ABSTRACT
An improved hospital or other type bed with included frame, in which the body-supporting surface, comprising a spring assembly, is suspended by two journal bearings located at the longitudinal center of the head and foot of the bed. This body-supporting surface can be adjusted from the flat position to a cradle or concave configuration; and in such cradle position it can be turned from side to side either by the patient himself, or by caretaking personnel. The other adjustments of the bed such as raising of head, feet or thigh sections thereof by motorized or manual means are unaffected by the construction permitting cradling; and these other adjustments can be made regardless of whether the body-supporting surface is in flat or cradling position. This cradling adjustment is accomplished with novel multiple hinges provided preferably one at each end of the bed; these hinges serve to extend or contract related telescoping end rails for the bed which end rails, in turn, move double side rails inwardly or outwardly from the center of the bed. Control of patient turning is effected by (a) a special brake at one end of the bed and also by (b) cables attaching the side rails to the bed frame. Other flexible cables are employed for articulation of the bed without interfering with the lateral turning of the body-supporting surface along the longitudinal axis of the bed.
Fig. 1

Indicates, generally, the interrelated assemblies for laterally extending and collapsing the spring assembly 24.
Indicates, generally, the multiple hinge structure comprised of related elements 22a through 22c.

Fig. 2
CRADLING AND ARTICULATED BED

Our invention, relating generally to articles of furniture which can be made to assume a variety of positions, has particular application to hospital beds and generally similar equipment through the use of which and following the practice of our invention, the patient himself, while he is reclining upon the bed, can readily adjust the same into a variety of positions conforming with his own precise desires and needs. As well, and when desirable, the bed can be locked against patient-turning, in such instance being subject to turning only by the attendant.

For more ready and thorough understanding of our invention, it should be noted that while non-ambulatory and bedridden patients, of whom those requiring long hospital stays are typical, must be frequently turned upon the bed from one side to another, and this for any one or more of a number of reasons, illustratively including comfort, to avoid cramping, to prevent bed sores, or to permit making up the bed, nevertheless the patient of impaired physical well being, though he suffers from the need to turn, ordinarily cannot accomplish such turning by himself without assistance from an attendant. On the contrary, such turning heretofore could usually be accomplished only by or with the aid of a nurse or nurses, depending upon the weight of the patient. Without private nursing then, and with the floor nurse at her call station or the like, the patient must, for such turning, await the pleasure and availability of hospital attendants.

Those skilled in the medical arts, and having particular reference to the field of orthopedics, have long been fully aware of this problem; and over many years they have directed concentrated study and efforts towards its resolution. Illustrative of these efforts are water beds, pulsating beds, beds using a flexible and at least a semimoldable filler of viscosity substantially greater than that of water, of which gels are illustrative; and generally similar resorts and practices. Both forced air and bead beds have also been resorted to and, following trial, have in general, been discarded. Turning frames, with attendant necessity of strapping the patient thereto, have only specialized application. Even more serious, however, is the fact that turning a patient in such a frame often hurts him; or as others turn him, he feels insecure, even to the point of fear and fright.

In sum, then, each of these prior proposals have, for one reason or another, uniformly fallen short of the attempted goals, still leaving it necessary for the attendant to turn the bedridden patient, or alternatively, for the patient to suffer. As well, those devices heretofore proposed and of which these applicants have knowledge, cannot be readily mounted on and operably connected with the present-day hospital bed. Rather, they require highly specialized bed assemblies and mechanisms, each costly in itself and quite expensive in the aggregate; they are costly to an extent such as to make them unfeasible from an economic standpoint. In short, these prior devices are simply too expensive, too incomplete or too ineffective for universal acceptance.

Through our new construction we make it possible for the first time that the bedridden patient can, with ready facility, and while reclining therein, himself turn the bed about its longitudinal, horizontal axis, and hence, to either side, the bed thereupon remaining in its adjusted position thus reached, and into which it has been turned.

Particularly important is the fact that through our new construction, embodied in hospital bed, the recumbent patient can readily turn the bed even though the bed itself may already have been adjusted (a) to raise the patient’s upper body or torso, (b) to bend the patient’s legs, or (c) any combination of these adjustments.

Accordingly, an object of our invention is to provide apparatus whereby the patient, prone upon a hospital bed or the like, can nevertheless, provided only he can move some portion of his body, readily rotate the bed from side to side through substantial angular movement about its horizontal axis.

Moreover, and with bed embodying our new construction, this bed, with patient resting thereon, will still, and it is an object of our invention to, in large measure retain its usual adjustability, such as vertical bodily displacement thereof, together with tilting of bottom and top portions of the bed or both, through transverse horizontal axis. Thus, for example, the patient’s head and chest can be raised or lowered, or his legs bent, all to achieve a position of maximum comfort. We accomplish all the foregoing in ready and efficacious manner.

Another object is to provide apparatus of the type described, wherein either the recumbent patient or the attendant can make longitudinal adjustments, to furnish comfortable cradling for the patient upon the bed.

Another object is to provide an apparatus of the type described that positively accommodates as to the magnitude of the angle relative to the horizontal through which the patient-carrying portion of the bed can be rotated about its longitudinal axis.

Another object is to provide apparatus whereby and as desired, the attendant can restrict the same against manipulation by the patient.

Further, our invention has as a major objective, the safe and inexpensive adaptation of an existing manual or electrically-controlled hospital bed so that, unlike present beds, the patient can lower himself or be lowered by others into a concave or cradled position in which he can readily and safely turn or be turned, to a series of different and nicely selected positions relative to the horizontal - all without ever changing his placement relative to the supporting surface of the bed.

A further object is to provide a method for allowing the patient or occupant of such a bed to rest at will, while in supine position on either his right or his left side, without any necessity whatsoever of materially shifting his weight or body alignment.

Another object is to provide control of all positions of the bed, relative to the horizontal, either by the patient himself or by his caretaking-personnel, such as doctor, nurse or others, when the patient either is unable or cannot be permitted this option. Thus the caretaking-personnel can, when required, restrict patient-turning of the bed from and out of any desired and preselected position of this latter.

Still another object is to provide the patient with different degrees of cradling concavities upon the bed, ranging from the lowest or fully cradled position on the one hand, to the highest, single plane and fully horizontal position of the typical bed on the other hand, all in dependence upon the patient’s needs or comfort of the moment.
A still further object is to assure, in the design of our new apparatus, full strength and durability of every component thereof, together with complete reliability of function, all easily maintainable and with full safety for both the patient and the caretaking personnel.

Another object is to maintain the appearance of the typical or standard bed; this, in order to relieve any possibility of the patient's fear of or resistance to the use of our new bed.

Yet another object is to provide for diversity of use beyond present hospital beds, as in the bed's employment as a patient-carrying stretcher, in the course of which use the concave position of the bed spring adds materially to the safety of the patient in transport, while reducing the width of the bed for easier wheeling through hospital doors and corridors. Furthermore, with bed at rest and with bed spring in the same concave position, the bed can serve as a safe and comfortable sofa or chair for use by several people, quite unlike the hospital beds as presently in use.

