(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 444 925 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
11.08.2004 Bulletin 2004/33

(21) Application number: **04075204.0**

(22) Date of filing: **28.01.2004**

(51) Int Cl.[7]: **A47C 27/14**, A47C 27/00, B26D 7/26, B26F 1/00, B26F 1/14

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IT LI LU MC NL PT RO SE SI SK TR
Designated Extension States:
AL LT LV MK

(30) Priority: **29.01.2003 BE 200300065**
15.05.2003 EP 03076480

(71) Applicant: **Artilat Naamloze Vennootschap**
2560 Nijlen (BE)

(72) Inventor: **Groenweghe, Ronald Jose**
8510 Marke (BE)

(74) Representative: **Valkonet, Rutger et al**
Algemeen Octrooi- en Merkenbureau
P.O. Box 645
5600 AP Eindhoven (NL)

(54) Perforation device and method for a mattress layer

(57) The present invention relates to a device (9) for forming a series of perforations (23) in a mattress layer (22), which device (9) at least comprises a punch (14) with punching pins (15) arranged in a specific matrix pattern and positioned opposite a piercing die (16) provided with holes (19) arranged in rows and columns according to the same matrix pattern, in line with the aforesaid punching pins (15), and wherein the diameter of the holes on the side facing towards the piercing die (16) is larger than the diameter of the punching pins (15). The present invention furthermore relates to a method for forming a series of perforations (23) in a mattress layer (22), using such a device; as well as to an upper mattress made of latex foam. More in particular, the present invention relates to the use of such an upper mattress.

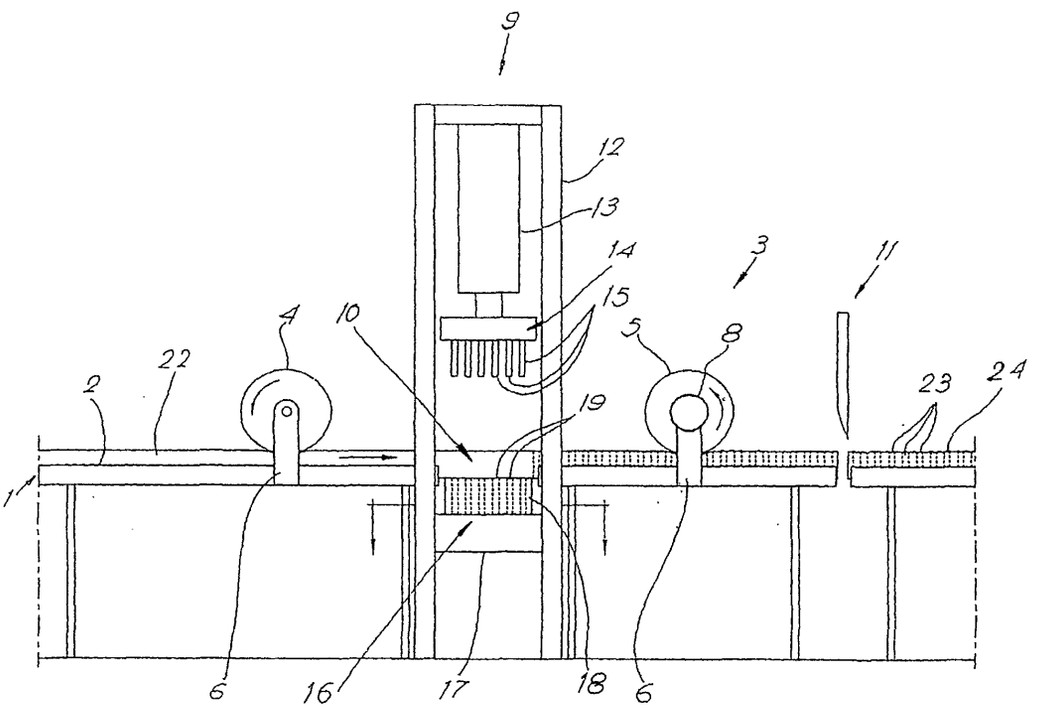

Fig. 1

EP 1 444 925 A1

Description

[0001] The present invention relates to a device for forming a series of perforations in a mattress layer, which device at least comprises a punch provided with punching pins arranged in a specific matrix pattern and positioned opposite a piercing die provided with holes arranged in rows and columns according to the same matrix pattern, in line with the aforesaid punching pins, wherein the diameter of the holes on the side facing towards the piercing die is larger than the diameter of the punching pins. The present invention furthermore relates to a method for forming a series of perforations in a mattress layer, using such a device; as well as to an upper mattress made of latex foam. More in particular, the present invention relates to the use of such an upper mattress.

[0002] It is a known fact that perforations in the mattress layer can enhance the comfort of the person lying on the mattress and improve the moisture discharge of the mattress, in which connection it can be mentioned in particular that people on average secrete up to 1 litre of sweat a night while sleeping. Said moisture is discharged into the surrounding atmosphere as a result of a good ventilation of the mattress, which in itself makes the mattress feel drier, which in turn enhances the sleeping comfort of the user of the mattress. If a moist mattress is insufficiently provided with moisture-discharging means, the mattress will be susceptible to fungoid growth. The provision of additional ventilation in the mattress gives the mattress a higher sense of comfort, and in addition ensures a longer life of the mattress. Furthermore it is known in that people make frequent movements while sleeping, and the shifts in the body weight on the mattress produce a so-called pumping movement, which in turn leads to a satisfactory ventilation and canalisation of the moisture.

[0003] The aforesaid perforations are usually provided according to a specific matrix pattern in the mattress layer, either over the entire surface area of the mattress layer or only in specific zones, after the latex layer has been formed.

[0004] Latex foam of itself has a unique open cell structure, which means that millions of microscopically small interconnected air bubbles in the latex foam provide a good ventilating effect. There are two methods of obtaining latex foam in accordance with the well-known Dunlop process. According to a first method, moulding elements such as waffle irons are used, with latex foam being poured into a closed mould provided with aluminium pins to ensure a good heat conduction, and subsequently being vulcanised, washed and dried into an end product. As a result of the presence of the aluminium pins in the closed mould, the mattress (the end product) comprises vertical, continuous recesses that ensure a proper ventilation of the mattress. According to this method, mattresses having a thickness of up to 20 cm can be produced, with the thickness mainly being limited by the speed at which the heat can be introduced into the core of the latex material. The second method for producing latex foam according to the well-known Dunlop process is the pouring of latex foam on an endless conveyor belt, followed by vulcanisation, washing and finally drying. The maximum height of the mattress built up of latex foam is approximately 5 cm, because heat cannot be introduced into the core of the latex material sufficiently quickly due to the absence of aluminium pins on the conveyor belt. Thus, owing to the absence of the aluminium pins on the conveyor belt, the latex plate that is obtained does not have any vertical, continuous channels. In order to obtain a good ventilation in such a mattress layer yet, the mattress plate is provided with perforations.

[0005] The prior art devices for forming such perforations consist of a punch provided with punching pins arranged in a specific matrix pattern on a punching block and positioned opposite a piercing die provided with holes arranged in the same matrix pattern, in line with the aforesaid punching pins.

[0006] The piercing die of these known devices comprises as many blocks as there are holes, each block being provided with only one hole, which blocks are arranged in rows and columns in a common framework.

[0007] One drawback of these known devices is the fact that a relatively large spacing must be maintained between the holes in the piercing die so as to prevent the walls of the individual mattress blocks surrounding the holes becoming too thin, which would increase the risk of the blocks tearing open or breaking during the perforating of the mattress layer, with all the consequent inconveniences and drawbacks.

