Office de la Propriété Intellectuelle du Canada
Un organisme d'Industrie Canada

Canadian Intellectual Property Office
An agency of Industry Canada

CA 2618630 C 2011/10/18

(11)(21) 2 618 630

(12) BREVET CANADIEN
CANADIAN PATENT

(13) C

(86) Date de dépôt PCT/PCT Filing Date: 2006/08/10
(87) Date publication PCT/PCT Publication Date: 2007/02/22
(45) Date de délivrance/Issue Date: 2011/10/18
(85) Entrée phase nationale/National Entry: 2008/02/08
(86) N° demande PCT/PCT Application No.: US 2006/031282
(87) N° publication PCT/PCT Publication No.: 2007/021878
(30) Priorités/Priorities: 2005/08/10 (US60/707,074); 2006/02/08 (US11/349,683)

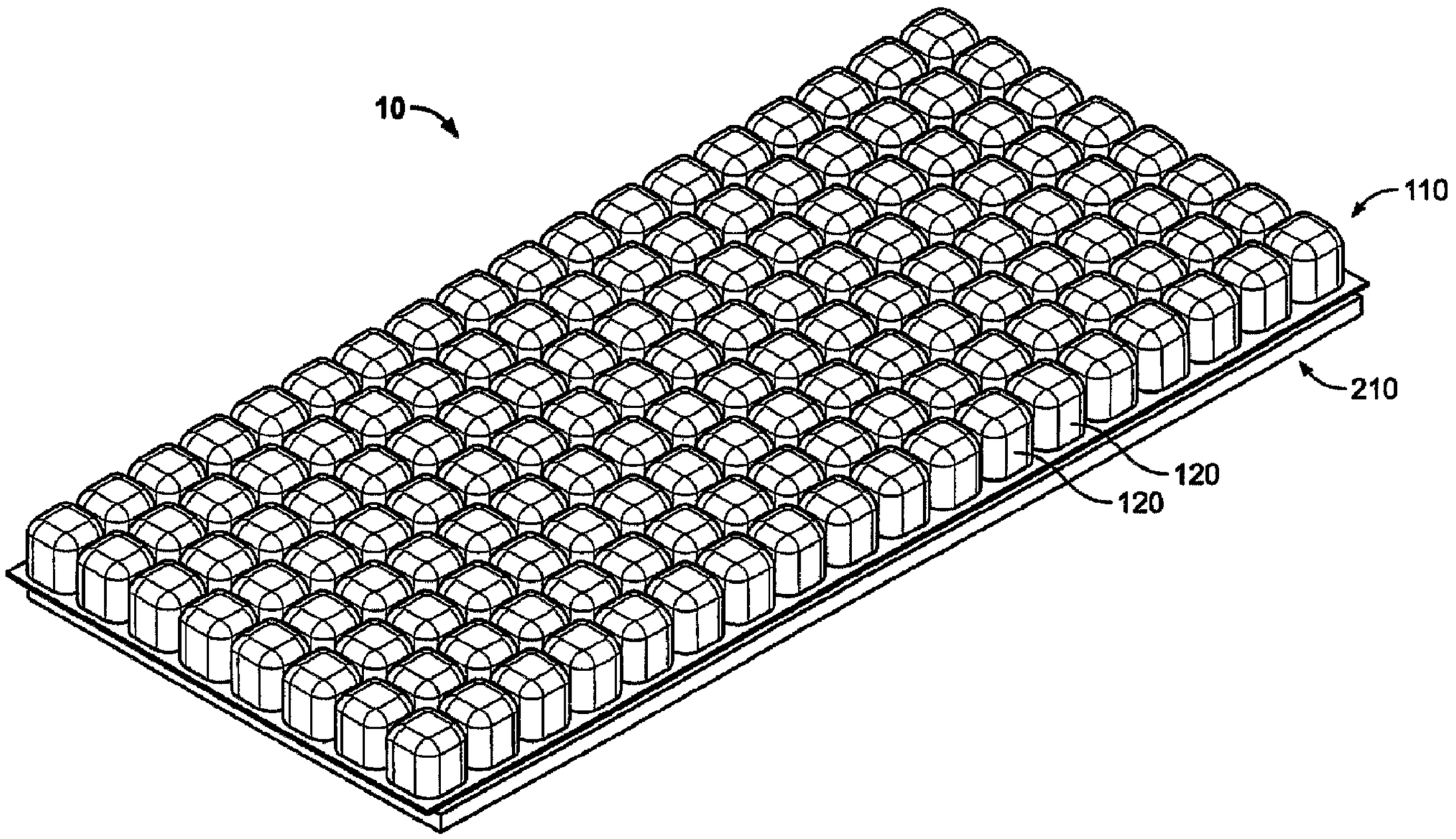
(51) Cl.Int./Int.Cl. *A47C 27/08* (2006.01), *A47C 27/14* (2006.01)

(72) Inventeur/Inventor:
POULOS, CRAIG, US

(73) Propriétaire/Owner:
KREG MEDICAL, INC., US

(74) Agent: RIDOUT & MAYBEE LLP

(54) Titre : MATELAS THERAPEUTIQUE
(54) Title: THERAPEUTIC MATTRESS



(57) Abrégé/Abstract:
A therapeutic mattress is providing including an encasing housing a base layer and a patient support layer in a cavity of the encasing. The base layer has a foam base member and foam side panels connected to the base member. The patient support layer is provided above the base layer and has a plurality of sections or zones. One of the plurality of sections is made of an inflatable component, and another of the plurality of sections is made of a non- inflatable component. In one embodiment, the zones of the patient support surface include a head zone adjacent a head of the mattress, a foot zone adjacent a foot end of the mattress, a seat zone adjacent the head zone, and a knee zone between the seat zone and the foot zone. A foam mattress is provided in the head zone, and an air mattress having a plurality of individual air cells fluidly interconnected is provided in the foot zone.

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
22 February 2007 (22.02.2007)

PCT

(10) International Publication Number
WO 2007/021878 A3

(51) International Patent Classification:
A47C 27/08 (2006.01) *A47C 27/14* (2006.01)

(21) International Application Number:
PCT/US2006/031282

(22) International Filing Date: 10 August 2006 (10.08.2006)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:

60/707,074	10 August 2005 (10.08.2005)	US
11/349,683	8 February 2006 (08.02.2006)	US

(71) Applicant *(for all designated States except US)*: **KREG MEDICAL, INC.** [US/US]; 2240 West Walnut Street, Chicago, IL 60612 (US).

(72) Inventor; and

(75) Inventor/Applicant *(for US only)*: **POULOS, Craig** [US/US]; 3716 Lake Avenue, Wilmette, IL 60091 (US).

(74) Agent: **MORNEAULT, Monique, A.**; WALLENSTEIN & WAGNER, LTD., 311 South Wacker Drive - 5300, Chicago, IL 60606 (US).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LV, LY, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

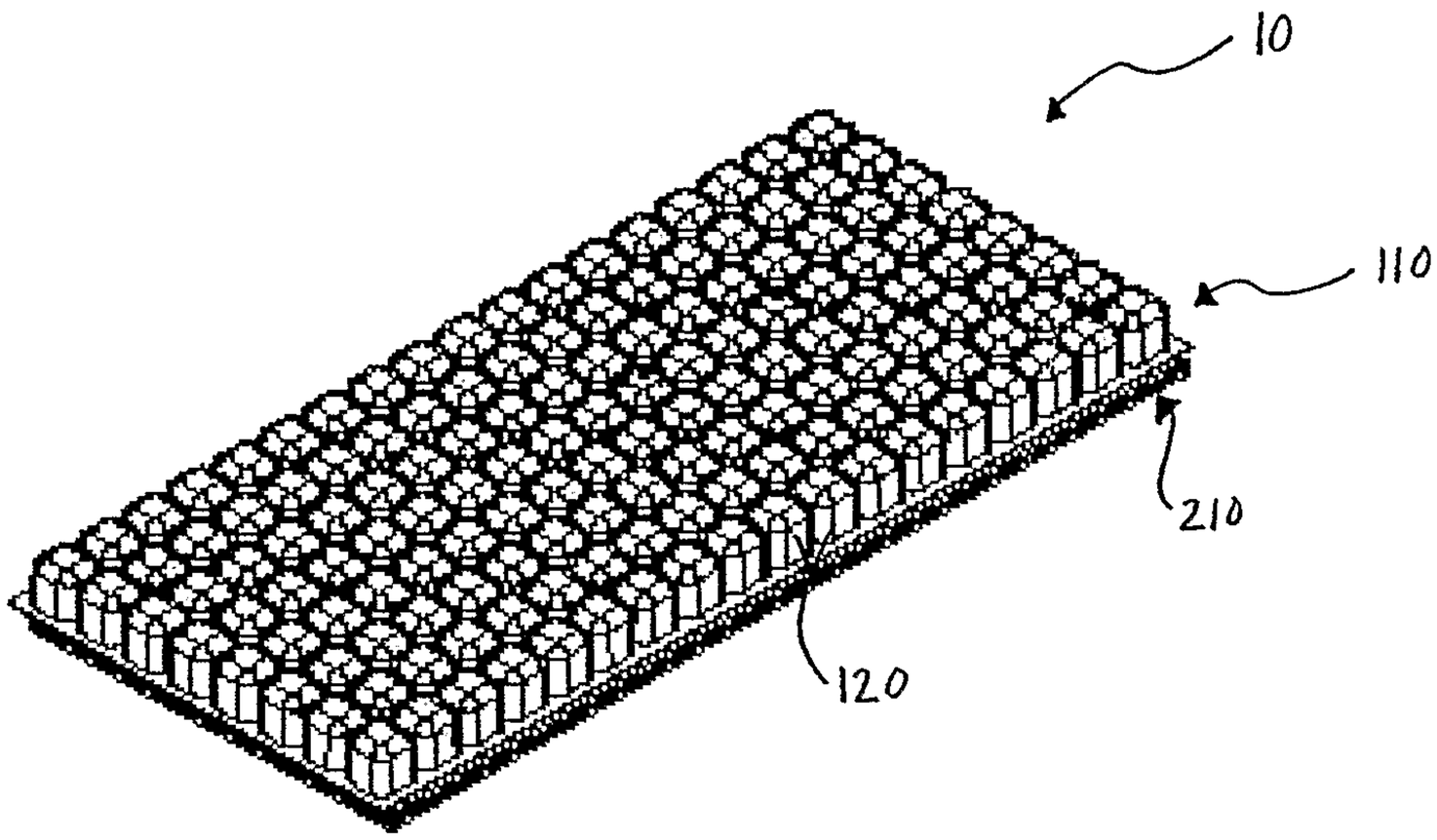
Published:
— *with international search report*
— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments*

(88) Date of publication of the international search report:
19 July 2007

(15) Information about Correction:
Previous Correction:
see PCT Gazette No. 16/2007 of 19 April 2007

[Continued on next page]

(54) Title: THERAPEUTIC MATTRESS



(57) Abstract: A therapeutic mattress is providing including an encasing housing a base layer and a patient support layer in a cavity of the encasing. The base layer has a foam base member and foam side panels connected to the base member. The patient support layer is provided above the base layer and has a plurality of sections or zones. One of the plurality of sections is made of an inflatable component, and another of the plurality of sections is made of a non- inflatable component. In one embodiment, the zones of the patient support surface include a head zone adjacent a head of the mattress, a foot zone adjacent a foot end of the mattress, a seat zone adjacent the head zone, and a knee zone between the seat zone and the foot zone. A foam mattress is provided in the head zone, and an air mattress having a plurality of individual air cells fluidly interconnected is provided in the foot zone.

WO 2007/021878 A3

WO 2007/021878 A3

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

THERAPEUTIC MATTRESS

DESCRIPTION

TECHNICAL FIELD

[0001] The present invention relates generally to a mattress for a hospital bed, and more specifically to a therapeutic mattress having portions made of a foam material and portions made of inflatable air cells.

BACKGROUND OF THE INVENTION

[0002] Mattresses, including therapeutic overlays which assist in preventing bed sores, for hospital beds are well known in the art. While such mattresses and overlays according to the prior art provide a number of advantageous features, they nevertheless have certain limitations. The present invention seeks to overcome certain of these limitations and other drawbacks of the prior art, and to provide new features not heretofore available. A full discussion of the features and advantages of the present invention is deferred to the following detailed description, which proceeds with reference to the accompanying drawings.

SUMMARY OF THE INVENTION

[0003] The present invention generally provides a therapeutic mattress having a base layer, a patient support layer above the base layer, and, an encasing over the base layer and the patient support layer. This therapeutic mattress is provided to assist in preventing bed sores and decreasing existing bedsores on patients.

[0004] According to one aspect, there is provided a therapeutic mattress for supporting an entire body of a user in a prone position, comprising: a base layer; a first longitudinally extending foam sidewall extending upwards from one side of the base layer, and a second longitudinally extending foam sidewall extending upwards from an opposing side of the base layer, the first and second longitudinally extending sidewalls and the base layer defining a well; a patient support layer positioned on the base layer and between the foam sidewalls in the well, the patient support layer having a plurality of separately zoned air cell sections extending from generally the first sidewall to the second sidewall, including a head zone adjacent a head end of the mattress, a foot zone adjacent a foot end of the mattress, and a seat zone between the head zone and the foot zone, wherein the patient support layer in the head zone comprises a first separate and independent air cell section extending generally from the first sidewall to the

second sidewall, wherein the patient support layer in the seat zone comprises a second separate and independent air cell section extending generally from the first sidewall to the second sidewall, and wherein the patient support layer in the foot zone comprises a third separate and independent air cell section, wherein each air cell section has a bottom wall adjacent the base layer, wherein each air cell section is independently inflatable and deflatable to independently set and adjust an air pressure of each air cell section, and wherein each air cell section comprises a plurality of individual air cell members arranged in rows and columns and fluidly interconnected to be self-equalizing, each of the air cell members having a sidewall extending vertically from a bottom of the air cell member and terminating in a top wall of each air cell member, each air cell having a height extending from the bottom of the air cell member to the top wall of the air cell member, each air cell member of the air cell sections also being independently moveable in a plurality of directions, including the x, y and z directions, and the air cell members in the head, foot and seat zones being able to move independently from the longitudinal extending sidewalls; and, a cover having an interior region covering the patient support layer.

[0005] According to another aspect, there is provided a therapeutic mattress for supporting an entire body of a user in a prone position, comprising: a base layer; a first longitudinally extending foam sidewall extending upwards from one side of the base layer, and a second longitudinally extending foam sidewall extending upwards from an opposing side of the base layer, the first and second longitudinally extending sidewalls and the base layer defining a well; and, a patient support layer positioned on the base layer and between the foam sidewalls in the well, the patient support layer having a plurality of separately zoned air cell sections extending from generally the first sidewall to the second sidewall, including a head zone adjacent a head end of the mattress, a foot zone adjacent a foot end of the mattress, and a seat zone between the head zone and the foot zone, wherein the patient support layer in the head zone comprises a first separate and independent air cell section extending generally from the first sidewall to the second sidewall, wherein the patient support layer in the seat zone comprises a second separate and independent air cell section extending generally from the first sidewall to the second sidewall, and wherein the patient support layer in the foot zone comprises a third separate and independent air cell section, wherein each air cell section has a bottom wall adjacent the base layer, wherein each air cell section is independently inflatable and deflatable to independently set and adjust an air pressure of each air cell section, and wherein each air cell section comprises a plurality of individual air cell members arranged in rows and columns and fluidly interconnected to be self-equalizing, each of the air cell members having a sidewall extending vertically from a bottom of the air cell member and terminating in a top wall of each

air cell member, each air cell having a height extending from the bottom of the air cell member to the top wall of the air cell member, each air cell member of the air cell sections also being independently moveable in a plurality of directions, including the x, y and z directions, and the air cell members in the head, foot and seat zones being able to move independently from the longitudinal extending sidewalls.

[0005a] According to another aspect, there is provided a therapeutic mattress for supporting an entire body of a user in a prone position, comprising: a base member and first and second generally firm upstanding longitudinally extending foam side walls connected at opposing sides of the base member to define a well; and, a patient support layer within the well, the patient support layer having a plurality of separately zoned sections, including a head zone adjacent a head end of the mattress, a foot zone adjacent a foot end of the mattress, and a seat zone between the head zone and the foot zone, wherein the patient support layer in the head zone comprises a first separate and independent air cell section extending generally from the first sidewall to the second sidewall, wherein the patient support layer in the seat zone comprises a second separate and independent air cell section extending generally from the first sidewall to the second sidewall, and wherein the patient support layer in the foot zone comprises a third separate and independent air cell section, wherein the air cell sections in each of the head, seat and foot zones are adjacent the longitudinally extending side walls, and wherein the members of the air cell sections in each of the head zone, foot zone and seat zone are free to move independently from the longitudinal extending sidewalls, wherein each air cell section has a bottom wall adjacent the base member, wherein the therapeutic mattress has an overall footprint and wherein the patient support layer in each zone has a footprint that is approximately one-quarter of the overall surface area of the therapeutic mattress, wherein each air cell section is independently inflatable and deflatable with respect to the air cell sections in other zones of the mattress to independently set and adjust an air pressure of each air cell section, and wherein each air cell section comprises a plurality of individual air cell members arranged in rows and columns and fluidly interconnected to be self-equalizing, each of the air cell members having a sidewall extending vertically from a bottom of the air cell member and terminating in a top wall of each air cell member, each air cell having a height extending from the bottom of the air cell member to the top wall of the air cell member, and each air cell member of the air cell sections also being independently moveable in a plurality of directions, including the x, y and z directions.

[0006] According to one embodiment, the base layer comprises a base member, a foam end member and a plurality of foam side panels connected to the base member. The base member may be comprised of foam, gel, fluid or some other pressure compensating media. Further, the base member may be comprised of one or more inflatable and/or non-inflatable components. Generally, the side panels extend from a head end of the base member to a foot end of the base member of the mattress to create a cavity or well to support the patient support layer.

[0007] According to another embodiment, the patient support layer is provided in the well of the base layer. The patient support layer has a plurality of sections or zones. In a preferred embodiment one of the plurality of sections is made of an inflatable component, and another of the plurality of sections is made of a non-inflatable component. The non-inflatable component may also comprise a plurality of individual air cells fluidly interconnected. In one embodiment, the patient support layer comprises alternating foam portions and air cell portions. Further, in another embodiment the patient support layer comprises a first foam layer adjacent a head end of the mattress, a first air mattress portion adjacent the foot end of the mattress, a second air mattress portion adjacent the first foam layer, and a second foam layer adjacent the first air mattress portion.

[0008] According to yet another embodiment, the encasing comprises a removable cover having a cavity. Further, in a preferred embodiment the encasing comprises a lower encasing connected with a zipper to an upper encasing. In one embodiment, the upper encasing comprises a urethane coated spandex to allow the top cover to be breathable but substantially impervious to water.

[0009] Other features and advantages of the invention will be apparent from the following specification taken in conjunction with the following drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] To understand the present invention, it will now be described by way of example, with reference to the accompanying drawings in which:

[0011] FIG. 1 is a perspective view of one embodiment of a therapeutic bed system;

[0012] FIG. 2 is a perspective view of the bed system of FIG. 1, showing a patient support layer exploded from a plenum layer;

[0013] FIG. 3 is a perspective view of a head section of the patient support layer;

[0014] FIG. 4 is a bottom view and a top view of the head section of the patient support layer;

[0015] FIG. 5 is a perspective view of a torso section of the patient support layer;

[0016] FIG. 6 is a perspective view of a lower body section of the patient support layer;

[0017] FIG. 7 is a top and bottom perspective view of an activation section of the patient support layer;

[0018] FIG. 7A is a perspective view of an alternate embodiment of an array of cells for the patient support layer as provided in an activation section;

[0019] FIG. 7B is an exploded view of a portion of the array of patient support cells;

[0020] FIG. 7C is a top plan view of the array of patient support cells of FIG. 7A;

[0021] FIG. 7D is a bottom plan view of the array of patient support cell of FIG. 7A;

[0022] FIG. 8 is a bottom view, a side view and a top view of the activation section of the patient support layer;

[0023] FIG. 9 is a perspective view of the bed system showing rotational elements extending from an underside of the patient support layer;

[0024] FIG. 10A is a perspective view of another embodiment of a therapeutic bed system showing the activation section and the patient support layer exploded from the plenum layer;

[0025] FIG. 10B is a perspective view of the activation section of FIG. 10A having two plenum chambers;

[0026] FIG. 11 is a perspective view of a blower assembly of the bed system;

[0027] FIG. 12 is a perspective view of an activation valve assembly mounted to a lower surface of the plenum layer;

[0028] FIG. 13 is a perspective view of the activation valve assembly;

[0029] FIG. 13A is a perspective view of an alternate embodiment of the activation valve;

[0030] FIG. 13B is an exploded view of the activation valve of FIG. 13A;

[0031] FIG. 14 is an exploded view of the activation valve assembly;

[0032] FIG. 15 is an end view of the activation valve assembly;

[0033] FIG. 16 is a cross-section of the activation valve assembly taken along lines 16-16 of FIG. 15;

[0034] FIG. 17 is a schematic of the valve assembly of the bed system;

[0035] FIG. 18 is a bottom view of another embodiment of an alternating pressure mattress assembly;

[0036] FIG. 19 is a schematic view of a cell of the alternating pressure mattress of FIG. 18;

[0037] FIG. 20 is a block diagram of a replacement therapeutic mattress assembly; and,

[0038] FIG. 21 is a cross-sectional schematic of one embodiment of a plenum utilized with the dynamic therapy bed system.

[0039] FIG. 22 is an assembled perspective view of one embodiment of a therapeutic mattress with the mattress cover partially open;

[0040] FIG. 23 is a top view of the therapeutic mattress of FIG. 22 with the mattress cover removed;

[0041] FIG. 24 is an exploded perspective of the therapeutic mattress of FIG. 22 with the mattress cover removed;

[0042] FIG. 25 is a side cross-sectional elevation view of the mattress through line 25-25 of FIG. 22;

[0043] FIG. 26 is an assembled perspective view of another embodiment of a therapeutic mattress with the mattress cover partially open; and,

[0044] FIGS. 27A and 27B are different embodiments of a bottom member of the therapeutic mattress.

DETAILED DESCRIPTION

[0045] While this invention is susceptible of embodiments in many different forms, there is shown in the drawings and will herein be described in detail preferred embodiments of the invention with the understanding that the present disclosure is to be considered as an exemplification of the principles of the invention and is not intended to limit the broad aspect of the invention to the embodiments illustrated.

[0046] A dynamic therapy bed system 10 is shown in the figures. Although the bed frame or support structure is not shown, it is understood that the system 10 is intended for use with a variety of conventional bed frames including those found in hospitals and health care facilities. In one embodiment, the bed system 10 includes a patient support layer 110, a plenum layer 210, a blower assembly 310, and an activation valve assembly 410. As explained in greater detail below, the bed system 10 provides treatment to a patient through several modes of operation, including standard, alternating pressure, percussion, vibration, rotation, wound therapy and various combinations thereof.

[0047] Referring to FIGS. 1-2, the patient support layer 110 is the uppermost layer of one embodiment of the bed system 10 or mattress and includes a head section 112, a torso section 114, an activation section 116, and a lower body section 118. As explained below, in one embodiment the activation section 116 is positioned within the torso section 114 and is configured to apply alternating pressure, percussion and/or vibration forces to treat the patient. Alternatively, the entire patient support layer 110 may be an activation section 116, such as with an full alternating pressure mattress. In another configuration of the bed system 10, the torso section 114 and head section 112 are combined as an integrated unit that receives the activation section 116. The head, torso, activation and lower body sections 112-

118 each have an array of cells 120 that are in fluid communication with other cells 120 in each respective section 112-118. The cells 120 of the sections 112-118 collectively define a patient support surface. The cells 120 may be comprised of closed cell configurations (i.e., wherein air pressure is generally maintained at a constant pressure in the mattress) or open-cell configurations (i.e., wherein a blower or other provider of air is connected to the mattress such that air pressure in the chamber of the mattress can be varied real time). Alternatively, any section of the patient support layer 110, other than the activation section 116, may be made of a non-inflatable component, such as foam, with an activation section 116 provided in the non-inflatable component as necessary.

[0048] As shown in FIGS. 3 and 4, the head section 112 has an array of cells 120 extending from a base 122. Each cell 120 has an upper portion 124 with a top wall 126, and a lower portion 128. The top walls 126 collectively define a head patient support surface 127 of the head section 112. The top wall 126 may by flat or have an alternate configuration such as a peaked star or otherwise as shown herein. The lower portion 128 of each cell 120 includes a side wall arrangement 130, wherein each interior side wall 130 includes an opening 132. As shown in FIG. 5, in one embodiment the openings 132 are aligned to provide fluid communication between the cells 120, allowing the blower assembly 310 or other provider of air to supply air simultaneously to all cells 120 that are in fluid communication within the section. In one embodiment the exterior side walls 130 lack an opening 132 since there is no cell 120 beyond the periphery 122a of the base 122. In one embodiment, the cells 120 have an overall height of between 2.5" and 10", and preferably approximately four inches, however, the overall height varies with the design parameters of the bed system 10. Accordingly, the cells 120 are generally elongated vertically as opposed to typical cells on certain alternating pressure pads. In one embodiment, the cells 120 are independent in structure in that they can attain movement in at least six degrees of freedom as shown in FIG. 19, including movement in both directions in an x-axis, both directions in a y-axis and both directions in the z-axis. By having a mattress that can move air from one cell 120 to adjoining cells 120 as necessary, and by having air cells 120 that are able to move in multiple directions assists in being able to immerse the patient in the mattress 10 to reduce the overall pressure on the surface of the contact areas of the patient.

[0049] The head section 112 includes an air supply fitting 134 or inlet port and an exhaust or relief fitting 138. As explained herein, with any section of the patient support layer 110 the air supply fitting 134 may also be utilized as an exit port such that only one port per chamber is necessary. The blower assembly 310 supplies air via the plenum layer 210 or directly to the cells 120 in the head section 112 to support the patient's head when it rests on the patient support surface 127. The air supply fitting 134 depends from a lower surface of the base 122. In one embodiment, the head section 112 has a three by eight array of cells 120 providing a rectangular configuration to the section 112, however, the precise number of cells 120 in the array can vary as well as the resulting configuration of the head section 112. The cells 120 and the base 122 are formed from urethane, neoprene, or any other material having similar strength and durability traits, wherein the material thickness is preferably greater than 10 mils.

[0050] Referring to FIG. 5, in one embodiment the torso section 114 has an array of cells 120 that are typically similar to those found in the head section 112. The top walls 126 of the cells 120 collectively define a torso patient support surface 127. In an embodiment with an activation section 116, the torso section 114 also has an aperture 136 configured to receive the activation section 116. Like the head section 112, the torso section 114 includes an air supply fitting 134 and an exhaust or relief fitting 138. The blower assembly 310 supplies air either directly to the cells 120 or via the plenum layer 210 to the cells 120 in the torso section 114 to support the patient's torso when it rests on the support surface 127. In one embodiment, the torso section 114 has a seven by eight array of cells 120 providing a rectangular configuration to the section 114, wherein a number of cells 120 are omitted to define the aperture 136. The aperture 136 is cooperatively dimensioned to receive activation section 116, so the precise configuration of the aperture 136 varies with the design parameters of the bed system 10. As mentioned above, the head and torso sections 112, 114 can be combined into a single unit of the patient support layer 110.

