Title: A PADDING LAYER

Abstract: There is disclosed a padding layer including fibres as a wadding. The wadding comprises a pleated or vertically-lapped non-woven web of fibres, the pleats or laps being oriented substantially perpendicularly to a support surface of the padding layer. At least a portion of the support surface of the padding layer may be provided with a profiled cross-section. The fibres may be polyester fibres. The padding layer is reliable and unreliable without permanent deformation.
A PADDING LAYER

This invention relates to padding layers, in particular to mattresses and mattress toppers for beds, divans and similar furniture, flooring underlay and upholstery padding (cushioning).

BACKGROUND

A mattress is generally defined as a mat or pad, usually placed on top of a bed base or divan (although sometimes placed directly on a floor) on which to sleep or lie. Historically, mattresses have been filled with a variety of natural materials, including straw and feathers. Modern mattresses usually contain either an inner spring core or materials such as latex, viscoelastic, or other polyurethane-type foams. Mattresses may also be filled with air or water, or a variety of natural and/or synthetic fibres, such as in futons.

A typical innerspring mattress consists of three components: the spring core, the foundation, and the upholstery layers. The core of the mattress supports the sleeper's body. Modern spring mattress cores, often called "innersprings," are made up of steel coil springs, or "coils."

Connections between the coils help the mattress retain its shape. Most coils are connected by interconnecting wires; encased coils are not connected, but the fabric encasement helps preserve the mattress shape.

Foam mattresses use shape-conforming latex or viscoelastic memory foam plus polyurethane flexi-foam to provide better support than springs alone, as well as in combinations of springs and foams. Latex mattresses generally come in two types of latex, Talalay® and Dunlop®, which are manufactured differently and provide different feels as well as different qualities.

There are three main types of foundations:

i) Box-springs consist of a rigid frame that contains extra-heavy-duty springs. This type of foundation contributes to softer support and a bouncier mattress.

ii) Traditional wood foundations are usually made of soft woods, such as pine, or hard woods.

iii) Grid foundations are a combination of steel and wood.

Upholstery layers cover the mattress and provide cushioning and comfort. Some manufacturers call the mattress core the "support layer" and the upholstery layer the
"comfort layer". The upholstery layer consists of three parts: the insulator, the middle upholstery, and the quilt.

[0008] The insulator separates the mattress core from the middle upholstery. It is usually made of fibre or mesh and is intended to keep the middle upholstery in place.

[0009] The middle upholstery comprises all the material between the insulator and the quilt. It is usually made from materials which are intended to provide comfort to the sleeper, including regular foam, viscoelastic foam, felt, polyester fibres, cotton fibres, convoluted ("egg-crate") foam, and non-woven fibre pads.

[0010] The quilt is the top layer of the mattress. Made of light foam or fibres stitched to the underside of the ticking, it provides a soft surface texture to the mattress and can be found in varying degrees of firmness. The protective fabric cover which encases the mattress is called ticking. It is usually made to match the foundation and comes in a wide variety of colours and styles. Most ticking is made of synthetic fibres like polyester, or acrylic; or of natural materials such as latex, cotton, silk, and wool.

[0011] Some prior art mattresses, for example as manufactured by the present applicant, comprise a spring core unit surrounded by an insulator pad (usually around 10mm in thickness), then overlaid with a support layer, followed by a comfort layer, and then overlaid with the ticking.

[0012] Mattresses currently on the market are generally made from foam blocks or a central spring unit provided with fibre or foam outer layers. Mattresses made of 100% fibre are occasionally sold as children’s mattresses, but are not suitable for the adult market because their performance is poor (they tend to sag or collapse under weight).

[0013] Foam, such as polyurethane foam, has a number of advantages, including good resilience and low density. However, polyurethane foams are environmentally unfriendly (both in manufacture, involving the use of organic solvents, and post-manufacture, since foams are not easily recyclable). Furthermore, it has been suggested that emission of volatile organic compounds (VOCs) from foam mattresses can be a contributor to Sudden Infant Death Syndrome (cot death), as well as triggering allergic reactions. Another disadvantage is that foams are often not breathable. This means that sweat and other body fluids tend to collect in foam mattresses leaving them damp to the touch, and in the case of infants, can cause suffocation if a child rolls onto its front during sleep.

