



(51) International Patent Classification:
A47C 27/05 (2006.01)

(21) International Application Number:
PCT/US2012/037766

(22) International Filing Date:
14 May 2012 (14.05.2012)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
61/485,364 12 May 2011 (12.05.2011) US

(71) Applicant (for all designated States except US): **SEALY TECHNOLOGY, LLC** [US/US]; One Office Parkway, Trinity, NC 27370 (US).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **MORET, David** [US/US]; 1000 Keabbohaw Lane, Winston-salem, NC 27104 (US). **BEAMON, Andy** [US/US]; 6006 Devoncourt Place, Jamestown, NC 27282 (US).

(74) Agent: **SCOTT, James, C.**; Roetzel & Andress, 1375 East Ninth Street, Cleveland, OH 44114 (US).

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

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(54) Title: TENSION RELIEF FOAM AND MATTRESS CONSTRUCTIONS

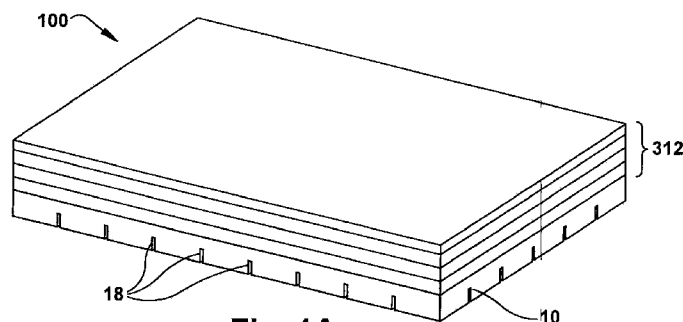


Fig. 1A

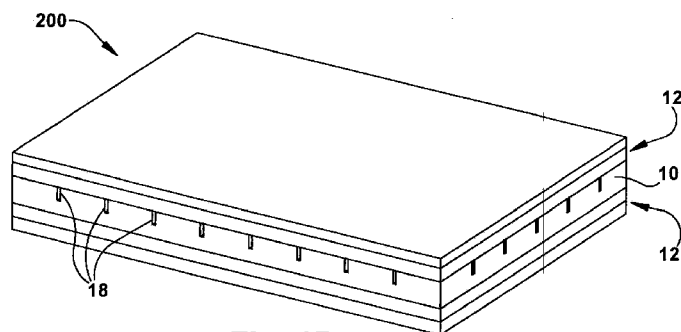


Fig. 1B

(57) Abstract: Engineered foam components for mattresses reduce tension forces in the foam and in the horizontal plane or block planar pieces, and improve the conformance and motion separation characteristics of foam support systems. The tension relief foam pad is a generally rectangular piece of foam having a top surface and a bottom surface. The length and width measurements of engineered foam pieces are substantially equal to that of a mattress with which it is to be used. Depending on the arrangement of the tension relief foam pad within the mattress construction, either the top or bottom surface contains a plurality of continuous cuts, slits or openings arranged in a checkerboard or other patterns with an opposite planar uncut surface.



Published:

— *with international search report (Art. 21(3))*

TITLE OF THE INVENTION**TENSION RELIEF FOAM AND MATTRESS CONSTRUCTIONS****UNITED STATES PATENT APPLICATION****SEALY TECHNOLOGY, LLC****RELATED APPLICATIONS**

This application claims priority to U.S. Provisional Patent Application No. 61/485,364, filed on May 12, 2011, which is incorporated herein by reference in its entirety.

FIELD OF THE INVENTION

The present invention is in the field of reflexive support systems including support systems for humans such as bedding or seating.

SUMMARY OF THE INVENTION

The present invention incorporates surface or structurally modified foam into a mattress for highly localized deformation and support, independent movement and reduced tension in the horizontal plane, an improvement in conformance and motion separation characteristics of the support system. In a representative embodiment, a tension relief foam pad is a generally rectangular piece of foam having a top surface and a bottom surface opposite and parallel to the top surface with four side wall which are perpendicular to and extend between the top and bottom surface. The length and width measurements of the pad are substantially equal to that of a mattress with which it is to be used. Depending on the arrangement of the tension relief foam pad within a mattress construction, discussed in greater detail below, either the top or bottom surface contains a plurality of cuts arranged in a checkerboard or other pattern, while the opposite surface is substantially planar. The cuts create a plurality of square or rectangular blocks on the surface of the pad and independent modules which have independent support characteristics, and which may be coupled with other support elements such as springs.

DESCRIPTION OF THE DRAWINGS

FIG. 1A is a perspective view of a preferred placement of a tension relief foam topper among other foam layers in a mattress system.

FIG. 1B is a perspective view of an alternate placement of a tension relief foam pad among other foam layers in a mattress system.

FIG. 2 is a side view of one embodiment of tension relief foam pad and innerspring.

FIG. 3 is a side view of an alternate embodiment of tension relief foam pad and innerspring.

FIG. 4 is a chart showing the surface deflection on a tension relief foam pad in various locations among other foam layers in a mattress system.

FIG. 5 is a chart showing the surface strain on a tension relief foam pad in various locations among other foam layers in a mattress system.

FIG. 6A is a perspective view showing the stress distribution across a tension relief foam pad when the pad is used as a top layer of a mattress system.

FIG. 6B is a perspective view showing the stress distribution across a tension relief foam pad when the pad is used as a bottom layer of a mattress system.

FIG. 7 is a side view of an alternate embodiment of tension relief foam pad and innerspring.

FIG. 8 is a top view of a tension relief foam pad with non-uniform sized blocks.

FIG. 9 is a side view of one embodiment of tension relief foam pad with non-uniform sized blocks.

FIG. 10 is a side view of an alternate embodiment of tension relief foam pad with non-uniform sized blocks.

FIG. 11 is a side view of an alternate embodiment of tension relief foam pad with non-uniform sized blocks.

