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(54) **METHOD FOR DESIGNING BACKREST MOVEMENT MECHANISM AND BACKREST MOVEMENT MECHANISM DESIGNED USING SAME**

(57) The present invention discloses a method for designing a backrest movement mechanism and a backrest movement mechanism designed using same. The method is implemented by analyzing the movement trail of a point A which bears the largest body pressure on a human spine. The backrest movement mechanism comprises an upper frame (1) and a backrest frame (2), and further comprises a backrest connecting mechanism (3), wherein a movement track is provided on the backrest connecting mechanism (3), and the backrest frame (2) is movably connected to the upper frame (1) via the backrest connecting mechanism (3) and moves along the movement track relative to the upper frame (1). The backrest movement mechanism changes the motion between the backrest and a seat cushion from a revolute pair to a sliding pair such that a mechanical rotating point between the backrest and the seat cushion is as close as possible to a rotating point of the human body, so that when the backrest angle is adjusted, the back of the human body can be comfortably in contact with the backrest, and accordingly the relative displacement caused by the relative motion between the back of the user and the backrest can be minimized, so as to minimize the "back rubbing sensation", thereby giving the user the most comfortable experience.

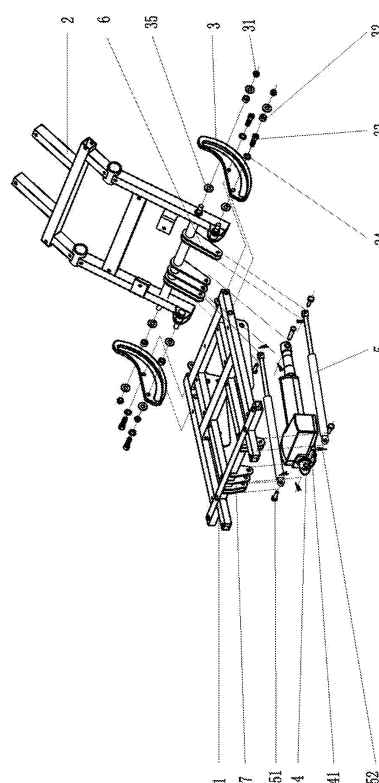


Fig. 2

Description**TECHNICAL FIELD**

5 **[0001]** The present invention relates to a method for designing a backrest movement mechanism and a backrest movement mechanism designed using same, more particularly, to a backrest movement mechanism applicable to a seat or a bed.

BACKGROUND

10 **[0002]** Seat and bed products are divided into a fixed backrest type and an adjustable backrest type according to an aspect that whether a backrest angle is adjustable. The present invention relates to the adjustable backrest type, an included angle between the backrest and a seat cushion is adjustable, or the backrest and the seat cushion may have a relative movement. All existing connecting mechanisms between the backrest and the seat cushion are revolutes pair or turning pair, which may also be called a hinge, and more particularly, a hinge type, a pin shaft type, a screw stem type, etc. are comprised. Moreover, with regard to the existing seat or bed having this connecting mechanism, when the backrest angle is adjusted, since a rotating point of the connecting mechanism is far from a rotating point of a human body, a scapulae at back of the human body and the backrest of the seat or the bed may have relative displacement with the change of the angle between the backrest and the seat cushion, so as to generate strong "back rubbing sensation", which makes people feel uncomfortable.

SUMMARY

25 **[0003]** In order to improve a comfort level of such products, the present invention provides a method for designing a backrest movement mechanism and a backrest movement mechanism designed using the method. In the process of adjusting a backrest angle of a seat or a bed including this backrest movement mechanism, a rotating point of a connecting mechanism is very close to a rotating point of a human body. Therefore, the back of the human body can be comfortably in contact with the backrest, and the relative displacement is eliminated, so as to give the user comfortable experience.

