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(12) # EUROPEAN PATENT SPECIFICATION

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(54) **GEL-FILLED, VARIABLY-ADJUSTABLE CUSHIONING SYSTEM FOR SUPPORTING A PERSON.**

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Description

Background of the Invention

This invention relates to cushioning pads, mattresses, and seats for supporting patients and others who must spend long periods in prone or seated positions. More particularly, the invention relates to a system for variably adjusting the distribution of sup porting force imposed over a support area of a person's body by a gel-filled cushioning device so as to reduce the incidence of decubitus ulcers (bed sores).

A substantial number of mattresses and mattress pads have been developed in the past having as their objective the reduction of the incidence of decubitus ulcers in patients and others who must spend long periods in bed. These prior devices comprise flexible enclosures containing various cushioning materials such as air, liquid, gel, foam or granular materials as dis closed, for example, in U.S. patents Nos. 4,163,297, 4,454,615 and 4,628,557. Cushioning devices of the type shown in U.S. patents Nos. 4,163,297 and 4,628,557 further include a plurality of small pillow-like elements or inserts to permit the support surface con figuration to be varied by the addition or removal of the pillow elements or inserts as the case may be, thereby enabling some adjustability of the distribution of the supportive force over the person's body. However, only adjustability in relatively large increments is provided by the addition or subtraction of such pillow elements or inserts, providing only a gross approximation of the optimum distribution of supporting force required by any particular patient depending on his individual weight, body shape, and posture required by his particular medical condition.

In an attempt to meet the need for a finer, more infinite variability in the adjustment of cushioning devices for patients, mattresses have been proposed having separate internal cells which are selectively inflatable and deflatable by connection with a set of patient-operated or automatically-operated valves which alternatively supply pressurized air to, or exhaust air from, the individual cells. While such a system provides infinitely-adjustable variability, as opposed to variability by gross increments, valving and controls therefor make the system expensive. More important, such a system of inflation and deflation is practical only if employed with an air-filled mattress where the individual compartments can thus be easily filled from, and exhausted into, the surrounding air. Unfortunately, air-filled mattresses do not produce the lowest skin-surface pressures. Rather, the lowest skin-surface pressures are obtained using a gel as the cushioning material, as taught, for example, by Berjian, et al., "Skin Pressure Measurements on Various Mattress Surfaces In Cancer Patients," 62 American Journal of Physical Medicine 217 (1983).

Accordingly, what is needed is a gel-containing cushioning device having separate compartments selectively capable of receiving or exhausting gel in infinitely variable increments to obtain infinitely variable adjustability of the distribution of supporting force on a person's body, together with an inexpensive external system for selectively receiving or delivering the gel as needed.

Summary of the Present Invention

According to the present invention there is provided a cushioning device for supporting a person's weight by distributing force over a support area of the person's body in a variably-adjustable manner to prevent pressure concentration points in predetermined portions of said support area, said cushioning device comprising: an assembly for forming a major flexible surface for distributing supportive force over a support area of a person's body, said assembly including means defining multiple compartments for containing a gel separated by walls for preventing the transfer of said gel from one of said compartments to another, each said compartment underlying different portions of said major flexible surface, and means defining a plurality of selectively openable and closable ports each communicating between the interior of a respective one of said compartments and the exterior of said assembly, and characterised by gel container means, having means defining an aperture for matingly and sealingly coupling with said ports, for selectively delivering gel to or receiving gel from the respective interiors of said compartments so as to variably adjust the distribution of said supportive force, said gel container means including means for forcing gel to flow through said aperture and ports into the respective interiors of said compartments.

Thus the present invention provides a cushioning device, such as a mattress, mattress pad, seat cushion, or the like, in the form of a flexible enclosure having multiple, flexible, gel-containing compartments structurally interconnected with one another for containing a flowable gel, each underlying a different portion of a major supporting surface for supporting a person's body. The enclosure may be of a unitary type having compartments permanently interconnected with one another or, alternatively, of a modular type composed of detachably interconnected compartments. A plurality of selectively openable and closable ports, each communicating between the interior of a respective

compartment and the exterior thereof, enable the flow of gel into and out of the respective compartments. An exterior gel container, separate from the compartments, has an aperture for matingly and sealingly coupling with the ports so that it can selectively deliver gel to or receive gel from each of the compartments to variably adjust the distribution of supportive force exerted by the major supporting surface against the user's body. In this way the exterior gel container becomes a highly portable and easily handled accessory to the cushioning device, serving as a convenient reservoir into which excess gel may be exhausted from a particular compartment underlying a portion of the supporting surface where pressure is to be reduced, or as a reservoir from which additional gel may be injected into a compartment underlying a portion of the supporting surface where pressure is to be increased to compensate for decreased pressure elsewhere. The gel container also includes means for forcing the gel to flow into the respective compartments, which could conceivably be a pump but, for greater economy, preferably constitutes merely a variable-volume feature of the gel container itself. Preferably, flexibly movable containment walls may be folded or rolled to decrease the volume of the gel container and thereby force the flowable gel into a respective compartment.

