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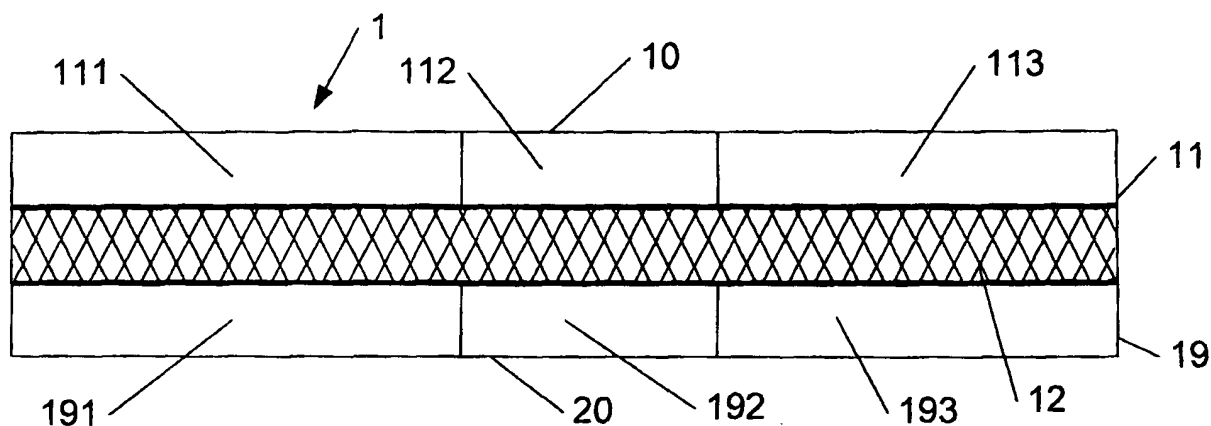
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(54) **Mattress with spaced knitted fabric**

(57) This invention relates to a mattress (1) comprising at least one support layer of soft material, enclosed by an upper wall (10) providing a resting surface, a lower wall (20) providing a support surface and a plurality of side walls (3,4,5,6), wherein the mattress, at least over part of its surface comprises a combination of two distinct layers (11,12), superimposed in the thickness di-

rection of the mattress, whereby the upper layer (11) of the combination is a first support layer of first soft material, and the lower layer (12) of the combination is a spaced knitted fabric, which spaced knitted fabric comprises at least two mutually substantially parallel and spaced woven and/or knitted fabrics, held together by a plurality of bridging fibres extending between the spaced planes of the fabrics.



**Fig. 3**

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## Description

**[0001]** The present invention relates to a mattress comprising at least one support layer of soft material, enclosed by an upper wall providing a resting surface, a lower wall providing a support surface and a plurality of side walls, as described in the preamble of the first claim.

**[0002]** Such a mattress is known from DE-A-10037888. The known mattress is made of an envelope having an upper wall, a lower wall and side walls, which enclose a multilayer core made of different layers of foamed material.

**[0003]** The different layers of soft material provide a support for the human body which can be tuned to different parts of the body, thereby providing a more or less constant level of support for the different body parts, thus avoiding locations of high local pressure on the body. The mattress of DE-A-10037888 however can be improved in that a better support of the different body parts can be achieved. In particular those body parts which protrude into the mattress, such as for instance buttocks, shoulders and calves, need to be better supported. To obtain a better support it is possible to use a softer mattress. In such a mattress body parts sink deeper, thereby increasing the support surface, and consequently decreasing local pressure on the body. However using a softer mattress has the disadvantage of curving the body along the spine for an extended period. This may lead to pain caused by damage to the spine and/or reaction of the muscles. In this respect it is particularly important to provide a support which is soft and warm on the one hand, but which also gives a sufficient elastic counterforce, such that a firm feel of the mattress against the body is obtained.

**[0004]** Another disadvantage of the known mattress is that it does not aerate very well. The known mattress is therefore prone to formation of condensate on its surfaces, which, in the long run, may lead to fungal growth. This of course is undesirable from a hygienic point of view.

**[0005]** It is clear that the known mattress does not provide optimum lying comfort to all body parts. There is therefore a need to provide a multilayer mattress with improved resting comfort for all body parts, in particular the wider head and shoulder portion, the heavier, but narrower back and hip portion and the leg portion.

