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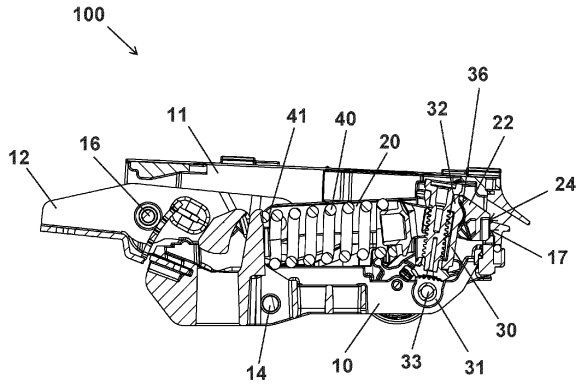
(54) TILT MECHANISM FOR A CHAIR

(57) A tilt mechanism for a chair comprises a base (10), a back support (12) configured to support a chair back (104), a seat support (11) configured to support a chair seat (103), a first link element (30), a second link element (20), a spring element (40), and a forward sitting adjustment element (50). A first end (31) of the first link element (30) is pivotably coupled to the base (10). A first end (21) of the second link element (20) is pivotably coupled to the back support (12) and a second end (22) of the second link element (20) is coupled to a second end (32) of the first link element (30). A first end (41) of the spring element (40) is mounted at the base (10) and a second end (42) of the spring element (40) is urging against the first link element (30) at an adjustable position between the first end (31) and the second end (32) of the first link element (30). The forward sitting adjustment element (50) is movable between a first position and a second position. When the forward sitting adjustment element (50) is in the first position, a distance piece (51, 52) of the forward sitting adjustment element (50) is arranged between a stop surface (24) of the second end (22) of the second link element (20) and a stop surface (17) of the base (10) thus keeping a predefined minimum distance (18) between the stop surface (24) of the second end (22) of the second link element (20) and the stop surface (17) of the base (10). When the forward sitting adjustment element (50) is in the second position, the distance piece (51, 52) of the forward sitting adjustment element (50) is not arranged between the stop surface (24) of the second end (22) of the second link element (20) and the stop surface (17) of the base (10) thus allowing the stop surface (24) of the second end (22) of the second link element (20) to contact the stop surface (17) of the base (10).

Fig. 10



EP 4 335 324 A1

Description

FIELD OF THE INVENTION

[0001] The present invention relates to a tilt mechanism for a chair. In particular, the present invention relates to a tilt mechanism for a chair having a chair seat and a chair back, wherein the tilt mechanism allows the chair seat to be displaced and the chair back to be inclined in a coordinated manner. The present invention relates furthermore to a chair comprising the tilt mechanism.

BACKGROUND OF THE INVENTION

[0002] Common adjustments for chairs, in particular office-type chairs, include a height adjustment of the chair seat, an adjustment of an inclination of the chair seat and the chair back as well as an arrangement of the chair seat with respect to the chair back. These chair adjustments allow users to change their sitting position in the chair as desired, such that fatigue may be minimized during long sitting periods.

[0003] Chair configurations may implement a feature which allows a chair back and a chair seat to move simultaneously during a tilting or rearward inclining motion of the chair back. The chair seat may also tilt in this motion or may be displaced otherwise relative to the chair base or chair back. The combined movement of the chair back and the chair seat may simplify chair adjustment.

[0004] For example, when the user leans back against the chair back and tilts the chair back and the chair seat rearward, a spring mechanism may be tensioned to urge the chair back and the chair seat forwardly in the initial position. The force with which the spring mechanism urges the chair back and the chair seat in the forward direction may be adjustable, e.g. to take into account the users weight. Adjusting this force may be burdensome, in particular when the mechanism for adjusting this force varies a bias of the spring mechanism which may be very high. For example, a screw based rotating mechanism may be used that moves one end of a spring of the spring mechanism in the longitudinal direction of the spring, i.e. in the direction of the spring force. Due to the large spring force, a large number of turns may be required to cover the full range of adjustment, for example 20 or more turns may be required, and still a large torque may be required for turning.

[0005] Furthermore, it has been found that tilting the chair seat in the forward direction, i.e. in a position where a rear section of the seat is higher than a front section of the seat with respect to ground, may be advantageous to minimize fatigue during long sitting periods. However, an easy and reliable way of resetting the chair seat in the initial horizontal position may be required in any situation.

[0006] Finally, a compact, reliable and cost-effective design of the mechanics providing the above discussed features may be required.

BRIEF SUMMARY OF THE INVENTION

[0007] There is a need in the art for a chair tilt mechanism and a chair which address some of the above requirements. In particular, there is a need in the art for a chair tilt mechanism which is a simple and reliable construction and which provides easy adaption to different chair requirements.

[0008] According to the present invention, these needs are met by a tilt mechanism for a chair and a corresponding chair as defined in the independent claims. The dependent claims define embodiments.

[0009] According to an embodiment, a tilt mechanism for a chair is provided. The tilt mechanism is configured to affect a coordinated movement of a chair seat and chair back. The tilt mechanism comprises a base, a back support, a seat support, a first link element, a second link element, a spring element and a forward sitting adjustment element. The base may be considered as a frame for supporting the remaining components. The base may be coupled to a chair base assembly which includes a pedestal column and a number of support legs for placing the chair on the ground. The back support is configured to support the chair back and is pivotably coupled to the base. The seat support is configured to support the chair seat and is pivotably coupled to the back support. The pivot axis with which the back support is coupled to the base may be different from the pivot axis coupling the seat support and the back support. As a result, the chair seat may be tilted with respect to the chair back in a coordinated manner. The first link element, the second link element and the spring element constitute a mechanism to provide an adjustable restoring force that acts on the back support and thus indirectly on the seat support. For this, a first end of the first link element is pivotably coupled to the base, and a first end of the second link element is pivotably coupled to the back support. A second end of the second link element is coupled to a second end of the first link element. A first end of the spring element is mounted at the base and a second end of the spring element is mounted at the first link element so that the spring element urges against the first link element at an adjustable position between the first end and the second end of the first link element. As a result, upon tilting the back support, the second link element may pivot the first link element, which urges against the spring element. As the position of contact between the spring element and the first link element is adjustable, a length of a lever arm acting on the spring element is adjustable such that the restoring force varies. For repositioning the second end of the spring element along the first link element between the first and second ends of the first link element, a relatively small force is required, so that adjusting the restoring force can be performed with a small amount of force, i.e. easily and quickly by a user.

[0010] Furthermore, the tilt mechanism comprises a forward sitting adjustment element which is movable between a first position and a second position. When the

forward sitting adjustment element is in the first position, a distance piece of the forward sitting adjustment element is arranged between a stop surface of the second end of the second link element and a stop surface of the base thus keeping a predefined minimum distance between the stop surface of the second end of the second link element and the stop surface of the base. When the forward sitting adjustment element is in the second position, the distance piece of the forward sitting adjustment element is not arranged between the stop surface of the second end of the second link element and the stop surface of the base thus allowing the stop surface of the second end of the second link element to move into contact with the stop surface of the base. By varying the stop position of the second link element with respect to the base, a forward tilting of the seat support can be easily and quickly enabled or disabled. Changing the seating position between a substantially horizontal arrangement of the chair seat and a forward tilted arrangement of the chair seat can be ergonomically advantageous. As this forward tilting functionality uses the second link element, additional efforts with regard to cost and space requirements may be low. Furthermore, as the second link element is pre-tensioned via the first link element by the spring element, a restoring force is provided in both positions, the forward tilted position and the not forward tilted position, i.e. the initial horizontal position.

[0011] According to various examples, the tilt mechanism may be configured as follows. When the back support is moved from a first position, in which the chair back is in an essentially upright position, to a second position, in which the chair back is in a rearward inclined position, the seat support is tilted in a rearward inclined position also. This coordinated movement may be provided by the coupling between the seat support and the back support. The first and second link elements effect that the spring element is compressed when moving from the first position to the second position. Thus a restoring force is generated that urges the back support into the first position.

[0012] The position at which the second end of the spring element urges against the first link element is adjustable. For example, adjusting this position may vary the active length of the first link element acting on the spring element when the back support is moved between the first position and the second position. Thus, the restoring force urging the back support into the first position may be varied. As a result, the restoring force can be adapted without varying the preload of the spring element. Varying the preload of the spring element usually requires a large amount of force or work by the user. This may be avoided by merely repositioning the second end of the spring element with respect to the first link element.

[0013] In further examples, the tilt mechanism may be configured such that, in the essentially upright position of the chair back, a length of the spring element depends on the adjustable position at which the second end of the spring element is urging against the first link element. For example, when the second end of the spring element is closer to the second end of the first link element, the length of the spring element may be longer than the length of the spring element when the second end of the spring element is closer to the first end of the first link element. As a result, adjustment in one direction, for example from the first end to the second end of the the first link element, may require less force or torque exerted by the user than adjustment in the opposite direction, for example from the second end to the first end the first link element. A feedback to the user whether the restoring force is enlarged or lowered, may be provided. However, the preload of the spring element is changed only slightly while the active length of the first connecting element is varied, so the force or torque required for adjustment can be moderate compared to simply varying the preload of the spring element.

[0014] For example, a section of the base, a section of the first link element and the spring element may be arranged in a triangle. Vertices of this triangle may be defined by a first pivot axis where the first end of the first link element is pivotably coupled to the base, a mounting point where the first end of the spring element is mounted at the base, and an urging point which is the adjustable position where the second end of the spring element is urging against the first link element. A geometry of this triangle depends on the adjustable position. The tension adjustment thus changes the geometry and also the preload on the spring.

[0015] According to an embodiment, for adjusting the position of coupling between the spring element and the first link element, the tilt mechanism may comprise a threaded bolt engaged with a screw nut. The screw nut is fixed to the second end of the spring element. The threaded bolt may be mounted at the first link element. Upon rotating the threaded bolt, the position between the first end and the second end of the first link element, at which the second end of the spring element urges against the first link element, is adjusted. For example, the threaded bolt may be driven by a user handle via a bevel gear arrangement. The threaded bolt and the bevel gear arrangement may be configured such that the screw nut is moved from the first end to the second end of the first link element or vice versa with a few turns of the user handle, for example with 4 to 6 turns. The restoring force of the chair back can be adjusted quickly and precisely with little effort.

[0016] Furthermore, the tilt mechanism may comprise a detent wheel coupled to the threaded bolt such that the detent wheel rotates together with the threaded bolt. The detent wheel is provided with a plurality of detent forms. The tilt mechanism may comprise at least one detent member that mates with the detent forms. The detent member is in engagement with the detent wheel. The detent member may be attached to the first link element. The detent member may resiliently engage a detent form of the detent wheel so that the detent wheel is held in detent steps without blocking rotation of the detent wheel.

The detent wheel in combination with the detent member may provide feedback to the user while adjusting the restoring force and may further contribute to avoid an inadvertent adjustment due to the restoring force of the spring element. A plurality of detent members may be provided, for example two detent members arranged at opposite positions with respect to a circumference of the detent wheel. The two or more detent members arranged at equally spaced positions around the circumference of the detent wheel may contribute to align, hold and center the detent wheel.

[0017] According to various examples, the tilt mechanism may be configured such that, when the forward sitting adjustment element is in the first position and the stop surface of the second end of the second link element contacts the distance piece of the forward sitting adjustment element, the back support and the seat support are arranged in a first arrangement. When the forward sitting adjustment element is in the second position and the stop surface of the second end of the second link element contacts the stop surface of the base, the back support and the seat support are arranged in a second arrangement. In the second arrangement the seat support is inclined or tilted in the forward direction with respect to the second arrangement. In the first arrangement, the seat support is arranged essentially in a non-inclined arrangement, e.g. in an essentially horizontal position. In the second arrangement, the seat support is arranged in a forward-inclined arrangement, for example tilted at least 3 or 4 degrees in the forward direction with respect to the first arrangement. Inclining the seat support in the forward direction means that the front section of the seat support is lower than the rear section of the seat support. As merely the stop position of the second link element is varied when the forward sitting is activated or deactivated, the adjustment of the restoring force for the back support is essentially not affected.

[0018] For example, in the first position of the forward sitting adjustment element, the spring element may urge, via the first link element, the stop surface of the second end of the second link element into contact with the distance piece of the forward sitting adjustment element. The forward sitting is deactivated. In the second position of the forward sitting adjustment element, the spring element may urge, via the first link element, the stop surface of the second end of the second link element into contact with the stop surface of the base. The forward sitting is activated. In both situations, when the forward sitting is activated or deactivated, the seat support takes a defined position when the chair and thus the tilt mechanism is unloaded, either the forward tilted position or the not forward tilted essentially horizontal position. However, although the spring element causes the seat support to take a defined position, the adjustment of the restoring force for the back support is not affected and therefore adjustable independent from the activation or deactivation of the forward sitting.

[0019] According to another aspect of the present invention, a chair is provided. The chair comprises a chair base assembly, a chair seat, a chair back, and a tilt mechanism as described above. The base of the tilt mechanism is attached to the chair base assembly, the chair seat is attached to the seat support of the tilt mechanism, and the chair back is attached to the back support of the tilt mechanism.

[0020] The tilt mechanism and the chair according to embodiments may be utilized for various applications in which a coordinated tilting motion of the chair back and the chair seat is desired. For example, the chair tilt mechanism may be utilized in an office chair.

BRIEF DESCRIPTION OF THE DRAWINGS

[0021] Embodiments of the invention will be described with reference to the accompanying drawings.

Fig. 1 is a schematic isometric view of a chair having a tilt mechanism according to an embodiment.

Fig. 2 is a schematic side view of the chair of Fig. 1 in a non-tilted position.

Fig. 3 is a schematic side view of the chair of Fig. 1 in a rearward tilted position.

Fig. 4 is a schematic side view of the chair of Fig. 1 in a forward tilted position.

Fig. 5 is a schematic isometric view of a top side of a tilt mechanism according to an embodiment.

Fig. 6 is a schematic isometric view of a bottom side of the tilt mechanism of Fig. 5.

Fig. 7 is a schematic isometric sectional view of the tilt mechanism of Fig 5.

Fig. 8 is a schematic cross-sectional side view of the tilt mechanism of Fig. 5 in a non-tilted position.

Fig. 9 is a schematic cross-sectional side view of the tilt mechanism of Fig. 5 in a rearward tilted position.

Fig. 10 is a schematic cross-sectional side view of the tilt mechanism of Fig. 5 in a forward tilted position.

Fig. 11 is a schematic partial side cross-sectional view of the tilt mechanism of Fig. 5 with a tension mechanism in a first setting.

Fig. 12 is a schematic partial side cross-sectional view of the tilt mechanism of Fig. 5 with the tension mechanism in a second setting.

Fig. 13 is a schematic isometric sectional view of the tilt mechanism of Fig. 5 showing details of a detent

mechanism of the tension mechanism.

Fig. 14 is a schematic side view of the tilt mechanism of Fig. 5 in a non-tilted position.

