

FOAM CUSHIONS HAVING AN ORTHOGONAL ALTERNATING STRUCTURE

BACKGROUND

5 [0001] Foam is commonly used as a cushioning material in a variety of applications. For example, mattresses are commonly formed of memory foam due to its ability to mold to the body to provide even support. However, memory foam also has various undesirable properties. Many individuals complain that memory foam feels dead, meaning that it tends to absorb force as opposed to springing back as would a traditional spring mattress or a conventional
10 polyurethane non-memory foam. It can also be difficult to roll over on a memory foam mattress due to the indentation that is formed around the body. Additionally, memory foam has minimal breathability and is therefore too hot for many individuals.

[0002] To address such disadvantages of foam, and particularly memory foam, other materials have been used for mattresses and other cushioning articles. For example, mattresses,
15 such as those marketed under the Purple trademark, have been formed of a gelatinous material having an adjoining hollow column shape. Mattresses made of this gelatinous material provide local instability and general stability due to the columns' ability to buckle where needed such as under an individual's hip. However, such mattresses are extremely heavy and require specialized manufacturing.

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BRIEF SUMMARY

[0003] The present invention extends to foam cushions having an orthogonal alternating structure and to cushioning articles formed of or containing such foam cushions. The orthogonal alternating structure can be formed by bonding together layers of foam where the
25 layers are formed from at least two types or stiffnesses of foam. The layered arrangement of foam can be cut, if necessary, to create a foam cushion where the layers extend along a length or width of the foam cushion, or orthogonal to the direction of the force that the foam cushion is intended to support. Foam cushion components having bases and layers that emanate from the bases could be used to form the foam cushion.

30 [0004] In some embodiments, the present invention may be implemented as a foam cushion that includes layers of foam that are arranged along a length of the foam cushion.

[0005] In some embodiments, the present invention may be implemented as a cushioning article that includes a first foam cushion. The first foam cushion may include layers of foam that are arranged along a length of the foam cushion.

[0006] In some embodiments, the present invention may be implemented as a method for manufacturing a mattress. Sheets of foam can be stacked along an axis to form a layered foam block. The layered foam block can be cut along the axis to form a foam cushion comprising layers of foam. The foam cushion can be oriented within the mattress to cause layers of foam to be arranged along a length of the mattress.

[0007] In some embodiments, the present invention may be implemented as a method for manufacturing a foam cushion. A first piece of foam and a second piece of foam can be created in a desired shape. The first piece of foam and the second piece of foam can be cut into corresponding layers. Alternating layers of the first piece of foam and the second piece of foam can be bonded together to form the desired shape.

[0008] In some embodiments, the present invention may be implemented as a method for assembling a foam cushion. A first foam cushion component that includes a base and layers that emanate from the base can be obtained. A second foam cushion component that includes a base and layers that emanate from the base can be obtained. The layers of the first foam cushion component can be inserted between the layers of the second foam cushion component to form the foam cushion.

[0009] This summary is provided to introduce a selection of concepts in a simplified form that are further described below in the Detailed Description. This Summary is not intended to identify key features or essential features of the claimed subject matter.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] Understanding that these drawings depict only typical embodiments of the invention and are not therefore to be considered limiting of its scope, the invention will be described and explained with additional specificity and detail through the use of the accompanying drawings in which:

[0011] Figures 1A and 1B are side perspective and side views respectively of a foam cushion having an orthogonal alternating structure in accordance with one or more embodiments of the present invention;

[0012] Figures 2A and 2B are side perspective and side views respectively of another foam cushion having an orthogonal alternating structure in accordance with one or more embodiments of the present invention;

[0013] Figures 3A and 3B are side perspective and side views respectively of another foam cushion having an orthogonal alternating structure in accordance with one or more embodiments of the present invention;

[0014] Figure 4 provides an example of how foam cushions having an orthogonal alternating structure could be formed in accordance with one or more embodiments of the present invention;

5 [0015] Figures 5A-5D are each cross-sectional side views of a mattress that includes a foam cushion having an orthogonal alternating structure in accordance with one or more embodiments of the present invention;

[0016] Figure 6 is a cutaway, perspective top view of a mattress that includes a foam cushion having an orthogonal alternating structure in accordance with one or more embodiments of the present invention;

10 [0017] Figures 7 and 7A-7C provide an example of how non-rectangular foam cushions having an orthogonal alternating structure could be formed in accordance with one or more embodiments of the present invention;

[0018] Figure 8 provides an example of a mattress that includes a foam cushion formed of opposing foam cushion components in accordance with one or more embodiments of the present invention;

[0019] Figure 9 provides another example of a mattress that includes a foam cushion formed of opposing foam cushion components in accordance with one or more embodiments of the present invention;

20 [0020] Figures 10A-10C provide examples of foam cushions formed of opposing foam cushion components that also include gaps;

[0021] Figure 11 provides an example of a foam cushion formed of opposing foam cushion components where the layers have rounded ends in accordance with one or more embodiments of the present invention;

25 [0022] Figures 12A-12C provide an example of a mattress that includes single foam cushion formed of opposing foam cushion components in accordance with one or more embodiments of the present invention;

[0023] Figures 13A-13E provide an example of a mattress that includes a two foam cushions that are each formed of opposing foam cushion components in accordance with one or more embodiments of the present invention;

30 [0024] Figure 14 provides an example of a pillow that is formed of opposing foam cushion components in accordance with one or more embodiments of the present invention;

[0025] Figures 15A and 15B provide an example of how foam cushions can be formed from opposing foam cushion components; and

[0026] Figures 16-18 are tables that summarize results of experiments that were performed to test embodiments of the present invention.