**[0006]** The object of the invention is therefore to provide a multilayer mattress with an improved resting comfort, as well as an improved resistance against fungus formation.

**[0007]** This object is achieved by a mattress having the technical features according to the characterising portion of the first claim.

**[0008]** The mattress according to the invention comprises at least one support layer of soft material, enclosed by an upper wall providing a resting surface, a lower wall providing a support surface and a plurality of

side walls, whereby it further comprises, at least over part of its surface viewed from the side a combination of two distinct layers whereby the upper layer of the combination is a first support layer of first soft material, and the lower layer of the combination is a spaced knitted fabric, which spaced knitted fabric comprises at least two mutually substantially parallel woven and/or knitted fabrics, held together by a plurality of fibres extending substantially straight and perpendicular to the plane of the fabrics.

**[0009]** By comprising the combination of a first soft material and a spaced knitted fabric, the mattress according to the invention shows an improved point elasticity, when compared with the known mattresses. Moreover the mattress of the invention remains dry under adverse circumstances, for instance when a person with extensive perspiration rests on the mattress for a prolonged period of time.

**[0010]** In the context of this application an improved point elasticity means that the elastic counter force experienced by the body of a person resting on the mattress is well distributed over the contact surface between the body and the mattress upper wall.

**[0011]** Although a spaced knitted fabric is in itself known in the art, it has hitherto not been used in combination with a mattress. A particular embodiment of a spaced knitted fabric, marketed under the registered tradename Aerosleep® has been used as separate cover on a mattress or pillow. Such cover generally has the dimensions of the surface of the mattress and is attached to the mattress by stretching 4 elastic bands on its corners around and underneath the mattress. These covers are believed to provide sleeping comfort for the person resting on it, by allowing air to freely flow between mattress and/or pillow and the human body. Spaced knitted fabrics suitable for such purpose typically have thicknesses of a few mm only up to about 7 mm. Covers with thicknesses larger than 7 mm are rarely used since a cover having this thickness cannot perform its function well. Indeed, due to the specific construction of the spaced knitted fabric with fibres extending substantially straight and perpendicular to the plane of the fabrics, these fibres readily buckle under the load of the human body parts resting directly on them. When the fibres buckle, the two spaced surfaces of the spaced knitted fabric contact each other, thereby removing the possibility for air to freely flow between the spaced surfaces. Covers therefore have limited thickness. By limiting the distance between the mutually substantially parallel woven and/or knitted fabric planes, the average length of the transverse fibres is also reduced. This limits the risk for buckling.

**[0012]** The inventor has now surprisingly found that by incorporating the spaced knitted fabric into a mattress, in combination with at least one additional support layer of a soft material, a mattress according to the invention is obtained having the desired resting comfort, as well as an improved aeration, in comparison to the

known mattress. More in particular, it has been found that it is now possible to incorporate spaced knitted fabrics with increased thickness into the mattress, without having the risk for substantial fibre buckling while still retaining improved aeration.

**[0013]** Surprisingly also, the point elasticity of the mattress is improved over known mattresses, such as for example inner spring mattresses with or without pocket springs.

**[0014]** Suitable spaced knitted fabrics can be made from all fibres known in the art. Although it is possible to use metallic fibres if desired, preferred fibres are natural, such as cotton for instance, and/or organic fibres. Organic fibres are preferably used since interference with electromagnetic earth waves is avoided. Preferred organic fibres include polyester, polyalkylene, such as polyethylene and polypropylene, and/or polyamid fibres. It is also possible to use elastic fibres. It is likewise possible to add specific additives to the fibre material, such as for instance flame retardants, antibacterial, coloring and/or anti-odorous additives. The fibres can be mono- and/or multifilament, and may be textured. The fibre density of the fibres extending substantially straight and perpendicular to the plane of the fabrics can be chosen at will, depending on the specific support properties needed for the mattress. Preferred densities are between 10 and 200 fibres per cm<sup>2</sup>. More preferred densities are between 20 and 100 fibres per cm<sup>2</sup>, most preferred between 30 and 70 fibres per cm<sup>2</sup>.

