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(54) **MECHANICAL STRETCHING DEVICE FOR MOVABLE SEAT UNIT AND SEAT UNIT**

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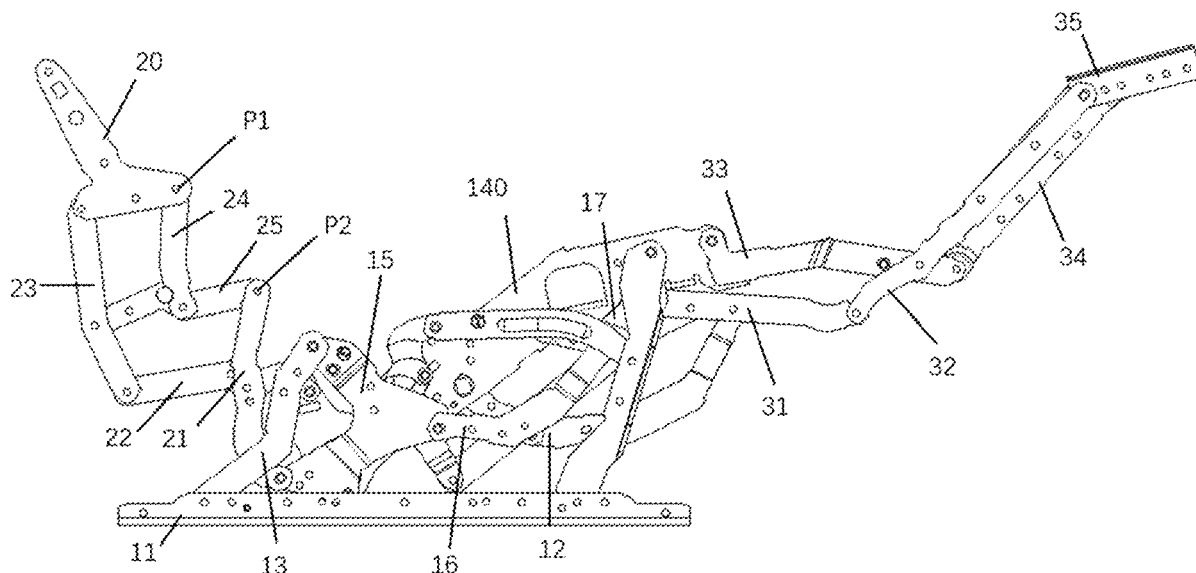
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(57) **ABSTRACT**

The present disclosure relates to a mechanical stretching device for a movable seat unit, including: a seat assembly, including a base assembly, a lateral plate, and a central driven member; a backrest assembly, pivotally connected to a rear part of the lateral plate; a leg stretching device, pivotally connected to a front part of the lateral plate, including a first footrest member; the mechanical stretching device allows the seat unit to be switched between a sitting position and a lying position; the first footrest member is folded below a seat when in the sitting position; and the backrest is relined backward, a highest point of the footrest is higher than a highest point of the backrest, and the first footrest member is stretched forward and upward, when in the lying position. The present disclosure further relates to a movable seat unit.