GENERAL DESCRIPTION OF PREFERRED AND ALTERNATE EMBODIMENTS

The tension relief foam pads, mattresses and support systems of the present disclosure and related inventions utilize surface modified foams to achieve independent and localized deformation, support and movement and reduced tension or shear forces in the horizontal plane, benefitting the conformance and motion separation characteristics of the system. The various forms of tension relief foam pieces and pads described herein (also referred to herein as “pad” or “foam pad” or “topper”) **10** are generally in the form of rectangular block planar shapes having a top surface and a bottom surface opposite and parallel to the top surface. For example, the length and width measurements of the pad **10** are substantially equal to that of a mattress with which it is to be used. Although described with reference to particular representative embodiments, it is understood that the concepts of the present disclosure can be applied and implemented in other physical forms of foam. As used herein, the term “tension relief foam” refers generally to each of the various described foam configurations and constructs, and more generally to foam body configurations which reduce or eliminate stress forces within the cellular structure of a body of foam. The design concepts and

configurations are equally applicable to any type of foam from which such shapes and configurations can be manufactured, including open cell and closed cell type foams. Depending on the arrangement of the tension relief foam pad 10 within the mattress construction, set forth in greater detail below, either the top or bottom surface contains a plurality of continuous cuts 18 arranged in a checkerboard or other pattern, while the opposite surface is substantially planar and generally without cuts. The cuts 18 create a plurality of square or rectangular blocks 16 on one surface of the pad 10.

A typical mattress system includes a foundation or box spring, a support unit and optionally, a comfort unit. The foundation can be of conventional internal design and construction, having a rectangular frame on which are mounted a plurality of spring elements or modules to provide flexible support for an overlying grid, which defines the foundation surface. The spring modules in the foundation may be formed of wire or made of a composite material, or be entirely without individual spring modules and rather in the form of a flexible support surface. Foundation units are typically supported by a bed frame which may further include side boards, a head board and foot board. The support unit or innerspring of the mattresses of the disclosure are dimensioned to fit upon the foundation surface and be fully supported thereby. The support unit or innerspring may be of conventional design, containing a plurality of interconnected spring coils. The support unit may alternatively be a high performance foam core structure without any internal wire or spring elements. The support surface has relatively few layers of material, which cover the innerspring, such as one or more layers of mat or foam or other sheet-like fabric or non-woven material. The primary purpose of layers is to provide a smooth surface over the ends of the coils of the innerspring. A comfort unit is dimensioned to fit upon the support unit. It has a generally horizontal top and bottom and generally vertical or tapered sides extending between the top and bottom to define a central space containing supporting and cushioning components. The comfort unit contains additional layers of compressible, conformable internal layers of materials. A comfort unit may contain one or more foam core layers and intermediate and outer layers made of matted material, synthetic or organic, such as cotton or wool fibers, polyester, or hybrid material mats. Extra material layers may also be used, such as woven cotton, wool or synthetic cloths or hybrids thereof, or sheet materials such as plastic films, solid or perforated, which may serve as moisture barriers, aeration promoters, liners or flame or heat retardants. The feel of the comfort unit may be adjusted by using different insert materials such as polyurethane foams, visco-elastic foams, latex foams, fibers, gels or various combinations thereof. The

comfort unit materials are encapsulated by upholstery, which may include ticking, for example foam or padding backed woven or embroidered material, side wall material or ticking, tape edges, and a gusset which extends from the pillowtop to the top of the support unit. The upholstery of the comfort unit may be a combination of materials.

In a preferred embodiment, the top surface of the tension relief pad **10** is generally planar while the bottom surface contains a plurality of cuts **18** arranged in a checkerboard or other pattern. The cuts or voids **18** between discrete islands of foam can be uniform in size and spacing or not, generally linear or not, and dimensioned uniformly or not. The foam structures **16** can be formed by molding, cutting, water-jet forming or by any other suitable process. When used in combination with an innerspring **15** or spring unit, the tension relief foam **10** pad is generally placed directly above the innerspring **15** and below any other foam layers **12** of the mattress or comfort unit, as shown in **FIGS. 1A, 2 and 3**. A thin fabric or fiber layer or insulation layer may be located between the tension relief foam pad **10** and the innerspring **15**. The individual blocks **16** on the bottom surface of the pad **10** may be aligned with or correspond in location to the positions of the upper terminal convolutions of the coils **14** of the mattress innerspring **15**, as shown in **FIGS. 2 and 3**. Depending on the size of the blocks **16**, each block may correspond and work in combination with two or more springs or coils **14** of the innerspring **15** to provide improved independent movement of the foam **10** and coils **14** accentuating the feel of the coils **14**. Each of the individual blocks **16**, in combination with the innerspring **15**, is separately compressible in response to the weight placed directly thereon. Placing the tension relief pad **10** directly on top of the innerspring **15**, below other foam layers **12**, is shown to provide more local compliance, a lower surface strain and a lower complex stress state, as shown in the charts of **FIGS. 4 and 5** and on the stress state mapping shown in **FIG. 6B**.

