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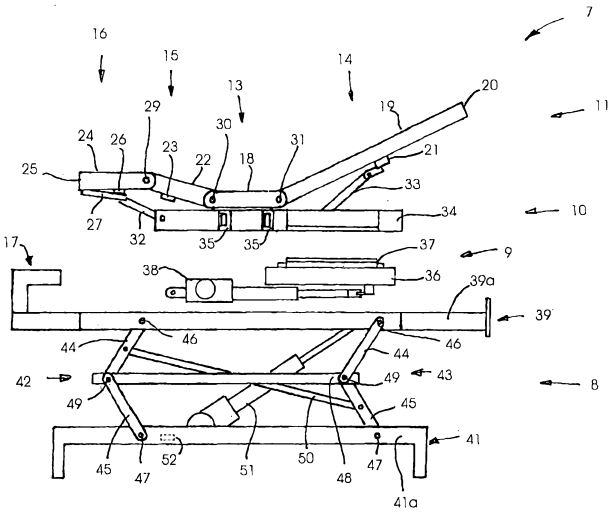
[Fortsetzung auf der nächsten Seite]

(54) **Title:** TREATMENT BED WITH IMPROVED LEVER

(54) **Bezeichnung:** PFLEGEBETT MIT VERBESSERTEM HEBER



(57) **Abstract:** The invention concerns a treatment bed adjustable in height having a stand (8), whereof the upper frame (39) and the lower frame (41) are mutually connected through four pairs of hinged levers (42, 43). Said pairs of hinged levers (42, 43) are mutually connected, on either side of the bed, through horizontal (48) and oblique (50) linking spacers. The horizontal linking spacers (48) connect the hinged levers at the articulation while the oblique linking spacers (50) connect a lower lever arm (45) to an upper lever arm (44). The motor (51) for lifting and lowering the upper frame (39) relative to the lower frame (41), extends directly between the two frames, such that the hinged levers with their linking spacers act like a parallel guiding, exclusively activated by hinged articulations, not requiring slides.

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WO 2005/105011 A1

Veröffentlicht:
— *mit internationalem Recherchenbericht*

Zur Erklärung der Zweibuchstaben-Codes und der anderen Abkürzungen wird auf die Erklärungen ("Guidance Notes on Codes and Abbreviations") am Anfang jeder regulären Ausgabe der PCT-Gazette verwiesen.

(57) Zusammenfassung: Ein höhenverstellbares Pflegebett weist einen Sockel (8) auf, bei dem der Oberrahmen (39) und der Unterrahmen (41) durch insgesamt vier Kniehebelpaare (42, 43) miteinander verbunden sind. Die Kniehebelpaare (42, 43) auf jeder Seite des Bettes sind durch horizontale (48) und schräg (50) verlaufende Koppelstreben zusätzlich miteinander verbunden. Die horizontale Koppelstrebe (48) verbindet die Knebelhebel im Bereich des Kniegelenks, während die schräge Koppelstrebe (50) einen unteren Kniehebelarm (45) mit einem oberen Kniehebelarm (44) verbindet. Der Motor (51) zum Heben und Senken des Oberrahmens (39) gegenüber dem Unterrahmen (41) erstreckt sich unmittelbar zwischen diesen beiden Rahmen, so dass die Kniehebel zusammen mit ihren Koppelstreben als eine Art Parallelführung wirken, die ausschließlich mit Hilfe von Scharniergelenken simuliert ist, was Gleitführungen entbehrlich macht.

NURSING BED WITH IMPROVED LIFTING MECHANISM

Technical Field

DE 198 54 136 A 1 describes a lifting mechanism for a nursing bed. The lifting mechanism consists of a frame that forms the pedestal of the lifting mechanism, as well as an upper frame that is realized approximately congruent with the aforementioned frame and serves as the lifting head. A total of four levers are provided in the side of the lifting mechanism, wherein two levers are respectively connected to one another by means of a toggle link. At the toggle links, two toggle lever pairs are kinematically connected to one another by a horizontal coupling brace. Another coupling brace connects one of the upper levers to a lower lever on each side, for example, the upper lever at the foot end of the bed to the lower lever at the head end. One end of the driving motor for moving the lifting mechanism engages on a cross brace of the pedestal and the other end engages on a connecting brace that connects the two horizontally extending coupling braces to one another.

