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(54) ACTUATING DRIVE FOR A SLIDING DOOR OF A VEHICLE

(57) The invention relates to an actuating drive, in particular for a sliding door of a motor vehicle, comprising a housing, a motor, a gear wheel (9) with a toothed disc (9f) driven by the motor to rotate about a drive axis (D) and having a first bearing sleeve (9d), and at least one first cable drum (13) mounted on the first bearing sleeve (9d) for guiding a first traction element (14).

To provide an actuating drive that allows a sliding door to be adjusted manually in a reliable manner and that is also functional when subjected to major external forces, the cable drum (13) and the gear wheel (9) are coupled to one another via a first ratchet gear (44), wherein the first ratchet gear (44) is adapted to drive the first cable drum (13) upon rotation of the gear wheel (9) about the drive axis (D) in the winding direction of the first cable drum (13) and to allow the first cable drum (13) to rotate about the driving axis (D) in the unwinding direction relative to the gear wheel (9).

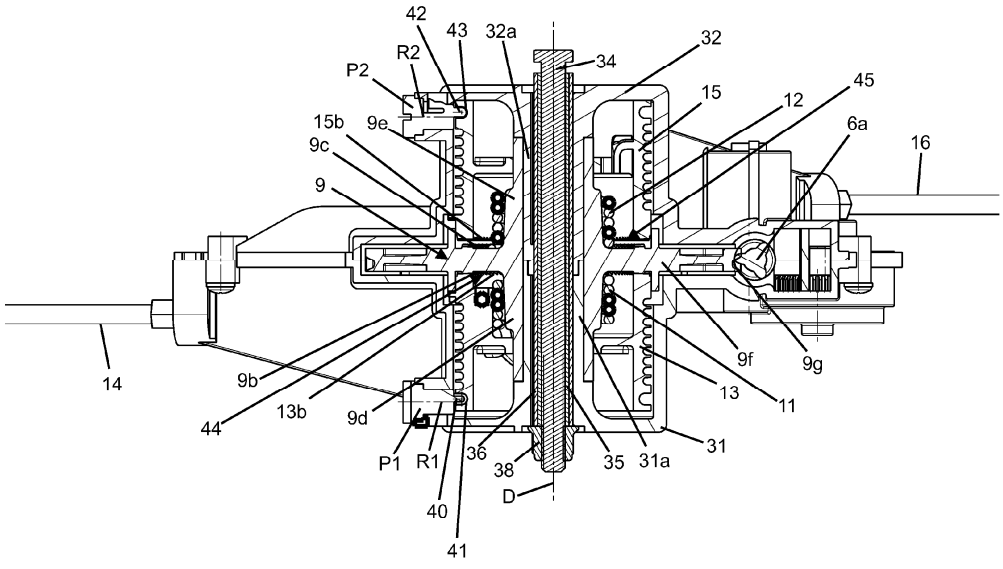


Fig. 2

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Description

[0001] The invention relates to an actuating drive, in particular for a sliding door of a motor vehicle, comprising a housing, a motor, a gear wheel with a toothed disc driven by the motor to rotate about a drive axis and having a first bearing sleeve, and at least one first cable drum mounted on the first bearing sleeve for guiding a first traction element.

[0002] Such actuating drives are well known from practical use, whereby the sliding door of the vehicle can be moved automatically back and forth between an open and closed position by operating the actuating drive. However, in addition to such fully automatic operation of the sliding door, manual adjustment of the sliding door is also provided for, whereby the actuating drive in particular provides support for manual adjustment of the sliding door in a so-called servo mode. In this case, the problem often arises that the pretension of the traction mechanism must be reliably maintained so that the traction mechanism does not jump out of the guide groove of the cable drum and is thereby jammed, causing the actuating drive to be blocked. Furthermore, for the realisation of a servo mode, a preferably controlled preload in a defined range is advantageous so that the actuating drive provides an auxiliary force that is as precise as possible. When the vehicle is parked on an incline, the force of gravity acts in the opening or closing direction of the vehicle door, which can make it difficult to open or close the vehicle door manually. Therefore, a braking or holding device is typically provided in actuating drives to compensate for the additional force exerted on the sliding door by gravity.

[0003] The object of the invention is to provide an actuating drive that allows a sliding door to be adjusted manually in a reliable manner and that is also functional when subjected to major external forces.

[0004] According to the invention, this object is achieved by an actuating drive having the features of an independent claim.

[0005] According to one aspect of the invention, an actuating drive is created, comprising a housing, a motor, a gear wheel with a toothed disc driven by the motor to rotate about a drive axis and having a first bearing sleeve, and at least one first cable drum mounted on the first bearing sleeve for guiding a first traction element. The actuating drive according to the invention is characterised in that the cable drum and the gear wheel are coupled to one another via a first ratchet gear, wherein the first ratchet gear is adapted to drive the first cable drum upon rotation of the gear wheel about the drive axis in the winding direction of the first cable drum and to allow the first cable drum to rotate about the driving axis in the unwinding direction relative to the gear wheel. The first ratchet gear is advantageous in ensuring that the first cable drum can maintain a defined pretension at all times in the event of jerky movement of the sliding door, which is particularly important when unwinding the traction element from the first cable drum. Likewise, the inelastic stretching of the traction element that occurs during continuous use is reliably compensated at all times, with the ratchet gear allowing discrete adjustment of the preload. In contrast, a system without a ratchet gear is too elastic, making it difficult to precisely adjust the auxiliary force provided in servo mode.

[0006] In a particularly preferred embodiment of the actuating drive, it is provided that the first cable drum is pretensioned relative to the gear wheel by means of a first pretensioning element in the winding direction of the first cable drum. The tensioning element is preferably designed as a torsion spring, which is arranged between the gear wheel and the first cable drum, with a first free end connected to the gear wheel and a second free end connected to the first cable drum. Advantageously, the traction element is automatically maintained at a certain tension during unwinding, so that the traction element does not slip out of the guide grooves of the first cable drum.

[0007] In a preferred further development of the actuating drive the first ratchet gear comprises a first gear tooth ring and a second gear tooth ring releasably in engagement with the first gear tooth ring. Expediently the first gear tooth ring is arranged on an end face of the first cable drum perpendicular to the drive axis and the second gear tooth ring is arranged on an end face of the toothed disc facing the first cable drum. In a preferred embodiment, the first gear tooth ring is formed on the front side of the first cable drum. In a further preferred embodiment, the second gear tooth ring is formed on the front side of the toothed disc. It is advantageous that the first gear tooth ring and the second gear tooth ring can be produced directly during an injection moulding process in the manufacture of the first cable drum and the gear wheel. In addition, the first ratchet gear formed in this way is particularly precise.

[0008] Preferably the first pretensioning element pretensions the first cable drum axially in the direction towards the toothed disc of the gear wheel. Advantageously, the first pretensioning element also pretensions the first gear tooth ring onto the second gear tooth ring, so that when the first cable drum is turned in the unwinding direction, an axial displacement of the first cable drum against the pretension of the first pretensioning element can take place, which is made possible by the diagonally arranged tooth flanks of the ratchet gear.

[0009] In a preferred embodiment of the actuating drive the gear wheel has a second bearing sleeve opposite the first bearing sleeve, with a second cable drum being arranged on said second bearing sleeve, wherein a second ratchet gear is arranged between the second cable drum and the gear wheel, which is adapted to drive the second cable drum upon rotation of the gear wheel about the drive axis in the winding direction of the second cable drum and to allow the second cable drum to rotate about the driving axis in the unwinding direction relative to the gear wheel. The winding direction of the first cable

drum is preferably opposite to the winding direction of the second cable drum. Advantageously, rotation of the gear wheel in a first direction of rotation corresponds to the winding direction of the first cable drum and the unwinding direction of the second cable drum, and the rotation of the gear wheel in a second direction of rotation opposite to the first direction of rotation corresponds to the unwinding direction of the first cable drum and the winding direction of the second cable drum.