Representative and non-limiting examples of springs which can be used in the tension relief foam mattress system of the present invention include those disclosed in the commonly assigned U.S. Patent Nos. 4,535,978; 4,726,572; 5,558,315; 6,134,729; 6,354,577; 6,406,009; 8,178,187; 7,404,223; 7,908,693 and any other spring or reflexive device or devices which could be mounted upon a frame or platform and support a grid or other mattress support structure over the frame or platform. The springs may be individually pocketed or Marshall-type coils or the coils may be without a pocket or encasement. Each of the individual foam blocks **16** may be associated with one or more corresponding spring **14** of a spring unit **15**, as

shown in **FIGS. 2, 3** and **7**. Having an axial upper end of each coil **14** in direct or indirect physical contact with an opposing face of a foam block **16** provides a hybrid spring combination by which a force applied to the area of a particular foam block **16** is transferred in whole or in part to the corresponding spring **14**, and the matched spring **14** or springs and foam block **16** respond together to applied forces. The size of each block **16** in the pattern may be uniform, such as, for example, the pad **10** shown in **FIG. 7** wherein each uniformly sized foam block **16** corresponds to a single coil unit **14** of the innerspring **15**. Also, **FIG. 3** shows a pad **10** with uniformly sized foam blocks **16** correspond to every two coil units **14** of the innerspring **15**. Alternatively, the size of the foam blocks **16** in the pattern may be non-uniform, such as, for example, the pad **10** shown in **FIG. 2**, wherein blocks **16** having a first size, which corresponds to three coil units **14** of the innerspring **15**, are interspersed between blocks **16** having a second size which corresponds to two coil units **14** of the innerspring **15**. The individual blocks **16** may be zoned such that the blocks **16** vary in number or size. For example, the blocks **16** located along the short edges of the pad **10** may have a larger width while the remainder of the blocks **16** located therebetween may have a uniform width, which is less than the width of the blocks **16** along the short edges of the pad **10**. Any pattern of uniform or non-uniform sized blocks **16**, which correspond to any number of coils **14** may be used to create different zones in the tension relief foam pad **10** and mattress system of the present invention.

In an alternate embodiment, the bottom surface of the tension relief foam pad **10** is generally planar while the top surface contains a plurality of cuts **18** arranged in a checkerboard or other uniform or non-uniform pattern. In this configuration, shown in **FIG. 1B**, the tension relief foam pad **10** is typically placed between additional foam layers **12** of the mattress construction. To prevent bunching or sticking between the blocks **16** on the top surface of the tension relief foam pad **10** and the bottom surface of an adjacent foam pad **12**, which may result in body impressions, the tension relief pad **10** may be laminated. The cuts **18** may be of any width or opening (or no opening, such as in the form of a slit) or any size width from 1mm to 10mm or greater. Also, the cuts **18** may have generally planar and parallel walls or tapered or other shape, and may be formed in straight and orthogonal lines as shown or in other arrangements which have the similar result of relieving tension in the foam piece.

The tension relief foam pad **10** dimensions, block cut and geometry affect the surface deformation, surface strain, stress state upon the layer and deformation modes of the pad **10**. For example, if the height of the blocks **16** is too great, it may cause weak points between each block **16**, which may be subject to tearing when a force is applied thereto. If the width of the cuts **18** or the gap between each block **16** is too wide, it may cause local depressions on the top surface of the mattress. If the gap **18** is too narrow, there may be too much contact between adjacent blocks **16** preventing independent movement. Also, if the height of the blocks **16** is too high, it may cause bending or deformation of the blocks **16**. Therefore, as general overall design considerations, the thickness of the foam pad **10** or the overall solid height of the foam pad **10** must be greater than or equal to 1 inch; the block **16** width must be greater than or equal to the block **16** height or greater than or equal to 2.5 inches; the gap width must be 15% of the smallest block **16** width or less than 0.75 inches.

As an example, a tension relief foam pad **10** may be approximately 3 inches thick with cuts **18** between each block **16** being approximately 2 inches deep or extending approximately 2/3 of the way into the foam pad **10**. The individual blocks **16** may have a uniform size, such as 3.75 inches wide by 3.75 inches long with the width of the cut or gap **18** between blocks **16** being approximately 0.25 inch wide. Alternatively, the individual blocks **16** may vary in size such that the blocks **16** located at the short edges are larger than the blocks **16** located therebetween, wherein the blocks **16** located at the short edges of the pad **10** are approximately 7.35 inches wide and the blocks **16** located therebetween are approximately 5.2 inches wide. This example tension relief foam pad **10** enables a zoned mattress construction wherein blocks **16** of different sizes can be formed and located in particular zones or regions where different support characteristics are desired, such as the shoulder or lumbar areas of the mattress where blocks **16** of a relatively larger size may have a relatively greater density and relatively less freedom of individual movement or deformation to provide firmer support which still has the enhanced conformance of the structurally modified foam and a corresponding spring or core unit support. Tension relief foam pads **10** having various thickness measurements are shown in **FIGS. 9, 10 and 11**.

It will be appreciated by persons skilled in the art that numerous variations and/or modifications may be made to the invention as shown in the specific embodiments without departing from the spirit or scope of the invention as broadly described. The present embodiments are, therefore, to be considered in all respects as illustrative and not restrictive.

Other features and aspects of this invention will be appreciated by those skilled in the art upon reading and comprehending this disclosure. Such features, aspects, and expected variations and modifications of the reported results and examples are clearly within the scope of the invention where the invention is limited solely by the scope of the following claims.

CLAIMS

What is claimed is:

1. A tension relief mattress system comprising:
an innerspring unit having a plurality of interconnected coils arranged
in
rows and columns;
a tension relief pad located directly above the innerspring, the tension
relief pad having a top surface which is generally planar and a bottom surface,
opposite the top surface, which has a plurality of cuts arranged to form a plurality of
square or rectangles thereon;
wherein the tension relief pad is at least 1 inch thick, the width of the
square or rectangles on the bottom surface is at least 2.5 inches and the distance
between each adjacent square or rectangle is less than 0.75 inches.
2. The tension relief mattress system of claim 1, wherein each of the plurality of
square or rectangles on the bottom surface of the tension relief pad sits directly above
each of the plurality of interconnected coils of the innerspring.
3. The tension relief mattress system of claim 1, wherein each of the plurality of
square or rectangles on the bottom of the tension relief pad sits directly above at least
one coil of the innerspring.
4. The tension relief mattress system of claim 1, wherein the plurality of square
or
rectangles on the bottom surface of the tension relief pad are uniform in size.
5. The tension relief mattress system of claim 1, wherein the plurality of square
or rectangles on the bottom surface of the tension relief pad are non-uniform in size.
6. Then tension relief mattress system of claim 1, wherein a first group of square
or

rectangles on the bottom surface of the tension relief pad are of a first size which corresponds to three coils of the innerspring unit and a second group of square or rectangles on the bottom surface of the tension relief pad are of a second size which corresponds to two coils of the innerspring unit.