Viewed from the side, the two lower levers and the horizontal coupling braces form a rod parallelogram that is raised by the spindle motor. The two upper levers also form a parallelogram together with the upper frame or lifting head, wherein this parallelogram is raised with the aid of the diagonally extending coupling brace.

Due to these kinematics, an extremely high pressure force acts in the diagonally extending coupling brace, wherein this pressure force does not depend at all on the patient's center of gravity being situated in the vicinity of the levers at the foot end or the levers at the head end.

Enormous pressure forces act in the lower lifting range.

Since the lower parallelogram is raised by the spindle motor, the forces to be generated by the motor when the lifting mechanism is lowered are comparatively high and decrease significantly as the parallelogram is raised. The transmission ratio in the lower lifting range is approximately 2:1, i.e., the lifting mechanism is stretched by twice the amount by which the motor is displaced. In the upper range, in contrast, the lifting ratio is reversed. This results in the lifting mechanism only being raised very slowly in the upper lifting range.

Based on these circumstances, the invention aims to develop a lifting mechanism with a more favorable load distribution.

Object of the Invention

It is the object of the present invention to substantially overcome or ameliorate one or more of the disadvantages of the prior art, or at least provide a useful alternative.

Summary of the Invention

An aspect of the present invention provides a nursing bed with a multi-part mattress support that has a head end as well as a foot end,

with a height-adjustable bed lifting mechanism that features a pedestal arranged on the floor and a lifting head, on which the mattress support is arranged,

with a lever mechanism that connects the pedestal to the lifting head and features on each side of the bed lifting mechanism:

- a lower lever on the head end as well as a lower lever on the foot end, both of which are coupled to the pedestal with their lower ends;
- a horizontal coupling brace that is connected in a pivoted fashion to the upper ends of both lower levers;
- an upper lever on the head end as well as an upper lever on the foot end, both of which are coupled in a pivoted fashion to the lifting head with their upper ends; and
- a diagonally extending coupling brace that connects an upper lever to a lower lever and is connected to the respective lever in a pivoted fashion in the region between the ends of this lever, and with a linear drive that extends from the pedestal to the lifting head.

This results in entirely different kinematics than in the state of the art. The lifting mechanism according to the state of the art preferably consists of two parallelograms that are stacked on top of one another and each of which is raised by a separate drive that is either realized in the form of the linear drive or the diagonal coupling brace. In the arrangement, the lever mechanism acts like a parallel motion. It absorbs the horizontal forces occurring during the lifting process similar to a parallel motion.

The force occurring in the diagonal coupling brace is dependent on the position of the patient's center of gravity. If the patient lies centrally between the lifting pair at the head end and the lifting pair at the foot end, the force in the diagonal coupling brace amounts to less than half that occurring in the present disclosure.

This significantly reduces the load in the joints that connect the diagonal coupling brace and the horizontal coupling brace to the levers.

Under a load, a pressure force acts in the horizontal coupling brace if the horizontal coupling brace is arranged quasi crosswise to the orientation of the linear drive. The corresponding tensile forces occur in the horizontal coupling brace. Tension and compression are interchanged once the diagonal coupling brace lies about parallel to the orientation of the linear drive. The pressure force under a load then acts in the horizontal coupling brace. Nevertheless, the previous explanations apply to the load distribution such that the engagement of the linear drive on the lifting head results in an improved state of the forces in the pressure brace that, in turn, can be realized with smaller dimensions. This naturally also applies to the joints. This is particularly important because the coupling of the diagonal coupling brace to the levers is realized in the form of an unsupported coupling, i.e., the hinge axes that connect the two structural elements to one another are not only subjected to shearing stress, but also to bending stress.

A comparison between the force when the lifting mechanism is lowered and the force when the lifting mechanism is raised shows that the altered kinematics also result in an improvement of the motor load. In comparison with the present disclosure according to the state of the art, in which the transmission ratio is highly non-linear and changes from a speed increasing ratio to a speed reducing ratio, the transmission ratio remains a speed increasing ratio, however, with a reduced force, when the lifting mechanism is lowered.

In addition, it was astonishingly determined that linear drives with the same travel as in the present disclosure according to the state of the art can also be used as long as the same lifting height needs to be reached.

The inclination of the lifting head relative to the pedestal under a one-sided lateral load can be significantly reduced if at least two corresponding levers are connected to an element that suppresses torsion between the levers on both sides of the lifting mechanism.