[0010] Preferably the winding direction of the first cable drum is opposite to the winding direction of the second cable drum. Advantageously, when the gear wheel is turned in a first direction of rotation, the first cable drum is wound up, i.e. the first traction element guided in the first cable drum transmits a pulling force to the vehicle door, while the second cable drum is unwound due to the movement of the sliding door, with the second ratchet gear advantageously ensuring that the second traction element maintains a certain tension. Conversely, when the gear wheel is turned in a second direction opposite to the first direction of rotation, the second cable drum is wound up, i.e. the second cable drum guided in the second cable drum transmits a tensile force to the vehicle door, while the first cable drum is unwound due to the movement of the sliding door, whereby it is advantageously ensured by the first ratchet gear that the first cable drum maintains a certain tension.

[0011] It is expedient to provide that the second cable drum is pretensioned relative to the gear wheel by means of a second pretensioning element in the winding direction of the second cable drum. The pretensioning element is preferably designed as a torsion spring, which is arranged between the gear wheel and the second cable drum, with a first free end connected to the gear wheel and a second free end connected to the second cable drum. Advantageously, the second traction element is automatically maintained at a certain tension during unwinding, so that the second traction element does not slip out of the guide grooves of the first cable drum.

[0012] Expediently the second ratchet gear comprises a third gear tooth ring and a fourth gear tooth ring releasably in engagement with the third gear tooth ring. Expediently the third gear tooth ring is arranged on an end face of the second cable drum perpendicular to the drive axis and the fourth gear tooth ring is arranged on an end face of the toothed disc facing the second cable drum. In a preferred embodiment, the third gear tooth ring is formed on the front side of the first cable drum. In a further preferred embodiment, the fourth gear tooth ring is formed on the front side of the toothed disc facing the second cable drum. It is advantageous that the third gear tooth ring and the fourth gear tooth ring can be produced directly during an injection moulding process in the manufacture of the second cable drum and the gear wheel. In addition, the second ratchet gear formed in this way is particularly precise.

[0013] Preferably the second pretensioning element pretensions the second cable drum axially in the direction towards the toothed disc of the gear wheel. Advantageously, the second pretensioning element also pretensions the third gear tooth ring onto the fourth gear tooth ring, so that when the second cable drum is turned in the unwinding direction, an axial displacement of the second cable drum against the pretension of the second pretensioning element can take place, which is made possible by the diagonally arranged tooth flanks of the ratchet gear.

[0014] In a preferred embodiment the first cable drum can be displaced axially with respect to the toothed disc of the gear wheel via a first locking pin, the first ratchet gear between the first cable drum and the gear wheel being adjustable between a coupling position and an uncoupling position as a result. The first locking pin is arranged on the housing so as to be rotatable about a first axis of rotation perpendicular to the drive axis, wherein the first locking pin has a first extension which is arranged eccentrically to the first axis of rotation and engages in a first recess provided on the first cable drum. The second cable drum may also be displaced axially with respect to the toothed disc of the gear wheel via a second locking pin, the second ratchet gear between the second cable drum and the gear wheel being adjustable between a coupling position and an uncoupling position as a result. The second locking pin is arranged on the housing so as to be rotatable about a second axis of rotation perpendicular to the drive axis, wherein the second locking pin has a second extension which is arranged eccentrically to the second axis of rotation and engages in a second recess provided on the second cable drum. The actuating drive can thus be delivered with the maximum length of uncoiled tension elements or cables, which makes installation of the actuating drive in the vehicle significantly easier.

[0015] When the tension elements were connected to the sliding door, the locking pins are turned around the axis of rotation and the first ratchet gear and the second ratchet gear are engaged again. Alternatively, the actuating drive can also be delivered with the ratchet gears engaged, in which case the operator must manually pull the cables to the required length to connect them to the sliding door or a chariot carrying the sliding door.

[0016] The actuating drive is preferably connected to the vehicle body by means of an elastic flange. It is advantageous that vibrations occurring in the actuating drive are reliably damped by the elastic flange. In a further preferred embodiment, the elastic flange is connected to the housing of the actuating drive by means of a bearing screw, which extends through the housing concentrically to the drive axle. The bearing screw is preferably surrounded by a metal sleeve, which in turn is surrounded by a rubber sleeve that is arranged radially between the metal sleeve and the first bearing sleeve of the gear wheel. Further preferably, the housing comprises a first housing part and a second housing part, the first housing part being connected to the second housing part by means of a plurality of screws.

[0017] According to another aspect of the invention, an actuating drive is created, comprising a housing, a motor having an output shaft which is connected to a drive shaft, a gear wheel with a toothed disc driven by the drive shaft to rotate about a drive axis and having a first bearing sleeve, at least one first cable drum mounted on the first bearing sleeve for guiding a first traction element and a braking device comprising a brake lever having a first end with a brake element and a second end for braking the gear wheel. The actuating drive is characterised in that the brake element is moveable from a braking section of the drive shaft via a control disc against the pretension of a brake spring wherein the control disc is rotatably driven by a brake motor. The braking device can be easily switched between an activated and a deactivated state by rotating the control disc, thus providing an increased holding force for the sliding door. This is particularly advantageous when the vehicle is parked on an incline, as the sliding door is then subject to additional forces due to gravity in the opening or closing direction.

[0018] In a preferred embodiment the control disc has a cam abutting against the second end of the brake lever, wherein the brake lever is rotatable about a bearing pin arranged between the first end and the second end of the brake lever in a bearing section.

[0019] Preferably, the cam has a first section with an increasing outer radius and an adjoining second section with a constant outer radius. Advantageously, the force necessary to adjust the braking element can be provided by rotating the cam, whereby the first section is first guided over the second end of the braking element, leading to the desired displacement of the same against the preload of the brake spring. Because the second portion has a constant outer radius, the cam is not reset by the force exerted by the brake lever, so that the braking element remains in the deactivated state.

[0020] Further preferably, the braking device comprises a first stop element and a second stop element, which define a first end position of the control disc, in which the braking device is activated, and a second end position of the control disc, in which the braking device is deactivated. The first stop element is preferably fixedly arranged on the housing and the second stop element is arranged on the control disc. The second stop element is particularly preferably formed in one piece with the control disc. Advantageously, the reaching of the respective end position can be detected simply by an electronic control unit detecting an increase in the current strength in the brake motor, whereupon the electronic control unit then switches off the brake motor.

[0021] Further advantages, properties, developments, and designs of the invention result from dependent claims and from the description of a preferred embodiment.

[0022] The invention is explained below with reference to the accompanying drawings using a preferred embodiment.

Fig. 1 shows a preferred embodiment of an actuating drive 1 for a sliding door of a motor vehicle in an exploded view.

Fig. 2 shows the assembled actuator 1 in a cross-section view.

Fig. 3 shows an isometric view of the activated braking device 19.

Fig. 4 shows the rear side of the activated braking device 19 shown in Fig. 3 in a side view.

Fig. 5 shows an isometric view of the deactivated braking device 19.

Fig. 6 shows the rear side of the activated braking device 19 shown in Fig. 5 in a side view.