DETAILED DESCRIPTION

5 [0027] In this specification and the claims, the term “cushioning article” is intended to encompass mattresses, pillows, couches, car seats, aircraft seats, after-market seat cushions, and other furniture or articles that provide cushioning to an individual. A cushioning article may include one or more foam cushions configured in accordance with one or more
10 embodiments of the present invention. A foam cushion configured in accordance with embodiments of the present invention may also be separate and/or independent from a cushioning article and may be covered with a fabric or plastic film or other pliable covering. The term “approximately” means within 10% of the stated value.

[0028] In accordance with embodiments of the present invention, a foam cushion can be formed of layers of foam that have an orthogonal alternating structure. In this context, the term
15 “orthogonal” is intended to represent that the layers are arranged along an axis that is orthogonal to the force that the foam cushion is intended to support. The term “alternating” is intended to represent that the layers are formed from alternating types or stiffnesses of foam.

[0029] Figures 1A and 1B provide an example of a foam cushion 100 that has an orthogonal alternating structure. Foam cushion 100 has a rectangular shape which is labeled as having a
20 length, a width, and a height. The height can be considered the vertical dimension when foam cushion 100 is lying flat, whereas the length and width can be considered the horizontal dimensions. Foam cushion 100 is formed of two types of foam which are arranged into alternating layers 101 and 102 along the length of the foam cushion (the length need not be longer than the width). Accordingly, the combined thickness of all layers 101 and 102 defines
25 the total length of foam cushion 100. In this embodiment, the width of each layer 101 and 102 defines a consistent width of foam cushion 100, but the layers could have different widths in some embodiments (e.g., to create non-rectangular-shaped foam cushions). In this embodiment, the height (L_H) of each layer 101 and 102 defines a consistent height of foam cushion 100, but the layers could have different heights or could be arranged in different
30 vertical positions relative to one another as described below.

[0030] The thickness (L_T) of each layer 101, 102 (i.e., the dimension of the layer along the length of foam cushion 100) can be less than the height of each layer to thereby create local instability. In other words, this smaller thickness can cause each layer 101, 102 to collapse more easily under a downward force such as from an individual’s hip or shoulder when lying

on foam cushion 100. However, the combination of layers 101 and 102 can still provide general stability across foam cushion 100. For example, if foam cushion 100 is a mattress, individual layers 101 and 102 can collapse under localized pressure from an individual's hip and shoulder while the combination of layers 101 and 102 extending across a broader portion of the body such as the torso can exhibit general stability to provide back support.

[0031] Because layers 101 can be formed of a different type of foam from layers 102, foam cushion 100 can exhibit synergistic benefits relative to the use of a single type of foam or a different structural arrangement of foams. Stated another way, the type of foam for layers 101 can have a first set of properties and the type of foam for layers 102 can have a second set of properties, and the orthogonal alternating structure of these layers can cause the first and second set of properties to yield synergistic benefits. For example, layers 101 could be formed of a relatively stiff foam and layers 102 could be formed of a relatively soft foam such that each layer will collapse/compress differently from the adjacent layer. As other examples, layers 101 and 102 could have different breathability, bounce-back, and/or softness.

[0032] The ratio between the height of each layer (L_H) and the thickness of each layer (L_T) can be selected to achieve a desired instability of the layers under significant pressure (e.g., due to the hips or shoulders when an individual lies on a mattress). In some embodiments, this ratio may be at least 2.5, at least 3.0, at least 3.5, at least 4.0, at least 4.5, or higher. A higher ratio may cause the layers to exhibit greater instability, or in other words, to collapse under pressure to better form to an individual's body.

[0033] The IFD of the foams used for each layer may also be selected to achieve a desired instability. For example, alternating layers of higher IFD foam with layers of lower IFD foam may make it easier for the layers of higher IFD foam to buckle because the layers of lower IFD foam do not provide significant resistance to such buckling (i.e., the layers of lower IFD foam may compress to accommodate the buckling of the layers of higher IFD foam).

[0034] The layered structure of a foam cushion configured in accordance with embodiments of the present invention allow this instability to occur only in response to sufficient loading/pressure. Accordingly, a mattress configured in accordance with embodiments of the present invention may be giving only under the hips or shoulders while remaining firm under the other parts of the body.

