

Dec. 10, 1968

J. F. STANLEY ET AL

3,414,913

ELECTRICALLY OPERABLE HOSPITAL BED

Filed April 24, 1967

5 Sheets-Sheet 1

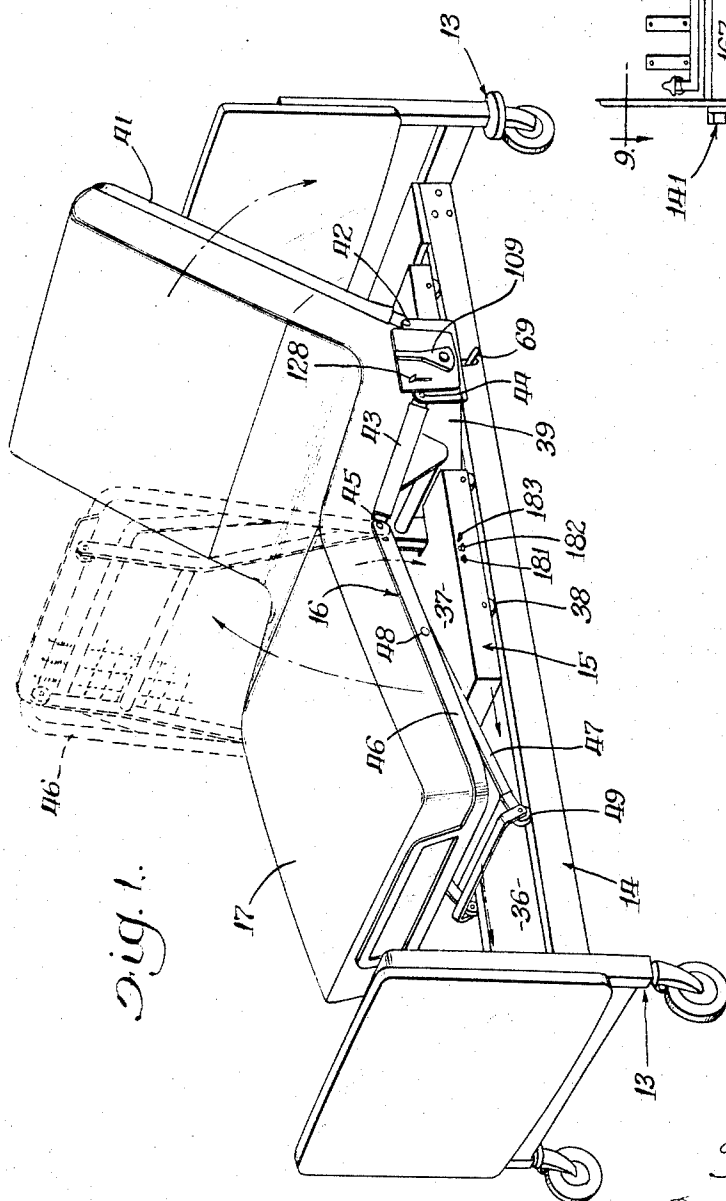


Fig. 8.

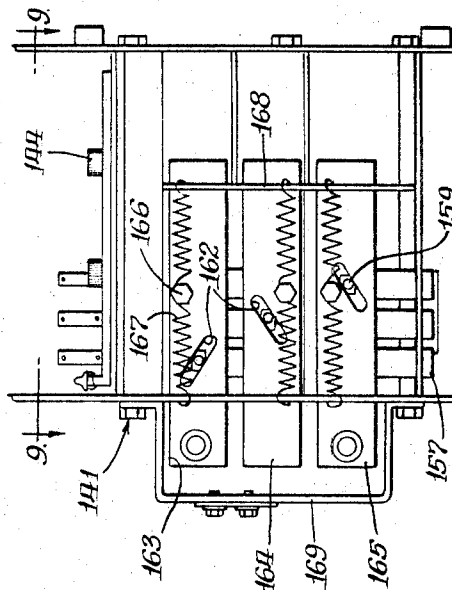
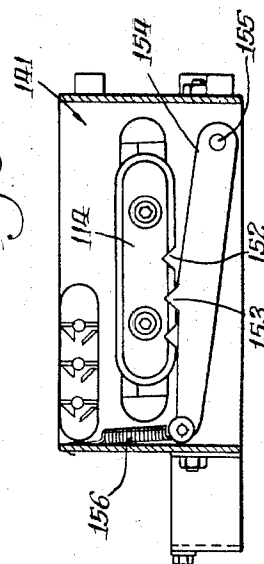


Fig. 9.



Inventors:
John F. Stanley
Ronald D. Dewey
By Horton, Davis,
Brewer & Brugman
Attys.

Dec. 10, 1968

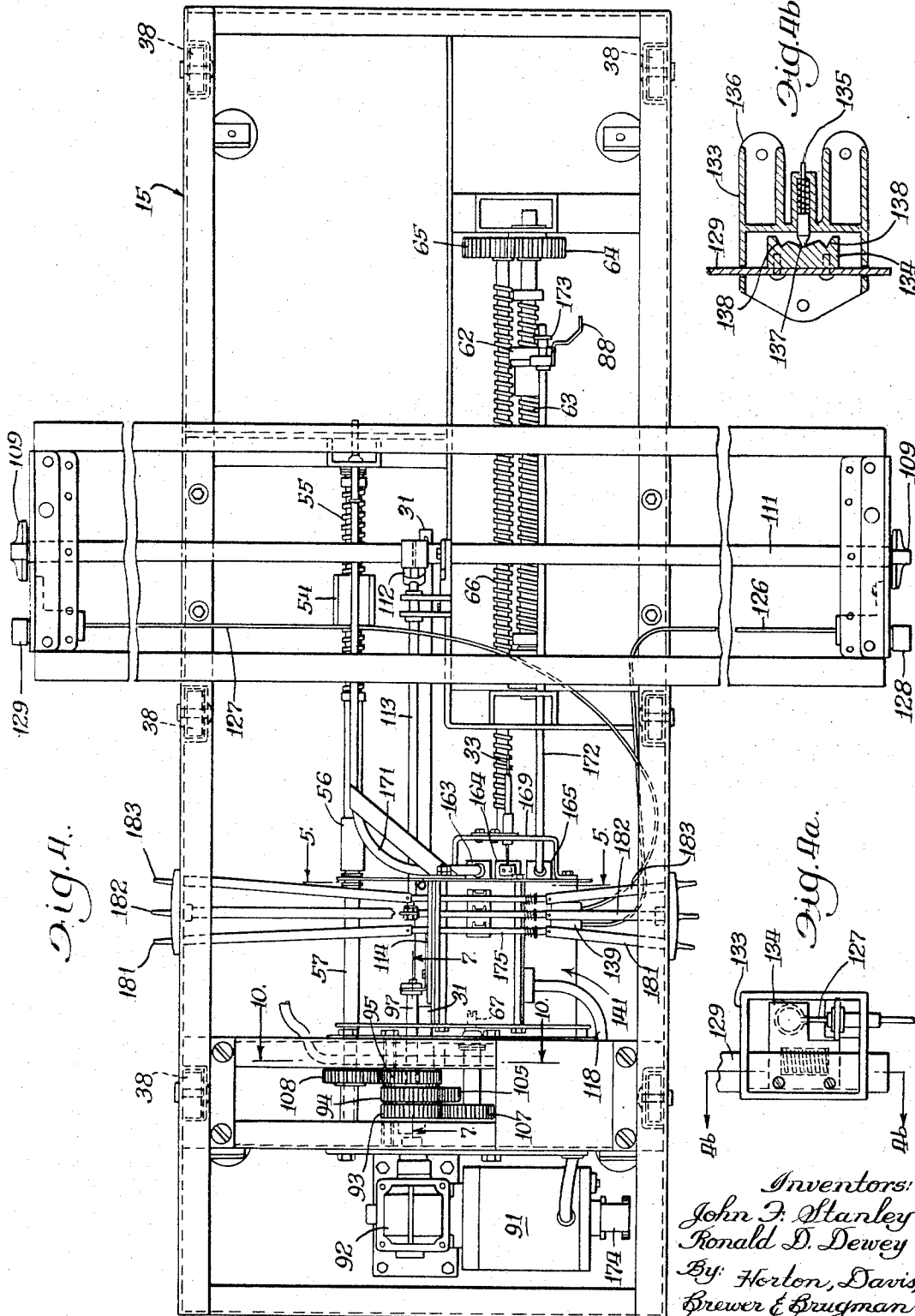
J. F. STANLEY ET AL

3,414,913

ELECTRICALLY OPERABLE HOSPITAL BED

Filed April 24, 1967

5 Sheets-Sheet 3



Inventors:
John F. Stanley
Ronald D. Dewey
By: Horton, Davis,
Brewer & Brugman
Attys.

