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(54) Title: MATTRESS WITH CROWNED PANEL

(57) Abstract: Mattresses and improved fabric covers for providing mattresses that have smooth surfaces. Additionally, methods for manufacturing non-quilted mattress covers and for manufacturing mattresses employing non-quilted mattress covers. The systems and methods described herein include mattress panels that can be manufactured separate from the inner core construction, and laid over the inner core to be fastened in place as a sleeping surface for the mattress. Optionally, these mattress panels can include a layer of fire retardant material, that may be added as a layer of material or that may be incorporated into one or more of the layers, such as a filler layer, in the mattress panel.

Mattress with Crowned Panel

Background

Mattress manufacture typically employs the covering of a resilient spring interior with a fabric cover that provides much of the comfort and the appearance of the mattress product. Such fabric covers are commonly made of quilted material formed by stitching patterns on multiple layered fabrics formed of a layer of backing material, one or more layers of thick filler material and an outer layer of facing material or ticking. The quilted fabric covers are most often formed on needle sewing machines that stitch the layers of material together with stitched patterns that contribute to the ornamental features of the mattress product. The layers of material become compressed along the lines of thread stitched into the layers. The contrast between the uncompressed layers of material and the indented stitch lines form an uneven surface on the mattress fabric cover.

The quilting operation by the sewing machines also provides the functional joining of the material that forms the quilted mattress cover. Although the sewing machines are generally reliable, the needles of the sewing machines repeated travel through several layers of material to sew the layers together and may break with use. This may damage, not only the sewing machine, but also the materials being quilted together. Moreover, a sewing machine may malfunction while stitching in various ways, such as mechanically jamming due to fabric or thread accidentally catching a moving part.

Accordingly, there is a need in the art for smooth mattress panels and mattress covers formed without being quilted.

Summary of the Invention

The systems and methods described herein include improved mattresses and improved fabric covers for providing mattresses that have smooth surfaces. Additionally, the invention encompasses methods for manufacturing non-quilted mattress covers and for manufacturing mattresses employing non-quilted mattress covers. The systems and methods described herein include mattress panels that can be manufactured separate from the inner core construction, and laid over the inner core to be fastened in place as a sleeping surface for the mattress. Optionally, these mattress panels can include a layer of fire

retardant material, that may be added as a layer of material or that may be incorporated into one or more of the layers, such as a filler layer, in the mattress panel.

According to one embodiment of the invention, a mattress comprises a core of inner springs and a mattress panel having a substantially smooth or even top surface. In certain embodiments, the mattress panel increases in thickness from the edge to a center portion, optionally at a substantially uniform angle. The panel may be composed of a fabric layer, a filler layer, and a backing layer. The panel may include an additional layer, such as a padding layer, a foam layer, or a water-resistant layer. The layers of material may be joined together at one or more edges of the panel. The layers of material may be joined at an edge by stitching, for example, overcast stitching and/or serging. The layers of material may also be joined at an edge by gluing, stapling, tying, melting or through any other mechanical or chemical joining technique, such as by rings, snaps, or grommets, or adhesive. The edges of the panel may be covered by a strip of fabric. The layers of material also may be bonded into one sheet by gluing, melting, or by using loop and hook fasteners.

According to a further embodiment of the invention, a mattress panel may be manufactured by providing a fabric layer, a filler layer, and a backing layer, overlaying or overlapping the fabric, filler and backing layers to form a common perimeter, and joining the perimeter of the fabric, filler and backing layers. In one embodiment, the fabric layer may have an angled lip section. In another embodiment, the filler layer may be a foam pad increasing in thickness from an edge to a center portion at a substantially uniform angle.

According to yet another embodiment, a mattress panel may be manufactured by providing a fabric layer, a filler layer, and a backing layer, cutting the fabric, filler and backing layers to form a perimeter, and joining the perimeter of the fabric, filler and backing layers.

According to a further embodiment of the invention, a flange is attached to the panel.

The foregoing and other objects, features, and advantages of the invention will become more apparent from the following description and from the claims.

Brief Description of the Drawings

Various illustrative systems, methods, devices, features and advantages of the invention are described below with reference to the appended drawings, which may not be drawn to scale and in which like parts are designated by like reference designations.

FIG. 1A depicts the layers of a mattress panel embodiment of a mattress according to the invention.

FIG. 1B is a perspective view of an assembled mattress panel embodiment according to the invention.

FIG. 1C is an exploded cross-sectional view of an edge of an assembled mattress panel embodiment according to the invention.

FIG. 2A depicts a perspective view of another assembled mattress panel embodiment according to the invention.

FIG. 2B is an exploded cross-sectional view of an edge of an assembled mattress panel of FIG. 2A.

FIG. 3 depicts a cross-sectional view of an embodiment of an innerspring mattress according to the invention.

FIG 4 presents a cut away view of one mattress according to the invention; and

FIG. 5 shows in more detail one section of the panel, with a portion cutaway to show internal components.

