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Davis

(54) **PNEUMATIC LIFT**

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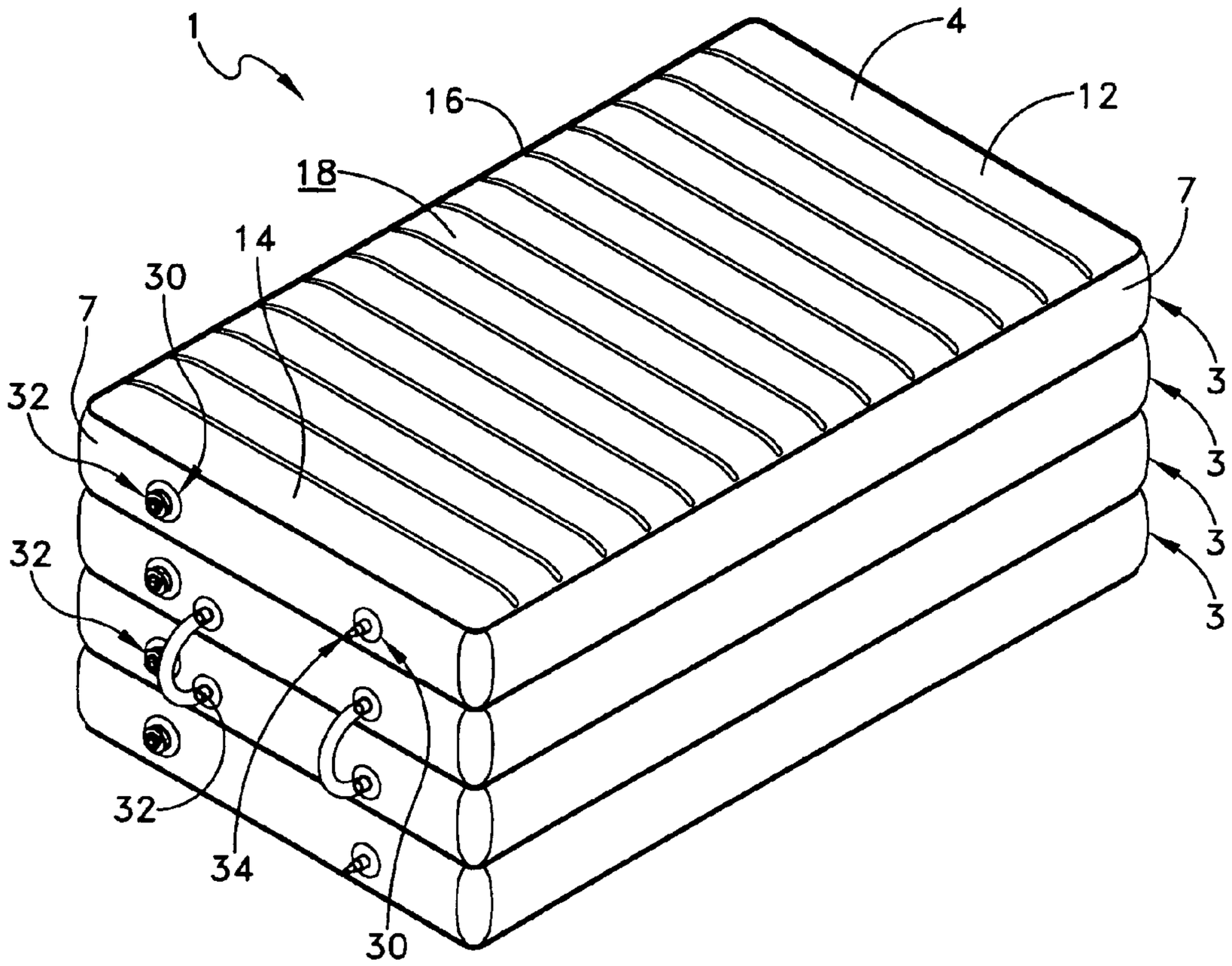
(57) **ABSTRACT**

A pneumatic lift including at least three jacking-mattresses stacked one atop another and arranged in air flow communication with one another. At least one of the jacking-mattresses is also arranged in air flow communication with a source of pressurized air.



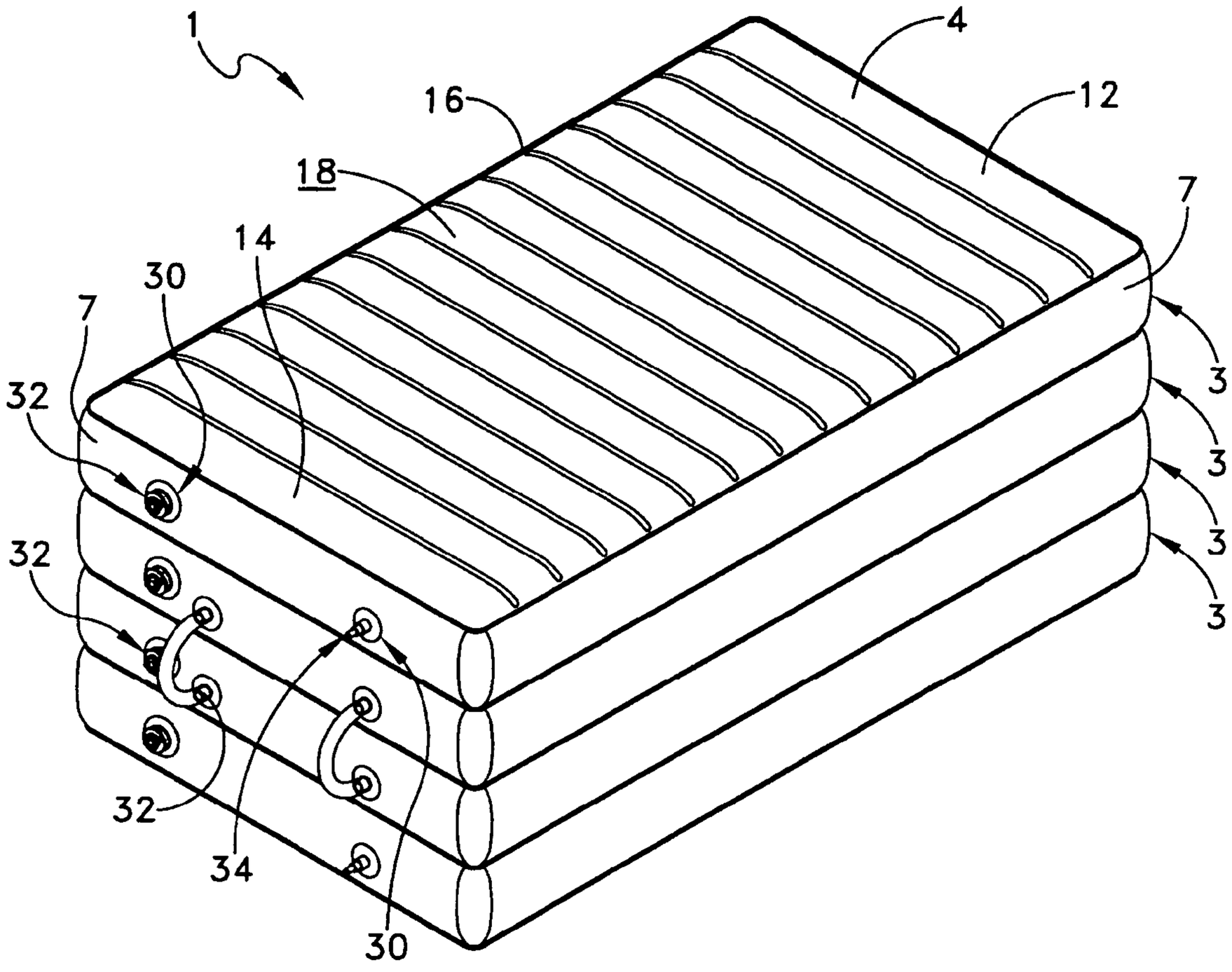


FIG. 1

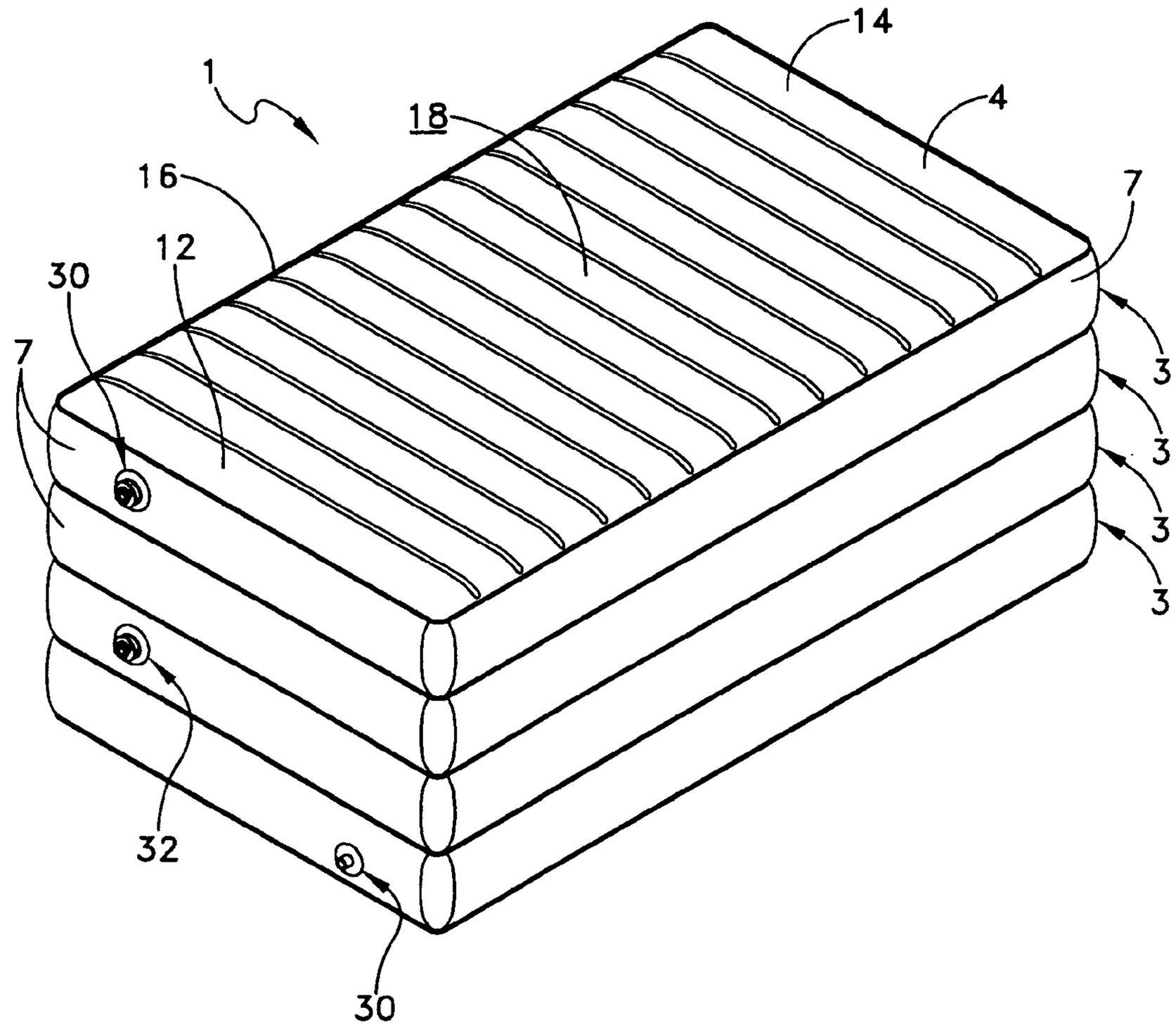


FIG. 2

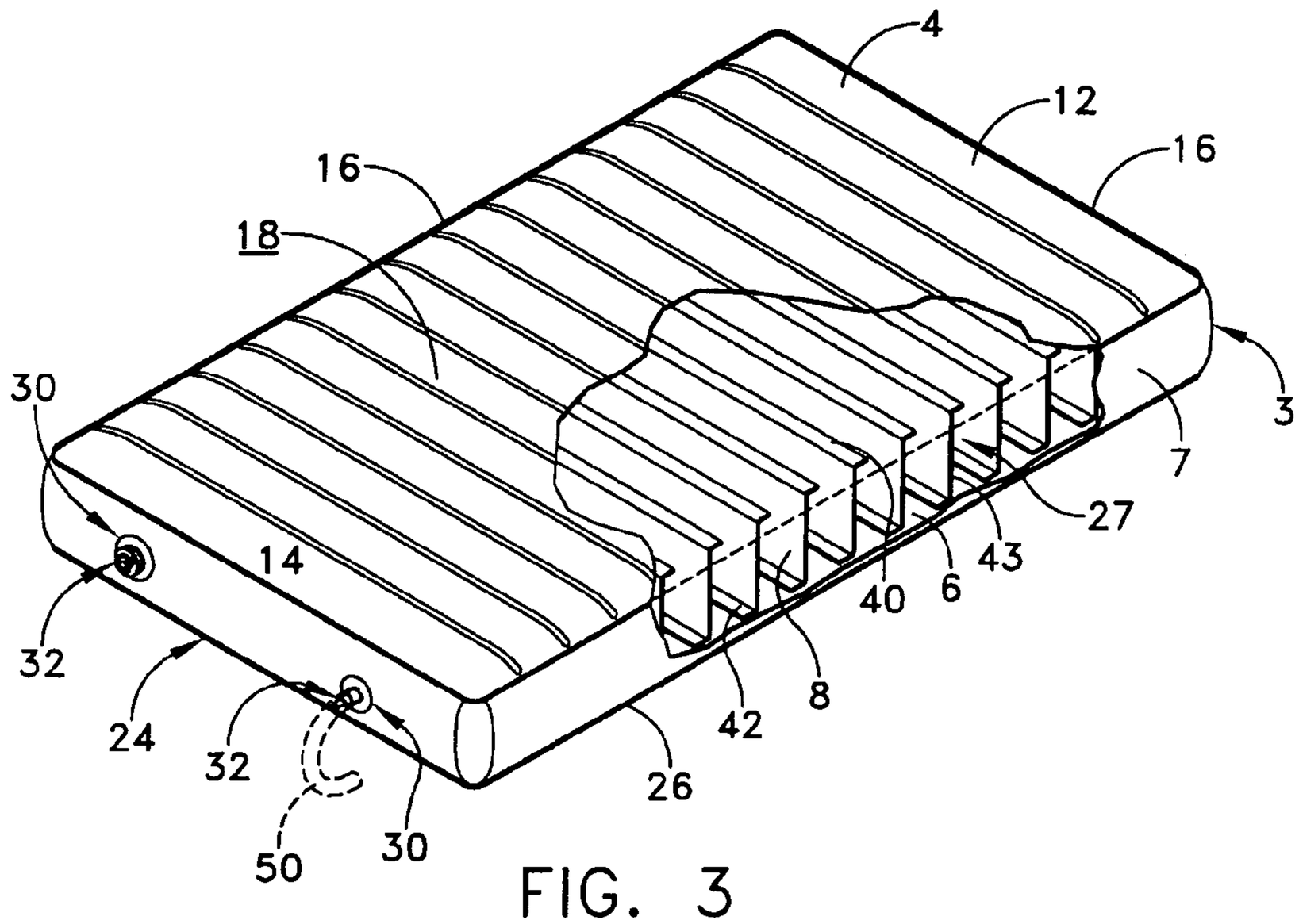

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FIG. 3

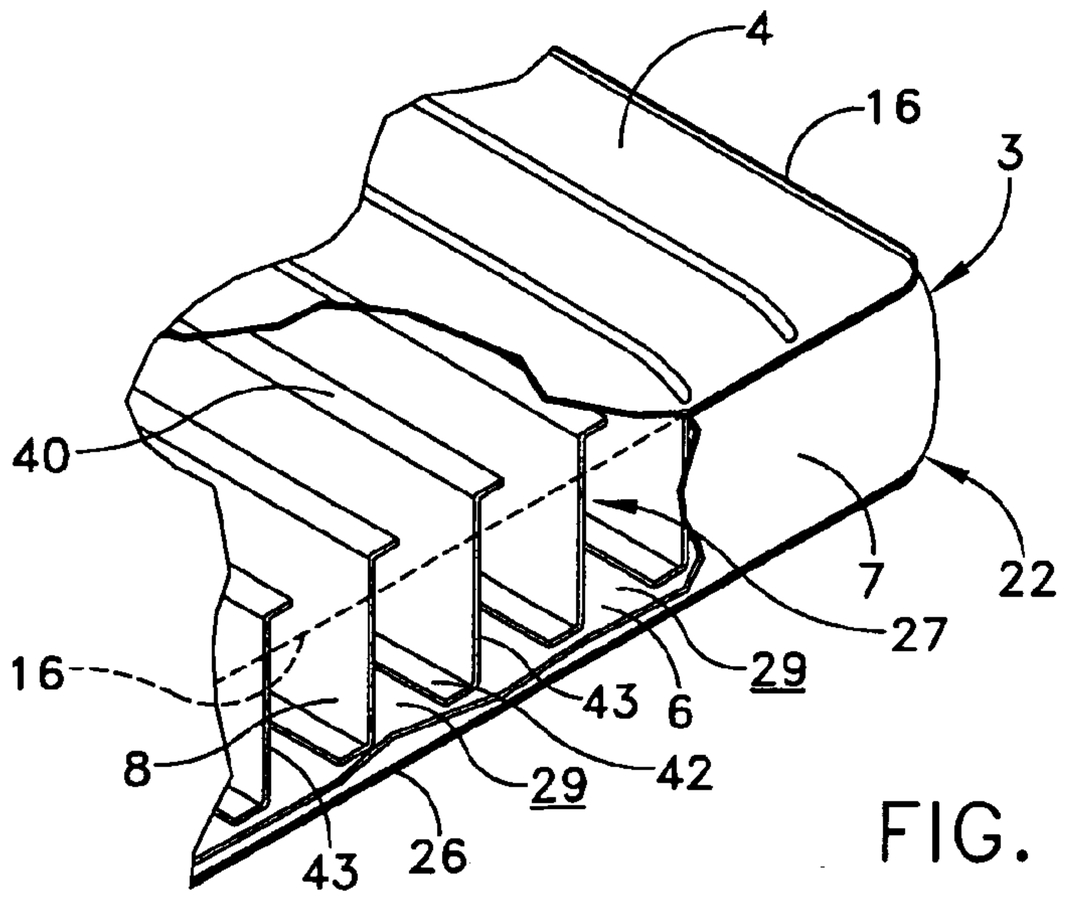
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FIG. 4

