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HOSPITAL BED WITH FRICTION DRIVE

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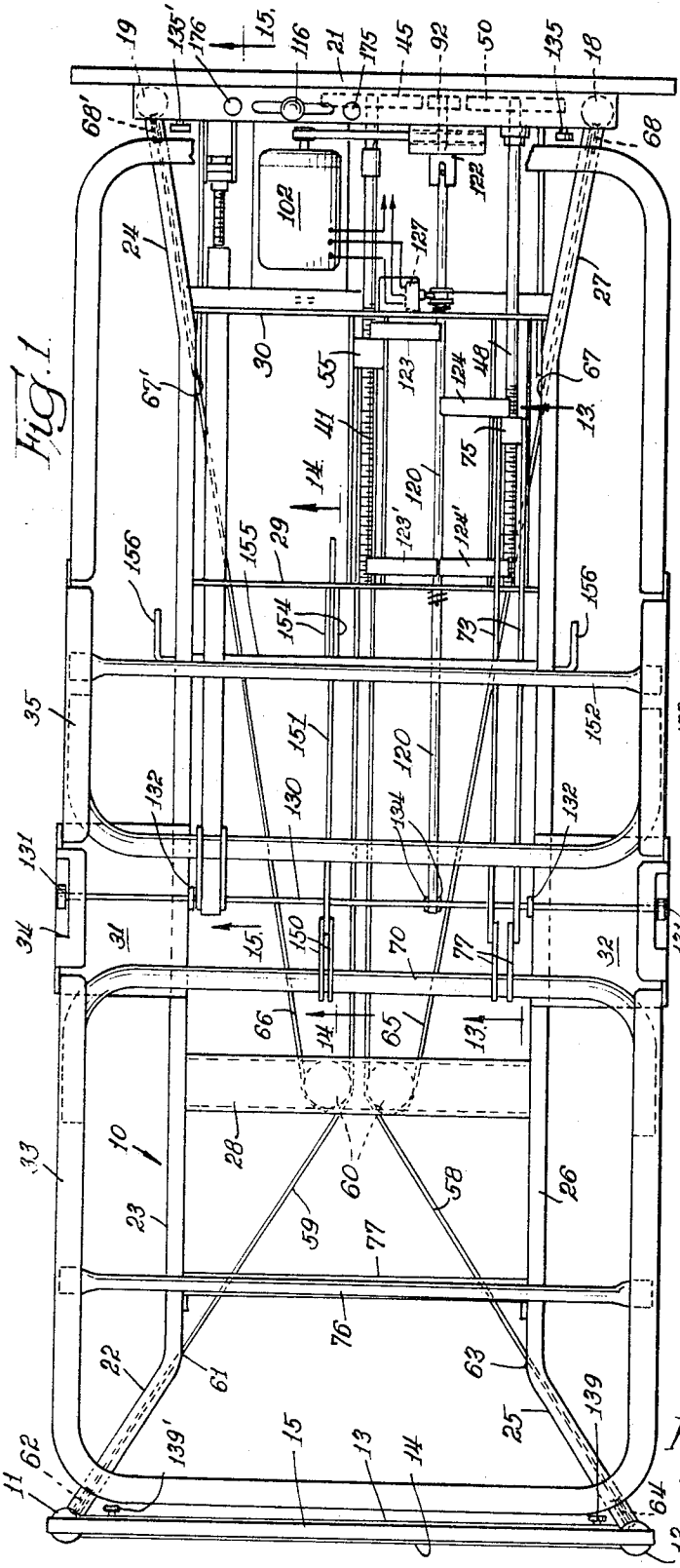

FIG. 1.

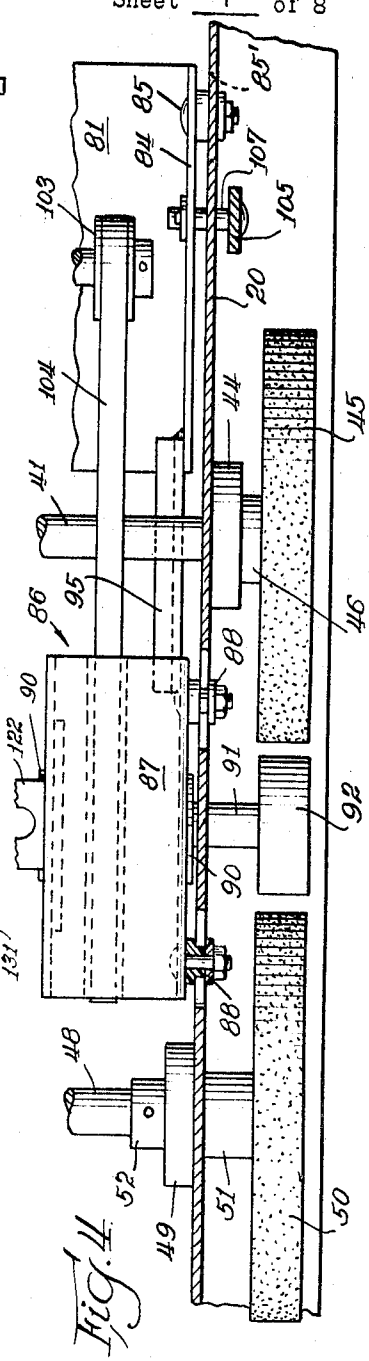

FIG. 4.

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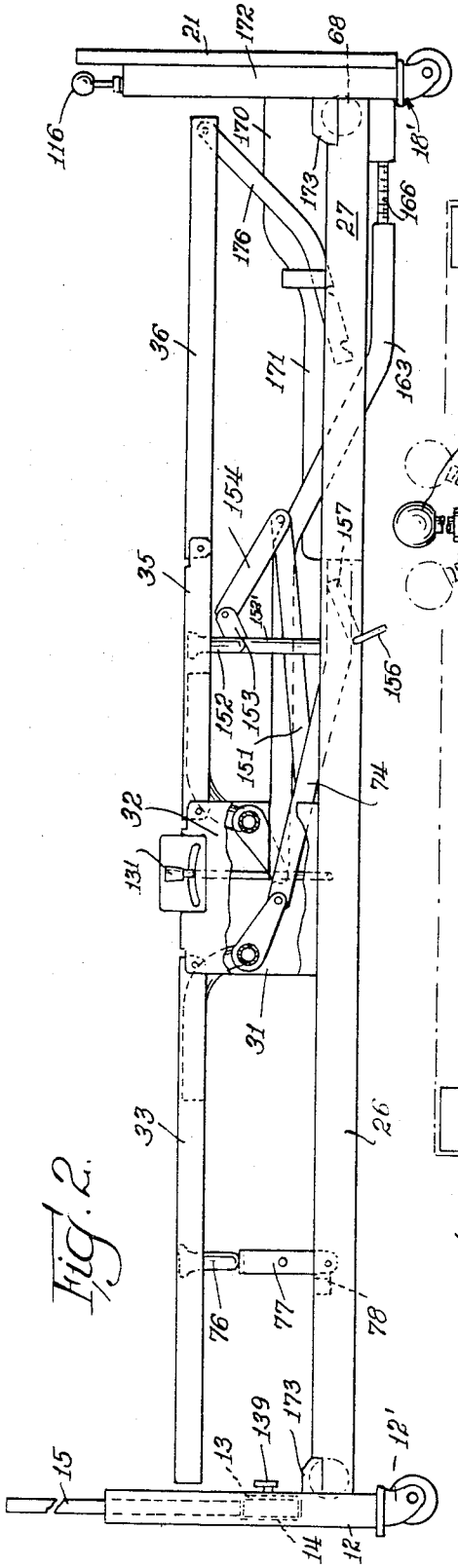

Fig. 2.