[0035] As one particular example, foam cushion 100 could represent a mattress or a portion of a mattress, and layers 101 could be formed of latex foam (or latex foam rubber) while layers 102 could be formed of memory foam. In such cases, the latex foam can give the mattress some properties desired in a mattress, such as breathability, bounce-back when shifting places

on the mattress, and softness. Memory foam lacks these properties. It is known for feeling 'dead' when lying down or doing other activities on a mattress. It is also known for making it hard to roll over on the mattress since it creates a body shaped depression that takes some time to return to original shape. It is also known for not being very breathable, so that the person

5 lying on the mattress gets hot from body heat or vapor that cannot escape. It does not have the amazing softness of latex foam (e.g., talalay latex foam rubber). Memory foam can also lack back support, since when the body heats up the memory foam, it becomes softer, and a body's heavy torso can sag into that softness. Memory foam does have positive properties, however, that latex foam lacks, the most significant of which is that memory foam is known for molding

10 itself to the shape of the body over time, giving a more even support to the body (relief from pressure points). So, alternating layers of memory foam with layers of latex foam can be synergistic. The latex foam instantly tends to spring to shape, which would hasten the memory foam's return to shape after deformation, and would feel much more lively (as opposed to memory foam's deadness). Latex foam is more breathable, and the body's heat and vapors can

15 escape through the intermittent latex foam layers. The softness of latex foam gives the mattress a much softer 'hand feel' to the mattress, and overcomes memory foam's initial hard feel which exists during the time when the memory foam is heating up to body temperature and slowly forming to the body. The latex foam's springy nature will help to offset the loss of support when the memory foam heats up and becomes softer. The alternating layers of memory foam

20 add to the synergy by enhancing the shape-to-fit properties which reduces pressure points. These synergistic benefits combined with the benefit of local instability and general stability can yield a highly-desirable mattress or other foam cushion.

[0036] In some embodiments, a foam cushion can have more than two types of foams arranged in layers. Using the above example, layers of reticulated foam could be used with

25 layers of memory foam and layers of latex foam to provide higher breathability. As another example, if more firmness is desired or if the spring-back to shape of the adjacent memory foam needs to be faster, a soft talalay latex in the above example can be replaced with a stiffer latex, generally made by the dunlop process rather than the talalay process. Although each layer 101 and 102 is represented as being formed from a single piece of foam, in some

30 embodiments, a layer 101 or layer 102 could be formed from multiple pieces of the same foam.

[0037] A wide variety of foams could be used in embodiments of the present invention. The foams include, but are not limited to: quick-rebound polyurethane foam (selected from the group comprising conventional polyurethane foam, high resiliency polyurethane foam, and reticulated polyurethane foam), slow-rebound polyurethane foam (selected from the group

comprising slower-rebound memory foam, quicker-rebound memory foam, and gel memory foam), latex foam (selected from the group comprising natural latex foam, organic natural latex foam, synthetic latex foam, and part natural part synthetic latex foam), expanded polyolefin foam, EVA foam, silicone foam, melamine foam, PVDF foam, polyethylene foam, shredded and then rebonded foam (comprising any shredded flexible foam types), Energex® foam (a unique foam made by Elite Comfort Solutions which is a highly breathable, somewhat viscoelastic foam that changes when warmed to body temperature from its original viscoelastic [memory] foam to a bouncy foam with resilience similar to latex), etc. Foams with different stiffnesses are intended to encompass, but not be limited to, using conventional polyurethane open-cell cushioning foams with stiffnesses of IFD (Indentation Force Deflection) 8, IFD 13, IFD 18, IFD 24, IFD 32, IFD 36, IFD 44, IFD 55, and IFD 60 or equivalents thereto. In embodiments of the present invention, either the type of foam may be different in one layer adjacent to the next, or the stiffness of the foam is different in one layer adjacent to the next, or both. Two or more types of foam can be selected for synergy of properties with the adjacent layer, and the two or more stiffnesses of foam may be selected to create stability under broad areas of the body or other cushioned object and instability under the pointy areas of the body or other cushioned object. Results can be more pronounced if the adjacent foams differ in both type and stiffness.

[0038] Figures 2A and 2B provide another example of a foam cushion 200 that has an orthogonal alternating structure. In foam cushion 200, layers 101 are vertically offset relative to layers 102 thereby forming gaps 103 at the top and bottom of foam cushion 200. In the depicted embodiments, gaps 103 are formed at the top of foam cushion 200 between adjacent pairs of layers 102 and gaps 103 are formed at the bottom of foam cushion 200 between adjacent pairs of layers 101.

[0039] Figures 3A and 3B provide another example of a foam cushion 300 that has an orthogonal alternating structure. In foam cushion 300, layers 102 have a different height than (i.e., are taller than) layers 101 thereby forming gaps 103 at the top of foam cushion 300 (or at the bottom if foam cushion 300 is flipped over) between adjacent pairs of layers 102.

[0040] In both foam cushion 200 and foam cushion 300, gaps 103 form air pockets that can provide more breathability, less overall stiffness, less initial stiffness during the initial descent of the body or other cushioned object into the foam cushion, and reduced foam cost.

