United States Patent

Lanigan

[15] **3,686,696**

[45] **Aug. 29, 1972**

[54] **HOSPITAL BEDS**

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[21] Appl. No.: **1,222**

[52] **U.S. Cl.** **5/63,** 5/62, 5/66
[51] **Int. Cl.** **A61g 7/00**
[58] **Field of Search** 5/63–65, 66–69; 108/143, 147; 248/421; 297/347; 254/8, 9, 122

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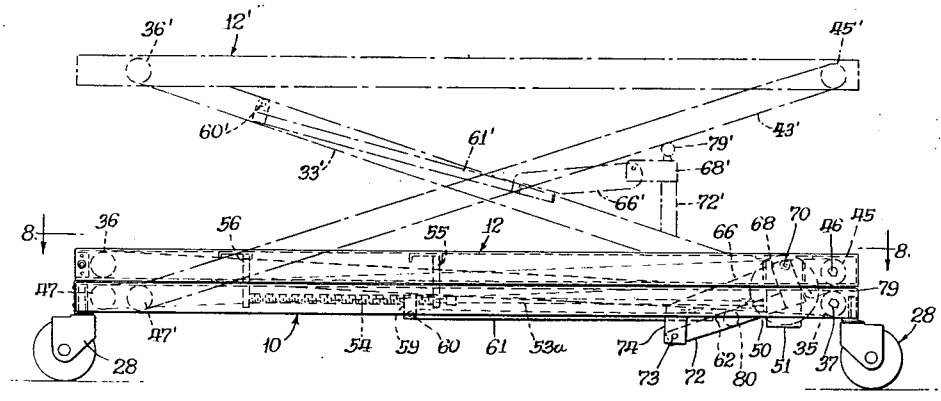
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[57] **ABSTRACT**

A hospital bed has a rectangular base frame and an intermediate frame assembly mounted for vertical movement with respect to the base frame by means of side scissors linkages extending therebetween. The intermediate frame assembly includes a perimetric retract frame having telescoping portions, one being a fixed portion and the other being a movable portion. The movable portion is received by the fixed portion for extension and retraction of the foot end of the retract frame which extends beyond the foot end of the base frame in the extended position. An articulated mattress frame which includes a head panel, seat panel and upper and lower leg panels is mounted on the retract frame. Adjacent panels are pivotally interconnected for rotation about transverse axes for achieving the desired patient positions. A linkage assembly is provided for lowering and inclining the seat panel as the head panel is raised. A lift mechanism selectively tilts the retract frame about either the head end or foot end of the intermediate frame to achieve the Trendelenberg and reverse Trendelenberg positions at all elevations of the intermediate frame. A selective latch mechanism is also provided for raising the lower leg panel parallel to the retract frame when the upper leg panel is raised or alternatively to permit the foot end of the lower leg panel to remain lowered while the upper leg panel is raised and thus achieve a bent knee position. The raising and lowering of the intermediate frame, the raising and lowering of the head panel while retracting the telescoping frame and tilting the seat panel, and the raising and lowering of the leg panels are all independent of each other to achieve any desired patient position.

10 Claims, 14 Drawing Figures



PATENTED AUG 29 1972

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SHEET 1 OF 6

Fig. 1.

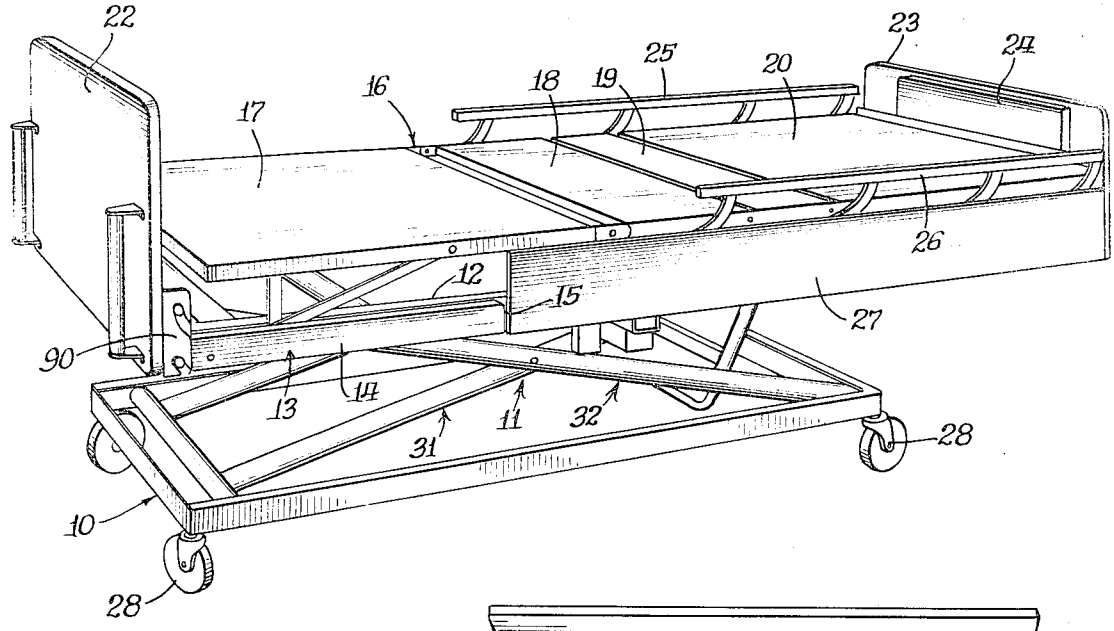


Fig. 3.

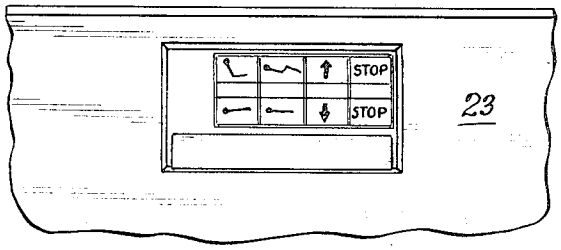
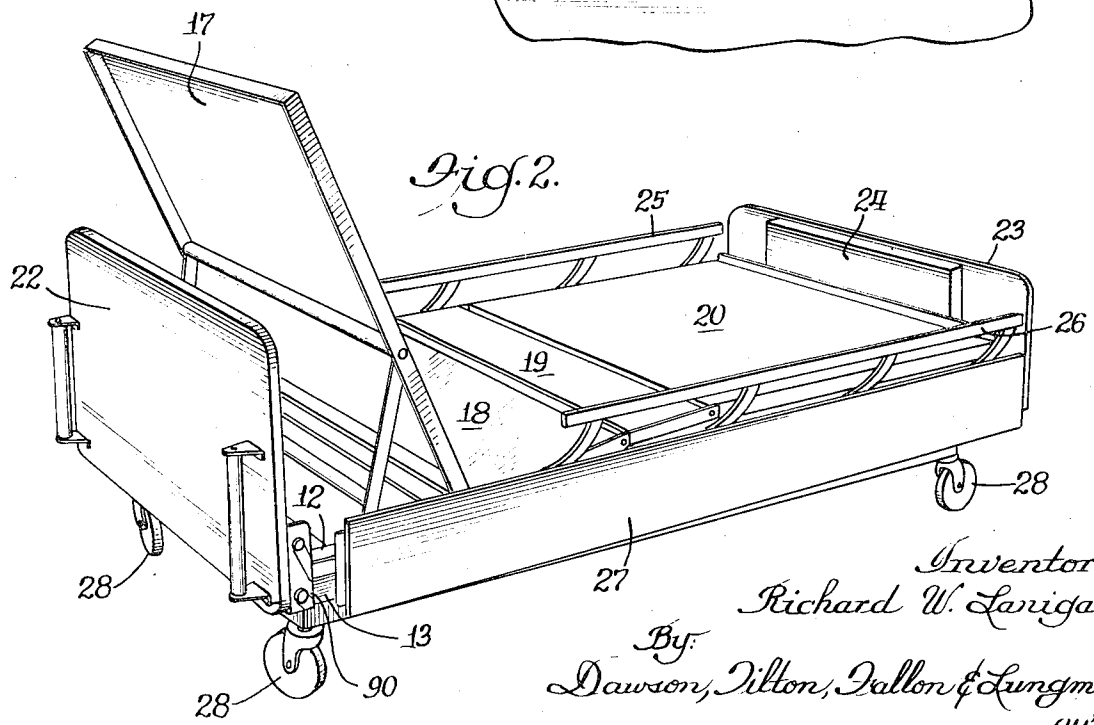


Fig. 2.