[0014] The use of mattress wadding made from polyester fibres is well-known. Polyester fibre wadding has a number of advantages, including recyclability (the fibres can be made from recycled material, such as polyester drinks bottles; as well as being recycled again at the end of the life of the mattress) and hydrophobicity (polyester fibre wadding does not
collect sweat or urine and remains dry to the touch). Furthermore, polyester fibre wadding is odourless and does not emit VOCs, and is generally considered to be a hypoallergenic material. However, in current mattresses, the polyester wadding is typically made from fibres having a linear mass of around 6 to 20 denier, this being necessary to give a reasonable level of support. Even then, additional support in the form of foam blocks or spring units is required to prevent sagging or collapse when bearing the weight of an adult person.

[0015] It is known, for example from US5955174, WO2006/092029 and EP0350627 to produce vertically-lapped or pleated non-woven webs. These webs are typically of blended fibres, not 100% polyester, and in some cases are made of wool.

[0016] Embodiments of the present invention seek to provide improvements to mattresses as a whole, and also to component parts of mattresses such as the upholstery or comfort layer, as well as mattress toppers which are mat-like devices for use on mattresses, and which may be configured to fit around the mattress.

[0017] Mattresses or mattress toppers with a profiled surface are well-known, for example from US 2008/0060139, but these mattresses are made of polyurethane or latex foams. Profiled surfaces help to reduce the incidence of pressure sores, especially for immobile persons.

[0018] Upper layers of carpets and laminate flooring are commonly laid onto a cushioning layer of flooring underlay. The underlay reduces the rate of wear that the upper layer experiences from foot and other traffic, increases the level of comfort for those walking across the upper layer, and to provide insulation against sound, moisture and/or heat. Flooring underlay is typically 6 to 10mm thick beneath carpet and typically about 3mm thick under solid flooring, and is conveniently supplied rolled or folded. Underlay is commonly manufactured from a cushioning layer of foam, sponge rubber, crumb rubber, felt or mixed needled non-woven fibre webs.

[0019] Disadvantageously, the existing products available on the market are heavy. Further, disadvantageously, existing products are not able to use fabric waste or carpet waste in their manufacture. Additionally, foam products are susceptible to discolouration. Yet further, existing products may be difficult to recycle at the end of life.

[0020] Further, disadvantageously, polyester fibre layers are not conventionally used in flooring underlay padding layers, since the high area density of polyester fibres that would be required in order to meet performance criteria would make the cost prohibitive. Further, laid non-woven polyester fibre layers are difficult to cut, which would make them impractical for use as underlay, due to the need of installation contractors to cut the
underlay, in situ, to fit the floor plan. Also, profiling of conventional underlay to provide enhanced performance can only be provided by a complex and expensive moulding process.

[0021] On the frames and spring systems of upholstered furniture, and beneath the upper finishing layers of fabric or leather, comfort is provided by one or more layers of padding, and/or separate cushions. Padding material used to provide cushioning layers in upholstery are commonly made from foam, in particular high density foam, and in the case of cushions (e.g. in the seat deck of chairs) the padding is commonly composite, having a core of high density foam that has been wrapped in either soft polyester, feather and down or a hypoallergenic down substitute.

[0022] In such composite padding materials, the outer soft polyester provides a soft surface texture, and in combination with the firmer core, it provides a varying degree of firmness with increasing depression of the outer surface.

[0023] Foam, such as polyurethane foam, also has a number of advantages, in the manufacture of underlay and cushions for upholstery padding, as discussed above in relation to mattresses and mattress toppers.

[0024] Disadvantageously, enhanced performance of the cushioning is provided by wrapping a softer layer around a stronger core, which is a complex and expensive manufacturing process. Further, disadvantageously, non-composite layers of polyester fibre are not conventionally used in high quality upholstery padding, since the high area density of polyester fibres that would be required in order to meet performance requirements would make the cost prohibitive. Yet further, laid non-woven polyester fibre layers are difficult to cut, which provides difficulty in cutting during manufacture. Cushions made of 100% non-woven laid fibre webs are not suitable for most applications because their performance is poor (they tend to sag or collapse under weight). Further, disadvantageously, conventional cushioning material is difficult to bend to (e.g. over the armrest of a chair), limiting the dimensions and performance of cushioning that is useable (e.g. requiring overlaid separate layers, which increases manufacturing cost).