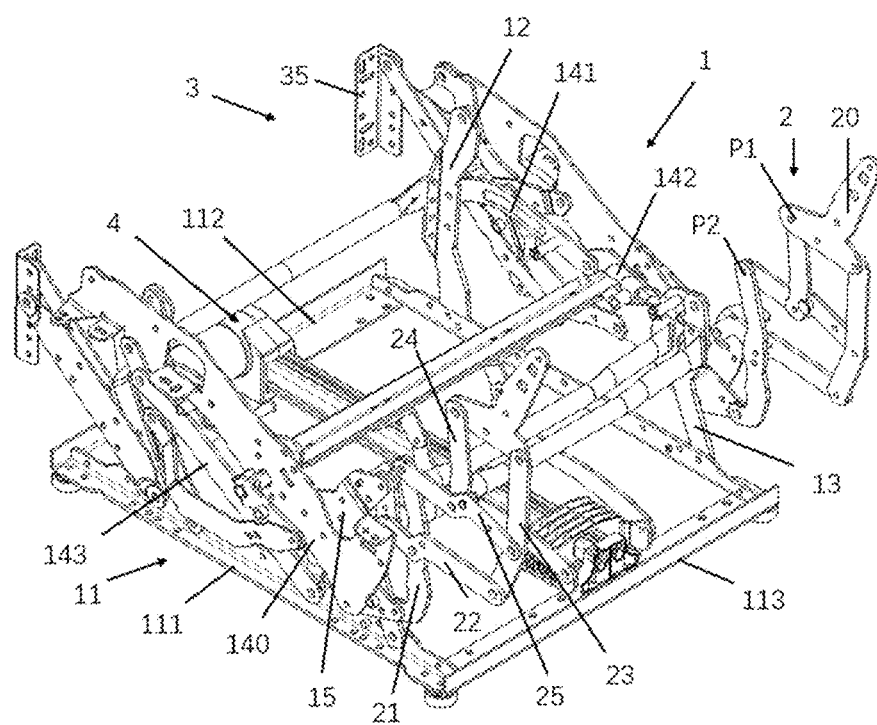


Fig. 1

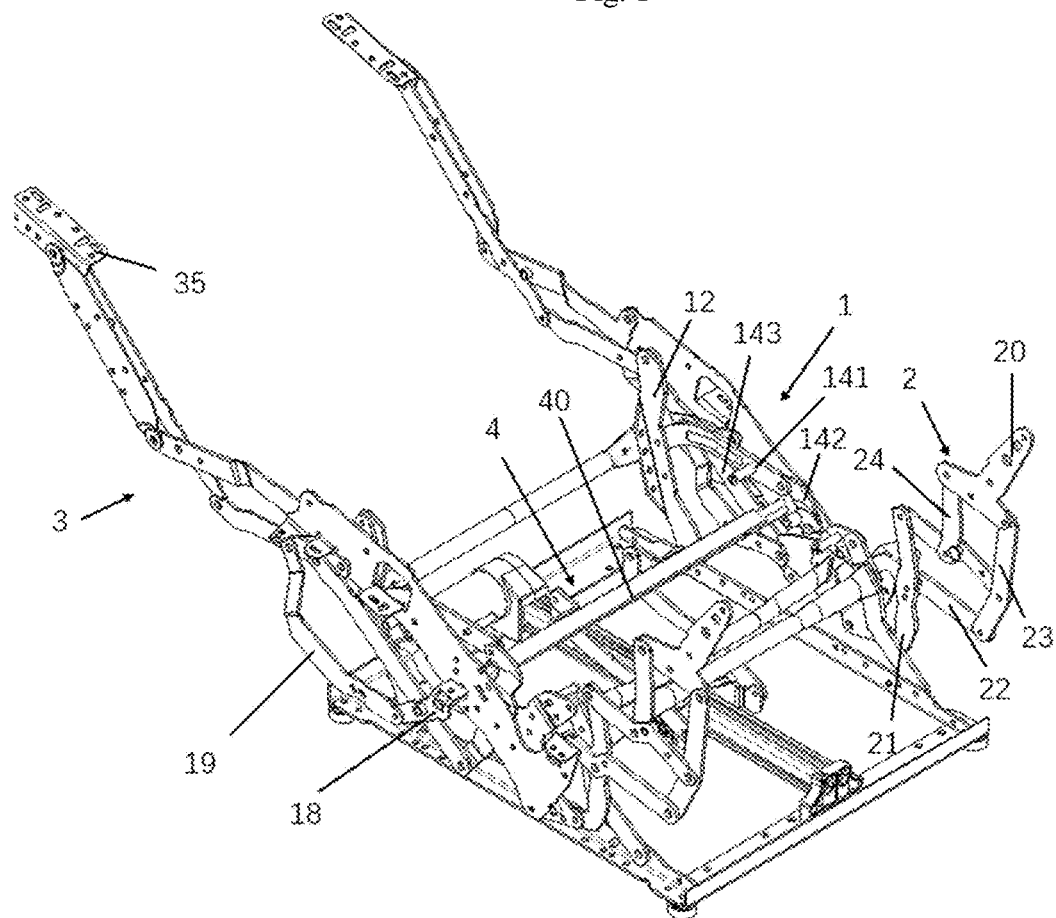


Fig. 2

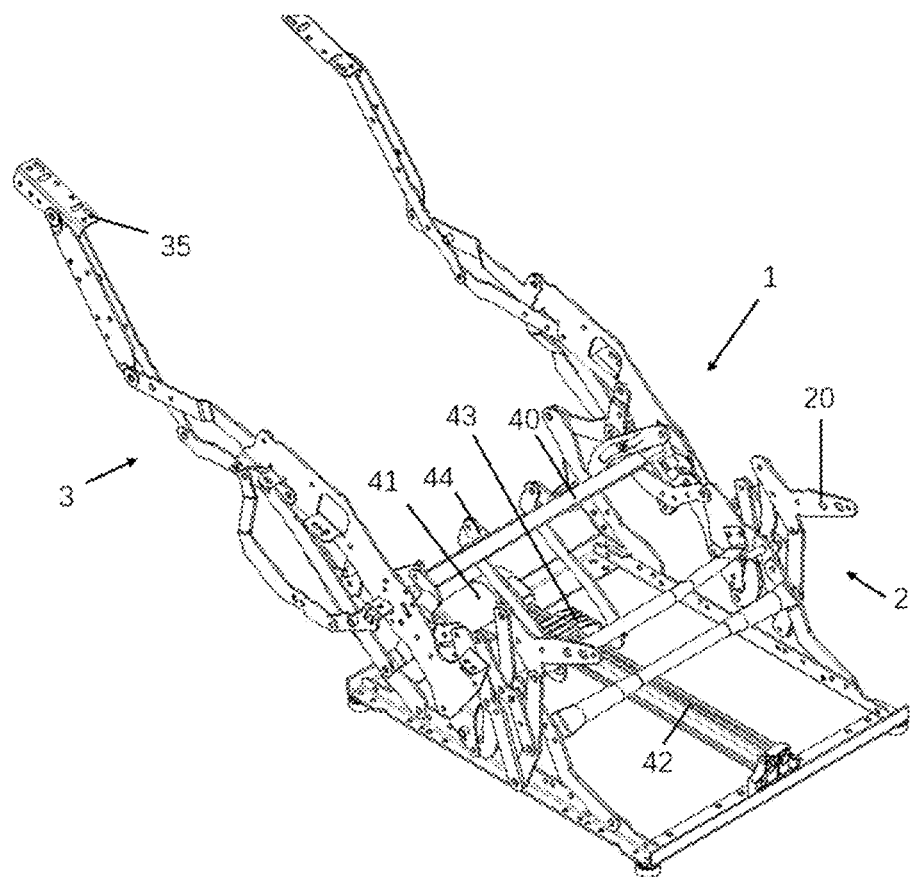


Fig. 3

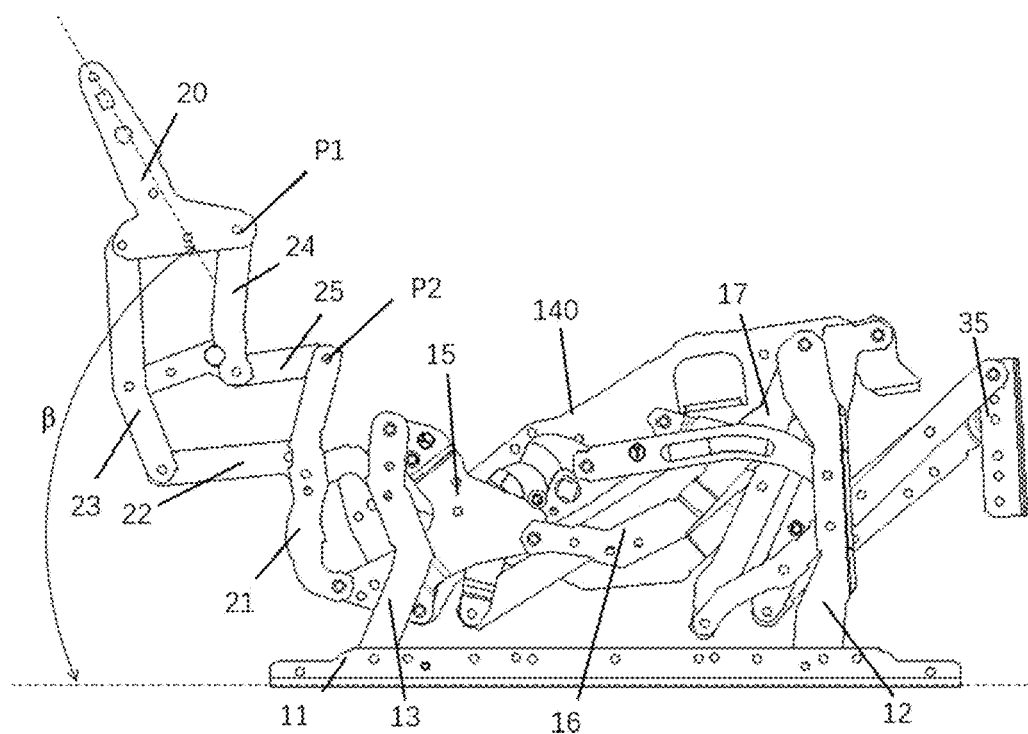


Fig. 4

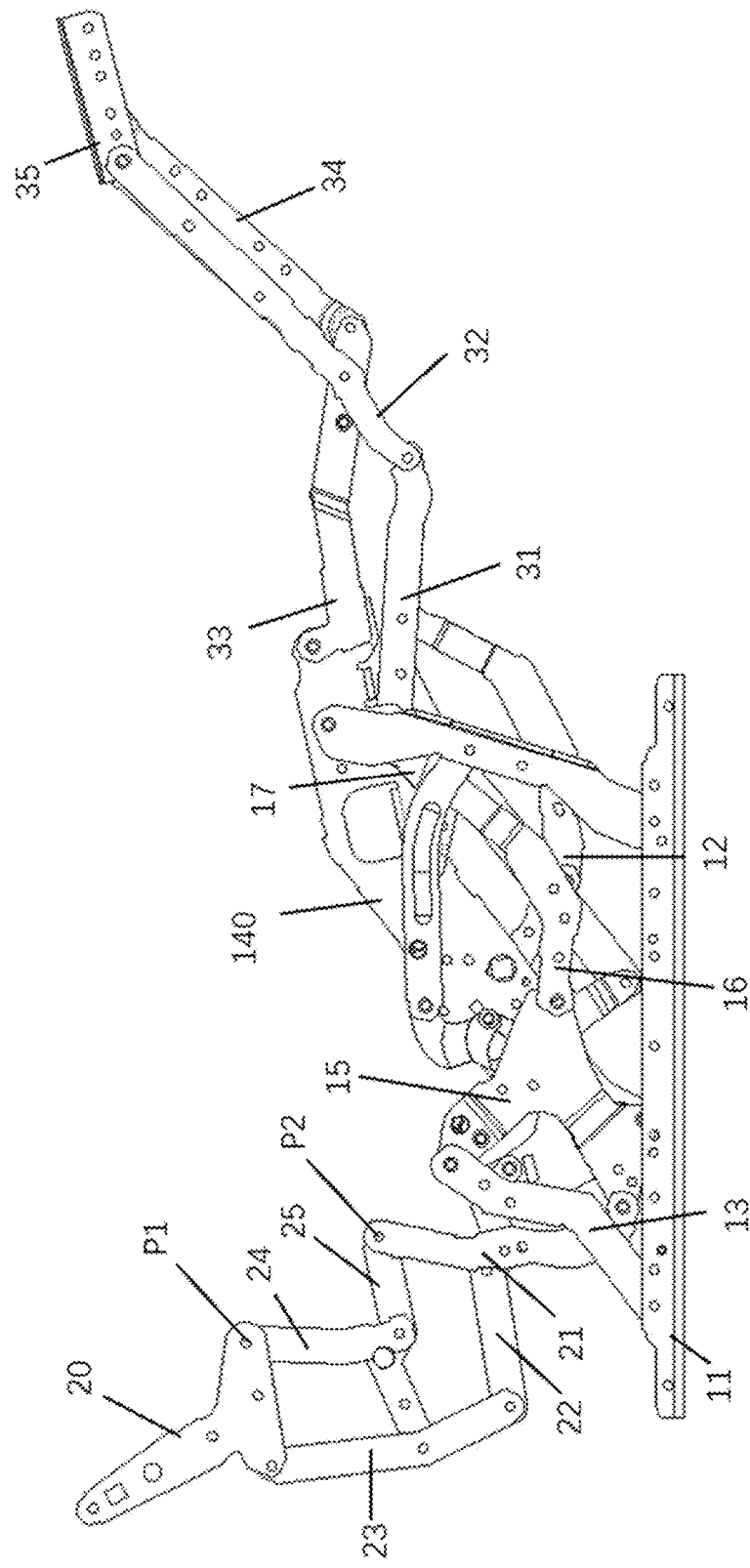


Fig. 5

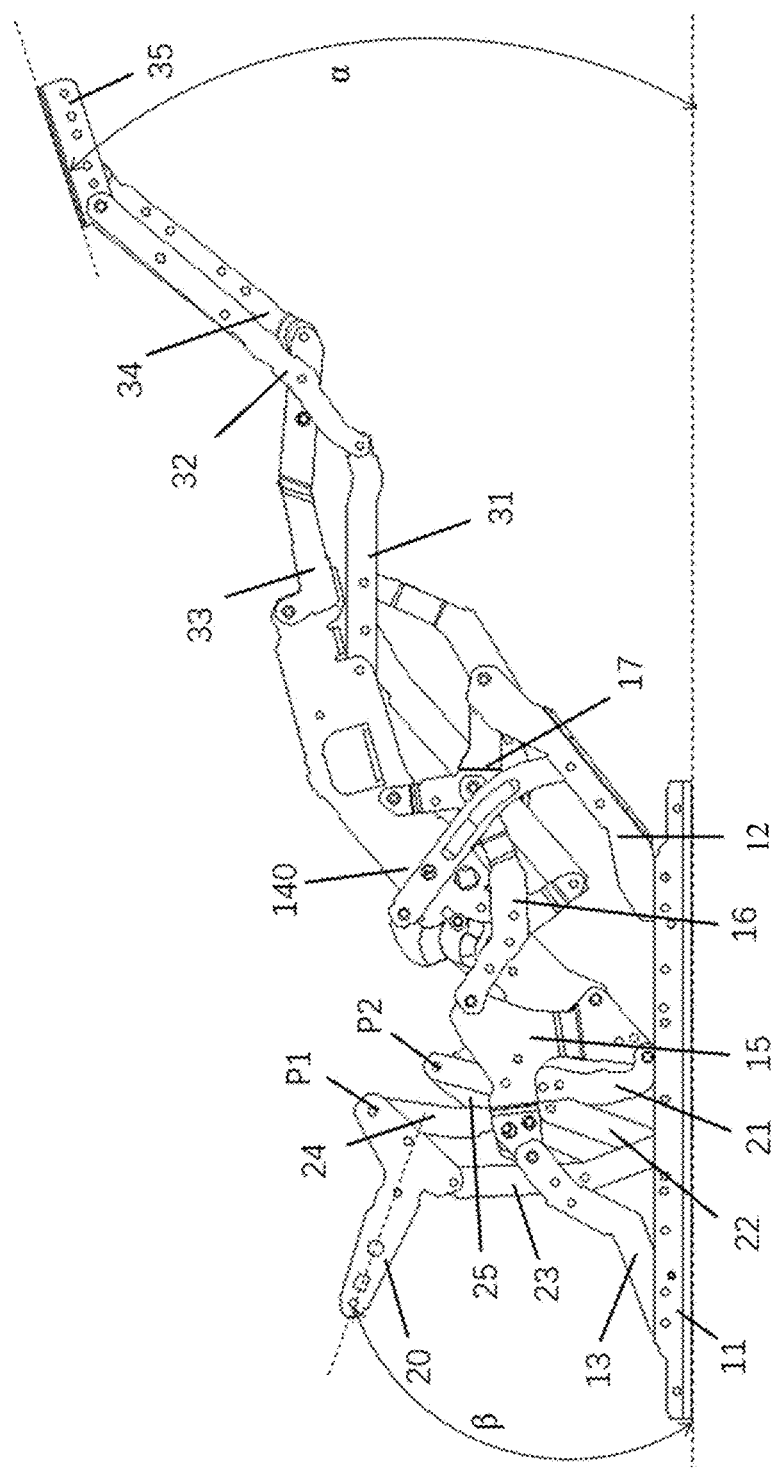


Fig. 6

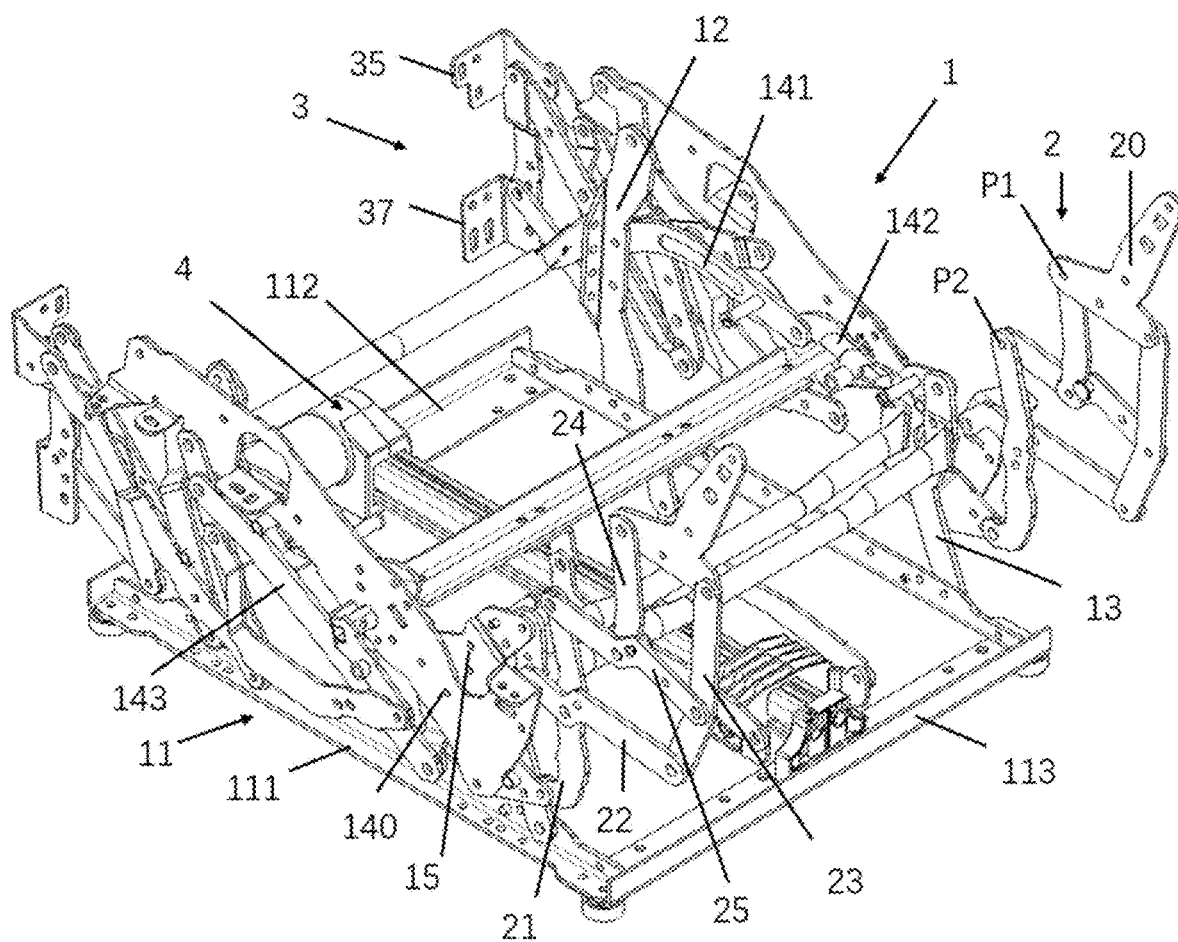


Fig. 7

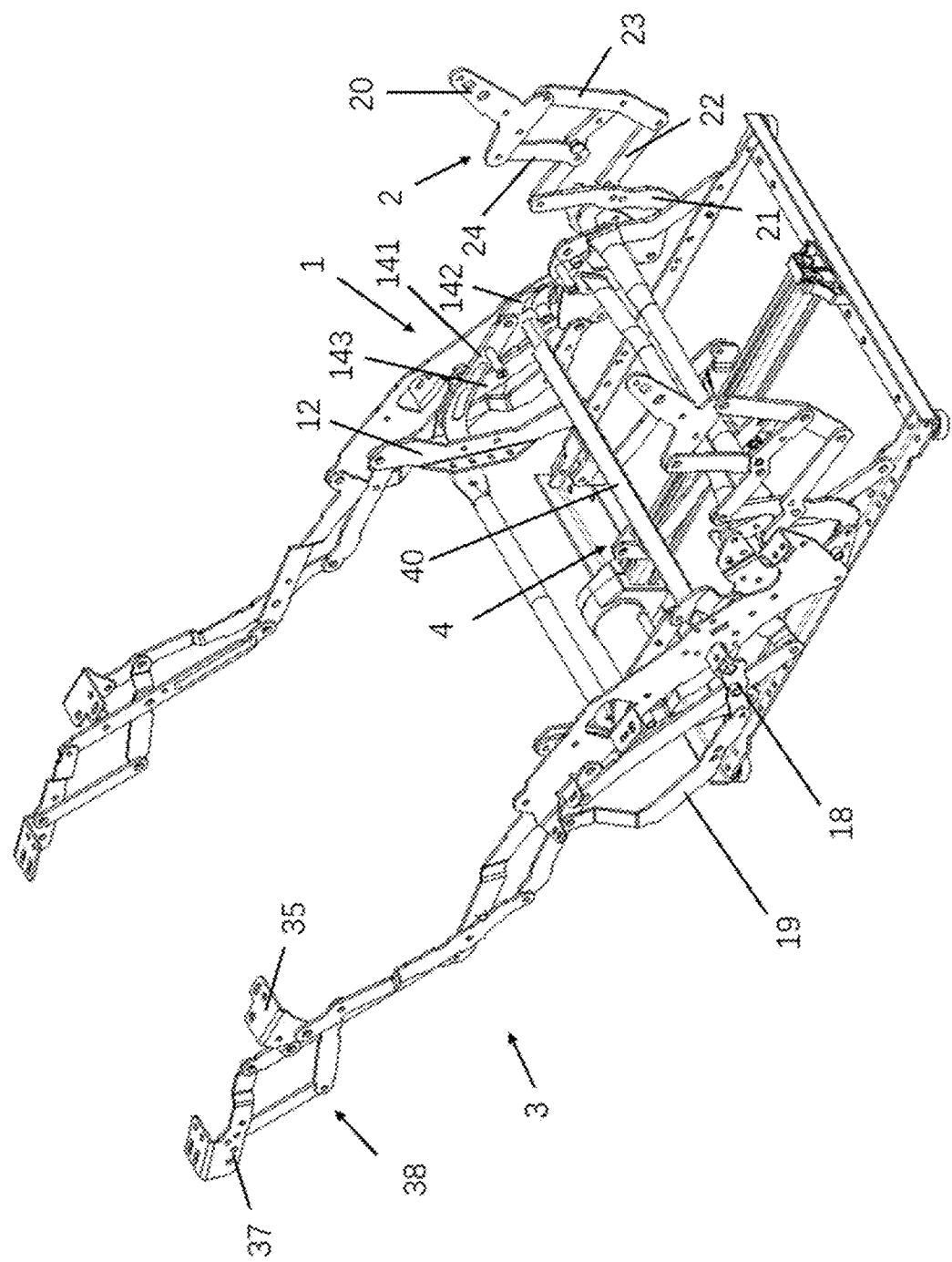


Fig. 8

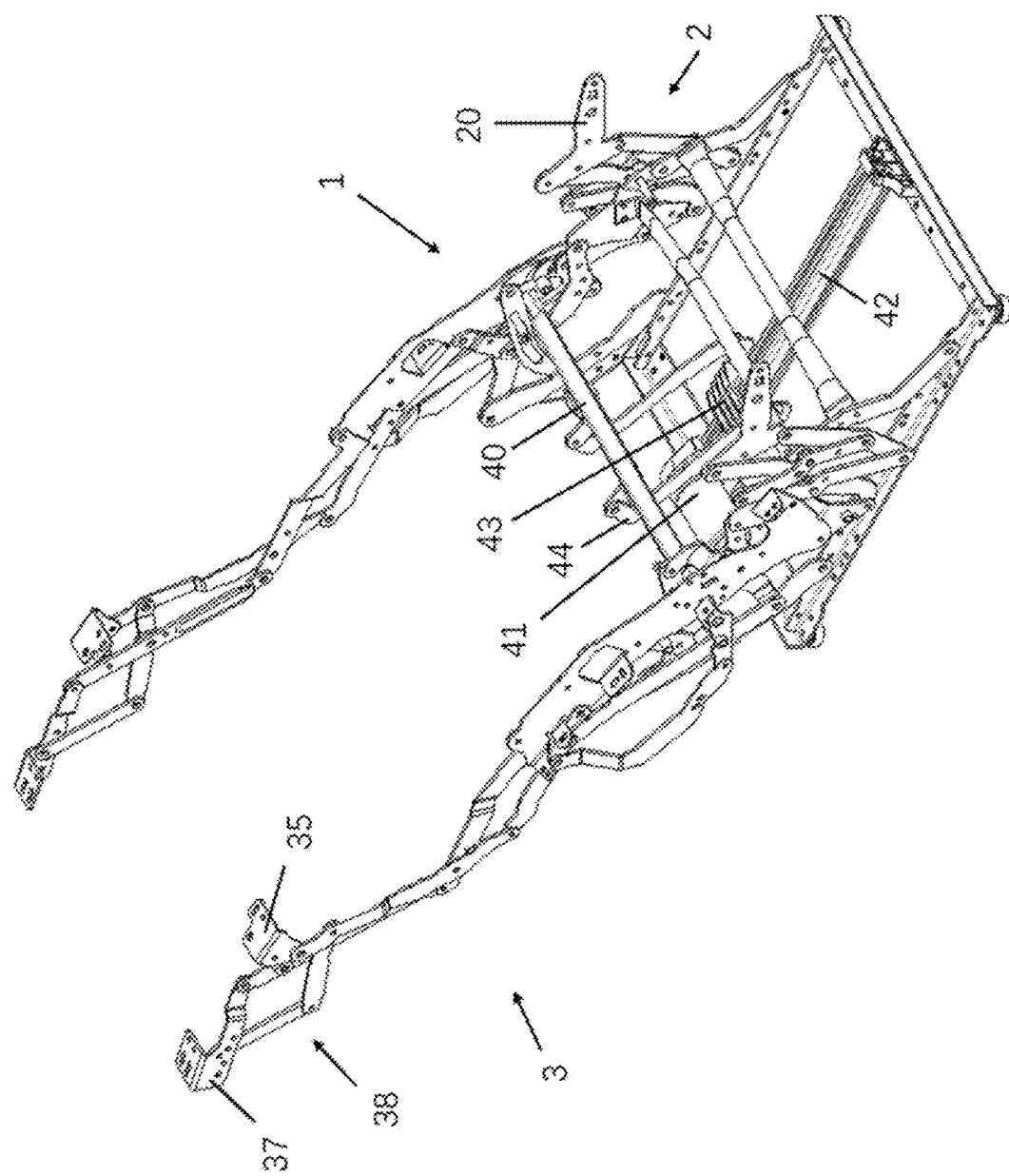


Fig. 9

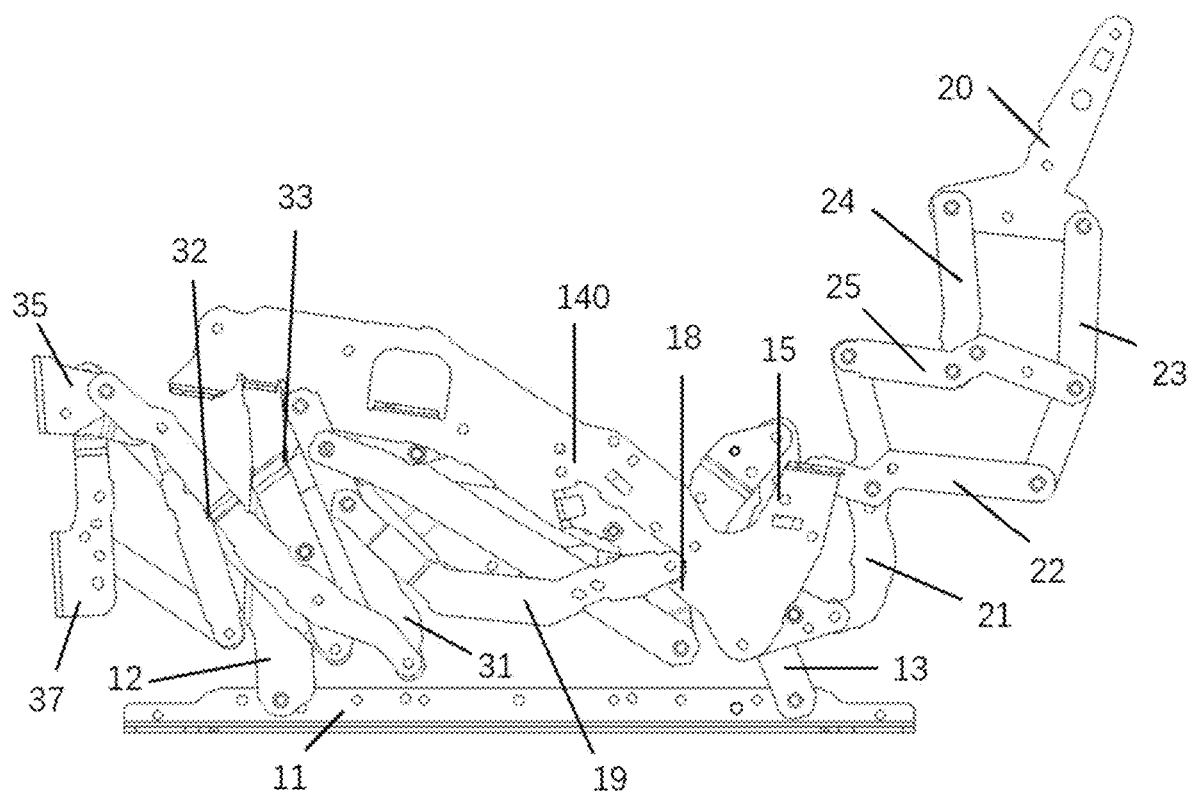


