

Aug. 5, 1930.

J. D. HART

1,772,310

VARIABLE PRESSURE BED OR MATTRESS

Filed Dec. 16, 1926

2 Sheets-Sheet 1

Fig. 1.

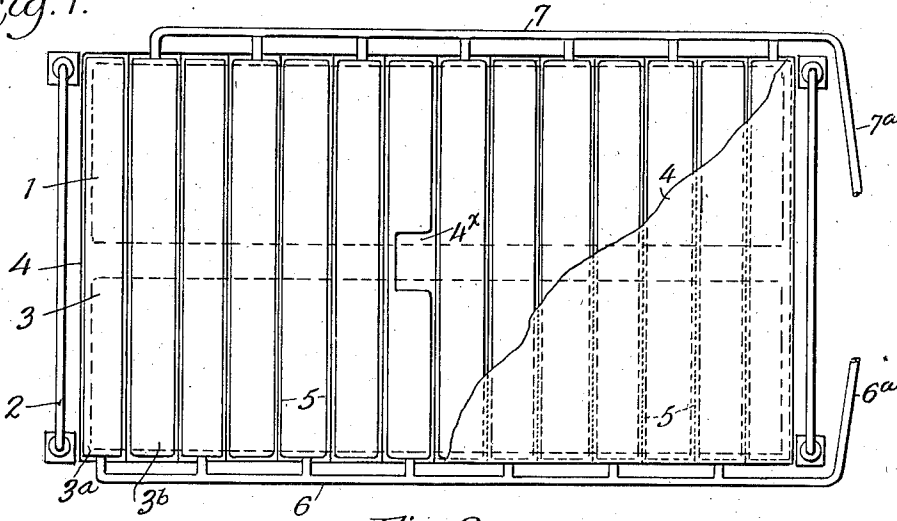


Fig. 2.

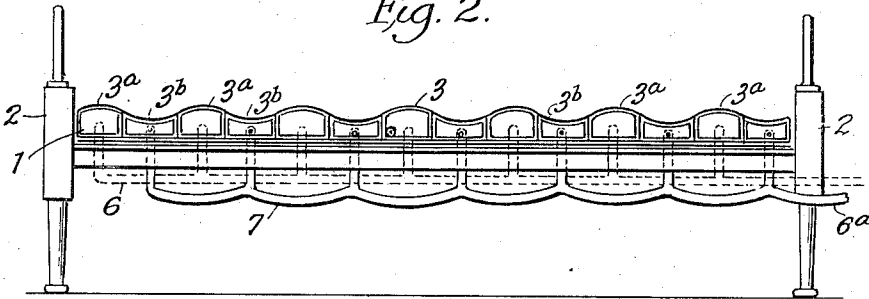


Fig. 3.

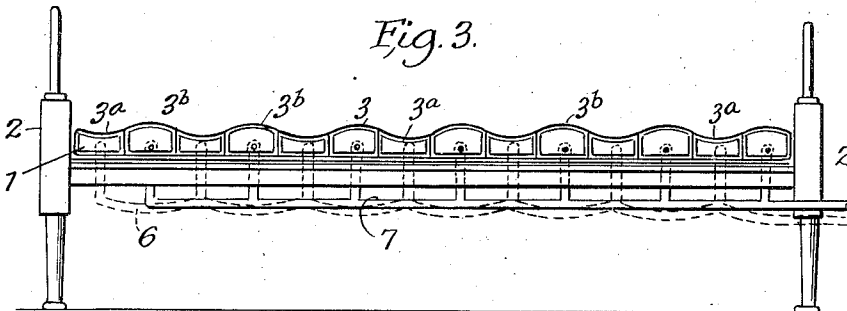


Fig. 10.

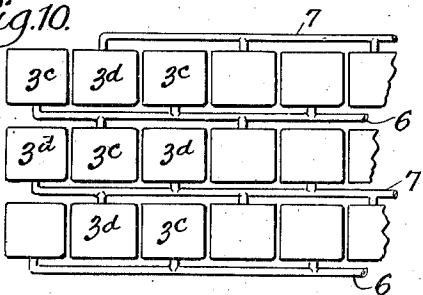
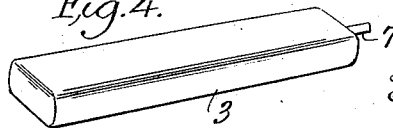


Fig. 4.