[0025] It is known, for example from US5955174, WO2006/092029 and EP0350627 to produce vertically-lapped or pleated non-woven webs. These webs are typically of blended fibres, not 100% polyester, and in some cases are made of wool.

[0026] Embodiments of the present invention seek to provide improvements to padding layers as a whole, and also to component parts of padding layers.
BRIEF SUMMARY OF THE DISCLOSURE

[0027] According to a first aspect of the present invention, there is provided a padding layer including fibres as a wadding, the wadding comprising a pleated or vertically-lapped non-woven web of fibres, the pleats or laps being oriented substantially perpendicularly to a support surface of the padding layer.

[0028] According to a second aspect of the present invention, there is provided a mattress comprising a padding layer including fibres as a wadding, the wadding comprising a pleated or vertically-lapped non-woven web of fibres, the pleats or laps being oriented substantially perpendicularly to a support surface of the padding layer.

[0029] According to a third aspect of the present invention, there is provided a mattress topper comprising a padding layer including fibres as a wadding, the wadding comprising a pleated or vertically-lapped non-woven web of fibres, the pleats or laps being oriented substantially perpendicularly to a support surface of the padding layer.

[0030] According to a fourth aspect of the present invention, there is provided a flooring underlay comprising a padding layer including fibres as a wadding, the wadding comprising a pleated or vertically-lapped non-woven web of fibres, the pleats or laps being oriented substantially perpendicularly to a support surface of the padding layer.

[0031] According to a fifth aspect of the present invention, there is provided an upholstery padding layer comprising a padding layer including fibres as a wadding, the wadding comprising a pleated or vertically-lapped non-woven web of fibres, the pleats or laps being oriented substantially perpendicularly to a support surface of the padding layer.

[0032] According to a sixth aspect of the present invention, there is provided an item of furniture comprising an upholstery padding layer comprising a padding layer including fibres as a wadding, the wadding comprising a pleated or vertically-lapped non-woven web of fibres, the pleats or laps being oriented substantially perpendicularly to a support surface of the padding layer.

[0033] According to a seventh aspect of the present invention, there is provided a method of manufacturing a padding layer, the method comprising forming a wadding of pleated or vertically-lapped non-woven web of fibres, the pleats or laps being oriented substantially perpendicularly to a support surface of the padding layer.

[0034] The fibres may comprise polyester fibres. The fibres may comprise waste carpet, including but not limited to fibres from polyester carpets. The fibres may comprise fibres from waste fabric, including but not limited to fibres from waste clothing. The fibres may comprise fibres manufactured from waste polyester bottles.
[0035] The wadding may be substantially 100% polyester fibre, although it will be appreciated by those of ordinary skill that negligible amounts of other fibres or impurities will likely become incorporated into the wadding during manufacture as a result of unwanted contamination. Embodiments of the invention seek to provide a wadding that does not deliberately include fibres other than polyester fibres as part of a blend.

[0036] Advantageously, in the case of polyester fibres, they are resistant to discolouration, and are easily recyclable at the end of life.

[0037] At least a portion of the support surface of the padding layer may have a profiled cross-section. The profiled cross-section may be cut into at the padding layer. The expression "profiled cross-section" includes ridges, corrugations, waves, projections, craters, peaks, troughs and other formations that provide a non-flat profile to the support surface of the padding layer when viewed along the major plane of the padding layer. Typical profiles include egg-crate or egg-box profiles, waffle profiles and stippled profiles.

[0038] The profiled section may be formed by a cutting process. In particularly preferred embodiments, the wadding is passed through a machine comprising a pair of adjustable rollers, which may themselves be profiled, and a band knife. By appropriate control of the roller separation and selection of the roller profiles, and appropriate operation of the band knife, it is possible to cut a profile into at least a portion of the support surface, and optionally across the entire support surface.

[0039] Advantageously, a relatively thick wadding may be cut in two so as to provide two padding layers with complementary profiled surfaces. In this way, two padding layers can be formed in around the same time that it would otherwise take to form a single padding layer using a thinner wadding.

[0040] It has surprisingly been found that a vertically-pleated or vertically-lapped fibre wadding can be cut in this way to provide a profiled surface without significantly damaging the integrity of the wadding, especially when a degree of cross-needling is applied during the pleating or lapping process. Hitherto, these profile cutting techniques have been restricted to foam materials, since cutting a standard horizontally cross-laid or air-laid fibre wadding would result in parts of the padding layer surface coming loose.

