A body support such as a mattress is provided formed of a top layer, an intermediate layer and a base layer. Optional side supports are also provided. Each of these layers and optional side supports are formed of different polyurethane and/or latex foam compositions. Maximum and average peak pressures are minimized by having the intermediate layer of the mattress or other body support be formed of high resilience foam, such as foam with between forty-five and sixty-five percent resilience factor. This intermediate layer is also provided with a greater density than typical prior art body supports, with a density of between 2.5 and 3.5 pounds per cubic foot.
LOW PEAK PRESSURE BODY SUPPORT

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims benefit under Title 35, United States Code §119(e) of U.S. Provisional Application No. 61/896,290 filed on Oct. 28, 2013.

FIELD OF THE INVENTION

[0002] The following invention relates to mattresses and other cushions for beds, chairs and other structures upon which at least portions of a body are able to rest. More particularly, this invention relates to mattresses and other cushions formed of multiple layers of polyurethane and/or latex foam having characteristics which minimize peak pressure when a user rests upon the mattress.

BACKGROUND OF THE INVENTION

[0003] Mattresses, seat cushions and other body supports are provided both for comfort and therapeutic purposes. Such supports are generally referred to herein as mattresses even when they are utilized as a seat cushion or other body support on a structure other than a bed. One form of mattress is formed of a mass of one or more layers of foam. Materials from which such foam mattresses are formed include polyurethane foam, latex foam, or combinations of polyurethane and latex foam, or other foams with similar functional characteristics. Examples of such prior art mattresses include those disclosed in U.S. Pat. Nos. 8,037,562 and 8,291,535, incorporated herein by reference in their entireties.

[0004] In various prior art mattress embodiments, such as those disclosed in the above referenced patents, multiple horizontal layers of foam are bonded together in a vertical stack. The different layers exhibit particular densities and particular layer thicknesses to optimize performance. When optimizing performance, at least two measures of performance can be evaluated, including average pressure and maximum pressure. In particular, testing can be performed where apparatuses of known standard weight simulating a human body or other object are placed upon the mattress and pressure readings between the mattress and the body simulator or other object are measured. Where no pressure is measured, such readings are generally ignored. Where a pressure reading is measured, it can be mapped to the point where the reading took place and display a pressure magnitude. “Average pressure” is the average of all non-zero pressures that are sensed and “peak pressure” is the highest magnitude pressure sensed.

[0005] Both for comfort and therapeutic purposes it is desirable to minimize average pressure and to minimize peak pressure. If the average pressure is lower, weight of the person or other object is distributed over a larger portion of the mattress so that high pressure in any particular points can be minimized. Peak pressure is another measure of the degree to which the mattress effectively avoids “pressure points” where higher pressure is measured. Such pressure points can be sufficiently high to cut off or restrict capillary blood flow, pinch nerves, or otherwise provide uncomfortable and medically undesirable conditions. Such conditions include pressure sores, also known as “bed sores.” Also, when a wound is healing lower pressure measurements generally indicate a more conducive environment for wound healing.

SUMMARY OF THE INVENTION

[0006] With this invention modifications to prior art mattresses such as those disclosed above have resulted in drastically improved peak pressures and drastically improved average pressures through construction of a unique multi-layer foam mattress as disclosed herein. Details of the mattress of this invention are similar to those disclosed in the above-referenced patents except where specifically identified herein.

[0007] First, the mattress of this invention utilizes a high resilience foam for the intermediate layer (the intermediate layer being the layer between the top layer and the bottom layer). In particular, the intermediate layer has a high resilience foam (such as that defined by ASTM D3770) with a resilience factor of preferably substantially about fifty-five percent while still within the same twenty-five to thirty-five lI/D (Indentation Force Deflection) range. High performance is also expected with high resilience foam with a resilience factor of forty-five to sixty five percent. Prior art foam mattresses, such as those disclosed above, utilize high density non-high resilience foam.