Detailed Description

To provide an overall understanding of the invention, certain illustrative practices and embodiments will now be described, including a mattress having an improved fabric cover with an optional smooth sleeping surface, and methods for manufacturing non-quilted mattress covers and for manufacturing mattresses employing non-quilted mattress covers. However, it will be understood by one of ordinary skill in the art that the systems and methods described herein can be adapted and modified and applied in other applications and that such other additions, modifications and uses will not depart from the scope hereof. Referring now to the figures, in which like numerals designate like elements

throughout the several views, FIGS. 1- 5 illustrate various embodiments of the invention.

Fig. 1A shows several layers of material prior to assembly into a mattress panel. The fabric layer 10 is the top layer and may be any desired sheet of material, such as cotton, linen, synthetic fibers or a mixture thereof. The top layer 10 may be a flat sheet of fabric or may be a substantially flat sheet with an angled lip of fabric (not shown) formed at each edge of the top layer 10. A lip may be formed by cutting out a wedge of fabric from each corner of the top layer 10 which border the edge and joining the cut sections of the top layer 10 together. The lip may be from about 0.5 inches to about 7 inches in length. When a mattress is assembled, the top layer 10 is an outer surface of the mattress.

The filler layer 20 is the cushioning layer and may be formed from any padding material, such as foam, cotton batting, gel, latex, visco elastic foam or other known padding materials and or combination of padding materials. The filler layer 20 may be from about 0.25 inches to about 5 inches in height, preferably from about 1 inch to about 4 inches. In one preferred embodiment, the filler layer may be a foam substantially 3 inches in height with an ILD of 12 and a density of 1.2. However, in other embodiments, the ILD may be different from this preferred embodiment and the density and ILD can vary according to the application. In certain embodiments the density can range from about 1.0 to about 5.0 and the ILD can vary from, for example, about 10 to about 40 ILD. Other values may also be used without departing from the scope of the invention. The filler layer 20 may have a substantially flat, smooth upper surface or may have a textured or patterned upper surface. In some embodiments, the center section of the filler layer may have a uniform height and decrease at a uniform angle toward its edges. The filler layer 20 may have multiple zones, including a lumbar zone and a shoulder zone. For example, in one embodiment, the panel has a foam filler layer 20 that includes a layer of gel material that is formed within the foam layer and that extends from one side of the mattress to the other side, providing a zone of gel material at an area where the lumbar of a sleeping user would be positioned. The number of zones and the location of the zones may vary according to the application.

A fire resistant layer 24 may be placed between the filler layer 20 and the fabric layer 10. In the depicted embodiment, the fire resistant layer 24 includes a barrier fabric 24 which can be incorporated in the panel structure between the fabric layer 10 and the filler

layer 20, as shown. However, in the other embodiments, the fire resistant layer may be a sock-like enclosure that fits over and around the filler layer to protect all sides of the filler layer 20 from heat, fire and flame.

Optionally, the fire barrier fabric 24 can also be attached to one of the layers, for example, the top layer 10, with an adhesive. The fire barrier fabric 24, when used as the backing material, can significantly reduce the fire hazard due to the material properties of the fire barrier fabric 24 that will hinder the propagation of a fire to the mattress body. For added fire protection, the fire barrier fabric 24 can also be placed directly under a border ticking.

The exemplary mattress panel depicted in FIG. 1 includes a fire blocking layer of for example, Fireguard® LWB, sold by Chiquola Industrial Products, LLC, Honea Path, SC, USA, which may optionally be included in both the mattress panels and the borders. The flame resistant material in another embodiment may be KEVLAR™ and PET (polyester) binder fiber, although other suitable materials may be employed and the actual material employed will depend upon the particulars of the application, including mattress type (e.g. open coil, pocketed coil, foam, water, and/or air), mattress size, material costs and other such factors.

In one exemplary optional embodiment, the depicted fire resistant layer 24 is formed of KEVLARTM fibers and PET fibers that are formed into a layer of fabric. In one practice the layer of fabric is formed by blending and joining the fibers by use of an adhesive or binder. In other embodiments, the layer 24 may be a layer of fabric formed by a weave of KEVLAR™ and PET fibers. Still other techniques may be used to form the layer 24 and any suitable technique for forming the layer 24 may be employed.

The layer 24 shown in Figure 1A may comprise KEVLAR fibers, but in other embodiments other suitable materials may be employed. Such other materials may be other flame resistant, or sometimes referred to as flame or fire retardant materials, and may include any of the commercially available flame resistant materials. These materials may be categorized into four general groups including inorganic materials, organophosphorous materials, halogenated organic materials (typically halogenated with chlorine or more popularly bromine) and nitrogen based compounds. Commercially available materials are sold under the tradenames NOMEX, KEVLAR, INDURA and others. Other materials

include fire resistant balanced corespun yarn such as described in U.S. Patent 5,540,980. The materials may comprise layers, or fibers incorporated into a layer, with the fibers being chopped fiber, staple fiber, spun yarn, and/or continuous filament. The type of fiber or layer used will depend upon the application. In other embodiments, the flame resistant layer may be a layer of treated material, such as cotton or polyurethane, where the treatment provides a degree of flame resistance. Fire resistant or retardant papers may also be employed. Still other flame resistant materials may be employed without departing from the scope of the invention.

