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(54) Therapeutic, self-inflating mattress

(57) A therapeutic, self-inflating mattress (1) of reticulated, open-cell foam comprises an airtight and watertight surface coating (5a, 5b) and equipped with at least one valve (4a, 4b). The mattress (1) comprises two superimposed layers (2, 3) of reticulated open-cell foam with an adhesive layer (6) between them, a bottom layer (3) of high resilience (HR) foam and a top layer (2) of visco-elastic foam, the two-layer assembly being covered with at least one film or coating of a polymer binder covering the entire outer surface of said two-layer assembly except in the vicinity of the at least one valve.

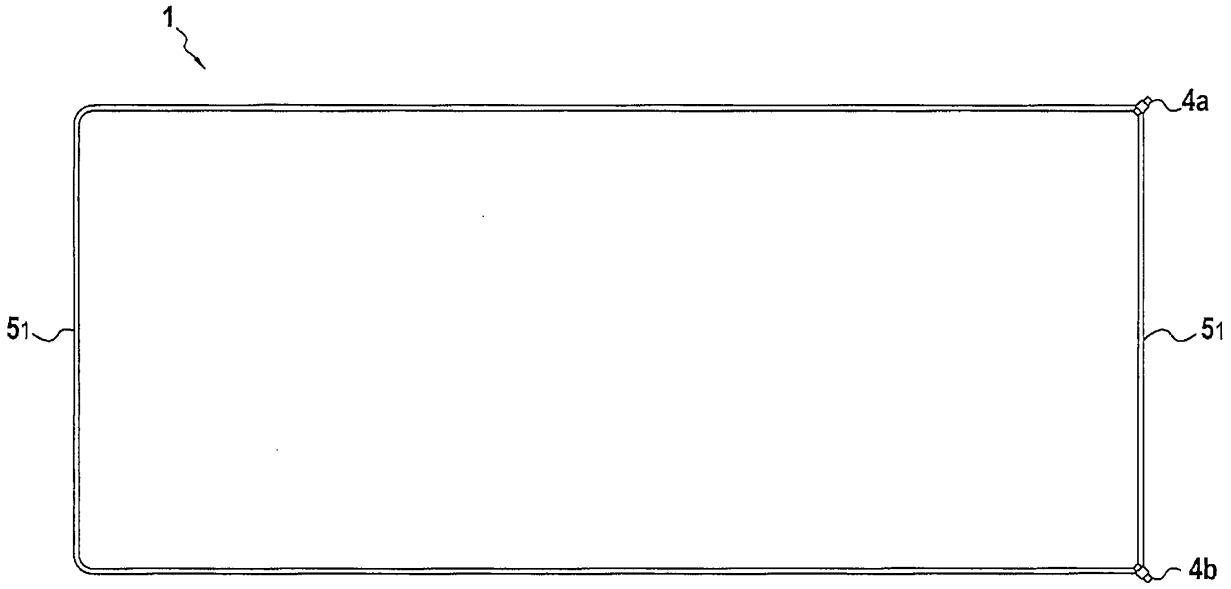

FIG.1

EP 2 198 822 A1

Description

[0001] This invention relates to the field of support devices such as mattresses or cushions for supporting the body of a seated or reclining person, and more particularly to foam support devices such as therapeutic mattresses or cushions for supporting the body of a patient and reducing the risk of bedsores.

[0002] Support devices of the aforesaid type are typically used as mattress pads in patient care, since they ensure an adequate distribution of interface pressures, i.e., the pressures exerted locally by each part of the body on the surface of the mattress, depending on the shape and position of patients, thereby preventing or reducing the risks of decubitus ulcers forming in the risk zones of the body, such as the sacrum and the heels.

[0003] In particular, the invention relates to a self-inflating, impermeable foam mattress pad on which a person can recline and be supported with optimum comfort. These self-inflating or self-inflatable mattresses are composed of reticulated, open-cell foam. They possess the interesting characteristic of being compactable for ease in transport and of automatically inflating simply by opening valves on the mattress pad and decompressing the foam, which thus fills with air as it resumes its original shape.

[0004] Self-inflating foam mattresses and mattress pads made exclusively of high resilience polyurethane foam are known to the prior art. These mattress have a thickness greater than 5 cm and are mainly used in camping.