[0041] Figure 4 provides an example of how foam cushions 100, 200, and 300 could be cut from a layered foam block 400. For example, sheets of different types and/or stiffnesses of foam could be alternately stacked and bonded together to create layered foam block 400.

Layered foam block 400 could then be cut (e.g., using a CNC band saw) with a desired pattern to produce foam cushions 100, 200, and/or 300. By cutting foam cushions 100, 200, and/or 300 from layered foam block 400, foam waste, labor, and time can be minimized. In some embodiments, the foam can be bonded together using a flexible or stretchable adhesive with precisely controlled thickness to prevent the bond from creating too much localized stiffness. It should be noted that in one embodiment, when foam cushion 300 is cut in the pattern shown in Figure 4, half of the resulting cushions 300 have the higher portion of the first type or stiffness of foam and the other half of the resulting cushions 300 have the higher portion of the second type or stiffness of foam. It is also possible to shift the cut by half a layer so that the higher portions and the lower portions each have 50% of the first type or stiffness of foam and 50% of the second type or stiffness of foam. This shifted cut would make it so that all of the foam cushions 300 were essentially identical, whereas the non-shifted cut would result in two different foam cushions 300 which may then go into separated cushion designs. For example, with the non-shifted cut where the higher portions were latex foam and the lower portions were memory foam, more of the latex foam properties may be exhibited than the memory foam properties. As another example, with the non-shifted cut where the higher portions were memory foam and the lower portions were latex foam, more of the memory foam properties may be exhibited than the latex foam properties.

[0042] Figures 5A-5D, which are cross-sectional views, provide examples of how foam cushions 100, 200, and 300 can be integrated into a mattress 500. In each example, foam cushion 100, 200, or 300 is supported on top of a base layer 501 and surrounded by a side layer 502. A top layer 503 can be positioned on top of the side layer 502 and foam cushion 100, 200, or 300. In Figure 5A, mattress 500 includes foam cushion 100 which has the same height as side layer 502 such that no air pockets are formed. In Figure 5B, mattress 500 includes foam cushion 200 which has the same height as side layer 502 so that gaps 103 are formed towards base layer 501 and towards top layer 503. In Figure 5C, mattress 500 includes foam cushion 300 which has the same height as side layer 502 with gaps 103 being oriented towards top layer 503. In Figure 5D, mattress 500 includes foam cushion 300 but gaps 103 are oriented towards base layer 501. Notably, a mattress could also be formed with foam cushion 100, 200, or 300 but without any or all of base layer 501, side layer 502, and top layer 503. Figure 6 is a cutaway perspective view of mattress 500 as configured in Figure 5A or Figure 5D.

[0043] Figures 7 and 7A-7C illustrate another technique that could be employed to produce a foam cushion that is configured in accordance with embodiments of the present invention. This technique is particularly suitable for producing foam cushions that do not have a

rectangular cross-sectional shape such as a pillow or a car seat. Figure 7 illustrates a piece of foam 700 that is shaped like a pillow. Notably, at least two pieces of foam 700 having different properties should be used (i.e., two different types and/or stiffnesses of foam as described above) and could be molded into the desired shape for a foam cushion.

5 **[0044]** Figure 7A is a side view of two pieces of foam 700 and represents how these pieces of foam 700 could be cut to produce layers 701 and 702 shown in Figure 7B. Each piece of foam 700 can be cut in a similar manner such that the set of layers 701 have the same shape and size as layers 702. Then, as represented in Figure 7C, layers 701 and 702 can be bonded together to form the orthogonal alternating structure described above thereby yielding two
10 foam cushions 750. Foam cushions 750 have the same general shape as pieces of foam 700, however, this need not be the case such as when less than all of layers 701 or 702 are used.

[0045] Non-rectangular foam cushions could also be created using the technique represented in Figure 4 by performing one or more cuts to create the desired shape (e.g., rounded edges, tapered edges, buckets or other indentations, etc.). This can be done by, for
15 example, band sawing block/stack 400 from two sides. In one embodiment, a bed pillow that tapers from its center in all four directions (a standard pillow shape) may be created by band sawing the tapered shape through one side of block/stack 400 to achieve tapering in two sides of the pillow and then band sawing the tapered shape through a second side of block/stack 400 to achieve tapering in the other two sides of the pillow. Non-rectangular foam cushions could
20 also be created using the technique represented in Figure 4 by first cutting a rectangular block as shown in Figure 4, then milling the cushion to final shape, for example, with a CNC mill.