30 **[0004]** The technical solution adopted by the present invention to solve the technical problem thereof is as follows:

a method for designing a backrest movement mechanism is implemented by analyzing the movement trail of a point A, which bears the largest body pressure, on the human spine, including the following steps:

35 firstly, establishing a human body coordinate system, taking the point A which bears the largest body pressure below a femoral head as an initial point, taking a direction straightly extending along a leg as an X-axis, and taking a front side direction vertical to the extending leg as an Y-axis;

40 secondly, taking a plurality of coordinate values of the point A in a process from lying to sitting or sitting to lying of the human body;

thirdly, conducting curve fitting to the coordinate values obtained, approximating the fitted curve into a first arc, and finding a circle center of the first arc;

45 fourthly, taking the circle center of the first arc above as a rotating point of the backrest movement mechanism, and making the backrest move along the first arc above; and

50 fifthly, taking the rotating point of the backrest movement mechanism as the circle center, taking a radius of a proper size in a sector formed by the backrest moving along the first arc above, and making a backrest connecting mechanism using a second arc corresponding to the radius, wherein the backrest connecting mechanism includes a movement track in conformity with the second arc.

55 **[0005]** The backrest movement mechanism designed according to the method above includes an upper frame and a backrest frame, and further includes the backrest connecting mechanism, wherein the backrest frame is movably connected to the upper frame via the backrest connecting mechanism and moves along the movement track relative to the upper frame.

[0006] Preferably, the movement track is a long hole approximately in conformity with the second arc.

[0007] Further, the backrest frame is provided with a pin shaft matched with a long hole on the backrest connecting mechanism, and the movement of the backrest frame is limited in the long hole via the pin shaft.

[0008] Preferably, the backrest connecting mechanisms are used in pairs, and are respectively arranged on two sides of the upper frame.

[0009] Preferably, the backrest connecting mechanism is also provided with two connecting holes, and the backrest connecting mechanism is fixed on the upper frame via the connecting holes.

[0010] Preferably, the backrest connecting mechanism is falciform or semicircular.

[0011] Preferably, the backrest movement mechanism further includes a driving link for driving the backrest frame, wherein two ends of the driving link are movably connected to the backrest frame and the upper frame via connecting plates respectively.

[0012] Preferably, the backrest movement mechanism further includes a supporting rod, wherein two ends of the supporting rod are rotationally connected to the backrest frame and the upper frame via the connecting plates respectively.

[0013] The present invention has the beneficial effects that: compared with the existing products, the present invention improves the technical defects of the original products, and creatively changes the motion between the backrest and the seat cushion from a revolute pair to a sliding pair with reference to an ergonomics idea. In the movement process of the backrest, a mechanical rotating point between the backrest and the seat cushion is as close as possible to a rotating point of the human body, so that when the human body moves from sitting to lying or from lying to sitting, the back of the human body can be comfortably in contact with the backrest, and accordingly the relative displacement caused by the relative motion between the back of the user and the backrest can be minimized, so as to minimize the "back rubbing sensation", thereby giving the user the best and most comfortable experience.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] The present invention is further described hereunder with reference to the drawings and specific embodiments.

Fig. 1 illustrates a human body coordinate system established according to a method of the present invention and coordinate values of a point A taken;

Fig. 2 is an explosion block diagram of a backrest movement mechanism according to the present invention; and

Fig. 3 is an explosion block diagram of a seat including the backrest movement mechanism according to the present invention.

DETAILED DESCRIPTION

[0015] Referring to Fig. 1, the present invention designs a backrest movement mechanism via analyzing the movement trail of a point A which bears the largest body pressure on a human spine. In the embodiment as shown in Fig. 1, considering the average height of Chinese, the inventor takes a man with a height of 167cm as a research object, and the method particularly includes the following steps:

firstly, as shown in Fig. 1, establishing a human body coordinate system, and taking the point A which bears the largest body pressure below a femoral head as an initial point O, taking a direction extending along a leg as an X-axis, and taking a front side direction vertical to the extending leg as a Y-axis;

secondly, obtaining a distance of 438mm between the point A and the point O at a back via measurement, and equally dividing an X-coordinate into 10 intervals, wherein a backrest movement angle generally ranges from 0 to 65 degrees, in the embodiment, taking the process from lying to sitting of the human body (i.e., within the range of 65 degrees as shown in the figure), and taking seven coordinate values of the point A from (X0,Y0) to (X6,Y6) via measurement, wherein the specific numerical values are as shown in the table below:

