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(54) Title: EXPANDABLE LEACHING FIELD SYSTEM

(57) Abstract: Disclosed herein is a leaching field module including a plurality of arrayed pockets. Preferably the pockets are arrayed edge to edge and in generally parallel rows. The pocket edges may be connected to form sleeves. At least some of the pockets have a stiffener disposed therein so that the pocket and stiffener combination may define an internal void area. The pockets and stiffeners are connected to provide the leaching field module. In some embodiments the module advantageously has void areas between connected pockets. In some embodiments the stiffeners and pockets can be deformed to expand the module.

EXPANDABLE LEACHING FIELD SYSTEM

This invention relates generally to drainage systems for distributing fluid, for example from a septic tank or the like, to the subterranean subsoil environment.

BACKGROUND OF THE INVENTION

Systems for receiving fluids and directing those fluids into the surrounding soil are known in the prior art. As one example, a subterranean septic system is comprised of a septic tank fluidly connected to a distribution box, which is in turn fluidly connected to rigid perforated pipes. The entire system is placed within an excavation and covered over in use. The perforated pipes of the leaching field distribute fluid from the septic tank into the subterranean environment. Very commonly, the perforated pipes are laid in gravel filled trenches and covered with gravel prior to the trench being filled with soil. The gravel serves to create a limited amount of void space and help prevent infiltration of the soil into the pipes. Gravel use is problematic in leaching field construction however. Gravel is dense and expensive to transport to a leaching field excavation site. Once gravel is provided to the site, it is difficult to move into, and level within, the excavation. The void space created within a gravel bed can also compress or block native soils during use, reducing the effectiveness of the installed leaching field.

There are other, much less common, leaching field systems in use that do not use gravel beds within the leaching field excavation. These systems are generally comprised of large, rigid chambers that are laid within the excavation trench and fluidly connected to the distribution box. While such systems are lighter in weight than gravel, their large size makes them difficult and expensive to transport, handle and install.

SUMMARY OF THE INVENTION

An object of the invention is to provide a fluid distribution system that can be easily transported from site of manufacture to site of use.

Another object of the invention is to provide a fluid distribution system having an efficient and economical design.

Briefly stated, one aspect of the invention comprises a leaching field module including a plurality of arrayed fabric pockets. Preferably the pockets are

arrayed edge to edge and in generally parallel rows. At least some of the pockets have a shaped stiffener disposed therein so that the pocket and stiffener combination defines an internal void area. The pockets and stiffeners are connected to provide the leaching field module. In some embodiments, the module advantageously has void areas between connected pockets.

In another aspect of the invention, the inventive leaching field module encompasses a plurality of fabric sleeves, preferably arranged in generally parallel rows. Each sleeve defines a plurality of pockets. At least some of the pockets have a shaped stiffener disposed therein so that the pocket and stiffener combination defines an internal void area. The sleeves are connected to provide the leaching field module. In some embodiments the module advantageously has void areas between connected sleeves.

In some embodiments of the invention the stiffeners are selectively deformable. In one embodiment the module is normally biased toward a collapsed state by the stiffeners. However, opposing outward forces applied on the outermost stiffeners function to pull the sleeves and pockets apart, expanding the module and creating a substantial void volume. In another embodiment the module is normally biased toward an expanded state by the stiffeners. However, opposing inward forces applied on the outermost stiffeners function to push the sleeves and pockets together, collapsing the module and creating a nested, compact unit.

The stiffeners are advantageously comprised of polymeric materials. The stiffeners can have dimples or protrusions extending from one or both faces to define a series of peaks and flow channels. The stiffeners can be porous or perforated to increase fluid flow there through. The pockets and sleeves are advantageously comprised of fluid permeable geotextile fabric and may be perforated to increase fluid flow therethrough. The pockets or sleeves can be attached to form the leaching field module using, for example, stitching, bonding and mechanical fastening.

In general, the invention may be alternately formulated to comprise, consist of, or consist essentially of, any appropriate components herein disclosed. The invention may additionally, or alternatively, be formulated so as to be devoid, or substantially free, of any components, materials, ingredients, adjuvants or species

used in the prior art or that are otherwise not necessary to the achievement of the function and/or objectives of the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

Other objects and advantages of the invention will be evident to one of ordinary skill in the art from the following detailed description made with reference to the accompanying exemplary drawings, in which:

Figure 1 is a schematic view, in perspective, of one aspect of a leaching field module of the invention in an expanded state.

Figure 2 is a schematic view, in perspective, of one embodiment of a pocket of the invention.

Figure 3 is a schematic view, in perspective, of one embodiment of a sleeve of the invention.

Figure 4 is a schematic view, in perspective, of one embodiment of a sleeve of the invention with a plurality of stiffeners disposed therein.

Figure 5 is a schematic view, in perspective and partially in section, of one embodiment of the invention illustrating attached pockets and stiffeners in an expanded state.

Figure 6 is a schematic view, in perspective, of a portion of one embodiment of sleeves and stiffeners of the invention in an expanded state.

Figure 7 is a schematic view, in perspective, of one embodiment of an inventive leaching field module in a collapsed state.

Figure 8 is a schematic top view, partly in section, of a portion of one embodiment of an inventive leaching field module in the collapsed state showing stiffener sheets including recessed areas with connector bands therein.

Figure 9 is a partial, schematic side view of one embodiment of an inventive stiffener with covered faces.

Figure 10 is a partially schematic illustration, in perspective, of one embodiment of a stiffener.

Figure 11 is a schematic view, in perspective, of another embodiment of an inventive pocket.

Figure 12 is a schematic, overhead view of an embodiment of an expanded leaching field module within an excavation.

Figure 13 is a perspective view of an embodiment of the invention illustrating an expanded leaching field module having a curved shape.

DETAILED DESCRIPTION OF THE INVENTION

In one aspect of the invention shown in Figure 1 the inventive leaching field module 10 encompasses a plurality of fabric pockets 12. As shown in Figure 2, the pockets 12 have opposing faces 14, 16 and are joined at opposing side edges 18, 20. The pockets 12 may be open at the top and bottom edges 24, 26, respectively. The pockets 12 are advantageously arrayed in edge to edge fashion in generally parallel rows, as shown in Figure 1, although other arrangements are also encompassed by this invention. In some embodiments, pockets 12 may be left out of the array to provide a module 10 having increased void volume and side wall area. Side wall area refers to the surface area along the length of the module that comes in contact with native soil. The side wall area is based on soil contact area and is typically larger than a side wall area based only on the overall length of the leaching field. Some of the pockets 12 have at least one stiffener 32 disposed therein. The stiffener 32 may be generally planar or can have an appropriate shape (for example, semi-cylindrical is shown in Figure 5) to separate the fabric pockets 12 and define void areas 34 within the pocket. The pockets 12 and/or stiffeners 32 are connected to provide a lightweight, non-collapsible leaching field module 10 having substantial void volume and side wall area.

