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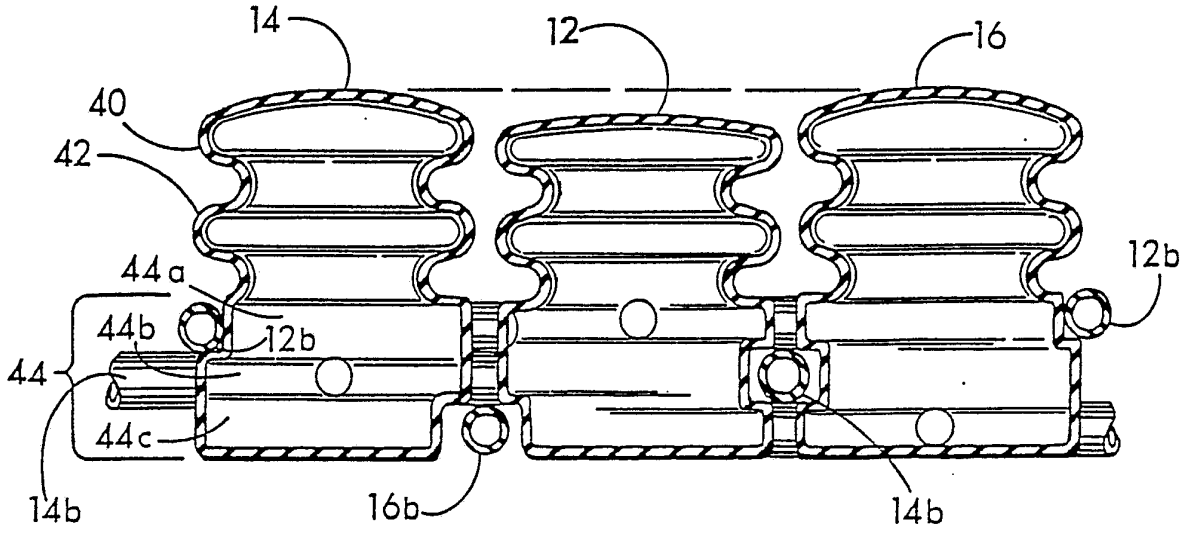

(57) Abstract

A hollow, air filled body support cushion (10) such as a seat cushion or mattress is formed from typically three interfitting matrices each comprising a set of hollow cells (12, 14, 16) formed from natural or synthetic rubber or rubberlike plastic. The cells (12, 14, 16) of each matrix are spaced apart to accommodate between them cells of each of the other matrices to define a body support surface (9) made up of the tops of all of the cells (12, 14, 16). Each matrix has separate fluid duct (12b, 14b, 16b) between its cells (12, 14, 16). A fluid pressurizing and control means (26, 28, 32) such as air pumps is used to inflate and deflate the matrices in sequence to shift body support from one set of cells to another for promoting blood circulation and enhancing comfort.

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FLUID PRESSURIZED CUSHION

FIELD OF THE INVENTION

The present invention relates to automatic and passively pressurized seat or bed cushions having interconnected hollow body support cells.

BACKGROUND OF THE INVENTION

Numerous inflated cushions have been proposed for varying the air pressure in selected portions of a cushion to change the areas of support over a period of time to improve comfort and blood circulation. These devices have been used on beds and wheelchairs to forestall or reduce skin breakdown in immobile or elderly patients. Skin breakdown can occur (usually at bony locations) when prolonged and uninterrupted sitting pressure reduces blood circulation below the level required to sustain tissue life. Breakdowns also can occur when a cushion does not provide adequate ventilation and causes the skin to be excessively moist and warm for prolonged periods.

Prior inflated cushioning devices have provided either passive or dynamic support for the body. While prior inflated devices have been useful, they have had some shortcomings. In some devices a leak can cause the cushion to collapse, rendering it ineffective. Some cushioning devices are not thick enough to fully contact and support the user's body contours without bottoming out. When cushion inflation pressure is increased to prevent bottoming out, the ability of the cushion to conform closely to the user's skin is reduced. As the cushion becomes more firm, its benefit to the user decreases. But if the cushion is made thicker to improve conformability, it tends to become unsteady and difficult for persons with impaired body balance to use. Moreover, as the cushion becomes more conformable it becomes more difficult for ventilating air to reach the skin and keep it cool and dry and thus increases the risk from skin maceration.

At the present time there are cushioning devices available which will support the body horizontally at pressures of about 10 millimeters of mercury and provide adequate ventilation. The fluidized bed is a prime example of one such device. But even fluidized devices cannot provide effective support for seated individuals in wheelchairs because there is insufficient seating area to reduce support pressures to the level of 10 millimeters of mercury advocated in medical literature for spinal cord injured persons. Sitting pressures at bony locations can be ten or thirty times higher than this amount and, except for cushion intervention, are the usual places where skin breakdown begins.

Cushion interventions which reduce the risk of skin breakdown generally involve providing increased conformability to reduce average sitting pressure (air or fluid filled passive cushions), contouring surfaces to support the user on the fleshier and non-bony parts of the sitting area which are less likely to develop pressure sores (foam composition passive cushions), conformable cushions with high heat acceptance capacity intended to delay heat build-up in the sitting area (gel filled passive cushions), dynamic cushions which continually shift sitting pressure to different parts of the resting surface to allow blood circulation and air circulation to be restored to all parts of the sitting area (alternating pressure cushions).

Medical authorities are in general agreement that an ideal cushion should not cause prolonged impairment of blood circulation to the tissues in the sitting area, should not cause the skin to become hot and moist, should provide stable support with postural and transfer benefits, should provide comfort, durability and convenience at an affordable price.