[0051] As shown in FIG. 6, the lower body section 118 also has an array of cells 120 that are similar to those found in the head and torso sections 112, 114. The top walls 126 of the cells 120 collectively define a lower patient support surface 127 of the section 118. Like the head section 112, the leg section 118 includes an air supply fitting 134 and an exhaust or relief fitting 138. The blower assembly 310 supplies air via the plenum layer 210 or directly to the cells 120 in the lower body section 118 to support the patient's lower body region

when it rests on the support surface 127. In one embodiment, the lower body section 118 has an eight by eight array of cells 120 providing a square configuration to the section 118, however, the configuration can be varied depending upon design parameters including the size of the cells 120.

[0052] Referring to FIGS. 7, 8 and 18, various embodiments of an activation section 116 are disclosed. The activation section 116 is configured to apply a therapeutic movement of cells 120. In one embodiment this comprises alternating pressure in alternating chambers of the mattress. IN another embodiment this comprises applying a percussive and/or vibratory force, including to a patient's torso region, however, it may also be utilized in other areas of the patient support layer 110, such as the thoracic area. The activation section 116 has an array of cells 120 that are similar to that found in the head, torso and lower body sections 112, 114, 118. The top walls 126 of the cells 120 collectively define a support and engaging surface 127 of the activation section 116. In a preferred embodiment the cells 120 within the activation section 116 are separated into at least two groups- - Group A and Group B - - whereby alternating pressure, alternating percussion and/or vibration and/or a flotation force is applied to the patient on a per group basis. As shown in FIGS. 8 and 18, the cells 120 in Group A are in fluid communication with each other by a number of channels 140, and the cells 120 in Group B are in fluid communication with each other by a number of channels 142, but the cells in Group A are not in fluid communication with the cells in Group B. In a preferred embodiment, the channels 140, 142 connect to the lower portion 128 of each cell 120. As a result of the fluid communication, the Group A cells 120 define a first fluid passageway for the supply and distribution of air to the cells 120 within Group A. Similarly, the Group B cells 120 define a second fluid passageway for the supply and distribution of air to the cells 120 within Group B. Accordingly, air can be supplied and distributed to the groups as needed for percussion, vibration, alternating pressure or a flotation/static state. Due to the array of cells 120, in different embodiments both the Group A channels 140 and the Group B channels 142 may have internal and external segments, meaning some channel segments are within the cell array and some channel segments that are near the periphery of the base 122, however other orientations may be different. Some segments of the channels 140, 142 are directed along diagonals, while other segments are linear and are positioned along the periphery of the base 122.

[0053] The activation section 116 also includes an air supply fitting 134 for each channel 140, 142, whereby air can be selectively supplied and distributed through the fitting 134 to a group. In this manner, the blower assembly 310 or other supplier of air supplies air initially to a lead cell 120 and the air is distributed to the remaining cells 120 in the group via the channels 140, 142. The activation section 116 includes an exhaust or relief fitting 138 for each group that permits air to be exhausted through the alternating valve assembly 410 during the percussion and/or vibration modes. As explained in greater detail below, when the bed system 10 is in the percussion mode and/or vibration mode, in one embodiment the blower assembly 310 supplies air through the fitting 134 to cells 120 in both Groups A and B, however, air in Groups A and B is alternately exhausted through the fitting 138 in controlled manner by the valve assembly 410. While the blower assembly 310 constantly supplies air, the valve assembly 410 exhausts air in an alternating manner from cells 120 in one of the Groups A and B to provide the percussion and/or vibration desired by the operator. Alternately, in the alternating pressure mode the blower assembly 310 generally provides air to increase the pressure in one of the groups of cells 120 while air is exhausted from the other group of cells, and then alternates to provide air to the previously exhausted group of cells and exhaust air from the previously inflated group of cells 120. As shown in FIGS. 7 and 8, in one embodiment the activation section 116 has a four by four array of cells 120 providing a square configuration to the section 114, however, the configuration can be altered depending upon design parameters including the size of the cells 120 and the dimensions of the activation section 116. For example, as shown in FIG. 18 an alternating pressure activation section 116 may be a full size mattress. Although the activation section 116 is only shown as having the cell Groups A and B, other sections within the patient support layer 110 may be so configured.

[0054] The patient support layer 110 can include an alternate array of cells 720, wherein each cell 720 has an upper sub-cell member, a middle sub-cell member and a lower sub-cell member. Collectively the upper, middle and lower sub-cell members define a cell stack 721. The alternate array of cells 720 and the cell stack 721 can be utilized in any section of the patient support layer 110, including the head section 112, the torso section 114, the activation section 116 and/or the lower body section 118. FIGS. 7A – D provide an example of one embodiment of a cell stack 721 as depicted in an alternate activation section 716. As

mentioned above, the cell stack 721 has an upper sub-cell member 717, a middle sub-cell member 718 and a lower sub-cell member 719, wherein the lower sub-cell 719 is joined to the base layer 722. It is understood that additional or less sub-cell members may be utilized without departing from the scope of the present invention. Of course, the cell stack 721 dimensions vary with the design of the sub-cell members 717, 718, 719. The sub-cell members 717, 718, 719 have a height of roughly 1.5 to 2.5 inches, causing the cell stack 721 to have an overall height ranging between 4.0 and 12.5 inches, however taller or shorter cell stacks may also be utilized. Generally, each sub-cell member 717, 718, 719 has an upper portion 724 and a top wall 726. In the upper sub-cell 717, the top wall 726 defines a patient support surface 727, that is the means of percussion and/or vibration and/or flotation for the patient. Therefore, the patient support system 110 does not require a percussion and/or vibration means separate from the cell stack 721. A lower portion 728 of each sub-cell member 717, 718, 719 has a side wall arrangement 730. The cells 720 and the cell stack 721 are made from thermoformed plastic or a similar material. As an example of the formation process, the sub-cell members 717, 718, 719 are individually thermoformed, joined together to form the stack 721 and then the stack 721 is connected to the base 722, such as via radio frequency welding. Additionally, the base 722 can be preformed with raised segments or channel segments therein.

[0055] As shown in FIG. 7B, the upper sub-cell member 717 is positioned over the middle sub-cell member 718, and the middle sub-cell member 718 is positioned over the bottom sub-cell member 719. The bottom sub-cell member 719 is sealed to the base layer 722 along the sealing line 723 (see Fig. 7D). Referring to FIG. 7B, in one embodiment each sub-cell member 717, 718, 719 has at least one orifice 727 that is operably connects that sub-cell to the adjoining sub-cell or sub-cells. The operable connection of the sub-cells 717, 718, 719 via the orifices 727 defines a fluid passageway for the transmission of air from the lower sub-cell 719 through the middle sub-cell 718 to top sub-cell 717. The top sub-cell 717 contains at least one orifice 727 (not shown in FIG. 7B) in a bottom wall 728 of the cell 720. Each middle sub-cell 718 has a top wall 726 with an orifice 727 that is aligned with the orifice 727 in the top sub-cell 717 to define one segment of the cell stack fluid passageway. Each middle sub-cell 718 has a bottom wall with an orifice 727 that is aligned with the orifice 727 in the bottom sub-cell 710 to define the remaining segment of the cell stack fluid

passageway. As mentioned above, the passageway allows air to be transmitted between the sub-cells 717, 718, 719 of the cell stack 721.

[0056] In another embodiment of the cell stack 721, the middle sub-cell 718 is replaced by at least one tube (not shown) in fluid communication with the orifices 727 in the top sub-cell 717 and the lower sub-cell 719. Therefore, the tube facilitates the exchange of air between the top and bottom sub-cells 717, 719. In yet another version of the cell stack 721, the sub-cells 717, 718, 719 lack the orifice 727 and instead have a breathable fabric layer that allows for the passage of air between two or more sub-cells.

[0057] Similar to the cells 120 in the embodiment of the activation section described above, the cell stacks 721 within the activation section 716 are separated into at least two groups- - Group A and Group B - - whereby alternating pressure, percussion and/or vibration force, alternating pressure and/or flotation force is applied to the patient on a per group basis. As shown in FIGS. 7C and D, the cell stacks 721 in Group A are in fluid communication with each other by a number of channels 740, and the cell stacks 721 in Group B are in fluid communication with each other by a number of channels 742, but the cells in Group A are not in fluid communication with the cells in Group B. The channels 740, 742 generally connect to the lower sub-cell 719 of each cell stack 721 within the group. As a result of the fluid communication, the Group A cell stacks 721 define a first fluid passageway for the supply and distribution of air to the sub-cells 717, 718, 719 within Group A. Similarly, the Group B cell stacks 721 define a second fluid passageway for the supply and distribution of air to the sub-cells 717, 718, 719 within Group B. Accordingly, air can be supplied and distributed to the groups as needed for alternating pressure, percussion, vibration, or a flotation/static state. In general, air is supplied from the channel 740 though the lower sub-cell 719 and the middle sub-cell 718 to the upper sub-cell 717.

[0058] As shown in FIG. 2, in one embodiment a plenum layer 210 is utilized. In such an embodiment the plenum layer 210 is generally positioned below the patient support layer 110. In alternate embodiments the plenum layer is not utilized and the cells of the patient support layer are plumbed directly from the blower. The plenum layer 210 has a bladder assembly 211 with a first air bladder 212 that distributes air to and receives air from the head section 112, a second air bladder 214 that distributes air to and receives air from the torso

section 114, and a third air bladder 216 that distributes air to and receives air from the lower body section 116. The first air bladder 212 is operably connected to the second air bladder 214 by a seam, and the second air bladder 214 is operably connected to the third air bladder 216 by a similar seam, both seams providing rigidity for the plenum layer 210.

[0059] The blower assembly 310 supplies air to the first air bladder 212 through a primary channel 220 that longitudinally extends through the second and third bladders 214, 216 and a collection of flexible supply lines 222. Air is distributed from the first air bladder 212 through a fitting 224 to the head section 112. The blower assembly 310 supplies air to the second air bladder 212 through a secondary channel 226 that longitudinally extends through the third bladder 216 and a collection of flexible supply lines 228. Air is distributed from the second air bladder 214 through a fitting 230 to the torso section 114. Instead of utilizing a channel 220, 226, the blower assembly 310 supplies air directly to the third air bladder 214 through a flexible supply line 232. Air is distributed from the third air bladder 216 through a fitting 234 to the lower body section 116. The primary and secondary channels 220, 226 can be welded by a drop-stitch technique to increase their strength and durability.

[0060] The blower assembly 310 supplies air to the activation section 116 through a pair of tubes 240, 242 that extend longitudinally along the third bladder 216 and an extent of the second bladder 214. Specifically, a first tube 240 supplies air from the blower assembly 310 through a fitting 244 to the Group A cells 120, and a second tube 242 supplies air from the blower assembly 310 through a fitting 244 to the Group B cells 120. In an another embodiment, the first and second tubes 240, 242 are replaced by a channel 220, 226 described above. A layer of foam may placed over the plenum layer, including the fittings, tubes and channels, to increase the patient comfort levels. The blower assembly 310 can include valve means, such as a one-way valve, to maintain a constant or static pressure in any of the bladders 212, 214, 261 and the activation section 216. It is understood, however, that any of the plenums may be eliminated or replaced with tubing directly from the blower/air supply to the cells.

[0061] An alternate plenum layer 960 is provided in FIG. 21. In that embodiment, the plenum 960 includes an internal bladder member 962 encased in the outer plenum layer 964. The internal bladder member 962 comprises a stringed material, such as a netting or webbing,

having a first layer 966, an opposing second layer 968 and internal cross-members 970 connecting the first and second layers 966, 968. The internal cross-members 970 maintain the first and second layers 966, 968 at a maximum spread distance therebetween. Accordingly, a thinner plenum is a resultant of this structure. Typically, the first and second layers 966, 968 of the internal bladder member 962 are backed with a urethane or other type material to make them substantially impervious to air flow therethrough. The internal bladder member 962 is encased in the outer plenum layer 964, thereby creating an internal plenum cavity 972. During such encasing, the outer plenum layer 964 is sealed to the first and second layers 966, 968 as shown in Detail B of FIG. 21. Further, additional cavities 974 are created between the outer surfaces of the first and second layers 966, 968 and the inner surface of the outer plenum layer 964. These additional cavities may be utilized as additional air bladders or plenums, or them may be utilized as a cavity to house tubing directed to different components of the system 10.

[0062] As shown in FIG. 9, the bed system 10 may also include a rotation assembly 810, typically having a left rotation element 812 and a right rotation element 814. In the embodiment reflected in FIG. 9, the rotation elements 812, 814 comprise a plurality of inflatable bladders, herein shown as posts 816. In one embodiment the rotation assembly 810 is positioned between the first air bladder 212 and the third air bladder 216 in the plenum layer 210. A central seam 818 bisects the elements 812, 814 to aid with the rotational operation of the assembly 810. A chord extending through the center of each group of posts 816 is parallel to the seam 818. Alternatively, a single bladder 816 may be utilized for each rotation element 812, 814, wherein the bladder 816 is placed on its side and it longitudinal axis is parallel to the seam 818. Preferably, the left and right rotation bladders are positioned below a lower surface of the torso section 114 whereby rotation is conducted on a per-side basis of the plenum layer 210. The left and right air elements 812, 814 can be a single inflatable bladder or multiple bladders each capable of having a variety of configurations, including rectangular, square, triangular, circular, etc. Similar to the first, second and third air bladders 212-216, the blower assembly 310 or some other supply of air supplies air to the left and right rotation bladders. In another embodiment, the left and right rotation bladders each comprise a number of smaller bladders that function as a rotation unit for rotation of each side portion of the patient support layer 110.

[0063] FIGS. 10A and 10B depict an alternate bed system 505, wherein the bed system 505 includes an activation section 516 operably connected to a pair of chambers 544, 546. Instead of distinct multiple bladders, the plenum layer 515 has a single bladder 512 with an opening 536 to receive the chambers 544, 546. The activation section 516 includes an array of cells 520 wherein each cell 520 has a depending fitting 534 for fluid connection with one of the chambers 544, 546. The activation section also includes Group A and Group B cells. The Group A cells 520 are in fluid communication with the chamber 544 through the fittings 534. The chamber 544 has a supply fitting 550 for the supply of air from the blower assembly 310 and an exhaust fitting 552 for the discharge of air from the chamber. The Group B cells 520, through the fittings 534 and an extension piece 548, are in fluid communication with the chamber 546. Like the chamber 544, the chamber 546 has a supply fitting 550 for the supply of air from the blower assembly 310 and an exhaust fitting 552 for the discharge of air from the chamber. Therefore, the chambers 544, 546 act as smaller plenums for the supply and/or exhaust of air from Group A and B in the activation section 516. When the activation section 516 and the chambers 544, 546 are in an assembled position, the chamber 544 for Group A is positioned between the activation section 516 and the chamber 546 for Group B.

[0064] As shown in FIG. 11, one embodiment of a blower assembly 310 for an embodiment of the bed system 10 includes a number of components to supply air to the patient support layer 110 and/or the plenum layer 210. These components include a blower or pump, a number of control valves and manifolds, a power supply (typically supplying 120 VAC), pressure transducers and other components associated with the air supply and zone controls. Preferably, the blower assembly 310 is mounted to the standard bed frame or support structure without modification. The actual blower can be sized to provide a sufficient amount of air to the support layer 110 for a patient weighing up to 1,000 pounds. As explained above, the blower may be an appropriately sized pump. The blower assembly 310 is configured to communicate with a combined control panel and user interface (not shown) such that an operator can control the operation of the blower assembly 310 and the settings of the bed system 10. Depending upon the settings entered by the operator in a control panel or other control member, the blower assembly 310 can supply air on a substantially constant basis to the plenum layer 210 and the patient support layer 110 through passageways, such as

supply lines 222, 228, 232 and the tubes 240, 242. While the blower assembly 310 supplies air to the plenum and support layers 110, 210, the activation valve assembly 410 controls the quantity of air exiting the activation section 116. The blower assembly 310 can be mounted to any portion of the bed frame or the support frame for the bed assembly. Alternately, the blower assembly 310 can be utilized without an activation valve assembly 410 and monitor and supply or exhaust air as needed from each group of cells as required by the specific therapy. For example, in an alternating pressure therapy the blower assembly 310 may supply from approximately 20 mm. Hg. to approximately 32 mm. Hg. in the pressurized group of cells 120 and may entirely exhaust the air pressure in the other group of cells 120.

[0065] Referring to the schematic of FIG. 17, in one embodiment, the blower assembly 310 includes a valve assembly 312 with a number of valves and at least one manifold. In general terms, in one assembly the blower assembly 310 includes the blower M; a rotation valve manifold RVM having left and right rotation valves V1, V2 and a vent valve V3; a patient support manifold PSM having a valve V5 for the head and torso sections 112, 114, a valve V6 for the lower body section 118 and a vent valve V8; and, an activation manifold AM having a flow control valve V4 and a torso to percussion/vibration crossover valve V10. The valves V4 and V10 are operably linked with the activation section 116 for alternating pressure, percussion and/or vibration. The precise number and type of valves varies with the design parameters of the bed system 10, including the patient support layer 110, the activation section 116, and the plenum layer 210. The schematic also includes the activation valve assembly 410 that is operably connected to the activation section 116 to control the exhaust of air from Group A and Group B cells 120 in the activation section 116. It is understood that other types of blowers/valves may be utilized to perform the functions described herein.

[0066] As explained above, in one embodiment of the blower assembly 310 an activation valve assembly 410 is utilized. The activation valve assembly 410 shown in FIGS. 12-16 is configured to control the quantity of air discharged or exiting the cells 120 of Groups A and B in the activation section 116. In one embodiment, the valve assembly 410 includes a first valve 420 and a second valve 424 in opposed positional relationship. The first valve 420 is in fluid communication with the Group A exhaust fitting 138 by a flexible line 422, and the second valve 424 of the assembly 410 is in fluid communication with the Group B exhaust

fitting 138 by a flexible line 422. Each valve 420, 424 has a vent 428 configured to release or vent air discharged from the Group A and B cells 120 in a controlled manner to ambient. Described in a different manner, the valve assembly 420 controls the quantity and pressure of air in Groups A and B for treatment purposes, including alternating pressure, percussion and vibration treatment.

[0067] Referring to FIG. 12, in one embodiment the valve assembly 410 is mounted to a lower surface of the plenum layer 210. The plenum layer 210 can include a substantially rigid support base and the valve assembly 410 can be mounted thereto. The lines 430 represent air supply lines to the activation section 116, namely Groups A and B. Referring to the schematic of FIG. 17, the valve assembly 410 controls the discharge of air from the activation section 116 while the blower assembly 310 supplies air to the activation section 116. The valve V11 in the schematic corresponds to the valve 420 and the valve V12 corresponds to the valve 424.

[0068] As shown in the embodiment FIG. 13, the valve assembly 410 includes two distinct valves 420, 424 that are affixed to a mounting plate 432. Referring to FIG. 14, the valves 420, 424 have a similar construction wherein each valve 420, 424 includes: a vent fitting 428, a valve body 434, a bearing 436, a ball valve 438, a spring 440, and a guide 442. The valve 420, 424 further includes a cap 444 and fasteners 446 to secure the cap 444 and secure the valve body 434. Inlet fitting 448 is in fluid communication with flexible lines 422, 426 which distribute air from cells 120 of Groups A and B to the valve assembly 410. Specifically, exhausted air from Group A is supplied to valve 420 via the flexible line 422, while exhausted air from Group B is supplied to valve 424 via the flexible line 426. Therefore, there is preferably a 1:1 relationship between a group and a valve 420, 424. As shown in FIGS. 15 and 16, each valve 420, 424 has a plunger 450, wherein the plungers 450 are positioned on opposite sides of a cam 452, preferably an eccentric cam.

[0069] The alternating valve assembly 410 has been described above as having opposed valves 420, 424 wherein there is a 1:1 relationship between the valves 420, 424 and Groups A, B. In another embodiment, the valves 420, 424 are configured in a different positional relationship whereby air is exhausted from the cells 120 of Groups A and B in a similar manner as described above. For example, the valves 420, 424 can be distinct valves operated

independently. In such an embodiment, one valve could be providing for vibration therapy in one of the activation cell groups, and the other valve could be providing for percussion therapy in the other activation cell groups. Alternatively, one of the valves could be providing alternating pressure, and flotation/static therapy. Similarly, the valves could be set for varying timing of the different therapies provided. Accordingly, it is understood that an unlimited variety of therapy and therapy timing combinations are possible with multiple independent valves for each activation cell group. In yet another embodiment, the valve assembly 410 includes a single valve 420 that is operably connected to Groups A and B, whereby the single valve 420 receives and exhausts air from cells 120 in both Group A and Group B. Further, it is understood that any valve assembly can be positioned within the blower box 310.

[0070] FIGS. 13A and 13B show yet another alternative valve 462, 464 which can be used in the activation valve assembly 410. The alternative valve 462, 464 includes an inlet 448 which is connected to a plate 432. The plate 432 is connected with fasteners 446 to one end of a cylindrically shaped body of the activation valve assembly. Near the opposite end, the body contains an exhaust shaft 428 which extends through the entire body of the activation valve assembly 410. The body of the activation valve assembly 410 houses a guide 442 which surrounds a ball valve 438 and a spring 440. An O-ring is situated between the interior of the plate 432 and the spring 440.

[0071] In this embodiment air is supplied from Groups A and B in the activation section 116, or any other portion of the mattress, to one of the valves 420, 424 through the inlet fitting 448. A variable speed motor (not shown) typically drives the cam 452 which, through the plunger 450, unseats one of the balls 438 in an alternating manner, however, it is understood that other drive means, such as actuators or solenoids, may be utilized without departing from the scope of the present invention. The motor is connected to the cam 452 by coupling shaft 454. The unseating of the ball 438 and the attendant compression of the spring 440 allows air within the valve body 434 to flow past the ball 438 and to the outlet fitting 428 for discharge from the valve 420, 424. Once the motor has moved the cam 452 to its smallest position, the plunger 450 moves towards the cam 452 and the spring 440 re-seats the ball 438 to prevent air from reaching the outlet fitting 428. By varying the speed of the motor, the frequency of the valve 420, 424 opening and closing and the resultant discharge of air

through the outlet fitting 428 can be increased or decreased. Due to the opposed configuration of the valves 420, 424, the valve assembly 410 alternates between venting the air from either Group A or Group B thereby causing the cells 120 in the other group to remain pressurized and exert a force on the patient. In this manner, the valve assembly 410 provides alternating cell group force application to a patient's thoracic region. As explained below in the operations section, the frequency at which the valve assembly 410 alternates determines whether alternating pressure, percussion or vibration is applied.

[0072] The therapy bed system 10 has several modes of operation, including standard, high pressure, alternating pressure, pulsation, percussion, vibration, rotation, flotation, wound therapy and any combination thereof. For example, the bed system 10 may include a combination of percussion and vibration, or a combination of rotation, percussion and vibration, etc. As another example, the bed system 10 can be placed in a high pressure state for emergency treatment of the patient, such as CPR. Additionally, the bed system 10 may be utilized for alternating pressure therapy. The precise number of operational modes is dependent upon the configuration of the bed system 10 and the end-users desired operating parameters.

[0073] In the standard mode, the blower assembly 310 supplies air to each of the head section 112, the torso section 114, the activation section 116 and the lower body section 118, while the activation valve assembly 410 is closed to retain generally constant air pressure with the sections 112-118. The air pressure level can be a default level or a level entered by an operator. In another version of the standard mode, different sections 112-118 can be maintained at different pressures. For example, the head and torso sections 112, 114 can be maintained at a first pressure while the lower body section 118 can be maintained at a second pressure. In this mode, the cells 120 and the support surface 127 acts as a local pressure reduction surface because the interconnecting cells 120 will self compensate or adjust to patient position to evenly distribute weight applied to the support surface 127.

[0074] In contrast to the standard mode, the percussion mode is a dynamic mode. While the blower assembly 310 supplies air to the cells 120 in Groups A and B of the activation section 116, the activation valve assembly 410 exhausts air in an alternating manner from Groups A and B thereby affecting the pressure with the Groups. As an example, when air is

exhausted from Group A by the valve assembly 410, the cells 120 in Group A generally deflate (thereby reducing their overall height), and the cells 120 in Group B remain pressurized to support the patient. The cells 120 in Group B may experience an increase in pressure that increases their overall height resulting in a force applied to the patient. The exhaustion of cells in Groups A and B alternate as the cam 452 and the plunger 450 are actuated during operation of the valve assembly 410. Therefore, the controlled exhaust of air provided by the valve assembly 410 enables the cells 120 within the Groups A and B to provide alternating force applications to the patient. In this manner, the cells 120 and the support surface 127 provide the means of treatment to the patient, not a separate element. Accordingly, when the valve assembly 410 closes for a certain group during a percussion therapy, for example, the group receives an almost instantaneous pressure increase, thereby causing those cells in the group to "pop" as may be required by a given therapy regimen. The force application results a dynamic system with pneumatically powered cell groups where the pressure therein is actively adjusted by the valve assembly 410 and the control panel.

[0075] Depending upon the frequency of operation of the valve assembly 410 and the resulting air exhaustion, the applied force can be a pulsation force, a percussive force, a vibration force, a flotation/static force or a combination thereof. The percussive forces are intended to be roughly equivalent to a procedure that a nurse would perform on a patient to break loose phlegm from the walls of the lungs by cupping the hands and beating on the back in the lung area. The frequency resulting in a percussive force is roughly one to five beats or cycles per second. The manifold air pressure of the activation section 116 is roughly 46 - 56 mm Hg (25-30 inches of water), whereas during percussion or vibration the maximum pressure in the head, torso and lower body sections 112, 114, 118 is roughly 9 - 37 mm Hg (5-20 inches of water).

[0076] The blower assembly 310, the activation section 116 and the activation valve assembly 410 operate in a similar manner to provide the vibration mode. Thus, the valve assembly 410 exhausts air in an alternating manner from Groups A and B to provide the applied force explained. In contrast to percussion, the frequency resulting in a vibratory force is roughly 6-25 beats or cycles per second. The goal of the vibration mode is to move the phlegm that has been loosened by the percussion action so that it can be expectorated. As

explained above, vibration and percussion can be combined in one treatment application to obtain the benefits of both therapies.

[0077] In the rotation mode, the patient is slowly rotated from side to side to facilitate the movement of fluid in the lungs so that it can be expectorated. The typical range of rotation is roughly 5 degrees to 60 degrees. Rotation occurs through the inflation and deflation of the bladders located beneath the torso section 114. Rotation can be used in conjunction with percussion and/or vibration to achieve greater fluid removal from the patient.