Fig. 10

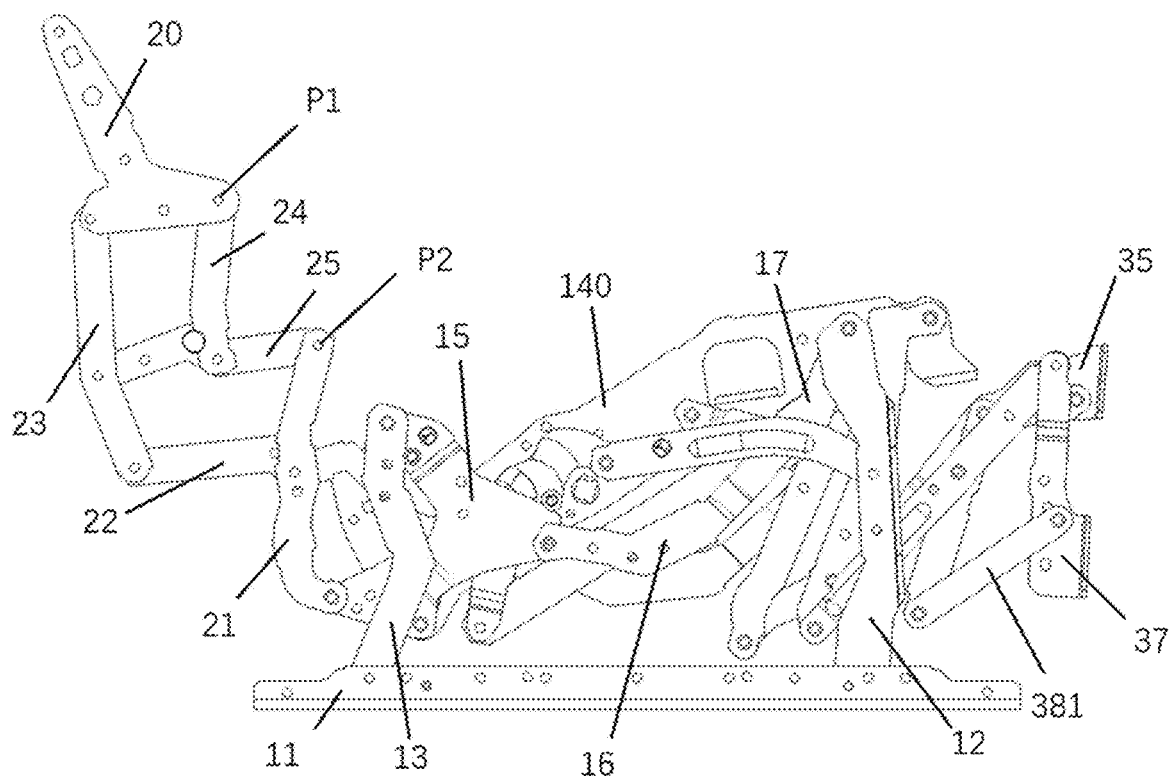


Fig. 11

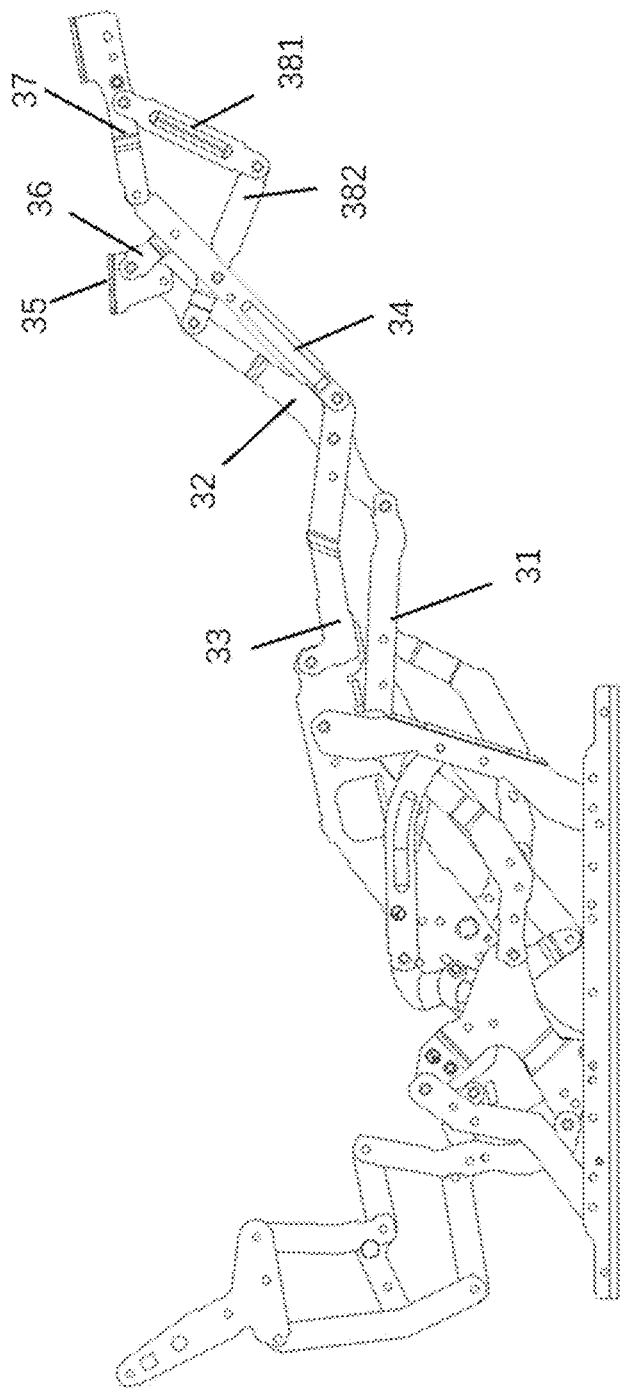


Fig. 12

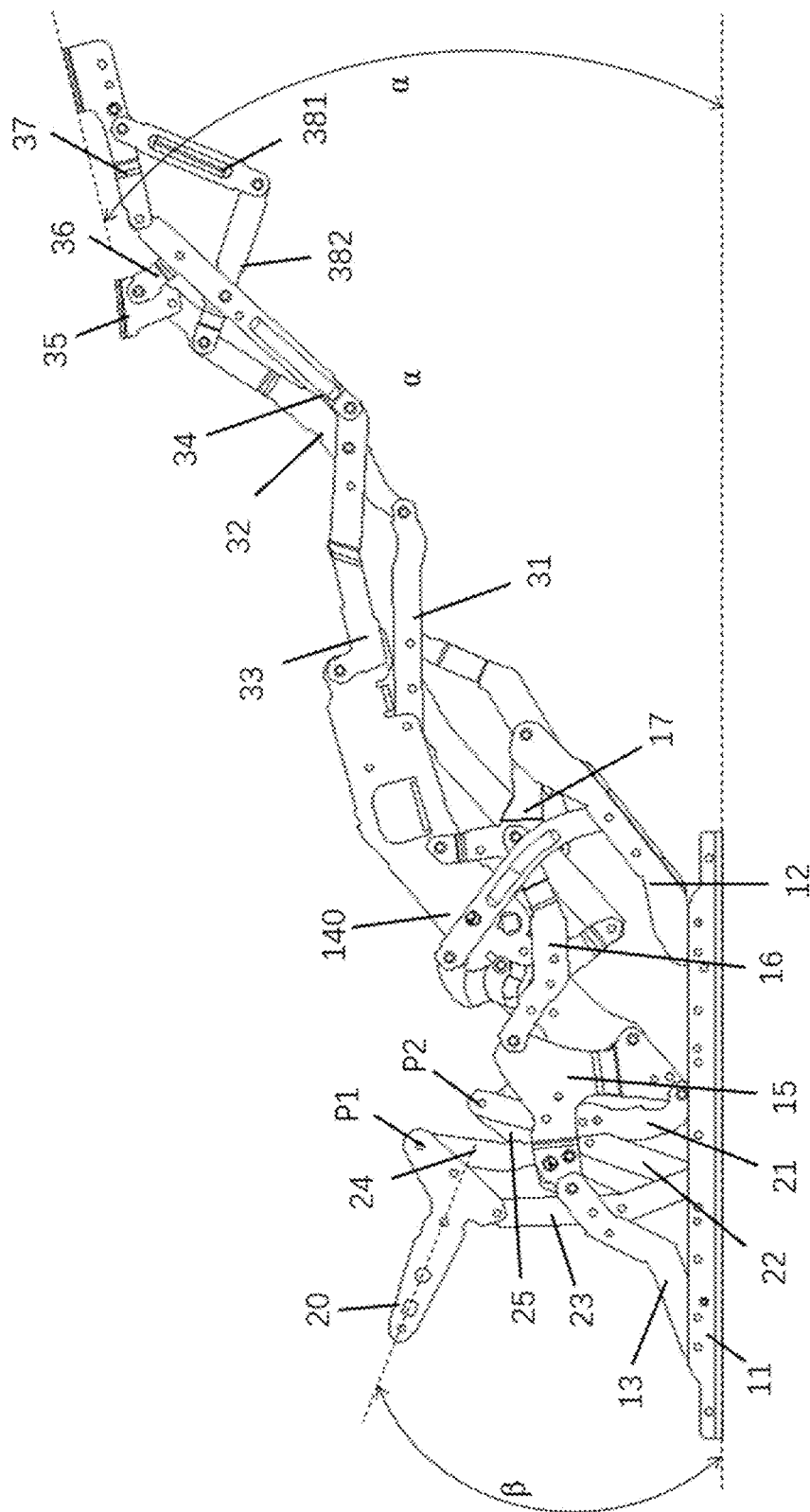


Fig. 13

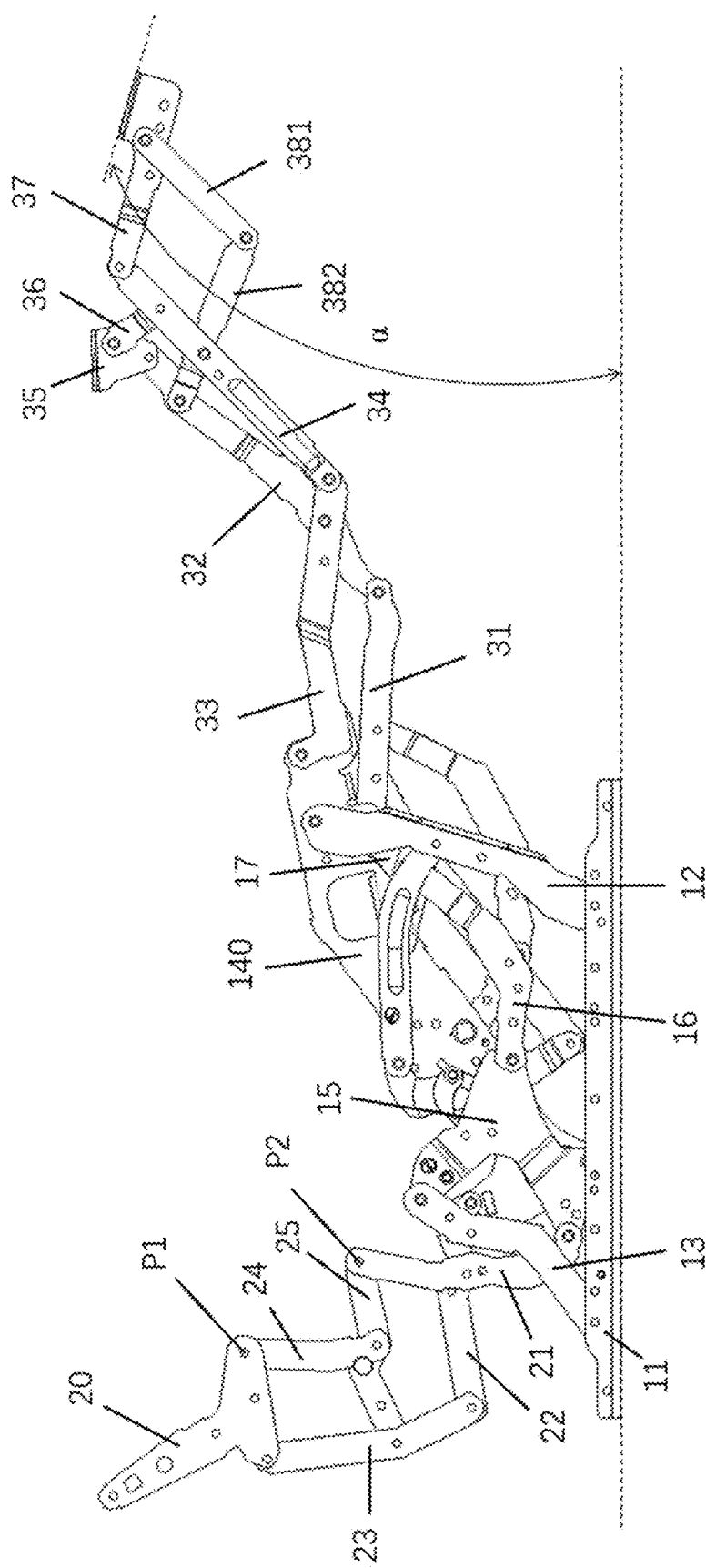


Fig. 14

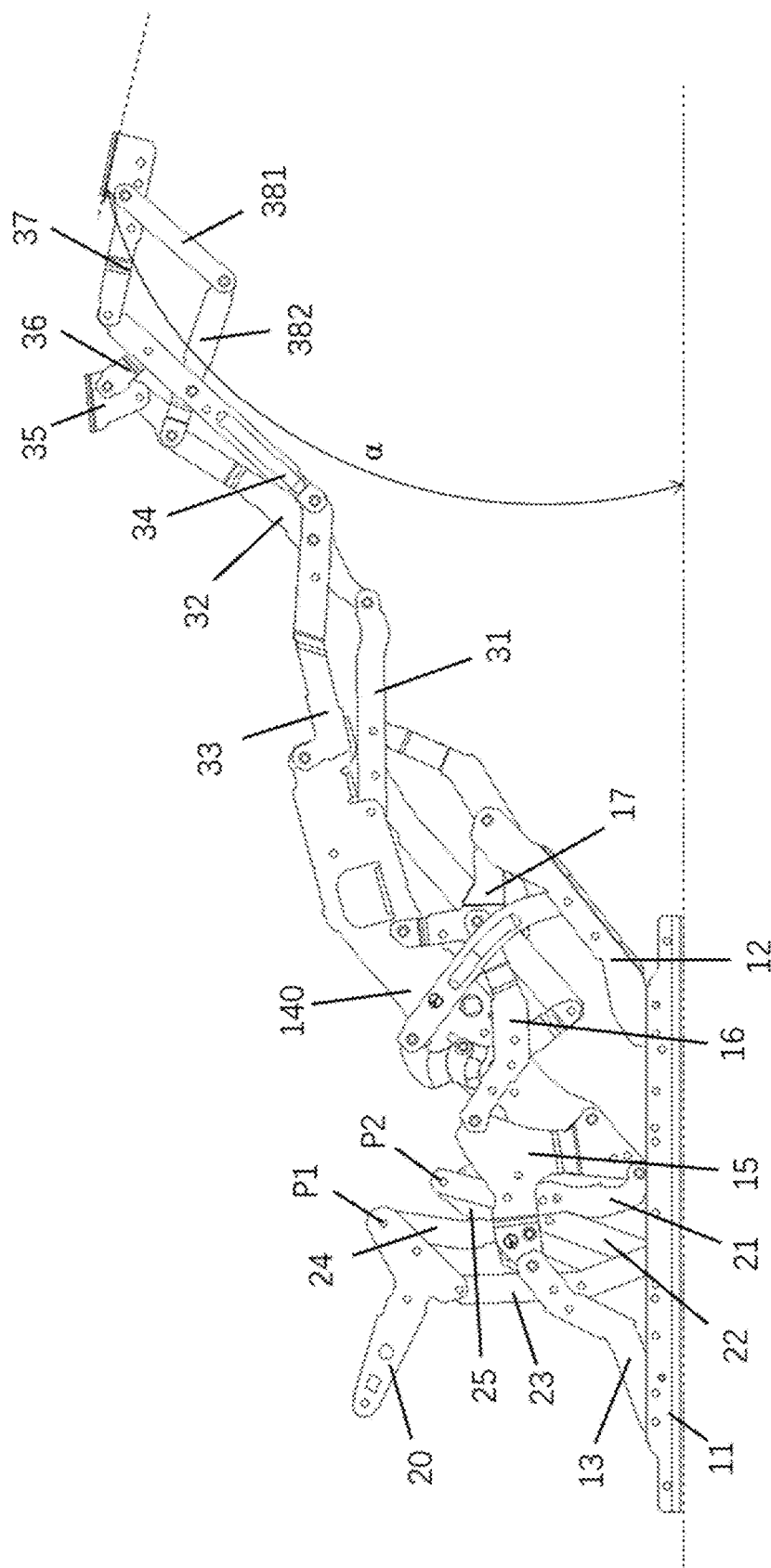


Fig. 15

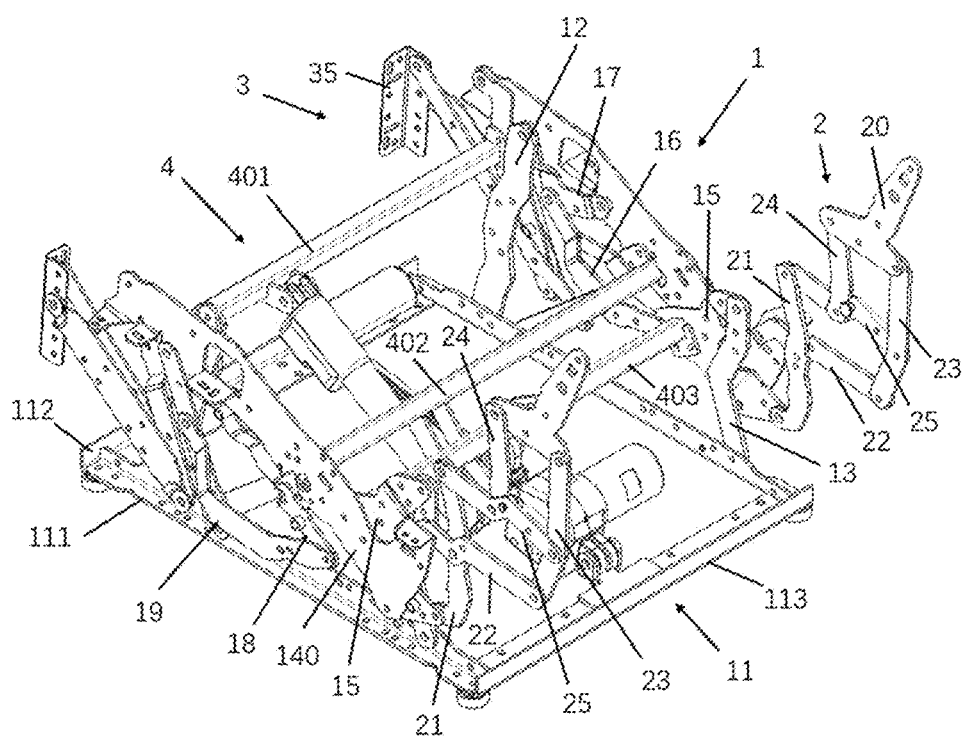


Fig. 16

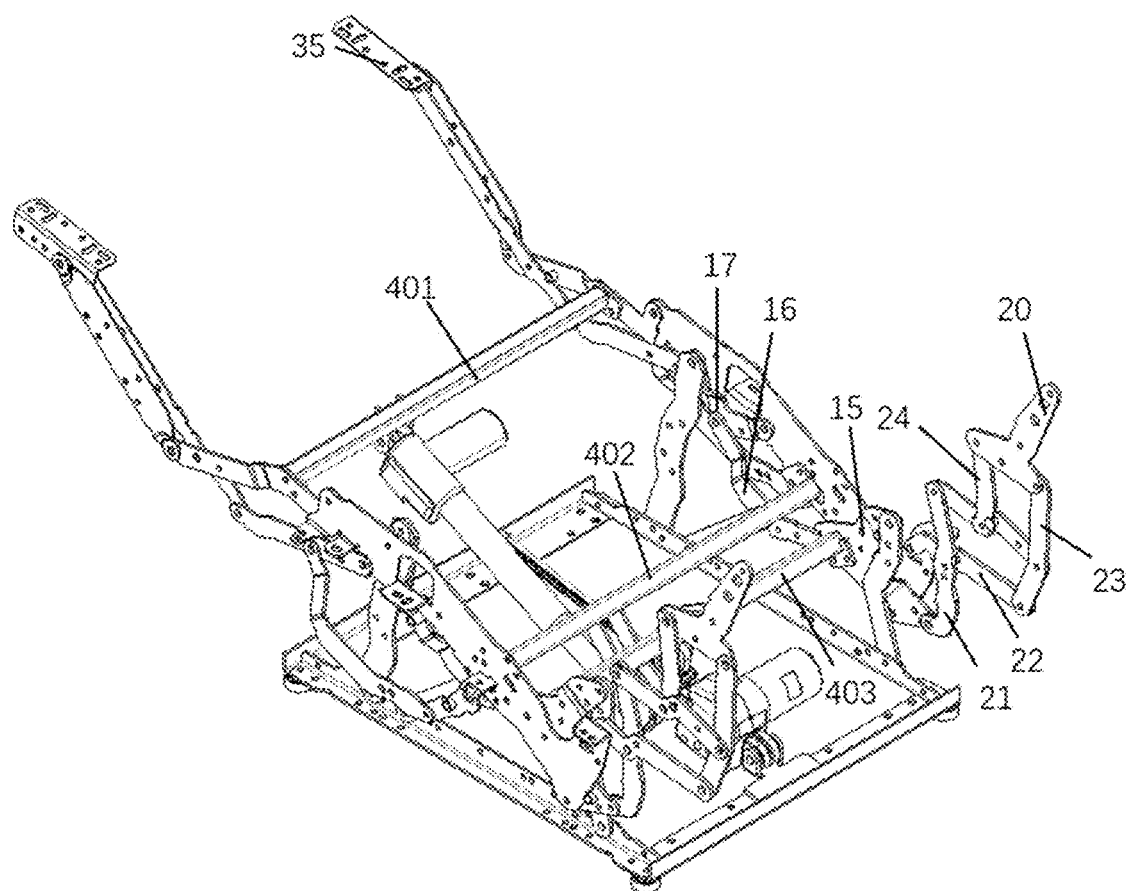


Fig. 17

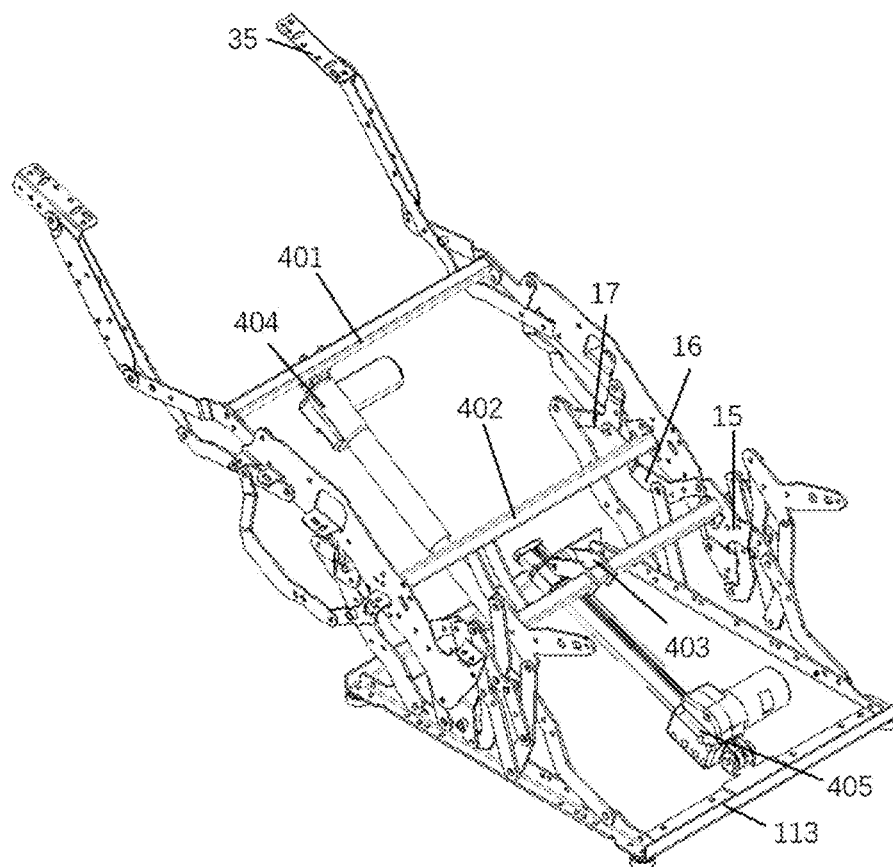


Fig. 18

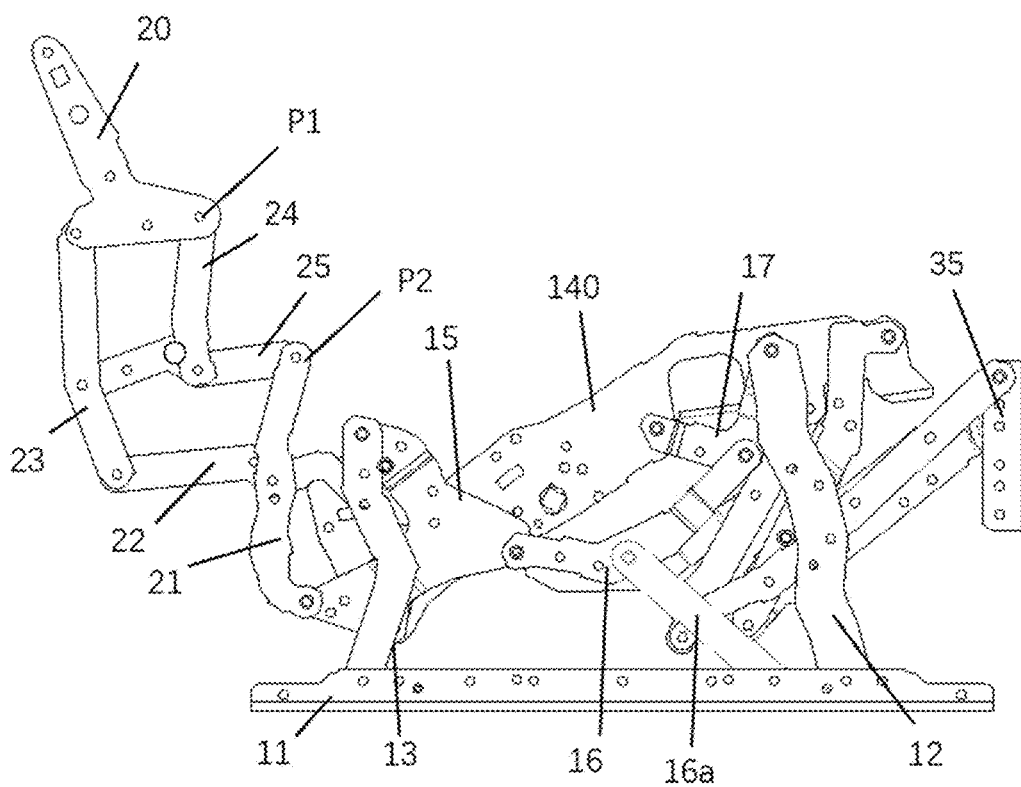


Fig. 19