In one form the present invention provides an alternating pressure cushion which has the foregoing benefits to wheelchair cushion users without the

limitations of earlier devices and concepts. The invention can also be used as a highly beneficial passive cushion. Moreover, it will not bottom out even if punctured.

SUMMARY OF THE INVENTION

The present invention provides a hollow, fluid pressurized body support cushion formed from at least two and preferably three interfitting matrices. Each matrix comprises a set of hollow cells formed from an elastomer such as natural or synthetic rubber or other resilient plastic material. The cells of one matrix are fitted between the cells of each of the other matrices to define a body support surface composed of all sets of cells. Separate fluid ducts are provided between the cells in each matrix so that the cells of one matrix are connected only to the cells of the same matrix. A fluid such as air is provided in the cells. Optionally, a fluid pressurizing means is connected to each matrix to inflate and deflate the separate matrices at different times to shift body support from one set of cells to another to promote blood circulation and comfort. When the pressurizing means is not used the invention acts as a passive cushion.

The present invention thus provides a cushion which can be used for a seat or bed which in addition to being very comfortable, yieldable and elastic allows the support points to be shifted from area to area. It can be made from a variety of resilient elastomers such as natural or synthetic rubber and operates automatically for as long as it is in use.

When the system is used as a dynamic support surface having automatic air inflation and deflation, two of the three matrices are pressurized at any given time and the third matrix is vented to the atmosphere. The vented matrix, one-third of the entire support surface, is unable to support any weight and so cannot exert any pressure on

the body. Because the dynamic cushion supports the body on only two-thirds of its surface, cushion support pressures against the body are higher than if the entire surface of the cushion were used to support the body. However those higher pressures on the skin are relieved as the matrices are sequentially pressurized and vented automatically at regular intervals of about two minutes. Blood flow is restored to another third of the resting area each time another set of matrices is pressurized and vented.

It is possible to use the cushion for passive support as well as for dynamic support. This is accomplished by admitting and retaining an appropriate amount of air by means of a valve which is fitted in each matrix for this purpose. When a body rests on the cushion, the air inside each matrix is forced from cells which are subjected to higher compressive forces to cells which are subjected to lesser external forces. Because the air inside the matrix of cells is at the same pressure, all cells in the same matrix support the external load with equal pressure.

Although passive cushions strive to maximize their load carrying area, all passive cushions develop excessive pressure and restrict blood circulation. Because passive cushion pressures are unrelieved and prolonged, blood flow is reduced and is not restored. Average passive cushion pressures (about 50 millimeters of mercury) significantly exceed recommended values for unrelieved support pressure (30 mmHg for non-paralyzed persons; 10 mmHg for paralyzed persons). However, many users of wheelchair cushions prefer passive cushions to dynamic cushions if they can shift or lift themselves periodically to relieve sitting pressure. This exertion helps them to avoid immobility deterioration. Furthermore, passive cushions are generally less expensive and somewhat more convenient to use then dynamic cushions. However, aging and a relatively immobile lifestyle eventually force wheelchair users to use better cushions or to spend more time in bed

in order to avoid skin breakdown.

The decision to use a passive or alternating pressure cushion is based on medical and economic factors which keep changing with the patient's health and economic status. An important benefit of the present invention is to make available a single superior passive cushion which can become a superior alternating pressure cushion at any time by simply connecting it to a controlled air module which operates from its own battery or from a wheelchair battery. It is less costly to upgrade from passive to dynamic support because the same cushion can be used; only the alternating air pressure module needs to be added. No support system currently in commercial use offers this benefit.

When used as a passive cushion, the present invention supports the user on three independent air matrices. If one matrix should develop a leak or be punctured, the user will not bottom out because his weight will be supported by the two remaining matrices. When other types of passive inflated cushions develop a leak or sustain a puncture, they allow the user to bottom out. If the patient is paralyzed or is not aware of the leak, he continues to sit on the deflated cushion and often sustains tissue damage or breakdown. The ability of the present invention to keep the user from bottoming out is an important safety benefit not available in other inflated cushions.

Because each matrix of cells in the present invention is an independent structure adjacent but not connected to the other matrices, ambient air can circulate to the resting area, i.e., patient support surface, and remove heat and humidity. Other cushion types have continuous support surfaces which restrict or prevent air circulation. An important benefit of the present invention is its ability to keep the user's skin cooler and drier. The important of keeping the skin at normal temperature and humidity is of major concern in medical

cushions. Passive cushions as a group are single-surface thermal insulators and do not permit air to communicate easily with the resting surface. The present invention is a multiple surface device which affords more opportunity for ambient air to circulate through the space surrounding each free-standing cell and reach the resting surface to carry away heat and humidity. When the present invention is used as a dynamic cushion the air circulation benefit increases.

If the present invention should require servicing or repair, the matrix that requires attention can be manually disengaged from the other matrices and a new matrix inserted in its place without complication or special tools. In addition to the speed and convenience of servicing, it is less costly to replace or repair one-third of a cushion than it is to replace an entire cushion.

Stable support and minimum thickness are additional desirable attributes in cushions when the user's balance is impaired, or when the cushion is to be used in a van where headroom is limited and cushion sway can affect the driver's control. Transfers to and from the cushion become more difficult when the cushion is unsteady. The present invention minimizes these problems by a two-level cell design. The lower portions of the cells interlock to constitute a stable base and the upper portions of the cells are individual bellows which conform closely to the body contours and move up or down to maintain uniform support pressure. When a bellows is compressed, it moves axially in a vertical direction and does not balloon outward. The bellows portion of the cell displaces only the distance needed to follow the body's contours. A prior device described in Patent 3,870,450 has cells which are more widely spaced and which must balloon outward to contact adjacent cells before they can develop a supporting surface. In that system cell walls are fluted and the cell height is increased to allow for ballooning.