Pinching points can be largely eliminated if the levers are inwardly offset relative to the pedestal and, the lifting head, respectively. This makes it possible to also use the new lifting mechanism without an outer lining.

It is preferred that the pedestal and the lifting head by respectively formed by a rectangular frame, the longitudinal members and cross members of which are formed of a rectangular frame whose longitudinal members and cross members preferably consist of rectangular tubes.

The pedestal contains a cross brace that serves as an abutment for the linear drive. The linear drive is preferably realized in the form of a spindle motor. A spindle motor also provides the advantage of being self-locking such that the lifting mechanism stops in the adjusted lifting position as soon as the current for the motor is switched off.

When reading the description of the figures, it also becomes clear that various modifications can be realized that do not have to be explained in detail.

Brief Description of the Drawings

A preferred embodiment of the present invention is illustrated in the figures. The figures show:

Figure 1, a rotary bed in the reclined position;

Figure 2, the rotary bed according to Figure 1 in the chair or sitting position;

Figure 3, a partially exploded side view of the bed lifting mechanism of the nursing bed, and

Figure 4, a top view of the two of the toggle lever arms of toggle lever pairs on different sides.

Detailed Description of the Preferred Embodiments

Figure 1 shows a perspective representation of a nursing bed 1 in the reclined position, and Figure 2 shows the nursing bed 1 in the sitting or chair position.

The nursing bed 1 features a bed frame 2 with a head part 3, a foot part 4 as well as side walls 5 and 6. The side wall 5 that faces the viewer is situated in the reclined position as indicated by the distance from the floor. This means that a gap between the underside of the side wall 5 and the floor enables the nursing personnel to place the forward section of their feet underneath the bed. The side wall 5 is movably supported and displaced downward in the chair position of the nursing bed 1 shown in Figure 2. The special support of the side wall 5 is explained in detail, for example, in DE 199 12937 A1.

A bed lifting mechanism 7 is situated within the bed frame 2 as indicated in Figure 3.

The bed lifting mechanism 7 comprises a height-adjustable pedestal 8, on the upper side of which a rotary hinge 9 with a vertical axis of rotation is mounted, an intermediate frame 10 as well as a bed frame 11 with a mattress 12 lying thereon. If viewed from the top, the bed frame 11 has a rectangular shape.

The bed frame is divided into a central section 13 that is rigidly connected to the intermediate frame 11, a back section 14 that is hinged to the central section 13, a thigh section 15 that is also hinged to the central section 13, as well as a lower leg section 16. The lower leg section 16 is hinged to the opposite end of the thigh section 15 referred to the central section 13. The hinge axes, about which the sections 14, 15, 16 can be pivoted relative to the central section 13, extend horizontally. The bed frame 12 also features a foot section 17 that is directly connected to the pedestal 8 in a rigid fashion.

The central section 13 of the bed frame 12 features two longitudinal rails 18 that extend parallel to one another and are spaced apart from one another in accordance with the width of the nursing bed 1. In this side view, the visible longitudinal rail 18 covers the corresponding longitudinal rail of the central section 13 that lies behind the visible longitudinal rail. Each of these rails 18 ends at hinge brackets for a hinge, the design of which is described in DE 102 50 075 A 1. This publication is hereby incorporated by reference.

Each rail 18 carries pins 31 that point inward, wherein molded rubber pieces that conventionally accommodate torsion rods can be pushed on said pins. Instead of utilizing torsion rods, the support could also be realized in the form of a plate as is common practice with hospital beds.

The back section 14 is bordered by a rail 19 and another rail that extends parallel thereto and is not visible in Figure 3. The rail 19 is hinged to the rail 18 while the other covered rail is connected to the longitudinal rail extending parallel to the longitudinal rail 18. The two rails 19 of the back section 14 are connected to one another on the upper end at 20 by means of a cross rail that is not visible in the figure. Another cross brace 21 connects the two longitudinal rails 19 on the underside.

The thigh section 15 is also bordered by two longitudinal rails, of which only the longitudinal rail 22 is visible. The other longitudinal rail is covered by the longitudinal

rail 22. The two longitudinal rails 22 are connected by means of a cross brace 23. The cross brace 23 approximately extends on the center of each longitudinal rail 22 on the underside.