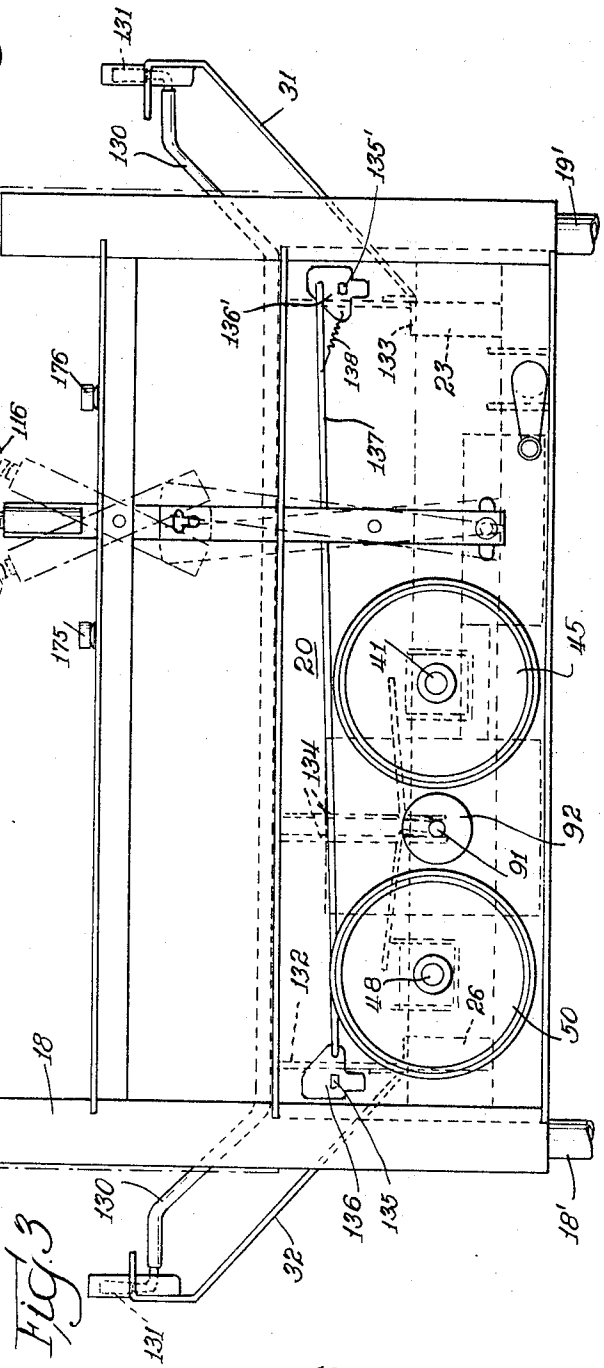

Fig. 3

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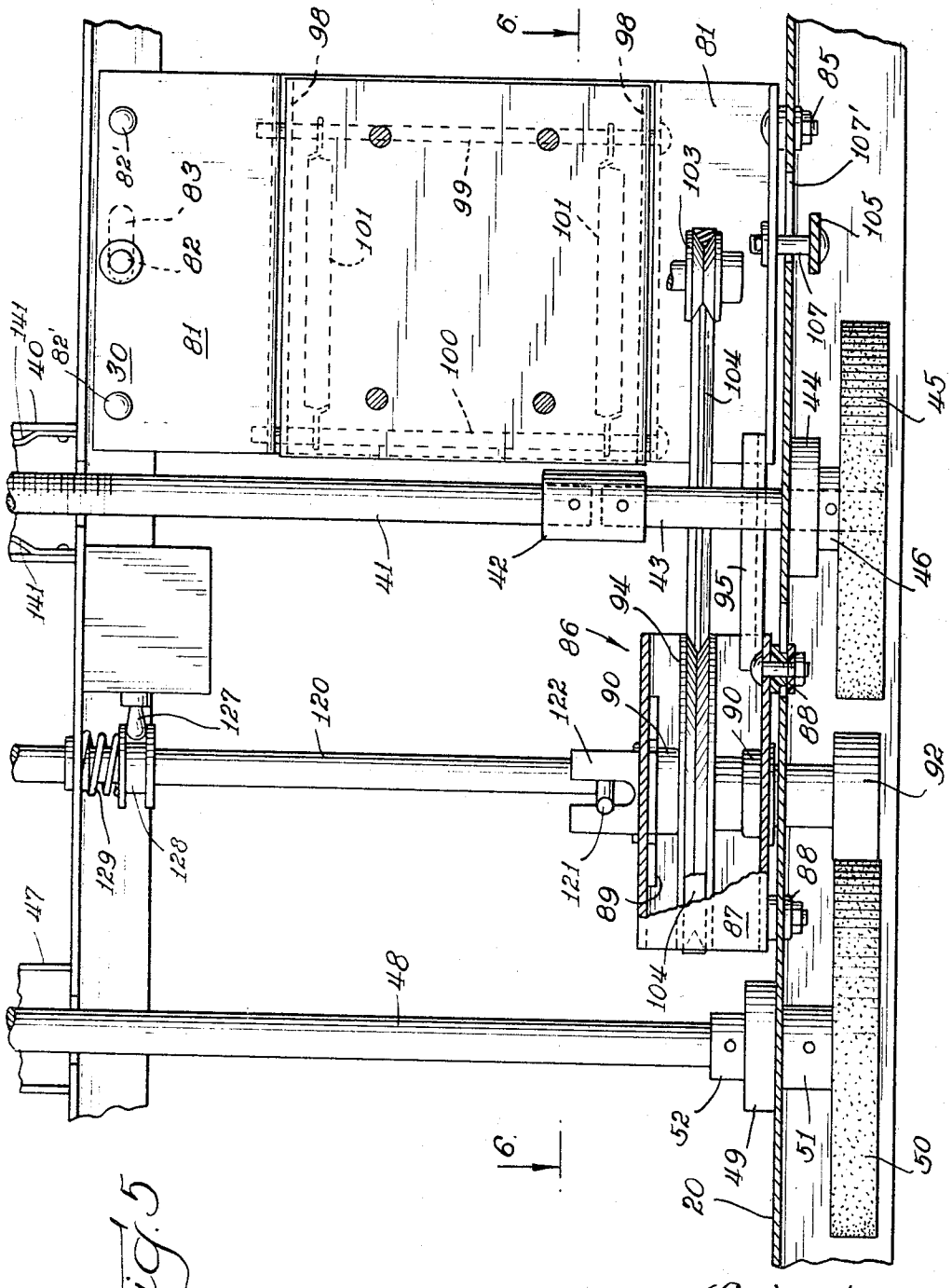

Fig. 5

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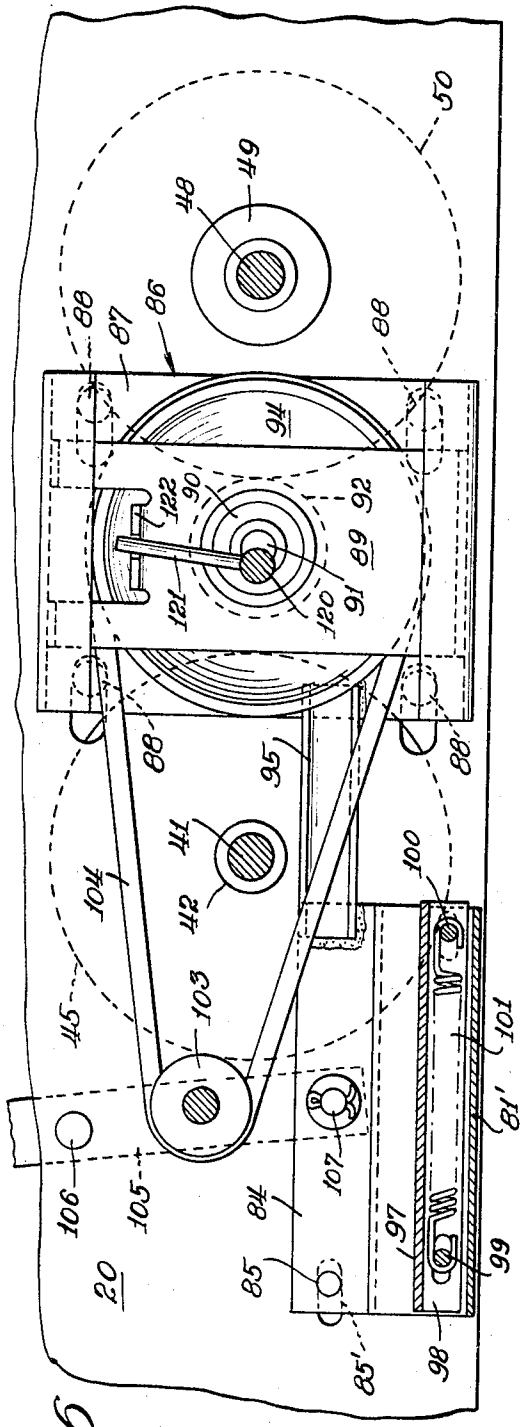

Fig. 6

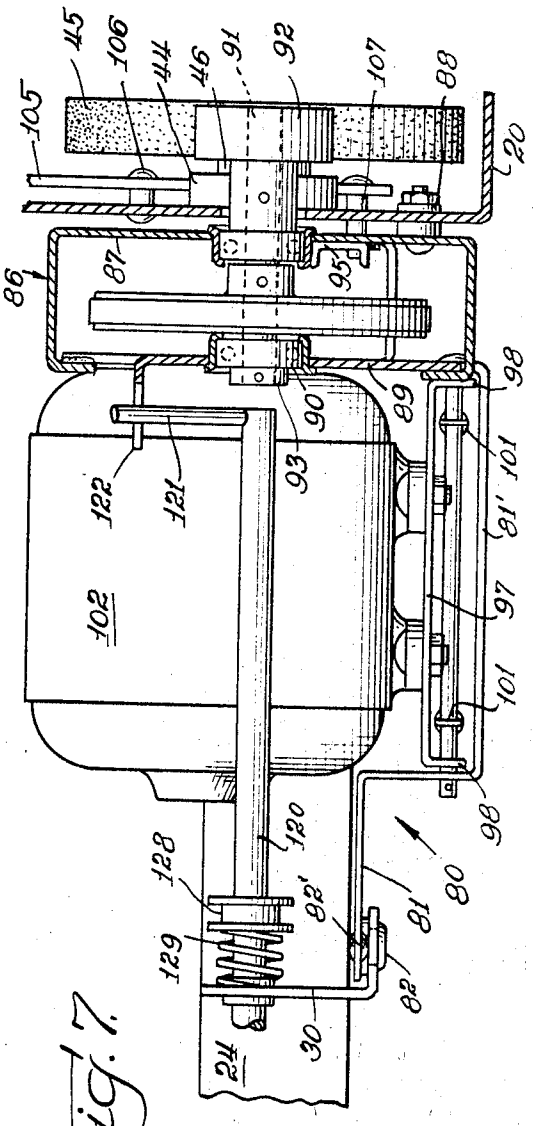

Fig. 7

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Fig. 10.

