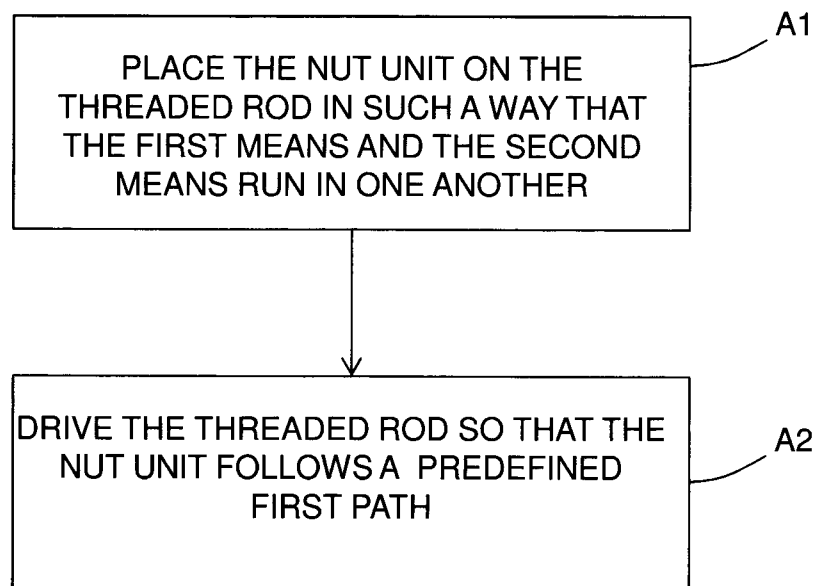


FIG. 7

INTERNATIONAL SEARCH REPORT

 International application No.
 PCT/SE2015/050660

A. CLASSIFICATION OF SUBJECT MATTER

IPC: see extra sheet

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: B62D, F16H, H02K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE, DK, FI, NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, PAJ, WPI data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 3606801 A (WILLIAMS BERNARD D), 21 September 1971 (1971-09-21); column 1, line 50 - column 2, line 8; figures 1,2 --	1-17
X	US 20090224456 A1 (LORIOT JEAN-MARC ET AL), 10 September 2009 (2009-09-10); paragraphs [0034]-[0037], [0076]; figure 1 --	1-17
A	DE 102011100707 A1 (FESTO AG & CO KG), 8 November 2012 (2012-11-08); paragraph [0052]; figures 1-9 --	1-17
A	US 20040140294 A1 (SALESSE CHRISTIAN ET AL), 22 July 2004 (2004-07-22); abstract; figures 1-3 --	1-17



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:

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“O” document referring to an oral disclosure, use, exhibition or other means

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“Y” document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

“&” document member of the same patent family

Date of the actual completion of the international search

07-10-2015

Date of mailing of the international search report

08-10-2015

Name and mailing address of the ISA/SE

Patent- och registreringsverket

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE2015/050660

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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A	EP 0485724 A1 (MAN NUTZFAHRZEUGE AG), 20 May 1992 (1992-05-20); abstract; figures 1-5 -- -----	1-17

Continuation of: second sheet**International Patent Classification (IPC)***F16H 25/20* (2006.01)*B62D 33/07* (2006.01)*H02K 7/06* (2006.01)*B62D 33/067* (2006.01)

INTERNATIONAL SEARCH REPORT

Information on patent family members

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