The ports by which gel is injected into or exhausted from each compartment preferably include one-way checkvalves which permit the gel to flow into the compartment but prevent its exhaust therefrom unless mechanically opened by engagement with a valve-opening member associated with the gel container. Thus spillage of the flowable gel, in the process of injecting or exhausting it through the ports, is prevented.

In a preferred embodiment of the invention, a small amount of a highly water-absorbent, gel-forming solid is provided inside of each gel-containing compartment in a predetermined quantity insufficient, by itself, to provide support but sufficient, upon the addition of a greater quantity of water, to form a supporting gel filling within the compartment. Accordingly, the user, upon placing the device in service, need merely inject a predetermined quantity of water into the compartment to form the gel. This greatly facilitiates the initial shipping of the system by making it compact, and also simplifies the initial placing into service of the system. After the initial injection of water and the mixing thereof with the gel-forming solid, the gel content of each compartment can be adjusted as described previously.

It is, therefore an object of embodiments of the present invention to provide an inexpensive cushioning device which enables gel-containing flexible compartments to be employed compatibly with an infinitely-variable system for adjusting the distribution of supporting force provided by the cushioning device against the body of the user.

The foregoing and other objectives, features, and advantages of the invention will be more readily understood upon consideration of the following detailed description of the invention, taken in conjunction with the accompanying drawings.

Reference is made to GB-A-1302522 from which the known features of the preamble of Claim 1 are derived.

Brief Description of the Drawings.

FIGURE 1 is a top view of an exemplary embodiment of a mattress pad constructed in accordance with the present invention, with such pad joined at one edge to a second pad shown partially.

FIGURE 2 is an enlarged sectional view taken along line 2-2 of FIGURE 1 showing a junction separating respective gel-containing compartments.

FIGURE 3 is an enlarged sectional view taken along line 3-3 of FIGURE 1, showing the joinder of the pair of pads.

FIGURE 4 is an enlarged view taken along line 4-4 of FIGURE 1, showing a front view of an exemplary port by which a flowable gel may be injected into, or extracted from, a compartment of the pad.

FIGURE 5 is a sectional view of the port taken along line 5-5 of FIGURE 4.

FIGURE 6 is a top view of an exemplary exterior gel container usable in conjunction with the mattress pad of FIGURE 1.

FIGURE 7 is a sectional view of the port of FIGURE 4 showing its operative coupling with the exterior gel container of FIGURE 6.

FIG. 8 is a perspective view of an alternative embodiment of a mattress pad constructed in accordance with the present invention, wherein the pad is of modular construction consisting of multiple detachably interconnected gel-containing compartments.

FIG. 9 is an enlarged perspective view of one of the modular compartments of the mattress pad of FIG. 8.

FIG. 10 is a schematic side view showing how the individual compartments of the mattress pad of FIG. 8 are detachably interconnected.

FIG. 11 is an enlarged exploded view of an alternative embodiment of a port by which a flowable gel may be injected into or extracted from a compartment of the mattress pad of FIG. 8.

Description of the Preferred Embodiment

With reference to FIG. 1, an exemplary mattress pad indicated generally as 10 comprises a series of flexible compartments 20a, 20b, 20c and 20d encapsulating a gel. The mattress pad may be of single-bed width and length for use alone on a single bed or, in conjunction with a second mating gel-filled mattress pad 10a of similar construction, for use on a king-size bed. Alternatively, the pad 10 could be of one-half double bed width or one-half queen bed width and equal to full bed length. Straps such as 12 secure the corners of the pad around the bottoms of the underlying corners of a conventional mattress, the straps such as 12a at the juncture of the two pads simply lying loose if not needed.

The top flexible panel 14 of the pad 10, composed of the flexible tops of the compartments 20a, 20b, 20c and 20d, together with the flexible compartment sidewalls 15, is preferably constructed of light, heat-formed vinyl approximately 0.02 inches thick coated on its exterior with a fabric or foam rubber, although other fluid-impervious flexible materials can also be used. The top panel 14 comprises the major supporting surface for distributing force over a support area of the user's body. A bottom panel 16 of the same or similar material, but somewhat thicker (e.g. 0.025 inches thick), is glued or welded to margins 15a at the bottoms of the sidewalls 15 in a fluid-impervious manner. Separating the compartments 20a, 20b, 20c and 20d are a series of interior compartment sidewalls 15 welded or glued in a fluid-impervious manner to the bottom panel 16 along junctions 18 (FIGS. 1 and 2). Thus, each of the compartments 20a, 20b, 20c and 20d, respectively, underlies a different portion of the major flexible surface 14 of the pad 10 and is isolated by the interior sidewalls 15 from any other compartment. This prevents the transfer of gel portions, such as 22c and 22d, respectively (FIG. 2), from one compartment to another. With reference to FIGS. 1 and 3, pads such as 10 and 10a may be joined together by mating Velcro™ strips 24a, 24b affixed to the respective pads, or by any other suitable means. Additional mating Velcro™ strips 24c and 24d may optionally be provided so that all pads such as 10 and 10a may be of identical construction and yet always be capable of joinder. Each compartment has a respective selectively openable and closable port 26a, 26b, 26c or 26d mounted therein through which the gel can be selectively injected into or extracted from the respective compartments separately. To enable the effective use of the ports, the gel employed is a stable, flowable gel of any suitable known type, such as a mixture of methyl cellulose, water, preservative, coloring and bittering agent or, alternatively, a silicone gel. With reference to FIG. 5, each port preferably comprises a body 27 glued between the sidewall margin 15a and the bottom panel 16, although mounting of the ports in the sidewalls or bottom panel themselves is permissible. Each port body 27 has a threaded aperture 28 therein into which a sealing plug 30 may be screwed when the port is not in use. On the inside of the port body 27, a one-way check-valve in the form of a flattened soft vinyl or rubber tube 32 is attached, such tube normally assuming the collapsed condition shown in FIGS. 4 and 5 which prevents gel from escaping through the port from inside the compartment when the plug 30 is removed.