[0046] Figure 8 provides an example of a mattress 800 that is configured in accordance with one or more embodiments of the present invention. Mattress 800 includes a base layer 801 and foam cushion 802 that, like foam cushions 100, 200 and 300, includes alternating
25 layers 101 and 102. However, unlike in foam cushions 100, 200 and 300, layers 101 and 102 in foam cushion 802 emanate from bases 101a and 102a respectively. In some embodiments, base 101a and each layer 101 may be a unitary piece of foam (or “foam cushion component”) and base 102a and each layer 102 may be a separate foam cushion component. In foam cushion 802, base 101a and base 102a have the same height (or vertical thickness) (B_H as labeled in
30 Figure 12C) and all layers 101 and 102 have the same height (L_H as labeled in Figure 12C). However, in other embodiments, base 101a and base 102a could have different heights and/or layers 101 and layers 102 could have different heights.

[0047] Figure 9 provides an example of a mattress 900 that is configured in accordance with one or more embodiments of the present invention. Mattress 900 includes only a foam

cushion 901. Foam cushion 901 is the same as foam cushion 802 except that, in foam cushion 901, base 101a has a substantially greater height than base 102a. For example, the height of base 101a can be increased so that base 101a can function as a base layer for mattress 900.

5 [0048] Figures 10A-10C provide additional examples of foam cushions 1001-1003 respectively that are similar to foam cushion 802 but include gaps 103. In foam cushion 1001, gaps 103 are formed between layers 101 and base 102a and between layers 102 and base 101a. This may be accomplished by gluing or otherwise adhering layers 101 to layers 102 without fully inserting the layers between one another.

[0049] In foam cushion 1002, gaps 103 are only formed between layers 101 and base 102a. 10 This may be accomplished by configuring layers 102 to have a greater height than layers 101 such that, even with layers 101 fully inserted between layers 102, gaps 103 will still be formed.

[0050] Foam cushion 1003 is similar to foam cushion 1002 except that gaps 103 are formed between layers 102 and base 101a. This may be accomplished by configuring layers 101 to have a greater height than layers 102 such that, even with layers 102 fully inserted between 15 layers 101, gaps 103 will still be formed.

[0051] Figure 11 provides an example of a foam cushion 1100 that includes layers 101 and 102 that emanate from bases 101a and 102a respectively as described above (i.e., foam cushion 1100 is formed of opposing foam cushion components). Unlike in previous examples, the ends of layers 101 and 102 are rounded and the portion of bases 101a and 102a between layers 101 and 102 respectively are correspondingly rounded. In some embodiments, layers 101 and 102 20 can be coupled together by gluing only the rounded ends, while in other embodiments, glue may be applied along the entire interface between the layers.

[0052] Figures 12A-12C provide an example of a mattress 1200 that is formed of a single foam cushion 1201. Foam cushion 1201 is the same as foam cushion 1100 except that base 25 102a has a greater height than base 101a. Figure 12C provides examples of suitable dimensions that foam cushion 1201 could have. However, any other reasonable dimensions could be used. In this example, layers 101 and 102 have a thickness (L_T) of approximately 1.4815 inches and the rounded ends have a radius (R) of approximately 0.7407 inches. Layers 101 and 102 have a height (L_H) of approximately 7.000 inches, while bases 101a and 102a may have heights of 30 approximately 0.500 inches and 2.500 inches respectively. Accordingly, the height of foam cushion 1201/mattress 1200 is approximately 10.000 inches.

[0053] Figures 13A-13E provide an example of a mattress 1300 that is formed of a foam cushion 1301 that is positioned on top of a foam cushion 1302. Foam cushions 1301 and 1302 each include opposing foam cushion components.

[0054] Figures 13B and 13C show foam cushion 1301 in isolation and provide suitable dimensions. However, any other reasonable dimensions could be used. In this example, layers 101 and 102 have a width of approximately 1.000 inches and the rounded ends have a radius of approximately 0.500 inches. Layers 101 and 102 have a height of approximately 3.000 or 4.000 inches and bases 101a and 102a have a height (B_H) of approximately 0.500 inches. Accordingly, the height of foam cushion 1301 may be approximately 4.000 inches or 5.000 inches.

[0055] Figures 13D and 13E show foam cushion 1302 in isolation and provide suitable dimensions. However, any other reasonable dimensions could be used. In this example, layers 101 and 102 have a width of approximately 1.4815 inches and the rounded ends have a radius of approximately 0.7407 inches. Layers 101 and 102 have a height of approximately 7.000 inches and bases 101a and 102a have a height of approximately 0.500 inches. Accordingly, the height of foam cushion 1302 may be approximately 8.000 inches and height of mattress 1300 may be approximately 12.000 inches or 13.000 inches.

[0056] With each of the foam cushions formed of opposing foam cushion components, the type of foam for the top foam cushion component and for the bottom foam cushion component can be selected to provide one or more desired benefits. For example, the top foam cushion component can be formed of a more breathable foam than the bottom foam cushion component to enhance breathability. In contrast, the top foam cushion component could be formed of memory foam, which is less breathable, while the bottom foam cushion component could be formed of a more breathable foam. In such cases, the more breathable foam of the bottom foam cushion component can enhance the breathability of the less breathable foam of the top foam cushion component. This may be because the layers of the bottom foam cushion component extend up towards and are positioned close to the base of the top foam cushion component, so that heat does not need to convect very far through the less breathable foam to reach the more breathable foam.