[0078] As identified herein, the therapeutic bed system l0 may be utilized for alternating pressure. In the alternating pressure mode the alternating cell 120 portion of the mattress may be the full size of the bed, or alternating cell activation sections 116 may be provided in a mattress made of additional cells 120 or of non-inflatable components, such as foam or gel. Additionally, the mattress 110 may be placed in a foam frame, may have a foam base member, and may be wrapped in a mattress cover for use on a hospital bed as described in related U.S. Patent No. 7,536,739. Typically, the cells 120 comprise a plurality of inflatable components such as soft, fluidly interconnected but independently movable, air-filled cells 120 which are grouped in groupings as described above. In a preferred embodiment two groupings of cells 120, Group A and Group B, are utilized, however it is understood that additional groupings of cells may be utilized with the alternating pressure mattress. In the alternating pressure mode, pressure is alternated between the cells of Group A and the cells of Group B. Further, the pressurized cells 120 of each group are able to redistribute air pressure between each of the cells 120 in the group to allow the cells 120 of the mattress 110 to conform to the contours of a patient's body with minimal tissue deformation to provide a friction and shear relief surface. Rather than being non-powered, in the alternating pressure air mattress the cells 120 are provided in an open system in connection with a pump or blower assembly 310, preferably plumbed directly to the chambers of the air mattress.

[0079] The air cells 120 of the alternating pressure mattress 110 are generally arranged in an array of rows and columns. In a preferred embodiment the air cells 120 are elongated vertically and extend from the generally flexible base 122, in a tower-like configuration. The cross-sectional shape of the cells 120 may be square, rectangular, round or any other design

that provides the proper qualities to the mattress 110. In a preferred embodiment, the inflatable components 60 are made of a durable neoprene rubber that is flame-resistant and can be easily cleaned. Additionally, in a preferred embodiment the air cells 120 extend approximately 3.5" from the base 122, however, in an alternate embodiment the cells 120 extend at least 2.5" from the base 122. When the mattress 110 is used alone on a bed the cells may have a height from 2.5" up to and including 10", however a typically mattress will have cells that are between 2.5" and 6.0". In another embodiment the air cells 120 are approximately 4.0" in height. Each of the cells 120 has a sidewall 128 and a top portion 126 defining a patient support surface 127. Further, each cell 120 has an interior cavity defined by the interior of the sidewall 128, the top portion 126 and the base 122. The cavities of the cells 120 of Group A, also referred to as the first group, are fluidly interconnected together to define a first group chamber, and the cavities of the cells 120 of Group B, also referred to as the second group, are fluidly interconnected together to define a second group chamber, with the first group chamber not being fluidly interconnected to the second group chamber. In one therapy the first group of cells has a volume of air and the other group of cells has a reduced volume of air.

[0080] The first group of cells 120 has an inlet port 134 and an exit port 138 to allow air to be injected into the first group of cells 120 at the inlet port 134 and to allow at least a portion of the air in the first group of cells 120 to be exhausted at the exit port 138 as appropriate for the alternating pressure therapy. Similarly, the second group of cells 120 has an inlet port 134 and an exit port to 138 to allow air to be injected into the second group of cells 120 at the inlet port 134 and to allow at least a portion of the air in the second group of cells 120 to be exhausted at the exit port 138 as appropriate for the alternating pressure therapy. The blower or pump 310 is in fluid communication with the inlet and outlet ports 134, 138 of the mattress 110 and supplies air pressure to the cells 120 as appropriate in the mattress 110. Alternatively, each of the group of cells 120 may have only an inlet port 134 and air may be able to be injected and exhausted from the same port 134 without requiring a separate exit port 138. In such an embodiment, the blower or pump 310 is in fluid communication with each of the inlet ports 134 and can supply and exhaust air therefrom.

[0081] As shown in FIG. 18, the cells 120 of the first group (i.e., the "A" cells) alternate across the mattress 110 with the cells 120 of the second group (i.e., the "B" cells), and

preferably they alternate diagonally across the mattress 110. Referring to the FIG. 18, in a preferred embodiment the mattress 110 has a plurality of adjacent and opposing edges 131a-d. The cells 120 of the first group extend in a plurality of diagonal groupings from one edge of the mattress 110 to an adjacent edge of the mattress 110, and the cells of the second group also extend in a plurality of diagonal groupings from one edge of the mattress 110 to an adjacent edge of the mattress 100 depending on the size and configuration of the mattress 110. It is possible, however, depending on the configuration of the mattress that the cells may extend to an opposing edge of the mattress.

[0082] In a preferred embodiment, the alternating pressure mattress 110 operates with each group of cells 120 having independent equilibrium flotation capabilities with constant restoring forces. Accordingly, the individual cells 120 are adapted to move independently in at least six degrees of freedom, including both directions in the z-axis (i.e., up and down), both directions in the x-axis (i.e., side to side) and both directions in the y-axis (i.e., front to back). Further, in certain embodiments the individual cells 120 can twist, turn and bend to adapt to the contours and anatomy of the patient thereon. Further, when the patient is provided on the mattress 110 the patient is partially immersed in the cells. With such immersion the forces and pressures pushing back on the patient are kept equal at all times. More specifically, because each of the cells 120 in a group are fluidly interconnected, greater contact area is achieved for dispersion of pressure on the entire body and the forces and pressures pushing back on the patient on the mattress are kept substantially equal at all points on the patient. Thus, the pressure on any one areas of the body of a patient on the alternating pressure mattress 110 is minimized.

[0083] In an alternative therapeutic operation, all of the cells 120 of the mattress 110 may be inflated and deflated simultaneously, and typically cyclically, to raise and lower a patient thereon.

[0084] FIG. 20 provides a block diagram of another alternate mattress system 900, wherein the mattress provides therapeutic treatment to a patient. In this system 900, a mattress assembly 905 having and external cover encasing a mattress 910, a right bolster assembly 912 and a left bolster assembly 914, wherein each bolster assembly 912, 914 comprises a bolster 916 and a sub-bolster 918. Preferably, the bolster 916 of each bolster

assembly is positioned above its respective sub-bolster 918. The overall height of the bolster assembly 912, 914 generally corresponds to that of the mattress 910, however alternate embodiments may be provided that are taller or shorter than the adjacent mattress 910. The system 900 further includes a control unit 920, that as explained below, is operably connected to the mattress 910 and the bolster assemblies 912, 914. Additionally, a controller (not shown) is typically electrically connected to the control unit 920. Although no alternating pressure, percussion or vibration elements are shown in the block diagram of FIG. 20, it is understood that both could be provided with the system 900 in a manner consistent with this disclosure.

[0085] In this embodiment the mattress assembly 905 has an external cover that encases the mattress 910 and bolster assemblies 912, 914. Accordingly, the external cover defines a cavity around the mattress 910. In one embodiment, the mattress 910 has a head section, a plurality of seat sections, and a plurality of lower body or foot sections. A high air loss blower 922 within the control unit 920 supplies air to the cavity at the rate of roughly 5-10 cubic feet per minute. In another embodiment, the blower 922 supplies air to the cells 120 for percussion and/or vibration treatment. Air is supplied through at least one line to the bolsters 916 by a compressor 924 located in the control unit 920. In the embodiment shown in FIG. 23, air is supplied from the bolster 916 through the valve V in the respective sub-bolster 918 and then to the cells 120 in the particular section of the mattress 910. The bolsters 916 may operate as bladders having a measurable internal volume which allows for the bolster 916 to act as a storage plenum for air supplied by the control unit 920. The sub-bolsters 918 are a generally semi-rigid structure, such as foam, with internal cavities to accommodate a plurality of pressure transducers PT and one-way valves V. When the valves are in a closed position, the cells 120 in the mattress 910 maintain a constant or static pressure whereby the patient undergoes floatation support or therapy. In another design configuration, the valves V are moved from the sub-bolsters 918 to the control unit 920 or within a lower portion of the mattress 910.

[0086] As mentioned above, the control unit 920 contains the high air loss blower 922 which provides air to the cavity within the enclosure 905, and the compressor 924 which supplies air to the bolsters 916 and mattress sections. A combination pressure/vacuum switch valve 926 is positioned between the compressor 922 and the bolsters 916, which allows for

air to be drawn out of the bolsters 916 in a vacuum mode. The control unit 920 further includes a power supply, a combined controller and valve board, a muffler, and an air filter. A user control interface 928 may be mounted to the control unit 920 or remotely connected to the unit 920. A electrical connector 930 is electrically positioned between the control unit 920 and the pressure transducers PT and the valves V within the sub-bolsters 918. The control unit 920 can be secured to any portion of the bed frame or support structure, including under the mattress 910. The user control interface 928 can be operably mounted in a similar manner, including to one of the bolster assemblies 912, 914.

[0087] Additional embodiments of a therapeutic mattress 1010 are shown in FIGS. 22 and 26. The therapeutic mattress 1010 generally comprises a covering or encasing 1012 housing a first or base layer 1014 and a patient support layer 1016. Often, patients confined to a bed for a long period of time frequently develop pressure sores, which can be known as decubitus ulcers or the more commonly referred to bedsores. The various embodiments of the therapeutic mattress 1010 described herein assist in preventing or decreasing the potential for such bedsores for some patients, in conjunction with proper care and nutrition.

[0088] As shown in the FIGS. 22-26, the therapeutic mattress 1010 has a head end 1018 and a foot end 1020 opposing the head end 1018, a first side 1022 and a second side 1024 opposing the first side 1024. The term "head end" is used to denote the end of any referred to object that is positioned to lie nearest the head end 1018 of the mattress 1010, and the term "foot end" is used to denote the end of any referred to object that is positioned to lie nearest the foot end 1020 of the mattress 1010. Generally, the therapeutic mattress 1010 provides components for the various sections of the base layer 1014 and patient support layer 1016 of the mattress 1010 that have varying levels of pressure relief and deflection as measured in units of either indentation load deflection (ILD) or pressure.

[0089] In one embodiment, the base layer 1014 of the mattress 1010 comprises a bottom member 1028 and a perimetral frame. The perimetral frame provides support and shape to the mattress 1010 and generally contains the patient support layer 1016 within a defined boundary. In one embodiment, the perimetral frame comprises first and second opposing transverse side panels or members 1030, 1032, and a first end member 1034. It is understood that in alternate embodiments, as discussed herein, a second end member opposing the first

end member 1034 may be provided to provide a perimetral frame that traverses about the entire perimeter of the mattress 1010 interior of the encasing 1012.

[0090] The bottom member 1038 is preferably made of a high density, high resilient, low compression open cell urethane foam that is fire retardant and is set for medical bedding. In one embodiment the bottom member 1028 is approximately 3" thick and has an ILD value of generally greater than 1030, and preferably 1040. The bottom member 1028 in the embodiment shown extends generally from the head end 1018 to the foot end 1020 of the mattress 1010, and generally from the first side 1022 to the second side 1024 of the mattress 1010. In alternate embodiments the bottom member 1038 may be much thinner, allowing for a thicker patient support layer 1016. Additionally, it is understood that instead of being comprised of foam, one or more sections or portions of the bottom member 1028 may be comprised of a gel, fluid or other pressure compensating media, generally referred to as a non-inflatable component. Further, the bottom member 1028 may be comprised of one or more inflatable and/or non-inflatable components. The bottom member 1028 may also be comprised of a foam having a plurality of independently projecting foam cells.

[0091] In various embodiments the bottom member 1028 is a substantially flat and unitary member, as shown in FIGS. 22-26. Alternate embodiments of the bottom member 1028 are shown in FIGS. 27A and 27B. In these embodiments, the bottom member 1028 may have various regions at different portions thereof. As shown in FIG. 27A, multiple transverse openings 1029 are provided through the bottom member 1028 to create separate zones thereof to allow more independent movement of the mattress 1010 in each zone. For example, openings 1029 are provided in the bottom member 1029 between the head zone 1031 and the seat zone 1033, between the seat zone 1033 and the knee zone 1035, and between the knee zone 1035 and the foot zone 1037 of the bottom member 1028. More or fewer openings 1029 may be provided in the bottom member 1028 to accomplish the desired result. While the openings 1029 shown in FIG. 27A do not intersect the perimeter of the bottom member 1028, such that the bottom member 1028 remains as a unitary element, it is understood that one or more of the openings 1029 could intersect the perimeter of the bottom member 1028 to separate portions thereof, such as shown in FIG. 27B. FIG. 27B also demonstrates that the bottom member 1028 may have one or more longitudinal openings 1039, including a longitudinal opening 1039 that intersects a transverse opening 1029.

Further, independent portions of the patient support member 1016 may be provided on each of the various regions of the bottom member 1028 created by the openings 1029, 1039. It is understood that the side members 1030, 1032 would hold the bottom member 1028 together.

[0092] As shown in FIGS. 24 and 25, the opposing side members 1030, 1032 are also preferably made of a high density, high resilient, low compression open cell urethane foam that is fire retardant and is set for medical bedding. In one embodiment the side members 1030, 1032 are approximately 2" thick by 6.25" high, and they have an ILD value which is greater than the ILD value of the bottom member 1018. In a preferred embodiment, the ILD value of the side members 1030, 1032 is generally greater than 1040, and preferably 1065.

[0093] In the embodiments shown, the side members 1030, 1032 extend approximately from the head end 1018 of the mattress 1010 to the foot end 1020 of the mattress 1010. The side members 1030, 1032 are connected to the side edges 1036, 1038 of the bottom member 1028, preferably at the contact surfaces at each side 1022, 1024, respectively, thereof. As shown in FIG. 24, the first side member 1030 is connected to the first side edge 1036 of the bottom member 1028 at the first side 1022 of the bottom member 1028, and the second side member 1032 is connected to the second side edge 1038 of the bottom member 1028 at the second side 1024 of the bottom member 1028. Preferably, any conventional and commercially available adhesive which is compatible with urethane foam and suitable for medical applications may be utilized.

[0094] Similarly, the end member 1034 is also preferably made of a high density, high resilient, low compression open cell urethane foam that is fire retardant and is set for medical bedding. In one embodiment, like the side members 1030, 1032, the end member 1034 is approximately 2" thick by 6.25" high, and it has an ILD value which is greater than the ILD value of the bottom member 1028. Additionally, in a preferred embodiment the ILD value of the end member 1034 is substantially similar to the ILD value of the side members 1030, 1032, and in a most preferred embodiment the ILD value of the end member 1034 is generally greater than 1040, and preferably 1065.

[0095] As shown in FIG. 24, the end member 1034 is connected to an end edge 1040 of the bottom member 1028 at the foot end 1020 thereof, and preferably at the contact surface at the foot end 1020 thereof. Additionally, in the embodiments shown, the end members 1034

extend approximately from the first side 1022 of the mattress 1010 to the second side 1024 of the mattress 1010. In such embodiments a first end 1042 of the end member 1034 is connected to an interior surface at the foot end 1020 of the first side member 1030, and a second end 1044 of the end member 1034 is connected to an interior surface at the foot end 1020 of the second side member 1032. Preferably, any conventional and commercially available adhesive which is compatible with urethane foam and suitable for medical applications may be utilized to secure the end member 1034 to the foot end 1020 of the bottom member 1028 and the first and second side members 1030, 1032.

[0096] As explained above, a second end member may be provided at the head end 1018 of the mattress 1010. This second end member would typically be secured to the head end 1018 of the bottom member 1028, and the head end 1018 of the first and second side members 1030, 1032, similar to the securement of the first end member 1034 to the foot end 1020 of the bottom member 1028.

[0097] Because the side members 1030, 1032 and the end member 1034 of the base are approximately 6.25" high and the bottom member 1028 is approximately 3" high, a cavity or well 1046 that is approximately 3.25" deep is defined between the bottom member 1028 and the opposing side members 1030, 1032 and end member 1034. Alternate embodiments employing different thicknesses of the bottom member 1028 and different thicknesses of the components making up the perimetral frame will have different depths of the well or cavity 1046. This cavity 1046 is preferably utilized to house the patient support layer 1016 as explained and shown herein.

[0098] Referring to FIGS. 24 and 26, the patient support layer 1016 is positioned above the base layer 1014, and the patient support layer 1016 generally comprises a plurality of zones or sections to support different portions of a patient's body. For example, in the embodiments of FIGS. 24 and 26, the patient support layer 1016 comprises a head zone 1050 adjacent a head end 1018 of the mattress 1010, a foot zone 1052 adjacent the foot end 1020 of the mattress 1010, a seat zone 1054 adjacent the head zone 1050 at the foot end thereof, and a knee zone 1056 adjacent the head end of the foot zone 1052 at one end and adjacent the seat zone 1054 at the other end thereof. It is understood, however, that a fewer number or greater number of zones of the patient support layer 1016 may be utilized with the present

mattress 1010, including zones which do not extend from one side of the mattress to the other side of the mattress, such as can be utilized with the bottom member 1028 as shown in FIG. 27B hereof. Further, the size of each zone may vary.

[0099] In preferred embodiments, various zones or sections of the patient support layer 1016 are made of a non-inflatable component 1058, and different zones or sections of the patient support layer 1016 are made of an inflatable or air mattress component 1060. For example, in the embodiment of FIGS. 23 and 34, the portion of the patient support layer 1016 in the head zone 1050 is made of a non-inflatable foam material component 1062, the portion of the patient support layer 1016 in the seat zone 1054 is made of inflatable component 1064, the portion of the patient support layer 1016 in the knee zone 1056 is made of a non-inflatable foam material component 1066, and the portion of the patient support layer 1016 in the foot zone 1052 is made of an inflatable component 1068. Alternately, the different zones or sections of the patient support layer 1016 may be made entirely of inflatable components 1058 or entirely of non-inflatable components. In generally any embodiment of the patient support layer 1016, however, including the embodiment of the patient support layer 1016 having inflatable components 1060 thereto, the patient support layer 1016 is provided on the base layer 1014. Instead of foam, however, the non-inflatable components 1058 of the patient support layer 1016 may be comprised of a gel, liquid fluid or some other non-inflatable pressure compensating media.

[00100] While different non-inflatable materials may be utilized without departing from the scope of the present invention, in one embodiment the first foam component 1062 utilized in the head zone 1050 adjacent the head end 1018 of the mattress 1010 is a urethane memory-type foam that is fire retardant and is set for medical bedding. Further, in a preferred embodiment, the foam component 1062 for the head zone 1050 has a density of between 2.0 and 6.0 lbs, and preferably at least 2.5 lbs but generally not greater than 5.0 lbs. Alternately, the foam component 1062 for the head zone 1050 may be referred to as having an ILD value of between 15 and 40 ILD. Additionally, the foam component 1062 for the head zone 1050 has a first side 1070 adjacent the first side member 1030, and a second side 1072 adjacent the second side member 1032. Moreover, in one embodiment the foam component 1062 in the head zone 1050 is approximately 3.25" thick to fill the cavity or well 1046 of the base layer 1014, which in one embodiment is approximately 3.25" deep as explained above. Preferably,

the ILD value of the foam component 1062 for the head zone 1050 is less than the ILD value of both the bottom member 1028 and the side members 1030, 1032 of the base member 1014. In one embodiment the foam component 1062 for the head zone 1050 is fixed, typically with an adhesive as explained above, to the base layer 1014.

[00101] Similarly, in one embodiment the second foam component 1066 utilized in the knee zone 1056 is a urethane memory-type foam that is fire retardant and is set for medical bedding. Further, in a preferred embodiment, the foam component 1066 for the knee zone 1056 has a density of between 2.0 and 6.0 lbs, and preferably at least 2.5 lbs but not greater than 5.0 lbs. Alternately, the foam component 1066 for the knee zone 1056 may be referred to as having an ILD value of between 15 and 40 ILD. As shown in FIG. 24, this foam component 1066 for the knee zone 1056 has a first side 1074 adjacent the first side member 1030, and a second side 1076 adjacent the second side member 1032. The foam component 1066 in the knee zone 1056 is also approximately 3.25" thick to fill the cavity or well 1046 of the base layer 1014. Finally, in a preferred embodiment the ILD value of the foam component 1066 for the knee zone 1056 is less than the ILD value of both the bottom member 1028 and the side members 1030, 1032 of the base member 1014, and is typically the same as the foam component 1062 for the head zone 1050. Further, the foam components for the patient support layer 1016 are typically less rigid than the foam components of the base layer 1014. This foam component 1066 may be secured to either the base layer 1014 or to the other components of the patient support layer 1016.

[00102] In one embodiment, a first inflatable air mattress component 1068 is utilized in the foot zone 1052, and a second inflatable air mattress component 1064 is utilized in the seat zone 1054. Alternately, additionally inflatable components 1060 may also be utilized in the head zone 1050 and knee zone 1056. In a preferred embodiment, as shown in the figures, the inflatable components generally comprise a plurality of low-pressure, soft, fluidly interconnected but independently movable, air-filled cells 1078 which are able to redistribute air pressure between each of the cells 1078 in the inflatable component to conform to the contours of a patient's body with minimal tissue deformation to provide a friction and shear relief surface. Such inflatable components are typically non-powered, meaning they are in a closed system. The air cells 1078 are generally arranged in an array of rows and columns which are fluidly connected across a flexible base 1080 on the inflatable components 1060.

In one embodiment, the air cells 1078 have a substantially rectangular body that is approximately 3.5" high, with a top wall that has a generally pyramidal or conical shape thereto. Further, the air cells 1078 have a generally square cross-sectional shape. Generally, like the foam mattress portions 1058 of the patient support member 1016, the air mattress components 1060 are provided in the cavity or well 1046 of the base layer 1014, and extend from the first side member 1030 to the second side member 1032 of the base layer 1014. In one embodiment, as disclosed in FIG. 22, the inflatable component 1060 is positioned such that the flexible base 1080 is provided adjacent the bottom member of the base layer 1014, and the air cells 1078 project upwardly toward the upper encasing member 1088. In alternate embodiments, multiple components of the inflatable component 1060 may be stacked on one another at various zones of the mattress 1010. For example, in one zone a first or lower inflatable component 1060 may be provided on the bottom member 1028 of the base layer 1014, and a second or upper inflatable component 1060 may be provided on the first inflatable component. Further, the lower inflatable component may be orientated such that its inflatable components are positioned adjacent the bottom member 1028 of the base layer 1014 and its flexible base 1080 is raised off the bottom member 1028. Then, the upper inflatable component is layered on the lower inflatable component by placing the base layer 1014 of the upper inflatable component on the base layer 1014 of the lower inflatable component, and having the inflatable components of the upper inflatable component project upwardly and away from the lower inflatable component. One of ordinary skill in the art would readily understand that additional combinations and orientations of the inflatable components may be utilized, such as having both the upper and lower inflatable components orientated similarly, without departing from the scope or the spirit of the present invention.

[00103] The air cells 1078 can be adjusted to the patient's body shape and size. In a preferred embodiment, the inflatable components 1060 are provided in a closed system, meaning they are non-powered and require no external power source once they are inflated to the appropriate pressure. Thus, after the inflatable components 1060 are inflated, they are maintained at that pressure, however, should any leakage or seepage occur they may be re-inflated to the desired pressure. In a preferred embodiment, the inflatable components 1060 are made of a durable neoprene rubber that is flame-resistant and can be easily cleaned. Each of the inflatable components 1060 of the different zones can be removed and replaced, if

necessary. Further, the inflatable components 1060 can be connected to adjacent members, including foam members, typically by snapping together, connecting with Velcro, or by some other acceptable means.

[00104] In the embodiment shown in FIGS. 22-25, the patient support layer 1016 comprises alternating foam components 1058 with inflatable components 1060. Specifically, foam components 1058 are provided in the head zone 1050 and knee zone 1056, and inflatable components 1060 are provided in the seat zone 1054 and foot zone 1052. Generally, inflatable components 1060 are utilized to support areas of the patient's body which are most susceptible to bed sores, such as the hips/buttocks and the heels. Accordingly, inflatable components 1060 having air cells 1078 are provided in these zones 1052, 1054. Conversely, in the embodiment shown in FIG. 26, the patient support layer 1016 comprises a single foam component 1058 in the head zone 1050, with inflatable components 1060 in each of the seat zone 1054, knee zone 1056 and foot zone 1052. Such an embodiment may be utilized with patients that need additional pressure relief in the knee zone 1056, or for patients in which the first embodiment described above is not satisfactory.

[00105] Referring now to FIGS. 22 and 25, the entire base member 1014 and patient support member 1016 are housed in a cavity 1086 of the removable encasing 1012. Typically the encasing 1012 comprises a top or upper encasing member 1088 and a bottom or lower encasing member 1090. The top encasing member 1088 is connected to the bottom encasing member 1090 with a connector 1092, such as a zipper 1092, generally positioned about the mid-line of the side walls 1030, 1032 of the mattress 1010. In a preferred embodiment, the top encasing member 1088 is made of a breathable (i.e., air permeable) stretch material that is coated with a material, such as urethane, to make it substantially impervious to water. Additionally, the material of the top encasing member 1088 should be stretchy, so as not to provide unacceptable shear for the patient. In a preferred embodiment the material of the top encasing member 1088 is made of a polyurethane coated nylon/spandex material. In a preferred embodiment, the stretch material is made of a 80% nylon and 20% spandex blend, such as lycra. The bottom encasing member 1090, however, is generally made of 200 denier double-sided nylon coated urethane. Opposing parts of the zipper 1092 are connected to the appropriate top and bottom encasing members 1088, 1090.

[00106] Several alternative embodiments and examples have been described and illustrated herein. A person of ordinary skill in the art would appreciate the features of the individual embodiments, and the possible combinations and variations of the components. A person of ordinary skill in the art would further appreciate that any of the embodiments could be provided in any combination with the other embodiments disclosed herein. Additionally, the terms "first," "second," "third," and "fourth" as used herein are intended for illustrative purposes only and do not limit the embodiments in any way. Further, the term "plurality" as used herein indicates any number greater than one, either disjunctively or conjunctively, as necessary, up to an infinite number. Additionally, the term "having" as used herein in both the disclosure and claims, is utilized in an open-ended manner.

[00107] It will be understood that the invention may be embodied in other specific forms without departing from the spirit or central characteristics thereof. The present examples and embodiments, therefore, are to be considered in all respects as illustrative and not restrictive, and the invention is not to be limited to the details given herein. Accordingly, while the specific embodiments have been illustrated and described, numerous modifications come to mind without significantly departing from the spirit of the invention and the scope of protection is only limited by the scope of the accompanying Claims.

What is claimed is:

1. A therapeutic mattress for supporting an entire body of a user in a prone position, comprising:

a base layer;

a first longitudinally extending foam sidewall extending upwards from one side of the base layer, and a second longitudinally extending foam sidewall extending upwards from an opposing side of the base layer, the first and second longitudinally extending sidewalls and the base layer defining a well;

a patient support layer positioned on the base layer and between the foam sidewalls in the well, the patient support layer having a plurality of separately zoned air cell sections extending from generally the first sidewall to the second sidewall, including a head zone adjacent a head end of the mattress, a foot zone adjacent a foot end of the mattress, and a seat zone between the head zone and the foot zone, wherein the patient support layer in the head zone comprises a first separate and independent air cell section extending generally from the first sidewall to the second sidewall, wherein the patient support layer in the seat zone comprises a second separate and independent air cell section extending generally from the first sidewall to the second sidewall, and wherein the patient support layer in the foot zone comprises a third separate and independent air cell section, wherein each air cell section has a bottom wall adjacent the base layer, wherein each air cell section is independently inflatable and deflatable to independently set and adjust an air pressure of each air cell section, and wherein each air cell section comprises a plurality of individual air cell members arranged in rows and columns and fluidly interconnected to be self-equalizing, each of the air cell members having a sidewall extending vertically from a bottom of the air cell member and terminating in a top wall of each air cell member, each air cell having a height extending from the bottom of the air cell member to the top wall of the air cell member, each air cell member of the air cell sections also being independently moveable in a plurality of directions, including the x, y and z directions, and the air cell members in the head, foot and seat zones being able to move independently from the longitudinal extending sidewalls; and,

a cover having an interior region covering the patient support layer.