Finally, it is an object of our invention to adjust the bed closely, not only for the degree of horizontal rotation of the body about the longitudinal axis of the bed, but also for the size of the occupant, be such occupant a baby, a broad-shouldered and heavy adult male, or an obese adult, whatever may be the patient's condition (whether he be burned, splinted, in traction, in a cast, or under sedation), and this either for brief or protracted periods, enduring even up to several months.

All the foregoing, as well as many other highly practical objects and advantages attend the practice of our invention and will be readily apparent to those skilled in the art, the scope of the application of all of which is more fully set forth in the claims at the end of the following description.

And now, having reference to the several views of the drawings attached hereto as part of this application, wherein we have disclosed, solely for purposes of illustration, and not as limiting, that embodiment of our invention which we presently prefer:

FIG. 1 is a perspective view of our new bed, disclosing the body-supporting surface or bed spring assembly in a cradled position and at full concavity, with the head, thigh and foot (i.e. the top, intermediate and bottom) sections of this spring assembly in lowered positions;

FIG. 2 is an end view of the bed, with the spring assembly in the same cradled position as shown in FIG. 1.

FIG. 3 presents a detail of the multiple hinge already disclosed in FIGS. 1 and 2:

FIG. 3A discloses, on enlarged scale, the drive mechanism with included, elongated screw, for actuating the multiple hinge unit as disclosed in FIGS. 1 through 3;

FIG. 4, comprising a side elevation, is a detail of the friction brake shown in FIGS. 1 and 2;

FIG. 5 discloses, in fragmentary perspective, the multiple spring assembly, with its head and thigh sections in raised positions;

FIG. 6 discloses a fragmentary plan, a detail of the body-supporting multiple spring assembly, already depicted in FIGS. 1 and 5:

FIG. 7, a side view, is a detail of the mechanism which raises the head segment of the transversely split spring assembly of FIGS. 1 and 6, the head section of the upper side rail 26 being disclosed in lowered position, (the raised position of which upper side rail is shown in FIG. 5);

FIG. 8 illustrates the mounting for special patient handling or control equipment, such as overhead frames for traction and/or exercising.

THE BED

And now, having particular reference to the several views of the drawings, we disclose (FIG. 1) a bed, typically a hospital bed, indicated generally at 10. And this hospital bed may be manipulated through any convenient power source, as through electrical (as for example, one or more electric motors), hydraulic or pneumatic drive; or it may be operated manually or through any other suitable and available powering means.

The frame of bed 10 (FIGS. 1 and 5) includes head 14 and foot 16. As will be seen, head 14 usually has greater height than does the foot 16. At the tops of each thereof, the head and foot of the bed are provided with rigid stretchers 14a and 16a, respectively (FIG. 1).

Through the intermediary of a multiple hinge structure, with included, suitable ant-friction bearings all to be later described with particularity, bed spring assembly 24 is pivotally swung from the rigid bed assembly 10, 14 and 16. The lower part of bed 10 carries the operating gearing essential for imparting requisite motion to the component elements of the bed and the elements of which, be they apparatus or mechanisms, will shortly be described in greater detail.

As is both customary and requisite with hospital beds, we provide (FIG. 1) legs 15, four in number, which support the bed itself in such manner that the bed can (a) be moved vertically in its entirety, or (b) either end thereof can be moved individually, to typical Trendelenburg positions.

THE BED SPRING ASSEMBLY

Novelty attends the bed spring assembly (this assembly is sometimes termed simply "bed spring" or "spring") for our new construction, and this bed spring assembly 24 is indicated in its entirety in FIG. 1.

As well, certain details of the structure and arrangement of the supporting surface of this bed spring assembly are disclosed in FIG. 6. This spring 24 can be topped by any mattress which has requisite flexibility in all three linear dimensions. For most comfortable support it should be of relatively thin construction, since its component slats of spring steel 24a nicely and closely accommodate to the weight and contours of the patient's body, either when these slats are in their flat, fully extended positions or when they are inclined, through collapse, at various degrees of concavity. For while spring steel responds resiliently to the bending caused by the patient's body, yet it is stiff enough to assume and maintain desired concave or cradle position, at the same time displaying requisite strength to support the heaviest person. After considerable experimentation, we find preferable the use of slats, on the one hand, to one or more and again for convenience, say, four sheets of spring steel, on the other hand. This, because we find slats to conform more readily to changes in positions of the patient during articulation of the spring. Nevertheless, other flexible supporting materials can be utilized, so long as the hinge of choice is a piano-type hinge 25 (FIG. 6) which links the spring 24 to all segments 26a, 26b and 26d (FIG. 5) of the upper side rails 26, this piano hinge being loosely af-
fixed at 24b (FIG. 6) to the slats 24a of bed spring assembly 24, at the one side of the hinge, while being firmly affixed to the side rail 26 at the other side of the hinge. It thus will be noted that in the embodiment disclosed, the spring 24 is comprised of a plurality of slats 24a (FIG. 6), each said slat being pivotally and loosely connected to stud 24b. These studs 24b are, in turn, mounted on and made fast to an elongated segment 25b of the piano-type hinge 25 (FIG. 6), the other portion of which hinge 25 is shown at 25e. Thus, and as has already been suggested, each end of slat 24a is made pivotally fast to a related hinge 25 (FIG. 6). And in this construction the slats are capable of limited rotational motion through an angle related to the vertical and about their related studs 24b, while movement about a horizontal axis at each end of the slats is provided by hinge 25.

MECHANISMS AND CONTROLLED STRUCTURES FOR MOVING THE BED SPRING ASSEMBLY INTO AND OUT OF POSITIONS OF SELECTED CONCAVITY

It becomes appropriate at this point to recall that we provide upper side rails 26, 26 at each end of the slat elements 24a of spring 24, and extending the length of the bed (see FIG. 1 and 6). Further, and to permit the bed to be adjusted to the typical hospital bed positions whereby various portions of the patient's anatomy can be raised and lowered at will, we recall that these rails 26 are transversely broken and hinged at various points along this length, as perhaps best disclosed in FIG. 5, i.e., into segments 26a, 26b, 26c, and 26d.

We employ the slats 24a of spring 24 to provide adjusted degrees of concavity for cradling the patient who, of course, will be directly carried upon a suitable and flexible mattress, not shown, and all as hereinafter more fully discussed. To this end, we provide that the upper side rails 26, 26 (as are also, of course, the lower side rails 28, 28) are movable towards and away from each other. Illustratively, concavity is increased by moving the rails 26, 26 transversely inwardly and towards the longitudinal center line of the bed, while concavity is reduced to a limiting fully horizontal plane position, by moving these upper side rails 26, 26 outwardly and away from each other.