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PATENTED AUG 29 1972

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SHEET 2 OF 6

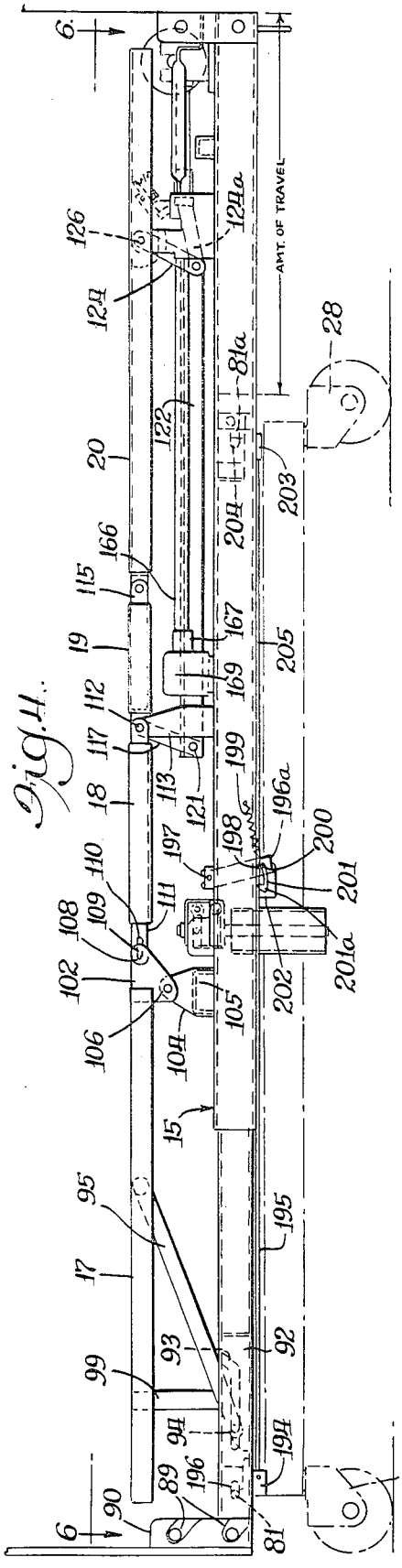


Fig. 4.

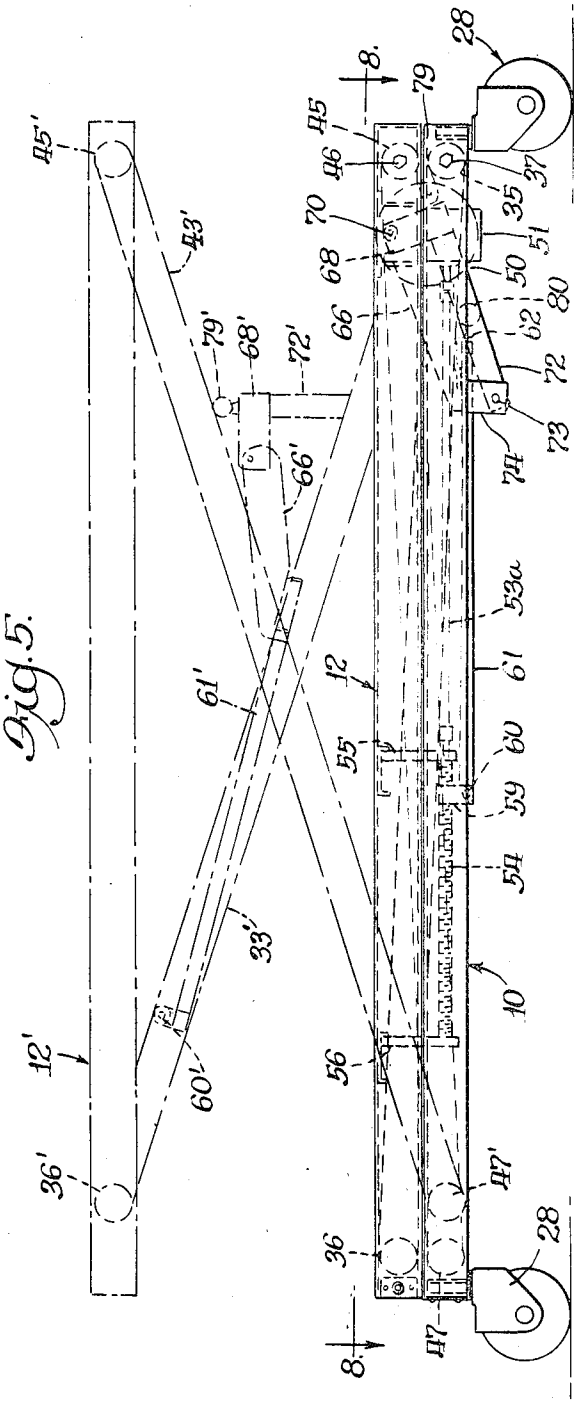


Fig. 5.

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PATENTED AUG 29 1972

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SHEET 3 OF 6

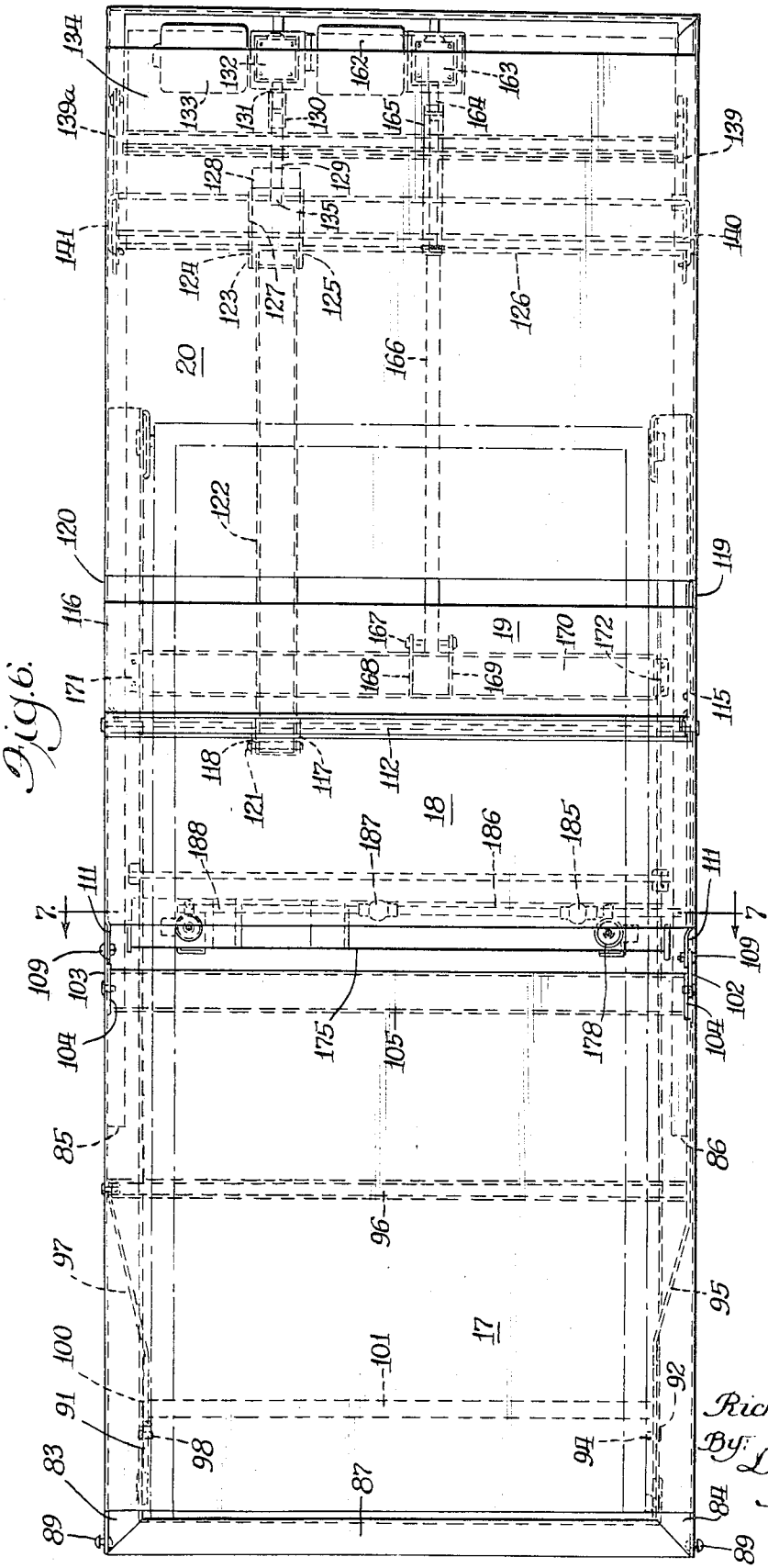


Fig. 6.

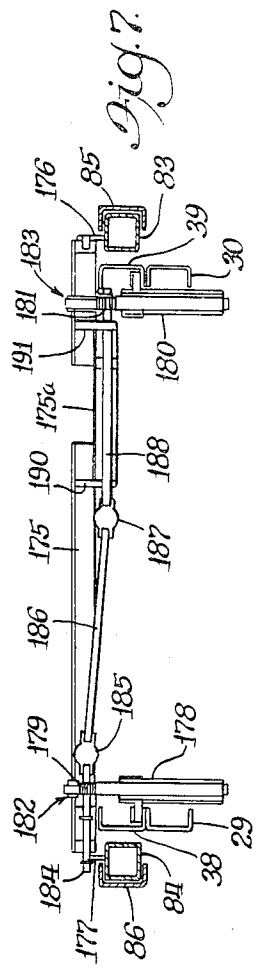


Fig. 7.