[0005] A foam is classified as a high resilience foam if the comfort factor c, as determined in an indentation force deflection test, is greater than 2.5, the comfort factor c being the ratio of the indentation obtained at 65% compression to the indentation obtained at 25% compression. The indentation force deflection test is described further below.

[0006] A self-inflating mattress pad for reducing the formation of bedsores and local interface pressures and for ensuring a more uniform distribution of interface pressures of the patient on the mattress is known to the prior art; said mattress or mattress pad contains only a visco-elastic polyurethane foam.

[0007] A foam is defined as visco-elastic by virtue of its rheological properties combining "elasticity," wherein the foam exhibits a nearly instantaneous, spring-like response after subjection to pressure, and "viscosity," wherein the foam exhibits a delayed response like a shock absorber after a compressive force is exerted thereon, whereas a typical foam, as a general rule, only exhibits an "elastic" response.

[0008] Such a visco-elastic foam mattress pad as described in the prior art adapts itself to patients by distributing the body weight more efficiently, i.e., homogeneously, and by limiting the overall surface pressures. In turn, as mentioned previously, these self-inflating visco-elastic foam mattress pads ensure a much better interface pressure distribution than self-inflating products made of high resilience polyurethane foam.

[0009] In terms of therapeutic use, particularly in terms of reducing the formation of bedsores, these self-inflating visco-elastic foam mattresses or mattress pads have the advantage of being able to support a relatively heavy patient with relatively less foam compared with an ordinary foam mattress.

[0010] However, a disadvantage resides in these mattress pads in that on one hand they are relatively heavy and less easy to handle, and on the other hand they are more expensive than high resilience foam mattresses.

[0011] This invention provides a therapeutic, self-inflating, reticulated open-cell foam mattress comprising an airtight and watertight surface coating and equipped with at least one valve, **characterized in that** the mattress comprises two superimposed layers of reticulated open-cell foam adhered to each other, consisting of a bottom layer of high resilience foam and a top layer of visco-elastic foam, the two-layer assembly being covered with a least one film or coating of a polymer binder covering the entire outer surface of said two-layer assembly except in the vicinity of at least one valve.

[0012] The mattress, which may take the form of a mattress pad, has the advantage of comprising of two kinds of foam, namely a high resilience foam providing lightness and low cost and a visco-elastic foam providing a high level of efficacy in terms of interface pressure distribution.

[0013] More precisely, the top visco-elastic foam provides comfort and molds to the body of the patient resting on the top visco-elastic layer, whereas the high resilience bottom layer provides support to the patient.

[0014] Because the mattress only has a top visco-elastic layer rather than being entirely constituted of a visco-elastic layer, and therefore its thickness is reduced compared to the prior art mattress pad containing only a visco-elastic layer, a mattress pad according to this invention costs less than a prior art mattress pad.

[0015] Furthermore, because the visco-elastic layer is supported by a self-inflating layer of high resilience foam, the patient is supported much more comfortably than on a mattress pad containing only visco-elastic foam.

[0016] In fact, it turns out that a thinner visco-elastic layer is sufficient for molding to the patient. On the other hand, a high resilience, self-inflating open-cell foam covered with an impermeable film or coating provides better support compared to a typical non-self-inflating foam, because the air contained in the self-inflating bottom layer of high resilience foam contributes to supporting the patient and, in particular, by virtue of its self-inflating nature, the bottom layer adapts precisely to the shape of the patient.

[0017] Typically in a self-inflating mattress, air enters the mattress when not in use and with the mattress thus inflated, the valves are closed and the patient is then laid on the mattress pad. Once the patient is in position, the valves can be opened until there is no more air exiting

the mattress. The mattress then molds perfectly to the shape of the patient, providing good interface pressure distribution, and the valves can then be closed again.

[0018] With the mattress of this invention, both of the mattress layers adapt specifically to each patient by virtue of their partial deflation, thus providing optimum results for all patients regardless of their weight in contrast to a typical mattress, which may be too hard for some patients and too soft for other patients.