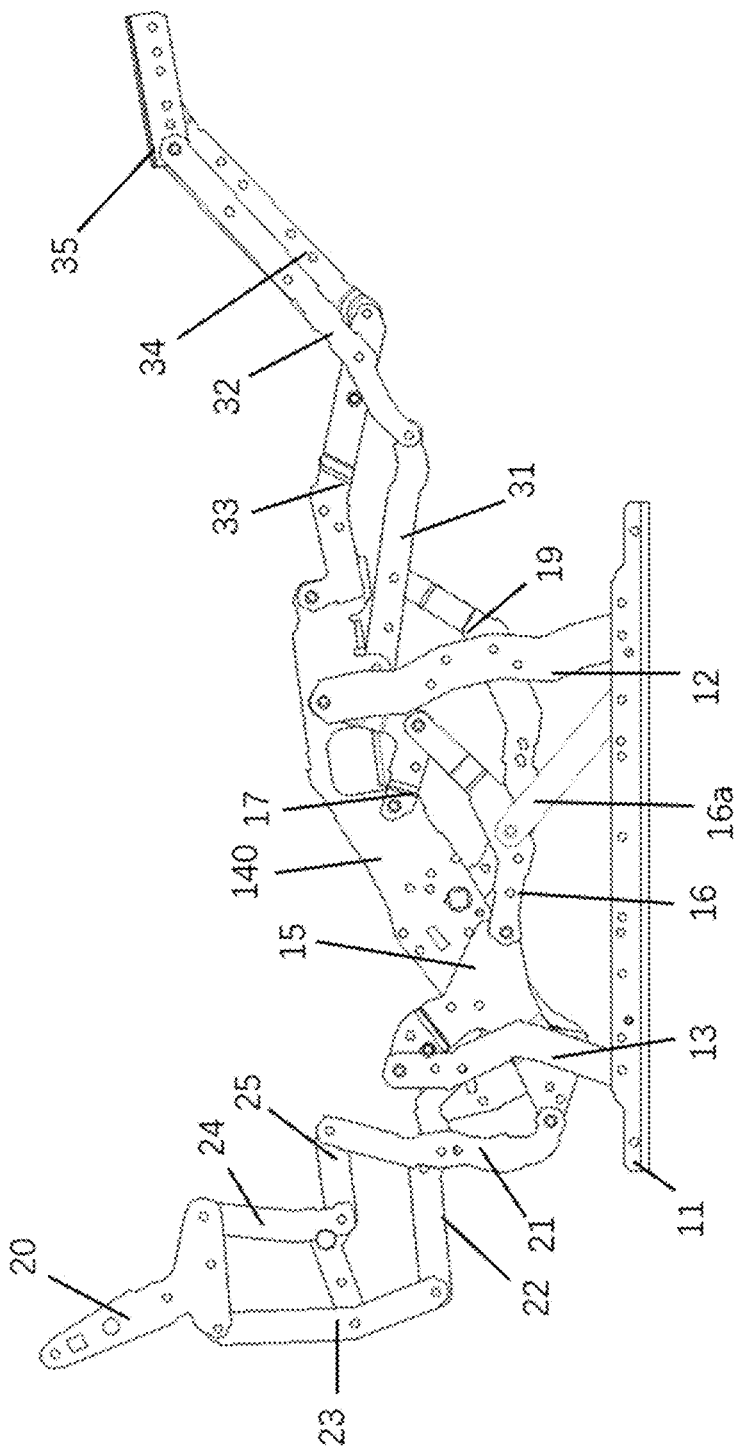


Fig. 20

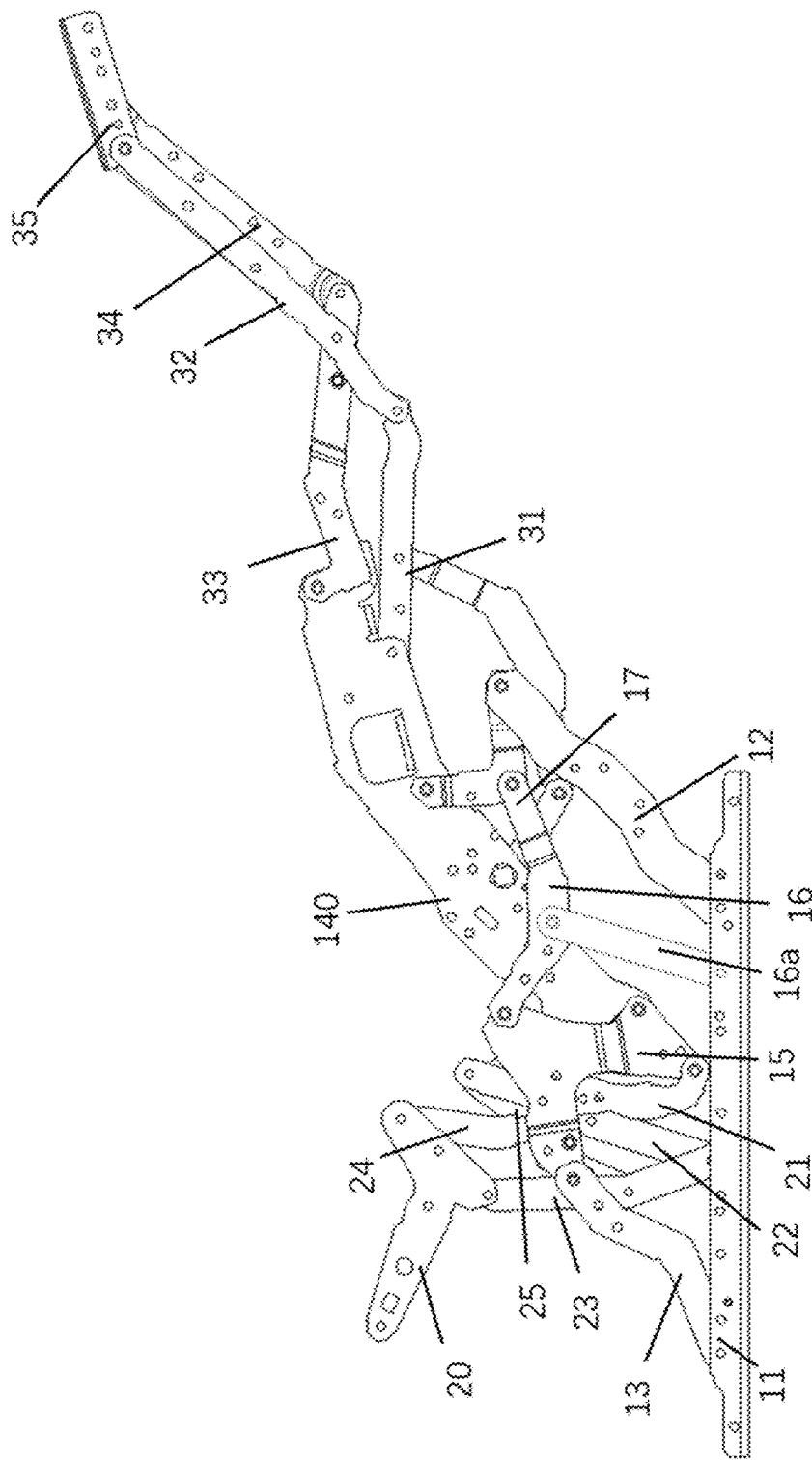


Fig. 21

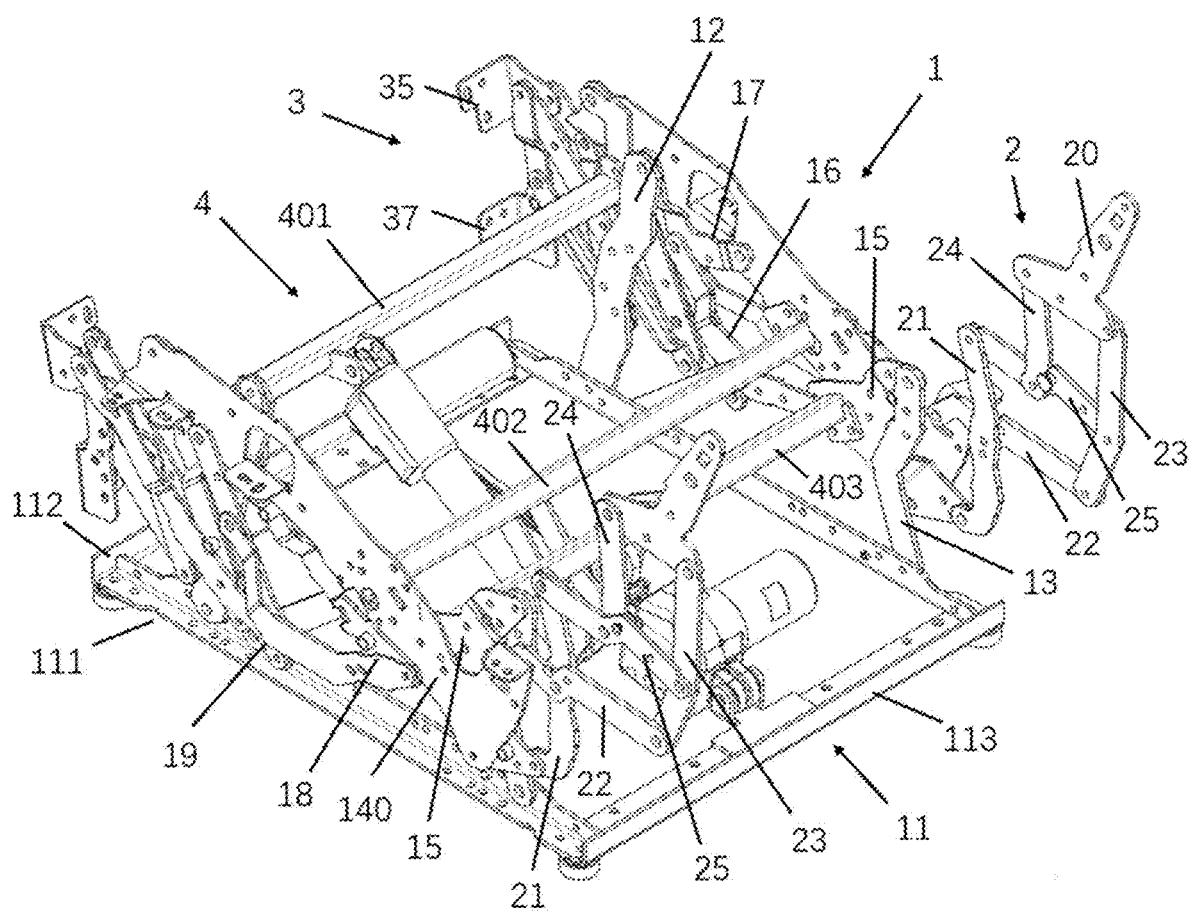


Fig. 22

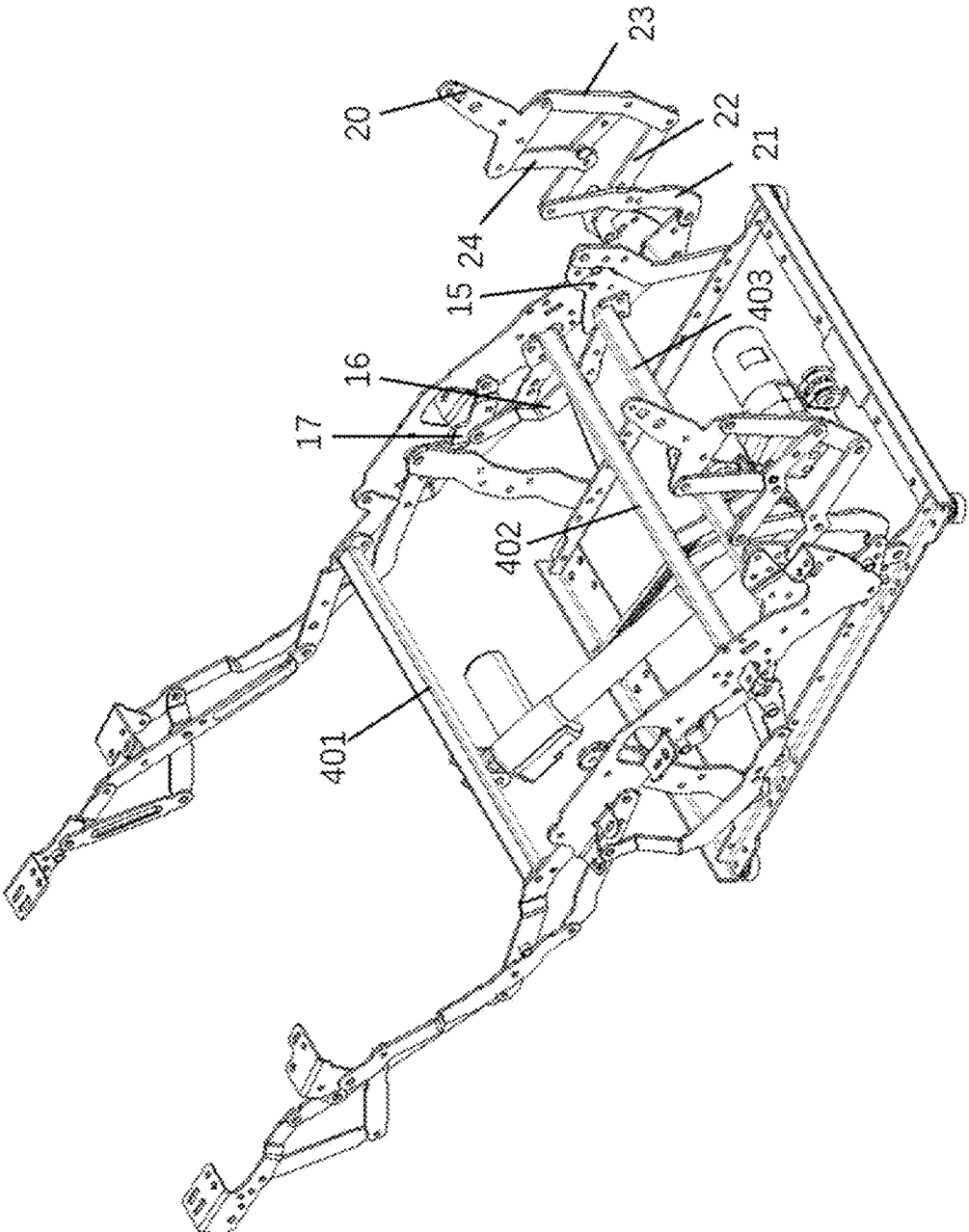


Fig. 23

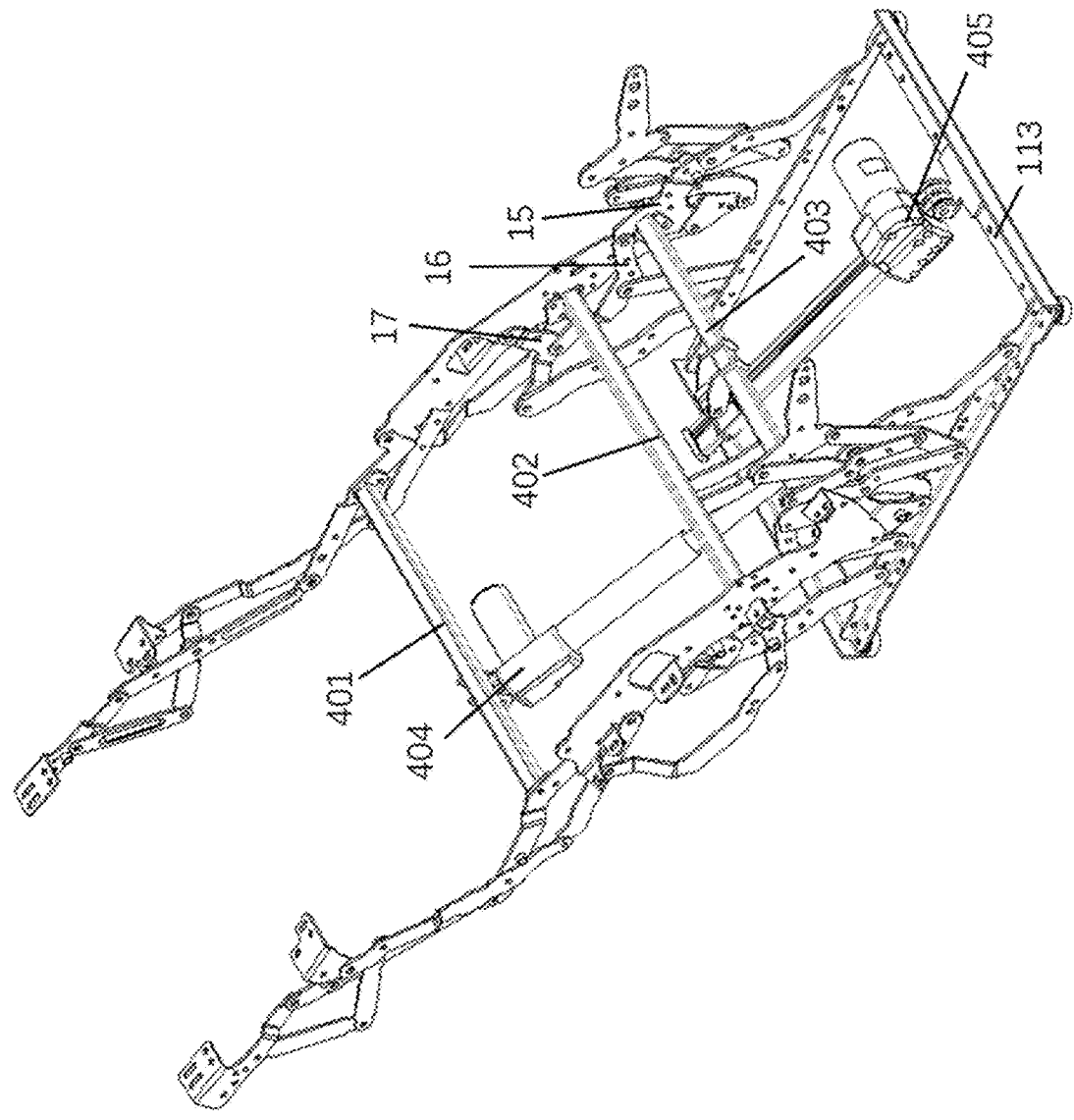


Fig. 24

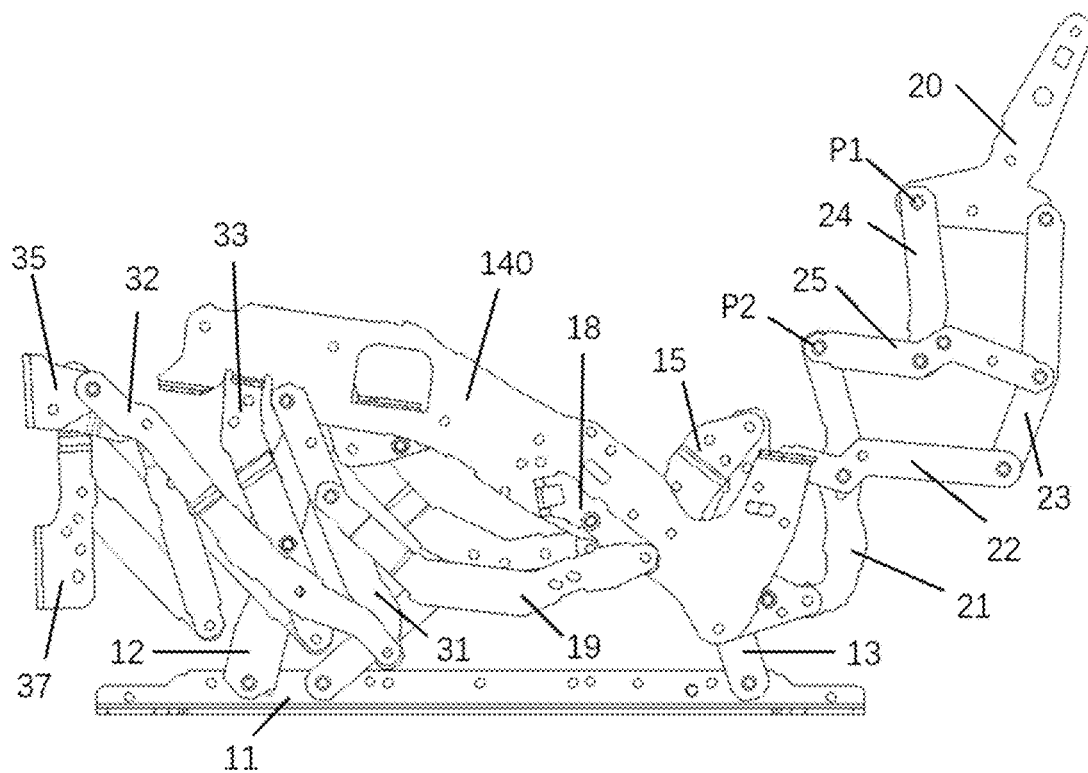


Fig. 25

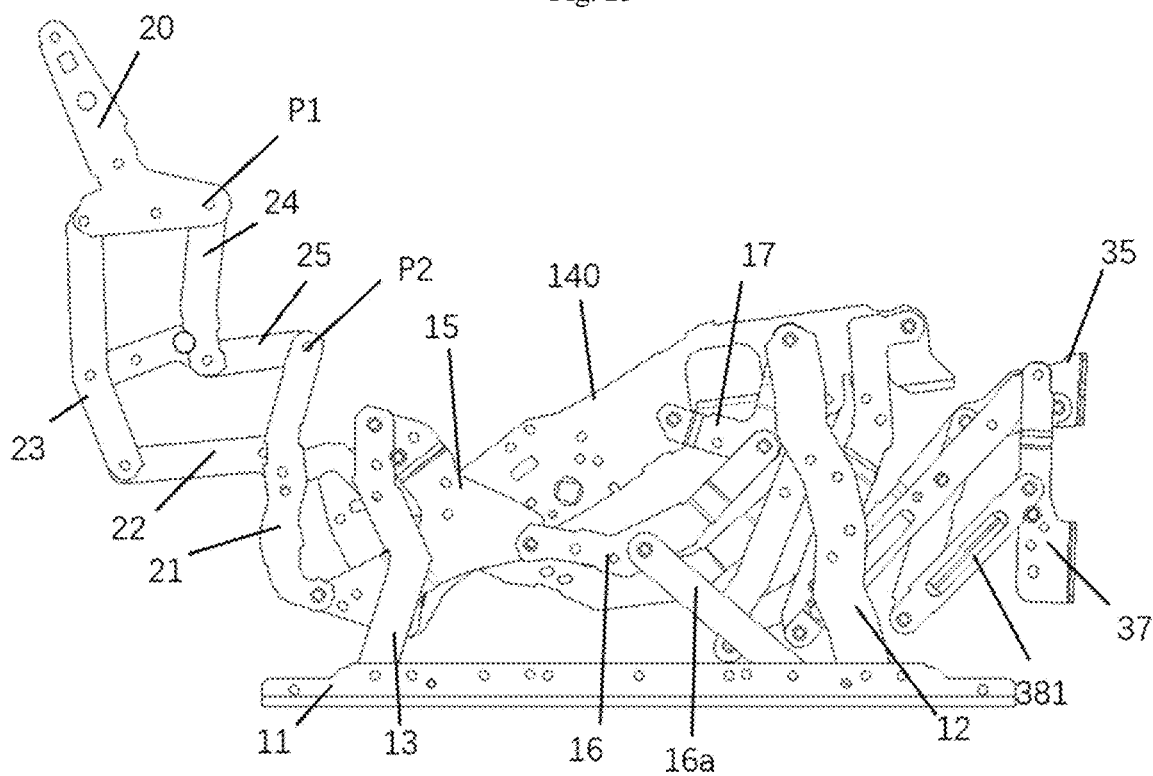


Fig. 26

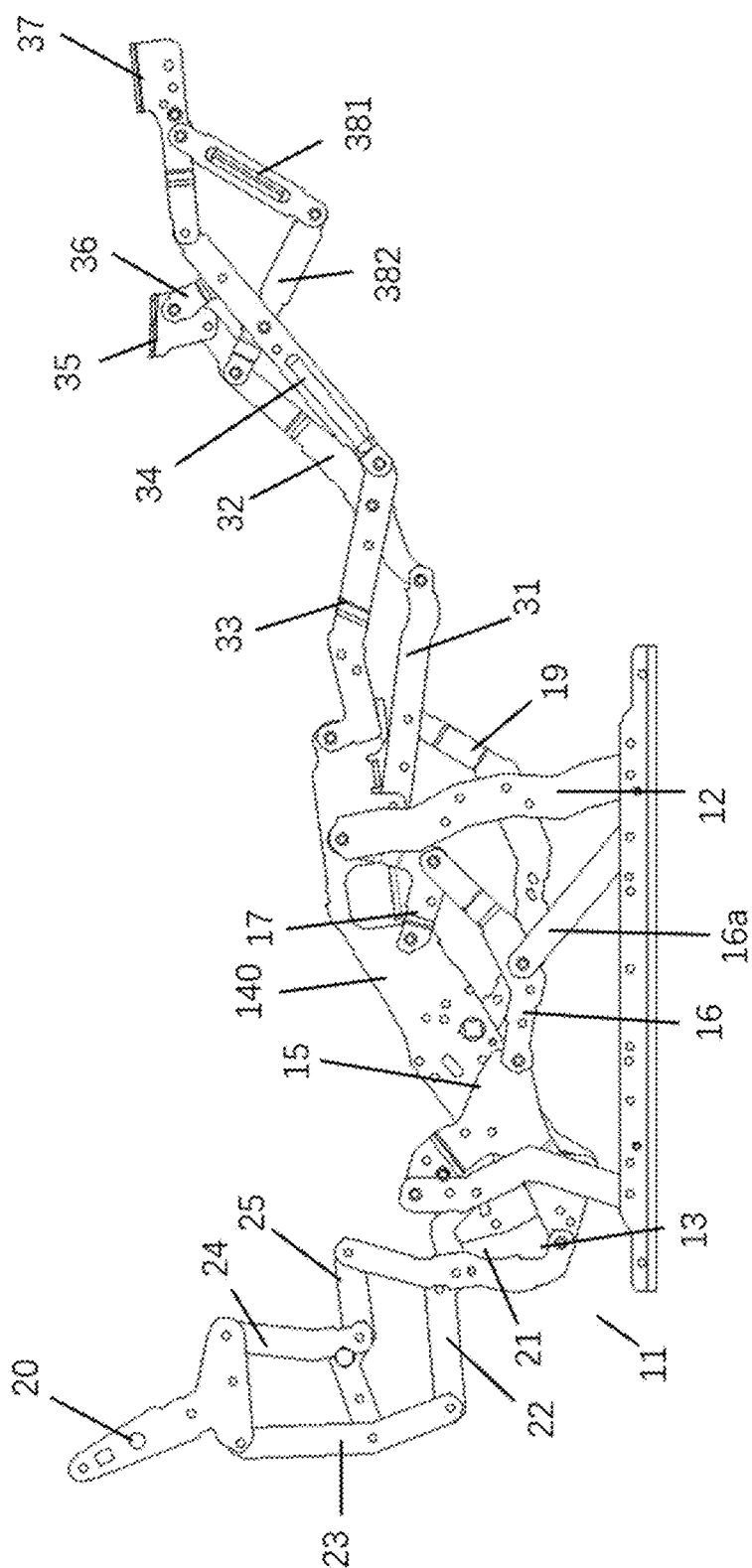


Fig. 27

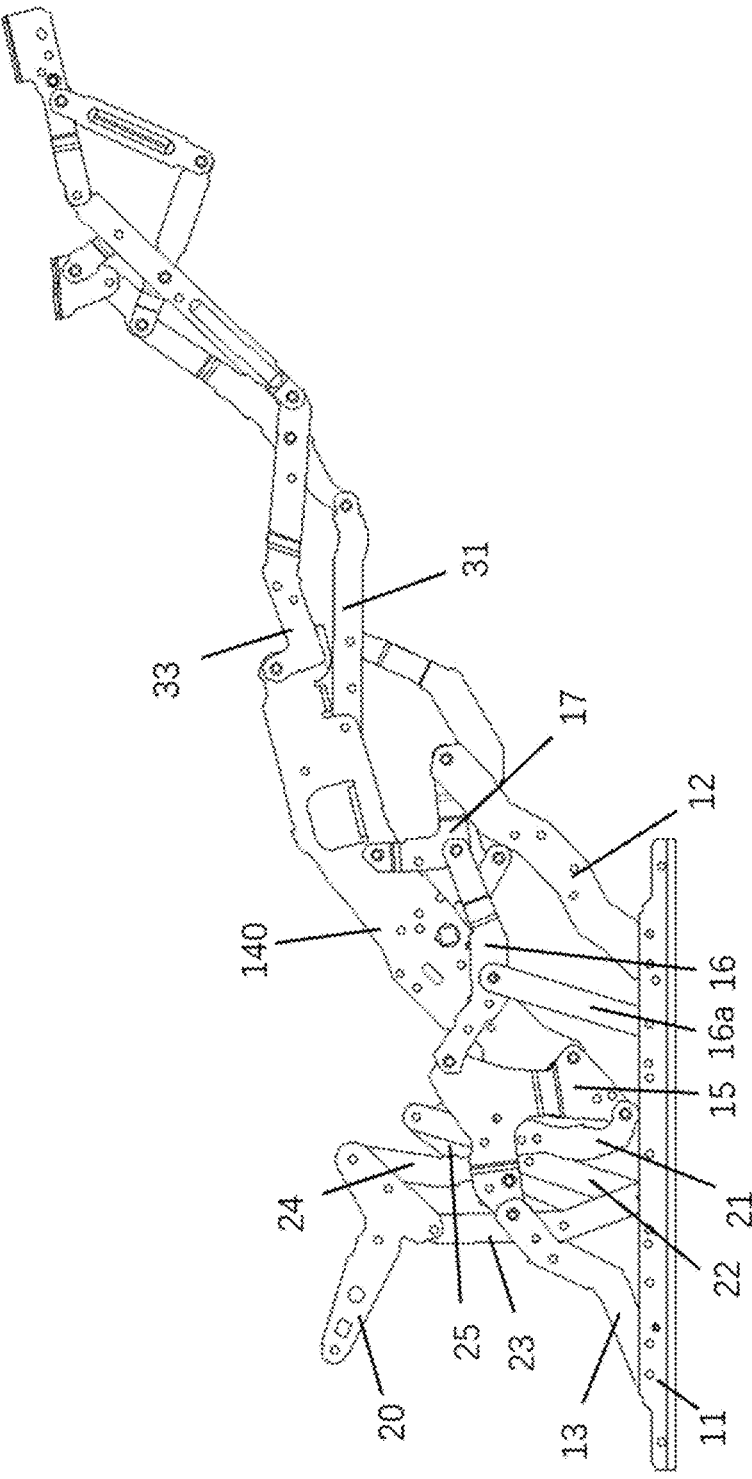


Fig. 28

## MECHANICAL STRETCHING DEVICE FOR MOVABLE SEAT UNIT AND SEAT UNIT

### CROSS REFERENCE TO RELEATED APPLICATIONS

[0001] The present application is a Continuation Application of PCT Application No. PCT/CN2024/127047 filed on Oct. 24, 2024, which claims priority of Chinese Patent Application No. 2023229044498 filed on Oct. 27, 2023 before CNIPA and Chinese Patent Application No. 2023229211683 filed on Oct. 27, 2023 before CNIPA. All the above are hereby incorporated by reference in their entirety as part of the present disclosure.