[Table 1]

Point A	(X0,Y0)	(X1,Y1)	(X2,Y2)	(X3,Y3)	(X4,Y4)	(X5,Y5)	(X6,Y6)
Coordinate value	(-438,0)	(-394.2, 204.8)	(-350.4, 270.3)	(-306.6, 315.8)	(-262.8, 349.4)	(-219, 379.3)	(-175.2, 401.5)

thirdly, conducting curve fitting to the coordinate values obtained using MATLAB, approximating the fitted curve into a first arc, and finding a circle center of the first arc;

fourthly, taking the circle center of the first arc above as a rotating point of the backrest movement mechanism, and making the backrest move along the first arc above; and

fifthly, taking the rotating point of the backrest movement mechanism as the circle center, taking a radius of proper size

in a sector formed by the backrest moving along the first arc above, and making a backrest connecting mechanism using a second arc corresponding to the radius, wherein the backrest connecting mechanism includes a movement track in conformity with the second arc.

[0016] Fig. 2 illustrates an embodiment of a backrest movement mechanism according to the present invention, which includes an upper frame 1 and a backrest frame 2, and further includes a backrest connecting mechanism 3, wherein the backrest connecting mechanism 3 includes the movement track in conformity with the second arc, and the backrest frame 2 is movably connected to the upper frame 1 via the backrest connecting mechanism 3 and moves along the movement track relative to the upper frame 1.

[0017] As an improvement to the embodiment above, the movement track is a long hole approximately in conformity with the second arc.

[0018] As a further improvement to the embodiment above, the backrest frame 2 is provided with a pin shaft matched with the long hole on the backrest connecting mechanism 3, and the movement of the backrest frame 2 is limited in a movement track limited by the long hole via the pin shaft.

[0019] As a further improvement to the embodiment above, the backrest connecting mechanisms 3 are used in pairs, and are respectively arranged on two sides of the upper frame 1.

[0020] As an improvement to the embodiment above, the backrest connecting mechanism 3 is also provided with two connecting holes, and the backrest connecting mechanism 3 is fixed on the upper frame 1 via the connecting holes.

[0021] In the embodiment, the backrest connecting mechanism 3 is fixed on the upper frame 1 using a hexagon socket head cap screw 33. Preferably, a spring shim 34 is arranged between the hexagon socket head cap screw 33 and the backrest connecting mechanism 3.

[0022] In the embodiment, the backrest frame 2 is connected to the upper frame 1 via the backrest connecting mechanism 3, and the backrest frame 2 is limited in the movement track of the backrest connecting mechanisms 3 at two sides using a self-locking nut 31, a sliding bearing 32, and a nylon spacer 35, wherein the sliding bearing 32 may also be replaced by a rolling bearing, a copper bush, etc.

[0023] As an improvement to the embodiment above, the backrest movement mechanism further includes a driving link for driving the backrest frame, driving elements such as a backrest motor, a hydraulic cylinder, a gas spring, etc. may be used in the driving link, and the embodiment shown in Fig. 2 is the situation that a backrest motor 4 is used.

[0024] As a further improvement to the embodiment above, two ends of the backrest motor 4 are rotationally connected to the backrest frame 2 and the upper frame 1 via the connecting plates 6 and 7 respectively.

[0025] As an improvement to the embodiment above, in order to decrease the sloshing of the backrest, the backrest movement mechanism further includes a supporting rod 5, two ends of the supporting rod 5 are rotationally connected to the backrest frame 2 and the upper frame 1 via the connecting plates 6 and 7 respectively. Meanwhile, the supporting rod can also has a certain aided effect to the starting up of the driving link.

