United States Patent [19]

Damico

[11] **3,840,910**

[45] **Oct. 15, 1974**

[54] **CONTROL MECHANISM FOR ELECTRICALLY OPERABLE BED**

[75] Inventor: **Frank W. Damico,** Stevens Point, Wis.

[73] Assignee: **Joeens Furniture Company,** Stevens Point, Wis.

[22] Filed: **Mar. 16, 1973**

[21] Appl. No.: **341,869**

[52] **U.S. Cl.** **5/66,** 5/68
[51] **Int. Cl.** **A47c 3/32**
[58] **Field of Search** 5/66–69; 200/5

[56] **References Cited**

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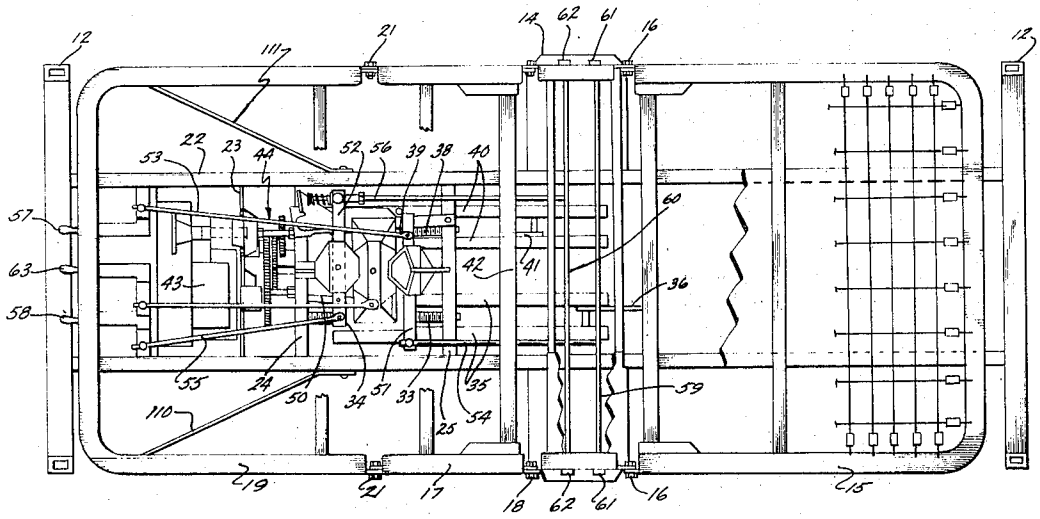
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Primary Examiner—Casmir A. Nunberg
Attorney, Agent, or Firm—Price, Heneveld, Huizenga & Cooper

[57] **ABSTRACT**

An electrically operable bed having a horizontal frame and an articulated spring supported by the frame which has pivotably mounted head, knee, and foot sections. Actuating means are mounted on the frame for effecting desired movement of the spring, including head section drive means and knee section drive means, the drive means being operated by a reversible electric motor via transmission means. A limiting means is associated with at least one of the drive means for limiting the degree of movement of the spring section movable thereby to a predetermined degree of movement.