Dec. 10, 1968

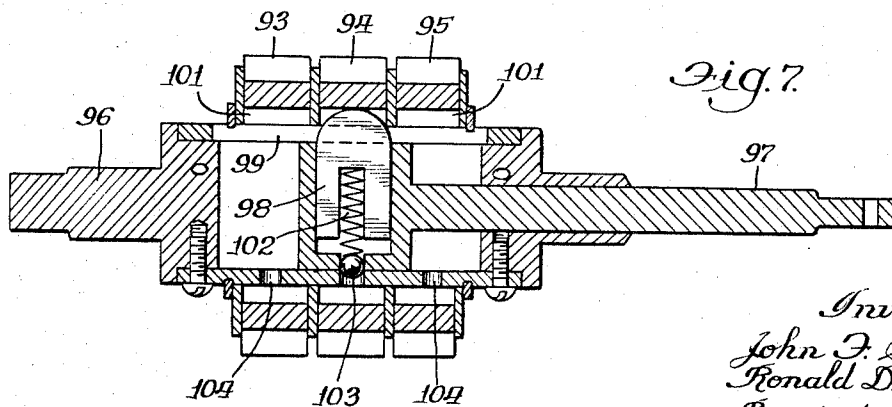
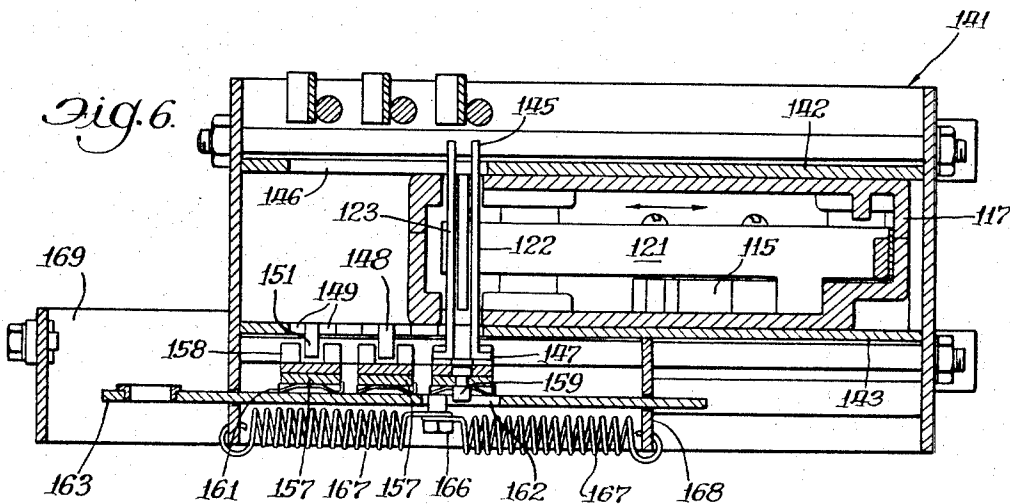
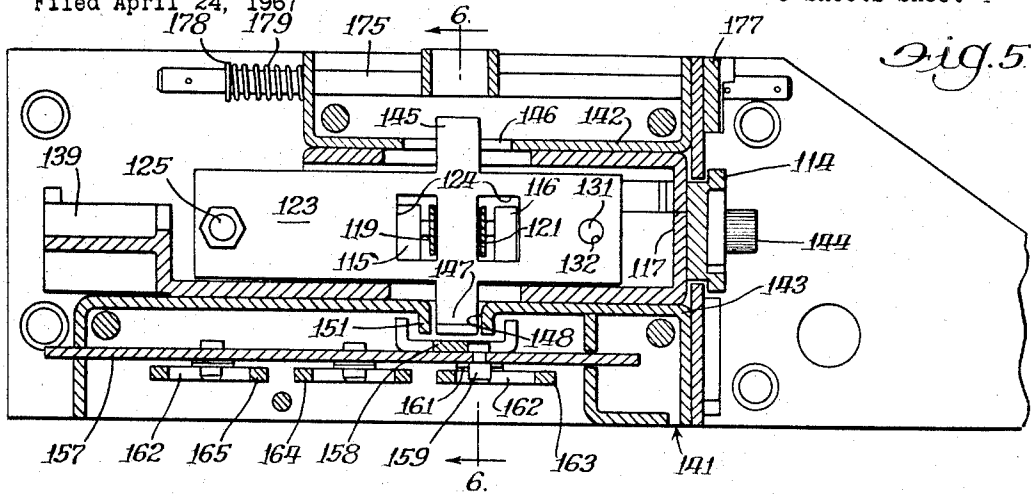
J. F. STANLEY ET AL

3,414,913

ELECTRICALLY OPERABLE HOSPITAL BED

Filed April 24, 1967

5 Sheets-Sheet 4



Inventors:
John F. Stanley
Ronald D. Dewey
By: Horton, Davis
Brewer & Brugman
Attys.

Dec. 10, 1968

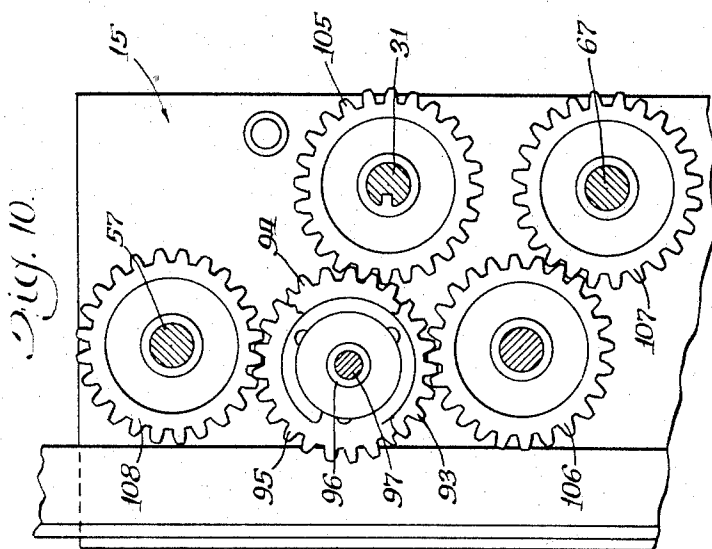
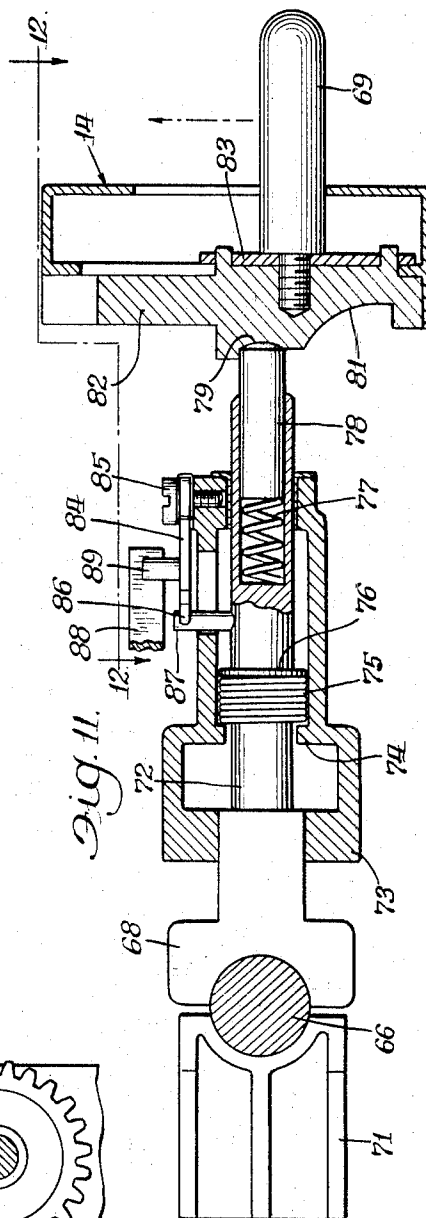
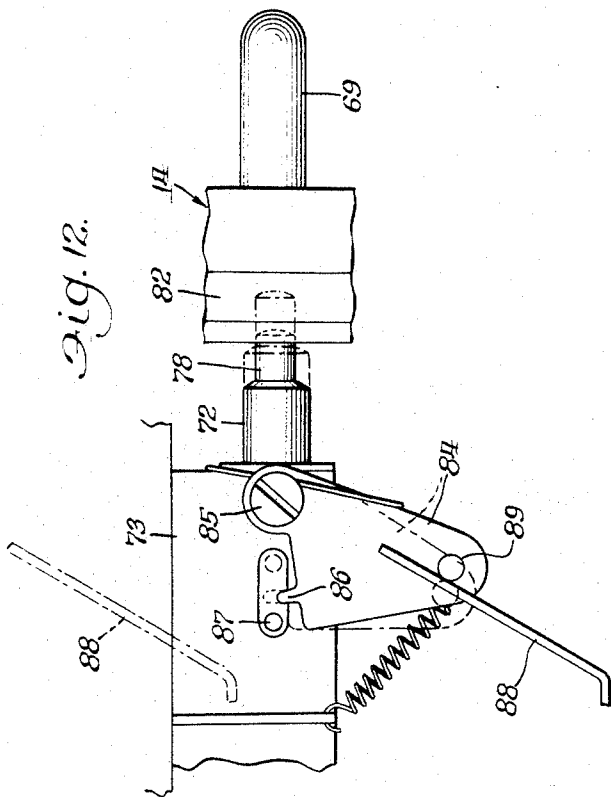
J. F. STANLEY ET AL