[0026] The supporting rod 5 may also be replaced by a gas spring, a draw bar, a spring, and other parts with similar functions.

[0027] As a further improvement to the embodiment above, one end of the connecting plate 6 is fixedly connected to the backrest frame 2, and the other end is provided with a round hole that is used to rotationally connect one end of the backrest motor 4; and one end of the connecting plate 7 is fixedly connected to the upper frame 1, and the other end is provided with a round hole that is used to rotationally connect the other end of the backrest motor 4.

[0028] As a further improvement of the embodiment above, the connecting plates are connected to the supporting rod 5 using a supporting rod pin 51 and a cotter pin 52, and similarly, the connecting plates are connected to the backrest motor 4 using a motor pin shaft 41 and the cotter pin.

[0029] In addition, the present invention also relates to a seat with comfortable backrest in an adjustment process of the backrest angle. As shown in Fig. 3, a seat cushion 11 and a backrest cushion 21 are included, wherein the seat cushion 11 and the backrest cushion 21 are respectively arranged on the upper frame 1 and the backrest frame 2, and the seat further includes the backrest movement mechanism above.

[0030] It should be understood that, the backrest movement mechanism above not only is applied to the seat but also is applied to the bed with similar functions.

[0031] The descriptions above are preferred embodiments of the present invention merely, but the present invention is not limited to the embodiments above, and those embodiments that achieve the technical effects of the present invention using any same or similar ways shall all fall within the protection scope of the present invention.

Claims

1. A method for designing a backrest movement mechanism, wherein the method is implemented by analyzing the movement trail of a point A which bears the largest body pressure on a human spine, comprising the following steps of:

firstly, establishing a human body coordinate system, taking the point A which bears the largest body pressure below a femoral head as an initial point, taking a direction straightly extending along a leg as an X-axis, and taking a front side direction vertical to the extending leg as an Y-axis;

secondly, taking a plurality of coordinate values of point A in a process from lying to sitting or sitting to lying of the human body;

thirdly, conducting curve fitting to the coordinate values obtained, approximating the fitted curve into a first arc, and finding a circle center of the first arc;

fourthly, taking the circle center of the first arc above as a rotating point of the backrest movement mechanism, and making the backrest move along the first arc above; and

fifthly, taking the rotating point of the backrest movement mechanism as the circle center, taking a radius of a proper size in a sector formed by the backrest moving along the first arc above, and making a backrest connecting mechanism using a second arc corresponding to the radius, wherein the backrest connecting mechanism comprises a movement track in conformity with the second arc.

2. The backrest movement mechanism designed according to the method of claim 1, comprising an upper frame (1) and a backrest frame (2), and further comprising the backrest connecting mechanism (3), wherein the backrest connecting mechanism (3) comprises the movement track in conformity with the second arc, and the backrest frame (2) is movably connected to the upper frame (1) via the backrest connecting mechanism (3) and moves along the movement track relative to the upper frame (1).

3. The backrest movement mechanism according to claim 2, wherein the movement track is a long hole approximately in conformity with the second arc.

4. The backrest movement mechanism according to claim 3, wherein the backrest frame (2) is provided with a pin shaft matched with a long hole on the backrest connecting mechanism (3), and the movement of the backrest frame (2) is limited in the long hole via the pin shaft.

5. The backrest movement mechanism according to claim 2, wherein the backrest connecting mechanisms (3) are used in pairs, and are respectively arranged on two sides of the upper frame (1).

6. The backrest movement mechanism according to claim 2, wherein the backrest connecting mechanism (3) is also provided with two connecting holes, and the backrest connecting mechanism (3) is fixed on the upper frame (1) via the connecting holes.

7. The backrest movement mechanism according to claim 2, wherein the backrest connecting mechanism (3) is sickle or semicircular.

8. The backrest movement mechanism according to claim 2, further comprising a driving link (4) for driving the backrest frame (2), wherein two ends of the driving link (4) are movably connected to the backrest frame (2) and the upper frame (1) via connecting plates (6 and 7) respectively.