12 Claims, 10 Drawing Figures



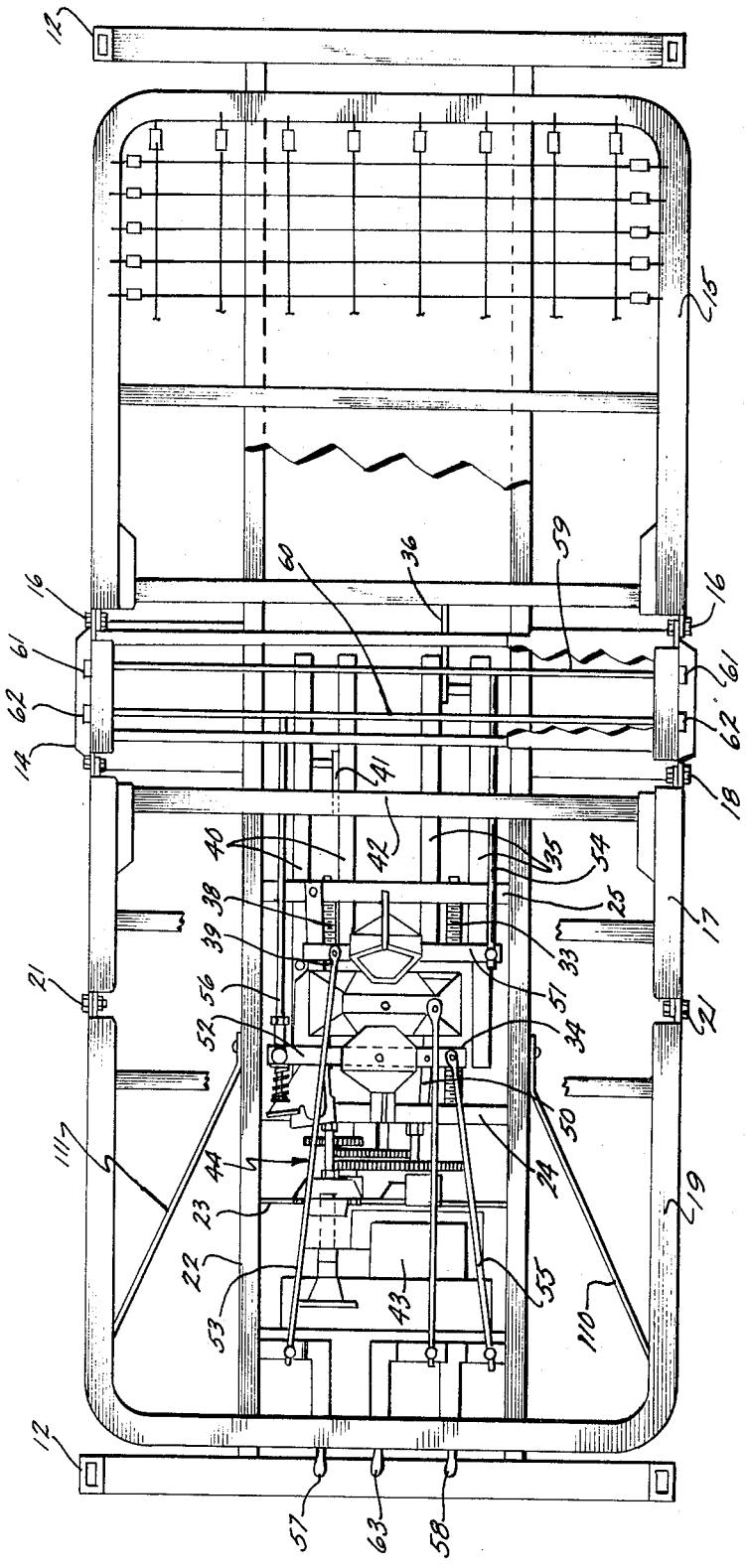

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FIG. 1.

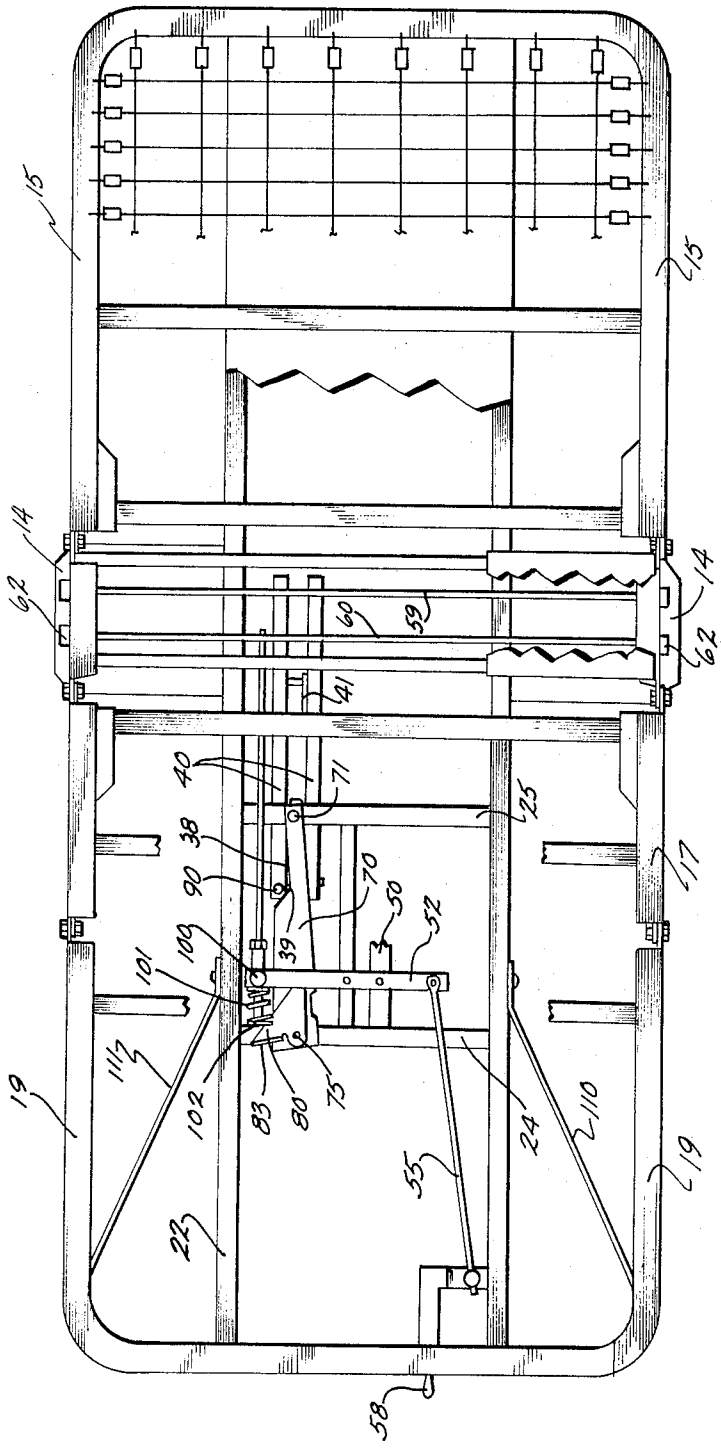

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FIG. 2.

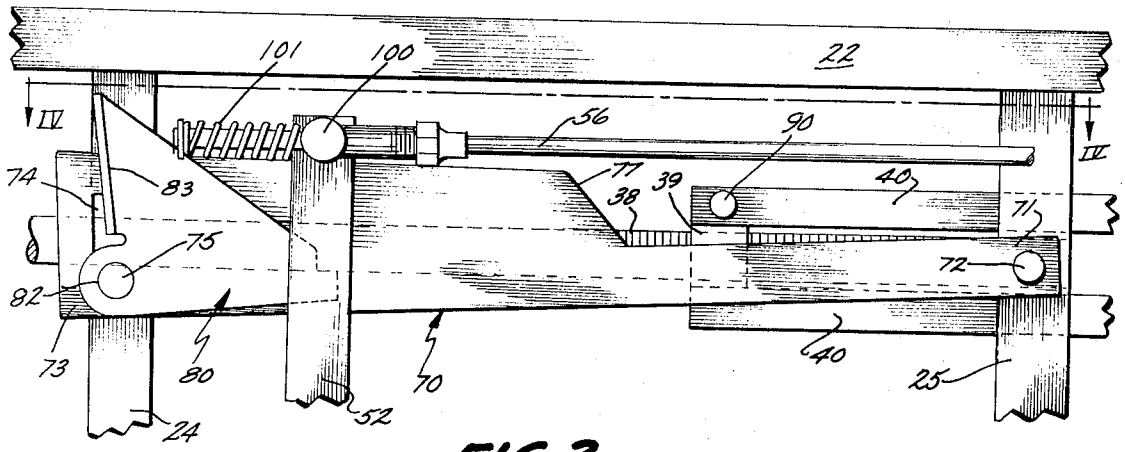


FIG. 3.