### TECHNICAL FIELD

[0002] The present disclosure relates to a mechanical stretching device for a movable seat unit, and a seat unit including the mechanical stretching device.

### BACKGROUND

[0003] A variety of movable chair units are known in the prior art, such as sofas or seats with multi-position transformation functions. With the improvement of people's living standards, the comfort requirements for sofas and chairs are also increasing. In the known design, the movable chair unit generally includes a mechanical stretching device, whereby it can be switched between a sitting position, a TV position (or relaxing position) and a lying position. When the chair unit is switched from the sitting position to the relaxing position, the footrest of the chair unit extends forward, and the angle between the backrest and the seat cushion remains basically unchanged. When the chair unit is switched from the relaxing position to the lying position, the footrest extends further forward and upward than in the relaxing position, and the backrest reclines significantly. Thus, when the user of the seat unit is in the lying position, the legs are higher than the head, experiencing the so-called "zero gravity" feeling.

[0004] However, the disadvantage in the known design is that as the seat unit is switched to the lying position, a gap occurs between the backrest and the seat, which, on the one hand, pulls the user's jacket upward, and on the other hand, causes the risk of the item falling out of the gap.

### SUMMARY

[0005] The technical problem to be solved by the present disclosure is to provide a seat unit with a simple structure and improved ergonomics.

[0006] In order to solve the above technical problems, provided in the present disclosure is a mechanical stretching device for a movable seat unit, including:

[0007] a seat assembly, including a base assembly, a lateral plate attached to a seat of the seat unit, and a central driven member coupled between the base assembly and the lateral plate;

[0008] a backrest assembly, pivotally connected to a rear part of the lateral plate, including a backrest connecting member configured to be attached to a backrest of the seat unit and a backrest link assembly pivotally connected to the backrest connecting member, the backrest link assembly including a first backrest link hinged to the central driven member and a

second backrest link hinged to the lateral plate, in which the first backrest link is hinged to the second backrest link; and

[0009] a leg stretching device, pivotally connected to a front part of the lateral plate, including a plurality of links pivotally connected with each other and a first footrest member configured to be attached to a footrest.

[0010] The mechanical stretching device allows the seat unit to be switched between a sitting position, a TV position, and/or a lying position; the first footrest member is folded below the seat when in the sitting position; the first footrest member is stretched forward when in the TV position; and the backrest is relined backward, a highest point of the footrest is higher than a highest point of the backrest, and the first footrest member is stretched forward and upward, when in the lying position.

[0011] In some implementations, the backrest is reclined at least 35° more in the lying position than in the sitting position. In some implementations, it is reclined backwards at least 40°. This provides users with a more comfortable zero-gravity experience.

[0012] In an alternative implementation, a front end of the first footrest member is raised in the lying position, so that an acute angle with an opening facing forward in a range of 10° to 23° is formed between the footrest surface of the first footrest member and the horizontal plane. In some implementations, the acute angle with the opening facing forward in a range of 16° to 19° is formed between the footrest surface of the first footrest member and the horizontal plane.

[0013] It is to be noted here that the acute angle of "the opening facing forward" as described herein refers to the direction of the opening of the acute angle faces the leg stretching device.

[0014] In another alternative implementation, the leg stretching device further includes a second footrest member; both the first footrest member and the second footrest member are folded below the seat when in the sitting position; both the first footrest member and the second footrest member are stretched forward when in the TV position; and the backrest is relined backward, a highest point of the footrest is higher than a highest point of the backrest, and the first footrest member is stretched forward and upward, when in the lying position, in which the second footrest member is located in front of the first footrest member.

[0015] In the first improvement to the alternative implementation, a front end of the second footrest member is raised in the lying position, so that an acute angle with an opening facing forward in a range of 10° to 23° is formed between the footrest surface of the second footrest member and the horizontal plane. In some implementations, the acute angle with the opening facing forward in a range of 12° to 15° is formed between the footrest surface of the second footrest member and the horizontal plane.

[0016] In the second improvement to the alternative implementation, the front end of the second footrest member is lowered in the lying position, so that the acute angle with the opening facing backward in a range of 8° to 30° is formed between the footrest surface of the second footrest member and the horizontal plane. In some implementations, the angle between the second footrest member 37 and the horizontal plane is in a range of 12° to 20°.

[0017] It is to be noted here that the acute angle “the opening facing backward” as described herein refers to the direction of the opening of the acute angle faces the backrest assembly.

[0018] In some implementations, the first footrest member is connected to the second footrest member through a footrest extension assembly, and the footrest extension assembly includes a first extension member and a second extension member hinged to each other.

[0019] In this implementation, an end of the first extension member is hinged to the second footrest member distal thereto, an opposite end of the first extension member is hinged to an end of the second extension member, an opposite end of the second extension member is hinged to the leg link connecting the first footrest member proximal thereto, and the front end of the second footrest is raised or lowered in the lying position by adjusting the hinge position of the first extension member with the second footrest member, so that a comfortable angle for the user is formed by the corresponding footrest surface with the horizontal surface.

[0020] In addition, in this implementation, the backrest connecting member is coupled to the seat assembly through the backrest link assembly, and the backrest link assembly itself is compressed while the backrest connecting member is compressed through the scissor structure of the backrest link assembly. This eliminates the clearance that may appear between the backrest and the seat during the position change of the seat unit. This not only achieves a true “zero against the wall” structure, saving installation space and eliminating the risk of items falling due to the clearance, but also avoids pulling the user’s shirt out to achieve a “zero rubbing back” comfort experience.

[0021] In some implementations, the backrest link assembly further includes a third backrest link, a fourth backrest link, and a fifth backrest link; a lower end of the third backrest link is hinged to the second backrest link, an upper end of the third backrest link is hinged to a rear end of the backrest connecting member, an upper end of the fourth backrest link is hinged to a front end of the backrest connecting member at a first hinge point, a front end of the fifth backrest link is hinged to the first backrest link at a second hinge point, a rear end of the fifth backrest link is hinged to a middle of the third backrest link, and a lower end of the fourth backrest link is hinged to a middle of the fifth backrest link.

[0022] In some implementations, when the seat unit is switched from the sitting position to the lying position, the backrest connecting member is reclined backwards by means of compression of the backrest link assembly.

[0023] In some implementations, when the seat unit is switched from the sitting position to the lying position, a relative movement between the lateral plate and the central driven member leads to an increase in a distance from a hinge point between the first backrest link and the central driven member to a hinge point between the second backrest link and the lateral plate, so as to achieve compression of the backrest link assembly.

[0024] In some implementations, when the seat unit is switched from the sitting position to the lying position, both the first hinge point and the second hinge point are moved forward, and a distance between the first hinge point and the second hinge point is decreased.

[0025] In some implementations, the seat assembly further includes a front swing rod, a rear swing rod, a seat driven member, and a lateral plate driven member; lower ends of both the front swing rod and the rear swing rod are pivotally connected to the base assembly, upper ends of both the front swing rod and the rear swing rod are connected to the lateral plate through the central driven member, the seat driven member, and the lateral plate driven member.

[0026] In some implementations, a movement of the backrest assembly and the leg stretching device relative to the seat assembly is caused by rotation of the lateral plate relative to the base assembly, so as to achieve a switching of the seat unit between the sitting position and the lying position.

[0027] In some implementations, the mechanical stretching device further includes an electric driving device coupled between the base assembly and the lateral plate.

[0028] In some implementations, the mechanical stretching device further includes an electric driving device, in which the electric driving device includes a first electric driver and a second electric driver, the first electric driver is configured to cause the leg stretching device to stretch and retract relative to the seat assembly, and the second electric driver is configured to cause the backrest assembly to move relative to the seat assembly.

[0029] In this implementation, the first electric driver and the second electric driver operate independently of each other, thereby enabling the backrest assembly and the leg stretching device to be flexibly adjusted independently of each other.

[0030] According to this implementation, the mechanical stretching device can be switched between multiple positions, for example, switched between a sitting position, a TV position, and/or a lying position. The footrest is folded below the seat when in the sitting position; the footrest is stretched forward when in the TV position; and the backrest is reclined backward, and a highest point of the footrest is higher than a highest point of the backrest, when in the lying position. It should be noted that the mechanical stretching device does not only show the three positions of sitting position, TV position, and lying position, but also can show the intermediate position between the three positions through the different positions of the backrest and the leg stretching device, for example, the backrest is inclined backward with respect to the seat assembly only by the second electric driver, and the first electric driver does not work, so that the footrest is still folded under the seat.

[0031] In an alternative implementation, the leg stretching device further includes a second footrest member; when the first electric driver causes the leg stretching device to stretch to the front of the seat assembly, the second footrest member is located in front of the first footrest member.

[0032] In addition, in this implementation, the backrest connecting member is coupled to the seat assembly through the backrest link assembly, and the backrest link assembly itself is compressed while the backrest connecting member is compressed through the scissor structure of the backrest link assembly. This eliminates the clearance that may appear between the backrest and the seat during the position change of the seat unit. This not only achieves a true “zero against the wall” structure, saving installation space and eliminating the risk of items falling due to the clearance, but also avoids pulling the user’s shirt out to achieve a “zero rubbing back” comfort experience.

[0033] In some implementations, the first electric driver acts between the seat assembly and the leg stretching device, and the second electric driver acts between the base assembly and the seat assembly.

[0034] In some implementations, the base assembly includes the base rear crossbeam, the leg stretching device includes a first motor crossbar, the seat assembly includes a second motor crossbar close to the leg stretching device and a third motor crossbar close to the backrest assembly. The first electric driver acts between the first motor crossbar and the second motor crossbar, and the second electric driver acts between the third motor crossbar and the base rear crossbeam.

[0035] In some implementations, the second motor crossbar is connected to the lateral plate, and the third motor crossbar is connected to the central driven member. In some implementations, the second motor crossbar is fixedly connected to the lateral plate, and the third motor crossbar is fixedly connected to the central driven member.

[0036] However, in an alternative implementation, it is also possible to provide only one lateral plate motor crossbar on the lateral plate of the seat assembly, rather than the second motor crossbar and the third motor crossbar. In this implementation, an end of the first electric driver is coupled to the first motor crossbar, and an opposite end thereof is coupled to the lateral plate motor crossbar. An end of the second electric driver is coupled to the base rear crossbeam, and an opposite end thereof is also coupled to the lateral plate motor crossbar.

[0037] In some implementations, the backrest link assembly further includes a third backrest link, a fourth backrest link, and a fifth backrest link; a lower end of the third backrest link is hinged to the second backrest link, an upper end of the third backrest link is hinged to a rear end of the backrest connecting member, an upper end of the fourth backrest link is hinged to a front end of the backrest connecting member at a first hinge point, a front end of the fifth backrest link is hinged to the first backrest link at a second hinge point, a rear end of the fifth backrest link is hinged to a middle of the third backrest link, and a lower end of the fourth backrest link is hinged to a middle of the fifth backrest link.

[0038] In some implementations, when the backrest assembly is moved relative to the seat assembly through the second electric driver, the backrest connecting member is reclined backwards through compression of the backrest link assembly.

[0039] In some implementations, when the backrest assembly is moved relative to the seat assembly through the second electric driver, a relative movement between the lateral plate and the central driven member leads to an increase in a distance from a hinge point between the first backrest link and the central driven member to a hinge point between the second backrest link and the lateral plate, so as to achieve the compression of the backrest link assembly.

[0040] In some implementations, when the backrest assembly is moved relative to the seat assembly through the second electric driver, both the first hinge point and the second hinge point are moved forward, and a distance between the first hinge point and the second hinge point is decreased.

[0041] In some implementations, the seat assembly further includes a front swing rod, a rear swing rod, a seat driven member, a lateral plate driven member, and a driving link;

lower ends of both the front swing rod and the rear swing rod are pivotally connected to the base assembly, upper ends of both the front swing rod and the rear swing rod are connected to the lateral plate through the central driven member, the seat driven member, and the lateral plate driven member, an upper end of the driving link is hinged to a middle of the seat driven member, and a lower end of the driving link is hinged to a middle of the base assembly.

[0042] In some implementations, a movement of the backrest assembly relative to the seat assembly is caused by rotation of the lateral plate relative to the base assembly.

[0043] In some implementations, both the first electric driver and the second electric driver are designed as linear electric drivers.

[0044] In order to solve the aforementioned technical problems, provided in the present disclosure is further a seat unit, including: a seat, a backrest, a footrest, and a aforementioned mechanical stretching device, in which the lateral plate is attached to the seat, the backrest connecting member is attached to the backrest, and the first footrest member is attached to the footrest.

#### BRIEF DESCRIPTION OF THE DRAWINGS

[0045] Embodiments of the present disclosure are described in detail below with reference to the accompanying drawings.

[0046] FIG. 1 is a perspective view of a mechanical stretching device according to a first embodiment of the present disclosure in the sitting position;

[0047] FIG. 2 is a perspective view of the mechanical stretching device shown in FIG. 1 in the TV position;

[0048] FIG. 3 is a perspective view of the mechanical stretching device shown in FIG. 1 in the lying position;

[0049] FIG. 4 is a side view of the mechanical stretching device shown in FIG. 1;

[0050] FIG. 5 is a side view of the mechanical stretching device shown in FIG. 1 in the TV position;

[0051] FIG. 6 is a side view of the mechanical stretching device shown in FIG. 1 in the lying position;

[0052] FIG. 7 is a perspective view of the mechanical stretching device according to a second alternative embodiment of the present disclosure in the sitting position;

[0053] FIG. 8 is a perspective view of the mechanical stretching device shown in FIG. 7 in the TV position;

[0054] FIG. 9 is a perspective view of the mechanical stretching device shown in FIG. 7 in the lying position;

[0055] FIG. 10 is a side view of the mechanical stretching device shown in FIG. 7;

[0056] FIG. 11 is a side view of another view of the mechanical stretching device shown in FIG. 10;

[0057] FIG. 12 is the mechanical stretching device of a first improvement solution of the alternative embodiment shown in FIG. 7 in the TV position;

[0058] FIG. 13 is a side view of the mechanical stretching device shown in FIG. 12 in the lying position;

[0059] FIG. 14 is the mechanical stretching device of a second improvement solution of the alternative embodiment shown in FIG. 7 in the TV position;

[0060] FIG. 15 is a side view of the mechanical stretching device shown in FIG. 14 in the lying position;

[0061] FIG. 16 is a perspective view of the mechanical extension device according to a third alternative embodiment of the present application in a sitting position;

[0062] FIG. 17 is a perspective view of the mechanical stretching device shown in FIG. 16 in the TV position;  
 [0063] FIG. 18 is a perspective view of the mechanical stretching device shown in FIG. 16 in the lying position;  
 [0064] FIG. 19 is a side view of the mechanical stretching device shown in FIG. 16;  
 [0065] FIG. 20 is a side view of the mechanical stretching device shown in FIG. 19 in the TV position;  
 [0066] FIG. 21 is a side view of the mechanical stretching device shown in FIG. 19 in the lying position;  
 [0067] FIG. 22 is a perspective view of the mechanical stretching device according to a fourth alternative embodiment of the present disclosure in the sitting position;  
 [0068] FIG. 23 is a perspective view of the mechanical stretching device shown in FIG. 22 in the TV position;  
 [0069] FIG. 24 is a perspective view of the mechanical stretching device shown in FIG. 22 in the lying position;  
 [0070] FIG. 25 is a side view of the mechanical stretching device shown in FIG. 22;  
 [0071] FIG. 26 is a side view of of the mechanical stretching device shown in FIG. 25 in another perspective;  
 [0072] FIG. 27 is a side view of the mechanical stretching device shown in FIG. 26 in the TV position;  
 [0073] FIG. 28 is a side view of the mechanical stretching device shown in FIG. 26 in the lying position.

#### DETAILED DESCRIPTION

[0074] Firstly, a first embodiment of a mechanical stretching device for a movable seat unit is schematically shown in accordance with FIGS. 1 to 6.

[0075] The mechanical stretching device includes a seat assembly 1, a backrest assembly 2, and a leg stretching device 3. The backrest assembly 2 is hinged to a rear part of the seat assembly 1 and the leg stretching device 3 is hinged to a front part of the seat assembly 1. The seat assembly 1 is attached to a seat of the seat unit, the backrest assembly 2 is attached to a backrest of the seat unit, and the leg stretching device 3 is attached to a footrest of the seat unit. The seat unit, or mechanical stretching device thereof, can be switched between a sitting position, a TV position, and/or a lying position by means of the relative movement of the seat assembly 1, the backrest assembly 2, and the leg stretching device 3. In the sitting position, the backrest is upright, and the footrest is folded under the seat; in the TV position, the backrest does not incline significantly backward, and the footrest is moved upward and forward to the front of the seat with the stretching of the leg stretching device; and in the lying position, the footrest remains extended to the front of the seat, and the backrest is reclined significantly backward.

