March 28, 1944. G. H. PERRY 2,345,421

PNEUMATIC MATTRESS

Filed May 3, 1941 2 Sheets-Sheet 1

FIG. 1.

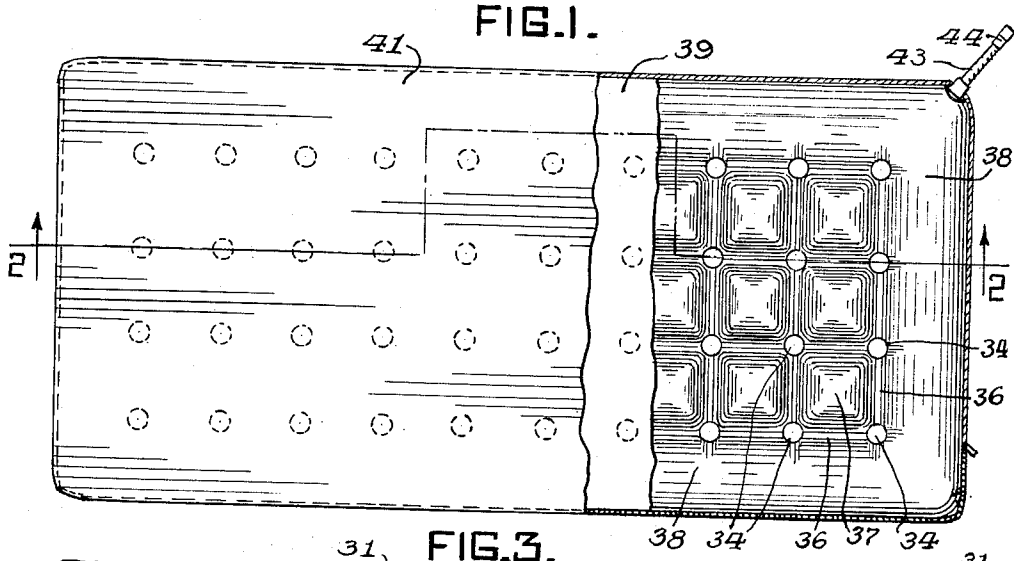


FIG. 3.

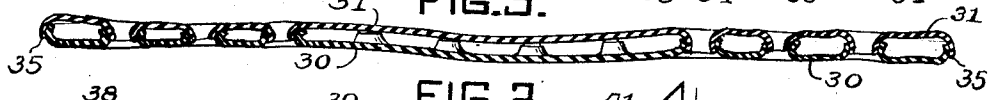


FIG. 2.

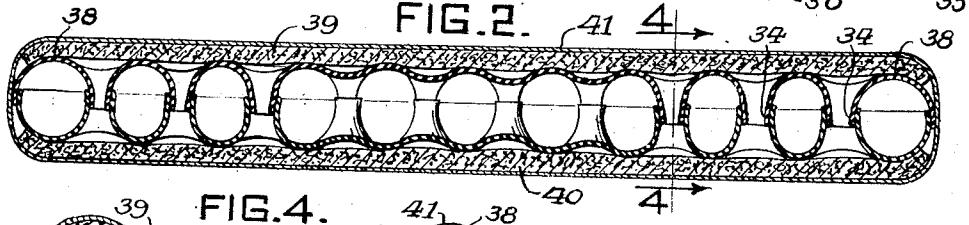


FIG. 4.

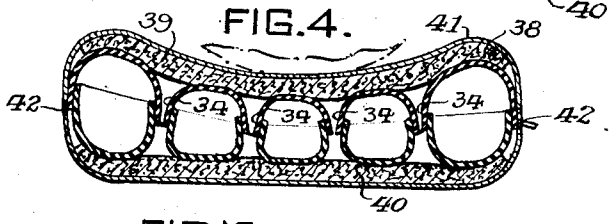


FIG. 5.

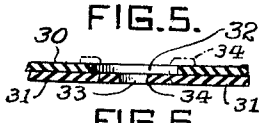


FIG. 6.