[0057] Figure 14 provides an example of a foam cushion 1400 that is in the form of a pillow. Foam cushion 1400 is formed by opposing foam cushion components configured in a similar manner as described above. Additionally, bases 101a and 102a each include tapered extensions 101b and 102b respectively that extend parallel to layers 101 and 102 to form the pillow shape.

[0058] Figures 15A and 15B provide an example of how foam cushions could be produced in accordance with one or more embodiments of the present invention. Figure 15A shows a first piece of foam 1510 and a second piece of foam 1520. Foam 1510 and foam 1520 may be

different types of foam and may be sized and shaped to allow multiple foam cushion components 1511 and 1521 respectively to be cut out from them. For example, foam 1510 and 1520 may have rectangular dimensions that are a multiple of the desired dimensions of a mattress to be produced. In Figure 15A, the length of foam 1510 and 1520 is two times the
5 desired length of the mattress, the width is presumably the same as the desired width of the mattress, and the height is six times the desired height of the mattress (which is the case in this example because foam cushion components 1511 and 1521 have the same height). Figure 15A also shows how foam cushion components 1511 and 1521 can be cut out from foam 1510 and 1520 respectively. In some embodiments, foam cushion components 1511 can be cut from
10 foam 1510 and foam cushion components 1521 can be cut from foam 1520 using a single CNC saw-cut program.

[0059] Figure 15B shows how a pair of opposing foam cushion components 1511 and a pair of opposing foam cushion components 1521 can be removed from foam 1510 and 1520 respectively and then separated from one another. One of foam cushion components 1511 and
15 one of foam cushion components 1521 can be flipped and then a foam cushion component 1511 and a foam cushion component 1521 can be coupled together. In some embodiments, this coupling can be performed in a zipper fashion. In particular, layers 101 and 102 at one end of foam cushion components 1521 and 1511 respectively can initially be inserted together followed by the next layers 101 and 102 until all the layers 101 and 102 have been combined.
20 In some embodiments, glue or another adhesive may be placed at least on the ends of layers 101 and 102 prior to zipping the layers together in this manner.

[0060] Although Figures 15A and 15B represent the production of foam cushions having a rectangular shape (e.g., for mattresses), the same production technique could be used to produce foam cushions with other shapes (e.g., foam cushion 1400).

25 **[0061]** In some embodiments, a lubricant may be used during the process of assembling foam cushion components. For example, the ends (whether or not rounded) of layers 101 and 102 may be coated with a lubricant to facilitate insertion of the layers between one another. In embodiments where an adhesive is used, the lubricant could be added to the adhesive and then the mixture of adhesive and lubricant can be applied to the ends of the layers 101 and 102. In
30 some embodiments, the adhesive could be water based (e.g., Simalfa 350) and the lubricant could also be water based (e.g., KY Jelly). In some embodiments, the mixture adhesive and lubricant could include 10% lubricant by volume, 20% lubricant by volume, or 50% lubricant by volume. In some embodiments, the lubricant may reduce the rate of evaporation of the adhesive and may therefore prolong the working time of the adhesive (i.e., the lubricant may

slow the drying of the adhesive). This may particularly be beneficial for assembling foam cushion components, such as foam cushion components 1511 and 1521, which can require a substantial amount of time to perform the zippering.

[0062] In embodiments in which glue (or other adhesive) is used to couple layers together, 5 instability of the layers may be controlled by applying glue only at or near the tops and/or bottoms of the layers as opposed to along the full interface between the layers. In this way, layers that are intended to be unstable (e.g., those with higher IFDs) can more easily collapse due to the reduced length along which they are coupled to the adjacent layer. As described above, this designed instability can cause a mattress (or other cushioning article) to give in 10 response to substantial pressure (e.g., at the hip or shoulder) while the remainder of the mattress provides firm support.

[0063] Experiments and Results

[0064] Various experiments were performed on the different types of foam cushions described herein and different configurations of such foam cushions. The results of these 15 experiments are summarized below.

[0065] Various foam cushions matching the configuration shown in Figures 1A and 1B (e.g., layers 101 and 102 were made of foams A and B respectively) were tested as foam cushions for mattresses. In each test, the foam cushions were placed on a base consisting of 1” 32 ILD conventional polyurethane foam atop an 8” pocketed coil spring. Figure 16 is a table 20 that summarizes the results of these tests. The results illustrate that different synergistic results can be obtained from using the layered arrangement of different foams.

[0066] Various foam cushions generally corresponding to the configurations shown in Figure 11 were tested as foam cushions for mattresses. In tests 14 and 15, no base was used. In test 16, the foam cushion was tested as the base of a mattress. Figure 17 is a table that 25 summarizes the results of these tests. The results illustrate that different synergistic results can be obtained from using the layered arrangement of different foams.

