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(54) **A longitudinally tiltable bed**

(57) Disclosed is a bed (1) comprising a bottom frame (2) including support means (5) for engaging an underlying ground and a bed frame (3) comprising a bed surface (6) for supporting a person lying in the bed (1). The bed frame (3) is rotatably connected to the bottom frame (2) in at least one tilt joint (7) having a tilt rotational axis (8) extending substantially parallel with the longitudinal extent of the bed (1) and the tilt rotational axis (8) being arranged at a central longitudinal area (9) of the bed frame (3). The bed (1) further comprises a tilt mechanism (4) connected to the bottom frame (2) in a bottom frame point of attack (10) and to the bed frame (3) in at least one bed frame point of attack (11) to tilt the bed frame (3) around the tilt rotational axis (8) and wherein the at least one bed frame point of attack (11) is arranged between the central longitudinal area (9) and the outer periphery (12) of the bed frame (3). The bed (1) further comprises a tilt mechanism (4) connected to the bottom frame (2) in a bottom frame point of attack (10) and to the bed frame (3) in at least one bed frame point of attack (11) to tilt the bed frame (3) around the tilt rotational axis (8), wherein the at least one bed frame point of attack (11) is arranged between the central longitudinal area (9) and the outer periphery (12) of the bed frame (3).

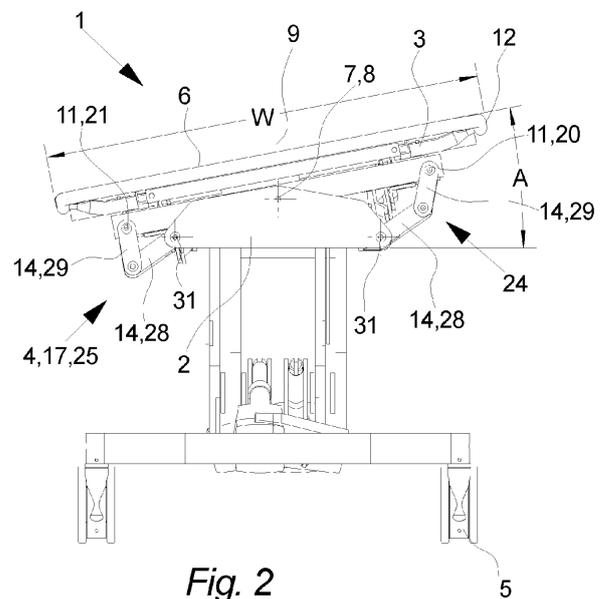


Fig. 2

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Description

Field of the invention

[0001] The invention relates to a bed comprising a bottom frame including support means for engaging an underlying ground and a bed frame comprising a bed surface for supporting a person lying in the bed.

Background of the invention

[0002] Beds comprising some sort of tilt mechanism for tilting the upper surface of the bed around a longitudinal axis of rotation have been known for several years particularly for use within hospitals, retirement homes, care homes but also in private homes e.g. to relieve the pressure on certain parts of a bedbound patient, to aid e.g. a nurse or staff nurse in placing a patient in a lateral position during examination or nursing or even to enable easier access to the bed.

[0003] Thus, from WO 2007/145544 A1 it is known to connect the upper bed frame to the bottom frame of the bed through three lifting columns allowing both transversal and longitudinal tilt of the bed. But lifting columns are expensive, they require a complex control and their large build-in dimensions entail a relative large minimum height of the bed.

[0004] From US 2007/0011811 A1 it is therefore also known to tilt a bed by means of two scissor jacks arranged along the longitudinal centre area of a bed to lift a longitudinal side of the bed frame around a rotational axis arranged at the outer periphery of the other longitudinal side. However, this tilting mechanism is very space consuming - particularly along the longitudinal centre area of the bed, hereby making it very difficult to provide the bed with further functionality, such as elevation, height adjustment etc. Furthermore, when the bed frame is tilted around an axis placed at the longitudinal periphery of the bed, the person lying in the bed will also be displaced considerably both horizontally and vertically when the bed frame is tilted, which is undesired. And rearranging the bed from tilting towards one side to tilting toward the other side is complicated and time consuming.

[0005] From EP 0 183 371 A2 it is known to tilt a centre part of a bed in one direction while tilting the lower outer part of the bed in an opposite direction or at least keep this outer part level. However, this tilt mechanism is very complex and space consuming.

[0006] An object of the invention is therefore to provide for a bed with a more advantageous tilt mechanism.

The invention

[0007] The invention provides for a bed comprising a bottom frame including support means for engaging an underlying ground and a bed frame comprising a bed surface for supporting a person lying in the bed. The bed frame is rotatably connected to the bottom frame in at

least one tilt joint having a tilt rotational axis extending substantially parallel with the longitudinal extent of the bed and the tilt rotational axis being arranged at a central longitudinal area of the bed frame. The bed further comprises a tilt mechanism connected to the bottom frame in a bottom frame point of attack and to the bed frame in at least one bed frame point of attack to tilt the bed frame around the tilt rotational axis and wherein the at least one bed frame point of attack is arranged between the central longitudinal area and the outer periphery of the bed frame. The tilt mechanism comprises a tilt actuator arranged between the bottom frame point of attack and the at least one bed frame point of attack to drive the tilt motion of the bed frame in relation to the bottom frame, by means of one or more rotatably connected lever arms.

[0008] Making the bed tilt around a longitudinal axis arranged at the central longitudinal area of the bed frame is advantageous in that it entails that the person in the bed is substantially only tilted and not displaced transversely or vertically, or it will at least entail that a slight displacement is substantially uniformly distributed no matter if the bed frame is tilted to one or the other side, hereby ensuring a more simple tilting procedure.

[0009] Furthermore, arranging the bed frame point of attack between the central longitudinal area and the outer longitudinal periphery of the bed frame is advantageous in that the bed frame point of attack is hereby moved away from the rotational axis and thereby enabling that less force is needed to tilt the bed.

[0010] Connecting the tilt actuator through one or more rotatably connected lever arms is advantageous in that it enables a more compact and efficient tilt mechanism in that the lever arms among other can allow the tilt actuator to be extending transverse to the direction of motion of the bed frame point of attack, during the tilt.

