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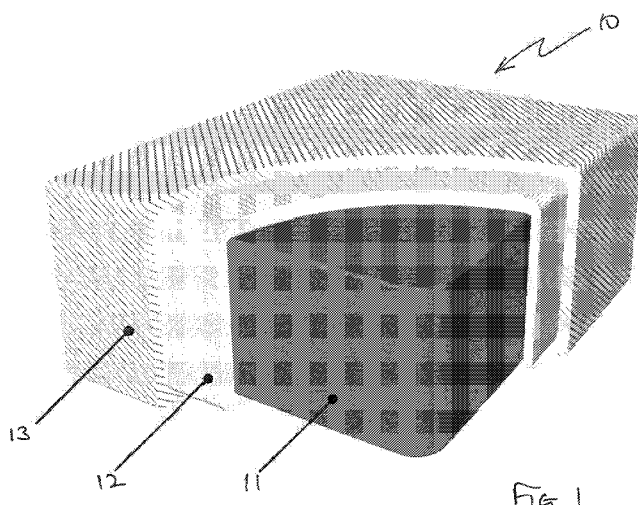
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(57) Abstract: The present invention relates to mattresses. In particular it relates to mattresses suitable for babies, infants and children. We describe a child mattress (10) having a mattress core (11) comprising first and second mattress core layers and having a cover (12), wherein the first mattress core layer is a spring layer and the cover (12) is a sealed, liquid-impermeable cover. Preferably, the polymeric material is coated or impregnated with a biocide, preferably an anti-microbial composition and preferably the mattress further comprises a removable outer cover formed of a fabric material coated with probiotic-containing microspheres.

MATTRESS

The present invention relates to mattresses. In particular it relates to mattresses suitable for babies, infants and children.

5

The sleeping environment for babies and very young children is extremely important. The phenomenon known as "cot death" or "Sudden Infant Death Syndrome (SIDS)", the mechanism of which remains a mystery, has been linked to the presence of two common bacteria, *Staphylococcus aureus* and *Escherichia coli*.

10

One theory for the mechanism of SIDS is the "bacterial toxin theory". The idea is that the bacteria grow in the upper respiratory tract of babies, releasing toxins which are the ultimate cause of death. Once the bacteria get into the throat, they colonise the respiratory tract. They warm up and produce "super-toxins", which trigger the immune system into abnormally severe assaults. When a baby's evolving immune system overreacts, the infant can die of anaphylactic shock. This theory fits other facts related to SIDS. It is known for example that a baby sleeping on its front increases the risk of SIDS and this also increases the number of pathogenic organisms in the upper airway. Likewise, the relationship with a mother smoking during pregnancy is explained by the change in the immune response to toxins.

20

One source of exposure of infants to these dangerous bacteria is the presence of vomit in mattresses. *Staphylococcus aureus* and *Escherichia coli* both seem to thrive in vomit-soaked polyurethane foam, particularly if the baby drinks formula rather than breast milk. Experiments at De Montfort University have shown that if the mattress is disturbed or pressed to mimic a baby's movements, then enough bacteria can rise into the air to cause life-threatening throat infections.

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Bodily fluids can be prevented from contacting and soaking into the foam by sealing the foam with a liquid-impermeable cover layer, and this will also prevent bacterial access. Foam mattresses are typically sealed by polyvinyl chloride (PVC), which can conveniently be welded by high frequency welding. The foam mattress is compressed such that it is as flat as possible, with PVC sheets on both surfaces. The sheets are then welded

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together and a seam is formed around the middle of the side edge of the mattress when the compression force is removed.

PVC is one of a number of plastics with chemical dipoles, others being polyamides, acetates and polyurethane, which can be heated with high frequency electromagnetic waves. High frequency welding, also known as radio frequency welding or dielectric sealing, uses this property to soften the plastics for joining. In the usual process, two pieces of material are placed on a table press that applies pressure to both surface areas. Dies are used to direct the welding process. When the press comes together, high frequency waves (usually 27.12 MHz) are passed through the small area between the die and the table where the weld takes place. This high frequency (radio frequency) field causes the molecules to oscillate and the material increases in temperature. The combination of heat and pressure causes the two sheets of material to melt together, and the resulting weld takes the shape of the die.