The lower leg section 16 is also bordered by two longitudinal rails, of which only the longitudinal rail 24 is visible in the figure. The two longitudinal rails 24 are connected to one another on the lower end at 25 by means of a cross brace that is not visible in the figure. The two longitudinal rails 24 are not only connected by means of this cross brace, but also a brace 26 on which two parallel guide rails 27 are mounted that extend as far as the end 25. They are angled relative to the longitudinal rail 24 as shown, namely such that they converge in the direction of the foot end 25. The distance between both guide rails 27 is significantly smaller than the distance between the two longitudinal rails 24. In comparison with these longitudinal rails, the guide rails 27 are inwardly offset by approximately 20 cm.

All longitudinal rails 19, 22 and 24 carry pins that point to the center of the bed and serve for connecting the longitudinal rails 19, 22 and 24 to molded rubber pieces, between which torsion rods are conventionally arranged.

The hinges that connect respectively adjacent longitudinal rails to one another on each side of the bed 1 are schematically illustrated at 29, 30 and 31.

The lower leg section 16 can be raised or lowered by means of a not-shown electric motor. The electric motor is coupled to a lever 32 via a gear and is situated in the intermediate frame 10.

Another electric motor 33 is supported in the intermediate frame 10 and extends to the cross brace 21. This makes it possible to raise or lower the back section 14.

The two longitudinal rails 18 of the central section 13 are rigidly connected to the intermediate frame 10.

The intermediate frame 10 is composed of rectangular tubes that are welded together into a rectangular frame, of which only one rectangular tube 34 is visible. The parallel rectangular tube is covered by the rectangular tube 34.

The rectangular frame is narrower than the distance between the longitudinal rails 18. A total of four extension arms 35 are welded to the parallel rectangular tubes 34, wherein two of these extension arms respectively carry a longitudinal rail 18. The

extension arms 35 extend horizontally and perpendicular to the longitudinal axis of the nursing bed 1.

The rotary hinge 9 connects the intermediate frame 10 to the height-adjustable pedestal 8.

It is composed of a ring 36 and a pivoted bolster 37 that is rotatably supported in the ring 36. The pivoted bolster 37 is screwed to the intermediate frame by means of not-shown screws. The exact design of the rotary hinge 9 is explained in DE 10250075 A1 that is hereby incorporated by reference.

The rotary hinge 9 makes it possible to turn the intermediate frame 10 about the vertical axis of rotation together with the bed frame 7. The turning motion is realized with an electric motor 38, one end of which is supported on the lifting mechanism 8 and the other end of which is supported on the pivoted bolster 37.

The height-adjustable pedestal 8 comprises an upper frame 39 as well as a lower frame 41, both of which consist of rectangular tubes that are welded together accordingly, wherein two of these rectangular tubes that extend parallel to one another form longitudinal rails 39a and 41a, respectively. The upper frame 39 is supported on the lower frame 41 by a total of four toggle lever pairs 42 and 43 are connected to one another. The rotary hinge is connected to the upper frame 39.

The toggle lever pairs 42, 43 are respectively situated adjacent to a longitudinal side of the pedestal 8 such that the corresponding toggle lever pairs 42, 43 on the other longitudinal side are not visible in the side view according to Figure 3.

The toggle lever pair 42, 43 is composed of an upper toggle lever arm 44 and a lower toggle lever arm 45. Each toggle lever 42,43 is connected in an articulated fashion to the upper and the lower frame 39, 41 on the corresponding side of the bed by means of a hinge 46 with a horizontal axis. All axes of the hinges 46 are arranged axially parallel to one another. The axes of the hinges 46 are arranged coaxial to the axes of the hinges of the invisible toggle levers 42, 43.

Hinges 47 connect the toggle lever pairs 42, 43 to the lower frame 41. The axes of the hinges 47 are arranged parallel to the axes of the hinges 46, wherein the axes of the hinges 46, 47 that correspond to one another on both sides are arranged coaxial to one another.

The two toggle lever pairs 42, 43 on each side of the pedestal 8 are respectively coupled to one another by a corresponding horizontal coupling brace 48. Each coupling brace 48 is connected to the toggle link 49 of each toggle lever pair 42, 43 in a hinge-like fashion as shown.

A diagonally extending coupling brace 50 connects the upper toggle lever arm 44 of the toggle lever pair 42 to the lower toggle lever arm 45 of the toggle lever pair 43 on each side of the pedestal 8.