Fig. 15 is a schematic cross-sectional side view of the tilt mechanism of Fig. 5 in a forward tilted position.

Fig. 16 is a schematic isometric view of a front side of the tilt mechanism of Fig. 5 in a non-tilted position with a forward sitting adjustment element in a first position.

Fig. 17 is a schematic isometric view of a front side of the tilt mechanism of Fig. 5 in a forward tilted position with the forward sitting adjustment element in a second position.

Fig. 18 is a schematic cross-sectional side view of the tilt mechanism of Fig. 5 in a non-tilted position with the forward sitting adjustment element in a first position.

Fig. 19 is a schematic cross-sectional side view of the tilt mechanism of Fig. 5 in a forward tilted position with the forward sitting adjustment element in a second position.

Fig. 20 is a schematic partial isometric sectional view of the tilt mechanism of Fig. 5 in a non-tilted position with the forward sitting adjustment element in a first position.

Fig. 21 is a schematic partial isometric sectional view of the tilt mechanism of Fig. 5 in a forward tilted position with the forward sitting adjustment element in a second position.

DETAILED DESCRIPTION OF EMBODIMENTS

[0022] Exemplary embodiments of the invention will be described with reference to the drawings. While some embodiments will be described in the context of specific fields of application, such as in the context of an office type chair, the embodiments are not limited to this field of application. The features of the various embodiments may be combined with each other unless specifically noted otherwise. Same reference signs in the various drawings refer to similar or identical components.

[0023] Figs. 1 to 4 show a chair 101 which includes a tilt mechanism 100 of an embodiment. The chair 101 is illustrated to be an office-type chair having a chair base assembly 102 and a superstructure. The superstructure includes a chair seat 103, a chair back 104 and components to interconnect the seat 103 with the chair back 104. The components which will be described in more detail below, include the tilt mechanism 100 for effecting a coordinated motion of the chair back 104 and the chair seat 103. The base assembly 102 includes a pedestal column 107, a number of support legs 105 extending radially from the column 107 and a corresponding number of casters 106 supported on the outer ends of the support legs 105. Additionally, a gas cylinder or any other lifting mechanism 108 may be supported by the column 107 to enable the height of the seat 103, and thus of the chair superstructure, to be adjusted by a user.

[0024] It is to be understood that the terms "front", "rear", "left", "right", "top" and "bottom", as used herein, each have a particular meaning that is defined in relation to a flat support surface beneath the chair, for example in relation to a floor on which the chair rests and in relation to a user sitting in a usual seated position on the chair. For example, the term "front" refers to a side of the chair seat at which the knees of the user are arranged and the legs are suspending, whereas the term "rear" refers to a side of the chair seat where the back of the user and the chair back are arranged. The term "left" refers to the left hand side of the chair seat as seen from the user sitting on the chair, and the term "right" refers to the right hand side of the chair seat as seen from the user sitting on the chair. The term "bottom" refers to the side facing to the flat support surface beneath the chair, and the term "top" refers to the side facing away from the flat support surface beneath the chair. It may be assumed that the resulting directions front-rear, left-right and top-bottom represent the axes of a three dimensional Cartesian coordinate system, usually named X-axis, Y-axis and Z-axis, respectively, which are orthogonal to each other. The front-rear and the left-right directions may extend in the plane of the flat support surface and the top-bottom direction may extend in a direction perpendicular to the flat support surface.

[0025] It is to be understood that the terms "forward", "rearward" and "lateral(ly)" as used herein, also each have a particular meaning that is defined in relation to a flat support surface beneath the chair and in relation to a user of the chair. For example, the term "forward" refers to a direction moving away from the chair back and in front of a chair user along an axis which extends parallel to such a flat support surface, while the term "rearward" refers to a direction opposite to the forward direction. The term "lateral" refers to a generally horizontal direction perpendicular to both the forward and rearward direction and extending parallel to the aforementioned flat support surface. For example, terms like "to the left" and "to the right" are lateral directions as seen from a user sitting on the chair.

[0026] Tilting or inclining in the forward direction, for example tilting the chair seat such that the front side of the chair seat moves down and/or the rear side of the chair seat moves up may be considered as a rotation around an axis of rotation which extends in the left-right direction. Tilting or inclining in the rearward direction may be considered as an opposite motion to the tilting or inclining in the forward direction. For example tilting the chair back such in the rearward direction may mean that

an upper part of the chair back moves to the rear with respect to the lower part of the chair back.

[0027] Furthermore, it is to be understood that the chair seat, in particular when being tilted, does not extend exactly and only in the front-rear and left-right directions. However, it is clear to a person skilled in the art, that also in this tilted condition, the chair seat essentially extends in the front-rear and the left-right directions. Likewise, it is to be understood that the chair back does not extend exactly and only in the left-right and up-down directions, in particular when being tilted or inclined, but essentially extends in these directions.

[0028] The chair 101 includes the tilt mechanism 100, and generally the tilt mechanism 100 is operated to cause coordinated movement of the chair seat 103 and the chair back 104 when the chair back 104 is tilted. Fig. 2 shows the chair 101 in a non-tilted home position, in which the chair seat 103 is oriented substantially horizontally, in particular, in the front-rear direction. For example, the chair 101 may automatically assume this position when it is unloaded, i.e., when no user is sitting on the chair. Fig. 3 shows a rearward tilted position of the chair 101. This position may be assumed, for example, when a user sits on the chair and leans rearward, causing the chair back 104 to tilt rearward. Because of the tilt mechanism 100, there is a coordinated movement between the chair back 104 and the chair seat 103. As a result, the seat surface of the chair seat 103 is also tilted rearward, i.e., the rear side of the seat surface is lower than the front side. A spring mechanism, which will be described in detail below, is tensioned by the reclining action so that the chair 101 can automatically return to the home position shown in Fig. 2 when the user stops pushing the chair back 104 rearward. Any intermediate positions between the home position shown in Fig. 2 and the rearward tilted position shown in Fig. 3 may be assumed. Also, a locking mechanism may be provided which enables a locking in any position between the home position and the rearward tilted position thus holding the chair 101 in a corresponding intermediate position even when the user is no longer applying a load to the chair back 104. However, when the locking mechanism is unlocked, the chair 101 may assume the home position again.

[0029] The tilt mechanism 100 includes a further device, which will be referred to hereinafter as a forward sitting device, FSD. The FSD allows the chair 101 to be adjusted to a further home position, namely a forward tilted position. This position is shown in Fig. 4. In this forward tilted position, the seat surface of the chair seat 103 is tilted forward, i.e., the front portion of the seat surface is lower than the rear portion of the seat surface. Due to the coordinated movement between the chair back 104 and the chair seat 103, the chair back 104 assumes a steeper position compared to the home position shown in Fig. 2. For example, as shown in Fig. 4, the chair back 104 is nearly vertical. An adjustment of the FSD via, for example via a control element or handle, allows the chair 101 to selectively assume the non-tilted position shown in Fig. 2 or the forward tilted position shown in Fig. 4 as home position which is automatically assumed when the user no longer pushes the chair back 104 rearward.

[0030] As in particular illustrated in Figs. 2 to 4, the tilt mechanism 100 includes a base 10. In the installed state of the tilt mechanism 100 in which the tilt mechanism 100 is incorporated into the chair 101, the base 10 is coupled to the pedestal column 107 via the lifting mechanism 108. The tilt mechanism 100 includes a seat support 11 which, in the installed state of the tilt mechanism 100, is coupled to the chair seat 103 and supports the chair seat 103 at a lower side thereof. The seat support 11 is connected to the base 10. The seat support 11 may be mounted to the base 10 such that it is displaceable with respect to the base 10 in a front-rear direction and/or pivotmounted around a lateral axis. The chair seat 103 may be fixedly coupled to the seat support 11, such that a translational or rotational motion of the seat support 11 causes the seat 103 to move jointly with the seat support 11 in a translational or rotational manner. The tilt mechanism 100 includes a back support 12 which, in the installed state of the tilt mechanism 100, is coupled to the chair back 104. The chair back 104 may be attached to the back support 12 using a suitable connecting member 109, such as a bar or bridge fixed to the back support 12. The connecting member 109 may be directly and rigidly attached to the back support 12.

[0031] The tilt mechanism 100 is configured such that the back support 12 is pivotably coupled to the base 10, allowing the back support 12 to pivot relatively to the base 10. As can be seen for example in Figs. 5, 6 and 8, the back support 12 may be coupled to the base 10 via a pivot 14. The seat support 11 is pivotably coupled to the back support 12. As illustrated for example in Fig. 6, the seat support 11 may be coupled to the base 10 via a slidable pivot 15.

[0032] As illustrated for example in Figs. 7 and 8, a first link element 30 and a second link element 20 are provided for tensioning a spring element 40. Furthermore, the second link element 20 defines a stop for the home position of the chair 101 as will be described below in connection with the FSD.

[0033] A first end 31 of the first link element 30 is pivotably coupled to the base 10, for example via pivot 33. A first end 21 of the second link element is pivotably coupled to the back support 12, for example via the pivot 23. The second link element 20 may have a U-shape with the legs extending in the front-rear direction and the base extending in the lateral direction. In the Fig. 7, only one leg of the U-shape is visible and the base of the U-shape forms a second end 22 of the second link element 20. The second end 22 of the second link element 20 is coupled to a second end 32 of the first link element 30. As illustrated in Figs. 7 and 8, the second end 22 of the second link element 20 may be coupled to the second end 32 of the first link element 30 via a curved contact and glide surface 36. Upon tilting the back support 12 in

the rearward direction with respect to the base 10, the second link 20 element is essentially moved in the rear direction with respect to the base 10 and the first end 22 of the second link element 20 urges the second end 32 of the first link element 30 such that the first link element 30 is turned around pivot 33. For example and as illustrated in Fig. 7, the second link element 20 may extend from the first end 21 to the second end 22 in essentially the front-rear direction, whereas the first link element 30 may extend from the first end 31 to the second end 32 in essentially the up-down direction. In other words, the angled arrangement of the first link element 30 with respect to the second link element 20 causes a translational movement of the second link element 20 to be translated into a rotational movement of the first link element 30.

[0034] The tilt mechanism comprises a tension mechanism comprising a spring element 40. The spring element 40 may comprise for example one or more spiral springs. A first end 41 of the spring element 40 is mounted at the base 10 and a second end 42 of the spring element 40 is urging against the first link element 30 at an adjustable position between the first end 31 and the second end 32 of the first link element 30. A mechanism for adjusting the position where the spring element 40 urges against the first link element 30 will be described in more detail in connection with Figs. 8 to 13.

[0035] As mentioned above, the tilting mechanism comprises the FSD. As will be described in more detail in connection with Figs. 14 to 21, the FSD comprises a forward sitting adjustment element 50 which is movable between a first position as shown in Fig. 16 and a second position as shown in Fig. 17. The forward sitting adjustment element 50 comprises one or more distance pieces. In the illustrated example, the forward sitting adjustment element 50 comprises two distance pieces 51 and 52. When the forward sitting adjustment element 50 is in the first position, the distance pieces 51 and 52 are arranged between a stop surface 24 of the second end 22 of the second link element 20 and a stop surface 17 of the base 10 thus keeping a predefined minimum distance between the stop surface 24 of the second end 22 of the second link element 20 and the stop surface 17 of the base 10. When the forward sitting adjustment element 50 is in the second position, the distance pieces 51, 52 of the forward sitting adjustment element 50 are not arranged between the stop surface 24 of the second end 22 of the second link element 20 and the stop surface 17 of the base 10 thus allowing the stop surface 24 to contact the stop surface 17.

[0036] As a result, when the chair 101 is in an unloaded state, i.e. for example no one is sitting on the chair, the spring element 40 urges the chair back 104 in an upright position via the first link element 30, the second link element 20 and the back support 12. Due to the coupling between the chair seat 103 to the chair back 104, the chair seat 103 is urged in an essentially horizontal or "neutral" home position. However, depending on the position of the forward sitting adjustment element 50, the front stop of the second link element 20 and thus the chair seat 103 may be varied. In the first position of the forward sitting adjustment element 50, the chair seat 103 may be actually in an essentially horizontal position, and in the second position of the forward sitting adjustment element 50, the chair seat 103 may be slightly inclined in the forward direction, for example by a few degrees, such as 3° or 4° or 5°, with respect to the essentially horizontal position when the forward sitting adjustment element 50 is in the first position. When the chair back 104 is tilted in the rearward direction, for example by a user sitting on the chair 101, the spring element 40 is compressed (tensioned) by the movement of the first and second link elements 30, 20. As the position where the spring element 40 urges against the first link element 30 is adjustable, an active length of lever arm provided by the first link element 30 is varied such that the restoring force exerted by the spring element 40 can be adjusted to meet the needs of the user.

[0037] In detail, Figs. 8 to 10 show a schematic cross-sectional side view of the tilt mechanism 100 in an essentially horizontal non-tilted home position (Fig. 8), in a rearward tilted position (Fig. 9) and a forward tilted home position (Fig. 10). When a user is a sitting on the chair 101 and leans back against the chair back 104, the back support 12 is pivoted around pivot 14 in the rearward direction (Figs. 8 and 9). The seat support 11 this coupled to the back support 12 via pivot 16. When the back support 12 is pivoted in the rearward direction, the pivot 16 moves rear and down which causes the seat support 11 to tilt in the rearward direction. The slidable pivot 15 (see Fig. 6) enables this tilting and sliding motion of the seat support 11.

[0038] The tension mechanism of tilt mechanism 100 acts as follows. When the back support 12 is pivoted in the rearward direction, for example by a user leaning back against the chair back 104, the second link element 20 is pulled in the rearward direction due to the coupling via pivot 23 (see Fig. 7). The second end 22 of the second link element 20 pushes against the second end 32 of the first link element 30 and thus pivots the first link element 30 around pivot 33 in the rearward direction. As a result, the spring element 40 is compressed and urges the chair back 104 in the forward direction, see Fig. 9. The chair seat 103 moves in a coordinated manner together with the chair back 104.

[0039] When the user releases the chair back 104, the chair back 104 moves in the forward direction and the chair seat 103 is moved back in the horizontal position, see Fig. 8. Depending on the position of the forward sitting adjustment element 50, the distance pieces 51, 52 are either present between the stop surface 24 of the second end 22 of the second link element 20 and the stop surface 17 of the base 10 or not. In Fig. 8 the distance pieces 51, 52 are present and keep the distance 18 between the stop surface 24 and the stop surface 17 such that the seat support 11 is in an essentially horizontal position. In Fig. 10 the distance pieces 51, 52 are not

present and the stop surface 24 abuts the stop surface 17 such that the seat support 11 is in a forward tilted position. It is to be noted that the spring element 40 is preloaded so that even in the forward tilted position shown in Fig. 10, there is a force pressing the stop surface 24 against the stop surface 17.