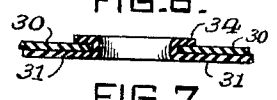


FIG. 7.



FIG. 8.

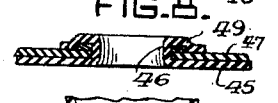


FIG. 18.

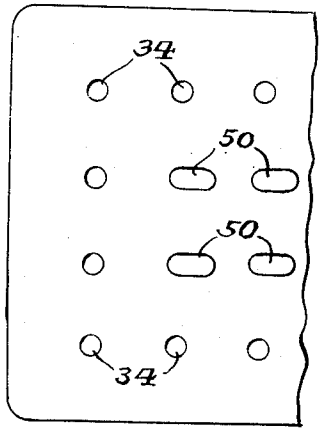


FIG. 19.

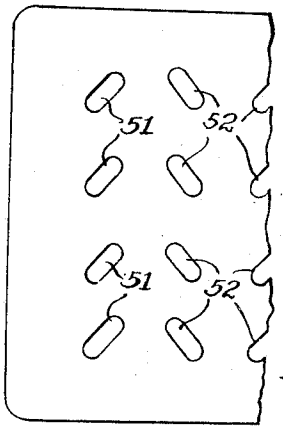
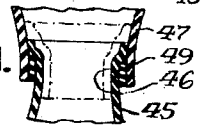


FIG. 9.



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PNEUMATIC MATTRESS

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FIG. 12.

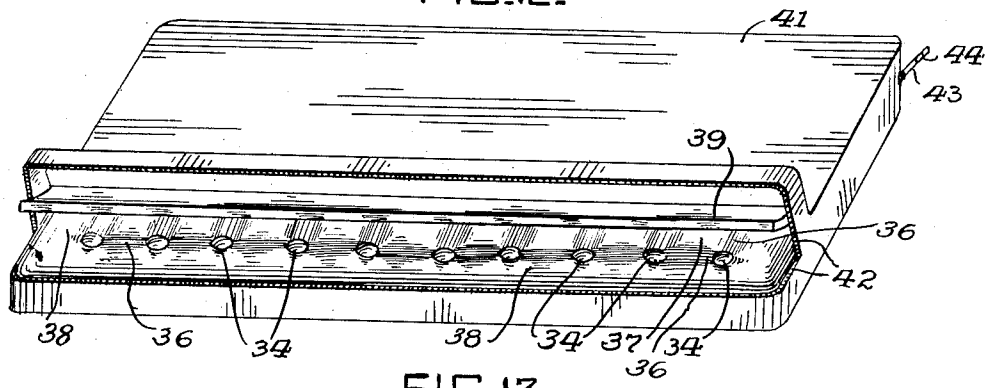


FIG. 13.

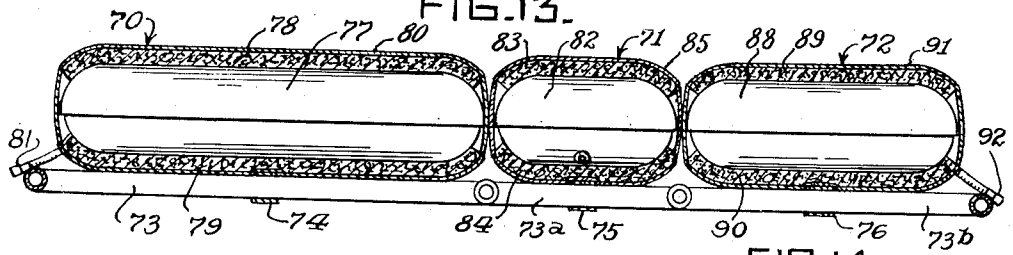


FIG. 17.

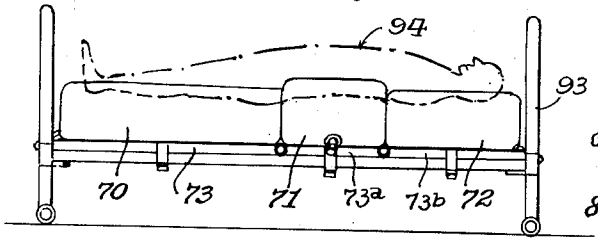


FIG. 14.