[0008] Second, the intermediate layer is provided with a density between 2.5 pounds per cubic foot and 3.5 pounds per cubic foot. This intermediate layer density is greater than the density of the prior art foam mattresses identified above. Third, a ratio of layer thicknesses has been modified to optimize mattress performance. In particular, the top layer and intermediate layer are provided with substantially the same thickness and the base layer has a thickness that is 15 percent of the intermediate layer thickness. This base layer has a tolerance range of plus or minus 0.5 to 1 inch. A formula which establishes this relationship includes:

\[ A = B = 2C \]

[0009] Where A is the thickness of the top layer, B is the thickness of the intermediate layer and C is the thickness of the base layer. The base layer has a tolerance of plus or minus 0.5 to 1 inch. The layers have progressively higher lI/D (Indentation Force Deflection) from top to bottom as is known with prior art mattresses.

[0010] One potential modification to the layer configurations disclosed herein is to have the base layer or other higher density layer extend up at perimeter edges of the mattress, partially or all of the way to the upper surface of the mattress, or even higher than the upper surface in the form of a “fall guard.” Such a stiff perimeter wall can tend to keep an individual located upon the mattress from too easily rolling off of the mattress.

OBJECTS OF THE INVENTION

[0011] Accordingly, a primary object of the present invention is to provide a mattress which minimizes both average peak pressure and maximum peak pressure.

[0012] Another object of the present invention is to provide a mattress which minimizes the occurrence of bed sores and assists in the remedying of bed sores which already exist.

[0013] Another object of the present invention is to provide a mattress, seat cushion or other bodily support which is comfortable for a user.

[0014] Another object of the present invention is to provide a bodily support which helps to keep a user from falling off of the support.
Other further objects of the present invention will become apparent from a careful reading of the included drawing figures, the claims and detailed description of the invention.

**BRIEF DESCRIPTION OF THE DRAWINGS**

- FIG. 1 is a perspective view of the mattress of this invention according to a first embodiment and showing the various layers bonded together to form the mattress.
- FIG. 2 is a side elevation view of that which is shown in FIG. 1.
- FIG. 3 is an end elevation view of that which is shown in FIG. 1.
- FIG. 4 is a perspective view similar to that which is shown in FIG. 1, but for an alternative embodiment including side supports thereon.
- FIG. 5 is a side elevation view of that which is shown in FIG. 4, with dashed lines illustrating hidden layers.
- FIG. 6 is a side elevation full sectional view of that which is shown in FIG. 4.
- FIG. 7 is an end elevation view of that which is shown in FIG. 4, with dashed lines revealing layers within the mattress of FIG. 4.
- FIG. 8 is an exploded parts view of that which is shown in FIG. 4 and with a dashed line illustrating a crease line about which the mattress is configured to more effectively bend.

**DESCRIPTION OF THE PREFERRED EMBODIMENT**

Referring to the drawings, wherein like reference numerals represent like parts throughout the various drawing figures, reference numeral 10 is directed to a mattress or other body support (FIG. 1) which is made up of multiple layers of foam and which minimizes pressure points experienced by a user resting upon the mattress 10.

In essence, and with particular reference to FIGS. 1-3, basic details of the mattress 10 are described, according to this first embodiment. The mattress 10 is formed of multiple layers of polyurethane and/or latex foam. The layers include a top layer 20 resting upon an intermediate layer 30 which is located upon a base layer 40. Each layer 20, 30, 40 is similar in horizontal surface area. The top layer 20 and intermediate layer 30 are similar in thickness. The base layer 40 is half of the thickness of the top layer 20 or intermediate layer 30 in this first embodiment with a tolerance of 0.5 to 1.0 inch. Each layer 20, 30, 40 is formed of a homogeneous foam material such as a polyurethane foam or latex foam. These layers 20, 30, 40 are provided with particular densities and particular indentation force deflection values, and selected resilience factors to keep pressure points to a minimum.

More specifically, and with continuing reference to FIGS. 1-3, specific details of the various layers 20, 30, 40 of the mattress 10 are described, according to this first embodiment. The top layer 20 is a planar unitary mass formed of a polyurethane or latex foam. Preferably, this foam is homogeneous within the top layer 20.