[0040] Referring to Figs. 11 and 12, the coupling of the spring element 40 to the first link element 30 will be described in more detail. Along the length of the first link element 30, a threaded bolt 34 is provided which extends from the first end 31 to the second end 32. The threaded bolt 34 may be rotatable coupled to the first link element 30. A screw nut 35 is mounted at the second end 42 of the spring element 40 and in engagement with the threaded bolt 34. Upon rotating the threaded bolt 34 the position of the screw nut 35 may be varied between the first end 31 and second end 32 of the first link element 30. As an example, the screw nut 35 may be positioned near the first end 31 as shown in Fig. 11. As another example, the screw nut 35 may be positioned near the second end 32 as shown in Fig. 12. In general, the screw nut 35 may be positioned at any position between the first end 31 and the second end 32. By changing the position of the screw nut 35 along the first link element 30, the position at which the second end 42 of the spring element 40 urges against the first link element 30 is adjusted. In this arrangement, the first link element 30 may be considered as a lever arm which compresses the spring element 40 upon rotation around pivot 33. By adjusting the position at which the second end 42 of the spring element 40 urges against the first link element 30, the active length of the lever arm of the first link element 30 is adjusted. Thus, the restoring force urging the chair back 104 in the forward direction is varied. For example, when the screw nut 35 is closer to the first end 31 of the first link element 30, the restoring force is lower than in the case the screw nut 35 is it closer to the second end 32 of the first link element 30 as the spring becomes more compressed in the latter position when the chair back 104 is moved from the non-tilted position to the rearward tilted position.

[0041] As can be seen for example from Figs. 11 and 12 in connection with Fig. 8, a "triangle" is formed by the spring element 40, a part of the base 10, and the active length of the first link element 30. The vertices of this triangle are defined by the pivot 33 where the first end 31 of the first link element 30 is pivotably coupled to the base 10, a mounting point where the first end 41 of the spring element 40 is mounted at the base 10, and a point where the second end 42 of the spring element 40 urges against the first link element 30. A geometry of this triangle depends on the adjustable position at which the second end 42 of the spring element 40 urges against the first link element 30. A change of the geometry of this a triangle modifies the characteristics of the restoring force when the chair back 104 and chair seat 103 position is varied between the rearward tilted, the non-tilted and the forward tilted positions.

[0042] It is to be noticed that the length of the spring element 40 is not significantly changed when the position of the screw nut 35 is adjusted such that adjusting the position of the screw nut 35 does not require significant force. This enables an easy and fast adjustment of the restoring force.

[0043] As for example shown in Fig. 6, the threaded bolt 34 may be driven by bevel gear 60. A first bevel wheel 61 is coupled to a handle 63 and engages a second bevel wheel 62 which is coupled to the threaded bolt 34 near the first end 31 of the first link element 30. When the user is turning the handle 63, the threaded bolt 34 is driven. The bevel gear 60 allows that the longitudinal axis of the threaded bolt 34 is inclined while maintaining the engagement between the first and second bevel wheels 61, 62. As no significant force is required for moving the screw nut 35, a gear ratio of the bevel gear 60 and a gear ratio of the threaded bolt 34 in connection with the screw nut 35 can be selected such that the full range of adjustment, i.e. moving the screw nut 35 between the first and second ends 31, 32 of the first link element 30, is covered by a few turns at the handle 63, for example by four to six turns at the handle 63.

[0044] As shown in Fig. 13, a detent mechanism may be provided comprising a detent wheel 70 coupled to the threaded bolt 34, for example near the second end 32 of the first link element 30. The detent wheel 70 rotates together with the threaded bolt 34. The detent wheel 70 is provided with a plurality of detent forms, for example alternating projections and recesses. The detent mechanism comprises two detent members 71, 72 that are provided at opposite positions with respect to the circumference of the detent wheel 70. The detent members 71, 72 match the detent forms and are in engagement with the detent wheel 70. The detent members 71, 72 may be elastically displaceable in the radial direction of the detent wheel 70. The detent mechanism may provide a feedback to the user turning the handle 63 and may inhibit an inadvertent adjustment of the screw nut 35.

[0045] As discussed above, the forward sitting device (FSD) is provided for setting the home position of the chair 101 in either the essentially horizontal position as shown in Fig. 2 or in the forwarded tilted position as shown in Fig. 4. In the following, the FSD is designated to be in an "inactive" state, when the forward sitting adjustment element 50 is in the first position in which the distance piece 51 is arranged between the stop surface 24 of the second end 22 of the second link element 20 and the stop surface 17 of the base 10 thus keeping the predefined minimum distance 18 between the stop surface 24 and the stop surface 17, see Fig. 8. In this inactive state, in the home position of the chair 101, the back support 104 and the seat support 103 are arranged in a first arrangement as shown in Fig. 2. The FSD is designated to be in an "active" state, when the forward sitting adjustment element 50 is in the second position in which the distance piece 51 does not keep the distance 18 between the stop surface 24 and the stop surface 17 such that the stop surface 24 can abut against the stop surface 17,

see Fig. 10. In this active state, in the home position of the chair 101, the back support 104 and the seat support 103 are arranged in a second arrangement as shown in Fig. 4.

[0046] Fig. 14 shows the tilt mechanism 100 in the home position with the FSD in the inactive state. In the inactive state, the upper surface of the seat support 11 may be oriented substantially horizontally. Fig. 15 shows the tilt mechanism 100 in the home position with the FSD in the active state. As can be seen, in the active state of the FSD, the seat support 11 is inclined in the forwarded direction compared to the arrangement of the seat support 11 in the inactive state of the FSD. Likewise, in the active state of the FSD, the back support 12 is inclined in the forwarded direction compared to the arrangement of the back support 12 in the inactive state of the FSD.

[0047] As a result, in the active state of the FSD, the chair seat 103 is tilted a few degrees in the forward direction with respect to the arrangement of the chair seat 103 in the inactive state of the FSD. For example, the chair seat 103 may be tilted in the forward direction about 3°, 4° or 5°.

[0048] Figs. 16 and 17 show further details of the FSD. The FSD comprises the forward sitting adjustment element 50. The forward sitting adjustment element 50 may be actuated by a user via a handle 53. The forward sitting adjustment element 50 may be moved laterally in the left-right direction. In Fig. 16, the forward sitting adjustment element 50 is moved to the right (as seen from a user sitting on the chair 101, i.e. to the left in Fig. 16) and in Fig. 17, the forward sitting adjustment element 50 is moved to the left (as seen from a user sitting on the chair 101, i.e. to the right in Fig. 17). At the forward sitting adjustment element 50 two distance pieces 51 and 52 are provided which move together with the forward sitting adjustment element 50 in the lateral left-right direction.

[0049] In the right position (Fig. 16, inactive FSD), the distance pieces 51 and 52 are arranged between the stop surface 24 of the second end 22 of the second link element 20 and the stop surface 17 (not visible in Fig. 16) of the base 10. In this right position, the distance pieces 51 and 52 prevent that the stop surface 24 contacts and abuts the base at 10 at the stop surface 17.

[0050] At the second end 22 of the second link element 20, two recesses 25, 26 are provided in the stop surface 24. In the left position (Fig. 17, active FSD), the distance pieces 51 and 52 are arranged opposed to the recesses 25, 26. In detail, distance piece 51 is arranged opposed to recess 25 and distance piece 52 is arranged opposed to recess 26. The recesses 25, 26 are dimensioned such that the distance pieces 51, 52 can be inserted completely in the corresponding recess without protruding from the stop surface 24. Therefore, in this left position, the distance pieces 51 and 52 do not prevent that the stop surface 24 of the link element 20 contacts and abuts the base at 10 at the stop surface 17. As a result, in the left position of the forward sitting adjustment element 50 the second link element 20 can be moved further in the forwarded direction than in the right position.

[0051] Figs. 18 and 19 illustrate details of the FSD in sectional views. In Fig. 18, the FSD is in the inactive state. The distance pieces 51, 52 are not arranged opposed to the corresponding recesses 25, 26 such that the stop surface 24 at the second end 22 of the second link element 20 contacts the distance pieces 51, 52 at one side and the opposing other side of the distance pieces 51, 52 contact the stop surface 17 of the base 10. The distance pieces 51, 52 keep the distance between the stop surface 24 and the stop surface 17 and inhibit a forward tilting of the seat support 11. In Fig. 19, the FSD is in the active state. The distance pieces 51, 52 are arranged opposed to the corresponding recesses 25, 26 such that the distance pieces 51, 52 do not block the space between the stop surface 24 and the stop surface 17. The stop surface 24 can directly contact the stop surface 17. As a result, the seat support 11 can tilt forward.

[0052] Figs. 20 and 21 shown further details of the operation of the distance pieces 51, 52 in the inactive state (Fig. 20) and the active state (Fig. 21) of the FSD. In the inactive state (Fig. 20) the distance pieces 51, 52 are opposed to the stop surface 24 such that the stop surface 24 cannot move in the forward direction to contact the stop surface 17 at the base 10. In the active state (Fig. 21) the distance pieces 51, 52 are arranged opposed to the recesses 25, 26 and can be completely inserted in the recesses 25, 26 such that the stop surface 24 gets into contact with the stop surface 17 at the base 10.

[0053] While exemplary embodiments have been described in the context of office-type chairs, the tilt mechanism 100 and the chair 101 according to embodiments of the invention are not limited to this particular application. Rather, embodiments of the invention may be employed to effect a coordinated motion of a chair back and the chair seat in a wide variety of chairs, for example living room chairs and vehicle chairs.

Claims

1. A tilt mechanism for a chair, configured to affect a coordinated movement of a chair seat (103) and chair back (104), the tilt mechanism (100) comprising:

   - a base (10),
   - a back support (12) configured to support the chair back (104) and pivotably coupled to the base (10),
   - a seat support (11) configured to support the chair seat (103) and pivotably coupled to the back support (12),
   - a first link element (30), wherein a first end (31) of the first link element (30) is pivotably coupled to the base (10),
   - a second link element (20), wherein a first end (21) of the second link element (20) is pivotably

coupled to the back support (12) and a second end (22) of the second link element (20) is coupled to a second end (32) of the first link element (30),

- a spring element (40), wherein a first end (41) of the spring element (40) is mounted at the base (10) and a second end (42) of the spring element (40) is urging against the first link element (30) at an adjustable position between the first end (31) and the second end (32) of the first link element (30);
- a forward sitting adjustment element (50) movable between a first position and a second position,

wherein, when the forward sitting adjustment element (50) is in the first position, a distance piece (51, 52) of the forward sitting adjustment element (50) is arranged between a stop surface (24) of the second end (22) of the second link element (20) and a stop surface (17) of the base (10) thus keeping a predefined minimum distance (18) between the stop surface (24) of the second end (22) of the second link element (20) and the stop surface (17) of the base (10), and, wherein, when the forward sitting adjustment element (50) is in the second position, the distance piece (51, 52) of the forward sitting adjustment element (50) is not arranged between the stop surface (24) of the second end (22) of the second link element (20) and the stop surface (17) of the base (10) thus allowing the stop surface (24) of the second end (22) of the second link element (20) to contact the stop surface (17) of the base (10).

2. The tilt mechanism of claim 1, wherein, when the back support (12) is moved from a first position, in which the chair back (104) is in an essentially upright position, to a second position, in which the chair back (104) is in a rearward tilted position, the seat support (11) is tilted in a rearward direction and the spring element (40) is compressed thus providing a restoring force urging the back support (12) in the first position.

3. The tilt mechanism of claim 2, wherein adjusting the position at which the second end (42) of the spring element (40) urges against the first link element (30) varies an active length of the first link element (30) acting when the back support (12) is moved between the first position and the second position, thus varying the restoring force urging the back support (12) in the first position.

4. The tilt mechanism of claim 2 or claim 3, wherein, in the essentially upright position of the chair back (104), a length of the spring element (40) depends on the adjustable position at which the second end (42) of the spring element (40) is urging against the first link element (30).

5. The tilt mechanism of any one of the preceding claims, wherein the tilt mechanism (100) comprises a threaded bolt (34) engaged with a screw nut (35), wherein the screw nut (35) is fixed to the second end (42) of the spring element (40), wherein upon rotating the threaded bolt (35), the position between the first end (31) and the second end (32) of the first link element (30) at which the second end (42) of the spring element (40) urges against the first link element (30) is adjusted.

6. The tilt mechanism of claim 5, wherein the tilt mechanism (100) comprises

- a detent wheel (70) coupled to the threaded bolt (34) to rotate with the threaded bolt (34), the detent wheel (70) being provided with a plurality of detent forms, and
- at least one detent member (71, 72) attached to the first link element (30), wherein each of the at least one detent member (71, 72) matches the detent forms of the detent wheel (70) and is in engagement with the detent wheel (70).

7. The tilt mechanism of claim 6, wherein the at least one detent member (71, 72) comprises two detent members (71, 72) being arranged at opposite positions with respect to a circumference of the detent wheel (70).

8. The tilt mechanism of any one of the preceding claims,

wherein, when the forward sitting adjustment element (50) is in the first position and the stop surface (24) of the second end (22) of the second link element (20) contacts the distance piece (51, 52) of the forward sitting adjustment element (50), the back support (12) and the seat support (11) are arranged in a first arrangement, wherein, when the forward sitting adjustment element (50) is in the second position and the stop surface (24) of the second end (22) of the second link element (20) contacts the stop surface (17) of the base (10), the back support (12) and the seat support (11) are arranged in a second arrangement,
wherein in the second arrangement the seat support (11) is inclined in the forward direction with respect to the second arrangement.

9. The tilt mechanism of claim 8,

wherein, in the first arrangement, the seat support (11) is arranged essentially in a non-inclined position, and
wherein, in the second arrangement, the seat support (11) is arranged in a forward-inclined position.

10. The tilt mechanism of claim 9,
wherein the seat support (11) in the second arrangement is tilted at least 3 degrees in the forward direction with respect to the first arrangement.

11. The tilt mechanism of any one of the preceding claims, wherein

in the first position of the forward sitting adjustment element (50), the spring element (40) urges the stop surface (24) of the second end (22) of the second link element (20) into contact with the distance piece (51, 52) of the forward sitting adjustment element (50), and
in the second position of the forward sitting adjustment element (50)), the spring element (40) urges the stop surface (24) of the second end (22) of the second link element (20) into contact with the stop surface (17) of the base (10).

12. The tilt mechanism of any one of the preceding claims,
wherein vertices of a triangle are defined by:

a first pivot axis (33) where the first end (31) of the first link element (30) is pivotably coupled to the base (10),
a mounting point where the first end (41) of the spring element (40) is mounted at the base (10), and
an urging point where the second end (42) of the spring element (40) urges against the first link element (30),

wherein a geometry of the triangle depends on the adjustable position at which the second end (42) of the spring element (40) urges against the first link element (30).

13. A chair, comprising

a chair base assembly (102),
a chair seat (103),
a chair back (104), and
a tilt mechanism (100) according to any one of the preceding claims, the base (10) of the tilt mechanism (100) being attached to the chair base assembly (102), the chair seat (103) being attached to the seat support (11) of the tilt mechanism (100), and the chair back (104) being attached to the back support (12) of the tilt mechanism (100).