The mechanisms for accomplishing this movement are disclosed in FIG. 1 at each end of the bed 10. For emphasis, it is repeated that these mechanisms, disposed one at each end of the bed 10, serve the ultimate purpose of raising and lowering (i.e., opening and closing) spring assembly 24 to and from its full planar position. When the spring 24 is in this full planar position with mattress atop thereof, bed 10 closely resembles the typical hospital bed and can be fully employed as such. Each such mechanism, indicated generally at 18, may be considered as including as part thereof, tubular and channelized, extensible end rails 20, 20, the details of which will shortly be discussed. Other components of the mechanisms 18, 18 will be disclosed hereinafter in connection with multiple hinge units 22, 22, which latter will be described at a later point herein along with their related control elements 30 et seq. As can be seen from Figs. 1 and 2, these end rails 20, 20 extend transversely across the spring assembly 24, one at each end thereof, and in effect comprise part of the spring assembly 24 itself, as do the upper side rails 26, 26 (FIG. 1). So that spring 24 may be adjustably collapsed to desired extent for requisite concavity, and so that it will be held with requisite rigidity, as by completing a structure which is of generally rectangular configuration as viewed in top plan, with this requisite rigidity being achieved regardless of whether the head and foot section of the spring 24 is moved in transverse articulation either upwardly or downwardly with respect to the other parts of the spring assembly, we make each end of the rail assemblies 20, 20 fast to its related upper side rail 26.

As best seen in FIG. 2, these end rail assemblies 20, 20 each include a pair of elongated, channelized, tubular sleeves 20a, 20a. As just hereinafore suggested, each sleeve 20a is made fast at its outer end to the adjacent end of the related upper rail 26 (see FIG. 1). These tubular sleeves 20a engage about and carry between them, a channel member 20b. The tubular sleeves 20a, 20a telescope about this intermediate channel member 20b at such times as the spring assembly 24 is collapsed, while becoming fully extended when the spring 24 is opened into planar position.

Although it is not absolutely essential, we prefer to provide frictional drag between the channel member 20b and sleeves 20a, 20a, thereby providing limited restraint against the relative movements between these parts. To that end we provide a leaf spring 20c (FIG. 2) which is made fast to one of the tubular members 20a, on the interior thereof, while frictionally engaging the exterior of channel member 20b.

This leaf spring 20c insures that the bed spring 24 tends to remain in the same configuration into which it has been adjusted, retaining this position until it is next again adjusted. Such tendency towards retention of adjustment is characteristic of the use of our bed at all degrees of concavity of spring 24.

In addition to the upper rails 26, 26 (see for example, FIG. 1) we provide paired and longitudinally extending lower rails 28, 28 (FIG. 5 - see also, FIG. 3), carried by and pivotally pinned one to each structural element 22a at the related outer ends of these latter. We note that end rail assemblies 20, 20 serve to restrain the side rails 28 against rotation about their horizontal axes, the purpose of which will be developed at a later point in this disclosure.

As previously stated, the bed spring assembly 24 is pivotally carried from bed 10 in such manner that, not only can the bed spring assembly be both collapsed and/or extended along a longitudinally horizontal axis, but as well, it can be rocked from side to side about that same longitudinal axis. To achieve requisite adjusted concavity, we provide, mounted on the bed 10, a suitable source of power, conventionally but not necessarily one or more electric motors. We observe that alternatively, hydraulic or pneumatic motive power may readily be resorted to. Or manual power may be utilized, if desired. Conveniently this motive power, comprised of one or more motors, as the case may be, together with related reduction gearing, may be located on bed 10. One such outwardly projecting motor shaft is coupled to a related flexible drive shaft 34 at each end of bed 10 (FIG. 2), with each such drive shaft 34 powering a related right-angle drive 36 (FIGS. 1 and 2). A related threaded shaft or screw 30, powered by drive 36, extends upwardly therefrom in a vertical or nearly vertical direction. We provide one such power take off assembly, comprised of flexible shaft 34, right-angle drive 36 and screw 30, for each of the two power take
off shafts extending from opposite ends of the motor, where a single motor is employed. One such assembly is provided at each end of the bed, and is ultimately carried from and supported by the frame of the bed 10.

These elongated screws or rods 30, 30 are oppositely threaded with respect to each other, i.e. screw 30 at one end of the bed will have right-hand threads, while the screw 30 at the other end of the bed will have left-hand threads. Moreover, and to insure identical travel at both ends of bed 10, the screws 30, 30 must be of the same diameter and same pitch, i.e. must have both the same bevel and the same thread count. As already alluded to, requisite synchronous movement of the two ends of the bed can be achieved through the use of power sources other than electric motors and gearing.

MULTIPLE HINGE STRUCTURE - DETAILS OF

It now becomes apparent that each mechanism 18 (FIGS. 1 and 3) for raising and lowering the bed spring 24 and provided, one at each end of the bed, is in reality a coherent structure comprised of end rail assembly 20, multiple hinge structure 22, in the nature of a scissor mechanism (see FIG. 3) and upper and lower side rails 26, 28. It is these mechanisms 18, 18 which, together, fold and unfold bed spring 24.

Referring, then, with greater particularity to this multiple hinge 22, and now having particular reference to the disclosure of FIG. 3, we first observe that there is one such multiple hinge 22 at each end of the bed 10. This hinge 22 is comprised of four elongated structural elements 22a, 22a and 22b, 22b (each of which is here and for convenience indicated as tubular), each of which four elements is hinged at its ends. More specifically, the outer ends of the elements 22a, 22a as shown in FIG. 3 are hinged, as by hinge pins 22c, 22c, to the related lower side rails 28, 28, while the innermost ends of these two elements 22a, 22a are hinged together as by another such hinge pin 22c.

Conveniently, the structural elements 22a, 22a are angled or bent intermediate their lengths so that while the outermost ends thereof (FIG. 3) are hinged to the elements 22a, 22a preferably toward the midpoints of these latter, as by other such hinge pins 22c, the inner ends of these arms 22a, 22b rapidly approach each other, and are mounted for rotation on a bearing shaft 23. The bearing itself for each bearing shaft 23, conventional in nature (typically, it may be some form of the well-known pillow block bearing), and therefore not itself shown, is carried at the head 14 and foot 16, respectively, of bed 10. Thus, and in typical embodiment the upper elements 22b, 22b serve to support the lower elements 22a, 22a in manner such that these elements 22a, 22a form a wide angle between each other. The geometry thus narrated insures fulfillment of an essential requirement, that at all times lower side rails 28, 28 and horizontal shaft 23 are located in fixed relationship with respect to each other in any transverse vertical plane. Moreover, to add structural rigidity and to reduce stress during operation, a rod member 50 connects the bases of the two sets of multiple hinges 22, 22 (FIG. 3).

DETAILS OF BED OPENING AND NARROWING THROUGH DRIVE ROD 30 AND RELATED MECHANISM

For ready understanding of the detailed description now to follow, it is to be noted that the threaded screw or rod 30 threads through the related driven nut 32 and, guided in manner shortly to be described serves, through this driven nut 32 (FIGS. 2 and 3A), (which latter is made pivotally fast to the right-hand, lower element 22a of multiple hinge 22), to lift these base arms 22a, in manner similar to an opening scissors, thereby spreading apart and straightening the slats 34a of the bed spring assembly. Conversely, of course, when the screw 30 is rotated in the opposite direction, as by reversing the driving means, not shown, the base arms 22a, 22a of the scissors or more accurately generally pantograph-like mechanism are swung downwardly, thereby lowering that hinge pin 22c which is disposed therebetweeen, and thereby, through inward movement of lower side rails 28, 28 and related upper side rails 26, 26 dropping the center of the bed slats 24a to the desired extent of concavity.