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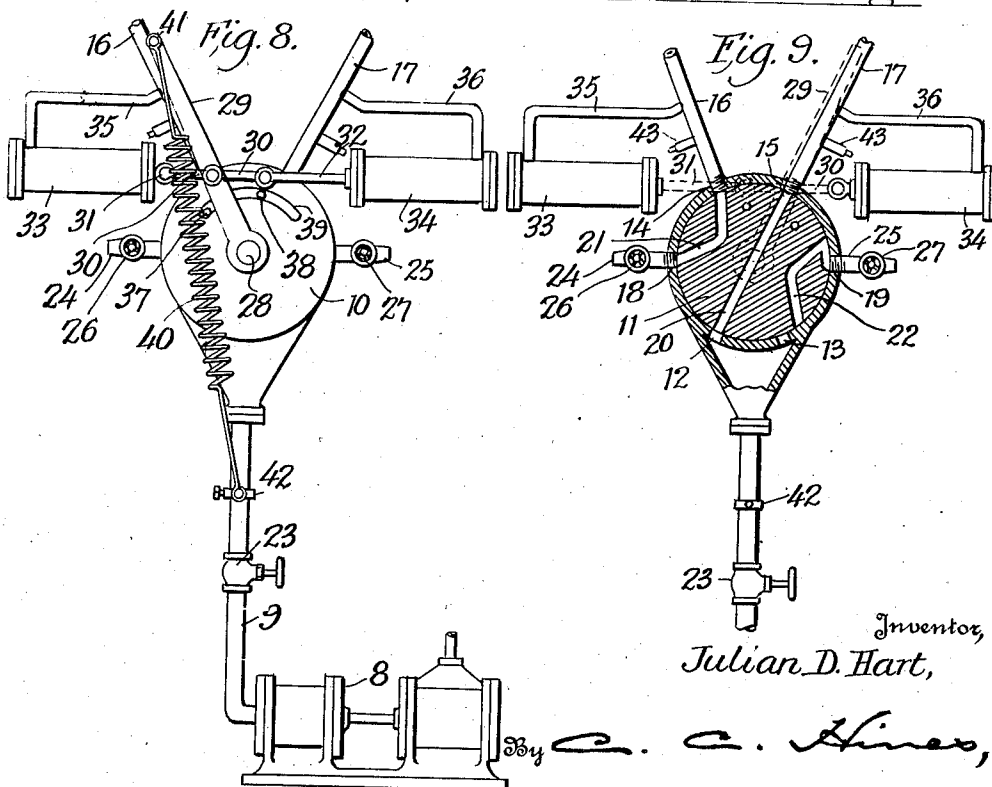
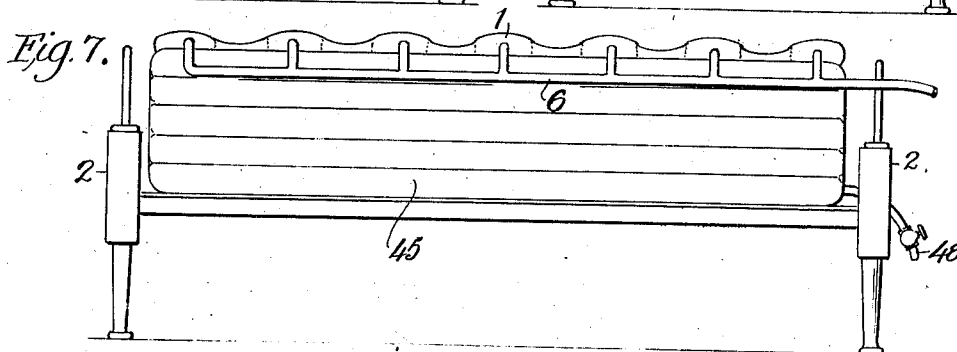
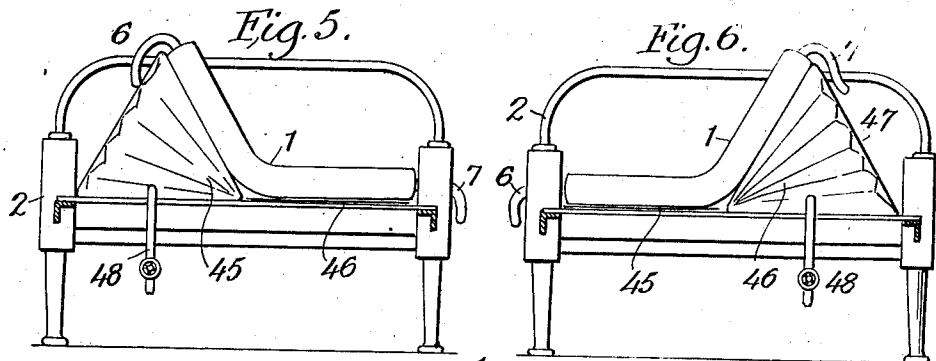
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VARIABLE PRESSURE BED OR MATTRESS

Filed Dec. 16, 1926

2 Sheets-Sheet 2



UNITED STATES PATENT OFFICE

JULIAN D. HART, OF BALTIMORE, MARYLAND

VARIABLE-PRESSURE BED OR MATTRESS

Application filed December 16, 1926. Serial No. 155,229.

In the care or treatment, in homes, hospitals and various institutions, of sick or injured patients who are confined permanently or for lengthy periods in bed and who are able to turn themselves only rarely, and in the care or treatment of very sick, severely injured or paralyzed patients who are unable to turn themselves at all, it is very difficult to prevent the formation of bed-sores. These bed-sores are caused by unduly long continued pressures upon the skin, generally most prominently displayed at the points of the bony protuberances, whereby the supply of blood with its tissue renewing substances to the body areas subjected to pressure is materially reduced or inhibited, with the result of the breaking down of the tissues and the development of so-called bed-sores. It is frequently impossible for nurses or other attendants because of other multifarious duties to be able to give time to turn the patients as often as is necessary with the use of present equipment to prevent such sores from being formed. There are also certain cases in which it is undesirable to turn the patient at too frequent intervals, making it all the more difficult to prevent bed-sores. Heretofore various efforts have been made to prevent bed-sores, the most common being that of placing the patients on pneumatic mattresses by means of which the pressure is more widely distributed instead of being most marked under the bony prominences. In certain cases, notably those of patients with complete paralysis, the patients are frequently placed in tubs containing warm water which must be kept at a constant temperature, with some means provided for the disposal of waste water and constant supply of warm water and some means for supporting the patient in the tub, presenting difficulties which require minute attention.