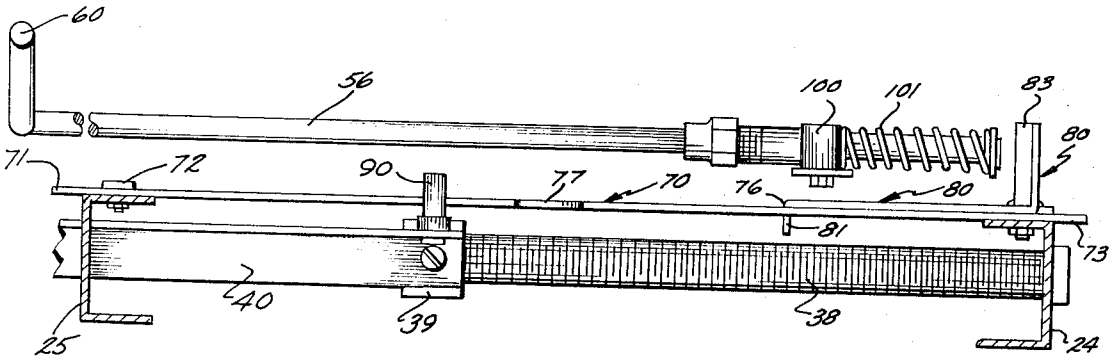


FIG. 4.

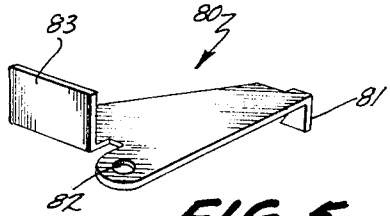


FIG. 5.

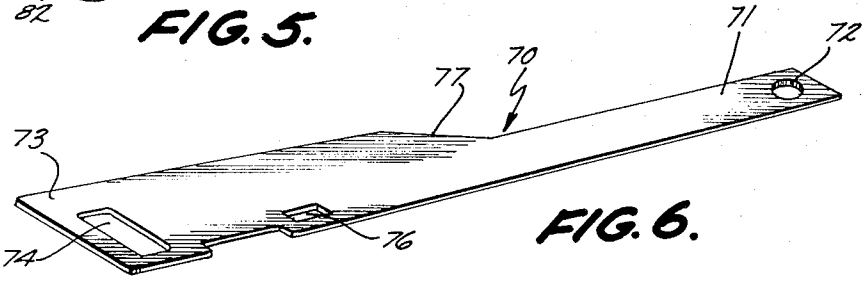


FIG. 6.

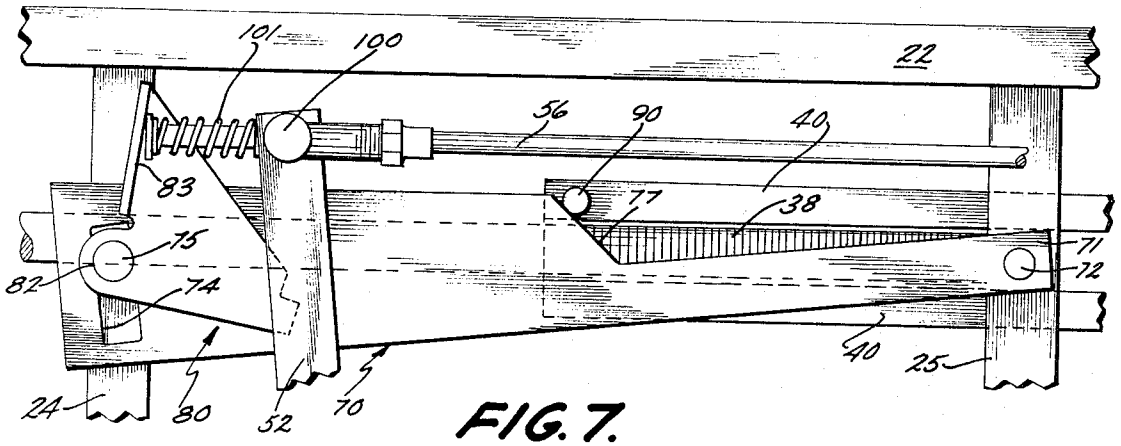

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FIG. 7.