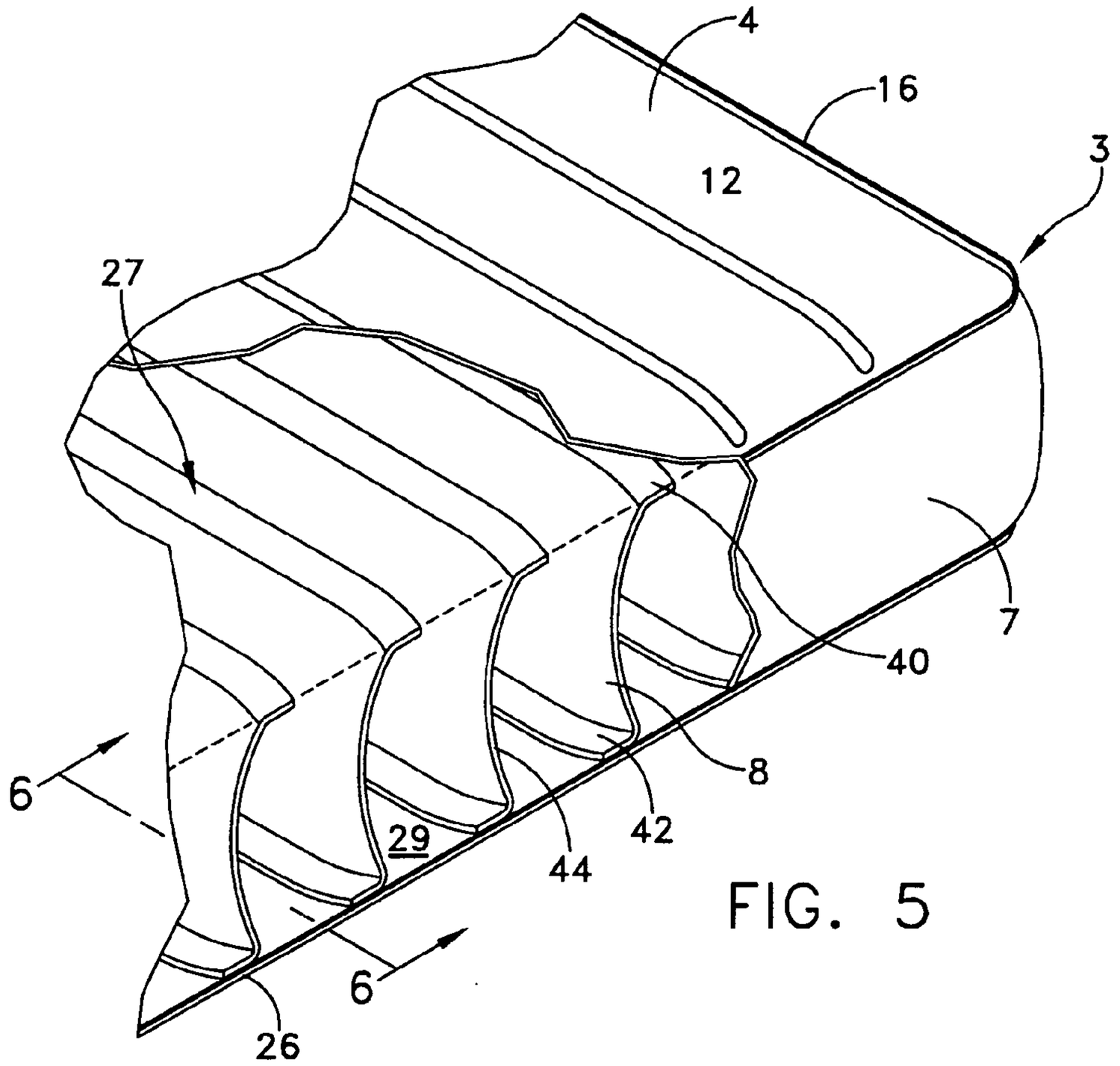

FIG. 5

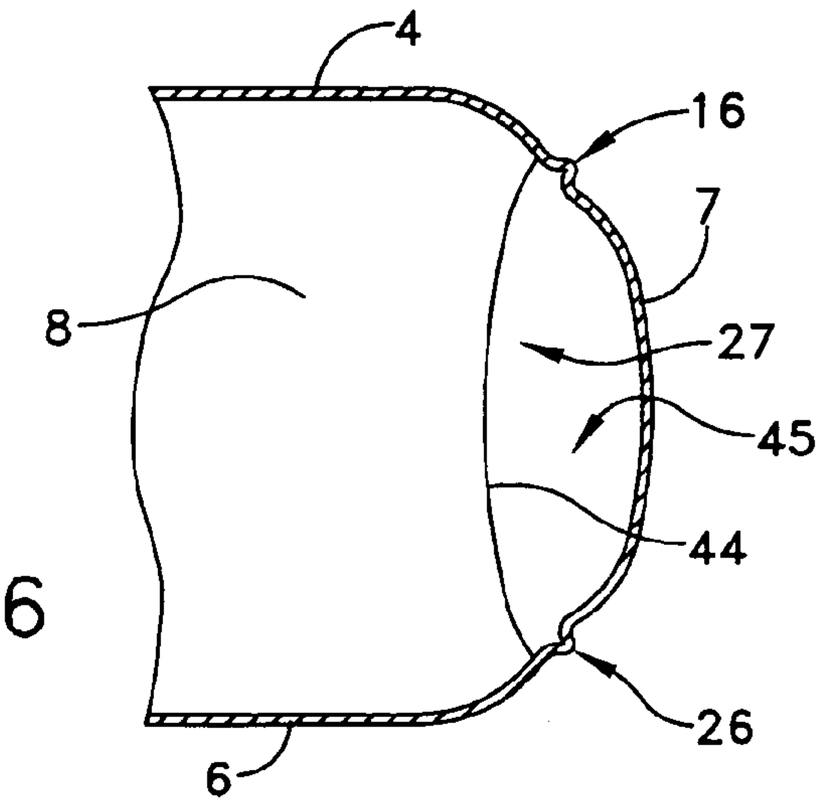

FIG. 6

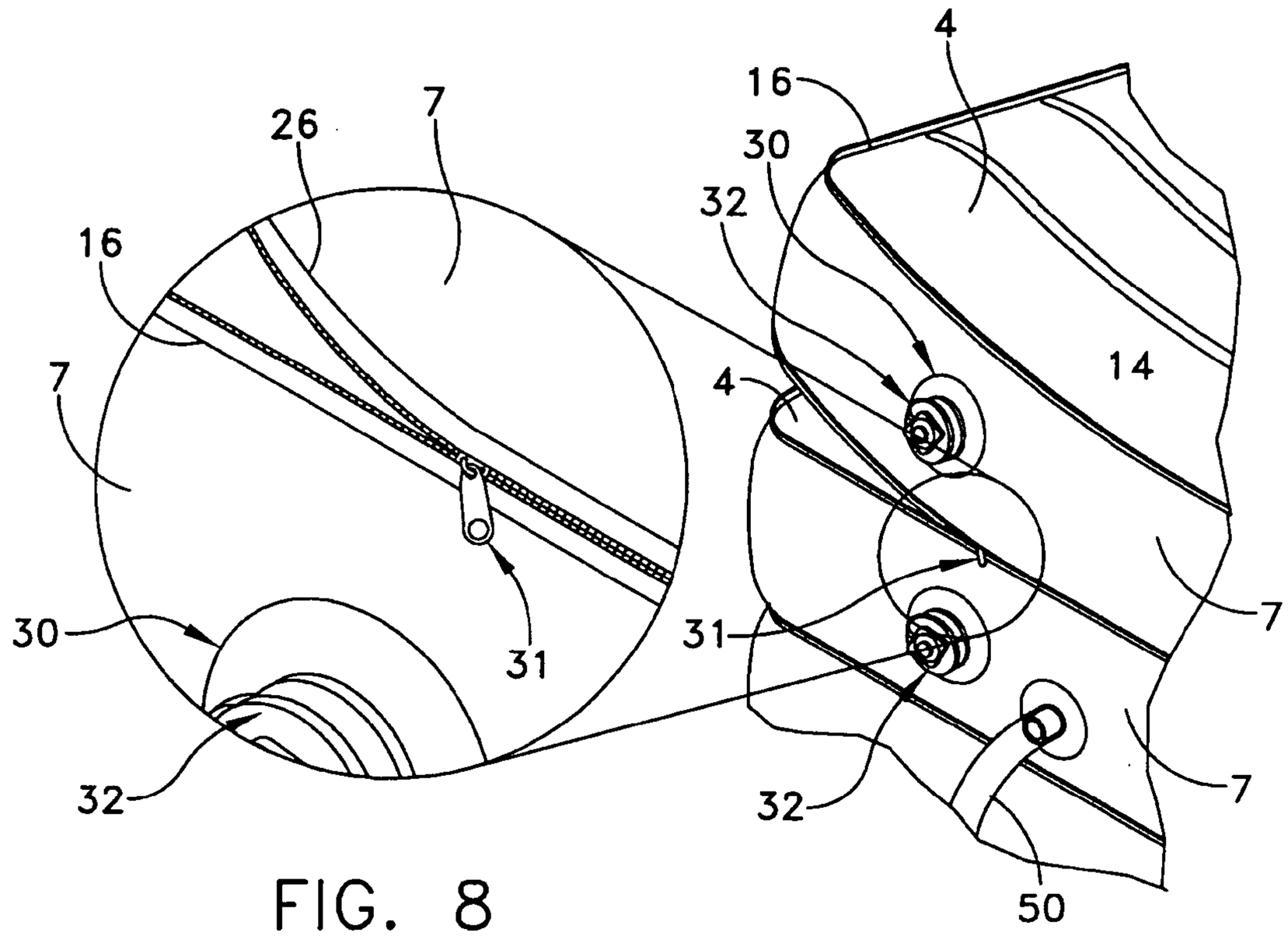

FIG. 8

FIG. 7

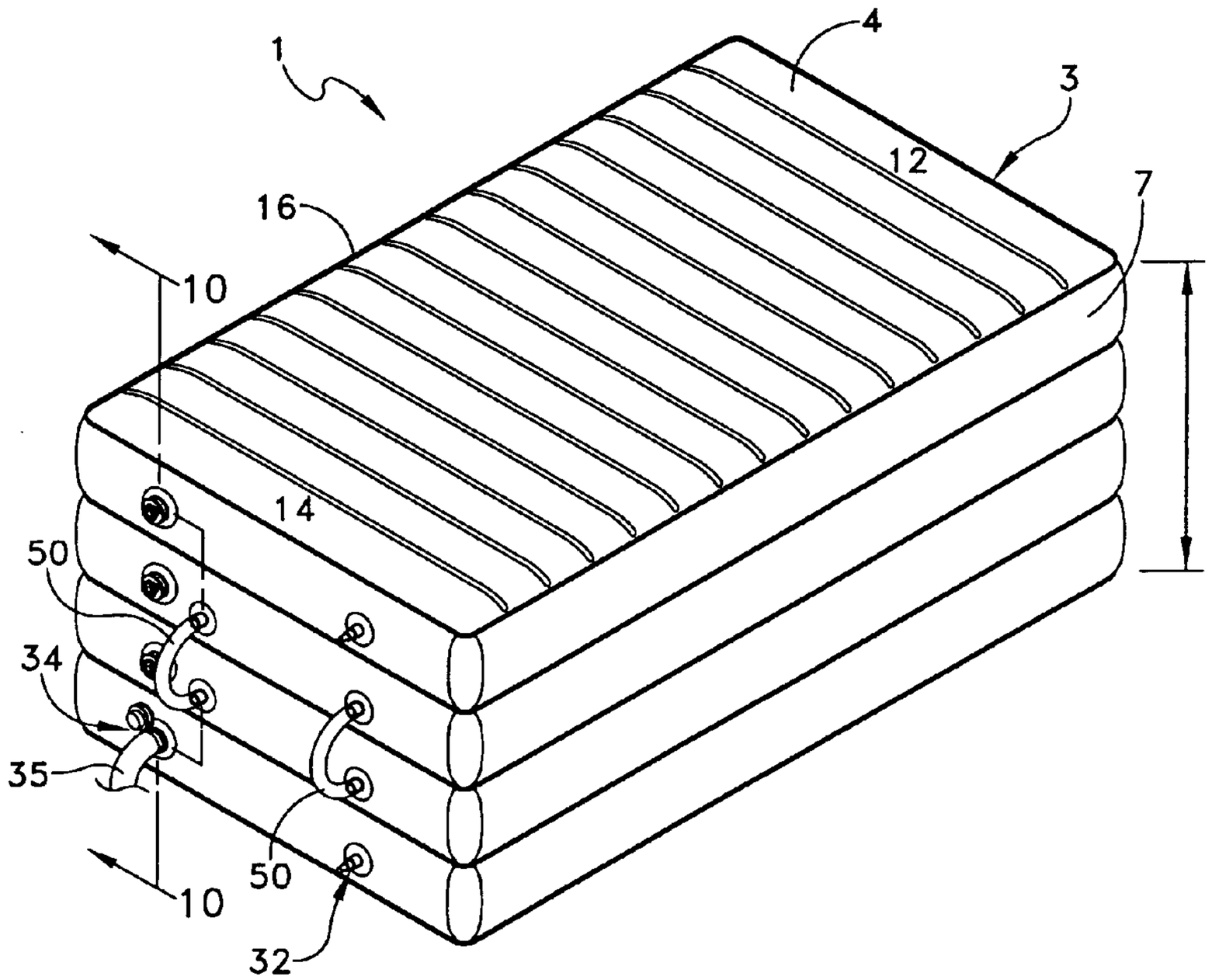

FIG. 9

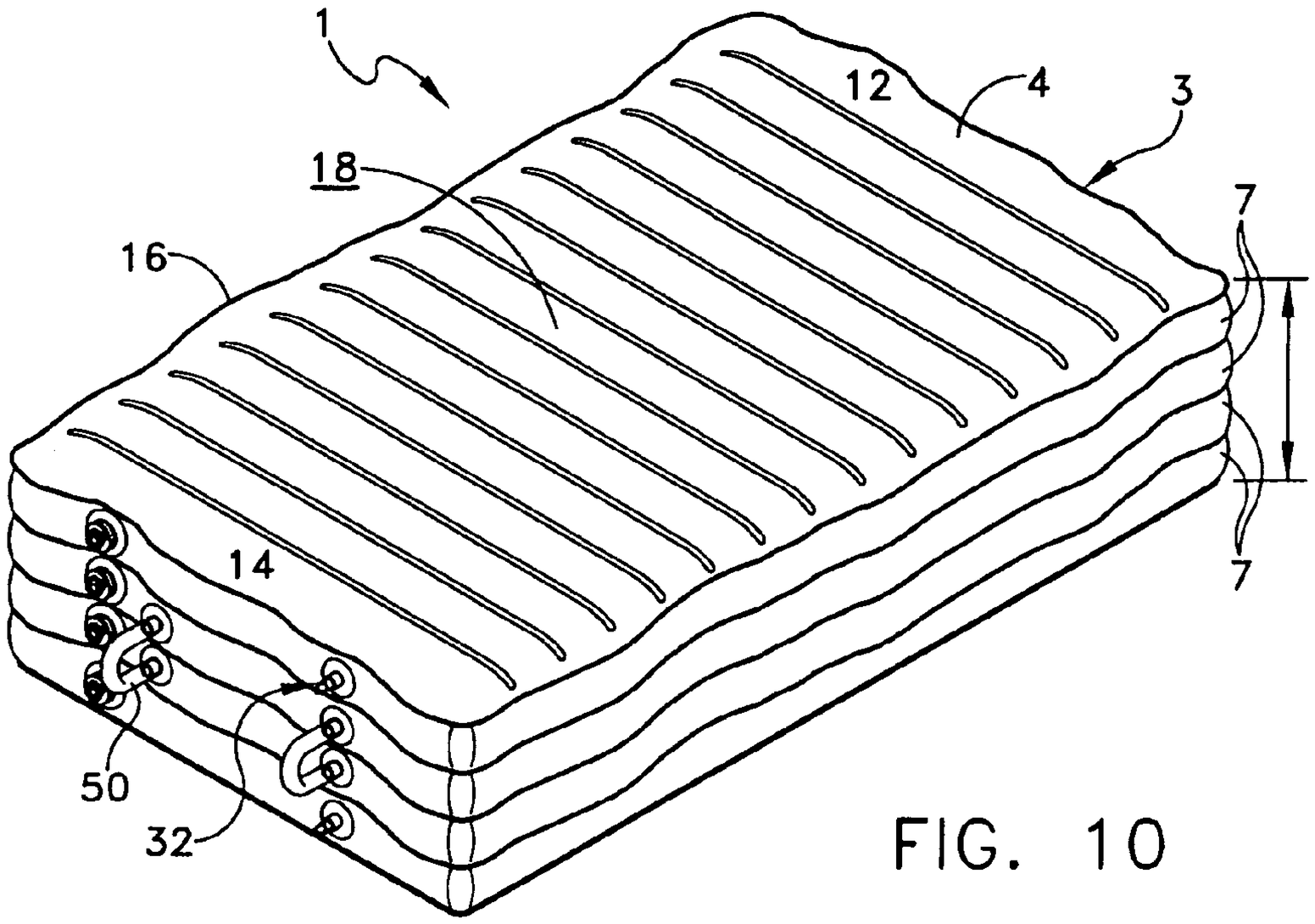

FIG. 10

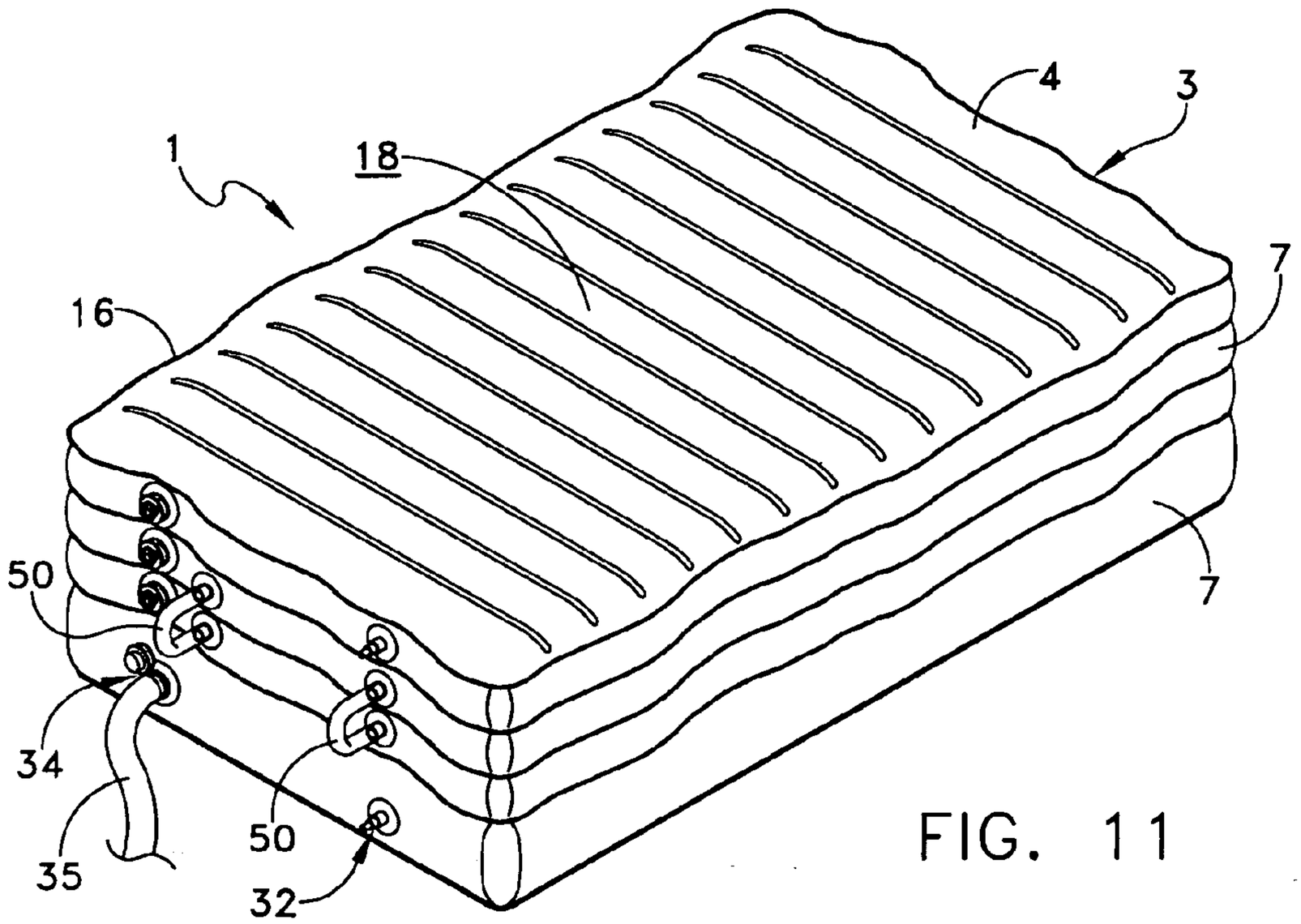

FIG. 11