That support has a rolling action and offers little or no resistance to sideways forces. It causes users to feel unsteady during sliding transfers onto or off the cushion or when experiencing changes in motion in vehicles.

The device described in Patent 3,870,450 and in related Patents 4,005,236 and 3,605,145 has significant limiting differences with respect to the present invention because all cells are interconnected whereas in one form of the present invention at least two independent configurations of cells or cell matrices are provided to constitute a body support. The prior device cannot provide alternating pressure support because it is only a single plenum. The prior device is inherently unstable because its cells cannot be positioned closely (following the techniques and reasoning presented in the patents). The wider spacing between these cells requires the cells to have enough volume and lateral extensibility to fill the spaces between the cells before the cells can begin to support the user. A pump is provided and care must be taken to not overinflate (or the support will be too firm for maximum conformability) or underinflate (or the user will bottom out). The cells of the present invention when assembled are in close proximity and immediately support the user's body weight without first laterally deforming and becoming unsteady.

These prior devices are manufactured by dip molding and require a number of careful manufacturing operations including the joining, without leaks, of the base section to the upper section along a long bond line. The present invention may be manufactured by rotational molding, whereby each matrix is molded complete without need for secondary operations except for valve assembly. The present invention is less costly to manufacture than prior designs and thus represents economic benefit to the purchaser.

The present invention when used as a passive cushion does not require a pump for inflation. When the valve in

each matrix of cells is vented to atmosphere, the self-supporting molded shape of the cells causes the cells to retain their molded shape. When the valves are closed, the cells are at full height and at ambient pressure and are ready to operate without user adjustment. This simple procedure permits the cushion to quickly and accurately adapt to operation at various altitudes. Other inflatable cushions do not have the present invention's ability to self-inflate or self-adjust.

The invention will now be described by reference to the figures.

THE FIGURES

Figure 1 is a perspective view of one preferred form of the invention.

Figure 2 is a plan view of the cushion of Figure 1.

Figure 3 is a schematic view of a cushion and its fluid pressurizing unit.

Figure 3A is a view of a preferred form of air inlet valve.

Figure 4 is a perspective view of one cell.

Figure 5 is a vertical cross-sectional view of a cell.

Figure 6 is a plan view of a portion of a cushion showing three adjacent cells.

Figure 7 is an exploded view of a portion of a cushion showing three interfitting matrices.

Figure 8 is a vertical cross-sectional view of the intermediate matrix.

Figure 9 is a vertical cross-sectional view of the uppermost matrix and

Figure 10 is a vertical sectional view showing three adjacent cells of a cushion taken on line 10-10 of Figure 2.

DESCRIPTION OF A PREFERRED EMBODIMENT

In Figures 1-3 is shown a cushion 10 made up of a plurality of cell matrices 12, 14 and 16 interfitted

between or among one another to produce a supporting surface 9 for all or a part of the human body. The cushion 10 can be suitable as a seat cushion or bed cushion. It can also be used as the back of a seat or for supporting other portions of the human body. Each of the cells 12, 14 and 16 are hexagonal in plan view as seen from above. Thus they each form an array connected together by ducts to be described below with spaces between the cells of each matrix sufficient to accommodate the cells of two other matrices. The invention is used as shown in Figure 1 without an air pressurizing means, such as an air pump, to provide a passive cushion.

In Figures 2 and 3, for convenience, the cells of matrix 12 are all indicated by horizontal cross-hatching, the cells 14 are clear and the cells 16 are designated by stippling so that the arrangement of the cells in each matrix relative to the others can be clearly seen.

As can be seen by reference to Figures 4-7, the cells of each matrix 12 are connected by interconnecting ducts 12b, the cells 14 by interconnecting ducts 14b and the cells 16 by interconnecting ducts 16b. Thus each set of cells has its own connecting ducts so that a separate air supply can be provided to each matrix 12-16, i.e., a separate set of cells. As shown in Figures 1 and 3, air is supplied to the matrix 12 through an air supply duct valve 12a. Air is supplied to the matrix 14 through an air supply duct 14a and to matrix 16 through air supply duct 16a. Each of the ducts 12a-16a as shown in Figure 3A has at its end an air supply valve 15 of a type known to the art containing a rubber plug 17 having a self-sealing opening 19 which is normally closed but which during use is adapted to receive a hollow needle 21 connected to a fluid supply tube 23. While any suitable fluid can be used in connection with the invention it is preferred to employ air.

As shown in Figure 3, which illustrates dynamic air pressurization, air is provided through supply ducts 20,

22 and 24 to the inlet duct 12a-16a from three separate pumps 26, each driven by an electric motor 28 connected to an electric operating control 32 which is itself connected via conductors 33 to a suitable source of power such as a battery (not shown). Each of the lines 20-24 is provided with a bleed valve 30 that allows air to escape slowly through a bleed hole. Thus when each one of the pumps is operating it will quickly fill up the matrix to which it is connected and maintain the desired internal pressure. However, as soon as the electric control turns off one of the motors 28, air in that matrix will escape through the bleed hole 30 over a period of, say, one minute until atmospheric pressure is reached within that matrix. Typically, two matrices are maintained pressurized at all times and one is unpressurized. Every two minutes pressure is released from one of the other matrices and the unpressurized matrix is inflated.