In recent years, there has been an increase in demand for cots which are convertible into beds as the child grows up, so that the expense of buying both a cot and a bed may be avoided. Mattresses which are suitable for use in both configurations and which are sufficiently durable for several years' use are therefore desirable. Standards requirements place limitations on the maximum thickness of a child's mattress and this impacts on the transposition of developments in adult mattresses to children's mattresses.

Accordingly, in its broadest sense, the present invention provides a child mattress having a mattress core comprising first and second mattress core layers and having a cover, wherein the first mattress core layer is a spring layer and the cover is a sealed, liquid-impermeable cover.

Preferably, the cover is formed of a polymeric material, more preferably a self-bondable polymeric material.

Suitably, the polymeric material is a polyurethane or polyvinyl chloride material. Preferably, the polymeric material is a polyurethane.

Preferably, the polymeric material has a fabric substrate.

Preferably, the cover is formed by bonding sheets of the polymeric material, thereby forming seams between adjacent sheets. Suitably, the polymeric material is thermally bondable or ultrasonically bondable. Preferably, the seams are formed by overlayering
5 two sheets of the polymeric material with an interposed fabric layer.

Preferably, the polymeric material is coated or impregnated with a biocide, more preferably an anti-microbial composition.

10 Preferably, the mattress further comprises a removable outer cover. More preferably, the removable outer cover is formed of a fabric material, most preferably a fabric material coated with probiotic-containing microspheres.

Advantageously, the mattress further comprises a barrier layer between the spring layer
15 or spring layers and the cover, the barrier layer being adapted to isolate the springs electrically during seam bonding. Suitably, the barrier layer is a foamed polymeric material or a felt layer.

Preferably, the mattress further comprises a comfort layer overlayering and surrounding
20 the mattress core. Suitably, the comfort layer is formed of a foamed polymeric material, a polymeric fibrous or spun material or a natural material such as woven, non-woven or spun cotton or wool.

In one embodiment, the second mattress core layer is a spring layer. Preferably, the first
25 spring layer is softer than the second spring layer.

Typically, each spring layer comprises a plurality or array of springs, which are preferably individually pocketed. Suitably, the pockets are formed of a non-woven or woven
polypropylene material.

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The first spring layer is softer or less firm than the second spring layer, in order to provide a mattress with two sides of differing softness. In one embodiment, the springs in the first spring layer are arranged at a different spring density from the springs in the second

spring layer. In preferred embodiments, the springs of the first spring layer have a lower spring constant than the springs of the second spring layer.

5 Preferably, the springs in each layer are constructed from steel wire having a diameter substantially between 1.0 mm and 1.9 mm. More preferably, the steel wire used for the springs in the first spring layer is between about 1.5 mm and 1.7 mm, or about 1.6 mm, in diameter, and the steel wire used for the springs in the second spring layer is between about 1.6 mm and 1.8 mm, or about 1.7 mm, in diameter.

10 In an alternative embodiment, the second mattress core layer is formed of a foamed polymeric material, a polymeric fibrous material or a natural material such as cotton or wool.

15 In one particular embodiment, the mattress core comprises a spring layer and a foamed polymeric material layer. Conveniently, the comfort layer is a foamed polymeric layer and the foamed polymeric mattress core layer and the comfort layer are formed together as a single component.

Preferably, the foamed polymeric layer is an open cell foam.

20

In preferred embodiments, the mattress core further comprises a core layer between the first and second mattress core layers.

Preferably, the core layer is a semi-rigid core layer

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Suitably, the core layer comprises a foam layer, preferably formed from a closed cell foam. Advantageously the foam layer is a relatively hard foam formed from a polyether material.

30 Preferably, the core layer is formed from a coir-based composition. More preferably, the coir core layer is formed from a latex and coir composition or a heat-bonded polyester or nylon and coir composition.

The above and other aspects of the invention will now be described in further detail, by way of example only, with reference to the accompanying drawings, in which:

Figure 1 is a schematic perspective view of a mattress in accordance with the present invention;

Figure 2 is a cross-sectional view of an embodiment of a mattress in accordance with a the present invention; and

Figure 3 is a cross-sectional view of a second embodiment of a mattress in accordance with the present invention.