[0011] It should be noted that by the term "*outer periphery of the bed frame*" is to be understood the outer edge or the outer extent of the bed frame, which in most cases would be the outer periphery of the bed surface. I.e. in many cases the outer periphery of the bed frame would be defined by the maximum length and the maximum width of the bed surface.

[0012] It should also be noted that by the term "*central longitudinal area*" is to be understood the area down the middle of the transversal extent of the bed frame i.e. in a traditional rectangular bed frame design the central longitudinal area is defined as the area extending around the axis of symmetry extending in the longitudinal extent of the bed frame. In an embodiment the central longitudinal area would therefore be defined as the same as the middle of the transverse extent of the bed.

[0013] In an aspect of the invention, said tilt mechanism comprises at least one lever arm gear arranged between said actuator and said at least one bed frame point of attack to gear the motion of said actuator in relation to said bed frame.

[0014] If the tilt actuator is connected directly to the bed frame, the bed frame point of attack will move in

accordance with the actuator in a ration one to one. But since the bed frame is rotatably connected to the bottom frame in the tilt joints, the bed frame point of attack and the bed frame will describe a circular motion where the rotational speed of the bed frame and the load on the actuator will depend on the angle between the bed frame and the actuator, if the actuator is moving at a constant speed. Thus, by connecting the actuator to the bed frame through at least one lever arm gear it is possible to gear the motion of the actuator in relation to the bed frame point of attack, but it is also possible to counteract the speed variation and variation in force required from the actuator - at least to some degree. Obviously the actuator has to be dimensioned according to the highest load and it is therefore advantageous to connect the actuator to the bed frame through a lever arm gear that can even out the force requirement and thereby enable that an actuator with a smaller capacity can actuate the bed frame over the entire tilt of the bed frame. And it is advantageous in that it also provides a more constant tilt speed through the entire tilt.

[0015] It should be noted that by the term "*lever arm gear*" is to be understood a gearbox or a transmission that will gear the motion of the actuator in relation to the motion of the bed frame by means of one or more lever arms. I.e. in relation to a traditional gear wheel transmission (as in a car) a lever arm gear enables that the gearing of the gear changes in accordance with the given extension of the actuators so that e.g. a 10 mm stroke of the actuators results in e.g. 2° angular displacement of the bed frame no matter if it is at the beginning or the end of the actuator stroke. This is of course ideally but in another embodiment the lever arm gear will at least improve the ratio in relation to a design where the actuator is connected directly to the bed frame.

[0016] In an aspect of the invention, said at least one bed frame point of attack is arranged between 30% and 98%, preferably between 45% and 92% and most preferred between 55% and 85% of the distance between said tilt rotational axis and said outer periphery of said bed frame from said tilt rotational axis as measured in a plane parallel with said bed surface.

[0017] If the bed frame point of attack is arranged too close to the tilt rotational axis, the force needed to tilt the bed frame becomes too high and the space around the rotational axis becomes too crowded, hereby complicating the tilt mechanism design. However, if the bed frame point of attack is arranged too far from the tilt rotational axis the stroke of the actuator has to be so big that it is difficult to fit the actuator beneath the bed and it becomes more difficult to shield the person using the bed or other personnel from the tilt mechanism.

[0018] Thus, the present placement ranged provides for an advantageous relationship between force requirement/optimal location and size of actuator/safety.

[0019] In an aspect of the invention, said central area of said bed frame is defined as the middle 30%, preferably the middle 20% and most preferred the middle 10% of

said bed frame, such as substantially the middle of the transversal width of said bed frame.

[0020] Arranging the tilt rotational axis within the present width ranges is advantageous in that the closer it is arranged to the middle of the transversal width of the bed frame the more uniformly the bed frame will tilt no matter which side it is tilted to.

[0021] In an aspect of the invention, said tilt mechanism is connected to said bed frame in a front bed frame point of attack and a back bed frame point of attack of said at least one bed frame point of attack and wherein said front bed frame point of attack and said back bed frame point of attack are arranged on the same side of said tilt rotational axis and wherein said front bed frame point of attack and said back bed frame point of attack are arranged at a mutual distance of at least 10%, preferably 25% and most preferred 45% of the length of said bed frame along said same side of said bed frame.

[0022] Connecting the tilt mechanism to the bed frame in two or more bed frame points of attack arranged along the same longitudinal side of the bed is advantageous in that the load transferred through each bed frame point of attack will be reduced hereby enabling a more simple tilt mechanism design.

[0023] Furthermore, by spacing these bed frame points of attack apart the load of the tilt mechanism can be more evenly distributed on the bed frame hereby reducing the demand to the rigidity of the bed frame.

[0024] In an aspect of the invention, said tilt mechanism comprises an actuator arm connected to a left bed frame point of attack of said at least one bed frame point of attack and connected to a right bed frame point of attack of said at least one bed frame point of attack and wherein said left bed frame point of attack being arranged on a substantially left side of said tilt rotational axis and said right bed frame point of attack being arranged on a substantially right side of said tilt rotational axis.

[0025] Arranging the bed frame points of attack on opposite sides of the rotational axis and connecting them so that one is going up while the other is going down, when the actuator arm is moved to one side, is advantageous in that by spacing these bed frame points of attack apart, the load of the tilt mechanism can be more evenly distributed on the bed frame hereby reducing the demand to the rigidity of the bed frame.

[0026] In an aspect of the invention, a left lifting mechanism is arranged between said actuator arm and said left bed frame point of attack and wherein a right lifting mechanism is arranged between said actuator arm and said right bed frame point of attack and wherein said left lifting mechanism is arranged to lift said bed frame and said right lifting mechanism is arranged to lower said bed frame when said actuator arm is moved away from one of said left lifting mechanism and said right lifting mechanism and towards the other of said left lifting mechanism and said right lifting mechanism and vice versa.

[0027] Lowering one side of the bed while lifting the other side to generate the tilt is advantageous, in that it

enables that the vertical and horizontal position of the bed frame is less affected by the tilt process. Hereby the tilt process is simplified.

[0028] In an aspect of the invention, said bed further comprises a bed frame lifting mechanism for changing the vertical position of said bed surface over said underlying ground.