FIG. 6 shows an exemplary flexible vinyl gel container bottle 34 having a threaded spout 36 sealed by a threaded cap 38. With reference to FIG. 7, when the cap 38 is removed preparatory to use of the gel container 34, the cap may be replaced by an internally and externally-threaded nozzle 40 which screws onto the spout 36 and is in turn screwed into the port body 27 after the plug 30 has been removed. The nozzle 40 has sufficient length that its end 40a forces the sides of the normally collapsed tube 32 apart so as to permit the flow of gel through the port. Thus, if it is desired to extract gel from a particular compartment to lessen the supportive force applied to the user's body by the portion of the flexible supporting surface 14 overlying the compartment, pressure is applied externally to the top of the compartment thereby forcing gel from the compartment through the nozzle 40 into the external gel container 34. When sufficient gel has been extracted from the compartment, the nozzle 40 is unscrewed from the port body 27 and, as it is withdrawn, the check-valve tube 32 automatically recloses to prevent any spillage. Thereafter the plug 30 may be reinserted in the port. Alternatively, if it is desired to add gel to the compartment to increase its share of the supportive force, the gel container 34 is connected to the port as shown in FIG. 7 and its volume gradually decreased by squeezing, folding or rolling its flexible containment walls so as to force gel through the nozzle 40 into the compartment. After the desired amount of gel has been added, the nozzle is withdrawn in the manner previously described and the plug 30 reinserted in the port.

In the foregoing manner gel may be transferred from one compartment to another, but only in a controlled, external manner rather than in an uncontrolled, internal manner, and without necessarily preserving a constant mass of gel within the pad 10. In this way the distribution of supporting force against the user's body may be adjusted in an infinitely variable, controlled manner to suit each user's individual needs.

It is also within the scope of the invention to equip the pad 10 with an electrically heated subpad, or with a cooled subpad, for heating or cooling the entire unit. Alternatively, if separate heating or cooling subpads such as 42a, 42b (FIG. 2) or other separate internal or external heaters or coolers are provided for the separate compartments, heating or cooling of selected compartments individually for the treatment of localized arthritic conditions or injuries is possible.

FIGS. 8 – 11 depict an alternative embodiment of a mattress pad constructed in accordance with the present invention. A mattress pad indicated generally as 50 in FIG. 8 comprises a plurality of modular flexible gel – containing compartments 52 detachably connected to one another. Each compartment 52 may be constructed of the same materials previously specified for the mattress pad 10. Along one longitudinal edge of each compartment 52 is a margin 54 having an upwardly – facing surface containing Velcro™ material 56. Along the opposite longitudinal edge of the compartment 52 a mating downwardly – facing strip of Velcro™ 58 is mounted so that the respective compartments 52 may be detachably joined together in side – by – side relationship as shown in FIG. 10 to form the single – bed – size mattress pad 50 of FIG. 8. Mating Velcro™ material may similarly be placed on the transverse edges 60, 62 of each compartment 52 so that multiple mattress pad assemblies 50 can be detachably interconnected in side – by – side relation for larger bed sizes.

Each of the compartments 52 is equipped with a port assembly 64 mounted in its bottom panel having a threaded connector 66 to which either a threaded cap 68 or a threaded connector 70a of a gel conduit 70 may be secured. The port assembly 64 is preferably equipped with a one – way check valve as previously described. However, in the absence of a check valve, the port assembly 64 is nevertheless usable for gel injection or withdrawal if the compartment 52 is inverted so that the port 64 faces upwardly. During such injection or withdrawal, the opposite threaded connector 70b of the conduit 70 may be connected to a gel container such as 34.

For initial filling of the gel – containing compartments 52 prior to placing them in service, it is preferable to provide each compartment 52 with a predetermined minor quantity of a polymeric gel – forming powder such as 72 within its interior space. The powder is poured into the interior of each compartment 52 through the port 64 either by the user or, preferably, by the manufacturer prior to shipment from the manufacturing plant. Thereafter, the user injects water into each compartment through the port 64 in a predetermined major amount which, when mixed with the powder 72, forms an initial quantity of supporting gel within the compartment. For this purpose, a highly water – absorbent, polymeric gel – forming powder material is preferred, such as a known partial sodium salt of cross – linked polypropenoic acid capable of absorbing a volume of water many times its solid volume. For example, for a modular gel container such as 52 having a length of 82 cm, a width of 40.5 cm, and a thickness of 5 cm, approximately 60 ml of such gel – forming powder would be inserted into each compartment and approximately 4.7 liters of water added by the user to each compartment through the respective ports 64, after which additional gel could be injected or gel withdrawn as needed to adjust the degree of support provided by the individual compartment. Alternative highly – absorbent polymeric gel – forming solids suitable for this purpose could include starch – graft copolymer compositions which are well known and described, for example, in U.S. Patent No. 3,981,100 which is incorporated herein by reference. By initially forming the gel within the compartments in this manner, both the shipping of the system and the initial placing in service of the system are greatly facilitated. This methodology is equally applicable to the permanently interconnected compartments of the mattress pad 10 of the previously described embodiment.