The top layer 20 has a thickness extending between a planar top surface 22 and a planar undersurface 24. The thickness is preferably uniform and in this first embodiment is exemplified with a thickness of three inches between the top surface 22 and undersurface 24. A perimeter 26 extends between the top surface 22 and the undersurface 24 and provides sides and ends for the top layer 20. Preferably corners are slightly rounded but could be squared off in this perimeter 26. The top layer is typically polyurethane foam, latex foam or some combination thereof. The density is typically between about 2.75 and 4.5 pounds per cubic foot with a density of 2.8 to 3.2 pounds per cubic foot being optimal. The indentation force deflection is from about ten to twenty. Thickness is most typically 0.5 to 3.0 inches. This top layer also preferably has a softness compression modulus of about 1.75 and about 2.35.

The intermediate layer 30 has a geometry similar to that of the top layer 20. Thus, the intermediate layer 30 includes an upper surface 32 opposite a lower surface 34. A perimeter 36 surrounds the upper surface 32 and lower surface 34. The intermediate layer 30 is also formed of polyurethane or latex foam and is preferably homogeneous between the upper surface 32 and lower surface 34. The intermediate layer 30 is located below the top layer 20 and with the upper surface 32 preferably bonded to the undersurface 24. Thus, the top layer 20 and intermediate layer 30 are joined together.

The base layer 40 is a planar layer of polyurethane or latex foam of a homogeneous character and formed of a unitary mass of foam. The base layer 40 has a related geometry to the top layer 20 and intermediate layer 30, but preferably less thick. The base layer 40 extends between a dorsal surface 42 opposite a bottom surface 44. A perimeter 46 surrounds the dorsal surface 42 and bottom surface 44.

The bottom surface 44 preferably includes a notch 48 therein which facilitates bending of the base layer 40 and further facilitates bending of the entire mattress 10, such as when the mattress 10 is placed upon a bed frame which is mechanized so that it can raise a head of the user by pivoting near this notch 48. A second notch is typically provided a few feet from the opposite end as well. The dorsal surface 42 of the base layer 40 is preferably bonded to the lower surface 34 of the intermediate layer 30 so that the base layer 40 is joined to the top layer 20 and intermediate layer 30 to form the mattress 10.

The base layer 40 is preferably thinner than the intermediate layer 30 and top layer 20. For instance, in the embodiment depicted in FIGS. 1-3, the top layer 20 and intermediate layer 30 have a similar thickness with each layer 20, 30 being three inches thick. The base layer 40 in this embodiment is two inches thick between the dorsal surface 42 and the bottom surface 44. Overall, the base layer 40 thickness can range from about 0.5 inch and 5.0 inches. This base layer 40 is typically formed of polyurethane foam with a density of about 2.5 to 3.0 pounds per cubic foot and an optimal density of between about 2.6 and 2.9 pounds per cubic foot. The base layer 40 typically has an indentation force deflection of about seventy-five to ninety.

Variations on the thickness of the base layer 40 are preferably provided following guidelines calling for the base layer 40 to be half of the thickness of the common layers 20, 30 with a tolerance of between 0.5 and one-half inch. Following the narrower tolerance of 0.5 inch, when the layers 20, 30 are three inches, the base layer 40 would have a thickness of 1.5 inches plus or minus 0.5 inch, so that the base layer 40 would have a thickness of between one inch and two inches. Following the wider tolerance of 1.0 inch for the base layer 40, the base layer 40 could have a thickness of between 0.5 inch and 2.5 inches. In each of these embodiments, the base
layer 40 has a thickness less than that of the top layer 20 and intermediate layer 30. However, a thicker base layer 40 is another option.

[0033] Layers 20, 30, 40 can be formed of polyurethane and/or latex foam, with the layers 20, 30, 40 preferably not formed of foam having identical characteristics. Rather, the indentation force deflection increases as the layers 20, 30, 40 progress downward, such that the top layer 20 has the lowest indentation force deflection, the intermediate layer 30 has an intermediate indentation force deflection and the base layer 40 has a highest indentation force deflection.

[0034] Experience has shown that the characteristics of the intermediate layer 40 have an important impact on the peak pressure experienced by the mattress 10. In particular, the intermediate layer 30 is preferably provided with a resilience factor of between forty-five and sixty-five percent, such that the intermediate layer 40 can be considered to be formed of foam that is high resilience. A most optimal resilience factor for the intermediate layer 30 is considered to be fifty-five percent. Furthermore, the intermediate layer 30 preferably has a density of between 2.5 and 3.5 pounds per cubic foot and an IFD of between about twenty-five and thirty-five. This intermediate layer also has a compression modulus of about 11.9 to about 2.5. These attributes of the intermediate layer 30 cause the intermediate layer to have the low average pressure and peak pressure readings described above.