[0023] Fig. 1 shows a preferred embodiment of an actuating drive 1 for a sliding door of a motor vehicle in an exploded view. The actuating drive 1 comprises a motor 2 which, in the embodiment shown, is in the form of an electric motor. The motor 2 has an output shaft 3 which is connected to a drive shaft 6, which is designed as a worm, via a lower coupling sleeve 4a and an upper coupling sleeve 4b, which are coupled to one another in an articulated manner via a ball- and-socket joint part 5. The lower coupling sleeve 4a is coupled in a rotationally positive manner to the output shaft 3 and the upper coupling sleeve 4b is coupled in a rotationally positive manner to the drive shaft 6. For this purpose, the drive shaft 6 has a coupling element 7 at one end facing the upper coupling sleeve 4b. This coupling element 7 is flat and is inserted into a slot-shaped receiver 8 provided on the upper side of the upper coupling sleeve 4b. A radial ball bearing 10 is provided for the rotatable bearing of the drive shaft 6.

[0024] The drive shaft 6 has a worm screw 6a that is threadedly engaged with the tooth spaces 9a of a gear wheel 9, thus driving the rotation of the gear wheel 9. The gear wheel 9 has a first bearing sleeve 9d and a second bearing sleeve 9e, on which a first torsion spring 11 and a second torsion spring 12 are placed on the opposite end faces of the gear wheel 9. The first torsion spring 11 is coupled to the gear wheel 9 with a first free end 11a and to a first cable drum 13 with a second free end 11b opposite the first free end 11a. The first cable drum 13 has a circumferential first guide groove 13a for guiding a first traction element 14 in the form of a cable. The second torsion spring 12 is coupled to the gear wheel 9 by means of a first free end 12a and is coupled to a second cable drum 15 by means of a second free end 12b located opposite the first free end 12a.

[0025] The second cable drum 15 has a circumferential second guide groove 15a for guiding a second traction element 16 in the form of a cable. To provide a tension-proof connection between the first traction element 14 and the first cable drum 13, the first traction element 14 has a first nozzle 17 at its free end. Similarly, the second traction element 16 has a second nozzle 18 at its free end, by means of which the second traction element 16 can be attached to the second cable drum 15 in a tension-proof

manner.

[0026] The first cable drum 13 has a radially extending first gear tooth ring 13b on an end face facing the gear wheel 9, which can be engaged with a second gear tooth ring 9b on the end face of the gear wheel 9. Similarly, the second cable drum 15 has a radially extending third gear tooth ring 15b on an end face facing the gear wheel 9, which can be engaged with a fourth gear tooth ring on the opposite end face of the gear wheel 9, which is not visible in Fig. 1. Advantageously, the first and third gear tooth ring 13b, 15b of the first cable drum 13 and the second cable drum 15 together with the second gear tooth ring 9b and the fourth gear tooth ring of the gear wheel 9 form ratchet gears, whereby the ratchet gears, when the gear wheel 9 is driven in a first direction of rotation, causes the form-fitting entrainment of one of the two cable drums 13, 15, whereas the other of the two cable drums 13, 15 can be rotated in the first direction of rotation relative to the gear wheel 9 against the pretension of the first torsion spring 11 or second torsion spring 12.

[0027] Similarly, when the gear wheel 9 is driven in a second direction of rotation opposite to the first direction of rotation, the ratchet gears causes the other of the two cable drums 13, 15 to be driven in a form-fitting manner and the other of the two cable drums 13, 15 to rotate in the second direction of rotation against the pretensioning of the first torsion spring 11 or second torsion spring 12. The first torsion spring 11 and the second torsion spring 12 pretension the first cable drum 13 and the second cable drum 15 in their respective winding direction. For example, the first direction of rotation corresponds to the winding direction of the first cable drum 13 and the second direction of rotation corresponds to the winding direction of the second cable drum 15.

[0028] The first torsion spring 11 and the second torsion spring 13 also pretension the first cable drum 13 and the second cable drum 15 axially towards the gear wheel 9 and thus gear tooth rings 13b, 15b of the first cable drums 13, 15 towards the gear tooth rings 9b of the gear wheel 9 towards each other. To decouple the gear tooth rings a first safety pin P1 and a second safety pin P2 are provided, wherein an axial movement of the first cable drum 13 may be driven by the first safety pin P1 and an axial movement of the second cable drum 15 may be driven by the second safety pin P2. Then safety pins P1, P2 also hold the cable drums in their respective position when engaged.

[0029] The actuating drive 1 further comprises a braking device 19 for breaking or holding the drive shaft 6. The braking device 19 includes a brake motor 20 having an output shaft 21 coupled to a drive pinion 22, the drive pinion 22 threadedly engaging an external thread 23a of a control disc 23. The control disc 23 is used to switch the braking device 19 back and forth between an activated and a deactivated state, as explained in more detail below. The control disc 23 sets a brake lever 24 against the pretension of a brake spring 25 in a decoupled state, in which the brake lever 24 does not interact with the drive shaft 6 in a braking manner, to deactivate the braking device 19. The braking device 19 further comprises a first stop element 26 to define the two positions of the control disc 23, as explained further below.

[0030] The actuating drive 1 further comprises a housing 30 with a first housing part 31 and a second housing part 32, which are connected to one another by means of a plurality of screws 33. Advantageously, all components are easily accessible by removing one of the two housing parts 31; 32. Furthermore, a bearing screw 34 is provided that passes through the housing 30 and, together with a metal sleeve 35, provides radial support for the housing 30. Furthermore, a circumferential rubber sleeve 36 surrounding the metal sleeve 34 is provided, wherein the rubber sleeve 36 serves to dampen vibrations. To secure the housing 30 to the vehicle body, the actuator 1 includes a flange 37 that is made of rubber. The flange 37 is attached to the housing 30 by means of the bearing screw 34 and is in turn connected to the vehicle body by a first lead-through 37a and a second lead-through 37b.

[0031] Fig. 2 shows the assembled actuating drive 1 in a cross-section view. The bearing screw 34 passes through the first housing part 31 and the second housing part 32, with the metal sleeve 35 being arranged radially between the bearing screw 34 and the rubber sleeve 36. The metal sleeve 35 forms an axial abutment for a screw nut 38, which is screwed onto the lower end of the bearing screw 34 on an external thread provided for this purpose and thus secures the bearing screw 34 axially with respect to the first housing part 31 and the second housing part 32. The bearing screw 34, the metal sleeve 35 and the rubber sleeve 36 pass through a first bearing tube 31a formed on the first housing part 31 and a second bearing tube 32a formed on the second housing part 32, which are inserted into one another at the front end and thus radially support the gear wheel 9.

[0032] The gear wheel 9 comprises a first bearing sleeve 9d, which extends longitudinally along the drive axis D on the front side and on which the first torsion spring 11 and the first cable drum 13 are arranged. Furthermore, the gear wheel 9 comprises a second bearing sleeve 9e, which extends longitudinally along the drive axis D and on which the second torsion spring 12 and the second cable drum 15 are arranged, on the opposite side of a toothed disc 9f. The toothed disc 9f has a circumferential external toothing 9g, wherein the worm 6a engages in the external toothing 9g, so that the toothed discs 9f together with the first bearing sleeve 9d and the second bearing sleeve 9e can be set in rotation about the drive axis D.

[0033] The first torsion spring 11 pretensions the first cable drum 13 about the drive axle D in the winding direction and simultaneously axially in the direction towards the toothed disc 9f. Similarly, the second torsion spring 12 pretensions the second cable drum 15 around the drive axle D in the winding direction and simultaneously axially in the direction towards the toothed disc 9f. As a result, the first gear tooth ring 13b provided on the

front side of the first cable drum 13 is pretensioned onto the second gear tooth ring 9b provided on a first side of the toothed disc 9f, and the third gear tooth ring 15b provided on the front side of the second cable drum 15 is pretensioned onto the fourth gear tooth 9c provided on the opposite second side of the toothed disc 9f. The first gear tooth ring 13b and the second gear tooth ring 9b together form a first ratchet gear 44 and the third gear tooth ring 15b and the fourth gear tooth ring 9c form a second ratchet gear 45.