The terms and expressions which have been employed in the foregoing specification are used therein as terms of description and not of limitation, and there is no intention, in the use of such terms and expressions, of excluding equivalents of the features shown and described or portions thereof, it being recognized that the scope of the invention is defined and limited only by the claims which follow.

Claims

1. A cushioning device (10, 50) for supporting a person's weight by distributing force over a support area of the person's body in a variably – adjustable manner to prevent pressure concentration points in predetermined portions of said support area, said cushioning device comprising: an assembly for forming a major flexible surface for distributing supportive force over a support area of a person's body, said assembly including means defining multiple compartments (20a, 20b, 52) for containing a gel separated by walls (15) for preventing the transfer of said gel from one of said compartments to another, each said compartment underlying different portions of said major flexible surface, and means defining a plurality of selectively openable and closable ports (26a, 26b, 64) each communicating be –

tween the interior of a respective one of said compartments and the exterior of said assembly, and characterised by gel container means (34), having means defining an aperture for matingly and sealingly coupling with said ports, for selectively delivering gel to or receiving gel from the respective interiors of said compartments so as to variably adjust the distribution of said supportive force, said gel container means including means for forcing gel to flow through said aperture and ports into the respective interiors of said compartments.

2. The apparatus of Claim 1 wherein said compartments (20a, 20b) are permanently attached to each other.

3. The apparatus of Claim 1 wherein said compartments (52) are detachably attached to each other.

4. The apparatus of Claim 1 wherein said gel container means (34) is of a variable volume type having movable containment walls for selectively decreasing or expanding its gel-containing volume.

5. The apparatus of Claim 1 wherein said gel container means (34) has flexibly movable containment walls.

6. The apparatus of Claim 1 wherein each of said ports includes one-way check valve means (32) for normally permitting gel to flow through the respective port into the interior of a respective compartment, and means for selectively engaging and opening said one-way check valve means so as to permit gel to flow through the respective port out of the interior of the respective compartment.

Patentansprüche

1. Ein Kissensystem (10, 50) zum Tragen eines Gewichtes einer Person, indem Kraft über eine Auflagefläche des Körpers der Person in einer veränderlich einstellbaren Weise verteilt wird, um Druckkonzentrierungspunkte in bestimmten Bereichen dieser Auflagefläche zu verhindern, welches Kissensystem enthält: eine Einrichtung zur Bildung einer größeren, flexiblen Oberfläche zum Verteilen der Tragkraft über eine Auflagefläche des Körpers der Person, welche Einrichtung Mittel umfaßt, die eine Vielzahl von Abteilungen (20a, 20b, 52) für die Aufnahme eines Gels bestimmen, welche durch Wände (15) voneinander getrennt sind, um den Übergang dieses Gels von einer dieser Abteilungen zu einer anderen Abteilung zu verhindern, von denen jede Abteilung unterhalb unterschiedlicher Abschnitte der größeren, flexiblen Fläche liegt, und eine Anordnung, die eine Vielzahl von selektiv zu öffnenden und zu schließenden Öffnungen (26a, 26b, 64) umfaßt, von denen jede eine Verbindung herstellt zwischen dem Innenraum einer bestimmten Abteilung und dem die obengenannte Einrichtung umgebenden Raum, und gekennzeichnet durch Gelbehälterelemente (34) mit Mitteln, die eine Öffnung enthalten, um sie passend und abdichtend mit den zuerst genannten Öffnungen in Verbindung zu bringen, um selektiv Gel zu den jeweiligen Innenräumen dieser Abteilungen zu liefern oder von diesen zu empfangen, um damit veränderlich die Verteilung dieser Tragkraft einzustellen, wobei die Gelbehälterelemente Mittel umfassen, um Gel zum Durchfluß durch diese Öffnung und diese Öffnungen in die jeweiligen Innenräume dieser Abteilungen anzutreiben.

2. Das Kissensystem nach Anspruch 1, bei dem diese Abteilungen (20a, 20b) permanent aneinander befestigt sind.

3. Das Kissensystem nach Anspruch 1, bei dem diese Abteilungen (52) lösbar aneinander befestigt sind.

4. Das Kissensystem nach Anspruch 1, bei dem das Gelbehälterelement (24) von einem im Volumen veränderlichen Typ ist und bewegliche Abteilungswände umfaßt, um dessen gelaufnehmendes Volumen selektiv zu verkleinern oder zu vergrößern.