**[0015]** Preferably, the mattress according to the invention comprises a second support layer of second soft material, extending at least over part of its surface and directly adjacent to the lower wall when viewed from the side.

**[0016]** In this preferred embodiment, the spaced knitted fabric is protected from damage by a support layer of soft material on its upper surface, and by a support layer of soft material on its lower surface, thereby forming a sandwich structure with two skin layers of soft material at both side surfaces, and in between them a spaced knitted fabric.

**[0017]** According to the invention it is possible to incorporate the combination of the two distinct layers into the mattress over part of the surface of the mattress only. This may be done to obtain the desired beneficial effect only over those parts of the mattress where it is most needed, such as for instance in the vicinity of the back or the hips. Especially for patients which have to rest onto a mattress for extended periods of time, long resting periods can have a detrimental effect on their skins. They may for instance develop open wounds. By applying the combination of the invention at those critical parts of the mattress, these problems may be avoided. Also, by incorporating the combination of the two distinct layers into the mattress over part of the surface of the mattress only, significant cost savings can be obtained.

**[0018]** Preferably, the mattress according to the invention comprises, extending substantially over its

whole surface, said combination of two distinct layers positioned on top of said second support layer of second soft material.

**[0019]** In this way, the desired comfort and aeration effect is readily achieved over the entire surface of the mattress, which improves this effect. Moreover, the mattress of the invention can be produced in an economical way, with a minimum of time-consuming hand labour.

**[0020]** The soft material of the support layers can be any suitable material known in the art. Suitable soft materials may for instance comprise wool, cotton, eventually unbleached, hemp, natural latex, silk, cashmere, hand teased hair, and so on. Preferably the soft materials comprise foamed materials. Suitable foamed materials are for instance polyurethane and/or rubber latex foams. It is also possible to use polyether foams. In principle foams with any hardness can be used. The hardness and/or elasticity of the foamed materials used can be chosen according to the desired personal comfort levels. Hardness and/or elasticity can be chosen according to principles, well known to the person skilled in the art. It is for instance possible to vary hardness and/or elasticity by choosing a particular material for the foam, or by choosing the specific construction of the foam. Suitable foam constructions include closed cell foams, open cell foams, syntactic foams consisting substantially of polymeric or other suitable material beads, embedded and glued together by a suitable adhesive, and so called viscoelastic foams.

**[0021]** A particularly preferred embodiment according to the invention is a mattress, characterised in that at least the first and/or the second foamed material is a viscoelastic foamed material.

**[0022]** These materials are known in the art but not in combination with a spaced knitted fabric. Viscoelastic foams suitable for the mattress of the invention are for example marketed under the registered tradename Tempur®, or are viscoelastic foams obtainable from the company Eupenfoam under the registered tradename Eucatherm®. These materials are essentially foams made of a viscoelastic polymer with relaxation times which may even range in the order of minutes. Such a foam responds to the body as follows. In an unslept bed, the foam has essentially acquired room temperature. At this temperature its relaxation times may be as long as several minutes, especially in winter time when room temperatures are low. When applying the pressure of the body to the foam, it will initially feel hard, since it can not relax quickly enough to adapt to the shape of the body. However aided by the temperature rise of the body contact, the viscoelastic foam will relax and gradually adapt its shape to the shape of the body parts resting on it. This will provide an almost exact copy of the body shape and therefore a well divided supporting pressure. This will enhance the feeling of comfort of a person resting on such a foam.

**[0023]** Applicant has surprisingly found that the combination of the invention comprising a spaced knitted

fabric and an upper layer of a viscoelastic foam enhances this effect.

**[0024]** Preferably the mattress according to the invention comprises first and/or second foamed material with an open cell structure. This further improves the dehydration and ventilation of the mattress. Moreover the mattress according to this preferred embodiment can be cleaned very easily and thoroughly, which is a great advantage for persons allergic to for instance dust mite.

**[0025]** A preferred embodiment of the mattress according to the invention has an upper layer of the combination divided in at least three parts along the length direction of the mattress, a first part having an elasticity of between 0,5-2,2 kPa, for receiving the head and shoulder portion of a person occupying the mattress, the second part having an elasticity of between 1,6-4,0 kPa, being provided for receiving the back and hip zone, the third part having an elasticity of between 0,5-2,2 kPa, for receiving the leg zone.