2. The therapeutic mattress of claim 1, wherein the base layer comprises a foam bottom member.

3. The therapeutic mattress of claim 1, wherein the plurality of separately zoned air cell sections comprises an array of individual air cells arranged in rows across a flexible base.

4. The therapeutic mattress of claim 1, wherein the sidewalls are more rigid than the base layer.

5. The therapeutic mattress of claim 1, wherein the cover comprises a lower encasing connected with a zipper to an upper encasing.

6. The therapeutic mattress of claim 5, wherein the upper encasing comprises a urethane coated spandex.

7. The therapeutic mattress of claim 1, wherein the base layer has a plurality of slices to divide the base layer into discrete sections.

8. The therapeutic mattress of claim 1, further comprising a firm end wall at one end of the base layer.

9. A therapeutic mattress for supporting an entire body of a user in a prone position, comprising:

a base layer;

a first longitudinally extending foam sidewall extending upwards from one side of the base layer, and

a second longitudinally extending foam sidewall extending upwards from an opposing side of the base layer, the first and second longitudinally extending sidewalls and the base layer defining a well; and,

a patient support layer positioned on the base layer and between the foam sidewalls in the well, the patient support layer having a plurality of separately zoned air cell sections extending from generally the first sidewall to the second sidewall, including a head zone adjacent a head end of the mattress, a foot zone adjacent a foot end of the mattress, and a seat zone between the head zone and the foot zone, wherein the patient support layer in the head zone comprises a first separate and independent air cell section extending generally from the first sidewall to the second sidewall, wherein the patient support layer in the seat zone comprises a second separate and independent air cell section extending generally from the first sidewall to the second sidewall, and wherein the patient support layer in the foot zone comprises a third separate and independent air cell section, wherein each air cell section has a bottom wall adjacent the base layer, wherein each air cell section is independently inflatable and deflatable to independently set and adjust an air pressure of each air cell section, and wherein each air cell

section comprises a plurality of individual air cell members arranged in rows and columns and fluidly interconnected to be self-equalizing, each of the air cell members having a sidewall extending vertically from a bottom of the air cell member and terminating in a top wall of each air cell member, each air cell having a height extending from the bottom of the air cell member to the top wall of the air cell member, each air cell member of the air cell sections also being independently moveable in a plurality of directions, including the x, y and z directions, and the air cell members in the head, foot and seat zones being able to move independently from the longitudinal extending sidewalls.

10. A therapeutic mattress for supporting an entire body of a user in a prone position, comprising:

a base member and first and second generally firm upstanding longitudinally extending foam side walls connected at opposing sides of the base member to define a well; and,

a patient support layer within the well, the patient support layer having a plurality of separately zoned sections, including a head zone adjacent a head end of the mattress, a foot zone adjacent a foot end of the mattress, and a seat zone between the head zone and the foot zone, wherein the patient support layer in the head zone comprises a first separate and independent air cell section extending generally from the first sidewall to the second sidewall, wherein the patient support layer in the seat zone comprises a second separate and independent air cell section extending generally from the first sidewall to the second sidewall, and wherein the patient support layer in the foot zone comprises a third separate and independent air cell section, wherein the air cell sections in each of the head, seat and foot zones are adjacent the longitudinally extending side walls, and wherein the members of the air cell sections in each of the head zone, foot zone and seat zone are free to move independently from the longitudinal extending sidewalls, wherein each air cell section has a bottom wall adjacent the base member, wherein the therapeutic mattress has an overall footprint and wherein the patient support layer in each zone has a footprint that is approximately one-quarter of the overall surface area of the therapeutic mattress, wherein each air cell section is independently inflatable and deflatable with respect to the air cell sections in other zones of the mattress to independently set and adjust an air pressure of each air cell section, and wherein each air cell section comprises a plurality of individual air cell members arranged in rows and columns and fluidly interconnected to be self-equalizing, each of the air cell members having a sidewall extending vertically from a bottom of the air cell member and terminating in a top wall of each air cell member, each air cell having a height extending from the bottom of the air cell member to the top wall of the air cell member, and each air cell member of the air cell sections also being independently moveable in a plurality of directions, including the x, y and z directions.

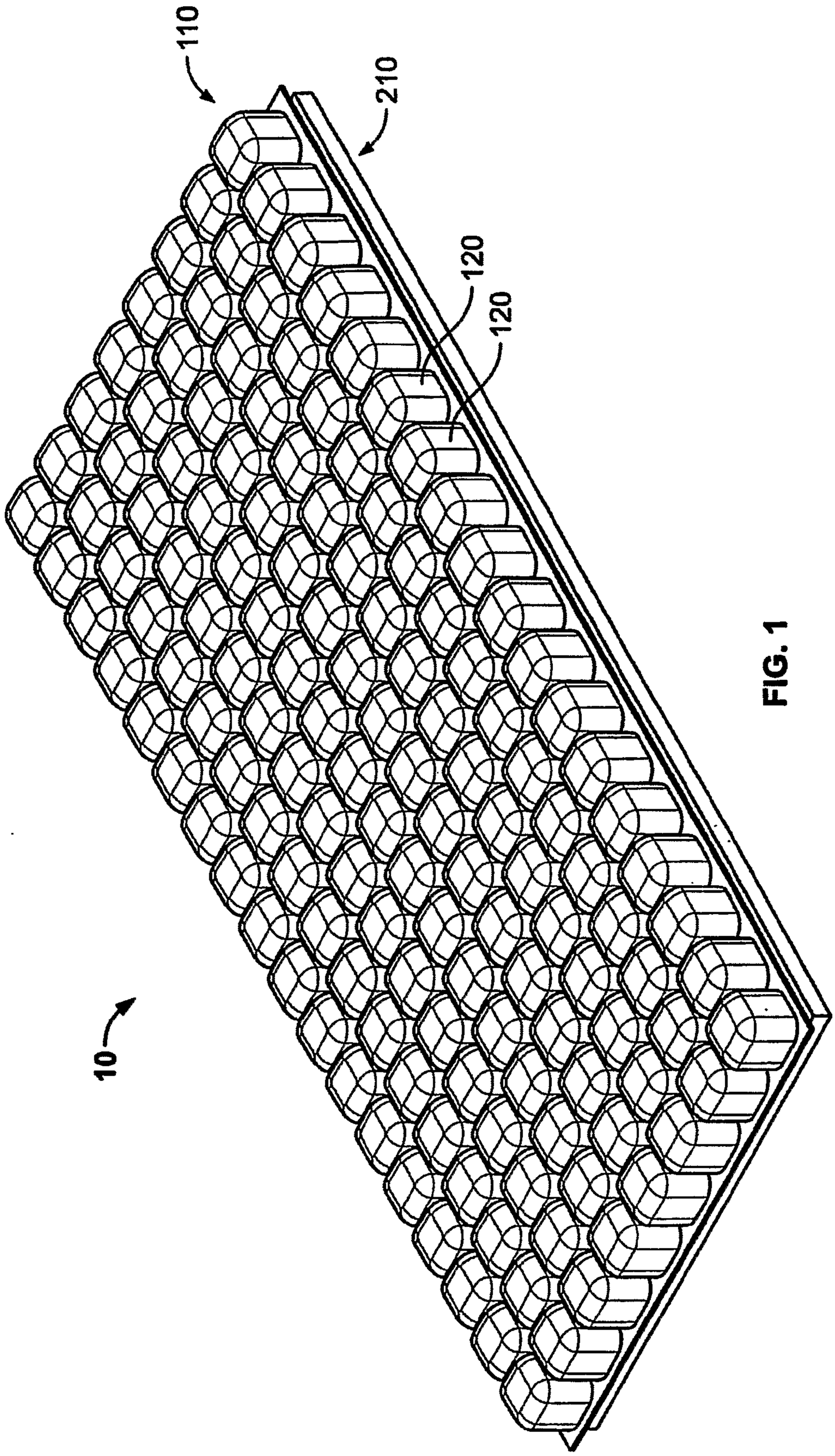


FIG. 1

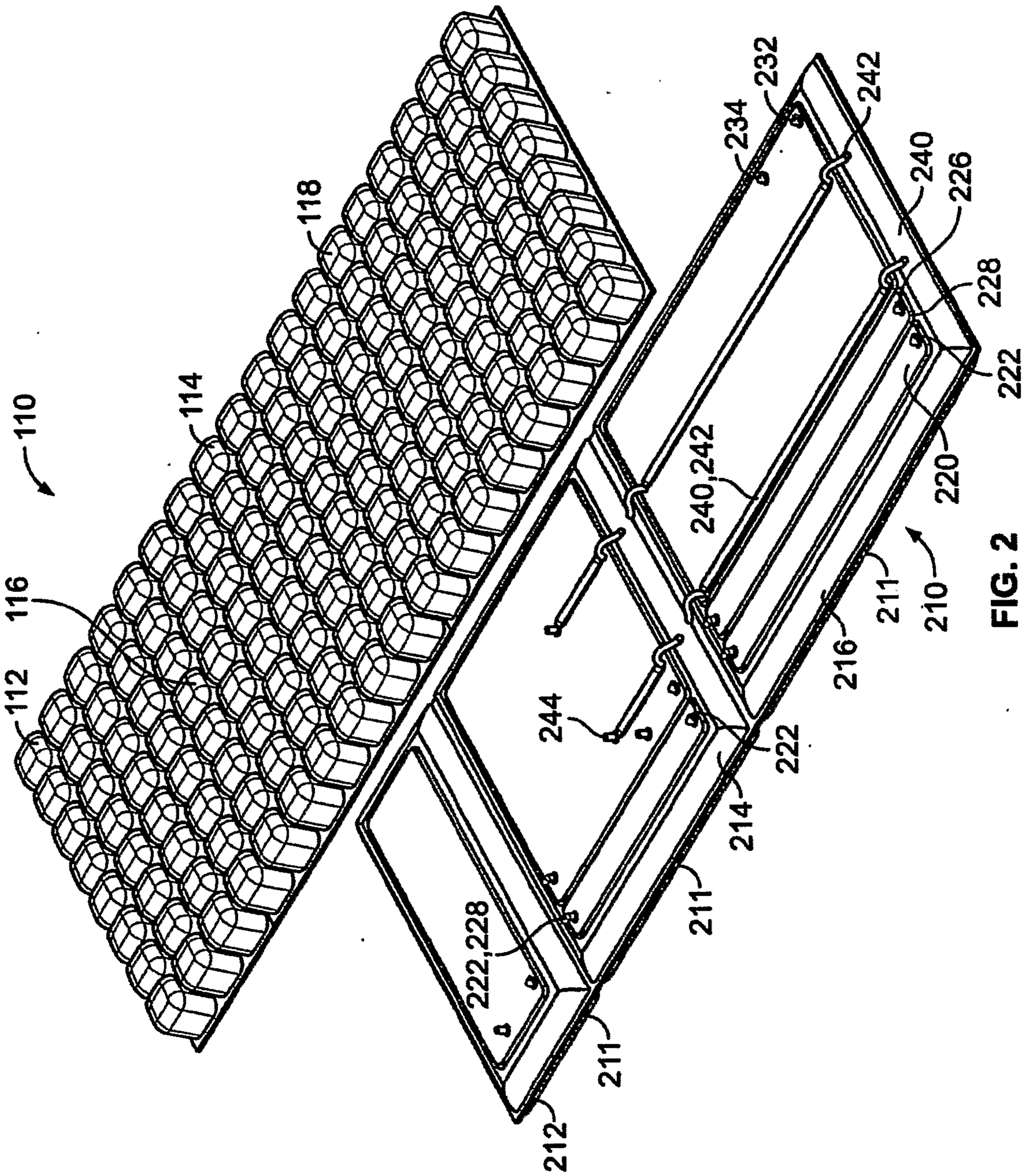

110
112
114
116
118
210
211
212
214
216
220
222
222,228
226
228
232
234
240
240,242
242
244

FIG. 2

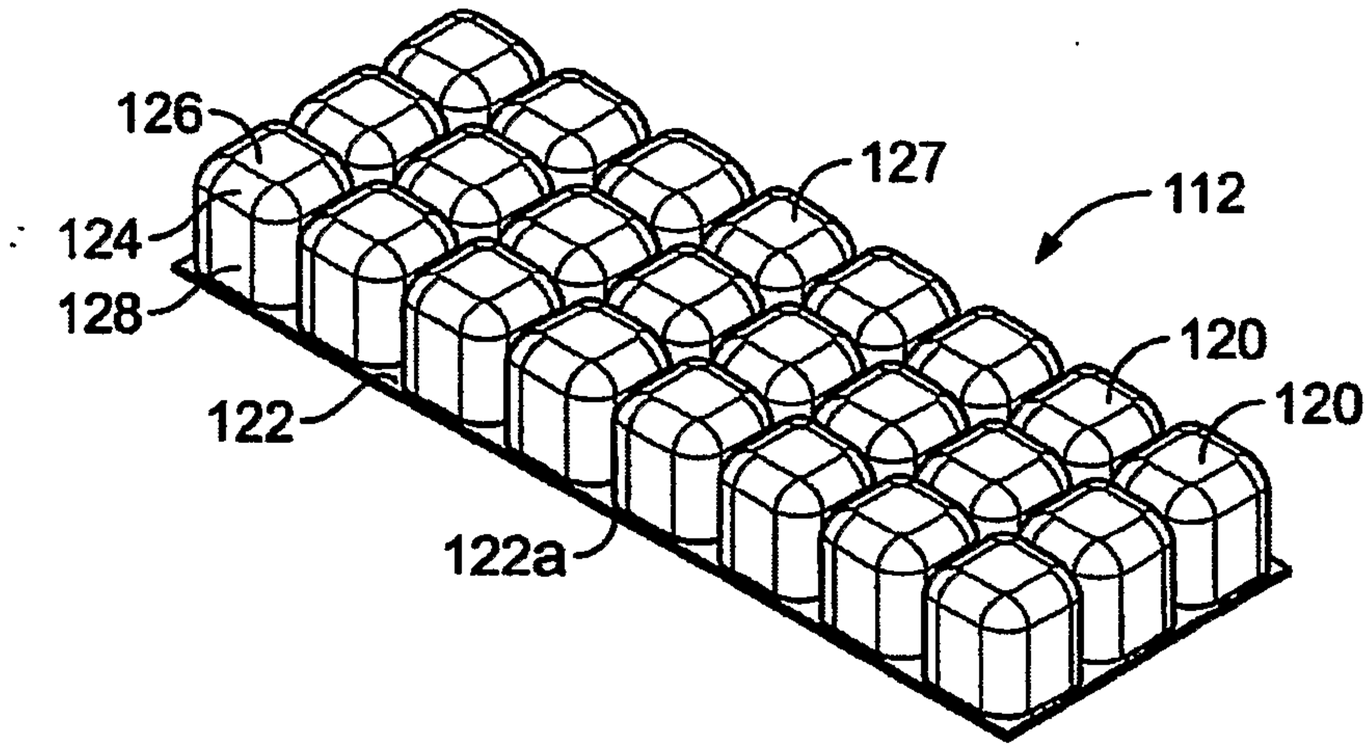
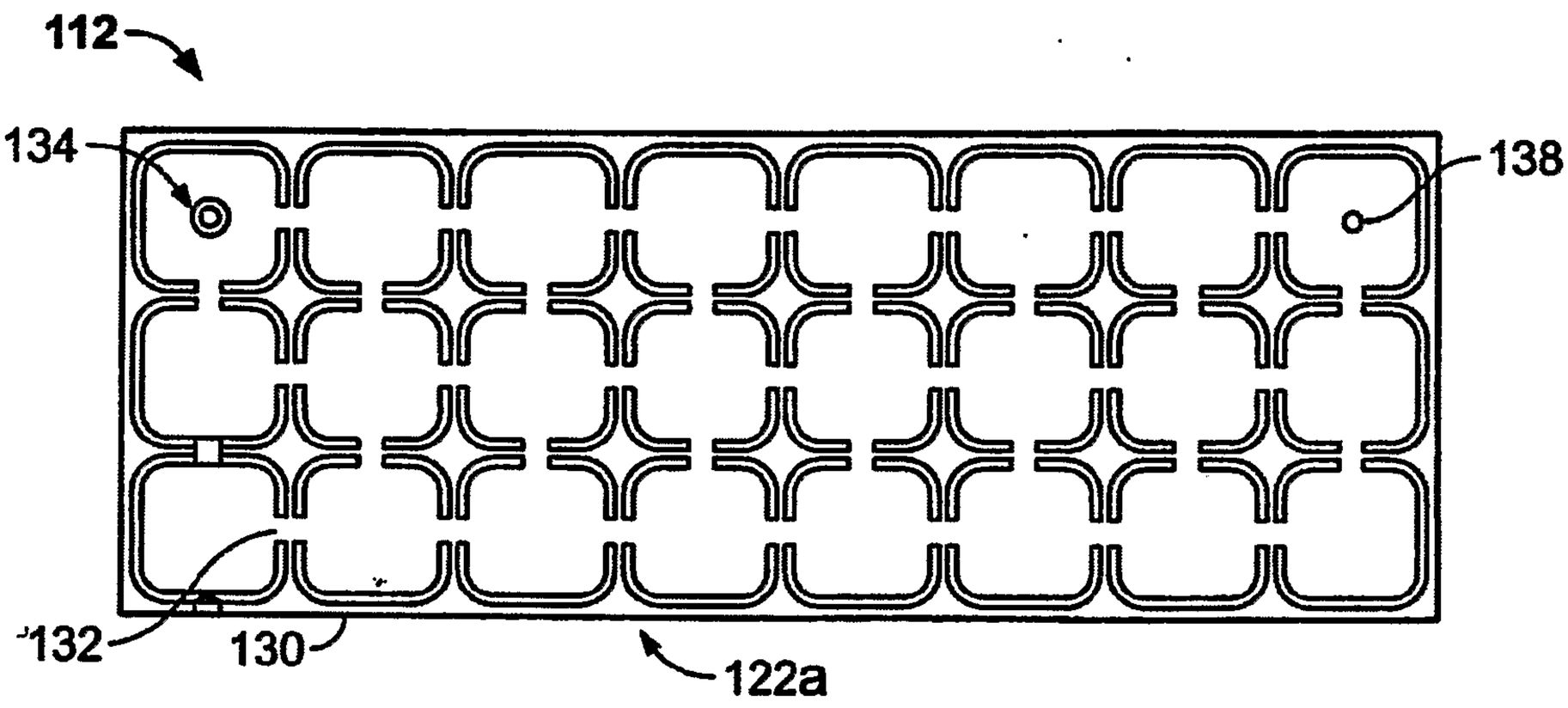