Figure 1 shows a mattress 10 in accordance with the present invention having a mattress core 11 enveloped within a sealed cover 12 and a removable outer cover 13. Outer cover 13 forms a soft outer surface to mattress 10. Preferably, the cover is formed of a fabric coated with probiotic-containing microspheres of the type described in WO 2006/117702 and available under the trade mark Purotex.

Figure 2 shows an embodiment of a child mattress 100 in accordance with the present invention and comprising a spring layer 101 comprising a plurality of pocketed springs each enclosing a spring 102 within a pocket 103, typically of a non-woven or spun polypropylene fabric, allowing the formation of an array of such pockets by joining of adjacent pockets, such as by heat welding, thereby forming a spring layer.

In this embodiment, a felt layer 104 is provided adjacent to the spring layer 101, forming a second core layer; and a foam comfort layer 105 is provided around the felt layer 104. Felt layer 104 has a function of protecting the foam layer 105 from damage resulting from contact with and relative motion between the springs and provides additional support.

The mattress includes a cover layer 106 formed, in preferred embodiments, of a polyurethane sheet material and which envelops foam comfort layer 105. In a preferred embodiment, cover layer 106 comprises a fabric-coated polyurethane layer, to give the

layer greater strength and greater durability than a purely plastics layer. In a preferred embodiment of the invention, the polyurethane layer is impregnated or coated with anti-fungal and anti-bacterial treatments.

5 While the impermeable cover may be made from a single, unitary piece of material, in practice the cover will be formed from several components bonded together. A seam will typically be formed at the join between the components as a result. A seam or join between the two or more impermeable cover components may be provided around the periphery of the mattress, for example around an edge or side of the mattress, or may be
10 provided just at one end.

The two or more impermeable cover components may be joined by any suitable process, including adhesive bonding, thermal bonding or mechanical bonding, such as stitching or stapling, followed by sealing of the seam. In preferred embodiments, thermal bonding is
15 employed, particularly high frequency welding processes.

The cover is formed from or includes polymeric or plastics materials in order that its surfaces will self-bond, for example through melting of the material, such as by the direct application of heat, or by ultrasonic bonding or radio-frequency bonding.

20

In preferred embodiments (not shown), a further fabric layer is interposed between the self-bonding materials within the seams to provide a substrate to which the materials may more strongly bond.

25 Cover layer 106 prevents bodily fluids from entering the core of the mattress and hence prevents the build-up of some harmful micro-organisms in the mattress. This layer also prevents the build-up of harmful micro-organisms in the mattress and prevents the growth of fungal spores and bed mites, both of which are linked to asthma in children. The layer is however, vapour permeable, making the cot mattress more comfortable by reducing
30 sweating and overheating

Cover layer 106 has a peripheral seam 107 formed by joining upper and lower cover layer parts 106a and 106b together. A high-frequency welding technique as discussed above is employed to create the bond at seam 107. Both felt layer 104 and foam layer 105 act

as barrier layers during the welding process to create the bond at seam 107, to prevent springs 102 adjacent the seam from creating arcing during manufacture. In the case of a sprung mattress which is to be sealed in a cover joined by high frequency welding, the presence of highly conductive metal springs immediately adjacent to the welding area
5 can potentially cause a short and risk damage to the welding equipment.

In certain embodiments therefore, the mattress includes a barrier layer between the spring layer and the impermeable cover. The barrier layer serves to isolate the metal springs from the high-frequency welding equipment during the bonding process. The barrier layer
10 may be provided around the entire spring layer, or may be located at least in the region of the seam or join. In some embodiments, the function of the barrier layer is formed by other layers within the mattress construction.

Water-based adhesive has traditionally been employed when constructing a foam
15 mattress, however this increases the risk of a short when the high-frequency welding method described above is employed during manufacture (when the adhesive may still be wet). Preferably therefore, the barrier layer is attached to the spring layer using a hot melt adhesive. Hot melt adhesive has a negligible moisture content, and therefore even if the adhesive has not set, the risk of a short is reduced.

Figure 3 is a cross-sectional view of a second embodiment of a mattress 200 according to the present invention. The mattress comprises a first spring layer 201 forming a first mattress core layer and a second spring layer 202 forming a second mattress core layer. Each spring layer 201,202 comprises an array of pocketed springs 203,204. Pocketed
25 springs in the first spring layer 201 are selected to provide a softer support layer than those in the second spring layer 2012, for example by having a lower spring constant than those in second spring layer 202. A core layer 205 is formed between the two spring layers.