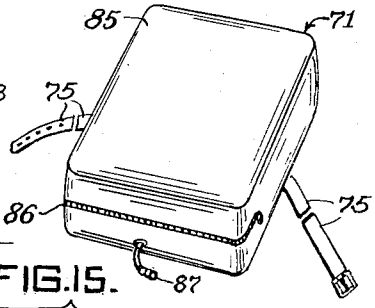


FIG. 16.

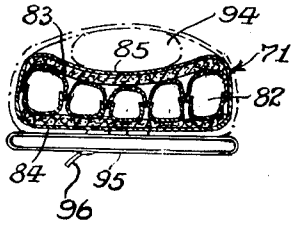


FIG. 15.

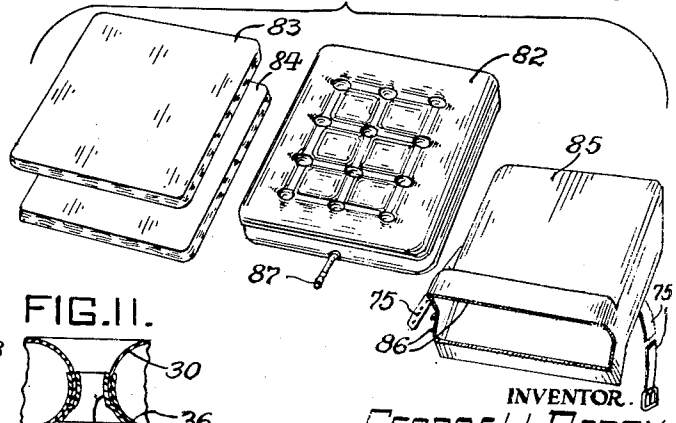


FIG. 10.

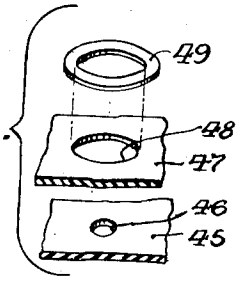


FIG. 11.

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Patented Mar. 28, 1944

2,345,421

UNITED STATES PATENT OFFICE

2,345,421

PNEUMATIC MATTRESS

George H. Perry, Brooklyn, N. Y., assignor to Airtress Corporation of America, a corporation of New York

Application May 3, 1941, Serial No. 391,697

7 Claims. (Cl. 5—348)

This invention relates to improvements in pneumatic mattresses and the like, and has for a principal object the provision of a mattress having the upper and lower sheets secured together to form "tufts," and in which the points at which said sheets are secured together are perforated, whereby ventilation therethrough is inherently provided when the mattress is in use.

Another object of the invention is the provision of a mattress or the like of improved comfort, flexibility, form-fitting ability, durable in construction, and more easily manufactured.

A further object of the invention is the provision in a pneumatic mattress or the like of a simple and inexpensive way of securing the upper and lower sheets of material together to form "tufts." This is done without the addition of extra material except in cases where it is desired to reinforce the points where the sheets are secured together.

Yet another object of the invention is the provision of a pneumatic mattress adapted to yield elastically under the weight of a user without abrupt snubbing and having a minimum tendency to curl and roll.

A still further object of the invention is the provision of a pneumatic mattress having an entrance and an exit for air, and means for drawing the air from said mattress, passing it through a medium for changing its heat content and returning it to said mattress continuously.

Another object of the invention is the provision of a pneumatic mattress having a section therein which may be inflated or deflated independently of the main body of the mattress. This form of mattress is particularly adapted for hospital or sick-room use as the separately deflatable section may be deflated to permit the placing of a bed-pan or the like in position with a minimum of discomfort and a minimum of movement of the patient.

A still further object of the invention is the provision of a mattress having independently and selectively inflatable and deflatable variations whereby the depth of such sections or the contour of the entire surface of the mattress as a whole may be changed in accordance with the use for which the mattress is to be put.