In another aspect, the inventive leaching field module 10 comprises a plurality of fabric sleeves, each 38, (shown individually in Figure 3). The sleeves 38 are advantageously arranged in generally parallel rows as shown in Figure 7, although other arrangements are encompassed by this invention. Each sleeve 38 defines a plurality of pockets 12. Some of the pockets 12 have at least one stiffener 32 disposed therein. The stiffener 32 can have an appropriate shape to separate the fabric pockets 12 and define a void area 34 within the pocket 12. At least some of the pockets 12 and/or stiffeners 32 are connected to provide a lightweight, non-collapsible leaching field module 10 having substantial void volume and side wall area.

The stiffener 32 is preferably comprised of a polymeric material or combination of polymeric materials such as, for example, polystyrene,

polyethylene or polypropylene, formed as an imperforate, generally planar sheet. As used herein, a generally planar sheet may comprise arrayed dimples or protrusions 40 (shown in Figure 8) extending from one or both faces. The dimples 40 define a plurality of peaks 48 and valleys or flow channels 50 in the stiffener. United States Patent Nos. 4,490,072, 4,880,333 and 6,048,131, the entire disclosures of which are incorporated by reference herein, describe similar sheet materials. Thickness of the stiffener 32 is not believed to be critical to practice of the invention. As one example, a stiffener having a material thickness of about 0.024 inches and an overall thickness from a peak on one face to a peak on an opposing face of about 0.75 inches has been found suitable for use in the invention. The stiffener 32 can be appropriately shaped to create void area 34 within the pocket 12. Some examples of appropriate shapes for a stiffener 32 include planar sheets, cylinders, semi-cylinders and polygons. The stiffener 32 can be cut from a larger sheet of material to an appropriate size for use in the module 10. In one advantageous embodiment shown in Figure 8 the stiffener 32 comprises two generally parallel sheets. The parallel sheets can be separate sheets or a single sheet folded over at one edge. At least one sheet typically has dimples 40 therein, the dimple 40 sizes of the parallel sheets can be chosen to minimize or maximize nesting of the dimples in the adjacent stiffeners 32 during handling and use as desired.

Other stiffener 32 variations will occur to those skilled in the art. For example, the stiffener 32 can be a perforated material. Another alternative would be to provide an imperforate stiffener 32 with one or more openings therein. Each opening may be, for example, about 0.25 to about 0.75 inches. A further alternative would be to provide a porous stiffener 32. Perforated or porous stiffeners 32 enhance transfer of fluid from one face of the stiffener to the other face and thereby from one void area of the module 10 to another. A still further alternative is to provide single or multiple non-sheet spacers between parallel stiffeners 32.

Fabric for the pockets 12 or sleeves 38 can comprise fluid permeable geotextile fabric, which is typically a polymeric, nonwoven web material known in the art. Typar 3401 fabric available from Remay Incorporated of Tennessee has

been found suitable for use in the invention. Fluid impermeable fabric can also be used in some embodiments if fluid transfer is not desired.

In one aspect of the invention, fabric may be taken from a roll and folded over; or cut sheets may be overlaid; to provide two overlaid fabric pieces 42, 44 (shown best in Figures 2-4). Each overlaid fabric piece provides an internal and an external face for the resulting pocket. The overlaid fabric pieces are joined at one edge (in embodiments where a single fabric piece is folded) or at opposing edges 18, 20 (in embodiments where multiple pieces are overlaid) to form a pocket 12 as shown in Figure 2. Advantageously, the fabric pieces 42, 44 comprise additional joined areas 46 between the edges 18, 20 so that a sleeve 38 having multiple pocket portions 12 defined therein is formed as shown in Figure 3. The fabric may be joined by, for example, stitching, heat bonding, adhesive bonding or mechanical fastening. In one advantageous embodiment, the top and bottom edges of each pocket are not joined.

For a module 10 comprised of pockets 12, a stiffener 32 or pair of stiffeners 32 is inserted within at least some of the pockets 12 and advantageously within each pocket 12. Since the pocket 12 is generally open at the top 24 and bottom 26, positioning of the stiffener 32 within the pocket 12 or sleeve pocket portion 12 is eased as compared to insertion of a stiffener 32 within a long fabric envelope. Each pocket 12 is typically connected to each adjacent pocket 12 to form an array. Preferably, the pockets 12, with stiffeners 32 disposed therein, are connected in generally parallel rows to form the leaching field module 10. The connection 52 between adjacent pockets 12 can comprise, for example, a band 54 encircling the facing stiffener sheets 32 and/or fabric pieces 42, 44 in adjacent pockets 12 of adjacent rows; or a nonextensible member penetrating the facing stiffener sheets and/or fabric pieces in adjacent pockets of adjacent rows. In embodiments comprising shaped stiffeners 56 there may not be a need to connect stiffeners 56 in one row to facing stiffeners 56 in an adjacent row. Therefore, fabric pieces 42 in these embodiments may be joined to adjacent fabric pieces 44 by, for example, stitching, heat bonding, adhesive bonding or mechanical fastening.

For a module 10 comprised of sleeves 38, a stiffener 32 or pair of stiffeners is disposed within some pockets 12 of the sleeve 38. Advantageously, a pair of

stiffeners is disposed within each pocket 12 of each sleeve 38. Since the pockets 12 are generally open at the top 24 and bottom 26, positioning of the stiffener 32 within the desired pocket 12 is eased as compared to insertion of a single long stiffener within a long fabric envelope. The sleeves 38, with stiffeners 32 disposed therein, can be arranged in generally parallel rows to form the leaching field module 10 as shown in Figure 7. The connection between adjacent sleeves 38 can comprise, for example, a band 54 encircling the facing stiffener sheets 32 and fabric pieces 42, 44 in adjacent pockets 12 of adjacent rows. Alternatively, a mechanical fastener penetrating the facing stiffener sheets and fabric pieces in adjacent pockets of adjacent rows can be used to connect the sleeves. In embodiments comprising shaped stiffeners there may not be a need to connect stiffeners in one row to facing stiffeners in an adjacent row. Therefore, fabric pieces in these embodiments may be joined by, for example, stitching, heat bonding, adhesive bonding or mechanical fastening.