The springs of both layers are typically about 40 mm in height and are constructed from
30 steel wire, individually encased in pockets formed of a non-woven polypropylene fabric. The adjacent pockets are then joined, for example by heat-welding, to form a spring layer.

The spring constant for each spring is determined by the thickness of the steel wire from which the spring is formed and the diameter of the spring. Springs having a diameter of about 48 mm have been found to be particularly suitable for a child's mattress. Preferably, springs having a diameter of 48 mm have a wire thickness within the range of 1.0 mm to 1.9 mm. In preferred embodiments, springs with a wire thickness of about 1.6 mm are used for the soft side of the mattress and 1.7 mm for the firm side of the mattress. Other absolute thicknesses and differential thickness are also suitable. Furthermore the person skilled in the art will appreciate that alternative spring types to steel springs may be used and are within the scope of the invention. Likewise, the skilled person will appreciate that alternative materials for the pockets of the springs may be used and will be within the scope of the invention.

The purpose of core layer 205 is to provide a degree of isolation or decoupling of the two spring layers 200,201 from each another in order that they can function as individual layers each with a predetermined (and different) firmness. In the absence of the core layer, the mattress would tend to function as if there were a single sprung core, as the springs of the two layers would tend to act in series with each another. The core layer also acts to prevent the mattress from bending or twisting whilst in transit, during which time it is usually stored upright.

The core layer is therefore semi-rigid, preferably of sufficient rigidity or stiffness to isolate the springs of the first and second spring layers from one another. This in effect involves preventing the transmission of force from one spring directly to a neighbouring spring in the other layer. Transmission will, of course, still occur, but the relatively stiff core layer acts to spread the transmission over a larger area. The core layer should also preferably allow for a degree of flexibility so that the mattress as a whole can flex to a degree similar to standard mattresses.

In preferred embodiments, the core layer comprises a sheet formed from or including coir. Coir is derived from the husk of coconuts and can provide the core layer with the rigidity required and a degree of flexibility. Coir can be formed into semi-rigid sheets by bonding with latex or by heat-bonding with polyester or nylon. Coir, being a natural resource is preferred to synthetic materials.

Bonding coir with latex can have a tendency, however, to produce a product which is too soft and flexible when formed as a thin sheet. It may become permanently deformed over time which creates a hollow in the cot mattress and which can be dangerous if the vomit from a child pools and creates a choking hazard. This permanent deformation is referred to as "taking a set". This phenomenon does not occur if there is sufficient thickness to the coir sheet. Typically a thickness of 80 mm or above avoids this problem.

However, the overall thickness of a child's mattress is laid down by British Standards (BS 1877-10:2011) and its equivalents in other countries. A child's mattress cannot be more than 100mm at the edge and not more than 125mm in the middle. This places substantial limitations on the transposition of developments in adult mattresses to children's mattresses. Therefore, when combined with twin layers of springs, the core layer must be relatively thin in order that the mattress complies with the standard for overall mattress thickness whilst allowing a sufficient spring layer thickness to provide adequate comfort.

Advantageously, therefore, an alternative method of making a coir sheet is therefore used in preferred embodiments of the present invention. This method comprises the use of very thin layers of coir and polyester adhered together. As an alternative, nylon may be used in the place of polyester. This creates a relatively rigid coir sheet which is less likely to take a set, and also gives a firmer base against which the springs can bear.

The person skilled in the art will appreciate that other materials may be used for the core layer, such as relatively hard foams such as polyether foams.

Other illustrated components such as comfort layer 105, cover layer 106 and seam 107 are the same as described above in respect of the corresponding components of the embodiment of Figure 2.

In alternative embodiments (not shown), second mattress core layer is formed of a foamed polymeric material, a polymeric fibrous or spun material or a natural material such as wool. In certain embodiments, the second mattress core layer and its adjacent comfort layer are formed as a single element. This is particularly convenient for a core layer formed of a foamed polymeric material.

In use, the mattress may be turned either so as to place the softer first spring layer uppermost or alternatively so as to place the firmer second spring layer uppermost. The former arrangement is appropriate for babies and very young children, who require a softer surface to sleep on. The latter arrangement is appropriate for older children.