3,414,913

ELECTRICALLY OPERABLE HOSPITAL BED

Filed April 24, 1967

5 Sheets-Sheet 5



Inventors:
John F. Stanley
Ronald D. Dewey
By: Horton, Davis,
Brewer & Brugman
Attys.

1

3,414,913

ELECTRICALLY OPERABLE HOSPITAL BED
John F. Stanley, Whiting, Wis., and Ronald D. Dewey,
Tacoma, Wash., assignors to Joerns Furniture Com-
pany, Stevens Point, Wis., a corporation of Wisconsin
Filed Apr. 24, 1967, Ser. No. 632,960
19 Claims. (Cl. 5—68)

ABSTRACT OF THE DISCLOSURE

Electrically operable hospital bed with bottom frame, high-low means to raise and lower same, upper frame mounted for longitudinal translation relative to bottom frame, articulated spring with seat section secured to upper frame and pivotal head and knee sections, head screw on upper frame for swinging head section, translating screw on upper frame operable with head screw, knee screw on upper frame for independently swinging knee section, electric motor on upper frame, drive means selectively controllable by function selector for interconnecting high-low means, head screw, or knee screw, respectively, with motor, half nut on bottom frame shiftably engageable with and disengageable from translating screw to effect coordinated translation of upper frame with swinging of head section but so shiftable only when head section is horizontal or at a limit of travel therebelow, normally inoperative switches protectively mounted below spring and manually operable by switch bars and remote control means to effect forward or reverse rotation of motor, limit controls automatically returning remote control means and switches to inoperative position, a lever adjacent each remote motor control means manually movable to any one of three positions to control the drive means and to align the switch bars with limit control associated with selected one of three functions, interlock preventing movement of levers while motor is energized, and lockout means below spring selectively operable to prevent energizing of motor to effect operation of any one or more of selectable functions.

Background of the invention

This invention relates generally to hospital beds, and more particularly to those selectively operable electrically under the control of the patient to raise and lower the latter and the pivotally swingable head and knee sections of an articulated spring.

Description of the prior art

Articulated springs have long been used in hospital beds, including those with a seat section, a head section pivoted thereon and a knee section comprising thigh and foot sections pivotally connected to the seat section and to each other. It also is well-known to mount such a spring on a high-low frame movable to raise and lower the spring relative to the floor. In addition to manual operation, which usually must be effected by someone other than the patient in bed, various arrangements have been made for electrically actuating such structures under the selective control of a patient in bed. And U.S. Letters Patent No. 3,237,212 of Mar. 1, 1966 provides an upper frame for supporting the articulated spring which is translatable longitudinally on the lower high-low frame in response to pivotal swinging movements of the head section of the spring to maintain the patient's head and shoulders at approximately the same distance from the headboard in all positions of the head section. This prior art device also has controls selectively operable by an attendant to result in automatic operation of knee or foot sections of the spring simultaneously with operation of the head section, but movements of the spring sections cannot be

2

power actuated selectively and independently of each other and separately from movement of the translatable frame, nor under the control of a non-ambulatory patient.

Summary of the invention

This invention provides for selective control by a patient in normal recumbent position on a bed of high-low, head section and knee section functions by an electric motor, as well as optional longitudinal translation of the articulated spring as a unit in coordination with movements of the head section, and comprises electrical hazard-free, mechanically fool-proof mechanism for assuring such operations, including electric switches protectively encased and disposed below the spring toward the foot end to facilitate safe use of oxygen by the patient, remote control slides disposed adjacent the sides of the spring for selective manual operation by the patient to actuate the switches, limit controls for automatically returning the appropriate activated switch to normal inoperative position, a function control selector selectively operable manually from points adjacent the control slides, interlocking means including means for preventing operation of the functional control selector whenever the motor is operating, lockout means disposed out of the reach of the patient to prevent operation of one or more motor operated functions as medically prescribed for that patient, and normally disengaged drive through mechanism selectively engageable with the motor to enable the latter to be rotated manually in the event of electrical power failure.

In the drawings:

FIGURE 1 is a side perspective view of a bed embodying the features of the invention, with the articulated spring and the mattress shown in full lines in a contour position and the knee section shown raised to an inoperative position in broken lines;

FIG. 2 is a plan view, with parts broken away, of the bed with the mattress removed and the articulated spring shown in horizontal position;

FIG. 3 is a detail vertical section taken substantially on the line 3—3 of FIG. 2 to show the bottom frame high-low drive mechanism;

FIG. 4 is a plan view similar to FIG. 2, on an enlarged scale, of the upper frame member with the articulated spring structure removed;

FIG. 4a is a detail elevation of the right-hand manual control slide;

FIG. 4b is a detail vertical section taken substantially on the line 4b—4b of FIG. 4a;

FIG. 5 is an enlarged detail vertical section taken transversely through the control assembly substantially on the line 5—5 of FIG. 4;

FIG. 6 is a detail vertical section taken substantially on the line 6—6 of FIG. 5 in a direction extending longitudinally of the bed;

FIG. 7 is an enlarged detail vertical section extending longitudinally through the transmission gear selector mechanism taken substantially on the line 7—7 of FIG. 4;

FIG. 8 is a detail bottom plan view of the control assembly as seen from the underside of FIG. 6;

FIG. 9 is a detail vertical section taken substantially on the line 9—9 of FIG. 8;

FIG. 10 is a detail vertical section showing the transmission gearing taken substantially on the line 10—10 of FIG. 4;

FIG. 11 is a detail vertical section through the upper frame translation control means as taken substantially on the line 11—11 of FIG. 2; and

FIG. 12 is a detail plan view of the control mechanism of FIG. 11 showing the same and locking means therefor in operative position in broken lines.

Referring more particularly to FIGURE 1 of the draw-

ings, a bed embodying the features of this invention is disclosed as comprising a supporting leg structure or means indicated generally by reference numeral 13, a main or bottom frame supported thereby in well-known manner and indicated generally by reference numeral 14, an upper frame indicated generally by reference numeral 15 mounted for longitudinal translation on the bottom frame 14, and an articulated spring structure indicated generally by reference numeral 16 which is supported by the upper frame 15 and the lower frame 14 and, in turn, has the usual mattress 17 disposed thereon.