126
127
112
124
128
120
120
122
122a

FIG. 3


112
134
138
132
130
122a

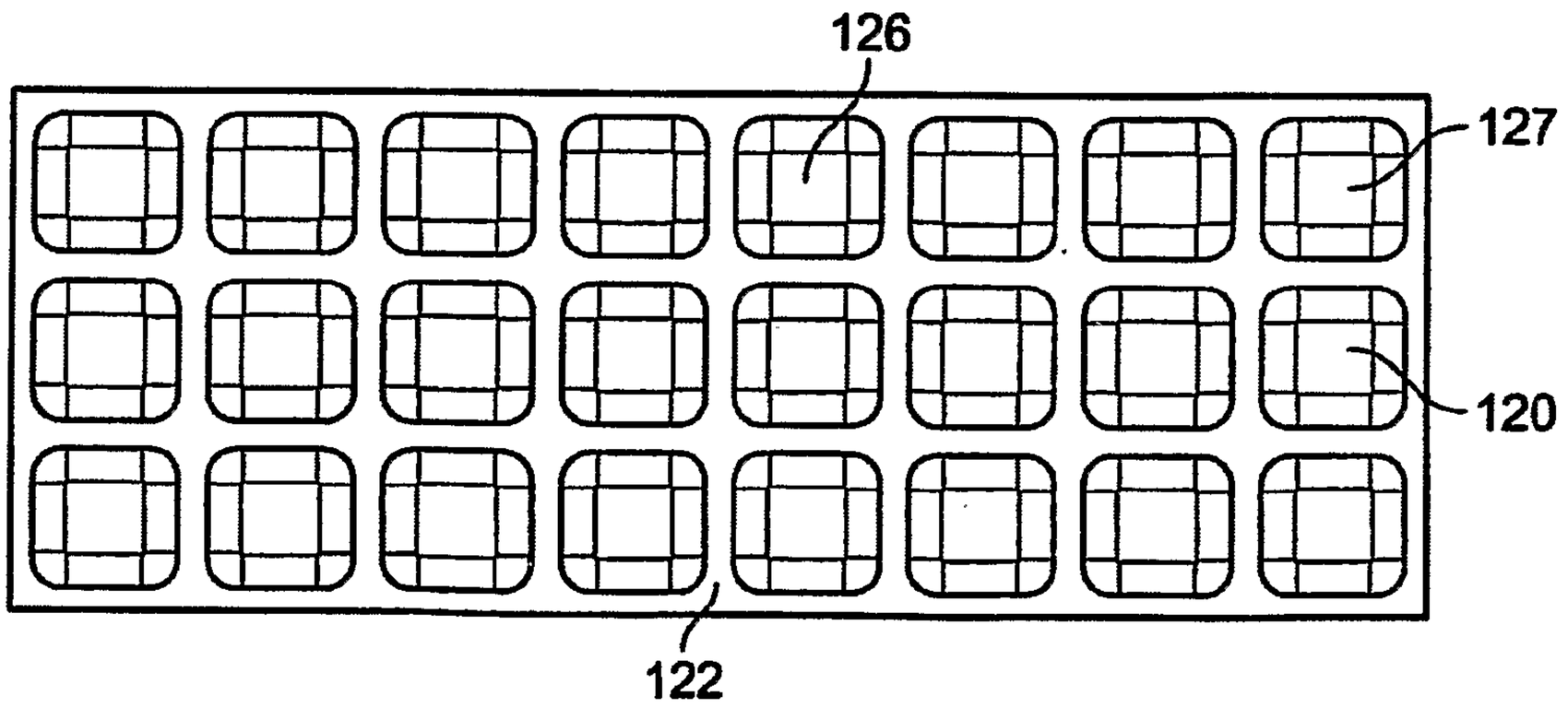

126
127
120
122

FIG. 4

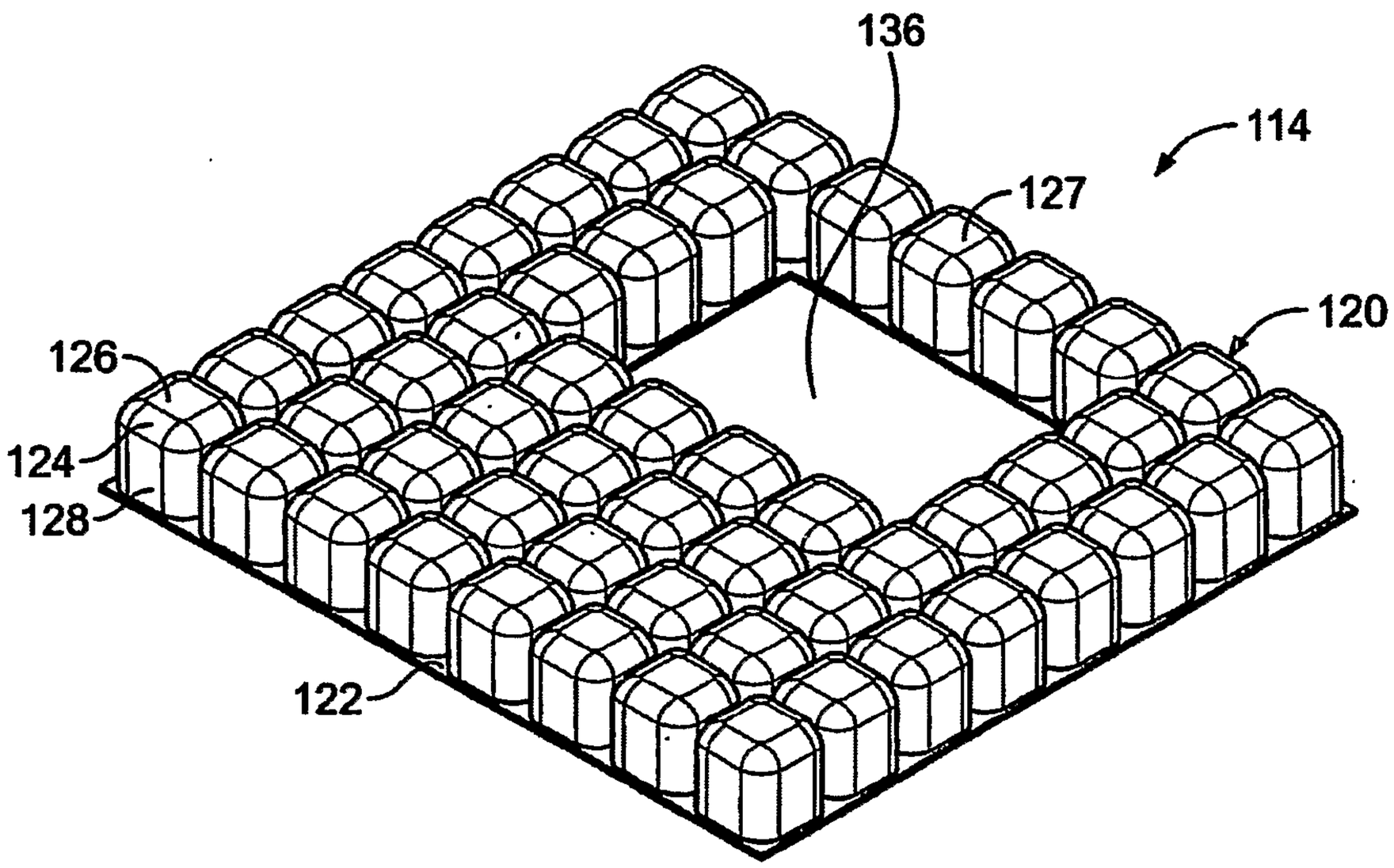


FIG. 5

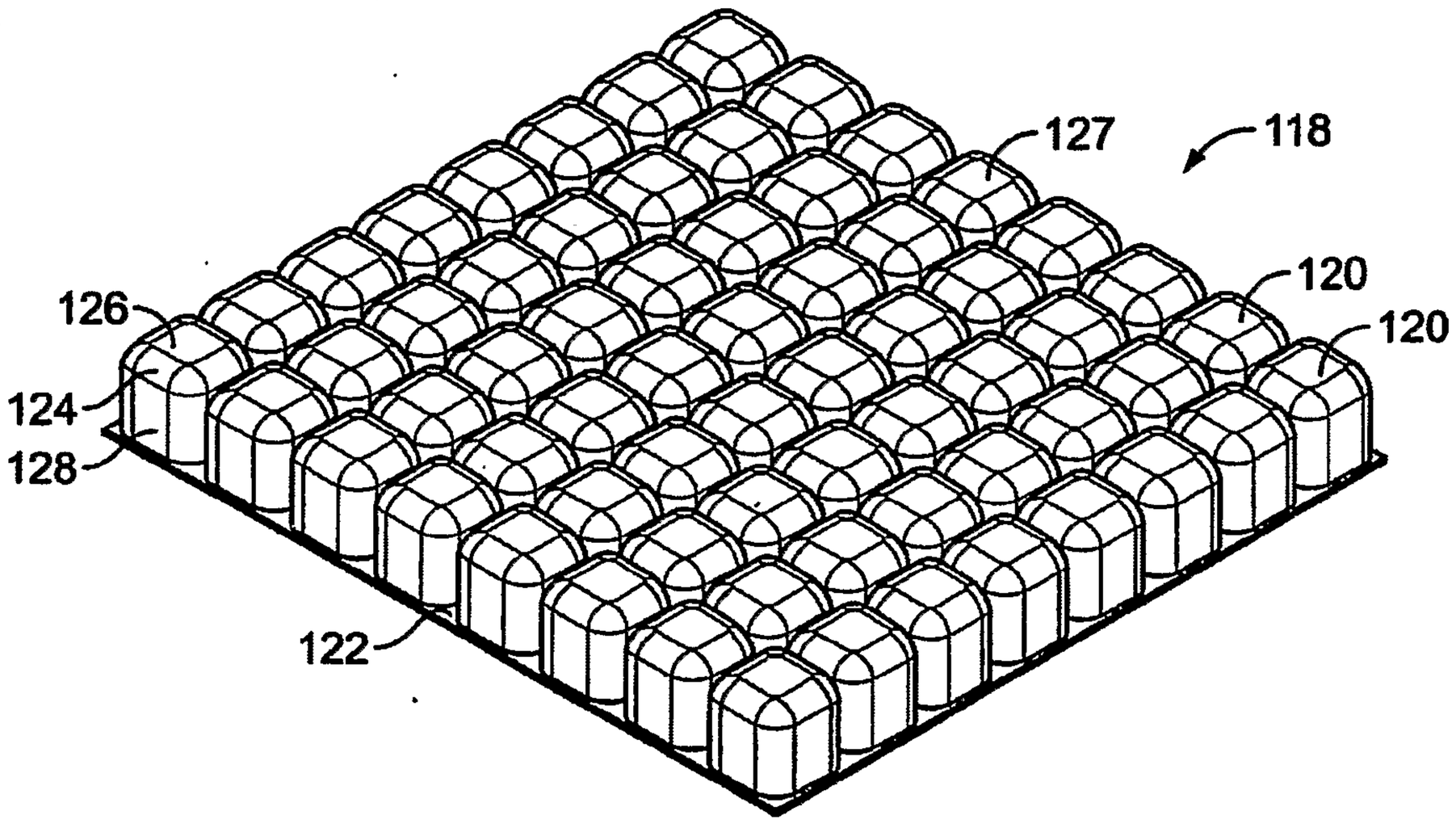


FIG. 6

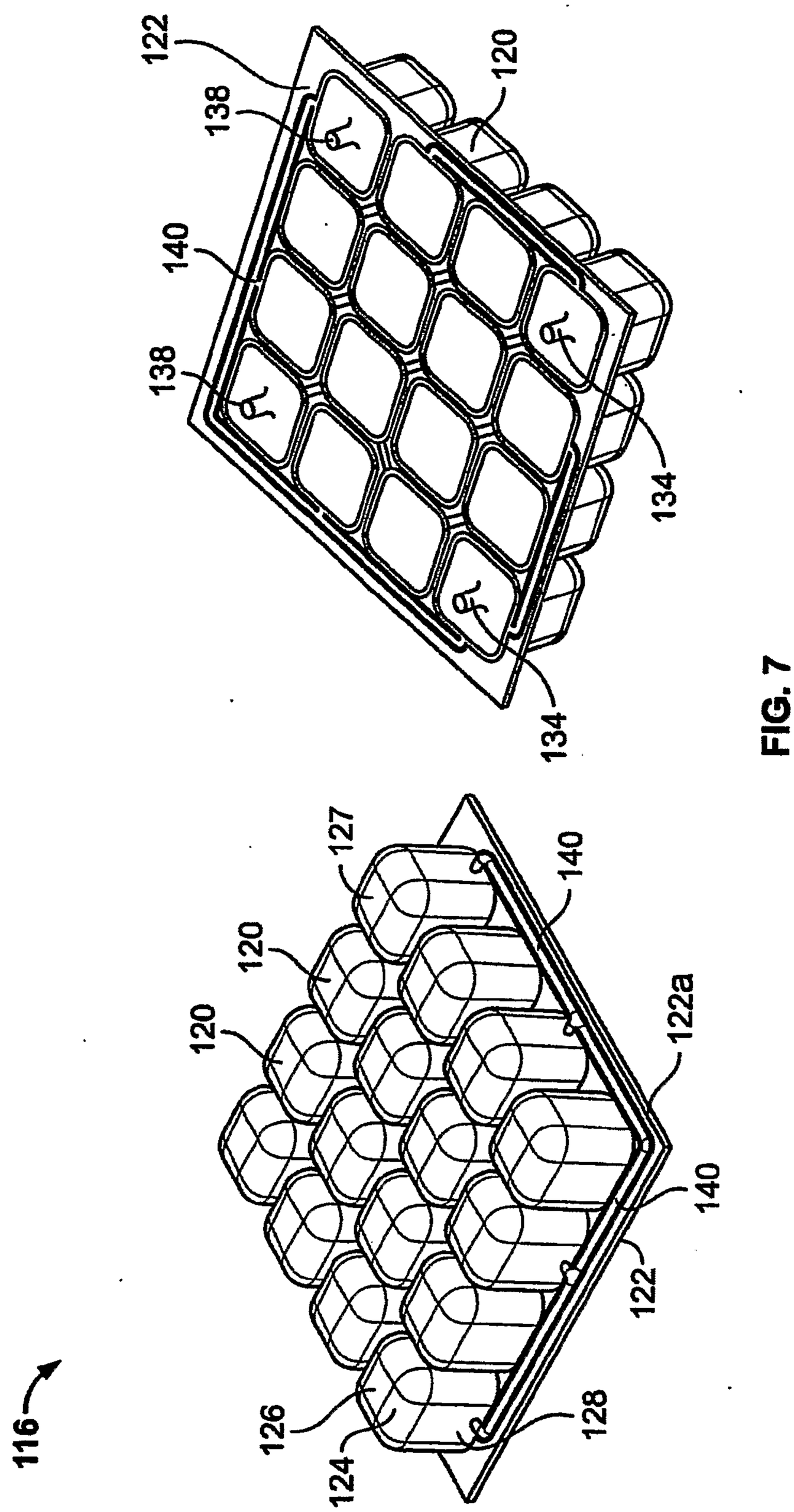

122
138
120
140
138
134
134
127
140
120
120
122a
140
122
116
126
124
128

FIG. 7

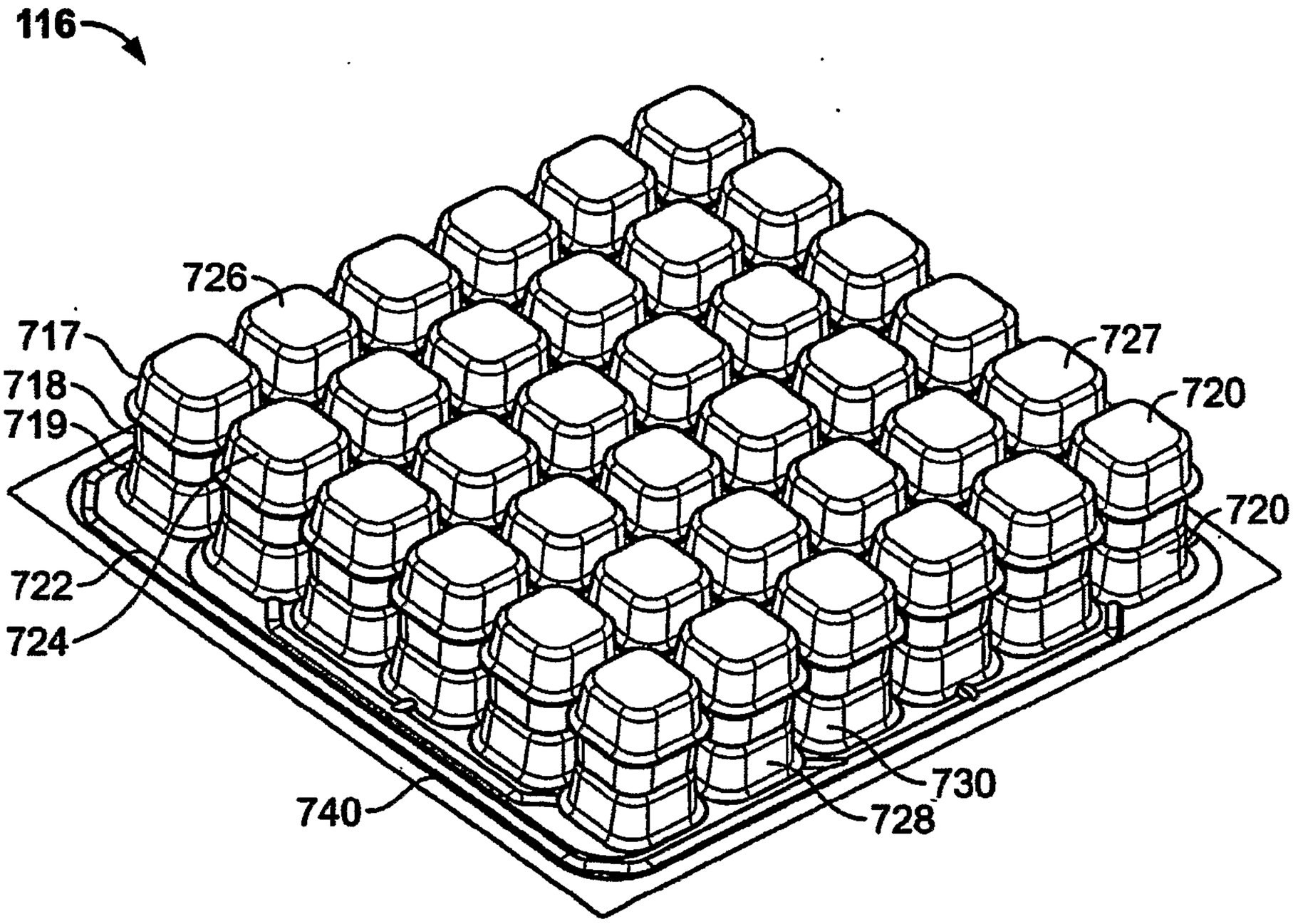

116
726
717
718
719
722
724
727
720
720
730
728
740

FIG. 7A

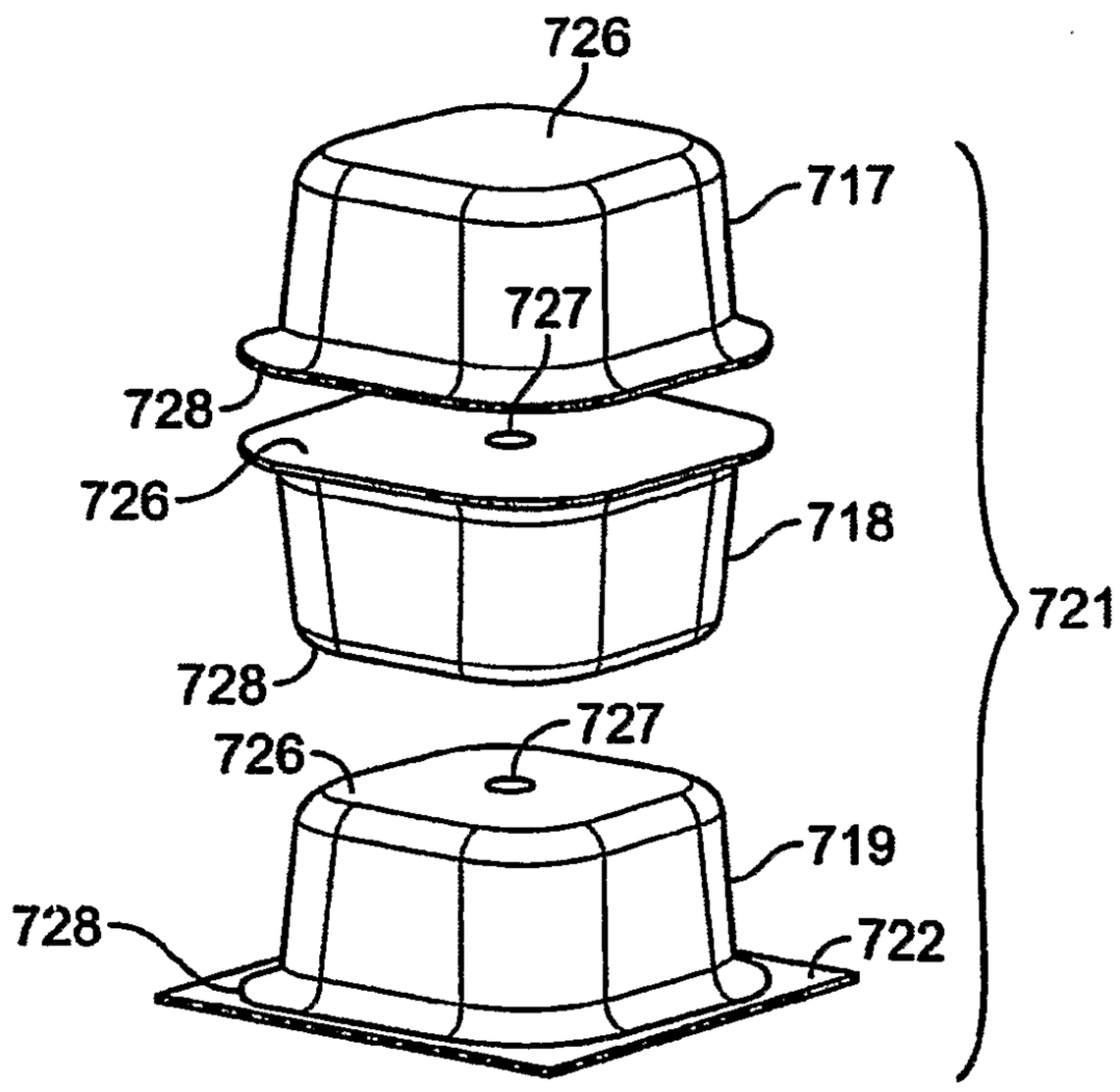

726
717
727
728
726
718
728
721
727
726
719
728
722

FIG. 7B

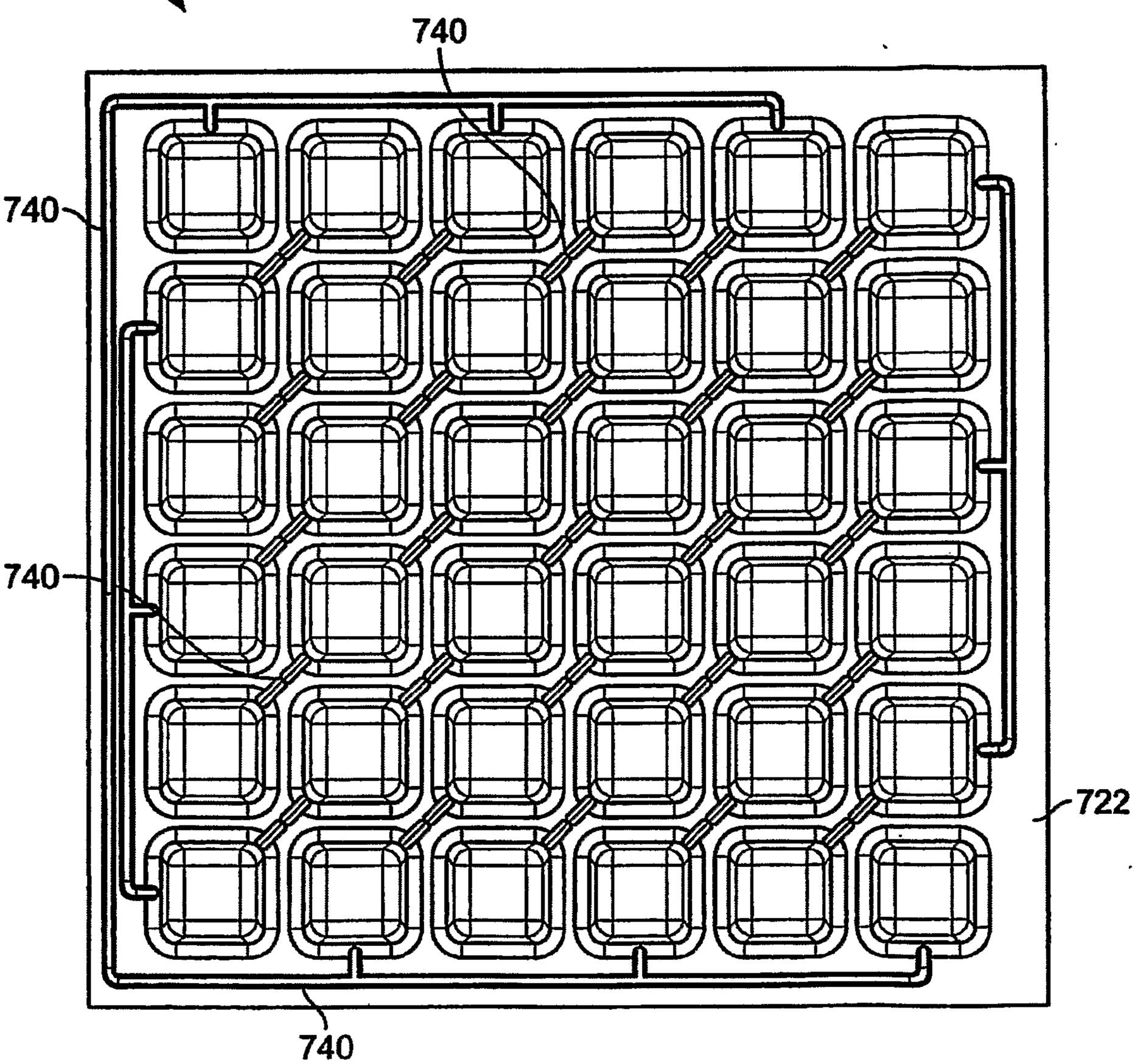


FIG. 7C

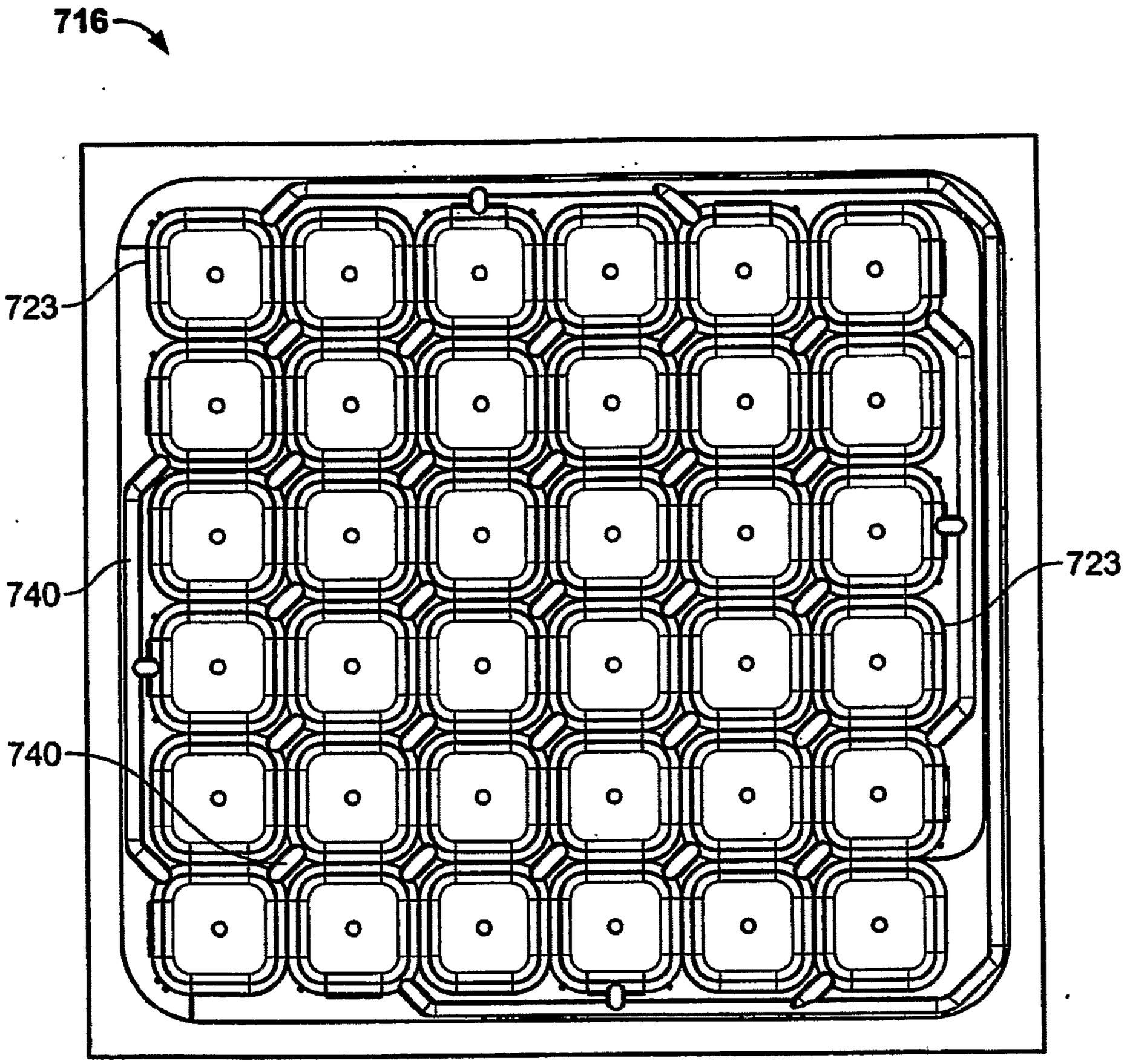


FIG. 7D

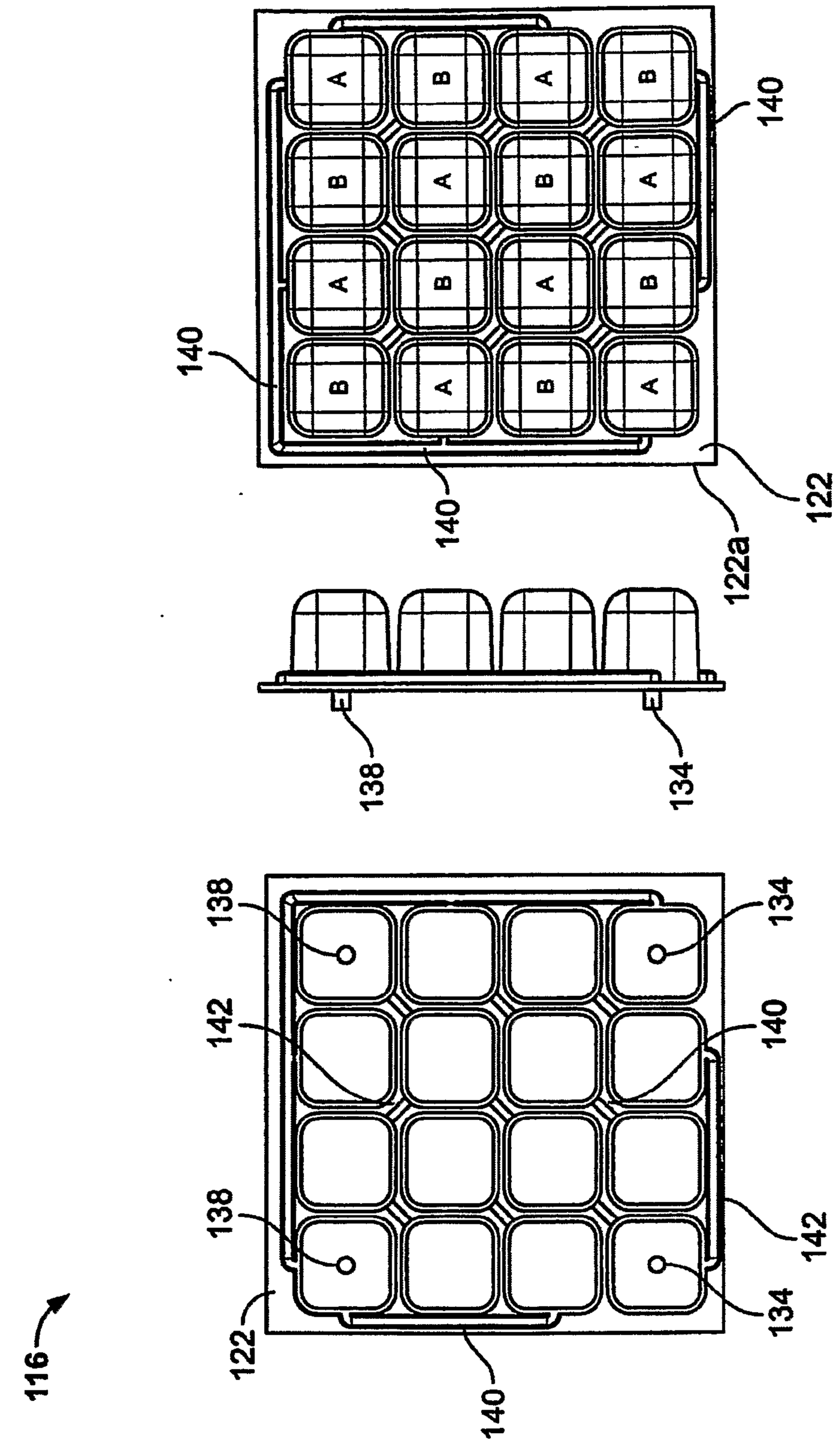
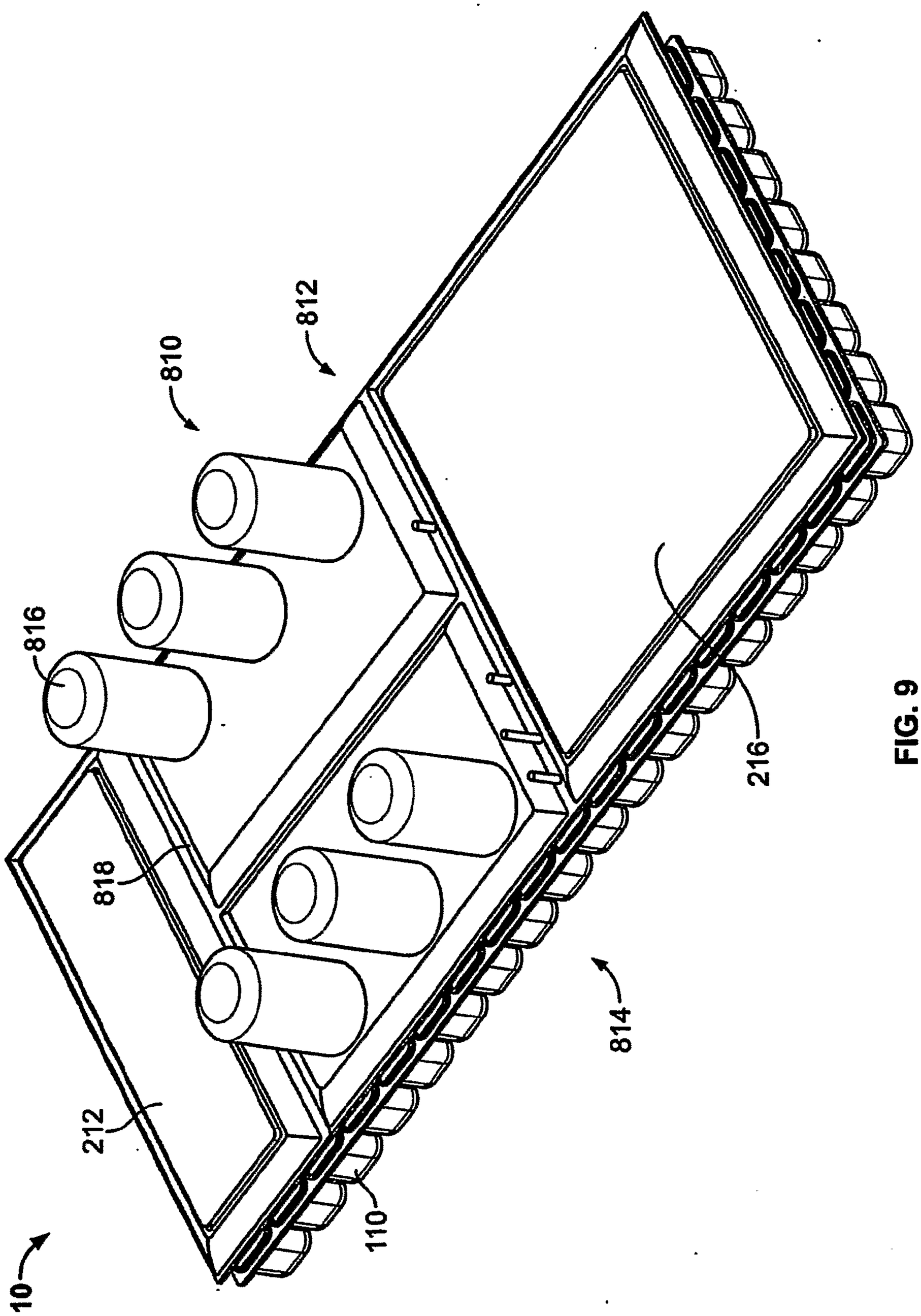