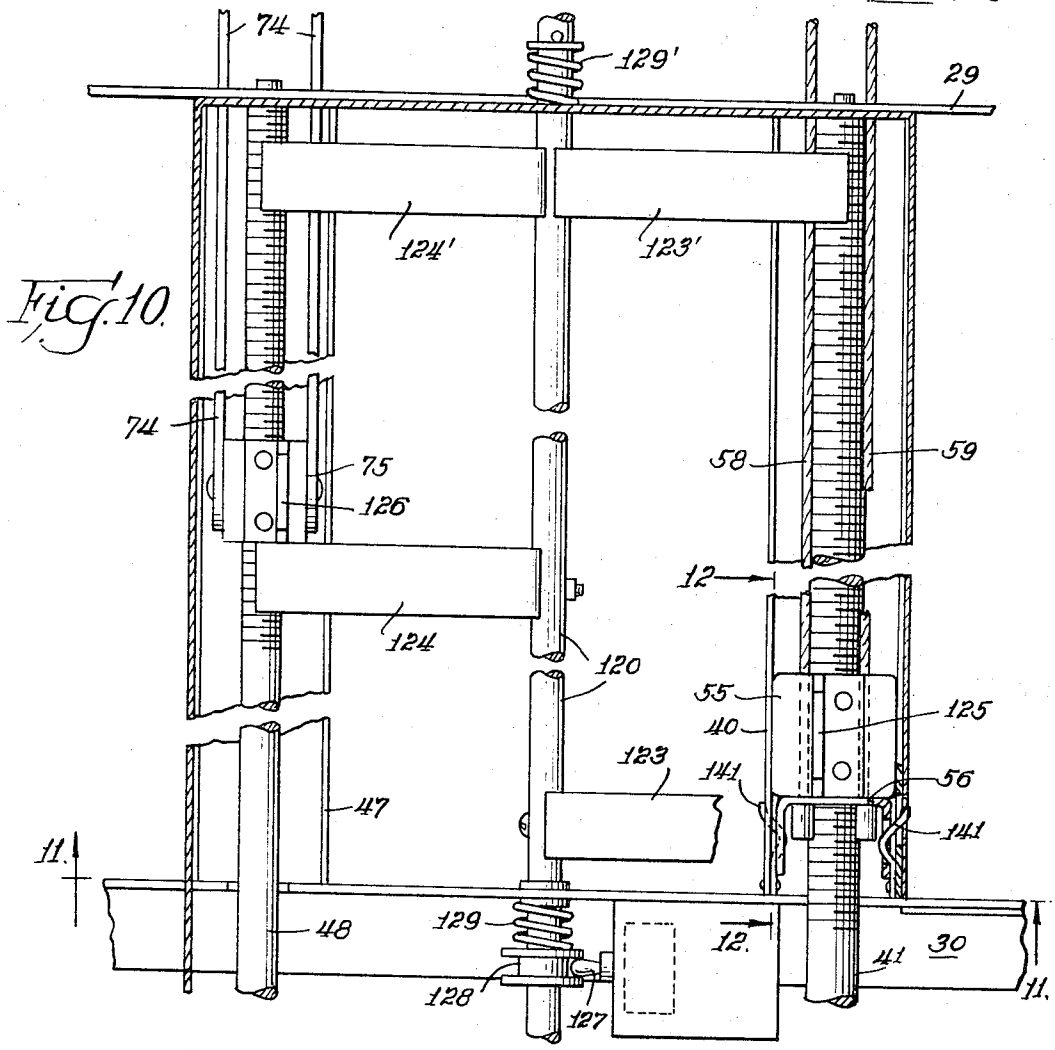


Fig. 11.

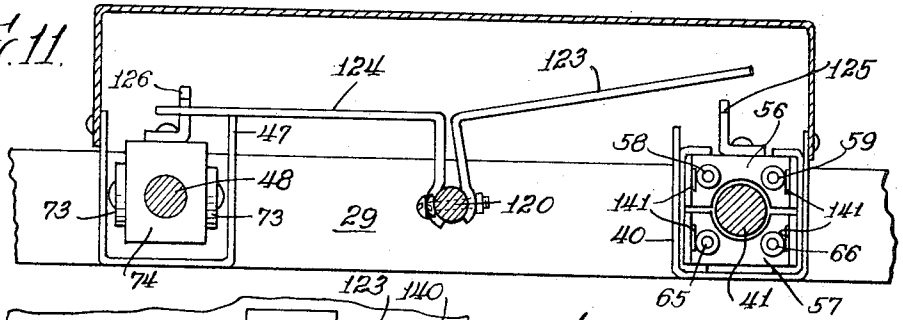
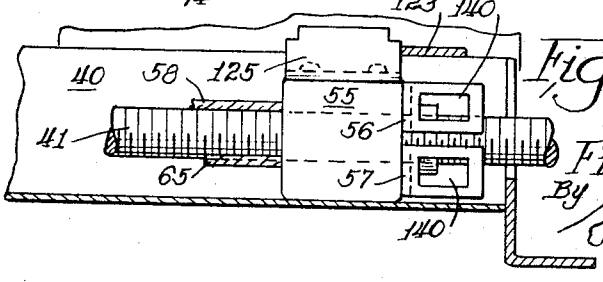


Fig. 12.



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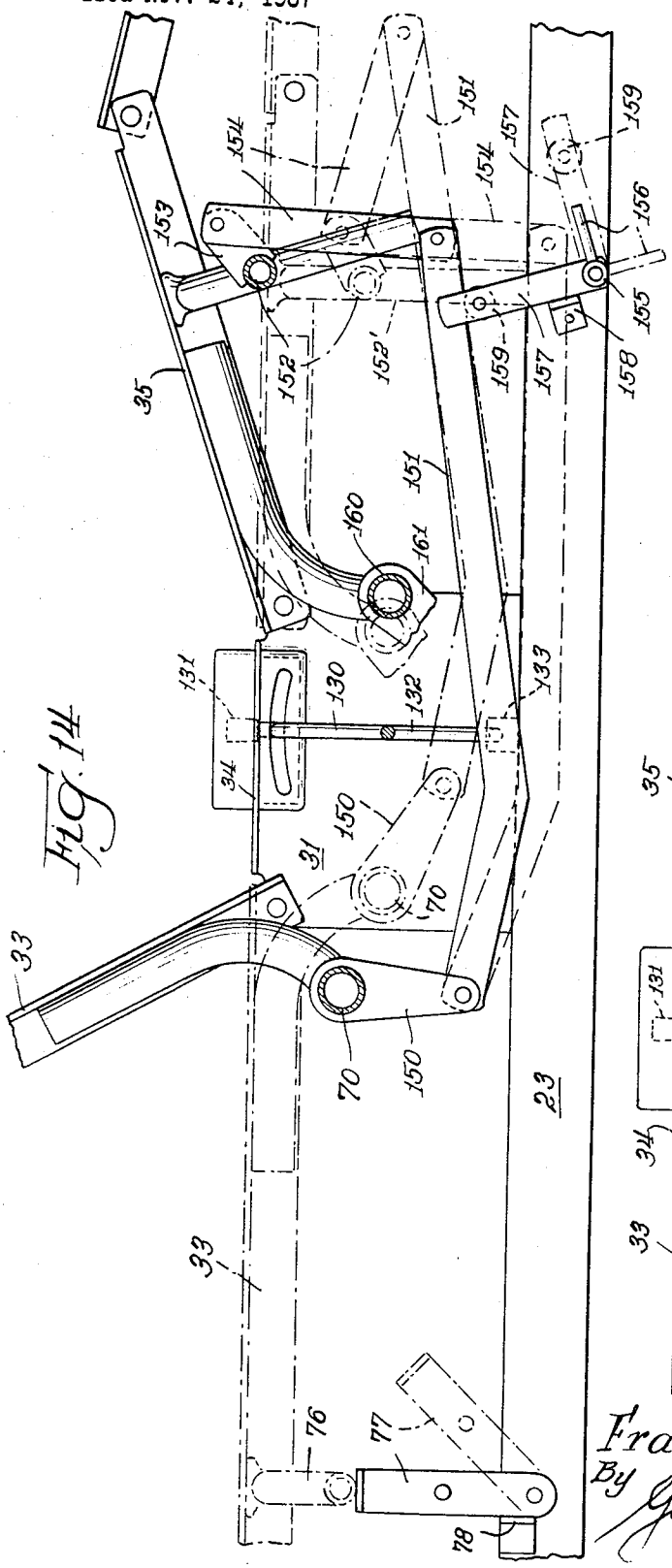