9. The backrest movement mechanism according to claim 1, further comprising a supporting rod (5), wherein two ends of the supporting rod (5) are rotationally connected to the backrest frame (2) and the upper frame (1) via the connecting plates (6 and 7) respectively.

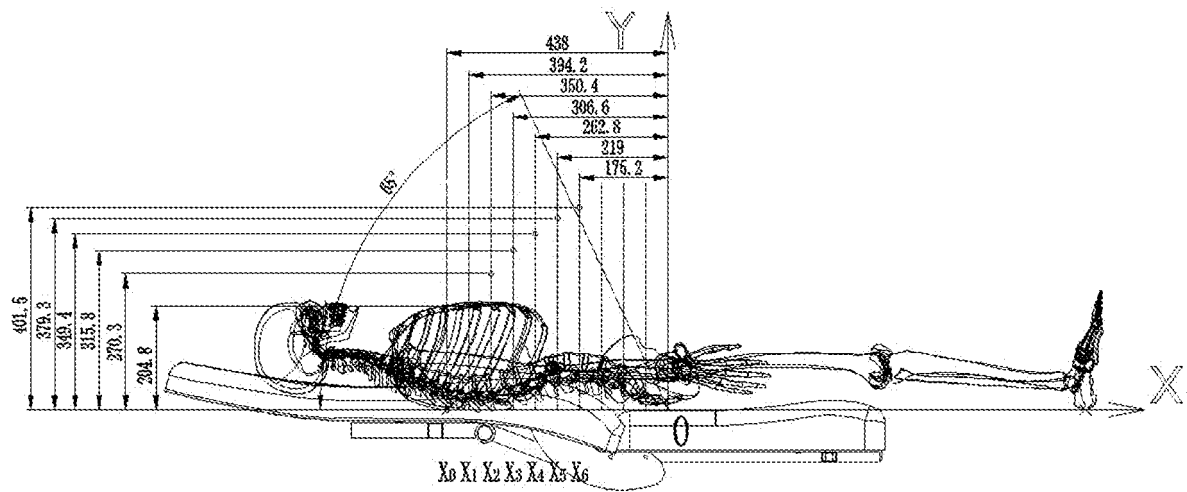


Fig. 1

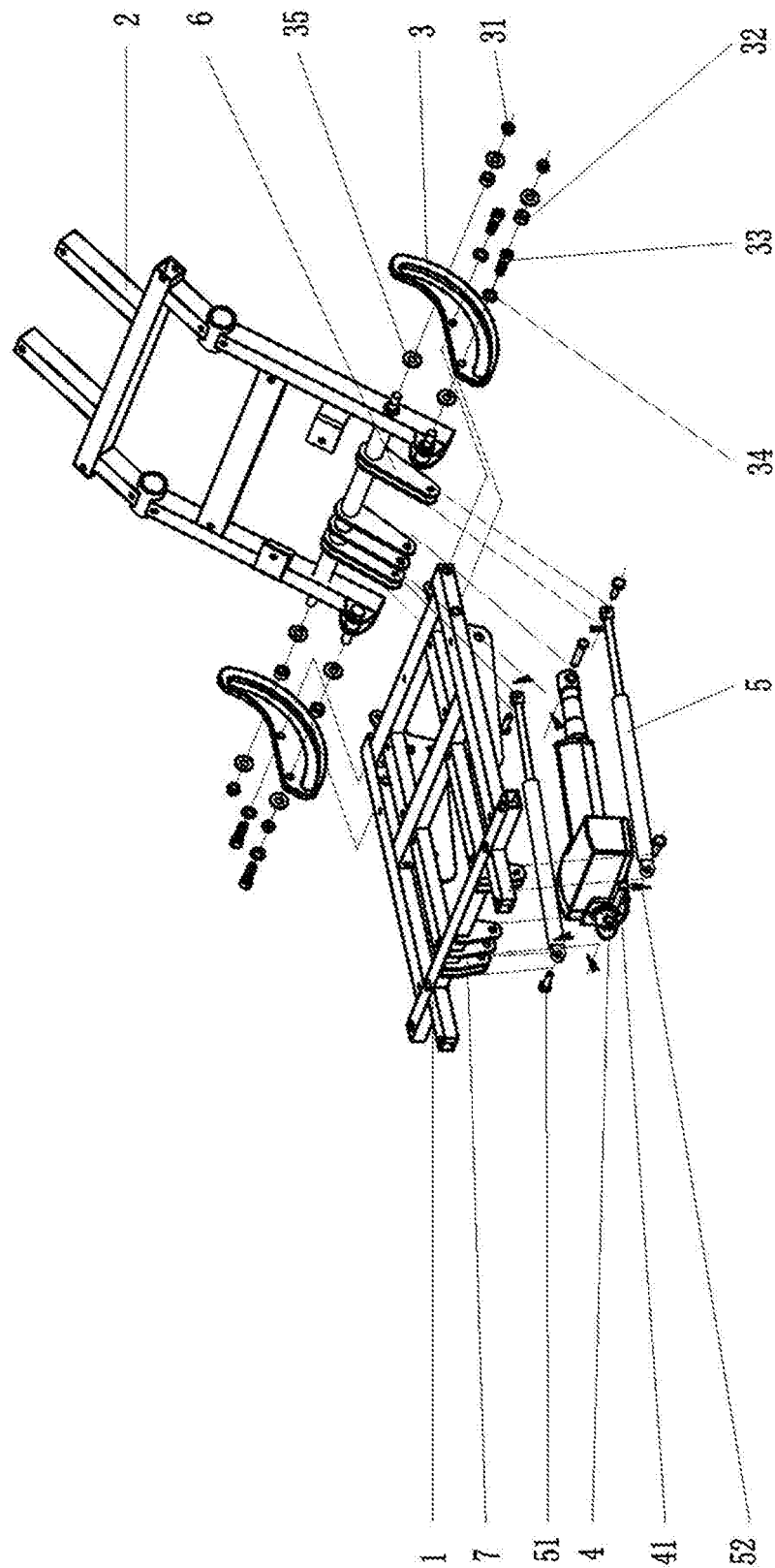


Fig. 2

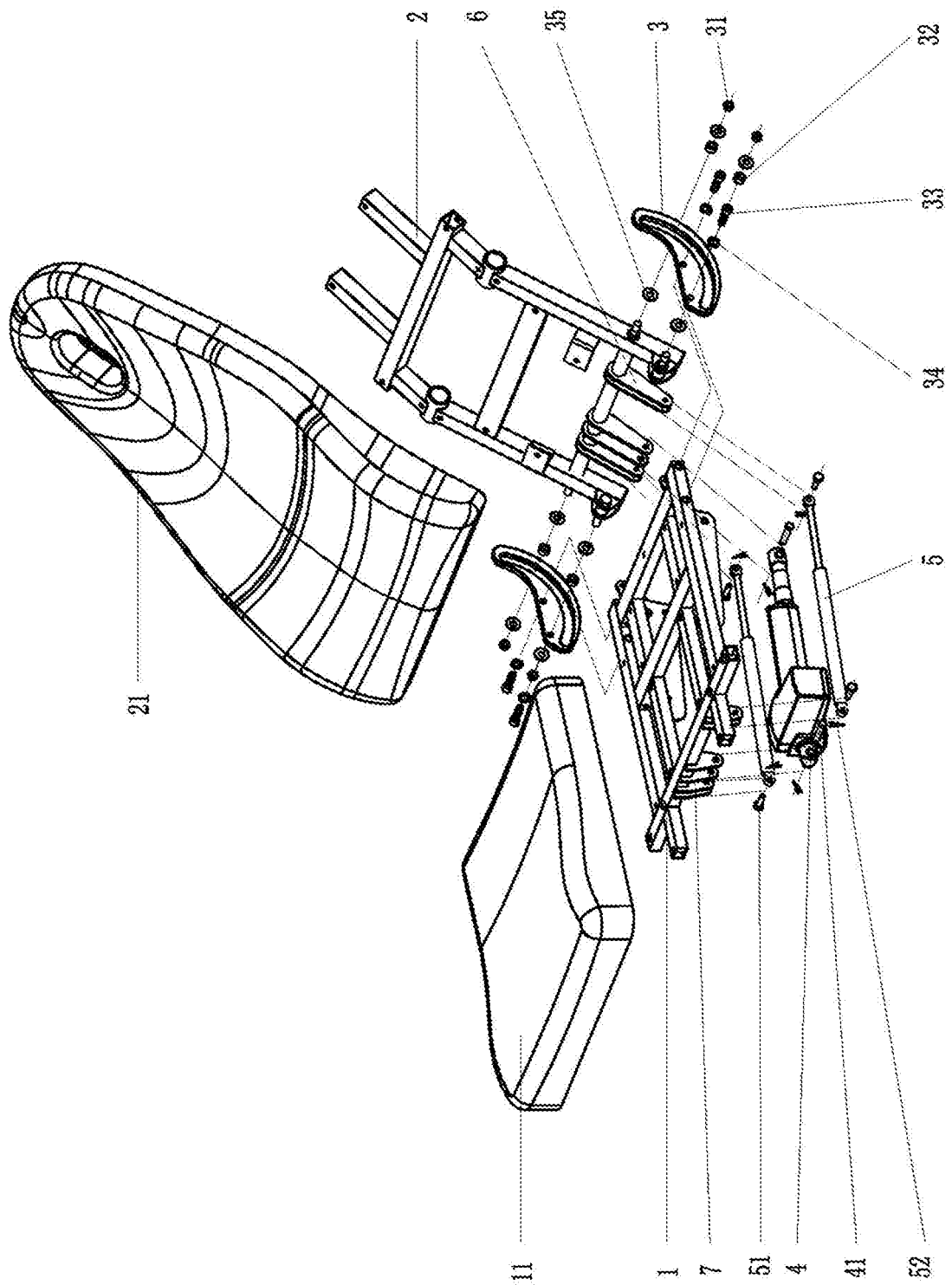


Fig. 3

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2015/089567

A. CLASSIFICATION OF SUBJECT MATTER

A47C 1/024 (2006.01) i; A47C 7/40 (2006.01) i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

A47C

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

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

