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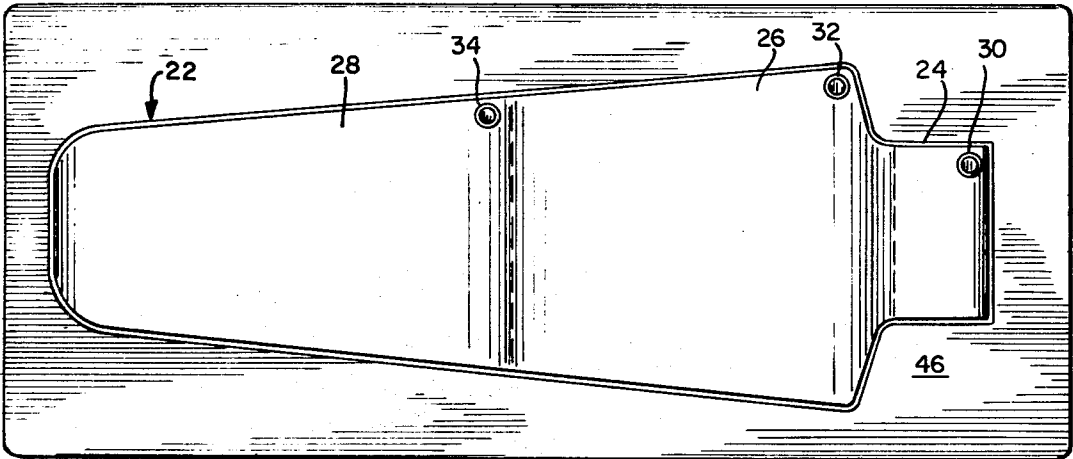
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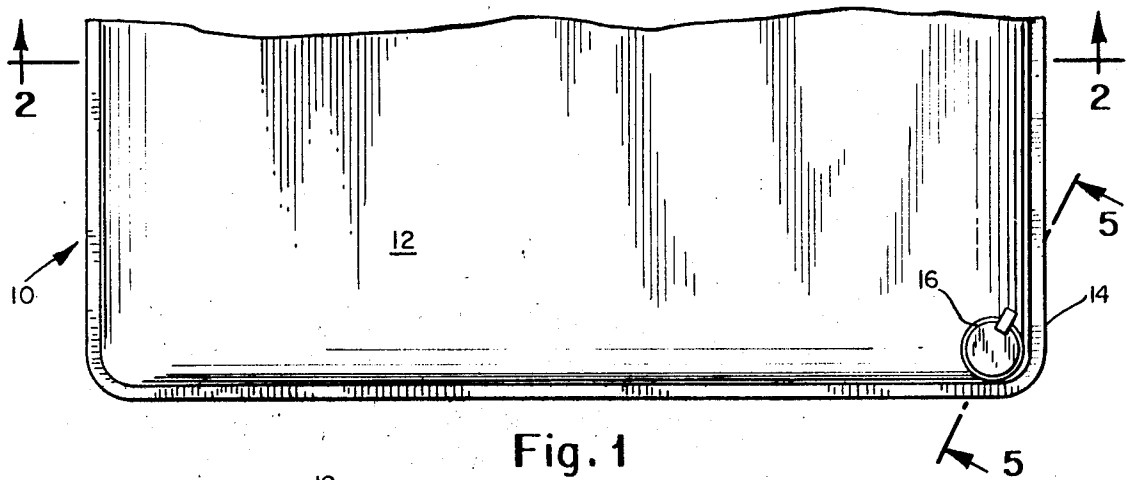
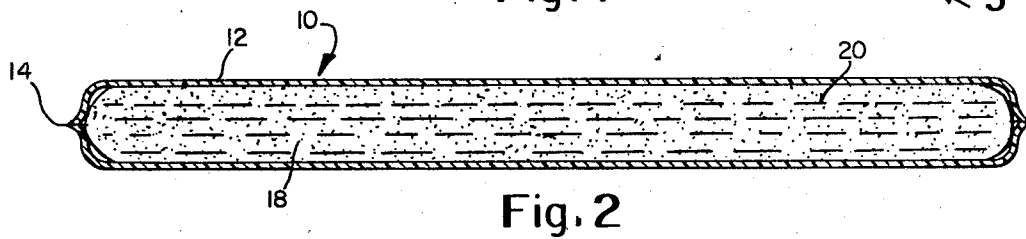