The specific details of the leg means 13 and bottom frame 14 are not important so far as this invention is concerned. Means are provided for raising and lowering the frame 14 relative to the leg means 13 which includes a high-low screw 18 (FIGS. 2 and 3) mounted in suitable thrust bearings carried by the bottom frame 14 and cooperating at its outer or head end with drive release brake means 19. The latter is similar in structure and function to the drive release brake means indicated generally by reference numeral 34 in United States Letters Patent No. 3,281,872, issued Nov. 1, 1966, and the high-low actuating mechanism, which includes the screw 18, comprises a structure which is generally similar to the manually operated high-low mechanism disclosed in U.S. Letters Patent No. 3,281,873 of Nov. 1, 1966. As in the latter, the high-low screw 18 is engaged by a nut 21 which is constrained against rotation and slidably guided for movement longitudinally of the frame by any well-known arrangement. Secured in any suitable manner to the nut 21 are the ends of two long and short pairs of cables 22, 23. Each of the short cables 22 passes around suitable guide sheaves 24 and 25 (FIG. 2) which are rotatably mounted in any suitable manner on the bottom frame 14, and these cables 22 are connected at their upper ends to the upper ends, respectively, of the supporting legs provided at the head end of the bed. The two long cables 23 extend from the high-low nut 21 forwardly around guide sheaves 26 and then rearwardly for cooperation with guide sheaves 24 and 25 similar to those previously described which are provided at the foot end of the bed, with the upper ends of these cables 23 being connected to the upper ends of the supporting legs forming a part of the leg means 13 at the foot of the bed. As best seen in FIG. 2, the foot end of the high-low screw 18 is connected by a suitable coupling 27 to a high-low shaft extension 28 in turn connected at its foot end by a suitable coupling 29 to the head end of a high-low shaft 31. As will more fully appear hereinafter, the high-low shaft 31 is rotatably carried by the upper frame 15 so that its head end may be slid longitudinally into the coupling 29 when that upper frame is initially assembled upon the bottom frame 14. The purpose of this arrangement is to permit of all of the driving mechanism for accomplishing the various operations of the moving parts of the bed to be mounted upon and carried by the upper frame 15, except for the above-described high-low screw 18 and those parts of the high-low mechanism operated thereby.

In connection with the previously described operation of this high-low mechanism, longitudinal movements of the nut 21 will effect corresponding raising and lowering movements of the bottom frame 14 relative to the supporting leg means 13 through the agency of the cables 22, 23 in the same manner as described in Patent No. 3,281,873. And in order to provide for a constant load without regard to the direction of such movements, the drive release brake means 19 will automatically become effective to apply a braking action against rotation of the high-low screw 18 as the frame 14 is moved downwardly relative to the leg means 13 in the same manner as is described with respect to the drive release braking means 34 in Patent No. 3,281,872.

Referring again to FIG. 3, a limit slide 33 is mounted in any suitable manner below the high-low screw 18 on the bottom frame 14 and is provided at its ends with upper

extensions adapted to be contacted by the high-low nut 21 as it reaches its limit positions wherein the frame 14 has been moved to its uppermost and lowermost positions, respectively. The limit slide 32 thus will be moved longitudinally of the bed to either pull towards the head of the bed or push towards the foot of the bed, a Bowden-type cable 33 which is connected at its head end at 35 (FIG. 3) to the limit slide 32. The foot end of this high-low limit cable 33 is shown in FIG. 4 and cooperates with the function and operation control assembly on the upper frame 15 in a manner to be later described.

As best seen in FIG. 1, the bottom frame 14 may be covered by metal shroud means 36, it being understood that suitable apertures are provided therein to accommodate the high-low limit cable 33. Similar metal shroud means 37 are provided as a cover for the upper frame 15 which, as best seen in FIGS. 1 and 2, thus will effectively protect the operating and control mechanisms to be hereinafter described which are mounted in the upper frame. This upper frame 15 is supported for longitudinal movement relative to the bottom frame 14 by any suitable means, such as the rollers 38 shown in FIGS. 1 and 4. Any additional means desired may be employed to prevent transverse movements of the frame relative to each other, and manually operable control means to be described hereinafter also are provided for effecting translation of the upper frame 15 relative to the bottom frame 14 and normally operable to lock the frames against relative movement in a "home" position.

Referring now more particularly to FIGS. 1 and 2, the instant bed further comprises an articulated spring structure 16 which is made up of an intermediate or seat section 39 mounted upon and secured in any suitable manner to the upper frame 15, a head section 41 pivotally connected at 42 to the seat section 39, and a knee section comprising a thigh section 43 pivotally connected at 44 to the seat section 39 and at 45 to a foot section 46. The foot section 46 may be provided with a subframe 47 (FIG. 1) pivotally connected at its upper end at 48 thereto and provided at its lower end with suitable rollers 49 for engagement with the bottom frame 14. This is a well-known arrangement to facilitate manual adjustment of the foot section 46 of the articulated spring and also slidably supports the lower end of the foot section on the bottom frame. In addition to power actuated operations of the head and knee sections of the articulated spring in a manner later to be described, the pivotal mounting of the foot section 47 permits the same to be raised manually to its broken-line position of FIG. 1 to facilitate cleaning and removal of the foot end shroud means 37 to provide access to the power, transmission and control mechanism disposed therebelow.

Referring particularly to FIGS. 1 and 2, the knee section of the articulated spring structure is adapted to be raised and lowered by the following mechanism. The thigh section 43 is provided with a transverse shaft 57 depending from and secured to its side rails in any suitable manner which, incidentally, corresponds to the shaft 27 in Patent No. 3,281,873. Secured at their upper ends to this shaft 27 and depending therefrom are a pair of lever arms 52 which are connected at their lower ends by means of links 53 (FIG. 2) to a nut 54 which engages a horizontal screw 55 which is rotatably supported at its head end in any suitable manner in the upper frame 15. The foot end of this longitudinal extending knee screw 55 is provided with a suitable coupling 56 for longitudinally slidably receiving and drivingly engageable by a knee shaft 57. Rotation of the knee screw 55 by shaft 57 will result in well-known manner in longitudinal movements of the nut 54 which, through the links 53 and lever arms 52 will move the transverse shaft 57 up or down to swing the thigh section 43 up or down about its pivot 44. This, of course, as will best be appreciated from FIG. 1, will correspondingly move the pivot 45 up and down to raise and lower the head end of the foot section 46, the rollers 49 supporting the

foot end of the latter for corresponding longitudinal movements relative to the bottom frame 14.

Similar power operated means are provided for independently raising and lowering the head section 41 of the spring structure 16. As seen in FIG. 2, this head section 41 is provided with a transverse shaft 58 similar to the transverse shaft 51 and depending from the side rails of the head section and secured at its ends thereto in any suitable manner. This transverse head section shaft 58 corresponds to the shaft 37 in Patent No. 3,281,873. A pair of lever arms 59 are secured at their upper ends to the shaft 58 and pivotally connected at their lower ends to links 61 which are connected to a nut 62 mounted on a longitudinally extending screw 63. This head screw 63 is rotatably supported at its ends in any suitable manner in the upper frame 15, and it will be appreciated, as with respect to the knee screw 55, that rotations thereof will result in longitudinal movements of the nut 62 to correspondingly swing the head section 41 of the articulated spring up and down about its pivot 42.

Adjacent its head end, the screw 63 is provided with a gear 64 which meshes with a similar gear 65 secured to a similar longitudinally extending screw 66 rotatably supported by the upper frame 15 somewhat below the head screw 63. The foot end of this retracting screw 66 is connectable by a coupling similar to the coupling 56 to a head screw shaft 67 shown in FIG. 10.