**[0026]** A more preferred embodiment of the mattress according to the invention has a second layer (19) divided in at least three parts (191, 192, 193) along the longitudinal direction of the mattress, a first part (191) having an elasticity of between 1,2-1,8 kPa for receiving the head and shoulder portion of a person occupying the mattress, the second part (192) having an elasticity of between 1,8-2,6 kPa, being provided for receiving the back and hip zone, the third part (193) having an elasticity of between 1,2-1,8 kPa, for receiving the leg zone.

**[0027]** Within the present disclosure, the elasticity of the different parts of the mattress is defined by measuring the compressive load for a certain deflection, according to ISO 3386-1.

**[0028]** As the length of the head and shoulder portion of a human being occupying the first or head part of the mattress is mostly larger than the length of the back and hip portion occupying the second part of the mattress, and as the length of the leg portion is usually in between these two, the length of the different parts of the upper layer of the combination and/or the second layer of the mattress is preferably chosen such that the first part has a length L1, the second part has a length L2 and the third part has a length L3, L1 being larger than L3, which in turn is larger than L2.

**[0029]** The dimensions of the mattress in the thickness can be chosen at will, depending on the desired comfort level and the particular requirements of the person purchasing the mattress. These requirements depend for instance on length and weight of the person.

**[0030]** It is advantageous to characterise the mattress according to the invention in that the height of the upper layer of the combination is between 40 and 80 mm, the height of the lower layer of the combination is between 20 and 60 mm, and the height of the optional second support layer is between 30 and 70 mm.

**[0031]** All layers of the mattress according to the invention may be attached to each other by all suitable means of the art, such as stitching, adhesively bonding,

and so on. The mattress may also be provided with additional pieces of foamed material to give the desired shape to the mattress. It is for instance possible to provide pieces of foamed material adjacent to the side walls of the mattress, in order to protect the sides of the mattress.

**[0032]** The invention is now further elucidated in the appending figures and description of the figures, without however being limited thereto.

**[0033]** Figure 1 is a schematic perspective view of a mattress in general.

**[0034]** Figure 2 is a schematic view of a preferred embodiment of the mattress of the invention, along a cross section ABCD.

**[0035]** Figure 3 is a schematic view of a preferred embodiment of the mattress of the invention, along a lengthwise cross section.

**[0036]** Figure 4a shows a detailed view from above of the support layer 12 according to the invention.

**[0037]** Figure 4b shows a detailed view from the side of the support layer 12 according to the invention.

**[0038]** Figure 4c shows a detailed view from the side perpendicular to the side of figure 4b of the support layer 12 according to the invention.

**[0039]** The mattress 1 shown in figure 1 comprises an envelope for the support layers, having an upper wall 10 providing a resting surface, a lower wall 20 providing a support surface to the mattress, and four side walls, being one at the foot end 3, one at the head end 4, a left side 5, and a right side 6. A cross section in the width direction of the bed is defined as ABCD. As can be seen from figure 2, the cross section ABCD is build up of the envelope sides (upper side 10, lower side 20, left side 5, and right side 6), which enclose a combination of two distinct layers 11, 12 extending over substantially the entire width of the mattress. The upper layer 11 consists of viscoelastic foam with an open cell structure, Eucatherm C®, Type TC50W, obtainable from the company Eupenfoam in Eupen, Belgium.

The lower layer 12 of the combination 11, 12 is a three-dimensional spacing knitwear fabric with a thickness of 40 mm, which may be provided with or without stitching. This three-dimensional spacing knitwear fabric is obtainable under the tradename of Pressless®, from the company Bodet & Horst GmbH, in Germany. This fabric provides substantially higher volume than any comparable standard compound fabric (bonded fabrics), and thus an additional padding effect further improving sleeping comfort. It moreover has better respiratory activity than any comparative standard double fabrics due to its extremely high air permeability. Moreover the balanced thermal insulation behaviour supports comfortable sleeping temperature. The lower layer 12 reacts to any type of load and weight with a particularly high compression elasticity. After load changes, the fabric immediately regains its original position. The sleeper will benefit from this with a much more comfortable position. The compression elasticity feature equally boosts humidity

transport and respiratory activity.