FIG. 8


812
810
816
818
212
110
10
814
216
FIG. 9

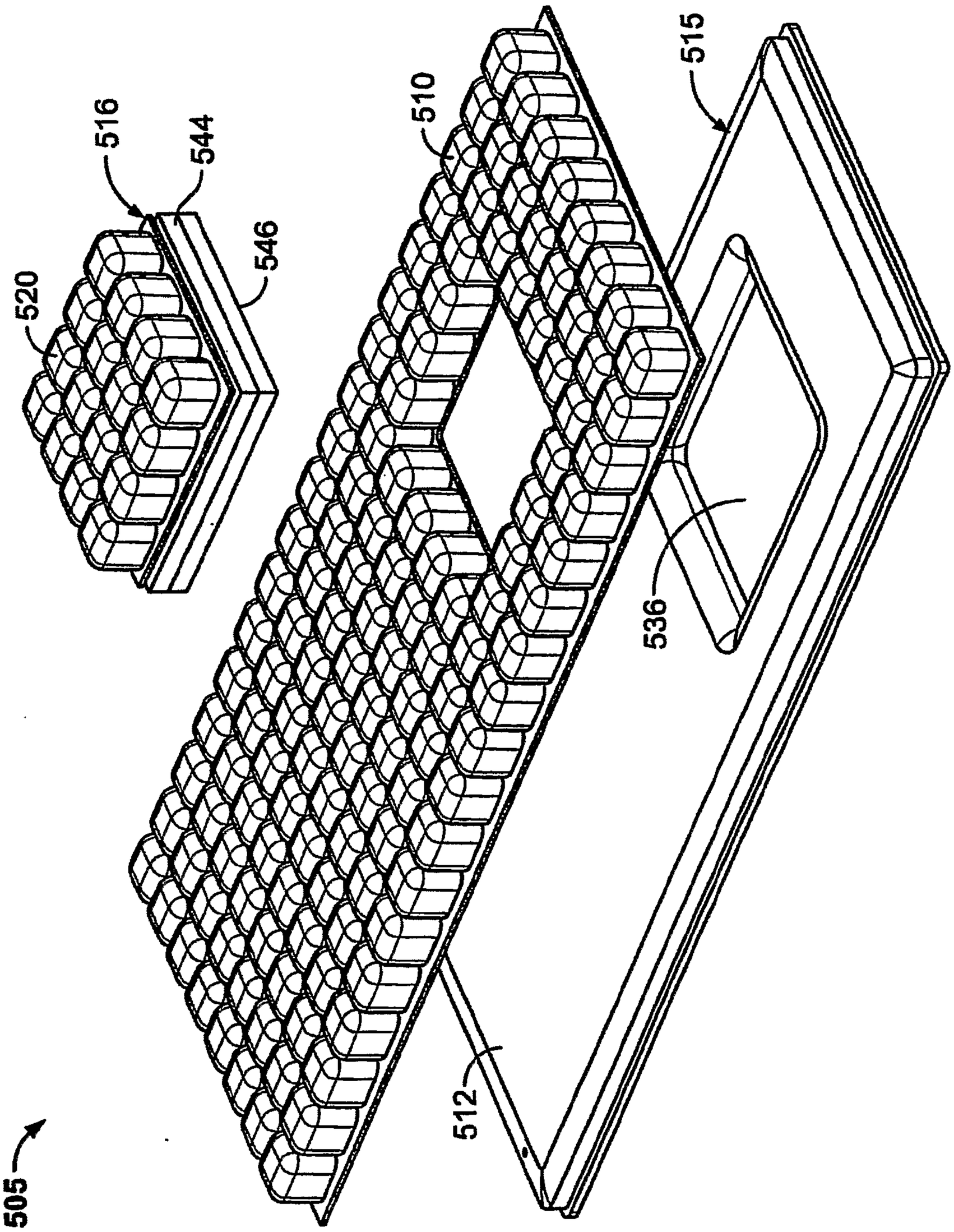


FIG. 10A

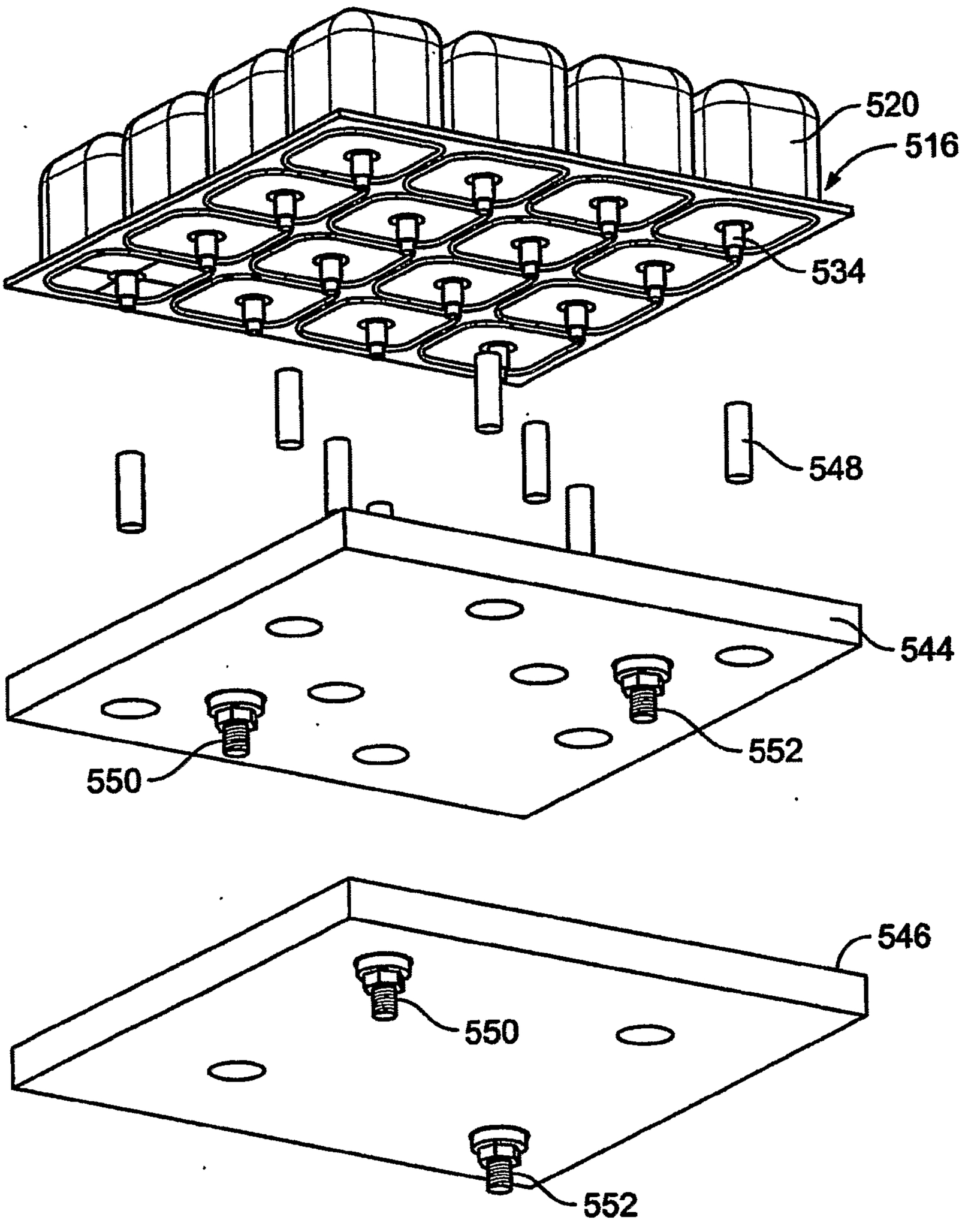


FIG. 10B

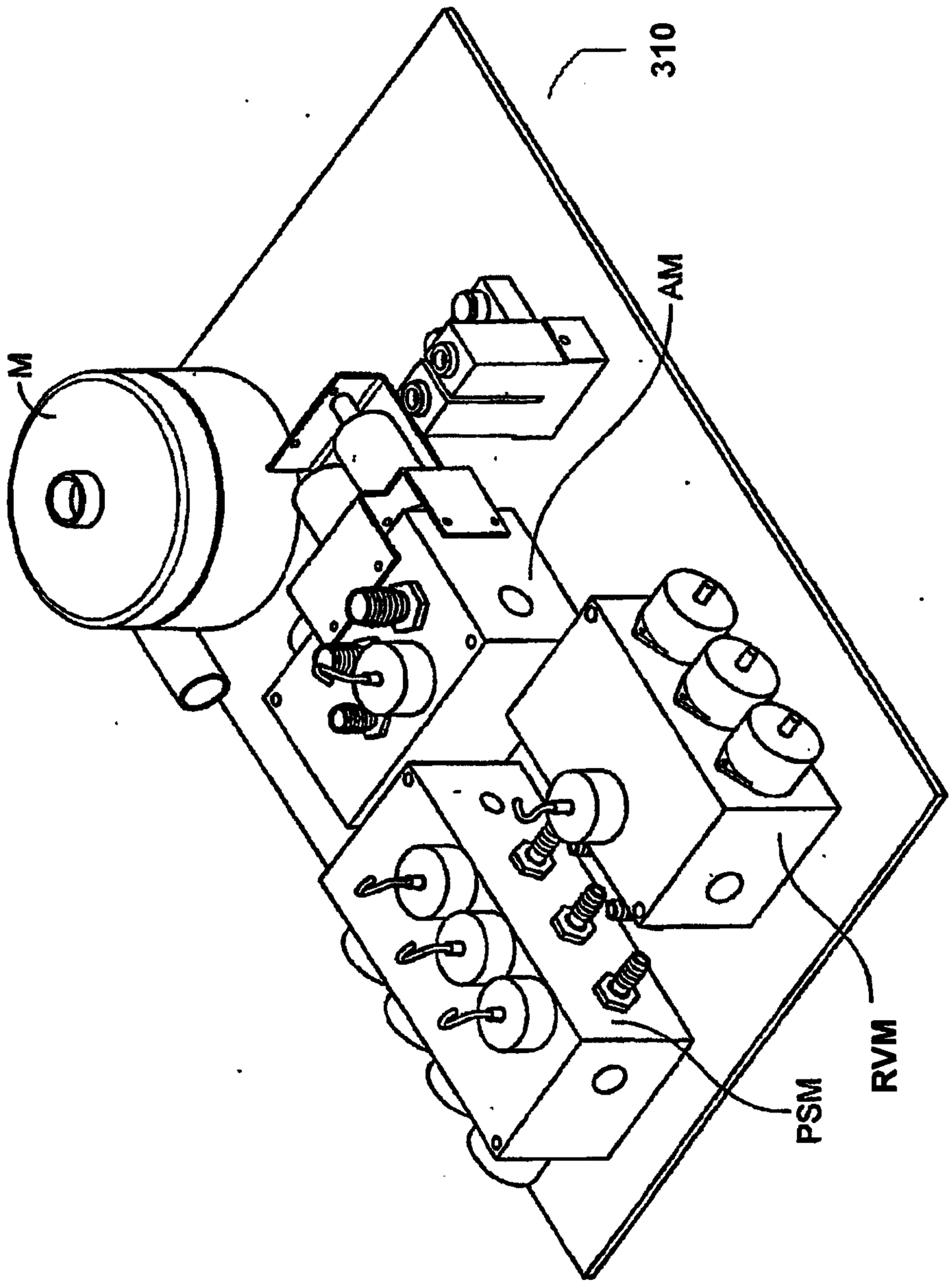


FIG. 11

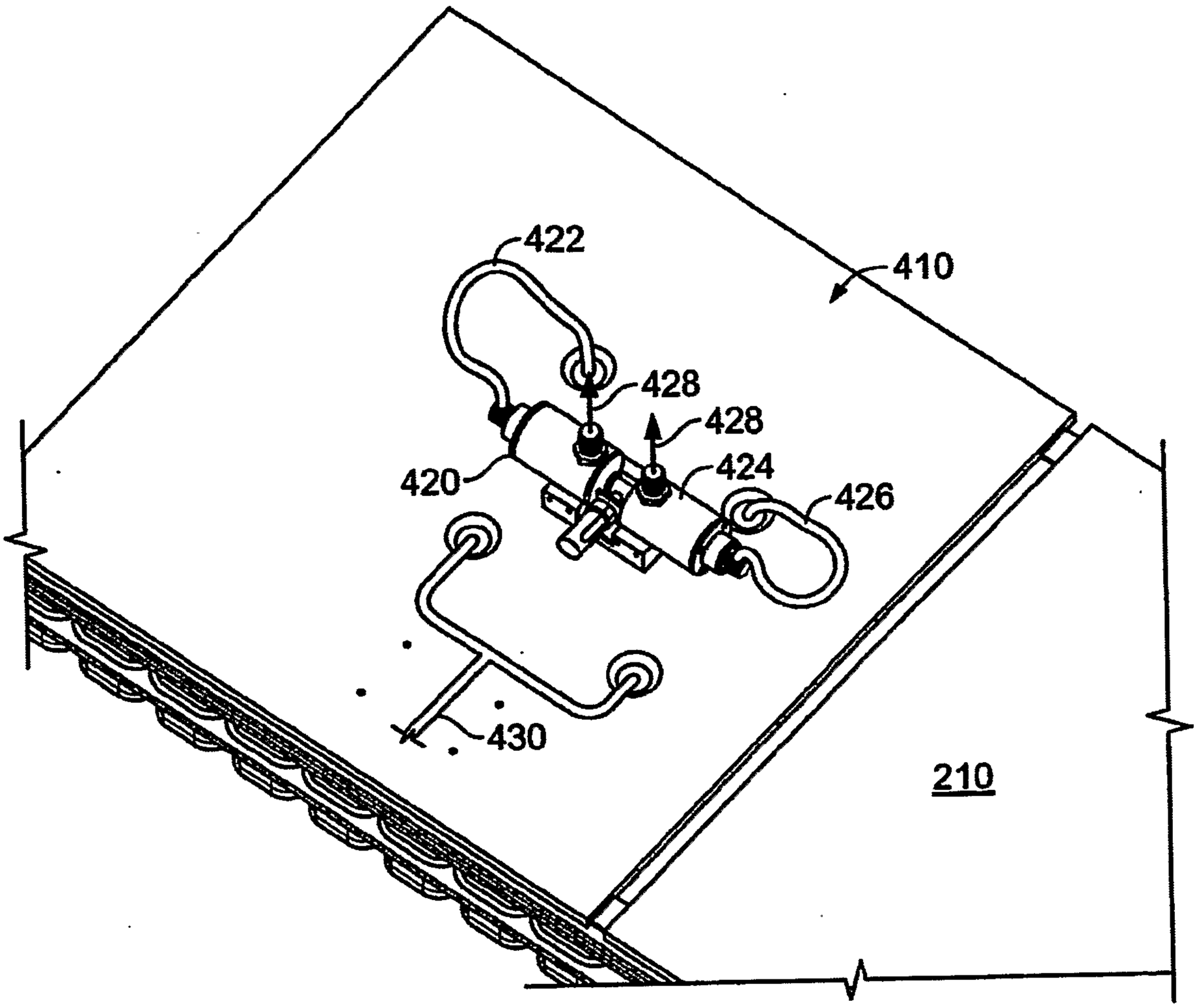

422
410
428
428
420
424
426
430
210

FIG. 12

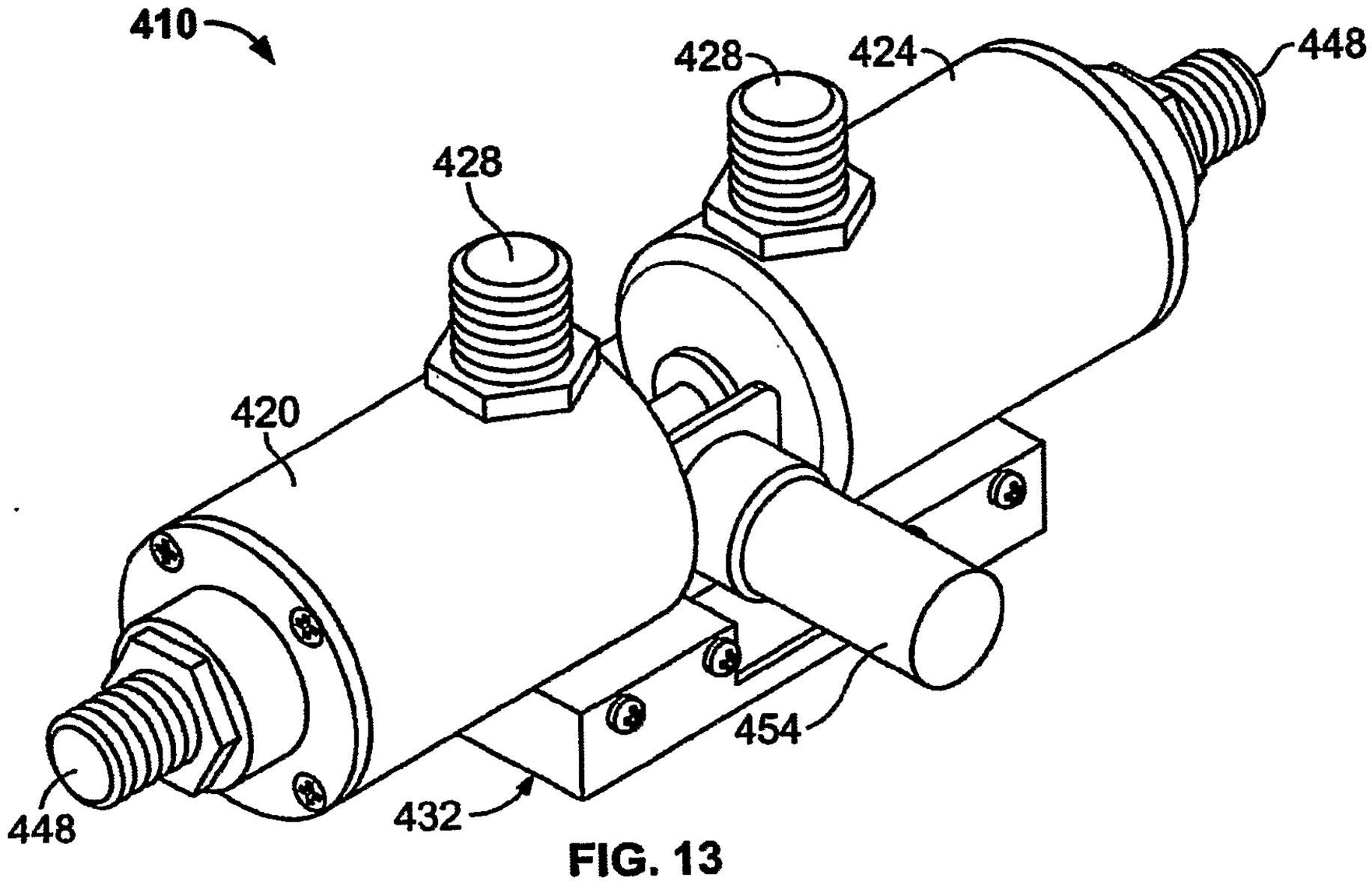

410
428
424
448
428
420
454
448
432

FIG. 13

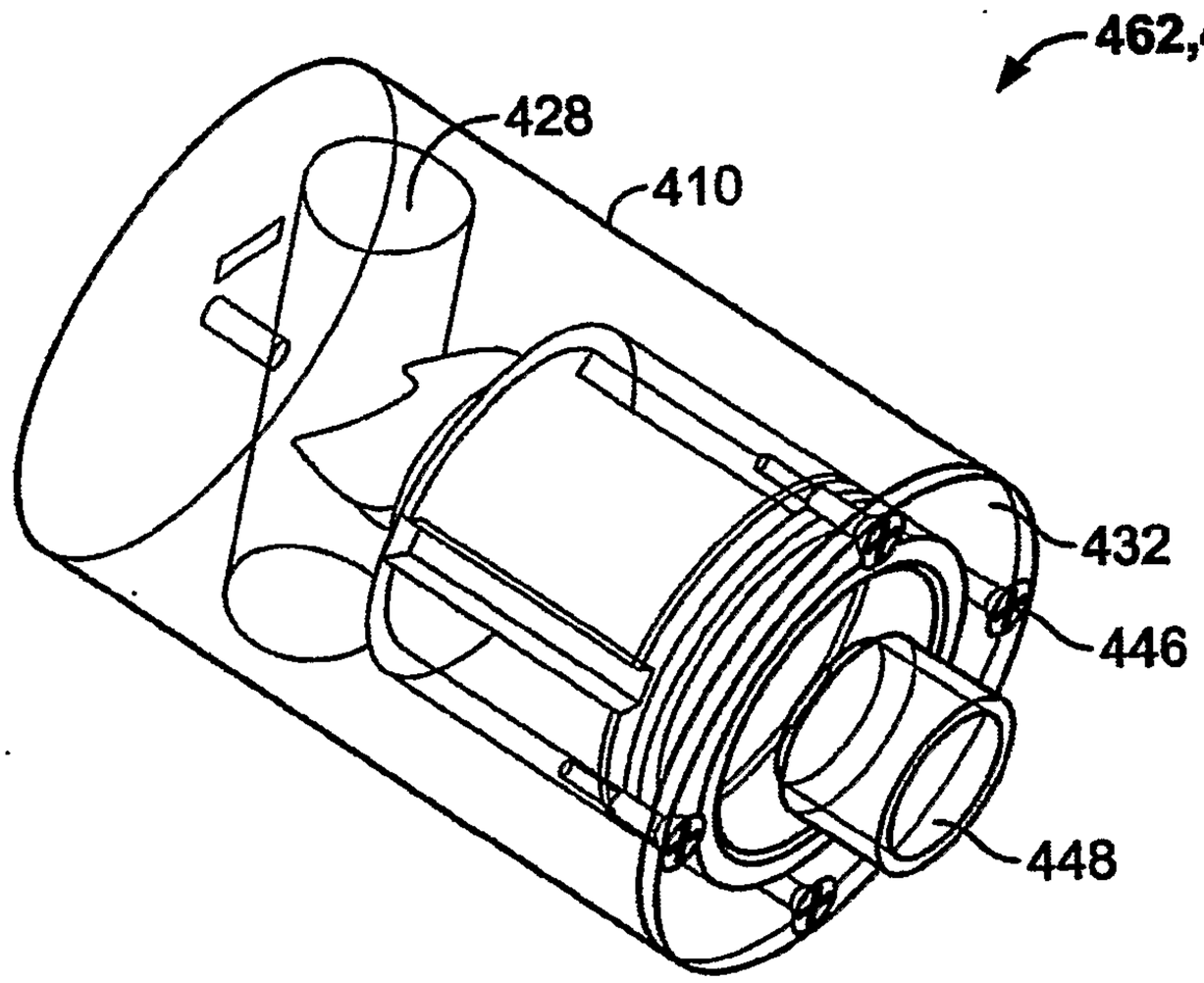


FIG. 13A

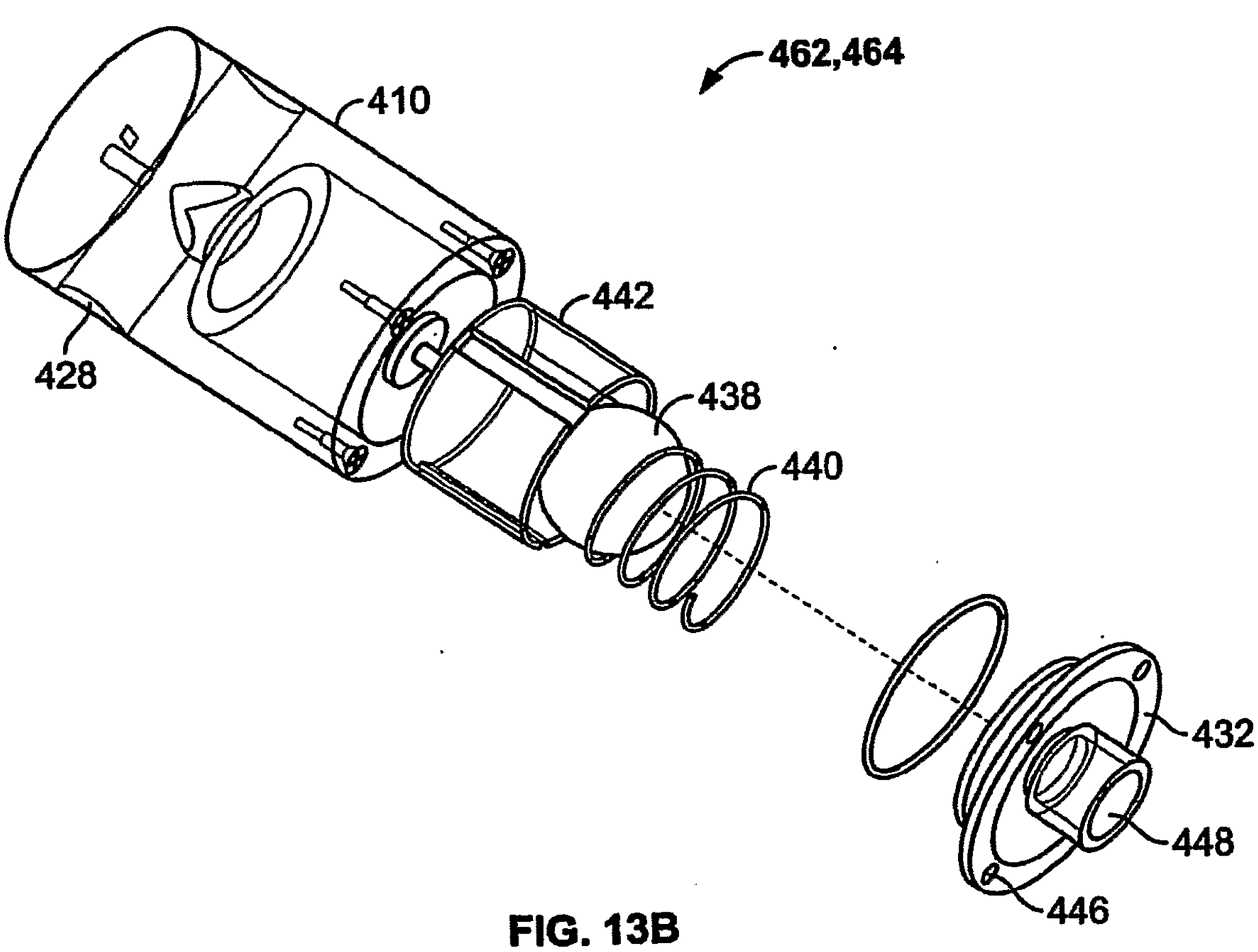


FIG. 13B

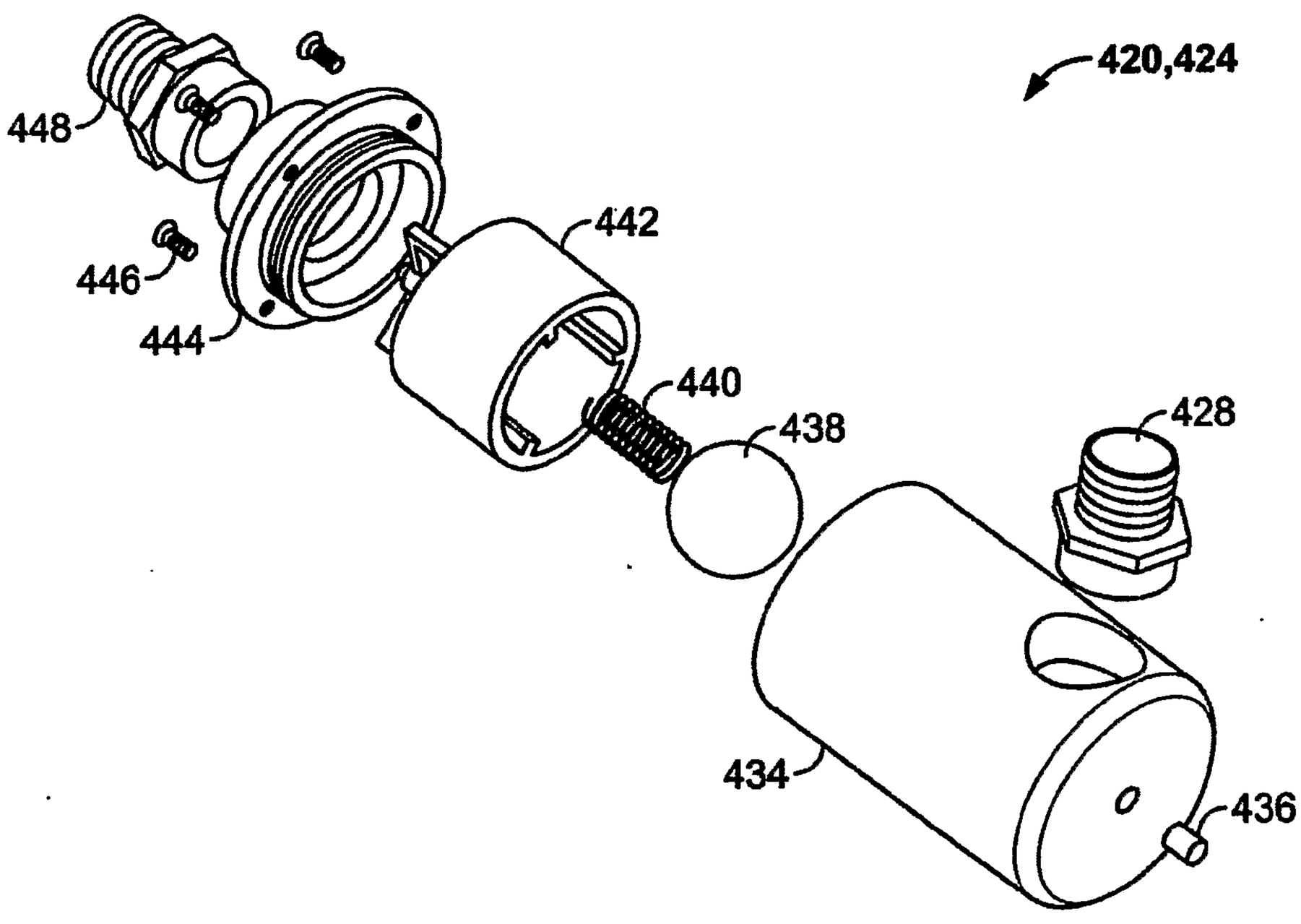


FIG. 14

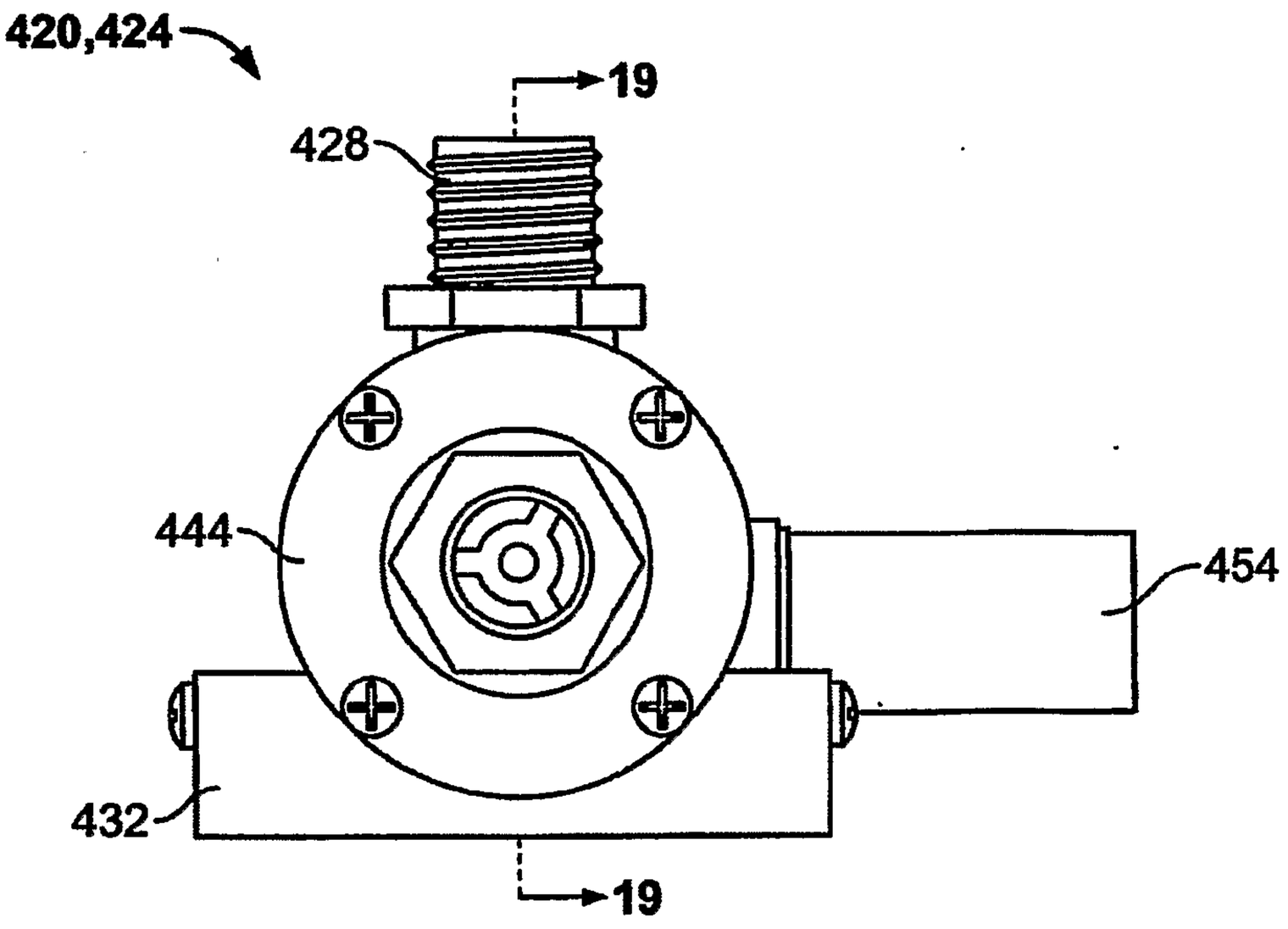

420,424
19
428
444
454
432
19

FIG. 15

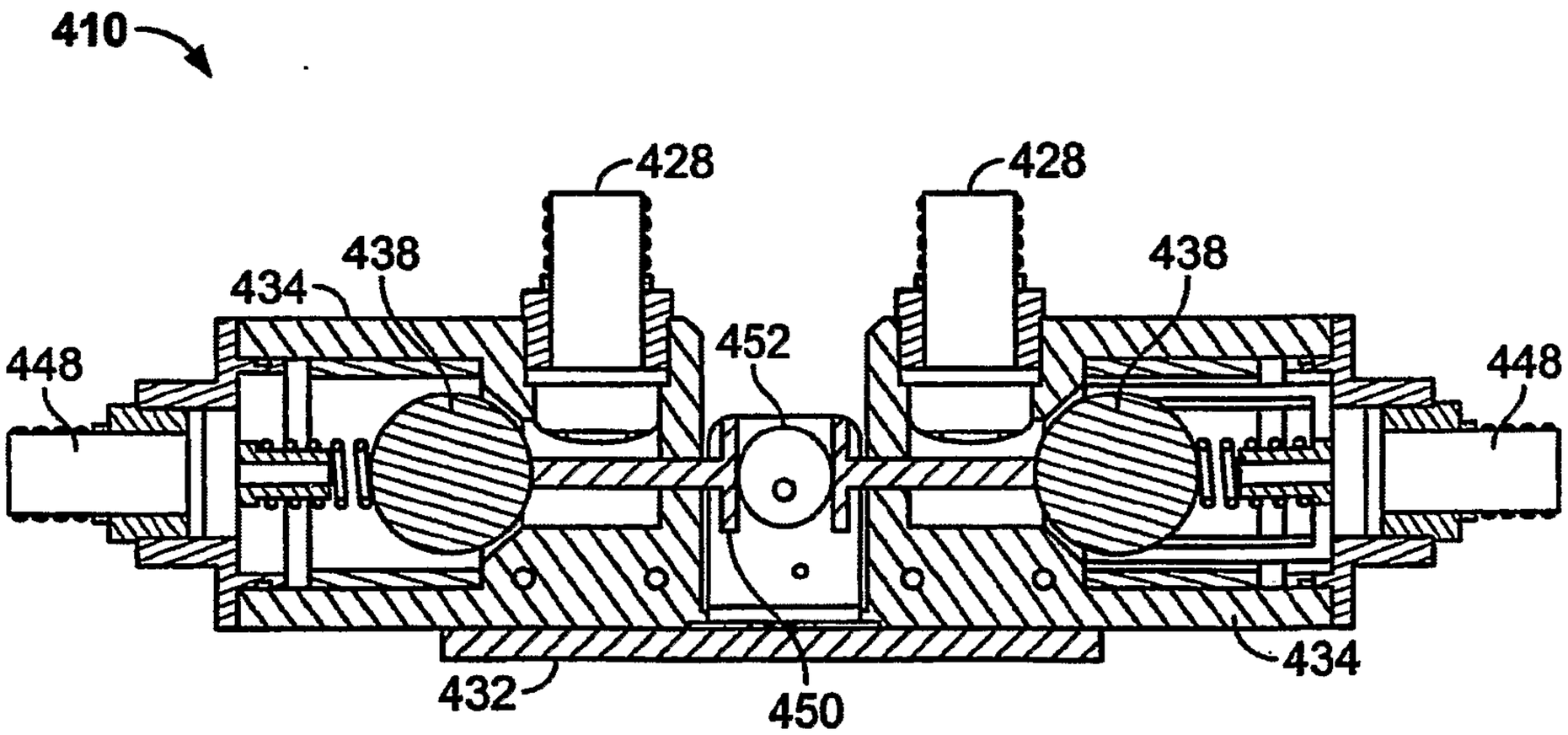

410
428
428
438
434
438
452
448
448
434
432
450

FIG. 16

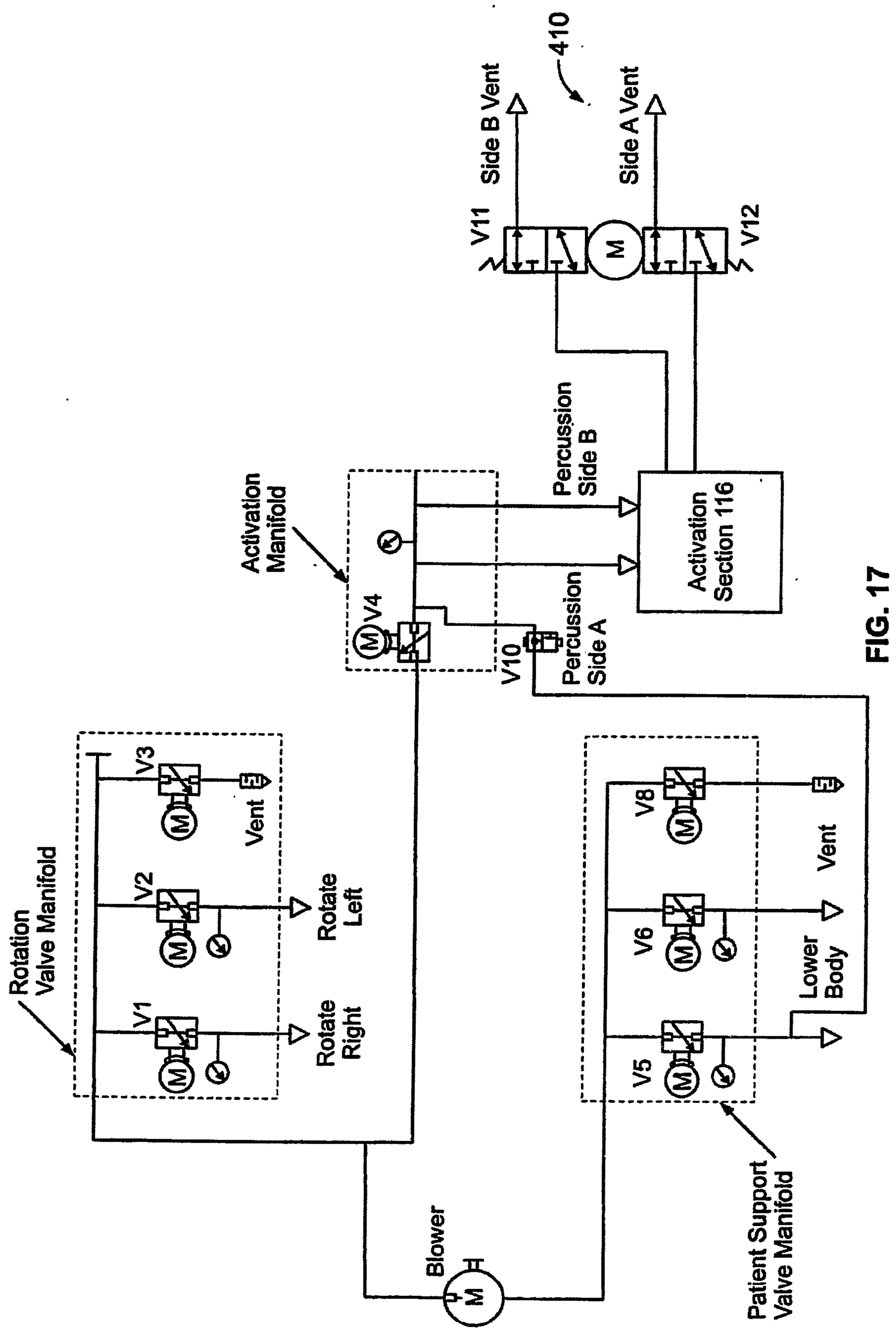

