

(12) UK Patent

(19) GB

(11) 2558746

(13) B

(45) Date of B Publication

27.10.2021

(54) Title of the Invention: Improvements to bed and mattress therefore

(51) INT CL: **A61G 7/057** (2006.01) **A47C 27/00** (2006.01) **A47C 27/14** (2006.01)

(21) Application No: 1718812.9

(22) Date of Filing: 14.11.2017

(30) Priority Data:  
(31) 1619243 (32) 14.11.2016 (33) GB

(43) Date of A Publication 18.07.2018

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(56) Documents Cited:  
**GB 1559851 A** **EP 0788752 A1**  
**US 5815865 A** **US 4189798 A**  
**US 20100180384 A1**

(58) Field of Search:  
As for published application 2558746 A viz:  
INT CL **A47C, A61G**  
Other: **WPI, EPODOC, Patent fulltext**  
updated as appropriate

Additional Fields  
Other: **None**

GB 2558746 B

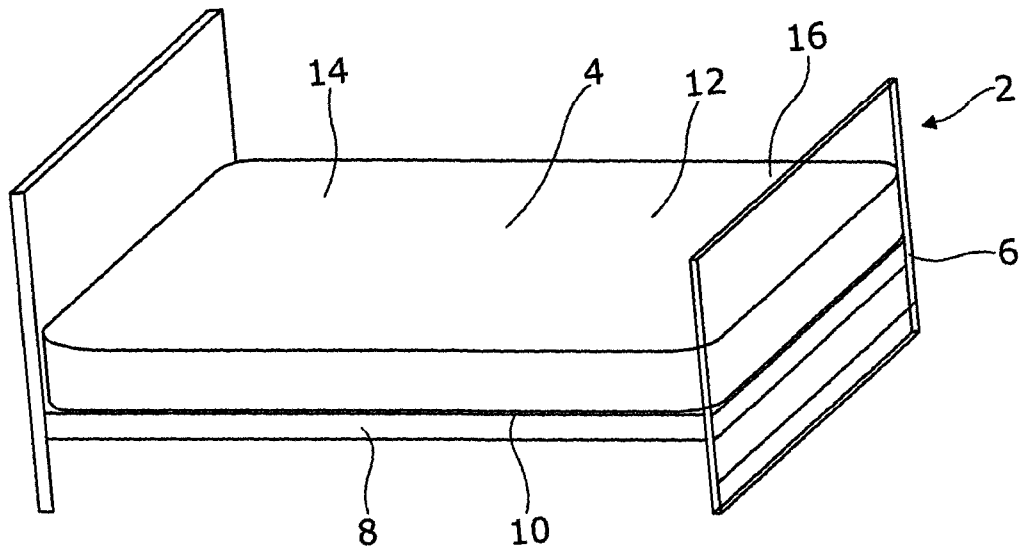


Figure 1

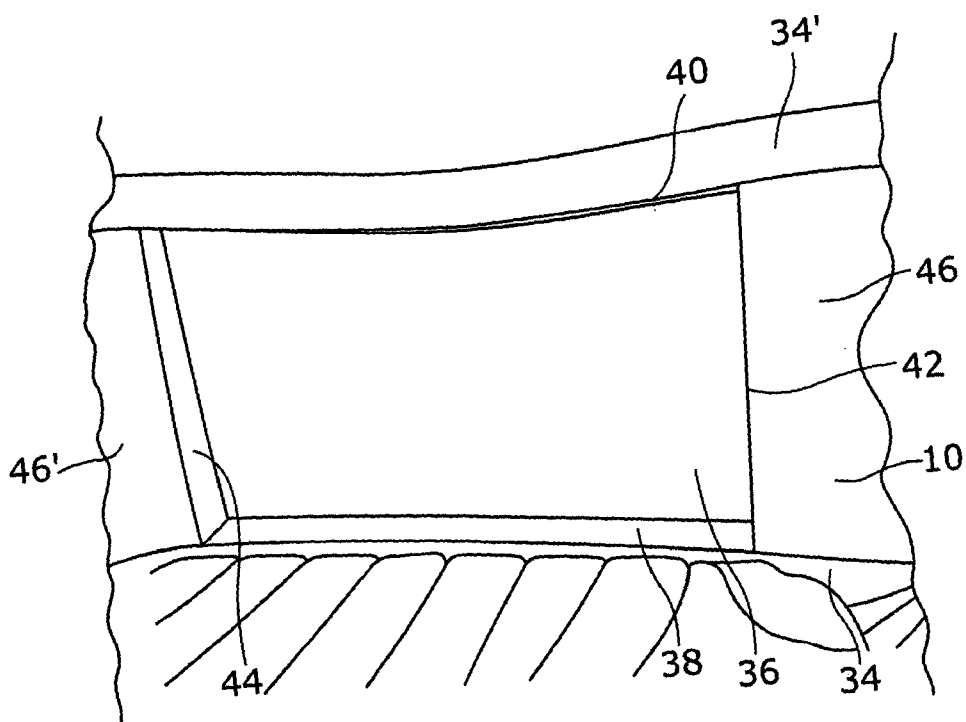
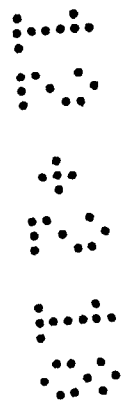


