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(56) Documents Cited:  
**EP 1525824 A1** **CH 000587035 A5**  
**US 6101648 A** **US 4715073 A**  
**US 20050172403 A1** **US 20020174487 A1**

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(54) Title of the Invention: **Adjustable furniture**  
Abstract Title: **An adjustable bed with a cam operated pivoting back rest**

(57) An article of adjustable furniture comprising a frame, a moveable support section 12 pivotally mounted to the frame, cam means 42 attached to the frame or support section and a cam follower 68 attached to the other wherein the cam means or follower attached to the frame can be moved by an actuator 52 which moves in a longitudinal direction of the frame wherein relative movement between the cam means 42 and follower 68 produces rotation of the support section 12. The cam arrangement may utilise a ramp 42 mounted on wheels 36 which sit in channels 30 in the frame upon which a bearing or wheel 68 of the follower can roll and the follower may be mounted on a sector of a circle or a quadrant 66. The device may be a bed with a pivoting backrest which also has an adjustable thigh support.

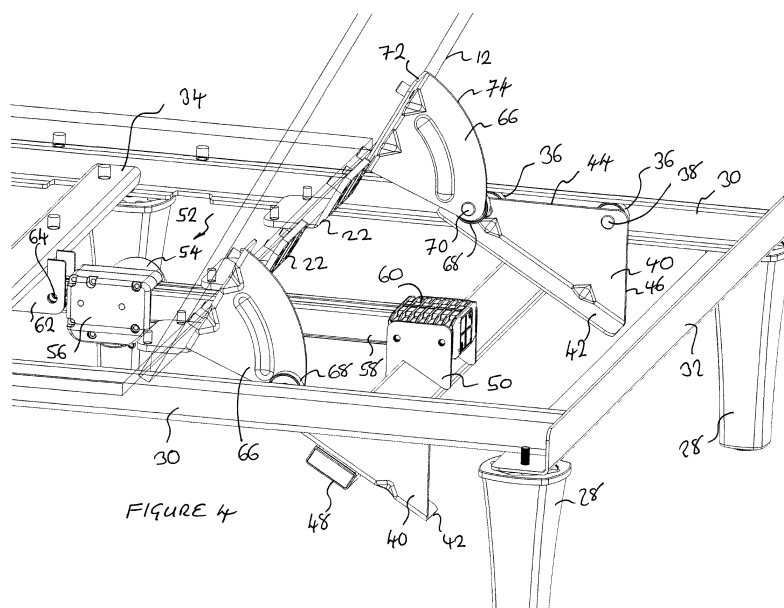


FIGURE 4

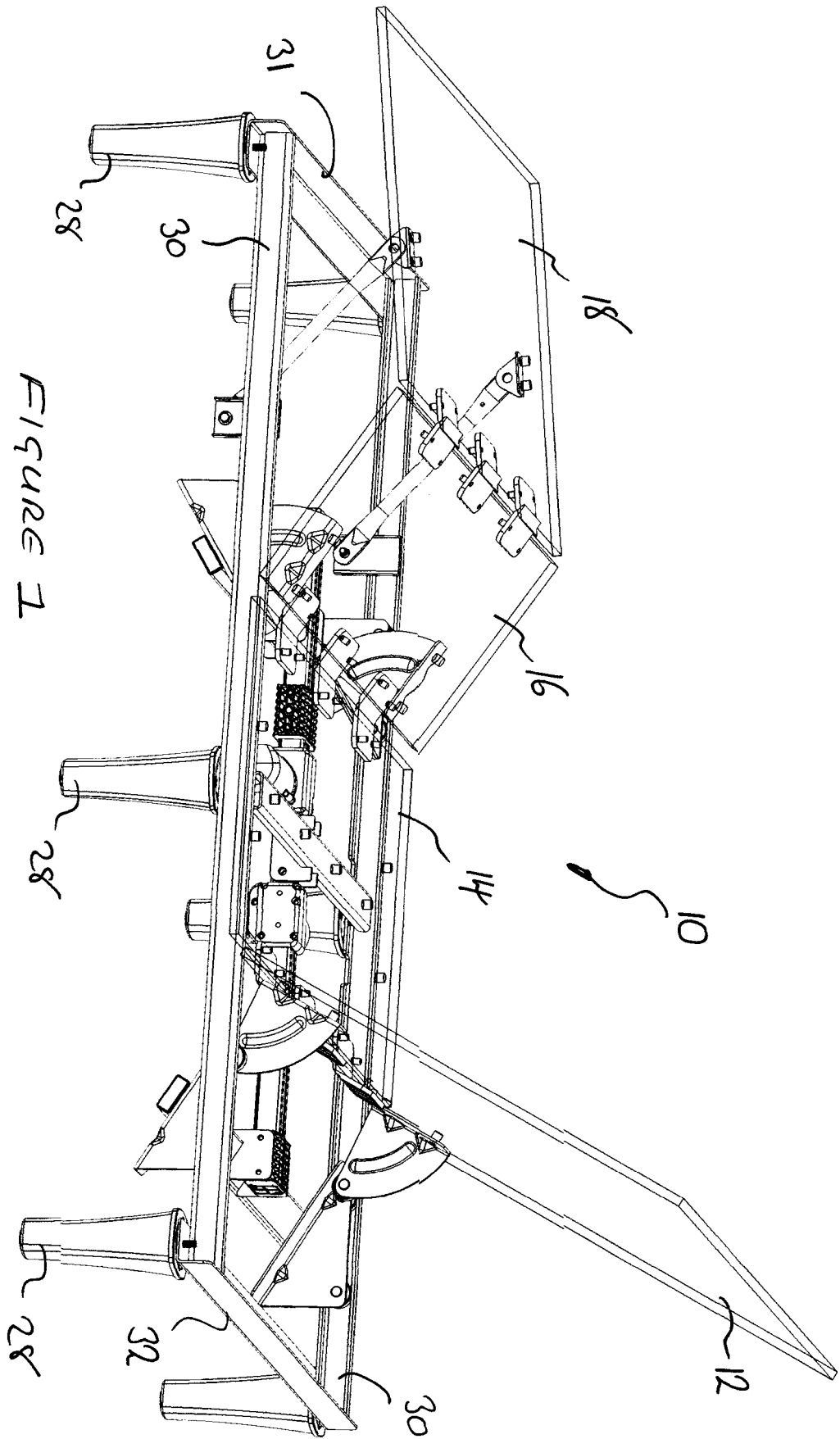
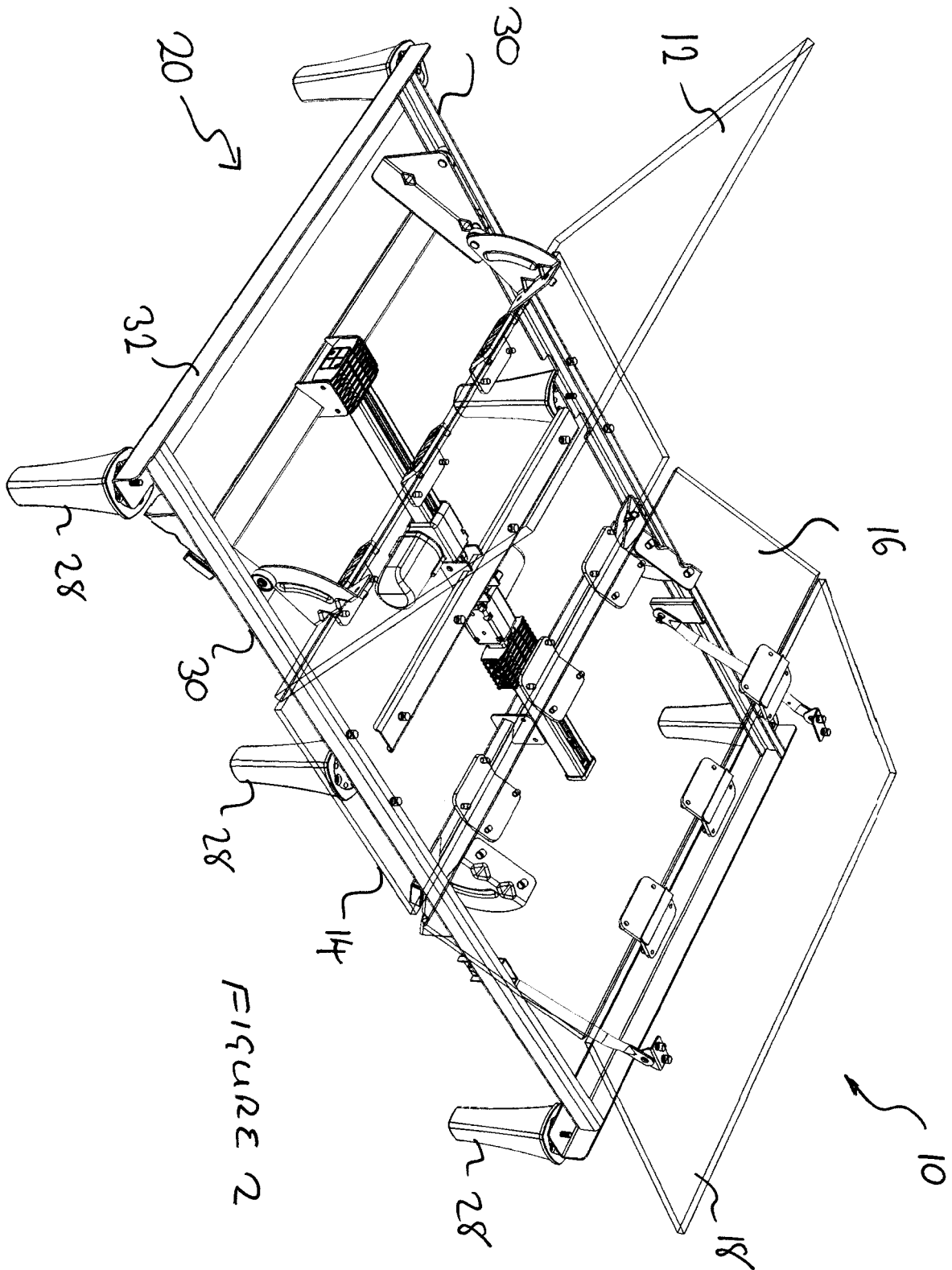
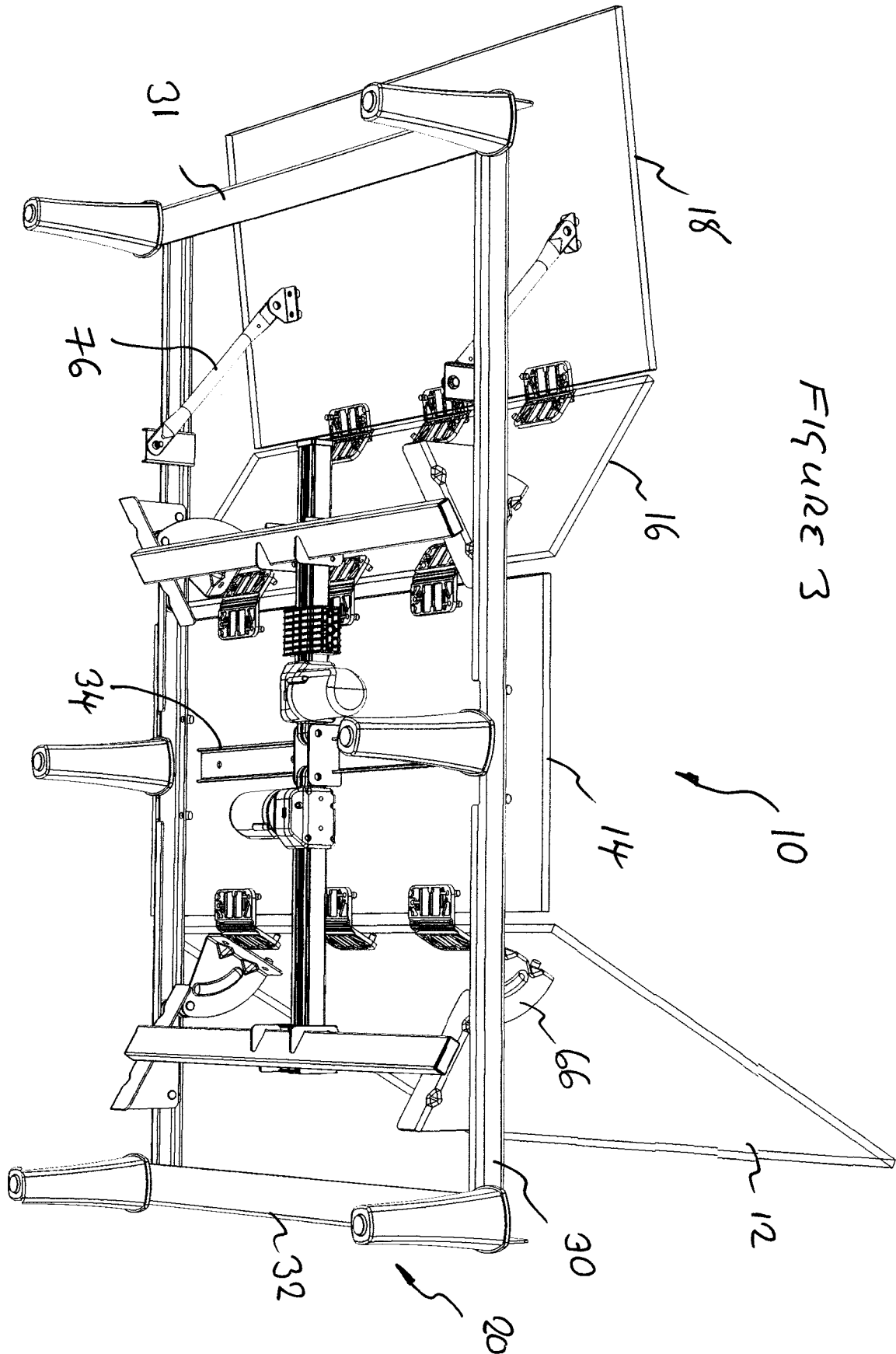