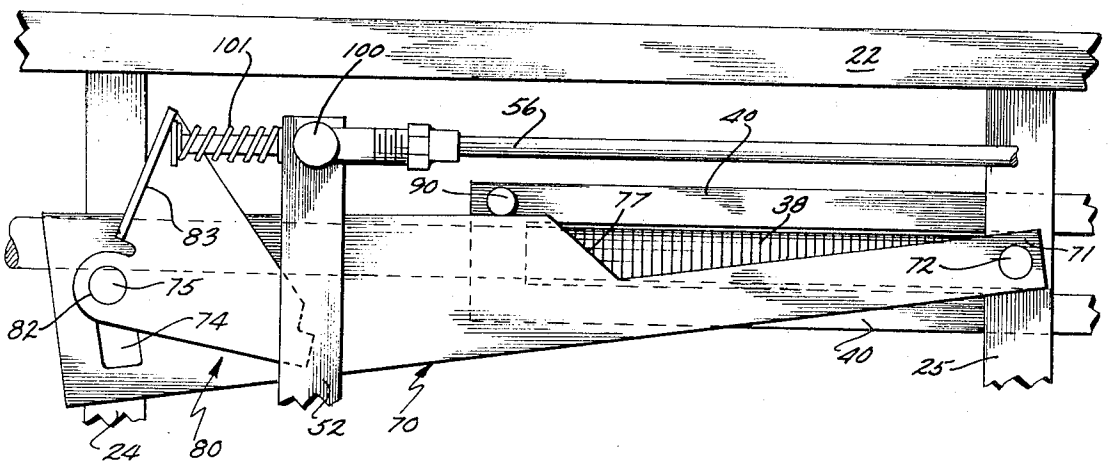

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FIG. 8.

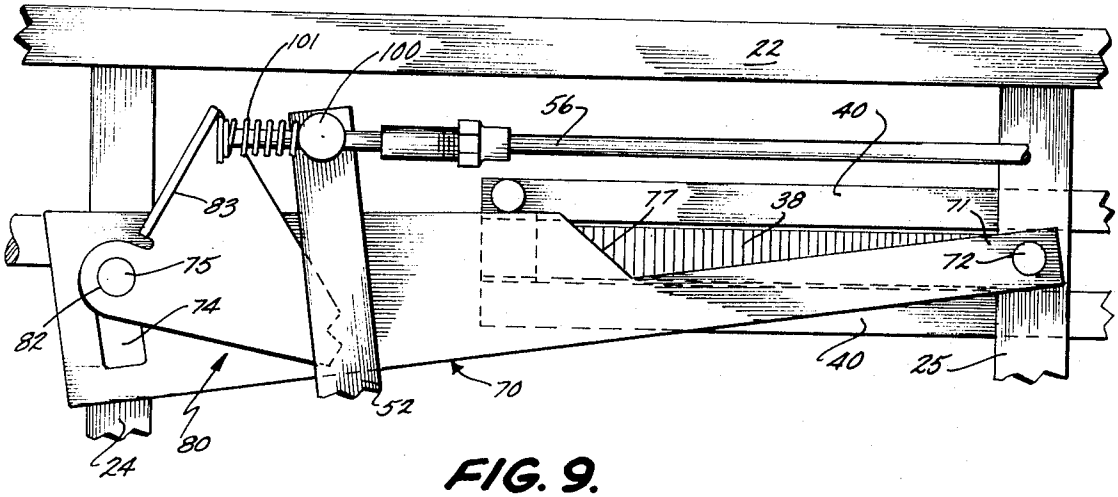

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FIG. 9.

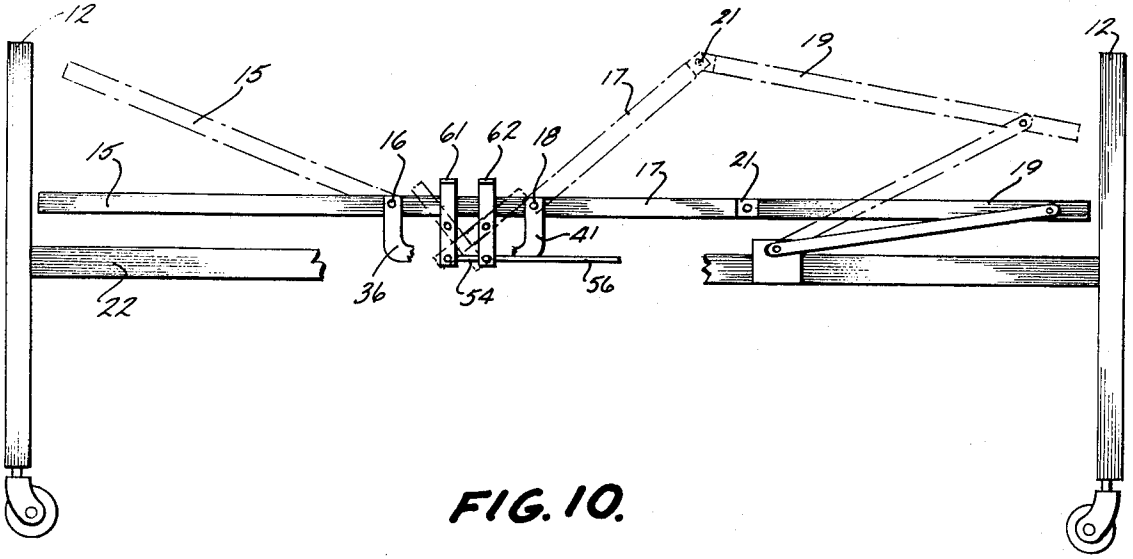

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FIG. 10.

CONTROL MECHANISM FOR ELECTRICALLY OPERABLE BED

BACKGROUND OF THE INVENTION

This invention relates to hospital beds, and more particularly to those selectively operable electrically to raise and lower pivotally swingable head and knee sections of an articulated frame of such beds.