With the foregoing in mind, and having attention to the enlarged detail of FIG. 3A, it will be seen that near its upper end, screw 30 extends through a cylindrical sleeve 33b with which it is loosely associated, so that it is free for relative rotation with respect thereto. And this sleeve 33b is carried by pin 33e which extends through rod 22b for rotation relative thereto. Pinned collars 33d, 33d closely encircle threaded rod 30, one on each end of cylindrical sleeve 33b, and are made fast to rod 30 as by pins 33f, 33f. Anti-friction bearings, typically roller bearings 33g, 33g (FIG. 3A), encircle screw 30, one on each side of cylindrical sleeve 33b.

MOTION LIMITING ASSEMBLIES - A FIRST, FRICTION-TYPE BRAKING SYSTEM

It will be seen from the foregoing that, without the provision of suitable restraint, the patient might inadvertently rotate the bed spring assembly 24 about its longitudinal axis without limit and to an extent such that he may well be dumped to the floor. To guard effectively against this, we provide two motion limiting means. The first such limiting means comprises the variable braking system indicated generally at 38 in FIGS. 1, 2, and 4, and which, generally of the friction type, is adjustable to infinite detail, so that closely controlled resistance can be interposed to rotation of this bed spring assembly 24. Thus the bed can be adjusted closely according to the differing weights of the individual patients. As well, the hospital or other attendant can himself make suitable adjustment to preclude patient-controlled rotation. Finally, the attendant can rotate the spring assembly 24, with patient reclinering thereon, to desired extent, so adjusting the brake 38 (FIG. 2) that the spring will remain in its adjusted and frictionally restrained position, thereby permitting retention of the patient in a particular position for such ample time as may be required.

Describing brake 38 in greater detail, it will be recalled that bearing shaft 23 (FIG. 4) carries bed spring assembly 24, to this end being mounted, one such shaft at each end of the bed 10, on the pillow block bearings or other suitable, conventional bearings, not shown. Still having reference to FIG. 4, it will be seen that a drum 38b encircles this bearing shaft 23, preferably provided with outwardly projecting hub 38c. Pin 38d extends through hub 38c, thereby making drum 38b fast to shaft 23. We make generally rectangular plate 38e fast, in any suitable manner, to the upper portion of bed 10. A brake band 38a fits about drum 38b and is made fast at one end to plate 38e, as by pin 38f, while
at its other end this band 38a is made fast to pin 38g. This pin 38g is itself made fast to a generally jaw-shaped connector 38b.

Screw 38i (which preferably has lefthanded threads for proper operation) threads through drive nut 38j. This drive nut is pivotally secured by pin 38k to connector 38h. Connector 38h fits loosely about and is carried by shaft 23, behind the brake drum 38b, (FIG. 4). Movement of connector 38h in clockwise direction will cause the brake band 38a to tighten around drum 38b, making bed spring assembly 24, carried on bearing shaft 23, fractionally fast to bed 10, to desired extent. Conversely, when screw 38i is operated so as to turn connector 38h in counterclockwise direction, the pin 38g which is mounted on connector 38h and to which one end of the brake band 38a is attached, is moved counterclockwise from pin 38j which itself is mounted on plate 38e. By result, the brake band 38a is relaxed. Plate 38p is made fast to bed 10. We make collar 38m pivotally fast to plate 38p as by pin, not shown.

We provide paired pin collars 38r, 38s concentric with collar 38m, and one on each side thereof and rotatable relative thereto. Pins 38n, 38o serve to make the pin collars 38r, 38s fast to screw 38i. As well, we provide suitable means for rotating screw 38i, such means, in the embodiment illustrated, comprising a hand crank 38v.

TO SUMMARIZE

By means of the foregoing construction, when the spring assembly 24 is adjusted to its cradle position as shown in FIG. 1, it is free to rotate about its longitudinal axis. Through use of adjustable brake 38, however, which we provide at one end - preferably the foot - of the bed 10, this bed spring assembly 24 can, to desired extent, be restricted against rotation.

It is to be noted that the construction of this brake 38 is such that it restricts transverse rotation of spring assembly 24 through a vertical sweep equally well in either direction of rotation of the spring. It is to be further noted that the restriction of motion is to selected and adjusted extent, as distinguished from a fixed and single magnitude of restriction. Thus, it is possible for caretaking personnel, where desired, to over-ride the brake which has previously been set to selected adjusted frictional braking position. Illustratively, this permits personnel to turn the patient and leave him in any desired stationary position, without the necessity of releasing the brake 38 each time the patient is moved.

MOTION-LIMITING STOP ASSEMBLY

Consideration will now be directed to the second means of restraint against undue rotation, which second means comprises an assembly including the flexible cables 40, 40 (FIG. 2), there being one pair of such flexible cables at each of the head and bottom ends of the bed 10, and one cable of each pair being made fast at one upper end and in desired manner, to a related arm 22a of the multiple hinge assembly 22; the other, lower end of each such flexible cable being made fast to suitable points on bed 10, typically at both the head 14 and foot 16 thereof. With spring assembly 24 adjusted to the cradle position of FIGS. 1 and 2, the limit of rotation of this spring assembly 24 about its longitudinal axis is determined through one or the other of the cables 40 of each pair thereof becoming taut, thereupon effectively restraining against further rotation in that direction.

As well, and when spring assembly 24 is spread and elevated to the single plane position of the usual hospital bed - which is accomplished through the energization and interplay of screws 30, 30 and multiple hinge units 22, 22 - the cables 40, 40 (FIG. 2) become taut at each end of the bed, automatically levelling and locking the bed spring into position parallel to the floor, and thereby effectively preventing all rotation whatsoever, a condition enduring until the spring assembly 24 is again collapsed into an adjusted, cradled position. When the two cables 40 of each pair thereof are taut, no reliance need be placed on brake 38. This is because, when spring assembly 24 is in its fully extended position, the cables 40, 40 effectively lock this spring against longitudinal rotation through vertical sweep.

When, however, bed spring assembly 24 is adjusted to any intermediate position, resulting in a selected degree of concavity, the cables 40 thereupon become slack. And these cables then serve to impede turning of spring assembly 24 through vertical angle to an extent controlled by and in inverse proportion to, the degree of concavity which the operator has caused to be imparted to the bed spring 24.

REQUIREMENT THAT TOP AND BOTTOM RAILS 26, 28 CLOSELY NEST, ONE UPON THE OTHER, DURING ROTATION OF BED SPRING ASSEMBLY 24 ABOUT ITS LONGITUDINAL AXIS - REASON THEREFOR

It is to be noted that when none of the transverse sections into which the bed is divided - the head portion 26d, the intermediate portion 26b, or the bottom portion 26a, or any combination thereof - is either raised or lowered, i.e. the surface of the bed is completely flat, then each segmental top rail 26, closely overlies and nests about its corresponding lower rail 28. Both rails have generally channel section (FIG. 5). And it is to this lower rail 28 (FIGS. 2 and 3) that motion is imparted by screws 30, action through the generally scissors-like multiple hinge units or assemblies 22, 22 (FIG. 3). Now, the telescopic arms 20a, 20a (FIG. 1) are made fast at their outer ends to these upper rails 26, 26. Accordingly, when any of the transverse sections 26a, 26b or 26d (with particular reference to head section 26d) of the bed is raised or lowered, then the outer ends of the upper rails 26, 26 will be raised above and will be free from the corresponding portion of the under rails 28. And since it is the force imparted by the lower rails 28, transmitted through the upper rails 26, that serves to collapse and open, as the case may be, the telescopic elements 20a, 20b, 20a, accordingly any transverse opening or closing movement of the lower rails 28, 28 while the upper rails 26, 26 (particular upper rail sections 26d, 26d) are raised therewith, will be accompanied by an resisted torque or twist which will tend to severely damage the head assembly of the bed.