410
Side B Vent
Side A Vent
V11
V12
M
Percussion Side B
Activation Manifold
V4
V10
Percussion Side A
Activation Section 116
Rotation Valve Manifold
V3
V2
V1
Vent
Rotate Left
Rotate Right
V8
V6
V5
Lower Body
Vent
Blower
Patient Support Valve Manifold

FIG. 17

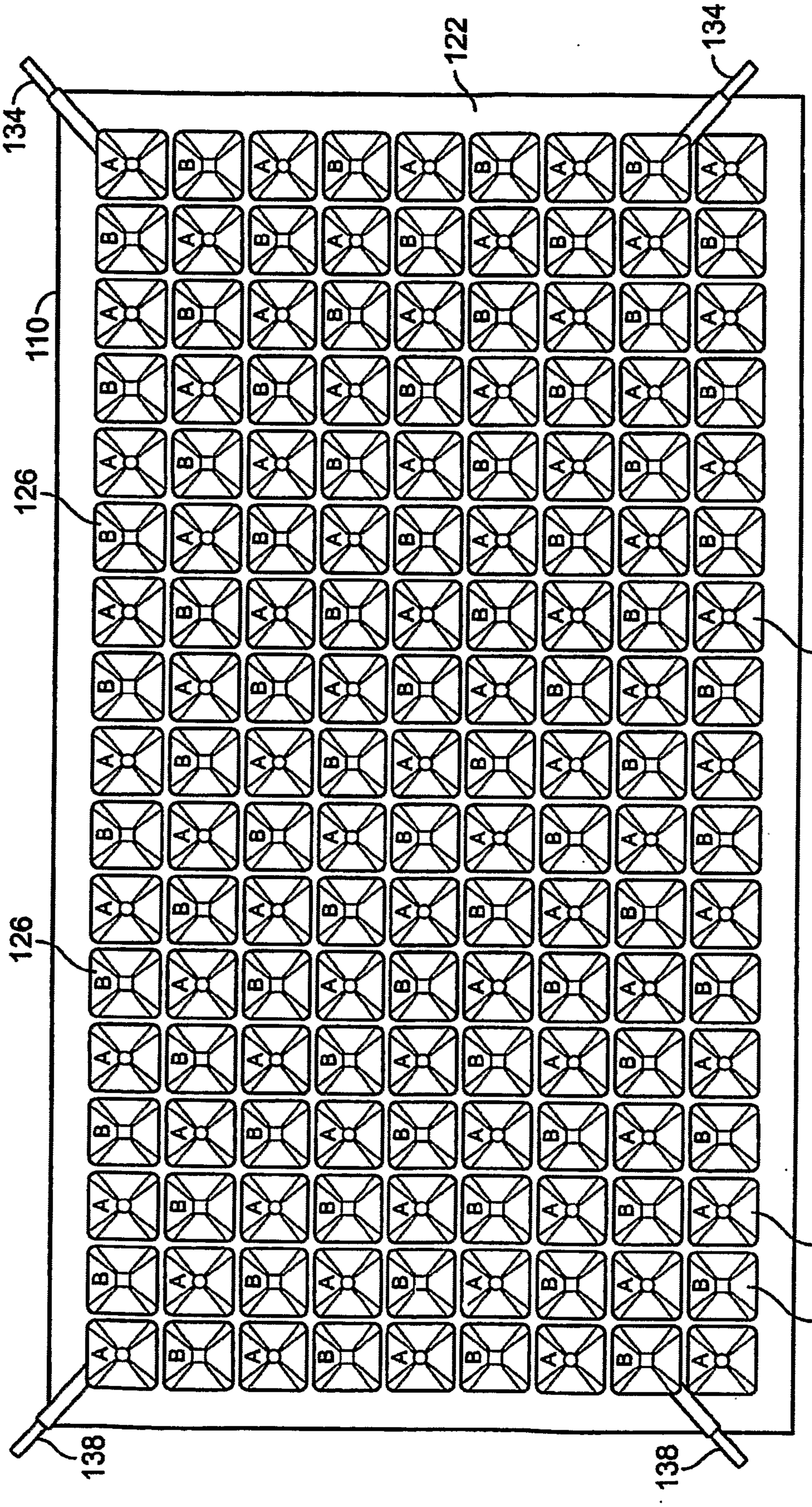


FIG. 18

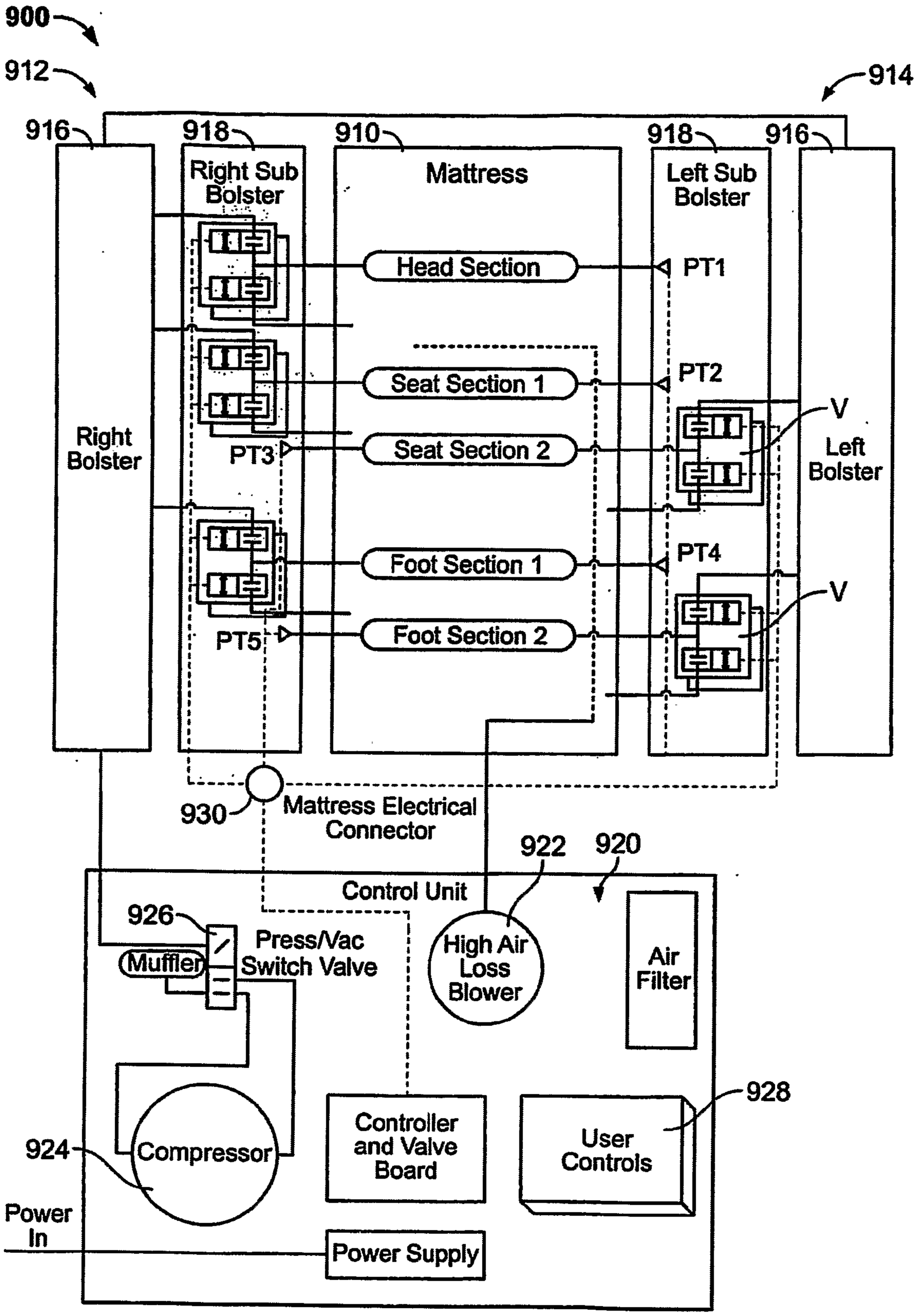

900
912
914
916
918
910
Mattress
918
916
Right Sub Bolster
Left Sub Bolster
Head Section
PT1
Seat Section 1
PT2
V
Right Bolster
PT3
Seat Section 2
Left Bolster
Foot Section 1
PT4
V
PT5
Foot Section 2
930
Mattress Electrical Connector
922
920
Control Unit
926
Press/Vac Switch Valve
Muffler
High Air Loss Blower
Air Filter
928
Controller and Valve Board
User Controls
924
Compressor
Power In
Power Supply