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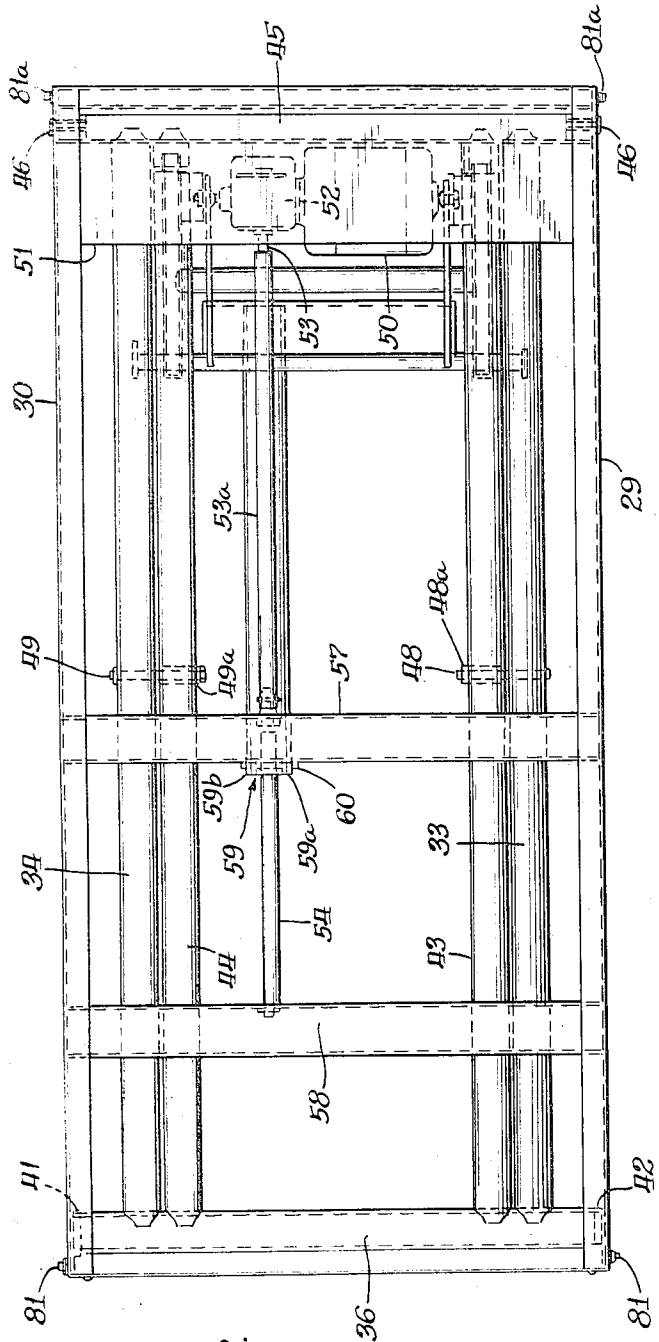


Fig. 8.

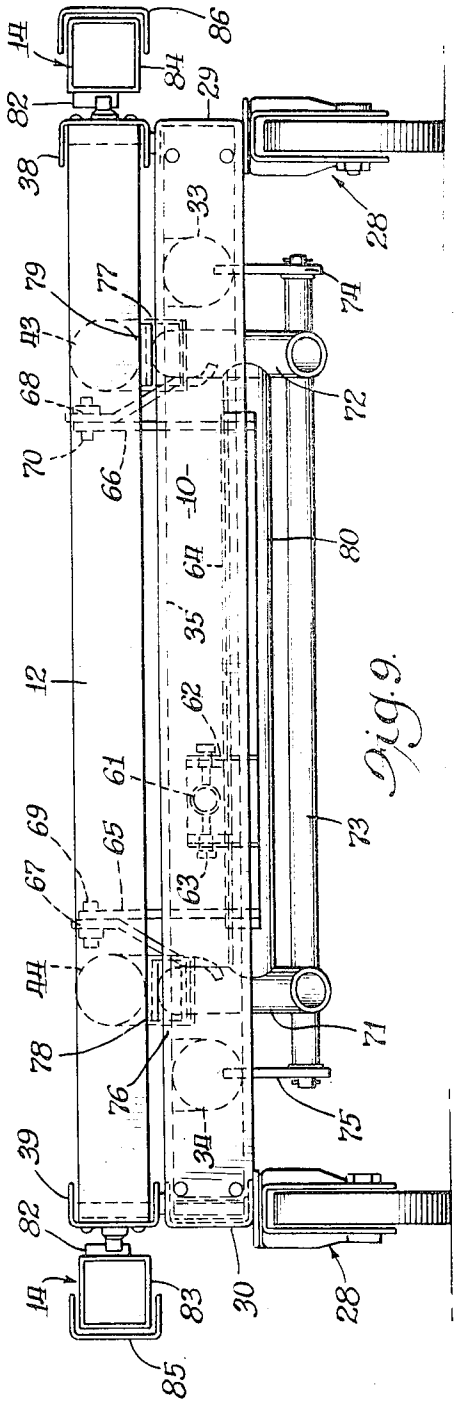


Fig. 9.

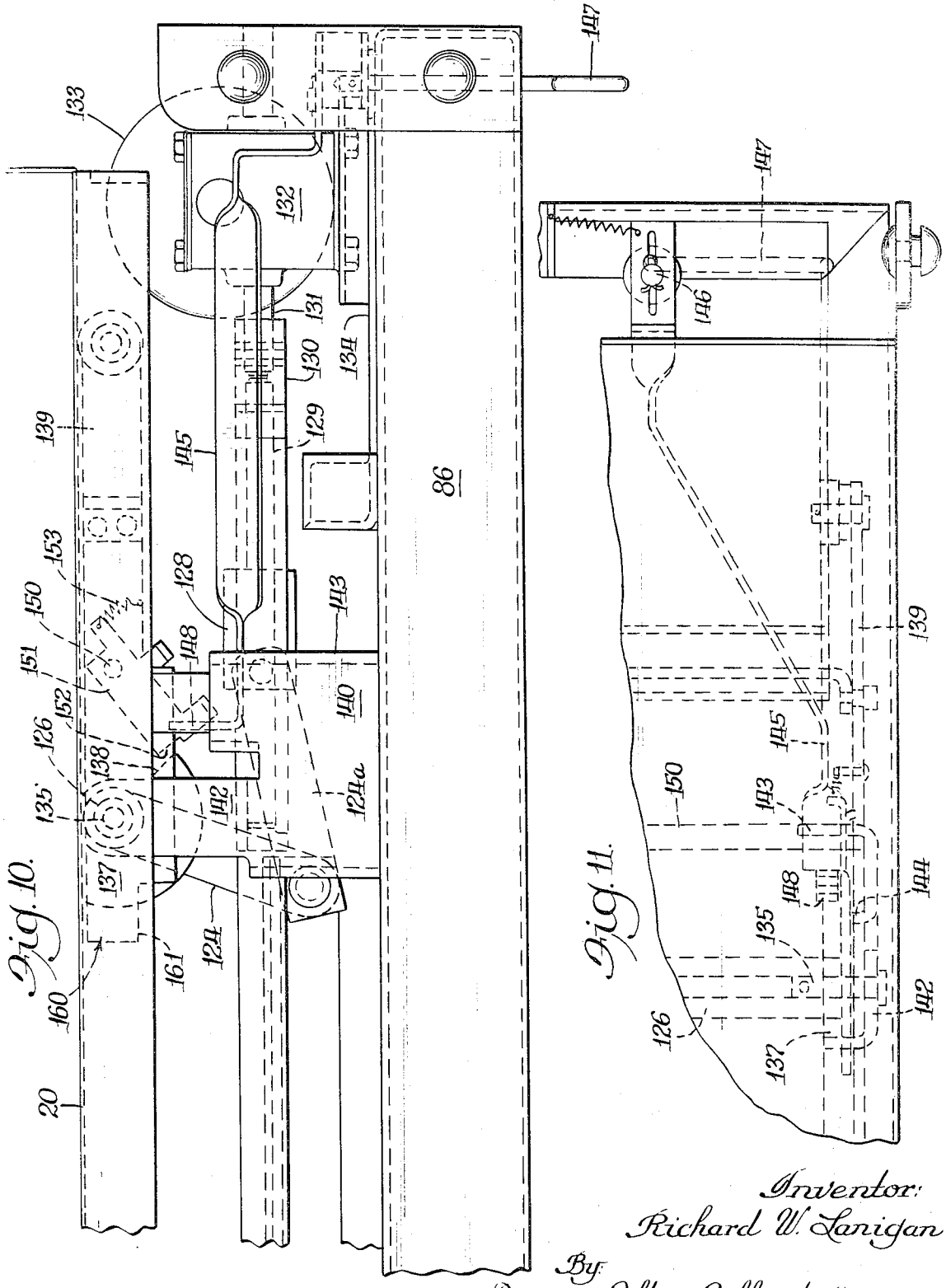
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SHEET 5 OF 6



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Fig. 12.