The backing layer 30 may be formed from any desired sheet of material, such as natural fibers such as cotton or linen, aluminum, fiberglass, synthetic fibers or a mixture thereof. In one preferred embodiment, the backing layer 30 may be a non-woven polypropylene material weighing from about 0.3 to about 3.0 oz per square yard. Resistance to tearing and flexibility are primary concerns for the backing layer 30. In another preferred embodiment, the backing layer is formed from a fire-retardant material.

Additional padding, insulating, water-resistant, or fire-resistant layers may be incorporated. The various layers may be may be laminated together, joined by adhesive or otherwise combined to form a single sheet of material. The size of the sheets formed may vary according to the application, but in certain embodiments, the sheets may be sized as is conventional for mattress manufacture, which typically is about 88 inches in width.

Fig. 1B depicts an assembled mattress panel 40 wherein the edges 40A of the mattress panel 40 are sewn with overcast stitches 50. The edges 40a of the mattress panel 40 are compressed by the overcast stitches 50 and have height of about 0.25 inches to about 1.0 inches. The center 40b of the mattress panel 40 is not compressed by any quilting or stitching and has a height of about 1.0 inches to about 4 inches, preferably about 3 inches.

Fig. 1C depicts an exploded cross-sectional view of an edge of the assembled mattress panel 40 of Fig. 1B. Overcast stitches 50 join top layer 10, filler layer 20 and backing layer 30. Edge 40a is compressed together by overcast stitches 50. Mattress panel 40 expands in height towards the center section of the mattress panel 40 as the center section of mattress panel 40 is not bound by any stitching.

It will be appreciated that Figs. 1A, 1B and 1C depict together another aspect of the invention, which includes a method of manufacturing a mattress having a quiltless crown

panel. As depicted above the panels may be formed as shown in Fig. 1A from a plurality of layers of materials that are disposed into a flange 7 and that are optionally overcast stitched to be joined together at the edge or edges. Overcast stitching is one preferred method of joining the layers, but in other embodiments and practices, the layers may be joined by other stitching processes, by application of adhesive, by clamping or by combinations thereof. Additionally, in other practices and embodiments the peripheral edges of the layers may be joined together and optionally other portions or sections of the layers may also be joined. This can include the center of the panel, or a border section of the panel, thereby forming a quilt-like appearance along the edge of the panel. Once the layers are joined, the flange 7 is typically secured to the innercore of the mattress to secure the panel in place. The flange 7 may be sized so that the fabric sidewall 21 extends above the interior layers when seated within the flange. In one embodiment for example, and only for example, the layers 10, 20, 24 and 30, when joined together are about one half to one inch in thickness. This thickness can vary as the materials used for the layers vary, the thickness of the different layers vary and as the number of layers may vary as well. The flange 7 may be stitched, glued or otherwise secured to the innercore. Further, in other optional embodiments, the flange may be absent from the panel and the joined layers may be directly secured to the innercore.

The panel thus formed may be disposed over a mattress core or body and secured thereto. Multiple panels may be applied to the mattress core, to cover the top surface, side surfaces and bottom. The number of sides covered can vary and those of skill in the art can choose which sides they wish to cover with the manufactured panels. The mattress panels may be attached to the mattress core by hog-rings, adhesive, plastic rings, stitching and combinations thereof. Other systems for attaching the panels to the mattress may be employed without departing from the scope of this application. It will be appreciated by those of skill in the art that the manufacturing techniques described herein produce less waste and material take up than current manufacturing quilting methods. Further, quiltless manufacturing may produce consistent panel sizing and higher quality panels, may be more manufacturing friendly and may requires less capital investments to manufacture.

Fig. 2A depicts a second embodiment of a mattress panel according to the invention. The mattress panel 60 has a top layer 62, a filler layer (not shown), a backing

layer (not shown), and a flange 67. The top layer 62, the filler layer, backing layer and flange 67 are joined at an edge of the mattress panel 60 by overcast stitches 65. As more clearly depicted in Fig. 2B, mattress panel 60 is crowned, for example, center portion 62a of the top layer 62 has a height greater than at the edge 63 and the height of the mattress panel 60 increases from the edge 63 to the center portion 62a at a substantially uniform angle. The panel in this embodiment has a picture frame formed around the perimeter of the panel 60 and formed of a foam peripheral edge. The foam peripheral picture frame edge may be stitched to the other layers in the panel 60 and optionally stitched to secure the panel 60 to the innercore of the mattress. In other embodiments, the picture frame peripheral edge may be absent from the panel and a layer of fabric or other material may be placed over the peripheral edge of the gel section and the stitching may pass directly through the gel to secure with the other layers and optionally with the innercore of the mattress.