A variety of electrically operable beds are currently used in hospitals which have controls accessible to the patient for raising and lowering the head and knee sections of the articulated frames of such beds. For example, such an electrically operable bed is disclosed in U.S. Pat. No. 3,581,319 issued June 1, 1971 to J. F. Stanley et al., and entitled ELECTRICALLY OPERABLE BED and in U.S. Pat. No. 3,710,404 issued Jan. 16, 1973, to W. J. Peterson and entitled ELECTRIC HOSPITAL BED. Although many of these beds are perfectly satisfactory from a mechanical point of view, in the case of certain injuries, it is not medically desirable to permit the patient to have too great a latitude in the adjustability of his bed because of the chance of aggrevation of his injuries by too great an adjustment of his bed and pressures which may be exerted on parts of the body when the bed is adjusted to too high a degree. For example, in the case of certain knee injuries, it has been found that raising the knee section of the bed more than about 20° can aggrevate such injury and exert a pressure behind the knee which may adversely effect the blood flow. Thus, in the case of such an injury, it is desirable to have a bed which the patient cannot raise the knee section thereof more than about 20°. However, since in the case of patients with other injuries, it may be desirable or even necessary to raise the knee section more than 20°, it would be impractical to construct a bed the knee section of which could not be raised beyond 20°.

Thus, there is a need for an electrically operable hospital bed which limits the patient's ability to adjust the spring sections thereof beyond a certain degree but which also permits the patient's controls to be overridden when a greater adjustment is desired or necessary.

SUMMARY OF THE INVENTION

According to the present invention, there is provided an electrically operable bed having a horizontal frame and an articulated spring supported by the frame which has pivotably mounted head, knee, and foot sections. Actuating means are mounted on the frame for effecting desired movement of the spring, including head section drive means for moving the head section relative to the frame, and knee section drive means for moving the knee section relative to the frame. The drive means are operated by a reversible electric motor mounted on the frame via transmission means. A limiting means is associated with at least one of the drive means, preferably the knee section drive means, for limiting the degree of movement of the spring section movable thereby to a predetermined degree of movement. At least one actuator push rod is provided for selectively actuating the motor in opposite directions to selectively operate the drive means to raise and lower the spring section movable thereby, the actuator push rod being movable between a rising, a neutral, and a lowering position.

The drive means preferably includes a rotatable screw member and a nut member threadably engaged therewith, the screw member being rotatable by the electric motor via the transmission means to produce actual movement of the nut member in either axial direction. The nut member is connected to the spring section by linkage means so that axial movement of the nut member in one direction raises that spring section and axial movement of the nut member in the opposite direction lowers that spring section. The limiting means is actuatable by the drive means to urge the actuator rod from the raising position toward the neutral position when the spring section movable by that drive means is raised to a predetermined position. Preferably, the limiting means comprises a cam follower stud on the nut member and cam means mounted on the bed frame positioned so that when the nut member is moved axially to an axial position where the spring section reaches the predetermined raised position, the stud member will move the cam means to urge the actuator rod from the raising position toward the neutral position. Preferably, a pair of actuator push rods are provided for each drive means which has limiting means associated therewith, with one of the actuator push rods being positioned on the bed so as to be easily operable by an occupant of the bed and the other actuator push rod being positioned on the bed remote from the occupant for operation by a nurse or other attendant. In such case, the remote actuator push rod is operable to override the limiting means so that the particular bed section can be raised beyond the predetermined raised position to which the bed occupant actuator rod is limited.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a plan view, with parts broken away, of a bed emobdying features of the present invention;

FIG. 2 is a plan view of the bed of FIG. 1 showing a single drive means with limiting means according to the present invention, with other elements of the bed having been removed;

FIG. 3 is an enlarged plan view of a portion of the bed of FIG. 2 illustrating the details of the preferred limiting means of the bed of the present invention;

FIG. 4 is a side, elevational view of the bed portion of FIG. 3 taken along the line IV—IV of FIG. 3;

FIG. 5 is a perspective view of a bell plate used in the preferred limiting means of the present invention;

FIG. 6 is a perspective view of a cam plate used in the preferred limiting means of the present invention;

FIGS. 7–9 are enlarged plan views of the bed portion shown in FIG. 3 showing the limiting means in various positions of adjustment; and

FIG. 10 is a schematic side-elevational view of the bed illustrating the various sections of the bed in different adjusted positions.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to the drawings in more detail, FIGS. 1, 2, and 10 show an electrically operable bed embodying the features of the present invention. The bed comprises a main frame 11 which is supported at each end in a well-known manner by means of four outer legs 12 secured thereto. The main frame 11 supports a normally horizontally disposed, articulated spring which comprises an intermediate or seat section 14 rigidly se-

cured to the frame, a head section **15** pivotally connected to the intermediate section at **16,** a knee section **17** pivoted to the seat section **14** at **18,** and a foot section **19** pivotally connected at **21** to the knee section **17.** The frame **11** includes side rails **22,** and a plurality of rigid transverse members including outer and inner gear box plates **23** and **24** and a bearing frame plate **25.**

Head section drive means are provided for raising and lowering the head section **15** of the spring about its pivot **16** relative to the frame **11** which includes a head screw **33** mounted in suitable thrust bearings carried by the inner gear box plate **24** and the frame plate **25.** A nut **34** threadably engages the screw **33** and is connected to the rear ends of the forwardly extending links **35.** The forward ends of links **35** are pivotally connected to crank arm means **36** to swing the head section **15** up or down about its pivot **16** depending upon the direction of rotation of the head screw **33** and the resultant axial movement of nut **34.**

Knee section drive means of similar construction are also provided for raising and lowering the knee section **17** about its pivot **18** relative to the frame **11.** The knee section drive means includes a knee screw **38** mounted in a similar manner to the screw **33,** a nut **39** threadably engaging screw **38** similarly to nut **34** and screw **33,** and forwardly extending links **40** connected at their rear ends to nut **39.** The forward ends of links **30** are pivotally connected to crank arm means **41** secured to a transverse crank shaft **42** depending from the inner end portion of the knee section **17.** Rotation of the knee screw **38** thus will be transmitted by means of nut **39,** links **40,** crank arm means **41** and crank shaft **42** to the knee section **17** to swing the same up or down about its pivot **18** depending on the direction of rotation of the screw **38** (see FIG. **10**).