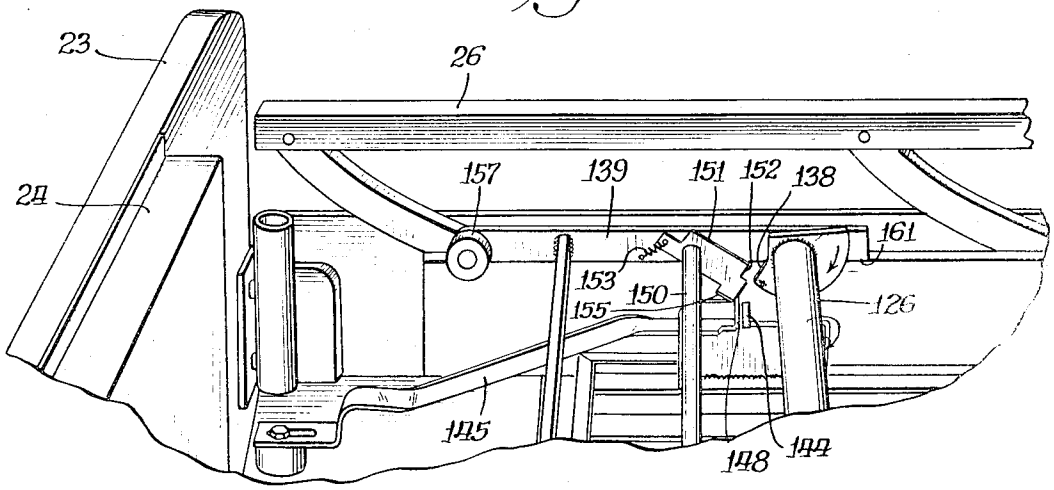


Fig. 13.

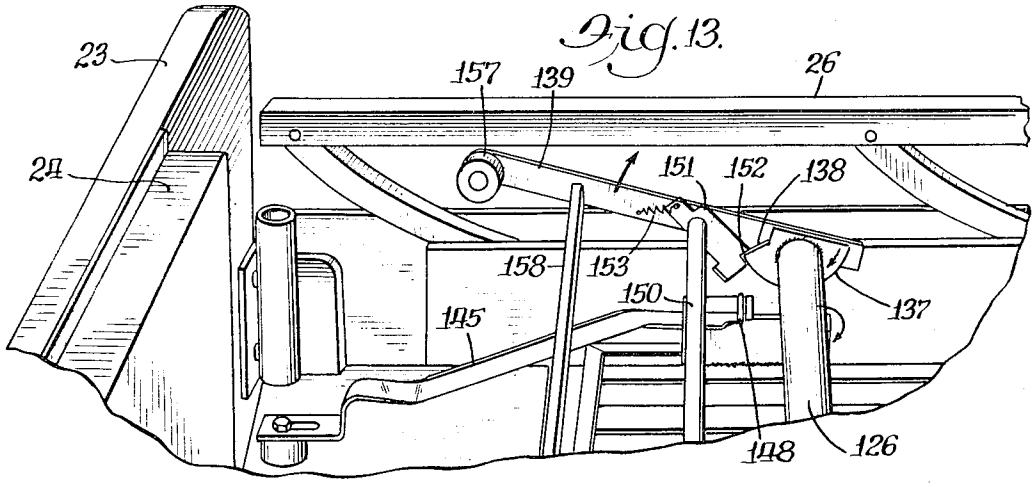
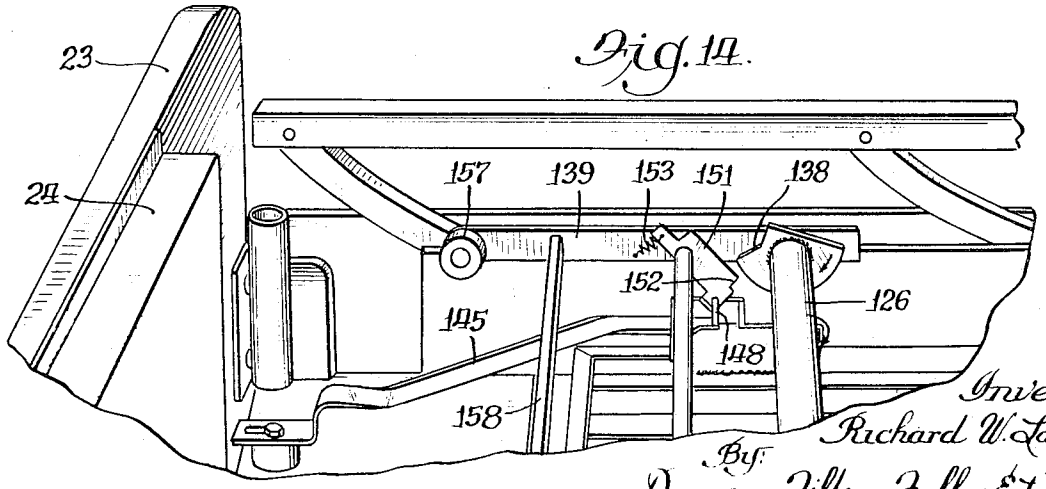


Fig. 14.



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HOSPITAL BEDS

BACKGROUND AND SUMMARY

The present invention relates to power-assisted beds of the type used in hospitals and nursing homes; and more particularly, it relates to an electrically driven hospital bed capable of independently achieving a wide range of patient positions for all elevations of the mattress frame.

Power-driven hospital beds are well known which are capable of elevating a mattress frame to raise and lower a patient and which have articulated or sectioned mattress frames for raising and lowering the head panel and the leg panels relative to a fixed seat panel. Further, there are commercially available hospital beds which are capable of raising the head panel while foreshortening the length of the bed to move a patient to a sitting position while simultaneously translating the leg panels towards the head of the bed so that the head and shoulders of the patient remain stationary relative to a night stand, for example, while achieving a sitting position.

In typical commercial constructions, however, the elevation of the patient is achieved by raising bed posts supporting the mattress frame on supporting legs provided with casters by drawing the posts with a cable and pulley arrangement. It will be realized that while elevating the patient, the mattress support frame should remain parallel with his initial position — that is, it must not tilt during elevation.

Link mechanisms have also been suggested for elevating the mattress frame; however, those which elevate the mattress frame by means of a tee linkage also translate the mattress frame relative to the base frame during elevation. Cross bar links have been used for elevating the mattress frame wherein the cross bars are located at the head and foot ends of the bed; but such arrangement is not practicable when it is desired to achieve a retractable or foreshortenable mattress frame.

The present invention provides a hospital bed which has a rectangular base frame, supported at its corners by casters and shorter in length than the overall length of the mattress supporting a patient. An intermediate frame assembly is disposed above the base frame and consists essentially of an intermediate frame which is connected to the base frame by lateral scissors linkages, and a retract frame which extends about the intermediate frame. The power-operated scissors linkage arrangement has been found to provide a relatively high degree of stability at all elevations of the intermediate frame assembly and to result in improved control over the elevating mechanism.

A fixed portion of the retract frame rests on studs projecting from the sides of the intermediate frame and a movable portion of the retract frame is telescopically received on the foot end of the fixed portion and extends beyond the foot end of the base frame. As the telescoping retract frame is foreshortened, a link mechanism interconnecting the head panel of a mattress supporting frame with the fixed portion of the retract frame raises the head panel. This mechanism, in turn, lowers the head of the seat panel so that it tilts downwardly and forwardly — thus providing a seat depression or recess which more comfortably accommodates the patient in a sitting position and which also serves to restrain sliding movement of the mattress relative to the mattress supporting frame.

The perimetric arrangement of the retract frame about the intermediate frame results in a relatively low silhouette when the bed is completely lowered, thereby permitting a patient to easily touch the floor with his feet for support when getting out of bed.

The articulated mattress frame includes a head panel, a seat panel and upper and lower leg panels. Adjacent panels are pivotally interconnected for rotation about a transverse axis to achieve any desired patient position.

A selective catch mechanism is also provided for raising the lower leg panel parallel to the retract frame when the upper leg panel is raised, or alternatively, to permit the foot end of the lower leg panel to remain lowered while the upper leg panel is raised, and thus achieve a bent knee position.

A lift mechanism selectively tilts the telescoping retract frame about either the head end or the foot end of the intermediate frame to achieve either the Trendelenberg or the reverse Trendelenberg position; and these positions may be achieved at all elevation settings of the bed.

Other features and advantages of the present invention will be apparent to persons skilled in the art from the following detailed description of an illustrative embodiment accompanied by the attached drawing wherein identical reference numerals will refer to like parts in the various views.

THE DRAWING

FIG. 1 is a perspective view from the head side of a hospital bed according to the present invention;

FIG. 2 is a perspective view of the bed of FIG. 1 showing it in its retracted position with the head panel raised and the seat panel tilted;

FIG. 3 is a fragmentary elevation view of the foot board of the bed of FIG. 1 showing the control panel;

FIG. 4 is a side elevation view of the bed of FIG. 1 without the side guard rail and cover panel;

FIG. 5 is a side elevation view of the bed of FIG. 1 illustrating the raised and lowered positions of the intermediate frame relative to the base frame;

FIG. 6 is a plan view of the bed of FIG. 1;

FIG. 7 is a vertical cross section view, on a reduced scale, taken through the sight line 7—7 of FIG. 6 showing the Trendelberg lift mechanism;

FIG. 8 is a plan view of the intermediate frame and scissors linkages for elevating the intermediate frame;

FIG. 9 is a head end view of the bed of FIG. 1;

FIG. 10 is a close-up side elevation view of the latching mechanism for raising the lower leg panel parallel to the intermediate frame;

FIG. 11 is a fragmentary plan view of the latching mechanism shown in FIG. 10; and

FIGS. 12–14 are perspective views showing the latching mechanism of FIGS. 10–11 in different operating conditions.