[0029] According to the present invention the bed frame points of attack are arranged at the sides of the bed. This is particularly advantageous in relation with a bed also comprising a bed frame lifting mechanism in that the tilt mechanism according to the present invention is less space consuming - particularly around the longitudinal centre area of the bed - hereby providing sufficient space for a simple and efficient bed frame lifting mechanism.

[0030] In an aspect of the invention, said bed further comprises a number of bed surface actuators arranged to transform said bed surface into a chair-like device.

[0031] As previously explained the bed frame points of attack are arranged at the sides of a bed according to the present invention. This is particularly advantageous in relation with a bed also comprising an elevation mechanism in the bed surface in that the tilt mechanism according to the present invention is less space consuming - particularly around the longitudinal centre area of the bed - hereby providing sufficient space for the bed surface actuators.

[0032] Furthermore, providing bed surface actuators that can transformed the bed surface into a chair-like device is advantageous in that it enables that a person using the bed can easily and gently get in and out of the bed even if this person mobility is impaired or if the transition between lying and sitting (or standing up) is normally related with much pain.

[0033] In an aspect of the invention, said actuator is an electrical linear actuator comprising an electrical motor and a spindle drive.

[0034] Hereby is achieved an advantageous embodiment of the invention.

[0035] In an aspect of the invention, said tilt mechanism enables said bed frame to be tilted between 1° and 30°, preferably between 3° and 20° and most preferred between 5° and 15° in relation to said bottom frame.

[0036] If the tilt mechanism is arranged to tilt the bed frame too little, the tilt will not provide the desired effect regarding pressure relief, assistance during nursing or other. But if the tilt is too large the person lying in the bed risks rolling out of the bed. Thus, the present angle ranges presents an advantageous relationship between functionality and safety.

[0037] In an aspect of the invention, said at least one tilt joint is located between 1% and 40%, preferably between 2% and 25% and most preferred between 5% and 15% of the width of said bed frame below said bed surface.

[0038] If the tilt joint is arranged too close to the bed surface it will not be possible fit a durable and reliable

joint design and if the tilt joint is arranged too far from the bed surface the sideward displacement of the person lying in the bed is increased. Thus, the present distance ranges presents an advantageous relationship between durability and functionality.

[0039] In an aspect of the invention, said bed comprises control means for controlling the tilt angle of said bed frame and wherein said controller comprises first operation means to activate a tilt of said bed frame until a certain low tilt angle and second operation means to activate a further tilt of said bed frame the rest of the way to an extreme tilt angle.

[0040] It is advantageous that the bed frame can only be tilted to a certain low tilt angle by means of first operation means in that it hinders that the operator by accident tilts the bed so much that the person in the bed rolls out of the bed. However, it is also advantageous that the controller is provided with second operation means so that the bed can be tilted to an extreme tilt angle if necessary.

Figures

[0041] The invention will be described in the following with reference to the figures in which

fig. 1 illustrates a bed according to the invention, as seen in perspective,

fig. 2 illustrates a bed tilted to the right, as seen from the front,

fig. 3 illustrates a bed tilted to the left, as seen from the front,

fig. 4 illustrates a circular cross section in a bed, as seen from the side,

fig. 5 illustrates a cross section B-B in a bed, as seen from the front,

fig. 6 illustrates a cross section C-C in a bed, as seen from the front,

fig. 7 illustrates a bed transformed into a chair-like position, as seen in perspective,

fig. 8 illustrates a bed in a contracted state, as seen from the side, and

fig. 9 illustrates a bed in an elevated state, as seen from the side.

Detailed description

[0042] Fig. 1 illustrates a bed 1 according to the invention, as seen in perspective.

[0043] In this embodiment the bed 1 comprises a bed

frame 3 provided with a bed surface 6 for supporting a person (not shown) lying in the bed 1. In another preferred embodiment the bed surface 6 would further comprise a mattress for cushioning a person (not shown) lying in the bed 1.

[0044] In this embodiment the bed frame 3 is rotatably connected to the bottom frame 2 in two tilt joints 7 arranged wherein one is arranged at the foot end of the bed 1 and the other is arranged substantially at the middle of the bed 1. In another embodiment the bed frame 3 could be connected to the bottom frame 2 through only one tilt joint 7 or by means of more than two tilt joints 7, such as three, four, five or more joints 7 and the joints 7 could be arranged elsewhere such as at both ends of the bed 1.

[0045] The tilt rotational axis 8 of the tilt joints 7 extends coaxially substantially parallel with the longitudinal extent of the bed 1.

[0046] In this embodiment a tilt mechanism 4 is arranged between the bed frame 3 and a bottom frame 2. The tilt mechanism 4 comprises a tilt actuator 13 connected to the bottom frame 2 in one end in a bottom frame point of attack 10 and to four bed frame points of attack 11, at the bed frame 3 through a number of rotatably connected lever arms 14, in another end.

[0047] In this embodiment the lever arms 14 forms a lever arm gear 17 between the tilt actuator 13 and each of the four bed frame points of attack 11. The lever arm gears 17 are arranged to gear the motion of tilt actuator 13 in relation to the motion of the bed frame 3.

[0048] In this embodiment each lever arm gear 17 comprises a bottom lever arm 28 which in one end is rotatably connected to a fixed joint 31 on the bottom frame 2. In this embodiment the position of the fixed joint 31 is fixed in relation to the tilt mechanism 4 but it could be mobile in relation to other functionality of the bed 1, such as a bed frame lifting mechanism 26, which will be discussed later.

[0049] At the other end each bottom lever arm 28 is connected to a top lever arm 29 which in turn is connected to the bed frame 3 in the bed frame points of attack 11. Along each side of the bed 1 a connection shaft 30 extends between the two bottom lever arms 28. The joints of the bottom lever arms 28 are arranged at the ends of the bottom lever arms 28 and the connection shaft 30 is connected to the two bottom lever arms 28 around the middle between these joints. Somewhere along the extent of the connection shaft 30 an actuator arm 23 is connected to the connection shaft 30 through a rotatable actuator arm joint 16. The actuator arm 23 is connected to both connection shafts 30 - i.e. the one extending along the left side of the bed 1 and the one extending along the right side of the bed 1 - so that when the actuator arm 23 is moved towards the left side of the bed 1, the left connection shaft 30, the left bottom lever arms 28, the left top lever arm 29 and thereby the left bed frame points of attack 11 are actuated to push the left side of the bed frame 3 upwards. Since the other end of the actuator arm

23 is connected to the right connection shaft 30 the right side of the bed frame 3 will simultaneously be lowered accordingly due to the symmetric tilt mechanism design.