7. The tension relief mattress of claim 1, wherein the square or rectangles located on a short edge of the bottom surface of the tension relief pad have a larger width than the remainder of the blocks located therebetween.

8. The tension relief mattress of claim 1, wherein the space between each adjacent pair of squares or rectangles on the bottom surface of the tension relief pad is of uniform size.

9. The tension relief mattress of claim 1, wherein the tension relief pad is made of polyurethane foam.

10. The tension relief mattress of claim 1, wherein a spacer fabric is located between the tension relief pad and the innerspring unit.

11. A tension relief mattress system comprising:

an innerspring unit having a plurality of interconnected coils;

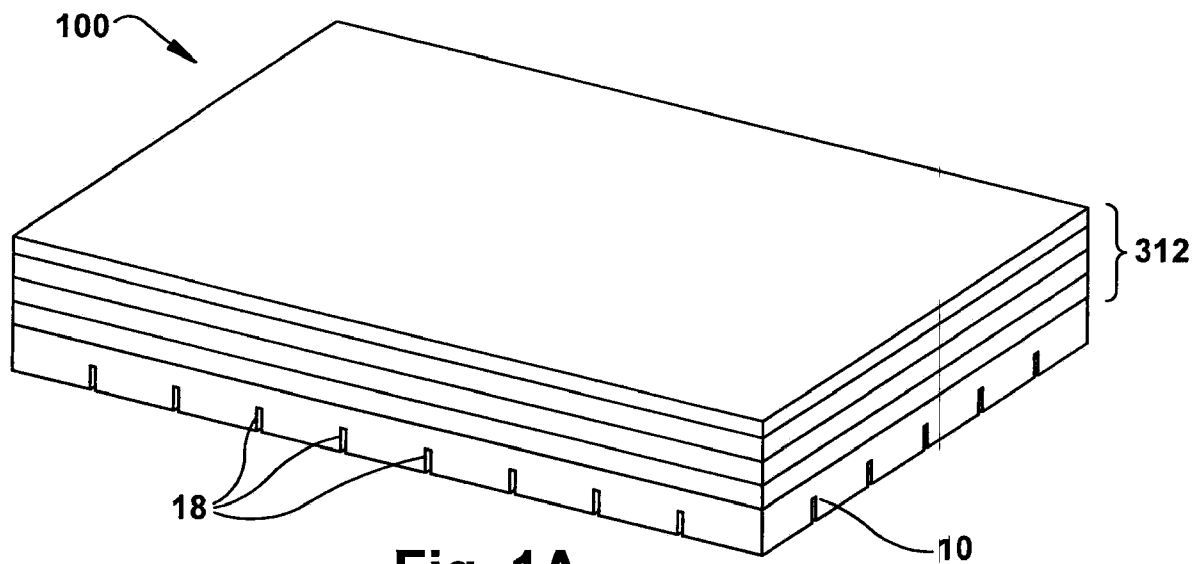
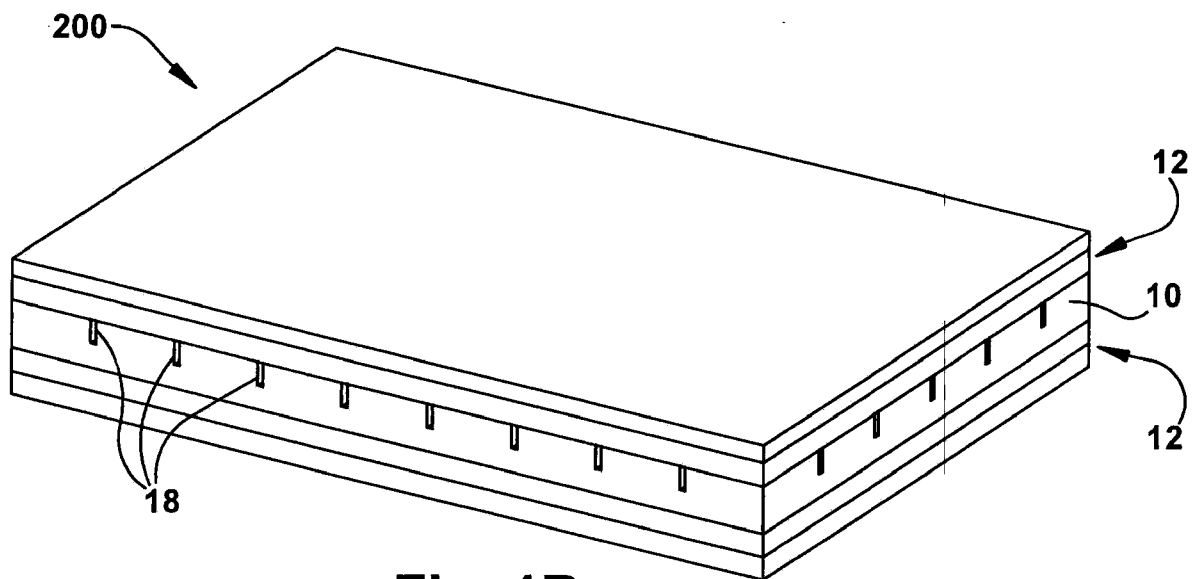
a tension relief pad having a top layer which is substantially planar and a bottom layer, opposite the top layer, which contains a plurality of cuts formed into a plurality of raised blocks;

wherein the thickness of the plurality of raised blocks is at least one inch, the width of the plurality of raised blocks is greater than or equal to the block height and the distance between each adjacent pair of the plurality of raised blocks is approximately 15% of the smallest block width.