Referring to FIG. 4, it will be seen that the hi-low screw shaft 31, the knee screw shaft 57 and the head screw shaft 67 are all carried by the upper frame 15, and it will be appreciated that the head end of the shaft 31 is adapted to be slidably inserted into the coupling 29 when the upper frame 15 initially is mounted upon the bottom frame 14 so as to drivingly interconnect the power means carried by the upper frame with the hi-low screw 18 which is carried by the bottom frame. The only other portion of power actuated mechanism carried by the bottom frame 14 is a part of the upper frame translating mechanism and the manually operable translation control means which cooperate with the retracting screw 66. This translating mechanism comprises a split nut 68 under the control of a selectively operable handle 69 which, as is shown in FIG. 2, is disposed on the lower frame generally below the seat section 39 of the articulated spring 16 so as to be inaccessible to a patient on the bed.

Referring more particularly to FIGS. 11 and 12, this split nut 68 includes a stationary backing portion 71 permanently engaging the retracting screw 66 and secured in any suitable manner to the bottom frame 14. The head portion of the split nut 68 is movable transversely of the bed into and out of engagement with the retracting screw 66 under the control of the manually operable handle 69. To this end the nut is formed as the inner head portion of a shaft portion 72 slidably mounted in and extending through a housing 73 which is secured in any suitable manner to the lower frame 14. This housing 73 is provided with an interior annular flange 74 and a coil spring 75 is mounted on the shaft portion 72 and disposed between a collar 76 fixed to the latter and the flange 74. The outer end of the shaft portion 72 is bored to receive a compression spring 77 and a plunger 78, the outer end of the latter cooperating with a cam surface comprising an upper dwell 79 and a lower dwell 81 on a vertically movable slide 82 which is secured to a backing plate 83 by the handle 69 for vertical movement in suitable slots provided in the longitudinally extending side rail of the lower frame 14. In its lowermost position as illustrated in FIG. 11, the upper dwell 79 of the slide 82 is engaged by the outer end of the plunger 78 which insures maintaining of the split nut 68 in operative engagement with the retracting screw 66. If the control handle 69 is moved upwardly from that lower position, it will lift the slide 82 to align the lower dwell 81 with the plunger 78 to permit the spring 75 to disengage the split nut 68 from the screw 66. It will be readily apparent that engagement of the split nut 68

with the screw 66 will cause the screw 66 to be moved longitudinally when it is rotated, since the nut 68 is prevented from moving relative to the bottom frame 14 in a direction longitudinally of the frame. Consequently, rotation of the retracting screw 66 when the split nut 68 is engaged therewith will result in translation of the upper frame 15 relative to the bottom frame 14.

It is essential to proper operation of the relatively movable parts of the bed that engagement and disengagement of the split nut 68 with the screw 66 be effected only when the upper frame 15 is in its normal "home" position with the head section 41 of the spring 16 in its horizontal position or at a limit of travel therebelow if the usual level stop has been rendered inactive to enable disposing the spring in Trendelenberg position. To this end, interlocking means are provided for preventing movement of the split nut 68 between operative and inoperative positions, wherein it engages or is disengaged from the screw 66, which comprises a locking dog 84 (FIGS. 11 and 12) pivotally secured by a shoulder bolt 85 to the housing 73 having a tooth 86 movable into and out of the path of movement of a pin 87 secured at its lower end to and extending upwardly from the shaft portion 72 of the split nut 68 through a suitable slot in the housing 73. The locking dog 84 is shown in an inoperative position in FIG. 12 in full lines to permit longitudinal sliding of the shaft portion 72 of the split nut and in broken lines to illustrate how the tooth 86 will prevent movement of the nut between operative and inoperative positions by blocking movement of the pin 87. The locking dog 84 is spring urged to this broken line operative position and means are provided for moving the same to its inoperative position whenever the head section 41 of the spring 16 is disposed in its normal horizontal or lower position. To this end, a slide member 88 which is secured to the head nut assembly 62, as shown in FIG. 2, is moved to its full line position of FIG. 12 when the head section 41 is disposed in such horizontal or lower position. In such position of the upper frame 15 and the head section 41, this slide member 88 has been moved against a pin 89 upstanding from the locking dog 84 to retract the latter to its full line inoperative position of FIG. 12. At that point, therefore, the handle 69 may be manually moved up or down to disconnect or connect the half nut 68 and the screw 66. As soon as the slide member 88 is moved in response to raising of the head section 41, as to a dotted line position such as that illustrated in FIG. 12, the locking dog 84 will be spring moved to its operative broken line position of FIG. 12 to prevent either disengaging or engaging movements of the split nut 68. In this connection, it also will be appreciated that lifting of the manual control handle 69 from its lower position of FIG. 11 may be prevented except in the desired relative positioning of the frames 14 and 15 by having the slide 82 disposed below a side rail of the upper frame 15 and providing a slot in the latter so disposed as to accommodate the slide 82 only when the frames are so positioned.

Power means are provided for selectively driving the high-low means, the head means with or without the upper frame translating means, and the knee means, respectively, which comprises an electric motor 91 (FIGS. 2 and 4), standard reduction gear means 92 connected thereto, and a transmission assembly mounted therewith in any suitable manner in the upper frame 15. As best seen in FIGS. 4 and 10, this transmission assembly includes three coaxially aligned function selector gears 93, 94 and 95 which, as shown in FIG. 7, are rotatably mounted upon a hollow shaft assembly 96 which is driven directly by the reduction gear means 92. This hollow shaft assembly 96 is similar in construction and function to the hollow stub shaft 61 disclosed in Patent No. 3,281,873. Mounted therein for longitudinal sliding movement relative to the gears 93-95 is a selector rod 97 having an enlarged inner end within which is slidably disposed a key 98. The outer end of this key 98 extends through a

slot 99 in the hollow shaft 96 and into one of the keyways 101 which are provided in the respective gears 93, 94 and 95. The key 98 is urged outwardly into engagement with the keyways 101 by a spring 102 which also urges a latching ball 103 outwardly into engagement with the corresponding one of three apertures 104 provided in the tubular portion of shaft 96 diametrically opposite the keyways 101. Longitudinal displacement of the selector rod 97, which is normally in its position of FIG. 7 in which the driving key 98 is engaged with the keyway 101 in the middle gear 94, will disengage the key therefrom and engage the same with one or the other of the keyways 101 of the outer gears 93 or 95. The gears 93, 94 and 95 thus will be selectively rendered operative by the motor 91 in accordance with the selective positioning of the rod 97.

The middle function selector gear 94, as shown in FIGS. 4 and 10, meshes with a high-low gear 105 that is secured to the high-low shaft 31. The outermost function selector gear 93 meshes with an idler gear 106 (FIG. 10) which drivingly engages a head gear 107 secured to the head screw shaft 67. The forward or innermost function selector gear 95 meshes with a knee gear 108 which is drivingly secured to the knee screw shaft 57. Thus the selective positioning of the rod 97 will determine whether operation of the electric motor 91 will rotate the high-low shaft 31, the knee screw shaft 57 or the head screw shaft 67.

This function selector or selectively controllable drive means includes two manually operable selector levers 109 (FIGS. 1 and 4) which are disposed at opposite sides of the intermediate seat section 39 of the articulated spring 16 for selective operation to position the rod 97. These levers 109 are secured at their lower ends to the opposite ends of a transversely extending shaft 111 which is provided intermediate its ends with a shift lever 112 connected in any suitable manner to the forward end of a shift rod 113. The rear or foot end of the shift rod 113 is connected to one end of a U-shaped bracket 114 which is similarly connected at its other end to the selector rod 97. With the manually operable selector levers 109 in their normal intermediate or vertical positions, the selector rod 97 is in its intermediate position as illustrated in FIG. 7. Movement of the upper end of either of the shift levers 109 forwardly or toward the head of the bed will displace the selector rod 97 toward the foot of the bed to render the function selector gear 93 effective. Consequently, whereas the normal intermediate position of the selector levers 109 results in the function selector gear 94 being actuated by the motor 91 to operate the high-low mechanism, such shifting of the upper ends of the levers 109 toward the head of the bed will result in the motor 91 driving the gear 93 to operate the head section raising and lowering mechanism. Conversely, shifting of the upper ends of the selector levers 109 toward the foot of the bed will move the selector rod 97 in the opposite direction to engage the key 98 with the function selector gear 95 so that subsequent operation of the motor 91 will be effective to drive the knee section operating mechanism.