5. Das Kissensystem nach Anspruch 1, bei dem das Gelbehälterelement (34) flexible, bewegliche Abteilungswände umfaßt.

6. Das Kissensystem nach Anspruch 1, bei dem jede der zuerst genannten Öffnungen ein Einwege-Absperrventil (32) umfaßt, um normalerweise eine Gelströmung durch die jeweilige Öffnung in den Innenraum eines jeweiligen Behälters zu ermöglichen, und eine Einrichtung, um selektiv auf dieses Einwege-Absperrventil einzuwirken und dieses zu öffnen, um eine Gelströmung durch die jeweilige Öffnung aus dem Innenraum der jeweiligen Abteilung zu ermöglichen.

Revendications

1. Dispositif de coussin (10, 50) pour le support du poids d'une personne par un effort de ré-

partition sur une zone de support du corps d'une personne à réglage variable afin d'éviter des points de concentration de pression dans des parties prédéterminées de ladite zone de support, ledit dispositif de coussin comprenant:

un ensemble de formation d'une surface principale flexible pour la répartition d'un effort de support sur la zone de support du corps d'une personne, ledit ensemble comprenant un moyen définissant plusieurs compartiments (20a, 20b, 52), devant contenir un gel, séparés par des parois (15) pour empêcher le transfert dudit gel d'un desdits compartiments à l'autre, chacun desdits compartiments étant sous-jacent à différentes parties de ladite surface principale flexible, et un moyen définissant plusieurs orifices (26a, 26b, 64), pouvant être ouverts et fermés de façon sélective et raccordant chacun l'intérieur d'un compartiment respectif desdits compartiments et l'extérieur dudit ensemble et

caractérisé par un moyen de récipient de gel (34) définissant un moyen définissant une ouverture pour raccorder lesdits orifices, de façon adaptée et étanche, afin de délivrer, de façon sélective, du gel ou pour recevoir du gel des espaces internes respectifs desdits compartiments afin d'ajuster, de façon variable, la répartition dudit effort de support, ledit moyen de récipient de gel comprenant un moyen pour forcer le gel à s'écouler à travers ladite ouverture et lesdits orifices dans les espaces internes respectifs desdits compartiments.

2. Dispositif selon la revendication 1, dans lequel lesdits compartiments (20a, 20b) sont fixés, de façon permanente, l'un à l'autre.

3. Dispositif selon la revendication 1, dans lequel lesdits compartiments (52) sont fixés, de façon amovible, l'un à l'autre.

4. Dispositif selon la revendication 1, dans lequel ledit moyen de récipient de gel (34) est du type à volume variable possédant des parois mobiles de récipient afin de diminuer ou d'augmenter, de façon sélective, son volume de réception de gel.

5. Dispositif selon la revendication 1, dans lequel ledit moyen de récipient de gel (34) possède des parois de récipient mobiles de façon flexible.

6. Dispositif selon la revendication 1, dans lequel chacun desdits orifices comprend un moyen de clapet anti-retour (32) pour permettre au gel de s'écouler, de façon normale, à travers l'orifice respectif dans l'espace interne d'un compartiment respectif et un moyen pour coopérer avec et ouvrir, de façon sélective, ledit moyen de clapet anti-retour de façon à permettre au gel de s'écouler à travers l'orifice respectif vers l'extérieur de l'espace interne du compartiment respectif.

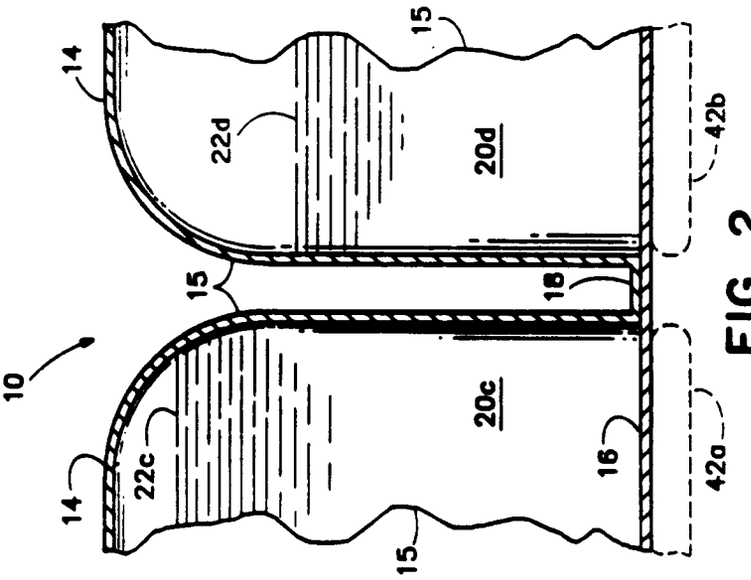
14
15
22d
20d
42b
18
10
22c
20c
16
42a
15