[0040] As can be seen from figures 4a, 4b and 4c, the three-dimensional knitted fabric 12 comprises two substantially plane textile structures 120 and 121, which extend substantially parallel to each other. It is however possible to bend the structures 120 and 121 over some angle to provide a curved lower layer 12. In between the structures 120 and 121 a plurality of fibres are provided which bridge the distance between both structures 120 and 121. The bridging fibres 122, 123 are integral to the textile structures 120 and 121. For instance, a fibre of the textile structure 120 at some point leaves the plane of structure 120, bridges the distance between the planes and re-enters the opposing structure 121. This is easily achieved by a person skilled in the art of textile techniques. The fibres 122, 123 extend between the two structures 120, 121 substantially straight. By this is meant that the fibres are preferably not extensively curled on themselves but cross the distance along a relatively short path. It does not mean that fibres may not show a curvature, such as the curvature shown in figure 4b. As shown in figure 4c, the fibres may cross each other at some angle, however they may also run more or less parallel to each other. From the side view of figure 4b, it is clear that the average direction of the bridging fibres may differ along the distance between the structures 120 and 121, but may also differ in the length direction from that in the width direction. Figure 4a shows a preferred textile structure for the two fabrics 120 and 121. This structure is substantially honey grate shaped. The top layer 120 is shifted with respect to the bottom layer 121 in the XX' direction. The legs 130, 131 of the honey grate comprise twined filaments which depart from the legs 130 about every mm to cross the distance and rejoin opposing legs 131. Obviously the density of the bridging fibres per cm<sup>2</sup> can be varied at will by changing the departing distance.

[0041] The preferred embodiment shown in figure 3 has a combination 11, 12 of which the upper layer 11 has been divided into three parts 111, 112, and 113. The lower layer 12 extends over the entire length of the mattress. An additional second support layer 19 is provided, which layer 19 is placed directly adjacent to the lower wall 20 of the mattress. This second layer 19 also has three parts 191, 192 and 193, with lengths preferably about equal to parts 111, 112 and 113. The first part 111 of the mattress has a length L1, the second part 112 has a length L2 and the third part 113 has a length L3, with preferably  $L1 > L3 > L2$ . In a typical situation L1 mostly varies from 60-100 cm, preferably from 70-90 cm, L2 varies from 30-70 cm, preferably from 40-60 cm, and L3 varies from 50-90 cm, preferably from 60-80 cm.

[0042] The height of upper layer 11 is about 60 mm, of layer 12 about 40 mm, and of layer 19 about 50 mm. A first part 111 corresponds to the surface part accommodating the head and shoulders of a person occupying the mattress. This first part 111 is made of a foamed material having the highest elasticity as the shoulders are

the part which extends the most from the body when occupying the mattress in a sideways position. In the sideways position, the pressure exerted by the shoulders per surface area unit will be higher as compared to the position when the body is laying on the back or front side. A larger stretching of the first part 111 will occur, as compared to the back rest position. Because of the high elasticity of this part 111, the upper wall 10 will adapt itself automatically to the resting position and the weight of the body occupying it.

[0043] The second part 112 corresponds to the surface part accommodating the back part of a person. As it is important that the vertebral column is supported in a substantially horizontal position when sleeping and supported over the entire length, this second part of the mattress is given a limited elasticity, which is substantially less than the elasticity of the first part 111.

[0044] The third part 113 corresponds to the foot-end of the mattress which is provided for accommodating the hips and legs of a body. The elasticity of this part 113 is limited as compared to the elasticity of the first part 111. Some elasticity is required so as to keep the vertebral column in the correct, preferably substantially horizontal position, on the other hand the elasticity needs to be limited as the hip and leg part of the body have the largest weight.

[0045] Another preferred embodiment is shown in figure 2. In this embodiment the mattress moreover comprises a bottom layer 22 of spaced knitted fabric with a height of about 5 mm. This embodiment provides for extra aeration in the area between the mattress and the bed or other supporting surface, such as the ground for instance. In summer time, the mattress may be rotated over its length axis and put on the supporting surface with the layer 22 on top. This provides for extra aeration directly between body and mattress.