Energization of the electric motor 91 is controlled by one or the other of two micro switches 115 and 116 which are mounted in opposed relationship to each other within the protective confines of the switch box portion of a glide 117 (FIGS. 5 and 6). These switches 115, 116 are electrically interconnected in well-known manner by means of a cable 118 (FIG. 4) with the motor 91 and a suitable power supply, are each normally open and are adapted to be closed to energize the electric motor 91 in response to laterally outward movement of associated switch actuators 119 or 121, respectively, from their normally central positions of FIG. 5. In this normal position, the switch actuators 119, 121 comprise inoperative switch means which includes the normally open switches 115 and 116. Movement of the end of the switch actuator 119 outwardly or to the left in FIG. 5 closes the micro switch 115 to cause the motor 91 to be energized to rotate in a

positive direction. Lateral movement outwardly or to the right in FIG. 5 of the outer end of the switch actuator 121, on the other hand, closes the micro switch 116 to cause energization of the motor 91 to rotate in a reverse direction.

Such actuation of either of the switch actuators 119 or 121 may be selectively effected manually by sliding of either one of two switch bars 122 and 123. These two switch bars 122 and 123 are mounted parallel to each other for limited longitudinal sliding movements transversely of the bed within the glide 117. As best seen in FIG. 5, each of these switch bars 122, 123 is provided with a pair of apertures 124. The outer end of the switch actuator 119 extends through the leftmost apertures 124 of both of the bars 122, 123 (as seen best in FIG. 5), while the outer end of the switch actuator 121 similarly extends through both of the right-hand apertures 124 of the two switch bars 122, 123. Thus, movement of either of the switch bars 122 or 123 longitudinally to the left in FIG. 5 will close the switch 115 to energize the motor for positive operation, while longitudinal movement of either of the switch bars 122 or 123 in the opposite direction or to the right in FIG. 5 will close the switch 116 to cause reverse rotation of the motor.

The left-hand ends of the switch bars 122 and 123 as viewed in FIG. 5 are connected, respectively, as by means of nuts and studs 125, to the lower ends of the inner wire portions of left-hand and right-hand Bowden cables 126 and 127 (FIG. 4) the upper ends of which are connected, respectively, to remote control means in the form of manually operable slides 128 and 129. It will be noted that these manually operable slides for effecting motor operation are located directly adjacent the selector levers 109 which facilitates selective operation of the various power operated mechanisms incorporated in the bed.

It also will be appreciated that when one of the slides 128 or 129 has been moved to actuate its associated switch bar 122 or 123, it is necessary to prevent operation of the other of these slides and switch bars. To this end and to prevent simultaneous operation of the slides 128 and 129 or the switch bars 122 and 123, interlocking means are provided in the form of a metal ball 131 (FIG. 5) which is disposed within an aperture of substantially the same diameter in a stationary member separating the switch bars 122 and 123 and also is normally seated loosely in both of a pair of smaller diameter apertures 132 provided, respectively, in the switch bars 122 and 123. Thus, in well-known manner, movement of one of the switch bars 122 or 123 in either direction will force the ball 131 into the aperture 132 in the other switch bar to prevent any longitudinal movement of the latter, and this arrangement similarly will prevent simultaneous longitudinal movements of the bars 122 and 123.

With the manually operable switch control slides 128 and 129 in their normal intermediate or inoperative positions, the switch bars 122 and 123 will be in their normal or inoperative position of FIG. 5 and the motor 91 will be deenergized. Raising or lifting up of either of the slides 128 or 129 pulls the associated switch bar 122 or 123 to the left in FIG. 5 to close the switch 115 to energize motor 91 to raise the bed frames and spring through the high-low mechanism, or swing the head section 41 upwardly, or swing the knee section upwardly, depending upon the set position of the selector levers 109. Conversely, depressing either of the manually operable slides 128 or 129 will push the associated switch bar 122 or 123 to the right in FIG. 5 to close the switch 116 which causes energization of the motor 91 in a reverse direction to lower the high-low, head section or knee section mechanisms, as determined by the setting of the selector levers 109. Either of the manually operable slides 128 or 129 may thus be actuated separately to energize the motor, and they will remain in such actuated position to maintain the motor energized until selectively manually returned to normal inoperative position or until returned

automatically to inoperative position by limit control means to be described hereafter.

Means are provided for latching either of the manually operable slides 128 or 129 in any one of its three possible positions to effect these results while permitting selective movement thereof manually or in response to operation of the limit control means. As shown in FIGS. 4a and 4b with respect to the right-hand slide 129, such latching means comprises a housing 133 mounted in any suitable manner on the intermediate or seat section 39, or the upper frame 15, within which a slide block 134 is retained for vertical movement, the block being attached in any desired manner to the slide 129. The upper end of the inner wire of the right-hand Bowden cable 127 also is secured to this slide block 134 and, as shown in FIG. 4a, the upper end of the outer housing portion of this cable 127 is secured in the usual manner to the housing 133. The housing 133 also contains a plunger 135 (FIG. 4b) mounted therein for horizontal movement and urged outwardly by a spring 136. The outer end of this plunger 135 is formed and disposed to cooperate as a latch with a cam surface provided on the inner face of the block 134 and defining a center dwell 137 and upper and lower dwells 138. Incidentally, the lower end of the interior wire portion of the right-hand Bowden cable 127 is connected to the switch bar 123 by the nut and stud 125 shown in FIG. 5 as previously described, while the outer housing portion of this cable 127 and that of the left-hand cable 126 are connected at their lower ends by suitable clamping means to the extension 139 of the glide 117 also shown in FIG. 5. It will be appreciated that the plunger 135 functions as a resilient latch to retain the slide block 134 and its associated control slide 129 in any one of its three possible positions, i.e., engagement with the middle dwell 137 to maintain the slide and the motor switches inoperative, in the upper dwell 138 to retain the switch 116 closed to effect reverse rotation of the motor 91, or in the lower dwell 138 to hold the switch 115 closed to maintain the motor rotating positively.

A function and motor control assembly, indicated generally by reference numeral 141, is mounted in any suitable manner in the upper frame 15 in the location best shown in FIGS. 2 and 4 and includes the glide and switch housing 117 and the parts enclosed and carried thereby heretofore described. To this end, the control assembly 141 includes a top plate 142 (FIGS. 5 and 6) and a bottom plate 143 secured in spaced parallel relationship by suitable side frames making up the assembly and defining a slide-way for the glide 117. The latter is adapted to be moved longitudinally of the bed within the control assembly 141 in response to operation of the selector levers 109 and this is accomplished by attachment of the glide 117 to the longitudinally movable U-shaped member 114 by suitable bolts 144 (FIG. 5). Each of the switch bars 122 and 123 is provided with an upward extension 145 which extends through a suitable aperture 146 in the top plate 142. These switch bars 122 and 123 are also each provided with a depending extension 147 terminating (as best seen in FIG. 6) in an outwardly extending bottom flange. The bottom plate 143 is provided with a longitudinally extending aperture 148 through which the extensions 147 pass to permit the longitudinal movement of the glide 117 previously described within the control unit 141. Corresponding to each of the three possible positions that the glide 117 may assume in response to operation of one of the selector levers 109, this longitudinal aperture 148 in the bottom plate 143 is provided with a pair of parallel lateral extensions 149 separated by depending guide fingers 151 the associated one of which will be disposed between the switch bars 122 and 123 when the latter are aligned therewith by longitudinal movement of the glide 117. The slots 148, 149 in the bottom plate 143 thus provide interlocking means cooperating with the depending extensions 147 of the switch bars 122 and 123 to prevent movement of the latter longitudinally thereof when the

same are in any position intermediate the three operative positions of the glide and also to prevent longitudinal movement of the glide 117 whenever either of the switch bars 122 or 123 has been moved longitudinally in either direction toward an operative position to close either of the switches 115 or 116 to energize the motor. Thus, manual operation of the control slides 128 or 129 will be prevented or rendered ineffective to energize the motor 91 unless the control levers 109 are disposed in any one of their three selective positions. This interlocking means also prevents operation of the selector levers 109 at any time that the motor 91 is energized.