In this alternative embodiment, a fire resistant layer may also be provided within the panel 60 by incorporating into one or more of the fabric layer, filler layer or backing layer, a fire resistant material, such as halogenated fire resistant fibers, or by forming one of these layers from a material that provides fire resistance or retards flames. Optionally, a separate fire resistant layer may be provided within the panel 60.

A flange, as the terms is used in the mattress construction industry, is a strip of material, generally non-woven, about 4 to 6 inches wide that is sewed to the underside of a mattress panel. Upon assembly of a mattress, the flange on the mattress panel is clipped or otherwise attached to the sides of the spring or foam mattress core to hold the mattress panel in place relative to the mattress core.

The top layer 62 is formed from five sections of fabric. The center section 62a is attached at a first edge to lip section 62b, a second edge to lip section 62c, a third edge to lip section 62d, and a fourth edge to lip section 62e. A side of each lip section is joined to the bordering side of another lip section, for example, a side of lip section 62b is joined to the bordering side of lip section 62c, to form top layer 62 with lip sections 62b, 62c, 62d, and 62e.

In another embodiment, the top layer may be formed by cutting wedge shapes from each corner of a sheet of fabric and joining the bordering cut edges together.

The lip sections 62b, 62c, 62d, and 62e angle downward from center section 62a toward the edges of the top layer 62. The lip sections 62b, 62c, 62d, and 62e may influence the expanded shape of the mattress panel 60. As described above with respect to Fig. 1C, the edges of mattress panel 60 are compressed together by overcast stitches 65 and expand in height toward the non-quilted center of the mattress panel 60. The lip sections 62b, 62c, 62d, and 62e may constrain the filler layer of the mattress panel 60 to expand at the angle of the lip sections 62b, 62c, 62d, and 62e rather than at the free rate of the filler layer material.

The length of outer edges of sections 62b and 62d are substantially the same as are the length of outer edges of sections 62c and 62e. The widths of lip sections 62b, 62c, 62d, and 62e may have uniform widths or varying widths. For example, lip section 62b may have a width of about 2 inches, lip sections 62c and 62e may have width of about 4 inches and lip section 62d may have a width of about 5 inches.

Fig. 2B is an exploded cross-sectional view of an edge of an assembled mattress panel of FIG. 2A. Overcast stitches 65 join top layer 62, filler layer 68, backing layer 69, and flange 67. Edge 63 is compressed together by overcast stitches 65. Mattress panel 60 expands in height from edge 63 toward the center section 62a of the mattress panel 60 at the angle of lip section 62d. The lip section 62d restrains the filler layer 68 from expanding in a curved fashion as depicted in Fig. 1C. The angle formed by the lip section 62d and backing layer 69 may be from about 10 degrees to about 70 degrees, preferably from about 25 degrees to about 45 degrees.

In some embodiments, the filler layer may have a uniform height across its surface, thus when compressed by stitching, expands against and is restrained by a top layer. However, in other embodiments, the center section of the filler layer may have a uniform height and decrease toward its edges. In such embodiments, the top layer does not substantially restrain the filler layer from expanding.

Fig. 3 depicts a cross-sectional view of an innerspring mattress embodiment according to one embodiment of the invention. The mattress 70 shows an innerspring mattress core 90 with crowned top, bottom and side mattress panels, however, a mattress may be formed with one or more conventional mattress panels. The top mattress panel is formed from top layer 71, filler layer 72, and backing layer 73. The bottom mattress panel

is formed from top layer 77, filler layer 78, and backing layer 79. Similarly, the right side mattress panel is formed from top layer 74, filler layer 75, and backing layer 76. The left side mattress panel is formed from top layer 80, filler layer 81, and backing layer 82. Either some or all of the panels may include an optional layer of fire resistant material. Alternatively, the mattress core 90 may be covered by a fire resistant enclosure, and the panels placed around the enclosed core.

The edge 85 joins the top mattress panel to the right side mattress panel. The edge 86 joins the right side mattress panel to the bottom mattress panel. The edge 87 joins the bottom mattress panel to the left side mattress panel. Joining of the top panel to the side border panel or panels may be accomplished by use of a tape edge machine or other suitable system or method. The edge 88 joins the top mattress panel to the left side mattress panel. Front and back side panels are not shown. Edges 85, 86, 87, and 88 may be covered with a strip of fabric for aesthetic effect. Typically, the mattress 70 will have a single side border panel that is sized to wrap around the full periphery of the mattress 70. However, multiple side border panels may also be used. It will be understood that during manufacture of the mattress 70, the top panel and side border panel may be selected from a number available panels, thereby providing for the panels used to the changed easily during manufacture. Thus, panels with fire resistant layers may be substituted for panels without such layers, and panels with zoned support, or gel material, may also be readily used or replaced during assembly. Further, the mattress 70 may use a side panel constructed according to the systems and methods described herein, with a side bore panel constructed using conventional techniques.