FIG. 14

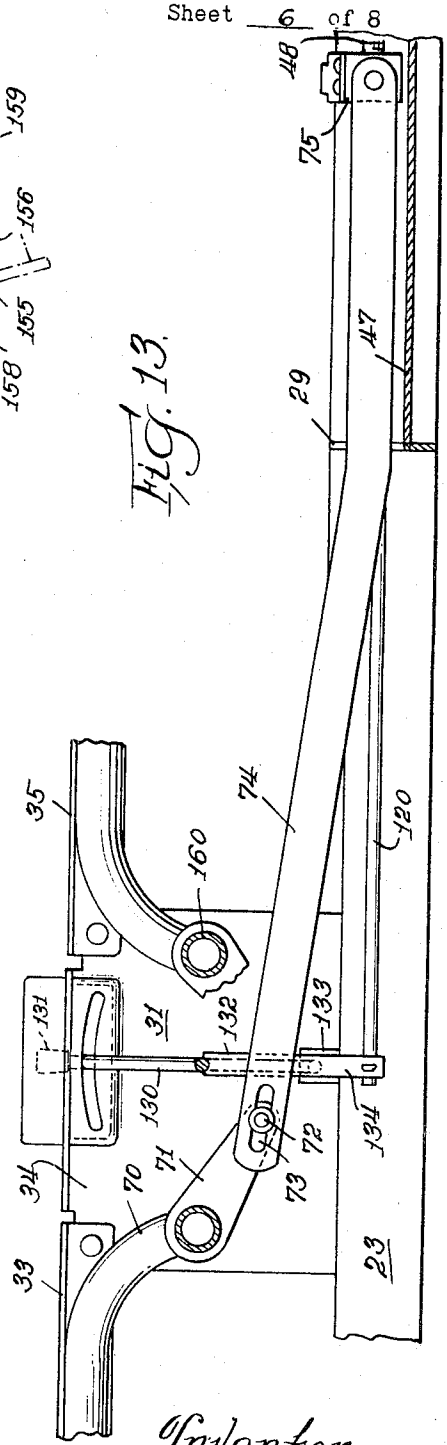

FIG. 13

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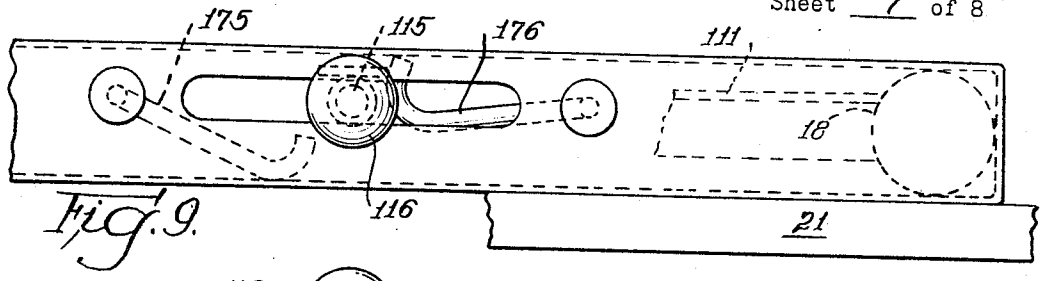

Fig. 9.

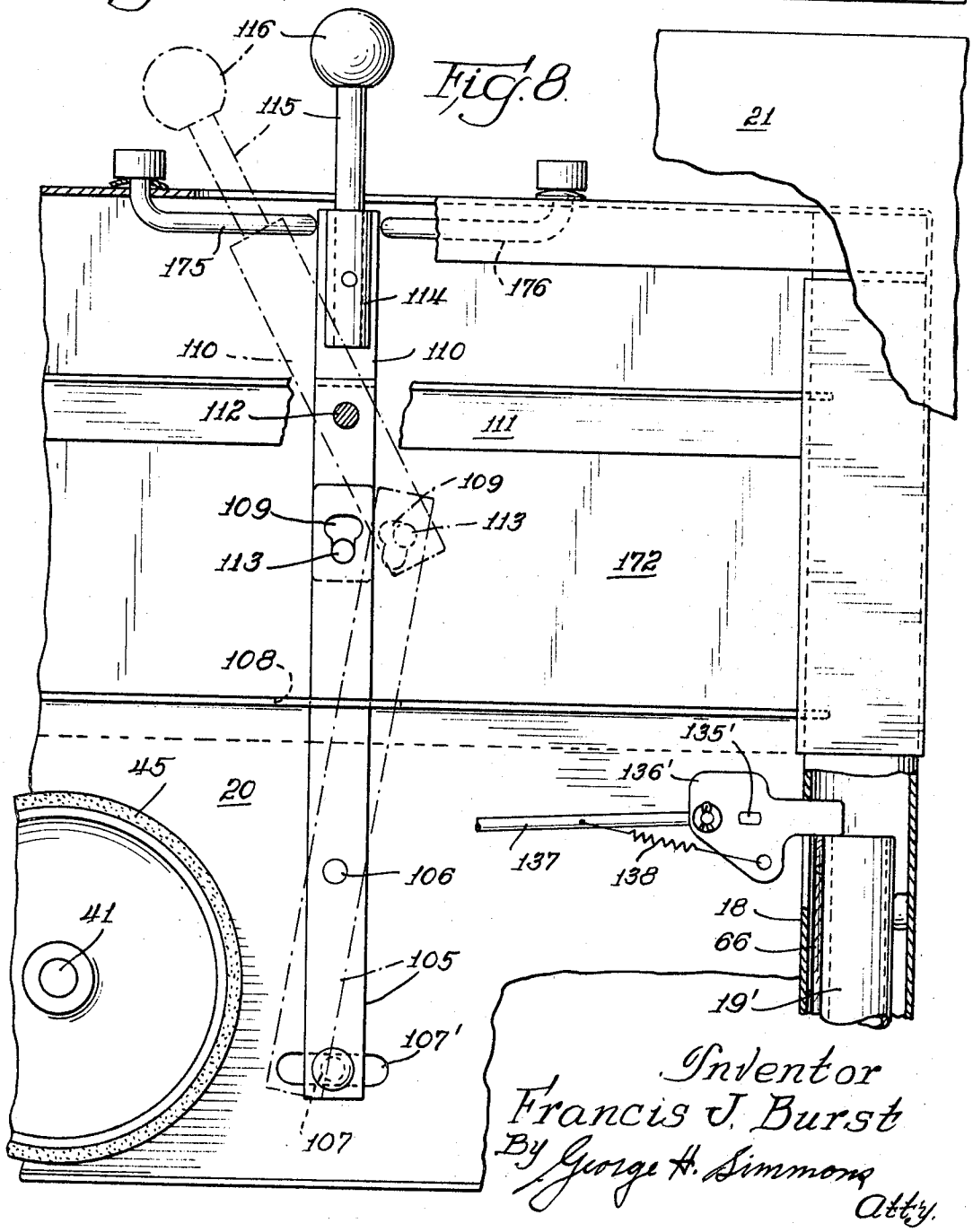

Fig. 8.

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HOSPITAL BED WITH FRICTION DRIVE

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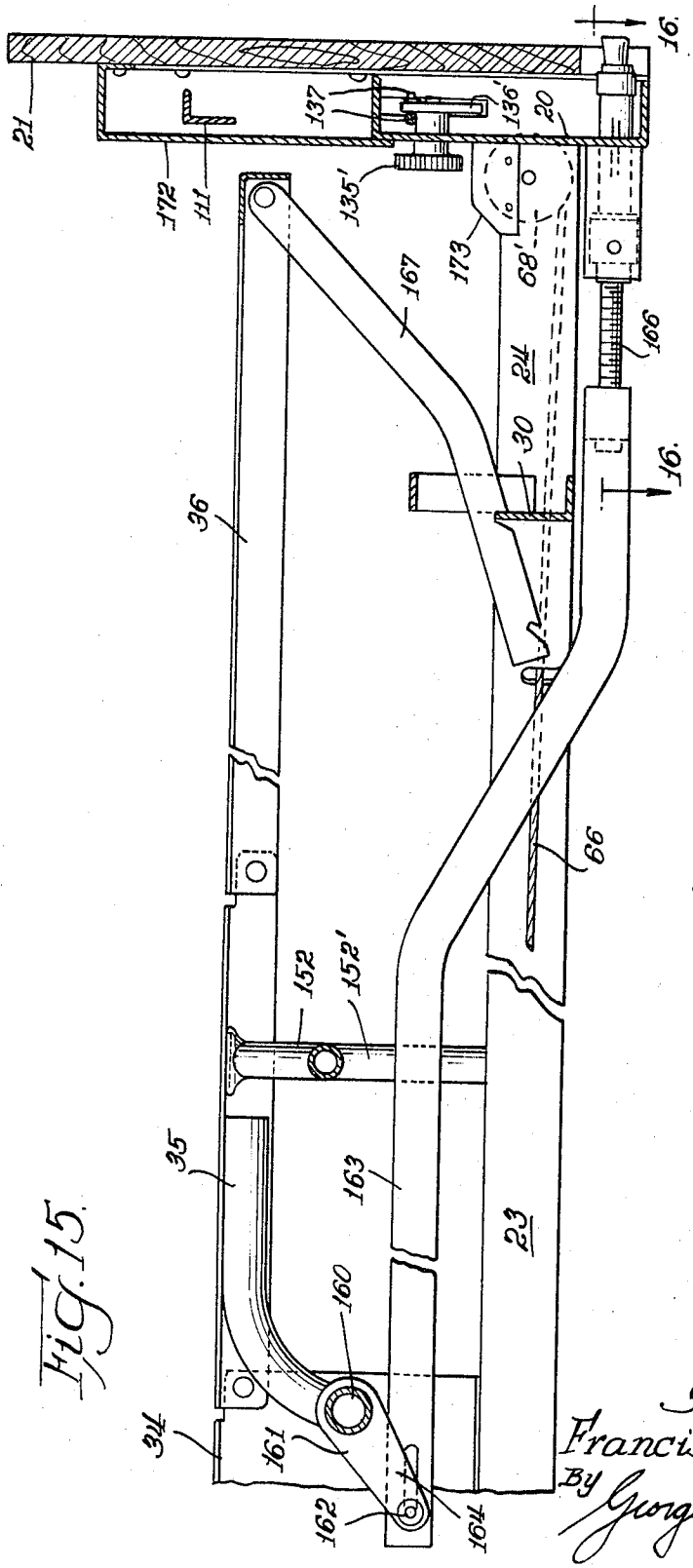