In one preferred embodiment of the invention, useful with either pockets 12 or sleeves 38, the stiffeners 32 are generally planar and deformable under an imposed load, but stiff enough to maintain their generally planar orientation when no load is present. The stiffener sheets 32 and fabric pieces 42, 44 in each adjacent pocket 12 are connected at about their center. In this embodiment, the planar stiffeners 32 function to normally bias the module 10 to the collapsed state as shown in Figure 7. The collapsed state can be less than one fifth of the length of the same module in the expanded state (similar to Figure 1). For example, in one embodiment, the collapsed module is about 10 inches high by about 29 inches wide by about 24 inches long and the expanded module is about 10 inches high by about 29 inches wide by about 120 inches long. Naturally, other module dimensions can be used. Use of stiffeners 32 with different dimple sizes in each pocket 12 can promote nesting of the dimples in one stiffener into the valleys of the facing stiffener, which can reduce the size of the collapsed module. The stiffeners 32 are connected so that a force applied on one stiffener 32 is transferred through a connection 52, such as a band 54, to each adjacent pocket 12. Opposing outwardly directed forces applied on the outermost stiffeners 32 of the inventive field module 10 function to deform the stiffeners 32 and pull the pockets 12 or sleeves 38 apart, expanding the module and providing multiple void

areas 34, 58 therein similar to Figure 1. Stiffeners can be selected to elastically or permanently deform under the outward forces. The collapsed state provides a considerable advantage in handling and shipping for the inventive modules 10 as compared to gravel or non-collapsible leaching field chambers.

In another embodiment of the invention useful with either pockets 12 or sleeves 38, the stiffeners 56 are shaped and deformable under an imposed load, but stiff enough to maintain their shape when no load is present. The fabric pieces 42, 44 in each adjacent pocket 12 are connected. The stiffeners 56 in each pocket 12 may be connected to the adjacent fabric if needed to prevent movement of the stiffener 56 out of the pocket 12. In this embodiment, the shaped stiffeners 56 function to normally bias the module 10 to the expanded state similar to Figure 1. Opposing inward forces applied on the outermost stiffeners 56 of the module 10 function to deform the stiffeners 56 and push the pockets 12 or sleeves 38 together, collapsing the module 10. The collapsed state can be one-fifth the length of the same module in the expanded state.

The band 54 used to connect adjacent rows will generally ride over the adjacent stiffener sheet dimples 40. Thus, the band 54 may not allow the peaks 48 of a facing stiffener sheet 32 to fully nest within the valleys 50 of a stiffener sheet 32 underlying the band 40. In some embodiments (shown best in Figure 8), it may be desirable to provide an area 64 typically recessed toward the pocket fabric 42, 44 and extending from top to bottom. The recessed area 64 accommodates the band 54 and allows the protrusions 48 of the facing sheet 32 to fit within the recessed area 64 overlying the band 54. This variation allows the most compact nesting of an inventive module 10. The recessed area 64 can be formed in the stiffener sheet 32 by, for example, lowering protrusion height in the recess area or pressing a heated form into the sheet. The recessed area 64 also prevents shifting of the band 54 out of the recessed area 64.

It should be noted that in any embodiment, the connections 52 between stiffeners 32 and/or pockets 12 or sleeves 38 can also help retain the stiffeners 32 within the pocket 12 or sleeve 38. Stiffeners 32 disposed in the outermost pocket 12 or sleeve 38 may be fastened to the exterior fabric piece for retention if desired.

In use, native soil is removed from a site to form an excavation. The module 10 is expanded and placed within the excavation. The excavation may include a bed of fluid permeable fill material such as sand, gravel or other porous media if desired. Stakes or other anchors may be used in some embodiments to maintain the module 10 in the expanded state within the excavation. As shown best in Figure 12, a manifold 90 is placed adjacent the module 10 to direct fluid into the voids 34, 58 of the expanded module 10. Typically, the manifold 90 comprises a pipe having wall perforations or fittings to direct fluid into the module. Advantageously, the manifold 90 is placed over the top of the module 10, to direct fluid into some of the module voids 34, 58. A geotextile fabric sheet or blanket 92 (only a portion shown in Figure 12) is placed over the manifold 90 and module 10 to prevent soil infiltration and the excavation is backfilled with native soil 94 to ground level. Fluid, for example from a septic tank, flows through the manifold 90 to the adjacent module voids 34, 58. The module voids 34, 58 function as a reservoir to hold fluid directed therein until the fluid can be absorbed into the subterranean environment. Fluid accumulating in one void can flow to any adjacent void through the fabric 42, 44 and open edges 66 of the stiffeners. Providing apertures in the stiffeners 68 and/or fabric 70 enhances fluid flow from one void area to another. As is typical in sewage systems, areas of the module 10 in contact with the fluid will eventually develop biological growth. While such biological growth may be beneficial to filtering and treatment of the fluid, it can also inhibit flow therethrough. Thus, fluid flow through the floor of the excavation and the fabric of the pockets or sleeves may be lessened somewhat over time as the biological mat accumulates. Provision of apertures in the stiffeners 68 and/or fabric 70 functions to maintain a minimum flow of fluid from one void to other adjacent voids as the biological mat accumulates over the module 10. Thus, fluid flow within the inventive leaching field module 10 and into the subterranean environment tends to be substantially optimized. Advantageously, multiple top to bottom apertures are provided in the stiffeners 68 and/or fabric 70 to allow fluid flow at various levels in the module.

In another embodiment, fluid permeable fill material, (e.g. sand, perlite) is disposed within some or all of the void areas 34, 58. This can be done by, for example, placing geotextile fabric over selected portions of the module within the

excavation. Fill material can be placed within module void areas 34, 58 not shielded by the overplaced geotextile fabric. The void areas 34, 58 may be partially or wholly filled with fill material. The overplaced fabric is removed and the manifold is placed adjacent the module. Geotextile fabric is placed over the manifold and module and the excavation is backfilled to ground level.