The individual cells will now be described with references to Figures 4, 5 and 8-10. As can be seen in Figure 4 each cell of matrix 12 is composed of a pair of upper bellows compartments 40 and 42 above one another which expand and contract vertically during use and during inflation and deflation. Between compartments 40 and 42 is a constricted neck portion of a smaller diameter than compartments 40 and 42. Together the upper compartments of cells 40 and 42 and the neck between them make up a bellows 43. The top compartment 40 of the bellows 43 has a generally hexagonal shape as seen from above with somewhat rounded corners for improved ventilation. The lower bellows compartment 42 has a circular cross-section as seen from above. It is doughnut-shaped with a convex wall. Below the bellows portion 43 is a pedestal portion 44 made up of three vertically aligned hexagonal sections 44a at the top, 44b at the center and 44c at the bottom. Alternate walls of the pedestal portions 44a-44c are of shorter and longer lengths to accommodate the ducts of adjacent cells as shown in Figure 4A. The ducts 12b and

14b accommodated between the pedestals sections 44a and 44b are clearly shown in Figure 4. The relative locations of the connected ducts surrounding each cell is shown in Figure 6.

Figure 7 which shows an exploded view of one portion of a cushion illustrates how three separate matrices, each having ducts 12, 14 and 16 at a different elevation, can be separated from one another and are fitted together during assembly to provide a complete cushion. First, the matrix 14 with the intermediate connecting ducts 14b which extend laterally from the pedestal section 44b is pressed downwardly onto the matrix 16 having ducts 16b lowermost. Next the matrix 12 having ducts 12b that extend from the uppermost pedestal section 44a is pressed downwardly into the remaining openings until the ducts 12b are accommodated between the adjacent walls of the pedestal section 44a.

Once the three matrices 12, 14 and 16 have been thus combined a complete cushion 10 is formed. The air supply ducts 12a-16a are then connected to the supply tubes 20-24 and the electric controller is turned on to operate two of the motors 28 while the other motor 28 is sequentially stopped for a period of, say, two minutes. The cycle is repeated causing each one of the matrices 12-16 to sequentially be deflated for a period of two minutes while the others are inflated throughout the cycle of operation thereby sequentially shifting support from one portion of the body to another throughout operation.

The cells are formed from a flexible but self-supporting molded elastomer having sufficient body to hold its molded shape when the interior is vented to the atmosphere with no weight thereon. The cells become a passive cushion when the matrix is sealed to the atmosphere. One self-supporting cell can be made, for example, of polyvinylchloride plastisol elastomer suitable for rotational molding and having a wall thickness of about 0.050" and a Shore durometer value of about 50 (A

scale).

The invention can be applied to a different number of matrices. For example, if two or four matrices are used, the top portion of each cell is preferably square in shape rather than hexagonal.

Many variations of the invention within the scope of the appended claims will be apparent to those skilled in the art once the principles described herein are understood.

WHAT IS CLAIMED IS:

1. A hollow, fluid pressurized, body support cushion formed from at least two interfitting matrices,

each such matrix comprising a set of hollow cells formed from a resilient elastomeric material,

the cells of one matrix being fitted between the cells of each other such matrix to define a body support surface composed of all sets of cells,

separate interconnecting fluid ducts between the cells in each matrix, and

fluid pressurizing means to inflate and deflate the separate matrices at different times to shift body support from one set of cells to another for promoting blood circulation and enhancing comfort for the user.

2. The cushion of Claim 1 wherein each cushion is composed of cells comprising an upper hollow bellows portion and a lower hollow pedestal portion and the interconnecting ducts extend between the pedestal portions of the cells in the same matrix.

3. The cushion of Claim 1 wherein each cushion comprises a plurality of spaced apart cells, the spacing between the cells being sufficient to accommodate the cells of the other matrices whereby the cells of each matrix are interfitted between the cells of another matrix.

4. The cushion of Claim 2 wherein the bellows portion comprises a pair of vertically disposed chambers, the upper one of which has a generally hexagonal configuration, the lower one of which has a generally circular configuration and said pedestal comprises a plurality of vertically aligned hollow hexagonal sections with alternate side edges longer than side edges intermediate them to accommodate ducts of an adjacent matrix.

5. The cushion of Claim 1 wherein three matrices are provided, each having cells arranged in a hexagonal array with spaces between cells of each matrix of the proper size to accommodate the cells of an adjacent matrix so that when the three of said matrices are interfitted together a complete cushion is formed having an upper supporting surface defined by adjacent top portions of all of the matrices and the ducts of each matrix are positioned at a different elevation to allow the matrices to be nested together.

6. The cushion of Claim 5 wherein each cell of each matrix includes an upper vertically expandable bellows portion and a lower less expandable pedestal portion, each pedestal portion includes an upper, an intermediate and a lower portion and the ducts of one matrix are all connected to the lower portion of the pedestal, the ducts of an intermediate matrix are all connected to an intermediate portion of the pedestal and the ducts of a third matrix are all connected to the upper portion of the pedestal.

7. The cushion of Claim 6 wherein the top portion of the bellows section of each cell is generally hexagonal as seen from above and a second lower portion of each bellows has a generally circular configuration.

8. The apparatus of Claim 1 wherein an air supply is connected to the cushion, said air supply includes air pressurizing means and timing means for alternately inflating and deflating selected ones of said matrices.

9. The apparatus of Claim 8 wherein the air pressurizing means comprises an inflation means for each of said cushions, motor means for operating each of said

inflation means and a control means for selectively operating said motors whereby when three matrices are provided two motors are operated simultaneously to inflate two of said matrices while the other motor is turned off and each motor is turned off in sequence to sequentially deflate one matrix at a time.

10. The cushion of Claim 1 which is self-inflating when vented to the atmosphere and is self-adjusting in volume due to the self-supporting shape and consistency of the cells whereby no pump is required for volume adjustment.

11. The cushion of Claim 1 wherein said cells have an upper portion of polygonal shape including corners, and said corners are rounded to enhance ventilation of a seating area.

12. The cushion of Claim 1 wherein at least some of said cells comprise a vertically extensible bellows having at least two bellows compartments of a selected diameter and a centrally constricted neck portion of a smaller diameter therebetween.