A further object of the invention is the provision of a pneumatic mattress or the like having a casing formed of ticking removably positioned thereon, said mattress including removable and replaceable padding between the rubber body and said outer casing. This type of mattress is very useful due to the fact that should the pads become matted or soiled, they may be removed and replaced with fresh ones.

Other objects of the invention will be obvious to those skilled in the art as this specification is read.

Referring to the drawings which illustrate embodiments of the invention and modifications thereof sufficient to illustrate the invention—

Figure 1 is a plan view of a mattress forming one embodiment of the invention and having a portion of the outer casing and a portion of the padding broken away to show the construction;

Figure 2 is a sectional elevation of the mattress as viewed along the lines 2—2 of Figure 1;

Figure 3 is a sectional elevation of the pneumatic portion of the mattress deflated, the casing and padding having been removed;

Figure 4 is a sectional elevation of the mattress as seen along the lines 4—4 of Figure 2 showing the form taken by the mattress when it is subjected to the weight of a body;

Figure 5 is a sectional elevation showing an upper sheet superimposed on a lower sheet with the holes therein concentric;

Figure 6 is a sectional view showing the arrangement shown in Figure 5 after the edges bordering the hole of the lower sheet have been pulled through the hole in the upper sheet and adhered to the latter;

Figure 7 is a view showing an upper sheet superimposed on a lower sheet, and a reinforcing ring positioned on the upper sheet, the holes in all of the members being concentric;

Figure 8 is a sectional view showing the arrangement shown in Figure 7 after the edges bordering the holes of the lower sheet have been pulled through the hole in the upper sheet and the reinforcing ring, and adhered to the latter and the upper sheet about said reinforcing ring;

Figure 9 is a fragmentary view showing the reinforced joint of Figure 8 when the mattress is inflated;

Figure 10 is a fragmentary exploded view showing the members in Figure 1 before they are placed together;

Figure 11 is a fragmentary view showing a joint such as is shown in Figure 6 after the latter has been inflated, a reinforcing grommet having been superimposed over the joint for reinforcing the same;

Figure 12 is a perspective view showing a mattress formed with a pneumatic body, the upper and lower surfaces of which are covered with a removable pad, said body and said pad being po-

sitioned within a casing which is zipped open so that the interior may be seen;

Figure 13 is an elevation, partly in section, of a modification in which the mattress is formed of a plurality of units, each being independently inflated and deflated;

Figure 14 is a perspective view of the middle section showing straps attached to the casing so that the latter may be secured to a support;

Figure 15 is an exploded view showing the pneumatic body of the section shown in Figure 14, the upper and lower removable pads, and the cover or casing with a zipper-type opening;

Figure 16 is a cross sectional view of the section shown in Figures 14 and 15 and the shape it assumes when the weight of a body is imposed thereon;

Figure 17 is a view showing how the sections of the arrangement shown in Figure 13 may be inflated to different heights for certain types of treatment;

Figure 18 is a fragmentary view showing a modified form of the pneumatic section of the mattress shown in Figure 1; and

Figure 19 is a fragmentary view showing a further modification of the pneumatic section of the mattress shown in Figure 1.

After the pneumatic mattress cushion has been made, the flat surfaces are substantially the same and it makes no difference which one is uppermost.

In Figure 3, the cushion is actually upside down with respect to the position it was in when being constructed. Figures 5 and 6 show the steps taken in securing the sheets together, and it will be noted that a sheet **30** is superimposed on a sheet **31** of rubber or the like, which at this stage is uncured.

The sheet **30** has a plurality of holes formed therein, such as the hole **32** shown in Figure 5, and the sheet **31** has a plurality of holes **33** formed therein. The holes are so positioned that when the sheets are positioned together with corresponding holes in alignment, they assume relative positions such as that shown in Figure 5.