[0050] Thus, in this embodiment a left lifting mechanism 24 - which comprises all the lever arms 14, 28, 29, joints 16 and shafts 30 arranged on the left side of the tilt rotational axis 8 - is arranged between the actuator arm 23 and the left bed frame points of attack 20 and a right lifting mechanism 25 - which comprises all the lever arms 14, 28, 29, joints 16 and shafts 30 arranged on the right side of the tilt rotational axis 8 - is arranged between the actuator arm 23 and the right bed frame points of attack 21. Accordingly, the lifting mechanisms 24, 25 are arranged so that one of them will extend - i.e. lift the bed frame 3 - and the other will collapse - i.e. lower the bed frame 3 - simultaneously, when the actuator arm 23 is moved away from one of the lifting mechanisms 24, 25 and towards the other.

[0051] However, in another embodiment of the invention a multitude of details of the disclosed embodiment of a tilt mechanism 4 could be changed. For example, one of the left lifting mechanism 24 and the right lifting mechanism 25 could be omitted, the connection shafts 30 could be omitted if the actuator arm 23 was connected directly to the bottom lever arms 28, one or both lifting mechanisms 24, 25 could comprise more or fewer lever arms 13 connected in series and/or in parallel and many other details could be altered within the scope of the claims.

[0052] In this embodiment the tilt mechanism 4 is connected the bed frame 3 in a front bed frame point of attack 18 and a back bed frame point of attack 19 arranged on the left side of the tilt rotational axis 8 and in a front bed frame point of attack 18 and a back bed frame point of attack 19 arranged on the right side of the tilt rotational axis 8. However, in another embodiment the tilt mechanism 4 could comprise another number of front bed frame points of attack 18 or back bed frame points of attack 19 such as one, three four or more, on one or both sides of the tilt rotational axis 8

[0053] In this embodiment the front bed frame point of attack 18 and the back bed frame point of attack 19 on the left side of the bed 1 are arranged in a mutual distance D of approximately 1174 mm and since the length L of the bed surface 6 in this case is approximately 1960 mm the mutual distance D is approximately 60% of the length L of the bed surface 6.

[0054] However, in another embodiment of the invention the distance D between the front bed frame point of attack 18 and the back bed frame point of attack 19 on one or both sides of the bed 1 could be arranged in a mutual distance D of at least 10%, preferably at least 25% and most preferred at least 45% of the length L of the bed frame 3.

[0055] In this case the bed frame points of attack 18, 19 on the right side of the bed 1 is arranged likewise but in another embodiment these bed frame points of attack 18, 19 could be arranged differently than the once on the

left side.

[0056] In this embodiment the bottom frame 2 comprises support means 5 for engaging an underlying ground in the form of four wheels arranged substantially at each of the four corners of the bottom frame 2 hereby enabling that the bed 1 can easily be moved around. However in another embodiment the bed 1 could be formed more stationary if the support means 5 were formed as legs, feet or similar or the bottom frame 2 could comprise a combination of wheels and feet.

[0057] Fig. 2 illustrates a bed 1 tilted to the right, as seen from the front and fig. 3 illustrates a bed 1 tilted to the left, seen from the front.

[0058] In this embodiment of the invention the tilt mechanism 4 enables that the bed frame 3 can be tilted to the left to an extreme tilt angle A of approximately 12° and to the right to an extreme tilt angle A of approximately 12° as measured in relation to the bottom frame 2 i.e. in relation to a horizontal plane when the bed 1 is placed on a level horizontal surface. However in another embodiment the extreme tilt angle A could be between 1 and 30°, preferably between 3° and 20° and most preferred between 5° and 15° in relation to the bottom frame 2.

[0059] In this embodiment the tilt rotational axis 8 is arranged in the middle of the central longitudinal area 9 of the bed frame 3 and both the left bed frame point of attack 20 and the right bed frame point of attack 21 are arranged between the central longitudinal area 9 and the outer periphery 12 of the bed frame 3 - i.e. between the tilt rotational axis 8 and the outer periphery 12 of the bed frame 3, which in this case is the outer periphery 12 of the bed surface 6.

[0060] In this embodiment the bed frame points of attack 11 are arranged approximately 300 mm from the tilt rotational axis 8 as measured in a plane parallel with the bed surface 6 and in this case the distance between the tilt rotational axis 8 and the outer periphery 12 of the bed frame 3 is approximately 425 mm hereby placing the bed frame points of attack 11 approximately 71 % of the distance between the tilt rotational axis 8 and the outer periphery 12, from the tilt rotational axis 8.

[0061] However, in another embodiment one or more of the bed frame points of attack 11 could be arranged between 30% and 98%, preferably between 45% and 92% and most preferred between 55% and 85% of the distance between the tilt rotational axis 8 and the outer periphery 12 of the bed frame 3 from the tilt rotational axis 8 as measured in a plane parallel with the bed surface 6.

[0062] In this embodiment of the invention the tilt rotational axis 8 is arranged in the middle of the bed frame 3 but in another embodiment of the invention the tilt rotational axis 8 could be arranged anywhere in the central longitudinal area 9 of the bed frame 3 defined as the middle 30%, preferably the middle 20% and most preferred the middle 10% of the bed frame 3.

[0063] In this embodiment of the invention the tilt rota-

tional axis 8 is arranged approximately 90 mm below the bed surface 6 which in this case has a width W of approximately 850 mm. I.e. in this embodiment of the invention the tilt joints 7 are located 10.5% of the width W of the bed frame 2 below the bed surface 6 but in another embodiment the tilt joints 7 could be located between 1% and 40%, preferably between 2% and 25% and most preferred between 5% and 15% of the width W of the bed frame 2 below the bed surface 6.

[0064] Fig. 4 illustrates a circular cross section in a bed 1, as seen from the side.

[0065] The figure further illustrates where the two cross sections B-B and C-C shown in figure 5 and 6 are made.

[0066] Fig. 5 illustrates a cross section B-B in a bed 1, as seen from the front.