Means are provided for latching the glide 117, and hence the control levers 109, in any of their three selected positions, which is shown in FIG. 9 as comprising three spaced notches 152 in a portion of the glide (or in the undersurface of the U-shaped member 114) with which the nose 153 of a latch pawl 154 cooperates. The pawl 154 is pivotally mounted at one end at 155 and is connected at its other end to a suitable spring 156 for resiliently retaining the nose 153 in any one of the three notches 152.

In addition to the manual return to their normal inoperative positions of FIG. 5 of the switch bars 122 and 123 previously described, limiting means are provided for effecting automatic return thereof and de-energization of the motor 91 whenever the mechanism being driven by the motor reaches either a lower home position or a desired maximum upper position. That part of this means which cooperates directly with the switch bars 122 and 123 comprises part of the control assembly 141 and is best illustrated in FIGS. 5, 6 and 8. Slidably mounted in suitable slots provided in end flanges forming a part of the bottom plate 143 (FIG. 5) are three limit leaves 157 which, as best seen in FIG. 6, are disposed parallel to each other and centrally aligned, respectively, with the three pairs of apertures 149 in the bottom plate 143. Each of these limit leaves 157 has an inverted U-shaped bracket 158 secured thereto in any suitable manner with the legs thereof being spaced to either side of the apertures 148, 149 and centrally slotted to provide clearance for the associated guide fingers 151 during longitudinal movements of these leaves 157. Extending downwardly from each limit leaf 157 is a shoulder rivet 159 which centrally secures thereto a leaf spring 161 that extends transversely of the limit leaf, as best seen in FIG. 6. The lower end of each of these three rivets 159 extends into and cooperates with an angularly disposed slot 162 in an associated limit bar 163, 164 or 165. Each of these limit bars 163-165 also is provided with a depending stud 166 (FIGS. 6 and 8) each of which anchors the inner ends of a pair of coil springs 167, the outer ends of which engage in suitable apertures adjacent the lower edges of one of the end plates of the control assembly, and a vertically disposed intermediate plate 168 thereof, respectively. As best seen in FIG. 6, this intermediate plate 168 and the said end plate of the control assembly are provided with suitable slots for receiving and guiding the limit bars 163-165 for longitudinal movements.

The central limit bar 164 has its forward end secured in any suitable manner to the foot end of the inner portion of the high-low limit cable 33, as best seen in FIG. 4, the lower end of the casing portion of that cable 33 being anchored in well-known manner to a bracket 169 attached to the front end of the control assembly 41. The limit bar 163 is provided at its front end with an aperture engageable by the foot end of a knee limit rod 171 which extends laterally toward the right-hand side of the bed (FIG. 4) and then forwardly in parallel relationship to the knee screw 55. Suitable stop or collar means are appropriately mounted on this portion of the rod 171 adjacent the screw 55 for cooperation with the following nut 54, whereby movements of the latter by the knee screw 55 when the knee section reaches its horizontal or home position, on the one hand, and the desired maximum

raised position thereof, on the other hand, moves the knee limit rod 171 either forwardly or rearwardly to displace the associated knee limit bar 163 from its normal inoperative or intermediate position shown in FIG. 6. This constitutes endwise movement of the knee limit bar 163 either to the right in FIG. 6 against the action of the left-hand spring 167 connected thereto, or to the left against the action of the right-hand spring 167. Either such movement will similarly displace the slot 162 in the bar 163 which, as best seen in FIG. 8, will correspondingly move the rivet 159 disposed therein to slide the associated limit leaf 157 laterally either to the right or left from its normal intermediate position of FIG. 5. This movement of that limit leaf 157, through the agency of its inverted U-shaped bracket 158, will engage the laterally extending flange on the bottom extension 147 of the active switch bar 122 or 123 to return that bar longitudinally to its normal inoperative position of FIG. 5 to de-energize the motor 91. At the same time, through the agency of the cable 126 or 127 connected to that active switch bar by the nut and stud 125, the manually operable slide 128 or 129 which was employed to effect energization of the motor 91 will be returned to its normal inoperative intermediate position. Thus, if the control levers 109 have been moved toward the foot of the bed to render the knee screw actuating mechanism operative, which similarly moves the glide 117 to align the switch bars 122, 123 with the limit leaf 157 closest to the foot of the bed which is operatively associated with the knee limit bar 163, raising of either of the slides 128 or 129 manually and releasing that actuated slide in its upper position moves the corresponding switch bar 122 or 123 to the left from its inoperative position of FIG. 5 to close the switch 115 which causes energization of the motor 91 in a positive direction to raise the knee section. As the knee section reaches its maximum desired raised position, the knee screw nut 54 will contact the associated stop on the knee limit rod 171 to move the latter and the knee limit bar 163 toward the head of the bed. This moves the associated limit leaf 157 to the right in FIG. 5 to return the active switch bar 122 or 123 to its normal or inoperative position which breaks the circuit to the motor 91.

In similar manner, operation of the high-low limit nut 21, through the agency of the limit slide 32 and cable 33, moves the middle or high-low limit bar 164 to return the active switch bar 122 or 123 and its associated slide 128 or 129 to normal inoperative position whenever the bed reaches either its lowermost or uppermost desired position. And in like manner, the head limit bar 165 is moved longitudinally of the bed to de-energize the motor and return the active control slide 128 or 129 to inoperative position by a head limit rod 172 (FIG. 4) connected to the limit bar 165 at its foot end, extending parallel to the head screw 63, and provided with suitable collars 173 for contact by the head screw nut 62.

In addition to conventionally locating the manually operable control members 109, 128 and 129 for selective manual operation as heretofore described to effect power raising or lowering of the bed as a whole and the head section and knee section of the articulated spring, translation of the upper frame 15 may selectively be effected coincidentally with the raising and lowering of the head section by means of the manually operable handle 69. The several different functions may be selected at will, and it will be appreciated from the foregoing description that misoperation thereof is prevented by the several interlocks and latching mechanisms provided. Only the positioning of one of the control levers 109 is required to determine which of the high-low, head section or knee section operations will result from subsequent operation of one or the other of the control slides 128, 129. Only one of these control slides 128 or 129 can be operated at the same time, however, and neither of them is operable during any movement of the control levers 109. Also, neither of the

control levers 109 can be moved while the motor 91 is energized.

Not only do these several interlocking functions safeguard the operating mechanisms, the previously described arrangement of the electrical apparatus and substantially all of the mechanical operating mechanism in the upper frame 15 simplifies and reduces the cost in both initial manufacture and assembly of the constituent parts and of any subsequent repairs that might be required. Fire hazards have been substantially eliminated by using wholly enclosed micro switches which additionally are encased within the switch housing portion of the glide (which preferably is made of suitable insulating material), and the control unit, together with the electric motor, are disposed between metal shrouds under the center portion of the upper frame beneath the patient-supporting spring so as to make it completely safe to simultaneously operate the bed and administer oxygen to a patient therein. In the event of power failure, the various mechanisms of this bed may be actuated manually through the agency of a drive through mechanism 174 (FIG. 4) which comprises a drive gear normally spring-maintained in an inoperative position and movable against that spring into meshing engagement with a pinion mounted on the outer end of the shaft of the motor 91 by insertion of a manually operable crank which then may be actuated to rotate the motor.

It will be appreciated that a doctor may find it desirable at times to prescribe one or more of the available bed movements in the case of any particular patient. For example, it may be necessary to require a patient with certain heart conditions to be kept in a fully reclined position and to prevent his initiating operation of either of the head or knee sections. Therefore, lockout means are provided for preventing any one or more of the previously described functions with manually operable controls mounted in the upper frame 15 below the spring 16, as best seen in FIG. 2, out of the reach of the patient in bed. Referring to FIGS. 5 and 6, this lockout means comprises three rods 175 rotatably mounted in suitable apertures provided in upstanding side flanges of the top plate 142 of the control assembly 141. Intermediate their ends, each of these rods 175 has suitably secured thereto a U-shaped bracket 176 aligned laterally of the bed with the upper extensions 145 of the switch bars 122, 123. These three rods 175 are aligned vertically, respectively, with the three limit leaves 157 and, therefore, are disposed in the three operable positions into which the switch bars 122, 123 may be placed. As shown in FIGS. 5 and 6, the U-shaped brackets 176 normally are disposed in an upper inoperative position. Rotation of a rod 175 through 90° in a counter-clockwise direction viewing FIG. 6 will dispose its bracket 176 in an active position with the then depending legs thereof being at either side of the upper extensions 145 of the switch bars 122, 123 when the latter are aligned with such activated lockout bracket. In such active position, the bracket 176 in effect embraces the upper ends of the extensions 145 to prevent longitudinal movements of either of the switch bars 122, 123. It will be appreciated, of course, that when a lockout bracket 176 is thus disposed in active position it does not interfere with movement of the glide 117 and the switch actuators 122, 123 in a direction longitudinally of the bed. Consequently, the motor control mechanism may be rendered inoperative with respect to any one or more of the three functions.