DETAILED DESCRIPTION

Referring to FIG. 1, there is seen a generally rectangular base frame designated in general by reference number 10. An intermediate frame assembly, which in the illustrated embodiment comprises an intermediate frame 12 and a telescoping or retract frame 13, is operatively connected to the base frame by scissors linkages designated generally by numeral 11. The

retract frame, which includes a fixed portion 14 and a movable portion 15, rests on the intermediate frame 12. The fixed portion 14 of the telescoping frame 13 seats on studs extending from the sides of the intermediate frame 12, as will be explained in greater detail hereafter, and the upper surfaces of these two frames lie in the same plane. In other words, the sides of the retract frame 13 are located respectively alongside the sides of the intermediate frame 12.

Supported on the retract frame 13 is an articulated mattress support frame generally designated by reference numeral 16. The mattress frame 16 can be seen to include a head panel 17, a seat panel 18, an upper leg panel 19, and a lower leg panel 20. Although the panels 17–20 in the illustrated embodiment are made of sheet metal for supporting an inner spring mattress, it will be appreciated that each of these panels could itself be a spring frame.

The bed is provided with a headboard 22 which is removable and a foot board 23 on which is mounted a control panel (FIG. 3) as well as control circuitry housed within a cabinet 24. First and second side rails 25 and 26, and first and second side panels (only panel 27 being seen in FIGS. 1 and 3) are also incorporated into the bed.

Turning now to FIGS. 5, 8 and 9, the scissors mechanism for elevating the intermediate frame 12 will be explained. As can be seen there, the base frame 10 and the intermediate (or high/low) frame 12 have the same dimensions in length and width; and the intermediate frame 12 is located directly above the base frame 10. The base frame 10 is supported at its corners by means of conventional casters 28 and includes a pair of U-shaped side channel members 29 and 30, each having upper and lower inwardly turned flanges. The scissors mechanism 11 includes inner and outer link units 31 and 32 (FIG. 1). The outer link unit 32 of the scissors mechanism is composed of rigid first and second elongated and parallel tubular members 33 and 34 which extend substantially the entire length of the base frame 10 and intermediate frame 12 and which are rigidly secured together at the foot end of the base frame by means of a transverse end bar or member 35. The transverse end member 35 of the outer link unit of the scissors mechanism is secured at the foot end of the base frame 10 by means of center locating pins 37.

The intermediate frame 12 is similar to the base frame 10 in that it includes U-shaped side channel members 38 and 39 with the open portions of the U turned inwardly so that they are facing each other. A transverse bar or member 36, similar to the previously described transverse member 35 is welded to the head ends of the elongated members 33 and 34 of the outer scissors link 32 to form a rigid assembly. Transverse bar 36 is movably received within the channel members 38 and 39 of the intermediate frame 12 by means of rollers 41 and 42 secured to it.

As can be seen in broken lines in FIG. 5, as the intermediate frame 12 is elevated, the transverse bar 36 will be translated toward the foot end of the bed to position 36' as the rollers 41 and 42 move within the side channel members 39 and 38 respectively of the intermediate frame 12.

The inner link unit 31 of the scissors mechanism 11 is a rigid, unitary structure similar to the outer link unit 32. The inner link unit 31 comprises first and second elongated tubular members 43 and 44, similar to the elongated members 33 and 34 of the outer scissors link unit. The elongated members 43 and 44 are welded to a first transverse bar or member 45 which is rotatably mounted to the foot end of the intermediate frame 12 by means of center guide pins 46. The ends of the tubular members 43 and 44 located at the head of the base frame 10 are welded to a transverse bar 47 which is mounted on rollers and received within the U-shaped channel members 29 and 30 of the base frame 10 in a similar fashion to the mounting of the head end of the outer scissors link unit. Thus, when the intermediate frame 12 is elevated, the transverse bar 47 moves to position 47' in FIG. 5.

The link members 33 and 43 are secured together at their midpoints by means of a roll pin 48 which permits relative rotation in parallel vertical planes. Similarly, a roll pin 49 secures the link members 34 and 44 together while permitting relative scissors-like rotation between the two. Each of the roll pins 48 and 49 is suitably journaled within their associated tubular members 43 and 44 by means of bushings 48*a* and 49*a* respectively.

As seen best in FIGS. 5 and 8, an electric drive motor 50 is mounted on a plate 51 which is secured to the sides of the intermediate frame 12. Also mounted on the mounting plate 51 and driven by the shaft of motor 50 is a gear box 52 housing a conventional miter gear mechanism for coupling the output of motor 50 to a shaft 53 which extends perpendicular to the shaft of the motor 50. A connecting rod 53*a* couples the shaft 53 to a worm 54. The worm 54 is journaled at its ends in two vertical mounting plates identified by reference numerals 55 and 56 respectively in FIG. 5. The vertical mounting plates 55 and 56 which support the worm 54 depend from transverse bars 57 and 58 (best seen in FIG. 8), which are secured to the top of the intermediate frame 12.

A yoke 59 defining a central, threaded aperture is received on the worm 54 so that as the worm 54 is driven by the motor 50 as previously described, the yoke 59 traverses the worm 54 longitudinally of the bed. The yoke 59 includes two ears 59*a* and 59*b* which are located to either side of the worm 54 and which extend downwardly. An axle pin 60 is journaled in the two ears of the yoke 59 beneath the worm 54; and a connecting rod 61 extends toward the foot of the bed; and it is received in a bracket 62. A locating pin 63 secures the foot end of the rod 61 to the bracket 62 (see FIG. 9). The bracket 62 is mounted on a transverse bar 64 having a width slightly less than the separation between the two inner tubular members 43 and 44 of the inner scissors link. The bar 64 is journaled within two side links 65 and 66 which extend toward the foot end of the bed and slightly upwardly as seen in FIG. 5.

Rotatably secured to the foot end of the links 65 and 66 are second links 67 and 68 (journaled thereto by means of pins 69 and 70 respectively). The links 67 and 68 extend downwardly and slightly toward the foot of the bed (see bar 68 in FIG. 5); and they are welded respectively to tubular members 71 and 72 which extend slightly downwardly and toward the head of the bed in generally parallel relation to the previously described links 65 and 66. Welded to the bottom of

each of the rods 71 and 72 is a transverse bar 73 which is rotatably supported at its ends by means of links 74 and 75 which are mounted respectively to the lower surfaces of the tubular members 33 and 34.

At the upper ends of the tubular members 71 and 72 there are mounted yokes 76 and 77 which receive roller members 78 and 79 respectively. The rollers 78 and 79 bear against the lower surfaces of the tubular members 44 and 43 respectively of the inner scissors link to provide an upward lift force when the rods 71 and 72 are rotated counterclockwise in FIG. 5. A second transverse brace 80 is welded between the tubular members 71 and 72 to add rigidity to the lifting structure.

In operation, as the worm 54 is driven in the proper rotational direction to force the yoke 59 to the left in FIG. 5, forces are exerted in rod 61 connected to the axle 60 to pull it toward the head of the bed which, in turn, pulls the bracket 62. This action pulls the links 65 and 66 toward the head of the bed thus exerting a counterclockwise coupling moment on the links 67 and 68. Since their lower ends are welded to the tubular members 71 and 72, this, in turn, forces the tubular members 71 and 72 in counterclockwise rotation (as viewed in FIG. 5) about the transverse bar 73 secured beneath the outer scissors link. Thus, the tubular members 71 and 72 will be rotated counterclockwise to the positions shown at 72' in chain line in FIG. 5, and thereby raise their associated rollers 78 and 79 to the position shown at 79'. Since the rollers 78 and 79 bear against the lower surfaces of the inner scissors link, it will be raised and as already mentioned, the lower transverse tube 47 thereof will be moved toward the foot of the bed to the position 47'. At the same time, the foot end of the rod 61 will become downwardly inclined due to clockwise rotation about the axle 60, as seen at 61' and 60' respectively in FIG. 5.

The bed is raised, as mentioned, by rotating a rigid structure including tubular member 71, 72 and 80, as well as the rigid links connected thereto (namely, the links 67 and 68 which are best seen in FIG. 9) about the transverse shaft 73. This shaft is pivotally connected to the side tubular scissors frame members 33 and 34 by means of the dogs 74 and 75. This structure just described is referred to in the claims as the "subframe."

When the drive motor 50 is stopped, the bed will remain in whatever state of elevation the drive mechanism had placed it; and this has been found to be a very accurate and reliable mechanism for achieving control over the elevation of the intermediate frame. In addition, the provision of the scissors mechanism has been found to add a great deal of stability (both lateral and longitudinal) to the intermediate frame 12 for all positions of elevation. This is considered to be an important feature of the present invention particularly since the telescoping frame extends well beyond the foot of the intermediate frame 12 when the mattress frame is in a horizontal position as can be seen in FIG. 4.

TELESCOPING RETRACT FRAME

Mounted to the sides of the intermediate frame 12 at the head and foot portions are four outwardly extending studs designated by reference numeral 81. The studs 81 receive mounting brackets 82 (see FIG. 9) which are welded to the inner surfaces of the fixed portion 14 of the retract frame 13. Each of the brackets 82 defines a downwardly facing aperture to receive its associated stud so that the retract frame may be lifted vertically off the intermediate frame, but is secured against sliding relative to it in a horizontal plane.

The fixed portion 14 of the retract frame 13 includes side members 83 and 84 which are tubular and have a generally square transverse cross section. U-shaped channel members 85 and 86 comprise the side sections of the moveable portion 15 of the telescoping frame; and they are received respectively on the box-shaped tubular members 83 and 84 for sliding motion longitudinally thereof. Referring now to FIGS. 4 and 6, the head ends of the box-shaped frame members 83 and 84 are joined together by a similarly shaped tube 87 to form a rigid structure. Riveted to the side of the box-shaped members 83 and 84 are caped studs 88 and 89 respectively for removably receiving the side flanges mounted on the head board 22 — one such flange being identified by reference numeral 90 in FIGS. 1, 2 & 4.

