United States Patent

[11] 3,600,726

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[21] Appl. No. **807,813**
[22] Filed **Mar. 17, 1969**
[45] Patented **Aug. 24, 1971**

[54] **SUPPORT FORCE DISTRIBUTION APPARATUS**
6 Claims, 5 Drawing Figs.

[52] **U.S. Cl.** **5/348**
[51] **Int. Cl.** **A47c 27/18**
[50] **Field of Search** 5/347, 348, 338; 297/DIG. 3; 244/117.1

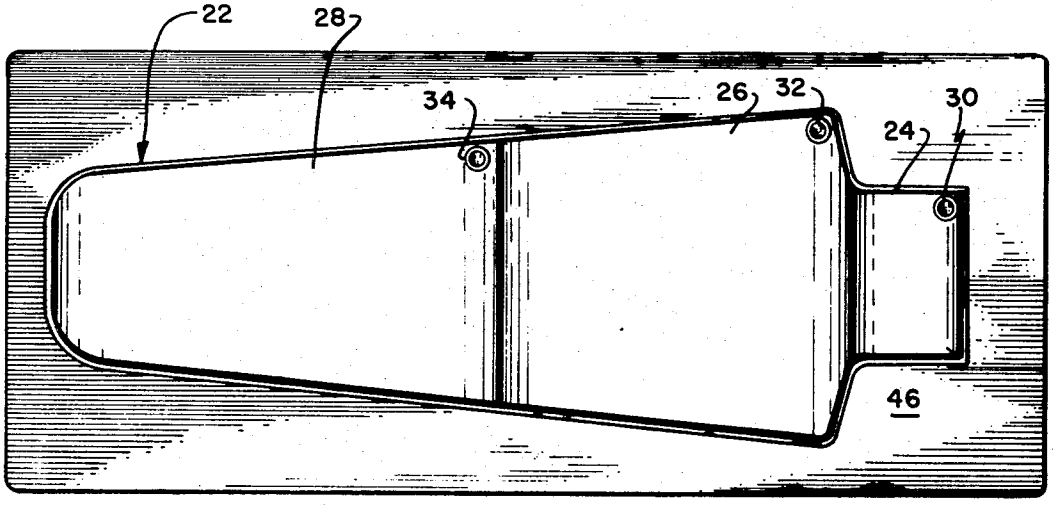
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ABSTRACT: The specification and drawing discloses a therapeutic or comfort pad as for sitting. The apparatus includes a flexible film outer envelope substantially filled with a fluid pervious foam material. Water or other noncompressible fluid is introduced 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.