FIGs. 4 and 5 depict a mattress according to the systems and methods described herein. In particular, FIG 4 depicts a mattress 90 having a quiltless top panel 92, showing a cut away section that exposes the inner foam layer 94 and a gel section 98 that forms a support zone proximate to where the user's lumbar would be located, and a second zone 100 positioned below the lumbar zone. Specifically, FIG 4 depicts the mattress 90 with a section of the upper fabric layer 92 cut away and replaced with a clear plastic film allowing the internal layers of the panel to be viewed. The foam layer 94 includes a zone of gel material 98 that extends from one side of the mattress to the other. FIG 5 illustrates that

the peripheral edge 102 of the panel was joined by action of a tape edge machine to the side border panel. FIG 5 also shows the picture frame edge of the foam panel that is stitched to the other layers (not shown) of the panel 90. The panel 90 is then secured to the innercore of the mattress, also not shown.

The mattress panels may be attached to the mattress core by hog-rings. Hog-ringing is a conventional means of attaching fabric or padding to an innerspring construction, although other mechanical or adhesive means may be used.

It should also be understood that foam, plastic springs, or other resilient material, could also be used as a substitute for metal innerspring constructions.

Therefore, it may be seen that a mattress panel is provided which provides a substantially smooth exposed surface. Moreover, the mattress panel may have a crowned effect and is understood to provide longer life and be more durable than traditional panels

While this invention has been described in specific detail with reference to the disclosed embodiments, it will be understood that many variations and modifications may be effected within the spirit and scope of the invention as described in the appended claims. For example, the mattress may include a foam core, or a combination of foam and springs. The mattress may be one-sided or two-sided. Consequently, those skilled in the art will know or be able to ascertain using no more than routine experimentation, many equivalents to the embodiments and practices described herein. Accordingly, it will be understood that the invention is not to be limited to the embodiments disclosed herein, but is to be understood from the following claims, which are to be interpreted as broadly as allowed under the law.

What is claimed is:

1. A mattress, comprising,

a mattress core having an upper primary surface,

a mattress panel lying on the upper primary surface of the mattress and having a substantially smooth top surface, the panel having ,

a fabric layer,

a filler layer, and

a backing layer,

wherein the fabric layer, filler layer, and backing layer are joined at a respective edge and the mattress panel increases in thickness from the edge to a center portion.

2. The mattress of claim 1, further including a fire resistant layer disposed within the mattress panel and being joined at the respective edge.

3. The mattress of claim 1, wherein the at least two of the fabric layer, filler layer, and backing layer are joined together by stitching, gluing, stapling, tying, or melting.

4. The mattress of claim 1, wherein at least two of the fabric layer, filler layer, and backing layer are joined together by overcast stitching.

5. The mattress of claim 1, wherein the thickness of the panel at its edge is from about 0.25 inches to about 1.0 inches.

6. The mattress of claim 1, wherein the thickness of the panel at its center is from about 1.0 inches to about 4 inches.

7. The mattress of claim 1, wherein the filler layer is a foam having an ILD of about 10 to 40 and a density of about 1.0 to 5.0.

8. The mattress of claim 2, wherein the fire resistant layer includes a material selected from the group consisting of a halogenated material, Kevlar ™, a thermoplastic material,

inorganic FR materials, organophosphorous materials, fire resistant balanced corespun yarn, a layer of FR treated cotton, a layer of FR treated polyurethane, and FR paper.

9. The mattress of claim 1, wherein at least one of the layers includes a fire resistant material.

10. The mattress of claim 1, wherein the mattress core comprises a core selected from the group of inner springs, pocketed inner springs, foam, visco-elastic foam, latex, and combinations thereof.

11. A method of manufacturing a mattress panel, comprising
providing a fabric layer,
providing a filler layer,
providing a backing layer,
forming a common edge with the fabric, filler, and backing layers, and
joining the common edge of the fabric, filler and backing layers and increasing a thickness of the panel from the common edge to a center portion.

12. The method of claim 11, further comprising
providing a fire resistant layer between the fabric layer and the backing layer.

13. The method of claim 11, further comprising providing two or more layers having substantially similar length and width.

14. The method of claim 11, further comprising clamping two or more of the layers to position the two or more layers for joining.

15. The method of claim 11, wherein joining comprises stitching, gluing, stapling, tying, melting or overcast sewing.

16. The method of claim 11, comprising providing a padding layer.

17. The method of claim 11, comprising attaching a flange to the mattress panel.

18. The method of claim 11, wherein a common edge is formed by lining up the edges of the fabric, filler and backing layers.

19. The method of claim 11, wherein a common edge is formed by overlaying the fabric, filler and backing layers and cutting the fabric, filler and backing layers simultaneously.

20. The method of claim 12, wherein providing a fire resistant layer includes incorporating into at least one of the fabric layer, filler layer or backing layer, a fire resistant material.

21. A method of manufacturing a mattress comprising

providing a mattress core defining an upper primary surface;

forming a mattress panel having a fabric layer, a filler layer and a backing layer joined at a respective edge;

attaching the mattress panel to the upper primary surface of the core;

wherein the mattress panel increases in height from the edge to a center portion.