[0008] Another drawback of the fact that in the known devices the spacing between the holes must not be smaller than a predetermined value is that this requirement also imposes limitations as regards the spacing between the perforations in the mattress layer, as a result of which the possibilities of increasing the comfort of the person lying on the mattress and the moisture discharge of the mattress layer by reducing the spacing between the perforations are relatively limited.

[0009] A first aspect of the present invention is to provide a method and a device for forming a series of perforations in a mattress layer, in which perforations are formed in the mattress layer in such a manner that said perforations are spaced considerably more closely than has been possible so far in the prior art, and that without the reliability of operation of the device being affected.

[0010] Another aspect of the present invention is to provide an upper mattress which exhibits very favourable characteristics as regards the comfort of the person lying on the mattress and the moisture discharge.

[0011] Another aspect of the present invention is to provide a method and a device for forming a series of perforations in a mattress layer, in which an upper mattress is obtained whose closed cell structure is visible at the upper side and the lower side thereof.

[0012] The present invention as referred to in the introduction is characterized in that the piercing die is substantially composed of one or more solid die blocks, each provided with several holes.

[0013] An advantage of a device according to the invention is the fact that a piercing die comprising several holes in one and the same solid die block is much more robust than in the known devices, as a result of which the holes in the piercing die can be spaced relatively closely, making it possible when using such a device according to the invention to realise mattress layers provided with perforations which can be spaced relatively closely at need.

[0014] Special embodiments of the present invention will become apparent from the description of the Figures herein; said embodiments are furthermore defined in the subclaims.

[0015] Preferably, the holes extend all through the thickness of the piercing die, with the diameter of the holes increasing over at least part of the thickness of the piercing die, in the direction away from the punch. As a result, the parts being punched out of the mattress can easily be discharged from the holes in the piercing die.

[0016] It is furthermore in particular preferable for the holes extending from the side facing towards the punch to have a constant diameter in a first part of the thickness of the piercing die and a larger diameter in a second part of the thickness of the piercing die. Since the holes have a constant diameter over a particular thickness from the side where the punching operation takes place, the piercing die can readily absorb the forces that are transferred thereto during a punching operation. The parts that have been punched out of the mattress can subsequently be discharged from the mattress in the part having the larger diameter.

[0017] Preferably, the diameter of the holes on the side facing towards the punch ranges between 3 and 8 mm, in particular between 4 and 6 mm, so that a mattress is obtained which is quite comfortable in use. If a diameter of less than 3 mm is used, the holes that have been punched out of the mattress layer will hardly be visible from the upper side of the mattress. Due to the compressible nature of the mattress, the holes will close at the upper side, whilst they will remain visible to a certain extent at the bottom side. This phenomenon is caused by the fact that the holes in the mattress are conical in shape.

[0018] In a specific embodiment, it is desirable that after the diameter of the holes has been enlarged in a direction away from the piercing die, the holes further extend at a constant diameter in the remaining part of the thickness of the piercing die towards the side of the piercing die remote from the punch.

[0019] Preferably, the diameter of the holes on the side remote from the punch ranges between 8 and 12 mm. On the one hand sufficient space is thus obtained between a punched-out part of the mattress and the punching pins, and on the other hand a robust surface is obtained on the side of the piercing die remote from the punch.

[0020] In one preferred embodiment of the invention, the spacing between two adjacent rows and/or two adjacent columns of the holes in the piercing die of the die block is less than 20 mm, preferably it ranges between 12 and 13 mm. A narrow spacing between holes in a mattress, which can be achieved in this manner, provides a higher degree of comfort than a wider spacing between the holes.

[0021] Preferably, the punching pins are connected to the punch in such a manner as to be pivotable with respect to the punch, so that sudden forces will not lead to fracture of the punching pins.

[0022] Preferably, the free ends of the punching pins facing towards the piercing die are constructed in such a manner that the distance measured between the free ends of the punching pins and the corresponding holes in the piercing die is not constant. As a result, not all the pins move simultaneously into the corresponding die holes when the punch comprising the punching pins is moved in the direction of the piercing die, so that the force that must be exerted by the device during the punching operation is distributed over the contact surface between the punching pins and the die holes. As a result, the period during which a force must be exerted is prolonged, to be true, but the duration of the peak load is reduced.

[0023] The surface facing towards the punch of at least one of the die blocks is preferably recessed in relation to the surface facing towards the punch of at least one of the other die blocks. This is a simple and practical manner of ensuring that not all the punching pins move simultaneously into the corresponding holes, so that the forces are evenly distributed.

[0024] In another preferred embodiment of the invention, not all the punching pins have the same length. Such differences in length may occur within one and the same punch, or different lengths may be used for different punches. In this way, the same result as discussed in the preceding paragraph is obtained in a simple and practical manner. This aspect can also be applied in existing devices having flat piercing dies.

[0025] In yet another preferred embodiment of the invention, guide means are provided between points of attachment of the punching pins on the one hand and the piercing die on the other hand, through which guide means the punching pins extend so as to be guided into the associated holes when the punch is being moved in the direction of the piercing die. Said guide means ensure that the punching pins are directly exactly towards the corresponding holes, thus reducing the risk of damage or wear between a punching pin and a corresponding hole.

[0026] Preferably, the punching pins partially extend through the guide means. Since the punching pins are accommodated in the guide means, they reciprote through said guide means during operation of the de-

vice, as it were, so that they are prevented from making undesirable movements or, in an unfavourable situation, moving out of the guide means.

[0027] The method for forming a series of perforations in a mattress layer, using the present device, is characterized in that the method comprises the following steps:

i) providing a mattress layer of latex foam,
ii) passing the mattress layer obtained in step i) between the punch and the piercing die,
iii) moving punching pins in downward direction into the underlying holes of the piercing die, and
iv) moving the punch upwards again.

[0028] In a special embodiment, it is preferred to repeat steps ii)-iv) after completion of step iv), with steps iii)-iv) being carried out in specific zones of the mattress layer.

[0029] In order to obtain an optimum comfort of the person lying on the mattress and a satisfactory discharge of moisture, it is preferable to provide a mattress layer in step i) in which specific zones at the upper side of the upper surface of the mattress layer are profiled.

[0030] Preferably, the free ends of the punching pins do not all reach the associated opposite holes in the punching die simultaneously in step iii). This has the aforesaid advantage that the force that is to be exerted by the device is distributed over a certain period.

[0031] Furthermore, the free ends of the punching pins preferably extend at least into the portions of the holes having the larger diameter at the end of step iii). The parts of the mattress that have been punched out of the mattress are now pushed past the widened portions by the punching pins and can thus be easily discharged.

[0032] Preferably, the punching pins permanently extend through the guide means while the steps i)-iv) are being repeated. The advantages of this aspect have already been discussed above in the description of the guide means.

[0033] In one preferred embodiment of the invention, the perforations are formed in the mattress in a pattern of rows of perforations and/or columns of perforations, the spacing between two adjacent rows of perforations and/or columns of perforations being less than 20 mm, preferably it ranges between 12 and 13 mm. As already discussed before, this gives the user of the mattress a higher degree of comfort.

[0034] The improved upper mattress according to the present invention, which upper mattress is made of latex foam, is characterized in that the vulcanised layer of latex foam is provided with perforations in at least one zone of the upper surface thereof and with a profile in at least one zone of said upper surface.