An electric motor 51 that is realized in the form of a spindle motor analogous to the electric motors 33, 38 extends between the upper frame 39 and the lower frame 41. It is coupled to a cross brace 52 of the lower frame 41 that is indicated with broken lines adjacent to the toggle lever 42. Its other end is hinged to a covered cross brace of the upper frame 39, namely adjacent to the toggle lever 43. The motor therefore lies directly between the two frames 39 and 41, namely crosswise referred to the diagonal coupling brace 50.

The toggle levers 42, 43 cooperate with the horizontal coupling brace 48 and the diagonal coupling brace 50 in the form of a parallel motion of sorts in order to realize the relative movement between the two frames 39 and 41.

This represents a fundamental difference in comparison with the kinematics of the bed lifting mechanism described in DE 10250075. In this lifting mechanism, the motor engages on a cross brace that connects the two horizontal coupling braces to one another. This arrangement kinematically results in a lower parallelogram and an upper parallelogram, both of which have a common horizontal coupling brace. The lower parallelogram is raised by the driving motor. In this known solution, the diagonal coupling brace transmits the lifting movement of the lower parallelogram to the upper parallelogram.

In the arrangement shown, the kinematics are completely different. The arrangement of the toggle levers in connection with the coupling braces must absorb shearing forces in the horizontal direction that occur during the raising and lowering movements in the inventive kinematics, in which the driving motor extends between the lower and the upper frame 39, 41. The kinematics must prevent displacement of the upper frame 39 relative to the lower frame 41 in the longitudinal direction of the bed by the shearing force originating at the motor instead of raising of the upper frame 39.

In one range, a quite precise parallel motion of the upper frame 39 relative to the lower frame 41 is achieved, i.e., the hinge axis of the upper hinge 46 almost remains on the vertical line extending through the axis of the lower hinge 47. This range lies between an angle of approximately 120° between the lower toggle lever arm 45 and horizontal line and an angle of approximately 80° that is also measured relative to horizontal. In comparison with the solution known from DE 102 50 075 A1, the force to be generated by the motor 41 of otherwise identical geometry in the longitudinal direction of the spindle motor 41 is reduced by a factor of 2.5.

In Figure 3, the toggle lever arms 44 and 45 are directly hinged to the longitudinal rails 39a, 41a of the upper frame and the lower frame 39, 41.

A detail of another option for connecting the toggle lever arms 45 to the lower frame 39 is illustrated in Figure 4.

Figure 4 shows a cross section through the lower frame approximately in the center of the cross brace 52, wherein the viewing direction extends in the direction of the foot end.

Figure 4 shows a cross section through the two lower longitudinal rails 41a. A tubular shaft 53 that contains invisible bushings on its ends extends between the two longitudinal rails 41a. The shaft 53 is rotatably supported between the two longitudinal rails 41a by means of bearing journals 54. The bearing journals 54 extend through corresponding bores in the longitudinal rails 41a and point into the bearing bushing contained in the tube 53 with their free end.

The two lower toggle lever arms 45 of the right and the left toggle lever pair 42 situated on the foot end are welded to the tube 53 a certain distance from the end faces thereof as shown. The upper end of the toggle lever arms 45 is connected in an articulated fashion to the corresponding toggle lever arms 44 via the horizontal coupling brace 48 as described above.

The arrangement shown ensures an improved tilting stability or tilting resistance of the upper frame 39 relative to the lower frame 41.

Since the spindle motor 51 is arranged about centrally between the longitudinal rails 41 a, a one-sided load as occurs in the chair or sitting position results in an asymmetric load that causes the upper frame 39 to be tilted relative to the lower frame 41. This tilting movement would cause the toggle lever pairs on the side subjected to the load

to yield more significantly than on the side subjected to a lesser load. Since the lower levers of at least one set of toggle lever pairs, for example, the toggle lever pairs on the foot end are connected to one another in a torsion-proof fashion, the lower toggle lever arms 45 of the toggle lever pair 42 on the foot end cannot tum relative to one another. This results in a slight tilting movement of the upper frame 39 relative to the lower frame 41.

The bracing can be additionally improved by also providing the connection between the lower toggle lever arms 45 shown in Figure 4 for the lower toggle lever arms of the toggle lever pair 43 at the head end. If the space conditions permit, it would also be possible to analogously couple the upper toggle lever arms 44 to one another in a torsion-proof fashion by means of a tube and to support this tube between the longitudinal rails 41a as shown in Figure 4.