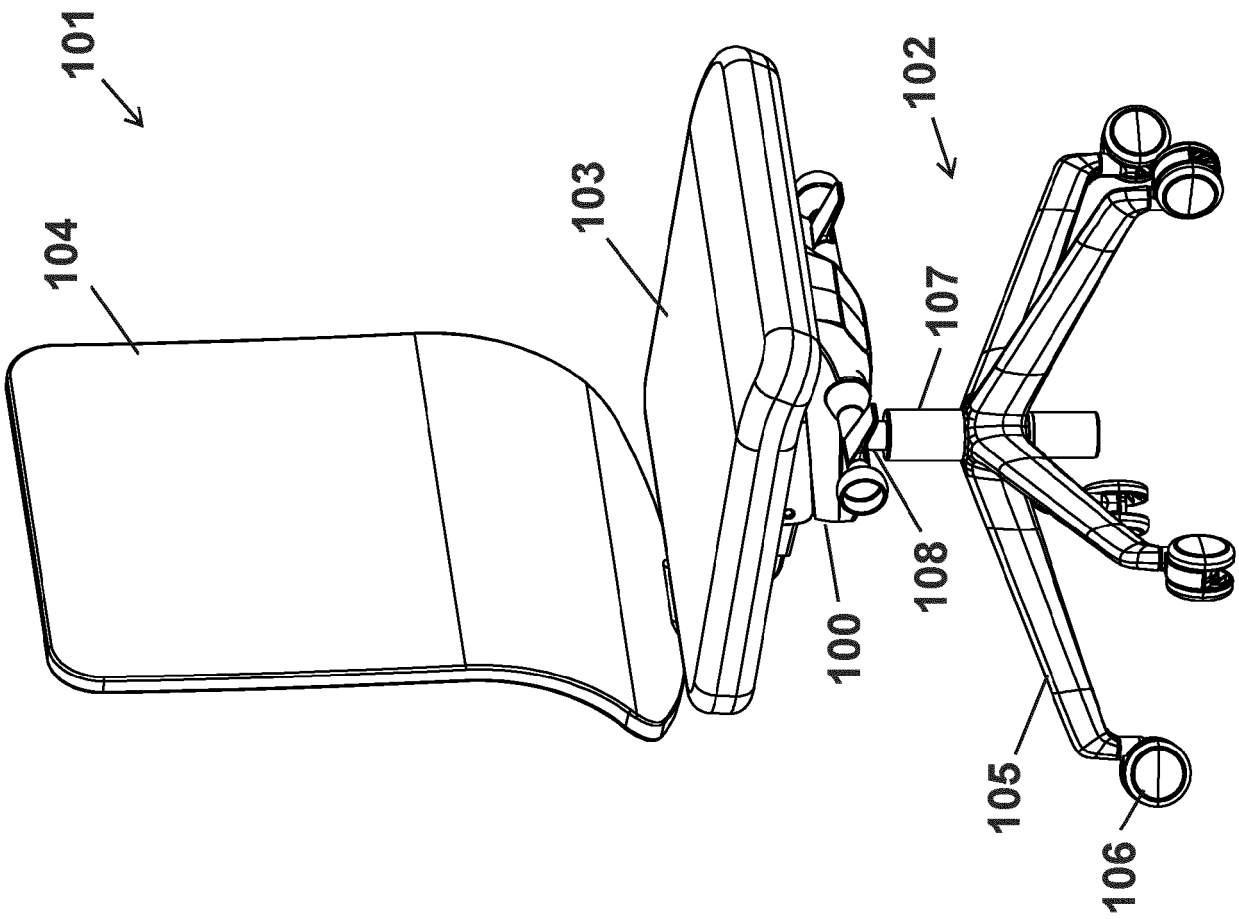


Fig. 1

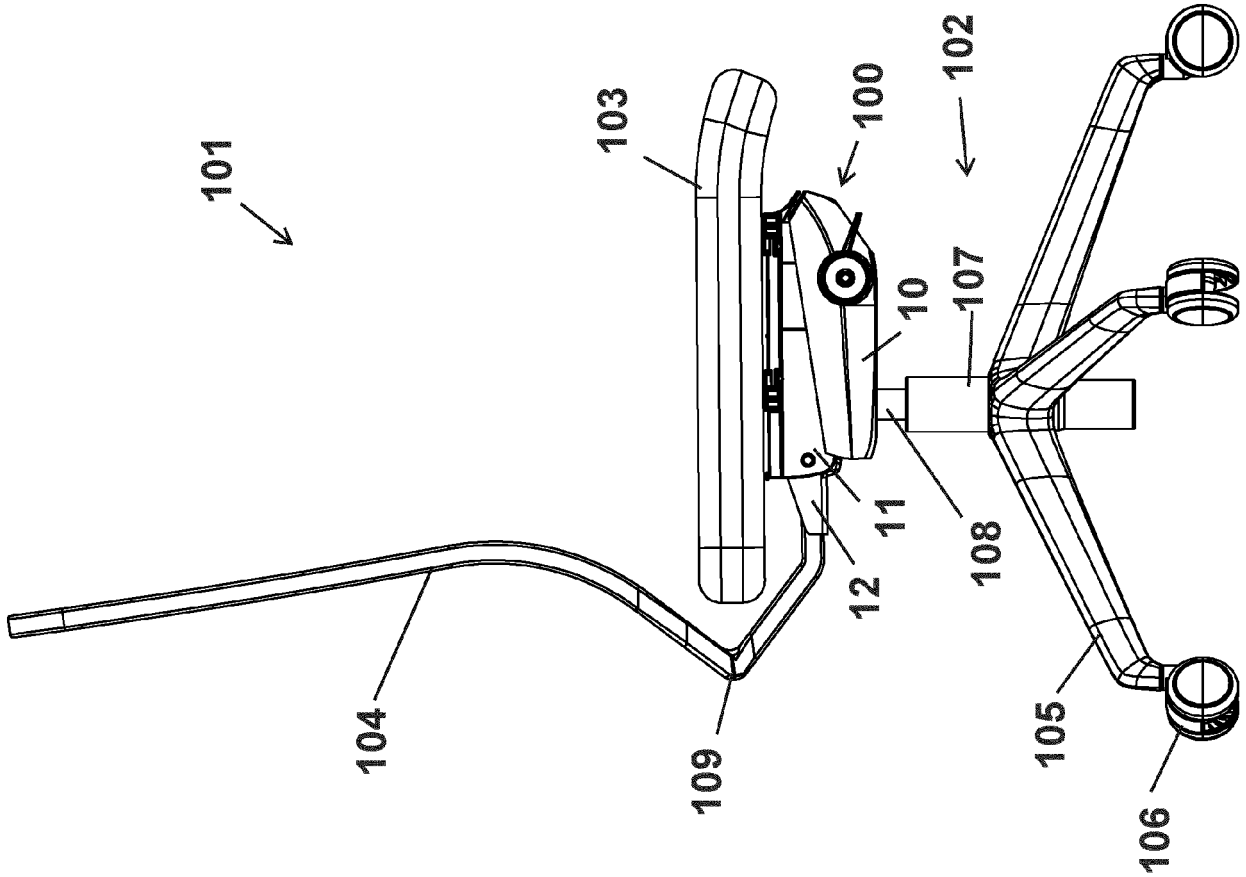


Fig. 2

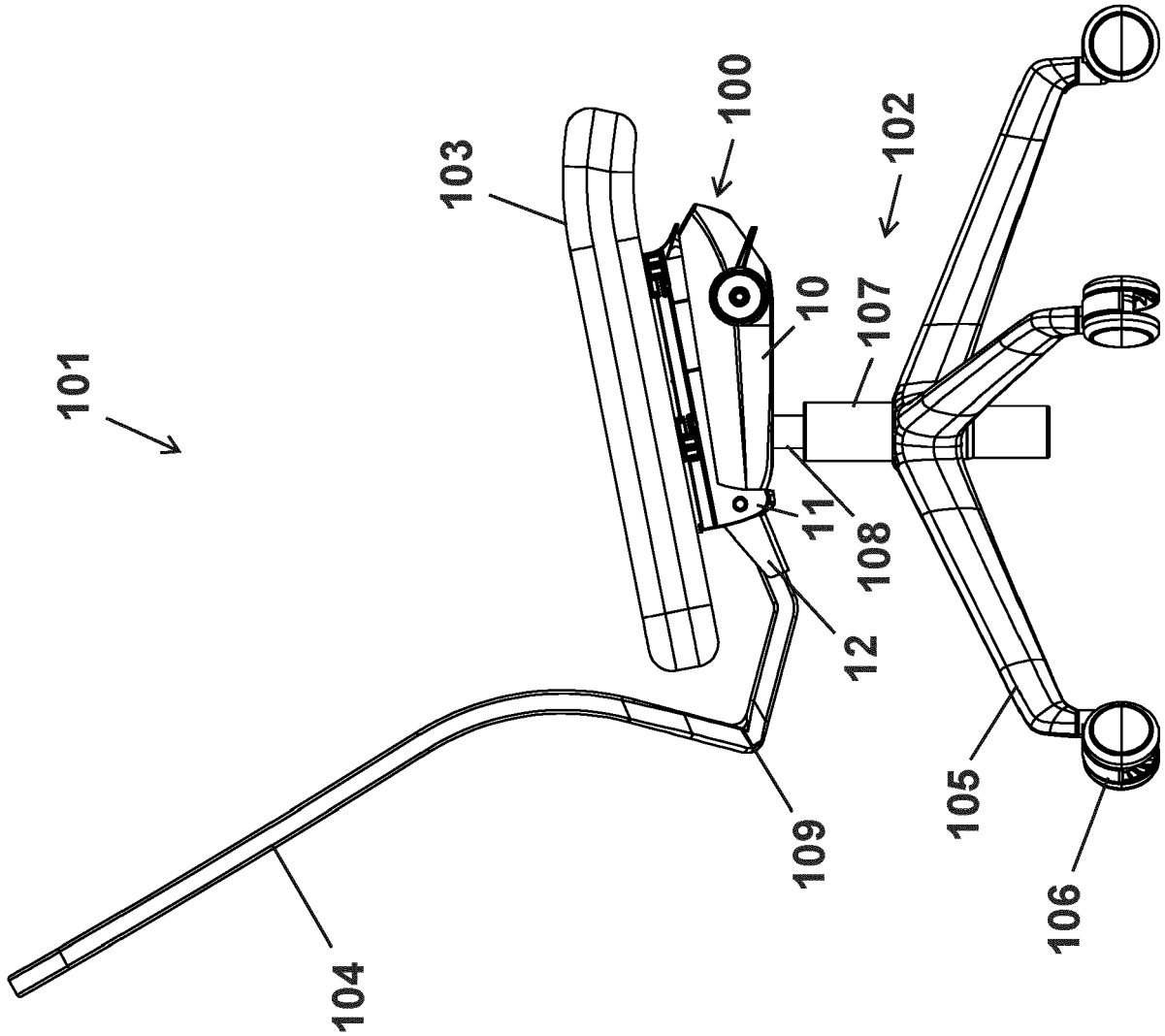


Fig. 3

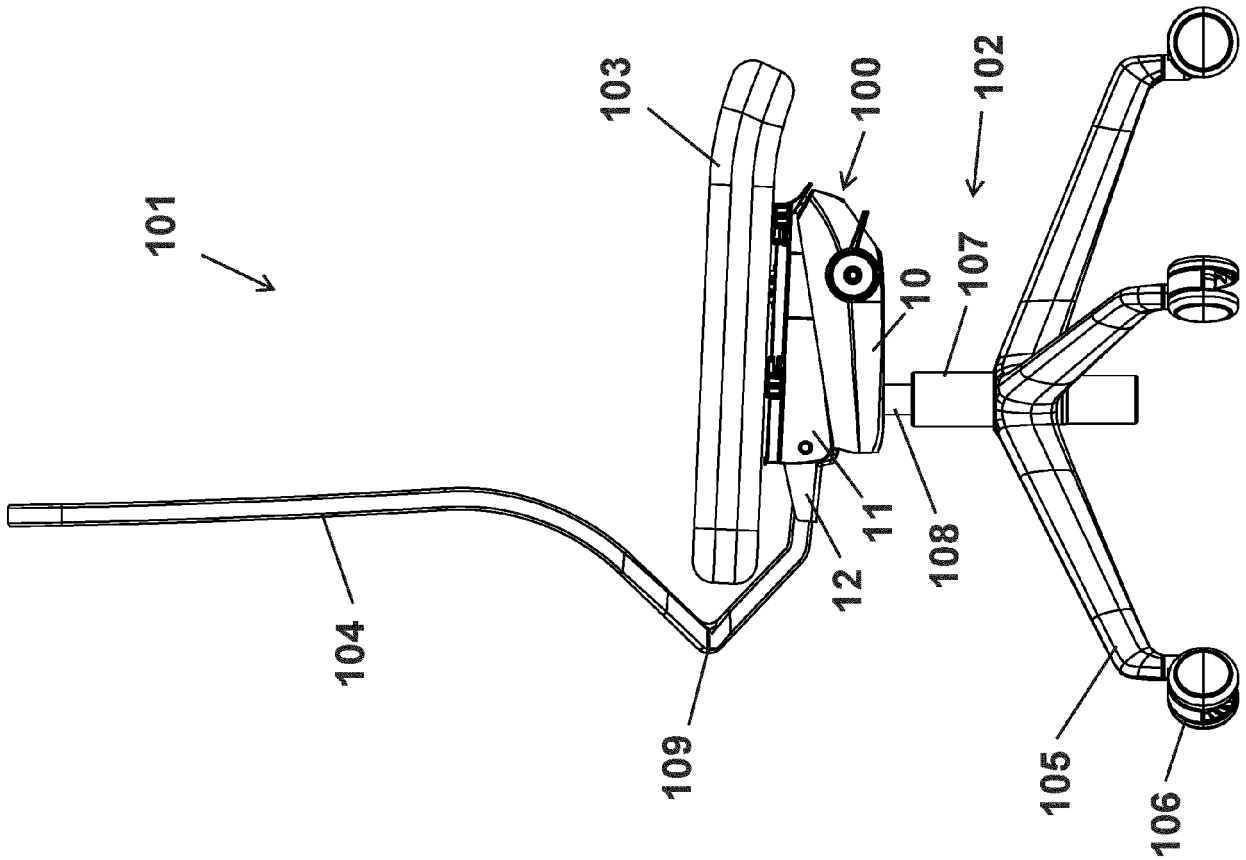


Fig. 4

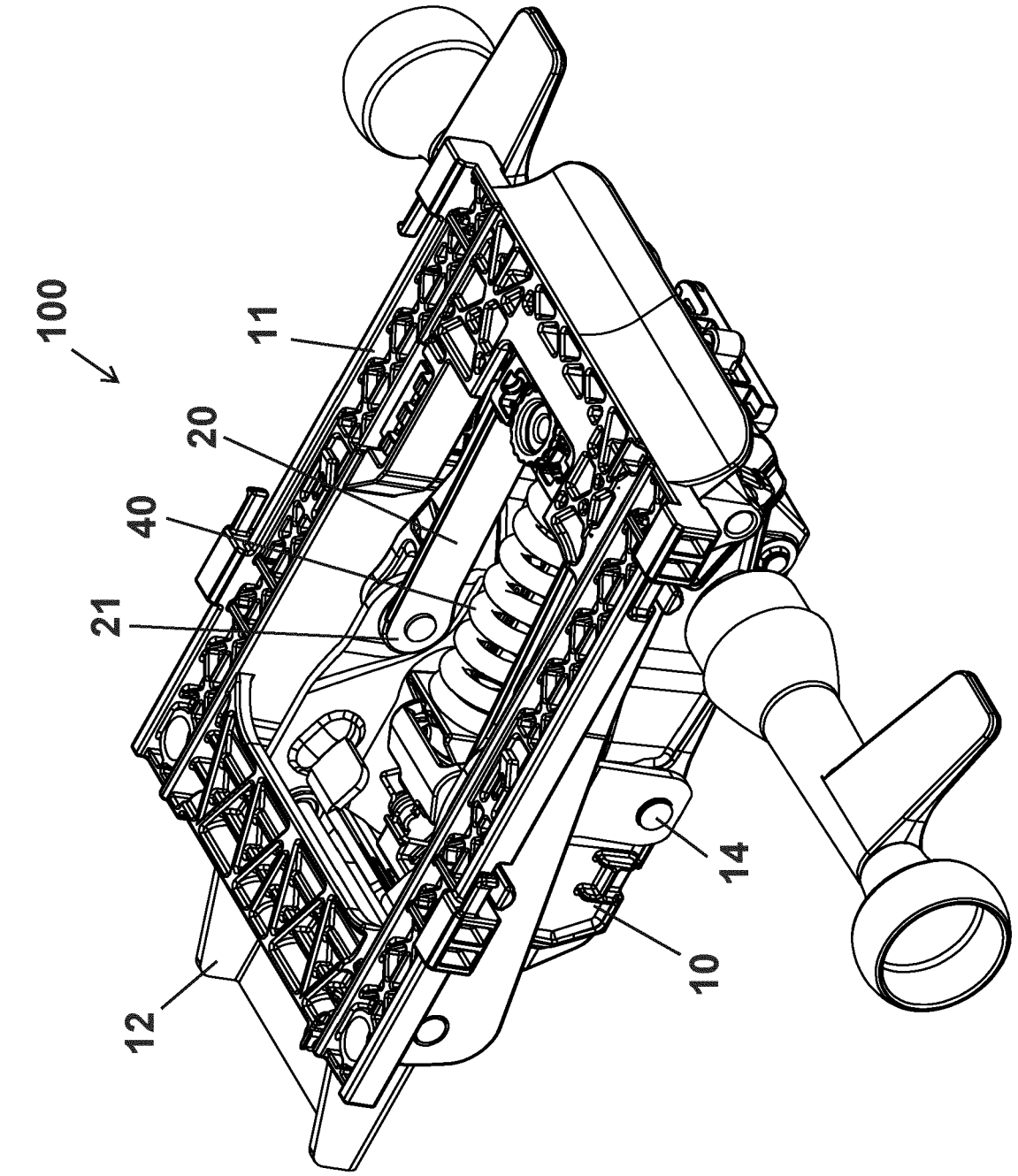


Fig. 5

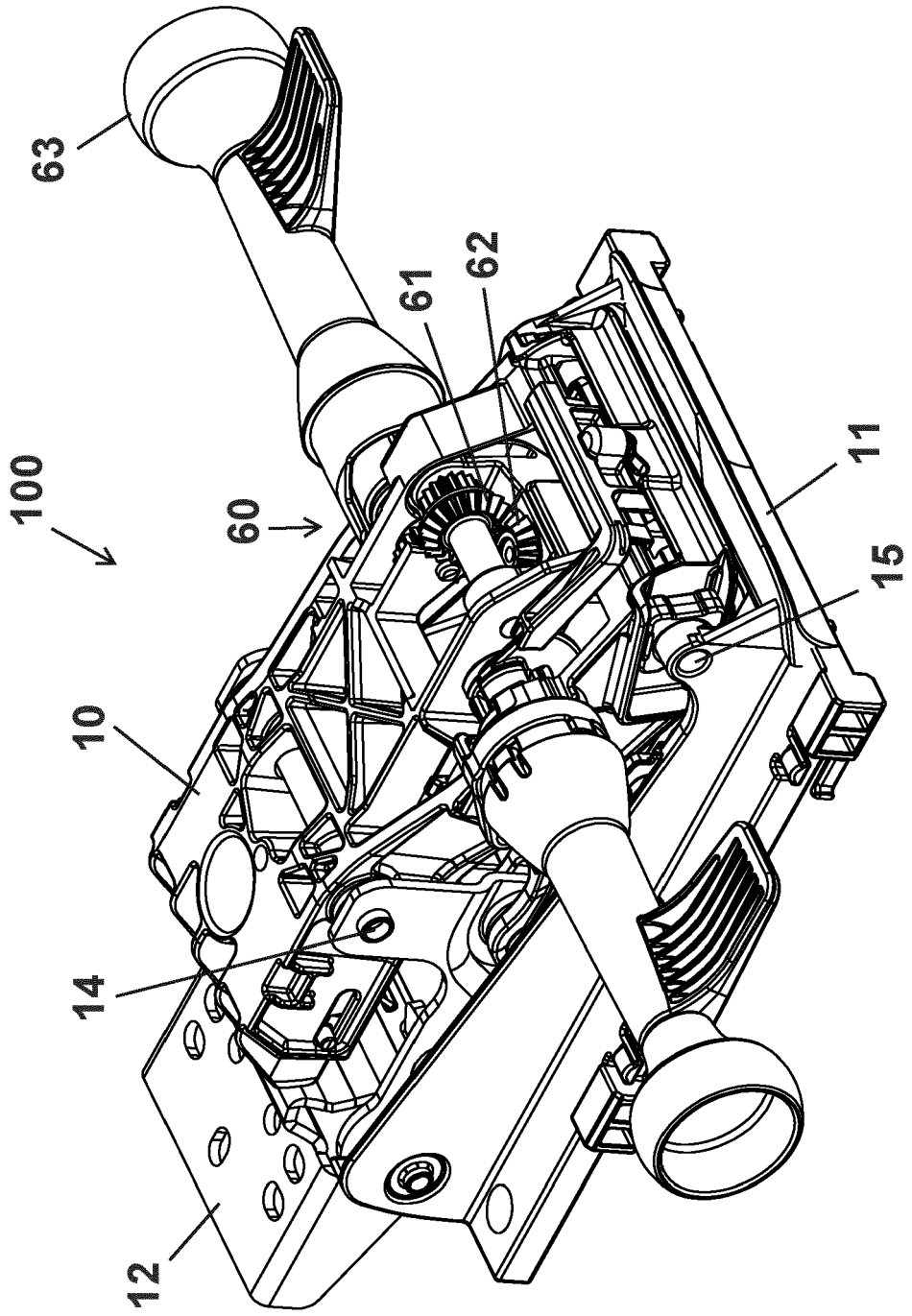