[0035] Preferably, the aforesaid perforations are formed in zones near those parts of a user's body that secrete the most sweat, mainly the neck, the back and the thighs.

[0036] The advantage of this is that the body moisture can be discharge directly via the aforesaid perforations, which is achieved in part as a result of the changes in the user's position, which produced movements of air through the perforations, thus effecting a natural ventilation of the upper mattress.

[0037] The perforations thus prevent moisture remaining accumulated within the mattress too long, which might lead to fungoid growth and further unpleasant effects.

[0038] The profiles present in specific zones at the upper side of the upper layer of the mattress enhance the sleeping comfort of the user, because the mattress feels softer in said zones, depending on the shape and the dimensions of said profiles.

[0039] A suitable selection of the zones comprising perforations alternating with zones comprising profiles will lead to an upper mattress which meets each and every requirement of an exacting user as regards sleeping comfort. Special embodiments of the present upper mattress are defined in the subclaims.

[0040] In order to provide a better understanding of the invention, a preferred, non-limitative embodiment of a device according to the invention for perforating a mattress layer will be described hereinafter with reference to the accompanying drawings, in which:

Figure 1 is a schematic side elevation of a device according to the invention;
Figure 2 is a top plan view of Figure 1;
Figure 3 is a larger-scale sectional view along the line III-III in Figure 1;
Figure 4 shows the device of Figure 1, in another position thereof;
Figure 5 shows a variant of Figure 3;
Figure 6 is a schematic, perspective view of an improved upper mattress according to the invention in this simplest form thereof;
Figure 7 is a sectional view along the line II-II in Figure 6;
Figure 8 is a sectional view of a mattress used in combination with an improved upper mattress according to the invention;
Figure 9 is a sectional view similar to the view of Figure 8, in this case during use of the mattress, however;
Figure 10 shows an embodiment of a mattress according to Figure 8;
Figure 11 is a larger-scale view of the part indicated at F6 in Figure 10;
Figures 12a and 12b are a cross-sectional view and a top plan view, respectively, of a piercing die according to the invention;
Figure 13 shows a sectional view and top plan view of a piercing die according to the invention comprising a recessed die block;
Figure 14 is a side elevation of a punching block comprising punching pins of unequal length; and

Figure 15 is a cross-sectional view of punching pins extending into the holes of the piercing die.

[0041] Figures 1-4 show a device according to the invention, which mainly consists of a table 1 having upright side edges 2; a driving mechanism 3 in the form of two rollers 4 and 5, respectively, which are arranged in spaced-apart relationship a certain distance above the top of the table 1, and which are mounted in supports 6-7 positioned opposite each other on either side of the table 1, the roller 5 being driven by a motor 8; a punching device 9, which is positioned near a transverse recess 10 in the table 1 between the aforesaid rollers 4-5, and which extends across the width of the table 1; and a cutting device 11, which is disposed some distance away from the roller 5 at the location of a second transverse recess in the table 1.

[0042] The punching device 9 mainly consists of a stand 12; a punch 14 suspended from said stand 12 by means of a hydraulic or motor-driven cylinder 13, which punch is provided with a series of punching pins 15 arranged in a specific matrix pattern, and a piercing die 16 positioned opposite said punch 14, which is attached to said stand by means of a framework 17, in such a manner that the upper surface of the piercing guide 16 lies in the same plane as the upper surface of the top of the table 1.

[0043] According to the invention, the piercing die 16 is made of one solid die block 18 in this case, in a special embodiment five such solid die blocks may be used, each provided with several holes 19 in line with the aforesaid punching pins 15, more specifically in the same matrix pattern as the punching pins 15, comprising a relatively small number of rows 20 extending across the width of the table 1 and a relatively large number of columns 21 extending in the longitudinal direction of the table 1.

[0044] The operation and the use of the device according to the invention, which are very simple, are as follows.

[0045] In the illustrated embodiment, the device is disposed at the end of the production line for manufacturing a continuous mattress layer 22 of latex foam or the like, in which, as is shown in Figures 1 and 2, the mattress layer 22 is moved over the table 1 between the punch 14 and the piercing die 16 by the driving mechanism 3, more in particular by the driven roller 5.

[0046] The motor 8 of the driven roller 5 is stopped temporarily each time a series of perforations 23 is to be provided in said continuous mattress layer 22, so that the mattress layer is held in a fixed position, after which, as is shown in Figure 4, the cylinder 13 of the punching device 9 is driven to move the punching pins 15 downwards into the underlying holes 19 of the piercing die 16, so that the punching pins 15 are driven through the mattress layer 22 in a manner which is known.

[0047] As a result of the arrangement of the punching pins 15 and the holes 19 in a matrix, single rows of perforations 23 extending across the width of the mattress layer 22 are formed in a relatively narrow strip of the mattress layer 22 in question with each stroke.

[0048] After such a strip has been punched, the punch 14 is moved upwards again, after which the mattress layer 22 is moved a suitable distance ahead over the table 1 by means of the driving mechanism 3 and the punch 14 is moved downwards again in order for a next strip to be punched.

[0049] In this way the continuous mattress layer 22 is provided with perforations 23 strip after strip in a semi-continuous process.

[0050] Pieces 24 of the perforated mattress layer 22 are cut to the desired length by means of the aforesaid cutting device 11, which pieces 24 can subsequently be used in the production process for composing mattresses.

[0051] An important advantage of the fact that the piercing die 16 is made of one solid die block 18 is that this makes it possible to space the holes 19 of the piercing die 16 relatively closely, as a result of which perforations 23 arranged in a relatively dense matrix pattern can be realised with one single punching movement, which may be advantageous in particular cases in connection with the comfort of a person lying on a mattress provided with such a piece of perforated mattress layer 24.

[0052] When the punching pins 15 are connected to the punch 14 in such a manner as to be pivotable with respect to the punch 14, with the punching pins 15 extending through guides (not shown) in the direction of the mattress layer 22 and the piercing die 16, the punching pins 15 and the holes 19 in the piercing die 16 can be spaced even more closely.

[0053] Although the pieces of mattress layer 24 are shown to be provided with perforations 23 over the entire surface thereof in the Figures, it is quite possible to provide such pieces of mattress layer 24 with perforations only in specific zones in alternative embodiments, with zones provided with perforations and zones not provided with perforations arranged in alternating relationship, in which case the punch 14 and the piercing die 16 do not necessarily have to extend across the entire widh of the mattress layer 22 to be perforated. Preferably, however, the piercing die 16 will extend across the entire width of the zone of the mattress layer 22 that is to be perforated.

[0054] Figure 5 shows a variant of a piercing die 16 according to the invention, in which the piercing die 16 is composed of several solid die blocks 18, each provided with holes 19 arranged in a matrix comprising several rows and columns of holes, which are arranged side-by-side in a continuous row in a common framework 17.

[0055] If the piercing die 16 as shown in Figures 5 and 13 is composed of several massive die blocks 18, it is possible to position a die block 18' with the surface facing towards the punch 14 in a recessed position. The punching pins 14 will all come into contact with the mat-

tress layer 22 simultaneously in that case, to be true, but because not all the punching pins 15 move into the corresponding holes 19 simultaneously, the force to be exerted by the punch 15 is distributed over time, as a result of which the peak load for the device is reduced.

[0056] Another possibility of achieving this is shown in Figure 14. Said figure shows a punch 14' fitted with punching pins 15' that vary in length. As a result, the various punching pins 15' not only enter the holes 19' of the piercing die 16' at different points in time, but they also come into contact with the piercing die at different points in time. The effect that is achieved in this manner is comparable with the embodiment of Figure 15.