22. A method of manufacturing according to claim 21, further comprising providing a fire resistant layer.

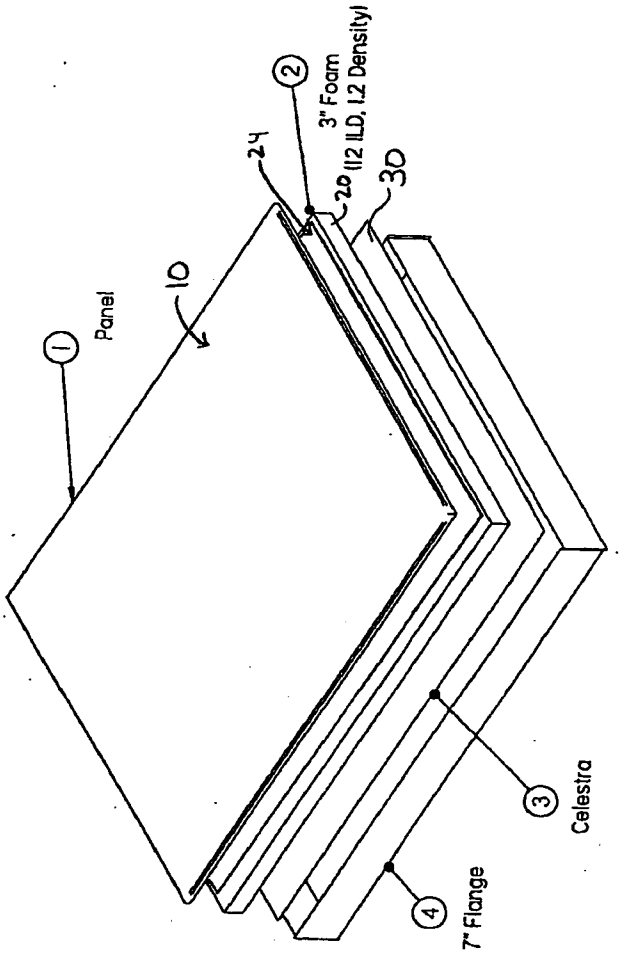
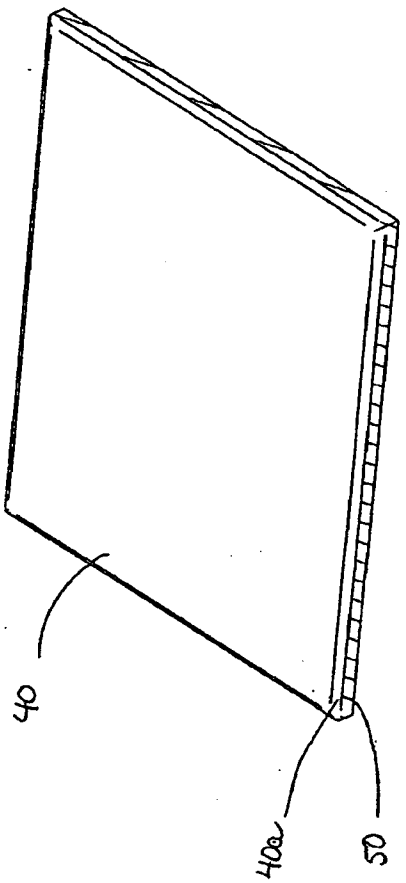