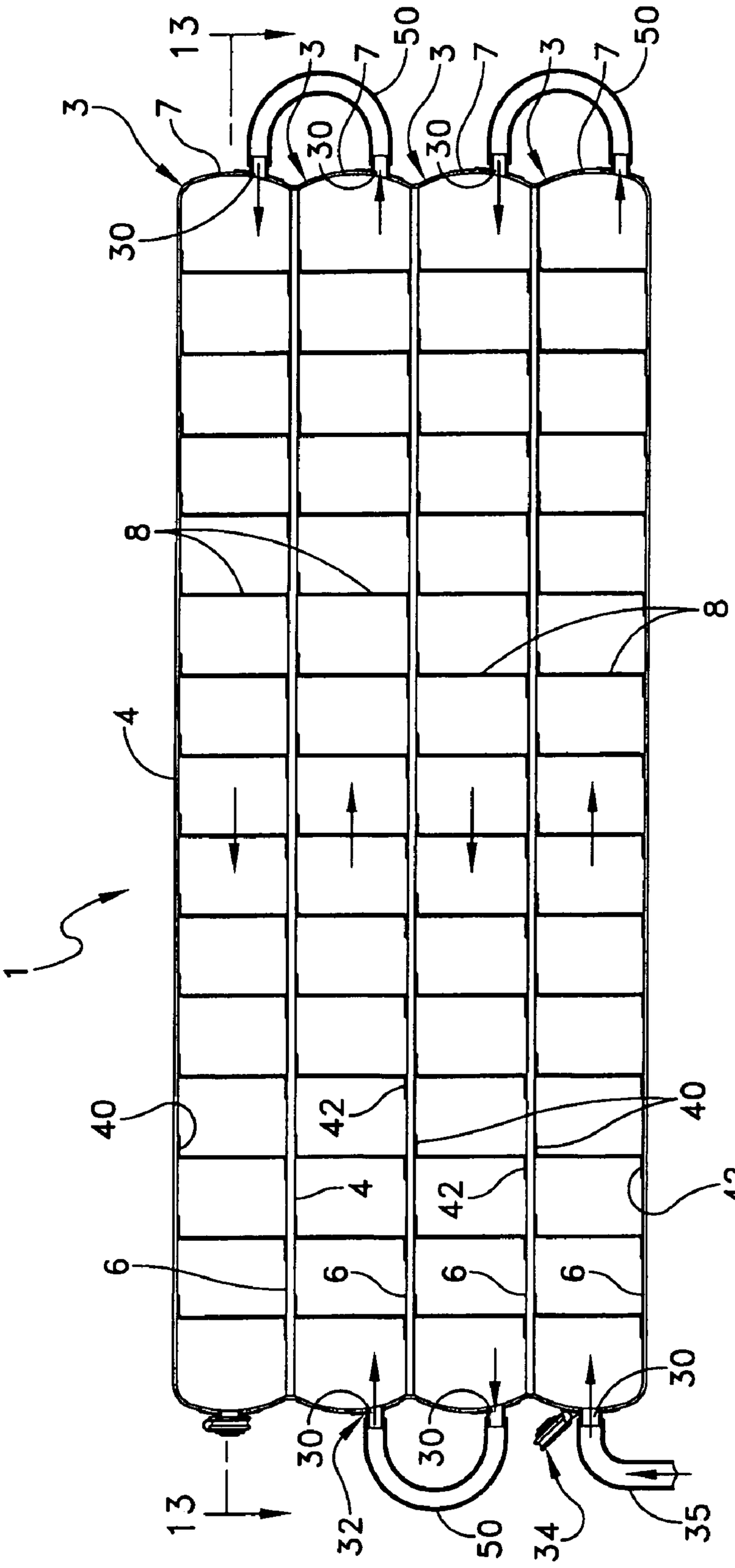

FIG. 12

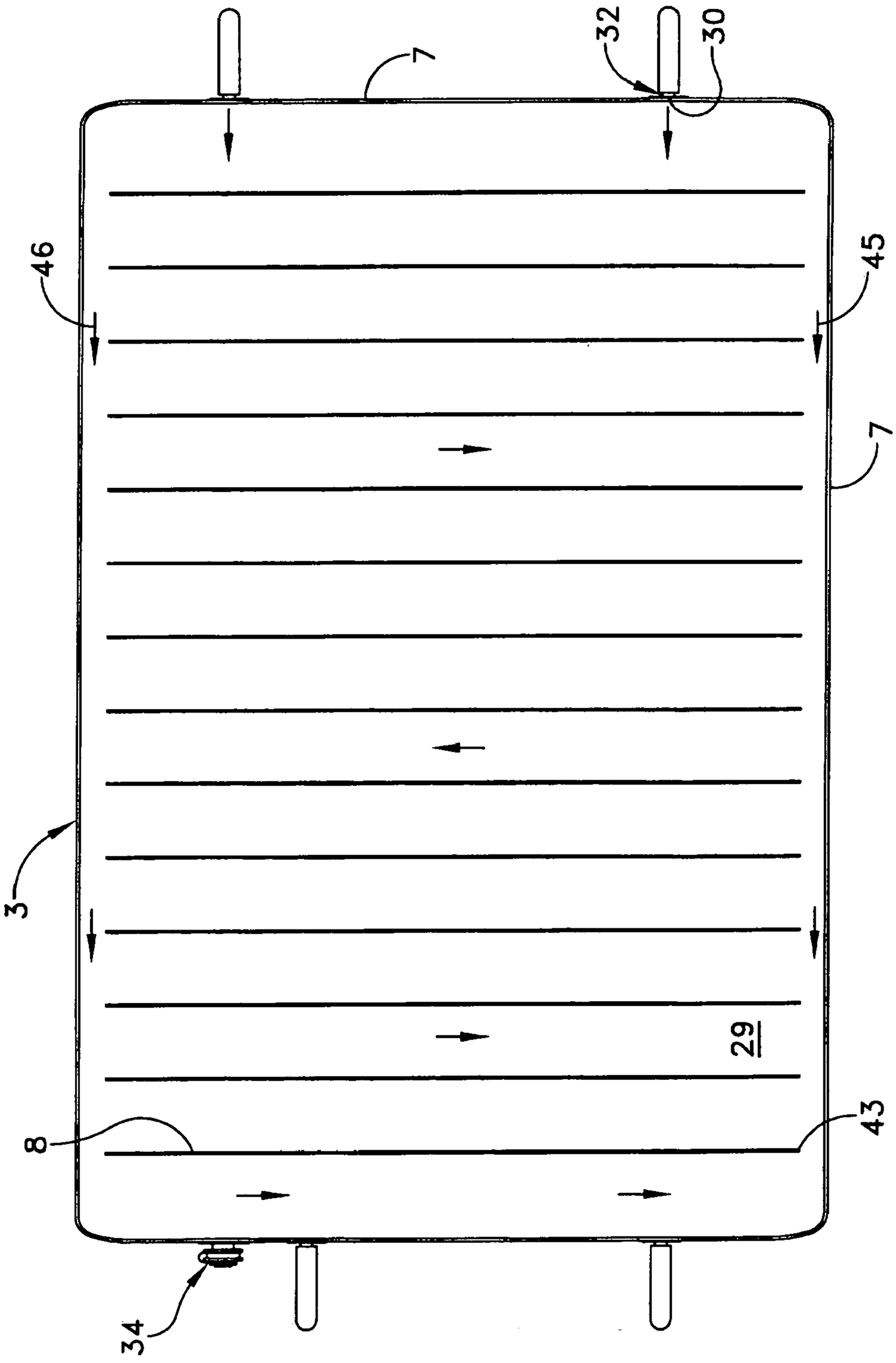

FIG. 13

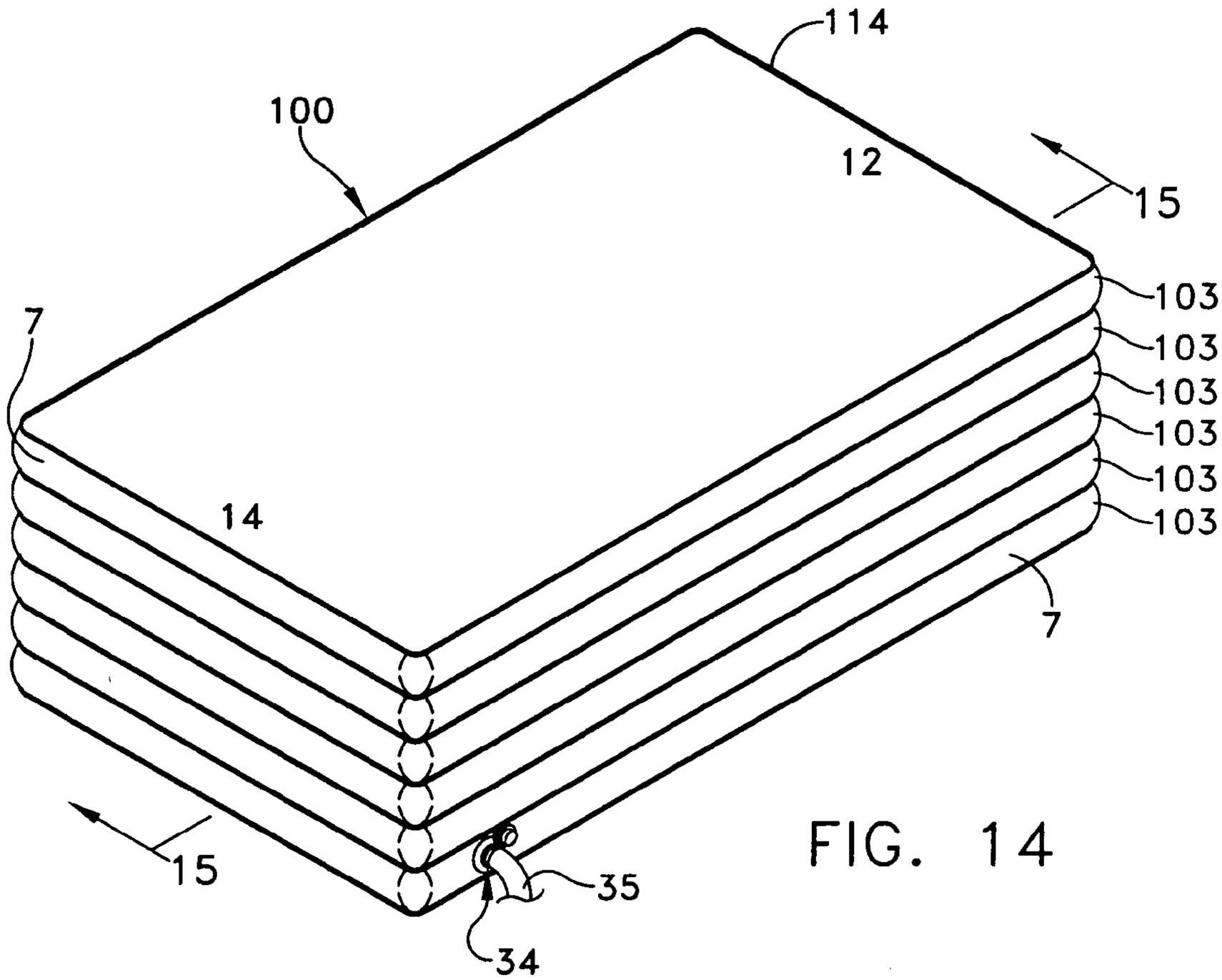

FIG. 14

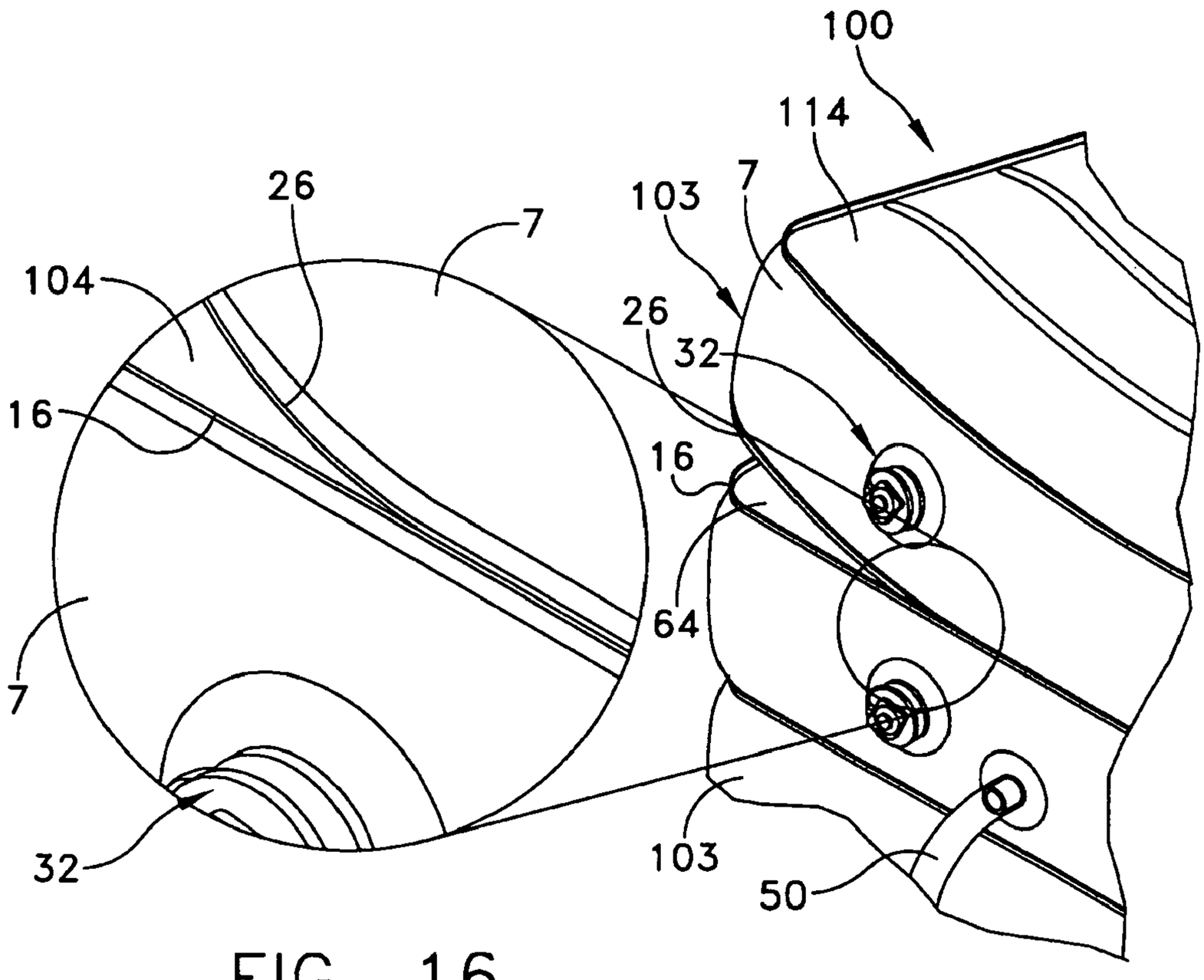

FIG. 16

FIG. 15

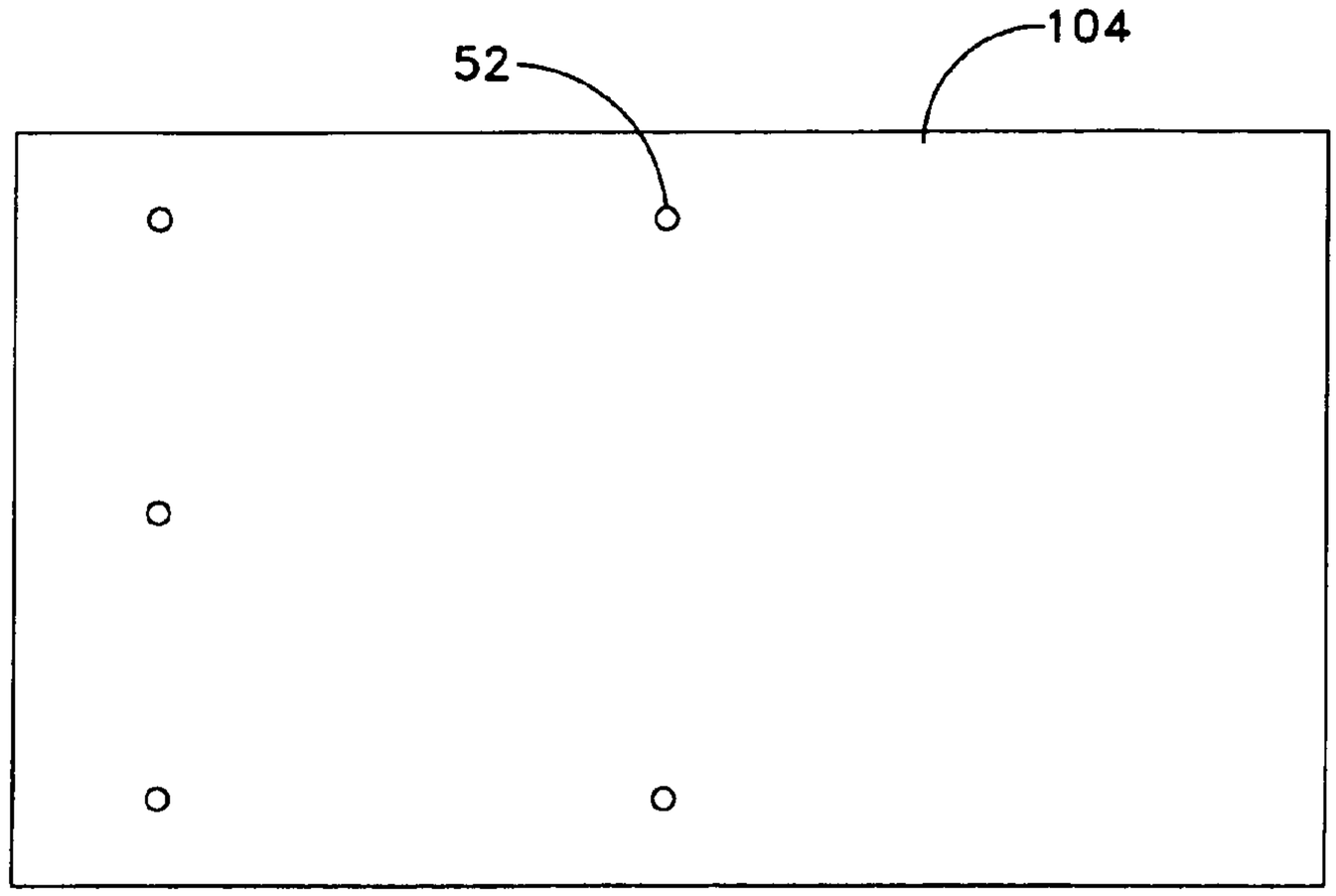

FIG. 17

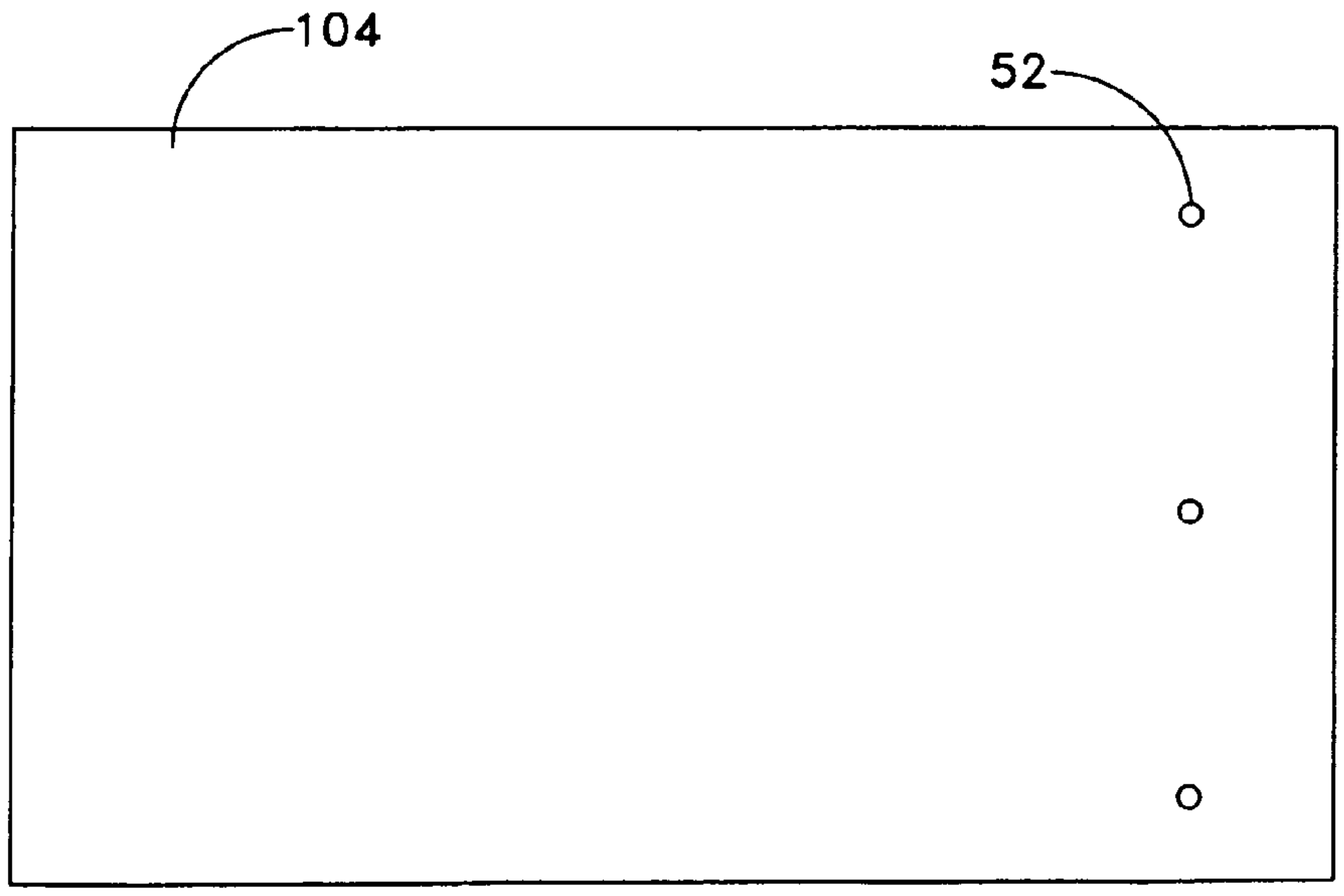

FIG. 18

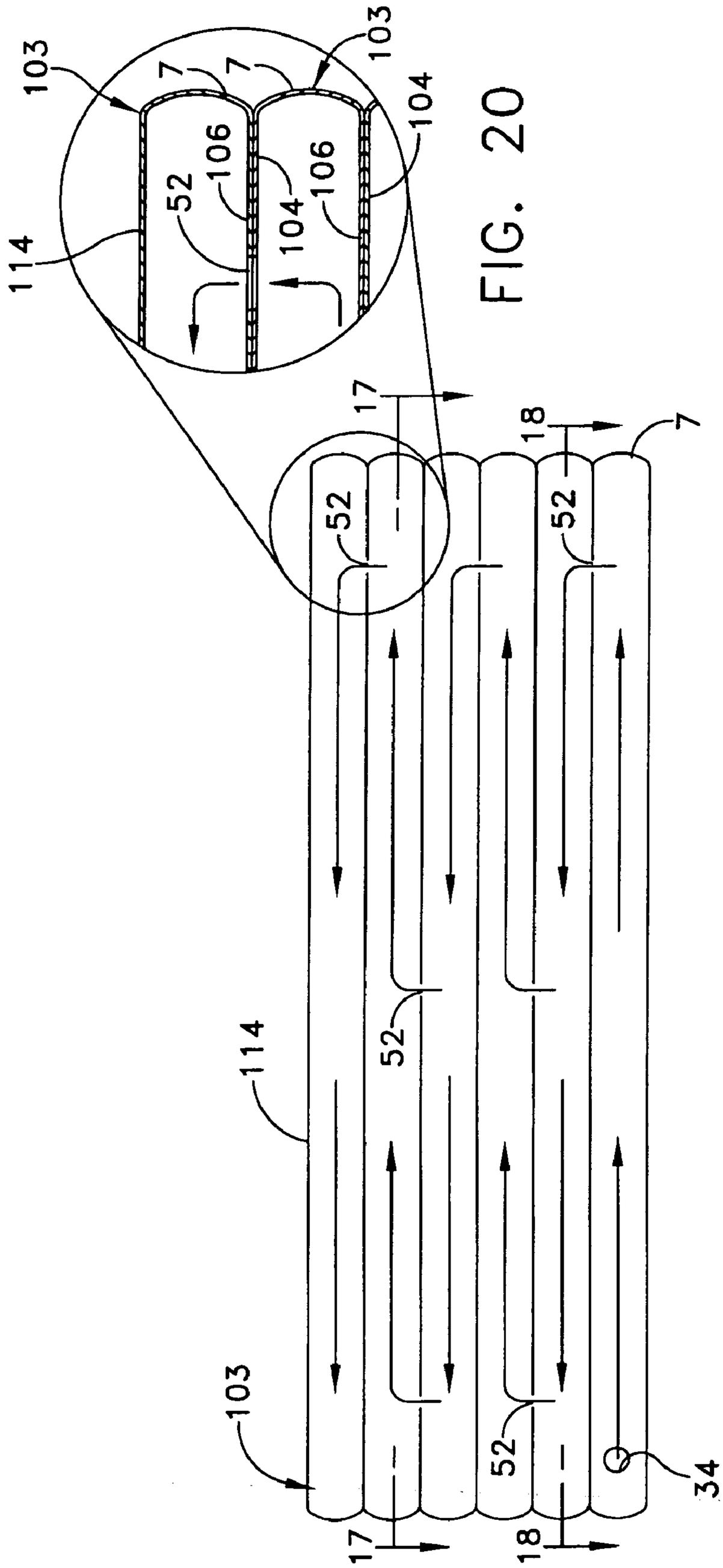