FIGURE 1





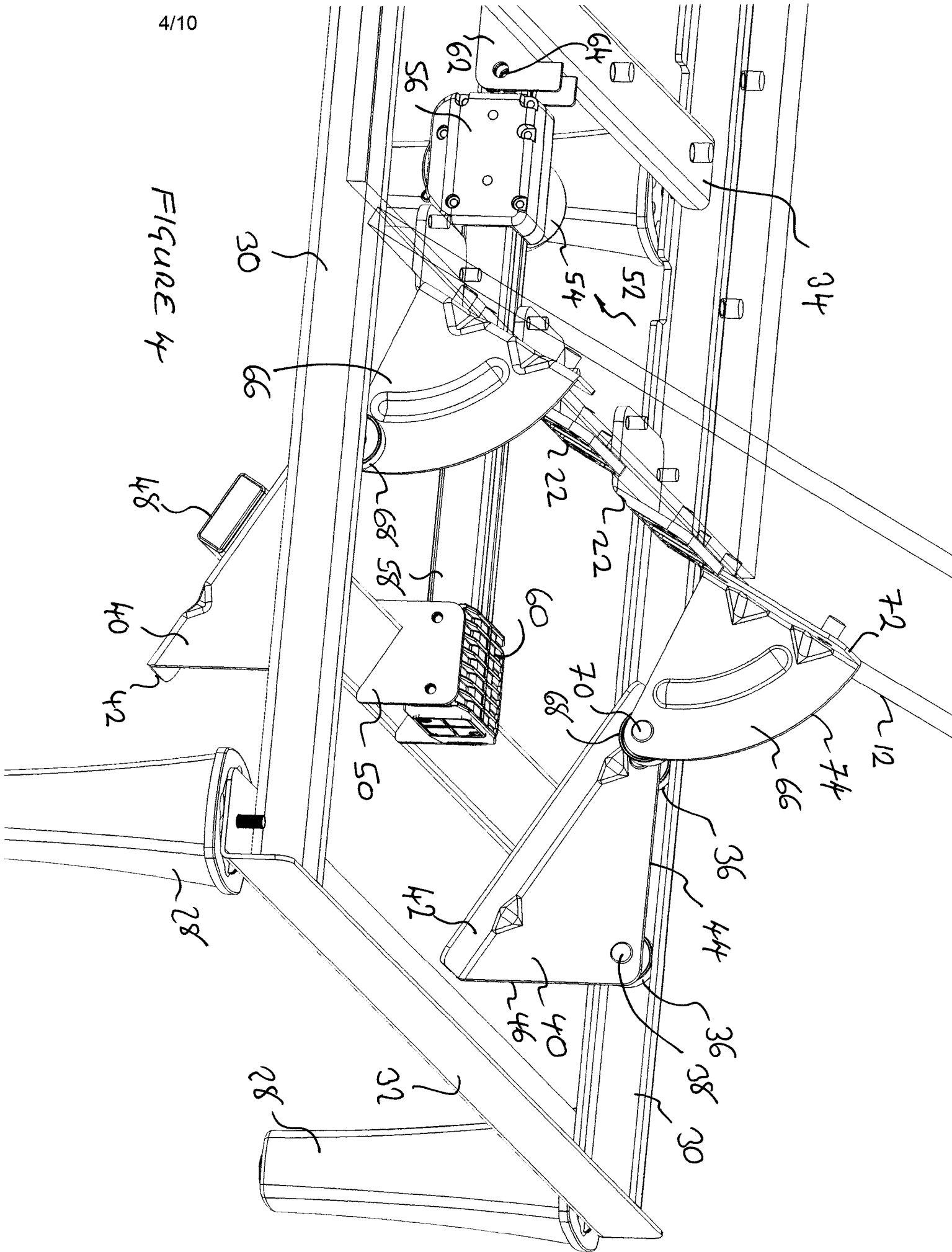


FIGURE 4

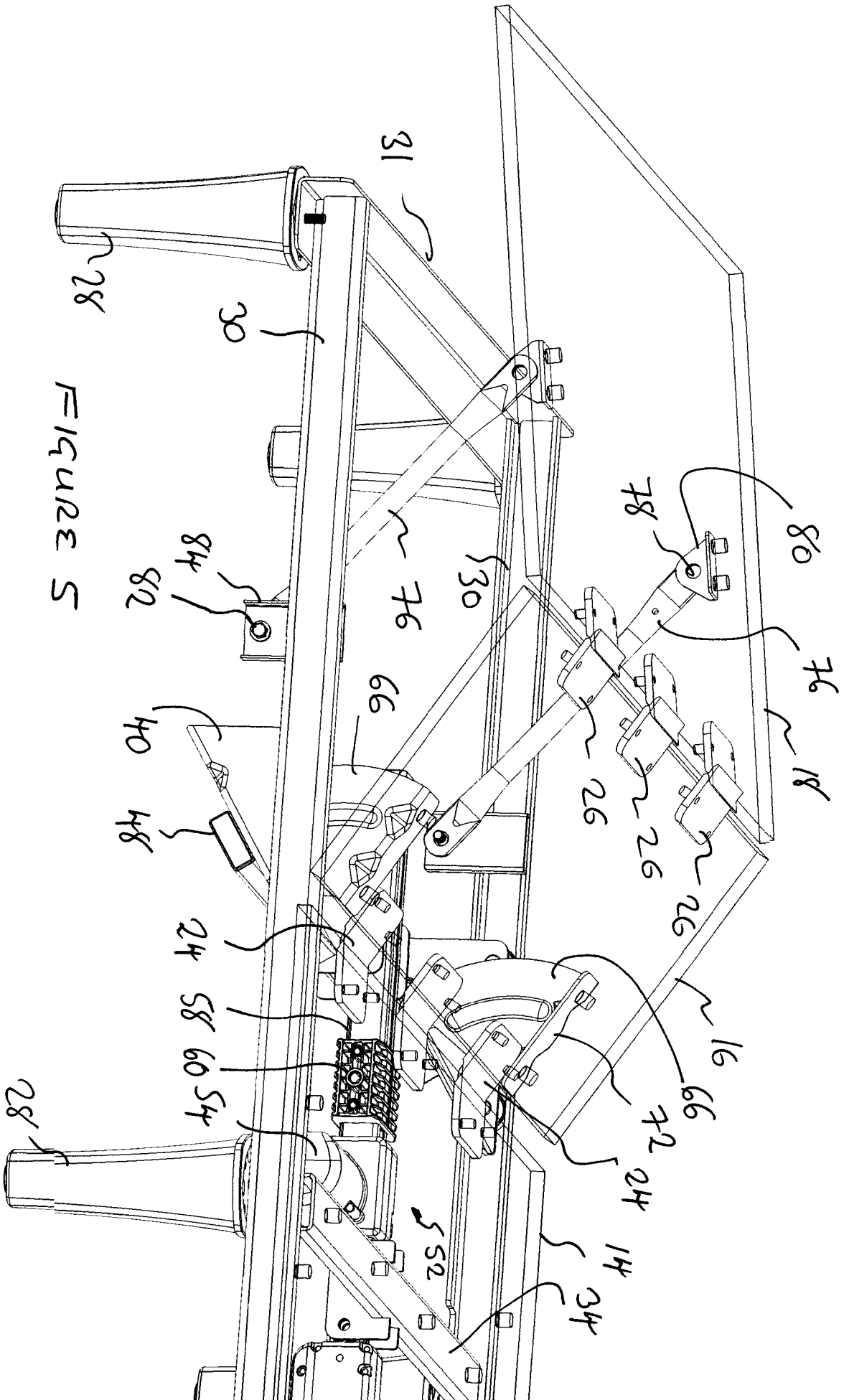


FIGURE 5

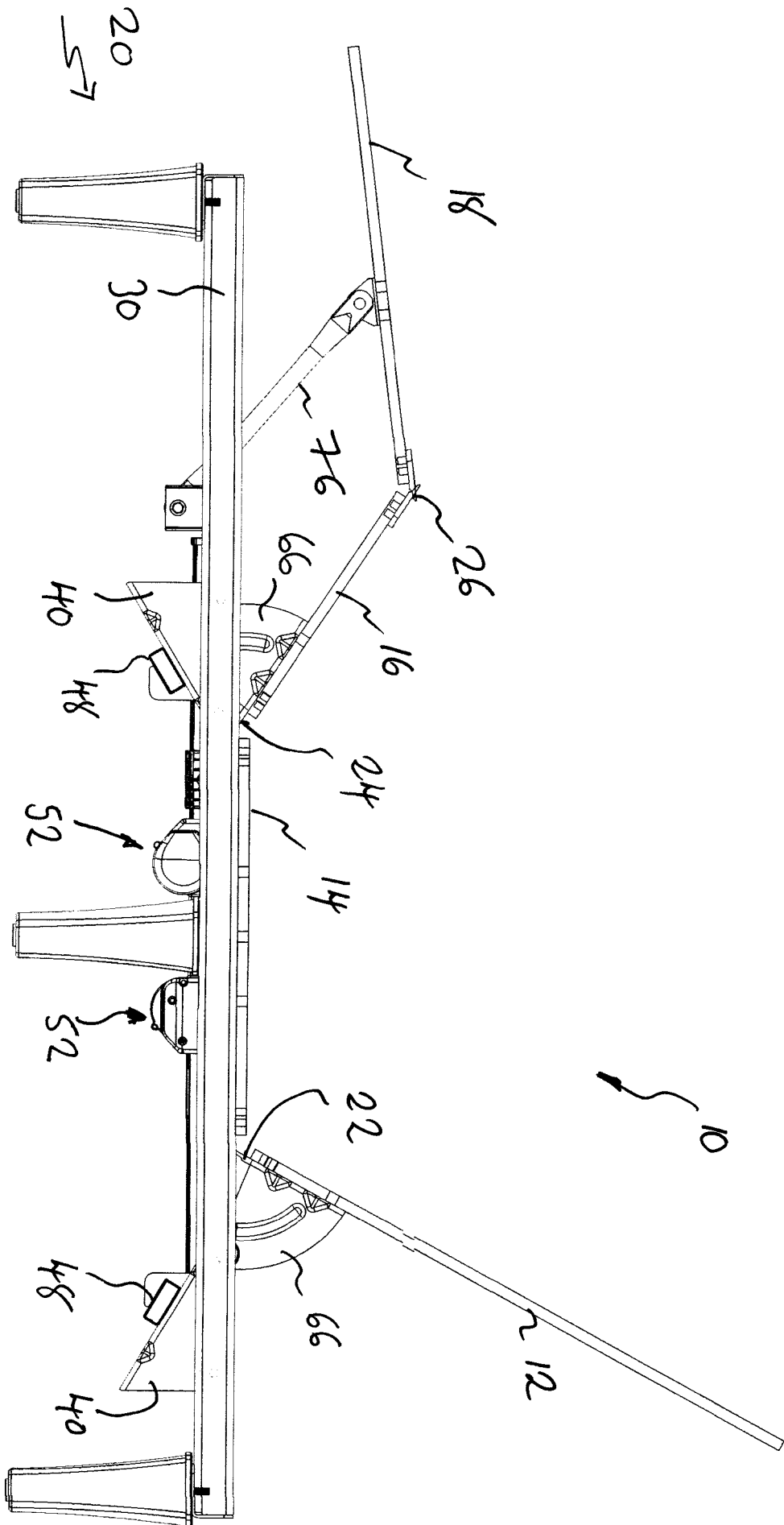


Figure 6

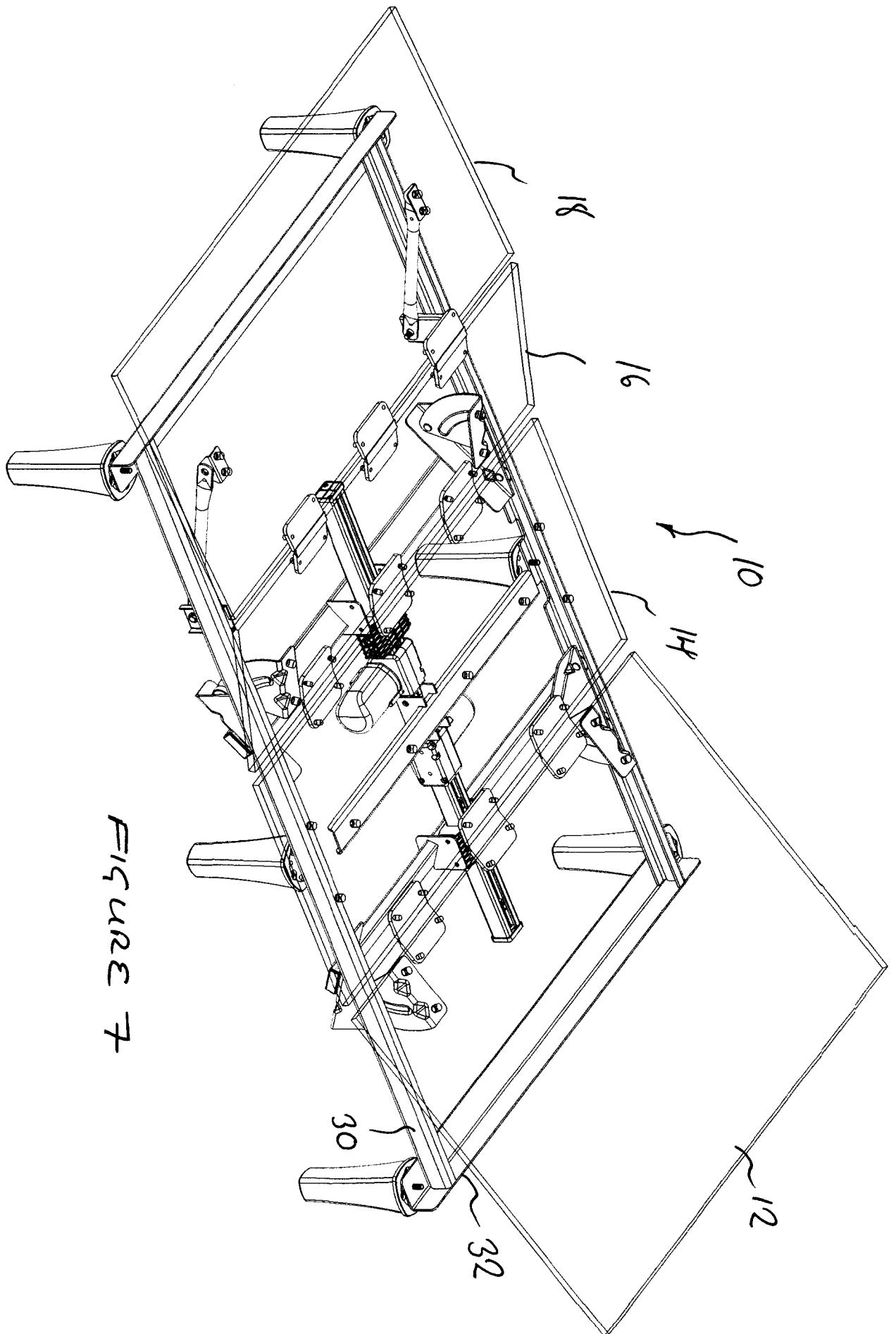


FIGURE 7



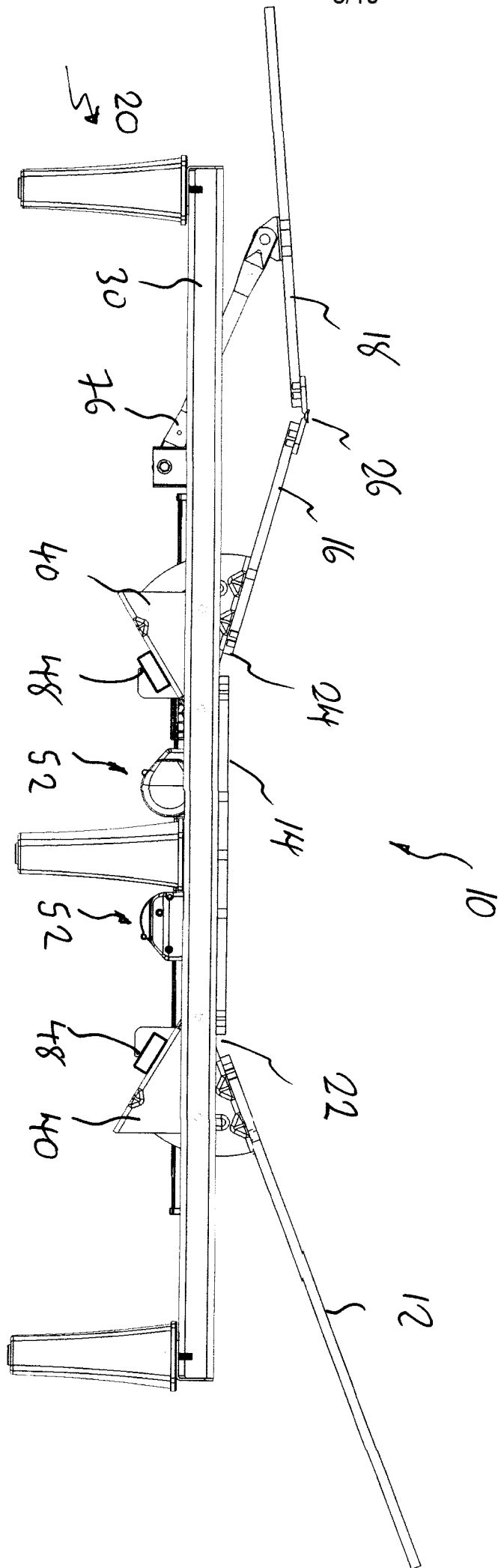


FIGURE 8

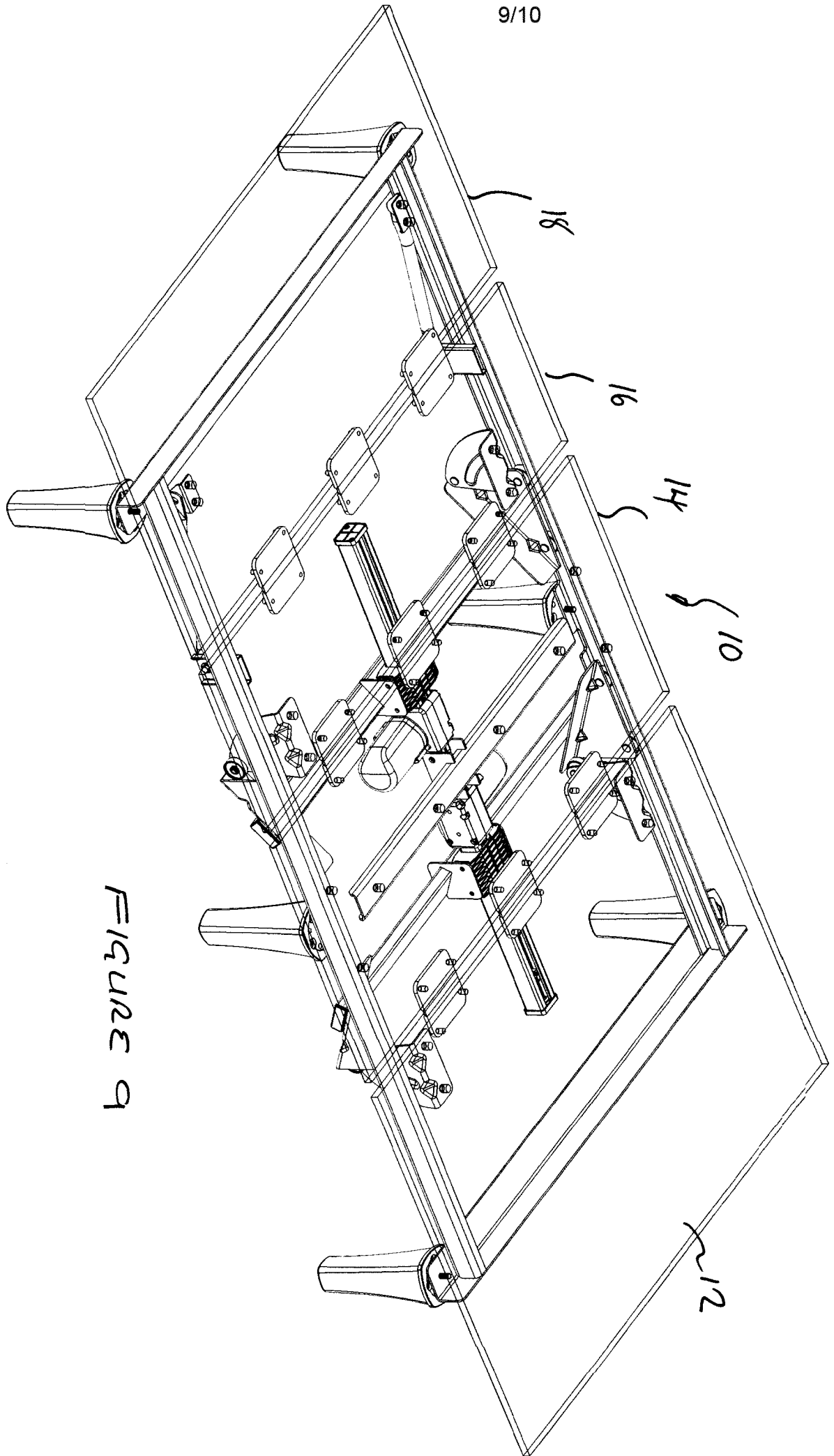


FIGURE 9

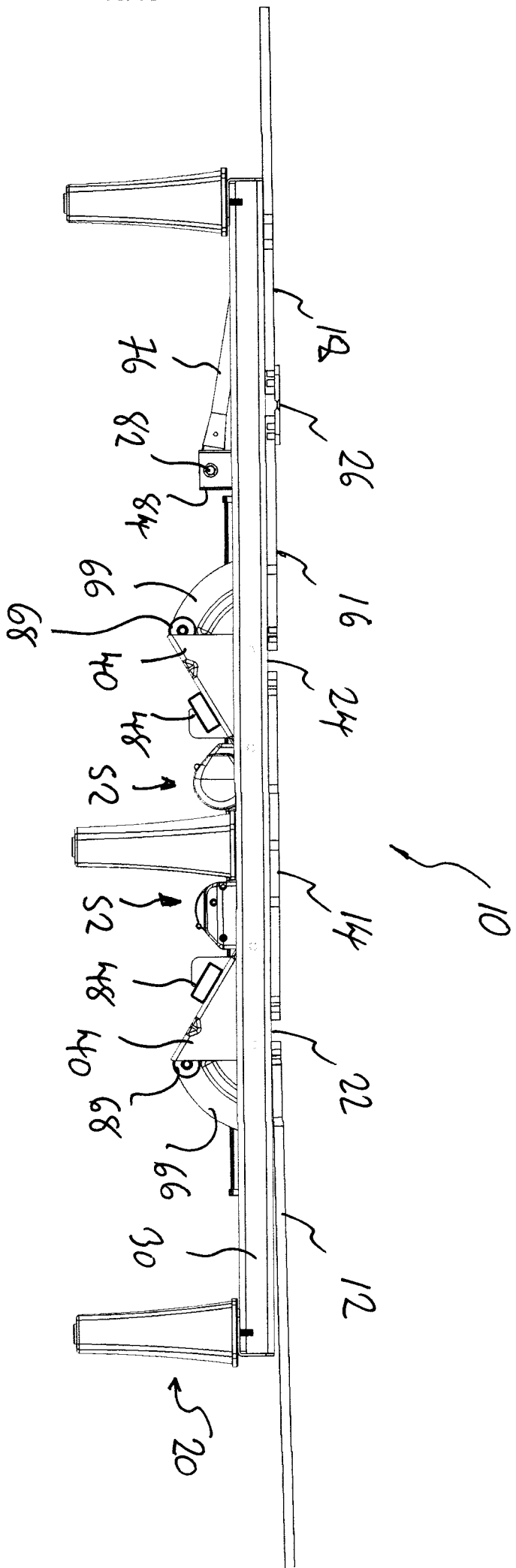


FIGURE 10

## ADJUSTABLE FURNITURE

This invention relates to adjustable furniture and in particular concerns adjustable beds  
5 having adjustable body-support sections which can be moved to adjust the configuration of the bed.

Adjustable beds are known, for example, from US2002/0174487 which discloses a hospital bed having adjustable back and thigh sections. The hospital bed of  
10 US2002/0174487 comprises a frame having a pair of parallel and spaced apart first and second side frame members; a mattress support deck including an adjustable back section having first and second sides; a fixed seat section located adjacent to the back section and an adjustable thigh section located adjacent to the seat section and movable relative to the seat section, to increase the length of the thigh section, as the  
15 thigh section is raised relative to the frame. First and second curved tubes are coupled to respective first and second sides of the back section. A plurality of rollers are coupled to the first and second side frame members, with the rollers being configured to support the first and second curved tubes to permit movement of the curved tubes and the back section relative to the frame. A linear actuator is disposed beneath the back  
20 section and coupled to the first and second tubes to move the back section from a horizontal position to an elevated position relative to the frame. Two concentric arcuate tubes are provided on each side of the bed which have a radius of curvature centred on a location which emulates the natural hip pivot of a person lying on the mattress of the bed. The tubes are secured between three rollers on each side of the  
25 bed. Two rollers are located on a bottom side of the radially outer tube, that is to say radially outwards thereof, and the third roller is located on a top side of the radially inner tube. A pair of cross-members extend between the tubes. The arrangement provides a so called shear-less pivot mechanism in which the adjustable back section pivots about the natural hip point of the person on the bed.