**EXAMPLE**

[0035] A mattress was tested having the layer thickness specified herein (three inch top layer, three inch intermediate layer, and two inch bottom layer) and layers of progressively higher IFD. The mattress had an intermediate layer of high resilience foam with resilience factor of fifty-five percent and an IFD in the range of twenty-five to thirty-five, and with a density of 2.5 to 3.5 pounds per cubic foot. While prior art mattresses have high performance in average and maximum pressure, the mattress of this test, including the adjusted parameters described above, exhibited unexpected and significantly higher performance than the prior art. In particular, prior art mattresses disclosed above have been tested to show an average pressure of between 23.99 and 24.36, with a maximum or peak pressure of between 91.68 and 95.87 (all measurements in millimeters of mercury). The mattress of this invention was independently tested and found to achieve an average pressure of 17.72 with a maximum pressure of 64.42. Thus, a maximum pressure of the mattress of this invention is approximately thirty percent less than prior art mattresses with average pressures also reduced a similar amount. This revolutionary performance can be seen in the context that their prior art mattresses disclosed above only exhibited performance improvement over earlier prior art in the range of five percent or less.

[0036] This reduction in peak and average pressure has significance not only in comfort but in therapeutic environments, such as where pressure sores (also known as “bed sores”) are being remedied or prevented. With such significantly lower peak and average pressures, significantly improved performance in therapy of the individual can be expected.

[0037] With particular reference to FIGS. 4-8, details of an alternative mattress 110 with lateral support is depicted. This mattress 110 is similar to the mattress 10 except as described herein. In particular, the mattress 110 includes side supports 50 which bound the perimeters 26, 36, 46 of the layers 20, 30, 40. These side supports 50 can be formed as separate pieces as shown, or can be one continuous circuit of common foam material.

[0038] The side supports 50 include an upper edge 52 opposite a lower edge 54. The upper edge 52 is preferably coplanar with the top surface 22 of the top layer 20, but could in other embodiments be somewhat higher (or lower). The lower edge 54 is preferably coplanar with the bottom surface 44 of the base layer 40. Thus, the side supports 50 have a height between the lower edge 54 and the upper edge 52 which is similar to a distance between the bottom surface 44 of the base layer 40 and the top surface 22 of the top layer 20 in the embodiment depicted. In the embodiment depicted in FIGS. 1-3, this thickness is eight inches so that eight inches of height would be provided between the lower edge 54 and the upper edge 52. In other embodiments, the side supports 50 are higher than other portions of the mattress 110, such as with a thickness/height two inches higher than the combined layers 10, 20, 30, 40. When the side supports 50 are so configured, an inside edge is typically beveled.

[0039] The side supports 50 include an inside surface 56 facing inwardly and an outside surface 58 extending outwardly. The outside surface 58 thus provides a perimeter for the mattress 110. The inside surface 56 is adjacent the perimeter 26, 36, 46 of the layers 20, 30, 40.

[0040] The side supports 50 can be sized so that the inside surface 56 is adjacent the perimeters 26, 36, 46 as one alternative. A second alternative is to shrink the size of the layers 20, 30, 40 at their perimeters 26, 36, 46, so that the outside surface 48 of the side supports 50 and thus the perimeter of the mattress 110 can be similar to the perimeter of the mattress 10. Most preferably, the inside surface 56 of the side supports 50 is bonded to the perimeter 26, 36, 46 of the layers 20, 30, 40 so that the mattress 110 has the side supports 50 bonded to the other layers 20, 30, 40.

[0041] The side supports 50 help to resist any potential for a user to fall off of the top surface 22 of the mattress 10. This is because the side supports 50 preferably have high density characteristics and indentation force deflection characteristics matching that of the base layer 40. The side supports 50 are thus more resistant to deflection than are the top layer 20 and intermediate layer 30, and act as a form of “barrier” to lateral movement of a user resting upon the top surface 20 of the mattress 10. In the embodiment shown, the side supports 50 completely surround the mattress 110, but can alternatively be provided only at the long lateral sides of the mattress 110 and not at the short ends. Preferably, the notch 48 in the base layer 40 continues into the side supports 50 so that the side supports 50 can also facilitate bending of the mattress 10, such as when on a frame which facilitates such bending.