The primary object of my invention is to overcome these difficulties and to provide a bed which allows the patient to be comfortably supported, and which provides for the shifting of the sustaining pressures from different portions or areas of the skin to other portions or areas as frequently as necessary, and which will operate automatically for pressure shifting actions with a minimum

amount of care or service on the part of the attendants and consequently with greater ease and comfort to the patient and decreased burden on the part of the attendants in the care of patients entrusted to them.

A further object of my invention is to provide a bed of inflatable mattress type which is suitably constructed or divided up into pressure sustaining fields, zones or areas, combined with inflating and deflating means for relatively varying the pressures of such fields, zones or areas at predetermined time periods, such means operating automatically to vary the pressures at such intervals as may be required in the treatment of any particular case, without particular care or attention on the part of the attendants.

A still further object of the invention is to provide a simple, reliable and efficient construction of bed or mattress of the type described, and a simple, reliable and efficient type of automatic means for varying the pressures and which is regulable at will for controlling the degree of pressure and the time periods of the pressure shifting actions.

A still further object of the invention is to provide automatic means for supplying air or other fluid under pressure, and varying the pressures thereof, which ensures a certainty of action and reliability against either over inflation or disruption of any of the component parts of the bed.

A still further object of the invention is to provide a bed of the character described which, through its pressure varying actions, will also operate to stimulate and keep the skin in a healthy condition.

A still further object of the invention is to provide for use in conjunction with such bed novel, reliable and efficient means for turning a patient from one side to the other of the bed whenever desired or required.

With these and other objects in view, the invention consists of the features of construction, combination and arrangement of parts, hereinafter fully described and claimed, reference being had to the accompanying drawings, in which:—

Figure 1 is a top plan view, showing a portion of the cover broken away, of a bed

or mattress embodying one of the many possible forms of which the invention is susceptible.

Figures 2 and 3 are similar vertical longitudinal sections thereof, omitting, for clarity of illustration, the turning means, and illustrating the pressure area varying or shifting actions.

Figure 4 is a perspective view of one form of mattress cell or section which may be employed.

Figures 5 and 6 are end elevations of the bed, illustrating the use of the means for turning a patient.

Figure 7 is a side elevation looking toward the right in Figure 5 or toward the left in Figure 6.

Figure 8 is a view in elevation showing one type of automatic fluid supply and exhaust mechanism which may be employed for pressure varying actions, the automatic governing valve thereof appearing in the position which it occupies for supplying fluid pressure to one set of cells and reducing the pressure in another set of cells.

Figure 9 is a view similar to Figure 8, but showing the valve in section and in its reverse position.

Figure 10 is a fragmentary plan view illustrating one of many possible modifications in the construction of the bed or mattress which may be employed.

In the constructional example shown in Figures 1 to 9, inclusive, of the drawings, 1 designates a bed or mattress embodying one form of the invention, and 2 a bedstead or supporting frame for the mattress which may be of any construction suitable for the purpose.

The body of the bed or mattress 1 is composed of a plurality of bags or cells 3 preferably of rubber or other suitable elastic material, although a non-elastic material or a semi-elastic material or suitable combination of elastic or non-elastic materials may be used. Any suitable number of these bags or cells may be employed, according to the size of the mattress and the number of pressure fields, zones or areas in which it is to be divided. In the present instance, the mattress is shown as made up of fourteen of such cells, each of substantially oblong rectangular form and of a length corresponding to the width of the mattress, the cells being arranged in parallel relation to each other and extending longitudinally in a direction transversely of the mattress. Preferably the cells are enclosed within an outer casing or covering 4 of canvas, ducking, or other suitable fabric, which casing or covering may be divided by partitions 5 into suitable pockets or compartments receiving and holding the cells slightly separated and preventing them from becoming displaced or shifting relatively to each other.