FAIL SAFE SWITCH

To prevent this we provide a two-part, fail safe, overcoming and normally closed switch 46 (FIG. 5). This normally closed switch is disposed within one set of rails, which set is composed of an upper rail 26 with its related lower rail 28 (FIG. 5) preferably near the head.
end of the bed. The electrical circuitry of this switch is such that with the switch 46 closed, it will override, bypass and maintain de-energized, that one or more motors which power the drive screws 30, 30 for the multiple hinge assemblies 22, 22. Thus, with the particular lower side rail 28 separated from any portion of its related upper side rail 26 (particularly the head section 26d), the bed spring assembly 24 cannot be powered into opening or closing. As part of this fail safe switch 46 the portion 26d of one of the upper side rails 26, 26 is provided with a plunger which cooperates with a related striker plate in the underlying lower rail 28, so that when the upper portion of the bed 10 is lowered to a horizontal position, with the particular top rail 26 fitting closely about its corresponding lower rail 28, the plunger will press against the striker plate, opening switch 46. With switch 46 in open position, its electrical circuitry will no longer bypass the power source for drive screw 30, 30, whereby the latter are freed to energize the multiple hinge units 22, 22, thereby causing these latter to move bottom side rails 28, 28 inwardly or outwardly, as the case may be. In turn, these lower side rails 28, 28, acting through the snugly enclosing upper rails 26, 26, are free to move the telescopic assemblies 20a, 20b, 20a inwardly or outwardly, as described.

Although usually not necessary it is within the contemplation of our invention that a similar switch assembly 46 may be provided for the side rail assembly at the foot of the bed 10.

PROVISION FOR TRACTION BAR

Since our invention is frequently employed in conjunction with traction bars or similar orthopedic apparatus, it becomes necessary, particularly when the patient's body is lowered to substantial extent upon collapse of the bed spring 24 to full concavity, for the traction bar to be lowered by like amount. So too, and when bed spring assembly 24 is rocked through vertical angle about its horizontal axis to either side, then to avoid injury to the patient the traction bar must thereupon be swung along with the spring.

We have resolved this difficulty with the provision as perhaps best shown in FIG. 8. Here, and as referred to the multiple hinge assembly 22, the traction bar has generally vertical arm portion 48a. For supporting this traction bar, we provide related sleeve members. One such sleeve member 50a is pivotally hinged, as by pin 50b, to and is carried by a selected one of the base or bottom arms 22a of multiple hinge 22. By reason of this hinged connection, sleeve member 50a may be maintained in vertical position regardless of whether multiple hinge 22 is opened or closed. Sleeve member 50a loosely receives the lower end of traction bar 48a, holding the same in adjusted position through suitable releasable securing means such as wing nut 50c. If desired, sleeve 50a may be provided with closed bottom, comprising a cup.

In generally similar manner, sleeve 50d is made hingedly fast, as by hinge pin 52b, to the corresponding upper and elongated structural element 22b of multiple hinge 22 so that, regardless of the degree of opening and closing of this multiple hinge 22, the sleeve or collar 50c can be maintained in anti-friction alignment with and encirclement about the arm 48a of the traction bar.

With this construction, the traction bar will faithfully and closely follow movements of the bed spring 24, eliminating possibility of damage to the patient from relative movement between the traction bar and bed spring 24.

MECHANICAL ADVANTAGE FOR CHANGING RELATIONSHIP BETWEEN TOP RAILS 26 AND BOTTOM RAILS 28

A problem of importance encountered in the use of the hospital bed in accordance with our new construction, is to provide, with powering equipment of but moderate capacity, a ready mode of elevating and lowering the head portion of the top rail 26 (which is hingedly pinned to bottom rail 28 at hinge pin 26c), particularly where an extremely heavy patient is carried thereon. To resolve this difficulty, we provide relatively simple means, powered from motivating means already provided. And we accomplish this by obtaining mechanical advantage in novel manner. Thus, we provide hangers 27, 27 (FIG. 7) made fast to and depending from the underside of each of the lower side rails 28. Describing one such disc 29 and its related structure, disc 29 is suspended from and is rotatably carried by anti-friction hanger bearing 27a. One end of flexible cable 31 is made fast to the periphery of disc 29. Near its other end this cable passes through a multiplicity of motion-changing pulleys, conventional in nature and hence not shown, terminating in a conventional powering device also not shown. As the flexible cable 31 is pulled to the right in FIG. 7, it remains at a fixed distance from the center of disc 29, i.e. it gives rise to a fixed force couple. A push rod 37 is made fast to the head end of upper side rail 26 and while it is not necessary that such be the case, we employ a hinged pin connector 37a for that purpose. That end of the push rod 37 remote from upper rail 26 is made hingedly fast, as by pin 39b, to an arm 39. Arm 39 is made fast to, and extended outwardly from the disc 29, beyond the periphery thereof and to such extent that the ratio between the radial distance from the center of disc 29 to hinge pin 39b, to the radius of the disc 29 itself, will give rise to the requisite mechanical advantage. With this structure we find it possible to elevate the head portion 26d of the top rail 26 of the bed 10 with relatively little difficulty. While it is apparent that the construction of FIG. 7 is by no means the only manner by which the head of the bed can be elevated, we find the construction disclosed to be relatively simple, fool proof and entirely adequate.

Also in FIG. 7 we disclose in alternate form a second means for gaining additional mechanical advantage for raising the head portion 26d of side rail 26. A second cable is shown, illustratively attaching to the strap 39. If hanger 27 were extended to include strap 39, the resulting power would be sufficient to permit raising patients of all but extreme weight. In other words, rather than the use of disc 29, in this alternative embodiment we employ a single lever in the form of an extended hanger strap 27, to effect greater mechanical advantage.

DETAILS OF RELATIONSHIP BETWEEN UPPER RAILS 26 AND LOWER RAILS 28

Returning to consideration of the construction disclosed in FIG. 1, we must bear in mind that, where hospital or similar bed 10 is employed, this latter either
may be mechanically operated, or it may be otherwise partially or fully powered. This bed 10 according to FIG. 1 being motorized, the various degrees of concavity or cradling of bed spring assembly 24, as well as all transverse articulation of head, thigh and foot sections of this assembly, together with the raising or lowering of one or both ends of the bed frame 12, is managed either by the patient himself with his conventional control switch 42 (FIG. 1) at the head 14 of the bed 10, or by the nurse or other attendant through her control switch 44 (FIG. 2) at the foot 16 of the bed 10.