In a variation of the invention at least some of the pockets 12 comprise a fabric flap 78 at the top edge 24. The flap 78 is pulled over the inserted stiffeners 32 and tucked into the pocket 12. The flap 78 is sized to cover the pocket 12 when the module 10 is expanded. The flap maintains module void volume by generally preventing fill material from accumulating in the pocket 12 and around the stiffener faces 80. The flap 78 may include an aperture 82 adjacent the pocket top edge 24 to allow a band 54 to pass therethrough. The flap 78 allows the module 10 to be backfilled with fill material while maintaining void volume within the pocket 12.

In another variation at least some stiffeners 32 are covered over their faces 80 and top with fluid permeable fabric. The fabric may comprise apertures to maximize fluid flow. The covered stiffeners are placed in at least some pockets 12. The fabric allows the pocket 12 to be backfilled with fill material while retaining void volume in the proximity of the stiffener faces 80.

It should be noted that the modular nature of the inventive leaching field module 10 allows efficient and rapid assembly from a plurality of easy to handle pockets and/or sleeves and stiffeners. Additionally, as shown in Figure 13 the inventive leaching field module 10 can be sufficiently flexible to allow expansion into non-linear shapes such as arcs, 90 degree corners or circles. Further, an assembled module may be readily customized at the worksite by separating adjacent rows at cut points 72 (shown best in Figure 1) to provide a leaching field module 10 of any desired size. No further work or connection of the separated module ends is required for use. Unused separated portions may be reconnected and used in other leaching field systems. Thus, the inventive leaching field module 10 provides efficiencies in manufacture and use with virtually no waste. Naturally, multiple inventive modules may be used within a leaching field system in a variety of configurations, for example end to end, side by side and over and under.

While preferred embodiments of the foregoing invention have been set forth for purposes of illustration, the foregoing description should not be deemed a limitation of the invention herein. Accordingly, various modifications, adaptations and alternatives may occur to one skilled in the art without departing from the spirit and scope of the present invention.

What is Claimed is:

1. A cell for a leaching field system, comprising:
a fabric pocket having attached sides; and
means for preventing collapse of the cell disposed within the pocket.

2. The cell of claim 1, wherein the means for preventing collapse exerts force outward on the pocket sides

3. A leaching field module, comprising:
a plurality of fabric pockets each having an exterior face;
at least one stiffener disposed within some of the pockets;
means for attaching the adjacent edges of two pockets; and
means for attaching the adjacent faces of two pockets.

4. The leaching field module of claim 3, wherein the module is biased toward a collapsed state.

5. The leaching field module of claim 3, wherein the module is selectively positionable between an expanded state and a collapsed state.

6. The leaching field module of claim 3, wherein apertures are defined within at least one pocket or at least one stiffener.

7. The leaching field module of claim 3, wherein at least one pocket comprises upper and lower non-attached edges.

8. The leaching field module of claim 3, wherein the means for attaching adjacent pocket edges is selected from at least one of stitching, bonding, heat joining and mechanical fastening.

9. The leaching field module of claim 3, wherein the means for attaching adjacent pocket faces is selected from at least one of stitching, bonding, heat joining and mechanical fastening.

10. The leaching field module of claim 3, wherein the module comprises a top edge and a bottom edge and the stiffeners resist deformation of the module when force is applied to the module top edge.

11. The leaching field module of claim 3, wherein the stiffeners are generally planar.

12. An expandable leaching field module, comprising:

first and second fabric sleeves, each sleeve comprising two fluid permeable sheets joined at opposing edges and joined at a point intermediate the edges to define a plurality of cavities in each sleeve, the sleeves arrayed in generally parallel rows;

a plurality of stiffeners arranged in pairs, each pair of stiffeners disposed within one cavity; and

a member connecting one said stiffener in the first sleeve to an adjacent stiffener in the second sleeve; wherein the stiffeners exert force on the sleeves.

13. The expandable leaching field module of claim 12, wherein the stiffeners exert force on the sleeves to bias the module to either an expanded state or a collapsed state.

14. An expandable leaching field module of claim 12, wherein the connecting member comprises a plurality of bands, each band connecting one said stiffener in a first said sleeve to an adjacent stiffener in a second said sleeve.

15. A leaching field system, comprising:

an excavation having a bottom;

an expanded leaching field module disposed within the excavation, the module including a plurality of sleeves, each sleeve comprising two fluid permeable sheets joined at opposing edges and joined at a point intermediate the edges to define a plurality of cavities in each sleeve, the sleeves arrayed in generally parallel rows, a plurality of stiffeners arranged in pairs, each pair of stiffeners disposed within one cavity to form a cell, and a plurality of connectors, each connect or joining one said stiffener in a first said sleeve to an adjacent stiffener in a second said sleeve;

a fluid supply in fluid communication with at least some of the cells; and

a layer of fill material over the module.

16. The leaching field system of claim 15 comprising fill material within at least some of the cells.

17. A method of manufacturing an expandable leaching field module, comprising:

providing a pair of fabric pieces, each fabric piece having opposing sides and top and bottom edges;

overlaying the fabric pieces in a face to face orientation;