[0076] The seat assembly 1 includes a base assembly 11, a front swing rod 12, a rear swing rod 13, and a lateral plate 140 attached to the seat of the seat unit.

[0077] In the embodiment shown in FIG. 1, the mechanical stretching device is configured to be applied to an iron frame floor-standing seat unit, the base assembly 11 supports the mechanical stretching device directly on the bottom surface, and includes two mirror-symmetrical base longitudinal beams 111 disposed on the left and right sides, and a base front crossbeam 112 and a base rear crossbeam 113 connecting the two base longitudinal beams 111. However, in embodiments not shown, the base assembly 11 may also indirectly support the mechanical stretching device above the bottom surface, e.g., the base assembly 11 is rotatably

mounted on the rotating base, or the base assembly 11 is fixedly coupled in position to the armrests of the seat unit with floor-standing armrests.

[0078] In the embodiment shown in FIG. 1, a lower end of the front swing rod 12 is hinged to a front end of the base longitudinal beam 111, and a lower end of the rear swing rod 13 is hinged to a rear end of the base longitudinal beam 111. The lateral plate 140 is movable relative to the base assembly 11, and for this purpose, in this embodiment, the seat assembly 1 further includes a central driven member 15, a seat driven member 16, and a lateral plate driven member 17. The central driven member 15 is provided with a plurality of hinge points, and the central driven member 15 is respectively hinged with the backrest assembly 2, the lateral plate 140, the seat driven member 16, and the rear swing rod 13 at different hinge points. An end of the seat driven member 16 is connected to the front swing rod 12 through the lateral plate driven member 17, and an opposite end of the seat driven member 16 is connected to the central driven member 15. Accordingly, the movement of the lateral plate 140 relative to the base assembly 11 can be driven by the rotation of the front swing rod 12 and the rear swing rod 13, which in turn drives the movement of the backrest assembly 2.

[0079] The backrest assembly 2 includes a backrest connecting member 20 attached to the backrest and a backrest link assembly pivotally connected to the backrest connecting member 20. The backrest link assembly includes a first backrest link 21, a second backrest link 22, a third backrest link 23, a fourth backrest link 24, and a fifth backrest link 25. An end of the first backrest link 21 is hinged to the central driven member 15, an end of the second backrest link 22 is hinged to a rear end of the lateral plate 140, and the first backrest link 21 is hinged to the second backrest link 22. An opposite end of the second backrest link 22 is hinged to a lower end of the third backrest link 23, and an upper end of the third backrest link 23 is hinged to a rear end of the backrest connecting member 20. An upper end of the fourth backrest link 24 is hinged to a front end of the backrest connecting member 20 at a first hinge point P1, a front end of the fifth backrest link 25 is hinged to an opposite end of the first backrest link 21 at a second hinge point P2, a rear end of the fifth backrest link 25 is hinged to a middle of the third backrest link 23, and a lower end of the fourth backrest link 24 is hinged to a middle of the fifth backrest link 25.

[0080] As shown in FIGS. 4 to 7, the leg stretching device 3 consists of a plurality of links pivotally connected with each other, in which a rear end of the first leg link 31 is hinged to the lateral plate 140, a front end of the first leg link 31 is hinged to a rear end of the second leg link 32, a rear end of the third leg link 33 is hinged to a front end of the lateral plate 140, a front end of the third leg link 33 is hinged to a rear end of the fourth leg link 34, and a front end of the second leg link 32 and a front end of the fourth leg link 34 are hinged to the first footrest member 35, respectively.

[0081] In addition, the mechanical stretching device further includes a first transmission member 18 and a second transmission member 19 pivotally connected with each other, an end of the first transmission member 18 is hinged to an end of the second transmission member 19, an opposite end of the first transmission member 18 is hinged to the lateral plate 140, and an opposite end of the second transmission member 19 is hinged to the leg stretching device 3, in particular to the first leg link 31. Thus, when the lateral

plate 140 of the seat assembly 1 moves relative to the base assembly 11, the lateral plate 140 drives the retracting and stretching movement of the leg stretching device 3.

[0082] In order to enable the seat unit to be switched between different positions, an electric driving device 4 is also provided. The lateral plate 140 includes a motor crossbar 40 fixedly connected in inner side of the lateral plate 140, and the electric driving device 4 is coupled between the motor crossbar 40 and the base front crossbeam 112 of the base assembly 11. In some embodiments, the electric driving device 4 is designed as a linear electric driver, and the lateral plate 140 can be moved relative to the base assembly 11 through the retracting and stretching movement of the linear electric driver, which drives the movement of the backrest assembly 2 and the leg stretching device 3, thereby realizing the switching of the seat unit between different positions, such as between the sitting position, the TV position and the lying position.

[0083] The electric driving device 4 is designed in this embodiment for causing the mechanical stretching device of the seat unit to be switched between the sitting position, the TV position and the lying position. The electric driving device 4 includes a motor head 41, a motor sliding rail 42 fixedly connected to the motor head 41, a motor slider 43 and a motor link 44 that can slide relative to the motor head 41 along the motor sliding rail 42. The motor head 41 is fixedly mounted on the base rear crossbeam 113. An end of the motor link 44 is hinged to the motor slider 43, and an opposite end thereof is hinged to the motor crossbar 40.

[0084] As shown in FIGS. 4 to 6, in the sitting position as shown in FIG. 4, the first footrest member 35 is folded under the seat. If the seat unit is switched from the sitting position shown in FIG. 4 to the TV position shown in FIG. 5, the first leg link 31 and the third leg link 33 are rotated driven by the lateral plate 140. During this process, the second leg link 32 and the fourth leg link 34 drive the first footrest member 35 to rotate upward. When the seat unit is switched from the TV position shown in FIG. 5 to the lying position shown in FIG. 6, the first footrest member 35 is raised, and the acute angle  $\alpha$  formed between the footrest surface of the first footrest member 35 and the horizontal plane with its opening facing forward is, in this implementation, in a range of  $16^\circ$  to  $19^\circ$ . In some implementations, the acute angle  $\alpha$  is  $17^\circ$ .

[0085] The mechanical stretching device further includes a first linkage member 141, a second linkage member 142, and a third linkage member 143. A middle of the second linkage member 142 is rotatably connected to the lateral plate 140, an end of the second linkage member 142 is connected to an end of the first linkage member 141, an opposite end of the first linkage member 141 is connected to the front swing rod 12, an opposite end of the second linkage member 142 is connected to an end of the third linkage member 143, and an opposite end of the third linkage member 143 is pivotally connected to the first leg link 31 of the leg stretching device 3.

[0086] When the mechanical extension device is in the sitting position shown in FIG. 4, the backrest connecting member 20 of the backrest assembly 2 is upright upward at an angle  $\beta$  between the backrest attached to the backrest connecting member 20 and the horizontal plane.

[0087] During the switching of the mechanical stretching device from the sitting position shown in FIG. 4 to the TV position shown in FIG. 5, the electric driving device 4 operates such that the motor slider 43 slides along the motor

sliding rail 42 towards the motor head 41, leading to a reduction in the distance between the motor head 41 and the motor slider 43. During this process, the motor slider 43 moves the lateral plate 140 forward, i.e., in a direction toward the leg stretching device 3, through the motor link 44, with the front swing rod 12 and the rear swing rod 13 swinging forward. Thus, the first linkage member 141 moves forward with the front swing rod 12 and pushes the first leg link 31 with the second linkage member 142 and the third linkage member 143; and thus the leg stretching device 3 is unfolded. The lateral plate driven member 17 and the seat linkage member 16 also move forward with the front swing rod 12 and drive the central linkage member 15 forward. In this process, the central linkage member 15 moves forward together with the lateral plate 140, thereby driving the backrest assembly 2 as a whole forward and downward through the first backrest link 21 and the second backrest link 22, while the backrest connecting member 20 does not incline significantly, in which the first hinge point P1 and the second hinge point P2 both move downward and forward.

[0088] During the switching of the mechanical stretching device from the TV position shown in FIG. 5 to the lying position shown in FIG. 6, the electric driving device 4 continues to operate, causing the motor slider 43 to slide further towards the motor head 41 along the motor sliding rail 42, so that the distance between the motor head 41 and the motor slider 43 is further reduced. During this process, the motor slider 43 continues to move the lateral plate 140 forward, i.e., in a direction toward the leg stretching device 3, through the motor link 44, with the front swing rod 12 and the rear swing rod 13 swinging forward with a greater amplitude. When the front swing rod 12 and the rear swing rod 13 swing to the maximum extent, the lateral plate 140 is moved significantly forward relative to the central driven member 15, thereby increasing the distance from a hinge point between the central driven member 15 and the first backrest link 21 to a hinge point between the lateral plate 140 and the second backrest link 22, thereby causing the backrest link assembly to be moved forward while also compressing the backrest link assembly itself, and the backrest connecting member 20 is reclined strongly backward. During this process, not only are the first hinge point P1 and the second hinge point P2 both moving forward, but the distance between the first hinge point P1 and the second hinge point P2 is also significantly reduced compared to the sitting position and the TV position. The backrest connecting member 20 is attached to the backrest of the seat unit, and the angle  $\beta$  between the backrest and the horizontal plane is increased by at least  $40^\circ$  during the switching of the seat unit from the sitting position to the lying position.

[0089] FIGS. 7 to 15 illustrate a second alternative embodiment according to the present disclosure, in which FIGS. 12 and 13 illustrate side views of a first improvement solution in the TV position and in the lying position, and FIGS. 14 and 15 illustrate side views of a second improvement solution in the TV position and in the lying position.

[0090] In contrast to the embodiment shown in FIGS. 1 to 6, the leg stretching device 3 of this second alternative embodiment further includes a second footrest member 37. The leg stretching device 3 is composed of a plurality of links pivotally connected with each other, in which a rear end of the first leg link 31 is hinged to the lateral plate 140, a front end of the first leg link 31 is hinged to a rear end of

the second leg link 32, a rear end of the third leg link 33 is hinged to a front end of the side plate 140, a front end of the third leg link 33 is hinged to a rear end of the fourth leg link 34, a front end of the second leg link 32 and a front end of the fourth leg link 34 are hinged to the first footrest member 35, and a front end of the fourth leg link 34 is hinged to the second footrest member 37, respectively. The first footrest member 35 is hinged to an end of the driven rod 36 and an opposite end of the driven rod 36 is hinged to a middle of the fourth leg link 34.

[0091] The leg stretching device 3 further includes a footrest extension assembly 38, the footrest extension assembly 38 includes a first extension member 381 and a second extension member 382, an end of the first extension member 381 is hinged to a middle of the second footrest member 37, an opposite end of the first extension member 381 is hinged to an end of the second extension member 382, an opposite end of the second extension member 382 is hinged to a middle of the second leg link 32, and a middle of the second extension member 382 is hinged to a middle of the fourth leg link 34.

[0092] In this second alternative embodiment, the first footrest member 35 is hinged to the fourth leg link 34 through the driven rod 36, the fourth leg link 34 is connected to the second footrest member 37, and the first footrest member 35 is not connected to the fourth leg link 34, increasing the flexibility of movement of the first footrest member 35 and the second footrest member 37 during retracting or stretching. The first footrest member 35, the driven rod 36, the fourth leg link 34, the second extension member 382, and the second leg link 32 form a five linkage mechanism. The first footrest member 35 can be more flexible to close or separate from the second footrest member 37, increasing the distance between the first footrest member 35 and the second footrest member 37 after separation, and increasing the extension length of the second footrest member 37.

[0093] According to the first improvement solution of the second alternative embodiment, in the sitting position as shown in FIG. 11, the footrest surfaces of the first footrest member 35 and the second footrest member 37 are in the same plane, the first footrest member 35 and the second footrest member 37 are folded under the seat, and the first footrest member 35 is located above the second footrest member 37. When the seat unit is switched from the sitting position shown in FIG. 11 to the lying position shown in FIG. 13, a front end of the second footrest member 37 is raised, and the acute angle  $\alpha$  formed between the footrest surface of the second footrest member 37 and the horizontal plane with its opening facing forward is, in this first improvement solution, in a range of  $12^\circ$  to  $15^\circ$ . In some implementations, the acute angle  $\alpha$  is  $13^\circ$ .

[0094] According to the second improvement solution of the second alternative embodiment, when the seat unit is switched from the sitting position shown in FIG. 11 to the TV position shown in FIG. 14, the first leg link 31 and the third leg link 33 are rotated under the drive of the lateral plate 140, causing the footrest extension assembly 38 to move from the retracted position shown in FIG. 11 to the limit position shown in FIG. 14. In this process, the second leg link 32 drives the first footrest member 35 to rotate upward, the driven rod 36 is rotated with the first footrest member 35, causing the first footrest member 35 to rotate more flexible while supporting the first footrest member 35,

and the fourth leg link 34 drives the second footrest member 37 and the footrest extension assembly 38 to extend forward and rotate upward until the second footrest member 37 is stretched to the limit position. When the footrest extension assembly 38 is stretched to the limit position shown in FIG. 14, the footrest surface of the first footrest member 35 is in a substantially horizontal position, while the footrest surface of the second footrest member 37 is inclined downward with its front end. In the lying position shown in FIG. 15, in some embodiments, the front end of the second footrest member 37 is lowered, and the acute angle  $\alpha$  formed between the footrest surface thereof and the horizontal plane with its opening facing backward is, in this second improvement, in a range of  $12^\circ$  to  $20^\circ$ . In some implementations, the acute angle  $\alpha$  is  $15^\circ$ . When in the TV position of the seat unit, the user's legs can be lowered slightly without causing the legs to uncomfortably tilted upwards.

[0095] A third alternative embodiment of the mechanical stretching device for the movable seat unit is schematically shown in accordance with FIGS. 16 to 21.

[0096] As shown in FIGS. 16 to 18, the mechanical stretching device includes a base assembly 11, a seat assembly 1, a backrest assembly 2, and a leg stretching device 3. The backrest assembly 2 is hinged to a rear part of the seat assembly 1 and the leg stretching device 3 is hinged to a front part of the seat assembly 1. The seat assembly 1 is attached to a seat of the seat unit, the backrest assembly 2 is attached to a backrest of the seat unit, and the leg stretching device 3 is attached to a footrest of the seat unit. The seat unit, or mechanical stretching device thereof, can be switched between a sitting position, a TV position, and/or a lying position by means of the relative movement of the seat assembly 1, the backrest assembly 2, and the leg stretching device 3. In the sitting position, the backrest is upright, and the footrest is folded under the seat; in the TV position, the backrest does not incline significantly backward, and the footrest is moved upward and forward to the front of the seat with the stretching of the leg stretching device; and in the lying position, the footrest remains extended to the front of the seat, and the backrest is reclined significantly backward.

[0097] In a third alternative embodiment, the mechanical stretching device is configured to be applied to an iron frame floor-standing seat unit, the base assembly 11 supports the mechanical stretching device directly on the bottom surface, and includes two mirror-symmetrical base longitudinal beams 111 disposed on the left and right sides, and a base front crossbeam 112 and a base rear crossbeam 113 connecting the two base longitudinal beams 111. However, in embodiments not shown, the base assembly 11 may also indirectly support the mechanical stretching device above the bottom surface, e.g., the base assembly 11 is rotatably mounted on the rotating base, or the base assembly 11 is fixedly coupled in position to the armrests of the seat unit with floor-standing armrests.

[0098] The seat assembly 1 includes a front swing rod 12, a rear swing rod 13, and a lateral plate 140 attached to the seat of the seat unit. In the embodiment shown in FIG. 16, a lower end of the front swing rod 12 is hinged to a front end of the base longitudinal beam 111, and a lower end of the rear swing rod 13 is hinged to a rear end of the base longitudinal beam 111.

[0099] The lateral plate 140 is movable relative to the base assembly 11, and for this purpose, in this illustrated embodiment, the seat assembly 1 further includes a central driven

member 15, a seat driven member 16, and a lateral plate driven member 17, in which the central driven member 15 is provided with a plurality of hinge points, the central driven member 15 being respectively hinged with the backrest assembly 2, the lateral plate 140, the seat driven member 16, and the rear swing rod 13 at different hinge points. An end of the seat driven member 16 is connected to the front swing rod 12 through the lateral plate driven member 17, and an opposite end of the seat driven member 16 is connected to the central driven member 15. Accordingly, the movement of the lateral plate 140 relative to the base assembly 11 can be driven by the rotation of the front swing rod 12 and the rear swing rod 13, which in turn drives the movement of the backrest assembly 2.

[0100] The backrest assembly 2 includes a backrest connecting member 20 attached to a backrest and a backrest link assembly pivotally connected to the backrest connecting member 20. The backrest link assembly includes a first backrest link 21, a second backrest link 21, a third backrest link 23, a fourth backrest link 24, and a fifth backrest link 25. An end of the first backrest link 21 is hinged to the central driven member 15, an end of the second backrest link 22 is hinged to a rear end of the lateral plate 140, and the first backrest link 21 is hinged to the second backrest link 22. An opposite end of the second backrest link 22 is hinged to a lower end of the third backrest link 23, and an upper end of the third backrest link 23 is hinged to a rear end of the backrest connecting member 20. An upper end of the fourth backrest link 24 is hinged to a front end of the backrest connecting member 20 at a first hinge point P1, a front end of the fifth backrest link 25 is hinged to an opposite end of the first backrest link 21 at a second hinge point P2, a rear end of the fifth backrest link 25 is hinged to a middle of the third backrest link 23, and a lower end of the fourth backrest link 24 is hinged to a middle of the fifth backrest link 25.

[0101] In the third alternative embodiment shown in FIGS. 16 to 21, the leg stretching device 3 is composed of a plurality of links pivotally connected with each other, in which a rear end of the first leg link 31 is hinged to the lateral plate 140, a front end of the first leg link 31 is hinged to a rear end of the second leg link 32, a rear end of the third leg link 33 is hinged to a front end of the lateral plate 140, a front end of the third leg link 33 is hinged to a rear end of the fourth leg link 34, and a front end of the second leg link 32 and a front end of the fourth leg link 34 are hinged to the first footrest member 35, respectively.

[0102] The mechanical stretching device 3 further includes a first transmission member 18 and a second transmission member 19 pivotally connected with each other, an end of the first transmission member 18 is hinged to an end of the second transmission member 19, an opposite end of the first transmission member 18 is hinged to the lateral plate 140, and an opposite end of the second transmission member 19 is hinged to the leg stretching device 3, in particular to the first leg link 31.