Figure 2



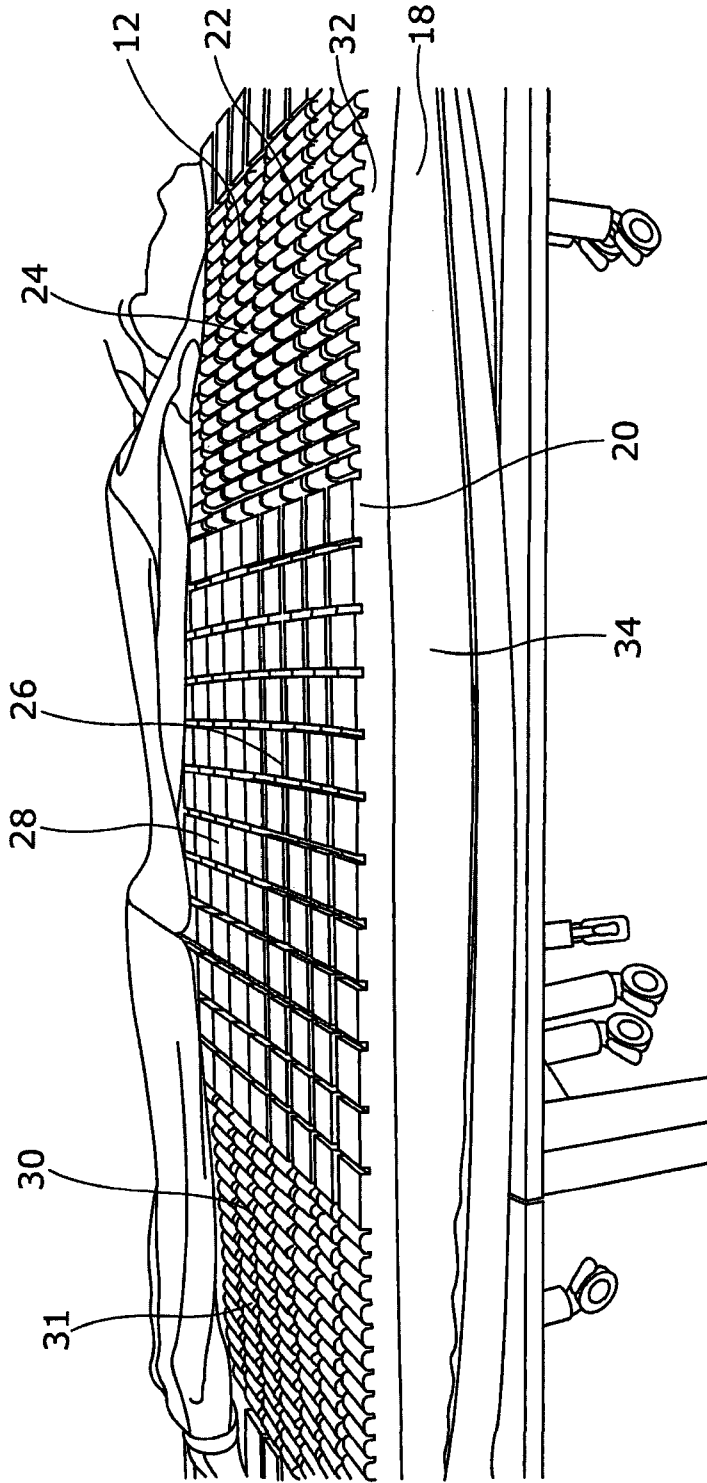


Figure 3