## Claims

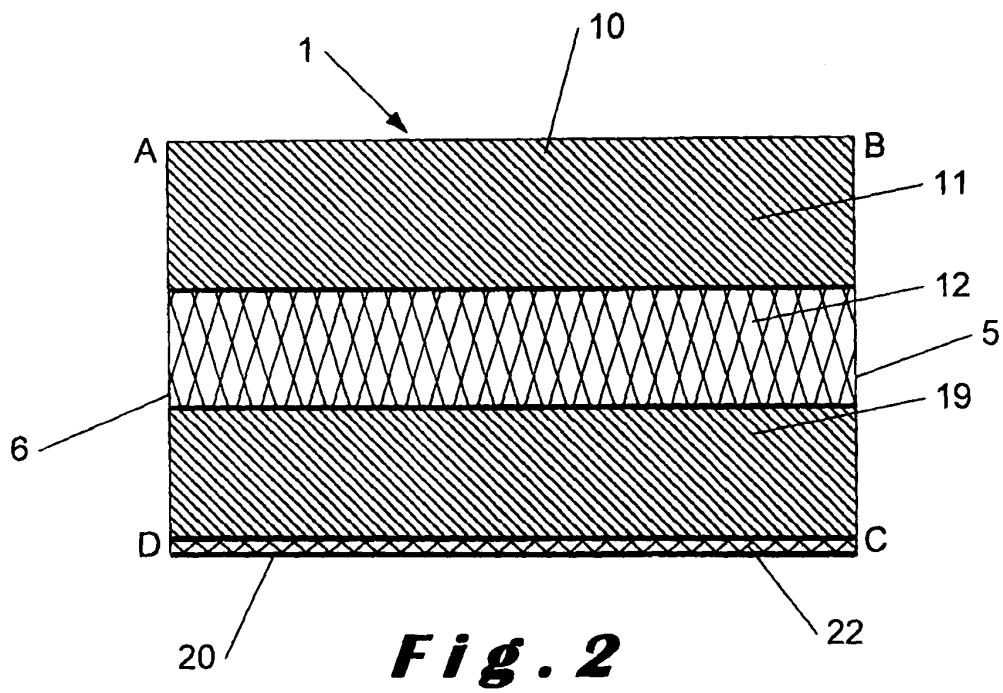
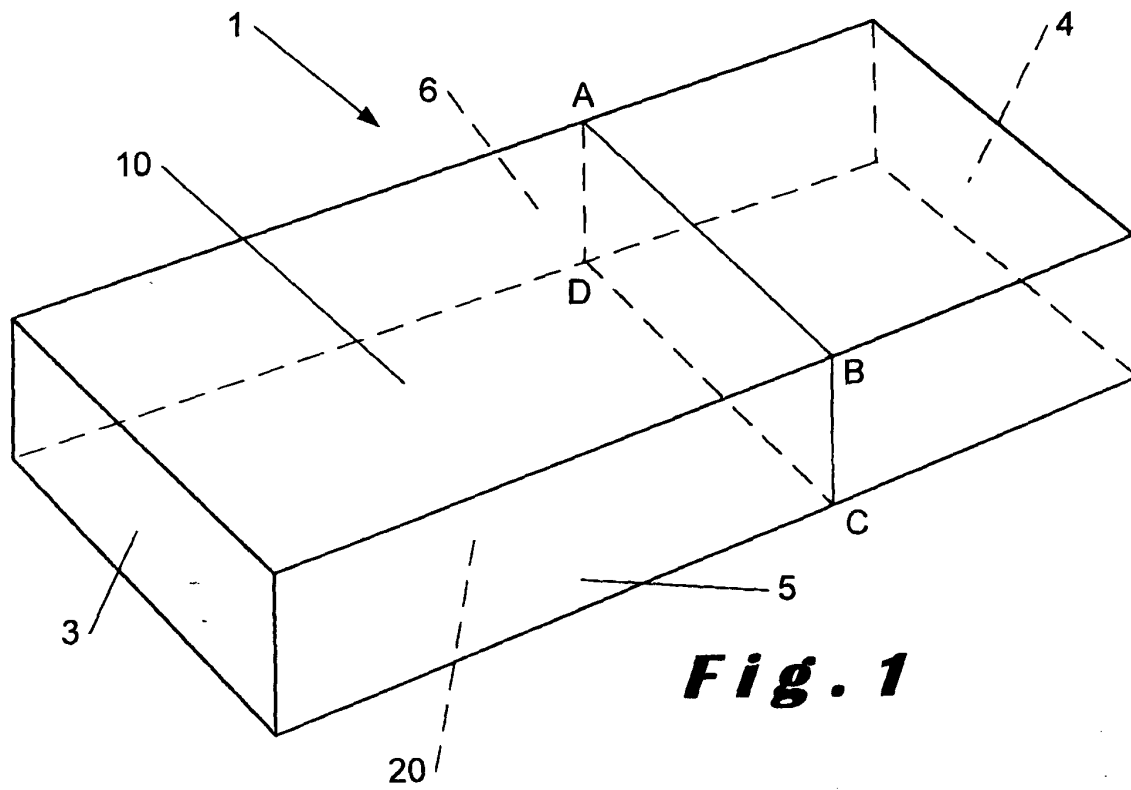
1. Mattress (1) comprising at least one support layer of soft material, enclosed by an upper wall (10) providing a resting surface, a lower wall (20) providing a support surface and a plurality of side walls (3, 4, 5, 6), **characterised in that** the mattress, at least over part of its surface comprises a combination of two distinct layers (11, 12), superimposed in the thickness direction of the mattress, whereby the upper layer (11) of the combination is a first support layer of first soft material, and the lower layer (12) of the combination is a spaced knitted fabric, which spaced knitted fabric comprises at least two mutually substantially parallel woven and/or knitted fabrics (120, 121), held together by a plurality of fibres (122, 123) extending between the spaced planes of the fabrics (120, 121).
2. Mattress (1) according to claim 1, **characterised in**