[0041] Fibre wadding has a number of advantages, including recyclability (the fibres can be made from recycled material, such as waste polyester drinks bottles, or shredded or pulled waste fabric, or fabric from waste carpets; as well as being recycled again at the end of the life of the padding layer). In the case of polyester fibre wadding, a further advantage is hydrophobicity (polyester fibre wadding does not collect sweat or urine and
remains dry to the touch). Furthermore, polyester fibre wadding is odourless and does not emit VOCs, and is generally considered to be a hypoallergenic material.

[0042] Yet further, a pleated or vertically lapped non-woven web of fibres (particularly polyester fibres) has a low area density, which may make products light and correspondingly less expensive to manufacture and transport. The padding layer may easily be cut (e.g. in the manufacture of upholstery or when fitting underlay), as a result of the vertically lapped arrangement of the fibres.

[0043] The padding layer may be an underlay. The padding layer may be an upholstery padding layer.

[0044] Preferably, the fibres have a linear mass of not more than 25 denier.

[0045] In preferred embodiments, the fibres have a linear mass of less than 15 denier, preferably less than 10 denier, preferably less than 5 denier, preferably less than 3 denier, and in particularly preferred embodiments no more than 1.5 denier. In some embodiments, microfibres (i.e. fibres of 1 denier or below) may be used, either exclusively or in combination with coarser fibres. Fibres of 0.8 denier or below can give a particularly good softness, while still maintaining good support due to the vertically-lapped wadding construction. The use of such fine fibres in the manufacture of wadding is counterintuitive in view of technical prejudices. Although fine fibres (for example, less than 5 denier) can produce a known wadding with a very soft surface texture, such waddings do not provide sufficient support, and tend to collapse or sag very quickly.

[0046] The present applicant has, surprisingly, found that the use of a vertical-lapping or pleating technique allows the use of much finer fibres (i.e. less than 5 denier) while still providing sufficient resilience to the wadding as a whole. Moreover, the use of finer polyester fibres makes possible an entirely new range of padding layers with special technical advantages not hitherto realized.

[0047] Firstly, the use of finer fibres (less than 5 denier, and especially less than 1.5 denier) results in a soft surface feel, not unlike the feel of a foam padding layer, but retaining excellent physical support characteristics without sagging or collapsing. This is due to the additional support provided by the vertically-lapped or pleated structure of the wadding.

[0048] Secondly, and particularly surprisingly, a padding layer of embodiments of the present invention can easily be rolled for packing, transport and storage (during the manufacturing process and when supplied to consumers). Additionally, the padding layer of the present invention may be used in curved regions (e.g. bent across the arm of a chair) in ways that existing padding layers having comparable dimensions and/or
performance may not. This is because the vertically-lapped or pleated structure of the wadding allows one major surface of the padding layer to stretch while the other major surface of the padding layer is compressed, the stretching and compressing being resilient, thereby allowing the padding layer to return to a generally flat configuration without deforming. Traditional fibre wadding padding layers do not roll easily, and tend bendingly to deform when rolled, leaving the padding layer with a banana-like profile that is impossible to remove. Foam padding layers can easily be rolled, but suffer from the various disadvantages outlined above. Accordingly, embodiments of the present invention, for the first time in the industry, provide padding layers that combine the advantages of wadding (breathability, non-toxicity, recyclability) with the advantages of foam (softness and physical support, rollability), while avoiding or at least ameliorating the major disadvantages of both.

[0049] Thirdly, the vertical lapping of the wadding makes it extremely breathable in a direction from top to bottom. This means that moisture (e.g. sweat or urine) is not retained by the padding layer, especially since fibres are hydrophobic.

[0050] Fourthly, the vertical lapping of the wadding gives excellent localised support for loads without deforming unduly in regions where no load is present. This is because each vertical lap of the wadding can provide relatively independent vertical resilience from other vertical laps, especially those some distance away. This is in stark contrast to a more traditional air-laid or cross-laid fibre wadding construction, where a load placed on top of the padding layer will tend to cause overall sag. In this way, the problem or roll-together on a double padding layer (e.g. a mattress or cushion where two people will tend to roll towards each other when asleep or seated, because of the central sag) is reduced or avoided. This is in some ways similar to the functionality of known pocket-sprung mattresses or seat decks, but can be achieved by embodiments of the present invention without the need for springs.