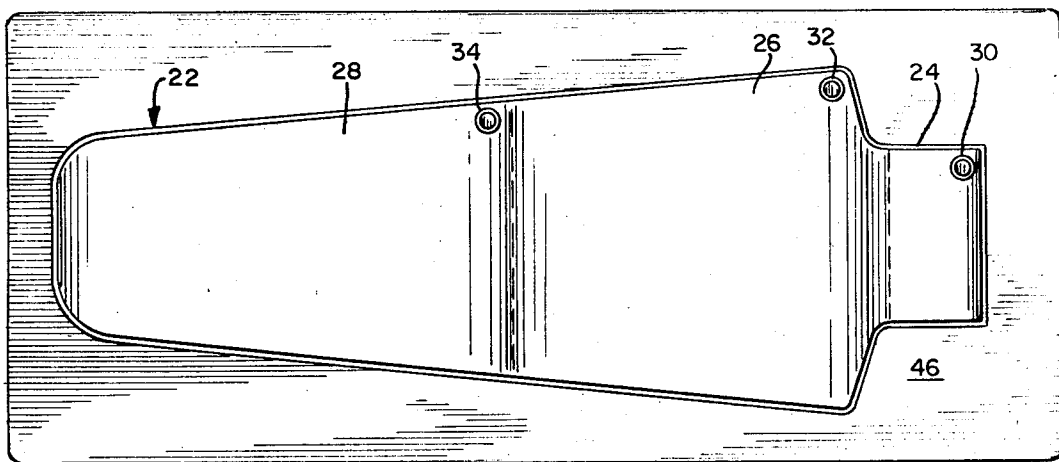
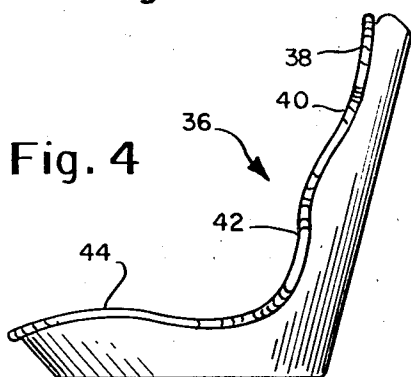
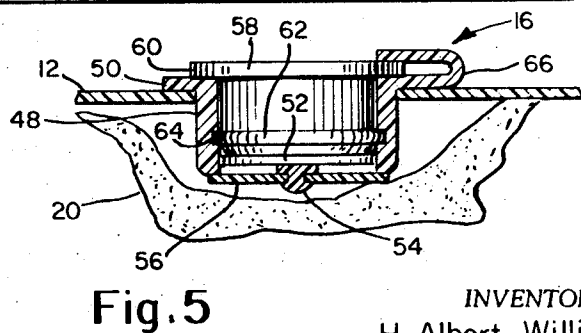
[54] **PRESSURE-CONTROLLED CUSHION STRUCTURE**
5 Claims, 5 Drawing Figs.