FIG. 2

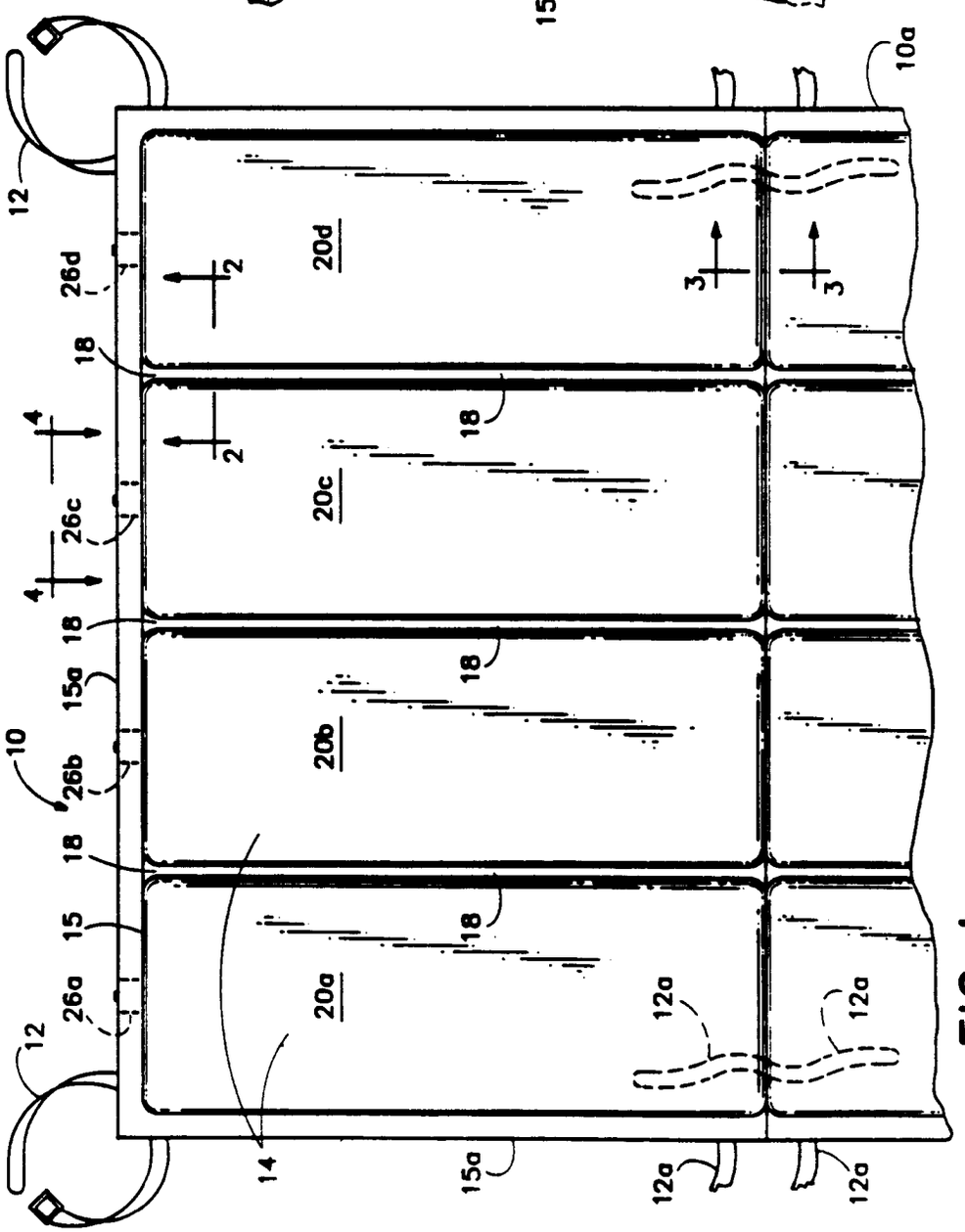
10a
12
26d
20d
2
3
18
20c
26c
4
15a
20b
26b
10
15
26a
20a
12a
14
15a