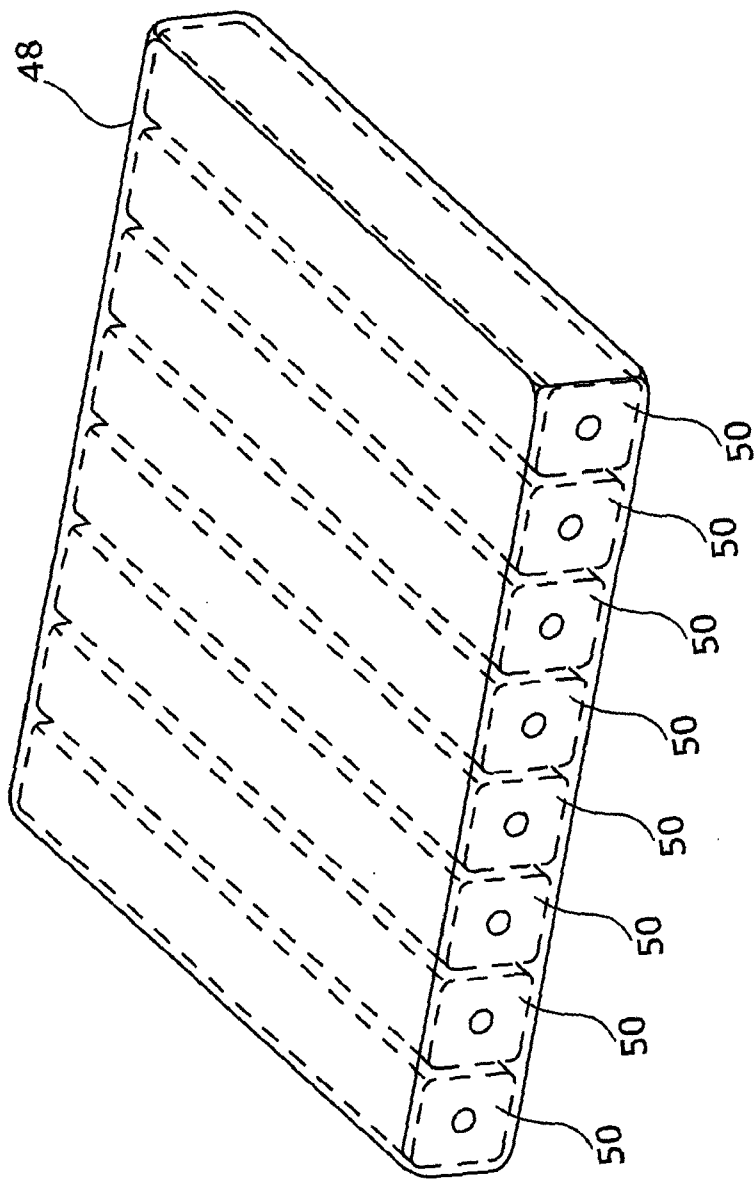
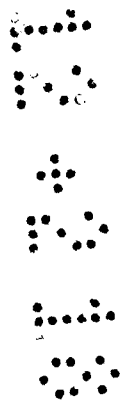