[0034] In order to axially space the first cable drum 13 or the second cable drum 15 from the toothed disc 9f and thus to break the coupling between the respective cable drum and the toothed disc 9f of the ratchet gear, the locking pins P1, P2 can be used. The first locking pin P1 is assigned to the first cable drum 13 and the second locking pin P2 to the second cable drum 15. The first locking pin P1 is arranged on the first housing part 31 so as to be rotatable about a first axis of rotation R1 and the second locking pin P2 is arranged on the second housing part 32 so as to be rotatable about a second axis of rotation R2. The first locking pin P1 has a first extension 40 which is arranged eccentrically to the first axis of rotation R1 and engages in a first recess 41 provided on the first cable drum 13, whereby rotation of the first locking pin P1 makes it possible to displace the first cable drum 13 axially away from the toothed disc 9f against the pretension of the first torsion spring 11. In the state shown here, however, the first cable drum 13 is engaged with its first gear tooth ring 13b with the second gear tooth ring 9b of the gear wheel 9. In contrast to this, the second locking pin P2 was turned around the second rotation axis R2 that the second extension 42 provided on the front side, which engages with the second recess 43 in the second cable drum 15, has pulled the second cable drum 15 away from the toothed disc 9f against the pretension of the second torsion spring 12. As can be seen, this causes the third gear tooth ring 15b provided on the second cable drum 15 to be spaced from the fourth gear tooth ring 9c on the toothed disc 9f, so that the second cable drum 15 is no longer coupled to the gear wheel 9 via the ratchet gear. The second cable drum 15 is thus locked in the tightened position.

[0035] Fig. 3 shows an isometric view of the activated braking device 19. In this view, the drive pinion 22 can be seen, which is in threaded engagement with the external thread 23a of the control disc 23. The control disc 23 is rotatably mounted in the second housing part 32, wherein a cam 23c concentrically arranged around the axis of rotation is formed on a first side face 23b shown here. The cam 23c has an outer radius which increases in an anticlockwise direction in a first section 23d, with the outer radius being constant in an adjacent second section 23e. The cam 23c is designed to lift the brake lever 24 off the drive shaft 6 against the pretension of the brake spring 25 and thus deactivate the braking effect. In the activated state of the braking device 19 shown here, the cam 23c exerts no pressure on the brake lever 24, so that the fork 24a acting on the drive shaft 6, which is formed on a first end 24b of the brake lever 24 opposite the cam 23c, is pretensioned radially onto the drive shaft 6 by the brake spring 25.

[0036] The cam 23c is arranged above a second end 24c located opposite the first end of the brake lever 24, wherein the brake lever 24 comprises a bearing section 24d between the fork 24a at the first end 24b and the second end 24c, on which bearing section 24d the brake lever 24 is pivotably mounted. The bearing section 24d of the brake lever 24 is designed as a semicircular elevation on the upper side of the brake lever 24 and as a semicircular recess on the underside of the brake lever 24. A bearing pin, not shown here, is arranged in the semicircular recess, which ensures the rocking-like mounting of the brake lever 24. The second end 24c is further from the bearing section 24d than the first end 24b of the brake lever 24, so that a sufficient torque can be exerted when the cam 23b rotates to lift the fork 24a off the drive shaft 6 against the pretensioning of the brake spring 25. The brake spring 25 is arranged directly above the fork 24a or the first end 24b of the brake lever 24 to provide sufficient braking force in the activated state of the braking device 19 as shown here. The parking brake 19 thus ensures that the sliding door is not moved by the force of gravity when the vehicle is parked on an incline, in either the closing or opening direction of the sliding door. However, it is still possible to open or close the sliding door manually in what is known as servo mode.

[0037] Fig. 4 shows the rear side of the activated braking device 19 shown in Fig. 3 in a side view. The second side face 23f of the control disc 23 can be seen here. It can also be seen that the braking device 19 comprises a stop device 29, the stop device 29 comprising the first stop element 26, which is fixedly attached to the second housing part 32. The stop device 29 further comprises a second stop element 27, which is formed on the second side face 23f of the control disc 23. The first stop element 26 is made of rubber and has a first stop face 26a and an opposing second stop face 26b. The second stop element 27 is rod-shaped and has a flat upper side 27a and a flat underside 27b, which run perpendicular to the second side face 23f of the control disc 23.

[0038] In the activated state of the braking device 19 shown here, the underside 27b of the second stop element 27 abuts against the first stop face 26a of the first stop element 26. Thus, the stop device 29 limits the rotation of the control disc 23 in the clockwise direction, so that further rotation of the control disc 23 in this direction via the drive pinion 22 is prevented. Conversely, when the control disc 23 is turned in the opposite direction via the drive pinion 22, it can be turned until the second stop element 27 abuts the second stop face 26b of the first stop element 26.

[0039] Furthermore, it can be seen in Fig. 4 that the brake lever 24 is mounted with its bearing section 24d in a rocking manner on a bearing pin 39, which is formed on

the second housing part 32. In the activated state of the braking device 19 shown here, the brake lever 24 is aligned parallel to the drive shaft 6, wherein the fork 24a at the first end 24b of the brake lever 24 has a smaller internal diameter than the external diameter of a braking portion 6b of the drive shaft 6, so that a braking force is applied to the drive shaft 6 under the bias of the brake spring 25. The brake section 6b is axially arranged between the worm 6a of the drive shaft 6 and the radial ball bearing 10. The outer diameter of the brake section 6b is larger than that of the worm 6a.

[0040] Fig. 5 shows an isometric view of the deactivated braking device 19. The control disc 23 was turned in a first direction of rotation, clockwise in the view shown here, by the drive pinion 22, which is in threaded engagement with the external thread 23a of the control disc 23. This also caused the cam 23c arranged on the first side face 23b of the control disc 23 to rotate accordingly, so that the first section 23d was turned over the second end 24c of the brake lever 24 and now the second section 23e of the cam 23c is in contact with the second end 24c of the brake lever 24. Accordingly, the second end 24c of the brake lever 24 was moved downwards as far as possible, so that the fork 24a at the first end 24b of the brake lever 24 was lifted off the braking section 6b of the drive shaft 6 by turning the brake lever 24 about the bearing section 24d against the bias of the brake spring 25.

[0041] As a result, there is no longer any contact between the brake lever 24 and the drive shaft 6, so that no braking force is exerted on the drive shaft 6. Because the second section 23e of the cam 23c has a constant outer radius, no torque is exerted on the cam 23c or the control disc 23 by the second end 24c of the brake lever 24. The position of the control disc 23 is thus advantageously stable in the event of a power failure of the brake motor 20.

[0042] Fig. 6 shows the rear side of the activated braking device 19 shown in Fig. 5 in a side view. By rotating the control disc 23 by means of the drive pinion 22, the second stop element 27 of the stop device 29 provided on the second side face 23f was turned anticlockwise, so that the upper side 27a of the second stop element 27 now rests against the second stop face 26b of the first stop element 26, which is fixed to the second housing part 32, and prevents a further rotation of the control disc 23. The brake motor 20 comprises an electronic control unit which detects the increased electrical current after the second stop element 27 abuts against the first stop element 26 and subsequently switches off the brake motor 20. The advantage is that no elaborate sensor device is required, which reduces the cost of the braking device 19.