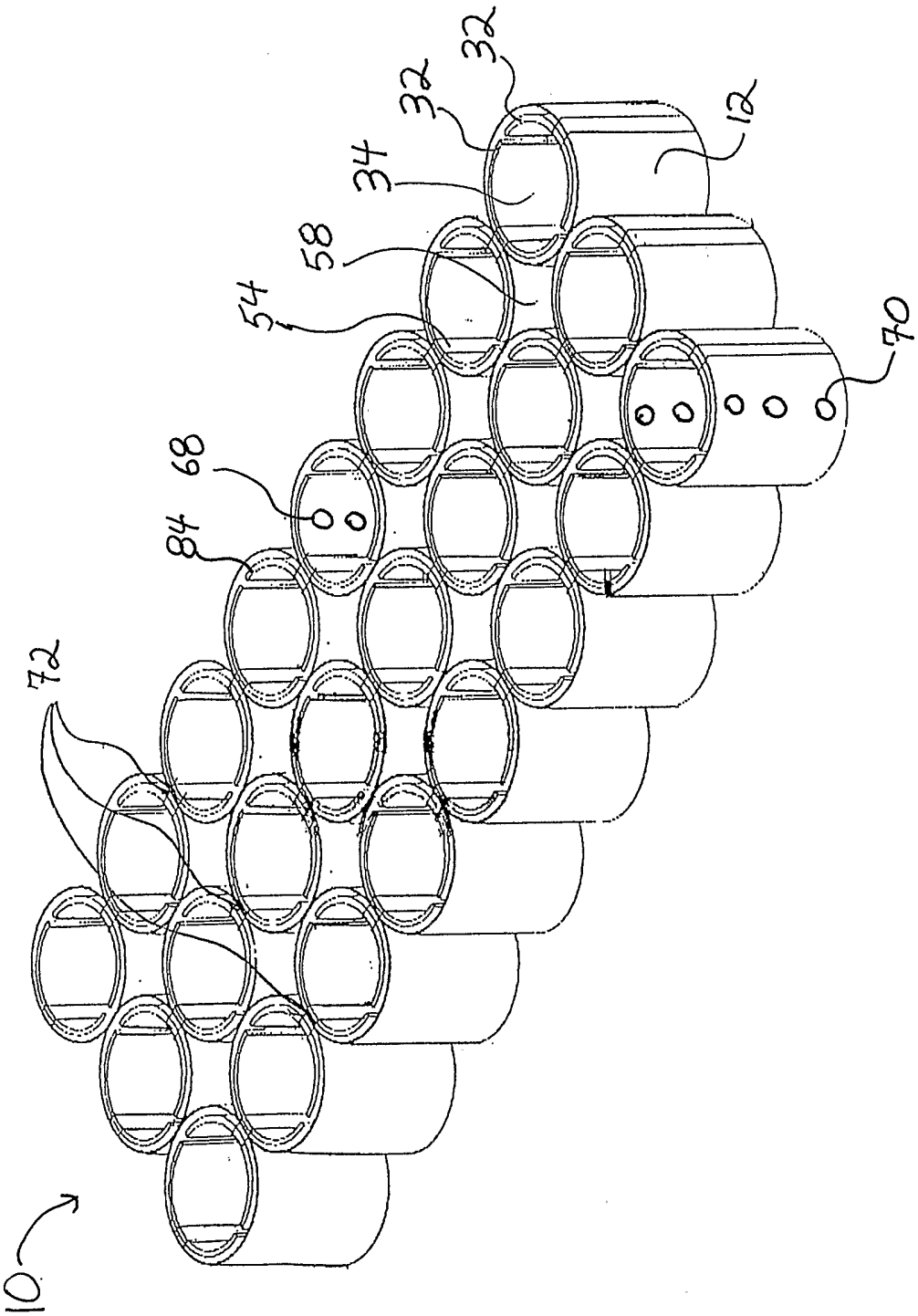
joining adjacent edges of the overlaid fabric pieces to form a pocket;

disposing a pair of stiffeners between the joined edges of the pair of fabric pieces;

aligning a plurality of pockets in edge to edge fashion in generally parallel rows; and

connecting each said pocket to an adjacent pocket, wherein outward force on one said pocket is transferred to other pockets.