[0042] FIGS. 1-7 illustrate with arrow A the direction with which the mattress 10 is typically loaded by having a user resting upon the top layer 20. While the body support is depicted as a mattress 10 sized and shaped to provide a bed, it could be shaped to fit upon a chair and thus be in the form of a seat cushion, or could have other shapes or other purposes for carrying a user thereon in a manner which provides comfort and resistance to the development or perpetuation of undesirable conditions such as pressure sores.

[0043] This disclosure is provided to reveal a preferred embodiment of the invention and a best mode for practicing the invention. Having thus described the invention in this way, it should be apparent that various different modifications can be made to the preferred embodiment without departing from
the scope and spirit of this disclosure. When structures are identified as a means to perform a function, the identification is intended to include all structures which can perform the function specified.

What is claimed is:

1. A mattress comprising in combination:
   a top layer of polyurethane and/or latex foam;
   an intermediate layer of polyurethane and/or latex foam bonded to an underside of said top layer;
   a base layer of polyurethane and/or latex foam bonded to an underside of said intermediate layer; and
   wherein said intermediate layer is formed of high resilience foam with a resilience factor of between about forty-five percent and sixty-five percent.

2. The mattress of claim 1 wherein said intermediate layer has a density of between 2.5 and 3.5 pounds per cubic foot.

3. The mattress of claim 1 wherein said layers have a thickness relationship of substantially about equal thickness for said top layer and said intermediate layer and said base layer having a thickness substantially about half of the intermediate layer.

4. The mattress of claim 3 wherein said base layer thickness has a tolerance of plus or minus 0.5 to 1 inches.

5. The mattress of claim 1 wherein said intermediate layer is formed of high resilience foam with a resilience factor of between twenty-five and thirty-five.

6. The mattress of claim 1 wherein said intermediate layer is formed of a foam having an indentation force deflection (IFD) of between twenty-five and thirty-five.

7. The mattress of claim 1 wherein said top layer is approximately three inches thick, said intermediate layer is approximately three inches thick and said bottom layer is approximately two inches thick.

8. The mattress of claim 1 wherein side supports bound lateral edges of said top layer, said intermediate layer and said base layer, said side supports formed of polyurethane and/or latex foam extending from a bottom surface of said base layer to a top surface of said top layer.

9. The mattress of claim 8 wherein said side supports are formed from a common foam with said base layer, and with said side supports bonded to each of said top layer, said intermediate layer and said base layer.

10. A low peak pressure mattress, comprising in combination:
   a top layer of polyurethane and/or latex foam;
   an intermediate layer of polyurethane and/or latex foam;
   a base layer of polyurethane and/or latex foam;
   and
   wherein said intermediate layer is formed of high resilience foam with a resilience factor of between about forty-five percent and sixty-five percent.

11. The low peak pressure mattress of claim 10 wherein said intermediate layer has a resilience factor of about fifty-five percent.

12. The low peak pressure mattress of claim 11 wherein said intermediate layer has a density of between 2.5 pounds per cubic foot and 3.5 pounds per cubic foot.

13. The low peak pressure mattress of claim 12 wherein said top layer, said intermediate layer and said base layer are each bonded together.

14. The low peak pressure mattress of claim 13 wherein said top layer is approximately three inches thick, said intermediate layer is approximately three inches thick and said bottom layer is approximately two inches thick.

15. The low peak pressure mattress of claim 14 wherein side supports bound lateral edges of said top layer, said intermediate layer and said base layer, said side supports formed of polyurethane and/or latex foam extending from a bottom surface of said base layer to a top surface of said top layer.

16. The low peak pressure mattress of claim 15 wherein said side supports are formed from a common foam with said base layer, and with said side supports bonded to each of said top layer, said intermediate layer and said base layer.

17. The low peak pressure mattress of claim 15 wherein said intermediate layer has an IFD of between about twenty-five and thirty-five.

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