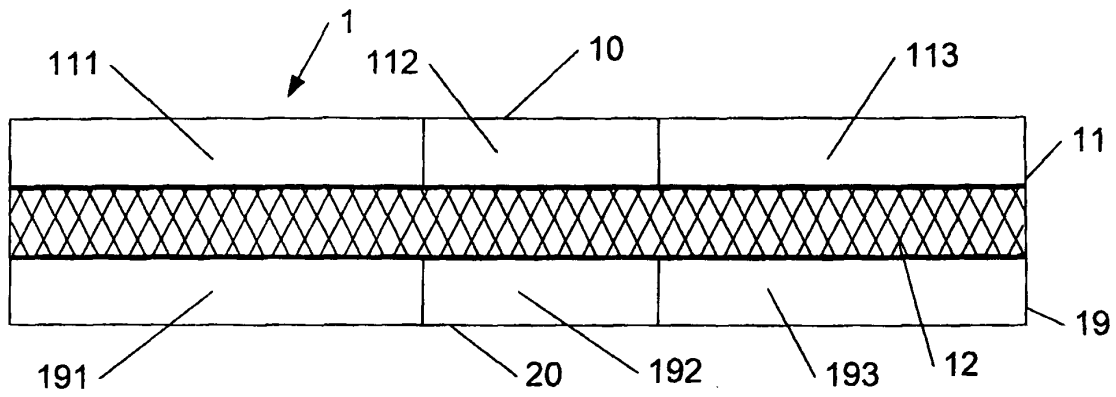
**that** it moreover comprises a second support layer (19) of second soft material, extending at least over part of its surface and directly below the combination (11, 12).