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FIG. 20

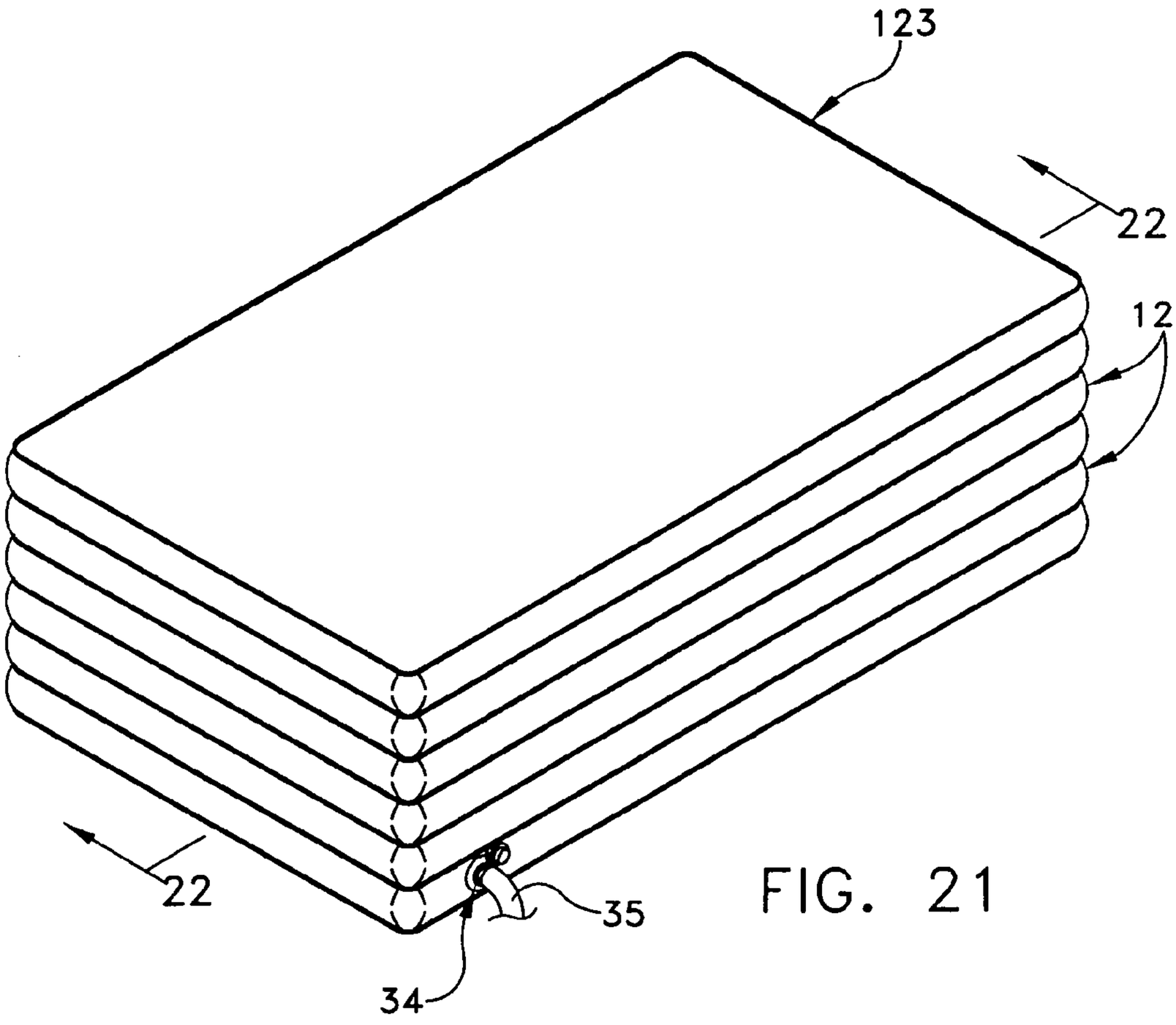

FIG. 21

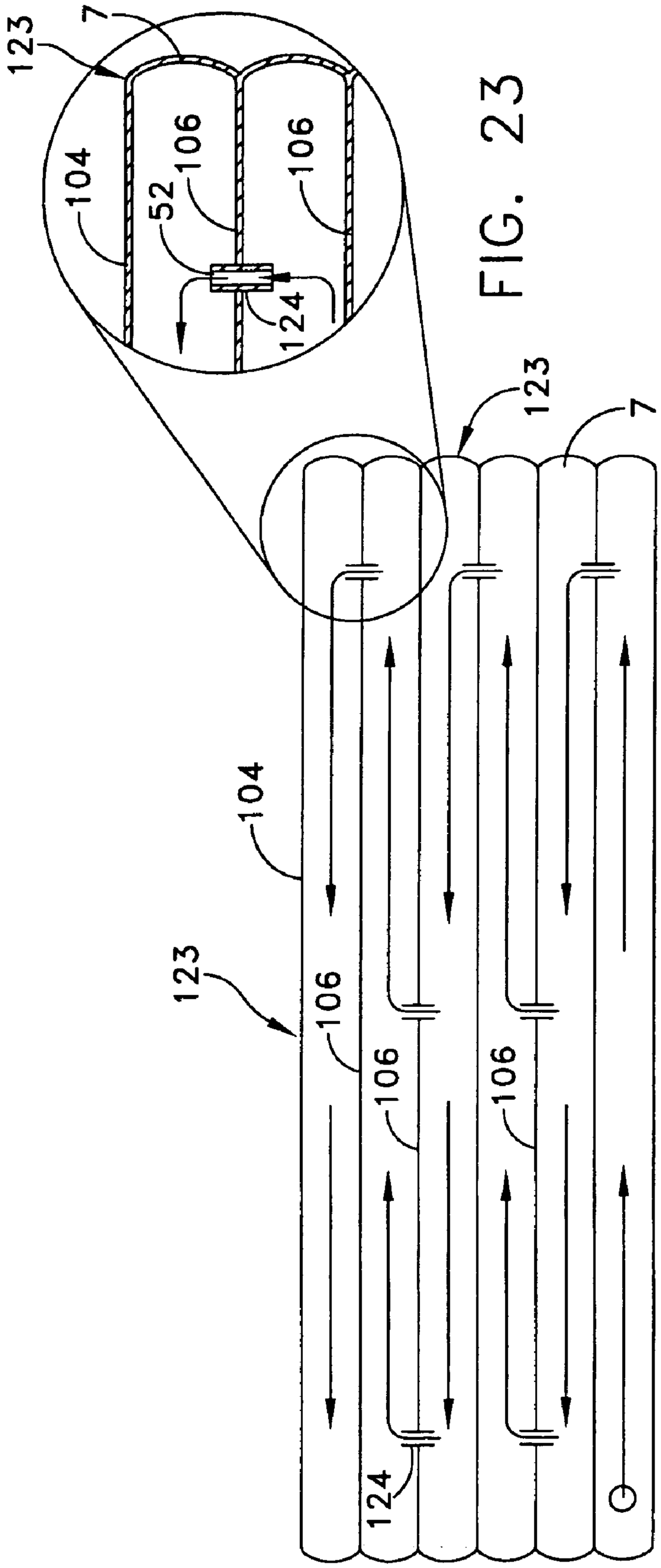

FIG. 22

FIG. 23

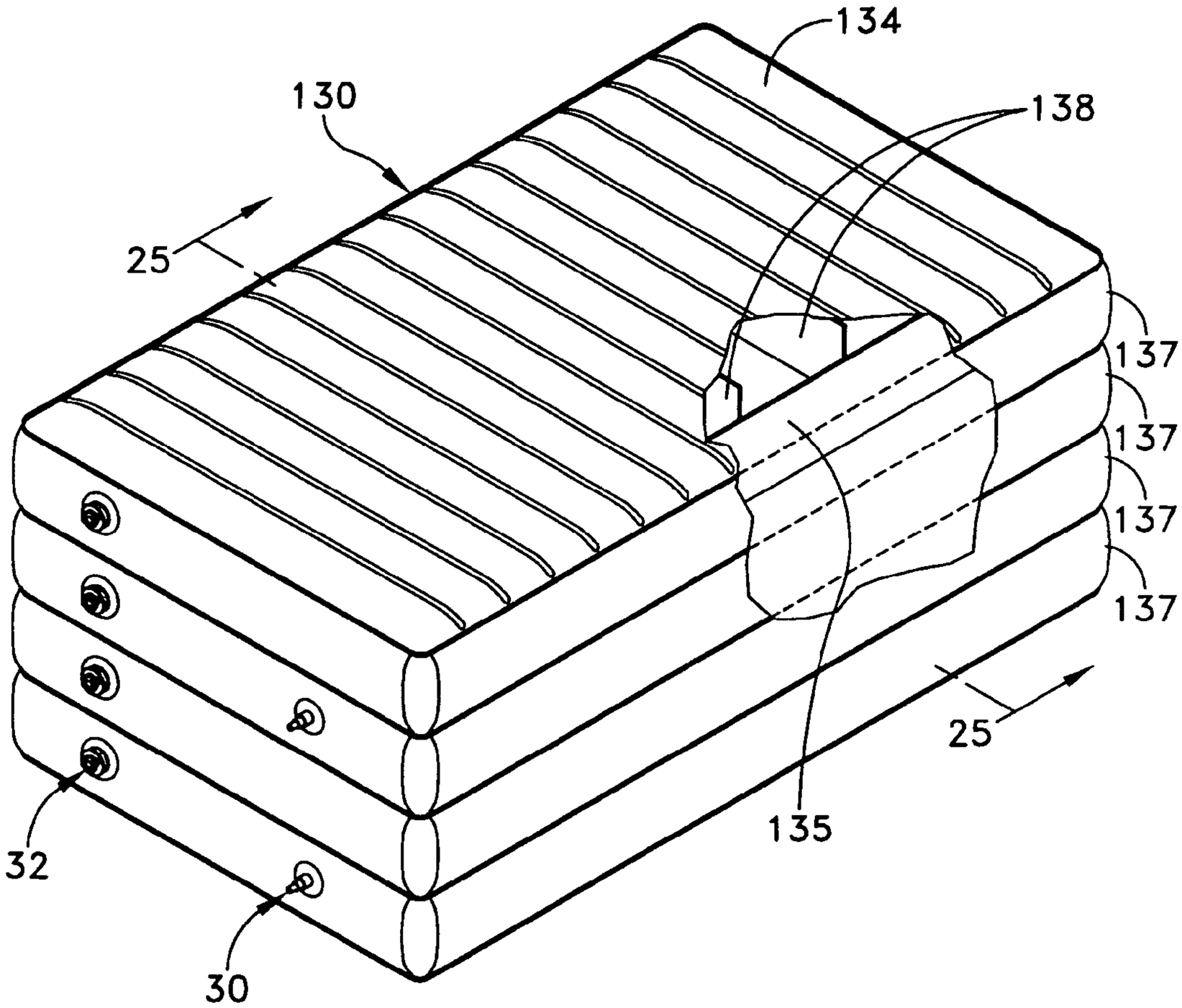

FIG. 24

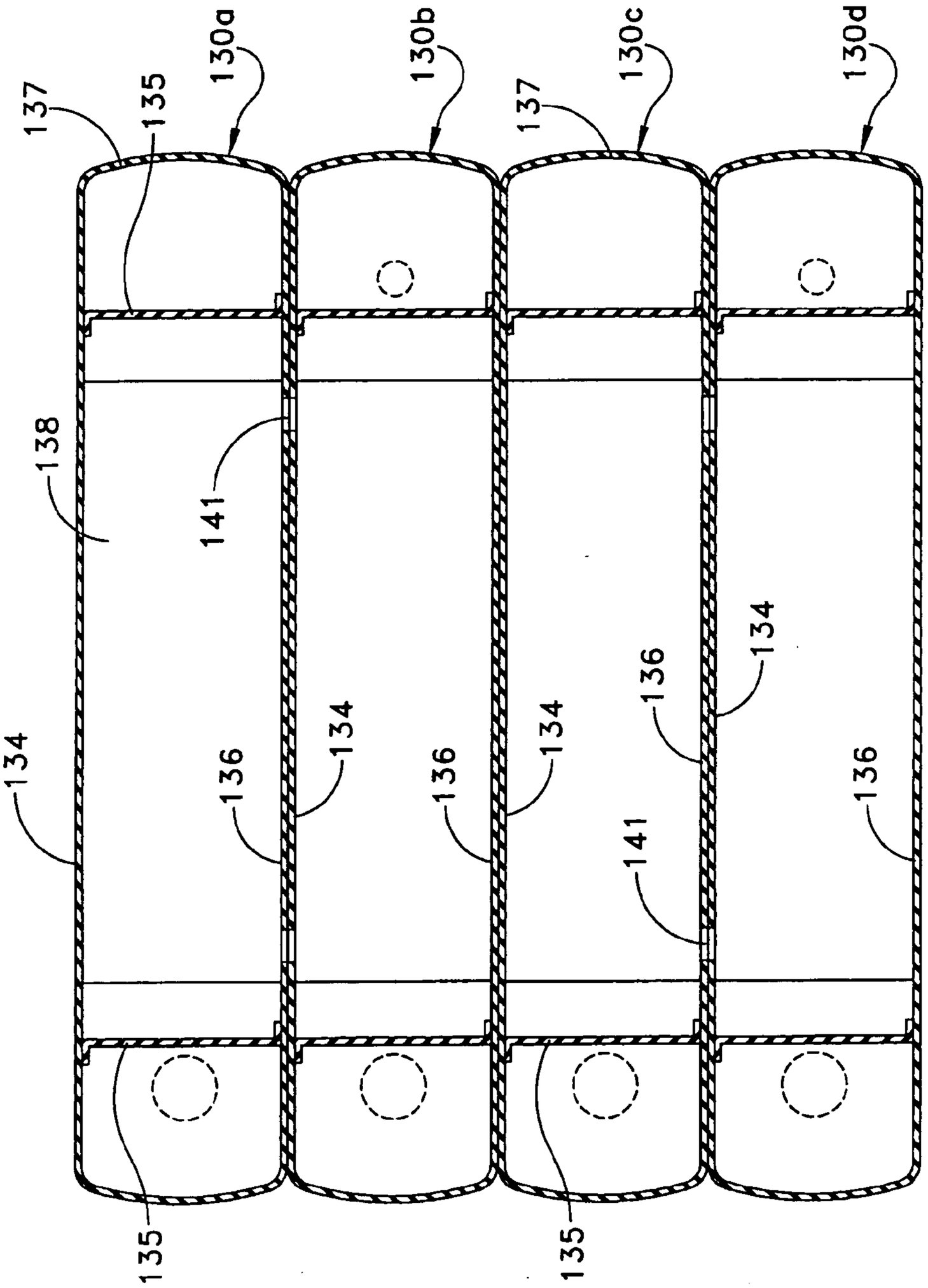
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FIG. 25