Referring now to FIGS. 4 and 6, guide plates 91 and 92 are welded to the inner surfaces of the box frame members 83 and 84 respectively. Each of the guide plates defines a slot similar to that shown for plate 92 and identified by reference numeral 93. The slot 93 extends generally horizontally and then upwardly at the foot end of the slot for receiving a pin 94 connected to a link 95 which is secured at its foot end to a transverse bar 96 extending beneath and supporting the head panel 17. At the other end of the bar 96 is a similar link 97, the lower end of which is provided with a pin 98 received in a slot in the bracket 91 similar to the previously described slot 93. The links 95 and 97 together with the transverse bar 96 form a supporting and raising structure for the head panel 17. The head panel is limited from lowering below a predetermined height above the intermediate frame 12 by means of rigid side links 99 and 100 interconnected at the sides of a transverse bar 101 which engages the head panel 17 when it is lowered to a horizontal position. The bar 101 is rotatable toward the foot of the bed to a lowered position for lowering the head end of the head panel.

As will be apparent presently, when the retract frame telescopes to its shortened condition, the head panel 17 is translated slightly to the head of the bed until pins 94 and 98, riding in their respective slots, engage the ends thereof, at which time the side links 95 and 97 pivot the head panel upwardly. At its foot end, the head panel 17 is provided with a pair of bracket extensions 102 and 103 which constitute rigid portions of the head panel. The extensions 102 and 103 are pivotally mounted by pins 106 and 107 to upwardly extending ears 104 which are fixed to a transverse support bar 105, the transverse line of pivotal movement being spaced forwardly (i.e., towards the head end of the bed) a substantial distance from the foot end of the head panel as defined by the rear ends of extensions 102 and 103. The support bar 105 is welded to the top of the movable portion 15 of the retract frame.

As best seen in FIG. 4 each head panel extensions 102 and 103 has a generally horizontal slot 108 which receives a roll pin 109 which is also received in a

similar slot 110 at the forward flanges 111 of the seat panel 18 thereby pivotally connecting the rear of the head panel to the front of the seat panel. As the movable portion 15 of the telescoping frame is translated towards the head board (by structure described herein), and when the pins 94 and 98 reach the ends of their respective slots, the links 95 and 97 are rotated counterclockwise and the head panel 17 is rotated clockwise (as viewed in FIG. 4) about the pins 106 and 107. Since the pivotal connection between the head panel extensions and the seat panel is behind (i.e., towards the bed's foot end) the pivotal connection of the head panel to the retract frame, upward pivotal movement of the head end of the head panel causes downward pivotal movement of the head end of the seat panel. The foot end of the seat panel 18 is pivotally mounted on a transverse bar 112 which is supported by upstanding flanges secured to the top of the channel members 85 and 86 of the movable portion of the telescoping frame (see flange 113 in FIG. 4). Thus, as the head panel is raised, the seat panel 18 rotates counterclockwise about the rod 112 to form a seat depression or recess, as seen in FIG. 2, which prevents gravitation of the mattress and patient toward the foot board of the bed and which provides a more comfortable sitting position for the patient. Because of the drop or lowering of the head end of the seat panel when the head panel is raised, a seated patient is supported in much the same manner as in a backwardly inclined lounge chair.

UPPER AND LOWER LEG PANEL MOVEMENT

Rigidly secured to ends of the transverse shaft 112 are first and second braces 115 and 116 which extend toward the foot of the bed and which support the upper leg panel 19. A pair of links 117 and 118 are also rigidly secured to the transverse shaft 112; and they extend downwardly and slightly toward the head of the bed (see link 117 in FIG. 4). The head end of the lower leg panel 20 is pivotally connected to the braces 115 and 116 as at 119 and 120 respectively. The links 117 and 118 together with the braces 115 and 116 of the upper leg panel 19 form a bell crank with the shaft 112 serving as the transverse pivotal axis to raise the upper leg panel 19.

At the lower end of the links 117 and 118 there is journaled a pin 121 which receives a connecting bracket 122 extending toward the foot of the bed. At the foot end of the connecting bracket 122 there is located a transverse pin 123 similar to the pin 121 the ends of which are journaled in a yoke 127 which holds a threaded journal block 128.

The journal block 128 receives a threaded shaft 129 which is connected by means of a coupler 130 to a shaft 131 of a gear box 132. The gears in the box 132 are driven by a drive motor 133 mounted on a mounting plate 134 at the foot end of the moveable member 15 of the telescoping frame 13. The head end of the threaded shaft 129 is journaled in a bracket at 135 for vertical support so that as the shaft 129 is driven in rotation, the bearing guide block 128 is translated longitudinally of the bed. As the block 128 is pulled towards the foot of the bed, the connecting bracket 122 will be pulled in the same direction; and the bell crank formed by the links 117 and 118 and the braces 115 and 116 will be rotated counterclockwise (as viewed in FIG. 4) to raise the upper leg panel 19.

Links 124 and 125 are rigidly secured to a shaft 126 and extend downwardly and slightly toward the head of the bed therefrom. The shaft 126 is rotatably received in upstanding brackets secured to the moveable portion of the retract frame and described in greater detail within. The lower portion of the links 124 and 125 are connected by means of second links (see links 124*a* in FIG. 4) to the journal block 128.

As has already been mentioned, it is desirable in some instances to raise the lower leg panel 20 in parallel relation with the intermediate frame as the upper leg panel is raised — and in other situations, to leave the foot end of the lower leg panel 20 in its lowered position as the upper leg panel 19 is raised. The mechanism for accomplishing this function is shown in detail in FIGS. 10–14.

Turning now to FIGS. 10 and 11, as has already been disclosed, the link 124 is pulled by the link 124*a* toward the foot of the bed when the journal box 128 is translated toward the foot of the bed. This rotates the shaft 126 counterclockwise as viewed in FIG. 10 and clockwise and viewed in FIGS. 12–14. In FIGS. 12–14, the lower leg panel 20 has been removed to obtain a clearer picture of the raising structure. At the right hand side of the shaft 126 (as viewed from the head end of the bed looking toward the foot end) is welded a cam 137. The cam 137 lies in a generally vertical plane which extends longitudinally of the bed; and it defines a cam-bearing surface 138 which extends downwardly and slightly rearwardly of the shaft 126 when the upper leg panel 19 is in a horizontal position — that is, before the shaft 126 has been rotated.

The shaft 126 is concentrically mounted on an axle 135; and at the outboard ends of the shaft 126 secured to the axle 135 are a pair of arms 139 and 139*a*, the right side arm being designated 139 in the drawing. The arms 139 and 139*a* extend toward the foot of the bed and their function is to raise the foot end of the lower leg panel when it is desired to do so.

Turning now to FIG. 10, a bracket 140 is secured to the top of the channel member 86 of the moveable portion 15 of the telescoping frame. A similar bracket (designated 141 in FIG. 6) is mounted to the top of the complementary channel member 85. Each of the brackets 140 and 141 defines a vertical finger (see the finger 142 integral with the bracket 140 in FIG. 10) for rotatably receiving the axle 135 on which is mounted the shaft 126. The bracket 140 also defines inwardly turned stop members 143 and 144 (best seen in FIG. 11), the function of which will be describe presently. The inwardly turned flange 143 defines an upwardly facing aperture for receiving a crank 145 which extends toward the rear of the bed where it is secured to a crank shaft 146 which extends beneath the channel member 86 to define a crank handle 147. The crank 145 is translated longitudinally of the bed by turning the crank handle 147; and, as mentioned, it is supported at its forward end by means of the slot at the top of the support member 143. The forward end of the crank 145 is provided with upwardly turned foot 148 which is translated back and forth within the vertical channel defined by the stop members 143 and 144.

As best seen in FIGS. 12–14, there is rotatably mounted to and extending between the arms 139 and 139*a* a transverse bar 150 at the right side of which is rigidly secured a key member 151. The key member 151 defines a bearing surface 152 which may be selectively moved into and out of engagement with the cam surface 138 of the cam 137 by moving the crank 145 to its forward and rear positions. The key 151 as well as the bar 152 are biased in a counterclockwise rotation (as viewed in FIG. 12) by means of a tension spring 153 so that an inwardly turned foot 155 on the end of the key 150 engages the upwardly turned corresponding foot 148 of the crank 145. Thus, as the crank is pulled toward the foot of the bed, the foot 148 will engage the foot 155 of the key 151 to rotate the same clockwise about the shaft 150 and thus out of engagement with the cam surface 138 of cam 137 as the shaft 126 is driven in clockwise rotation.

As can be seen best in FIG. 13, when the crank 145 is left in its forward position and the shaft 126 is driven by the motor 133 and links 124 and 124*a*, the cam surface 138 will engage the bearing surface 152 of the key 151 and lift the arms 139 and 139*a* to raise the lower leg panel (shown in chain line in FIGS. 12 and 13). At the distal end of the arms 139 and 139*a* are nylon roller bearings 157 which engage the lower surface of the foot panel to raise the same. The arms 139 and 139*a* are rotated in a clockwise direction in FIG. 13 about the axle 135; and they are connected together intermediate their ends by means of a connecting rod 158 to form a rigid structure in supporting the lower leg panel.