Fig. 15.

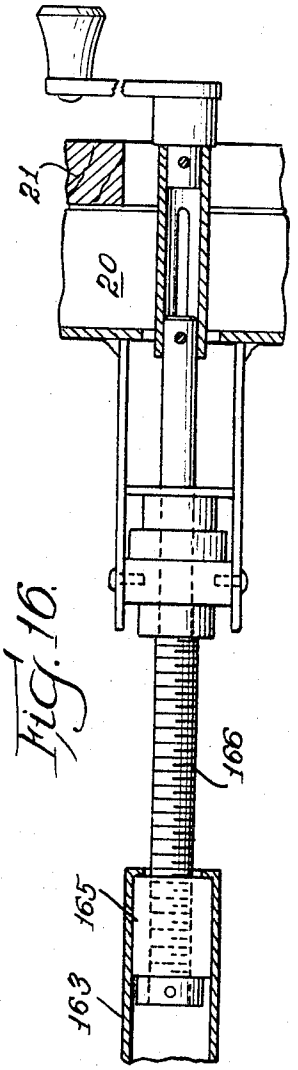

Fig. 16.

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United States Patent Office 3,436,769 Patented Apr. 8, 1969

3,436,769

HOSPITAL BED WITH FRICTION DRIVE

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Filed Nov. 24, 1967, Ser. No. 685,421
Int. Cl. A61g 7/06, 7/00; F16h 15/00
U.S. Cl. 5—67 13 Claims

ABSTRACT OF THE DISCLOSURE

A hospital bed having an electric motor and a friction drive selectively moved to connect the motor to mechanism for elevating the bed or to mechanism for elevating the head section of the spring frame of the bed, the motor being reversible to lower the portion of the bed to which it is connected.

This invention relates to electric hospital beds and has for its principal object the provision of a new and improved bed of this kind.

It is a main object of the invention to provide, without sacrificing quality, an electric hospital bed at a cost comparable to that of manually operated beds, thereby to render electric beds available for installations where the cost of prior art electric hospital beds has been deemed detrimental.

Another object of the invention is to provide in a hospital bed a friction drive mechanism selectively positioned by manual means not available to a patient in the bed, which mechanism is operated by an electric motor that is controlled by means available to a patient in the bed.

Another object of the invention is to provide in a hospital bed a power unit mounted for translatory movement transversely of the bed and containing an electric motor, a drive shaft upon which a pulley and a drive wheel are fixed, a belt connecting the motor to the pulley and spring means for maintaining a predetermined tension on said belt.

Another object of the invention is to provide in a hospital bed a control rod journaled in the frame of the bed, rotatable around its axis in both directions from a neutral position to establish limit positions for the operating mechanisms of the bed and movable axially to operate a switch to start and stop the electric motor by which the operating mechanisms are activated.

Another object of the invention is to provide in a friction driven electric hospital bed a screw rotatable to elevate the head section of the spring frame and means enabling said screw to elevate the knee section of the frame as the head section is elevated to prevent a patient in the bed from gravitating towards the foot of the bed.

Another object of the invention is to provide in a hi-low hospital bed that is capable of being placed in Trendelenberg positions, a mechanism for limiting the development of slack in the cables leading to the end of the bed that is retained in elevated position while the other end of the bed is lowered.

Further objects of the invention not specifically mentioned here will be apparent from the detailed description and claims which follow, reference being had to the accompanying drawings in which a preferred embodiment of the invention is shown by way of example and in which:

FIGURE 1 is a plan view of a hospital bed embodying the invention with a part of the protective covers removed;

FIGURE 2 is a side elevational view of the bed in normal position and with the protective covers in place and with a part broken away to show parts hidden thereby;

FIGURE 3 is a foot end elevational view of the bed drawn to an enlarged scale and with the foot board removed;

FIGURE 4 is a plan view of the friction power unit in neutral position, partly in cross section and drawn to an enlarged scale;

FIGURE 5 is a plan view of the power unit in one operated position;

FIGURE 6 is a cross sectional view taken along the line 6—6 of FIGURE 5 looking in the direction of the arrows;

FIGURE 7 is a side elevational view of the power unit, partly in cross section through the drive shaft mounting;

FIGURE 8 is an elevational view, partly in cross section and showing the selector lever;

FIGURE 9 is a plan view of the structure shown in FIGURE 8;

FIGURE 10 is a plan view of the drive mechanism of the bed;

FIGURE 11 is an end elevational view partly in sections along the line 11—11 of FIGURE 10;

FIGURE 12 is a fragmentary cross sectional view of the hi-low nut in limit position;

FIGURE 13 is a fragmentary view of the head elevating mechanism in normal position taken along the line 13—13 of FIGURE 1;

FIGURE 14 is a fragmentary view of the automatic knee elevating mechanism taken along the line 14—14 of FIGURE 1;

FIGURE 15 is a fragmentary view, partly in cross section along the line 15—15 of FIGURE 1 showing the manual foot end control mechanism; and

FIGURE 16 is a fragmentary cross sectional view taken along the line 16—16 of FIGURE 15.

Present day hospital beds are usually of the so-called hi-low variety in which the frame of the bed is supported by cables attached to the tops of the legs of the bed which are telescoped into posts at the corners of the bed. Mechanism for operating the bed to elevate the same to a height convenient to a nurse or doctor administering to a patient in the bed are in certain instances manually operated and in other instances an electric motor is employed for this purpose. These beds contain the usual articulated spring frame together with a mechanism for elevating the head section of the frame, mechanism for elevating the thigh section thereof, and mechanism for elevating the foot section of the spring frame. In certain beds these mechanisms are all manually operated and in other beds an electric motor is used for this purpose.

Electrically operated hospital beds are necessarily more costly than manually operated beds and there are many places in a hospital where the hospital administrators find it difficult to justify the added cost of an electric bed and consequently manual beds are commonly used at these locations.

The present invention seeks to render available, without sacrificing quality, an electric bed at a cost more nearly comparable to the cost of a manual bed, thereby to render electric beds available for many uses now dominated by manually operated beds. In the production of the low cost electric bed, most, if not all, of the features of the more expensive electric beds are retained.

The bed of the present invention includes a pair of screw shafts journaled in the main frame of the bed, each shaft having a friction wheel fixed upon it and disposed within a cross channel at the foot end of the bed. One of these screw shafts is equipped to operate the hi-low mechanism of the bed and the other equipped to operate the mechanism for raising and lowering the head section of the spring frame and when it is desired to do so to simultaneously raise the thigh section of the spring frame slightly so as to prevent a patient in the bed from gravitating to the bottom thereof.

The power unit of the bed consists of an electric motor mounted for movement transversely of the bed and

coupled to a drive shaft by a belt which drive shaft is journaled in a housing member that is attached to the motor mount for movement transversely of the bed. The drive shaft contain a drive wheel, normally located midway between the two friction wheels and moved into engagement with one or the other of these wheels by the transverse movement of the power unit. An apparatus for effecting this selective movement of the drive wheel is located on the foot end of the bed and hence not available to a patient lying in the bed.

Control means for starting and stopping the motor are located in the seat section of the spring frame and hence readily available to a patient in the bed. Since it is rarely desirable to elevate the thigh section more than required to prevent the patient from gravitating to the foot of the bed when the head section of the spring frame is in elevated position the usual manual control of the thigh section is included so that when necessary in the treatment of a patient in the bed the thigh section can be elevated as required by that treatment. The usual manual arrangement for elevating the foot section of the spring frame to put the bed in so-called contour position is likewise retained.

The invention will be best understood by reference to the drawings where in FIGURES 1, 2 and 3, it will be seen that the bed contains a main frame **10** which has at the head end of the bed posts **11** and **12** between which a channel **13** is fixed. As will be seen in FIGURE 2 the channel **13** is disposed with its web located on the side towards the foot of the bed and there is a cover **14** that extends between the flanges of the channel to close off the same. A head board **15** of suitable design is supported upon the channel and posts in known manner.