Fig. 6

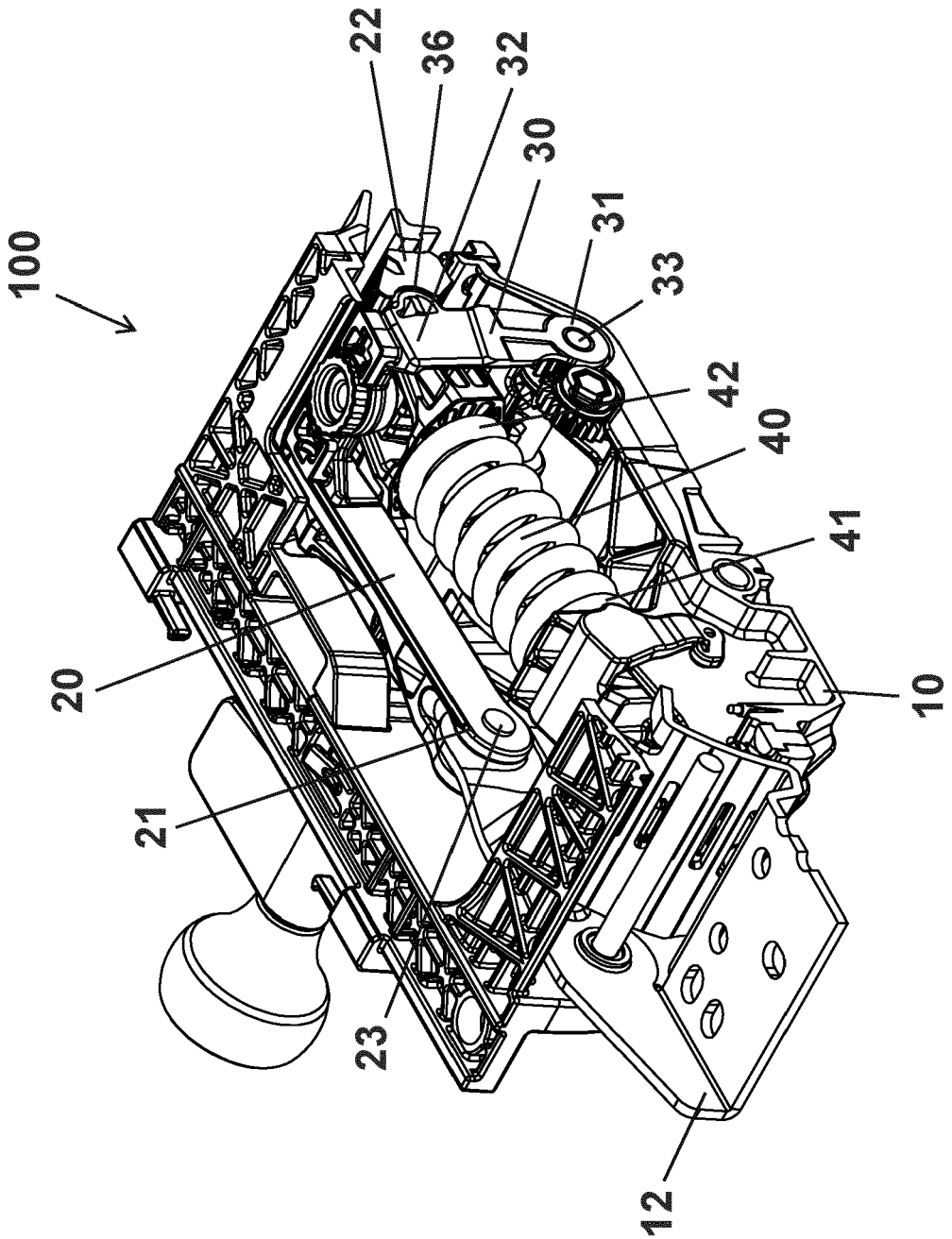


Fig. 7

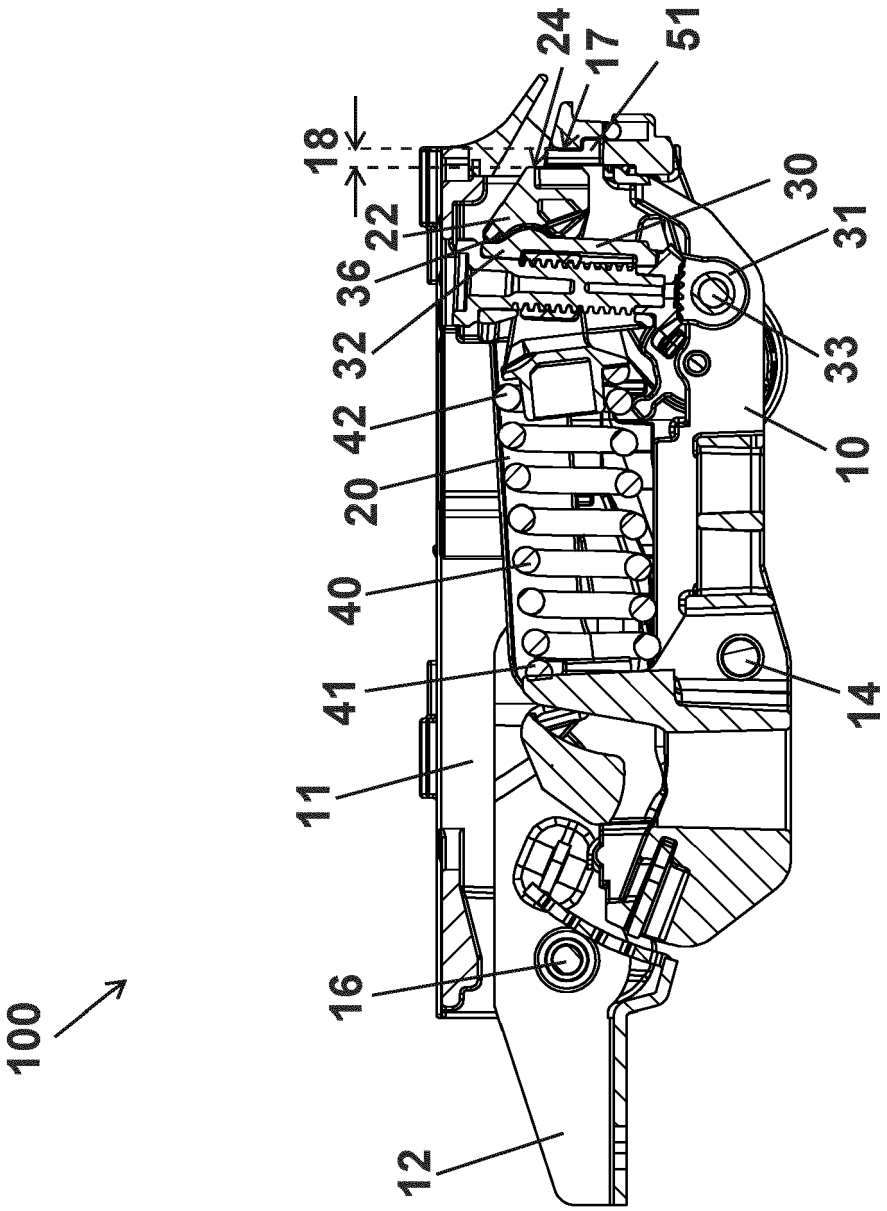


Fig. 8

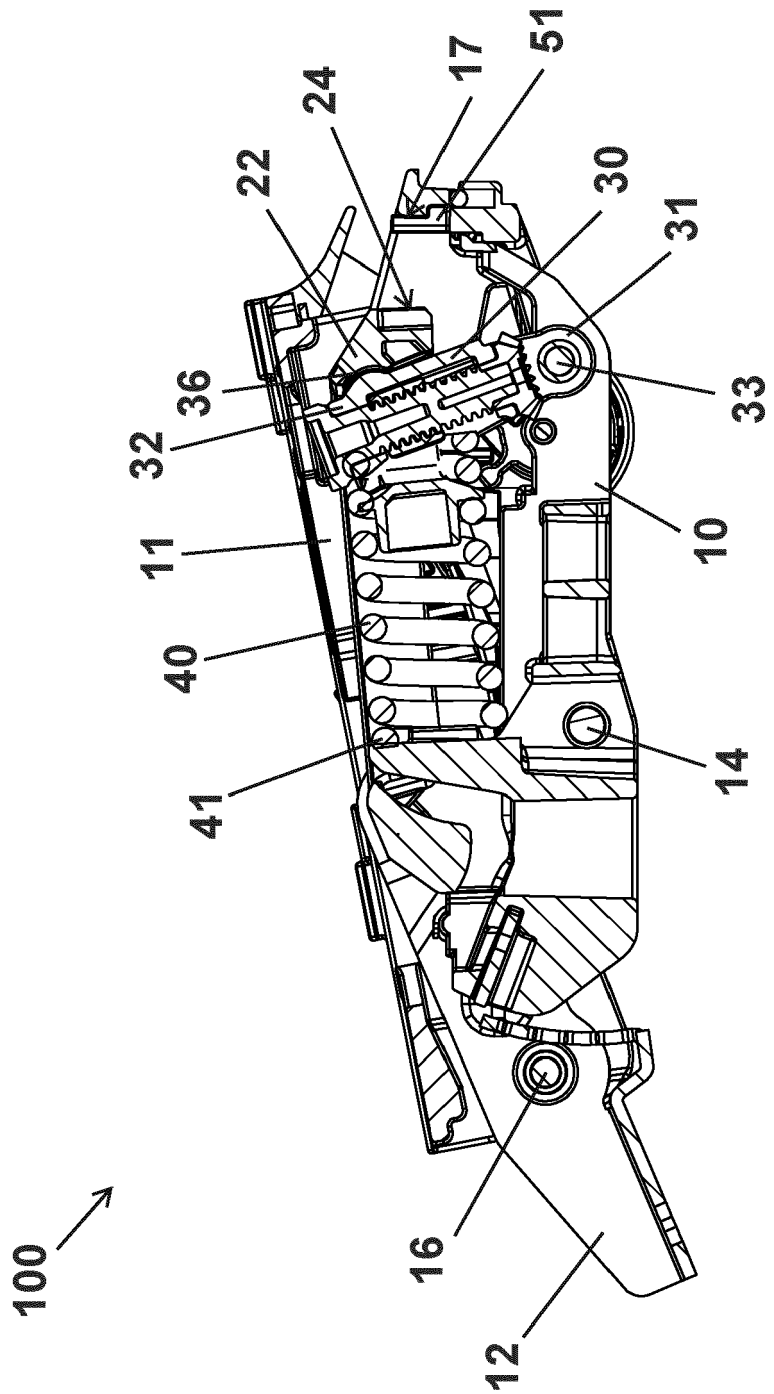


Fig. 9

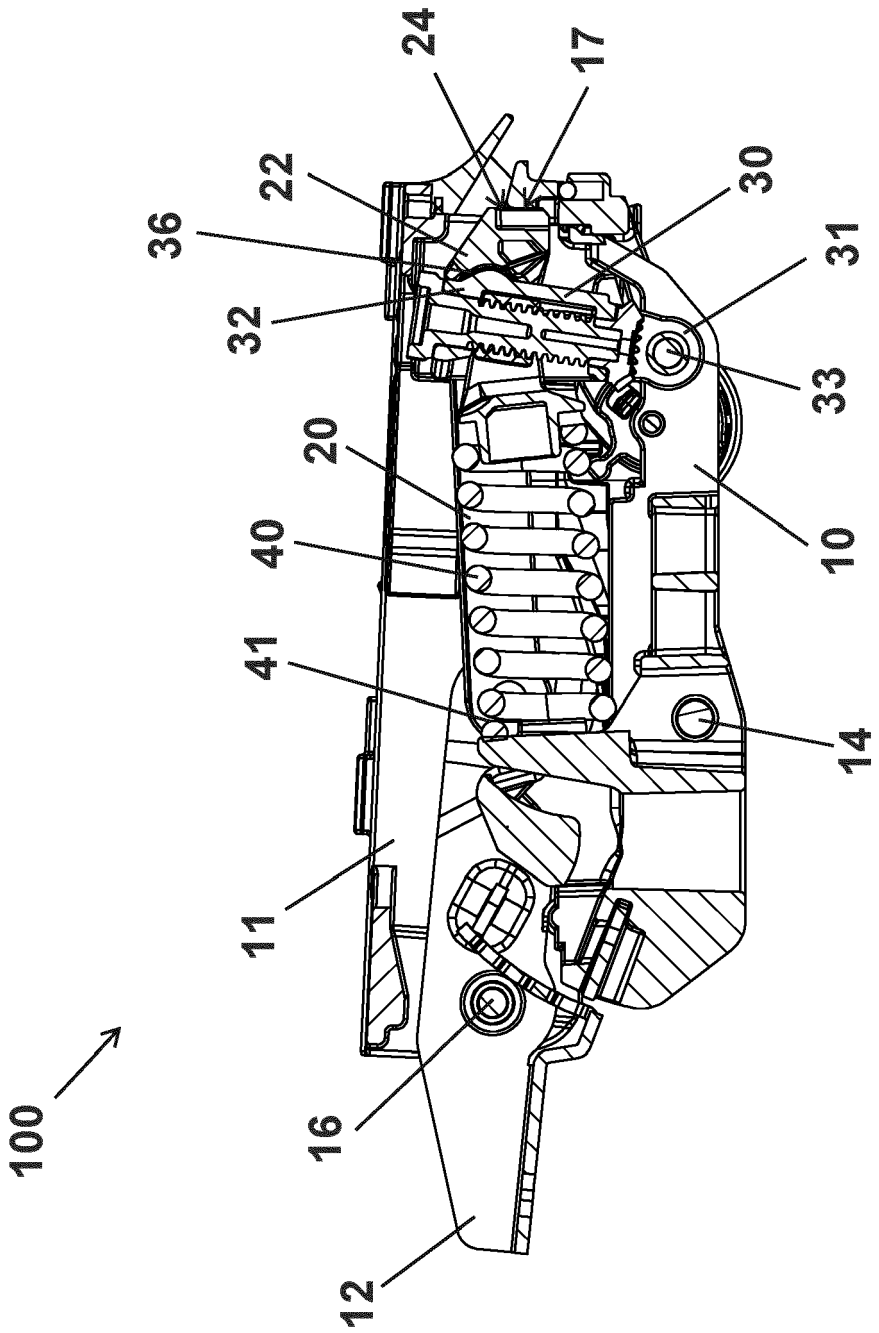


Fig. 10

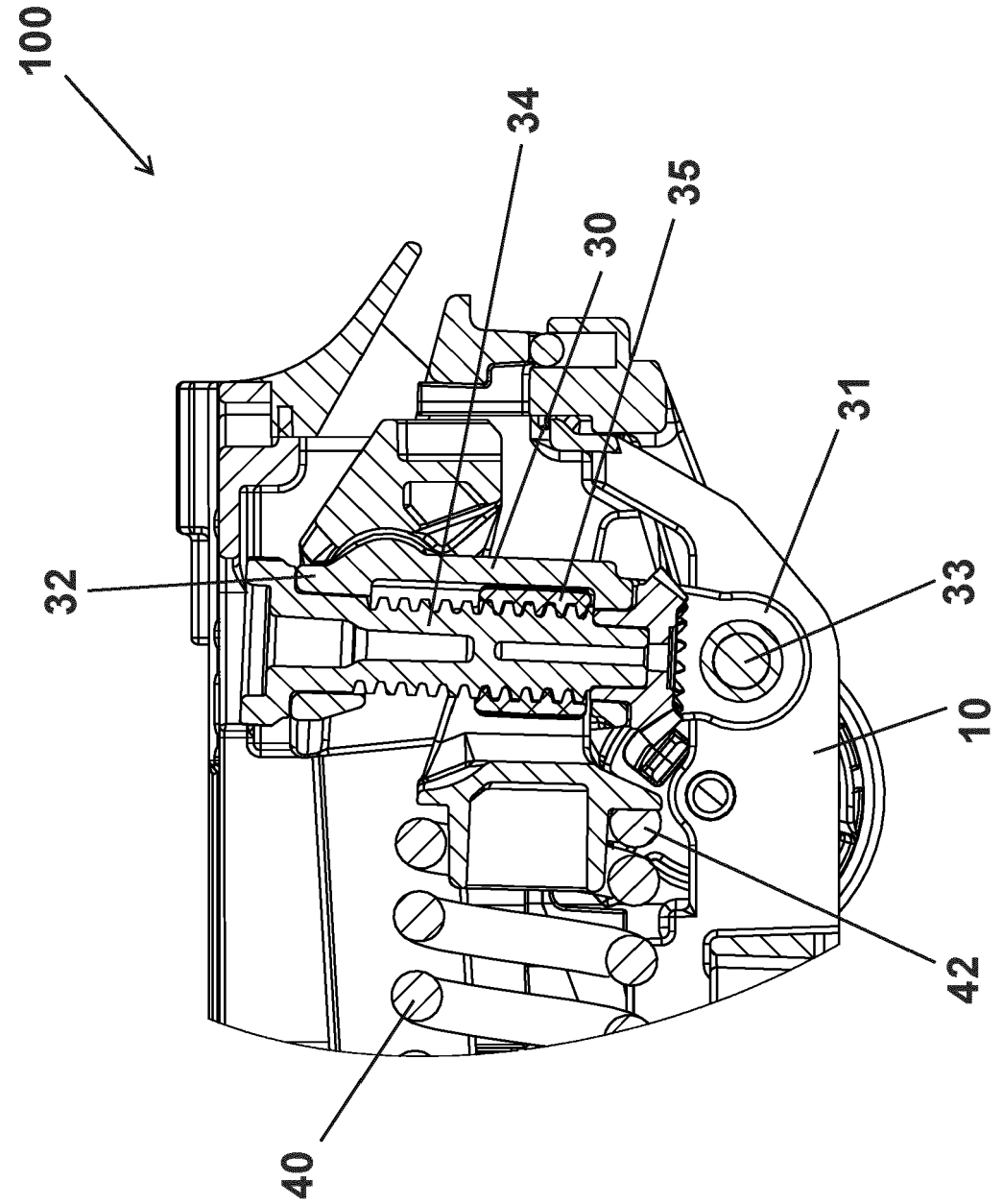


Fig. 11