CNPAT, CNKI, WPI, EPODOC: adjustable, backrest, chair, rotate, adjust, arc, groove, rail, hole, design

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
PX	CN 104545063 A (SILVER FOX BEAUTY INSTRUMENT (JIANGMEN) CO. LTD.), 29 April 2015 (29.04.2015), description, paragraphs 3-18, and figures 1-3	1-9
A	CN 2557014 Y (LIN, Kui), 25 June 2003 (25.06.2003), description, page 1, paragraphs 3-4 and page 4, paragraph 5, and figure 5	1-9
A	US 4372608 A (HOTTA, M.), 08 February 1983 (08.02.1983), the whole document	1-9
A	CN 101513377 A (SANYO ELECTRIC CO., LTD.), 26 August 2009 (26.08.2009), the whole document	1-9
A	CN 201977234 U (CAO, Liang), 21 September 2011 (21.09.2011), the whole document	1-9
A	CN 201675412 U (FUZHOU DEHUI FURNITURE CO., LTD.), 22 December 2010 (22.12.2010), the whole document	1-9

☒ Further documents are listed in the continuation of Box C.☒ See patent family annex.

* Special categories of cited documents:

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2015/089567

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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Form PCT/ISA/210 (continuation of second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

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CN 201977234 U	21 September 2011	None	
CN 201675412 U	22 December 2010	None	
CN 102160716 A	24 August 2011	CN 102160716 B	12 December 2012

Form PCT/ISA/210 (patent family annex) (July 2009)