The material about the edges of the hole **33**, designated by the numeral **34**, is pulled through the hole **32** and adhered to the surface of the sheet **30** about the hole **32**, as shown in dot-dash lines in Figure 5, or as shown in solid lines in Figure 6. The sheets of material are formed of rubber in the uncured state, and as received from the suppliers, they have their surfaces treated with a powder to prevent them from sticking together. After the holes are formed therein and the sheets are positioned as described, the operator cleans the surfaces of sheet **30** in zones adjacent to the edges of the holes **32** with gasoline, benzine, or the like. This removes the powder and all dirt and grease therefrom so that the "pulled through" edges of the holes **33** readily adhere to said cleaned surfaces. When the sheets are joined in this manner through all of the holes formed therein, and the edges **35** of the sheets are secured together and the entire cushion is vulcanized, an air-tight bag is formed.

Joints constructed in the manner shown in Figures 5 and 6 may be termed "annular self-seams" and this term may be taken to mean annular seams which are formed by pulling the material about a small hole in one of the sheets through the superimposed larger hole in the other of the sheets and securing the "pulled through" material to said last sheet. The relative separating movement of the two sheets under inflation and the consequent shaping or formation of the body into "tufts" etc., is controlled by positioning these annular self-seams at a plurality of predetermined positions in the pneumatic mattress cushion.

In some instances, as will hereinafter be described, holes in the sheets of material are oblong or of other shapes than circular and may be herein termed "elongated self-seams." In either event registering holes are punched through both sheets, the holes in the lower sheets being somewhat smaller than those in the upper sheet. If the holes are circular, they register concentric; whereas if they are of other shapes, they will register on their major axes. In either case the aperture formed should for best effectiveness be of material size and larger than would be required if no other function than that of separation-control were intended. However, the connected points have another very important function which will also presently be described. With this in view, it is preferable that the holes be not less than two inches in any dimension.

This method of forming the entire body of a pneumatic mattress cushion by lapping the edges of a multiplicity of registering apertures distributed over its entire surface is believed to be novel in this art because it not only dispenses with ties, reeds, stays, or tubes heretofore commonly used for controlling distention, but it also results in the formation of an entire body which possesses new and important features not obtainable in the same degree or with the same simplicity by similar devices of the prior art.

The pneumatic cushion or core of the mattress when inflated assumes the shape illustrated in Figure 2. The connected points **34** form a comparatively large elastic wall opening through the body, and these openings become in effect a cell within the inflated body, each cell being subjected to atmospheric pressure. These cells have sides which converge to a more or less constricted middle, to some extent resembling an hour-glass, and these cells have an important function in producing flexibility and yet stability and comfort, as will presently be described.

It is obvious that the separation of the upper and lower sheets is in proportion to the distance between the connected points **34**, and that said sheets will have their greatest separation at the point which is farthest away from any of the connected points **34**.

The exceptional flexibility afforded by this method of construction enables me to shape the cushion both as to its thickness and to the surface contours thereof. This is taken care of entirely by spacing of the connected points relative to each other. This method has a distinct advantage over prior methods for producing surface contours by employing interior stays or inserts of various shapes and lengths.

It can be seen by referring to Figure 1 that small parallelograms are formed in the surface of the pneumatic core consisting of depressed channels or troughs **36** extending between adjacent connected points **34**; the midportions of these parallelograms are rounded upwardly and form peaks or "tufts" **37**.

In the embodiment shown in Figures 1 to 4, the connected points adjacent to the marginal edges of the cushion are spaced farther apart from said marginal edges than they are from each other. This produces a slightly higher and slightly firmer edge **38**, which is often desirable in large cushions of this type.

In the embodiment shown in Figures 1 to 4, the pneumatic cushion or core of the mattress is

provided with an upper pad 39, which may be formed of cotton, kapok, or any other material desired, and a lower pad 40 which may be identical with the pad 39. A casing 41, which may be made of ticking or any other material desired, completely encloses the pneumatic core and the pads.

The casing may be provided with a zipper 42, which may open along one edge and along each end for a short distance, as shown in Figure 12. Whenever it becomes necessary, the zipper 42 may be opened, and either one or both sheets of the padding and/or the core may be removed for cleaning or dusting, and either or both of the pads may be replaced with new ones, after which the casing may be again closed.