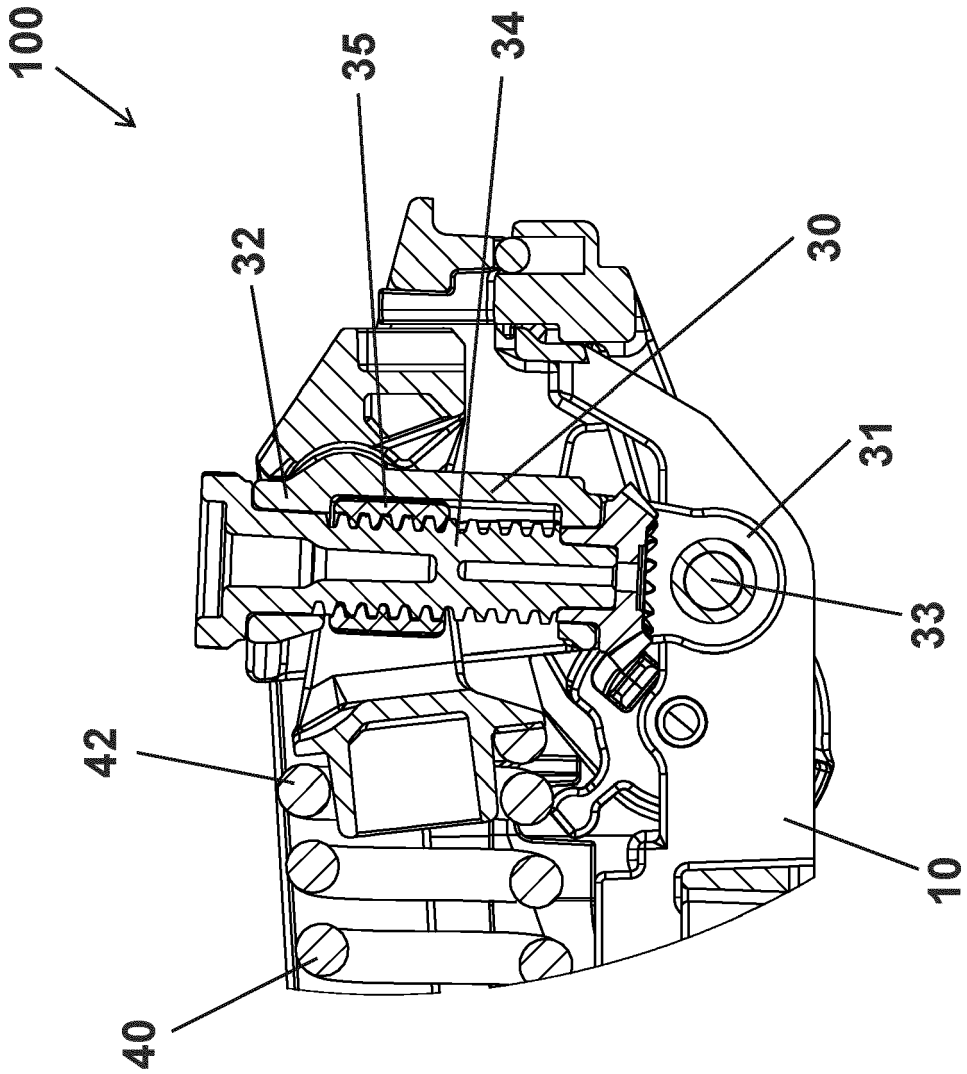


Fig. 12

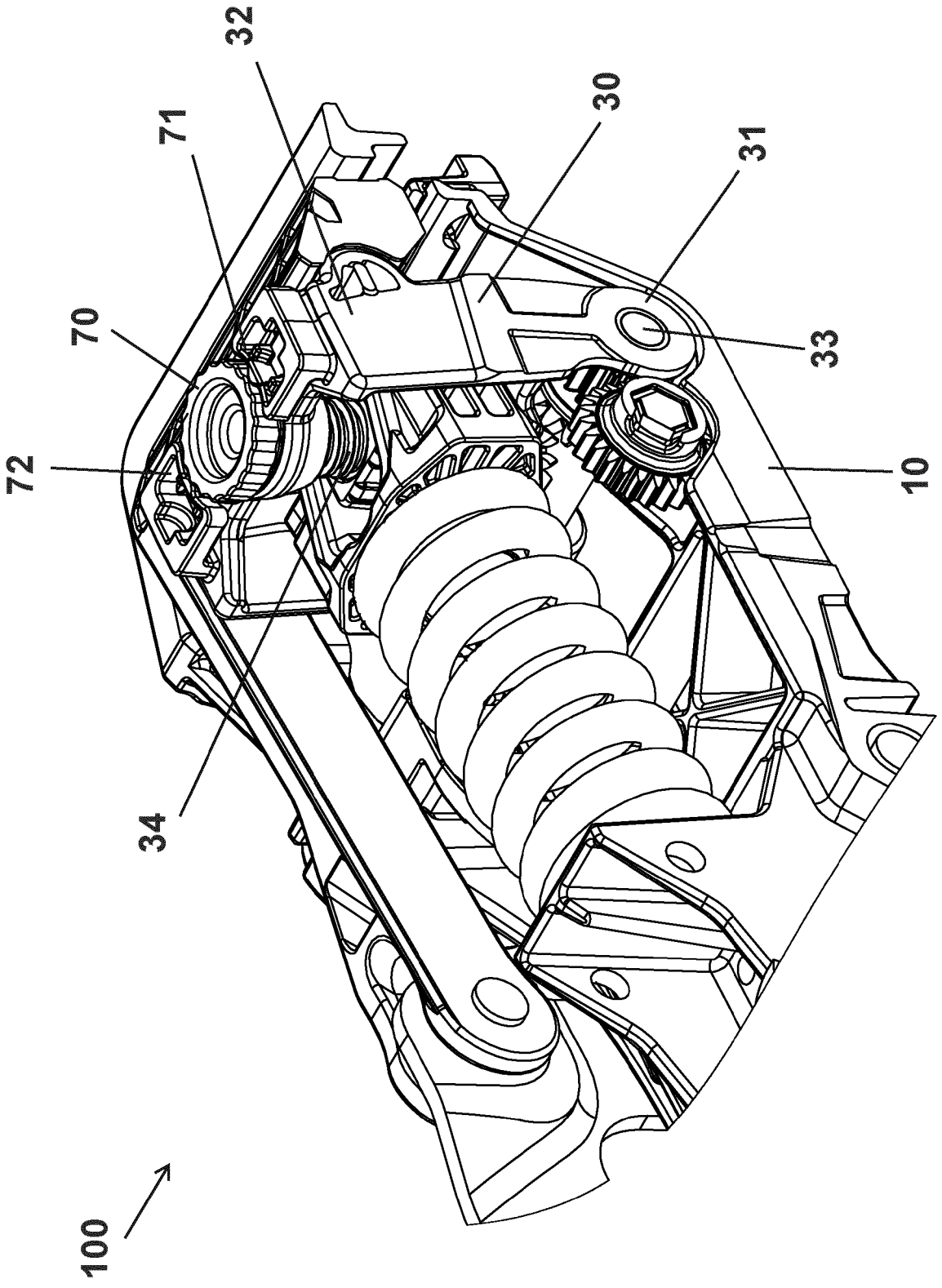


Fig. 13

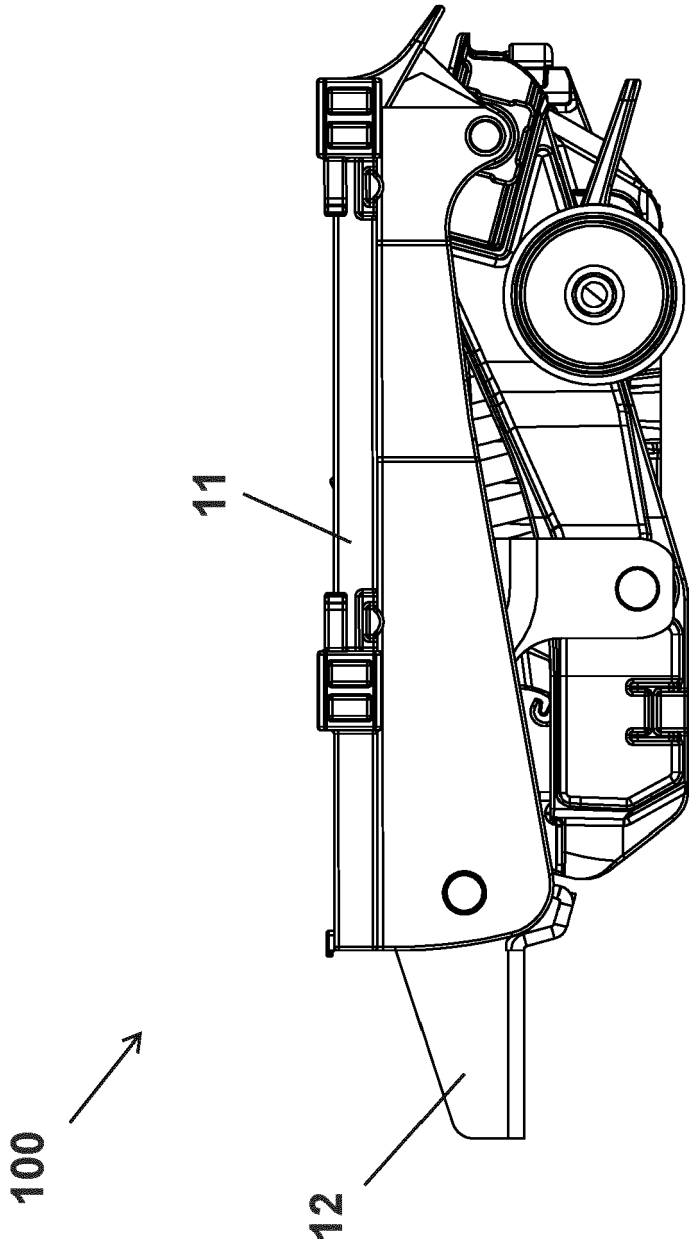


Fig. 14

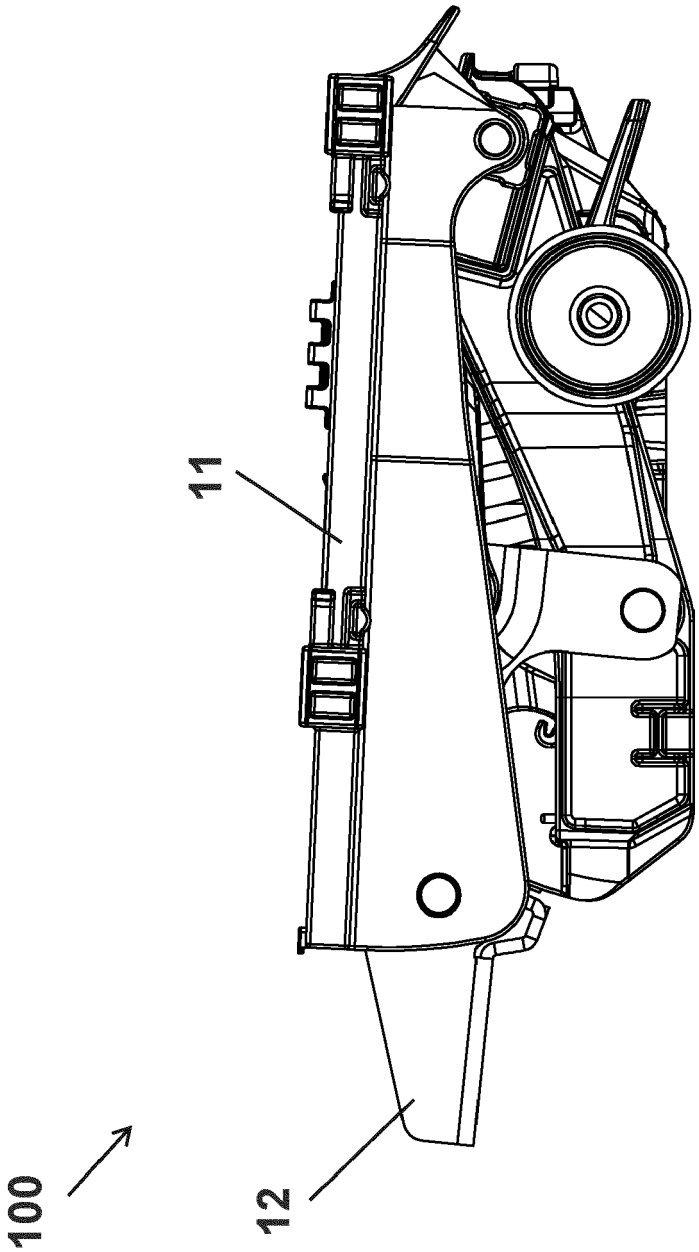


Fig. 15

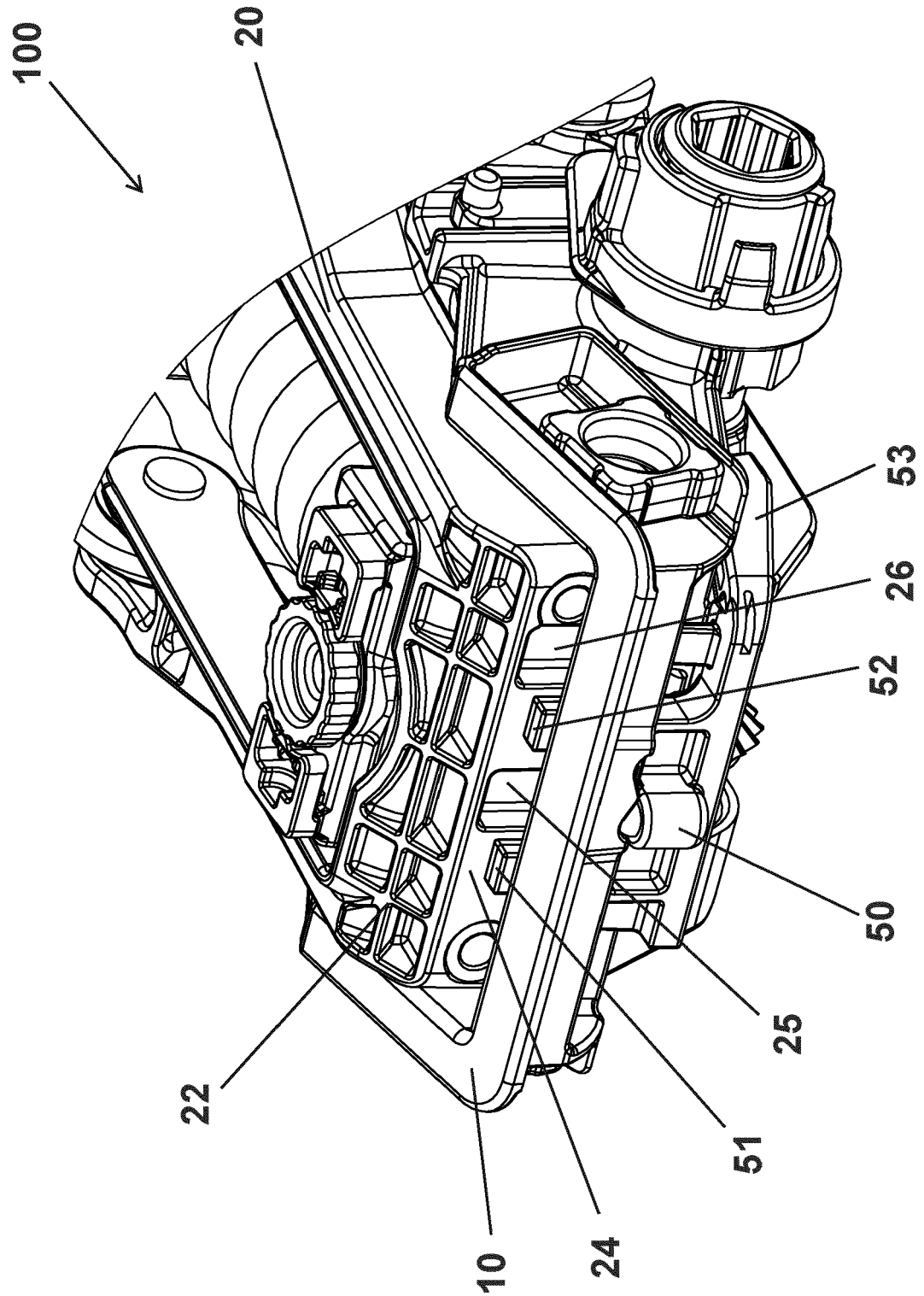


Fig. 16

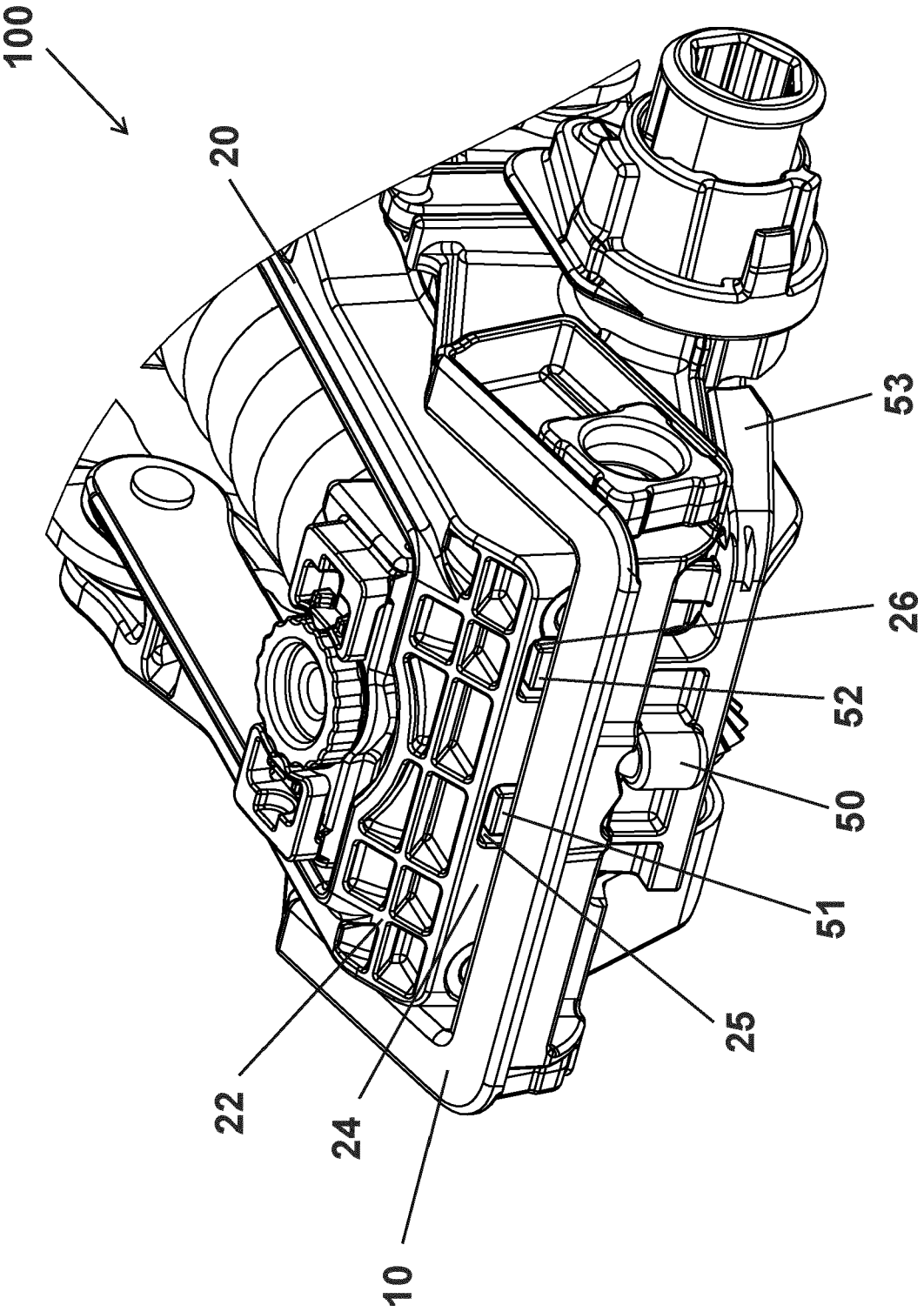