FIG. 1

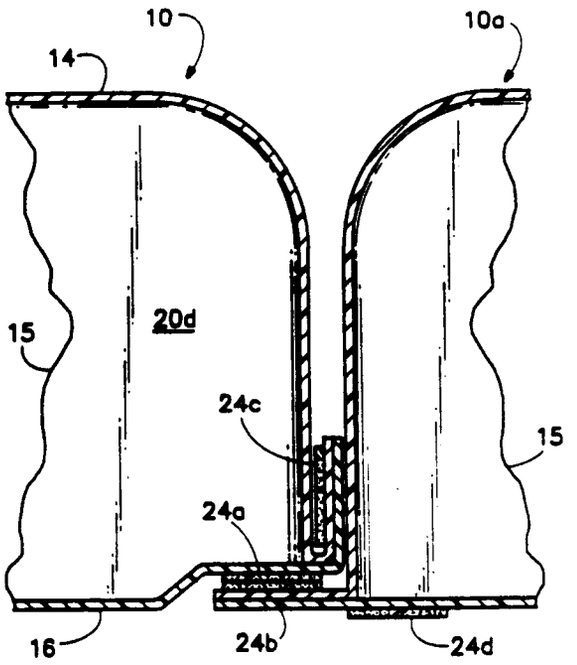

FIG. 3

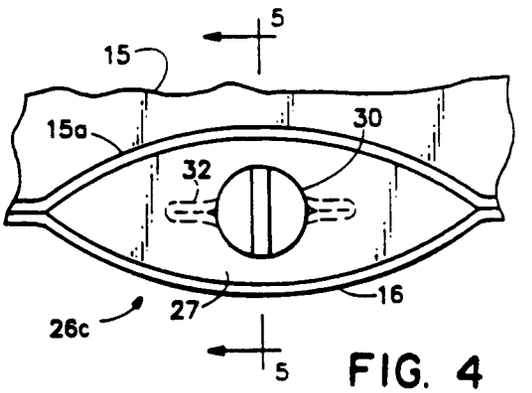

FIG. 4

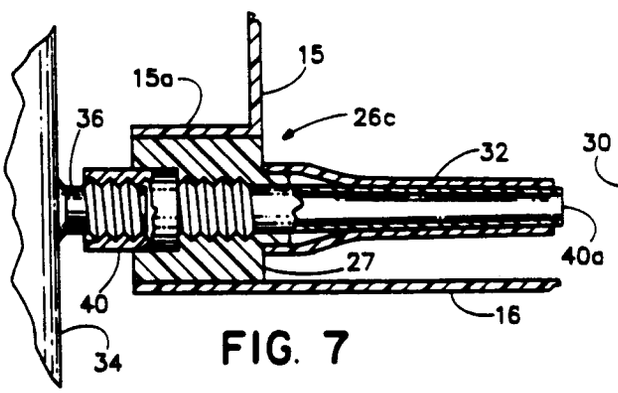

FIG. 7

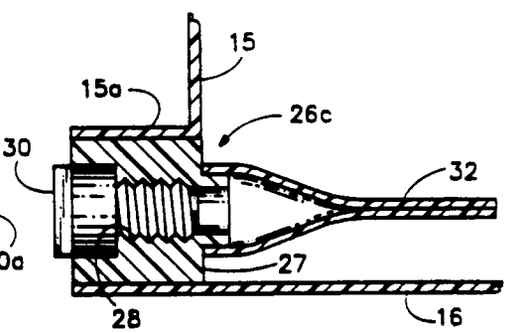

FIG. 5