30 The arrangement disclosed in US2002/0174487 may be considered heavy, robust and mechanically complex. This structure, while suitable for hospital beds, does not readily provide an arrangement that is suitable for more lightly used applications such as domestic furniture, where other design considerations, such as weight and cost and  
35 mechanical simplicity, come into play.

An adjustable bed particularly suitable for domestic furniture applications is described in WO2011/048384. This bed comprises a mattress support deck having a plurality of mattress support sections, including a movable back support section, a fixed seat

section adjacent to the back support section, a movable thigh support section adjacent the seat section and a movable foot or lower leg support section adjacent and hinged to the thigh support section. The back and thigh support sections are mounted with respect to the base to allow angular adjustment of their relative positions to alter the configuration of the bed. Linear actuators are provided for moving each of the movable sections to effect angular adjustment of the bed. A pair of load-bearing arcuate members are spaced apart on opposite lateral sides of both the back and thigh sections. The load bearing members project from the underside of the respective support sections and are each provided with bearings arranged to run on a respective curved support provided in or on a respective side panel of the base. The load bearing members are rigidly connected together by a suitable cross-member on the underside of the respective support sections. Each cross member provides a suitable attachment point for one end of a linear actuator. The arrangement provides a robust box-section type construction, the four sides of which are provided by the support section, typically a panel of board material, the two load bearing members on opposite sides of the support section and the cross-member. This construction provides for rigidity that resists twisting of the structure and hence maintains alignment of the bearings and respective curved support guides in the side panels of the base.

There is a requirement for an adjustable bed which is mechanically less complicated than hitherto known designs and which has attendant weight and cost advantages.