Located at the foot end of the bed are posts **18** and **19** between which a channel **20** is extended and disposed with its web on the side towards the head end of the bed. A foot board **21** is fixed to the posts **18** and **19** by known means and extends to the bottom of the channel **20** serving as a cover therefor, as will presently appear.

Extending between the posts **11** and **19** is a side rail composed of rectangular tubing and having an end section **22** fixed to the post **11** and extending inwardly therefrom at an angle with respect to the longitudinal median line of the bed. Section **22** merges into a middle section **23** which is disposed parallel to the longitudinal median line of the bed and merges into an end section **24** which extends outwardly to the post **19** to which it is attached.

On the other side of the bed is a similar side rail having an end section **25** fixed to the post **12** and extending inwardly therefrom and merging into a middle section **26** which is parallel to the section **23** which merges into an end section **27** which is fixed to post **18**. Cross members **28**, **29** and **30** extend between the side rails and are fixed thereto.

Fixed to the middle section **23** of the side rail is a seat support member **31** which as will be seen best in FIGURE 3 extends upwardly and outwardly from the side rail. A similar seat support **32** is fixed to the middle section **26** and extends upwardly and outwardly therefrom. The seat section **34** of the spring frame is attached to these supports.

The head section **33** of the spring frame is pivotally connected to one side of the seat supports **31** and **32** in the usual manner and the thigh section **35** is pivotally connected to the other side of the seat supports. The foot section **36** of the spring frame is pivotally connected to the thigh section **35** in the usual manner.

The spring frame members are preferably angles to which the usual spring fabric is attached, which fabric has been omitted from the drawings to avoid an unnecessary complication thereof.

As will be seen best in FIGURES 10 and 11, fixed to and extending between the cross members **29** and **30** of the main frame is a guide **40** which is rectangular in cross section and has an open top. Journaled in the cross member **29** and located centrally of the guide **40** is a hi-low screw shaft **41** which as will be seen best in FIGURE 5 is connected by a coupling **42** to a stub shaft **43** that is journaled in a thrust bearing **44** mounted in the web of channel **20**. A friction wheel **45** is fixed upon shaft **43** with its hub **46** engaging the movable portion of the thrust bearing **44**. Also fixed to and extending between cross members **29** and **30** is a similar guide **47** and centrally located in this guide **47** is a head operating screw shaft **48** which as will be seen in FIGURE 5 is journaled in a thrust bearing **49** carried upon the web of channel **20**, the shaft extending through this bearing and web. Fixed upon the end of the shaft **48** disposed within the channel is a friction wheel **50**, the hub **51** of which abuts against the inner member of the thrust bearing. It will be noted that screw shafts **41** and **48** are disposed parallel to each other and that there is an appreciable distance between the adjacent edges of friction wheels **45** and **50**.

As will be seen best in FIGURES 1, 10, 11 and 12, the hi-low mechanism includes a nut **55** threaded upon shaft **41** and disposed in the guide **40**. This nut contains four openings, the axes of which are parallel to the axis of the shaft **41**. Fitted against the end of the nut **55** are the webs of a pair of channel shaped catch plates **56** and **57** which webs contain perforations aligned with the holes in the nut **55**.

A pair of cables **58** and **59** extend through the nut and the web of catch plates **56** and terminate in a cable fastening device of known design. These cables extend along the shaft to a pair of double groove pulleys **60** journaled in the cross member **28** of the main frame of the bed. Preferably the member **28** is a rectangular tubing and the pulleys **60** are journaled within the tubing, there being openings in the vertical walls of the tubing to permit entrance and exit of the cables.

Cable **59** extends from one of the pulleys through an opening **61** in the vertical wall of the side rail at the junction of sections **22** and **23** thereof. The cable extends through the end section **22** around a sheave **62** journaled in that section adjacent the post **11**, thence upwardly to a point of attachment at the top of the leg **11'** telescoped in post **11**.

Cable **58** extends around the other pulley of the pair **60**, thence through an opening **63** in the vertical wall of the side rail at the junction of sections **25** and **26** thereof, thence thru the end section **25** and around a sheave **64** and upwardly to a point of attachment at the top of the leg **12'** telescoped in the post **12**. A second pair of cables **65** and **66** extend through a perforation in the web of catch plate **57** and the openings in the nut **55** aligned therewith, thence around the other grooves in the pair of pulleys **60**, cable **65** then extending through an opening **67** at the junction of sections **26** and **27** of the side rail, thence through the section **27** around a sheave **68** and thence upwardly to a point of attachment at the top of the leg **18'** telescoped in the post **18**. In a similar manner cable **66** extends through an opening **67'** at the junction of sections **23** and **24** of the side rail, around a sheave **68'** journaled in the end section **24**, thence upwardly to a point of attachment at the top of a leg **19'** telescoped into the post **19**. Through this arrangement the frame of the bed is hung on the legs telescoped into the post by the cables and the tension on the cables maintains the catch plates **56** and **57** snugly against the end of the nut **55**.

As will be seen in FIGURES 1 and 13, the bed is equipped with the usual mechanism for elevating and lowering the head section of the spring frame. This mechanism includes a cross tube **70** fixed to the head section **33** of the bed near its pivotal connection to the seat section **34**. A pair of crank arms **71** are fixed upon the cross tube **70** and equipped with pins **72** which project through slots **73** in the operate bars **74** which bars at their distal ends

are pivotally connected to opposite sides of the nut **75** that is threaded upon the shaft **48**. Movement of the nut **75** in one direction elevates the head section of the bed in known manner, and when moved in the opposite direction lowers that section.

As will be seen in FIGURES 1, 2 and 14, the head section **33** of the spring frame is equipped with a cross tube **76** on the main frame with a levelizer **77**. The levelizer is engaged by the cross tube when the section **33** is in horizontal position. Should treatment of a patient in the bed require the head section **33** to be placed below horizontal while the other sections of the spring frame are horizontal the levelizer must be moved. To this end the levelizer is pivotally connected to the sections **23** and **26** of the main frame and can be rotated on its pivots away from the stop block **78** into the postiion shown in dotted lines in FIGURE 14. Head sections may then be lowered until cross tube engages the side rails of the main frame.

Power unit

As will be seen in FIGURES 4 through 7 inclusive, the power unit consists of a motor support indicated generally at **80** and containing a horizontal portion **81** that is supported upon the bottom portion of the cross member **30** of the main frame by a low friction mounting bushing **82** which projects through a slot **83** in the member **30** and by buttons **82'** which engage member **30**. The horizontal member contains a channel shaped depressed portion **81'** and terminates in an upstanding flange **84** best seen in FIGURE 6. This flange is attached to the web of the channel **20** by a low friction bushing **85** that extends through a horizontal slot **85'** in the web of the channel.

The drive shaft housing indicated generally at **86** consists of a channel shaped front member **87**, the web of which is supported upon the web of the channel **20** by four low friction bushings **88** each of which is registered with and supported in a horizontal slot in the web of channel **20**. The housing includes a back plate **89** fixed to the flanges of the front channel **87** in convenient manner such as by welding. Thrust bearings **90** are mounted in the web of the member **87** and in the back member **89** and the drive shaft **91** is journaled in these bearings and extends through a suitable opening in the web of channel **20**. The drive wheel **92** is fixed upon the drive shaft and disposed between the friction wheels **45** and **50** the shaft being held against axial movement by the hub of the drive wheel **92** and by a collar **93** secured on the shaft. A pulley **94** is fixed upon the drive shaft between the thrust bearings **90**. The motor support **80** and the drive shaft housing **86** are connected together by a link **95**, preferably a channel, welded to the flange **84** of the motor support and to the web of the front member **87** of the housing. Through this arrangement the motor support and the housing are capable of translatory movement as a unit, which movement is transversely of the bed.

Disposed in the depressed portion **81'** of the motor suppotr **81** is a motor slide plate **97** from the ends of which flanges **98** project downwardly. Fixed in the motor support plate **81** and extending through slots in the flanges **98** is a stationary pin **99**. Fixed in the flanges **98** and extending through slots in the motor support **81** is a movable pin **100**. Springs **101** are connected between the stationary and movable pins. The motor **102**, which may be any one of a number of suitable motors readily available upon the open market, is fixed upon the motor slide plate **97** and a belt **104** encircles the motor pulley **103** and the pulley **94** on the drive shaft. The tension of springs **101** tend to move the slide plate **97** and motor mounted thereupon to the left as seen in FIGURE 6. These springs are calibrated to maintain a predetermined tension upon the belt **104**.

Selector mechanism

As will be seen best in FIGURE 8, the mechanism for moving the power unit transversely of the bed consists of a control arm **105** connected by pivot **106** to the web of channel **20**. A pin **107** fixed in the lower end of arm **105** extends through a slot **107'** in the web and through a perforation in the flange **84** of the motor support **81** and is fixed thereto. Arm **105** extends upwardly from pivot **106** through a slot **108** in the flange of channel **20** and contains near its upper end a T-shaped slot **109**.