[0019] By thermoforming on contact with the patient's body, the visco-elastic top layer provides a maximum contact surface between the mattress pad or mattress and the patient, thus limiting the number of points having pressure peaks capable of causing bedsores. Under the effect of his weight, on the other hand, the patient sinks into the mattress or mattress pad and into the high resilience bottom layer as well. Finally, the fact that the high resilience bottom layer is integrated in the self-inflating mattress confers an improved reactivity of the latter in response to compression exerted by the patient, in comparison with the combination of a mattress pad containing only a visco-elastic layer resting on a non-self-inflating mattress made of typical, high resilience foam.

[0020] The surface coating ensures an overall impermeability to air and water, the valve enabling the self-inflation and deflation of the mattress.

[0021] When the mattress is not in use, it can be rolled up by opening its valves in order to expel the air trapped inside, and once it is completely rolled up, the valves can be closed again and the mattress pad can be stowed in a carrying bag.

[0022] According to preferred embodiments said two foam layers comprise polyurethane foam, the high resilience bottom layer has a thickness greater than that of the visco-elastic top layer, and the density of the high resilience foam of the bottom layer is less than the density of the visco-elastic foam of the top layer.

There are different variants of polyurethane polymers with different derivatives, particularly so-called "green" foams with polyurethane polymers derived from soybean oil constituents. It is also possible to use synthetic or natural latex foams, but the use thereof is prohibited in hospitals due to sanitation regulations.

[0023] Preferably the adhesive layer between the top visco-elastic foam layer and the bottom high resilience foam layer, respectively, does not entirely cover the bottom and top surfaces of said top and bottom foam layers.

[0024] In practice, there is in fact a high density of open cells on the bottom surface of the visco-elastic foam layer and on the top surface of the high resilience foam layer, hence it is possible to glue the two foam layers without obstructing all of the open cells with glue. Thus, the air is still able to flow freely between the top visco-elastic layer and the bottom high resilience layer, and the two valves can be oppositely positioned relative to the single bottom layer in the vicinity of the junction with the top layer, as described below.

[0025] According to other preferred characteristics of embodiment:

Preferably the high resilience foam of the bottom layer has a density of 15 to 40 kg/m^3, an indentation force deflection [IFD] of 50 to 130 N at 40% compression, and a resistance of 1 to 4 kPa at 40% compression, and the visco-elastic foam of the top layer has a density of 40 to 100 kg/m^3, an indentation force deflection [IFD] of 20 to 90 N at 40% compression, and a resistance of 1 to 3 kPa at 40% compression.

[0026] The densities are measured according to the standard NF EN ISO 845.

[0027] Indentation corresponds to a test according to the standard NF EN ISO 2439. According to the principle of this standard, the forces applied to push a plate smaller than the mattress test sample to depths of 25%, 40%, and 65% of the original thickness of the mattress are measured, wherein the force applied to indent the sample to 40% is the indentation force deflection [IFD] and the ratio of the forces applied to indent the mattress sample to 65% and 25% of its original thickness is the compression modulus, also known as the "sag factor" or the "comfort factor."

[0028] The resistance to compression test is performed according to the standard NF EN ISO 3386/1 and corresponds to the pressure applied with a plate larger than the foam mattress test sample. The pressure required to obtain an indentation corresponding to a compression of 40% of the original thickness of the mattress is measured.

[0029] As a general rule, visco-elastic foams have IFD and resistance to compression values lower than those of high resilience foams. Nevertheless, there are low density high resilience foams that have IFD and resistance to compression values comparable to those of higher density visco-elastic foams.

[0030] As a general rule, visco-elastic foams have densities of at least 40 kg/m^3. Also, at a given density, a visco-elastic foam will have IFD and resistance to compression values lower than those of a high resilience foam.

[0031] Preferably the high resilience foam is a polyurethane foam with a density of 25 kg/m^3, an IFD of 70 N at 40% compression, and a resistance of 1.5 kPa at 40% compression, and the visco-elastic foam is a polyurethane foam with a density of 64 kg/m^3, an IFD of 62 N at 40% compression, and a resistance of 1.8 kPa at 40% compression.

[0032] Polyurethane foams of this kind are marketed by the company Recticel, under the designations "OS 25 cm" for the high resilience foam and "VF 6020" for the visco-elastic foam.

[0033] Other high resilience polyurethane foams are the "W2515" foam from the company Eurofoam (Austria), the "ELAST 25" foam from the company OLMO (Italy), and the "SB 32S" foam from the company Recticel (UK).