According to an aspect of the present invention there is provided an article of adjustable furniture comprising: a frame, at least one movable support section pivotally mounted for angular adjustment with respect to the frame; cam means associated with one of the frame and the movable support section, cam follower means associated to the other of the frame and the movable support section; said cam means or cam follower means associated with the frame being movable with respect to the frame by actuator means; whereby movement of said actuator means in a longitudinal direction of said furniture effects relative movement of said cam means with respect to said cam follower means; whereby said relative movement effects angular rotation of said support section relative to the frame about its pivot axis and thereby alters the configuration of the article of furniture.

The above aspect of the invention provides a simple arrangement for adjustable furniture, particularly adjustable beds of the aforementioned type. Mutual engagement of the cam means and cam follower means is readily maintained in all adjustment configurations. This can reduce weight and cost in arrangements of adjustable furniture

as less complex structures may be implemented. In particular the above aspect of the invention contemplates embodiments without complex and expensive actuating elements. This aspect of the invention can achieve significant weight and cost advantages without compromising performance and durability. This is a particular consideration in the domestic furniture industry where manufacturing cost is often of critical importance to product success in the marketplace. A significant advantage of this aspect of the present invention is that in embodiments where the article of furniture is an adjustable bed, the profile of the bed, that is to say the depth dimension of the bed, can be minimised, and thereby a low profile adjustable bed can be realised with attendant storage and shipping cost advantages. Particularly when compared with hitherto known designs, due to a smaller depth dimension of the part assembled bed and actuation system. In this respect it will be understood that the depth dimension for shipping purposes is the depth of the bed minus legs or other support means which are shipped unassembled. Thus the reduced depth dimension readily enables greater number of units to be shipped in a given space, such as an ISO container or the like.