Referring now to FIG. 14, when the crank 145 is pulled to its rear position, the upstanding foot member 148 at its forward end rotates the key 151 against the tension in the spring 153 in a clockwise direction so that the bearing surface 152 cannot be engaged by the cam surface 138 of the cam 137 as the shaft 126 is driven when the upper leg panel is raised as previously described. Under these circumstances, the roller bearing 157 will remain in a lowered condition so that it will not raise the foot end of the lower leg panel, thereby resulting in a bent knee position when the upper leg panel is raised.

Since the arms 139 and 139*a* are freely rotatable relative to the shaft 126, the lower leg panel may be raised to maintain the feet in an elevated condition by hand rotation of the arms 139 and 139*a* about the shaft 135. Referring to FIG. 10, the head end of the arm 139 is provided with an extension 160 which projects forwardly of the shaft 135 and defines a lower limit surface 161 which engages the stop member 144 of the bracket 140 when the arm 139 is thus raised. As can be seen in FIG. 12, if the arm 139 is rotated clockwise, the stop surface 161 will extend slightly forwardly of the axis of rotation of the shaft 126 to engage the stop member 144 to stabilize the position of the arms 139 and 139*a* in holding the leg panel elevated.

RETRACTION DRIVE

Referring again to FIG. 6, the drive mechanism for forcing the retract frame to its retracted and expanded states will now be described in detail. A motor 162 is mounted on the mounting plate 134 and adapted to drive gears housed within a gear box 163. The gears within the housing gear box 163 drive a shaft 164 which rotates a coupling member 165 and a threaded screw 166 according to the direction of rotation of the motor 162. An internally threaded nut is received in a yoke having side flanges 168 and 169 and which is mounted on the top of a transverse mounting plate 170.

The mounting plate 170 is secured at each side by means of flanges 171 and 172 to the top of the box-shaped longitudinal side members 83 and 84 of the fixed portion 14 of the telescoping retract frame 13. Thus, as the motor 162 is driven in one direction, the connecting screw 160 is rotated to draw the yoke toward the foot of the bed and thereby pull the movable member 15 of the telescoping frame over its associated fixed member 15. By driving the motor 162 in the opposite direction, the moveable member 15 of the telescoping frame 13 is driven away from the fixed member 14.

TRENDELENBERG LIFT MECHANISM

As seen best in FIGS. 4, 6 and 7, a transverse support bar 175 is located about midway of the base frame 10 and intermediate frame 12; and it is rigidly mounted at each side to the box-shaped side members 83 and 84 of the fixed portion of the telescoping frame by means of vertical supports 176 and 177 respectively. Secured to the lower flange of the channel member 38 of the intermediate frame 12 is a housing 178 for a first helical gear 179 which extends in a generally vertical direction. Similarly, a housing 180 for a second helical gear 181 is secured to the lower flange of the channel member 39 of the intermediate frame 12 (see FIG. 7). The upper end of the helical gear 179 is rigidly fastened to the cross bar 175 as at 182; and the upper end of the helical gear 181 is similarly secured to the cross bar 175 at 183.

A crank shaft 184 extends to the side of the intermediate frame 12 where it removably receives a crank handle (not shown). The crank shaft 184 is coupled to a gear which drives the helical gear 179 directly; and it is coupled by means of a universal joint 185, a connecting rod 186, a second universal joint 187 and a second connecting rod 188 to a similar gear which drives the helical worm 181. The connecting rod 188 is seen to be at a lower level than the crank shaft 184; and it is journaled within mounting plates 190 and 191 which extend from beneath the cross bar 175. The cross bar 175 is made of a continuous rigid structure by means of a portion 175*a* extending beneath the pressure therein. As the crank shaft 184 is rotated, the helical worms 179 and 181 are raised thereby raising the cross bar 175 and the telescoping frame relative to the intermediate frame as defined by the channel members 38 and 39.

It will be remembered from the previous discussion concerning FIG. 9, that the telescoping frame seats on the intermediate frame by means of corner studs which extend outwardly of the sides of the intermediate frame; and these studs have bee previously designated by reference numerals 81 and 81*a* in FIG. 8, the forward studs being denoted 81, and the studs at the foot end of the bed being 81*a*. Turning now to FIG. 4, a bracket 194 defining an open channel 196 facing toward the head of the bed is mounted on the box-shaped elongated side member 84 of the telescoping frame for selective horizontal movement over the pin 81.

A connecting rod 195 couples the bracket 194 to a lever 196 which depends from a pivotal connection at 197 from the box-shaped frame member 84. The rod 195 is pivotally connected to the lever 196 by means of a pin 198; and the lever 196 is biased by means of a spring 199 in a rearward position. A pin 200 extending from the side of the lever 196 is received in a slot 201 on a bracket 202 which is secured to the bottom of the side member 84 of the fixed portion of the retract frame. The slot has a circular lower curve to accommodate the arcuate motion of the pin 200 on the lever 196, but at its forward end, it defines an upwardly-inclined race 201*a* to lock the pin thereat and thus hold the lever 196 in a forward position against the tension of spring 199.

Similarly, a bracket 203 defines an open channel 204 which faces the foot of the bed for selectively fitting over the rear stud 81*a* and is connected to the lever 196 by means of a connecting rod 205. It will be appreciated that when the lever 196 is in a rearward position, the bracket 203 locks on the rear stud 81*a* so that the fixed member of the telescoping frame cannot be raised relative to the intermediate frame 12 at this point. At the same time, the forward bracket 194 is disengaged from the forward stud 81. Hence, when the lever 196 is in the position shown in FIG. 4, and the Trendelenberg lift mechanism is cranked upward, the telescoping frame will pivot about the stud 81*a* to achieve the reverse Trendelenberg position. Conversely, when the lever 96 is moved to its forward position so that the pin 200 catches in the upwardly turned portion 201*a* of the slot 201, the forward bracket 195 will prevent a relative vertical motion between the retract frame and the intermediate frame; and the rear bracket 2–3 will be moved to allow the foot end of the telescoping frame to be lifted above the intermediate frame as the Trendelenberg crank is actuated to achieve the Trendelenberg position.

From the foregoing detailed description of the illustrated embodiment accompanied, where appropriate, with description of the function and operation of the disclosed structure, the details of the operation of each element of the bed will be apparent to persons skilled in the art. However, a summary of bed operation in order to achieve the various patient positions will now be given.

In order to shorten the bed, the drive motor 162 (FIG. 6) drives the screw 166 to draw the nut 167 toward the foot of the bed. The nut 167 is, of course, rigidly secured to the fixed portion 14 of the retract frame 13; and the motor 162 is mounted on a mounting plate which is a unitary part of the moveable portion 15 of the retract frame. Thus, by turning the screw 166, the U-shaped side channel members 85 and 86 of the moveable portion of the retract frame slide forwardly toward the head of the bed over their corresponding box-shaped side members 83 and 84 of the fixed portion of the retract frame.

Referring also to FIG. 4 now, the transverse bar 105 which is secured to the moveable portion 15 of the retract frame is also translated toward the head of the bed; and it carries with it the head panel 17 and the seat panel 18 of the mattress supporting frame. For a short while, the pins 94 and 98 will ride in their associated slots 92 and 91 until they engage the head ends of the slots. At this time, forward motion of the links 95 and 97 will be prevented; and they will begin to rotate about their respective lower pins to translate the head panel upwardly. This, in turn, rotates the brackets 102 and 103 about the pins 106 and 107 and, in turn, lowers the head end of the seat panel 18 by rotating it about the transverse horizontal axis defined by the shaft 112 which is also mounted to the movable portion of the retract frame. It will be appreciated that the foreshortening of the retract frame is independent of any elevation of the mattress support frame as well as of the position of the upper leg panel 19 and lower leg panel 20. As indicated in FIG. 3, separate buttons are provided for controlling the raising and the lowering of the mattress support frame, for controlling the raising and the lowering of the upper leg panel, and for controlling the raising and the lowering of the head panel. Diagrammatic symbols are shown on each of six buttons for energizing the drive motors in the required direction to achieve these positions.

Elevation of the mattress support frame is achieved by energizing the motor 50 (FIG. 8) to drive the screw 54 in a direction to pull the bearing lock 59 toward the head of the bed. This, in turn, rotates the tubular bars 71 and 72 about the transverse bar 73 which is mounted beneath the tubular members 33 and 34 of the outer scissors link. Rotation of the tubular bars 71 and 72 exerts an upward force on the elongated members 43 and 44 of the inner scissors link via the rollers 78 and 79 as seen in FIG. 5. It will be appreciated that this action is independent of either the knee-bending operation or the head panel elevating mechanism since both of these operations rely on the intermediate frame 12 only for support.

In order to elevate the upper leg panel 19, drive motor 133 turns screw 129 in a bearing block 128 to draw the bracket 122 toward the foot of the bed. A bell crank formed about the shaft 112 (including the rearwardly extending support arms 115 and 116) then raises the intersection between the upper leg panel 19 and the lower leg panel 20.

If it is desired to raise the lower leg panel 20 in parallel relation with the intermediate frame when the upper leg panel 19 is raised, the crank handle 145 of FIG. 12 is left in its forward position so that the cam-bearing surface 138 of cam 137 engages the corresponding bearing surface 152 of the key 151 to rotate the side arms 139 and 139*a* about the shaft 135. The roller bearings 157 will then engage the lower surface of the lower leg panel 20 to raise it in parallel relation with the intermediate frame.