[0067] In this embodiment the tilt mechanism 4 comprises an actuator arm 23 connected to a left bed frame point of attack 20 arranged on the left side of tilt rotational axis 8 and to a right bed frame point of attack arranged on the right side of the tilt rotational axis 8.

[0068] In this embodiment all the rotatable joints between the different parts and arms are rotatably connected to each other, to shafts or other through journal bearings ensuring reduced friction in the joints. In another embodiment these and other rotatable connections may be formed simply by making one part or arm at least partly enclose a shaft or a shaft-like device of the joint, it could be made by means of ball bearings, roller bearings or any other type of bearings enabling that an arm may be connected to a shaft-like device and still be able to rotate around this device.

[0069] Fig. 6 illustrates a cross section C-C in a bed 1, as seen from the front.

[0070] In this embodiment a tilt actuator 13 is rotatably connected to the actuator arm 23 in a tilt actuator joint 15 in one end and rotatably to the bottom frame 2 in the bottom frame point of attack 10 in the other end.

[0071] In this embodiment the actuator 13 is an electrical linear actuators comprising an electrical motor and a spindle drive but in another embodiment of the invention the actuator 13 could be a motor, a hydraulic or pneumatic cylinder or the motor driving the linear actuator could be powered by other means than electricity. In another embodiment the tilt motion could also be manually driven e.g. by means of a lever arm, a spindle or other e.g. connected to and thus displacing the actuator arm 23.

[0072] It should also be noted that in all illustrated embodiments the bed 1 is provided with only one tilt actuator 13 but in another embodiment the tilt mechanism 4 could comprise a tilt actuator for driving the tilt motion of only the left side, a tilt actuator for driving the tilt motion only on the right side, a tilt actuator for driving the tilt motion only at the front end of the bed, a tilt actuator for driving the tilt motion only at the rear end of the bed left side or any combination thereof or the bed could comprise individual tilt actuators 13 at each bed frame point of attack 11. In another embodiment one or more of the bed frame

points of attack 11 could also be actuated by means of two, three or more actuators that could be coupled in parallel and/or in series.

[0073] In a preferred embodiment the bed 1 would be provided with control means (not shown) for controlling the tilt angle A of the bed frame 3. The control means could be provided with first operation means - e.g. in the form of a first button, a first part movement of a button, a first switch, a first handle or similar - to activate the first part of the tilt motion of the bed frame 3 e.g. until the bed frame 3 was tilted to a first low tilt angle A of e.g. 3°, 4°, 5° or similar to either side. The control means could then also be provided with second operation means - e.g. in the form of a second button, a further part movement of a button, a second switch, a second handle or similar - to activate the last part of the tilt motion of the bed frame 3 from the first low tilt angle A and the rest of the way to an extreme tilt angle A of e.g. 10°, 12°, 15° or more.

[0074] Fig. 7 illustrates a bed 1 transformed into a chair-like device, as seen in perspective.

[0075] In this embodiment the bed 1 is also provided with joints 22 in the bed surface 6 and dedicated bed surface actuators 27 capable of transforming the previously flat and horizontal bed surface 6 into a chair-like device from which the user may easily enter or exit the bed 1. To aid this transformation the bed 1 is in this embodiment also provided with bed frame lifting mechanism 26 which is capable of tilting the front end of the bed 1 down towards the ground to ensure a suitable seat height of the chair-like device.

[0076] Fig. 8 illustrates a bed 1 according to the invention in a contracted state, as seen from the side and fig. 9 illustrates the bed 1 shown in fig. 8 in an elevated position, also seen from the side.

[0077] In this embodiment the bed frame 3 can also be moved up and down while the bed surface 6 is maintained substantially parallel with the underlying ground. This vertical displacement of the bed frame 3 is facilitated by means of a bed frame lifting mechanism 26.

[0078] It is only possible to fit the bed 1 with such a bed frame lifting mechanism 26 because the present tilt mechanism 4 is primarily arranged along the sides of the bed frame 3 hereby providing free space at the centre area 9 of the bed 1 to fit the bed frame lifting mechanism 26. This advantage is particularly distinct when the bed 1 is collapsed as disclosed in fig. 8. The very low position of the bed surface 6 is only possible due to the present tilt mechanism design.

[0079] The invention has been exemplified above with reference to specific examples of beds 1, tilt mechanisms 4, tilt actuators 13 and other. However, it should be understood that the invention is not limited to the particular examples described above but may be designed and altered in a multitude of varieties within the scope of the invention as specified in the claims.

List

[0080]

- | | |
|----|---|
| 5 | 1. Bed |
| | 2. Bottom frame |
| | 3. Bed frame |
| | 4. Tilt mechanism |
| | 5. Support means |
| 10 | 6. Bed surface |
| | 7. Tilt joint |
| | 8. Tilt rotational axis |
| | 9. Central longitudinal area of bed frame |
| | 10. Bottom frame point of attack |
| 15 | 11. Bed frame point of attack |
| | 12. Outer periphery of bed frame |
| | 13. Tilt actuator |
| | 14. Lever arm |
| | 15. Tilt actuator joint |
| 20 | 16. Actuator arm joint |
| | 17. Lever arm gear |
| | 18. Front bed frame point of attack |
| | 19. Back bed frame point of attack |
| 25 | 20. Left bed frame point of attack |
| | 21. Right bed frame point of attack |
| | 22. Joints of bed surface |
| | 23. Actuator arm |
| | 24. Left lifting mechanism |
| | 25. Right lifting mechanism |
| 30 | 26. Bed frame lifting mechanism |
| | 27. Bed surface actuators |
| | 28. Bottom lever arm |
| | 29. Top lever arm |
| | 30. Connection shaft |
| 35 | 31. Fixed joint |
| | A. Tilt angle |
| | W. Width of bed frame |
| | L. Length of bed frame |
| 40 | D. Distance between front and back bed frame points of attack |