A height-adjustable nursing bed features a pedestal, in which the upper frame and the lower frame are connected to one another by a total of four toggle lever pairs. The toggle lever pairs on each side of the bed are additionally connected to one another by means of horizontally and diagonally extending coupling braces. The horizontal coupling brace connects the toggle levers in the region of the toggle link while the diagonal coupling brace connects a lower toggle lever arm to an upper toggle lever arm. The motor for raising and lowering the upper frame relative to the lower frame extends directly between these two frames such that the toggle levers and their coupling braces act as a parallel motion of sorts that is simulated with the aid of hinged joints only and slideways can be eliminated.

The claims defining the invention are as follows:

1. A nursing bed with a multi-part mattress support that has a head end as well as a foot end,

with a height-adjustable bed lifting mechanism that features a pedestal arranged on the floor and a lifting head, on which the mattress support is arranged,

with a lever mechanism that connects the pedestal to the lifting head and features on each side of the bed lifting mechanism:

- a lower lever on the head end as well as a lower lever on the foot end, both of which are coupled to the pedestal with their lower ends;
- a horizontal coupling brace that is connected in a pivoted fashion to the upper ends of both lower levers;
- an upper lever on the head end as well as an upper lever on the foot end, both of which are coupled in a pivoted fashion to the lifting head with their upper ends; and
- a diagonally extending coupling brace that connects an upper lever to a lower lever and is connected to the respective lever in a pivoted fashion in the region between the ends of this lever; and with a linear drive that extends from the pedestal to the lifting head.

2. The nursing bed according to claim 1, wherein corresponding joint axes on the two sides of the bed lifting mechanism are arranged coaxial to one another.

3. The nursing bed according to claim 1, wherein the diagonally extending coupling brace is inclined in the same direction as the linear drive.

4. The nursing bed according to claim 1, wherein the diagonally extending coupling brace is inclined in the opposite directed referred to the linear drive.

5. The nursing bed according to claim 1, wherein at least one lever on one side of the bed lifting mechanism and the corresponding lever on the other side of the bed lifting mechanism are connected to a common torsion element in order to minimize the turn of the levers relative to one another under an uneven load.

6. The nursing bed according to claim 1, wherein the levers are set back relative to the outer contour of the pedestal.

7. The nursing bed according to claim 1, wherein the pedestal is formed by a rectangular frame.

8. The nursing bed according to claim 7, wherein the rectangular frame features a cross brace that serves as an abutment for the linear drive.

9. The nursing bed according to claim 1, wherein the linear drive is formed by a spindle motor.

10. The nursing bed according to claim 1, wherein the fact that the spindle motor is self-locking.

11. The nursing bed according to claim 1, wherein a spring device lies parallel to the linear drive.

12. The nursing bed according to claim 11, wherein the spring device is formed by a pneumatic spring.

Dated 21 October, 2011

Hans-Peter Barthelt

Patent Attorneys for the Applicant/Nominated Person

SPRUSON & FERGUSON

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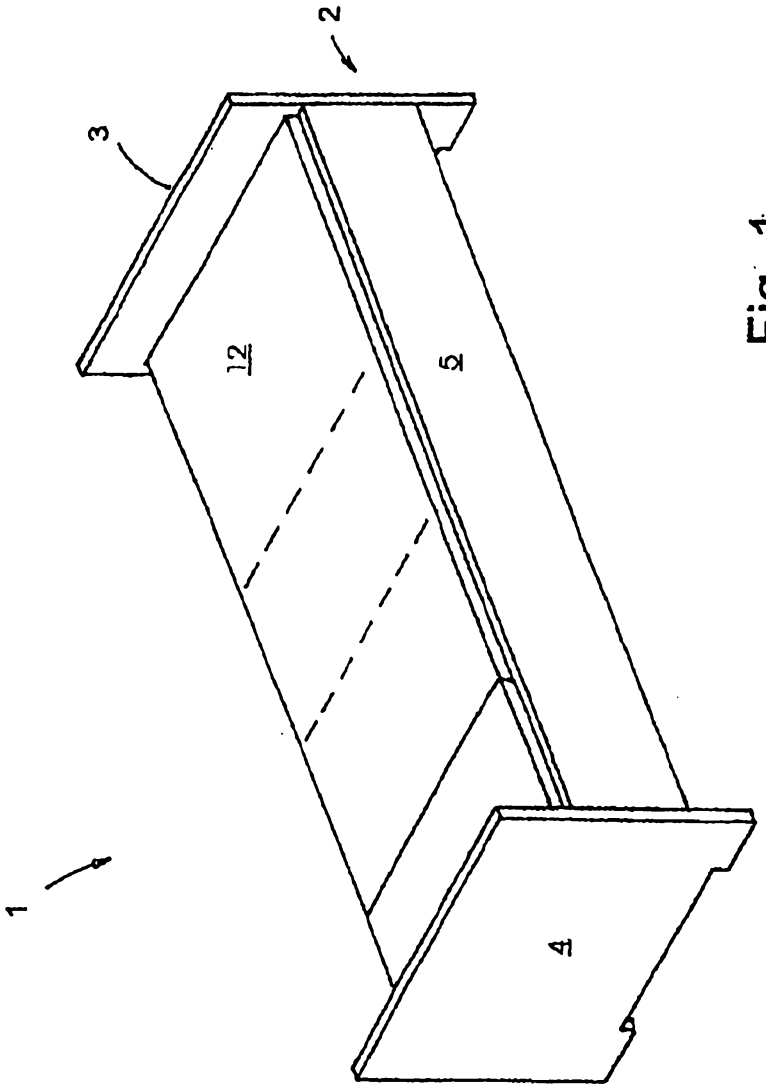