FIG. 20

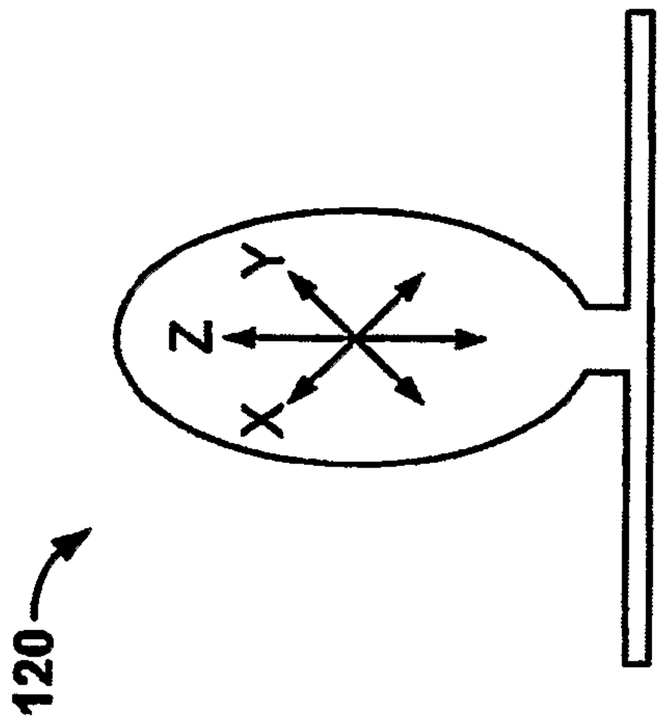


FIG. 19

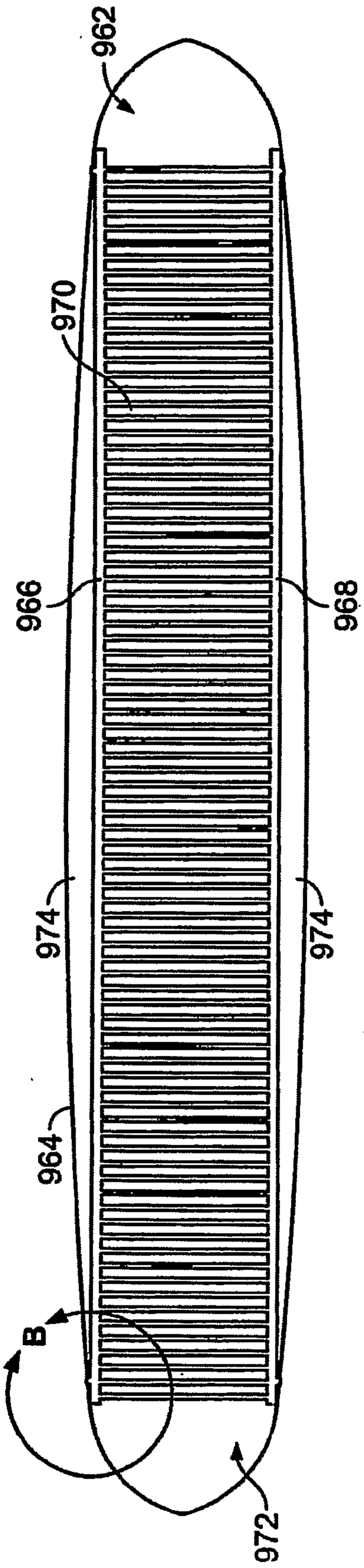
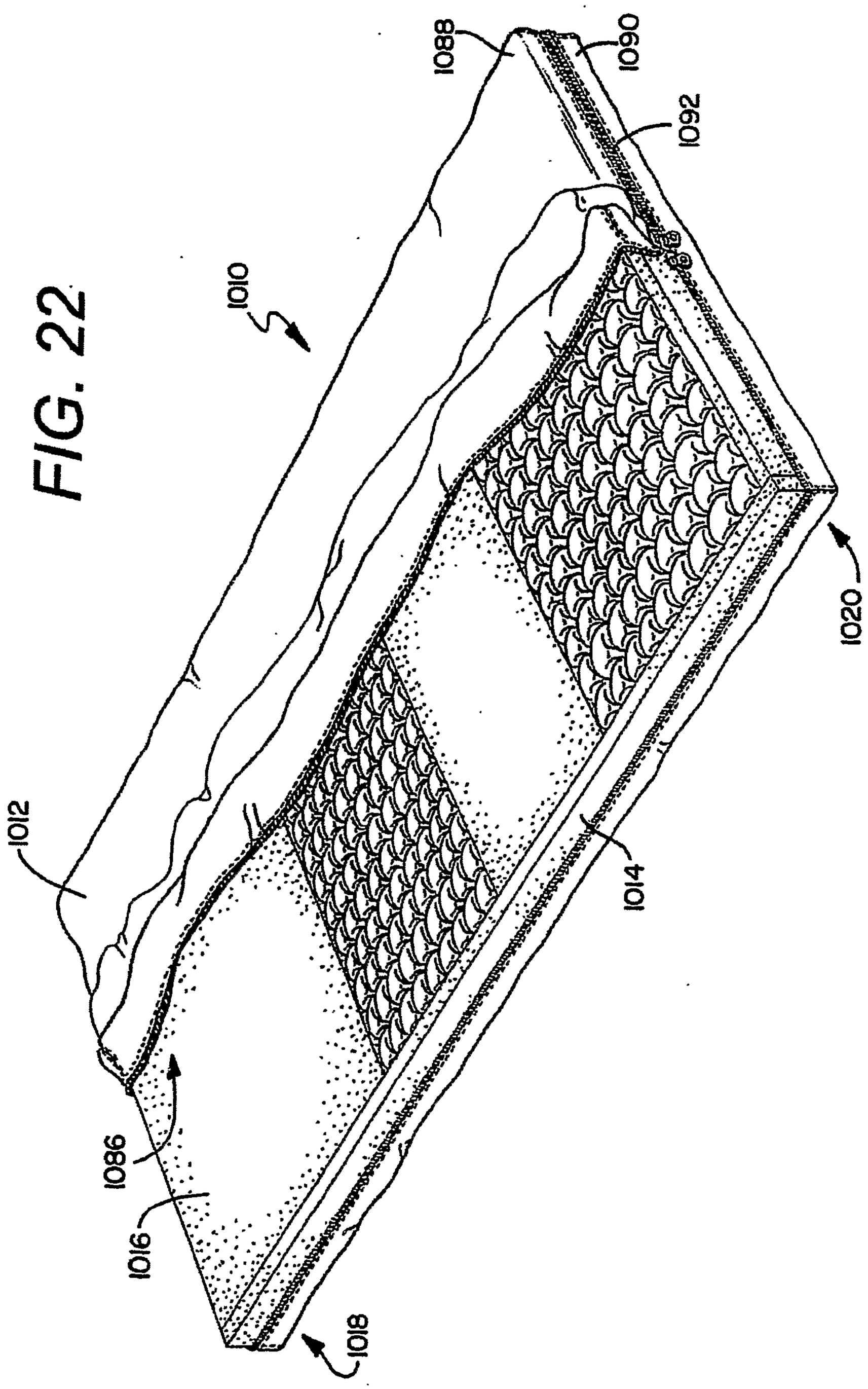


FIG. 21

FIG. 22



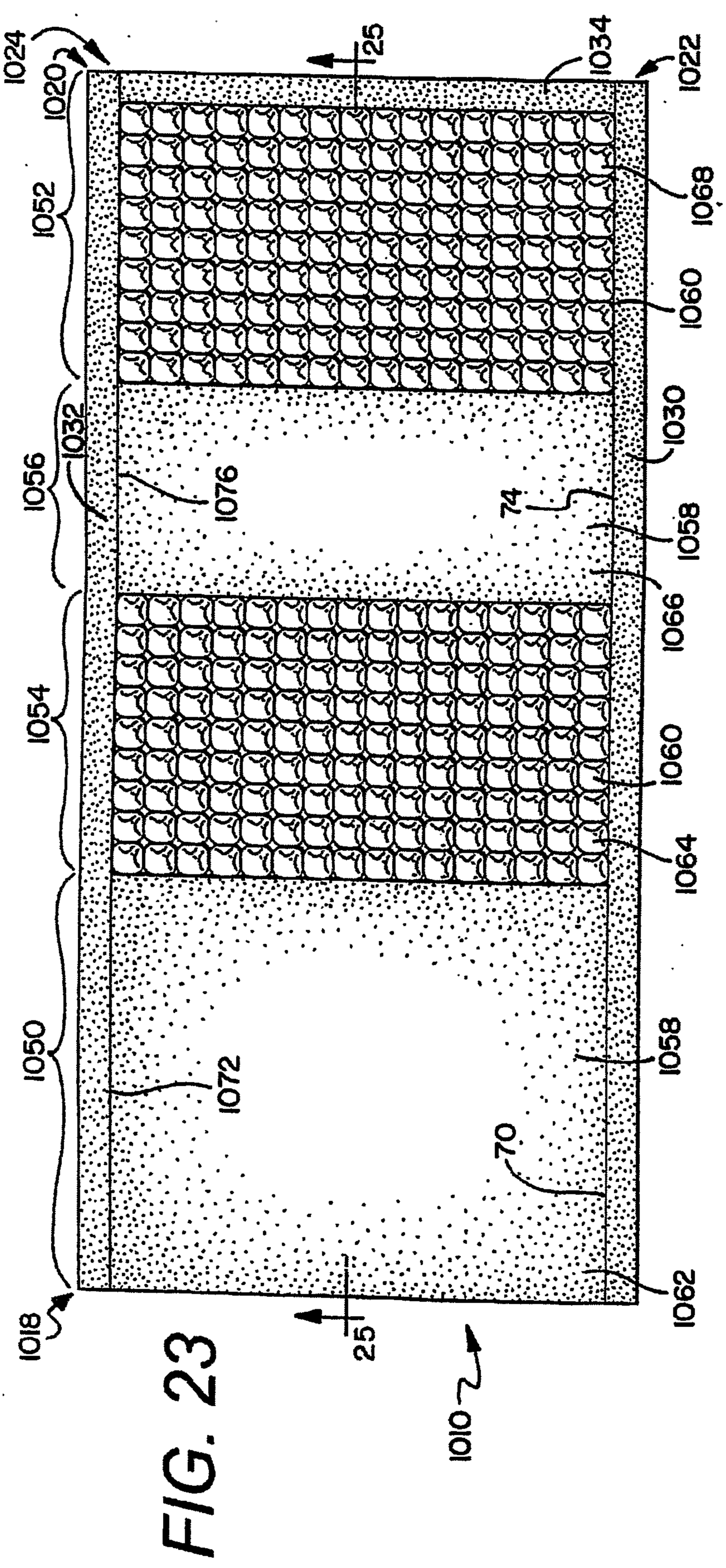

1024
1020
1052
1056
1032
1054
1050
1018
25
1034
1022
1068
1060
1030
1076
74
1058
1066
1060
1064
1072
70
1058
1062
25
1010

FIG. 23

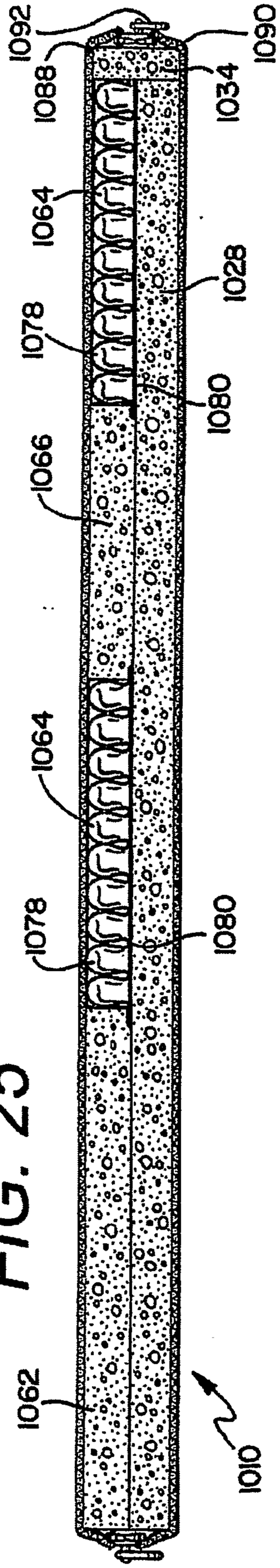

1092
1090
1088
1034
1064
1028
1078
1080
1066
1064
1078
1080
1062
1010

FIG. 25

FIG. 24

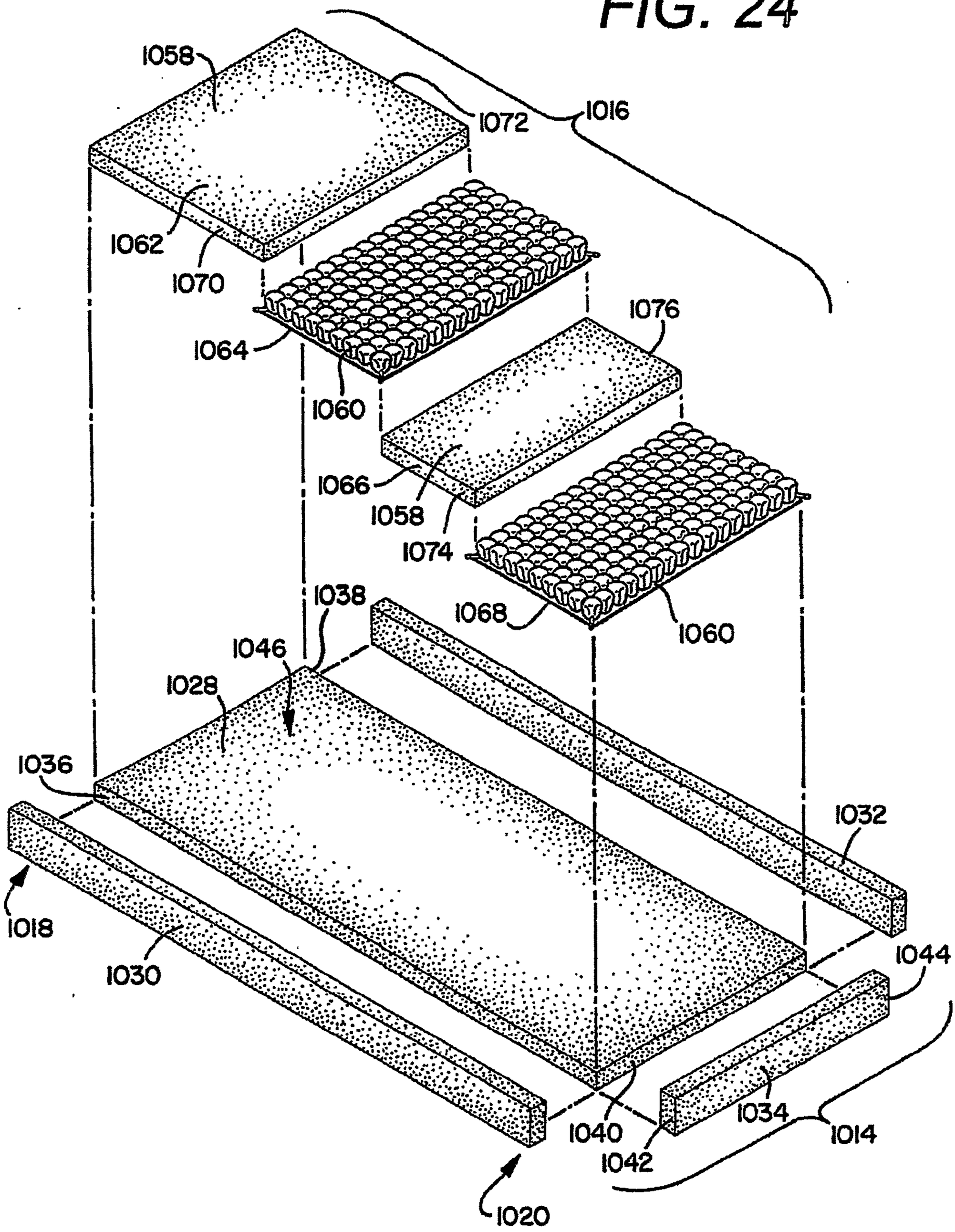
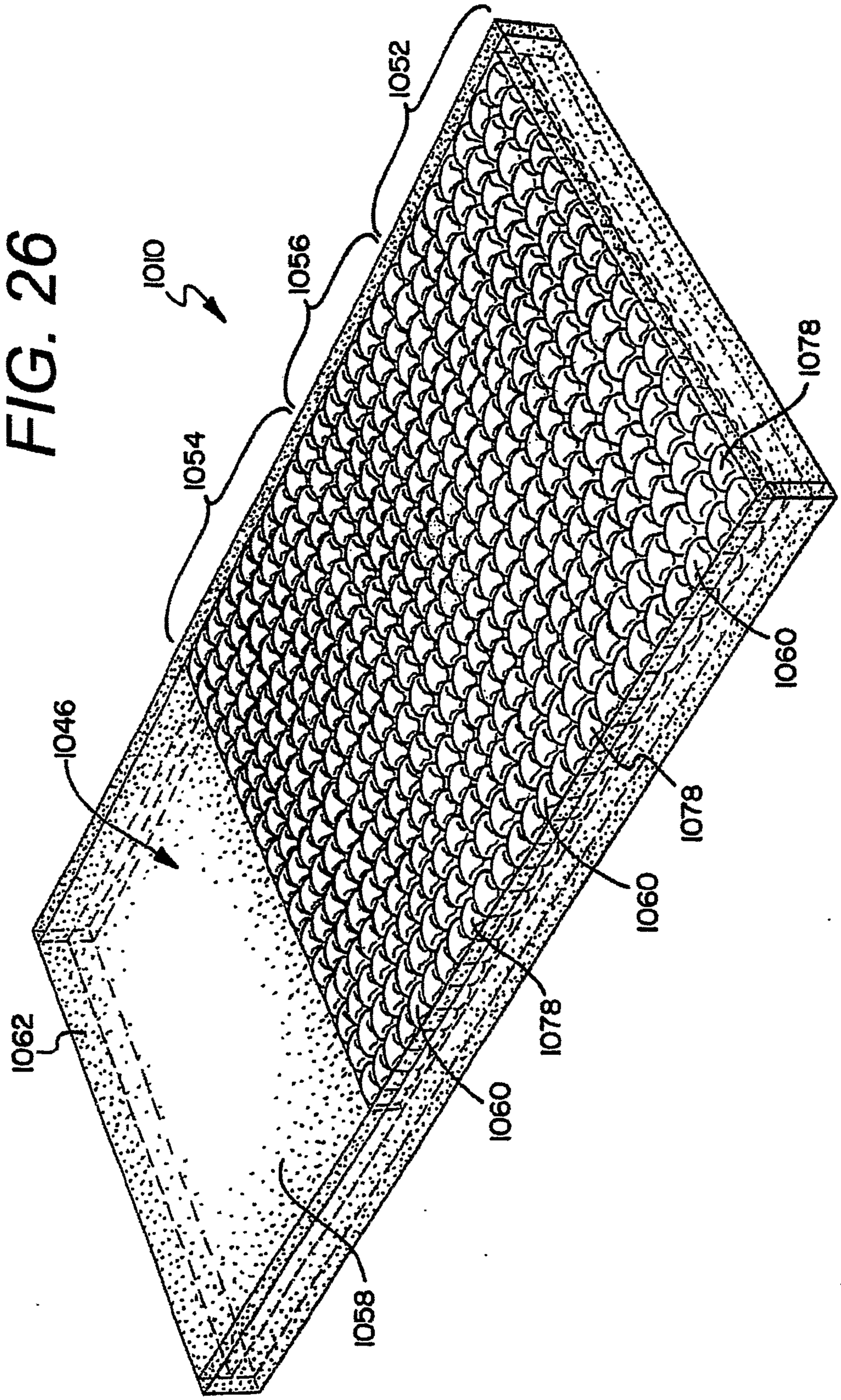

1058
1072
1016
1062
1070
1064
1076
1060
1066
1058
1074
1038
1068
1060
1046
1028
1036
1032
1018
1030
1044
1034
1040
1014
1042
1020

FIG. 26



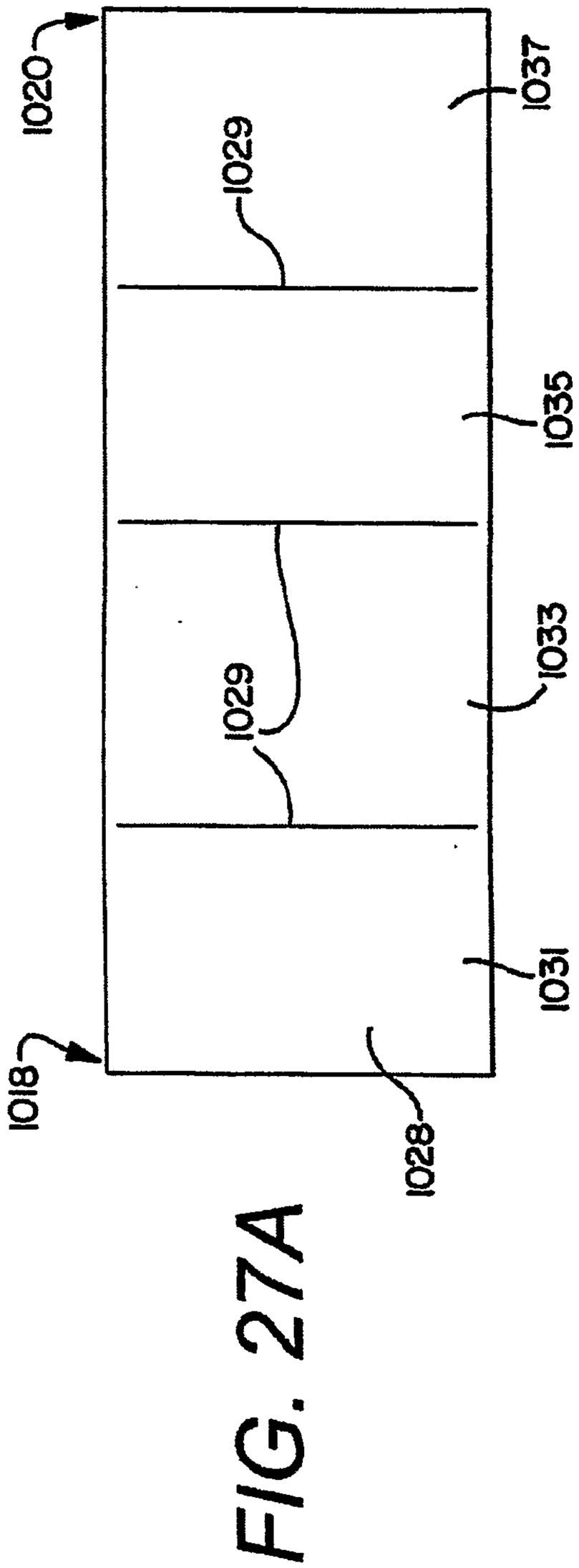


FIG. 27A

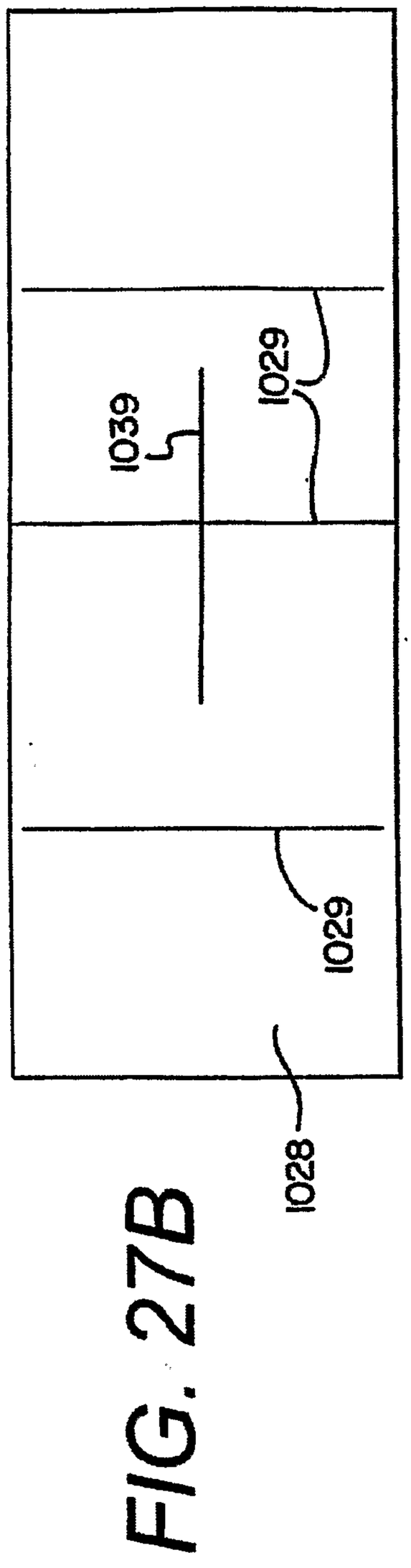
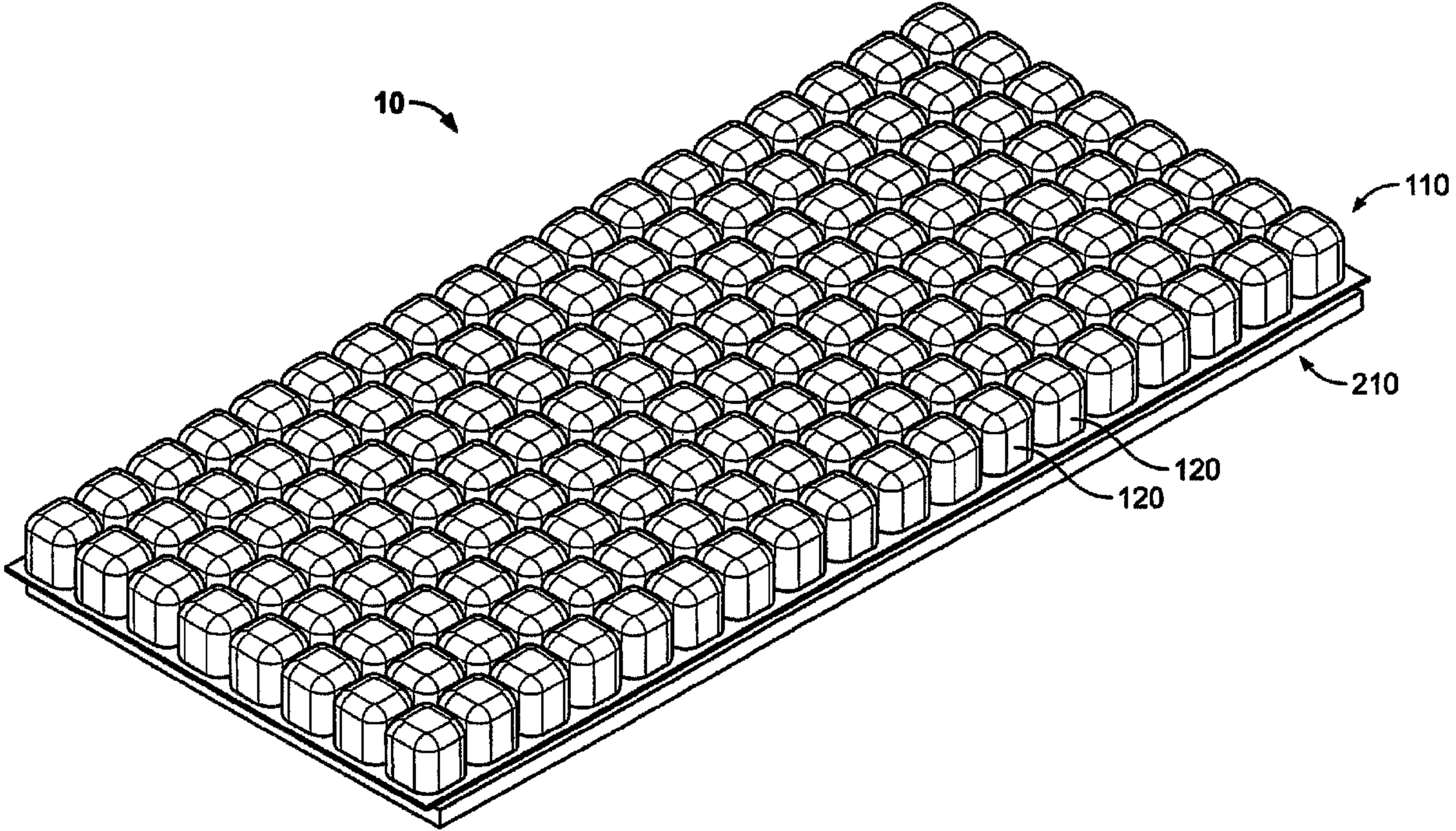


FIG. 27B


10
110
210
120
120