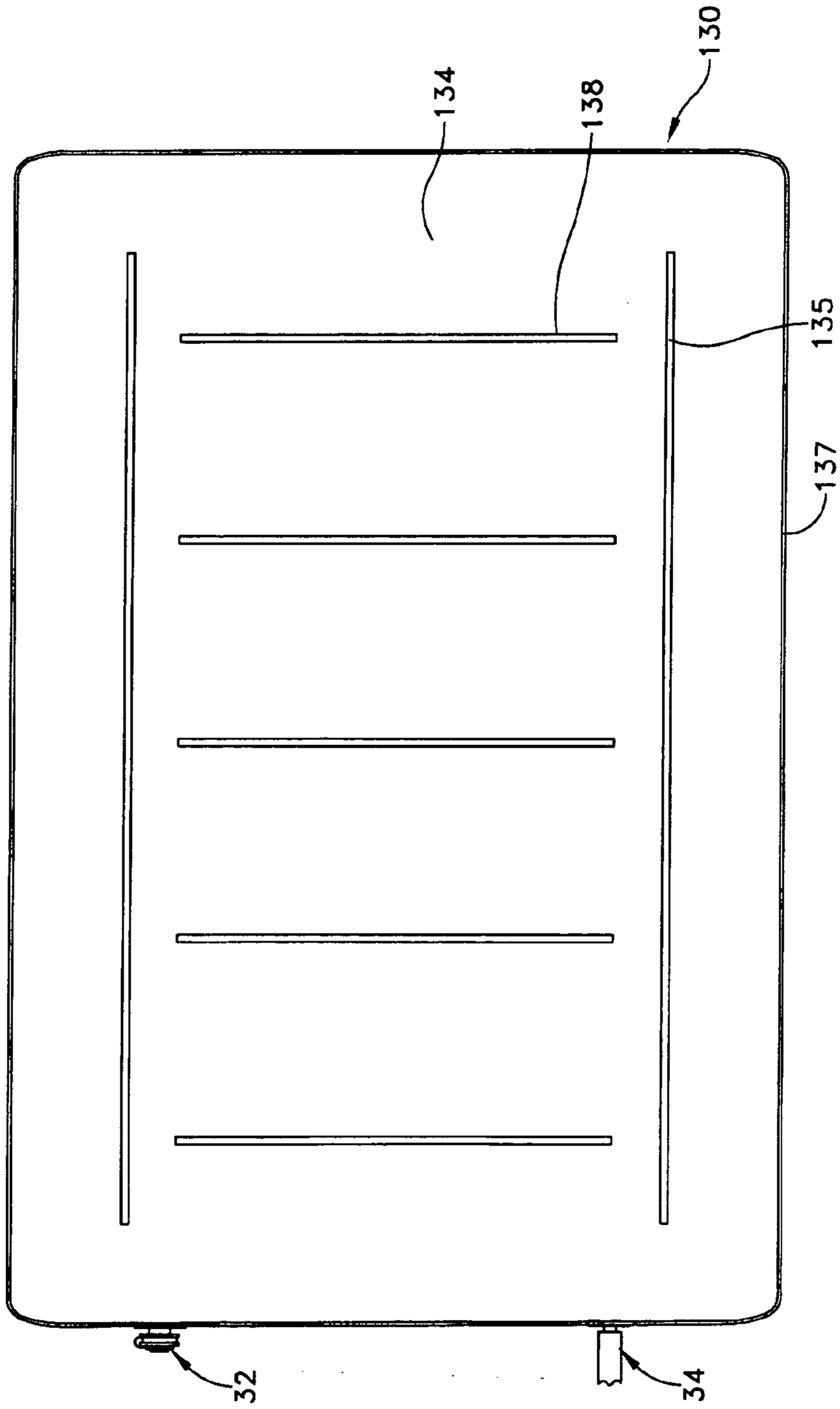

FIG. 26

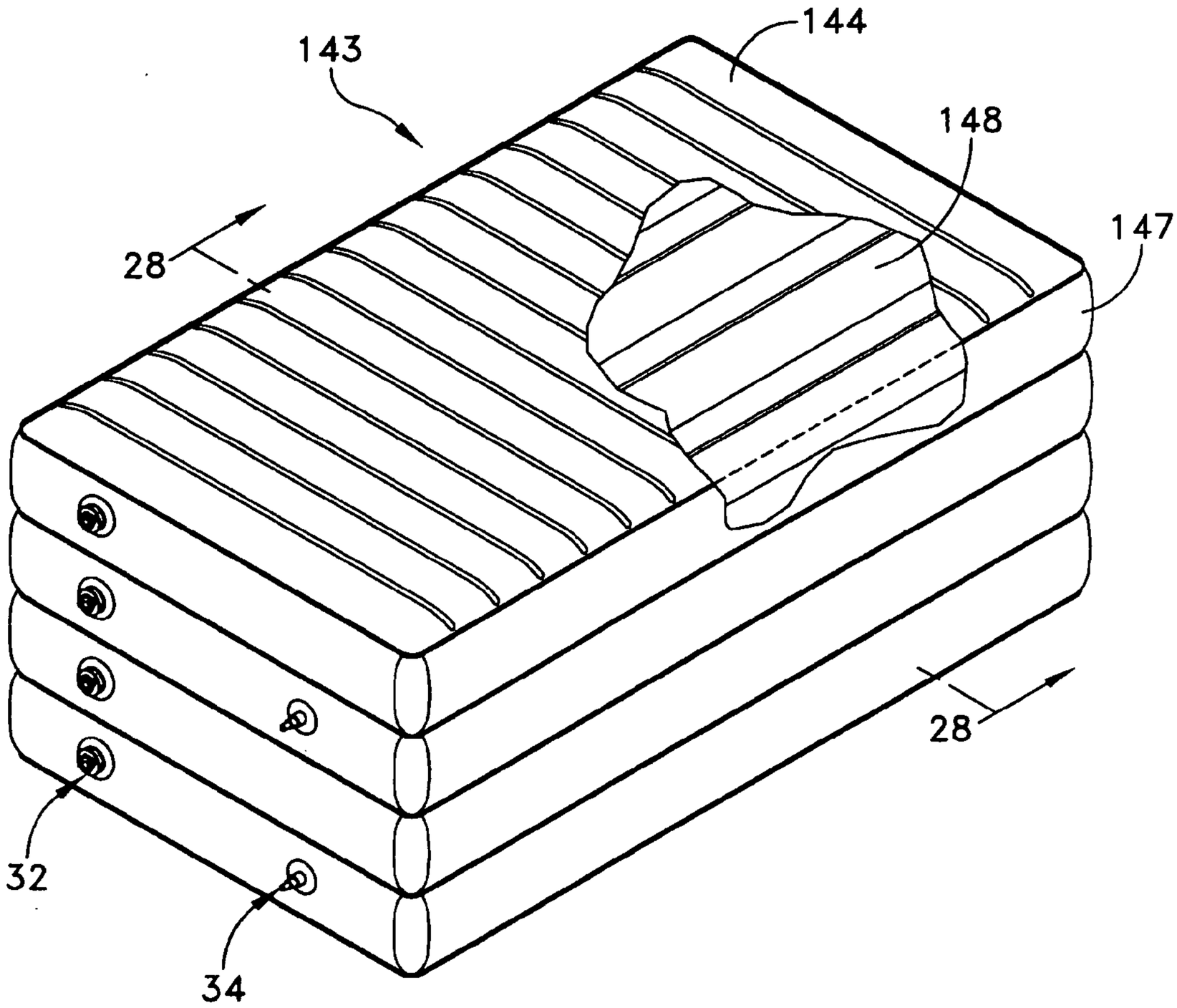

FIG. 27

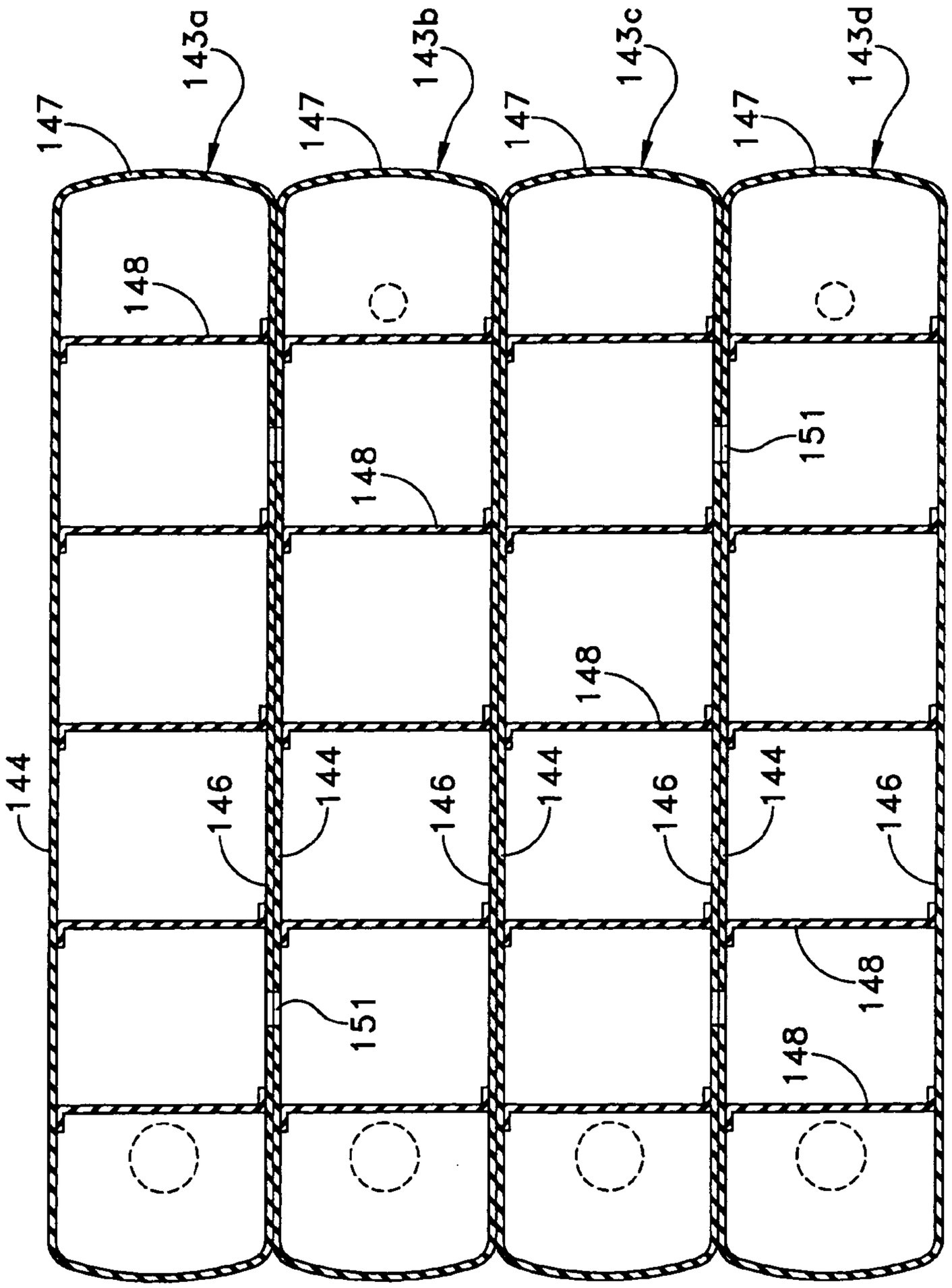
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FIG. 28