The drive screws **33** and **38** are adapted to be selectively actuated by a reversibly operable electric motor **43** through the agency of transmission means mounted between the plates **23** and **24.** The transmission means **44** are conventional and comprise a series of sprocket wheels, chains, and gears such as disclosed in the above-mentioned U.S. Pat. Nos. 3,581,319 and 3,710,404. Thus, motor **43** can be selectively actuated to rotate either screw **33** or screw **38** to raise or lower head section **15** and knee section **17,** respectively.

As disclosed in U.S. Pat. No. 3,581,319 and U.S. Pat. No. 3,710,404, the operation of reversible motor **43** is controlled by microswitches which are selectively actuated by longitudinal movement of a switch bar **50.** Longitudinal movement of switch bar **50** is produced in a conventional manner by pivoting movement of rigid control straps or bars **51** or **52,** pivoting of control bar **51** causing motor **43** to be energized to raise or lower head section **15** and pivoting of control bar **52** causing motor **43** to be energized to raise or lower knee section **17.**

Control bar **51** is pivoted by means of either of a pair of actuator push rods **53** and **54,** and control bar **52** is pivoted by means of either of a pair of actuator push rods **55** and **56.** Actuator push rods **53** and **55** extend from their respective control bars to the foot of the bed where they are secured to and actuable by means of bell crank handles **57** and **58,** respectively, which are actuable by a nurse or other attendant. (A third bell crank handle **63** can be included to operate a vertical bed raising mechanism [not shown] if such is included on the bed.)

Actuator push rods **54** and **56** extend to intermediate section **14** where they are linked to the transverse control rods **59** and **60,** respectively, which in turn are connected to the control levers **61** and **62,** respectively, provided on both sides of the bed and which are accessible to the bed occupant. Thus, a pivoting movement of either of levers **61** will rotate control rod **59** to move actuator push rod **54** for actuation of motor **43** to raise or lower head section **15.** Similarly, pivoting movement of either of levers **62** will rotate control rod **60** to cause movement of actuator push rod **56** to actuate motor **43** to raise or lower knee section **17.** As will be appreciated, as knee section **17** is raised, the end of foot section **19** which is hinged thereto will also be raised with the other end of foot section **19** being supported by pivoting arms **110** and **111** (see FIG. **10**).

A novel limiting means is associated with the knee section drive means for limiting the degree of raising movement of knee section **17** by the bed occupant via control levers **62.** This limiting means is most clearly shown in FIG. **2** in which other elements of the bed have been removed to more clearly show the elements of the limiting means. Further structural detail of the limiting means is shown in FIGS. **3–9** to which reference will also be made. The limiting means includes a stop plate **80** which is moved into the path of the actuator push rod **56** (which is the rod actuated by the patient) in response to the knee section **17** being pivoted to a predetermined position. Thus, stop plate **80** prohibits further raising of the knee section by the patient.

As shown, the limiting means includes a cam means comprising a cam plate **70,** the stop plate **80,** and a cam actuator member **90.** One end **71** of cam plate **70** is pivotally mounted to frame plate **25** by means of a shoulder bolt or the like through aperture **72** so that the opposite end **73** can be swung through an arc. End **73** has an elongated aperture **74** for mounting end **73** to frame plate **24** on a shoulder bolt member or the like **75** so that end **73** can be swung through a limited arc. Cam plate **70** also has an aperture **76** for receipt of depending tongue **81** of stop plate **80.** Stop plate **80** is mounted on top of end **73** of cam plate **70** by means of shoulder bolt member **75** passing through aperture **82** so that stop plate **80** is pivotable on shoulder bolt member **75.** Depending tongue **81** is positioned through aperture **76** so that when end **73** of cam plate **50** is swung through a clockwise arc, stop plate **80** will be pivoted through a counterclockwise arc and vice versa. Extending up from stop plate **80** is a stop flange **83** for engagement with the end of actuator push rod **56** as will be expalined more fully hereinafter.

Cam plate **70** includes a cam ramp portion **77** for engagement by cam actuator **90.** Cam actuator **90** is rigidly mounted adjacent nut member **39.** Thus, as nut **39** is moved axially toward the foot of the bed, cam actuator **90** will contact cam ramp portion **77** of cam plate **70** to pivot end **73** in a counterclockwise arc to produce clockwise pivoting of stop plate **80.**

The end of actuator push rod **56** is secured to control bar **52** by means of a collar member **100** which is affixed to one end of control bar **52.** The end of actuator push rod **56** has a stepped-down diameter which passes through an aperture in collar **100.** The stepped-down diameter of the end of push rod **56** provides a shoulder

portion which abuts the inward side of collar **100** so that as push rod **56** is pushed toward the foot of the bed, control bar **52** will be pivoted counterclockwise. The stepped-down diameter portion of push rod **56** passes through and beyond the aperture in collar **100** for receipt of a coil spring **101** which is secured on the end of push rod **56** by means of a suitable washer **102** or the like. The diameter of coil spring **101** is greater than the diameter of the aperture through collar **100** and the rigidity of coil spring **101** is great enough so that as push rod **56** is moved toward the head of the bed, control bar **52** will be pivoted in a clockwise direction. The purpose of coil spring **101** is to permit the limiting means to be overridden by movement of actuator push rod **55** as will be explained more fully hereinafter.