CLAIMS

1 A child mattress having a mattress core comprising first and second mattress core
layers and having a cover, wherein the first mattress core layer is a spring layer and the
5 cover is a sealed, liquid-impermeable cover.

2 A child mattress as claimed in claim 1 wherein the cover is formed of a polymeric
material.

10 3 A child mattress as claimed in claim 2 wherein the polymeric material is a
polyurethane or polyvinyl chloride material, preferably a polyurethane material.

4 A child mattress as claimed in claim 2 or claim 3 wherein the polymeric material
includes a fabric substrate.

15 5 A child mattress as claimed in any one of claims 2 to 4 wherein the cover is
formed by bonding sheets of the polymeric material, thereby forming seams between
adjacent sheets.

20 6 A child mattress as claimed in claim 5 wherein the polymeric material is self-
bondable, preferably thermally self-bondable or ultrasonically self-bondable.

7 A child mattress as claimed in claim 5 or claim 6 wherein the seams are formed
by overlaying two sheets of the polymeric material with an interposed fabric layer.

25 8 A child mattress as claimed in any one of claims 2 to 7 wherein the polymeric
material is coated or impregnated with a biocide, preferably an anti-microbial composition.

9 A child mattress as claimed in any preceding claims further comprising a removable
30 outer cover.

10 A child mattress as claimed in claim 9 wherein the removable outer cover is formed
of a fabric material, preferably a fabric material coated with probiotic-containing
microspheres.

11 A child mattress as claimed in any preceding layer further comprising a comfort
layer overlayering and surrounding the mattress core, preferably a comfort layer formed
of a foamed polymeric material, a polymeric fibrous or spun material or a natural material
5 such as woven, non-woven or spun cotton or wool.

12 A child mattress as claimed in any preceding claim wherein the second mattress
core layer is a spring layer.

10 13 A child mattress as claimed in claim 12 wherein the spring layer of the first
mattress core layer is softer than the spring layer of the second mattress core layer.

14 A child mattress as claimed in any preceding claim wherein each spring layer
comprises a plurality or array of springs, preferably individually pocketed springs.

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15 A child mattress as claimed in any one of claims 12 to 14 wherein the springs in
the first spring layer are arranged at a different spring density from the springs in the
second spring layer.

20 16 A child mattress as claimed in any one of claims 12 to 14 wherein the springs of
the first spring layer have a lower spring constant than the springs of the second spring
layer.

25 17 A child mattress as claimed in any preceding claim wherein the springs in each
spring layer are constructed from steel wire having a diameter substantially between 1.0
mm and 1.73 mm.

18 A child mattress as claimed in claim 17 wherein the second mattress core layer is
a spring layer and wherein the steel wire used for the springs in the first spring layer is
30 between about 1.2 mm and 1.4 mm, or about 1.3 mm, in diameter, and the steel wire
used for the springs in the second spring layer is between about 1.5 mm and 1.7 mm, or
about 1.6 mm, in diameter.

19 A child mattress as claimed in any one of claims 1 to 11 wherein the second mattress core layer is formed of a foamed polymeric material, a polymeric fibrous material or a natural material such as cotton or wool.

5 20 A child mattress as claimed in claim 19 wherein the second mattress core layer and the comfort layer are formed together as a single foamed polymeric layer.

21 A child mattress as claimed in any preceding claim further comprising a core layer between the first and second mattress core layers.

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22 A child mattress as claimed in claim 21 wherein the core layer is a semi-rigid core layer