1
Panel
10
24
2
3" Foam
1/2 ILD, 1.2 Density
20
30
3
Celestra
4
7" Flange

FIG..1A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40a
50

FIG..1B

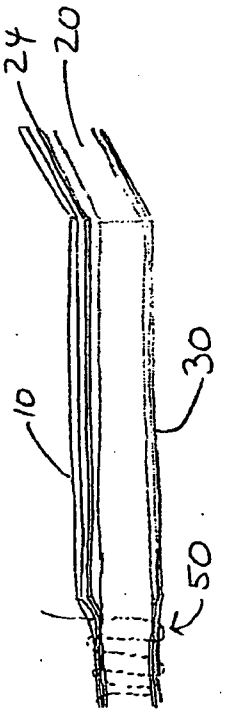

FIG..1C

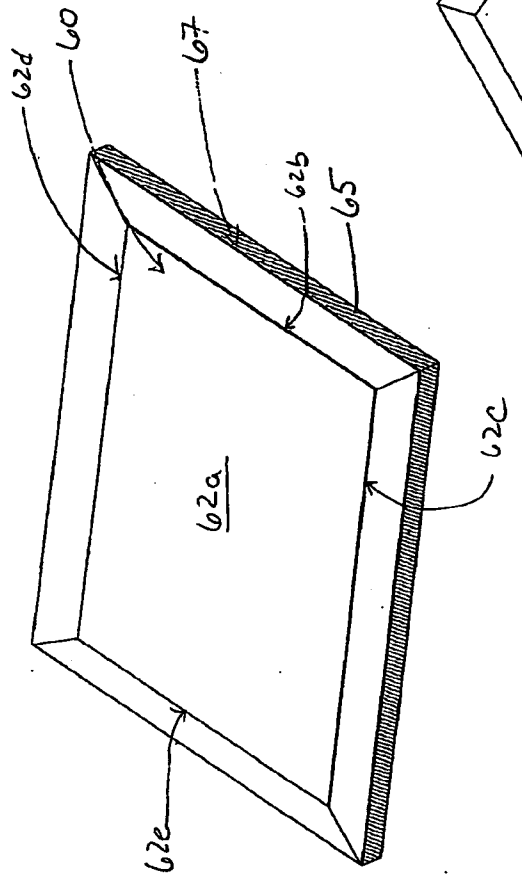
62d
60
67
62b
65
62a
62c
62e

FIG..2A

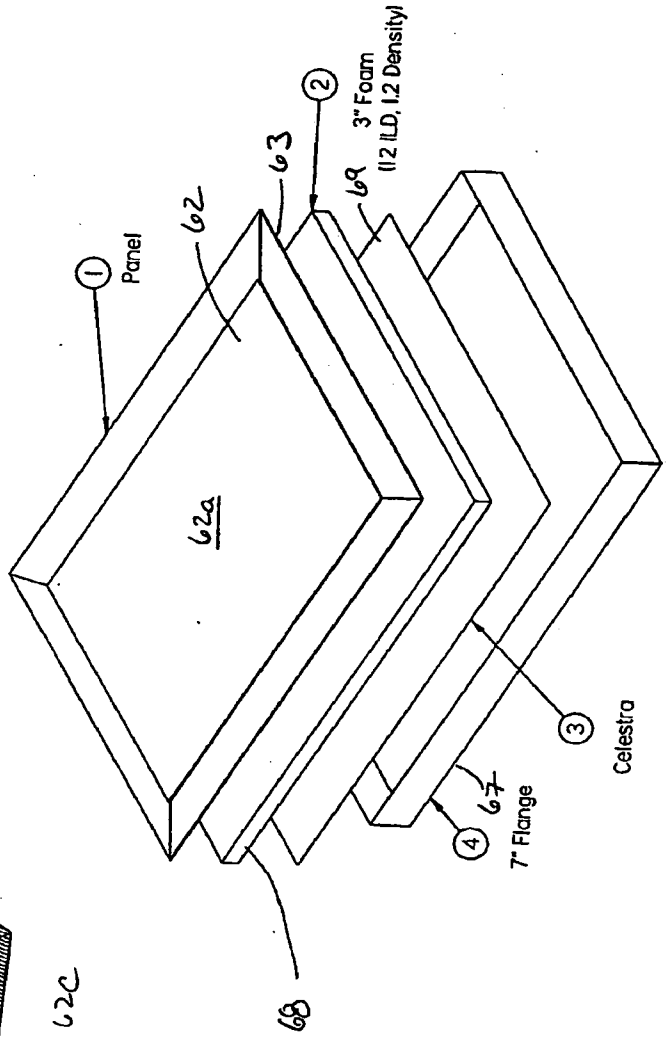
1 Panel
62
63
2 3" Foam 1/2 LD, 1.2 Density
69
62a
3 Celestra
4 7" Flange
67
68