OPERATION

The operation of the limiting means to limit the bed occupant's ability to raise knee section **17** beyond a predetermined raised position will now be explained. FIG. **3** depicts actuator push rod **56** in the neutral position, i.e., with motor **43** not being energized. When the bed occupant desires to raise knee section **17,** he pulls one of the control levers **62** toward the head of the bed which moves push rod **56** toward the foot of the bed to pivot control bar **52** in a counterclockwise direction which in turn moves switch bar **50** toward the head of the bed to energize motor **43** in the raising direction. Energizing of motor **43** causes the screw **38** to rotate to move nut **39** axially in the direction of the foot of the bed to raise knee section **17** via links **40** and crank arm means **41.** As nut member **39** moves axially toward the foot of the bed, cam actuator **90** will contact cam ramp portion **77** of cam plate **70** to pivot the end **73** in a counterclockwise direction. This in turn will pivot stop plate **80** in a clockwise direction so that stop flange **83** moves toward the end of push rod **56** (FIG. **7**). As nut **39** continues toward the foot of the bed, cam actuator **90** will reach the end of cam ramp portion **77,** at which point the end **73** of cam plate **70** will be swung to the end of the counterclockwise arc permitted by aperture **74** and stop flange **83** of stop plate **80** will have contacted the end of push rod **56** and urged it back toward the neutral position (FIG. **8**). Moving push rod **56** toward the neutral position will de-energize motor **43** via control bar **52** and switch bar **50** to stop the raising movement of knee section **17.** It is not necessary to move push rod **56** completely back to the neutral position since motor **43** will be de-energized by only a small movement of push rod **56** toward the neutral position. As long as cam actuator **90** remains in contact with the side of cam plate **70,** as shown in FIG. **8,** stop flange **83** will prevent push rod **56** from being returned to the raising position, and thus, the bed occupant will not be able to raise knee section **17** any further.

In the event it is deemed desirable for medical reasons, etc, to raise knee section **17** beyond this predetermined raised position, the limiting means may be overriden by energizing motor **43** via actuator push rod **55** from the foot of the bed. As actuator push rod **55** is moved toward the head of the bed by bell crank handle **58,** control rod **52** will again be pivoted in a counterclockwise direction to move switch bar **50** toward the head of the bed to re-energize motor **43** to continue the raising movement of knee section **17.** Because of the stepped-down diameter on the end of actuator push rod **56,** collar **100** will be moved toward the end of push rod **56** against the biasing force of spring **101** when actuator handle **58** and push rod **55** are employed to pivot control rod **52** (FIG. **9**). Thus, even though push rod **56** still cannot be returned to the raised position because of stop flange **83,** stop flange **83** does not prevent the pivoting of control bar **52** by means of actuator **58.** However, stop flange **83** does offer resistance to movement of rod **56** and thus, the attendant at the end of the bed as he or she actuates handle **58** very clearly will sense when the knee section is raised to 20° because as that point is reached, an extra amount of force on handle **58** is required to overcome the force of spring **101.** Accordingly, the mechanism does indicate to the attendant when the 20° raised position is reached.

In order to lower knee section **17** to the horizontal position, either push rod **55** is pulled toward the foot of the bed by handle **58** or push rod **56** is pulled toward the head of the bed by handle **62** to pivot control bar **52** in a clockwise direction to push switch bar **50** toward the foot of the bed to actuate motor **43** in reverse. As screw **38** is rotated in reverse, nut **39** will travel axially toward the head of the bed to lower knee section **17.** Cam actuator **90** will travel with nut member **39** back to the position shown in FIG. **3.** Although cam plate **70** will then be left in the extreme of its counterclockwise arc and stop flange **82** of stop plate **80** adjacent the end of push rod **56** when push rod **56** is returned toward the neutral position, movement of push rod **56** by the bed occupant toward the foot of the bed will cause stop plate **80** and cam plate **70** to return to the position of FIG. **3** since cam actuator **90** will not be adjacent cam plate **70** to prevent clockwise pivoting thereof. Of course, conventional spring means can be employed to bias cam plate **70** and stop plate **80** back to the position of FIG. **3** as soon as cam actuator **90** disengages from contact with cam plate **70,** but this is not necessary and will not affect the efficiency of the operation of the limiting means.

Although the limiting means of the present invention has been described and illustrated in connection with the knee section, it will be obvious to those skilled in the art that the limiting means can be employed in conjunction with the drive means for the head section in similar fashion. Further, the limiting means can be employed to limit the degree of raising of a particular spring section to any predetermined limit and is dependant only upon the location of cam ramp **77** on cam plate **70** relative to the point at which it will be engaged by cam actuator member **90** to actuate the limiting means. Thus, although it will generally be preferred to design the limiting means to limit raising of the knee section by the bed occupant no more than about 20°, as discussed above, this is merely a matter of choice. Finally, it will be obvious to those skilled in the art that a variety of modifications can be made in the limiting means of the present invention without departing from the spirit thereof. For example, the limiting means can be employed to restrict lowering the bed section as well as to restrict the raising thereof. In addition, the particular configuration of the bell crank plate, the cam plate, and the cam follower stud can be changed or rearranged to provide similar results. Thus, the scope of the present invention is deemed to be limited only by the following appended claims.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. In an electrically operable bed having a horizontal frame; an articulated spring supported by said frame having at least one adjustable section; electrically operable actuating means mounted on said frame for effecting desired movements of said spring section, including drive means for moving said section relative to said frame; a reversible electric motor mounted on said frame, and transmission means mounted on said frame for selectively operating said drive means by said motor; the improvement which comprises: limiting means operably associated with said drive means for limiting the degree of movement of the spring section movable by said drive means to a predetermined degree of movement, said predetermined degree of movement being less than the full raising movement obtainable by said electrically operable actuating means; and wherein said electrically operable actuating means includes a first control means accessible to an occupant of said bed and being operably connected to said limiting means whereby said first control means is operable by an occupant of said bed to selectively operate said drive means only to the extent permitted by said limiting means; and a second control means positioned on said bed remote from said occupant to selectively operate said drive means to the full raising movement obtainable independently of said limiting means.