The cells may be of rectangular, oblong rectangular, circular, elliptical or any other suitable form in cross-section, and their top walls may be normally flat or convexly curved or of other suitable form and adapted to assume any preferred supporting form when inflated. In the present instance I have shown the cells so formed or constructed that the top wall surface of each cell will, when the cell is expanded, assume a transversely convex form, and, when the cell is more or less deflated will assume a concave form, so that by a proper arrangement of the cells, to control inflation of certain cells and deflation of others, the upper or supporting surfaces of a certain number of the cells may be projected and the upper or supporting surfaces of the remaining cells retracted with respect to a certain mean level whereby the supporting zones or areas on which the patient rests may be varied at will. With this construction when certain cells are inflated and others relatively deflated a bed surface of wavy, undulating or corrugated form will be presented, the elevated portions or crests of which will serve as the sole or main supporting areas, and the valleys or depressed portions of which will serve as non-supporting or minor supporting areas. The relative elevations of the elevated and depressed portions of the bed may, therefore, be such as to provide a more or less continuous supporting surface, the supporting pressures of which on different portions of the body of the patient contacting therewith will vary, thus giving the desired pressure relief actions, which can be shifted relatively to different portions of the body of the patient by making those areas which have been high areas low areas, and vice versa. On the other hand, the degrees to which the different cells or areas are inflated, or relatively inflated and deflated, as well as the form of the cells, may be such that the more highly inflated areas may constitute the entire supporting surface in use at any time to sustain the patient, while the deflated or relatively inflated cells or areas will be wholly devoid of supporting action, i. e., lie out of contact with the body of the patient. I, therefore, do not limit my invention to any particular form or shape of the cell bodies or their top walls, or to any particular cell arrangement for securing or mode of serially inflating the cells in order to secure shifting pressure applying (supporting) and pressure relief surfaces, except when particularly specified in the appended claims. It is also to be understood that by the use of the word "deflating" I mean either total deflation or partial deflation of one cell or set of cells with respect to another cell or set of cells, as either mode may be employed dependent upon the construction of the bed or mattress, and as under many conditions total deflation would be uneconomical in the use of fluid

and unnecessary for the purpose of securing the desired pressure relief action.

In the particular cell arrangement shown for the purpose of exemplification, the cells are disposed in two sets or series, those of one set or series being denoted 3^a and those of the other set or series being denoted 3^b, the cells of the two sets or series being disposed from end to end of the mattress in alternation with each other. The cells of series 3^a are all connected with a fluid supply and exhaust pipe 6 and the cells of series 3^b are all connected with a fluid supply and exhaust pipe 7, so that the cells of each series may be simultaneously inflated or deflated, and so that the cells of one series may be inflated and the cells of the other series simultaneously deflated. By inflating the cells of one series and simultaneously wholly or more or less deflating the cells of the other series, alternate cells of the mattress, from head to foot thereof, will be inflated and deflated, with the result of projecting or raising the upper surfaces of one set of cells and lowering or retracting the upper surfaces of the other set of cells with respect to a mean horizontal plane, whereby a bed or mattress having a supporting surface of undulating contour will be presented, as shown in Figures 2 and 3. The top cells of the inflated or expanded cells will accordingly form the pressure zones or areas, or points of support for the patient, while the top walls of the deflated or relatively deflated cells will be located at such a lower level as to lie out of contact with the patient, so that a broken instead of a continuous surface for the support of the patient will be produced. The cells may be so dimensioned and shaped that the tops of the inflated and deflated cells will provide a regular or irregular undulating supporting surface, i. e., of curved or non-curved contour, the crests of which, represented by the tops of the inflated cells, will lie in direct contact with portions of the body of the patient and be sufficiently close together to form a comfortable elastic support, while the tops of the deflated cells will lie below and rest lightly against or lie out of contact with the body of the patient and thus relieve the patient, partly or wholly from pressure along those areas of the mattress constituted by the deflated cells. Under the weight of the patient resting upon the tops of the inflated cells, such portions of the inflated cells tend to flatten out and overlap to an extent the tops of the deflated cells, so that the extent of the supporting area will be increased to a degree proportionate to the flattening extent, which may be governed by the pressure to which the inflated cells are inflated, without, however, in such action bringing the tops of the inflated and deflated cells into a common plane. As a result, it will be apparent that the concaved surfaces of the de-

flated cells may also form supports for certain portions of the body which are not directly sustained by the inflated cells, so that such portions of the body may rest very lightly upon or be wholly out of contact with adjacent deflated cells. The arrangement of the cells in sets or series adapts the respective sets or series of cells to be alternately inflated and deflated at such intervals as may be desired, so that the undulating contour of the top surface of the mattress may be varied. Figure 2, for example, shows an undulating contour presented when the cells 3^a are inflated and the cells 3^b are deflated, while Figure 3 shows a different undulating contour presented by deflation of the cells 3^a and inflation of cells 3^b. Through the provision of means, as hereinafter described, for alternately and successively inflating and deflating the sets of cells, the pressure fields, zones or areas of the supporting surfaces of the mattress may be shifted or varied from certain portions of the body of the patient to other portions of the body of the patient, thus periodically relieving the different portions of the body of the patient resting on the mattress from supporting pressures, which pressures may be varied as often as is necessary or desirable in general or particular cases in order to prevent the formation of bed-sores.

In Figures 8 and 9 I have shown a type of fluid pressure supply and control mechanism for inflating and deflating the cells. This mechanism is of automatic type and operable to alternately inflate and deflate the sets or series of cells 3^a and 3^b at periods desired. The mechanism comprises a pump, compressor or other suitable source of fluid pressure supply 8 with which connects a fluid pressure supply pipe 9 communicating with a governing valve casing 10 containing an oscillatory governing valve 11. The casing 10 is provided with a pair of inlet ports 12 and 13 for communication with the pipe 9, a pair of feed ports 14 and 15 communicating with feed pipes 16 and 17, and a pair of pressure relief or exhaust ports 18 and 19, while the valve 11 is provided with a feed duct or passage 20 and a pair of exhaust ducts or passages 21 and 22. The feed pipes 16 and 17 are suitably connected in practice with the ends 6^a and 7^a of the pipes 6 and 7 and are designed by reverse oscillations of the valve to be alternately connected by the valve feed port 20 with the proper feed opening 12 or 13 and by the proper exhaust duct 21 or 22 with the proper exhaust port 12 or 19, so that fluid pressure may be caused to flow to one set of cells for inflating the same and simultaneously caused to flow to the atmosphere from the other set of cells for deflating the same to any predetermined extent. In practice, the pipe 9, instead of being directly