Fig. 17

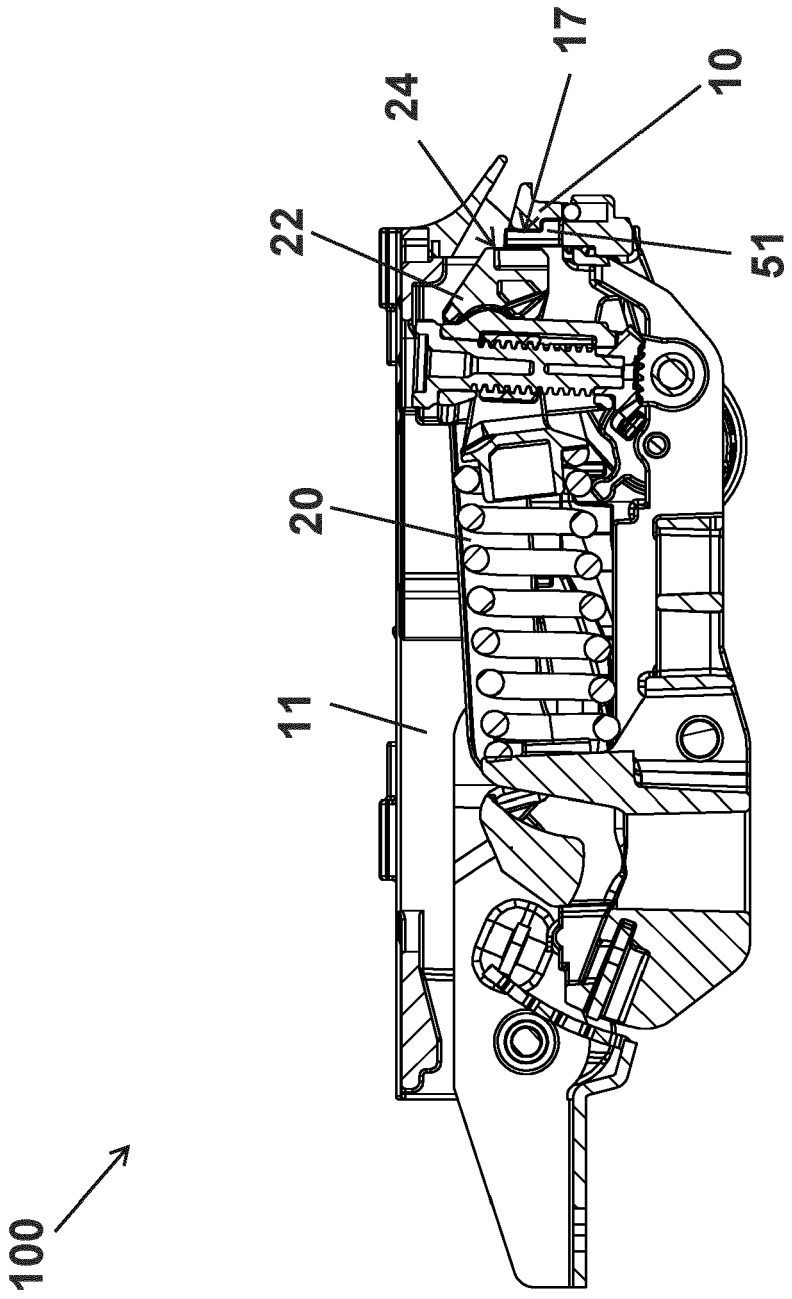


Fig. 18

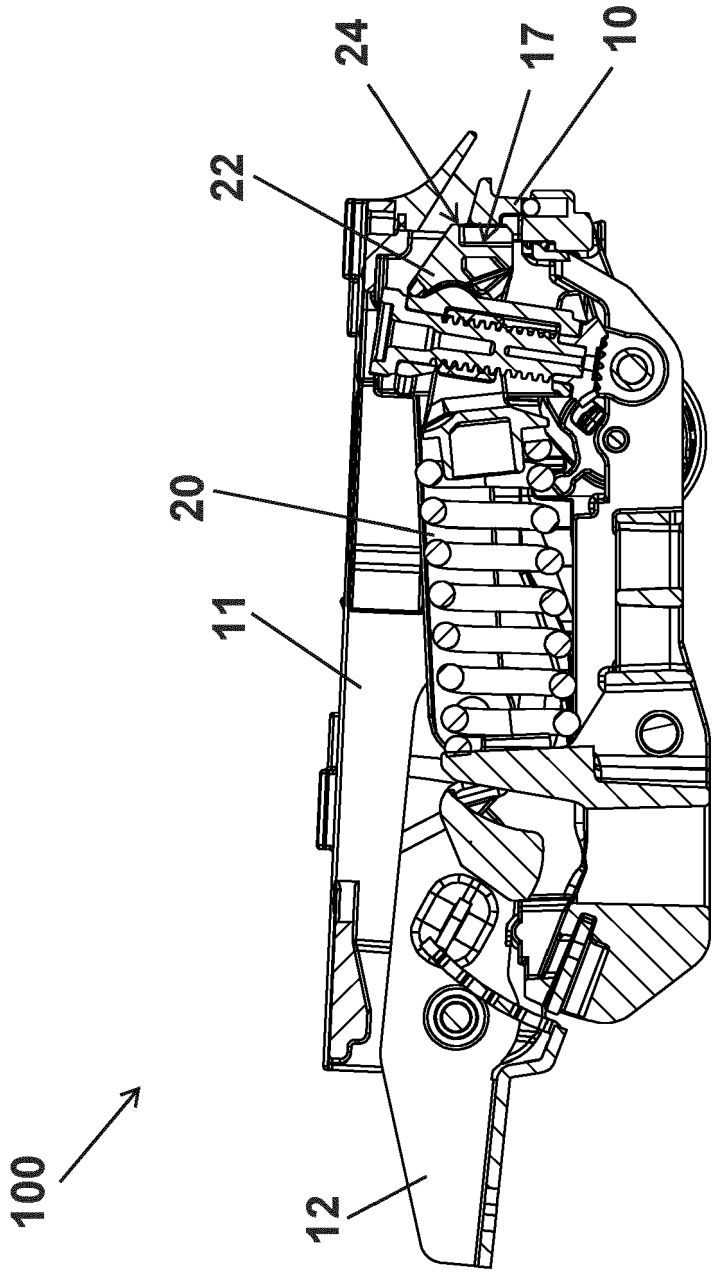


Fig. 19

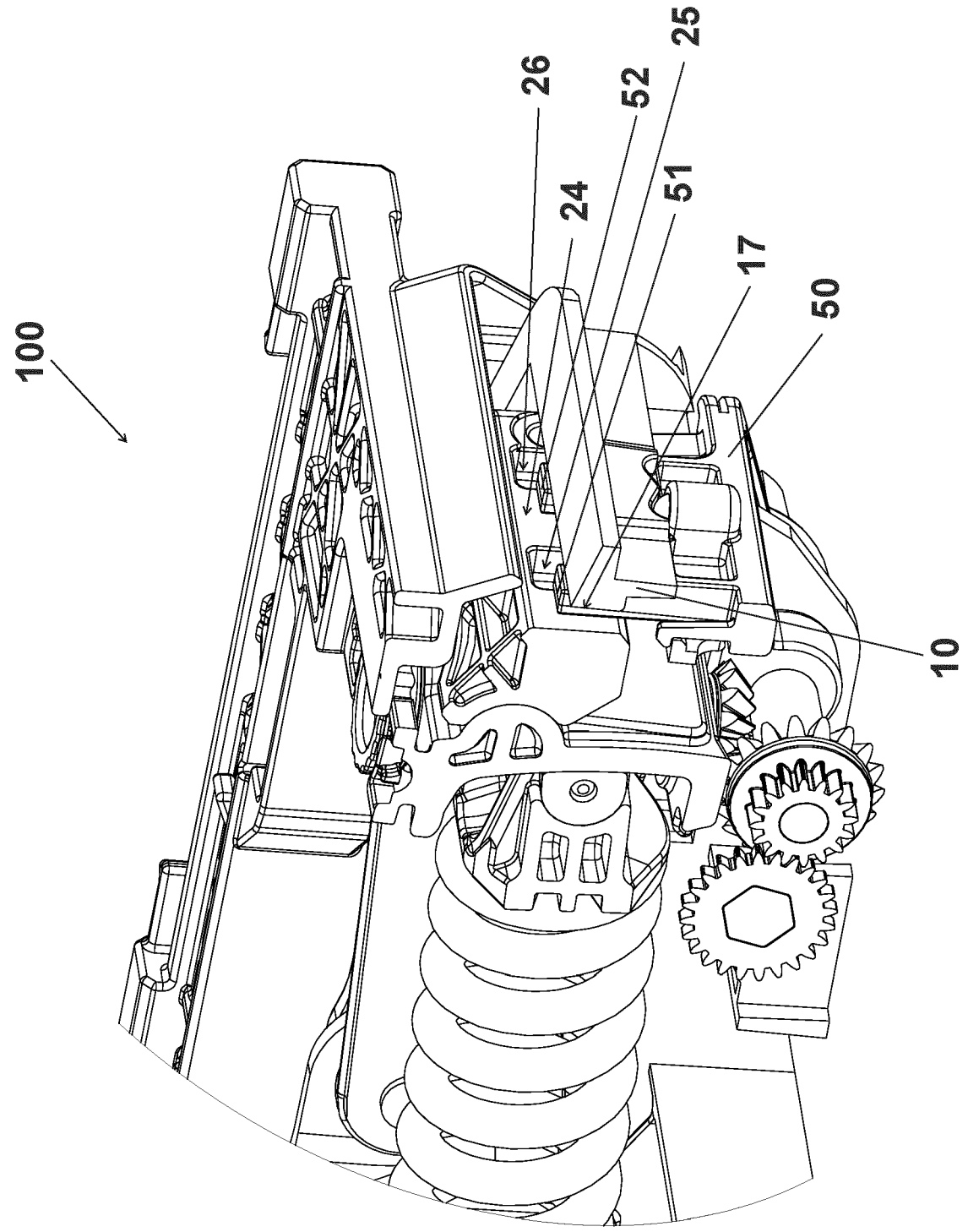


Fig. 20

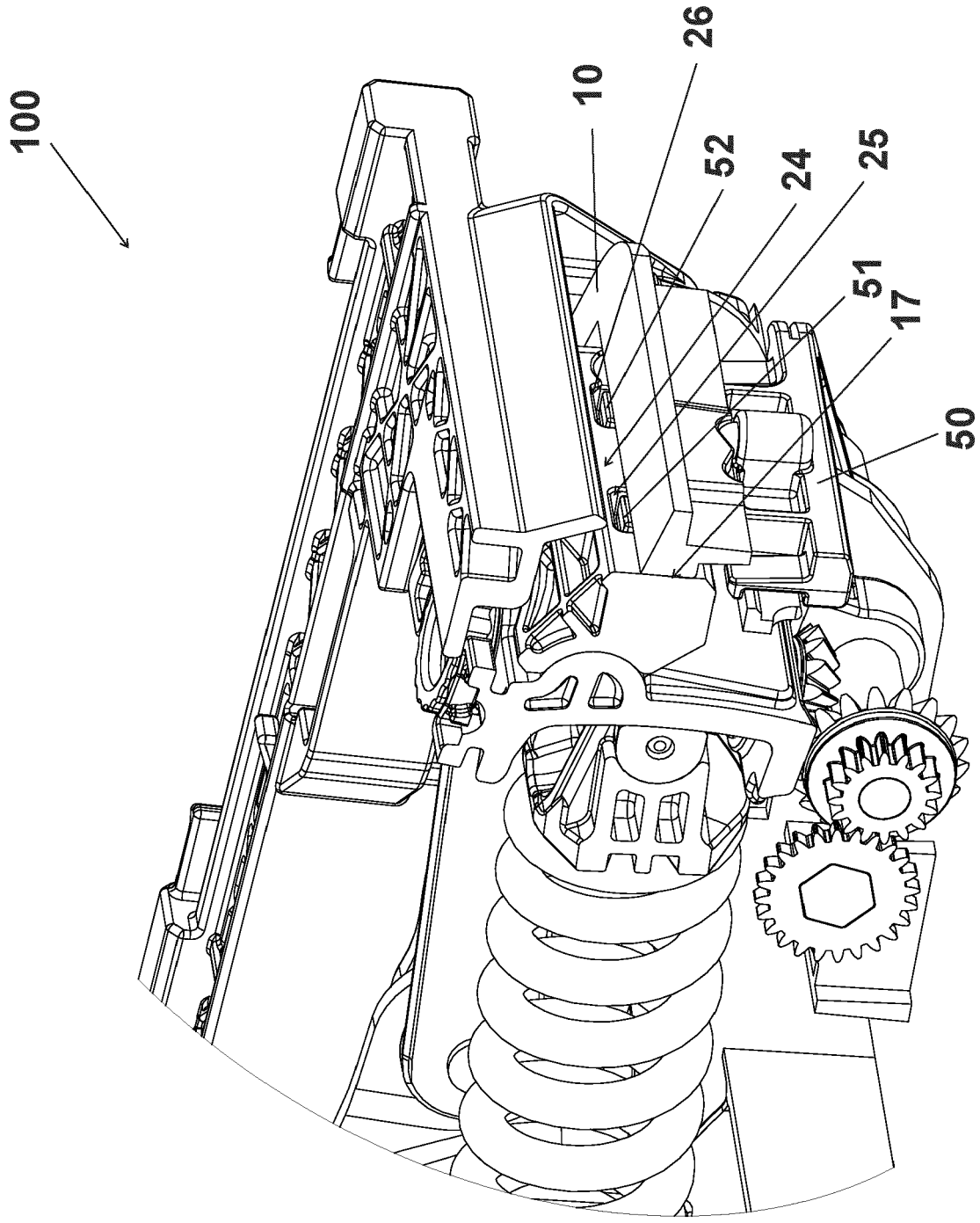


Fig. 21

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EUROPEAN SEARCH REPORT

Application Number
EP 22 19 4098

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A47C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	14 February 2023	Kis, Pál

CATEGORY OF CITED DOCUMENTS

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