[0043] As already shown in Fig. 5, the brake lever 24 is tilted in relation to the drive shaft 6 about the bearing pin 39, so that the fork 24a provided at the first end 24b is held away from the braking portion 6b of the drive shaft 6 against the bias of the brake spring 25. It is now advantageous to be able to move the vehicle door slightly by hand, which is particularly necessary in an accident situation to ensure that the vehicle can be exited.

Claims

1. Actuating drive (1), in particular for a sliding door of a motor vehicle, comprising

   a housing (30),
   a motor (2),
   a gear wheel (9) with a toothed disc (9f) driven by the motor (2) to rotate about a drive axis (D) and having a first bearing sleeve (9d), and
   at least one first cable drum (13) mounted on the first bearing sleeve (9d) for guiding a first traction element (14),

   characterised in that the cable drum (13) and the gear wheel (9) are coupled to one another via a first ratchet gear (44), wherein the first ratchet gear (44) is adapted to drive the first cable drum (13) upon rotation of the gear wheel (9) about the drive axis (D) in the winding direction of the first cable drum (13) and to allow the first cable drum (13) to rotate about the driving axis (D) in the unwinding direction relative to the gear wheel (9).

2. Actuating drive (1) according to claim 1, **characterised in that** the first cable drum (13) is pretensioned relative to the gear wheel (9) by means of a first pretensioning element (11) in the winding direction of the first cable drum (13).

3. Actuating drive (1) according to claim 1 or 2, **characterised in that** the first ratchet gear (44) comprises a first gear tooth ring (13b) and a second gear tooth ring (9b) releasably in engagement with the first gear tooth ring (13b).

4. Actuating drive (1) according to claim 3, **characterised in that** the first gear tooth ring (13b) is arranged on an end face of the first cable drum (13) perpendicular to the drive axis (D) and the second gear tooth ring (9b) is arranged on an end face of the toothed disc (9f) facing the first cable drum (13).

5. Actuating drive (1) according to one of claims 2 to 4, **characterised in that** the first pretensioning element (11) pretensions the first cable drum (13) axially in the direction towards the toothed disc (9f) of the gear wheel (9).

6. Actuating drive (1) according to one of the preceding claims, **characterised in that** the gear wheel (9) has a second bearing sleeve (9e) opposite the first bearing sleeve (9d), with a second cable drum (15) being arranged on said second bearing sleeve (9e), where-

in a second ratchet gear (45) is arranged between the second cable drum (15) and the gear wheel (9), which is adapted to drive the second cable drum (15) upon rotation of the gear wheel (9) about the drive axis (D) in the winding direction of the second cable drum (15) and to allow the second cable drum (15) to rotate about the driving axis (D) in the unwinding direction relative to the gear wheel (9).

7. Actuating drive (1) according to claim 6, **characterised in that** the winding direction of the first cable drum (13) is opposite to the winding direction of the second cable drum (15).

8. Actuating drive (1) according to claim 6 or 7, **characterised in that** the second cable drum (15) is pretensioned relative to the gear wheel (9) by means of a second pretensioning element (12) in the winding direction of the second cable drum (15).

9. Actuating drive (1) according to one of claims 6 to 8, **characterised in that** the second ratchet gear (45) comprises a third gear tooth ring (15b) and a fourth gear tooth ring (9c) releasably in engagement with the third gear tooth ring (15b).

10. Actuating drive (1) according to claim 9, **characterised in that** the second gear tooth ring (15b) is arranged on an end face of the second cable drum (15) perpendicular to the drive axis (D) and the fourth gear tooth ring (9c) is arranged on an end face of the toothed disc (9f) facing the second cable drum (15).

11. Actuating drive (1) according to one of claims 6 to 10, **characterised in that** the second pretensioning element (12) pretensions the second cable drum (15) axially in the direction towards the toothed disc (9f) of the gear wheel (9).

12. Actuating drive (1) according to one of the preceding claims, **characterised in that** the first cable drum (13) can be displaced axially with respect to the toothed disc (9f) of the gear wheel (9) via a first locking pin (P1), the first ratchet gear (44) between the first cable drum (13) and the gear wheel (9) being adjustable between a coupling position and an uncoupling position as a result.

13. Actuating drive (1) according to claim 12, **characterised in that** the first locking pin (P1) is arranged on the housing (30) so as to be rotatable about a first axis of rotation (R1) perpendicular to the drive axis (D), wherein the first locking pin (P1) has a first extension (40) which is arranged eccentrically to the first axis of rotation (R1) and engages in a first recess (41) provided on the first cable drum (13).

14. Actuating drive (1) according to one of the preceding claims, wherein the housing (30) is connected to the vehicle body by means of an elastic flange (37), wherein the elastic flange (37) is connected to the housing (30) by means of a bearing screw (34), which extends through the housing (30) concentrically to the drive axle (D).

15. Actuating drive (1), in particular for a sliding door of a motor vehicle, comprising

a housing (30),
a motor (2) having an output shaft (3) which is connected to a drive shaft (6),
a gear wheel (9) with a toothed disc (9f) driven by drive shaft (6) to rotate about a drive axis (D) and having a first bearing sleeve (9d),
at least one first cable drum (13) mounted on the first bearing sleeve (9d) for guiding a first traction element (14), and
a braking device (19) comprising a brake lever (24) having a first end (24b) with a brake element (24a) and a second end (24c) for braking the gear wheel (9),

characterised in that the brake element (24a) is moveable from a braking section (6a) of the drive shaft (6) via a control disc (23) against the pretension of a brake spring (25), wherein the control disc is rotatably driven by a brake motor (20).