Claims

- | | |
|----|---|
| 45 | 1. A bed (1) comprising |
| | a bottom frame (2) including support means (5) for |
| | engaging an underlying ground, |
| | a bed frame (3) comprising a bed surface (6) for sup- |
| 50 | porting a person lying in said bed (1), |
| | wherein said bed frame (3) is rotatably connected to |
| | said bottom frame (2) in at least one tilt joint (7) hav- |
| | ing a tilt rotational axis (8) extending substantially |
| | parallel with the longitudinal extent of said bed (1) |
| | and said tilt rotational axis (8) being arranged at a |
| 55 | central longitudinal area (9) of said bed frame (3), |
| | wherein said bed (1) further comprises a tilt mecha- |
| | nism (4) connected to said bottom frame (2) in a bot- |
| | tom frame point of attack (10) and to said bed frame |

- (3) in at least one bed frame point of attack (11) to tilt said bed frame (3) around said tilt rotational axis (8), wherein said at least one bed frame point of attack (11) is arranged between said central longitudinal area (9) and the outer periphery (12) of said bed frame (3), and
 wherein said tilt mechanism (4) comprises a tilt actuator (13) arranged between said bottom frame point of attack (10) and said at least one bed frame point of attack (11) to drive the tilt motion of said bed frame (3) in relation to said bottom frame (2), by means of one or more rotatably connected lever arms (14).
2. A bed (1) according to claim 1, wherein said tilt mechanism (4) comprises at least one lever arm gear (17) arranged between said tilt actuator (13) and said at least one bed frame point of attack (11) to gear the motion of said tilt actuator (13) in relation to said bed frame (3).
 3. A bed (1) according to any of the preceding claims, wherein said at least one bed frame point of attack (11) is arranged between 30% and 98%, preferably between 45% and 92% and most preferred between 55% and 85% of the distance between said tilt rotational axis (8) and said outer periphery (12) of said bed frame (3) from said tilt rotational axis (8) as measured in a plane parallel with said bed surface (6).
 4. A bed (1) according to any of the preceding claims, wherein said central longitudinal area (9) of said bed frame (3) is defined as the middle 30%, preferably the middle 20% and most preferred the middle 10% of said bed frame (3), such as substantially the middle of the transversal width (W) of said bed frame (3).
 5. A bed (1) according to any of the preceding claims, wherein said tilt mechanism (4) is connected to said bed frame (3) in a front bed frame point of attack (18) and a back bed frame point of attack (19) of said at least one bed frame point of attack (11) and wherein said front bed frame point of attack (18) and said back bed frame point of attack (19) are arranged on the same side of said tilt rotational axis (8) and wherein said front bed frame point of attack (18) and said back bed frame point of attack (19) are arranged at a mutual distance (D) of at least 10%, preferably 25% and most preferred 45% of the length (L) of said bed frame (3) along said same side of said bed frame (3).
 6. A bed (1) according to any of the preceding claims, wherein said tilt mechanism (4) comprises an actuator arm (23) connected to a left bed frame point of attack (20) of said at least one bed frame point of attack (11) and connected to a right bed frame point of attack (21) of said at least one bed frame point of attack (11) and wherein said left bed frame point of attack (20) being arranged on a substantially left side of said tilt rotational axis (8) and said right bed frame point of attack (21) being arranged on a substantially right side of said tilt rotational axis (8).
 7. A bed (1) according to claim 6, wherein a left lifting mechanism (24) is arranged between said actuator arm (23) and said left bed frame point of attack (20) and wherein a right lifting mechanism (25) is arranged between said actuator arm (23) and said right bed frame point of attack (21) and wherein said left lifting mechanism (24) is arranged to lift said bed frame (3) and said right lifting mechanism (25) is arranged to lower said bed frame (3) when said actuator arm (23) is moved away from one of said left lifting mechanism (24) and said right lifting mechanism (25) and towards the other of said left lifting mechanism (24) and said right lifting mechanism (25) and vice versa.
 8. A bed (1) according to any of the preceding claims, wherein said bed (1) further comprises a bed frame lifting mechanism (26) for changing the vertical position of said bed surface (6) over said underlying ground.
 9. A bed (1) according to any of the preceding claims, wherein said bed (1) further comprises a number of bed surface actuators (27) arranged to transform said bed surface (6) into a chair-like device.
 10. A bed (1) according to claim 1 or 2, wherein said tilt actuator (13) is an electrical linear actuator comprising an electrical motor and a spindle drive.
 11. A bed (1) according to any of the preceding claims, wherein said tilt mechanism (4) enables said bed frame (3) to be tilted to a tilt angle (A) between 1° and 30°, preferably between 3° and 20° and most preferred between 5° and 15° in relation to said bottom frame (2).
 12. A bed (1) according to any of the preceding claims, wherein said at least one tilt joint (7) is located between 1% and 40%, preferably between 2% and 25% and most preferred between 5% and 15% of the width (W) of said bed frame (2) below said bed surface (6).
 13. A bed (1) according to any of the preceding claims, wherein said bed (1) comprises control means for controlling the tilt angle (A) of said bed frame (3) and wherein said controller comprises first operation means to activate a tilt of said bed frame (3) until a certain low tilt angle and second operation means to activate a further tilt of said bed frame (3) the rest of

the way to an extreme tilt angle.