[0034] Other suitable visco-elastic polyurethane

foams include foams with the designations "V5020" from the company Eurofoam (Austria), "V50040" and "V50080" from the company Recticel (France), and "GV5030" from the company Eurofoam (Germany).

[0035] These polyurethane foams have the flame retardant properties specified in the standard BS 5552 (UK).

[0036] This polyurethane film renders the mattress impermeable to air, to water, and more generally to liquids and bacteria. Thus, the air contained in the mattress can only escape via the valves. On the other hand, the mattress optimally fulfills the hygienic requirements for hospital use, as the interior of the mattress cannot be soiled and the surface of the mattress can be cleaned very easily with standard disinfectants.

[0037] More particularly, the surface coating on the outer surface of the two-layer assembly comprises two polyurethane films, a top film and a bottom film, preferably 100 to 250 μm in thickness.

[0038] By virtue of their elasticity, the coatings form a polyurethane cover providing a soft and comfortable surface with a long, useful life. Furthermore, they are easy to clean and form a slide-proof interface with the bottom surface of the mattress.

[0039] The coating preferably comprises at least one film, preferably a top and bottom film, with the or each film comprising two polyurethane layers, each polyurethane layer being formed of a polyurethane exhibiting a vitreous transition temperature different from that of the polyurethane of the other layer.

[0040] Thanks to this characteristic, the coating film with a lower vitreous transition temperature can be applied in such a way that by heating the coating to the lower vitreous transition temperature, the film that is in contact with the foam attains its vitreous transition point, becomes viscous, and impregnates the foam, whereas the other film does not attain its vitreous transition temperature and remains unaffected, and thus retains all of its impermeability properties.

[0041] Preferably, the therapeutic self-inflating mattress comprises a high flow valve at each corner of one end of the mattress, on the end edge. In one embodiment, the two valves are positioned between the bottom and top layers.

[0042] These high flow valves ensure an automatic, effortless inflation of the mattress, thus making it possible to dispense with a hand or mechanical pump.

[0043] When the coating consists of two films as described above, the two valves are advantageously sandwiched and glued between the top and bottom films of the coating.

[0044] The mattress is advantageously a mattress pad, and the bottom layer has a thickness of 3 to 7 cm and the top layer has a thickness of 2 to 5 cm, the total thickness of the two superimposed layers being 5 to 12 cm.

[0045] This invention also provides a therapeutic support device comprising a foam mattress, preferably of high resilience polyurethane, on which such a mattress pad is laid.

[0046] The support device can be contained in an outer cover, the mattress pad thereby benefitting from a double protection.

[0047] There is also disclosed a method of using the therapeutic, self-inflating mattress according to the invention, comprising the following steps:-

1) the valves of the mattress are opened until it is fully inflated,
2) the patient is positioned on the mattress to expel a portion of the air contained therein, with the valves open; and
3) when there is no more air coming from the mattress, the valves are closed again.

[0048] Once the patient positioned on the mattress has partially expelled the air contained therein, the mattress molds to the patient thanks to the visco-elastic foam and the air. Equilibrium is reached when there is no more air coming from the mattress, and the two layers of visco-elastic and high resilience foam, respectively, of the mattress are thus "programmed" or specifically adapted to the weight and the shape of the patient.

[0049] Closing the valves allows this equilibrium to be maintained. Good distribution is achieved through a maximum contact surface and minimum pressure peaks. Interface pressure sensors positioned between the mattress and the patient are used for checking the interface pressures. Software, particularly "X Sensor" software known to the skilled professional, is used to record the pressures. The pressure distributions, the pressure peaks, the pressure means, and the pressure contact surfaces are checked, in particular.

[0050] The invention at least in the preferred embodiments provides a self-inflating foam therapeutic support device which reduces the risk of bedsores forming, is light for ease in transport, is less expensive than therapeutic self-inflating mattresses consisting solely of visco-elastic foam, and is more effective in terms of interface pressure distribution than therapeutic self-inflating mattress pads made of visco-elastic foam.

[0051] The invention will now be further described by way of example with reference to the accompanying drawings, in which:

- Figure 1 is a view from above of a self-inflating mattress pad according to this invention, and
- Figure 2 is a side view of the edge of the mattress pad of Figure 1.