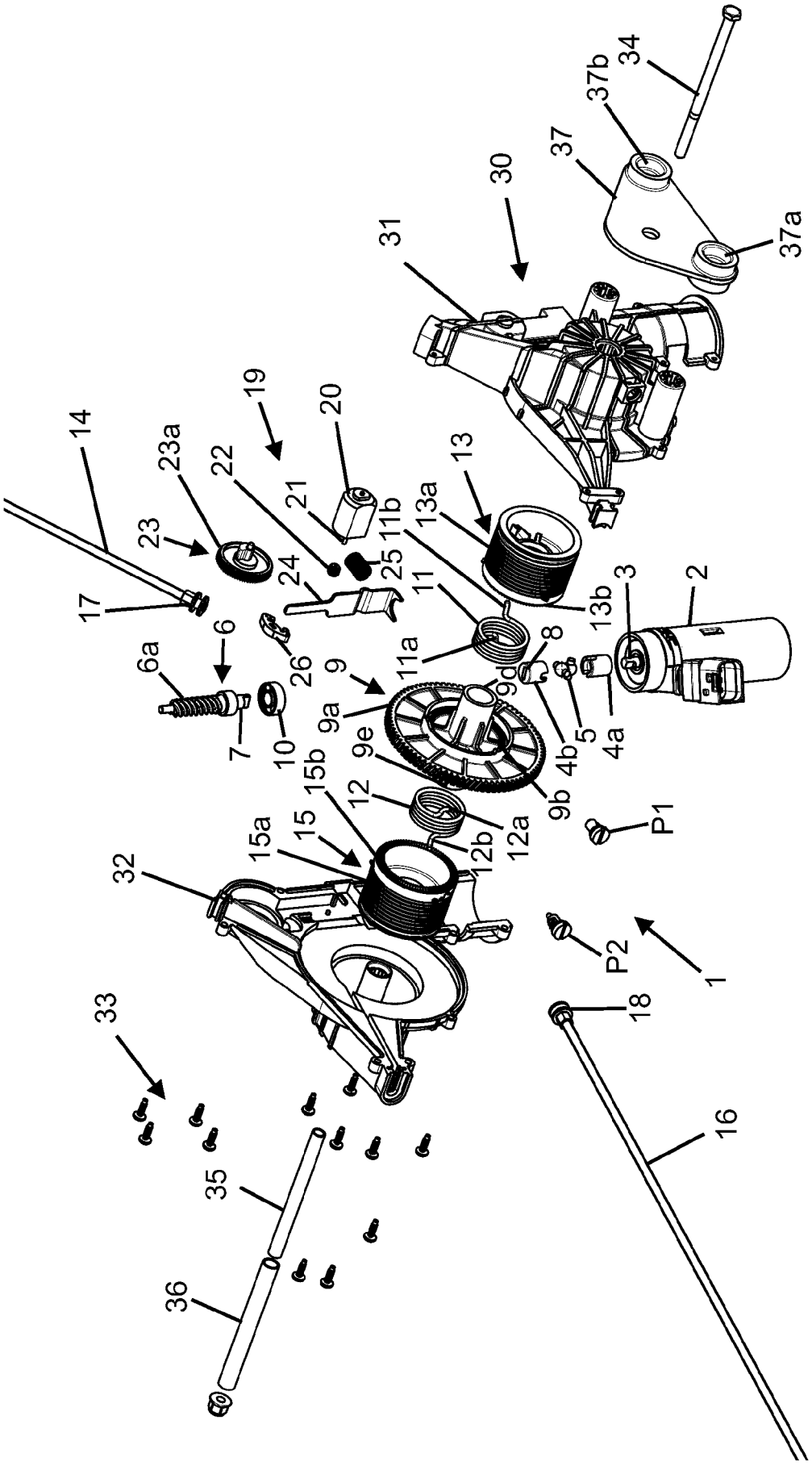

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23a
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19
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11b
13a
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24
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13b
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17
6
26
9
11a
8
6a
9d
9a
9e
4b
5
4a
7
10
15b
12
9b
P1
15a
15
12b
12a
32
P2
1
33
18
16
35
36
31
30
37
37b
34
37a

Fig. 1

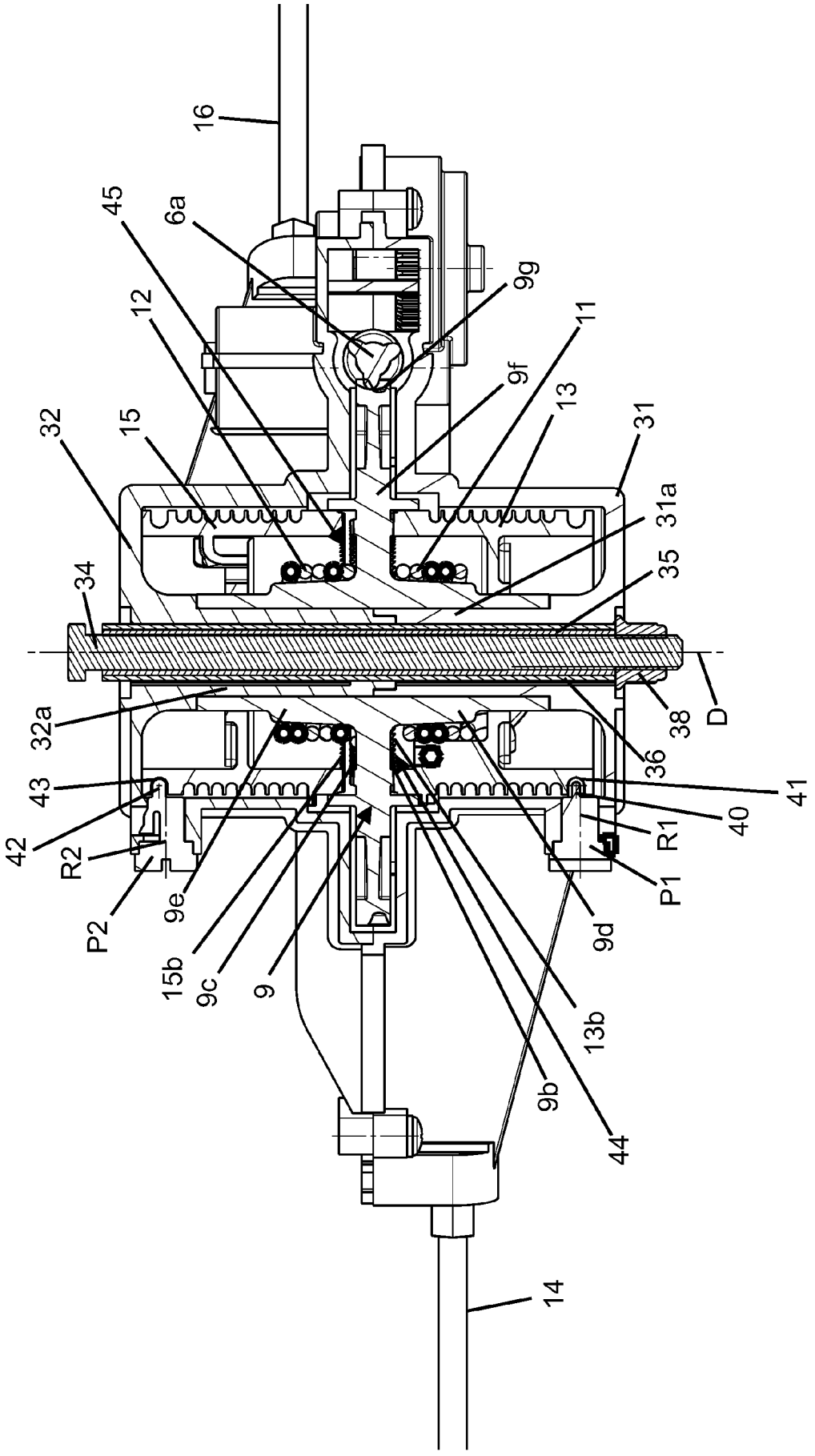

16
45
6a
12
9g
11
9f
13
31
32
15
31a
35
34
32a
38
D
36
43
41
42
40
R2
R1
P2
9e
P1
15b
9c
9
9d
13b
9b
44
14