12. The tension relief mattress system of claim 11, wherein the size of the plurality of raised blocks is uniform.

13. The tension relief mattress system of claim 11, wherein the size of the plurality of raised blocks is non-uniform.

14. The tension relief mattress system of claim 11, wherein the size of the plurality of foam blocks corresponds to one or more coils of the innerspring unit.
15. The tension relief mattress system of claim 11, wherein the tension relief pad is made of polyurethane foam.
16. A tension relief mattress system comprising:
 - an innerspring unit having a plurality of interconnected coils;
 - a comfort unit comprising two or more foam layers and a tension relief pad positioned between the two or more foam layers, the tension relief pad having a top surface which contains a plurality of cuts formed into a plurality of raised blocks;
 - wherein the thickness of the tension relief pad is at least one inch, and
 - wherein the tension relief foam pad is laminated.
17. The tension relief mattress system of claim 11, wherein the size of the plurality of raised blocks is uniform.
18. The tension relief mattress system of claim 11, wherein the size of the plurality of raised blocks is non-uniform.
19. The tension relief mattress system of claim 11, wherein the tension relief pad is made of polyurethane foam.
20. The tension relief mattress system of claim 11, wherein the height of the plurality of raised blocks is at least 2.5 inches.

**Fig. 1A****Fig. 1B**

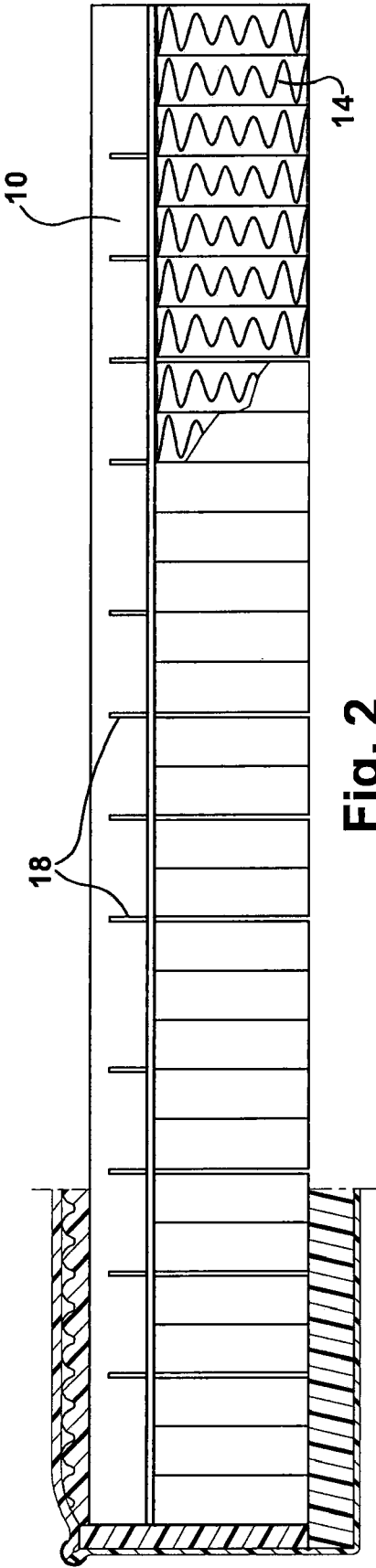


Fig. 2

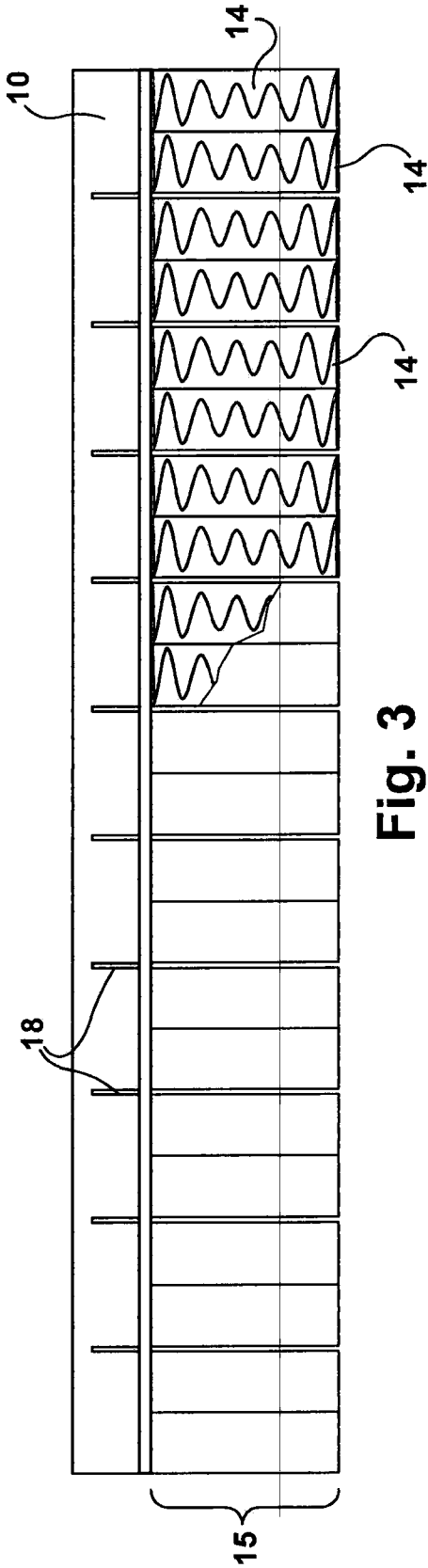


Fig. 3

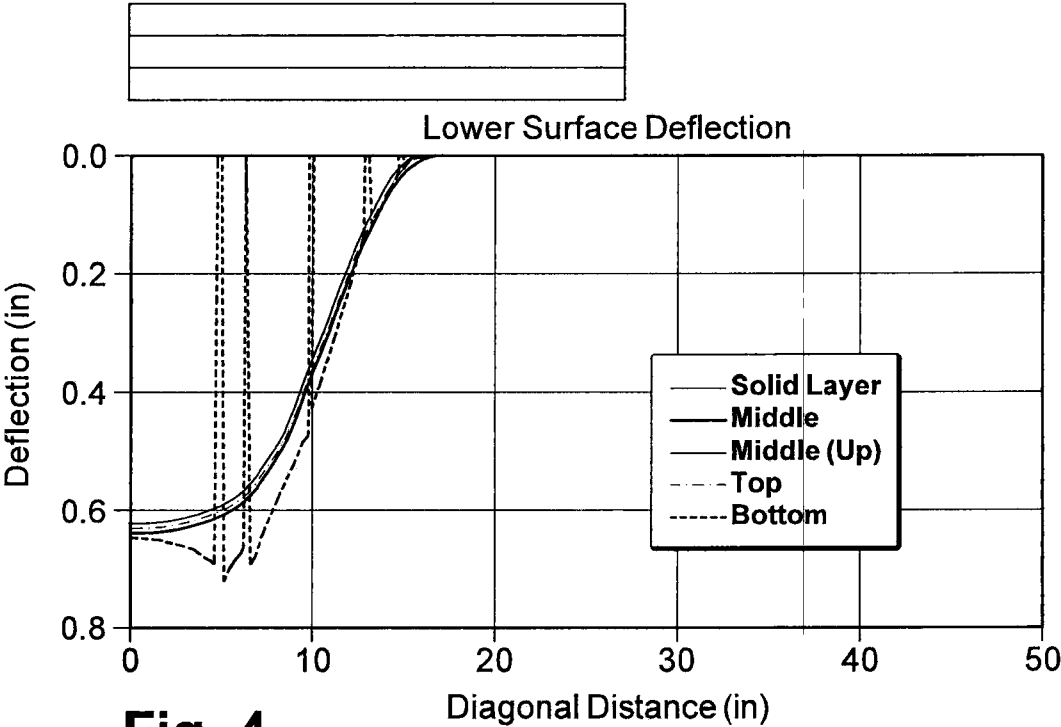


Fig. 4

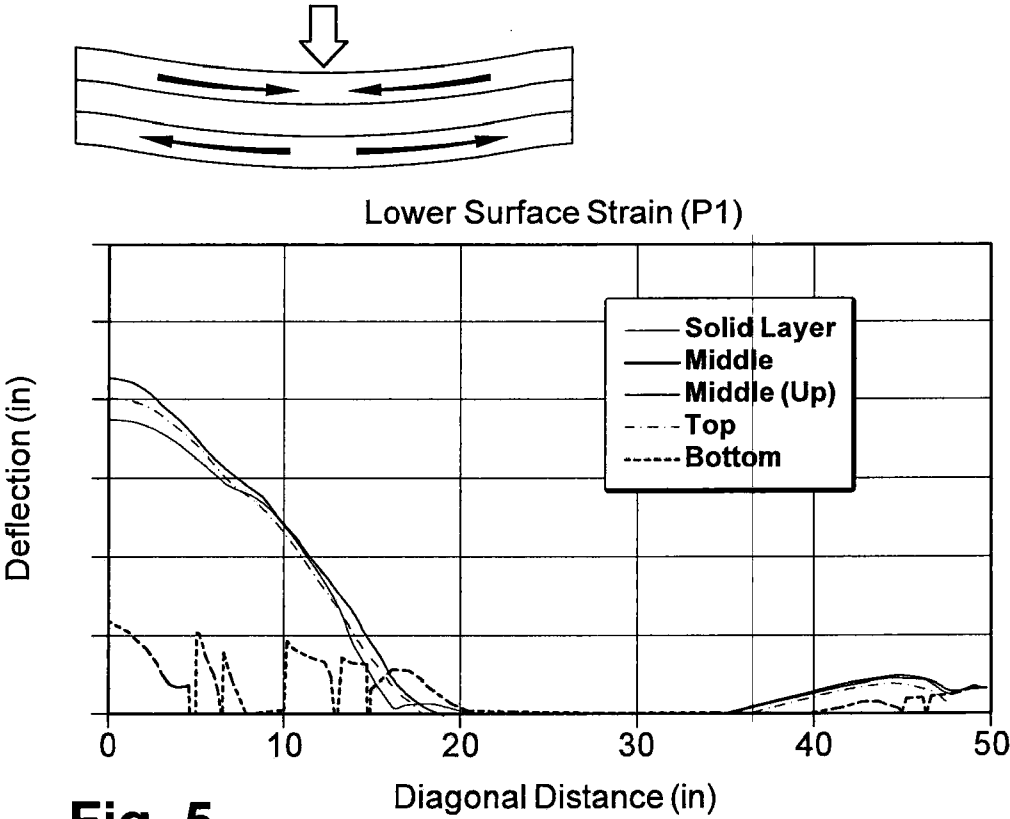
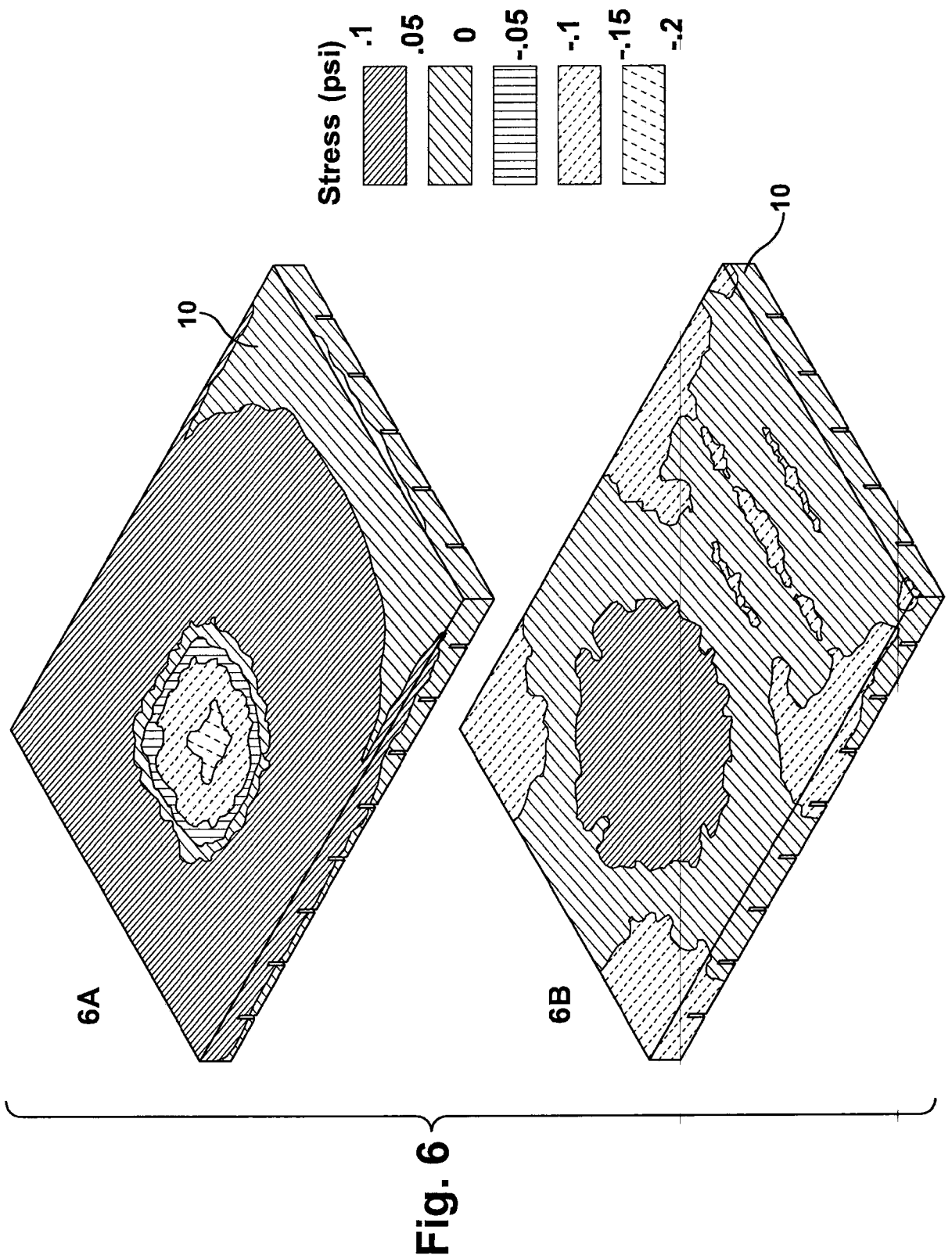
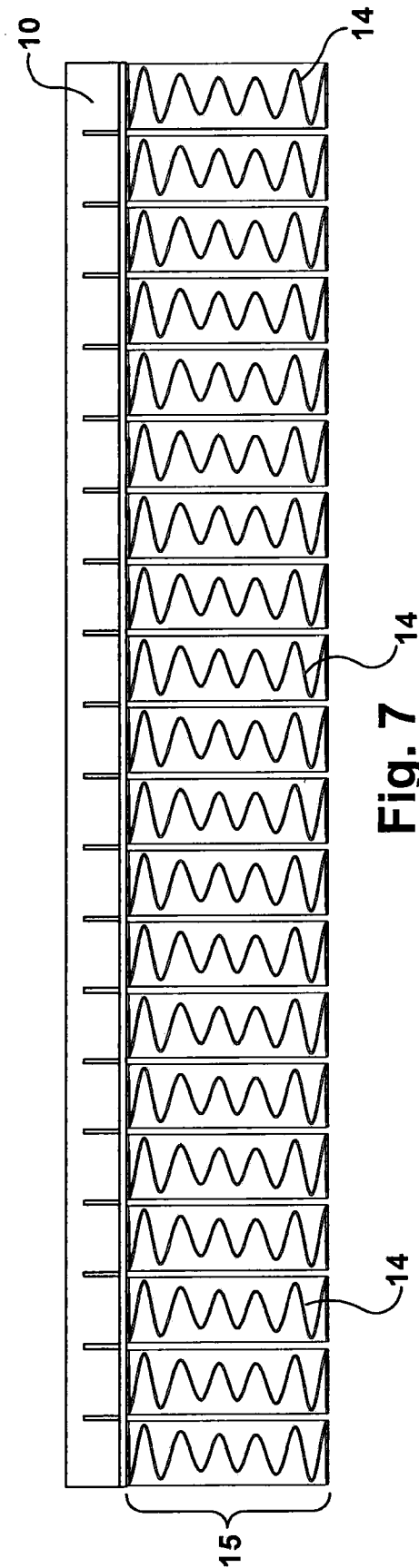