connected with a pump or compressor 8, may communicate with a receiver or reservoir or with main supply pipes of a fluid pressure system designed to supply fluid pressure to any number of beds at a time. In practice also, the fluid supplied under pressure may be air, water, oil or any other suitable fluid, and this fluid as supplied to the pipe 9 may have an initial pressure of, say, 50 pounds per square inch. For the purpose of reducing and controlling the flow of this pressure to the valve and parts of the mattress, there is provided in the pipe 9 a reducing, regulating and cut off valve 23. Also for controlling the exhaust of fluid from the cells on deflation, exhaust pipes 24 and 25 connect with the ports 18 and 19 and are provided with valves 26 and 27 acting as retarding valves, whereby the rate of exhaust of fluid from a set of cells and the degree of deflation of such cells may be regulated and controlled as desired.

Figure 9 shows the valve in section and the position of the rotary valve member 11 for connecting the pipes 7 and 17 through feed port 12 and passage 20 with the set of cells 3^b for inflating such cells, at which time duct 22 is in blank position but duct 21 connects pipes 6 and 16 through ports 14 and 18 with pipe 24 leading to the atmosphere for the exhaust of fluid pressure to any desired extent from the cells 3^a at a determined rate and within a certain period dependent upon the time periods of movements of the valve 26. The valve 11 is movable to a reverse position for connecting pipes 6 and 16 through ports 13 and 14 and duct 20 with the pipe 9 for supplying fluid pressure to inflate the cells 3^a, in which position of the valve duct 21 is moved to a blank position while duct 23 is brought to a position to connect pipes 7 and 17 through ducts 15, 22 and 19 with the exhaust pipe 25 for the exhaust of fluid pressure from the cells 3^b to deflate the same more or less in a certain time period dependent upon the retarding position of valve 27. Thus it will be understood that the valve 11 in oscillating in opposite directions will alternately bring the aforementioned ports, ducts and pipes into coaction to successively and alternately inflate one set of cells 3^a and deflate the other set of cells 3^b, and vice versa, at predetermined time periods which may be governed by the factors hereinafter described.

Extending from valve 11 through one side of the casing is a stub shaft or axle 28 on which is pivotally mounted for swinging movements with and independently of the valve a valve actuating lever 29. This lever 29 is coupled by links 30 to the rods 31 and 32 of pistons operating in cylinders 33 and 34, said cylinders being connected by combined feed and exhaust pipes 35 and 36 with the pipes 16 and 17, so that when fluid pres-

sure is supplied through either pipe 16 or 17 for inflation of the mattress cells connected therewith fluid pressure will also be supplied to the cylinder communicating therewith. Thus when the valve 11 is arranged in the position shown in Figure 9 to supply air to pipe 17 and cells 3^b, fluid pressure will also be supplied through pipe 36 to the cylinder 34 to move the piston therein on its working motion. In this position of the valve shown in Figure 9, air exhausting through the pipe 16 from cells 3^a and controlled in its discharge by the valve 26 will govern the discharge of fluid from the working end of cylinder 33, in which the piston will be on its return travel during the working travel of the piston in cylinder 34. When the valve 11 is adjusted to its reverse position from that shown in Figure 9, so as to connect pipe 16 with the feed pipe 9 and connect pipe 17 with the exhaust pipe 25, for inflation of the cells 3^a and deflation of the cells 3^b, respectively, pressure will be supplied to the cylinder 33 to move the piston therein on its working stroke while simultaneously the fluid may exhaust from behind the piston in cylinder 34 during its return stroke through pipe 36 and discharge with the air discharging through pipe 16 and pipe 25, governed in its discharging action by the retarding valve 27, so that on reverse oscillatory motions of the valve 11 the pistons in the cylinders 33 and 34 will be successively and alternately operated for swinging the valve actuating lever 29 in opposite directions.

The lever 29 is adapted for engagement on its reverse motions with studs or tappets 37 and 38 projecting from one face of the valve 11 outwardly through an arcuate slot 39 in one face of the valve casing, and in which slot the studs travel in the oscillatory movements of the valve. The lever 29 lies above its pivoted end between these studs, which are spaced so as to be engaged by the lever 29 at certain points in its opposite working travels. The purpose of the pistons in the cylinders 33 and 34, operating under working pressure from the pressure supply system, is to shift the lever in one direction or the other for a portion at least of its working action, a spring 40 or other auxiliary power device being provided to assist in completing or for completing the remainder of each working motion of the lever. As shown in the present instance, the spring 40 is a coiled contractile spring connected at its upper end with the upper end of the lever 29, above the pivot point 28 of the latter, as indicated at 41, and connected at its lower end below the pivot point of the lever to the pipe 9 or any other suitable fixed support by adjustable fastening means 42 whereby its working tension may be varied. The spring is normally distended under tension and exerts its least contractile force when the lever 29 is moved to

a full valve adjusting position in opposite directions and exerts its maximum contractile force for a lever throw action upon the movement of the lever in either direction beyond a perpendicular or dead center position.