[0057] It will be understood that a piercing die 16 according to the invention may also be composed of die blocks 18 comprising several aligned holes 19, which may form part of a respective row or column of the matrix pattern of the piercing die 16.

[0058] Figures 12a and 12b show special embodiments of a piercing die 16, in which the diameter A of the holes 19' on the side facing towards the punch 14 is smaller than the diameter B of the holes on the side remote from the punch 14. In this special embodiment, a hole 19' first extends over a distance X from the upper side of the piercing die 16 that faces towards the punch, over which distance X the diameter remains constant, viz. A. Subsequently, the diameter of the hole 19' increases over a distance Y in the direction of the side of the piercing die 16 remote from the punch 14. Finally, the hole 19' extends over a distance Z up to the side of the piercing die 16 remote from the punch 14, over which distance the diameter of the hole 19' remains the same, viz. B. The values of A and B may vary from 4-6 and from 8-12 mm, respectively. Also the values of X, Y and Z may vary. The advantage of using holes 19' having a shape as described above is that mattress material that has been punched through the upper side of the die 16 can exit the hole in the die without getting stuck between the walls of the hole 19'. Figures 12a and 12b furthermore show the spacing between two rows and between two columns c and d, respectively, which is 12.5 mm in this case.

[0059] Figure 15 finally shows the situation in which the punching pins 15 are in their lowermost position in the corresponding holes 19 of the piercing die 16. The figure clearly shows that the punching pins extending to within the widened portion of the holes 19, as a result of which mattress material that has been punched out of the mattress by the punching pins 15 via the upper side of the holes 19 can exit the die 16 without getting stuck inside the holes 19.

[0060] Figures 6 and 7 schematically show an improved upper mattress according to the invention in the simplest form thereof.

[0061] In this embodiment, the layer 1 is a rectangular layer of latex foam having a specific thickness. The upper surface 2 of the layer 1 is provided with profiles 4 in particular zones 3, for example in the form of corrugations extending in the crosswise direction of the layer 1, over the entire width thereof, with perforations 6 being provided in the intermediate zones 5, which perforations form a connection between the upper surface 2 and the lower surface 7 of the layer 1, with the zones 3 and the zones 5 thus alternating in the longitudinal direction of the mattress.

[0062] Figures 8 and 9 show an embodiment of a mattress, in this case consisting of two layers arranged one on top of the other, viz. an improved upper mattress or layer 1 of latex foam as described above, and a full lower layer 8.

[0063] Figure 9 clearly shows that the zones 2 provided with perforations 6 are located near those parts of a user's body 9 where the user secretes the most sweat, viz. the neck 10, the back 11 and the thighs 12. At these locations the bodily fluid is indeed directly discharged in downward direction through the perforations 6, so that the latex foam layer 1 that is in contact with the user's body 9 will remain dry at all times, and consequently will not be affected by fungoid growth or the like.

[0064] The varying thickness of the layer 1 in the profiles zones 3 makes the mattress feel softer or harder in said zones 3, as desired, depending on the shape and the dimensions of the corrugations.

[0065] Figures 10 and 11 show a variant of an embodiment of a mattress in which, in this case, the improved upper mattress or layer 1 of latex foam is arranged on top of an elastic lower layer 13 composed of spring elements 14 arranged in side-by-side relationship, for example in the form of metal coil springs, elastic elements of plastic material or the like, in which case a protective layer 15, for example in the form of a mattress ticking made of a layer of a textile such as felt, jute or the like, is preferably arranged between the layer 1 of latex foam and the lower layer 13.

[0066] The present invention is by no means limited to the embodiments described and shown herein by way of example; an improved upper mattress according to the invention can be realised in various forms and dimensions without departing from the scope of the invention.

Claims

1. A device for forming a series of perforations in a mattress layer, which device at least comprises a punch (14) with punching pins (15) arranged in a specific matrix pattern and positioned opposite a piercing die (16) with holes (19) arranged in rows (20) and columns (21) according to the same matrix pattern, in line with the aforesaid punching pins (15), wherein the diameter of the holes (19) on the side facing towards the piercing die (16) is larger than the diameter of the punching pins (15), **characterized in that** the piercing die (16) is substantially composed of one or more solid die blocks (18),

each provided with several holes (19).

2. A device according to claim 1, **characterized in that** each die block (18) comprises a matrix of holes (19) comprising several rows (20) and columns (21).

3. A device according to claim 1 or 2, **characterized in that** the piercing die (16) is composed of two or more die blocks (18).

4. A device according to any one or more of the preceding claims, **characterized in that** the piercing die (16) extends across the entire width of the zone of the mattress layer (22) that is to be perforated.

5. A device according to any one or more of the preceding claims, **characterized in that** the holes (19) extend all through the thickness of the piercing die (16), with the diameter of the holes (19) increasing over at least part of the thickness of the piercing die (16), in the direction away from the punch (14).

6. A device according to claim 5, **characterized in that** the holes (19) extending from the side facing towards the punch (14) have a constant diameter in a first part of the thickness of the piercing die (16) and a larger diameter in a second part of the thickness of the piercing die (16).

7. A device according to claim 6, **characterized in that** the diameter of the holes (19) on the side facing towards the punch (14) ranges between 3 and 8 mm.

8. A device according to claim 6 or 7, **characterized in that** after the diameter of the holes (19) has been enlarged in a direction away from the piercing die (16), the holes (19) further extend at a constant diameter in the remaining part of the thickness of the piercing die (16) towards the side of the piercing die (16) remote from the punch (14).

9. A device according to claim 8, **characterized in that** the diameter of the holes (19) on the side remote from the punch (14) ranges between 8 and 12 mm

10. A device according to any one or more of the preceding claims, **characterized in that** the spacing between two adjacent rows (10) and/or two adjacent columns (21) is less than 20 mm.

11. A device according to claim 10, **characterized in that** the spacing between two adjacent rows (20) and/or two adjacent columns (21) ranges between 12 and 13 mm.

12. A device according to any one or more of the preceding claims, **characterized in that** the punching pins (15) are connected to the punch (14) in such a manner as to be pivotable with respect to the punch (14).

13. A device according to any one or more of the preceding claims, **characterized in that** the punching pins (15) comprise free ends facing towards the piercing die (16), wherein the distance measured between the free ends of the punching pins (15) and the corresponding holes (19) in the piercing die (16) is not constant.

14. A device according to claim 13, **characterized in that** the surface facing towards the punch (14) of at least one of the die blocks (19) is recessed in relation to the surface facing towards the punch (14) of at least one of the other die blocks (19).

15. A device according to any one or more of the preceding claims, **characterized in that** not all the punching pins (15) have the same length.

16. A device according to any one or more of the preceding claims, **characterized in that** guide means are provided between points of attachment of the punching pins (14) on the one hand and the piercing die (16) on the other hand, through which guide means the punching pins (15) extend so as to be guided into the associated holes (19) when the punch (14) is being moved in the direction of the piercing die (16).

17. A device according to claim 14, **characterized in that** the punching pins (15) partially extend through the guide means.

18. A method for forming a series of perforations in a mattress layer, using a device as defined in any one or more of the preceding claims, **characterized in that** the method comprises the following steps:

i) providing a mattress layer of latex foam,
ii) passing the mattress layer obtained in step i) between the punch (14) and the piercing die (16),
iii) moving punching pins (15) in downward direction into the underlying holes (19) of the piercing die (16), and
iv) moving the punch (14) upwards again.