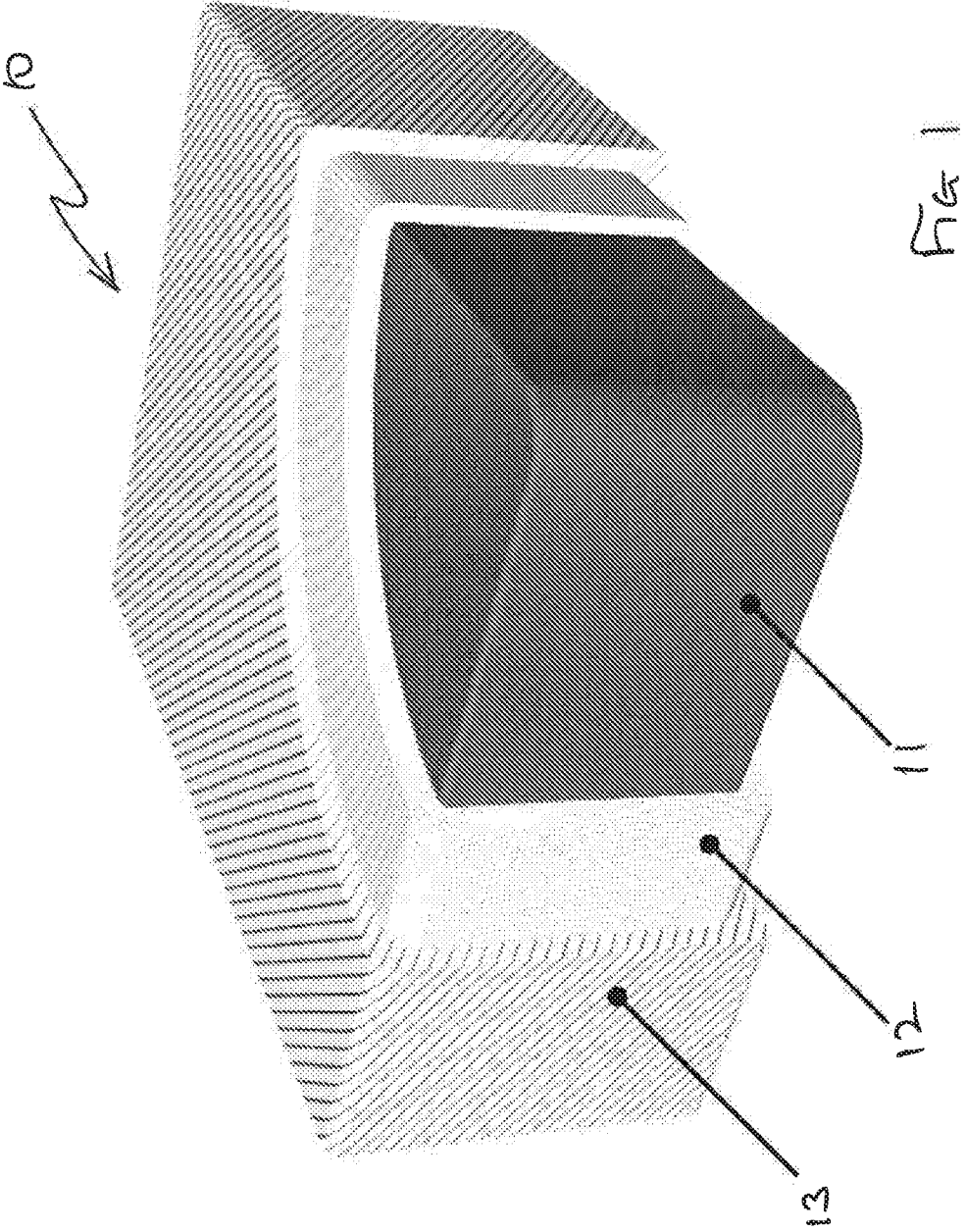
15 23 A child mattress as claimed in claim 21 or claim 22 wherein the core layer comprises a foam layer, preferably formed from a closed cell foam, more preferably a relatively hard foam formed from a polyether material.

20 24 A child mattress as claimed in claim 21 or claim 22 wherein the core layer is formed from a coir-based composition, preferably, a coir core layer formed from a latex and coir composition, or a heat-bonded polyester or nylon and coir composition.

25 25 A child mattress as claimed in any preceding claim further comprising a barrier layer between the or each spring layer and the cover, preferably a barrier layer of a foamed polymeric material or felt.

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26 A child mattress as claimed in claim 25 wherein the barrier layer is adhered to the or each spring layer, preferably with a hot melt adhesive.