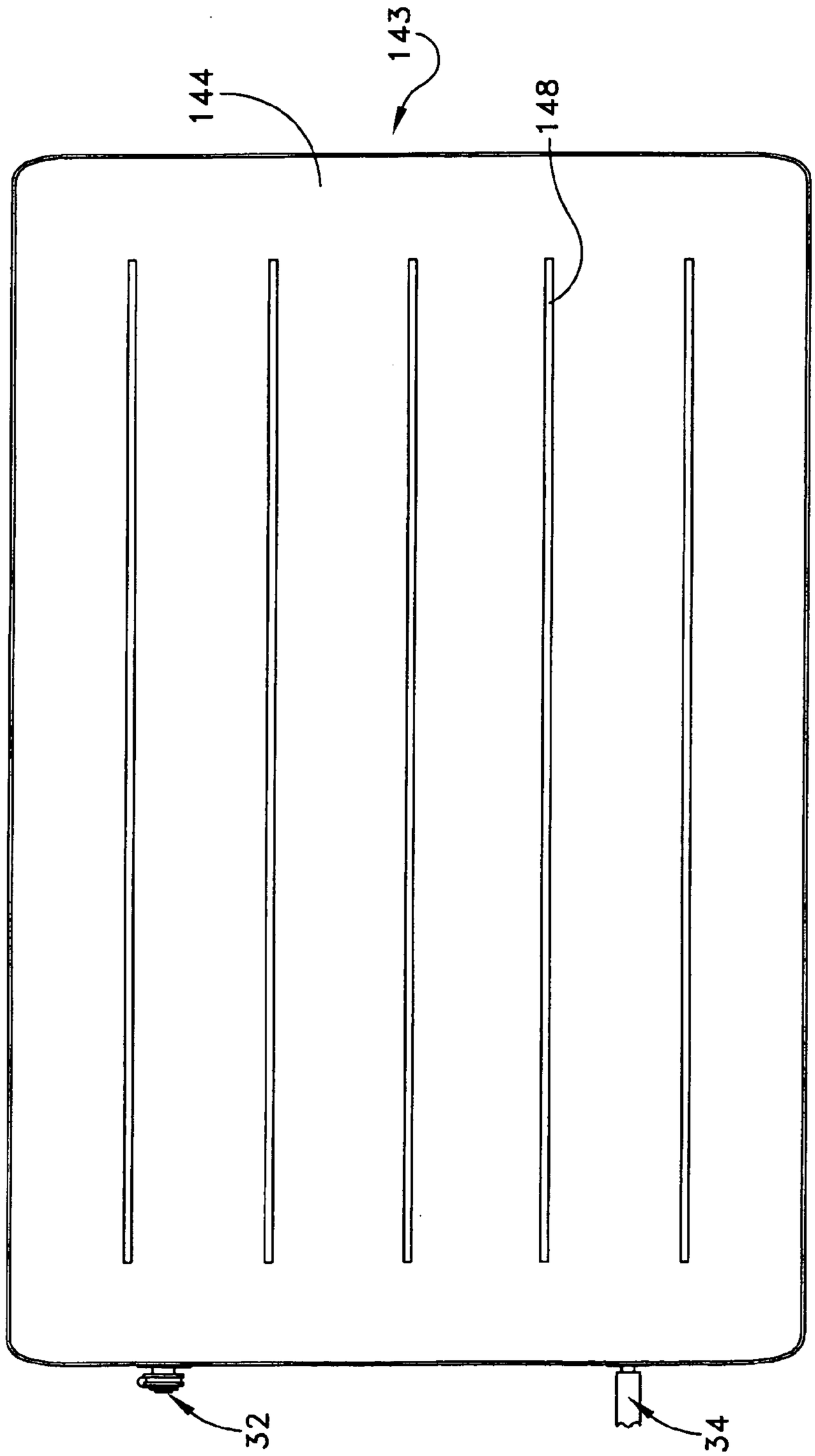

FIG. 29

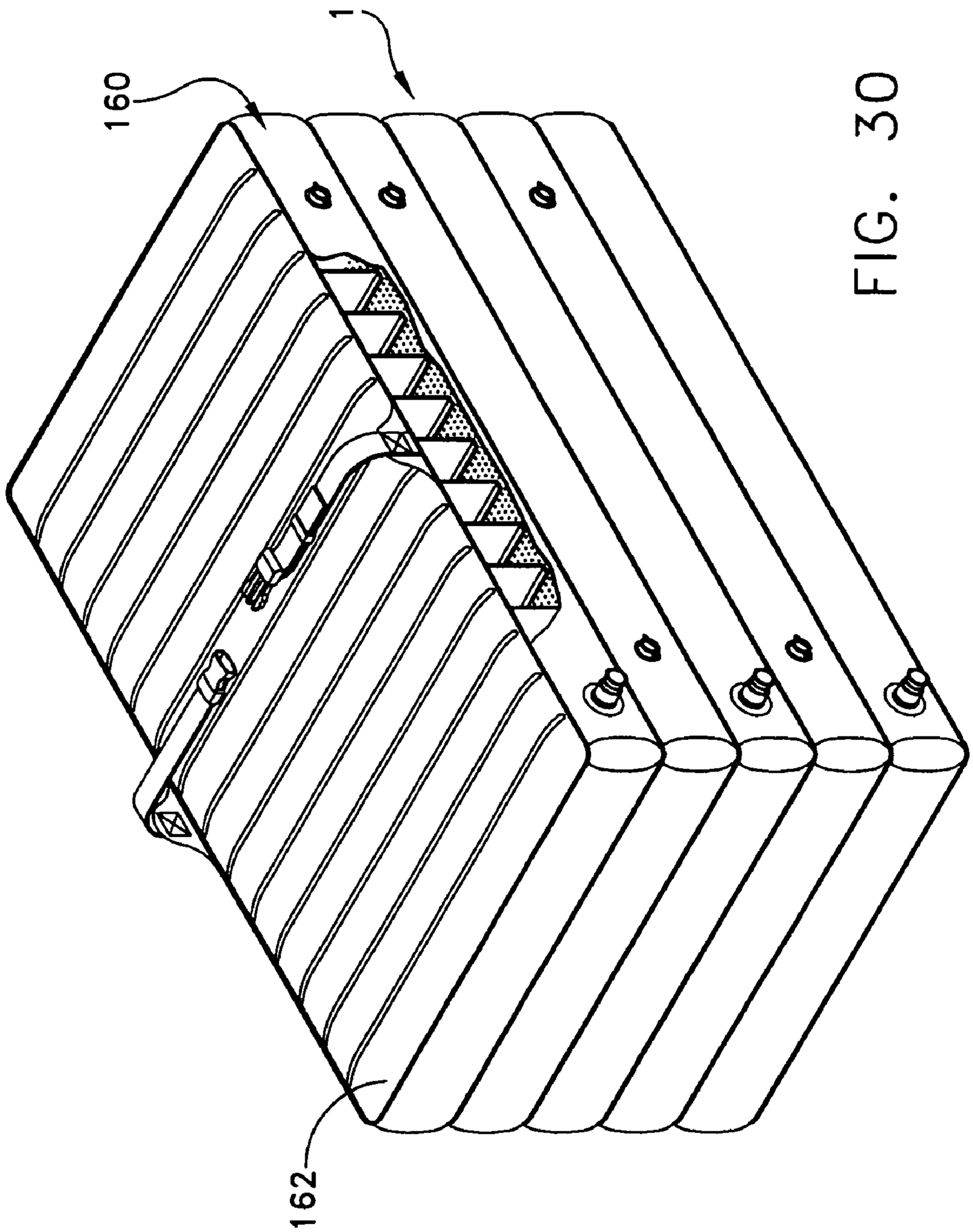

FIG. 30

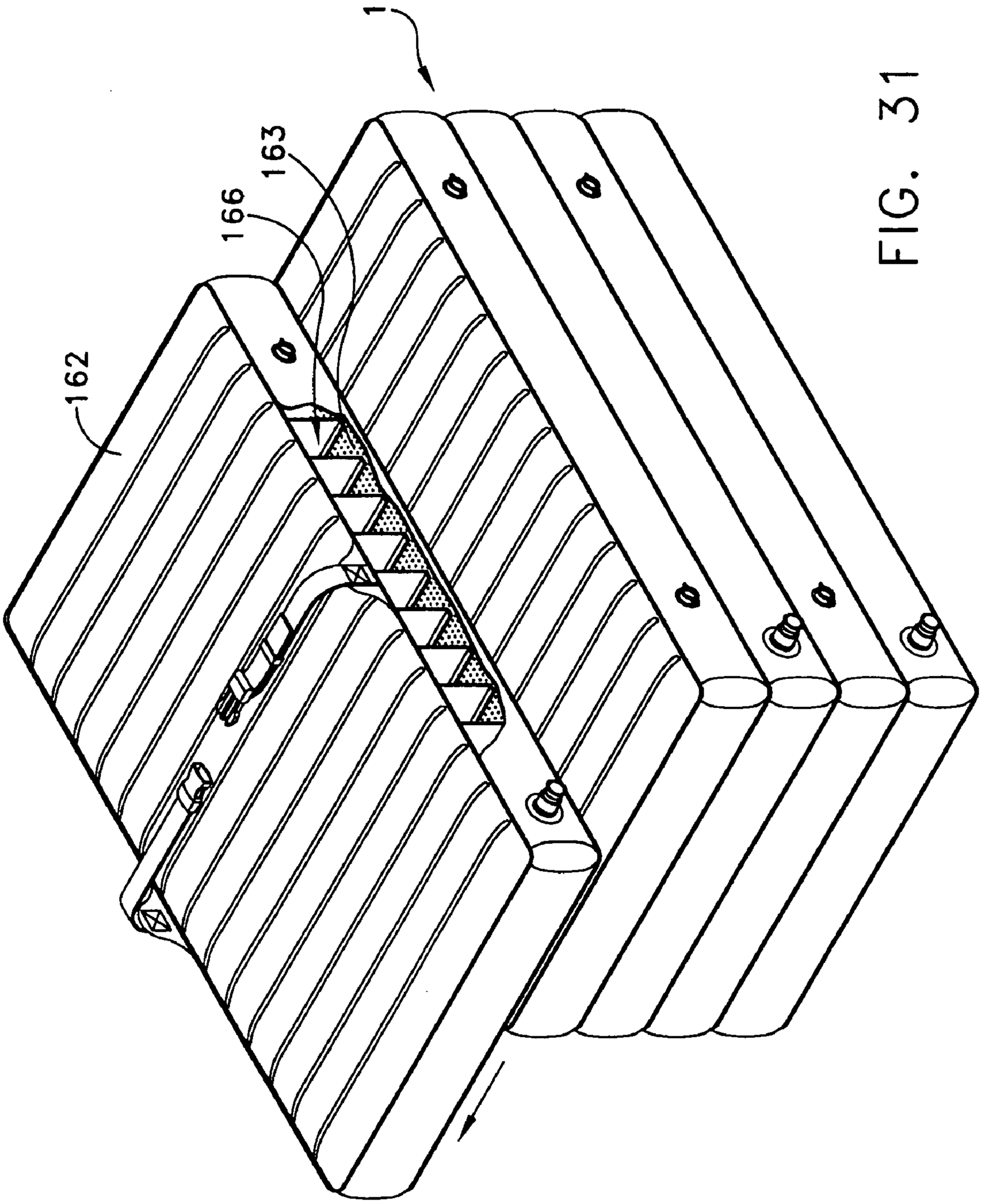

FIG. 31

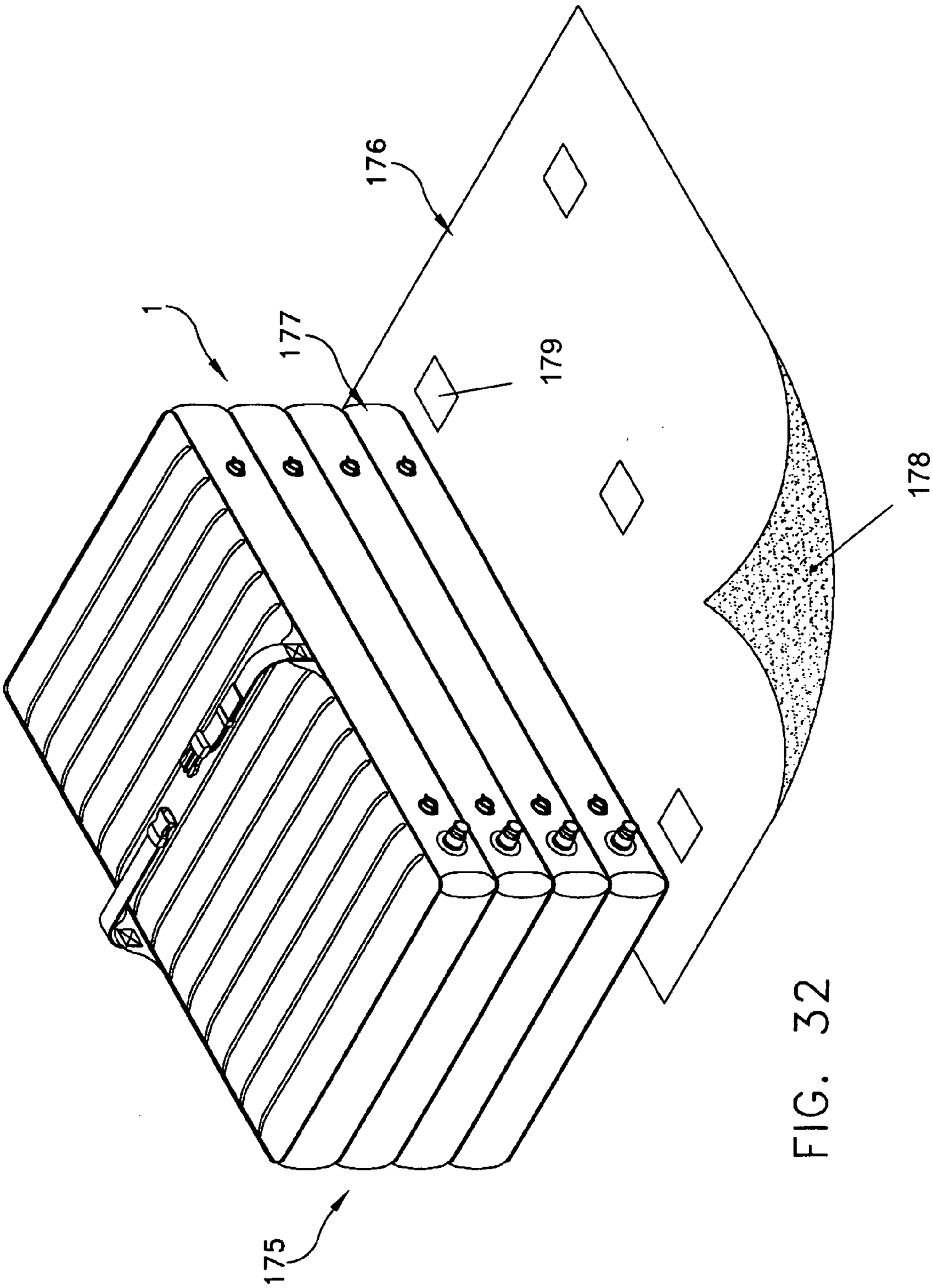

FIG. 32

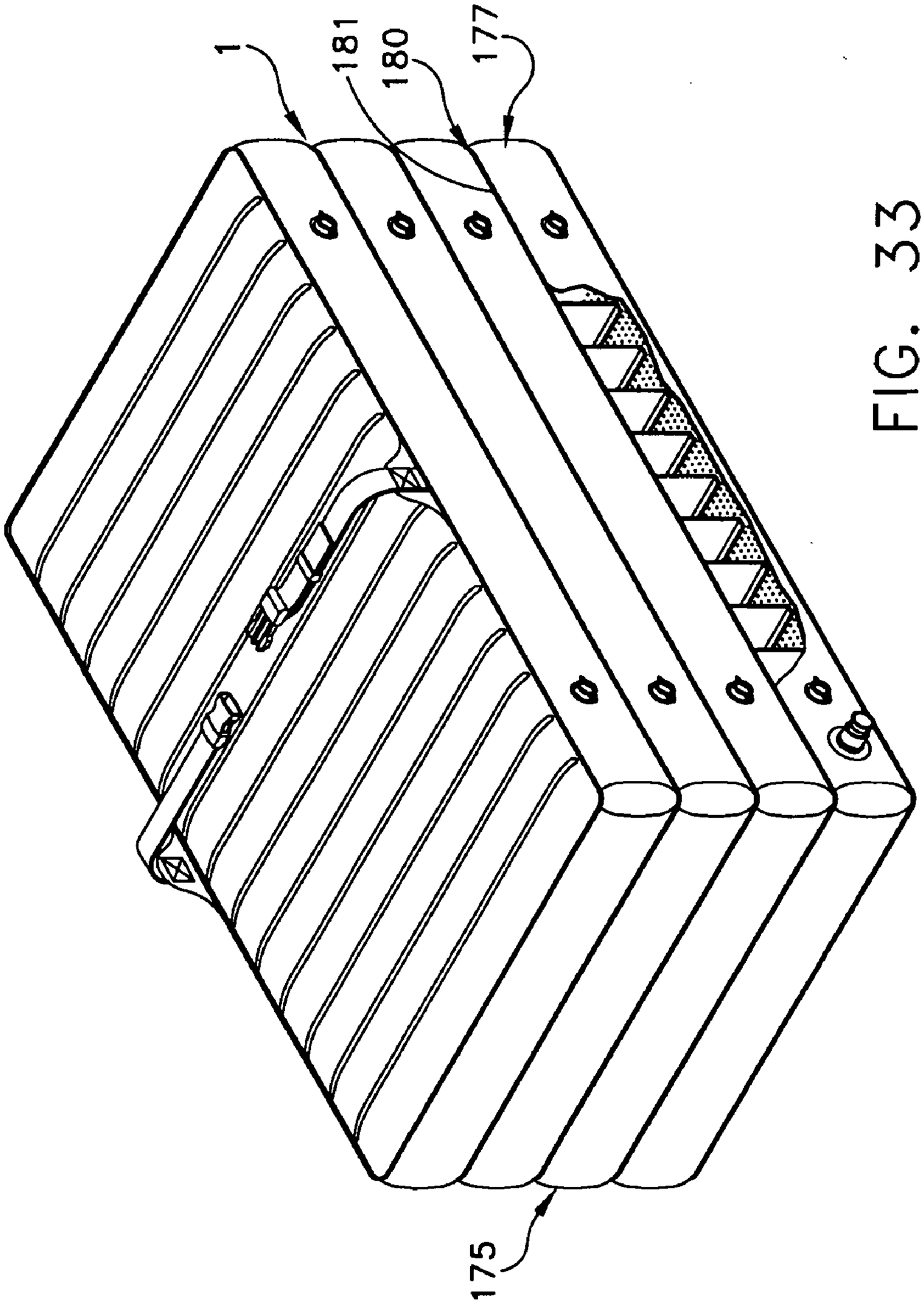

FIG. 33

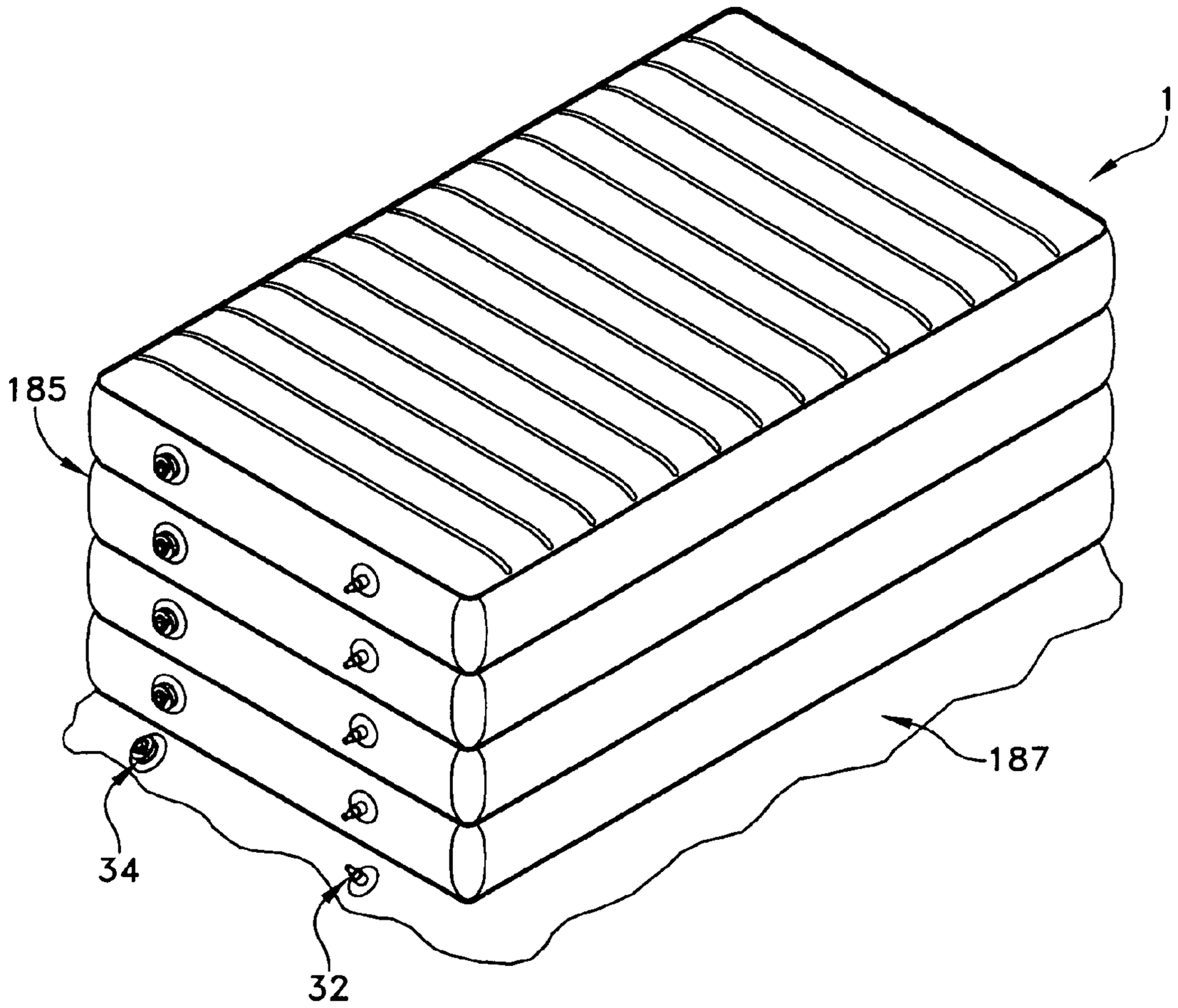

FIG. 34

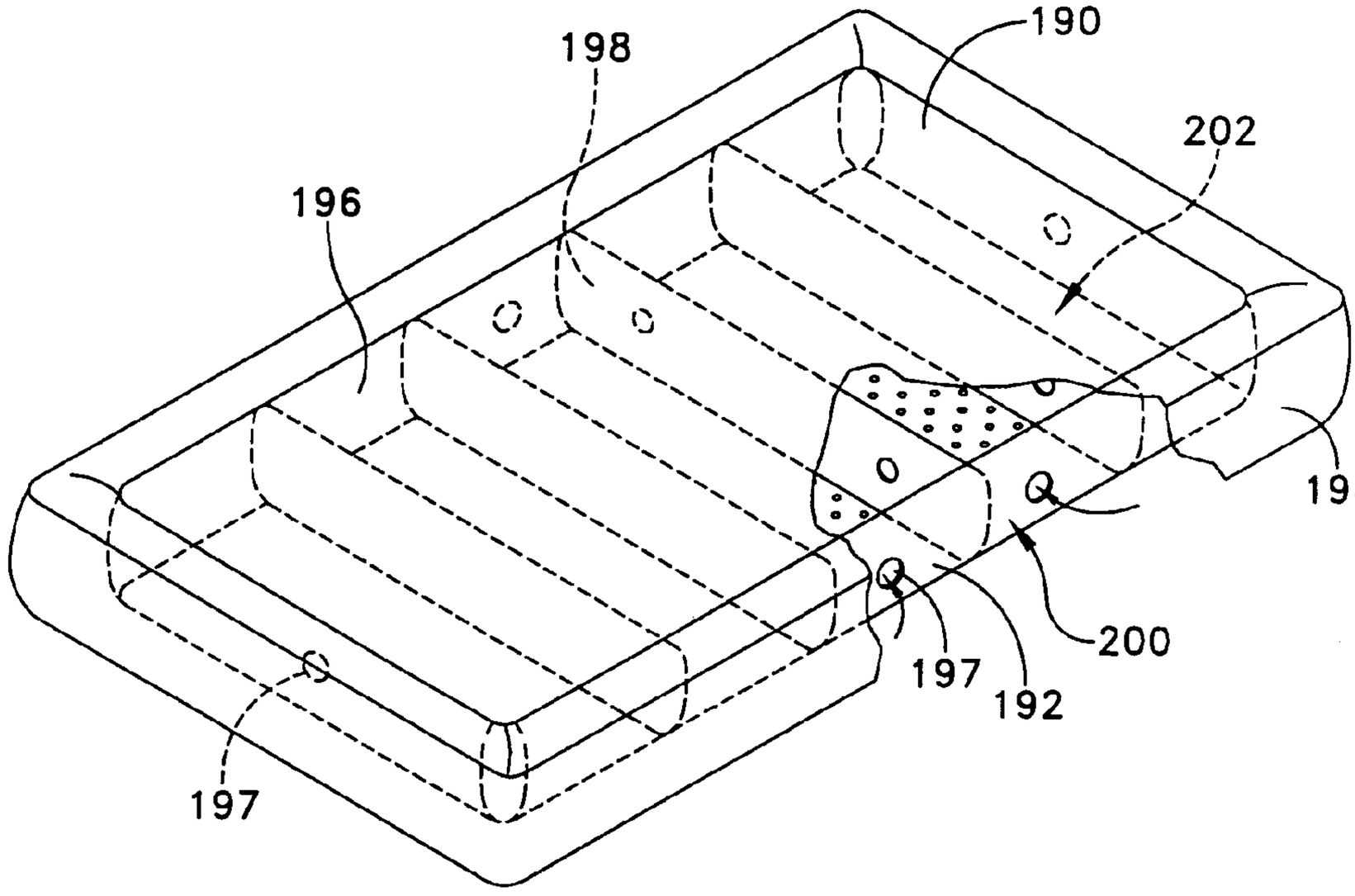

FIG. 35

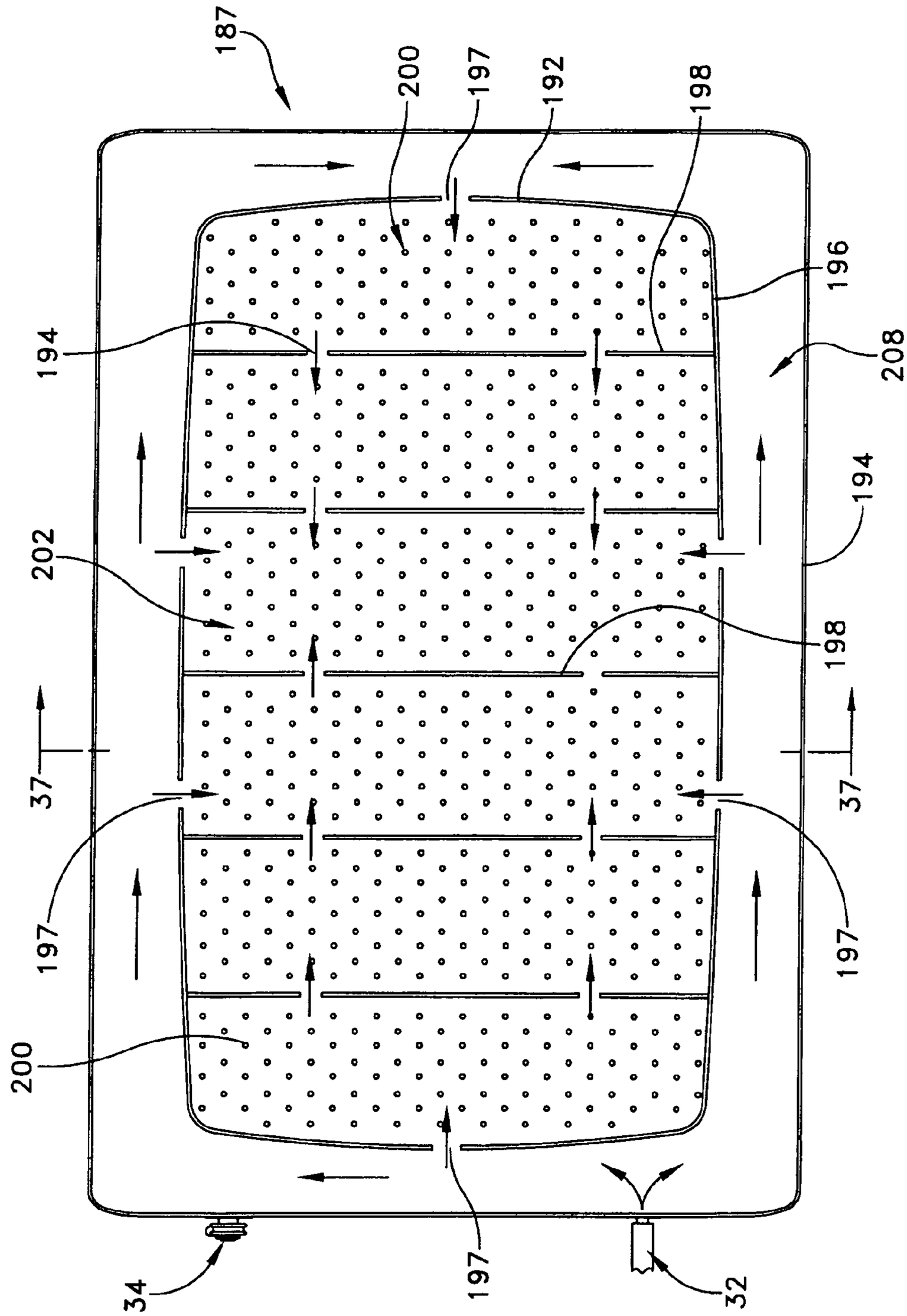
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FIG. 36

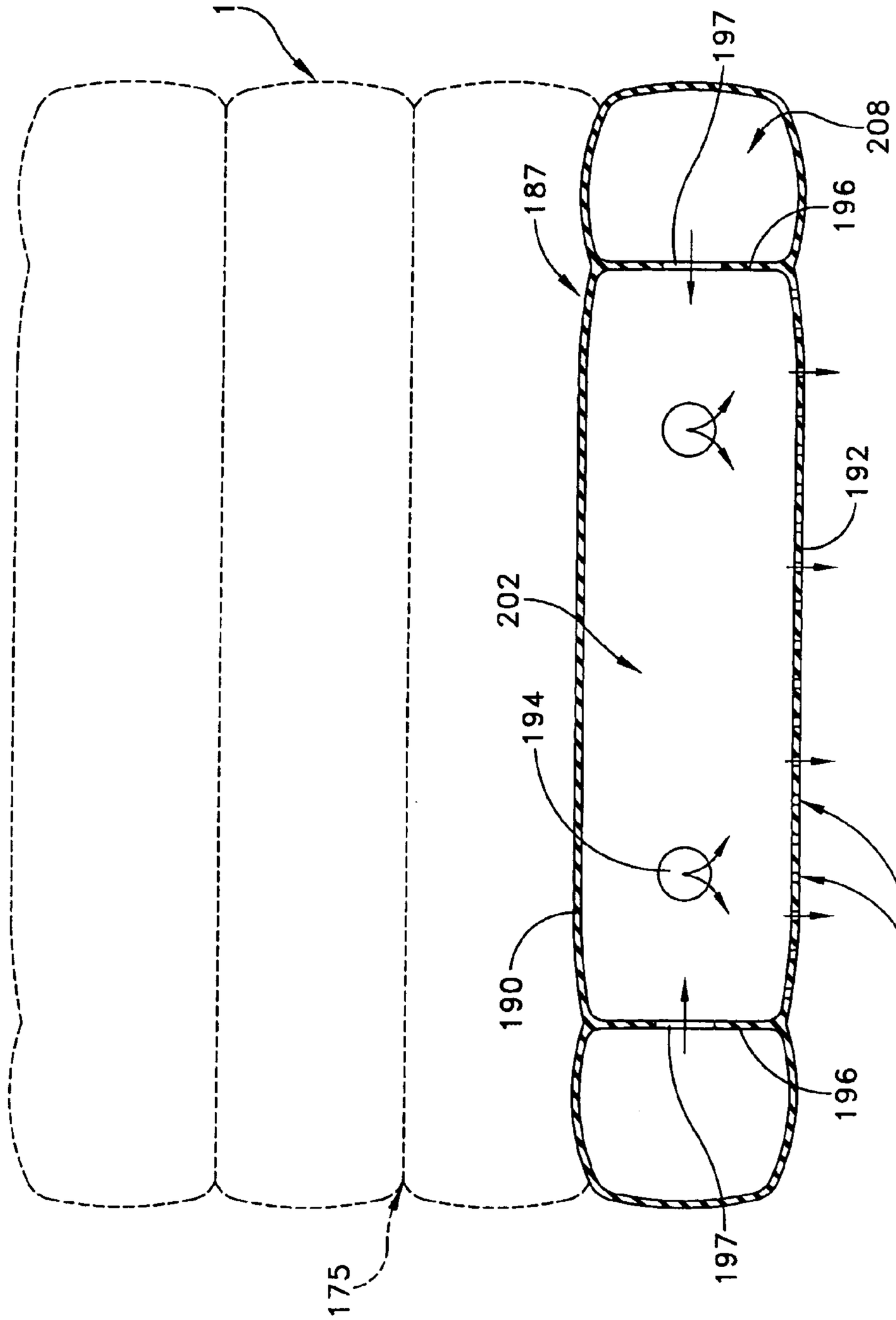

FIG. 37

PNEUMATIC LIFT

[0001] This application is related to, and claims the benefit of U.S. provisional patent application Ser. No. 60/530,161, filed Dec. 17, 2003, and entitled Pneumatic Lift.