Figure 4



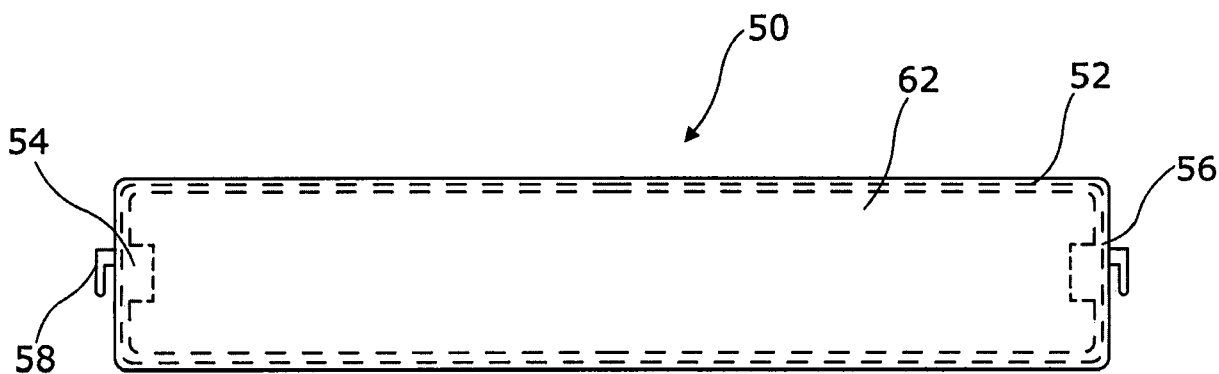


Figure 5a

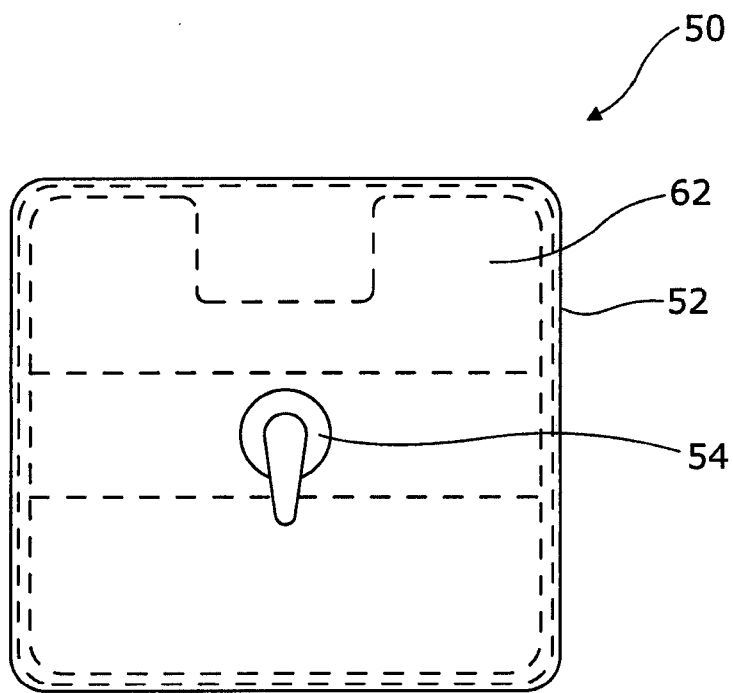


Figure 5b



## **Improvements to Bed and Mattress therefore**

The invention to which this application relates is to improvements for a bed, and a mattress therefore. In particular, although not necessarily exclusively, the invention relates to beds and mattresses which are provided for use by persons who are patients in a hospital or are recovering in another environment.

The use of beds for patients is an important aspect in the recovery of those patients from operations and/or the alleviation of discomfort and provision of comfort to those patients who may be suffering from relatively long term or permanent debilitating illnesses which require the patient to spend long periods of time in bed. If the beds are not appropriate then the risk of general discomfort and also pressure damage to the patient, resulting in development of pressure ulcers, can affect any individual, although it is more prevalent in older people. This can result in reduction of mobility and activities such as daily living, poor nutritional status, increased pain, and an increased financial cost to the care sector. This, in turn, can lead to an increased stay in hospital, increased community nurse visits and/or a reduction in health-related quality of life for those who have a pressure ulcer, and/or general discomfort, compared to those without.

Pressure ulcers are areas of localised damage to the skin and underlying tissue, believed to be caused either by pressure, or by a combination of pressure and shear (European Pressure Ulcer Advisory Panel & National Pressure Ulcer Advisory Panel, 2014). The costs of treating and managing pressure damage is dependent on severity of skin damage and in 2010 the Department of Health in the UK stated that the cost of treating a category 1 pressure ulcer (superficial damage) to be approximately £1,214, rising to £14,108 for a category 4 pressure ulcer (damage to the skin that extends to the bone). The prevalence of pressure ulcers in patients in European hospitals is believed to range from 8.3% to 23% and it will therefore be appreciated that this will have a significant impact on patient comfort, treatment and resources. Furthermore, the presence of pressure ulcers in a patient has been associated with a two-to four-fold increase in risk of death in older people in intensive care units.