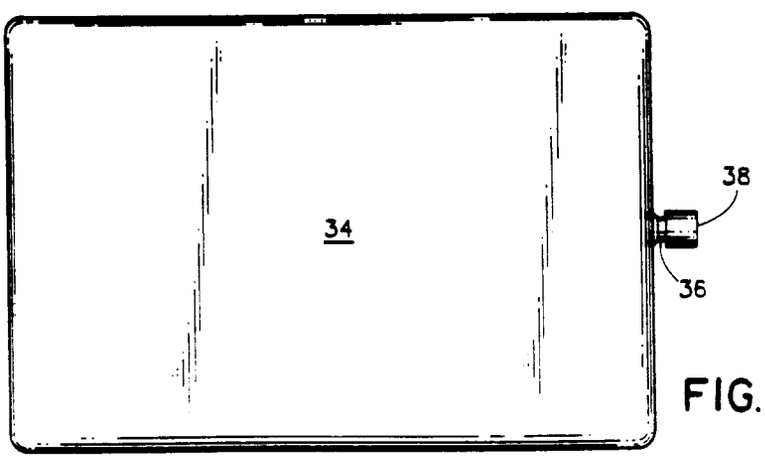

FIG. 6

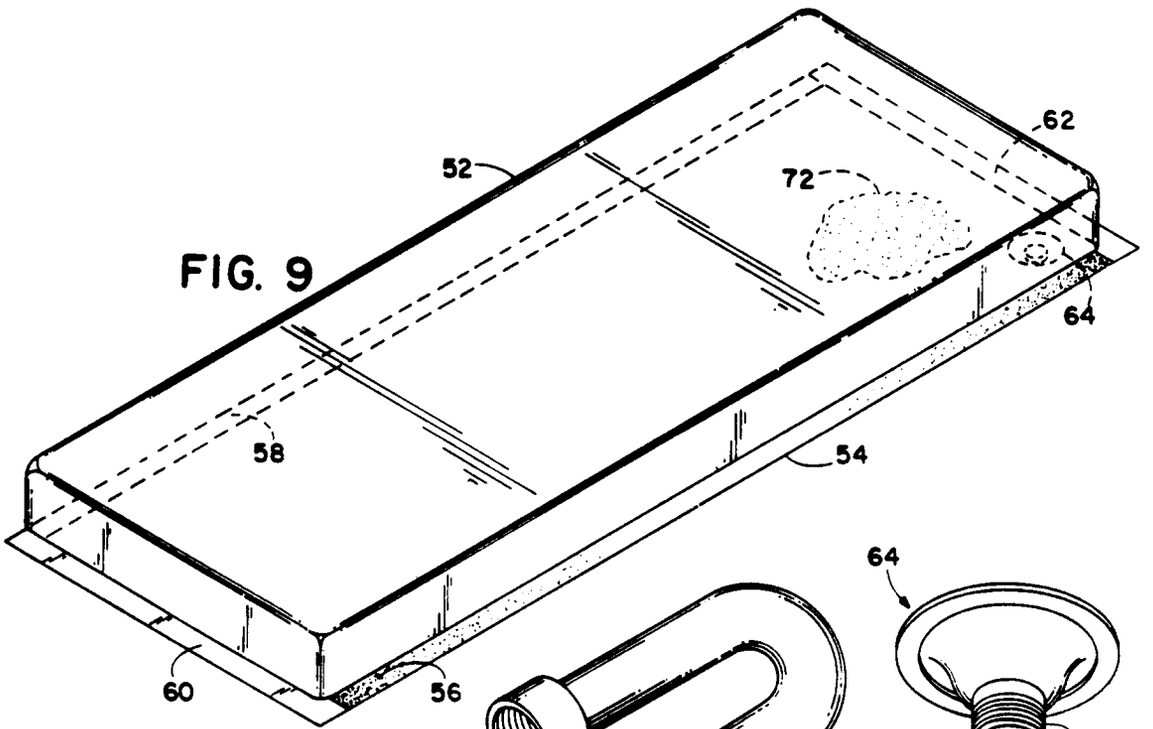

FIG. 9

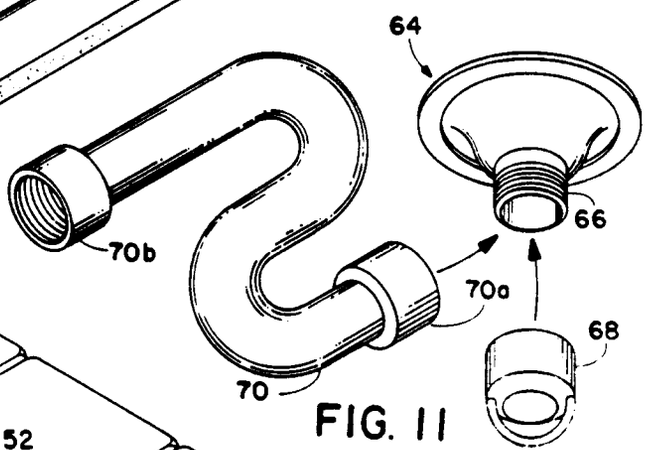

FIG. 11

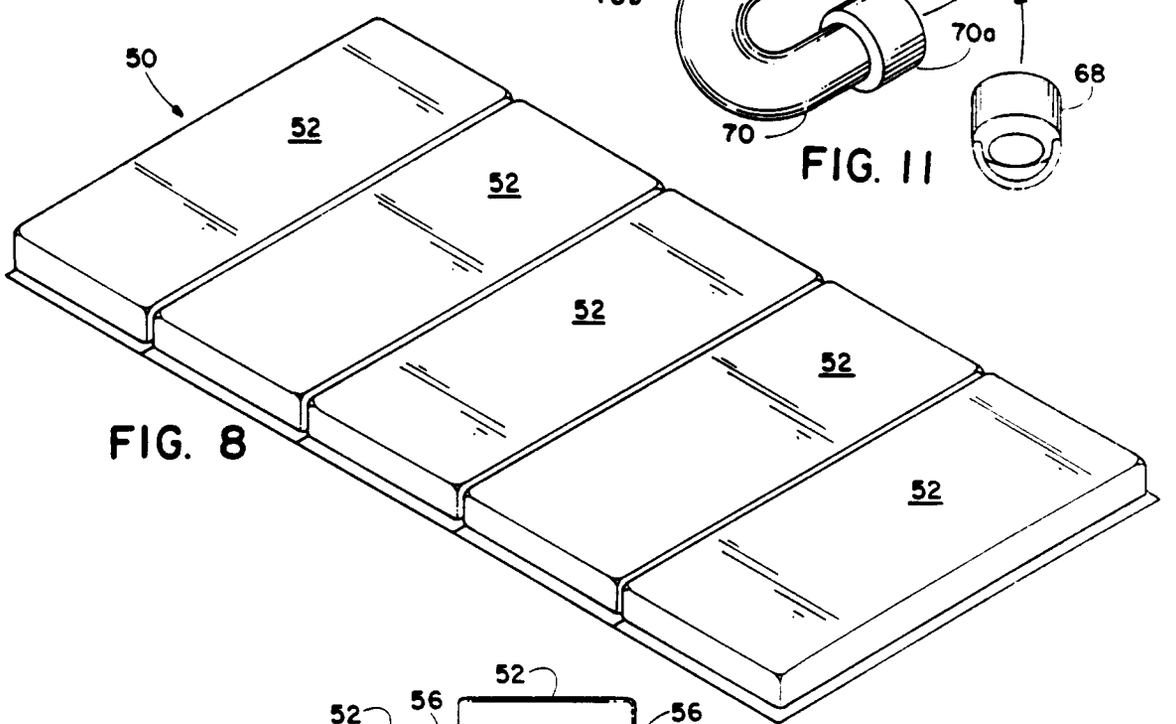

FIG. 8

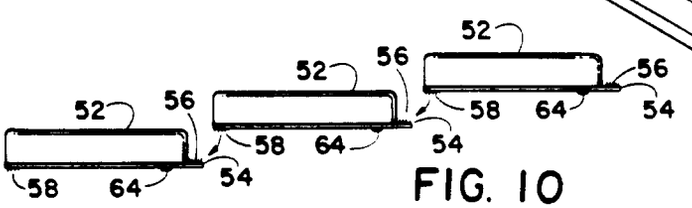

FIG. 10