A selector lever **110** is pivoted to cross member **111** of the bed by a pivot **112**. A pin **113** fixed in the lower end of the lever **110** is registered in the T-slot **109**. Fixed on lever **110** near the upper end thereof is a socket **114** in which the shank **115** of a selector knob **116** is telescoped and secured in convenient manner such as by a set screw.

It will be noted that the distance between the selector knob **116** and the pivot **112** is greater than the distance between that pivot and the pin **113**. It will also be noticed that the distance between the T-slot **109** and the pivot **106** is greater than the distance between pivot **106** and the pin **107**. As a result of this mechanical leverage the force required to produce a given pressure between the drive wheel **92** and the selected one of the friction wheels **45** and **50** is achieved by the application of a smaller force to the selector knob **116**. When this knob is moved from the position shown in full lines in FIGURE 8 to the position shown in dotted lines therein the power unit is moved to the left as seen in FIGURE 5 and drive wheel **92** is moved into driving engagement with the friction wheel **50**. Pin **113** is moved into the end of the cross portion of T-slot **109** to hold the apparatus in this position after the force is removed from the knob **116**. The mechanism for moving the power unit transversely of the bed is located at the foot thereof and consequently is not readily available to a patient in the bed.

Control mechanisms

To render movement of the bed, particularly the head section thereof, available to a patient, a control rod **120** best seen in FIGURES 5, 6, 7, 10 and 11, is journaled in the cross members **29** and **30** of the main frame of the bed for both rotational and axial movement. Fixed on the end of the rod **120** adjacent the drive shaft housing **86** is a pin **121** which projects into a slot in the bifurcated ear **122** that is bent out of the back wall member **89** of the housing. As will be seen best in FIGURE 5 when the power unit is moved to engage the drive wheel **92** with the friction wheel **50** movement of the ear **122** rotates the rod **120** through a small arc.

Limit positions setting

Fixed upon the rod **120** are spaced apart hi-low limit plates **123** and **123'** and head limit plates **124** and **124'**. Rotation of the rod **120** occasioned by the movement of the power unit to the position shown in FIGURE 5 lowers the limit plates **124** and **124'** into the path of a limit bracket **126** fixed upon the nut **75**. Thus is responsive to moving the control rod **120** towards the cross member **29** results in operating the switch **127** to move nut **75** towards the cross bar **30** engagement of the bracket **126** with plate **124** will move the rod **120** in the opposite direction and thereby stop the motor.

Movement of the nut **75** in the opposite direction is stopped by the engagement of bracket **126** with stop plate **124'** in a similar manner. Nut **55** on the hi-low screw shaft is equipped with a similar limit bracket **125** which engages limit plate **123** or **123'** when nut **55** approaches its limit position.

Motor control

As will be seen best in FIGURE 10 a switch **127**, preferably a single pole double throw snap action switch, is mounted upon the cross member **30** and preferably disposed within a suitable housing. Fixed upon the rod **120** is a collar and the operating lever of switch **127** extends into a groove in the periphery of this collar. A spring **129** encircles the rod **120** and extends between the

collar **128** and the cross member **30**. A similar spring **129'** abuts against the cross member **29** and a pin carried upon the rod **120**.

As will be seen best in FIGURES 1, 3 and 13, an operate rod **130** disposed within the seat section supports **31** and **32** and terminates in operating knobs **131** located at the sides of the bed within easy reach of a patient therein. Depending from rod **130** are pivot bars **132** which extend down to and are pivotally connected to brackets **133** mounted upon the side rails of the main frame. Also fixed upon operate rod **130** and depending therefrom are a pair of levers **134** to which control rod **120** is pivotally connected. Movement of either one of the control knobs **131** from neutral in one direction moves the control rod **120** axially in a corresponding direction. This movement causes collar **128** to operate the switch **127**, thereby to initiate an operation of the motor **102**. It is sufficient to note here that the main spring of the switch **127** is connected to one side of a source of power and the two make contacts of the switch are connected to the two operate leads of the motor, the common lead of the motor being connected to the other side of a source of power. When the switch is operated in one direction the motor will be operated in one direction and when the switch is operated in the opposite direction the motor will be operated in the opposite direction. Through this arrangement movement of the head section of the spring frame is under the control of a patient in the bed.

Trendelenberg positions

There are times when the treatment of the patient in the bed requires that the spring frame be put in one or the other of the Trendelenberg positions, that is with the spring frame flat and with one end of it lower than the other end. To permit placing the spring frame in these positions as will be best seen in FIGURES 1 and 3, knobbed shafts **135** and **135'** are journaled in the web of channel **20** and carry at their inner ends cams **136** and **136'**. A tie rod **137** connects together these two cams. When it is desired to maintain the foot end of the bed elevated while the head end thereof is lowered, the hi-low mechanism is operated to raise the bed to its upper limit position. Knobs **135** or **135'** are then operated to position the tongue of the cams **136** and **136'** into the paths of legs **18'** and **19'** at the foot end of the bed. The hi-low mechanism is then operated to lower the bed and when the tongues on the cams engage the upper ends of the legs further downward movement of the foot end of the bed is prevented. Further operation of the hi-low mechanism to lower the head end of the bed removes tension from the cables **65** and **66** which are connected to the foot end of the bed.

Cable slack prevention

As will be seen best in FIGURES 10 and 12, unwanted slack in the cables **65** and **66** is prevented. As will be seen best in FIGURE 12, each of the flanges of catch plates **56** and **57** contain a rectangular opening **140** into which project latch springs **141**, fixed upon the guide **40**. Since the tension on cables **65** and **66** has been removed these springs hold the catch plate **57** against movement in the guide **40**. Tension still being on cables **58** and **59**, catch plate **56** is held in contact with the nut **55**.

When the spring frame of the bed is being restored to horizontal position as the nut **55** reaches its upper limit position, the tongues on cams **136** and **136'** are out of engagement with the tops of the legs **18'** and **19'** and a spring **138** extending between the guide rod **137** and the cam **136'** restores the cams to their normal position.

In order to permit holding the head end of the bed elevated while the foot end thereof is lowered, the mechanism just described is duplicated in the channel **13** at the head end of the bed and operated by knobs **139** and **139'** in the foregoing manner.

Automatic knee elevating

To eliminate the tendency of a patient in the bed to gravitate towards the foot end when the head section of the spring frame is elevated, the bed is equipped with mechanism for automatically elevating the knee joint of the spring frame as the head section thereof is being elevated.

As will be seen best in FIGURE 14, this mechanism consists of a pair of crank arms **150** fixed upon the cross tube **70** and between which a tie bar **151** is pivotally connected. Fixed to the thigh section of the spring frame is a cross tube **152** to which a crank arm **153** is fixed. A pair of links **154** are pivotally connected to the crank arm **152** and also to the tie bar **151**.

A cross tube **155** journaled in the main frame and extending between side rail sections **23** and **26** thereof is equipped with L-shaped bars **156** which journal it in the main frame and form handles for rotating the tube around its axis. Fixed to the cross tube **155** are a pair of support arms **157** between which a roller **159** is journaled. Tie bar **151** extends between the support arms **157** and rests upon the roller **159** when the mechanism is set for automatic knee elevation.

As will be seen in FIGURE 14 when the sections of the spring frame are horizontal the mechanism is in the position shown in dotted lines in this figure. It will be noted that the links **154** are disposed at an acute angle to the tie bar **157**, this angle being approximately 30°. As the head elevating mechanism is operated, this angle increases and when the spring frame of section **33** is in fully elevated position in which it is shown in full lines in this figure, the angle between the links **154** and the tie rod **151** is slightly greater than a right angle, namely an obtuse angle. The shape of the tie bar **151** and length of the links **154** and length of the support arms **157** are proportioned so that when the head section **33** is in fully elevated position the elevation of the knee joint between the thigh and foot sections is not sufficient to result in an undesired elevation of the knee.

In the event that it is desired that the thigh section remain horizontal while the head section **33** is being elevated, cross tube **155** is rotated clockwise as seen in FIGURE 14 away from stop brackets **158** into the position shown in dotted lines in this figure. The distal end of tie bar **151** is then supported by the links **154** and during movement of the tie bar as the head section **33** is being elevated, links **154** swing on their pivots and the thigh section **35** of the spring frame remains horizontal being supported by the engagement of the feet **152'** with the side rails **23** and **26** of the main frame **10**.

Manual elevation of knee hinge

There may be times when treatment of the patient in the bed requires elevating the thigh and leg sections of the spring frame and the bed is equipped with the usual manual means for accomplishing this purpose. As will be seen in FIGURE 15 the cross tube **160** on the thigh section of the spring frame carries a pair of crank arms **161** between which a tube **163** is positioned and pivotally connected to the crank arms by a pin **162** which projects through an elongated slot **164** in the tube. A nut **165** is fixed in the end of the tube **163** and threaded upon a screw shaft **166** that is journaled in brackets attached to the channel **20** at the foot end of the bed. The usual foot levelizer **167** is pivotally connected to the foot end of the foot section **36** of the spring frame and the cross member **30** is engaged in a notch in this levelizer to hold the foot section in horizontal position. It will be noted that since the pin **162** projects into and through slot **164** and the tube **163** the thigh section of the spring frame can be elevated by the automatic knee elevating mechanism notwithstanding that the manual mechanism is not operated.