[0051] It will therefore be appreciated that the present invention provides a very surprising synergy of advantages that goes far beyond what would be expected by a person of ordinary skill in the art.

[0052] Padding layer waddings of embodiments of the present invention preferably have a thickness (from a first major surface to an opposite second major surface) of at least 20mm, often in the range 20mm to 35mm, in some embodiments at least 50mm, or at least 60mm, and in some embodiments at least 100mm or 150mm. The thickness, in this context, is to be understood as the thickness provided by a single layer of wadding - in other words, each lap or pleat has a height of at least 20mm etc. in these embodiments. Some embodiments of the present invention use only a single layer of wadding, rather
than multiple layers of wadding layered on top of each other to achieve a desired thickness. Other embodiments comprise two, three or more layers of wadding; in this way, a thicker wadding can be constructed from multiple layers of thinner wadding.

[0053] Preferably, the vertical laps or pleats of the wadding are cross-needled to provide additional structural strength. This helps to reduce or prevent damage to the padding layer when it is rolled or cut in half between its major surfaces.

[0054] A special advantage of the present invention is that it is environmentally friendly. The fibres for the wadding can be obtained from drinks bottles, or carpets, and other waste by chipping, melting and spinning. Moreover, at the end of its life, the wadding can also be easily recycled without having to go through a time consuming manual process of removing polyurethane foam blocks that are traditionally used to provide necessary support in known padding layers.

[0055] The padding layer of the present invention may include springs or spring units as a padding layer core, in which case it will generally not be reliable, may not be cut in half, although parts of its support surface may still be profiled. Alternatively, because of the superior support characteristics provided by the vertically-lapped or pleated wadding, a sprung padding layer core may be omitted entirely so as to provide an easily reliable padding layer.

[0056] In some embodiments, the padding layer wadding may be adhered onto a reliable or bendable layer of backing material, such as a thin, densely-needled backing layer or sheet. An example of a suitable backing layer or sheet may comprise a felt, for example 2mm to 4mm needlefelt. Polyester may be used as a material for the backing layer or sheet. In the case of underlay, a further example of a backing layer may be a damp-proof membrane.

[0057] The padding layer wadding of embodiments of the present invention may be provided with a ticking or cover.

BRIEF DESCRIPTION OF THE DRAWINGS

[0058] Embodiments of the invention are further described hereinafter with reference to the accompanying drawings, in which:

Figure 1 is a schematic view of a known cross-laid fibre wadding for a padding layer;

Figure 2 is a schematic view of a known air-laid fibre wadding for a padding layer;
Figure 3 is a schematic view of vertically-lapped fibre wadding for a padding layer of the present invention;

Figure 4 is a schematic view of the wadding of Figure 1 bearing a load;

Figure 5 is a schematic view of the wadding of Figure 2 bearing a load;

Figure 6 is a schematic view of the wadding of Figure 3 bearing a load;

Figure 7 is a schematic view of the wadding of Figure 4 after the load is removed;

Figure 8 is a schematic view of the wadding of Figure 5 after the load is removed;

Figure 9 is a schematic view of the wadding of Figure 6 after the load is removed;

Figure 10 is a schematic view of the wadding of Figure 1 in a rolled configuration;

Figure 11 is a schematic view of the wadding of Figure 10 in an unrolled configuration;

Figure 12 is a schematic view of the wadding of Figure 3 in a rolled configuration;

Figure 13 is a schematic view of the wadding of Figure 12 in an unrolled configuration;

Figure 14 shows a wadding of embodiments of the present invention provided with a cut profiled cross-section on its support surface;

Figure 15 is a schematic view of a wadding for a padding layer of the present invention passing between a pair of profiling rollers and being split in two by a band knife or splitting blade; and

Figure 16 is a schematic cross-sectional view of a pair of padding layers with complementary profiled surfaces that have been cut from a single wadding.

**DETAILED DESCRIPTION**

[0059] Figure 1 shows a known padding layer (wadding) 1, such as a mattress wadding, wadding of a mattress topper, underlay layer or upholstery layer, made of cross-laid fibres having a general orientation 2 that is generally in the plane of the wadding 1 (although exaggerated in the drawing for clarity).