It has therefore been identified that there is a need to reduce the prevalence

of pressure ulcer occurrence in patients and there are several known designs of mattress which are intended to attempt to provide this solution and which can be selectively purchased and used. While these mattresses may provide some improvement, it is found that there are still problems caused by pressure ulcers occurring and the level of comfort is often not satisfactory. It is also important to provide improvements to mattresses in terms of handling, cleaning, temperature control and the like, as these all lead to improvements in the comfort of the patient.

The aim of the present invention is to provide a bed, and a mattress for the same, which has a composition and structure which provides further improvements in the provision of comfort to the patient in comparison to conventional mattresses.

In a first aspect of the invention there is provided a mattress including a body with a top surface to support a person, an opposing bottom surface which is supported by a bed frame and wherein at least the top surface is provided of a foam material layer which has a density of at least  $35\text{kg/m}^3$  wherein the mattress includes a cover which enclose the said body therein and the cover is formed as a multi-layered structure including an outer layer with an external contact surface and an internal surface, a polyurethane coating layer applied to said internal surface, a layer of foam material, a bonding layer and an inner layer.

Preferably the said density is greater than  $40\text{kg/m}^3$  and yet further preferably is  $60\text{ kg/ m}^3$ .

In one embodiment the foam material is a polyether/viscoelastic polyurethane material.

In one embodiment the foam material top surface is provided in a manner so as to define at least two zones. In one embodiment the zones are at least partially defined by differences in the contour shape of the said top surface.

In one embodiment the said contours are provided of a first form to specify a first zone located towards a first end of the mattress on which the person's lower legs and feet are to be located and in a second form to specify a second zone located intermediate the said first zone and the opposing end of the mattress on which the person's torso is located.

In one embodiment a third zone towards the said second end of the mattress is defined by contours which, in one embodiment may be the same or similar to those used to define the first zone.

Typically the contours are provided in the form of castellations and the castellations used to form the first and third zones are narrower in width than those used to specify the second zone.

The provision of 3 zones on the mattress top surface allow zones to be provided for the heels, body torso and head respectively, which are the parts which impact most on the mattress and therefore represent vulnerable areas for pressure ulcer occurrence, to be provided with the form of support by the mattress which best matches the requirements at that location, therefore minimizing the need for supporting accessories such as heel offloading aids.

The use of foam in the form as specified for at least the top surface of the mattress body means that the contact area of the top surface of the mattress is maximized which, in turn, reduces the occurrence of relatively concentrated pressure point areas. Typically the foam has an open cell structure which improves air flow through the same.

In one embodiment the foam material includes graphene..

In one embodiment the said foam material used to form the top surface of the body is provided as a layer, and at least part of which is attached to a base layer of foam material, with different characteristics. In one embodiment the base layer of foam material is formed by foam of a second type located to form the longitudinal edges of the mattress and first and second portions of foam material of a third type located under the upper layer at the first and third zones respectively.

In one embodiment the second and third types of foam have lower density values, typically in the range of 30-38 Kg/m<sup>3</sup>, than the foam material used to form the top surface. In one embodiment the cover forms contact surfaces with bed sheets and the bed frame.

In one embodiment a cavity is defined in the mattress body, said cavity have an



the bottom surface towards the top surface but does not extend to the foam material layer which forms the top surface of the body.

In one embodiment the said cavity receives therein at least one, but typically a plurality of cells. Typically the cells are provided as an assembly which includes an envelope in which the cells are located and the envelope is, in turn, located in the cavity.

Typically a cell includes an enclosure which defines a space in which, typically a block of foam is located, and the passage of air into and from the cell is possible and controlled by at least one valve means. In one embodiment the valve or valves are self-adjusting to take into account the pressure exerted on the cell at that time and thereby allow the escape or introduction of air so as to allow a change in support which is required with respect to pressure being applied to the cell.