19. A method according to claim 18, **characterized in that** steps ii)-iv) are repeated after completion of step iv).

20. A method according to any one or more of the claims 18 and 19, **characterized in that** steps iii)-

iv) are carried out in specific zones of the mattress layer.

21. A method according to any one or more of the preceding claims 18-20, **characterized in that** a mattress layer is provided in step i) in which specific zones at the upper side of the upper surface (2) of the mattress layer are provided with a profile (4).

22. A method according to any one or more of the preceding claims 18-21, **characterized in that** the free ends of the punching pins (15) do not all reach the associated opposite holes (19) in the punching die (16) simultaneously in step iii).

23. A method according to any one or more of the preceding claims 18-22, insofar as being dependent on any one of the claims 4-17, **characterized in that** the free ends of the punching pins (15) extend at least into the portions of the holes (19) having the larger diameter at the end of step iii).

24. A method according to any one or more of the preceding claims 18-23, insofar as being dependent on claim 16 or 17, **characterized in that** the punching pins (15) permanently extend through the guide means while the steps i)-iv) are being repeated.

25. An upper mattress obtained by carrying out the method as defined in any one or more of the claims 18-24.

26. An upper mattress according to claim 25, **characterized in that** the perforations in the mattress are arranged in a pattern of rows of perforations and/or columns of perforations, the spacing between two adjacent rows of perforations and/or columns of perforations being less than 20 mm.

27. An upper mattress according to claim 26, **characterized in that** the spacing between two adjacent rows of perforations and/or columns of perforations ranges between 12 and 13 mm.

28. An upper mattress made of latex foam, **characterized in that** the vulcanised layer (1) of latex foam is provided with perforations (6) in at least one zone (5) of the upper surface (2) thereof and with a profile (4) in at least one zone (3) of said upper surface (2).

29. An upper mattress according to claim 28, **characterized in that** said zones (3-5) extend across the width of the mattress and **in that** the zones (5) provided with perforations (6) and the zones (3) provided with a profile (4) alternate in the longitudinal direction.

30. An upper mattress according to claim 29, **characterized in that** the zones (5) provided with perforations (6) are located near those parts of a user's body (9) that secrete the most sweat, in particular the neck (10), the back (11) and the thighs (12).

31. An upper mattress according to any one or more of the preceding claims 25-30, **characterized in that** said profile (4) is in the form of a pattern of corrugations.

32. An upper mattress according to claim 31, **characterized in that** the corrugations of said pattern of corrugations extend in the crosswise direction of the mattress.

33. An upper mattress according to any one or more of the claims 25-32, **characterized in that** the upper mattress has a closed cell structure along the upper surface (2) and the lower surface (7) thereof.