[52] U.S. Cl..... **5/348**
[51] Int. Cl..... **A47c 27/18**
[50] Field of Search..... **5/348**

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ABSTRACT: A therapeutic comfort pad or mat includes a flexible film outer envelope substantially filled with a fluid-pervious foam material. Noncompressible fluid is introduced through a valve in the envelope and the proportion of air to water to foam is adjusted at the valve by the introduction or withdrawal of air and/or water therethrough. The valve is self-closing under the influence of internal pressure but can be opened by finger pressure applied externally.





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PRESSURE-CONTROLLED CUSHION STRUCTURE

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates generally to cushioning pads and mats, primarily those in the field of health care, and more particularly to novel hydraeric support cushions (i.e., fluidic whether compressible or noncompressible and whether normally gaseous or liquid) for distributing reaction forces for comfort and/or hygienic purposes, upon the human or other body.

Although the present invention has particularly advantageous application in the field of seat pads for wheel chair patients and although, in the cause of brevity and clarity of presentation herein, much of the following discussion and description of examples of the invention relate thereto, it is expressly to be understood that the advantages of the invention are equally well manifest in other fields wherein it is desired that such a body or portions thereof whether human or inanimate be supported with minimum concentration of forces over the supported surfaces thereof.

2. Discussion of the Prior Art

With particular reference, then, to the problems of an invalid patient for whom long periods of reclining or sitting is required, as in a wheel chair, for example, the development of decubitus ulcers in the regions of the body's bony protuberances is well recognized as a particularly severe medical problem. The concentration of reaction forces exerted on the body by the seating structure creates deleterious localized pressures tending to preclude necessary circulation of blood to these regions; the resulting ulcers are painful and dangerous with respect to infection and are typically extremely difficult to heal.

Prior art attempts to provide effective cushioning have typically been directed toward developing a rubberlike or otherwise soft pillow or a carefully constructed, conformed-to-the-body apparatus, or the combination of both, for supporting the patient in a seated, reclining or other position.

The pillow approach provides, of course, an improvement over normal chair seats, but in practice has not prevented decubitus ulcers in most instances and has not afforded conditions to permit their cure once they have developed. The resilient or compressible material simply packs until some force distribution has occurred and the material, where the forces are the greatest, has become firm enough deleteriously, to support those forces.

The contoured or conformed-to-the-body approach has provided further improvement; but, to be effective in problem cases, it must be custom made at a relatively high expense. Furthermore, at best, the conformed seat or other structure totally limits the patient from shifting his seating or other disposition without losing his relationship of conformation with the pad. In addition, lateral forces due to leaning or slumping cause a redistribution of forces resulting in their deleterious concentration with, likely, the incumbent loss of adequate circulation in the regions of concentration.

Another approach in the prior art has utilized liquid or gas-filled cushions in attempts to distribute the supporting forces away from the firmer protrusions of the body. However, these attempts have required such firm outer containers in order to achieve an adequate degree of positional stability when supporting a body as to defeat, in large measure, the pressure distributing capability of the fluid within the cushion. Insufficient stability stemming, for example, from the reacting hydraulic pressure being exerted upwardly and laterally to push the body sideways or to "roll" it off the cushion is obviously intolerable for an already uncomfortable patient.

Another problem not solved by the prior art is thermal discomfort suffered by the patient due to the insulative nature of pillow or gas-filled cushions. The resulting heavy sweating of the patient further adds to his unhappiness and discomfort.

Accordingly, it is an object of the present invention to provide improved supporting force distribution apparatus which is not subject to these and other limitations of the prior art.

It is an important object of this invention to provide a supporting pad for health care use, which provides a cushion of air which is adjustably releasable by the patient to a maximum comfort level while it is supporting his weight, which adapts itself to an optimum configuration for distributing body-supporting pressure essentially uniformly over the supported portion of the patient's body, and which tends to retain its comfort and configuration characteristics when the patient is removed from and later returned to the supporting pad.

Still another object is to provide such a pad which has a valve that is controllable by the patient which is automatically urged toward a closed position in response to the patient's body pressure, but which can be opened by finger pressure by the patient, but which is also urged to a closed position in response to the removal of the patient's body from the pad.

It is another object to provide such apparatus which is adaptable to function as a body support pad, seat pad, back rest, head rest, foot rest, or the like with very high efficiency of reaction force distribution away from regions of firm protuberances at which there would otherwise exist a concentration of such forces.

It is another object to provide such apparatus which is relatively thin compared to chair height such that its interposition on or withdrawal from the chair seat does not significantly affect the chair height.

It is another object to provide such apparatus which is versatile to function with total effectiveness for a range of weights and sizes of persons from a small child to an obese adult.

It is another object to provide such apparatus which affords complete dispositional stability without requiring a heavy envelope and without other compromise in achieving reaction force distribution.

It is another object to provide such apparatus which has a relatively high specific heat and a large total thermal capacity and which is also thermally conductive to remove heat continually from the supporting regions of the body.

It is another object to provide such apparatus which is reliable in all respects and long lived, inexpensive to manufacture, mechanically rugged, and aesthetically nonobtrusive in all respects.

SUMMARY OF THE INVENTION

Very briefly, these and other objects of the invention are achieved in an example thereof which includes a low-density, fluid-pervious foam pad encased within a thin, highly deformable plastic film envelope having a specially designed valve for introducing a volume of liquid therewithin which permeates the foam pad and for controlling the flow of air into and out of the pad. The ratio of gas to liquid and of their combination to the foam substance is adjustable by the patient who can manipulate the valve to release a controlled portion of the gas while the pad is supporting his body.

Further details of these and other novel features of the invention as well as additional objects and advantages thereof will become apparent and be best understood when considered in connection with the description of the accompanying drawing which is presented by way of illustrative example only.