FIGURE 1



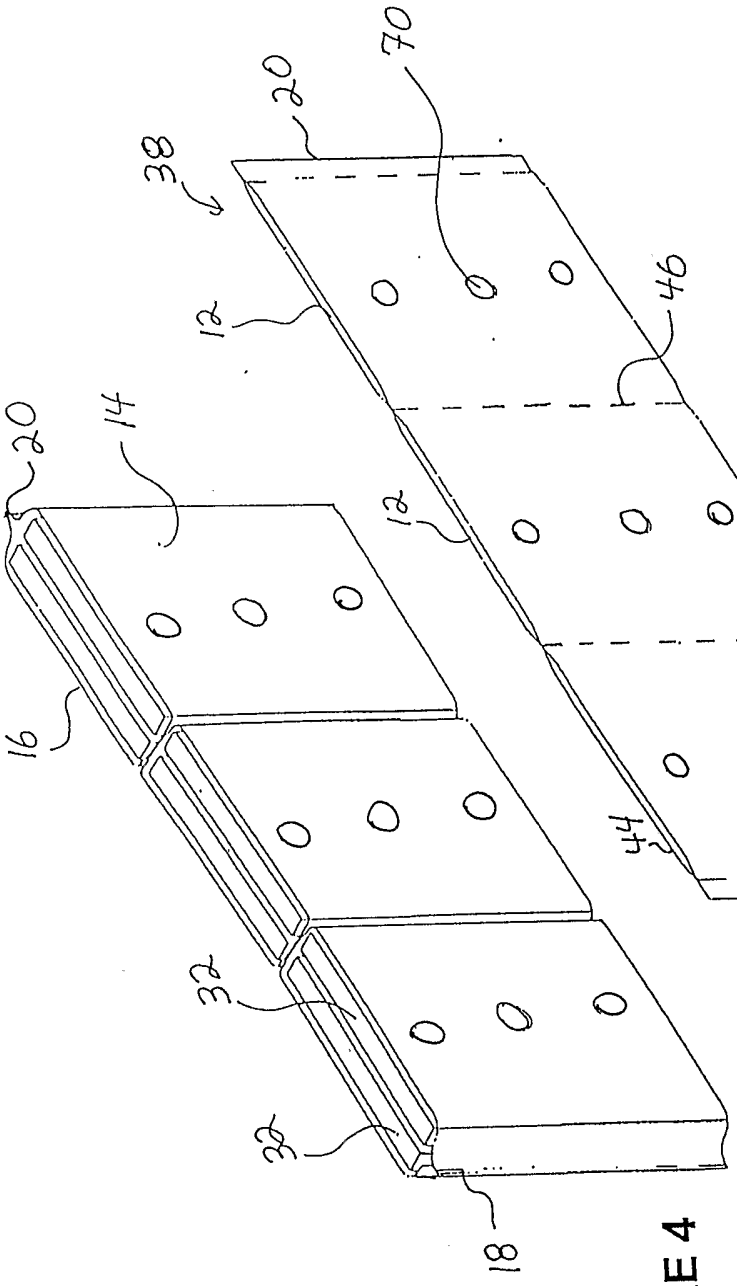


FIGURE 4

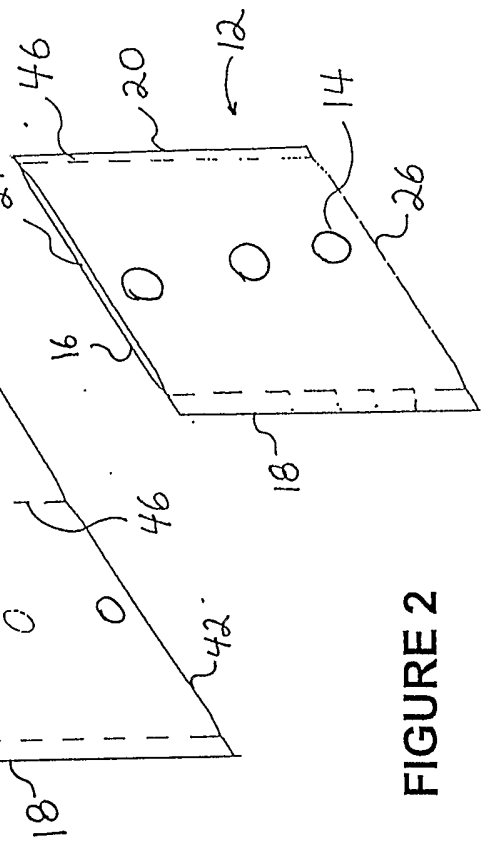
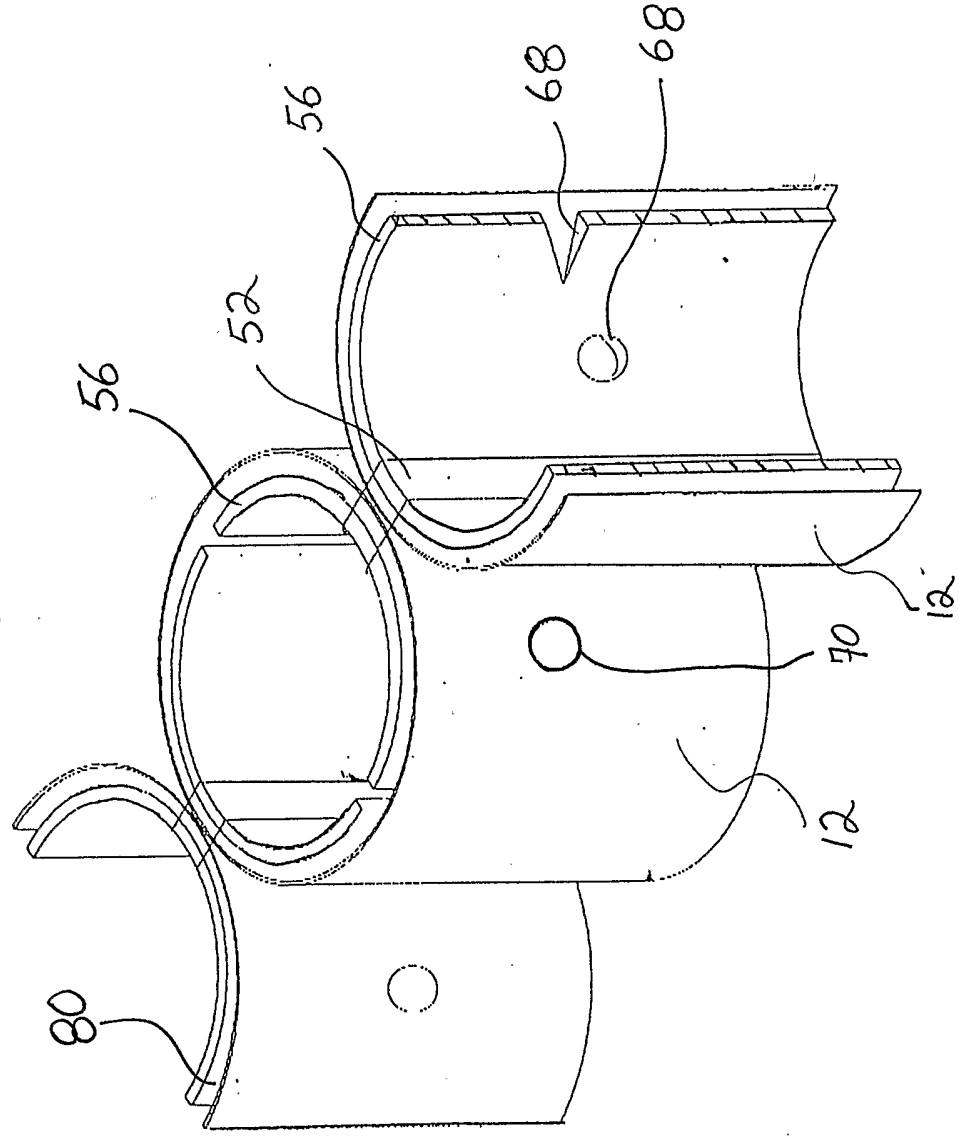