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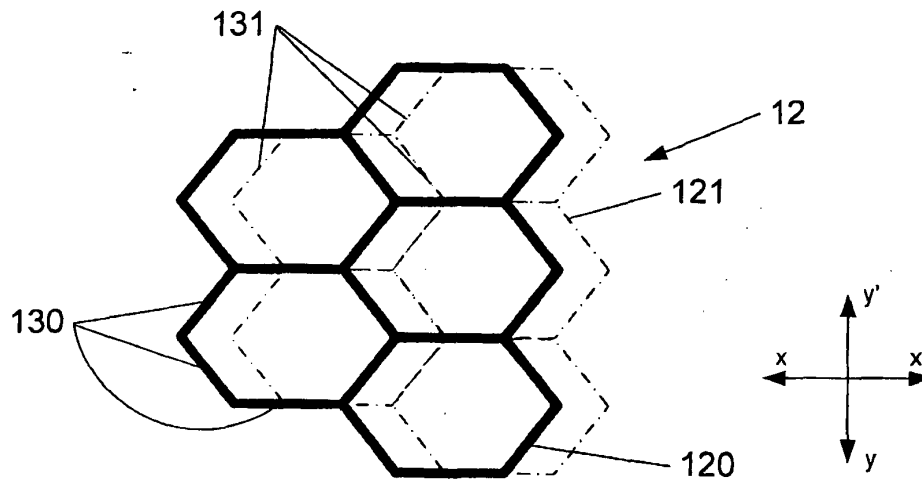
3. Mattress (1) according to claim 1 or 2, **characterised in that** it comprises, extending substantially over its whole surface, said combination of two distinct layers (11, 12) positioned on top of said second support layer (19) of second soft material. 10
4. Mattress (1) according to any one of claims 1 - 3, **characterised in that** at least one of the first (11) and/or the second (19) soft material is a viscoelastic foamed material. 15
5. Mattress (1) according to any one of claims 1 - 4, **characterised in that** the first (11) and/or the second (19) soft material is a foam with an open cell structure. 20
6. Mattress (1) according to any one of claims 1 - 5, **characterised in that** the upper layer (11) of the combination is divided in at least three parts (111, 112, 113) along the longitudinal direction of the mattress, a first part (111) having an elasticity of between 0,5-2,2 kPa, for receiving the head and shoulder portion of a person occupying the mattress, the second part (112) having an elasticity of between 1,6-4,0 kPa being provided for receiving the back and hip zone, the third part (113) having an elasticity of between 0,5-2,2 kPa, for receiving the leg zone. 25 30
7. Mattress according to any one of claims 1 - 6, **characterised in that** the second layer (19) is divided in at least three parts (111, 112, 113) along the longitudinal direction of the mattress, a first part (111) having an elasticity of between 1,2-1,8 kPa for receiving the head and shoulder portion of a person occupying the mattress, the second part (112) having an elasticity of between 1,8-2,6 kPa, being provided for receiving the back and hip zone, the third part (113) having an elasticity of between 1,2-1,8 kPa, for receiving the leg zone. 35 40 45
8. Mattress (1) according to any one of claims 1 - 7, **characterised in that** the height of the upper layer (11) of the combination is between 40 and 80 mm, the height of the lower layer (12) of the combination is between 20 and 60 mm, and the height of the optional second support layer (19) is between 30 and 70 mm. 50

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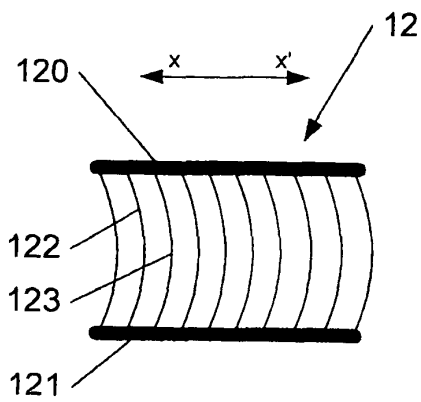




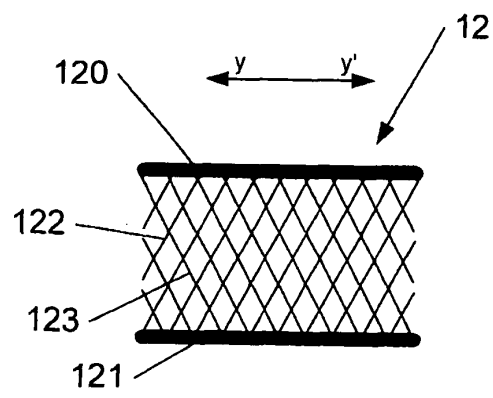
**Fig. 3**



**Fig. 4a**



**Fig. 4b**



**Fig. 4c**