Preferably, the cam means is associated with the frame and the cam follower means is associated with the movable support section. The present invention also contemplates embodiments with the opposite arrangement, that is to say where the cam means is associated with the movable support section and the cam follower means is associated with the frame. However, the former arrangement, as in the illustrated embodiment disclosed herein, has been found to provide for a compact and mechanically efficient actuation system for adjustable furniture, particularly adjustable beds.

In preferred embodiments the cam follower means is fixed in relation to the at least one movable support section. The present invention therefore contemplates embodiments in which the cam means, via the cam follower means, acts directly on the movable support section. In this way complex linkage arrangements can be avoided and the compound effect of manufacturing tolerances minimised.

Preferably, the cam means is movably mounted on or with respect to the said frame. In this way the cam means can be readily moved with respect to the frame by said actuator means secured to the frame.

In preferred embodiments, the cam means is movably mounted on guide means fixed with respect to the frame. The guide means may be in the form of a track or rail provided on or in respective side rails of the frame, so that the cam means is movably

mounted for translational movement with respect to the frame, preferably in the direction of the side rails of the frame. In preferred embodiments the cam means is mounted on followers such as bearings which run on guides on the frame, preferably the side rails of the frame.

5

The cam means preferably comprises a guide ramp. In this way translational movement of the cam means readily provides for upwards or downwards movement of the cam follower means with respect to the frame.

10 In preferred embodiments the guide ramp comprises an inclined guide.

The guide ramp preferably has a linear inclination. In this way the response of the cam follower means corresponds to the movement of the cam mean in a linear relationship. That is to say the upwards or downwards movement of the cam follower mean is  
15 directly proportional to the translational movement of the cam means relative to the frame.

The guide may have an angle of inclination in the range 20 to 45 degrees, preferably 25 to 35 degrees, most preferably 30 degrees  $\pm 1$  degree. The inclination of the guide  
20 may be determined therefore by the particular geometry of the adjustable furniture and determined by the amount of gearing required for a particular application. For example, the present invention contemplates embodiments where the actuator means comprises an electrical linear actuator of known type having a specific power rating, maximum loading, range of linear movement and linear velocity (speed). In the present  
25 invention the angle of inclination of the guide may be selected based on the known performance characteristics of the electrical liner actuator to be used. The effective gearing provided by the angle of inclination may be selected based on the actuator performance characteristics and the required rate of motion (rotational velocity) of the respective movable support section with respect to the frame. By altering the angle of  
30 inclination of the guide, the performance characteristics of a known actuator can be best matched to the desired motion characteristics of the movable support section of the article of furniture. In a preferred embodiment the guide is fixed along the hypotenuse of a right angle guide support plate and therefore the gearing ratio of the inclined guide is based on simple trigonometric geometry, in the case where the  
35 upward and downward trajectory and rotational velocity of the cam follower means is determined by the angle of inclination of the guide means with respect to the translational direction of the inclined cam guide means, in addition to the translational velocity of the cam guide means.

The cam means is preferably fixed in relation to a moving part of the actuator means. In this way movement of the cam means is directly related to movement of the actuator.

5

The actuator means preferably comprises a linear actuator arranged to move said cam means in the longitudinal direction of the frame. The present invention therefore contemplates embodiments where commercially available linear actuators can be utilised.

10

Preferably, the cam follower is fixed in relation to a cam follower support element fixed in relation to said movable support section. The cam follower support element preferably comprises a planar element disposed on the underside of a panel of said movable support section. This provides for a compact mechanical arrangement on the underside of the panel where the planar element can be positioned closely adjacent to the frame.

15

In preferred embodiments, the cam follower support element comprises a planar element having the shape of a sector of a circle. The cam follower support element is preferably positioned at or closely adjacent to the hinged end of the panel of the movable support section with its centre of curvature closely adjacent to, or co-incident with, the pivot axis of the movable support section. In this way the cam follower support element readily provides a guard against potential entrapment points between the frame and the panel of the movable support section in the region of the pivot (hinge) axis.

25

Preferably, the planar element is the shape of a quadrant of a circle, and wherein the circumferential edge (arc) of the quadrant is disposed between the cam follower and a panel of the movable support section.

30

Preferably, the article of furniture is an adjustable bed. Thus, the above aspect of the invention contemplates an adjustable bed in which the adjustable support sections collectively provide all or part of a mattress support deck

35

In preferred embodiments, the at least one movable support section includes at least a movable back support section movable between a horizontal position and an inclined elevated position relative to the frame. The present invention therefore contemplates embodiments in which the bed has at least an adjustable back support section which



may be raised or lowered, preferably between a horizontal position and a raised inclined position as is well known in the art.

5 In preferred embodiments, the at least one movable support section may also include a movable thigh support section movable between a horizontal position and an inclined elevated position relative to the frame. Thus embodiments are contemplated with or without an adjustable thigh section.

10 Preferably, the adjustable bed of the above aspect of the invention further comprises a fixed mattress support seat section adjacent the back support section, the fixed mattress support seat section preferably being fixed with respect to the frame. The above aspect of the invention therefore contemplates embodiments having adjacent fixed and adjustable support sections.

15 In preferred embodiments the guide means is linear, preferably inclined, most preferably inclined in a forward direction towards a toe end of the bed.

20 In preferred embodiments, the floor standing frame comprises first and second spaced apart parallel side frame members. This provides for a robust construction and which is preferably in the form of a rectangular structural frame.

25 In preferred embodiments actuator means is arranged to apply the adjustment force substantially to the underside of the moveable support section to which it is attached. In this way the actuator loads may be minimised by increasing the perpendicular distance between the pivot axis of the respective support section and the point of application of actuator load.

30 In preferred embodiments the actuator means comprises of at least one electric motor driving a movable block on a guide rail. In preferred embodiments, actuator means, preferably a single linear actuator, is associated with each of the relatively moveable upper and lower body support sections so that each may be operated independently or in co-ordination. In preferred embodiments the or each actuator is disposed substantially horizontally with the frame on the underside of the respective adjustable support sections, and more preferably the or each linear actuator remains substantially horizontal throughout its range of extension.

In preferred embodiments, the cam means and cam follower means are provided at both lateral sides of the frame such that the movable support section is supported on

both sides thereof. Thus, the above aspect of the invention readily enables the weight of the article of furniture, including the weight of an occupant and actuation system, to be evenly supported by the load bearing structure of the furniture, which structure may be integrated in such a way that the weight carried by the furniture is evenly supported  
5 by the frame. The arrangement of the cam and cam follower means readily enables the adjustable support sections to be moved, independently if necessary, about their respective pivot axis.

Various embodiments of the present invention will now be more particularly described,  
10 by way of example only, with reference to the accompanying drawings; in which:

Figure 1 is a perspective view from above and the rear, left hand side rear quarter, of a frame and operating mechanism of an adjustable bed according to an embodiment of the present invention, with the bed in an upright configuration for supporting an  
15 occupant in a recombinant position, and the mattress support deck shown in ghost outline;

Figure 2 is a perspective view of the bed of Figure 1 with the bed viewed from the right  
hand side rear quarter;  
20

Figure 3 is a perspective view of the bed of Figure 1 with the bed viewed from below;

Figure 4 is an enlarged perspective view of the rear, or head end, of the bed shown in  
Figure 1;  
25

Figure 5 is an enlarged perspective view of the front, or toe end, of the bed shown in  
Figure 1;

Figure 6 a side elevation view of the bed of Figures 1, with the bed in the upright  
30 configuration of Figure 1;

Figure 7 is a perspective view of the bed of Figure 1 with the bed viewed from the left  
hand side front quarter, with the bed shown in an intermediate position, between fully  
raised and fully lowered, for supporting an occupant in a semi-recombinant position  
35

Figure 8 a side elevation view of the bed of Figure 1, with the bed in the intermediate  
semi-recombinant position of Figure 7;

Figure 9 is a perspective view of the bed of Figure 1 with the bed viewed from the left hand side front quarter, with the bed shown in the fully lowered position;

Figure 10 a side elevation view of the bed of Figure 1, with the bed in the fully lowered position of Figure 9.