2. An electrical operable bed according to claim 1 wherein said first control means includes a first actuator push rod for selectively actuating said motor in opposite directions to selectively operate said drive means to raise and lower said spring section movable thereby, said first actuator rod being movable between a raising, a neutral, and a lowering position; said limiting means being actuatable by said drive means to urge said first actuator rod toward the neutral position and/or to restrain said first actuator rod from being positioned in the raising position when said spring section movable by said drive means is raised to said predetermined position.

3. An electrical operable bed according to claim 2 wherein said second control means includes a second actuator push rod, and said second rod is operable to override said limiting means whereby said second rod can be retained in the raising position after said predetermined raised position is reached to raise said section movable by said drive means beyond said predetermined raised position.

4. An electrically operable bed according to claim 1 wherein said first control means includes a first actuator for selectively actuating said motor in opposite directions to selectively operate said drive means to raise and lower said spring section movable thereby, said first actuator being movable between a raising, a neutral, and a lowering position; said limiting means being actuatable by said drive means to urge said first actuator toward the neutral position and/or to restrain said first actuator from being positioned in the raising position when said spring section movable by said drive means is raised to a predetermined position.

5. An electrically operable bed according to claim 4 wherein said second control means includes a second actuator and said second actuator is operable to override said limiting means whereby said second actuator can be retained in the raising position after said predetermined raised position is reached to raise said section movable by said drive means beyond said predetermined raised position.

6. An electrically operable bed according to claim 2 wherein said drive means includes a rotatable screw member and a nut member threadably engaged therewith, said screw member being rotatable by said motor via said transmission means to produce axial movement of said nut member in either axial direction and said nut member being connected to said spring section movable by said drive means by linkage means so that axial movement of said nut member in one direction raises said spring section movable by said drive means and axial movement of said nut member in the opposite direction lowers said spring section movable by said drive means; said limiting means comprising a cam actuator adjacent said nut means; and cam means on said frame positioned so that when said nut means is axially moved to an axial position where said spring section movable by said drive means is at said predetermined raised position, said cam actuator will move said cam means to urge said first actuator push rod toward the neutral position and/or to restrain said first actuator push rod from being positioned in the raising position.

7. An electrically operable bed according to claim 6 wherein said cam means comprises a cam plate and a stop plate; said cam plate and said stop plate each being pivotably mounted on said frame and positioned with respect to each other so that pivoting of either one of said plates causes the other of said plates to pivot; said cam plate having a cam ramp portion engageable by said cam actuator when said nut means is at said axial position to pivot said cam plate to cause said stop plate to pivot to urge said first actuator push rod toward the neutral position and/or to restrain said first actuator push rod from being positioned in the raising position.

8. An electrically operable bed according to claim 3 wherein said drive means includes a rotatable screw member and a nut member threadably engaged therewith, said screw member being rotatable by said motor via said transmission means to produce axial movement of said nut member in either axial direction and said nut member being connected to said spring section movable by said drive means by linkage means so that axial movement of said nut member in one direction raises said spring section movable by said drive means and axial movement of said nut member in the opposite direction lowers said spring section movable by said drive means; said limiting means comprising a cam actuator adjacent said nut means; and cam means on said frame positioned so that when said nut means is axially moved to an axial position where said spring section movable by said drive means is at said predetermined raised position, said cam actuator will move said cam means to urge said first actuator push rod toward the neutral position and/or to restrain said first actuator push rod from being positioned in the raising position.

9. An electrically operable bed according to claim 8 wherein said cam means comprises a cam plate and a stop plate; said cam plate and said stop plate each being pivotally mounted on said frame and positioned with respect to each other so that pivoting of either one of said plates causes the other of said plates to pivot; said cam plate having a cam ramp portion engageable by

said cam actuator when said nut means is at said axial position to pivot said cam plate to cause said stop plate to pivot to urge said first actuator push rod toward the neutral position and/or to restrain said first actuator push rod from being positioned in the raising position.

10. An electrically operable bed according to claim **9** wherein said first and second actuator push rods are coupled to a common pivotally mounted rigid control bar, the pivotal movement of said control bar by either of said actuator push rods causing actuation of said motor, said first rod being resiliently coupled to said control bar so that said control bar can be pivoted by said second rod by being moved to the raising position of said second rod without movement of said first rod whereby said second rod is operable for said overriding of said limiting means.

11. An electrically operable bed according to claim **10** wherein said adjustable section is the knee section and said drive means is the knee section drive means.

12. An electrically operable bed according to claim **1** wherein said adjustable section is the knee section and said drive means is the knee section drive means.

* * * * *

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,840,910 Dated October 15, 1974

Inventor(s) Frank M. Damico

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

On Cover Page;

After "Inventor:", "Frank W. Damico" should be

--Frank M. Damico--;

Column 1, Line 66;

"rising" should be --raising--;

Column 6, line 28;

"82" should be --83--.

Signed and sealed this 8th day of April 1975.

(SEAL)
Attest:

RUTH C. MASON
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents
and Trademarks

FORM PO-1050 (10-69)

USCOMM-DC 60376-P69
* U.S. GOVERNMENT PRINTING OFFICE : 1969 O—366-334.