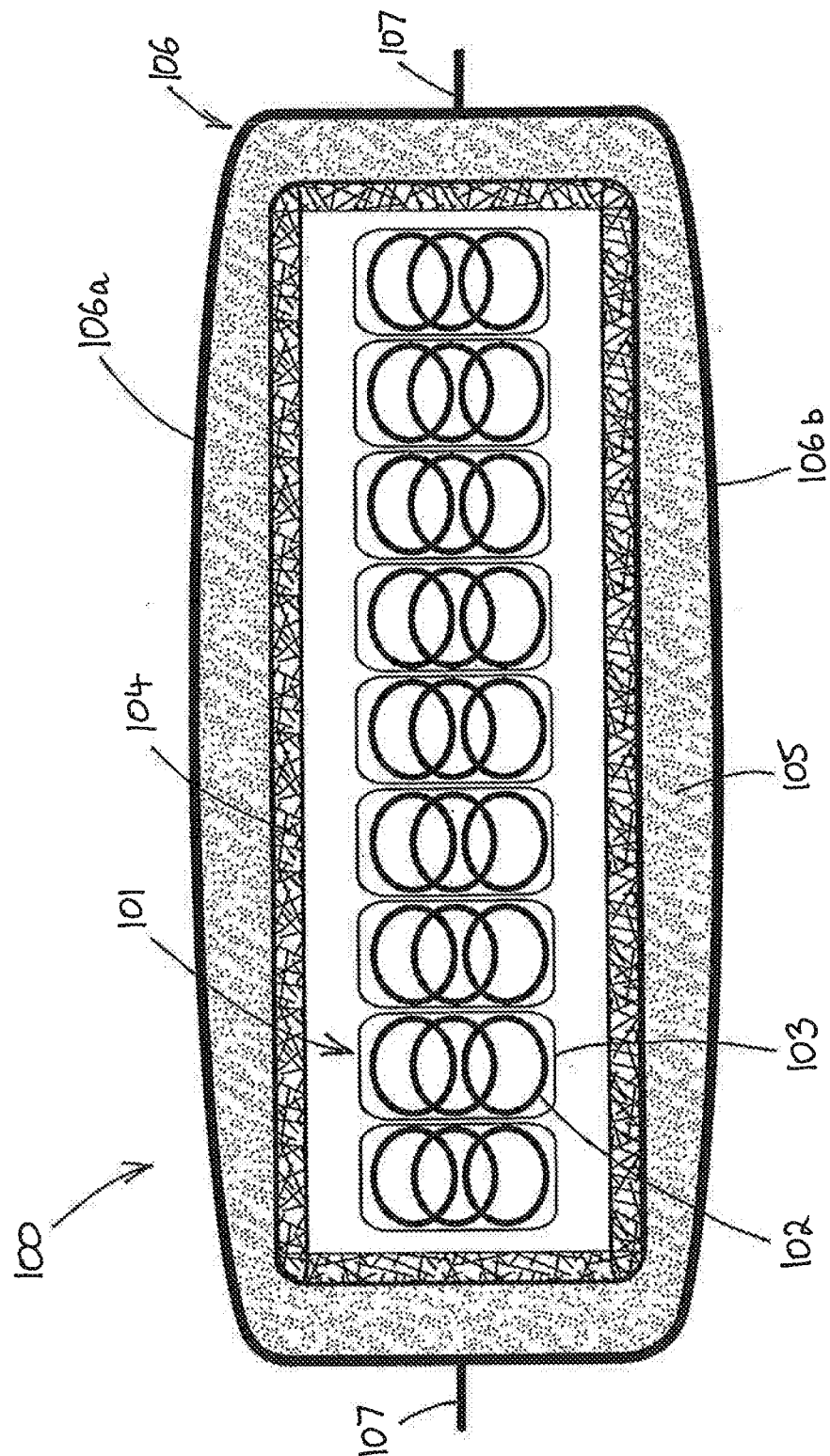


FIG. 2

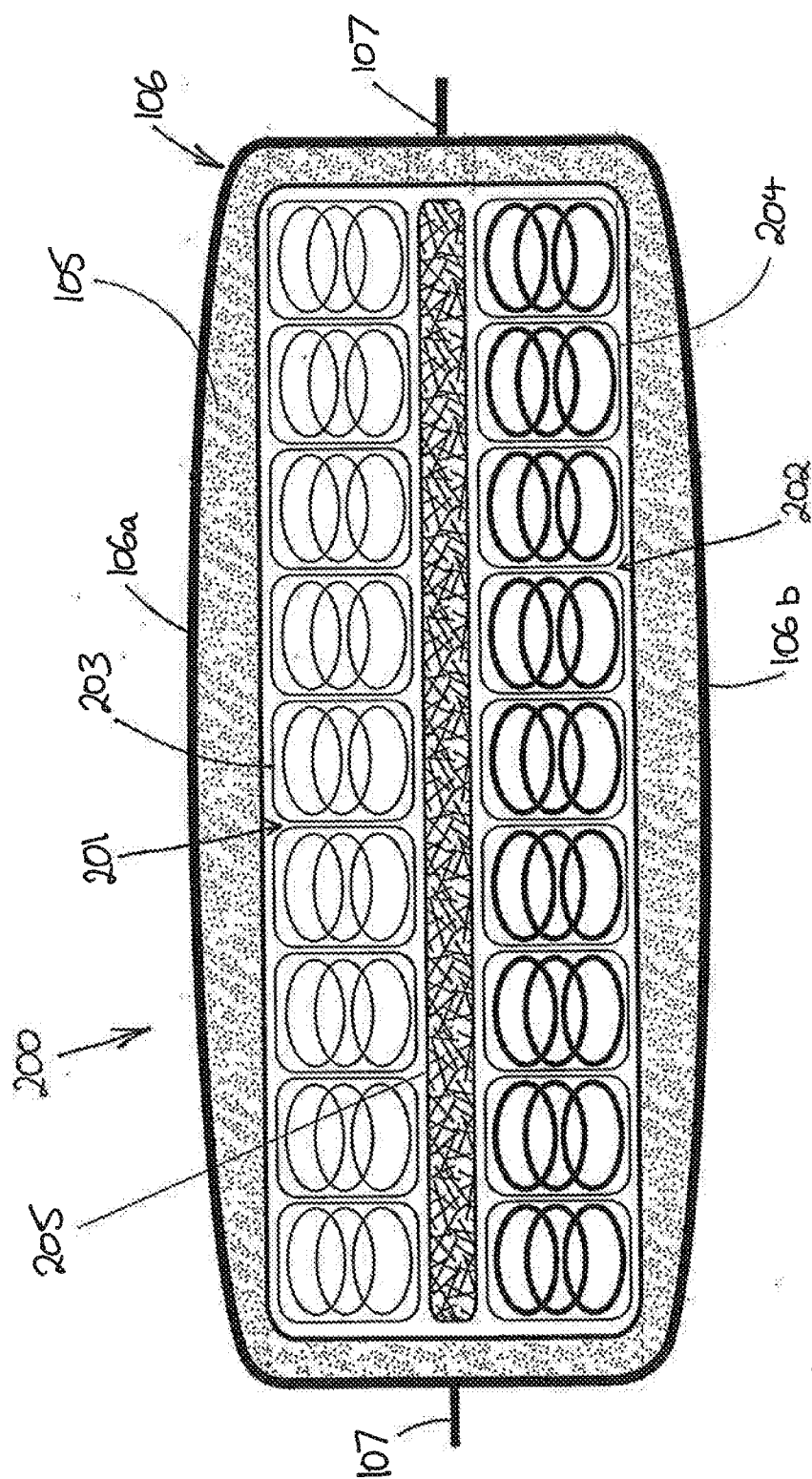


FIG. 3

INTERNATIONAL SEARCH REPORT

International application No

PCT/GB2014/050922

A. CLASSIFICATION OF SUBJECT MATTER

INV. A47C27/00 A47D15/00 A47C31/10 A47C31/00 A47C27/05
A47C27/06

ADD.

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)

A47C A47D

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)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2005/046988 A1 (LANCASTRIA LTD) 26 May 2005 (2005-05-26) claims; figures -----	1-26
A	US 2 257 994 A (ZOFNASS) 7 October 1941 (1941-10-07) figures -----	11,21,22
A	EP 1 201 164 A1 (SIDALL AND HILTON LTD) 2 May 2002 (2002-05-02) paragraph [0026]; figures -----	12-14, 16,21-24
A	WO 2012/131331 A1 (KIT FOR KIDS LTD) 4 October 2012 (2012-10-04) claims; figures ----- -/-	1-26



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

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"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

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Date of the actual completion of the international search

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INTERNATIONAL SEARCH REPORT

International application No

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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DE 203 09 795 U1 (BODET & HORST GMBH & CO KG) 2 October 2003 (2003-10-02) page 3, paragraph 1 - paragraph 2; claims; figure 1 -----	1-26

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

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