[0103] In addition, the mechanical stretching device further includes a driving link 16a, an upper end of the driving link 16a is hinged to the seat driven member 16, and a lower end thereof is hinged to the base longitudinal beam 111. In the sitting position and the TV position of the mechanical extension device 3, the upper end of the driving link 16a is more backward than its lower end, that is, the driving link 16a is reclined backward with its upper end, while in the lying position, the upper end of the driving link 16a is more

forward than its lower end, that is, the driving link 16a is reclined forward with its upper end.

[0104] In order to enable the seat unit to be switched between different positions, an electric driver 4 is also provided. The first motor crossbar 401 is fixedly connected to the first leg link 31 of the leg stretching device 3, the second motor crossbar 402 and the third motor crossbar 403 are provided at the seat assembly, in particular, the second motor crossbar 402 is fixedly connected at the lateral plate 140, and the third motor crossbar 403 is fixedly connected at the central driven member 15. The electric driving device 4 includes a first electric driver 404 coupled between the first motor crossbar 401 and the second motor crossbar 402, and a second electric driver 405 coupled between the third motor crossbar 403 and the base rear crossbeam 113 of the base assembly 11. In some embodiments, the first electric driver 404 and the second electric driver 405 are designed as linear electric drivers including, respectively, a motor head, a motor sliding rail fixedly connected to the motor head, and a motor slider 43 slidable relative to the motor head along the motor sliding rail. The distance between the motor head and the motor slider 43 is changed by the sliding of the motor slider 43 along the motor sliding rail, so that the relative movement between the components coupled to the motor head and the components coupled to the motor slider 43 can be made possible by this retracting and stretching movement of the linear electric driver.

[0105] In this embodiment, the first electric driver 404 and the second electric driver 405 operate independently of each other. The first electric driver 404 is designed to achieve stretching and retracting attached to the leg stretching device 3, thereby achieving stretching and retracting of the footrest; and the second electric driver 405 is designed to achieve stretching and retracting of the backrest assembly 2, thereby achieving tilting of the backrest. By causing the first electric driver 404 and the second electric driver 405 to operate separately or in conjunction with each other, the seat unit can be in different positions, for example, the sitting position as shown in FIG. 19, the TV position as shown in FIG. 20, and the lying position as shown in FIG. 21.

[0106] In the sitting position shown in FIG. 19, the backrest connecting member 20 of the backrest assembly 2 and the backrest attached thereto are upright upward, and the first footrest member 35 of the leg stretching device 3 causes the footrest to be folded below the seat. In the TV position shown in FIG. 20, the leg stretching device 3 is unfolded and the footrest is stretched to the front of the seat by the first footrest member 35. In the lying position shown in FIG. 21, the backrest connecting member 20 is reclined strongly backward.

[0107] To this end, if the seat unit is to be switched from the sitting position to the TV position, only the first electric driver 404 is caused to operate, in which the distance between the motor head 41 of the first electric driver 404 and the motor slider 43 is increased, so that the distance between the first motor crossbar 401 and the second motor crossbar 402 is increased, and the leg stretching device 3 is driven to be unfolded relative to the lateral plate 140 by the first leg link 31, thereby switching the mechanical stretching device from the sitting position shown in FIG. 19 to the TV position shown in FIG. 20.

[0108] At this time, if the second electric driver 405 is operating, the distance between the motor head 41 of the second electric driver 405 and the motor slider 43 is

increased, and the distance between the third motor crossbar 403 and the base rear crossbeam 113 is increased, so that the lateral plate 140 is pushed forward relative to the base assembly 11 by the central driven member 15, that is, in a direction toward the leg stretching device 3, and the front swing rod 12 and the rear swing rod 13 swing forward accordingly. The lateral plate driven member 17 and the seat driven member 16 are also moved forward with the front swing rod 12. Since the driving link 16a is originally inclined backward at its upper end in the TV position, when the front swing rod 12 and the rear swing rod 13 swing forward, the driving link 16a pivots forward at its upper end, supporting the seat driven member 16 to move forward and upward, thereby driving the central driven member 15 to rotate while moving forward, increasing the distance from a hinge point between the central driven member 15 and the first backrest link 21 to a hinge point between the lateral plate 140 and the second backrest link 22, thereby causing the backrest link assembly itself to be compressed while moving forward and the backrest connecting member 20 to be reclined strongly backward. During this process, not only are the first hinge point P1 and the second hinge point P2 both moving forward, but the distance between the first hinge point P1 and the second hinge point P2 is also significantly reduced compared to the sitting position and the TV position. The lying position shown in FIG. 21 is thus achieved.

[0109] Of course, the seat unit may also be in other positions not specifically shown in the figures. For example, when only the second electric driver 405 is operating, the backrest connecting member 20 causes the backrest to be reclined backward, while the first electric driver 404 is not operating, so that the leg stretching device is still folded below the seat.

[0110] FIGS. 22 to 28 illustrate a fourth alternative embodiment according to the present disclosure. In contrast to the third alternative embodiment, in the fourth alternative embodiment, the leg stretching device 3 further includes a second footrest member 37. The leg stretching device 3 is composed of a plurality of links pivotally connected with each other, in which a rear end of the first leg link 31 is hinged to the lateral plate 140, a front end of the first leg link 31 is hinged to a rear end of the second leg link 32, a rear end of the third leg link 33 is hinged to a front end of the side plate 140, a front end of the third leg link 33 is hinged to the a end of the fourth leg link 34, a front end of the second leg link 32 is hinged to the first footrest member 35, and a front end of the fourth leg link 34 is hinged to the second footrest member 37. The first footrest member 35 is hinged to an end of the driven rod 36 and an opposite end of the driven rod 36 is hinged to a middle of the fourth leg link 34.

[0111] The leg stretching device 3 further includes a footrest extension assembly 38, the footrest extension assembly 38 includes a first extension member 381 and a second extension member 382, an end of the first extension member 381 is hinged to a middle of the second footrest member 37, an opposite end of the first extension member 381 is hinged to an end of the second extension member 382, an opposite end of the second extension member 382 is hinged to a middle of the second leg link 32, and a middle of the second extension member 382 is hinged to a middle of the fourth leg link 34.

[0112] In a fourth alternative embodiment, the first footrest member 35 is hinged to the fourth leg link 34 through

the driven rod 36, the fourth leg link 34 is connected to the second footrest member 37, and the first footrest member 35 is not connected to the fourth leg link 34, increasing the flexibility of movement of the first footrest member and the second footrest member during retracting or stretching. The first footrest member 35, the driven rod 36, the fourth leg link 34, the second extension member 382, and the second leg link 32 form a five linkage mechanism. The first footrest member 35 can be more flexible to close or separate from the second footrest member 37, increasing the distance between the first footrest member 35 and the second footrest member 37 after separation, and increasing the extension length of the second footrest member 37.

[0113] FIGS. 26 to 28 exemplarily illustrate several positions of the mechanical stretching device of the fourth alternative embodiment.

[0114] In the sitting position as shown in FIG. 26, the footrest surfaces of the first footrest member 35 and the second footrest member 37 are in the same plane, and the first footrest member 35 and the second footrest member 37 are folded under the seat, and the first footrest member 35 is located above the second footrest member 37. In the TV position shown in FIG. 27, both the first footrest member 35 and the second footrest member 37 are stretched in front of the seat. In the lying position shown in FIG. 28, the first footrest member 35 and the second footrest member 37 remain in front of the seat, while the backrest connecting member 20 is reclined strongly backward.

[0115] If the seat unit is switched from the sitting position shown in FIG. 26 to the TV position shown in FIG. 27, only the first electric driver 404 is allowed to be stretched, causing the first motor crossbar 401 to drive the first leg link 31 and the third leg link 33 to rotate forward so that the footrest extension assembly 38 moves from the retracted position shown in FIG. 26 to the limit position shown in FIG. 27. In this process, the second leg link 32 drives the first footrest member 35 to rotate upward, the driven rod 36 is rotated with the first footrest member 35, causing the first footrest member 35 more flexible to rotate while supporting the first footrest member 35, and the fourth leg link 34 drives the second footrest member 37 and the footrest extension assembly 38 to extend forward and rotate upward until the second footrest member 37 is stretched to the limit position. When the footrest extension assembly 38 is stretched to the limit position shown in FIG. 27, the footrest surface of the second footrest member 37 is reclined upward with its front end. The TV position shown in FIG. 27 is thus achieved.

[0116] If the seat unit is switched from the TV position shown in FIG. 27 to the lying position shown in figure. 28, the second electric driver 405 is operated, in which the distance between the third motor crossbar 403 and the base rear crossbeam 113 is increased, thereby pushing the lateral plate 140 forward relative to the base assembly 11 by means of the central driven member 15, that is, in a direction toward the leg stretching device 3, with the front swing rod 12 and the rear swing rod 13 swinging forward. The lateral plate driven member 17 and the seat driven member 16 are also moved forward with the front swing rod 12. Since the driving link 16a is originally inclined backward at its upper end in the TV position, when the front swing rod 12 and the rear swing rod 13 swing forward, the driving link 16a pivots forward at its upper end, supporting the seat driven member 16 to move forward and upward, thereby driving the central driven member 15 to rotate while moving forward, increas-

ing the distance from a hinge point between the central driven member **15** and the first backrest link **21** to a hinge point between the lateral plate **140** and the second backrest link **22**, thereby causing the backrest link assembly itself to be compressed while moving forward and the backrest connecting member **20** to be reclined strongly backward. During this process, not only are the first hinge point **P1** and the second hinge point **P2** both moving forward, but the distance between the first hinge point **P1** and the second hinge point **P2** is also significantly reduced compared to the sitting position and the TV position. The lying position shown in FIG. **28** is thus achieved.

#### LIST OF REFERENCE NUMERALS

|     |                             |     |                             |
|-----|-----------------------------|-----|-----------------------------|
| 1   | seat assembly               | 3   | leg stretching device       |
| 11  | base assembly               | 31  | first leg link              |
| 111 | base longitudinal beam      | 32  | second leg link             |
| 112 | base front crossbeam        | 33  | third leg link              |
| 113 | base rear crossbeam         | 34  | fourth leg link             |
| 12  | front swing rod             | 35  | first footrest member       |
| 13  | rear swing rod              | 36  | driven rod                  |
| 140 | lateral plate               | 37  | second footrest member      |
| 141 | first linkage member        | 38  | footrest extension assembly |
| 142 | second linkage member       | 381 | first extension member      |
| 143 | third linkage member        | 382 | second extension member     |
| 15  | central driven member       | 4   | electric driving device     |
| 16  | seat driven member          | 40  | motor crossbar              |
| 16a | driving link                | 41  | motor head                  |
| 17  | lateral plate driven member | 42  | motor sliding rail          |
| 18  | first transmission member   | 43  | motor slider                |
| 19  | second transmission member  | 401 | first motor crossbar        |
| 2   | backrest assembly           | 402 | second motor crossbar       |
| 20  | backrest connecting member  | 403 | third motor crossbar        |
| 21  | first backrest link         | 404 | first electric driver       |
| 22  | second backrest link        | 405 | second electric driver      |
| 23  | third backrest link         | 44  | motor link                  |
| 24  | fourth backrest link        |     |                             |
| 25  | fifth backrest link         |     |                             |

**1.** A mechanical stretching device for a movable seat unit, comprising:

- a seat assembly, comprising a base assembly, a lateral plate attached to a seat of the seat unit, and a central driven member coupled between the base assembly and the lateral plate;
- a backrest assembly, pivotally connected to a rear part of the lateral plate, comprising a backrest connecting member configured to be attached to a backrest of the seat unit and a backrest link assembly pivotally connected to the backrest connecting member, the backrest link assembly comprising a first backrest link hinged to the central driven member and a second backrest link hinged to the lateral plate, wherein the first backrest link is hinged to the second backrest link;
- a leg stretching device, pivotally connected to a front part of the lateral plate, comprising a plurality of links pivotally connected with each other and a first footrest member configured to be attached to a footrest,

wherein the mechanical stretching device allows the seat unit to be switched between a sitting position, a TV position, and/or a lying position; the first footrest member is folded below a seat when in the sitting position; the first footrest member is stretched forward when in the TV position; and the backrest is reclined

backward, a highest point of the footrest is higher than a highest point of the backrest, and the first footrest member is stretched forward and upward, when in the lying position.

**2.** The mechanical stretching device according to claim **1**, wherein the backrest is reclined at least  $35^\circ$  more in the lying position than in the sitting position.

**3.** The mechanical stretching device according to claim **1**, wherein a front end of the first footrest member is raised in the lying position, so that an acute angle with an opening facing forward in a range of  $10^\circ$  to  $23^\circ$  is formed between a footrest surface of the first footrest member and a horizontal plane.

**4.** The mechanical stretching device according to claim **1**, wherein the leg stretching device further comprises a second footrest member; both the first footrest member and the second footrest member are folded below the seat when in the sitting position; both the first footrest member and the second footrest member are stretched forward when in the TV position; and the backrest is reclined backward, a highest point of the footrest is higher than a highest point of the backrest, the first footrest member is stretched forward and upward, when in the lying position, and the second footrest member is located in front of the first footrest member.

**5.** The mechanical stretching device according to claim **4**, wherein a front end of the second footrest member is raised in the lying position, so that an acute angle with an opening facing forward in a range of  $10^\circ$  to  $23^\circ$  is formed between a footrest surface of the second footrest member and a horizontal plane.

**6.** The mechanical stretching device according to claim **4**, wherein a front end of the second footrest member is lowered in the lying position, so that an acute angle with an opening facing backward in a range of  $8^\circ$  to  $30^\circ$  is formed between a footrest surface of the second footrest member and a horizontal plane.

**7.** The mechanical stretching device according to claim **4**, wherein the first footrest member is connected to the second footrest member through a footrest extension assembly, and the footrest extension assembly comprises a first extension member and a second extension member hinged to each other.

**8.** The mechanical stretching device according to claim **1**, wherein the backrest link assembly further comprises a third backrest link, a fourth backrest link, and a fifth backrest link; a lower end of the third backrest link is hinged to the second backrest link, an upper end of the third backrest link is hinged to a rear end of the backrest connecting member, an upper end of the fourth backrest link is hinged to a front end of the backrest connecting member at a first hinge point, a front end of the fifth backrest link is hinged to the first backrest link at a second hinge point, a rear end of the fifth backrest link is hinged to a middle of the third backrest link, and a lower end of the fourth backrest link is hinged to a middle of the fifth backrest link.

**9.** The mechanical stretching device according to claim **8**, wherein, when the seat unit is switched from the sitting position to the lying position, a relative movement between the lateral plate and the central driven member leads to an increase in a distance from a hinge point between the first backrest link and the central driven member to a hinge point between the second backrest link and the lateral plate, so as to achieve compression of the backrest link assembly.

**10.** The mechanical stretching device according to claim **8**, wherein, when the seat unit is switched from the sitting position to the lying position, both the first hinge point and the second hinge point are moved forward, and a distance between the first hinge point and the second hinge point is decreased.

**11.** The mechanical stretching device according to claim **1**, wherein the seat assembly further comprises a front swing rod, a rear swing rod, a seat driven member, and a lateral plate driven member; lower ends of both the front swing rod and the rear swing rod are pivotally connected to the base assembly, upper ends of both the front swing rod and the rear swing rod are connected to the lateral plate through the central driven member, the seat driven member, and the lateral plate driven member.

**12.** The mechanical stretching device according to claim **1**, wherein the mechanical stretching device further comprises an electric driving device coupled between the base assembly and the lateral plate, the electric driving device comprises a first electric driver and a second electric driver, the first electric driver is configured to cause the leg stretching device to stretch and retract relative to the seat assembly, and the second electric driver is configured to cause the backrest assembly to move relative to the seat assembly.

**13.** The mechanical stretching device according to claim **12**, wherein the leg stretching device further comprises a second footrest member; when the first electric driver causes the leg stretching device to stretch to the front of the seat assembly, the second footrest member is located in front of the first footrest member.

**14.** The mechanical stretching device according to claim **12**, wherein the first electric driver acts between the seat assembly and the leg stretching device, and the second electric driver acts between the base assembly and the seat assembly.

**15.** The mechanical stretching device according to claim **14**, wherein the base assembly comprises a base rear crossbeam, the leg stretching device comprises a first motor crossbar, the seat assembly comprises a second motor crossbar close to the leg stretching device and a third motor crossbar close to the backrest assembly; the first electric driver acts between the first motor crossbar and the second motor crossbar, and the second electric driver acts between the third motor crossbar and the base rear crossbeam.

**16.** The mechanical stretching device according to claim **15**, wherein the second motor crossbar is connected to the lateral plate, and the third motor crossbar is connected to the central driven member.

**17.** The mechanical stretching device according to claim **12**, wherein the backrest link assembly further comprises a third backrest link, a fourth backrest link, and a fifth backrest link; a lower end of the third backrest link is hinged to the second backrest link, an upper end of the third backrest link is hinged to a rear end of the backrest connecting member, an upper end of the fourth backrest link is hinged to a front end of the backrest connecting member at a first hinge point, a front end of the fifth backrest link is hinged to the first backrest link at a second hinge point, a rear end of the fifth backrest link is hinged to a middle of the third backrest link, and a lower end of the fourth backrest link is hinged to a middle of the fifth backrest link.

**18.** The mechanical stretching device according to claim **17**, wherein, when the backrest assembly is moved relative to the seat assembly through the second electric driver, a relative movement between the lateral plate and the central driven member leads to an increase in a distance from a hinge point between the first backrest link and the central driven member to a hinge point between the second backrest link and the lateral plate, so as to achieve compression of the backrest link assembly.

**19.** The mechanical stretching device according to claim **17**, wherein when the backrest assembly is moved relative to the seat assembly through the second electric driver, both the first hinge point and the second hinge point are moved forward, and a distance between the first hinge point and the second hinge point is decreased.

**20.** The mechanical stretching device according to claim **12**, wherein the seat assembly further comprises a front swing rod, a rear swing rod, a seat driven member, a lateral plate driven member, and a driving link; lower ends of both the front swing rod and the rear swing rod are pivotally connected to the base assembly, upper ends of both the front swing rod and the rear swing rod are connected to the lateral plate through the central driven member, the seat driven member, and the lateral plate driven member, an upper end of the driving link is hinged to a middle of the seat driven member, and a lower end of the driving link is hinged to a middle of the base assembly.

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