[0067] Various mattresses generally corresponding to the configurations shown in Figure 12A-13E were also tested. In each test, the foam cushion of test 16 or a variation was used as the base foam cushion. Figure 18 is a table that summarizes the results of these tests. The 30 results illustrate that different synergistic results can be obtained from using the layered arrangement of different foams in both the top foam cushion and the bottom foam cushion.

[0068] Various pillows generally corresponding to the configurations shown in Figure 14 were also tested. Figure 19 is a table that summarizes the results of these tests. The results

illustrate that different synergistic results can be obtained from using the layered arrangement of different foams.

[0069] The present invention may be embodied in other specific forms without departing from its spirit or essential characteristics. The described embodiments are to be considered in
5 all respects only as illustrative and not restrictive. The scope of the invention is, therefore, indicated by the appended claims rather than by the foregoing description.

CLAIMS

What is claimed:

1. A foam cushion comprising:
5 layers of foam that are arranged along a length of the foam cushion.
2. The foam cushion of claim 1, wherein the layers of foam are formed of at least two types of foam.
- 10 3. The foam cushion of claim 2, wherein the at least two types of foam are arranged in alternating layers.
4. The foam cushion of claim 3, wherein the at least two types of foam have Indentation Force Deflections (IFDs) that differ by at least 15%.
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5. The foam cushion of claim 3, wherein the at least two types of foam have Indentation Force Deflections (IFDs) that differ by at least 20%.
6. The foam cushion of claim 3, wherein the at least two types of foam have
20 Indentation Force Deflections (IFDs) that differ by at least 25%.
7. The foam cushion of claim 3, wherein the at least two types of foam are selected from:
quick-rebound polyurethane foam;
25 slow-rebound polyurethane foam;
latex foam;
expanded polyolefin foam;
EVA foam;
silicone foam;
30 melamine foam;
PVDF foam;
polyethylene foam;
shredded and then rebonded foam; and
Energex foam.

8. The foam cushion of claim 1, wherein each layer has a thickness and a height, the thickness being less than the height.

5 9. The foam cushion of claim 8, wherein a ratio of the height to the thickness is at least 2.5.

10 10. The foam cushion of claim 8, wherein a ratio of the height to the thickness is at least 3.

11. The foam cushion of claim 8, wherein a ratio of the height to the thickness is at least 3.5.

15 12. The foam cushion of claim 8, wherein a ratio of the height to the thickness is at least 4.

13. The foam cushion of claim 1, wherein the layers are formed from opposing first and second foam cushion components.

20 14. The foam cushion of claim 13, wherein each of the first and second foam cushion components includes layers that emanate from a base and the layers of the first foam cushion component are alternated with the layers of the second foam cushion component.

25 15. The foam cushion of claim 14, wherein the base of first foam cushion component has a greater height than the base of the second foam cushion component.

16. The foam cushion of claim 14, wherein a height of the layers of the first foam cushion component is greater than a height of the layers of the second foam cushion component.

30 17. The foam cushion of claim 16, wherein gaps are formed between the layers of the second foam cushion component and the base of the first foam cushion component.

18. The foam cushion of claim 14, wherein gaps are formed between the layers of the second foam cushion component and the base of the first foam cushion component.

19. The foam cushion of claim 18, wherein gaps are also formed between the layers of the first foam cushion component and the base of the second foam cushion component.

5 20. The foam cushion of claim 14, wherein ends of the layers of the first and second foam cushion components are rounded.

21. The foam cushion of claim 20, wherein the layers of the first and second foam cushion components are secured together by applying glue only to the rounded ends.

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22. The foam cushion of claim 14, wherein each layer has a thickness and a height, the thickness being less than the height.

23. The foam cushion of claim 22, wherein a ratio of the height to the thickness is
15 at least 2.5.

24. The foam cushion of claim 22, wherein a ratio of the height to the thickness is at least 3.

20 25. The foam cushion of claim 22, wherein a ratio of the height to the thickness is at least 3.5.

26. The foam cushion of claim 22, wherein a ratio of the height to the thickness is at least 4.

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27. The foam cushion of claim 14, wherein the layers of the first foam cushion component are formed of a first type of foam and the layers of the second foam cushion component are formed a second type of foam.

30 28. The foam cushion of claim 27, wherein the first and second types of foam have IFDs that differ by at least 15%.

29. The foam cushion of claim 27, wherein the first and second types of foam have IFDs that differ by at least 20%.

30. The foam cushion of claim 27, wherein the first and second types of foam have IFDs that differ by at least 25%.

5 31. The foam cushion of claim 1, wherein the layers of foam are vertically offset to create gaps between layers.

32. The foam cushion of claim 1, wherein the layers of foam have different heights that create gaps between layers.

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33. The foam cushion of claim 1, wherein the foam cushion has a rectangular cross-sectional shape.

15 34. The foam cushion of claim 1, wherein the foam cushion has a non-rectangular cross-sectional shape.

35. A cushioning article comprising:
a first foam cushion comprising layers of foam that are arranged along a length of the foam cushion.