OUTLINE OF THE DRAWING

FIG. 1 is a plan view of a portion of an example of a supporting force distribution device constructed in accordance with the principles of the present invention;

FIG. 2 is a sectional view of the structure of FIG. 1 taken along the reference lines 2—2 thereof;

FIG. 3 is a plan view of an alternative example of the invention;

FIG. 4 is a side elevational view of a further example of structure according to the invention; and

FIG. 5 is a cross-sectional view of a portion of FIG. 1 taken along the lines 5-5 thereof.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

With specific reference now to the figures in detail, it is stressed that the particulars shown are by way of example and for purposes of illustrative discussion only and are presented in the cause of providing what is believed to be the most useful and readily understood description of the principles and structural concepts of the invention. In this regard no attempt is made to show structural details of the apparatus in more detail than is necessary for a fundamental understanding of the invention. The description taken with the drawing will make it apparent to those skilled in the medical and plastic arts how the several forms of the invention may be embodied in practice.

Specifically, the detailed showing is not to be taken as a limitation upon the scope of the invention which is defined by the appended claims forming, along with the drawing, a part of this specification.

In FIG. 1, the example illustrated comprises a seating pad assembly 10 having a thin plastic film envelope body portion 12 with a peripheral seam 14 extending thereabout and having a fluid controllable, pressure supportable valve 16 communicating therethrough between the internal volume of the envelope body and the external environment thereof. The overall lateral dimensions of the pad assembly may be of the order of 17 to 20 inches square or the like.

Referring to FIG. 2, the seating pad assembly 10 is again seen to include a thin film envelope 12 which may be of vinyl plastic and have a thickness of the order of a few tens of thousands of an inch. The internal volume of the envelope 12 is substantially filled with a low-density, fluid-permeable plastic foam 18 which, in this example, may be polyurethane or polyethylene. The thickness of the pad is preferably approximately 2 inches overall.

The envelope 12, being supported by the fluid filled foam 18 may be exceedingly soft and pliable to conform closely to the supportive contours of the human body.

In practice the volume within the envelope body 12, is filled approximately 60 percent to 80 percent with water as indicated at 20. The water acts further to distribute the support reaction forces over the upper surface of the envelope and provides intrainterstices support for the material of the foam filler. The fluid also is considered effective to some degree in "lubricating" or minimizing the friction associated with the action of the foam material as it is being deformed by movement of the body which it is supporting. In addition, the cooperation of the foam and fluid is such that all movement of the liquid laterally across the pad is clamped by the flow impedance of the foam to the liquid. This tends to stabilize the pad in all respects and significantly adds to the comfort and security of the patient.

It is deemed presently preferable to allow approximately 10 percent of the volume of the envelope to be filled with air. The variation of this parameter by controlling introduction or withdrawal of air through the valve 16 while the patient is supported on the pad is an important factor in optimizing softness and coolness and lateral stability for the particular patient.

When desired, the liquid may be chosen to have a higher specific heat than water for greater coolness capacity; greater thermal conductivity for increased feeling of coolness to the patient; or more viscosity for greater lateral stability.

Referring to FIG. 3, a full body flotation support pad example of the invention is illustrated. The pad 22 comprises a plurality of segments 24, 26, 28 each having its own valve 30, 32, 34, respectively. The overall pad may be shaped to conform to the support areas appropriate for the head, shoulders, trunk, and leg portions of the body as indicated. Different parameters of liquid-gas-foam and their ratios may be utilized to optimize comfort, coolness, softness, stability as desired in ac-

cordance with the versatility and other such features of the invention.

With further reference to FIG. 3, a dry foam frame body 46 is provided, having a thickness comparable to that of the pad 22 and being formed with a recess or opening therethrough for receiving, in a peripherally fitted relation, the pad 22. The frame body 46 effectively levels the pad to a simple planar bed surface and thereby adds to the comfort of the patient and to the lateral stability and overall appearance of the assembly. The foam of the frame body 46 may be any relatively easily deformable, stable, expanded cellular plastic having a suitable effective softness for supporting the patient's limbs or bedside equipment and furnishings.

In FIG. 4, a segmented, substantially full body seating pad is illustrated. The pad assembly 36 includes a head rest portion 38, upper and lower back portions 40, 42, respectively, and upper leg portion 44. Each segment is preferably sealed from the other segments and supplied with its own control valve, not shown, thereby to achieve independency of support parameters while minimizing the hydrostatic pressure differential along the height of the back portions. Again the flexibility and universality of utilization of the apparatus is manifest.