13. A fluid pressurized body support cushion for supporting the body in a sitting or lying position comprising a plurality of side-by-side hollow cells each adapted to containing a pressurizing fluid and each cell including at least two vertically spaced bellows compartments each of a selected diameter with a centrally constricted neck between them of a smaller diameter than said compartments whereby the cells are vertically extensible to thereby provide cushioning support for the body.

14. The cushion of Claim 13 wherein said cells are adjacent to one another and include separate side

walls enabling the cells to be moved independently of one another in a vertical direction.

15. A body support cushion comprising a plurality of separable matrices which can be taken apart from one another or assembled in interfitting relationship to define said cushion and fluid pressurizing means to alternately inflate and deflate said matrices.

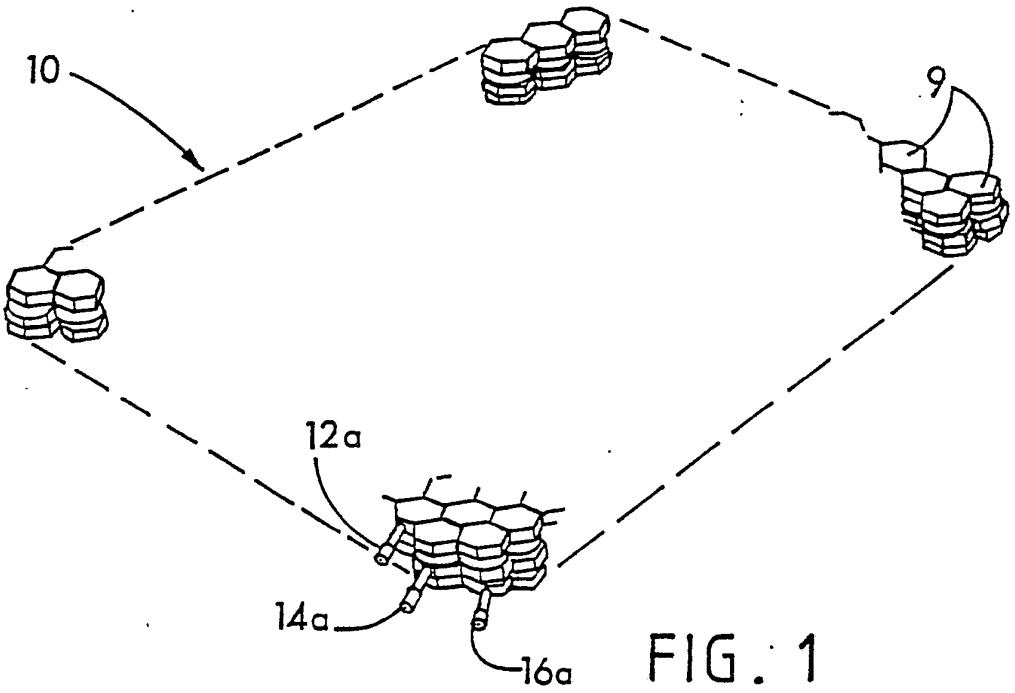

FIG. 1

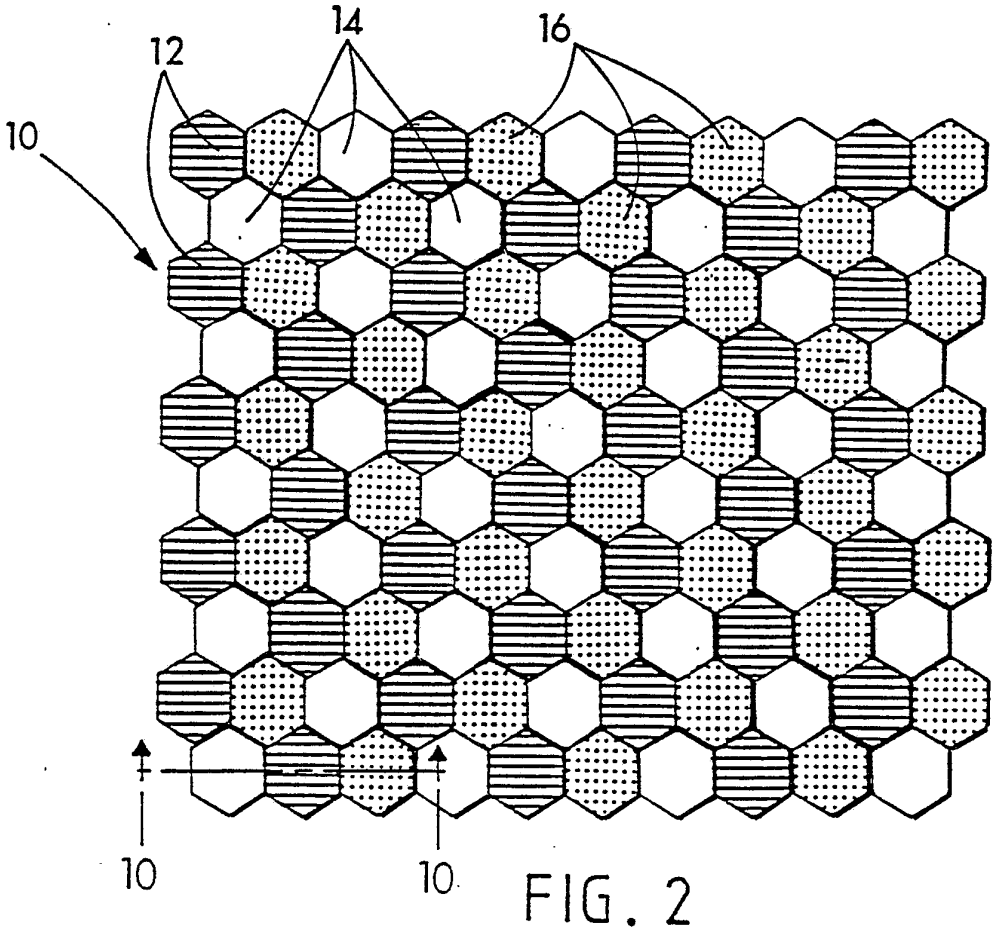

FIG. 2

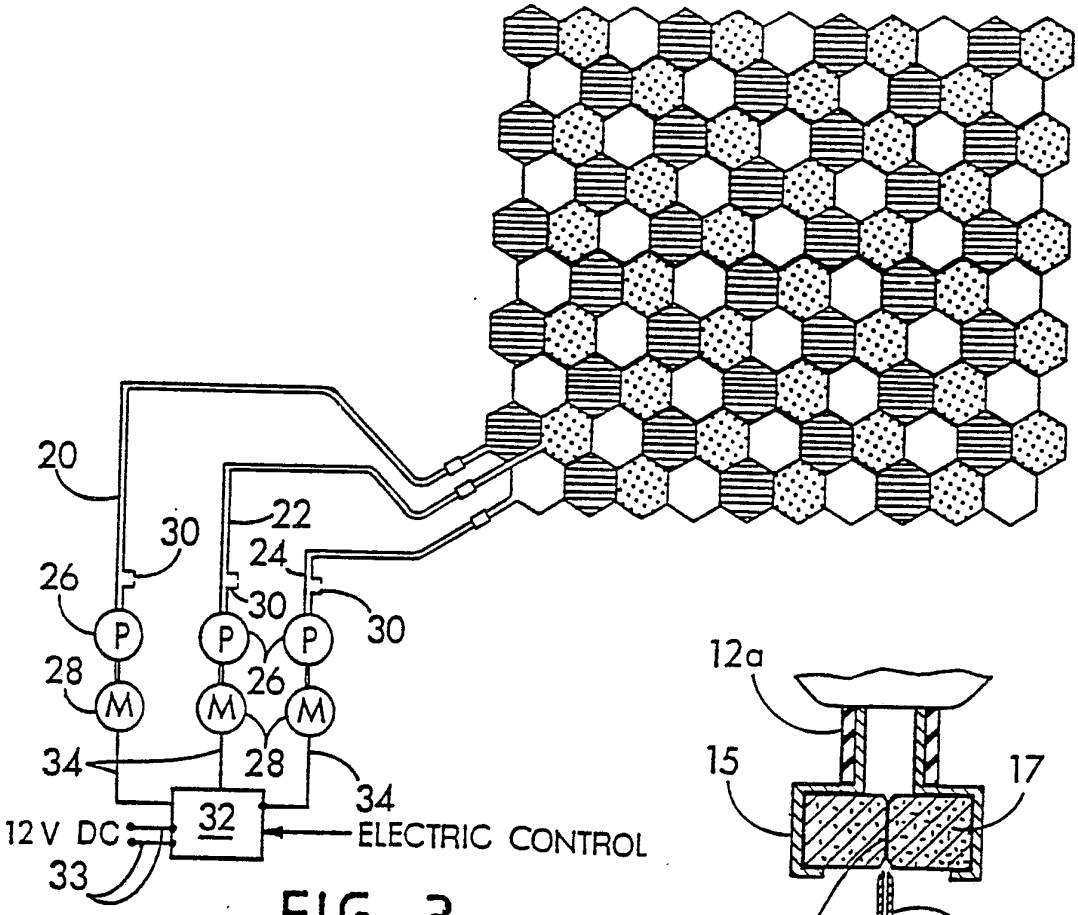