Fig. 5





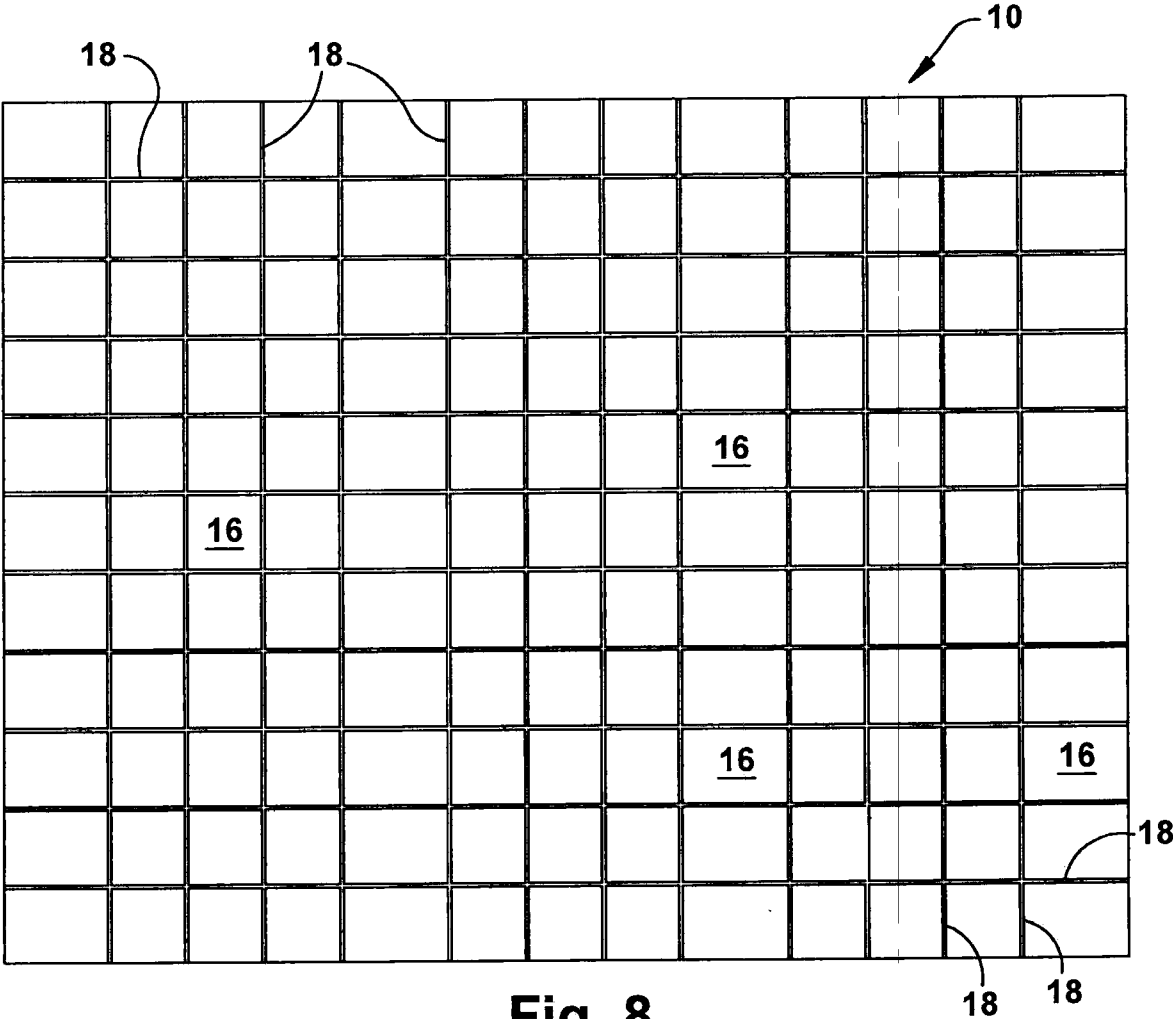


Fig. 8

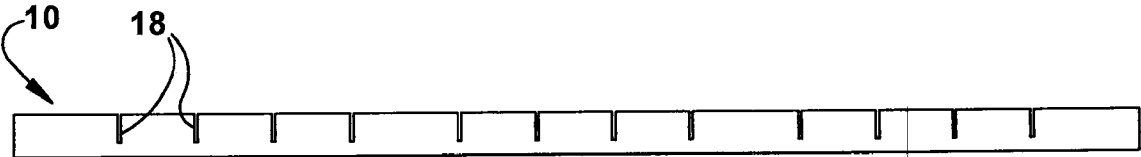


Fig. 9

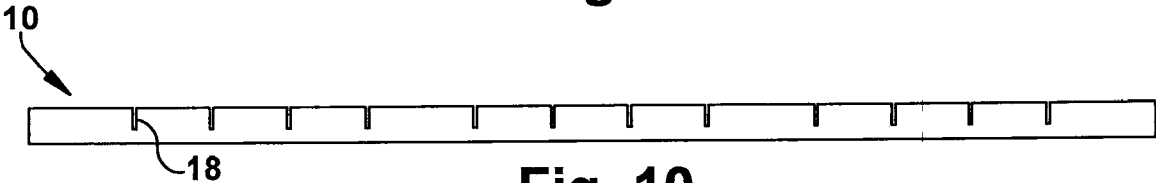


Fig. 10

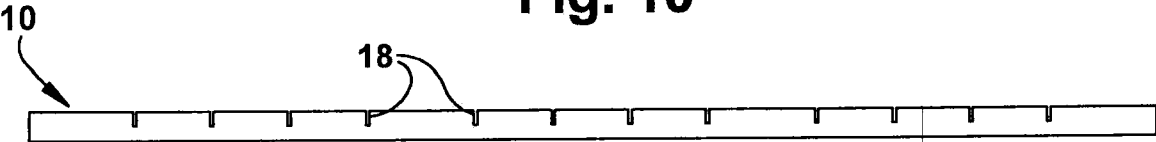


Fig. 11

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US2012/037766

A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - A47C 27/05 (2012.01)

USPC - 5/721

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC(8) - A47C 23/30, 27/05, 27/14, 27/15, 27/16 (2012.01)

USPC - 5/716, 721, 727, 730, 740

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

PatBase

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	DE 7834455 U1 (DUNLOP) 01 March 1979 (01.03.1979) entire document	1-20
Y	US 2005/0050640 A1 (AHN) 10 March 2005 (10.03.2005) entire document	1-20

☐ Further documents are listed in the continuation of Box C.

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

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Date of the actual completion of the international search

09 July 2012

Date of mailing of the international search report

27 JUL 2012

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