Figure 8 shows the position of the lever 29 when the valve 11 is adjusted to the opposite position from that shown in Figure 9, or to the position in which valve 11 connects pipe 16 with pipe 9 for inflating the cells 3^a and pipe 17 with exhaust pipe 25 for deflating cells 3^b, in which position of lever 29 said lever has engaged stud 37 and through the working action of the piston in cylinder 34 and that of the spring 40, on its movement to the left beyond a perpendicular position, has through its working pressure on the stud 37 shifted the valve to the opposite position from that shown in Figure 9. When the valve is so shifted as shown by Figure 8, stud 38 occupies a position a little to the right or a little ahead of the valve lever 29 when swung back to a perpendicular position for the purpose of shifting the valve from the position shown in Figure 8 to that shown in Figure 9, during which movement of the lever 29 from the position shown in Figure 8 to a position in which it is brought into contact with stud 38 the lever travels idly between the studs 37 and 38 and leaves the valve immovable during such time period of travel and before it engages the stud 38 and begins to shift the valve shown in Figure 9. During this period of movement of lever 29 between studs 37 and 38 the valve 11 remains in position to supply fluid pressure to the cells 3^a to inflate them and hold them inflated and to allow the pressure to exhaust from cells 3^b to deflate them to the predetermined extent allowed by the retarding valve 27, thus maintaining the pressure conditions and undulating form of the mattress shown, for example, in Figure 2. During this period of idle travel of the lever 29, and while it is being urged forward for engagement with stud 38 against a certain degree of resistance of spring 40 by the action of the piston in cylinder 33, the spring is elongated, and its tension increased, so that upon the passage of the lever 29 to the right beyond center and on its engagement with stud 38, the spring, supplementing the final force of motion of piston in cylinder 33, quickly swings the lever 29 to the reverse position shown in dotted lines in Figure 9, thus shifting the valve to the position shown in Figure 9 to reverse the cell inflating and deflating actions. This operation of the valve 11 by lever 29 shifts the stud 38 to the right hand end of slot 39 and brings the stud 37 to a position just to the left of the center of the slot, so that on the ensuing reverse movement of lever 29 to shift the valve from the position shown in Figure 9 back to the position shown in Figure 8 the lever 29 will travel idly over

stud 38 to stud 37 before beginning its valve reversing action and the spring 40 will shift from the right to the left hand side of the center of the valve and assist the piston in cylinder 34 to quickly shift the lever 29 to the left beyond center whereby it is returned to the position shown in Figure 9 to adjust the valve for inflating cells 3^a and deflating cells 3^b. It will be observed, therefore, that when the valve is in either working position to connect either set of cells with the supply pipe 9, the associated cylinder is also in communication with the supply pipe for the flow of fluid pressure to operate the piston therein to transmit motion to the lever 29 for a valve reversing action during a time period while the valve is stationary and inflating one set of cells and deflating the other set of cells, and that immediately upon the beginning of a shifting motion of the valve by lever 29 the spring 40 comes into play to complete the movement of the valve at or just after the time of cut off of the supply of fluid pressure to the working cylinder, avoiding any reliance upon the momentum of the lever to effect its full positive travel and ensuring also a positive lever motion and valve shift under all working conditions as against any tendency of the lever or valve to stick at or beyond a dead center position of the lever. Thus through a certain time period while the lever and valve are traveling in one direction one set of cells will be inflated and maintained in inflated condition, while the other set of cells will be deflated and maintained in such condition, this action with respect to the set of cells being reversed during the time period of the opposite direction of travel of the lever and valve, so that the relative pressures in the sets of cells will be varied at and for determined periods, during which one set of cells will be projected into contact with certain portions of the body of the patient and serve to support him, while the other set of cells are withdrawn from contact with other portions of the body of the patient so as to relieve such portions from pressure. The shifting of the valve from the position shown in Figure 8 to that shown in Figure 9 changes the undulating contour of the supporting surface of the mattress from that shown in Figure 2 to that shown in Figure 3. The rate of oscillation of the valve is dependent on the rate of inflow and exhaust of fluid and the working power of the valve actuating spring 40. Through the action of this spring, the rate of feed and pressure of the fluid supplied through pipe 9, and the rate of retarding action of the valves 26 and 27, the pressure in the cells is regulated. As will be readily understood, the working pressure in the cylinders 33 and 34 must be sufficient to overcome the resistance of the spring in order to effect a shifting motion of lever 29 from either of its

thrown positions, in which it has adjusted the valve 11 to one working position or the other, up to and slightly beyond a mid position of the lever and a neutral position of the spring, at which point the lever engages a stud and the spring operates in conjunction with the piston in one of the cylinders to complete the throw of the lever and movement of the valve to the reverse position.