FIGURE 3

FIGURE 2

FIGURE 5



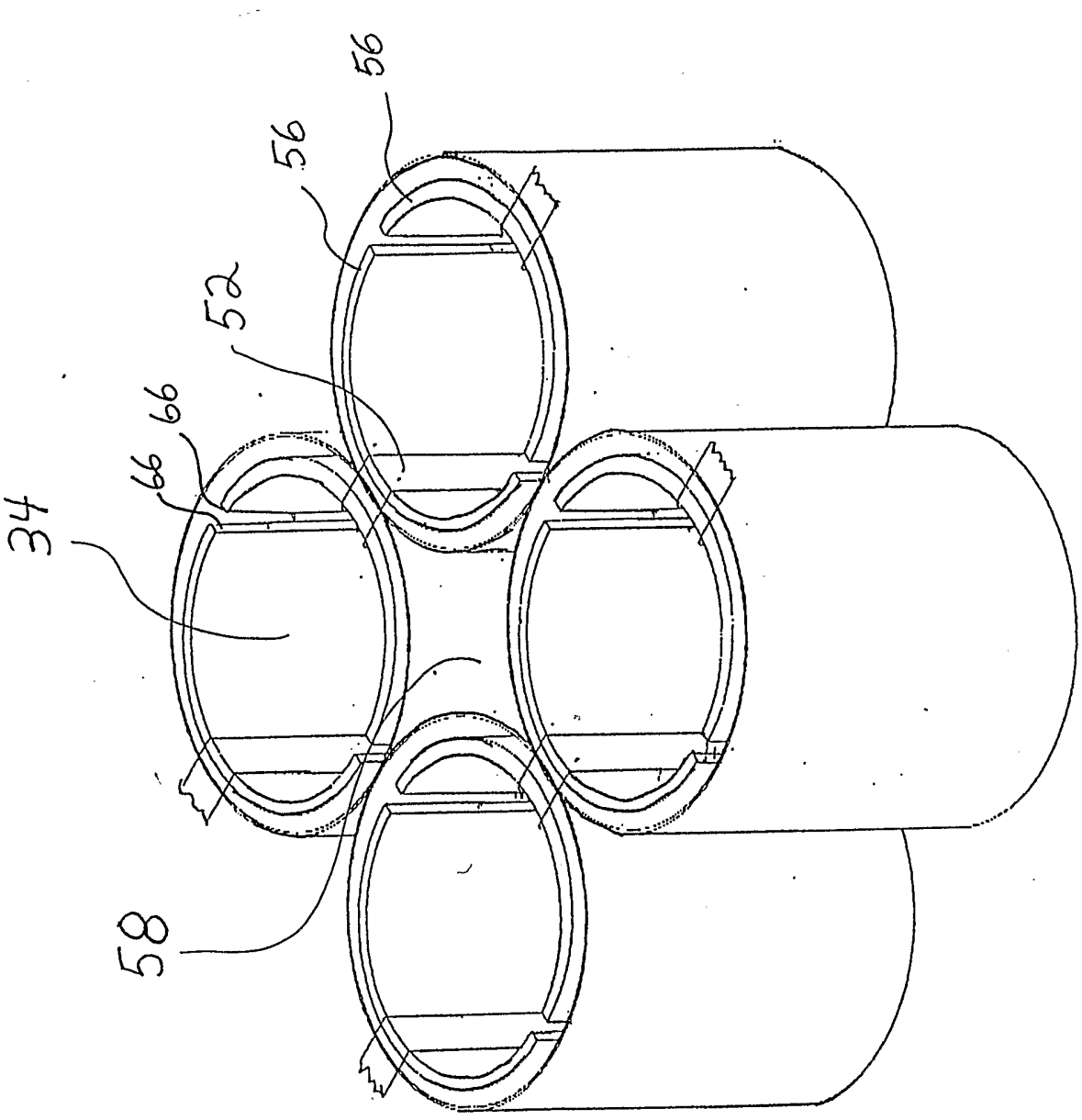


FIGURE 6

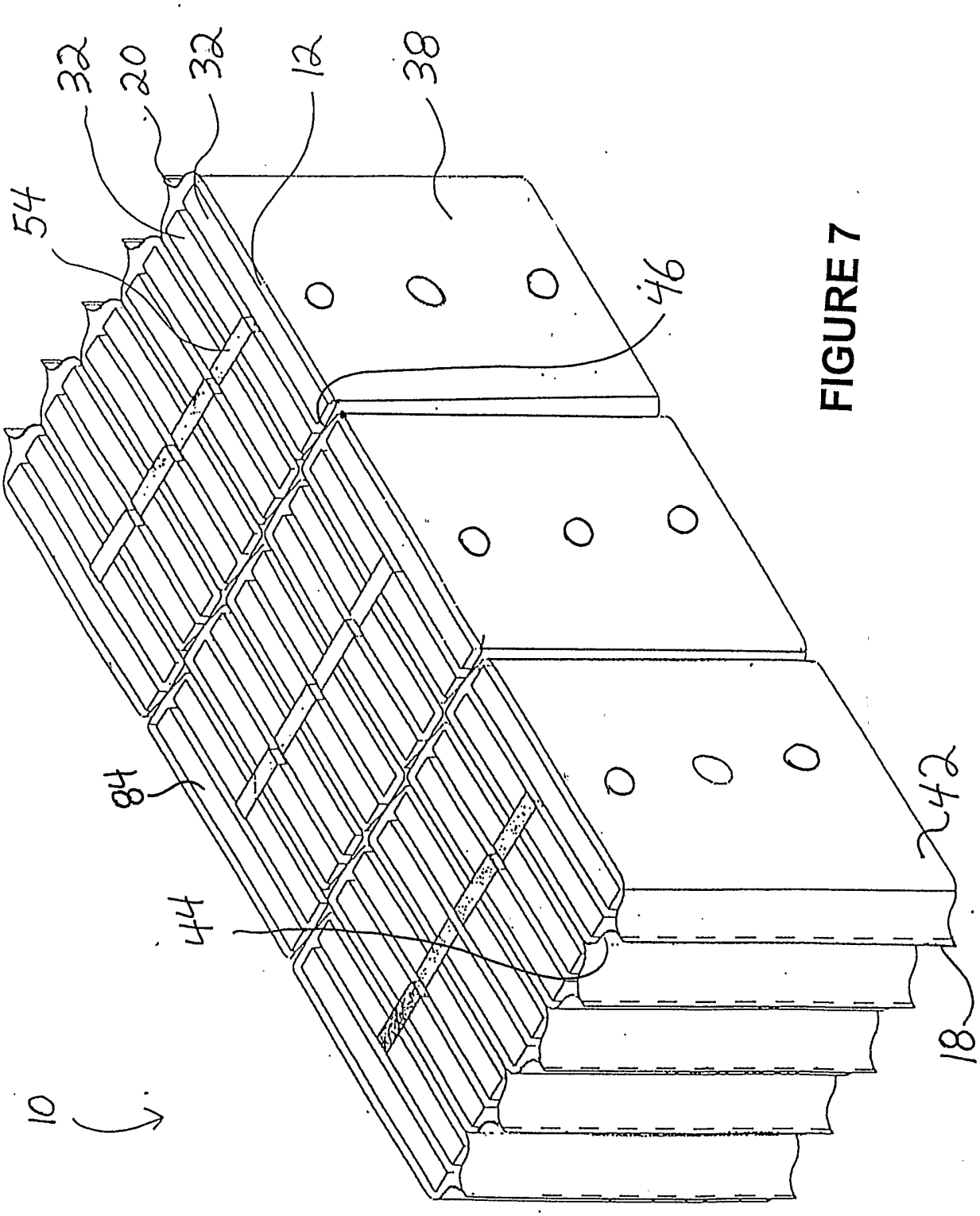


FIGURE 7

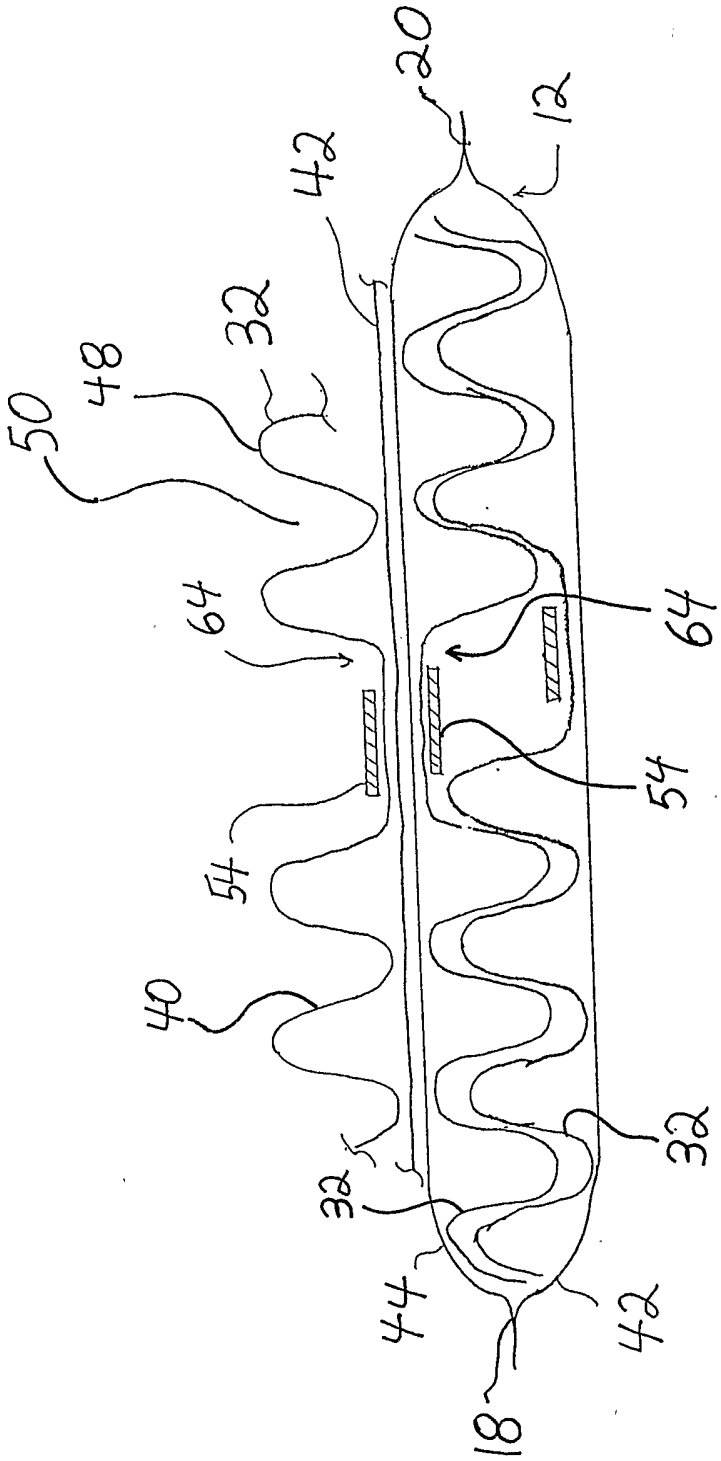