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36. The cushioning article of claim 35, further comprising:
a second foam cushion comprising layers of foam that are arranged along a length of the foam cushion, the first foam cushion being positioned on top of the second foam cushion.

25 37. The cushioning article of claim 36, wherein the layers of the first foam cushion are formed from opposing first and second foam cushion components, and the layers of the second foam cushion are formed from opposing third and fourth foam cushion components.

30 38. The cushioning article of claim 37, wherein each of the first and second foam cushion components includes layers that emanate from a base and the layers of the first foam cushion component are alternated with the layers of the second foam cushion component, and each of the third and fourth foam cushion components includes layers that emanate from a base and the layers of the third foam cushion component are alternated with the layers of the fourth foam cushion component.

39. The cushioning article of claim 38, wherein the layers of the first and second foam cushion components have a shorter height than the layers of the third and fourth foam cushion components.

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40. The cushioning article of claim 38, wherein the layers of the first, second, third and fourth foam cushion components are each made of a different type of foam.

41. The cushioning article of claim 38, wherein each layer of the first, second, third and fourth foam cushion component has a height and a thickness, and wherein a ratio of the height to the thickness is at least 2.5.

42. The cushioning article of claim 35, further comprising:
a second foam cushion, the first foam cushion being positioned on top of the second foam cushion.

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43. The cushioning article of claim 35, wherein the layers comprise alternating types of foam.

44. The cushioning article of claim 43, wherein the alternating types of foam have different IFDs.

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45. The cushioning article of claim 35, wherein each of the layers has a height and a thickness, and wherein a ratio of the height to the thickness is at least 2.5.

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46. A method for manufacturing a mattress comprising:
stacking sheets of foam along an axis to form a layered foam block;
cutting the layered foam block along the axis to form a foam cushion comprising layers of foam; and

orienting the foam cushion within the mattress to cause layers of foam to be arranged along a length of the mattress.

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47. The method of claim 46, wherein a thickness of each of one or more layers of the layers of foam is less than a height of each of the one or more layers of the layers of foam.

48. The method of claim 46, wherein the foam cushion is oriented on top of a base layer of the mattress.

5 49. The method of claim 46, wherein the foam cushion is surrounded by a side layer of the mattress.

50. The method of claim 46, wherein cutting the layered foam block along the axis comprises performing a linear cut.

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51. The method of claim 46, wherein cutting the layered foam block along the axis comprises performing non-linear cuts to create gaps between the layers of foam.

52. The method of claim 46, further comprising:
15 bonding together the stacked sheets of foam prior to cutting the layered foam block.

53. The method of claim 46, further comprising:
bonding together the layers of foam after cutting the layered foam block.

20 54. The method of claim 46, further comprising:
bonding the foam cushion to another cushioning layer comprising one or more of springs, foam, quilted panels, gelatinous elastomer, or air bladders.

55. The method of claim 54, further comprising:
25 applying a fabric cover overtop the foam cushion.

56. The method of claim 46, wherein the layers of foam comprise alternating types of foam have different IFDs.

30 57. The method of claim 46, wherein each of the layers has a height and a thickness, and wherein a ratio of the height to the thickness is at least 2.5.

58. A method for manufacturing a foam cushion comprising:
creating a first piece of foam and a second piece of foam in a desired shape;

cutting the first piece of foam and the second piece of foam into corresponding layers;
bonding together alternating layers of the first piece of foam and the second piece of
foam to form the desired shape.

5 59. The method of claim 58, wherein the desired shape is a pillow, an after-market
seat cushion, a furniture cushion insert, or a bucket seat insert.

60. The method of claim 58, wherein the first piece of foam and the second piece
of foam are molded or cut into the desired shape.

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61. The method of claim 58, wherein at least some of the layers have a thickness
that is less than their height.

62. A method for assembling a foam cushion comprising:
15 obtaining a first foam cushion component that includes a base and layers that emanate
from the base;

obtaining a second foam cushion component that includes a base and layers that
emanate from the base; and

inserting the layers of the first foam cushion component between the layers of the
20 second foam cushion component to form the foam cushion.

63. The method of claim 62, wherein the layers of the first foam cushion component
are inserted between the layers of the second foam cushion component in a zipper fashion.

25 64. The method of claim 62, further comprising:
applying glue to ends of the layers of the first and second foam cushion components
before inserting the layers of the first foam cushion component between the layers of the second
foam cushion component.

30 65. The method of claim 64, wherein the ends are rounded.

66. The method of claim 62, further comprising:

applying a lubricant to ends of the layers of the first and second foam cushion components before inserting the layers of the first foam cushion component between the layers of the second foam cushion component.

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67. The method of claim 66, wherein the lubricant is mixed with an adhesive.

68. The method of claim 62, wherein the layers of the first foam cushion component are formed of a first type of foam and the layers of the second foam cushion component are formed of a second type of foam.

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69. The method of claim 68, wherein the first and second types of foam have different IFDs.

70. The method of claim 62, wherein each of the layers has a height and a thickness, and wherein a ratio of the height to the thickness is at least 2.5.

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