34. Use of an upper mattress according to any one or more of the claims 25-33 on a spring construction.

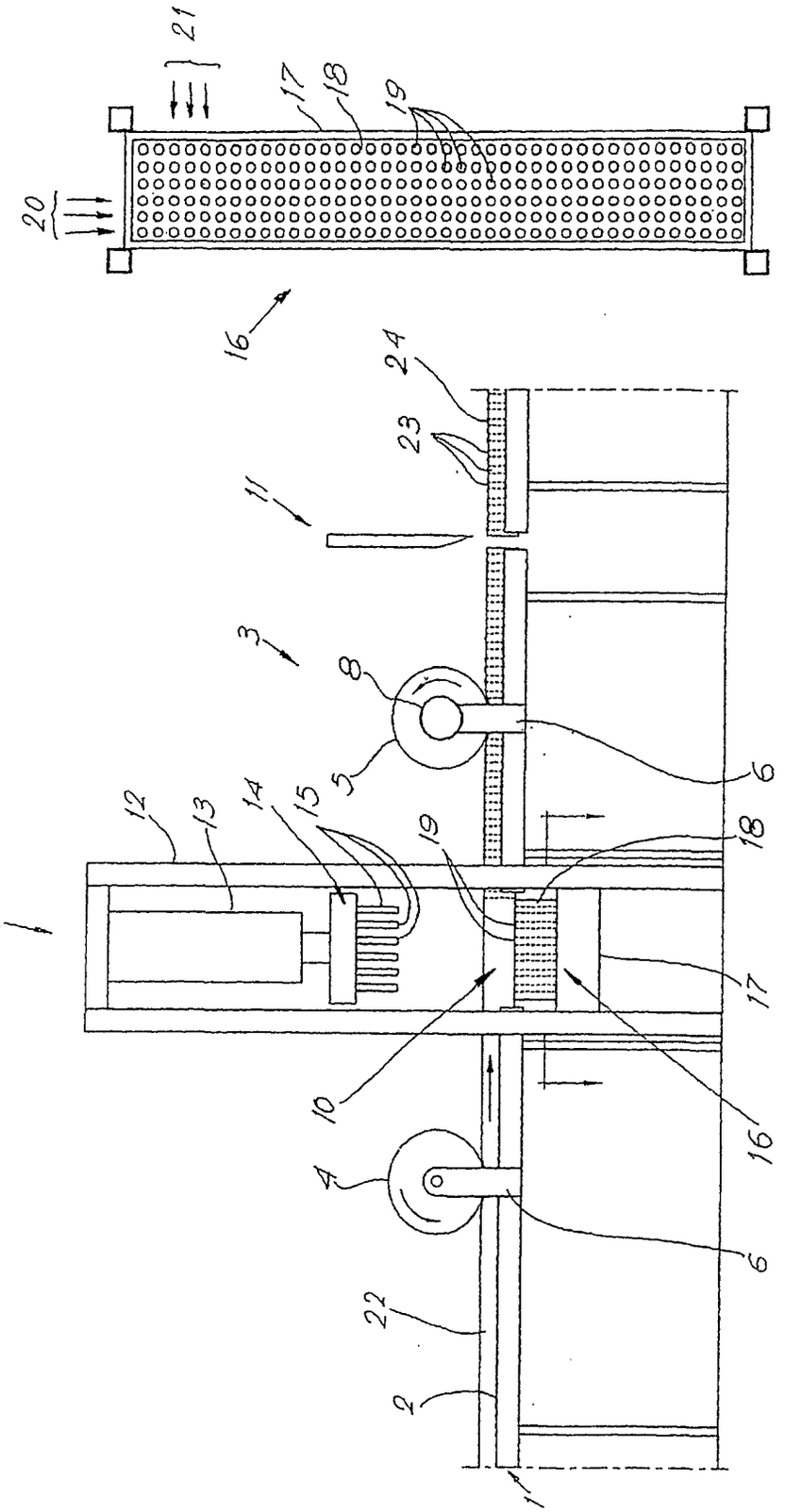

Fig. 3

Fig. 1

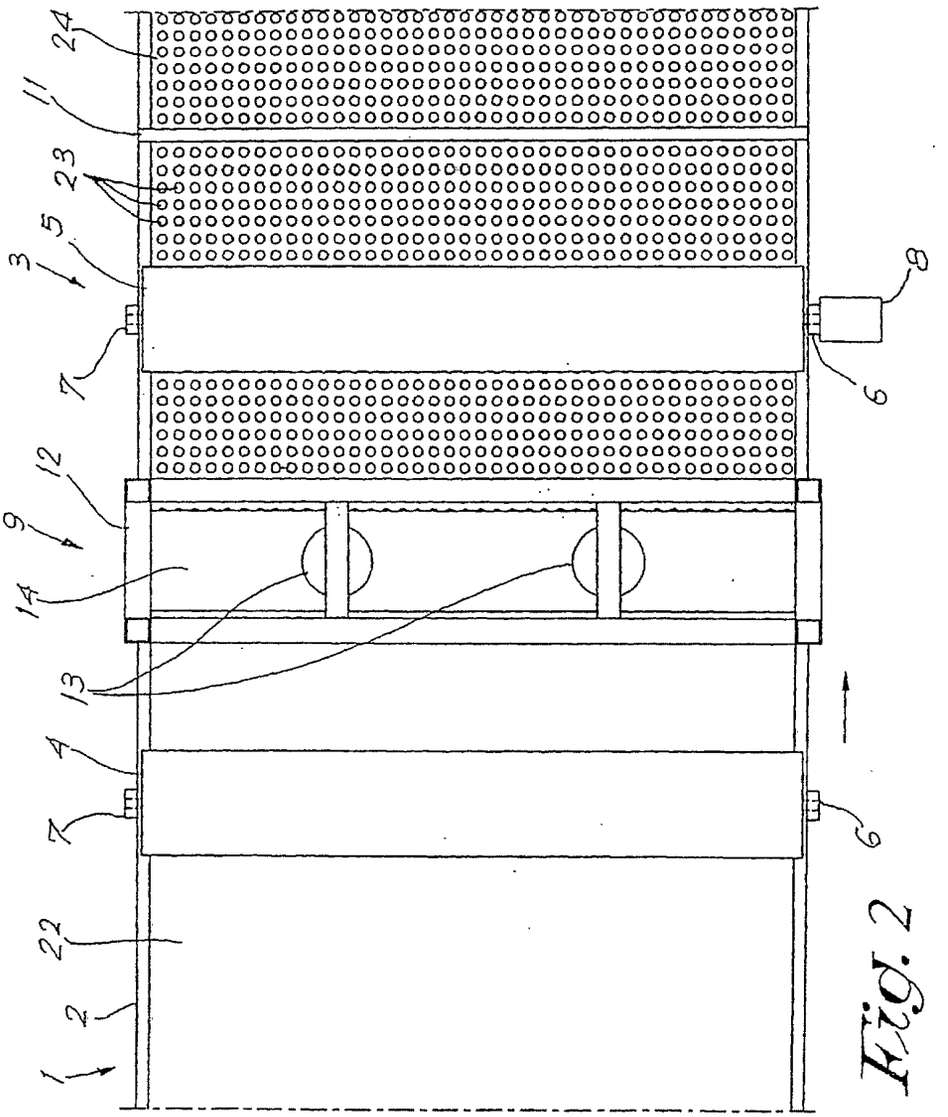

Fig. 2

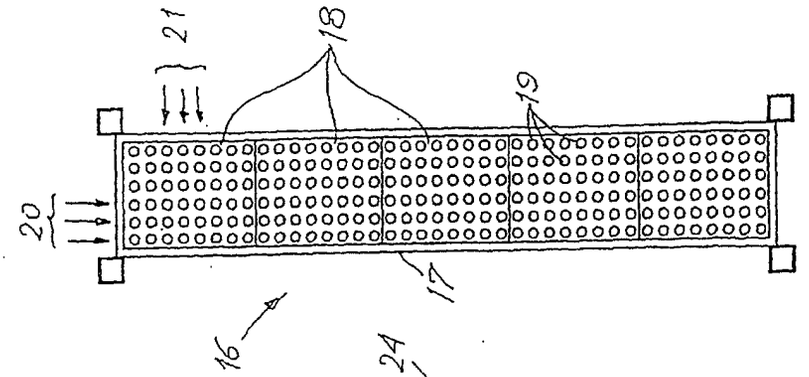

Fig. 5

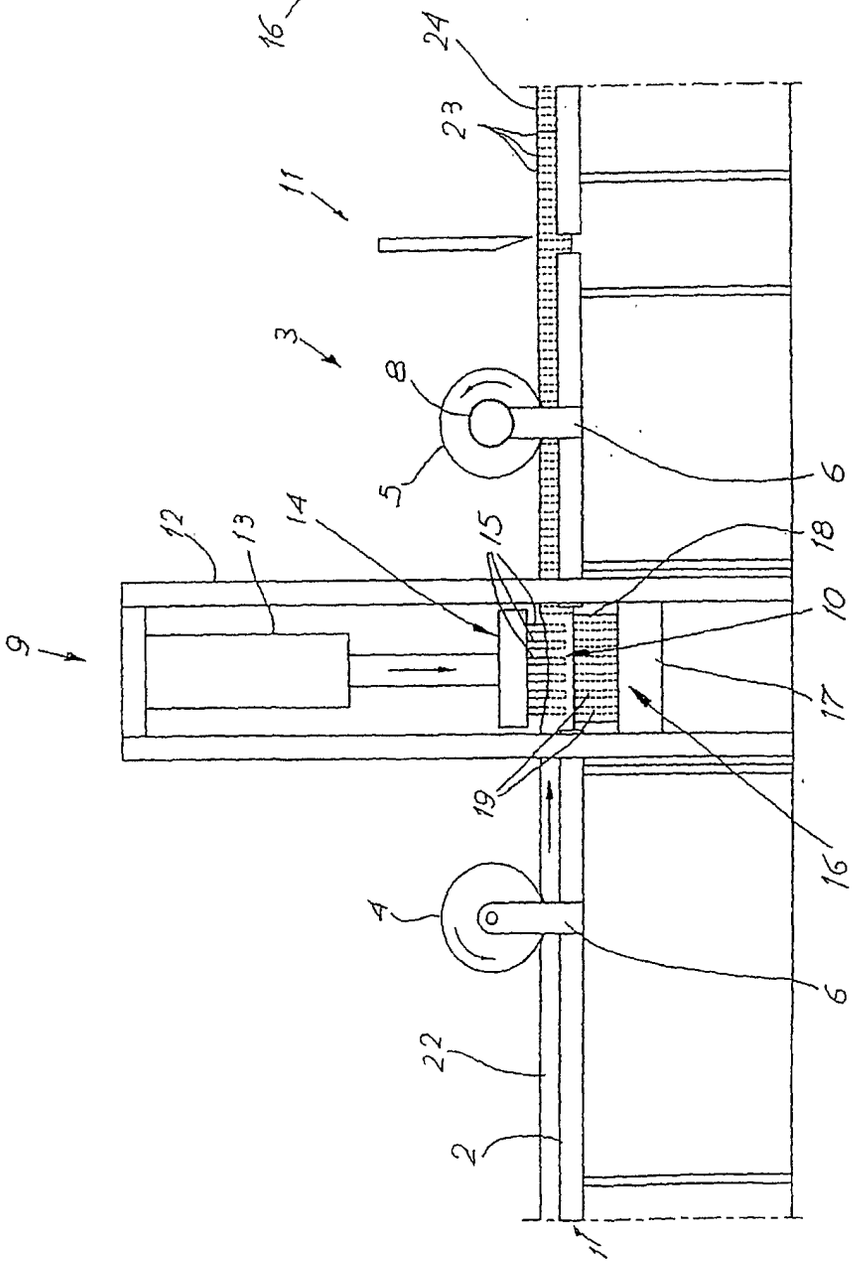

Fig. 4

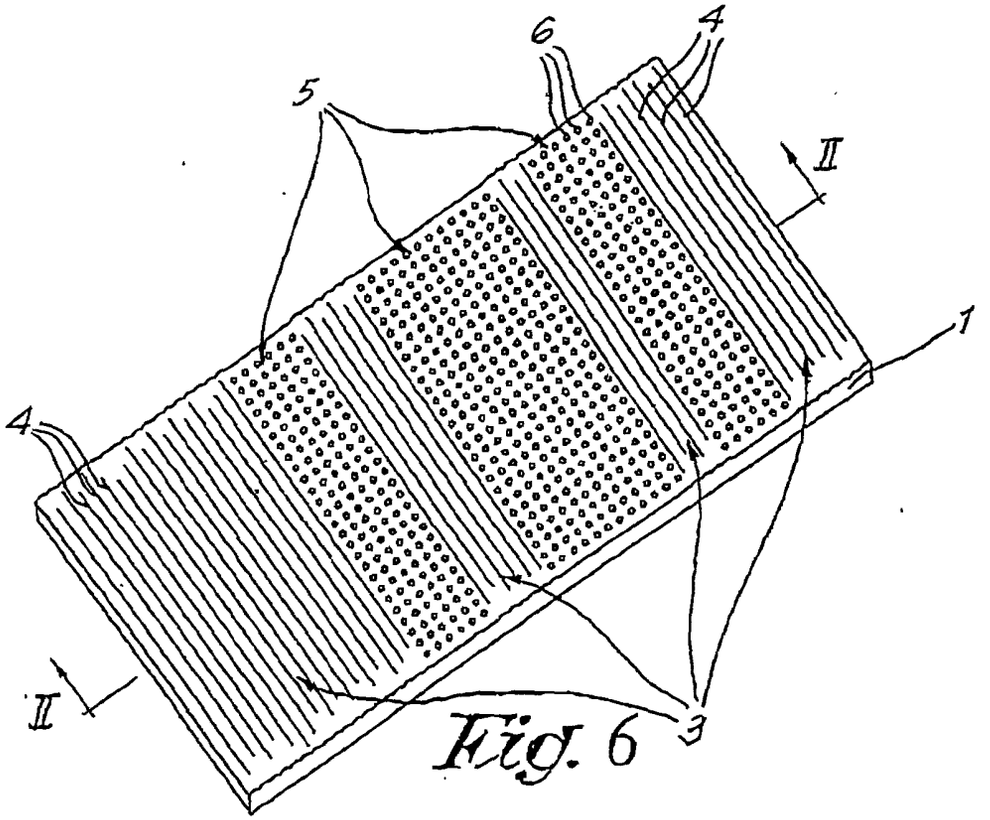

Fig. 6

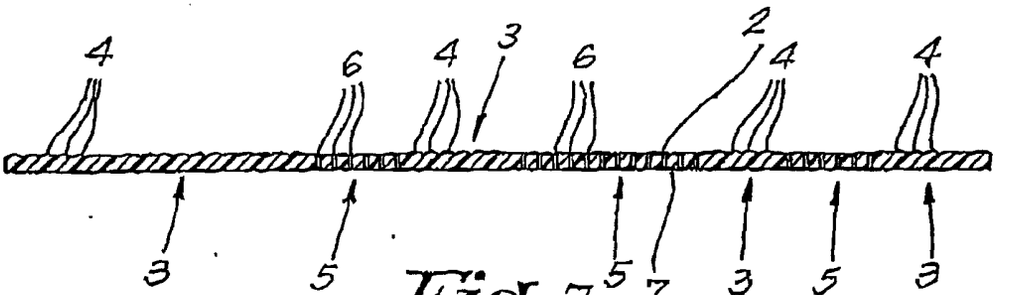

Fig. 7

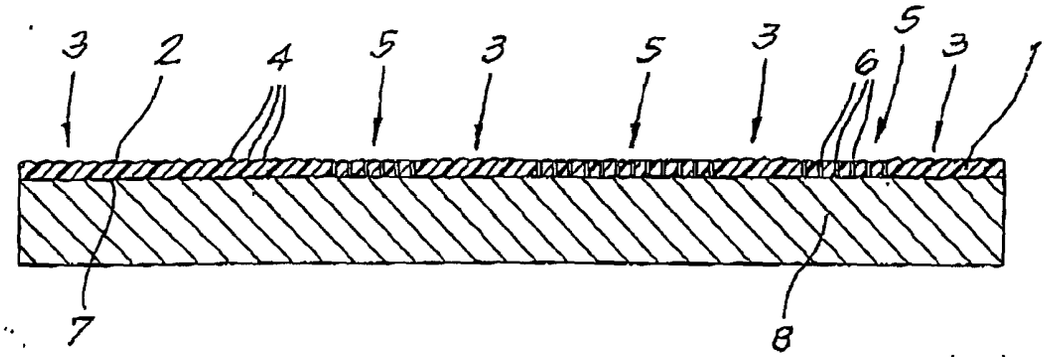

Fig. 8

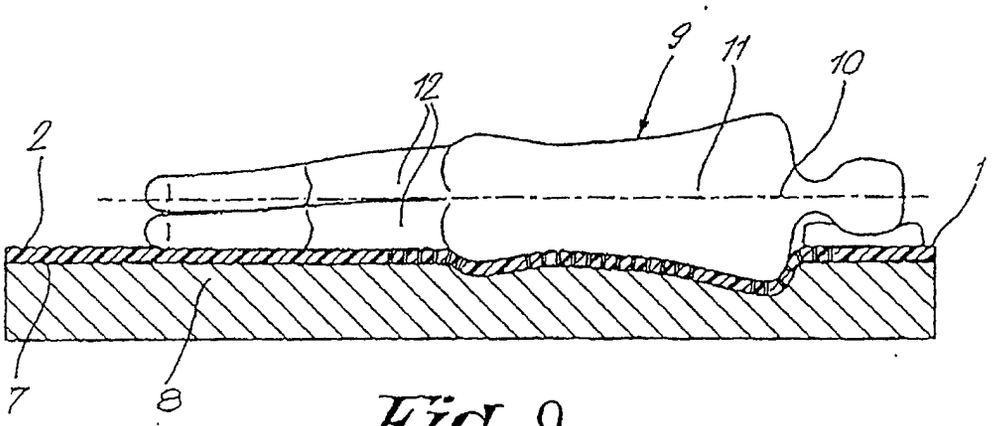

Fig. 9

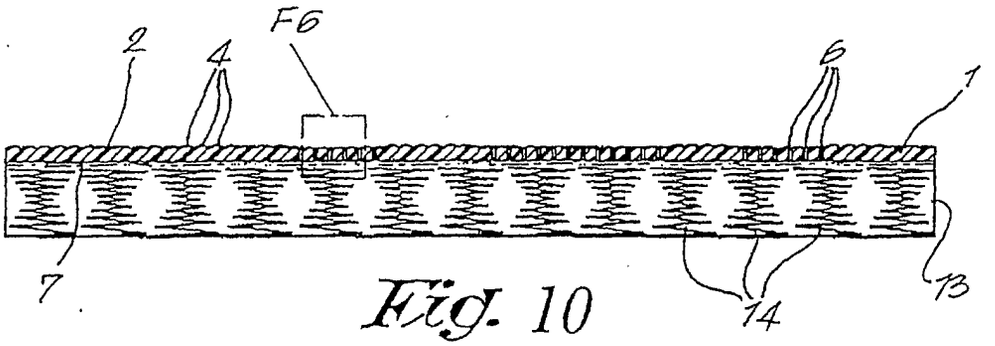

Fig. 10

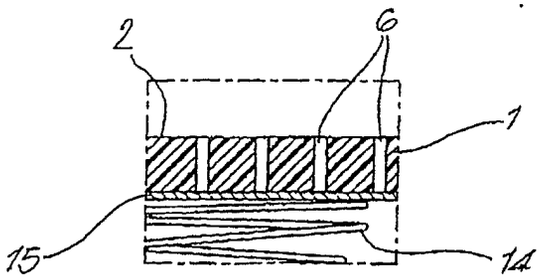

Fig. 11

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 04 07 5204

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X	WO 87/00118 A (B J SYSTEM RANDERS APS) 15 January 1987 (1987-01-15) * page 3, line 24 - page 7, line 3; figures 1-4 *	1,2,4, 18,25,34	A47C27/14 A47C27/00 B26D7/26 B26F1/00 B26F1/14
X Y	US 3 217 547 A (GUSTAFSON WAYNE F ET AL) 16 November 1965 (1965-11-16) * column 6, lines 56-60; figures 1-5 *	1,2,4 3	
Y	EP 0 993 885 A (NGK INSULATORS LTD) 19 April 2000 (2000-04-19) * column 6, lines 46-54; figure 2 *	3	
Y	DE 456 441 C (EMIL KAHLE FA) 19 June 1930 (1930-06-19) * the whole document *	3	
Y A	US 3 407 691 A (SCHLESINGER WILLIAM A) 29 October 1968 (1968-10-29) * column 5, line 11 - column 7, line 22; figures 1-6 *	3 13,15,16	
A	GB 522 558 A (WILLIAM YULLE BARCLAY; JAMES ARTHUR BARCLAY) 20 June 1940 (1940-06-20) * page 2, line 55 - page 3, line 130; figures 1-5 *	16,18-20	TECHNICAL FIELDS SEARCHED (Int.Cl.7) B26F B26D A47C
Y	DE 34 10 603 A (GEHRING ALEXANDER E) 26 September 1985 (1985-09-26) * page 8, line 8 - page 9, line 13; figures 1,2 *	28-31	
Y	US 5 327 597 A (ROTHBARD MICHAEL) 12 July 1994 (1994-07-12) * column 3, line 29 - column 4, line 58; figures 1-7 *	28-31	

-/--

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	23 June 2004	Vollering, J

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 04 07 5204