From the foregoing, it becomes readily apparent that while in the ordinary bed, such as the typical hospital bed as previously known, the patient's act of turning can oftentimes be fraught with danger and as well, is both painful and with quite likely require more energy than the bedridden patient can safely expend (indeed, the situation is frequently encountered in the case of the patient who, say, is in traction or who otherwise is in diseased or helpless state, that self-turning of his body is impossible), need strongly exists for a bed, the patient-bearing portion of which turns while the patient is reclining thereon. And this is in strong contrast to forcing the patient to turn on the bed's surface, and relative thereto.

All this we accomplish through safe and comparatively inexpensive construction, simple in itself, of long useful life, substantially free of malfunctions and maintenance over continued use, with component parts which are readily available in the market place at minimal cost. And through our new construction the patient can himself, and while prone thereon, readily alter the flat surface of the bed, and thereby and without expenditure of appreciable effort, further himself into a selected position of concavity or cradling, in which position he can either turn or be turned about a generally horizontal axis to a selected one of many different positions of which supine, right or left side, are but illustrative. Moreover, the patient can accomplish this without changing his placement relative to the supporting surface of the bed 10. Thus, so long as the patient remains in the same position in relation to the bed spring assembly 24, he can avoid unwanted stress on any part of his body.

Viewed from the standpoint of the attendant, our construction permits ready changing of bed clothing by nursing personnel in manner virtually painless to the patient, while permitting the attendant readily and easily to turn the patient, first to one side and then the other. Thus the bed clothing can be changed without requiring the nurse to rotate the patient's body relative to the bed spring 24, and without necessity of change in the alignment of the patient's spine or extremities during such change of bedding. At the same time, and when our new construction is embodied in a hospital bed, the motions conventional in such beds are retained almost in their entirety, such as those raising and lowering the upper portion of the body, the thighs, the feet, all coupled with total bed elevation. And such total elevation, in turn, may be accomplished without regard to and either with or without raising either the head or the foot of the bed. Maximum patient comfort is assured. The substance of the last two paragraphs, this included, as well as the scope of this application, may be synopsisized in the following abbreviated

SUMMARY

In many cases of illness or injury the patient cannot turn over or cannot even be turned. The result is bed sores, cramping and cumulative forms of discomfort. In the past, nurses or other caretaking personnel have laboriously turned such patients periodically or where this was impossible, as with casts, traction, and other bone or circulatory disorders, the suffering deriving from immobility simply must be endured.

When occupying the present bed, the patient can turn or be turned without changing his position relative to the surface of the bed. In short, when this bed is caused to assume a cradling position, the occupant can turn or be turned with full impunity. Thus he can change position relative to and against the earth pull of gravity without dangerous or painful shifting upon the mattress itself.

And this cradling adjustment to any desired degree and turning to a desired lateral angle does not affect the other normal operations of hospital or other beds such as raising of upper or lower body, Trendelenburg position, and the like. Thus the patient need not lift his weight, or be lifted by others, in order to achieve the relief which can be achieved through a shift in position.

Nor need the patient be transferred from bed to rotating frames nor be removed from traction or casts to achieve relief. Provided only he can move head or hand, he can turn at will to a new body attitude, remaining there until again he wishes to change positions.

All the foregoing, as well as many other practical fields of application and advantages, will be readily apparent to those skilled in the art, falling within the direct ambit of our invention, the scope of the application of all of which is more fully set forth in the following claims.

We claim:

1. As a new article of manufacture, a bed with included head and foot together with connecting bottom structure, which bed is generally adapted for hospital use and in which bed the patient, while prone on the patient-carrying portion thereof, can rotate this latter in its entirety through a vertical angle in either lateral direction to a continuously-variable, pre-selected limited extent, which said patient-carrying portion comprises a bed spring assembly disposed between the head and foot of said bed; multiple, generally pantograph-like hinge units disposed one at each end of said bed and pivotally journaled thereon; first means extending between and connected to said multiple hinge units and which said first means are in physical association with and carry cooperating second means which said second means are included in and comprise part of said bed spring assembly, the association between said first and second means being such that they are movable into and out of close physical relationship with each other and such that when the two means are in fact, in close physical relationship to each other then, upon opening said multiple hinge units the bed spring assembly can be moved in either lateral direction to continuously-variable pre-selected extent from between a nearly planar or flat position on the one hand, and its fully concave position on the other hand; and means carried from and related to said bed, for energizing said multiple hinge units to cause such pantograph-like opening and closing at the will of either the patient or the attendant.
2. A bed according to claim 1, wherein adjustable frictional braking means are interposed at one end of the bed between the bed itself and its related journal, to provide for selected resistance against rotation of the bed spring assembly about its longitudinal axis.

3. As a new article of manufacture, a bed with included head and foot together with connecting bottom structure, which bed is generally adapted for hospital use and in which bed the patient, while reclining on the patient-carrying portion thereof can rotate this latter from side to side to selected limited extent, which said patient-carrying portion comprises a bed spring assembly disposed between the head and foot of said bed; multiple generally pantograph-like hinge units disposed one at each end of said bed and pivotally journaled thereon whereby the said multiple hinge units are freely carried for bodily opening and closing; first means interconnecting said hinge units and members related thereto, second means comprising part of bed spring assembly, with which said second means said members are cooperable in such manner that, upon opening said multiple hinge units, the bed spring assembly can be moved to selected extent between its nearly planar or flat position and its fully concave position, and frictional braking means interposed between one said multiple hinge unit and its related journal, providing in continuous adjustment, for selected resistance against turning of the bed spring assembly about the longitudinal axis of the latter, up to and closely approaching full lock of the bed spring assembly against rotation.

4. As a new article of manufacture, a bed with included head and foot together with connecting bottom structure, which bed is generally adapted for hospital use and in which bed the patient, while reclining on the patient-carrying portion thereof, can rotate this latter from side to side to selected limited extent, which said patient-carrying portion comprises a bed spring assembly disposed between the head and foot of said bed; multiple generally pantograph-like hinge units disposed one at each end of said bed and pivotally journaled thereon whereby the said multiple hinge units are freely carried for bodily opening and closing; means interconnecting said hinge units and related members for imparting opening and closing motion to said bed spring assembly whereby, when said multiple hinge units are opened the bed spring assembly can be moved to selected extent between its nearly planar or flat position and its fully concave position; and means interposed between the multiple hinge units and the frame of bed for limiting the extent to which the bed spring assembly can be rotated in either direction about its longitudinal axis.

5. As a new article of manufacture, a bed with included head and foot together with connecting bottom structure, which bed is generally adapted for hospital use and in which bed the patient, while reclining on the patient-carrying portion thereof, can rotate this latter from side to side to selected limited extent; which said patient-carrying portion comprises a bed spring assembly disposed between the head and foot of said bed; multiple generally pantograph-like hinge units disposed one at each end of said bed and pivotally journaled thereon whereby the said multiple hinge units are freely carried for bodily opening and closing; first means interconnecting said hinge units and related members of said bed spring assembly whereby, when said multiple hinge units are opened, the bed spring assembly can be moved to selected extent between its nearly planar or flat position and its fully concave position; and second means so interposed between said multiple hinge units and said bed as to limit, in dependency upon the extent of the momentary concavity of this bed spring assembly, the extent to which this bed spring assembly can be rotated about its longitudinal axis; the relationship between said second means, on the one hand, and the multiple hinge unit and the bed, on the other hand, being such that the extent of permitted movement of this bed spring assembly increases with and proportionally to increase in the extent of concavity of the bed spring assembly.