[0052] The mattress pad 1 has two layers:

- a bottom layer 3 of "OS 25 cm" high resilience, open-cell polyurethane foam from the company Recticel, exhibiting the following characteristics:

- density: 25 kg/m^3,
- IFD: 70 N at 40% compression
- resistance at 40% compression: 1.5 KPa.

[0053] The bottom layer 3 of OS 25 cm high resilience polyurethane foam has a thickness of 5 cm.

- a top layer 2 consisting of "VF 6020" visco-elastic, open-cell polyurethane foam from the company Recticel, exhibiting the following characteristics:

  - density: 64 kg/m^3,
  - IFD: 62 N at 40% compression
  - resistance at 40% compression: 1.8 KPa.

Under tension, the stress required for reaching the elongation-to-break of the bottom layer is 73 kPA and the resistance to tearing of the "VF 6020" foam is 241 N/m.

[0054] These two layers are glued together on the bottom side of the top layer and the top side of the bottom layer, notably with a water-based adhesive.

[0055] The adhesive layer does not completely coat the bottom surface of the top layer 2 and the top surface of the bottom layer 3, because there are too many open cells on these surfaces for all of them to be obstructed by the glue. Thus, air is still able to flow freely between the two layers, which permits the joining and the molding of the two layers when the patient is positioned on the mattress.

[0056] The two-layer assembly is entirely covered on its free outer surfaces by two polyurethane films, comprising two layers of polyurethane with different vitreous transition temperatures, specifically one layer that is heated to make it viscous and adhere to the foam of both the bottom and top layers of the mattress, whereas the outer film of the polyurethane coating does not attain its vitreous transition temperature.

[0057] The thickness or height of the visco-elastic polyurethane foam 2 is 3 cm.

[0058] The top polyurethane film 5a covers the top surface and edges of visco-elastic foam top layer 2 and also covers the top edge of the side walls of the bottom layer 3 of high resilience foam.

[0059] The top film 5a overlaps the gluing junction line of the adhesive layer 6 between the top layer 2 and the bottom layer 3.

[0060] The valves 4a, 4b are inserted and glued at the junction line 5_1 between the top film 5a and the bottom film 5b of the coating.

[0061] The two mattress pad foams "OS 25 cm" and "VF 6020" exhibit flame retardant properties enabling them to pass the flame resistance tests specified in UK standard BS 6807 CR IB5.

[0062] The valves 4a, 4b are placed on the two corners of the foot end for easy access; when the mattress pad is placed on a bed, the two valves are preferably placed on the edge of the mattress and positioned in the vicinity of the interface 6 of the top layer 2 and the bottom layer 3.

[0063] The dimensions of a mattress pad may be 180 to 210 cm, particularly 197 cm, in length; 70 to 100 cm, particularly 86 cm, in width, and 5 to 12 cm, particularly 8 cm, in height.

Claims

1. Therapeutic self-inflating mattress (1) of reticulated, open-cell foam, comprising an airtight and watertight surface coating (5a, 5b) and equipped with at least one valve (4a, 4b), **characterized in that** the mattress (1) comprises two superimposed layers (2, 3) of reticulated open-cell foam with an adhesive layer (6) between them, a bottom layer (3) of high resilience (HR) foam and a top layer (2) of visco-elastic foam, the two-layer assembly being covered with at least one film or coating of a polymer binder covering the entire outer surface of said two-layer assembly except in the vicinity of the at least one valve (4a, 4b).

2. Therapeutic self-inflating mattress as in claim 1, wherein both foam layers comprise polyurethane foam.

3. Therapeutic self-inflating mattress as in claim 1 or 2, wherein the high resilience bottom layer (3) has a greater thickness than the visco-elastic top layer (2).

4. Therapeutic self-inflating mattress as in any preceding claim, wherein the density of the high resilience foam of the bottom layer (3) is less than the density of the visco-elastic foam of the top layer (2).

5. Therapeutic self-inflating mattress as in any preceding claim, wherein the adhesive layer (6) between the top visco-elastic foam layer (2) and the bottom high resilience foam layer (3) does not entirely cover the bottom and top surfaces of the top and bottom foam layers.

6. Therapeutic self-inflating mattress as in any preceding claim, wherein the high resilience foam of the bottom layer has a density of 15 to 40 kg/m^3, an indentation force deflection [IFD] of 50 to 130 N at 40% compression, and a resistance of 1 to 4 kPA at 40% compression.