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
A	WO 02/21976 A (SEIDL UDO ; OMASI ANSTALT (LI)) 21 March 2002 (2002-03-21) * page 17, line 10 - page 20, line 27; figures 1-9 *	32	
A	US 4 357 725 A (AHLM LARS G W) 9 November 1982 (1982-11-09) * column 1, line 32 - column 2, line 65; figure 1 *	33	
A	US 6 041 459 A (NUNEZ ANTONIO ET AL) 28 March 2000 (2000-03-28) * figure 1 *	34	
A	EP 0 545 374 A (LUECK WERNER) 9 June 1993 (1993-06-09) * the whole document *	1	
A	DE 655 320 C (JAROSLAW S ERSTE GLIMMERWAREN) 14 January 1938 (1938-01-14) * figures 7,8 *	5	
A	DE 297 02 699 U (TRUMPF GMBH & CO) 10 April 1997 (1997-04-10) * figures 1-10 *	6	TECHNICAL FIELDS SEARCHED (Int.Cl.7)
A	US 4 273 015 A (JOHNSON DONALD R) 16 June 1981 (1981-06-16) * figure 3 *	8,12,13	
A	US 5 471 901 A (NISHIYA YUICHI ET AL) 5 December 1995 (1995-12-05) * column 4, line 60 - column 8, line 58; figures 1-11 *	8,12,16	
A	US 6 334 280 B1 (FRAPPART ETIENNE ET AL) 1 January 2002 (2002-01-01) * columns 3-4; figures 1-4 *	16	

-/--

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	23 June 2004	Vollering, J

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 04 07 5204

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
A	US 3 477 317 A (LIANDER LEONARD E) 11 November 1969 (1969-11-11) * column 2, line 25 - column 4, line 18; figures 1-3 *	16	

TECHNICAL FIELDS SEARCHED (Int.Cl.7)

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	23 June 2004	Vollering, J

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 04 07 5204

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

23-06-2004

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 8700118 A	15-01-1987	DK 288185 A	26-12-1986
		AU 5993686 A	30-01-1987
		WO 8700118 A1	15-01-1987
		EP 0229091 A1	22-07-1987
US 3217547 A	16-11-1965	NONE	
EP 0993885 A	19-04-2000	JP 2000094398 A	04-04-2000
		DE 69904134 D1	09-01-2003
		DE 69904134 T2	10-07-2003
		EP 0993885 A1	19-04-2000