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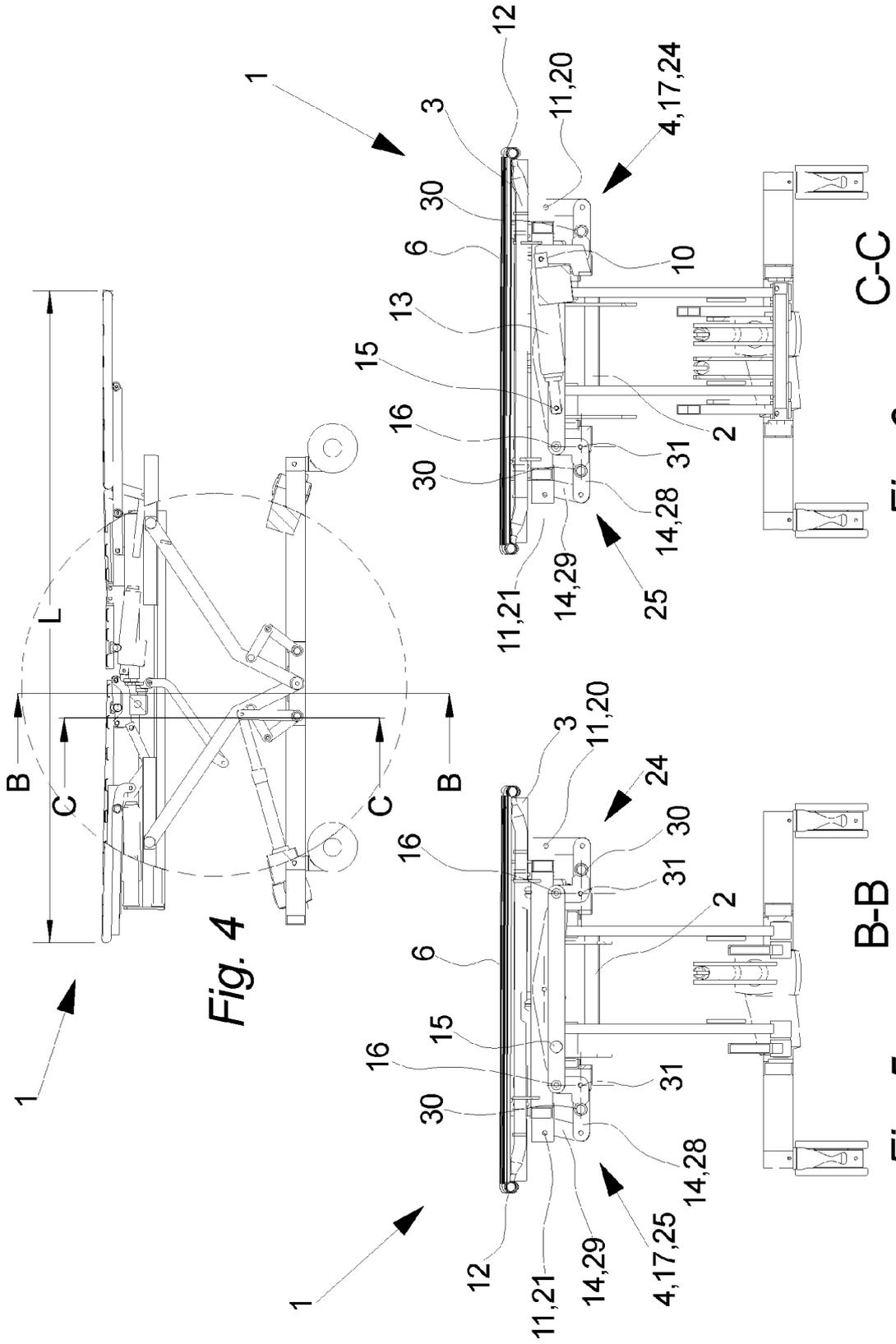