FIELD OF THE INVENTION

[0002] The present invention generally relates to devices suitable for lifting living creatures and, more particularly, to a pneumatic lift suitable for use in vertically moving living creatures.

BACKGROUND OF THE INVENTION

[0003] There is a need for a compact, lightweight and easily portable patient lifting device to assist caregivers in lifting prone patients from a lower position, e.g., the floor, to a relatively higher position, e.g., a bed, table, gurney, or vehicle, etc.; for use in the home, in institutional settings, and in the outside world. Transferring of disabled patients is a leading cause of injury in the health-care industry, with the nursing occupation having among the highest incidence of back injury, despite the prior art and the availability of commercial patient lifts. These lifts are under-utilized for a number of reasons, such as restricted space in many hospital wards and bathrooms, cumbersome operating requirements, the indignity involved in the mode of transport, the additional time required for performing the transfer, and the unavailability of the lift at both the patient's starting and destination locations. In addition, many patients are essentially home-bound due to the unavailability of a conveniently portable lift, reducing their quality of life unnecessarily. A device is required that is simple to set up and use, feels safe, secure and is not intimidating for the patient, and can be transported with the patient.

[0004] This problem is pervasive in the home health care industry as well, where spaces are not designed for safe patient transfers, and the caregiver is often alone and has no help during lifts. Since conventional lifts are available in less than ten percent of the homes visited by home health care professionals, a device that can be easily brought from home to home is also required. In addition, most prior art lifting devices do not provide for the reduction of hip and back deflection during lifting. This is a significant problem, since if a person's hip or back is already injured, such uncontrolled deflections could exacerbate the existing condition, or possibly cause additional injury.

[0005] While this field contains considerable prior art, these devices have proven inadequate. For example, U.S. Pat. No. 4,805,248, issued to Lunau is typical of ceiling-mounted patient lifts. While effective, these are limited to use in very well defined areas. U.S. Pat. No. 3,137,011, issued to Fischer is representative of a common type of mobile patient lift. A major disadvantage of this design is that the patients are essentially suspended from a hook. The resultant swaying motion during transfer is disconcerting to most patients. In addition, the patient is transported in a partially reclined position, increasing their sense of helplessness and indignity, particularly if used outside in public.

[0006] U.S. Pat. No. 3,914,808, issued to Woods teaches the use of a short flexible sling in a front-loading orientation, with a pivoting column. The base must be relatively wide in order to avoid tipping as the column is rotated, and there is no means for compactly transporting or storing the lift. Additionally, the use of a fixed length sling requires that the patient be sitting precisely on the center of the sling, to avoid tipping the patient as the column is raised. This increases the time and training required to use the lift.

[0007] Pneumatically inflatable, and hydraulically expandable lifting bags are also known. For example, DE-U-1,897,870 discloses an extendable or inflatable lifting device having a pressure release valve assembly. U.S. Pat. No. 3,695,582, issued to Clay discloses a lifting jack for motor vehicles which uses fluid pressure for operating power to raise the wheel of a vehicle. The jack relies upon a pair of stacked hollow flexible plastic bags that may be filled with a suitable fluid.

[0008] In U.S. Pat. No. 5,606,785, issued to Shelberg et al., an inflatable air mattress positioner is provided for use with a casket, coffin or alternative container. The assembly includes a partially pneumatic pillow with a chamber in which is disposed a plurality of air chambers, each one of which has a corresponding air tube and valve assembly. A cushion coacts with the air bladders to position the head, upper arm, chest and shoulder region of a cadaver so that the cadaver chin is disposed in an acceptable proper height in relation with the chest. The assembly includes an inflatable air mattress having a plurality of air chambers which are independently inflatable to position a cadaver at an appropriate height and angle in the casket. Additional separate independent air bladders are also provided to be disposed under the cadaver to aid in positioning the cadaver and tilt the cadaver along its longitudinal axis for mourner viewing as well as positioning the back, arms, head, neck or any other part of the cadaver that requires adjustment.

[0009] In the U.S. Pat. Nos. 4,688,760, 4,786,032, 4,993,736, 5,651,149, and 5,669,086, all issued to Garmen et al., a variety of lifting apparatus are provided that include a base, a platform disposed above the base, a thrust mechanism positioned between the platform and the base to lift the platform with respect to the base. Garmen et al. often choose a pneumatic thrust mechanism in the form of stacked bellows including a flexible wall composed of substantially inelastic material and having a vertically spaced horizontal stiffener. The bellows include an inlet to allow a gaseous material to inflate each bag for applying lifting forces to the platform. U.S. Pat. No. 6,199,827, issued to Rimington, et al., also discloses an extendable or inflatable lifting device.

[0010] None of the foregoing patents adequately address the problem of insuring that a lift is available at both a patient's starting and final locations. Patient transfer mattresses are also well known in the art which include at least two flexible material sheets, that together define a plenum chamber, with at least one sheet being completely perforated with small pinholes over its surface area, and which open up directly to the interior of the plenum chamber. Such prior art mattresses are used by arranging the perforated sheet so that it faces an underlying fixed, generally planar support surface, such as a floor or table. When the mattress is charged with pressurized air, the escape of air under pressure through the pinholes acts initially to jack a load placed upon the mattress (i.e., to lift the load in increments) and thereby creates an air bearing of relatively small height between the underlying fixed, generally planar support surface and the perforated flexible sheet.

[0011] For example, in U.S. Pat. No. 4,517,690, issued to Wegener, an air pallet is disclosed that is formed from upper and lower thin flexible film sheets sealed at their edges to form a plenum chamber. Wegener's air pallet functions to move a load with minimal friction over an underlying generally planar fixed support surface. The bottom thin flexible material sheet is perforated by small diameter perforations such as pin holes.

[0012] In U.S. Pat. No. 4,417,639, issued to Wegener, a pair of relatively rigid planar members are arranged overlying each other, and are coupled about their edges by a flexible film band to form a jacking plenum chamber. The upper planar member functions as the load support, having a gas inlet hole adjacent one edge. Gas under pressure enters an end of the jacking plenum chamber and escapes through the outer end which allows for jacking of the load. Wegener's design is only capable of jacking the load, e.g., a patient lying on the mattress, several inches above the underlying support surface.

SUMMARY OF THE INVENTION

[0013] The present invention provides, in its broadest aspects, a pneumatic lift including at least two jacking-mattresses stacked one atop another, where the jacking-mattresses are arranged in air flow communication with one another.

[0014] In one embodiment, each of the jacking-mattresses includes a top panel having a width, a length, a peripheral edge, a bottom panel having the same width, length, and a peripheral edge, and a perimeter band extending between the top panel and the bottom panel. The peripheral edges of the top and bottom panels are sealingly fastened to one another to form the jacking-mattress. The peripheral band defines at least one through-hole for air flow communication with the interior of at least one other jacking-mattress. A plurality of baffle-panels are also provided each having a width and a length and being attached to an inner surface of the top panel and an inner surface of the bottom panel so as to be transversely oriented between the top panel and the bottom panel. In this way, the baffle-panels define a pair of longitudinally extending air flow passageways disposed between an edge of the baffle-panels and an interior surface of the perimeter band. At least one conduit is arranged in air flow communication between the at least one through-hole in adjacent jacking-mattresses. A source of pressurized air is arranged in airflow communication with one of the at least one through-holes so as to be in airflow communication with the interior of one of the jacking-mattresses.

[0015] In another embodiment of the invention, a pneumatic lift is provided that includes a top jacking-mattress, a bottom jacking-mattress, and a plurality of intermediate jacking-mattresses that are stacked one atop another between the top jacking-mattress and the bottom jacking-mattress. Select ones of the jacking-mattresses are arranged in air flow communication with one another. Each of the jacking-mattresses includes a top panel having a width, a length, a peripheral edge, where select ones of the intermediate jacking-mattresses have a top panel having at least one through-hole. A bottom panel is provided having the width, the length, and a peripheral edge, where corresponding select ones of the intermediate jacking-mattresses have a bottom panel having at least one through-hole. A perimeter band extends between the top panel and the bottom panel of each of the jacking-mattresses such that the peripheral edges of the top and bottom panels are sealingly fastened to one another. A plurality of baffle-panels are provided where each has a width and a length and is attached to an inner surface of the top panel and an inner surface of the bottom panel so as to be transversely oriented between the top panel and the bottom panel. Together, the baffle-panels and the perimeter band define a pair of longitudinally extending air flow passageways disposed between an edge of the baffle-panels and an interior surface of the perimeter band. A source of pressurized air is arranged in airflow communication with the interior of at least one of the jacking-mattresses.

[0016] In a further embodiment of the invention, a transportable pneumatic lift is provided including a plurality of jacking-mattresses stacked one atop another with selected ones of the jacking-mattresses being arranged in internal air flow communication with one another. A transfer mattress forms a bottom most jacking-mattress. The transfer mattress includes a top panel having a width, a length, and a peripheral edge and a bottom panel having the same width, the same length, and a peripheral edge. A plurality of pinholes are defined in a central portion of the bottom panel. An outer perimeter band extends between the top panel and the bottom panel such that the peripheral-edges of the top and bottom panels are sealingly fastened to one another. A plurality of baffle-panels are attached to an inner surface of the top panel and an inner surface of the bottom panel so as to be transversely oriented between the top panel and the bottom panel. An inner perimeter band extends between the top panel and the bottom panel and enclosing the plurality of baffle-panels so as to define an annular air flow passageway disposed between the outer perimeter band and the inner perimeter band. The inner perimeter band also encloses the baffle-panels thereby forming individual chambers between the baffles. The annular air flow passageway is in flow communication with the individual chambers. A source of continuous pressurized air is arranged in flow communication with the annular air flow passageway.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017] These and other features and advantages of the present invention will be more fully disclosed in, or rendered obvious by, the following detailed description of the preferred embodiment of the invention, which is to be considered together with the accompanying drawings wherein like numbers refer to like parts and further wherein:

[0018] **FIG. 1** is an end on perspective view of a pneumatic lift formed in accordance with the present invention;

[0019] **FIG. 2** is another end on perspective view of the pneumatic lift shown in **FIG. 1**;

[0020] **FIG. 3** is a partially broken-away, perspective view of a jacking-mattress formed in accordance with the present invention;

[0021] **FIG. 4** is a broken-away perspective view of a corner portion of the jacking-mattress shown in **FIG. 3**;

[0022] **FIG. 5** is a broken-away perspective view of a corner portion of an alternative jacking-mattress having scalloped edged baffle-panels;

[0023] **FIG. 6** is a broken-away, cross-sectional view of the jacking-mattress having scalloped edged baffle-panels shown in **FIG. 5**;

[0024] **FIG. 7** is a broken-away perspective view of a corner end portion of the pneumatic lift shown in **FIG. 1**;

[0025] **FIG. 8** is an enlarged view of a first embodiment of jacking-mattress interface;

[0026] **FIG. 9** is a perspective view of a pneumatic lift shown in **FIGS. 7 and 8**, in a fully inflated state;

[0027] **FIG. 10** is a perspective view of the pneumatic lift shown in **FIGS. 1, 2**, and **9**, in a partially deflated state;

[0028] **FIG. 11** is a perspective view of pneumatic lift shown in **FIGS. 1, 2**, and **9**, after a first jacking-mattress has been inflated;

[0029] **FIG. 12** is a cross-sectional view, as taken along line **12-12** in **FIG. 9**, showing one possible internal air movement pattern in accordance with the present invention;

[0030] **FIG. 13** is a cross-sectional view of the pneumatic lift, as taken along line **13-13** in **FIG. 12**;

[0031] **FIG. 14** is an end on perspective view of a pneumatic lift formed in accordance with an alternative embodiment of the present invention;

[0032] **FIG. 15** is a broken-away perspective view of a corner end portion of the pneumatic lift shown in **FIG. 14**;

[0033] **FIG. 16** is an enlarged view of a second embodiment of jacking-mattress interface which is heat sealed or ultrasonically welded;

[0034] **FIG. 17** is a plan view of a top panel for use with intermediate jacking-mattresses used in connection with the alternative embodiment shown in **FIG. 14**;

[0035] **FIG. 18** is a plan view of a bottom panel for use with intermediate jacking-mattresses used in connection with the alternative embodiment shown in **FIG. 14**;

[0036] **FIG. 19** is a cross-sectional view of the pneumatic lift shown in **FIG. 14**, as taken along lines **19-19** in **FIG. 14**;

[0037] **FIG. 20** is an enlarged view of a corner section of the pneumatic lift shown in **FIG. 20**;

[0038] **FIG. 21** is an end on perspective view of a pneumatic lift formed in accordance with yet a further alternative embodiment of the present invention;

[0039] **FIG. 22** is a cross-sectional view of the pneumatic lift shown in **FIG. 21**, as taken along lines **22-22** in **FIG. 21**;

[0040] **FIG. 23** is an enlarged view of a corner section of the pneumatic lift shown in **FIG. 22**;

[0041] **FIG. 24** is a perspective view of one alternative embodiment of jacking-mattress;

[0042] **FIG. 25** is a cross-sectional view of the jacking-mattress shown in **FIG. 24**, as taken along lines **25-25** in **FIG. 24**;

[0043] **FIG. 26** is a top view of the jacking-mattress shown in **FIGS. 24 and 25** illustrating one seam pattern;

[0044] **FIG. 27** is an end perspective view of a further alternative embodiment of jacking-mattress including longitudinal internal baffles;

[0045] **FIG. 28** is a cross-sectional view of the jacking-mattress shown in **FIG. 27**, as taken along lines **28-28** in **FIG. 27**;

[0046] **FIG. 29** is a top plan view of the jacking-mattress shown in **FIGS. 27 and 28** showing a seam pattern associated with longitudinal internal baffles;

[0047] **FIG. 30** is a perspective view of a jacking-mattress used in combination with a transfer mattress according to the present invention;

[0048] **FIG. 31** is a perspective view of the jacking-mattress and transfer mattress shown in **FIG. 30**, with the transfer mattress slid transversely relative to the jacking-mattress;

[0049] **FIG. 32** illustrates a jacking-mattress formed in accordance with the present invention including a low friction sheet for dragging across a smooth surface;

[0050] **FIG. 33** is a perspective view of a jacking-mattress and transfer mattress combination formed in accordance with the present invention;

[0051] **FIG. 34** is a perspective view of the jacking-mattress and transfer mattress combination shown in **FIG. 33**, with the transfer mattress deflated;

[0052] **FIG. 35** is a perspective view, partially broken away and partially in phantom, of a transfer mattress portion of the jacking-mattress shown in **FIGS. 33-34**;

[0053] **FIG. 36** is a top plan view of the transfer mattress portion of the jacking-mattress and transfer mattress combination illustrating a central chamber defined by an inner perimeter band; and

[0054] **FIG. 37** is a cross-sectional view taken along lines **37-37** in **FIG. 36**, showing internal structure of the transfer mattress portion of a jacking-mattress and transfer mattress combination.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0055] This description of preferred embodiments is intended to be read in connection with the accompanying drawings, which are to be considered part of the entire written description of this invention. The drawing figures are not necessarily to scale and certain features of the invention may be shown exaggerated in scale or in somewhat schematic form in the interest of clarity and conciseness. In the description, relative terms such as "horizontal,""vertical, ""up,""down,""top" and "bottom" as well as derivatives thereof (e.g., "horizontally,""downwardly,""upwardly," etc.) should be construed to refer to the orientation as then described or as shown in the drawing figure under discussion. These relative terms are for convenience of description and normally are not intended to require a particular orientation. Terms including "inwardly" versus "outwardly,""longitudinal" versus "lateral" and the like are to be interpreted relative to one another or relative to an axis of elongation, or an axis or center of rotation, as appropriate. Terms concerning attachments, coupling and the like, such as "connected" and "interconnected," refer to a relationship wherein structures are secured or attached to one another either directly or indirectly through intervening structures, as well as both movable or rigid attachments or relationships, unless expressly described otherwise. The term "operatively connected" is such an attachment, coupling or connection that allows the pertinent structures to operate as intended by virtue of that relationship. In the claims, means-

plus-function clauses are intended to cover the structures described, suggested, or rendered obvious by the written description or drawings for performing the recited function, including not only structural equivalents but also equivalent structures.

[**0056**] Referring to **FIGS. 1-4**, a pneumatic lift **1** formed in accordance with one embodiment of the present invention comprises a plurality of jacking-mattresses **3** that are stacked and secured together, one atop another. Each jacking-mattress **3** includes a top panel **4**, a bottom panel **6**, a perimeter band **7**, and a plurality of internally disposed, transverse baffle-panels **8**. More particularly, top panel **4** comprises a head portion **12**, a foot portion **14**, and a peripheral edge **16**, and is formed from a sheet of nylon scrim or the like, that is coated on at least its outer surface **18** with a water proof coating. The inner surface of top panel **4** may also be coated with a water proof coating as well. Water proof coatings that may be used in connection with the invention include any of the well known polymeric or elastomeric compounds that are known to be impervious to semi-solids and liquids, such as, blood, urine, feces, hospital strength disinfecting compounds, alcohol, or the like.

[**0057**] Bottom panel **6** comprises a head portion **22**, a foot portion **24**, and a peripheral edge **26**, and is also formed from a sheet of nylon scrim or the like, that may also be coated on at least its outer surface with a water proof coating. Inner surface **29** of bottom panel **6** may also be coated with a water proof coating as well. Perimeter band **7** extends between peripheral edges **16** and **26**, and circumferentially around top panel **4** and bottom panel **6**, so as to enclose a central chamber **27** and thereby form each jacking-mattress **3**. Through-bores **30** are defined in the portions of perimeter band **7** that lie between head portions **12**,**22** and foot portions **14**,**24**. Peripheral edges **16** and **26** may have fastening means attached them, such as a conventional zipper mechanism **31**, snaps, or the like. A plurality of inlet/outlet fixtures **32** are positioned within through-bores **30** in the central portion of perimeter band **7** (**FIG. 8**). Each inlet/outlet fixture **32** is sealingly positioned therethrough so as to controllably communicate with central chamber **27** of jacking-mattress **3**. One or more of inlet/outlet fixtures **32** may be a closable opening or a valve **34** that sealingly accepts an air supply hose **35** (**FIG. 9**) from a source of flowing air of the type well known in the art.