Fig. 1

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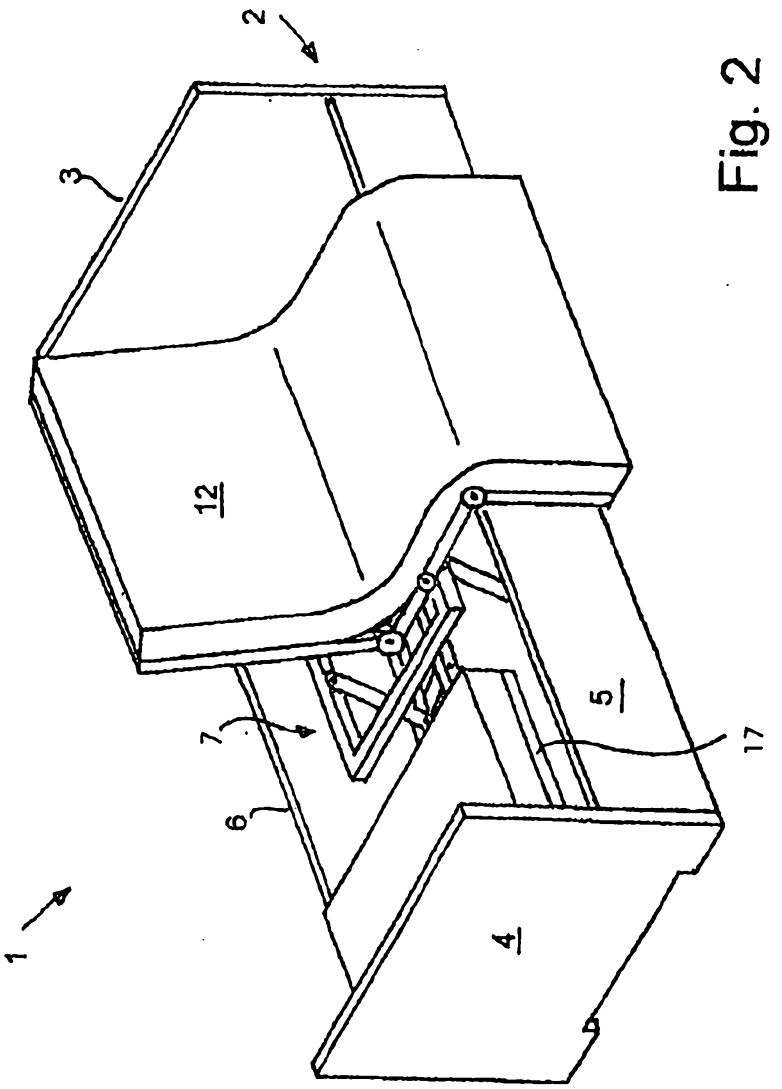