With the lever in either of its positions beyond center, in which it engages stud 37 or stud 38 to start movement of the valve 11 in one direction or the other, and with a spring of fixed power and cylinders and pistons of equal dimensions, the ratios will be such that the pressures in the sets of cells will be the same or equalized when the lever is in either of the positions mentioned. The throw of the lever in either direction, in which it acts on stud 37 or stud 38, thereafter effects a predetermined degree of change or variation in the relative pressures of the sets or series of cells. By varying the pressure and rate of inflow of the fluid through the pipe 9, the rate of exhaust of the fluid through adjustment of the valves 26 and 27, and varying the working pull of the spring by adjustment of the adjustable connection 42, both the working pressure in the cylinders 33 and 34 and the rapidity of inflation and deflation of the sets or series of cells may be regulated, such adjustments of parts varying the rapidity of action of the valve 11. By also varying the pressure and rate of supply of the fluid and its rate of exhaust, the working pressure in the sets or series of cells may be varied to suit the weight of the patient or other conditions to be met. Instead of employing the type of valve operating means defined, I may employ any other suitable type of valve actuating means, such as of pulley and weight type connected with lever 29, or time-controlled type governed by a time-control mechanism, so that the time periods of operation of the valve 11 may be varied and made as fast or slow as desired.

In practice, the valves 23, 26 and 27 may be of any suitable type for pressure reducing and retarding actions, such as are employed in air brake systems and other fluid pressure controlling systems for pressure reducing and retarding or releasing actions. These valves may also be of any suitable structure designed for the use of compressed air, water, oil, or any other fluid which may be used as the inflating and deflating medium. It may be found desirable to provide also a safety valve 43 of suitable type in each feed pipe 16 and 17, or in other suitable portions of the pressure supply system for the purpose of relieving the mattress cells of excess pressures to prevent undue inflation or disruption of any cells under inflation and to thereby provide a variable pressure mat-

tress which may be operated with safety under all conditions. These valves 43 may be of the automatic safety release type used in airbrake systems or equivalent valves used in fluid pressure systems of all kinds for pressure relief actions. When desired, the mattress may be provided with an opening 4x formed in a single cell or conjointly in a pair of cells to admit of the use of bed pans or the like in the customary manner.

In the form of the invention shown in Figures 1 to 7, inclusive, and as above-described, the mattress is composed of continuous cells arranged in parallel relation and extending in a direction transversely of the bed. It is, however, to be understood that the mattress cells may be arranged to extend lengthwise in a direction longitudinally of the bed. Instead of, under these conditions, employing cells of full length type extending either transversely or longitudinally of the bed, I may employ a mattress structure made up of small cells 3^c and 3^d, arranged in rows, of a plurality of cells in each row, extending either transversely or longitudinally of the bed. The cells of each row may be connected with the supply pipes so that all the cells of a common row may be simultaneously inflated and deflated throughout a group of rows forming a mattress from side to side or from end to end of the mattress, or I may, as shown in Figure 10, connect the cells of each row alternately with the pipes 6 and 7, and with the cells of adjacent rows, so that alternate cells of each row may be inflated and deflated and the cells of adjacent rows inflated and deflated in a staggered manner with relation to each other. By constructing the mattress in the general manner shown in Figure 10, of which many modifications in the system of piping are possible in order to vary the pressure reducing and pressure relief points throughout the mattress, a type of mattress may be produced having a very large number of inflatable and deflatable fields, zones or areas which may be inflated and deflated so as to obtain wide variations in the points or places of pressure applying or sustaining and pressure reducing actions, as will be readily understood. I, therefore, do not limit the invention to any particular construction and arrangement of the cells of the mattress, or their piping connections for inflating and deflating actions, provided a plurality of areas may be inflated and a plurality of areas simultaneously deflated at a time, as obviously the construction of the mattress may be modified in such respects to wide degrees without departing from the principle of the invention.

In the care or treatment of bed ridden patients it is also desirable to provide means whereby the patient may be turned from one side of the bed to the other in a convenient and gentle manner and to save time and labor,

in this connection, on the part of nurses or other attendants. For this purpose I provide turning devices whereby the mattress 1 may be raised and lowered on either side of its longitudinal center, as shown in Figures 5, 6 and 7, thereby adapting the patient to be turned from side to side of the bed at such time periods as may be found necessary or desirable without effecting the pressure varying actions of the mattress. The turning devices consist of inflatable and deflatable bags or cells 45 and 46 located on opposite sides of the longitudinal center of the mattress 1 and between the same and its supporting base of the bedstead 2. Each of these cells is preferably of elastic material and of a length conforming to the length of the mattress and is of pyramidal or triangular form or other suitable form in cross-section, each cell having one of its sides 47 and preferably both of its ends plaited or otherwise constructed or formed to fold; accordion-fashion, to permit the cell to expand freely to its major dimensions and to collapse in a substantially flat manner. Pipes 48 are provided for connecting the cells with a source of fluid pressure supply, such as that shown, so that either cell may be expanded and collapsed at will. When both cells are collapsed, they lie in a substantially flat condition beneath the mattress, so that the mattress throughout will lie in a normal horizontal plane. By inflating cell 45, the half of the mattress on the left hand side of its longitudinal center may be elevated to turn the patient over onto the other side of the mattress which remains in its normal horizontal position. Similarly, when cell 45 is deflated, and cell 46 is inflated, the half of the mattress on the right hand side of its center, as shown in Figure 6, will be elevated to turn the patient in the opposite direction over upon the right hand side of the mattress remaining in normal horizontal position. By gradually supplying the fluid pressure to or exhausting the same from either cell a very easy and gentle lowering or raising action may be effected to turn the patient without causing jolts, jars or other distress to him. In practice, the control of the fluid pressure supplied to and its exhaust from the cells may be hand operated or governed by automatic means in either event with a saving of time and labor to nurses and attendants. It is to be understood that this principle of turning device may be employed in various forms, to suit conditions in different cases. The turning device, for example, instead of being coextensive in length with the mattress, may be shorter than the mattress and employed to elevate any certain portion or restricted portion of the body of a patient, that is to say, to raise the body of the patient at one side between the shoulder and the hip, or below the hip, or the turning device may be made in the form of a bolster