In one embodiment the valves are bi-directional and in one embodiment each valve for each cell is preset by utilizing a restrictor to regulate air flow. In one embodiment there may be a range of different settings which can be selected perhaps with respect to the location of each cell in the envelope so that within the same envelope different cells may have different air flow settings to define different support characteristics at different locations within the envelope, and hence zone, of the mattress body. For example, if there are 8 cells provided, two may have the same setting to define a first characteristic, the next 2 may have a different air flow setting for a second characteristic, the next two have a different airflow setting to define a third characteristic and the last two cells have a different airflow setting to define a further support characteristic. This allows the controlled movement of air to allow a cushioning effect to be created but without rapid adjustment, whilst the provision of the foam block allows a relatively consistent comfort support. In one embodiment the foam block is formed of the same foam material as used to form the top surface of the mattress.

In one embodiment each of the cells are independently adjustable in terms of air flow into and from the same and arranged with their longitudinal axes in parallel.

In one embodiment the said cavity is arranged substantially centrally of the mattress body and within the second zone of the mattress. In one embodiment

the side walls of the cavity are defined by the portions of material of the second type and the end walls are defined by the portions of material of the third type.

In a further aspect of the invention there is provided a cell for use in the formation of a mattress for a bed, said cell comprising an enclosure which defines a space therein in which is received a foam block, and wherein said enclosure includes therein at least one valve to allow the controlled passage of air into and from the space of the enclosure so that the foam block and air present within the enclosure at any given time provide a required level of support.

Typically the foam block provides a first level of adjustable support and the selective flow of air allows further adjustment of the support provided by the cell.

In a further aspect of the invention there is provided a bed, said bed including a mattress as defined herein.

Specific embodiments of the invention are now described with reference to the accompanying Figures; wherein

Figure 1 illustrates schematically a bed frame and mattress in accordance with one embodiment of the invention;

Figure 2 illustrates a plan view of the bottom surface of a mattress in accordance with one embodiment of the invention;

Figure 3 illustrates a perspective view of a side and top surface of the mattress in accordance with one embodiment of the invention;

Figure 4 illustrates a perspective view of a cell assembly in accordance with one embodiment of the invention; and

Figures 5a and b illustrate end and side views of a cell in accordance with one embodiment of the invention.

Figure 1 illustrates in a schematic manner a bed 2 comprising a mattress 4 and a support frame 6 which has a support base 8 on which the bottom surface 10 of the mattress is located. The mattress has a top surface 12 provided to support the

patient thereon and the frame has a head end 14 and a foot end 16 with respect to the expected orientation of the person when using the bed. The mattress 4 is provided with an external cover which is typically provided as a protective cover for the mattress body which is located within the cover. For ease of illustration, in the remaining Figures the mattress cover has been removed to show the mattress body.

Referring now to Figure 3 there is illustrated a view of the top surface and side wall of a mattress body 18 in accordance with one embodiment of the invention. The top surface 12 is formed with a series of contours in the form of castellations 20 of different forms, comprising a first set of a first shape 22 which form a first, foot, zone 24 of the mattress body, a second set of a second shape 26 which form a second, torso, zone 28 of the mattress body. In accordance with this embodiment, a third set 30, of the same shape as the first set 22, form a third, head, zone 31 of the mattress body.

The top surface 20 of the mattress body is formed by a layer of foam material 32 which is of a greater density than the base portions 34 of foam material which forms at least part of the lower surface of the mattress body. The provision of greater density foam material layer provides a comparatively greater contact area and this, in conjunction with the selective castellation contour shapes for the different zone of the mattress top surface are found to provide improved resistance to the creation of pressure ulcers on patients when lying on the bed mattress.

Turning now to Figure 2 there is provided a plan view of the bottom surface 10 of the mattress and it will be seen that in this embodiment there is provided a cavity 36 which underlies the layer 32 at the second zone 28 of the mattress body and does not penetrate through the layer 32 of the first foam material. The side walls 38,40 of the cavity are defined by the base portions 34, 34' of foam material and the end walls 42, 44 of the cavity are defined by portions 46, 46' of foam material which is of a different form to the foam material of layer 32 and of portions 34, 34' and which are located in the zones 24, 31 respectively of the mattress body.