The pneumatic insert or core is provided with a tube 43 having a valve 44 thereon through which the cushion may be inflated.

When building cushions of very light weight, for example, to be used in airplanes where light weight is necessary or important, I may use very thin upper and lower sheets of rubber and reinforce the bonds between the sheets in the manner shown in Figures 7, 8, and 10.

The lower sheet 45 may have holes 46 therein which are smaller than the holes 33 above described in connection with the thicker material. Superimposed on this sheet is an upper sheet 47 having holes 48 therein which are concentric with the holes 46. An annular reinforcing ring 49 is adhered to the upper surface of the sheet 47 with its hole coinciding with the hole 48, as shown in Figure 7. The edges of the sheet 45 about the hole 46, which project inwardly beyond the edges of the hole 48, are pulled through the hole 48 and lapped over the reinforcing ring 49, thereby avoiding sharp creases and danger of weakening at the point of bending, and said edges are adhered both to the ring 49 and to the upper sheet 47 immediately thereabout. This construction provides a very strong joint between the sheets.

Figure 9 is a fragmentary view which illustrates the shape assumed by the reinforced connected points 46.

When the weight of the user falls first on the points of the high tufts (as distinguished from falling first on a plane surface or on parallel, unbroken ridges present in air mattresses of the prior art), the tufts having free space all around them, have a high degree of elastic compressibility and lateral expansion. They therefore yield easily to the weight of the user and conform to the curves of his body. This may be seen in Figure 4.

As the tufts flatten toward the lower, firmer, surrounding ridges, the resistance to vertical compression and lateral expansion is progressively increased. This gives the desired combination of initial softness and final stability. In the progressive resistance just described, the hour-glass or double conoidal shape of the converging sides of the apertures play an important part even beyond the point where they function in common with the sloping walls of the tufts.

The body of the user, when it finally comes to a "bearing" is supported in part by the partially flattened tufts and partially by the firmer ridges which now tend to hold the tufts from lateral movement. This prevents instability, rolling and curling. The elasticity of the confined air is now also increased by the remaining tendency of the walls of the "hour-glass" connected points to collapse upon themselves, or to expand, as the movements of the user cause increases or reductions of the surface pressures.

An additional important function of the hour-glass connected points is to provide ventilation through and over the surface of the rubber body, thereby avoiding perspiration. The hour-glass shape of the apertures assists materially in performing this function, as its very shape facilitates a pumping action under the movements of the user. Furthermore, this shape lends a vertical stability to the hollow cushion which is not present in straight, stiffer walls of a tubular or other form of inserted stay which is liable to bend under vertical pressure besides being less yielding to lateral air-pressure.

Where cushions of this type are to be used for persons of light weight, or for hospital use, I further increase the flexibility and form-fitting softness of the article by using a limited number of holes of oblong or elongated oval shape in combination with the circular holes above described.

This modification is shown in Figure 18 wherein the hour-glass holes 34 are positioned the same as usual relative to the outer edges of the mattress, and where the oblong or oval holes 50 are at or toward the middle or main weight-bearing surface of the mattress or cushion.

This combination of circular and elongated apertures produces a mattress or cushion having a relatively soft, yielding center with a relatively firm surrounding area. It avoids the tendency to roll that the elongated holes would have if used alone, and in parallel arrangement.

A further modification shown in Figure 19 contemplates the provision of utmost stability, softness and comfort, for example in mattresses for ambulances, hospital stretchers, operating tables, etc.

In this arrangement the oblong apertures are used throughout the mattress and the apertures 51 along one end of the mattress are inclined at an angle of substantially 45-degrees with the longitudinal axis of the mattress. The second row of elongated or oval apertures 52 are inclined at the opposite angle of 45-degrees with the longitudinal axis of the mattress. Throughout the mattress the rows of angular apertures are alternated. This 45-degree arrangement has a definite and important effect on the stability of the mattress without materially reducing the initial softness and form-fitting features above described; it produces an inflated body which has far less tendency to lateral "sliding" or rolling than when the elongated apertures are placed with their axes parallel to the longitudinal or the lateral axis of the mattress.