[**0058**] Referring to **FIGS. 3-6**, plurality of baffle-panels **8** each comprise substantially rectangular sheets of nylon scrim or the like, and include a top edge **40**, a bottom edge **42**, and end edges **44**. Baffle-panels **8** may have differing widths depending upon their position within jacking-mattress **3**. Each top edge **40** is fastened transversely to a portion of the inner surface of top panel **4**, and each bottom edge **42** is fastened transversely to a portion of inner surface **29** of bottom panel **6**. End edges **44** are arranged in spaced relation to the inner facing surface of longitudinally extending portions of perimeter band **7** (**FIGS. 3-6**), so as to define a pair of longitudinally oriented air flow channels **45** and **46** (**FIG. 13**) within each jacking-mattress **3**. In one embodiment, a curved or scalloped end edge **44** (**FIGS. 5 and 6**) may be employed to increase the size of air flow channels **45** and **46**.

[**0059**] A pneumatic lift **1** is assembled according to the present invention in the following manner. Two, three, four, or more jacking-mattresses **3** are each individually assembled by laying out a bottom panel **6** on a suitable support surface so that baffle-panels **8** may be transversely arranged along the length of inner surface **29**. Once in this position, bottom edge **42** of each baffle-panel **8** is fixedly fastened to inner surface **29** of bottom panel **6**. Each baffle-panel **8** is often heat sealed along the interface between bottom edge **42** and inner surface **29** of bottom panel **6**. This heat sealing may be done with the application of heat or ultrasonic energy at the interface between bottom edge **42** and inner surface **29**. Once a plurality of baffle-panels **8** are fastened to inner surface **29** of bottom panel **6**, top panel **4** is arranged in overlying confronting relation to bottom panel **6** so that head portion **12** of top panel **4** is confronting head portion **22** of bottom panel **6** and foot portion **14** of top panel **4** is confronting foot portion **24** of bottom panel **6**. Once in this position, each top edge **40** of each baffle-panel **8** is fixedly fastened to the inner surface of top panel **4**. In order to complete construction of each jacking-mattress **3**, it is necessary to sealingly fasten peripheral edge **16** of top panel **4** and peripheral edge **26** of bottom panel **6** to corresponding edges of perimeter band **7**. In one embodiment, conventional zipper mechanisms **31** are fastened to peripheral edges **16** and **26** so that several jacking-mattresses **3** may be stacked, one upon another, and releaseably secured to one another by zippers **31** (**FIGS. 1, 2, 7** and **8**). Alternatively, jacking-mattresses **3** may be held in a stack by heat sealing their respective peripheral edges **16**,**26** or by other fastening techniques. In one embodiment, a plurality of air conduits **50** are assembled to the plurality of jacking-mattresses **3** so as to interconnect through-bores **30** of adjacent jacking-mattresses **3** in air flow communication, via inlet/outlet fixtures **32**.

[**0060**] Pneumatic lift **1** is operated in the following manner. An object to be lifted, e.g., a human being, is placed atop outer surface **18** of top most jacking-mattress **3**, while pneumatic lift **1** is in a fully or partially deflated state (**FIG. 10**). It will be understood by fully deflated that little or no air will be present in central chambers **27** of each of the stacked jacking-mattresses **3** making up the pneumatic lift. Once the object is in position, high pressure air (e.g., at or around 2.8 psi or between 75 and 100 cubic feet per minute of air flow) is introduced through air supply hose **35** (**FIG. 9**) which is interconnected in air flow communication with valve **34**. Although not a requirement of the invention, air supply hose **35** is often engaged with valve **34** in the lower most jacking-mattress **3** in the stack forming pneumatic lift **1**. As air enters central chamber **27** of the first jacking-mattress **3**, it flows through air flow channels **45**, and thereby between each of baffle-panels **8** so as to inflate this first jacking-mattress. In one embodiment, air also travels outwardly through through-bores **30** and conduits **50** into the next jacking-mattress **3** in the stack, while in another embodiment each individual jacking mattress **3** is separately and often sequentially filled with pressurized air via that jacking-mattress' own valve **34** (**FIGS. 1-13**). This air filling process continues until each of jacking-mattresses **3** are completely filled with pressurized air (**FIGS. 1, 2, 9, 12**, and **14**). It will be understood that a maximum achievable height of the fully inflated pneumatic lift **1** will be determined by the number of jacking-mattresses **3** that have been stacked one atop the other. In order to lower an object, it is simply

necessary to open one or more inlet/outlets **32** so as to allow the pressurized air to flow outwardly thereby deflating pneumatic lift **1**.

[**0061**] Referring to **FIGS. 14-23**, it is also possible to form a pneumatic lift **100** in which each jacking-mattress **103** is fixedly fastened to it's adjacent jacking-mattresses. In this embodiment, peripheral edges **16** and **26** are heat sealed or otherwise bonded to one another so as to form an air tight interface extending around the perimeter of adjacent jacking-mattresses (**FIGS. 15 and 16**). In order to allow for air flow communication between the fixedly fastened jacking-mattresses **103**, internally positioned top panels **104** and bottom panels **106** may comprise through-holes **52** (**FIGS. 17 and 18**) that are arranged so as to allow for free air flow between respective central chambers **27** of adjacent jacking-mattresses **103**. Of course, the top most panel **114** and bottom most panel **116** do not include openings so as to maintain air tight inflation.

[**0062**] For example, internally situated jacking-mattresses **123** may have common walls forming top panel **104** and bottom panel **106** such that only one through-hole is formed between select panels in order to provide for airflow communication between the select central chambers **27**. Fittings **124** may be disposed within openings **52** so as to maintain a fully open configuration during inflation. Referring to **FIGS. 24-26**, one alternative jacking-mattress **130** includes a top panel **134**, a bottom panel **136**, a perimeter band **137**, a pair of longitudinal baffles **135**, and a plurality of internally disposed, transverse baffle-panels **138**. Adjacent, intermediate top and bottom panels **134,136** also comprise through-holes **141** that communicate between selected ones of the jacking-mattresses so that they are arranged in internal air flow communication with one another. In one embodiment, selected pairs of jacking-mattresses are arranged in internal fluid flow communication, e.g., between **130***a* and **130***b* and between **130***c* and **130***d*, but not between **130***a* and **130***d* or **130***b* and **130***c*. This arrangement allows for a more controlled inflation and deflation of the jacking-mattress.

[**0063**] Additionally, another alternative jacking-mattress **143** includes a top panel **144**, a bottom panel **146**, a perimeter band **147**, and a plurality of internally disposed, longitudinal baffle-panels **148** (**FIGS. 27-29**). Adjacent, intermediate top and bottom panels **144,146** also comprise through-holes **151** that communicate between selected ones of the jacking-mattresses so that they are arranged in internal air flow communication with one another. In one embodiment, selected pairs of jacking-mattresses are arranged in internal fluid flow communication, e.g., between **143***a* and **143***b* and between **143***c* and **143***d*, but not between **143***a* and **143***d* or **143***b* and **143***c*. However, in this embodiment, baffles **148** are arranged longitudinally in spaced transverse relation to one another. This arrangement allows for a more controlled inflation and deflation of the jack while at the same time providing greater stability when unloading the jack.

[**0064**] Referring to **FIGS. 30-31**, it is often the case that a patient will need to be transferred to and from a jacking-mattress when it is in a fully inflated state. In these cases it is convenient to utilize a transfer mattress **160** such as the one disclosed in U.S. Pat. No. 6,073,291, issued to Davis, and incorporated herein by reference. Transfer mattress **160** may be positioned atop the jacking-mattress to further facilitate the transfer of patients. More particularly, a transfer mattress **160** suitable for use with the present invention will often include a flexible top sheet **162** and a flexible bottom sheet **163**, that together define a plenum chamber **166**. Bottom sheet **163** is perforated with pinholes **168** over at least a central surface area, and which open up directly to the interior of plenum chamber **166**. When transfer mattress **160** is continuously charged with pressurized air, the escape of air under pressure through pinholes **168** acts initially to lift a patient, resting on the outer surface of top sheet **162**, above perforated bottom sheet **163** so as to create an air bearing of relatively small height between the outer surface of top sheet **162** and the bottom sheet **163**.

[**0065**] The patient may be transferred from a fully inflated jacking-mattress using transfer mattress **160** by first inflating the jacking-mattress, as described hereinabove, and then inflating transfer mattress **160**. Once inflated, and positioned adjacent to another surface, e.g., a bed, a nurse or other health care worker need merely to slide transfer mattress **160** off of the jacking-mattress to position the patient atop the bed. Once atop the bed, transfer mattress **160** may be deflated so as to position the patient on the bed.

[**0066**] In some cases, it will be necessary to transport the patient while they are lying atop the jacking-mattress. Referring to **FIGS. 32-36**, a jacking-mattress **175** may be formed in accordance with the present invention having either a sheet of low friction material **176** attached to its lowest most jacking-mattress or a transfer mattress **177** as its lowest most jacking-mattress. Low friction sheet **176** may be formed from polytetraflouroethylene **178**, commonly referred to as Teflon®. It may be attached to the bottom surface of jacking-mattress **175** by, e.g., Velcro® hook and felt fasteners **179**. Alternatively, transfer mattress **177** may be attached to jacking-mattress **175** by having their respective peripheral edges **180** and **181** fastened to one another by, e.g., a conventional zipper mechanism, snaps, or by heat sealing.

[**0067**] In a preferred embodiment, a jacking-mattress **185** comprises a transfer mattress **187** having a top sheet **190**, a bottom sheet **192**, an outer perimeter band **194**, an inner perimeter band **196**, and a plurality of internally disposed, transverse baffle-panels **198** (**FIGS. 35-37**). Transfer mattress **187** is similar in general construction to transfer mattress **160**, in that top sheet **190** is attached at its peripheral edges to bottom sheet **192** via perimeter band **194**. Bottom sheet **192** is perforated with pinholes **200**. However, in this embodiment, pinholes **200** are present in bottom sheet **192** so as to only communicate with a centrally located individual chambers **202** that are defined by plurality of transverse baffle-panels **198**. Chambers **202** are encircled and enclosed within transfer mattress **187** by inner perimeter band **196**. Inner perimeter band **196** is periodically perforated with through-holes **197**. Baffle panels **198** may also include through holes **199** (**FIG. 37**). An annular air flow passageway or plenum chamber **208** is defined within transfer mattress **187** that encircles and encloses central chamber **202** defined by inner perimeter band **196** and plurality of transverse baffle-panels **198** within transfer mattress **187**.

[**0068**] When transfer mattress **187** is charged with pressurized air, plenum chamber **208** is filled with air first. Central chamber **202** fills with air via through-holes **197** in inner perimeter band **196**. In this way, an annular portion of bottom sheet **192** bulges outwardly so as to form a skirt that

surrounds that portion of bottom sheet **192** that comprises pinholes **200**. The escape of air under pressure through pinholes **200** acts to lift already inflated jacking-mattress **185**, which may then be slid along the ground on a cushion of air created by pinholes **200**.

[**0069**] It is to be understood that the present invention is by no means limited only to the particular constructions herein disclosed and shown in the drawings, but also comprises any modifications or equivalents within the scope of the claims.

What is claimed is:

1. A pneumatic lift comprising:

at least three jacking-mattresses stacked one atop another wherein at least two of said jacking-mattresses are arranged in internal air flow communication with one another.

2. A pneumatic lift according to claim 1 wherein each of said jacking-mattresses comprise a top panel having a peripheral edge and a bottom panel having a peripheral edge with a perimeter band sealed to and extending between said peripheral edges so as to define an internal chamber.

3. A pneumatic lift according to claim 2 wherein said internal chamber houses a plurality of spaced apart transverse baffle-panels that extend between said top panel and said bottom panel.

4. A pneumatic lift according to claim 2 wherein said top panel and said bottom panel are formed from a sheet of nylon scrim that is coated on at least an outer surface with a water proof coating.

5. A pneumatic lift according to claim 2 wherein an inner surface of said top and bottom panels is coated with a water proof coating.

6. A pneumatic lift according to claim 2 wherein said peripheral edges include cooperative means for fastening said peripheral edges together.

7. A pneumatic lift according to claim 2 wherein said perimeter band defines fluid flow inlet/outlet fixtures that are sealingly positioned therethrough so as to controllably communicate with said internal chamber.

8. A pneumatic lift according to claim 7 wherein said inlet/outlet fixtures comprises a valve that sealingly accepts an air supply hose from a source of flowing air.

9. A pneumatic lift according to claim 3 wherein each of said baffle-panels comprise a substantially rectangular sheet that is transversely fastened to a portion of an inner surface of said top panel and an inner surface of said bottom panel.

10. A pneumatic lift according to claim 9 wherein each of said baffle panels includes end edges that are arranged in spaced relation to an inner facing surface of longitudinally extending portions of said perimeter band.

11. A pneumatic lift according to claim 10 including a pair of longitudinally oriented air flow channels.

12. A pneumatic lift according to claim 10 wherein each of said baffle panel end edges comprises a curve.

13. A pneumatic lift comprising:

at least four jacking-mattresses stacked one atop another wherein select ones of said jacking-mattresses are arranged in internal air flow communication with another of said jacking-mattresses; and

a source of pressurized air arranged in airflow communication with said select ones of said jacking-mattresses thereby to sequentially inflate all of said jacking-mattresses when an object is placed upon a top most one of said jacking-mattresses.

14. A pneumatic lift according to claim 13 wherein each of said jacking-mattresses is fixedly fastened to an adjacent jacking-mattress.

15. A pneumatic lift according to claim 14 wherein each of said jacking-mattresses comprises a top peripheral edge and a bottom peripheral edge that are bonded to one another so as to form an air tight interface extending around the top and bottom perimeter of said adjacent jacking-mattresses.

16. A pneumatic lift according to claim 15 wherein said jacking mattresses include a top panel and a bottom panel with at least one through-hole being defined between internally positioned top panels and bottom panels, said through-holes being arranged so as to allow for free air flow communication between adjacent jacking-mattresses.

17. A pneumatic lift according to claim 13 each of said jacking-mattresses is fixedly fastened to an adjacent jacking-mattress.

18. A pneumatic lift according to claim 14 wherein each of said jacking-mattresses comprises a top peripheral edge and a bottom peripheral edge that are bonded to one another so as to form an air tight interface extending around the top and bottom perimeter of said adjacent jacking-mattresses.

19. A pneumatic lift according to claim 15 comprising a top jacking-mattress and a bottom jacking-mattress and at least one intermediate jacking mattress positioned between said top jacking-mattress and said bottom jacking mattress wherein a bottom wall of said top jacking-mattress and a top wall of said at least one intermediate jacking-mattress are common.

20. A pneumatic lift according to claim 15 comprising a top jacking-mattress and a bottom jacking-mattress and at least one intermediate jacking mattress positioned between said top jacking-mattress and said bottom jacking mattress wherein a top wall of said bottom jacking-mattress and a bottom wall of said at least one intermediate jacking-mattress are common.

21. A pneumatic lift according to claim 20 comprising fittings disposed within openings that are defined through said top wall and said bottom wall of said at least one intermediate jacking-mattress so as to maintain a fully open configuration during inflation.

22. A pneumatic lift comprising:

a plurality of jacking-mattresses stacked one atop another wherein select ones of said jacking-mattresses are arranged in internal air flow communication with one another, each of said jacking-mattresses comprising;

a top panel having a width, a length, a peripheral edge;

a bottom panel having said width, said length, and a peripheral edge;

a perimeter band extending between said top panel and said bottom panel such that said peripheral edges of said top and bottom panels are sealingly fastened to one another, said peripheral band defining at least one through-hole;

a plurality of baffle-panels each having a width and a length and being attached to an inner surface of said top panel and an inner surface of said bottom panel so as to define air flow passageways;

at least one conduit arranged in air flow communication between said at least one through-hole in adjacent jacking-mattresses; and

a source of pressurized air arranged in airflow communication with one of said at least one through-holes so as to be in airflow communication with the interior of one of said jacking-mattresses.

23. A pneumatic lift according to claim 22 comprising a plurality of longitudinal baffle panels.

24. A pneumatic lift according to claim 22 comprising a plurality of transverse baffle panels.

25. A pneumatic lift comprising:

a plurality of jacking-mattresses stacked one atop another, each of said jacking-mattresses comprising;

a top panel having a width, a length, a peripheral edge;

a bottom panel having said width, said length, and a peripheral edge;

a perimeter band extending between said top panel and said bottom panel such that said peripheral edges of said top and bottom panels are sealingly fastened to one another, said peripheral band defining at least one through-hole;

a plurality of baffle-panels each having a width and a length and being attached to an inner surface of said top panel and an inner surface of said bottom panel so as to define air flow passageways;

at least one valve sealingly positioned within said at least one through-hole so as to provide air flow access to said air flow passageways; and

a source of pressurized air having a conduit suitable to be sequentially received in airflow communication with each of said at least one valves so as to be in sequential airflow communication with the interior of each of said jacking-mattresses.

26. A pneumatic lift according to claim 25 comprising a plurality of longitudinal baffle panels.

27. A pneumatic lift according to claim 25 comprising a plurality of transverse baffle panels.

28. A pneumatic lift comprising:

a top jacking-mattress, a bottom jacking-mattress, and a plurality of intermediate jacking-mattresses stacked one atop another between said top jacking-mattress and said bottom jacking-mattress, wherein selected ones of said jacking-mattresses are arranged in internal air flow communication with one another, each of said jacking-mattresses includes;

a top panel having a width, a length, and a peripheral edge, wherein selected ones of said intermediate jacking-mattresses comprise a top panel having at least one through-hole;

a bottom panel having said width, said length, and a peripheral edge, wherein selected ones of said intermediate jacking-mattresses comprise a bottom panel having at least one through-hole;

a perimeter band extending between said top panel and said bottom panel of each of said jacking-mattresses such that said peripheral edges of said top and bottom panels are sealingly fastened to one another;

a plurality of baffle-panels each having a width and a length and being attached to an inner surface of said top panel and an inner surface of said bottom panel so as to be transversely oriented between said top panel and said bottom panel so as to define a pair of longitudinally extending air flow passageways disposed between an edge of said baffle-panels and an interior surface of said perimeter band; and

a source of pressurized air arranged in airflow communication with the interior of at least one of said jacking-mattresses.

29. A transportable pneumatic lift comprising:

at least three jacking-mattresses stacked one atop another wherein at least two of said jacking-mattresses are arranged in internal air flow communication with one another; and

a sheet of Teflon releasably fastened to a bottom surface of a bottom most one of said at least three jacking mattresses.

30. A transportable pneumatic lift according to claim 29 wherein said sheet of Teflon is coextensive with said bottom most one of said at least three jacking mattresses.

31. A transportable pneumatic lift comprising:

at least three jacking-mattresses stacked one atop another wherein at least two of said jacking-mattresses are arranged in internal air flow communication with one another; and

a transfer mattress fastened to a bottom most one of said at least three jacking mattresses.

32. A transportable pneumatic lift according to claim 31 wherein said transfer mattress comprises a top sheet and a bottom sheet, that together define a plenum chamber with said bottom sheet being perforated with pinholes over at least a central surface area, said pinholes being in open flow communication with said plenum chamber so that when said transfer mattress is continuously charged with pressurized air, said air escapes through said pinholes so as to create an air bearing of relatively small height below an outer surface of said bottom sheet.

33. A transportable pneumatic lift comprising:

a plurality of jacking-mattresses stacked one atop another wherein selected ones of said jacking-mattresses are arranged in internal air flow communication with one another; and

a transfer mattress forming a bottom most jacking-mattress comprising;

a top panel having a width, a length, and a peripheral edge;

a bottom panel having said width, said length, and a peripheral edge and defining a plurality of pinholes in a central portion thereof;

an outer perimeter band extending between said top panel and said bottom panel such that said peripheral edges of said top and bottom panels are sealingly fastened to one another;

a plurality of baffle-panels being attached to an inner surface of said top panel and an inner surface of said bottom panel so as to be transversely oriented between said top panel and said bottom panel;

an inner perimeter band extending between said top panel and said bottom panel and enclosing said plurality of baffle-panels so as to define an annular air flow passageway disposed between said outer perimeter band and said inner perimeter band and said baffle-panels thereby forming individual chambers between said baffles, said annular air flow passageway being in flow communication with said chambers; and

a source of continuous pressurized air arranged in flow communication with said annular air flow passageway.

34. A transportable pneumatic lift according to claim 33 wherein said pinholes in said bottom panel only communicate with said individual chambers.

35. A transportable pneumatic lift according to claim 33 wherein said inner perimeter band is periodically perforated with through-holes so as to provide for air flow communication between said annular air flow passageway and said individual chambers.

36. A transportable pneumatic lift according to claim 33 wherein said baffle panels include through holes.

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