Referring to the drawings, Figures 1 to 10 schematically show an adjustable bed 10 according to an embodiment of the present invention. The bed 10 comprises a mattress support deck 11 having four adjacent mattress support section panels, including an adjustable back/head (upper body) support section 12, a fixed stationary seat support section 14, an upper leg or thigh support section 16 and a foot and lower leg support section 18. The panels 12, 16 and 18 are adjustably mounted on a support frame 20, best shown in Figure 2. As shown in Figures 9 and 10, in a fully un-articulated configuration, the panels 12, 14, 16 and 18 are aligned flat in a planar relationship. Throughout the drawings the panels 12, 14, 16 and 18 are shown in ghost outline in order to reveal the construction detail of the adjustable bed.

The seat section 14 is fixed in relation to the frame 20. The panels may include upholstered cushions/pads (not shown) or the like for supporting a mattress (not shown) positioned on top of the cushions or pads, alternatively a mattress may be positioned directly on top of the panels 12-18.

In Figures 1 to 6 the bed 10 is shown in a fully articulated configuration, adjusted for supporting an occupant of the bed in a recumbent position. In this position the back support section panel 12 is raised about, and inclined with respect to, the fixed seat section panel 14 about a pivot axis defined by hinges 22 which pivotally connect the upper body support panel 12 to the seat section support panel 14 at their respective adjacent edges. The thigh support section panel 16 is raised about, and inclined with respect to, the fixed seat section panel 14 about a second pivot axis defined by hinges 24 which pivotally connect the thigh support panel 16 to the seat section support panel 14 at their respective adjacent edges, at the other end of the panel 14 to the upper body support panel 12. The lower leg section panel rotates through a third pivot axis defined by hinges 26 which pivotally connect the lower leg support panel 18 to the other end of the thigh section support panel 16. Hinges 22, 24 and 26 are constructed in preferred embodiments of a fatigue resistant plastics material and constructed as a so called "living hinge". Other types of hinge are also contemplated including extruded metal tubes, for example extruded aluminium or aluminium alloy, having a d or p shape cross section, including a longitudinal mounting flange as an integral part of the

extrusion. A hinge pin passes through the extruded tube in a known manner and may be mounted on bearings (ball bearing type) located at the respective ends of the tube to support the hinge pin in a low friction manner.

- 5 The present invention also contemplates embodiments (not shown) where only the upper body support section is adjustable, that is to say, articulated with respect to the frame 20. The other support panels 14, 16 and 18 being fixed relative to the frame and non-articulating. Embodiments of this type may therefore provide an adjustable backrest only so that the backrest may be raised to lift the occupant to a seated  
10 position.

In the lowered position the adjustable support panels 12 16 and 18 combine with the seat section panel 14 to define a substantially flat planar horizontal support platform. The various support panels 12-18 may each have a mattress support cushion (not  
15 shown) of pre-determined thickness, which combine to provide a mattress foundation for supporting a suitable mattress. The panels 12-18 may be upholstered, with or without support cushions. The bed may be a so called "soft edge" adjustable bed. The present invention also contemplates arrangements where the frame 10 is integrated in a divan type bed foundation structure. In the illustrated embodiment the bed frame 20 is  
20 provided with floor standing legs 28 and is thus self-supporting. The dimensions of the bed are such that the bed has the size of a double bed, but the present invention contemplates beds of many different widths including standard single size beds to much larger doubles.

- 25 The frame 20 comprises a generally rectangular structural support, preferably constructed of metal but other materials may be used for various component parts, in addition to or instead of metal, including board type material, for example engineering plastic, MDF, timber or other fibre type board for example.

30 The frame 20 comprises a pair of elongate parallel lateral side frame members in the form of rails 30. The side frame members extend longitudinally along the length of the bed, on opposite sides thereof, and are joined together at their respective ends by L-section metal, preferably steel, cross-members 31, 32 to form a rectangular box type structural support frame. A further cross-member 34 is positioned between the side  
35 frame members 30 at a mid-point along their length. The side frame members 30 are constructed of suitably dimensioned C-section metal plate, preferably pressed steel, and the cross-member 34 of rectangular box section metal tube. The frame 20 is provided with legs 28 at each of the corners of the rectangular frame structure, as well

as mid-way along the frame 20 at the position of the cross-member 34. The side members 30 and cross-members 31, 32 are joined together by welding or alternatively by fixing means such as screws, bolts, fasteners or the like. In preferred embodiments the legs are attachably/detachably fixed to the frame by suitable reversible fixing means as well known in the art. Cross member 34 is fixedly attached to the underside of stationary panel 14 by screws, bolts or the like, but is not directly connected to the side members 30.

The support frame 20 thereby constitutes the floor standing part of the bed 10 and in this respect the frame may stand directly on legs 28 or be provided with castors, feet or the like at the end of the legs, as is also well known in the art.

The C-section side members 30 define rails on which parts of a movable actuation system are mounted. The open side of the C-section members faces the interior region of the bed on the underside of the panels 12-18. The rails accommodate respective rollers in the form of bearings 36 mounted on respective bearing pins 38 on ramp brackets 40. The ramp brackets 40 have a generally triangular shape, when viewed in plan, as in the side elevation view of the bed in Figures 6, 8 and 10, and include an inclined flange 42 orthogonal to the main triangular body of the bracket. The triangular shape of the bracket is that of a right angled triangle and the inclined flange 42 is provided along the hypotenuse of the triangular plate forming the main part of the bracket. The flange 42 extends outwards from the triangular plate of the bracket towards the interior region of the frame. Two bearings 36 are mounted on each of the brackets 40, one at the forward end of the bracket and the other at the rearward end, that is to say, at the longitudinal ends of the bracket when mounted on the rails 30. The brackets are arranged closely adjacent to the respective rails 30 with the main triangular part in a plane parallel to the rail. The brackets are arranged on the rails such that the longer 44 of the two right angle sides extends along and is aligned with the top of the adjacent rail 30 and the other of the sides 46 extends downwards at the rearwards end of the bracket below the rail. The inclined flange is thus inclined downwards in a rearwards direction towards the head end of the bed frame.

The downwards inclination of the flange 42 is about 30 degrees from the horizontal as defined by the horizontal side rails 30 in the normal operational orientation of the bed.

The ramp brackets 42 on opposite sides of the bed are fixedly connected together by means of a rectangular box—section tube 48, preferably of metal construction, most preferably steel. The tube 48 is fixedly connected to the underside of the respective

brackets 40 at a mid-point along the underside of the flange 42. This may be by welding or other means. A sliding block bracket 50 is attached to the tube 48 at a midpoint along the length of the tube.

- 5 A sliding block type actuator 52 for moving the backrest upper body support panel 12 is provided on the underside of the frame between the respective side rails 30. The actuator is of the Beta-drive type produced by Dewert-Okin GmbH and comprises a reversible motor part 54, a gearbox 56, a guide rail 58 and a slidable block part 60 which is mounted on and arranged to move back and forth in a linear motion on the
- 10 guide rail 58. The actuator 52 is pivotally mounted at the gearbox end of the actuator to the cross-member 35 via a cross-member bracket 62 and pivot pin 64. At the other end the movable block 60 is fixedly secured to the sliding block bracket 50. The cross-member bracket 62 is also positioned approximately mid-way along the length of the cross-member such that the actuator extends parallel to the side rails 30 and is
- 15 disposed horizontally in the normal operational orientation of the bed.

The movable actuation system of the upper body support section further comprises a pair of bearing brackets 66 fixedly secured to the underside of the panel 12 towards the hinged end of the panel 12. Each bracket carries a roller in the form of a bearing 68

20 mounted on a pin 70 on the bracket 66. The bearing 68 defines a cam follower which engages with and runs on the upward facing surface of the inclined flange 42 which defines a corresponding cam of the actuation system.

Each bracket 66 comprises a planar element having an arcuate form and is in the

25 shape of a sector of a circle. The sector angle is approximately 90 degrees and therefore the bracket may be considered to be a quadrant with one of the radial extending edges being provided with a mounting flange 72 for mounting the bracket 66 on the underside of the panel 12 by suitable fixing means such as screws, bolts, fasteners or the like. The bearing 68 is mounted at the other end of the quadrant near

30 the circumferential edge 74 of the quadrant. The bearing 68 is mounted on the side of the quadrant bracket 66 that faces the bracket 44. The dimensions of the respective brackets 44 and 66, the angle of the inclined flange 42 and the positioning of the bearing 68 are such that the panel 12 lies flat on top of the frame 20 when the block is moved to its fully forwards position along the guide 58, and the panel 12 is raised to its

35 maximum inclined position when the block is at the opposite end of its range of movement on the guide 58 when moved to its rear most position on the guide, that is to say when it is moved fully rearwards in the direction of the head end of the bed, as shown in Figure 1 to 6.