[0060] Figure 2 shows an alternative known padding layer (wadding) 3 is made of air-laid fibres having a general orientation 4 that is generally perpendicular to the plane of the wadding 3, but it can be seen that there is little side-to-side support between the fibres.
Figure 3 shows a padding layer (wadding) 5 of the present invention comprising a vertically-lapped or pleated web 6 of polyester fibres of linear mass not greater than 5 denier. The laps or pleats 7 have a generally vertical orientation 8. The laps or pleats 7 are formed from a non-woven web of fibres that is less than 3mm thick, and preferably about 1mm thick (e.g. a mattress approximately 2000mm long has about 2000 pleats). Greater than 75%, and preferably 90% of the fibres of the non-woven web are aligned such that they are substantially perpendicular to the 8 in the surface of the pleated padding layer 5.

As shown in Figures 4 and 5, both of the known cross-laid and air-laid waddings 1 and 3 tend to flatten under a load 9, and do not conform well to the shape of the load 9. In contrast, Figure 6 shows the vertically-lapped or pleated wadding 5 of Figure 3 (the present invention) supporting the load 9 in a spring-like manner, compressing vertically to accommodate the shape of the load 9 without flattening in neighbouring regions 10. In effect, each lap or pleat 7 acts as a vertical spring, cross-needling providing limited horizontal attachment between neighbouring pleats but without causing the wadding 5 to flatten except under the load 9.

Figure 7 shows how the known cross-laid wadding 1 struggles to recover after the load 9 is removed, since the fibres are matted with each other. The known air-laid wadding 3 in Figure 8 recovers somewhat better after removal of the load 9, but still remains flattened due to fibre matting. It is only the vertically-lapped or pleated wadding 5 (the present invention) shown in Figure 9 that readily recovers its shape due to the independently springy nature of the laps or pleats 7.

Figure 10 shows the known cross-laid wadding 1 of Figures 1, 4 and 7 in a rolled configuration. It can be seen that the inner surface 11 of the wadding 1 becomes puckered, while the outer surface 12 becomes stretched. The stretching and puckering remains evident after unrolling, as shown in Figure 11, leading to permanent deformation into a banana-like shape.

In contrast, the vertically-lapped or pleated wadding 5 (the present invention) of Figures 3, 6 and 9 can be rolled (Figure 12) and unrolled (Figure 13) without permanent deformation. This is because the cross-needling (not shown) allows the laps or pleats 7 to move apart on the outer surface 14 of the wadding 5 while moving closer together on the inner surface 13.

The surface of the wadding layer may be provided with profiling. The provision of profiling can be used to modify the depression performance of the wadding layer, being the extent by which the surface is depressed as a function of applied pressure. The provision of a more easily compressible surface wadding region on a firmer wadding region, can
provide an initially soft feeling when pressure is applied, which may be perceived as being
more luxurious. Such a luxurious feel can be desirable in upholstery cushioning and
underlays.

[0067] The wadding layer may be provided with a uniform profile pattern across the
wadding layer. For example, in the case of carpet or laminate flooring underlay, a uniform
profiling on the surface of the underlay will provide a uniform compression performance
(i.e. extent of depression of the surface as a function of applied pressure) across an entire
floor fitted with the underlay.

[0068] Alternatively, a different compression performance may be provided in different
regions by use of different profiling patterns in the different regions, or by selective profiling
in different regions. For example, in the case of a chair or sofa, it may be desirable to
provide a single layer of wadding covering the seat deck and back regions, with different
levels of support (i.e. different compression performances) in those regions. In a further
example, that of upholstery wadding for an automotive seat, it may be desirable to provide
a non-uniform level of support (i.e. non-uniform compression performance) across a seat,
e.g. a softer feel in a central region of the wadding, and a firmer feel at edge regions.

[0069] Figure 14 shows a wadding layer (e.g. a mattress wadding, mattress topper, or
upholstery layer, such as a cushion) 20 having a support surface (e.g. major plane) 21 with
a profiled cross-section 22. The support surface 21 is provided with a variety of different
profiled features selected to give different support in different regions 21A, 21B and 21C of
the support surface 21. This can provide a wadding layer 20 with enhanced support and
comfort. In the case of a mattress, it is able to provide different support characteristics for
different parts of the body, for example, providing high and low pressure areas, such that
the regions corresponding to the locations of the hips, buttocks and shoulders of a person
sleeping on the mattress receive greater support than other regions, since these projecting
parts of the body depress the support surface more than other parts of the body, such as
the head, feet, legs and the small of the back. As well as different profile patterns, a
uniformly recessed region may also be provided (now shown). For example a three zoned
mattress may be provided with an egg-box-like pattern at each end and two recessed
regions, each interspersed by zones with a ribbed pattern. The wadding layer is
advantageously provided with the same profile on both sides, so that the wadding layer
can be turned so that use of each side can be alternated.