Fig. 2

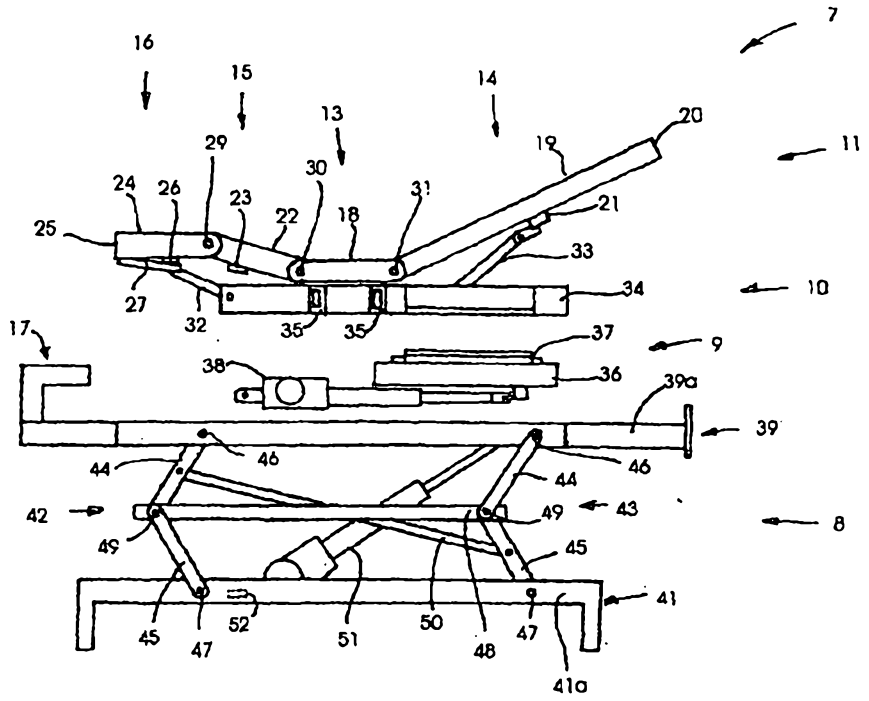
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Fig. 3

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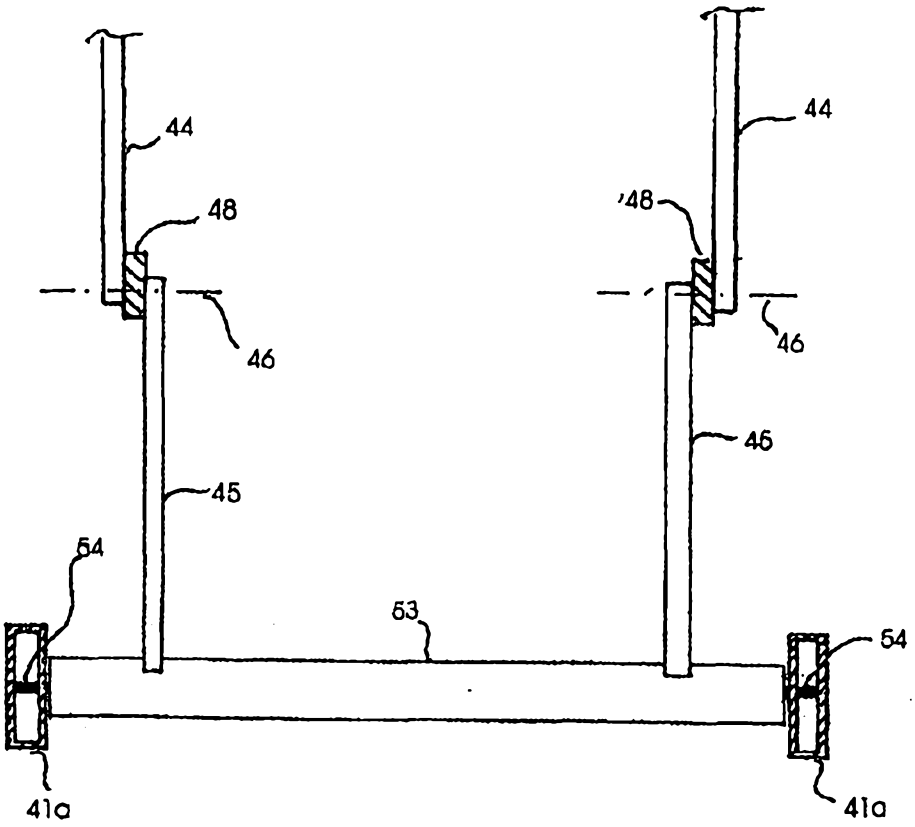

Fig. 4