Referring now to Figures 13 to 17, inclusive, a further modification is shown in which the mattress is made in a plurality of sections 70, 71 and 72. These sections are all independently inflatable and deflatable. This form of the invention is particularly useful in connection with operating tables and certain special forms of beds for invalids, particularly in cases where certain parts of the patient's body, such as the dorsal arch, require special support or elevation. Each section is provided with means whereby it is associated with its neighbor, and collectively the sections form one continuous cushion.

Figure 13 shows the separate sections 70, 71 and 72 as used on an adjustable bedstead or frame. The separations between the sections coincide with the pivotal or other joints of the bedstead or frame, each section being attached

to its supporting frame section by means of straps which are secured to the center of each inflated section to permit blankets or sheets to be tucked between the straps and under the surface of the section. The strap on section 70 is designated by the numeral 74; the one on section 71 by the numeral 75; and the one on section 72 is designated by the numeral 76.

The section 70 has a pneumatic core 77 with a top pad 78 and a bottom pad 79 enclosed in a casing 80. A valve 81 is provided for inflating or deflating the core 77.

The section 71, which is also shown in the exploded view Figure 15, includes a pneumatic core 82 having an upper pad 83 and a lower pad 84, said core and said pads being enclosed in a casing 85 which is provided with straps 75 for securing it to the sub-frame 73a, as hereinbefore described. The casing may be provided with any desired form of closure, but in the arrangement illustrated, a zipper 86 is provided for quickly opening and closing the casing. The core 82 is provided with a valve 87 through which it may be inflated or deflated.

The section 72 is likewise provided with a pneumatic core 88, with upper and lower pads 89 and 90 enclosed in a casing 91, and inflatable and deflatable via the valve 92.

The section 73a and/or the section 73b may be moved independently of the section 73 for the comfort of the patient or to place certain parts of his body in preferred positions.

The sub-frame 73 may be placed on a bed 93, for example, and in cases where the patient's spine needs special support the middle section 71 may be inflated to a level higher than the level of the surfaces of the sections 70 and 72.

Where the cores 77, 82 and 88 are constructed in the manner hereinbefore described, these sections, when subjected to the weight of a body 94, assume a form approximate to that shown in Figure 16.

A further modification contemplates the provision of a separately inflatable support for the sections. For example, referring to Figure 16, the support 95 can be independently inflatable through the bag valve 96. This would place at the disposal of the nurse or attendant an even greater combination of arrangements for the patient's comfort because not only can the attendant vary the thickness of the sections 70, 71 and 72, independently of each other, but can also vary the thickness of the pneumatic supporting members, such as 95. For example, suppose it were desired that some one of the sections 70, 71 or 72 be higher than the others and at the same time softer than the others, that section could be deflated to the desired degree of softness and its height could be taken care of by increasing the inflation of the pneumatic supporting member 95.

In Figure 11 is shown a modification of the arrangement shown in Figure 6, wherein an extra reinforcing grommet 98 is applied over the joint 34 and adhered to both the walls 30 and 31. This reinforcing member assumes the position shown in Figure 11.

Although I have herein shown and described, by way of example, a method of constructing pneumatic cores for mattresses and several modifications thereof, it is obvious that many changes may be made in the arrangement shown without departing from the spirit of the invention as set forth in the annexed claims.

What is claimed is:

1. The method of making a pneumatic mattress which includes, the formation of a plurality of spaced holes of predetermined diameters in one sheet of uncured rubber or the like, the formation of a plurality of holes of the same spacing in a second sheet of uncured rubber or the like, said last holes being larger in diameter than said first holes, superimposing said second sheet on said first sheet with said holes matching concentrically, pulling the material about the edges of said first holes through said second holes and adhering the pulled-through material to said second sheet about the peripheries of said second holes, adhering the edges of said sheets together in overlapping relation, and the final step of vulcanizing said mattress.