Referring to FIG. 5, an example of the valve 16 is illustrated as including a short cylindrical body 48 having a sealing flange portion 50 which is bonded to the pad envelope 12 and a large opening grid assembly 52 all formed integrally with the body 48. The grid includes a retainer post element 54 which holds a sealing flapper disk 56 in a valve-sealable relation over the grid assembly in a manner to seal, unilaterally, the contents of the envelope body 12 from escaping. This sealing action may be defeated, when desired for adjustment, by digitally pushing the flapper disk 56 downwardly away from its sealed relation with the grid assembly.

Hydraeric flow in the opposite sense is substantially precluded by a sealing plug cap member 58 which seals somewhat in the outward or exit sense but seals securely in the inlet or ingress sense by virtue of its peripheral flange portion 60 which matingly is held against the upper surface of the flange portion 50 of the body 48. A retaining ridge and shoulder 62, 64 may be molded into the plug cap member 58 and body 48 respectively, for removably retaining the plug 58 in a sealed relation with respect to the body 48. The plug cap member 58 may be flexibly affixed to the body 48 by a molded strap element 66, as shown.

Accordingly, it will be apparent that the envelope 12 may be filled partially with water or other liquid by removing plug 58, depressing valve 56 digitally and pouring in the water. The intercommunicating nature of the cells of the foam 18 permits the water to distribute itself uniformly throughout the foam. Of course, that portion of the space within the envelope 12 which is not occupied by foam material or water is occupied by air which is also substantially uniformly distributed along the surface and partially in the cells of the foam.

When the pad is subjected to the patient's weight, the air, water and foam within the envelope 12 are subjected to pressure which bears upon the valve 56 and urges it firmly toward its closed position. If the patient desires to release some of the air, he need simply pull out the plug 58 and depress the grid assembly 52 with his finger, thus opening valve 56 and permitting air to escape. During this period his body gradually compresses the foam 18. Any minor amount of water tending to escape with the air is entrained in the cells of the foam 18. When a proper amount of air has been released to provide maximum conformity of the pad to the shape of the patient's body, the patient removes his finger from grid 52, allowing the residual internal pressure due to the weight of the patient's body to close the valve 56. He then replaces plug 58 in body 48 and members 62 and 64 form a further seal.

If the patient should subsequently depart from or be removed from the pad, the foam 18 tends to expand toward resumption of its original shape and correspondingly expands the envelope 12 so that the internal pressure is suddenly

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decreased, forming a vacuum tending to open the valve 56. But this reduction in pressure or creation of vacuum also draws plug 58 and its flange more tightly into its closed position, preventing any inward flow of air and preserving the carefully regulated liquid air balance within the envelope 12 so that it will retain the proper shape and conformity characteristics for the patient's return to, and reuse of, the pad. These are important and advantageous features of the invention.

There have thus been disclosed and described a number of examples of the invention which achieve the objects and exhibit the advantages set forth hereinabove.

The following is claimed:

1. Pressure-controlled cushion structure comprising a deformable plastic film envelope having an enclosed space therein, fluid permeable foam means having intercommunicating cells disposed within and extending substantially throughout said space, a liquid disposed within said envelope and partially filling said space, a gas also disposed within said envelope and partially filling said space, and valve means carried by said envelope and having an opening communicating with said space for controllably flowing fluid into and out of said space in response to compression and expansion of said foam, said valve means including an external member which is urged toward its closed position when the external pressure

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exceeds the pressure within said space, and said valve means including an internal member which is urged toward its closed position when the pressure within said space is greater than the external pressure.

2. The structure defined in claim 1 wherein said valve means includes an internal valve seat and said internal valve member is reciprocable toward and away from said seat.

3. The structure defined in claim 1 wherein said external member is a manually operable plug valve.

4. The structure defined in claim 3 wherein said valve means includes an external valve seat and said plug valve has a flange arranged externally of said envelope in a position to contact said external valve seat.

5. The structure defined in claim 1 wherein said valve means includes an internal valve seat and said internal valve member is reciprocable toward and away from said seat, and wherein said valve means includes an external valve seat and said plug valve has a flange arranged externally of said envelope in a position to contact said external valve seat, whereby the pressure within the envelope may be adjusted by manually grasping said flange and removing said plug valve and shifting said internally arranged valve member away from its seat.

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