[0070] Figure 15 shows a relatively thick wadding 23 passing between a pair of profiling
rollers 24, 25. A band knife or splitting blade 26 is provided generally between the rollers
24, 25. By moving the knife or blade 26 up and down, and/or by moving the rollers 24, 25
up or down, together or independently, it is possible to split the wadding into two layers 27,
28, with the cut surfaces having complementary profiles 29, 30 as shown in Figure 16. In this way, it is possible to make two padding layers from a single piece of wadding, thus speeding up the manufacturing process. In the case that the wadding is not profiled, this manufacturing process can provide a very accurate and consistent thickness to the finished product, which is particularly advantageous in the case of flooring underlay.

[0071] Throughout the description and claims of this specification, the words "comprise" and "contain" and variations of them mean "including but not limited to", and they are not intended to (and do not) exclude other moieties, additives, components, integers or steps. Throughout the description and claims of this specification, the singular encompasses the plural unless the context otherwise requires. In particular, where the indefinite article is used, the specification is to be understood as contemplating plurality as well as singularity, unless the context requires otherwise.

[0072] Features, integers, characteristics, compounds, chemical moieties or groups described in conjunction with a particular aspect, embodiment or example of the invention are to be understood to be applicable to any other aspect, embodiment or example described herein unless incompatible therewith. All of the features disclosed in this specification (including any accompanying claims, abstract and drawings), and/or all of the steps of any method or process so disclosed, may be combined in any combination, except combinations where at least some of such features and/or steps are mutually exclusive. The invention is not restricted to the details of any foregoing embodiments. The invention extends to any novel one, or any novel combination, of the features disclosed in this specification (including any accompanying claims, abstract and drawings), or to any novel one, or any novel combination, of the steps of any method or process so disclosed.

[0073] The reader's attention is directed to all papers and documents which are filed concurrently with or previous to this specification in connection with this application and which are open to public inspection with this specification, and the contents of all such papers and documents are incorporated herein by reference.
CLAIMS:

1. A padding layer including fibres as a wadding, the wadding comprising a pleated or vertically-lapped non-woven web of fibres, the pleats or laps being oriented substantially perpendicularly to a support surface of the padding layer.

2. A padding layer as claimed in claim 1, wherein the fibres comprise polyester fibres.

3. A padding layer as claimed in claim 2, wherein the fibres are substantially 100% polyester fibres.

4. A padding layer as claimed in any preceding claim, wherein the fibres comprise fibres from waste carpet and/or fabric.

5. A padding layer as claimed in any preceding claim, wherein the wadding comprises no polyurethane or other foam materials.

6. A padding layer as claimed in any preceding claim, wherein at least a portion of the support surface of the padding layer has a profiled cross-section.

7. A padding layer as claimed in claim 6, wherein regions of the support surface of the padding layer have differently profiled cross-sections.

8. A padding layer as claimed in claim 6 or claim 7, wherein the profiled cross-section comprises ridges, corrugations, waves, projections, craters, peaks, troughs or other formations that provide a non-flat profile to the support surface of the padding layer when viewed along a major plane of the padding layer.

9. A padding layer as claimed in any preceding claim, wherein the fibres have a linear mass of not more than 25 denier.

10. A padding layer as claimed in any preceding claim, wherein the fibres have a linear mass of not more than 5 denier.

11. A padding layer as claimed in any preceding claim, wherein the fibres have a linear mass of not more than 1.5 denier.
12. A padding layer as claimed in any preceding claim, wherein the fibres have a linear mass of not more than 1 denier, preferably not more than 0.8 denier.

13. A padding layer as claimed in any preceding claim, wherein the web is cross-needled.

14. A padding layer as claimed in any preceding claim, wherein the wadding is provided with a backing layer.

15. A padding layer as claimed in claim 14, wherein the backing layer is denser than the wadding.

16. A padding layer as claimed in any preceding claim, wherein the padding layer is reliable and unreliable without permanent deformation.