extending transversely of the bed so as to raise the head or upper portion of the body of the patient, or to raise any portion of the body of the patient between his head and his feet. I therefore do not limit the invention in this particular.

By "inflating" I mean supplying supporting pressure of any degree desired to those cells or subdivision of cells which are to have a supporting action, and, as before stated, by "deflating" I mean a reduction of pressure to any degree from those cells not at the time used or to be used for a supporting action, which reduction may be of any degree between absolute deflation and a pressure falling slightly short of full supporting pressure. In practice, those cells which are "deflated" for a pressure relieving action may be simply relieved of sufficient pressure to more or less relieve their supporting pressures from the patient, as full deflation is unnecessary and undesirable from the standpoint of economy of use of the pressure field.

From the foregoing description, taken in connection with the drawings, the construction and mode of operation and use of my improved mattress will be readily understood, and it will be seen that the invention provides a mattress of the character and for the purpose described which is simple of construction and adapted to be operated to overcome the objections to prior constructions of beds or mattresses and effectually obviate and prevent those conditions causing the formation of bed-sores. By its use patients, even when long bed ridden, may be made more comfortable and kept free from sores brought about from prolonged pressure upon and lack of blood circulation in some areas. Incidentally the mattress also has an additional function, that is to say, the change of pressure from portions to portions of those parts of the body of the patient lying upon the mattress causes a gentle but effective massaging action whereby the skin is stimulated and a counteracting influence exerted as against the supporting pressures exerted, serving as a further prevention against the formation of bed-sores.

Having thus fully described my invention, I claim:—

1. A pneumatic mattress having a supporting surface comprising juxtaposed rows of inflatable and deflatable cells arranged in groups to provide a body supporting surface, the cells of each group being connected for inflation and deflation in unison, and the cells of the respective groups being arranged in alternation with each other, and means for automatically inflating all the cells of one group and simultaneously deflating all the cells of another group and reversing the order of inflation and deflation of the cell groups on successive inflating and deflating actions.

2. A pneumatic mattress comprising lon-

- gitudinal and transverse rows of cells forming a body supporting surface, the cells of the rows being connected in groups alternating in arrangement with each other in adjacent rows of cells, and means for automatically and simultaneously inflating all the cells of one group and deflating all cells of another group and reversing the order of inflation and deflation of the cell groups on successive inflating and deflating actions. 70
3. A pneumatic mattress having a supporting surface comprising inflatable and deflatable cells connected in groups to form a body supporting surface, the cells of the groups being alternated with relation to each other, a source of fluid under pressure, means for reducing the pressure of the fluid and automatic means supplying the fluid under reduced pressure to a certain group of cells for simultaneously inflating all the cells thereof while simultaneously deflating all the cells of another group, and for reversing the order of inflation and deflation of the groups of cells on successive inflating and deflating actions, and means for relieving excess pressure in the cells when the fluid pressure exceeds to a predetermined degree the reduced pressure. 75
4. A mattress formed of a plurality of inflatable and deflatable sections arranged in groups, the sections of one group alternating in arrangement with the sections of another group to form a continuous body supporting surface, and automatic means for simultaneously inflating all of the sections of one group and deflating all of the sections of another group, said means acting to inflate and deflate said groups in serial order. 80
5. A mattress composed of a plurality of inflatable and deflatable cells, arranged in groups, the cells of the groups being alternated and juxtaposed to provide a substantially continuous body supporting surface, and automatic means alternately inflating all the cells of one group, and simultaneously deflating all the cells of another group, and then deflating the cells of the first-named group and inflating the cells of the second-named group. 85
6. In an article of manufacture, a plurality of juxtaposed inflatable and deflatable cells forming a mattress, a source of fluid pressure supply, means connecting said supply with said cells, means controlling the flow of fluid pressure from said source to the cells and the discharge of fluid pressure from the cells, said means being automatically operated to increase the pressure in certain cells and decrease the pressure in certain other cells and to periodically change the cells in which the pressure is so increased or decreased whereby pressure on the body of the person lying on the mattress will be periodically relieved. 90
7. In an article of manufacture, a plurality of juxtaposed inflatable and deflatable cells forming a mattress, a source of fluid pressure supply, means connecting said supply with said cells, means controlling the flow of fluid pressure from said source to the cells and the discharge of fluid pressure from the cells, said means being automatically operated to inflate certain cells and to deflate certain other cells and to periodically change the cells so inflated or deflated whereby pressure on the body of the person lying on the mattress will be periodically relieved. 95
- In testimony whereof I affix my signature.
JULIAN D. HART. 100
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