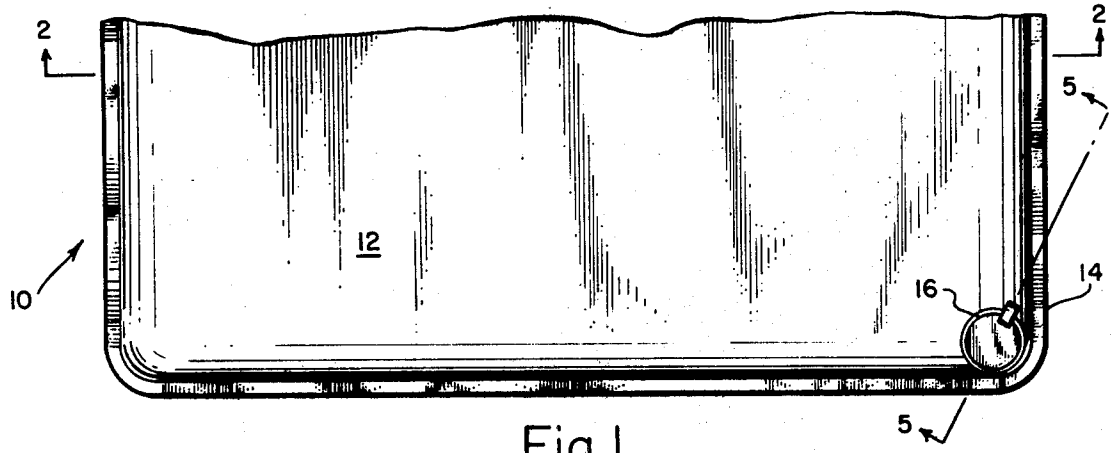


Fig. 1

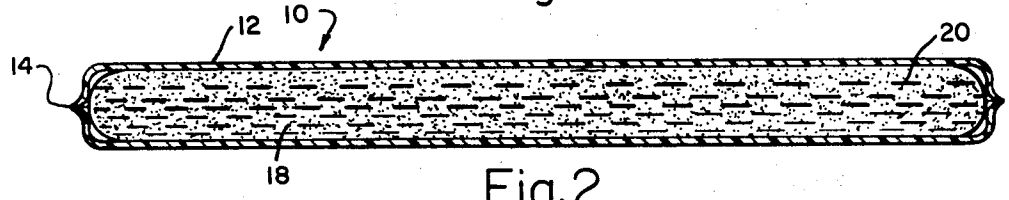


Fig. 2

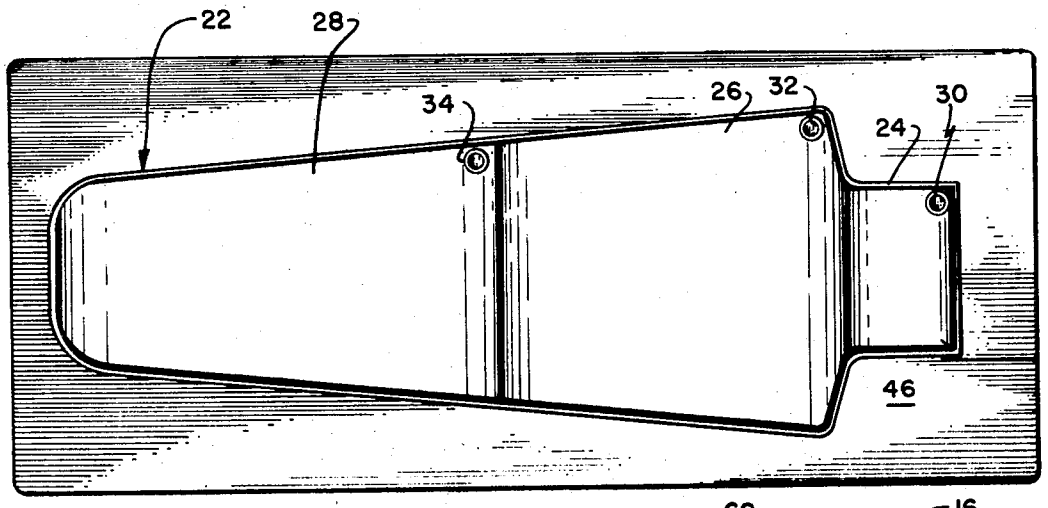


Fig. 3

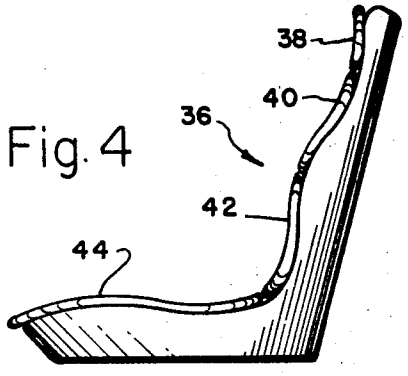


Fig. 4

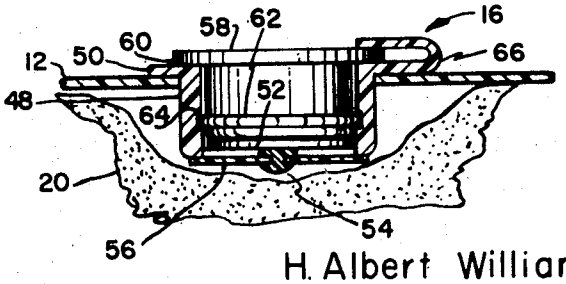


Fig. 5

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SUPPORT FORCE DISTRIBUTION APPARATUS

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates generally to cushioning apparatus and more particularly to novel hydraeric (i.e., fluidic whether compressible or noncompressible and whether normally gaseous or liquid) devices for distributing, for comfort and/or hygenic purposes, reaction forces exerted by a supporting structure against the human or other body.

Although the present invention exhibits particularly advantageous application in the field of sitting pads for wheel chair patient use 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 sitting is required as in a wheelchair, 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 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 seating apparatus or the combination of both.

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 totally limits the patient from shifting his seating 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 stemmings, for example, from the reacting hydraulic pressure being exerted upwardly and laterally to push the body sideways or to "roll" him off the cushion is obviously intolerable for an already uncomfortable patient.

Another problem not solved by the prior art approaches 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 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 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. A valve is provided for introducing a volume of liquid therewithin which permeates the foam pad. A quantity of air or other gaseous material is also introduced within the envelope and the ratio of gas to liquid and of their combination to the foam substance is adjustable at the valve.

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 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.

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 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 fluid acts further to distribute the support reaction forces over the upper surface of the envelope and provides intra interstices 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 fluid. 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 sitting 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 accordance with the versatility and other such features of the invention.

In FIG. 4, a segmented, substantially full body seating 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 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.

With further reference to FIG. 3 a dry foam frame body **46** 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 foam 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.

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** for bonding 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 and body **48** for removably retaining the plug in a sealed relation with respect to the body **48**. The plug cap member may be flexibly affixed to the body **48** by a molded strap element **66**, as shown.

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.

I claim:

1. Force distribution cushion apparatus comprising: a deformable plastic film envelope defining a hydraerically sealable internal volume; fluid permeable plastic foam means disposed within and extending substantially throughout said predetermined internal volume, a liquid disposed within said envelope and partially filling said volume, and a gas also disposed within said envelope and partially filling said volume.

2. The invention according to claim **1** which further includes valve means carried by said envelope body means for controllably introducing fluid material therewithin.

3. The invention according to claim **2** in which said foam material is fluid permeable to a degree such that at least approximately 75 percent of said predetermined volume may be filled with said liquid.

4. The invention according to claim **3** in which said foam material is low density, expanded cellular in character and is in the class of materials comprising polyurethane and polyethylene plastic foam.

5. The invention according to claim **1** wherein the quantity of substantially noncompressible fluid disposed within said body envelope is such as to fill approximately 60 to 80 percent of said volume.

6. The invention according to claim **4** wherein the gaseous fluid disposed within said envelope body means fills at least approximately 10 percent of said volume.