2. The method of forming a tufted pneumatic mattress which includes the formation in one sheet of uncured rubber a plurality of holes of predetermined diameters spaced apart from each other in accordance with the desired spacing of the tufts, the formation of a plurality of holes of the same spacing in a second sheet of uncured rubber, said last holes being larger in diameter than said first holes, superimposing said second sheet on said first sheet with said holes matching concentrically, cleaning the surface of said second sheet in annular zones surrounding said second holes, pulling the material about the edges of said first holes through the overlying second holes and adhering the pulled-through material to said second sheet within said zones, cleaning the edges of said second sheet along zones adjacent to the edges thereof, adhering the edges of said first sheet to the edges of said second sheet in overlapping relation, and the final step of vulcanizing said mattress.

3. The method of making a tufted pneumatic mattress which includes the formation in one sheet of uncured rubber, of a plurality of holes of predetermined diameters, and of predetermined spacing in accordance with the desired positions of the tufts, the formation of a second plurality of holes of the same spacing but larger in diameter than said first holes in a second sheet of uncured rubber, positioning said second sheet on said first sheet with said holes matching concentrically, thereby leaving within said second holes uncovered annular areas about said first holes, adhering a plurality of reinforcing rings to said second sheet, said reinforcing rings having holes therein of substantially the same diameter as said second holes, pulling each of said uncovered areas about said first holes through both the overlying hole in said second sheet and the hole in its reinforcing ring and adhering the material of these uncovered areas to the outer surfaces of said reinforcing rings, adhering the edges of said sheets together in overlapping relation, and the final step of vulcanizing said mattress.

4. The method of forming hollow tufts in pneumatic mattresses which consists of forming aligned holes in the sheets of rubber or the like of which said mattress is formed, one aligned hole being slightly larger in diameter than the other, the step of pulling the edges of the smaller hole through the larger hole and adhering said edges to the material immediately about the larger hole, and the step of vulcanizing said sheets together along the area which is adhered, whereby when said mattress is inflated the vulcanized joint is positioned substantially midway the hollow tuft, and the tuft itself is solely formed in part of one of said sheets and in part of the other of said sheets.

5. The method of making a pneumatic mat-

tress which includes the formation both of a plurality of spaced round holes of predetermined diameters and elongated holes in one sheet of uncured rubber or the like, the formation of holes of both kinds and of the same spacing in a second sheet of uncured rubber or the like, said last holes being larger than said first holes, superimposing said second sheet on said first sheet with said round holes matching concentrically and said elongated holes matching axially, pulling the material about the edges of the holes in said first sheet through the holes in said second sheet and adhering said pulled-through material to said second sheet adjacent to the outline of the holes therein, adhering the edges of said sheets together in overlapping relation, securing a valve stem thereto, and the final step of vulcanizing said mattress.

6. The method of making a pneumatic mattress which includes the formation of a plurality of elongated holes in rows in one sheet of uncured rubber or the like, the axes of said holes being substantially parallel, the formation of other rows of elongated holes interspersed between said first rows and having their axes substantially parallel to each other and angular with respect to the axes of said first elongated holes, the forming of holes of both kinds and of the same spacing in a second sheet of uncured rubber or the like, said last holes being larger than said first holes, superimposing said second sheet on said first sheet with the holes in said sheets matching axially, pulling the material about the edges of the holes in said first sheet through the holes in said second sheet and adhering said pulled-through material to said second sheet adjacent to the outlines of the holes therein, adhering the edges of said sheets together, and the final step of vulcanizing the mattress.

7. The method of making a pneumatic mattress which includes the formation in one sheet of uncured rubber or the like, of a plurality of holes of predetermined diameters and arrayed therein in accordance with a predetermined pattern, the formation of a plurality of slightly larger holes of the same spacing in a second sheet of uncured rubber or the like, superimposing said second sheet on said first sheet with said holes matching concentrically, pulling the material about the edges of said first holes through said second holes and adhering the material to said second sheet about the peripheries of said second holes, adhering the edges of said sheets together to form a closure, and the final step of vulcanizing said mattress.

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