Fig. 2

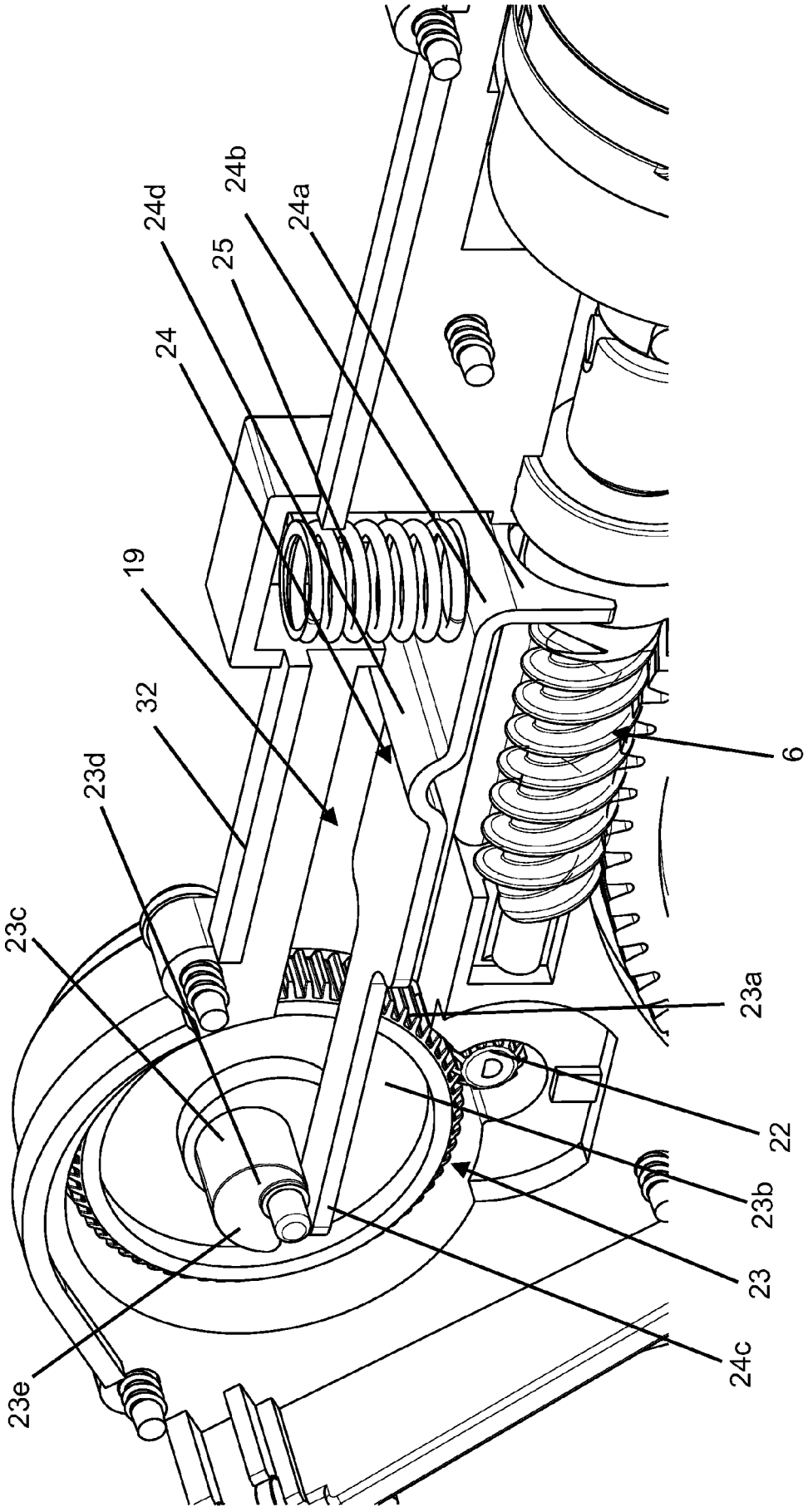


Fig. 3

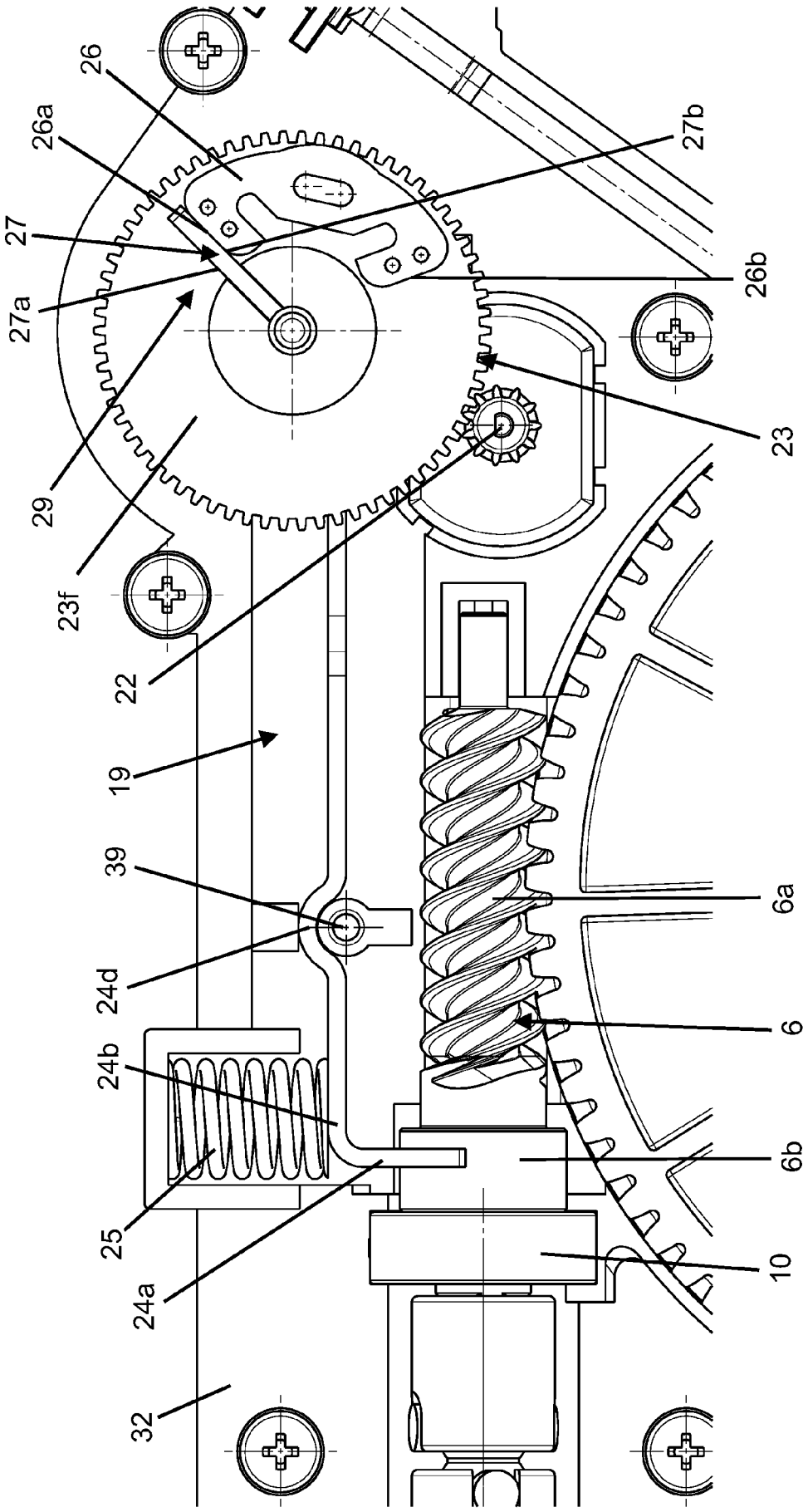


Fig. 4

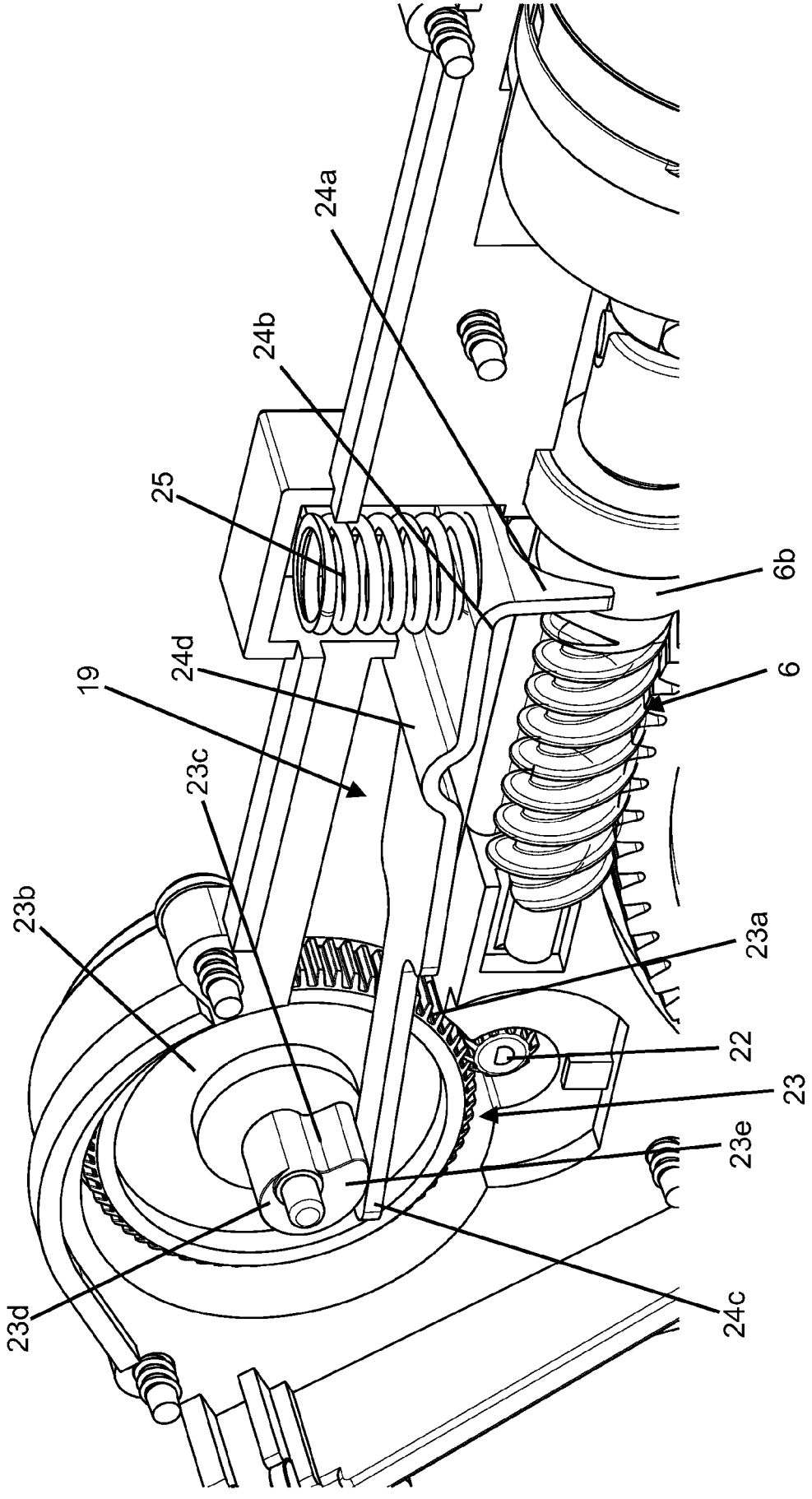


Fig. 5

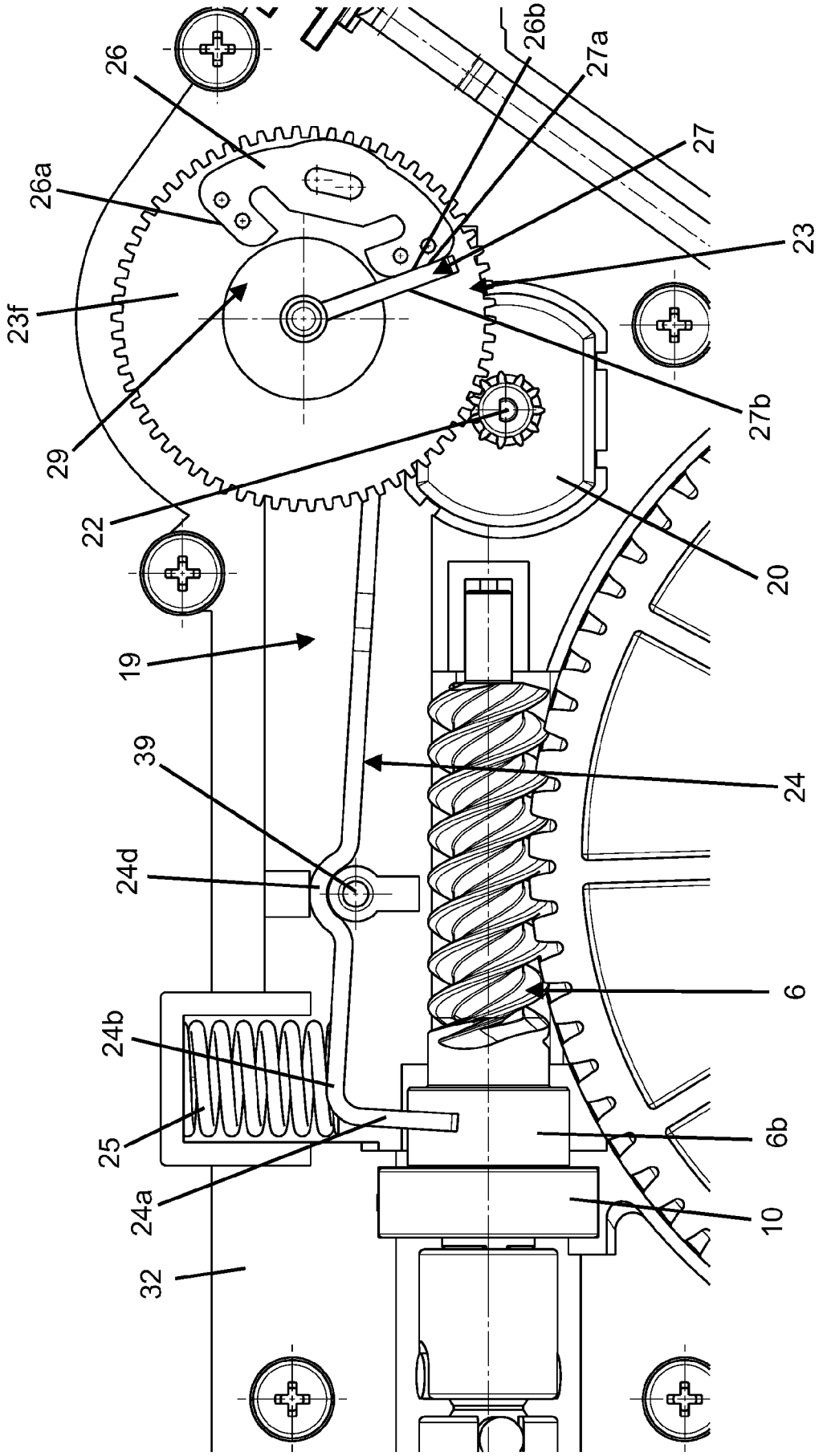

26
26b
27a
26a
27
23
23f
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27b
22
20
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39
24
24d
6
24b
25
6b
24a
10
32

Fig. 6

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EUROPEAN SEARCH REPORT

Application Number
EP 25 16 8045

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	8 December 2025	Viethen, Lorenz

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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L : document cited for other reasons

& : member of the same patent family, corresponding document

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EUROPEAN SEARCH REPORT

Application Number
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	8 December 2025	Viethen, Lorenz

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Application Number
EP 25 16 8045

CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing claims for which payment was due.

☐ Only part of the claims have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due and for those claims for which claims fees have been paid, namely claim(s):

☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due.

LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

see sheet B

☒ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.

☐ As all searchable claims could be searched without effort justifying an additional fee, the Search Division did not invite payment of any additional fee.

☐ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:

☐ None of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims, namely claims:

☐ The present supplementary European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims (Rule 164 (1) EPC).

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LACK OF UNITY OF INVENTION
SHEET B

Application Number
EP 25 16 8045

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

1. claims: 1-14

   Actuating drive with ratchet gear for tensioning
   ---

2. claim: 15

   Actuating drive with brake

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 25 16 8045

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08-12-2025

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