FIG. 3

FIG. 3A

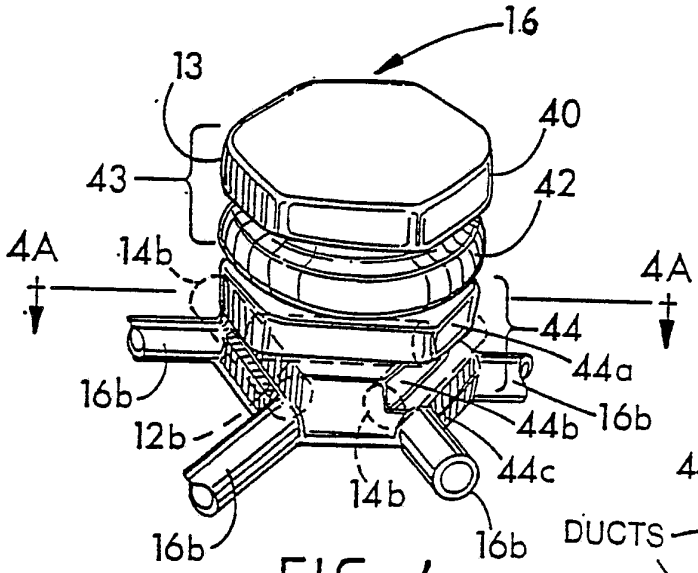

FIG. 4

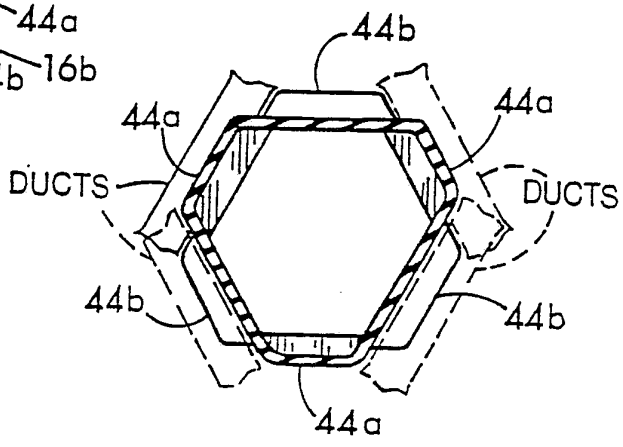

FIG 4A

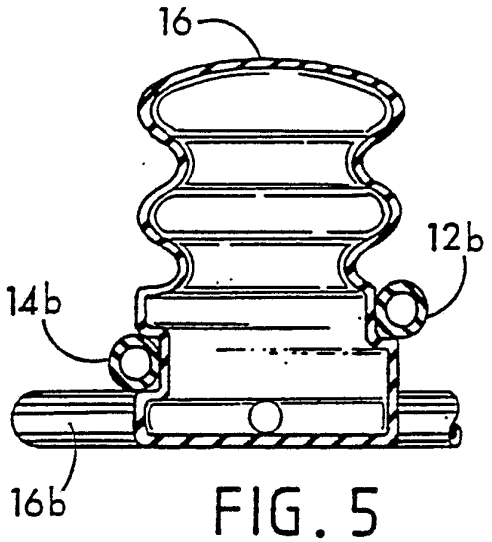

FIG. 5

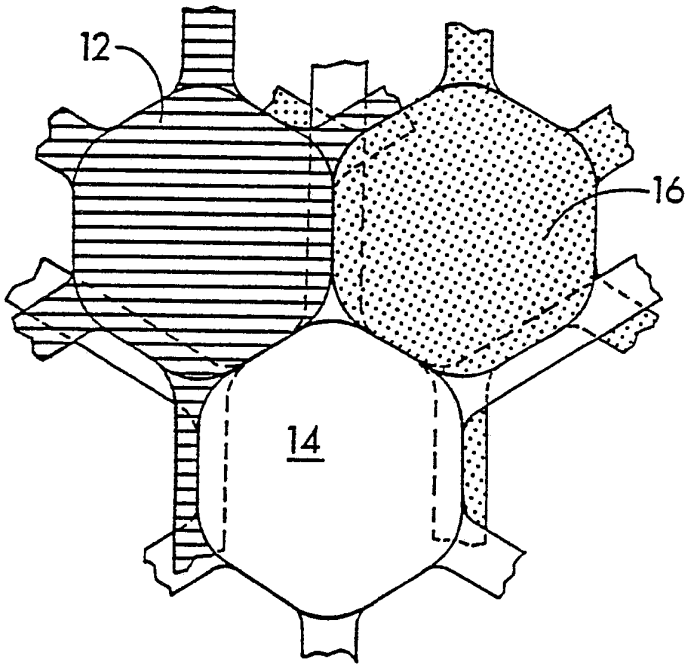

FIG. 6

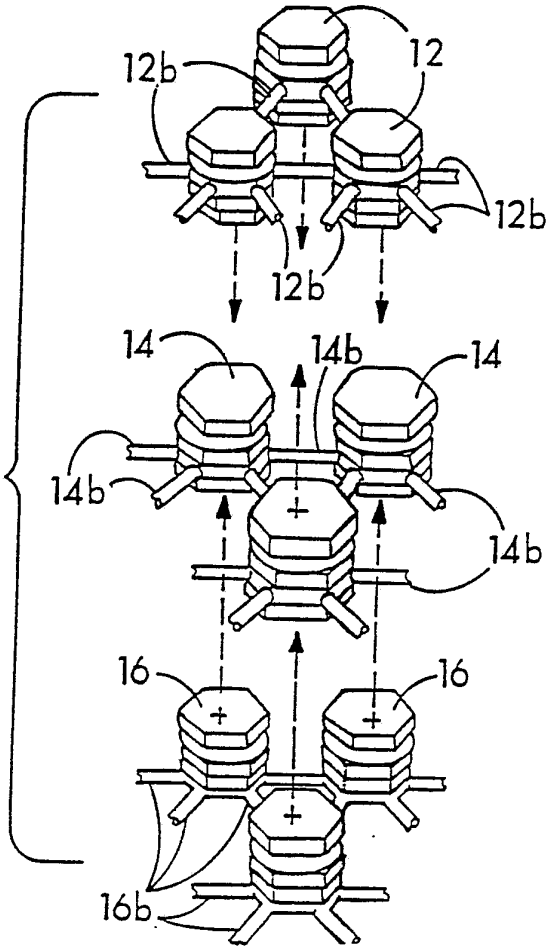

FIG. 7

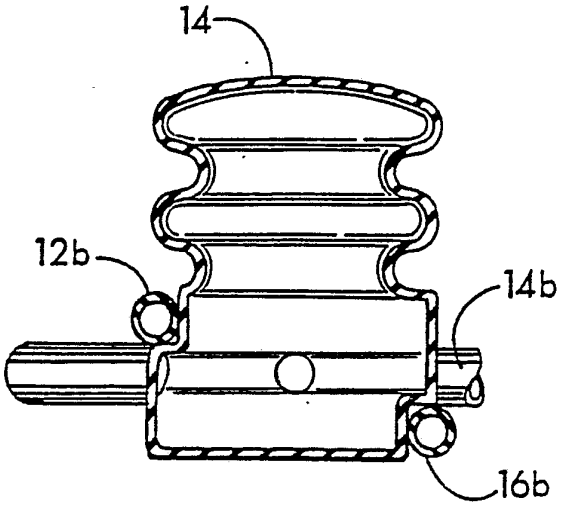

FIG. 8

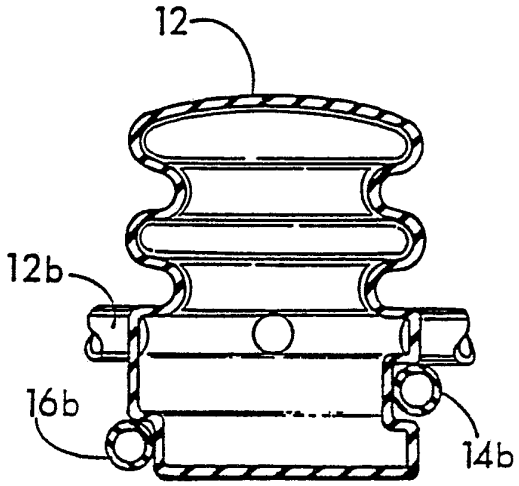

FIG. 9

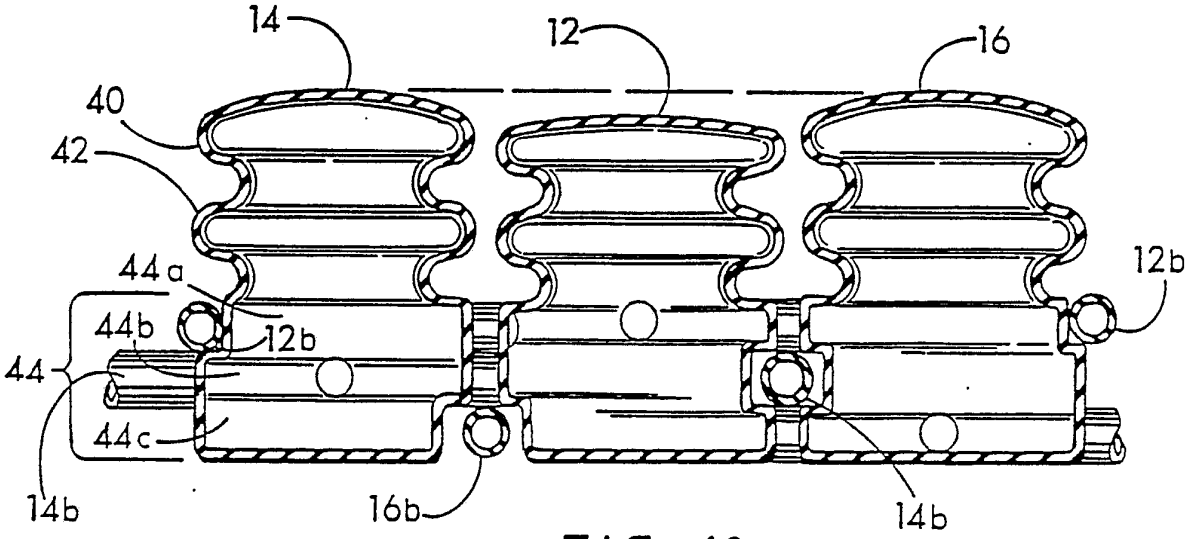

FIG. 10

INTERNATIONAL SEARCH REPORT

International Application No PCT/US 88/03555

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [6]

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC[4]: A 61 G 7/04; A 47 C 27/10

II. FIELDS SEARCHED

Minimum Documentation Searched [7]

Classification System	Classification Symbols
IPC[4]	A 61 G; A 47 C

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [8]

III. DOCUMENTS CONSIDERED TO BE RELEVANT [9]

Category *	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No. [13]
X	US, A, 1772310 (HART) 5 August 1930 see page 3, lines 3-18, 82-96; page 6, lines 85-125; figure 10	1,3,8,15
A	--	13,14