Fig. 4

Fig. 6

Fig. 5

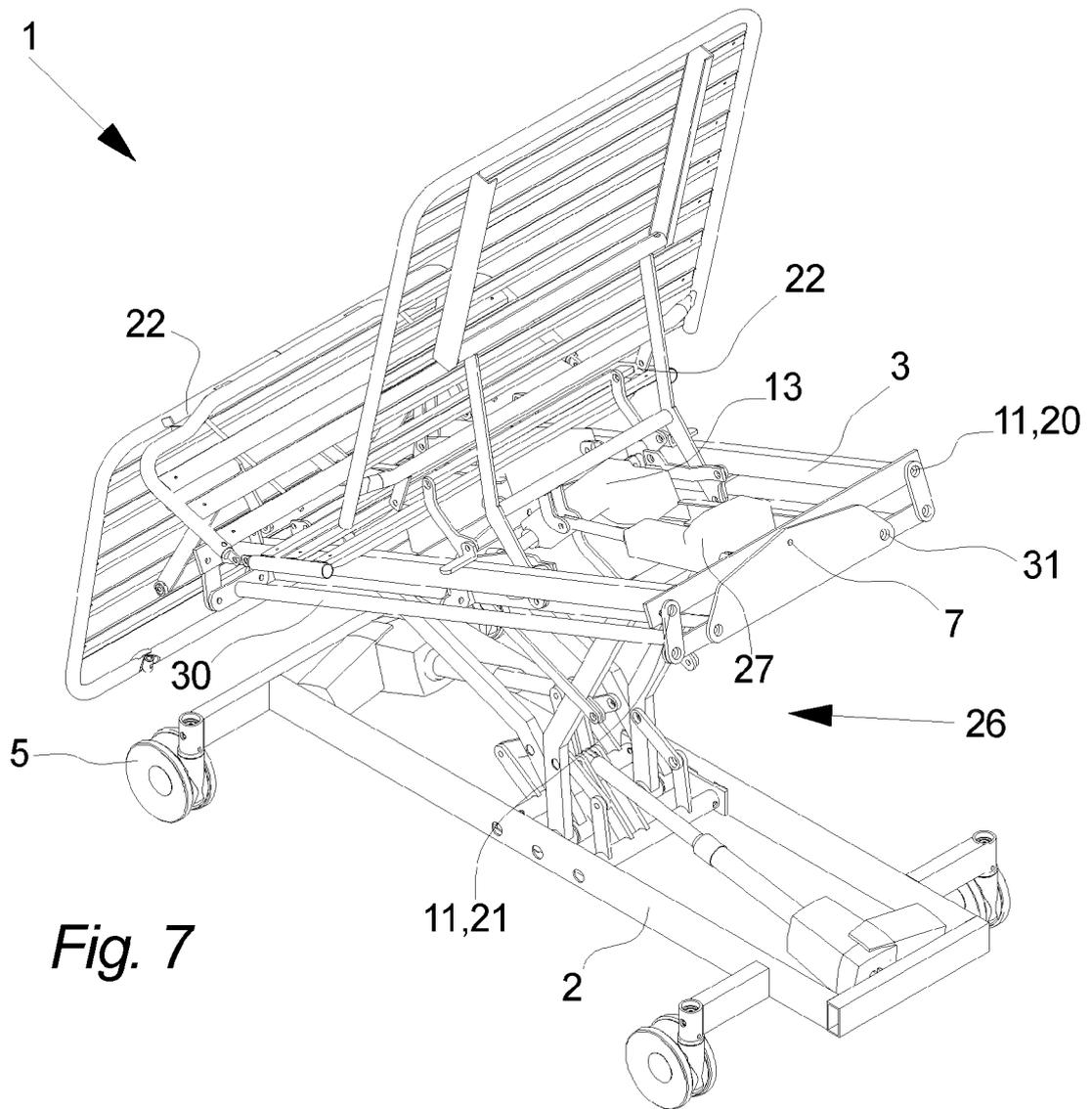


Fig. 7

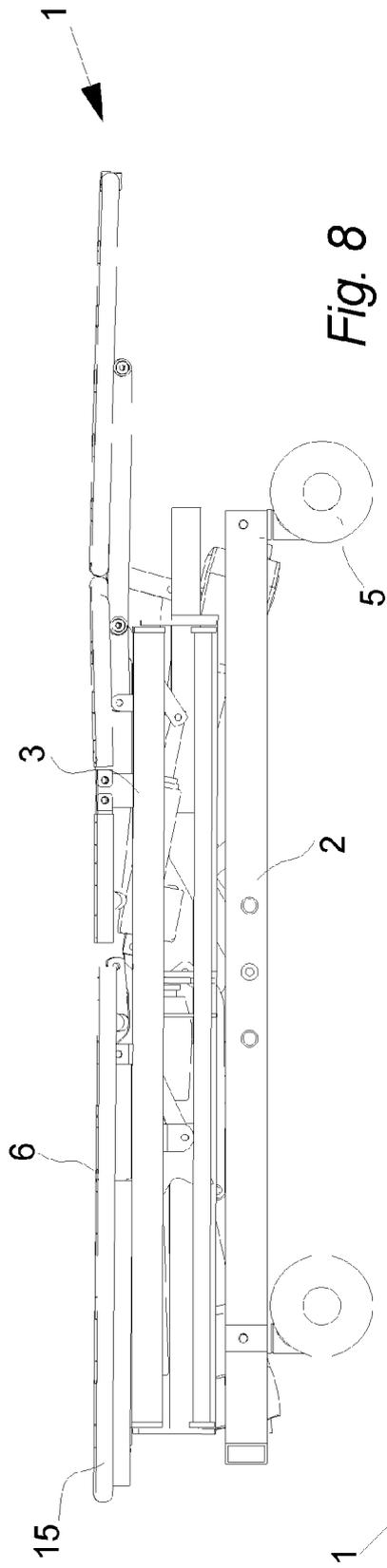


Fig. 8

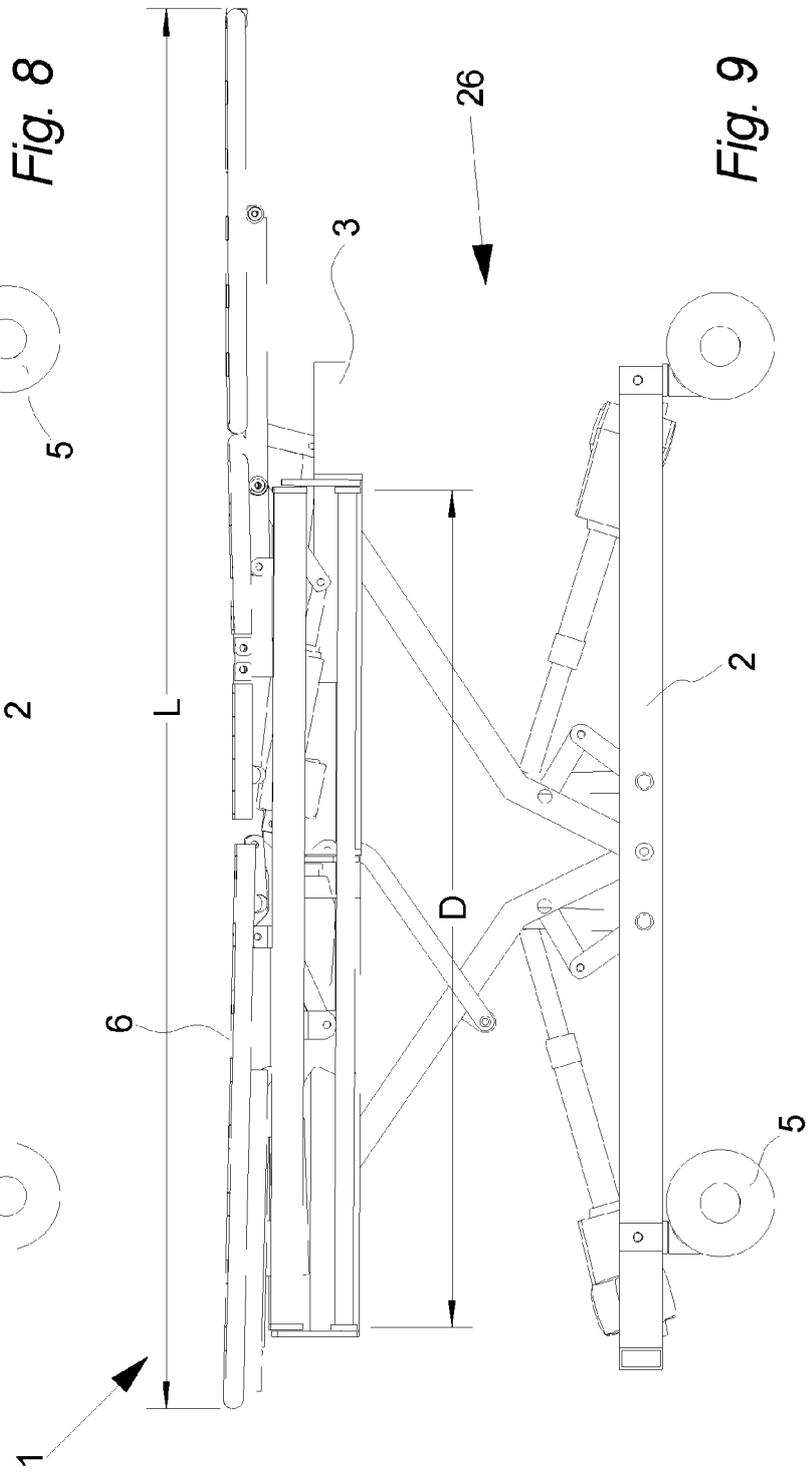


Fig. 9



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EP 13 18 7388

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