The lockout rods 175 are selectively manually rotatable between active and inactive positions through such 90° movement by means of suitable control members operable from either side of the bed adjacent the side rails of the frame 15 but below the articulated spring 16 so as to be out of the reach of a patient on the bed. To this end, each of the rods 175 is retained at one end against the upstanding flange of the top plate 142 by a collar 177 (FIG. 5) secured in any suitable manner to the rod, and at its other end by a generally similar collar 178 having a relatively stiff coil spring 179 mounted on the rod and interposed

between that collar 178 and the adjacent upstanding flange of the top plate 142. Secured in any suitable manner to the ends of these three rods 175 are a plurality of lateral extensions which terminate at their outer ends in suitable manually operable portions, the extensions preferably being attached to the rods 175 at their inner ends by pivot pins extending through suitable apertures in both members. As best seen in FIG. 4, the rod 175 toward the foot of the bed is thus connected at each end to a manually operable extension 181 which comprise the knee lockout members, since that rod 175 and its U-shaped bracket 176 will effectively block out active movements of the switch bars 122, 123 when the glide 117 is in its position of FIGS. 5 and 6 in which the knee drive mechanism normally is operable. The middle rod 175 likewise is connected to manually operable extensions or high-low lockout controls 182, while the rod 175 nearest the head of the bed similarly is rotatable by a pair of manually operable extensions or head lockout controls 183. It will be appreciated that 90° rotation of any of these lockout controls 181, 182, 183 from their normal inoperative positions will move the associated U-shaped bracket 176 into operative position with relation to the switch bars 122, 123, but that the latter are not thereby prevented from movement longitudinally of the bed during function selective movements of the glide 117 and are only prevented from motor activating movements transversely of the bed when the glide has been selectively operated to dispose the upper extensions 145 of the switch bars in alignment with an activated U-shaped bracket 176. When so disposed, however, the active U-shaped bracket 176 will effectively prevent motor energizing operation of either of the manually operable slides 128 or 129.

It is thought that the invention and many of its attendant advantages will be understood from the foregoing description, and it will be apparent that various changes may be made in the form, construction, and arrangement of the parts without departing from the spirit and scope of the invention or sacrificing all of its material advantages, the form hereinbefore described and shown in the drawings being merely a preferred embodiment thereof.

We claim:

1. A bed, comprising a bottom frame, leg means for supporting said bottom frame, high-low means operable to raise and lower said frame relative to said leg means; an upper frame mounted on said bottom frame for longitudinal translation relative thereto; an articulated spring structure, comprising a seat section secured to said upper frame, and head and knee sections pivotally connected to said seat section; head means mounted on said upper frame for raising and lowering said head section relative thereto; knee means mounted on said upper frame for raising and lowering said knee section relative thereto; motor means mounted on said upper frame; and selectively controllable drive means for drivingly interconnecting said high-low means, said head means, and said knee means, respectively, with said motor means.

2. In a bed according to claim 1, interlocking means for preventing simultaneous operation of any of said high-low means, head means, and knee means.

3. In a bed according to claim 1, normally disengaged drive through mechanism selectively engageable with said motor means to enable the latter to be rotated manually in the event of failure of electrical power for said motor means.

4. In a bed according to claim 1, translation control means selectively movable from inoperative to operative position for effecting translation of said upper frame relative to said bottom frame simultaneously with operation of said head means.

5. In a bed according to claim 4 wherein said upper frame normally is disposed in a home position, interlocking means cooperating with said translation control means when said upper frame is in said home position to prevent

relative translation of said frames when said translation control means is in said inoperative position.

6. In a bed according to claim 4 in which said head section has a normal horizontal position, means for locking said translation control means against movement between said inoperative and operative positions except when said head section is in said normal position.

7. A bed according to claim 1, wherein said selectively controllable drive means comprises a lever manually movable to any one of three different positions to effect driving interconnection of said high-low means, head means, and knee means, respectively, with said motor means, and latching means for resiliently retaining said lever in any such selected position.

8. A bed according to claim 7, wherein said motor means comprises an electric motor, normally inoperative switch means for selectively effecting energization of said motor to rotate either forwardly or reversely, and control means manually operable from normal position to move said switch means to operative position.

9. In a bed according to claim 8, means for resiliently latching said control means in normal and switch means operated positions, said control means being manually returnable to normal position at any time to move said switch means to inoperative position to deenergize said motor.

10. In a bed according to claim 9, limit means operable automatically by said high-low means, said head means, and said knee means, respectively, to overcome said means for latching said control means and return the latter to normal position and said switch means to inoperative position to deenergize said motor.

11. In a bed according to claim 1, means for protectively housing said motor means, electrical switch means disposed adjacent said motor means below said spring structure, means for separately protectively enclosing said electrical switch means, and manually operable remote control means for effecting operation of said electrical switch means disposed adjacent and spaced laterally outwardly from said spring structure.

12. In a bed according to claim 11, lockout means disposed below said spring structure and selectively operable to prevent operation of one or more of said high-low means, said head means, and said knee means.

13. A bed according to claim 1, wherein said motor means comprises an electric motor, two normally open switches disposed below said spring structure and closable to effect energization of said motor in forward and reverse directions, respectively, two translatable switch bars each movable from normal inoperative position in one direction to one operative position to close one of said switches and in the opposite direction to another operative position to close the other said switch, two manually operable control slides mounted, respectively, at opposite sides of said spring structure and each operatively connected to a said switch bar to effect translational movements thereof in both directions, and interlocking means associated with said switch bars to prevent movement of either one thereof from normal position when the other has been moved from normal position.

14. In a bed according to claim 13, means for resiliently latching said control slides in normal and switch bar operated positions, and movement limit means operable automatically by said high-low means, said head means, and said knee means, respectively, to return an operated said control slide and its associated said switch bar to normal position to deenergize said motor.

15. A bed according to claim 14, wherein said selectively controllable drive means comprises function selector means, and a lever mounted adjacent each of said control slides manually movable to any one of three positions to cause said function selector means to effect driving

15

interconnection of said high-low means, said head means, and said knee means, respectively, with said motor means.

16. A bed according to claim 15, wherein said motor means comprises a translatable glide for housing said switches and slidably mounting said switch bars and inter-
connected with said function selector means for move-
ment therewith to any one of three positions to dispose
said switch bars in operable alignment with said move-
ment limits means operable, respectively, by said high-low
means, said head means, and said knee means.

17. In a bed according to claim 16, latching means
cooperating with said glide for resiliently retaining the
same and said levers in any selected one of said three
positions.

18. In a bed according to claim 17, interlocking means
cooperating with said switch bars to prevent operation
of said levers while said motor is energized.

19. In a bed according to claim 17, lockout means
selectively operable manually to cooperate with said

16

switch bars to prevent motor energizing operations there-
of when the same are aligned with said movement limit
means operable, respectively, by said high-low means,
said head means, and said knee means.

References Cited

UNITED STATES PATENTS

2,913,300	11/1959	Darnell et al.	5—68
3,059,248	10/1962	Wetzler	5—68 X
3,220,019	11/1965	Nelson	5—67 X
3,216,026	11/1965	Mann	5—66
3,237,212	1/1966	Hillenbrand et al.	5—68
3,281,873	11/1966	Stanley et al.	5—68
3,317,931	5/1967	Benoit et al.	5—68

CASMIR A. NUNBERG, *Primary Examiner.*

U.S. Cl. X.R.

5—63