FIG..2B

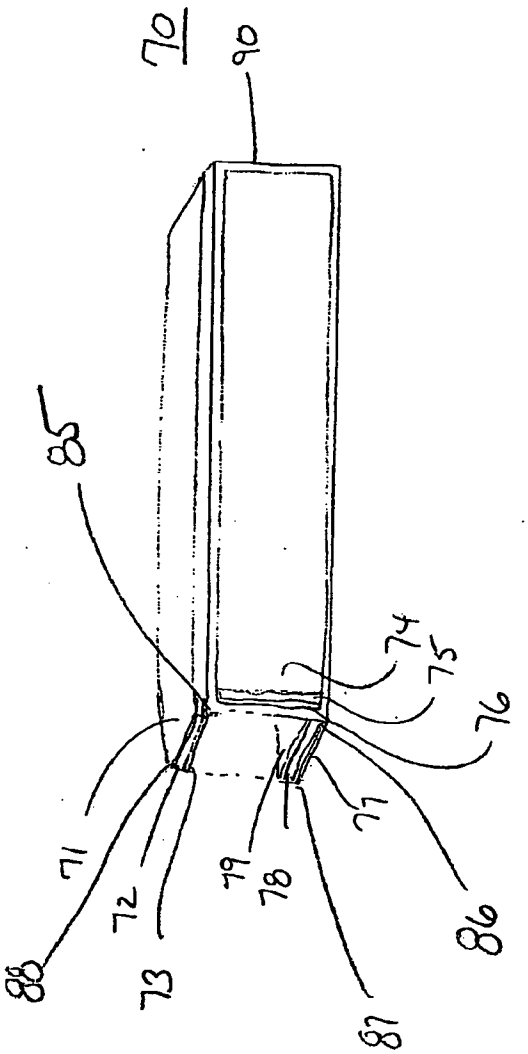

FIG..3

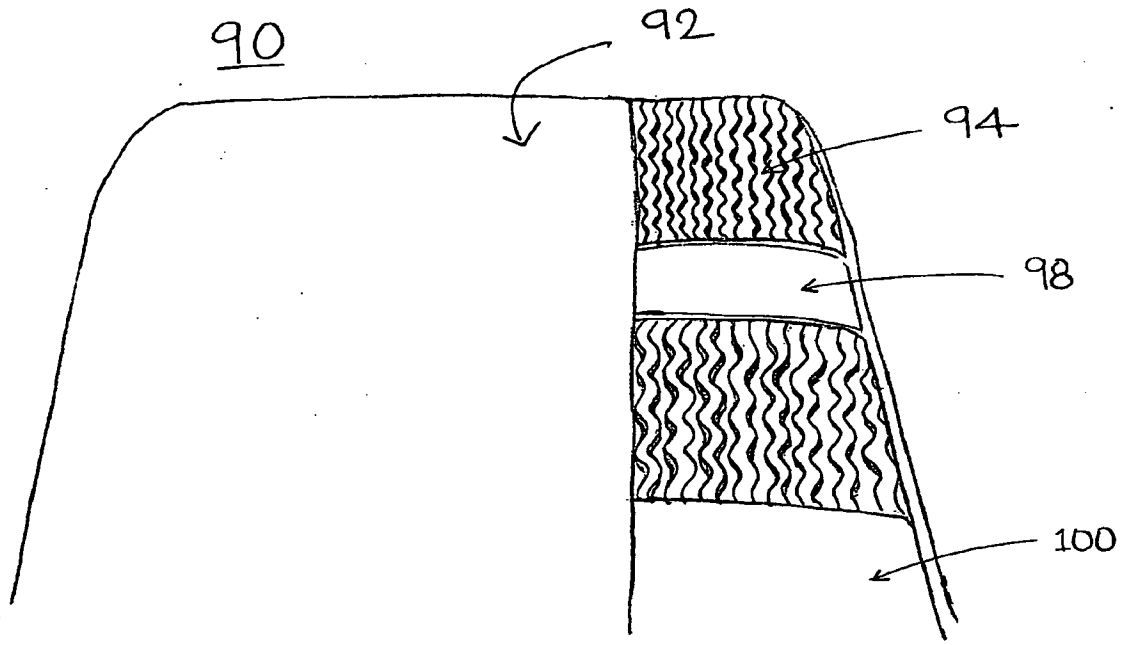

FIG..4

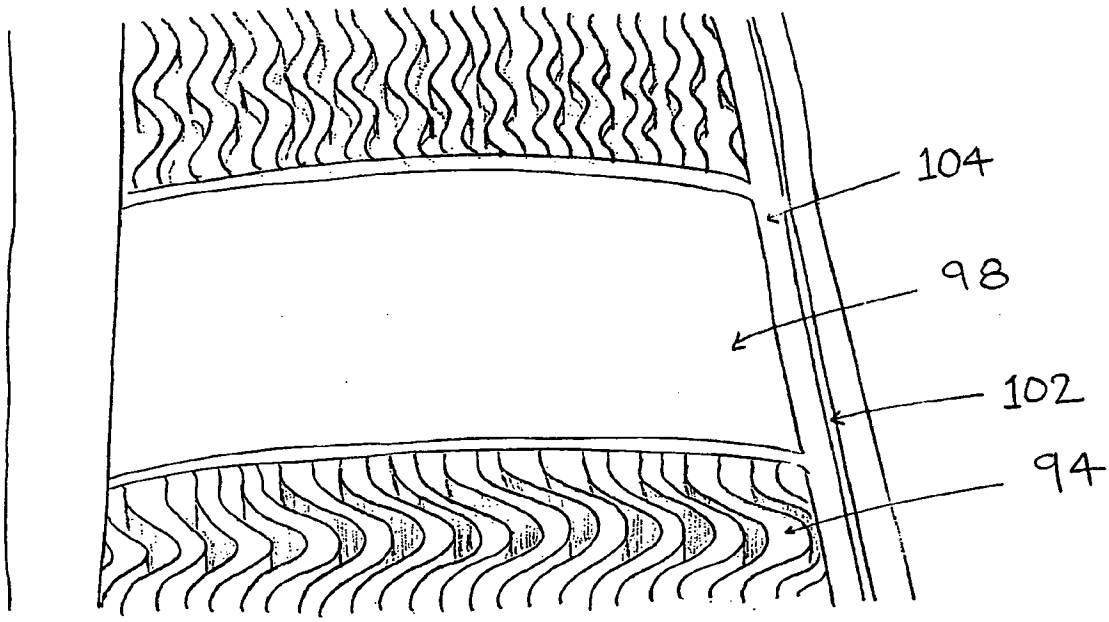

FIG..5