17. A padding layer as claimed in any one of claims 1 to 15, wherein the padding layer includes a sprung core.

18. A mattress comprising a padding layer according to any preceding claim.

19. A mattress topper comprising a padding layer according to any one of claims 1 to 16.

20. A flooring underlay comprising a padding layer according to any one of claims 1 to 16.

21. An upholstery padding layer comprising a padding layer according to any one of claims 1 to 16.

22. An item of furniture comprising an upholstery padding layer according to claim 21.

23. A method of manufacturing a padding layer, the method comprising forming a wadding of pleated or vertically-lapped non-woven web of fibres, the pleats or laps being oriented substantially perpendicularly to a support surface of the padding layer.
24. A method as claimed in claim 23, wherein the padding layer is profiled, and the method comprises cutting a profiled cross-section into at least a portion of the support surface of the padding layer.

25. A method according to claim 24, wherein a wadding is cut in two between its major surfaces so as to provide two padding layers with complementary profiled surfaces.

26. A method according to claim 24 or 25, wherein the profiled section is cut by a band knife.

27. A method according to claim 26, wherein the wadding is passed through a machine comprising a pair of adjustable rollers which controllably compress the wadding before it is cut by the band knife.

28. A method according to claim 27, wherein at least one of the rollers has a profiled surface.

29. A method according to any one of claims 23 to 28, wherein the wadding comprises polyester fibres.

30. A method according to any one of claims 23 to 29, wherein the wadding comprises no polyurethane or other foam materials.

31. A padding layer substantially as hereinbefore described with reference to or as shown in Figures 3, 6, 9 and 12 to 16 of the accompanying drawings.

32. A method of manufacturing a profiled padding layer substantially as hereinbefore described with reference to or as shown in Figures 3, 6, 9 and 12 to 16 of the accompanying drawings.
**INTERNATIONAL SEARCH REPORT**

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<td>18 March 2003 (2003-03-18) col umn 2, lines 24-36; figures 1,3-6 col umn 4, lines 29-35 col umn 4, line 61 - col umn 5, line 40 col umn 6, lines 27-43 claims</td>
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<th>Relevant to claim No.</th>
</tr>
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<tbody>
<tr>
<td>X</td>
<td>US 5 008 141 A (SHINOZUKA TOKIHIRO [JP]) 16 April 1991 (1991-04-16) figures 5-9 column 3, lines 3-8 column 5, lines 15-22 claims</td>
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</tr>
<tr>
<td>X</td>
<td>US 2 419 971 A (HERMAN RUMPF ET AL) 6 May 1947 (1947-05-06) column 3, lines 16-25; figures</td>
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<td>WO 03/049581 A2 (DU PONT [US]) 19 June 2003 (2003-06-19) page 4, lines 1-6 page 6, line 36 - page 7, line 4 page 7, line 31 - page 8, line 17 page 13, lines 13-22 claims; figures 4a, 5; examples</td>
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<tr>
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<td>US 5 623 888 A (ZAFIROGLU DIMITRI P [US]) 29 April 1997 (1997-04-29) column 1, lines 10-17; figures 3, 4; example 1</td>
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</tr>
<tr>
<td>X</td>
<td>EP 0 350 627 A1 (VYSOKA SKOLA STROJNI TEXTILNI [CS] INCOTEX SRO [CZ]) 17 January 1990 (1990-01-17) cited in the application column 4, lines 16-28</td>
<td>1, 2, 23, 29, 30</td>
</tr>
<tr>
<td>X</td>
<td>WO 2006/092029 A1 (V LAP PTY LTD [AU]; COOPER JASON IAN [AU]; ROBERTS ERIC [AU]) 8 September 2006 (2006-09-08) figures 1-4</td>
<td>1, 2, 3, 14, 23, 29, 30</td>
</tr>
<tr>
<td>X</td>
<td>US 4 576 853 A (VAUGHN EDWARD A [US] ET AL) 18 March 1986 (1986-03-18) column 1, lines 38-60; figure 5.6</td>
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</tr>
<tr>
<td>X</td>
<td>EP 2 008 963 A1 (TS TECH CO LTD [JP]) 31 December 2008 (2008-12-31) paragraphs [0045] - [0047]; figures 3, 4, 9, 10</td>
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<td>EP 1 488 719 AI (WELLMAN INTERNAT LTD [IE]) 22 December 2004 (2004-12-22) the whole document</td>
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<td>WO 2007114232 A1</td>
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