The cavity 36 is provided to receive a fabric envelope 48 in which are located a series of elongate cells 50 as shown in Figure 4. The cells are independently located within the envelope 48 which is placed into the cavity so as to underlie the layer 32 in the zone 28 and thereby provided flexible support during use of

the mattress. A cell in accordance with one embodiment of the invention is shown in more details in Figures 5a and b. Each cell 50 is provided with an enclosure 52 formed of a plastic material in which are provided first and second apertures 54, 56. One of the apertures 54 is connected with a non-return inlet valve 58 and the other aperture 56 is attached to a non-return outlet valve 60 so as to allow the controlled flow of air into and out of the enclosure via the respective valves. In addition located within the enclosure 52 is one or more foam material blocks 62 so that, in conjunction with the air, a varying level of support is provided by each cell, with the variance depending on the level of air present in the cell at an instant in time.

In limited tests which have been undertaken using the mattress in accordance with the invention as illustrated in the embodiment illustrated with respect to Figures 2- 5b, in comparison with conventional foam based mattresses patient comfort, temperature and sleep quality were found to be at least comparable and with respect to the domains of aesthetics, ease of use, ergonomics and temperature control; patient moving and handling and mattress stability; and cleaning and sodium hypochlorite use mattress in accordance with the invention was found to be substantively better than the conventional mattresses as summarized below in the results tables.

Table 1 - comparison of mattress in accordance with the invention and conventional standard mattresses on aesthetics and related domains

Characteristic	Mattress type		Significance	Effect size
	<u>invention</u>	Standard		
Aesthetics				
Very good or excellent	25/34 (73.5%)	2/12 (16.7%)	$\chi^2_{(1)}=11.8;$ $p=0.001$	$\phi=0.507;$ large
Good, adequate or poor	9/34 (26.5%)	10/9 (83.3%)		
Ease of use				
Very good or excellent	29/40 (72.5%)	2/12 (16.7%)	$\chi^2_{(1)}=12.0;$ $p=0.001$	$\phi=0.479;$ large
Good, adequate or poor	11/40 (27.5%)	10/9 (83.3%)		
Ergonomics				
Very good or	27/37 (73.0%)	2/11	$\chi^2_{(1)}=10.6;$	$\phi=0.471;$ l

excellent		(18.2%)	p=0.001	arge
Good, adequate or poor	10/37 (27.0%)	9/11 (81.8%)		
Temperature control				
Very good or excellent	21/32 (65.6%)	1/12 (8.3%)	$\chi^2_{(1)}=11.5$ ; p=0.001	$\phi=0.510$ ; large
Good, adequate or poor	11/32 (34.4%)	11/12 (91.7%)		

Table 2: comparison of mattress in accordance with the invention and standard mattresses on moving and handling domains

Characteristic	Mattress type		Significance	Effect size
	<u>invention</u>	Standard		
Patient moving and handling				
Very good or excellent	26/41 (63.4%)	5/15 (33.3%)	$\chi^2_{(1)}=4.02$ ; p=0.045	$\phi=0.268$ ; moderate
Good, adequate or poor	15/41 (36.6%)	10/15 (67.6%)		
Mattress stability				
Very good or excellent	29/41 (70.7%)	4/13 (30.8%)	$\chi^2_{(1)}=6.63$ ; p=0.010	$\phi=0.350$ ; moderate
Good, adequate or poor	12/41 (29.3%)	9/13 (69.2%)		

Table 3: comparison of mattress in accordance with the invention and conventional standard mattresses on cleaning domains

Characteristic	Mattress type		Significance	Effect size
	<u>invention</u>	Standard		
Ease of cleaning				
Very good or excellent	30/39 (76.9%)	4/11 (36.4%)	$\chi^2_{(1)}=6.49;$ $p=0.011$	$\phi=0.360;$ moderate
Good, adequate or poor	9/39 (23.1%)	7/11 (63.6%)		
Sodium hypochlorite use				
Very good or excellent	17/23 (73.9%)	3/9 (33.3%)	$\chi^2_{(1)}=4.55;$ $p=0.033$	$\phi=0.377;$ moderate
Good, adequate or poor	6/23 (26.1%)	6/6 (66.7%)		

**Claims-**

1. A mattress including a body with a top surface to support a person, an opposing bottom surface which is supported by a bed frame and wherein at least the top surface is provided of a foam material layer which has a density of at least  $35\text{kg/m}^3$  wherein the mattress includes a cover which enclose the said body therein and the cover is formed as a multi-layered structure including an outer layer with an external contact surface and an internal surface, a polyurethane coating layer applied to said internal surface, a layer of foam material, a bonding layer and an inner layer.