Covers

To guard against the entrance of lint or other extraneous material into the operating mechanisms of the bed, a power unit cover **170** is employed to protect the power unit, a cover **171** to protect the limit position control mechanisms, a cover **172** best seen in FIGURES 8 and 15 to cover the selector mechanisms and covers **173** over each of the sheaths by which the cables are conducted into the posts of the bed. The foot board **21** aids in covering the selector mechanisms and covers the mechanism disposed within the channel **20**.

Lockout

There may be times when the attending physician desires to have the head section of the spring frame and the hi-low mechanism disabled so that the bed must remain in a position in which it has been set notwithstanding that the patient may try to alter this position. As will be seen in FIGURES 8 and 9, fixed in the cover **172** are lock bars **175** and **176**, each of which is journaled in the top edge of the cover and equipped with a knob disposed thereabove. When the bed has been set in a desired position and the selector mechanism moved to its neutral or middle position, the lock bars **175** and **176** may be rotated into the path of the socket **114** engaging that socket to prevent movement of the selector mechanism in either direction. Should the patient in the bed move the operate rod **130** out of its neutral position, the motor may be started but the mechanisms of the bed will not be operated since the drive wheel is in neutral position and not engaging either of the friction wheels.

From the foregoing it will be apparent that the bed of the present invention lends itself to use by ambulatory patients requiring a minimum of nursing care. The bed can be used in locations where manually operated beds are now commonly used because of their lower cost. Since positioning of the head section of the spring frame is controlled by the patient, less care by hospital personnel is required by this bed than is required with manual beds. My improved bed is capable of being placed in all positions that may be required in the treatment of patients. The power unit, including the friction drive, is of simple construction and is thoroughly reliable in operation. The placing of the selector at the foot end of the bed renders it inaccessible to a patient in the bed and simplifies the structure of the bed. Automatically established limit positions guard the mechanisms from being damaged during operations. Protective covers prevent the entrance of lint and the like into the operating mechanisms of the bed to insure long trouble free service of the bed.

What is claimed is:

1. In a hi-low hospital bed having a main frame supported by legs telescoped into posts on the frame and having supported thereon the usual spring frame having head, seat, thigh and foot sections pivotally connected together, said bed having manual means for elevating the thigh and foot sections and having journaled in the main frame a pair of screw shafts spaced apart and parallel to each other, one of said shafts for operating the hi-low mechanism and the other operating the mechanism for raising and lowering the head section of the spring frame; the improvement comprising:

(a) a pair of friction wheels, one attached to each of said screw shafts;

(b) a power unit, including an electric motor, a drive shaft upon which a drive wheel is mounted and disposed between said friction wheels, and a belt for establishing a driving connection between said motor and shaft;

(c) means for selectively moving said power unit transversely of the bed from a central position to engage said drive wheel with said friction wheels, one at a time, to establish driving connections therebetween;

(d) control means for starting and stopping said motor;

(e) and means connecting together said head and thigh sections of the spring frame to enable movements of the head section to effect corresponding movements of the thigh section.

2. A hospital bed as specified in claim **1** in which the main frame includes a channel, fixed to and extending between the posts at the foot end of the bed, disposed with its web innermost and in which the friction wheels and drive wheel are disposed within said channel.

3. A hospital bed as specified in claim **2** on which the power unit comprises a motor support mounted for translatory movement transversely of the bed by means engaging the web of said channel and a cross member of the main frame spaced from said web, a drive shaft housing comprising a front member mounted on said web for translatory movements transversely of the bed, a back member fixed upon and spaced from said front member, a thrust bearing in each of said members in which bearings the drive shaft is journaled, a pulley fixed on said shaft between said bearings, means connecting together said motor support and said drive shaft housing, a motor slide plate mounted upon said motor support for movement transversely of the bed upon which plate the electric motor is fixed, a belt encircling said pulley and a pulley on the shaft of the motor, and spring means for urging said slide plate away from said shaft housing to maintain a predetermined tension on said belt.

4. A hospital bed as specified in claim **3** in which the means for mounting the motor support and front member of the drive shaft housing consists of low friction bushings fixed upon said members and extending through slots in said web and the cross member of the frame.

5. A hospital bed as specified in claim **4** in which the means for selectively moving the power unit consists of a control arm pivoted to the web of the channel and extending through a slot in the upper flange of the channel, a pin fixed in said arm adjacent its lower end and extending through a slot in said web to the motor support to which the pin is fixed; a selector lever pivotally mounted on a cross member of the frame disposed above said channel and extending above said pivot to a selector knob, a pin fixed in the lower end of said lever and extending through a T-shape slot in the upper end of said control arm, said pin moving into one end of the cross portion of said T-slot to maintain the power unit in the operative position in which it has been set by rotation of said arm and lever about their respective pivots.

6. A hospital bed as specified in claim **5** in which there are a pair of lock bars, each of which is engageable with the selector lever to prevent movement of that lever in one direction from a neutral position of the lever.

7. A hospital bed as specified in claim **6** in which the distance between the selector knob and the pivot of said selector lever is greater than the distance between said pivot and the pin at the lower end of the lever and in which the distance between the T-slot in and the pivot of the control arm is greater than the distance between that pivot and the motor support pin, so that a given operating pressure applied to the selector knob to move the mechanism into operating position produces a greater pressure between the driving and friction wheels.

8. A hospital bed as specified in claim **1** in which the control means includes a control rod journaled in cross members of the frame for rotary and axial movements, a pin fixed on said rod and engaged in a slot in the power unit to rotate the rod as the power unit is moved by the moving means; plates fixed upon said rod and moved by rotation thereof into the path of a nut on the screw shaft selected by said movement of the power unit, to determine limit positions for said nut; an electric switch; a collar on said rod engaging the operating lever of said switch; means for moving said rod axially from neutral in either of two directions and thereby operate said switch to start the motor, engagement of the nut with one of said plates

moving the rod axially in the opposite direction to stop the motor.

9. A hospital bed as specified in claim 8 in which the means for moving the control rod axially comprises an operate rod pivotally mounted on said main frame beneath the seat section of the spring frame which rod extends upwardly at the ends of the seat section and terminates in operate knobs readily accessible to a patient in the bed; a pair of levers fixed on said operate rod and pivotally connected to said control rod so that movement of the operate rod around its pivots moves the control rod axially, and spring means surrounding said control rod for returning said rods to a normal position when pressure on the operate knobs is removed.

10. A hospital bed as specified in claim 1 in which the main frame contains side rails composed of rectangular tubing, each of which rails has end sections extending inwardly from each post at an acute angle to the longitudinal median line of the frame and merge into a central section that is parallel to said median line; a sheave journaled in each end section of the rail and extending into the associated post, there being a perforation in the rail at each junction of the ends and middle sections thereof through which perforations the cables of the hi-low mechanisms of the bed enter the end sections of the rail and extend around said sheaves into a space between the posts and legs telescoped therein to a point of attachment at the tops of the legs to support the frame upon the legs.

11. A hospital bed as specified in claim 1 in which the hi-low mechanism includes a nut threaded upon the screw shaft and containing four holes, the axes of which are parallel to the axis of the shaft; a pair of channel shaped catch plates, each having a web abutted against the end of the nut and containing perforations coinciding a pair of holes in the nut; a perforated flange at each end of each catch plate; a pair of cables attached to one of said plates and extending through the holes in the nut to the legs at the head end of the bed to which they are attached; a second pair of cables attached to the other plate and extending through the holes in the nut to the legs at the foot end of the bed to which they are attached; cam means in the end structure at each end of the bed adapted to engage the ends of the legs when the bed is in elevated position to retain the end of the bed in that position; latch springs engaged in the perforations in the flanges of the catch plates to hold the plate associated with the retained end of the bed against movement as the nut is moved to lower the other end of the bed to place the spring frame in position inclined with respect to horizontal.

12. A hospital bed as specified in claim 1 in which the mechanism for raising and lowering the head section of the spring frame includes a cross tube fixed on the head section near the pivotal connection thereof to the seat section; a crank arm fixed upon said cross tube; a tie bar pivotally connected to said crank arm and extending towards the foot of the bed; a roller upon which said tie bar rests; a cross tube fixed upon the thigh section of the spring frame; a crank arm fixed upon said latter cross tube, link means pivotally connected to said latter crank arm and to the distal end of said tie bar and disposed at an acute angle to said tie bar when the head section of the spring frame is in horizontal position, operation of said mechanism to elevate said head section moving said tie bar over said roller and increasing said angle through a right angle into an obtuse angle to elevate the thigh section and thereby prevent a patient in the bed from gravitating towards the foot when the head section is in elevated position.

13. A hospital bed as specified in claim 12 in which the roller is journaled between support arms fixed upon a cross tube that is journaled in the main frame of the bed, which tube can be rotated to disengage the roller from said tie rod when it is desired to have the thigh section of the spring frame remain in horizontal position when the head section is in elevated position.

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U.S. Cl. X.R.

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