7. Therapeutic self-inflating mattress according to claim 6, wherein the high resilience foam is a polyurethane foam with a density of 25 kg/m^3, an IFD of 70 N at 40% compression, and a resistance of 1.5 kPa at 40% compression.

8. Therapeutic self-inflating mattress according to any preceding claim wherein the visco-elastic foam of the top layer has a density of 40 to 100 kg/m^3, an IFD of 20 to 90 N at 40% compression, and a resist-

ance of 1 to 3 kPa at 40% compression.

9. Therapeutic self-inflating mattress according to claim 8, wherein the visco-elastic foam is a polyurethane foam with a density of 64 kg/m^3, an IFD of 62 N at 40% compression, and a resistance of 1.8 kPa at 40% compression.

10. Therapeutic self-inflating mattress according to any preceding claim wherein the surface coating (6) on the outer surface of the two-layer assembly comprises two polyurethane films, a top film (5a) and a bottom film (5b), each preferably 100 to 250 μm thick.

11. Therapeutic self-inflating mattress according to claim 10, wherein the surface coating comprises at least one film (5a, 5b), preferably a top (5a) and a bottom (5b) film, wherein the or each film comprises two polyurethane layers, each polyurethane layer formed of a polyurethane exhibiting a vitreous transition temperature different from that of the polyurethane of the other layer.

12. Therapeutic self-inflating mattress according to any preceding claim wherein there is a high flow valve (4a, 4b) at each corner of one end of the mattress and located on the end edge of the mattress.

13. Therapeutic self-inflating mattress according to claim 12, as dependent on claim 10 wherein the two valves are sandwiched and glued between the top and bottom films of said surface coating.

14. Therapeutic self-inflating mattress according to any preceding claim wherein the mattress is a mattress pad, and the bottom layer (3) has a thickness of 3 to 7 cm and the top layer (2) has a height of 2 to 5 cm, and the total height of the two superimposed layers is 5 to 12 cm.

15. Therapeutic support device comprising a foam mattress, preferably formed from high resilience polyurethane, on which a mattress as claimed in claim 14 is laid.