2. A mattress according to claim 1 wherein the said density is greater than  $40\text{kg/m}^3$ .

3. A mattress according to claim 2 wherein the said density is  $60\text{ kg/ m}^3$ .

4 A mattress according to claim 1 wherein the foam material is a polyether/viscoelastic polyurethane material.

5. A mattress according to claim 1 wherein the foam material top surface is provided in a manner so as to define at least two zones.

6 A mattress according to claim 5 wherein the said zones are at least partially defined by differences in the contour shape of the said top surface.

7 A mattress according to claim 1 wherein the said contours are provided of a first form to specify a first zone located towards a first end of the mattress on which the person's lower legs and feet are to be located and in a second form to specify a second zone located intermediate the said first zone and the opposing end of the mattress on which the persons torso is located.

8 A mattress according to claim 7 wherein a third zone towards the said second end of the mattress is defined by contours.

9 A mattress according to claim 8 wherein the said contours are the same shape as those used to define the first zone.

10 A mattress according to any of the preceding claims wherein the contours are provided in the form of castellations.

11 A mattress according to claim 10 wherein the castellations used to form the first and third zones are narrower in width than those used to specify the second zone.

12 A mattress according to any of the preceding claims wherein foam material is used to form at least the top surface of the mattress body.

13 A mattress according to claim 12 wherein the said foam has an open cell structure to aid air flow through the same.

14 A mattress according to claim 12 or 13 wherein the foam material includes graphene.

15 A mattress according to claim 1 wherein the said foam material used to form the top surface of the body is provided as a layer, at least part of which is attached to a base layer of foam material with different characteristics.

16. A mattress according to claim 15 wherein the base layer of foam material includes a foam material of a second type to form the longitudinal edges of the mattress and first and second portions of a foam material of a third type are located under the upper layer at the first and third zones respectively.

17 A mattress according to claim 16 wherein the second and third types of foam material have lower density values, than the foam material used to form the top surface.

18 A mattress according to claim 17 wherein the said densities of the second and third types of foam material are in the range of 30-38 Kg/m<sup>3</sup>.

19 A mattress according to claim 1 wherein a cavity is defined in the mattress body, said cavity have an opening on the bottom surface of the body which extends from the bottom surface towards the top surface but does not extend to the foam material layer which forms the top surface of the body.

20. A mattress according to claim 19 wherein the said cavity receives therein a plurality of cells.

21. A mattress according to claim 20 wherein the cells are provided as an assembly



which includes an envelope in which the cells are located and the envelope is, in turn, located in the cavity.

22. A mattress according to claim 21 wherein each cell includes an enclosure which defines a space in which a block of foam is located, and the passage of air into and from the cell is possible and controlled by at least one valve means.

23. A mattress according to claim 22 wherein the valve or valves are self-adjusting to take into account the pressure exerted on the cell at that time and thereby allow the escape or introduction of air so as to allow a change in support which is required with respect to pressure being applied to the cell.

24 .A mattress according to claim 23 wherein the valves are bi-directional.

25 A mattress according to claim 23 wherein each valve for each cell is preset by utilizing a restrictor to regulate air flow with regard to a range of different settings which can be selected.

26 A mattress according to claim 20 wherein the cells are independently adjustable in terms of air flow into and from the same and arranged with their longitudinal axes in parallel.

27 A mattress according to claim 19 wherein the said cavity is arranged substantially centrally of the mattress body and within the second zone of the mattress. In one embodiment the side walls of the cavity are defined by the portions of foam material of the second type and the end walls are defined by the portions of foam material of the third type.

28 A bed, said bed including a support frame on which a mattress is mounted and supported and wherein said mattress is as defined in any of claims 1-27.