6. As a new article of manufacture, a bed with included head and foot together with connecting bottom structure, which bed is generally adapted for hospital use and in which bed the patient, while reclining on the patient-carrying portion thereof, can rotate this latter from side to side to selected limited extent, which said patient-carrying portion comprises bed spring assembly disposed between the head and foot of said bed; multiple generally pantograph-like hinge units disposed one at each end of said bed; journal bearings disposed one at each end of said bed and each said journal bearing pivotally carrying a related one of said hinge units in such manner that the said multiple hinge units are freely capable of being bodily opened and closed; first means pivotally interconnecting said hinge units and related members; second means, comprising part of said bed spring assembly, with which second means the aforesaid members are cooperable in such manner that, upon closing said multiple hinge units, the bed spring assembly can be moved to selected extent between its nearly planar or flat position and its fully concave position; adjustable, frictional breaking means interposed between said bed spring assembly and its related journal for interposing resistance of selected degree against rotation of the bed spring assembly about its longitudinal axis; additional means interposed between the frame of the bed and the hinge units for limiting the extent to which said bed spring assembly can be rotated about its longitudinal axis, the interposition of said additional means being such that greater concavity of the bed spring assembly permits greater freedom of rotation of the bed spring assembly about its aforesaid longitudinal axis.

7. As a new article of manufacture, a bed with included head and foot together with connecting bottom structure, which bed is generally adapted for hospital use and in which bed the patient, while reclining on the patient-carrying portion thereof, can rotate this latter from side to side to selected limited extent, which said patient-carrying portion comprises a bed spring assembly disposed between the head and foot of said bed; multiple generally pantograph-like hinge units disposed one at each end of said bed; journal bearings disposed one at each end of said bed and each said journal bearing pivotally carrying a related one of said hinge units in such manner that the said multiple hinge units are freely capable of being bodily opened and closed; paired and lower, longitudinally extending rails disposed one on each side of spring assembly and which rails are pivotally carried by the hinge units near the outer extremities of these hinges, there being one such rail along each longitudinal side of the spring assembly; said bed spring assembly including channelized upper rails disposed one on each side thereof, said upper rails...
normally closely overlying the lower rails and being bodily carried and movable by these related lower rails towards and away from each other as viewed along the longitudinal horizontal axis of said bed spring assembly, as and when these lower rails are moved by the hinge units.

8. As a new article of manufacture, a bed with included head and foot together with connecting bottom structure, which bed is generally adapted for hospital use and in which bed the patient, while reclining on the patient-carrying portion thereof, can rotate this latter from side to side to selected limited extent, which said patient-carrying portion comprises a bed spring assembly disposed between the head and foot of said bed; multiple generally pantograph-like hinge units disposed one at each end of said bed; journal bearings disposed one at each end of said bed and each said journal bearing pivotingy carrying a related one of said hinge units in such manner that the said multiple hinge units are freely capable of being bodily opened and closed; paired and lower, longitudinally extending rails disposed one on each side of spring assembly and which rails are pivotally carried by the hinge units near the outer extremities of these hinges, there being one such rail on each longitudinal side of the spring assembly; said bed spring assembly including channelized upper rails disposed one on each side thereof, said upper rails normally closely overlying the lower rails and being bodily carried and movable by these related lower rails towards and away from each other as viewed along the longitudinal horizontal axis of said bed spring assembly, as and when these lower rails are moved by the hinge units; and means operably comprising part of the structure of the bed spring assembly and operably related to the upper rails in such manner as to interpose limited resistance to movement of these upper rails towards and away from each other.

9. As a new article of manufacture, a bed with included head and foot together with connecting bottom structure, which bed is generally adapted for hospital use and in which bed the patient, while reclining on the patient-carrying portion thereof, can rotate this latter from side to side to selected limited extent, which said patient-carrying portion comprises a bed spring assembly disposed between the head and foot of said bed; multiple generally pantograph-like hinge units disposed one at each end of said bed; journal bearings disposed one at each end of said bed and each said journal bearing pivotingy carrying a related one of said hinge units in such manner that the said multiple hinge units are freely capable of being bodily opened and closed; paired and lower, longitudinally extending rails disposed one on each side of spring assembly and which rails are pivotally carried by the hinge units near the outer extremities of these hinges, there being one such rail along each longitudinal side of the spring assembly; said bed spring assembly including channelized upper rails disposed one on each side thereof, said upper rails normally closely overlying the lower rails and being bodily carried and movable by these related lower rails towards and away from each other as viewed along the longitudinal horizontal axis of said bed spring assembly, as and when these lower rails are moved by the hinge units; and means operably comprising part of the structure of the bed spring assembly and operably related to the upper rails in such manner as to interpose limited resistance to movement of these upper rails towards and away from each other; and means operably comprising part of the structure of the bed spring assembly and operably related to the upper rails in such manner as to interpose limited resistance to movement of these upper rails towards and away from each other, said upper rails each being divided transversely along their lengths into a plurality of sections, the sections of each rail being of the same length as the like sections of the other upper rail; means provided on said bed for raising and lowering at will, certain of the sections into which the upper rails have been transversely divided; and an overriding lockout switch provided between the upper and lower rails, and interposed in the electrical circuitry of the powering means for said bed in manner such that the hinge units cannot be energized when the upper rails are moved out of their position closely overlying the related lower rails.

10. As a new article of manufacture, a bed with included head and foot together with connecting bottom structure, which bed is generally adapted for hospital use and in which bed the patient, while reclining on the patient-carrying portion thereof, can rotate this latter from side to side to selected limited extent, which said patient-carrying portion comprises a bed spring assembly disposed between the head and foot of said bed; multiple generally pantograph-like hinge units disposed one at each end of said bed; journal bearings disposed one at each end of said bed and each said journal bearing pivotingy carrying a related one of said hinge units in such manner that the said multiple hinge units are freely capable of being bodily opened and closed; paired and lower, longitudinally extending rails disposed one on each side of said bed spring assembly and which rails are pivotally carried by the hinge units near the outer extremities of these hinges, there being one such rail along each longitudinal side of the spring assembly; said bed spring assembly including channelized upper rails disposed one on each side thereof, said upper rails normally closely overlying the lower rails and being bodily carried and movable by these related lower rails towards and away from each other as viewed along the longitudinal horizontal axis of said bed spring assembly, as and when these lower rails are moved by the hinge units; means operably comprising part of the structure of the bed spring assembly and operably related to the upper rails in such manner as to interpose limited resistance to movement of these upper rails towards and away from each other; and means operably comprising part of the head section of each upper rail and the related lower rail, for facilitating bodily movement of the head supporting portion of bed spring assembly during swing of this portion of the bed spring assembly through vertical angle extending transversely of the bed.