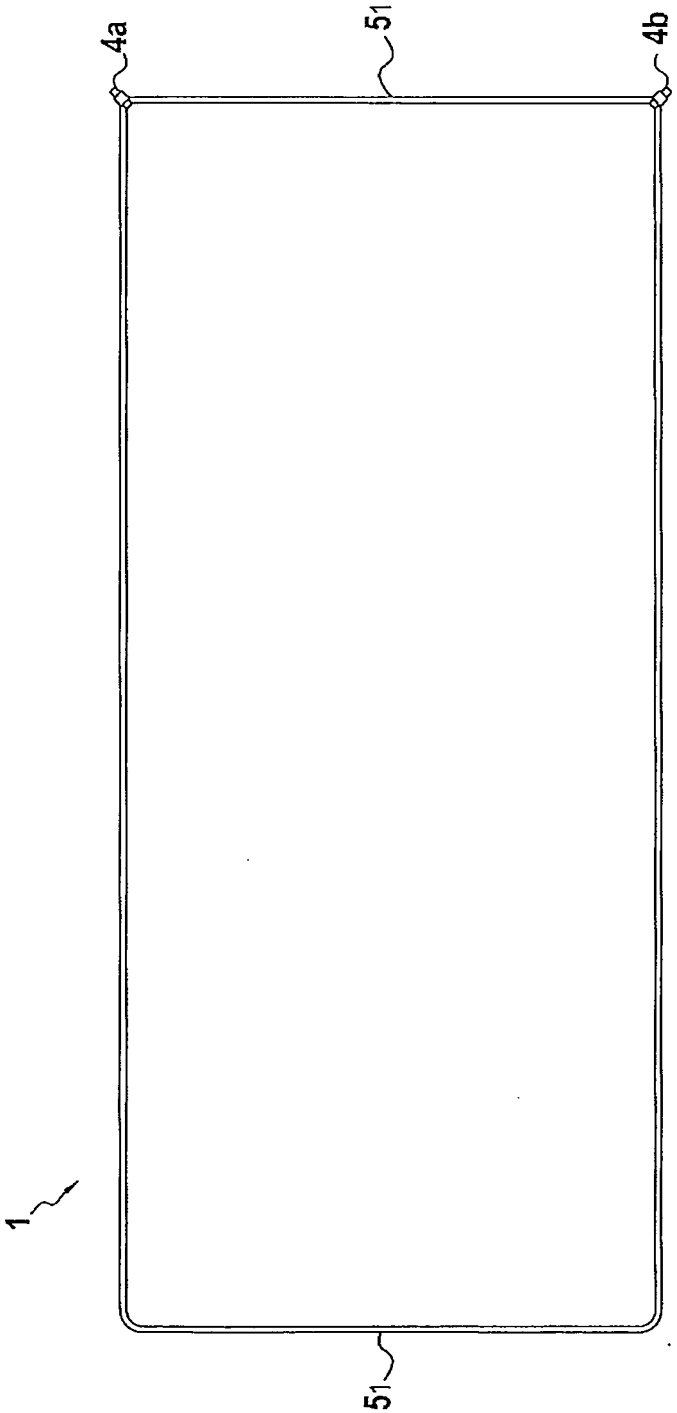

FIG.1

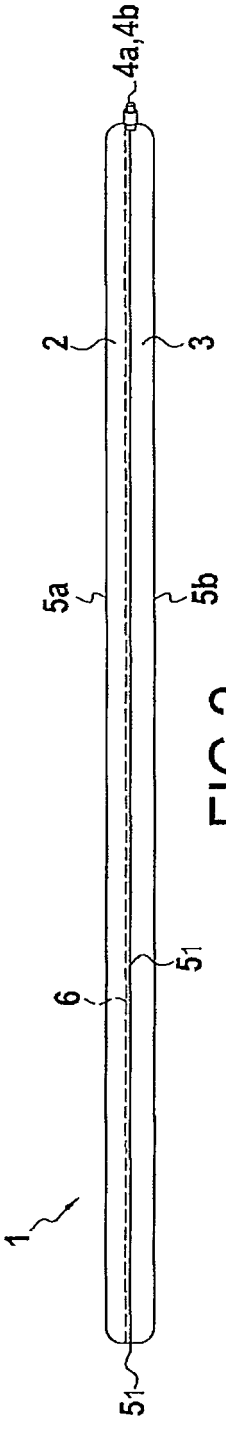

FIG.2

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EUROPEAN SEARCH REPORT

Application Number
EP 09 25 2812

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
Y	US 2003/009830 A1 (GIORI GUALTIERO G [US] ET AL) 16 January 2003 (2003-01-16) * paragraphs [0003], [0071], [0072]; figure 7 *	1-4,6,7, 14,15	INV. A61G7/057 A47C27/14
Y	US 5 595 806 A (KORFMACHER GEORG [DE]) 21 January 1997 (1997-01-21)	5,8-13	
A	* column 4, lines 31-64; figures 4,6 *	1-4,6,7, 14,15	
A	US 2003/217414 A1 (MARSON JAMES E [US]) 27 November 2003 (2003-11-27) * paragraphs [0020] - [0025]; figure 2 *	1-15	
Y	GB 2 290 256 A (FAGERDALA WORLD FOAMS AB [SE]) 20 December 1995 (1995-12-20) * page 2, lines 16-21; figures 1-3 *	1-15	
A	US 5 960 496 A (BOYD DENNIS [US]) 5 October 1999 (1999-10-05) * column 2, lines 44-62; figure 1 *	1-15	
			TECHNICAL FIELDS SEARCHED (IPC)
Y	US 6 108 835 A (HWANG MIKE [TW]) 29 August 2000 (2000-08-29) * the whole document *	11,13	A61G A47C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	16 February 2010	Bielsa, David

CATEGORY OF CITED DOCUMENTS

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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
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16-02-2010

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2003009830 A1	16-01-2003	US 2002148045 A1 US 2003009831 A1	17-10-2002 16-01-2003
US 5595806 A	21-01-1997	NONE	
US 2003217414 A1	27-11-2003	AU 2003239612 A1 WO 03099067 A2	12-12-2003 04-12-2003
GB 2290256 A	20-12-1995	US 6159574 A	12-12-2000
US 5960496 A	05-10-1999	US 6256821 B1	10-07-2001
US 6108835 A	29-08-2000	NONE	

EPO FORM P0459

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