If it is desired to achieve a bent knee position, the crank handle 145 is moved to its rear position so that the upwardly extending finger 148 thereof pulls the key 152 to a retracted position so that as the shaft 126 is driven in rotation by the motor 133, the cam-bearing surface 138 does not engage its corresponding surface on the key 151; and the foot end of the lower leg panel will then remain lowered.

The Trendelenberg lift mechanism has an upper moveable section including threaded shafts 179 and 181 rigidly connected to the box-shaped members 83 and 84 of the moveable portion of the retract frame to lift the intermediate section of the retract frame relative to the intermediate frame 12. If the lever 196 is in a

rearward position, bracket 203 (FIG. 4) slides over and engages the stud 181*a* so that when the lift mechanism is cranked, the retract frame is tilted relative to the intermediate frame about the foot end thereof for achieving the reverse Trendelenberg position. When the lever 196 is moved to the forward position so that the pin 200 slides upwardly in the portion 201*a* of the slot 200, the bracket 194 engages the forward stud 81 and the bracket 203 is removed from the rear stud 81*a* so that when the Tendelenberg lift mechanism is cranked, the retract frame will be tilted relative to the intermediate frame by rotating it about the stud 81. It will be appreciated that achieving either Trendelerberg positions is accomplished independent of the elevation of the mattress supporting frame. Further, the mutually exclusive coupling action of the two locking brackets 194 and 203 is advantageous in achieving the safety feature of always having one end of the retract frame coupled to the intermediate frame. That is to say, the length of the rods 195 and 205 is such that, in combination with the bistable shape of the bracket 200, there will always be one but only one end of the retract frame which is raised when the Trendelenberg lift mechanism is cranked.

As previously mentioned, the retract frame and the intermediate frame are both components of an intermediate frame assembly interposed between the base frame 10 and the mattress supporting frame 16. If Trendelenberg and Reverse Trendelenberg operations are not required, then it is believed apparent that the intermediate frame assembly may be simplified, with the independently tipable perimetric frame arrangement eliminated and the intermediate frame 12 adapted to serve as the fixed portion of the retract frame 13.

Having thus described in detail one embodiment of our inventive bed construction, it will be appreciated by persons skilled in the art that many structural modifications may be made to the bed to achieve similar functions without departing from the inventive principle; and it is, therefore, intended that all such modifications and substitutions be covered as they are embraced within the spirit and scope of the appended claims.

I claim:

1. A hospital bed comprising: a generally rectangular base frame having a head end and a foot end and including floor-engaging support means; an intermediate frame assembly above said base frame; a scissors link mechanism interconnecting said base frame with said intermediate frame assembly, said scissors link mechanism including first and second pairs of scissors links on opposite sides of said bed and extending longitudinally thereof, said links of each pair being adapted to move said intermediate frame assembly between a raised position and a lowered position wherein said intermediate frame assembly rests on said base frame, thereby to prevent a complete closing of said scissors links; elevation adjustment mechanism for said scissors links comprising a subframe pivotally connected to said bed for rotation about an axis transverse of the direction of elongation of said bed, said axis of rotation being below the connection of said scissors links to said base frame and said subframe being inclined when said intermediate frame is in a lowered position, the upper ends of said subframe engaging corresponding links of said pairs of scissors links when said subframe is rotated to open said scissors links and thereby raise said intermediate frame; and power-operated means pivotally connected to said subframe at a location above its axis of rotation for selectively rotating said subframe to raise and lower said intermediate frame assembly to a selected elevation.

2. The structure of claim 1 wherein said power-operated means comprises an electric motor carried by one of said frames, an elongated threaded screw rotatably mounted to corresponding ones of said pairs of scissors links, means interconnecting said screw with said electric motor, a yoke threadedly received on said screw for moving therealong when said screw is turned by said motor, and link means interconnecting said yoke with said subframe at said location above its axis of rotation, whereby as said screw is turned by said motor, said yoke is moved therealong in determining the angle of inclination of said subframe and the upper edge of said subframe rollably engages the lower surfaces of corresponding ones of said pairs of scissors links to selectively raise and lower the same in determining the elevation of said intermediate frame.

3. The structure of claim 2 wherein said subframe is pivotally connected at its lower end to corresponding ones of said pairs of scissors links and wherein said means interconnecting said yoke with said subframe includes a link pivotally connected to said subframe and adapted to fold with said subframe as said bed is lowered, said subframe being located between said side pairs of scissors links, whereby said bed may be lowered while maintaining leverage for raising the same.

4. The structure of claim 1 further comprising a mattress support frame mounted on said intermediate frame assembly and comprising a plurality of articulated panels including a seat panel pivotally mounted at its foot end to said intermediate frame and a head panel pivotally mounted adjacent its foot end to said intermediate frame and including a foot-end extension beyond said pivotal connection to said intermediate frame, the head end of said seat panel being pivotally connected to said extension; and power-actuated means for raising said head panel about its pivotal connection with said intermediate frame thereby to lower the head end of said seat panel relative to its pivotal connection with said intermediate frame.

5. The structure of claim 4 wherein said mattress support panel further comprises an upper leg panel pivotally connected to said intermediate frame at the location at which said foot end of said seat panel is connected thereto; and a lower leg panel having its head end pivotally connected to the foot end of said upper leg panel.

6. The structure of claim 5 further comprising drive means including lever means for raising the foot end of said upper leg panel, support means mounted on said mattress frame and supporting said lower leg panel; and selective latch mechanism movable between the first position and the second position, said latch mechanism, when in said first position selectively engaging said support means for said lower leg panel to maintain said lower leg panel in a generally horizontal disposition when said upper leg panel is raised and when in said

second position, permitting the foot end of said lower leg panel to remain lowered as the head end of said lower leg panel is raised, thereby to cause a bend in the knees of a patient resting on said bed.

7. In a hospital bed, the combination comprising rectangular base frame supported on a floor, an intermediate frame mounted to said base frame for adjustable elevation relative thereto, articulated mattress frame means supported on said intermediate frame including an upper leg panel adapted for rotation about a first horizontal axis transverse of said bed, said horizontal axis being at the head end of said upper leg panel, and a lower leg panel having its head end pivotally connected to the foot end of said upper leg panel; drive means for rotating the upper leg panel about said first transverse axis to raise the same; support means pivotally mounted to said mattress frame for supporting said lower leg panel; a shaft defining a second transverse axis and driven by said drive means when said upper leg panel is raised and lowered, said second transverse axis being located adjacent the pivotal connection of said support means to said mattress frame and including a cam movable therewith; a key member on said support means including a bearing surface, said key member being movable between a first position wherein its bearing surface engages said cam, whereby said support means is rotated when said shaft is driven to raise said lower leg panel in a horizontal disposition, said key means being selectively movable to a second position of disengagement from said cam, whereby said support means is not rotated when said shaft is driven and the foot end of said lower leg panel remains in a lowered position.

8. The structure of claim 7 further comprising a crank mounted to said bed and movable between a first and a second position, said crank including a dog adapted to engage said key member of said support means for said lower leg panel to move the same selectively between said first and second positions.

9. In a hospital bed, the combination of a base frame including floor-engaging support means, an intermediate frame above said base frame, power-driven link means interconnecting said base frame with said intermediate frame for selectively elevating said intermediate frame above said base frame; a telescoping mattress support frame having a fixed member carried by said intermediate frame and located to the side thereof and a movable member telescopically received on said fixed member; crank mechanism for lifting said fixed member of said telescoping mattress support frame above said intermediate frame along a transverse line intermediate the head and foot ends of said bed; and latching means for selectively locking one end of the fixed member of said telescoping frame to a corresponding end of said intermediate frame, whereby as said crank mechanism is extended, said telescoping frame will tilt about the locked end thereof relative to said intermediate frame.

10. In a hospital bed having an articulated mattress frame and support means therefor, said mattress frame including a head panel, a seat panel, and upper and lower leg panels, the improvement comprising: means for pivotally mounting said head panel adjacent its foot end to said support means for pivotal movement between a generally horizontal lowered position and an upwardly inclined raised position, said head panel defining a footward extension beyond said pivotal connection to said support means to provide a pivotal connection for the head of said seat panel, said support means being an integral portion of the frame of said bed; means for pivotally mounting the foot end of said seat panel to said support means while preventing relative vertical motion between the foot end of said seat panel and said support means, whereby as said head panel is raised, the footward extension thereof will lower the head end of said seat panel to cause the same to be inclined relative to the horizontal and thereby provide a seat depression in the zone of connection between said head and said panels; said upper leg panel being pivotally connected at its head end to said support means for rotation about a horizontal transverse axis; and a lower leg panel having a head end pivotally connected to the foot end of said upper leg panel, said system further including drive means for rotating said upper leg panel about its transverse horizontal axis of connection with said support means; a lever mechanism mounted on said support means and operatively associated with the foot end of said lower leg panel and including selective latch means movable between a first position of disengagement with said lever thereby permitting the foot end of said lower leg panel to remain in a lowered position as the head end thereof is raised, said selective latch means being movable to a second position of engagement with said lever mechanism for maintaining the foot end of said lower leg panel at substantially the same elevation as the head end thereof.

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