		US 2002129677 A1	19-09-2002
		US 6408728 B1	25-06-2002
DE 456441 C	19-06-1930	NONE	
US 3407691 A	29-10-1968	FR 1526431 A	24-05-1968
		DE 1561491 A1	12-02-1970
		GB 1128725 A	02-10-1968
GB 522558 A	20-06-1940	NONE	
DE 3410603 A	26-09-1985	DE 3410603 A1	26-09-1985
US 5327597 A	12-07-1994	NONE	
WO 0221976 A	21-03-2002	DE 10046457 A1	18-04-2002
		AU 9186701 A	26-03-2002
		WO 0221976 A1	21-03-2002
US 4357725 A	09-11-1982	SE 423304 B	03-05-1982
		DE 3000489 A1	24-07-1980
		DK 10180 A	11-07-1980
		FI 800069 A	11-07-1980
		FR 2446091 A1	08-08-1980
		GB 2045073 A ,B	29-10-1980
		NL 8000051 A	14-07-1980
		NO 794304 A	11-07-1980
		SE 7900237 A	11-07-1980
US 6041459 A	28-03-2000	NONE	
EP 0545374 A	09-06-1993	DE 9202731 U1	09-07-1992
		AT 142446 T	15-09-1996
		DE 59207120 D1	17-10-1996
		EP 0545374 A1	09-06-1993

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 04 07 5204

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

23-06-2004

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0545374 A		ES 2094268 T3	16-01-1997
DE 655320 C	14-01-1938	NONE	
DE 29702699 U	10-04-1997	DE 29702699 U1	10-04-1997
US 4273015 A	16-06-1981	NONE	
US 5471901 A	05-12-1995	JP 6034818 U	10-05-1994
		DE 4334417 A1	14-04-1994
		KR 134168 B1	15-06-1998
US 6334280 B1	01-01-2002	AT 217666 T	15-06-2002
		AU 728866 B2	18-01-2001
		AU 1800897 A	28-08-1997
		BR 9707390 A	04-01-2000
		CA 2246245 A1	14-08-1997
		CZ 9802494 A3	14-04-1999
		DE 69712601 D1	20-06-2002
		DE 69712601 T2	02-01-2003
		DK 879327 T3	09-09-2002
		EP 0879327 A1	25-11-1998
		ES 2176678 T3	01-12-2002
		WO 9729254 A1	14-08-1997
		GB 2309985 A ,B	13-08-1997
		HU 9900793 A2	28-07-1999
		ID 17684 A	22-01-1998
		JP 2000504797 T	18-04-2000
		NO 983621 A	08-10-1998
		NZ 331239 A	28-02-2000
		PL 328408 A1	18-01-1999
		SK 107398 A3	12-07-1999
		TW 401474 B	11-08-2000
		ZA 9700970 A	08-08-1997
US 3477317 A	11-11-1969	NONE	

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82