The thigh section panel 16 is provided with an identical actuation system as described above in relation to the upper body support section panel 12. The orientation of the actuation system for the panel 16 may be considered to be a mirror image of that described with reference to panel 12 above, with the second actuator 52 for panel 16 mounted back to back with the first actuator 52 for the panel 12 on the cross-member mounting bracket 62. The panel 16 has a shorter longitudinal dimension to that of the panel 12 and its range of angular adjustment is less, but in all other respects the actuation system for panel 16 is the same as for panel 12 previously described. The same reference numerals are therefore used for the same components in both actuation systems.

As previously mentioned, the lower leg and foot support section panel 18 is pivotally connected to the thigh support panel 16 along their respective adjacent edges by hinges 24. The panel 18 is further connected to the side rails 16 of the frame by means of a pair of stays 76. The stays 76 are pivotally connected at one end to the underside of the panel 18 by means of pivot pins 78 on brackets 80. The brackets 80 are fixedly secured to the panel 18 towards its lateral side edges but sufficiently inboard so that they lie within the interior space envelope of the frame as defined by the side rails. This is so that they are accommodated within the frame in all configurations of the bed, that is to with the thigh and lower leg panels 16 and 18 fully raised or fully lowered. The other end of each stay is pivotally connected to the adjacent side rail by means of pivot pins 82 on brackets 84. The brackets 84 are fixedly secured to the side rails on the inward facing side thereof. The stays support the panel 18 when it is raised by the raising of the panel 16.

Rotational movement of the panels 12, 16 and 18 is effected by activation of linear electrical actuators 52 on the underside of the bed within the space envelope of the frame. Thus panel 12 is raised and lowered by respective extension and retraction of the associated upper body support actuator 52 and panel 16, with attached panel 18, is raised and lowered by respective extension and retraction of the lower body support actuator 52. In operation, in the fully lowered configuration of the bed the adjustable panels 12, 16 and 18 lie flat on the side rails 30, with the sliding block 60 of the forward and rearward actuators 52 fully retracted towards the respective gearbox end of the actuators. This position is shown in Figures 9 and 10. In order to raise the panels 12, 16 and 18, the sliding block 60 is moved away from the gearbox end towards the cross-member 48 end of the actuator, in the case of the thigh and lower leg section actuator the block 60 is moved towards the foot end of the bed and in the case of the upper

body support section actuator the block 60 is moved towards the head end of the bed. Movement of the respective cam follower bearings 68 over the inclined cam flanges 42 causes the respective panels to rotate on their hinges. Selective movement of the panels by the actuators 52 is possible by selective activation of the actuators. Thus  
5 movement of the upper and lower body support panels may be independent or coordinated according to a particular designated command signal. At full extension the actuators 52 position the panels 12, 16 and 18 in the fully raised configuration of the bed as shown in Figures 1 to 6, moving through the intermediate position of Figures 7 and 8. Movement of the panels 12, 16 and 18 through their respective range of  
10 movement can best be seen with reference to the sequence of side elevation images shown in Figures 6, 8 and 10.

It will be understood that while the illustrated embodiment of Figures 1 to 10 concerns a bed the present invention also contemplates embodiments wherein the article of  
15 furniture is an adjustable chair, for example a chair having a recliner function in which the back rest is angularly adjustable relative to a seat section, and adjustment of the backrest relative to the seat section is achieved in a manner similar to that hereinbefore described.



## CLAIMS

- 5 1. An article of adjustable furniture comprising: a frame, at least one movable support section pivotally mounted for angular adjustment with respect to the frame; cam means associated with one of the frame and the movable support section, cam follower means associated to the other of the frame and the movable support section; said cam means or cam follower means associated with the frame being movable with respect to the frame by actuator means; whereby movement of said actuator means in a longitudinal direction of said furniture effects relative movement of said cam means with respect to said cam follower means; whereby said relative movement effects angular rotation of said support section relative to the frame about its pivot axis and thereby alters the configuration of the article of furniture.
- 15 2. An article of furniture as claimed in Claim 1 wherein the cam means is associated with the frame and the cam follower means is associated with the said movable support section.
- 20 3. An article of furniture as claimed in Claim 2 wherein the cam follower means is fixed in relation to the said at least one movable support section.
- 25 4. An article of furniture as claimed in Claim 2 or Claim 3 wherein the said cam means is movably mounted on or with respect to the said frame.
5. An article of furniture as claimed in Claim 4 wherein the said cam means is movably mounted on guide means fixed with respect to the said frame
- 30 6. An article of furniture as claimed in any preceding claim wherein the cam means comprises a guide ramp.
7. An article of furniture as claimed in Claim 6 wherein the guide ramp comprises an inclined guide.
- 35 8. An article of furniture as claimed in Claim 7 wherein the guide has an angle of inclination in the range 20 to 45 degrees, preferably 25 to 35 degrees, most preferably 30 degrees +/-1 degree.

9. An article of furniture as claimed in any of Claims 6 to 8 wherein the guide ramp is linear.
- 5 10. An article of furniture as claimed in any preceding claim wherein the cam means is fixed in relation to a moving part of said actuator means.
- 10 11. An article of furniture as claimed in any preceding claim wherein said actuator means comprises a linear actuator arranged to move said cam means in the longitudinal direction of the frame.
12. An article of furniture as claimed in any preceding claim wherein said cam follower is fixed in relation to a cam follower support element fixed in relation to said movable support section.
- 15 13. An article of furniture as claimed in Claim 12 wherein said cam follower support element comprises a planar element disposed on the underside of a panel of said movable support section.
- 20 14. An article of furniture as claimed in Claim 12 or Claim 13 wherein said cam follower support element comprises a planar element having the shape of a sector of a circle.
- 25 15. An article of furniture as claimed in Claim 14 wherein said planar element is the shape of a quadrant of a circle, and wherein the circumferential edge of said quadrant is disposed between said cam follower and a panel of said movable support section.
- 30 16. An article of adjustable furniture as claimed in any preceding claim wherein said article of furniture is an adjustable bed.
- 35 17. An adjustable bed as claimed in Claim 16 wherein said at least one movable support section comprises at least a movable back support section movable between a horizontal position and an inclined elevated position relative to the frame.
18. An adjustable bed as claimed in Claim 17 wherein said at least one movable support section further comprises a movable thigh support section movable

between a horizontal position and an inclined elevated position relative to the frame.

5 19. An adjustable bed as claimed in Claim 17 or Claim 18 further comprising a fixed mattress support section adjacent said back support section, said fixed mattress support section being fixed with respect to the said frame.

10 20. An article of adjustable furniture as claimed in any preceding claim wherein said frame comprises first and second spaced apart parallel side frame members.

21. An article of adjustable furniture as claimed in any preceding claim wherein said cam means and cam follower means are provided on both lateral sides of the article of furniture.

15 22. An article of furniture as claimed in any preceding claim wherein said cam follower means comprises a roller, bearing or the like.

20 23. An article of furniture as claimed in any preceding claim wherein said cam means and said cam follower means are provided at both lateral sides of the frame such that said movable support section is supported on both sides thereof.



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**Examiner:** Daniel Cox

**Claims searched:** 1-23

**Date of search:** 11 May 2015

## Patents Act 1977: Search Report under Section 17

### Documents considered to be relevant:

Category	Relevant to claims	Identity of document and passage or figure of particular relevance
X	1, 6-11, 16, 17 & 19-23	EP1525824 A1 NETO, See whole document
X	1-7, 9-13, 16, 17 & 20-23	US4715073 A BUTLER, See whole document
X	1, 6, 7, 9-11, 16, 17 & 20-23	CH587035 A5 SENNHAUSER, See whole document
X	1, 6, 7, 16, 17 & 20-23	US2005/172403 A1 DARLING, See whole document
X	1-3, 6, 7, 9-13 & 16-23	US6101648 A SOMMERFELD, See whole document
X	1, 6, 7, 10, 11 & 16-23	US2002/174487 A1 KRAMER, See whole document

### Categories:

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.

### Field of Search:

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC<sup>X</sup> :

Worldwide search of patent documents classified in the following areas of the IPC

A47B; A47C; A47D; A47F; A61G

The following online and other databases have been used in the preparation of this search report

EPODOC and WPI



**International Classification:**

<b>Subclass</b>	<b>Subgroup</b>	<b>Valid From</b>
A61G	0007/015	01/01/2006
A47C	0020/04	01/01/2006