11. As a new article of manufacture, a bed generally adapted for hospital use and in which bed the patient, while reclining prone on the patient-carrying portion thereof, can rotate this latter from side to side; which said bed comprises a frame with included head and foot together with interconnecting bottom structure; which said patient-carrying portion comprises a bed spring assembly disposed between the head and foot of said bed and pivotally journaled therefrom for rotation through a vertical angle to limited extent about the longitudinal, horizontal axis of the bed, the transverse ends of said bed spring assembly being telescopic, permitting the said bed spring assembly, as desired, either to be collapsed inwardly to cradle the patient, or to be fully extended, into planar position; mechanisms provided for and also carried by said bed frame, one at each end thereof, which said mechanisms serve for opening and closing the bed spring assembly, along with its telescopic
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ends; and energizing means with included controls therefor, mounted on said bed and connected with said opening and closing mechanisms for operating these latter to cause opening and closing of the bed spring assembly to desired extent through a range delineated between fully extended and fully collapsed positions thereof.

12. A bed according to claim 11 wherein the telescopic transverse ends of bed spring assembly are of multi-part construction with a friction element interposed between parts of the telescopic ends, for impeding limited resistance to movement of the transverse ends away from any position into which they may have been adjusted.

13. An article of manufacture according to claim 11 in which the bed spring assembly comprises side rails which are articulated along their length to provide head, middle and bottom segments of the bed spring assembly; and a plurality of thin, flexible slats, each said slat being connected at each end thereof to a related one of said rails in such manner as to extend therebetween and to provide for pivotal movement of each such slat, separate and apart from each other, relative to the rails.

14. A bed according to claim 13 wherein piano hinges are interposed between and serve to pivotally connect the ends of said slats to the related rails, the said piano hinges themselves each comprising longitudinally extending multiple segments, which are swingable relative to each other about horizontal axes; and in which each said slat is loosely pinned to the related hinge segment, for limited rotation of these slats through vertical angle.

15. A bed according to claim 11 wherein multiple hinge units, provided one at each end of said bed spring assembly, serve to facilitate collapsing the bed spring assembly, which said multiple hinge units are connected to and are powered by said energizing means; and means interconnecting said bed frame and the multiple hinge units for limiting the transverse rotation of said bed spring assembly in either direction of rotation.

16. An article of manufacture according to claim 11 wherein pivotal mounts serve to carry the bed spring assembly through limited rotation; and in which manufacture is included an adjustable frictional brake cooperating with said pivotal mounts, for controlled braking of said bed spring assembly and for fixing the same in selected attitude to the vertical.

17. A bed according to claim 14 in which bearing shafts extended longitudinally and horizontally inwardly from the head and foot portions of said bed and serve to carry the opening and closing mechanisms and through these, the bed spring assembly, and in which the bed carries a braking system, which latter frictionally engages about one said bearing shaft, said braking system including means for adjusting its frictional engagement about its related bearing shaft.

18. A bed according to claim 16 in which the adjusting means for the braking system permits continuous adjustment thereof.

19. An articulated cradling apparatus for incapacitated patients, comprising a bed frame with included head and foot portions; a patient-carrying bed spring assembly with included telescopic end rails, provided one at each end of said bed spring assembly, said assembly having included top side rails extending longitudinally along the length of the bed, on each side thereof, and each said top rail being articulated at several intermediate points along its length into multiple segments so pivoted together that they can be separately raised into position partly folded with respect to each other, thereby to provide for transverse adjustment of the spring assembly at selected points along the length thereof, for nice accommodation of the patient; the said telescopic end rails each being fast in the region of their ends to the adjacent ends of the related top rail, multiple hinge units provided one at each end of the bed spring assembly and respectively pivotally mounted on and carried from the head and foot portions of the bed and the outer ends of each of which said multiple hinge units are pivotally connected to and carry respective lower rails, one along the length of each side of the bed, and serve to physically and bodily, laterally move such lower rails towards and away from each other; each said top rail, when none of the segments thereof are raised into their partly folded position, normally closely nesting over the corresponding lower rail; these lower rails serving, when nested with and under the top rails, to open and close these latter; and drive means and their associated controls on said bed and connected to said multiple hinge units for opening and closing the same and along with them and through the intermediary thereof, the bed spring assembly itself.

20. As a new article of manufacture, a bed with included head and foot together with connecting bottom structure, which bed is generally adapted for hospital use and in which bed the patient, while prone on the patient-carrying portion thereof, can rotate this latter in its entirety through a vertical angle in either lateral direction to a continuously-variable, pre-selected limited extent; which said patient-carrying portion comprises a bed spring assembly disposed between the head and foot of said bed, multiple, generally pantograph-like hinge units disposed one at each end of said bed and pivotally journeled thereon; first means extending between and connected to said multiple hinge units and which said first means are in physical association with and carry cooperating second means, which said second means are included in and comprise part of said bed spring assembly, the association between said first and second means being such that they are movable into and out of close physical relationship with each other and such that when the two means are in fact in close physical relationship to each other then, upon opening said multiple hinge units the bed spring assembly can be moved in either lateral direction to continuously variable pre-selected extent from between a nearly planar or flat position on the one hand, and its fully concave position on the other hand; means, carried from and related to said bed, for energizing said multiple hinge units to cause such pantograph-like opening and closing at the will of either the patient or the attendant; and means associated with said pantograph-like hinge multiple units for enabling patient-serving auxiliary equipment to be freely supported from, carried by and movable with the bed spring assembly regardless either of the degree of concavity or angle of rotation of the latter.

21. As a new article of manufacture, a bed with included head and foot together with connecting bottom structure, which bed is generally adapted for hospital use and in which the bed is patient, while prone on the patient-carrying portion thereof, can rotate this latter
in its entirety through a vertical angle in either lateral
direction to a continuously-variable, pre-selected limited extent; which said patient-carrying portion comprises a bed spring assembly disposed between the head and foot of said bed; multiple, generally pantograph-like hinge units disposed one at each end of said bed and pivotally journaled thereon; first means extending between and connected to said multiple hinge units and which said first means are in physical association with and carry cooperating second means which said second means are included in and comprise part of said bed spring assembly, the association between said first and second means being such that they are movable into and out of close physical relationship with each other and such that when the two means are in fact, in close physical relationship to each other then, upon opening said multiple hinge units the bed spring assembly can be moved in either lateral direction to continuously-variable pre-selected extent from between a nearly planar or flat position on the one hand, and its fully concave position on the other hand; means, carried from and related to said bed, for energizing said multiple hinge units to cause such pantograph-like opening and closing at the will of either the patient or the attendant; and means associated with said pantograph-like hinge multiple units for enabling patient-serving auxiliary equipment to be freely supported from, carried by and movable with the bed spring assembly regardless either of the degree of concavity or angle of rotation of the latter; which said last-mentioned means comprises vertically disposed arm portions carried from said multiple hinges in freely slidable, linear and pivotal manner, one at each end of the bed, said arm portions at their outer ends being physically and rigidly interconnected in manner such as they partially outline and together partially form a generally rectangular frame-like structure.