X	FR, A, 2083865 (TALLEY) 17 December 1971 see page 5, lines 20-35; figure 1	1,3,8
	--	
X	DE, C, 876760 (DRÄGERWERK) 18 May 1953 see page 1, lines 24-38; page 2, lines 34-51; figure	1,8
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A	US, A, 4120061 (CLARK) 17 October 1978 see abstract; figures 1-5	2,13,14
	--	
A	US, A, 3919730 (REGAN) 18 November 1975 see abstract; figures 1-4	1
	-- ./.	

* Special categories of cited documents: [10]

"A" document defining the general state of the art which is not considered to be of particular relevance

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IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
7th February 1989	23 FEB 1989
International Searching Authority	**Signature of Authorized Officer**
EUROPEAN PATENT OFFICE	P.C.G. VAN DER PUTTEN

International Application No. PCT/US 88/03555

III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)

Category *	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No
A	GB, A, 1341325 (SCALES) 19 December 1973 see page 3, lines 65-85, 90-94; figures 6,7	1
A	US, A, 4662012 (TORBET) 5 May 1987 see abstract; figure 1	1
A	US, A, 3605145 (GRAEBE) 20 September 1971 see the whole document cited in the application	1
A	US, A, 4005236 (GRAEBE) 25 January 1977 see the whole document cited in the application	1
A	US, A, 3870450 (GRAEBE) 11 March 1975 see the whole document cited in the application	1

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO. US 8803555 SA 25215

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the European Patent Office EDP file on 15/02/89
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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US-A- 1772310		None	
FR-A- 2083865	17-12-71	NL-A- 7103049	15-09-71
		DE-A,B,C 2103499	23-09-71
		GB-A- 1286197	23-08-72
		US-A- 3678520	25-07-72
		BE-A- 761360	16-06-71
		SE-B- 362785	27-12-73
DE-C- 876760		None	
US-A- 4120061	17-10-78	None	
US-A- 3919730	18-11-75	None	
GB-A- 1341325	19-12-73	US-A- 3822425	09-07-74
US-A- 4662012	05-05-87	None	
US-A- 3605145	20-09-71	None	
US-A- 4005236	25-01-77	US-A- 3870450	11-03-75
US-A- 3870450	11-03-75	US-A- 4005236	25-01-77