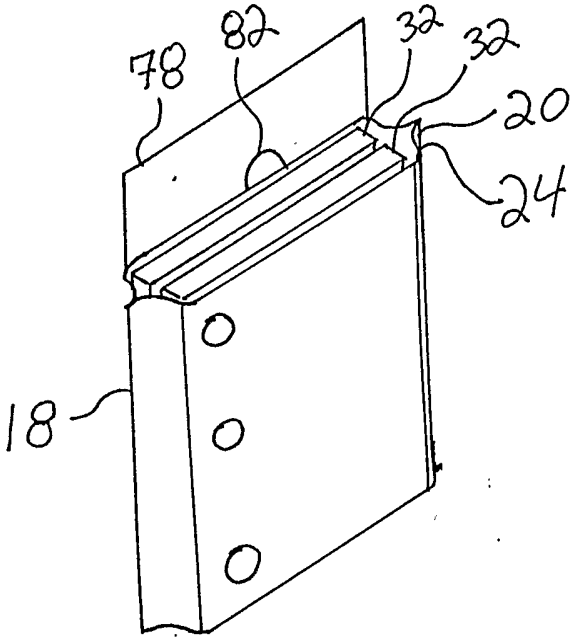


FIGURE 8

FIGURE 11



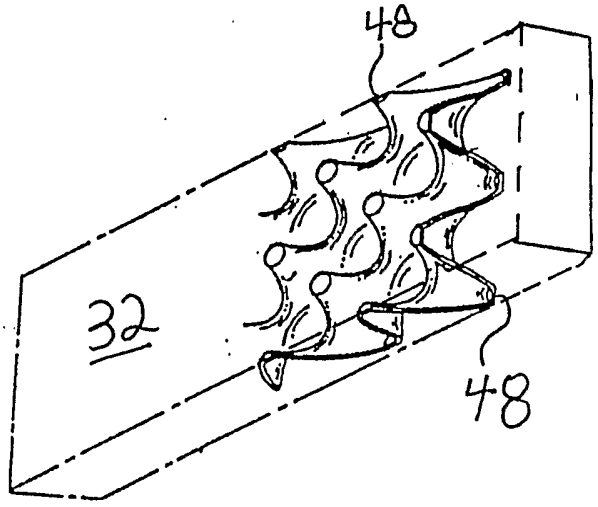


FIGURE 10

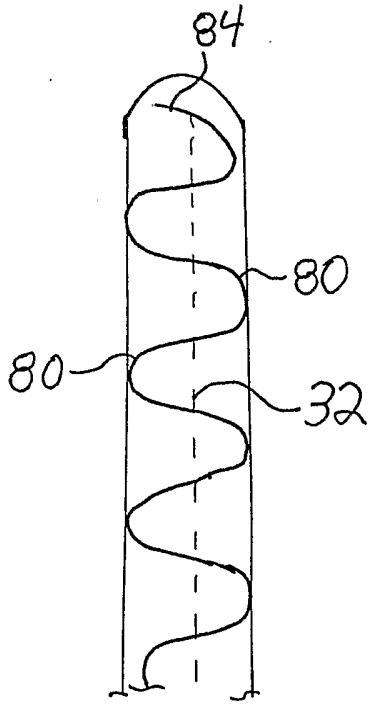


FIGURE 9

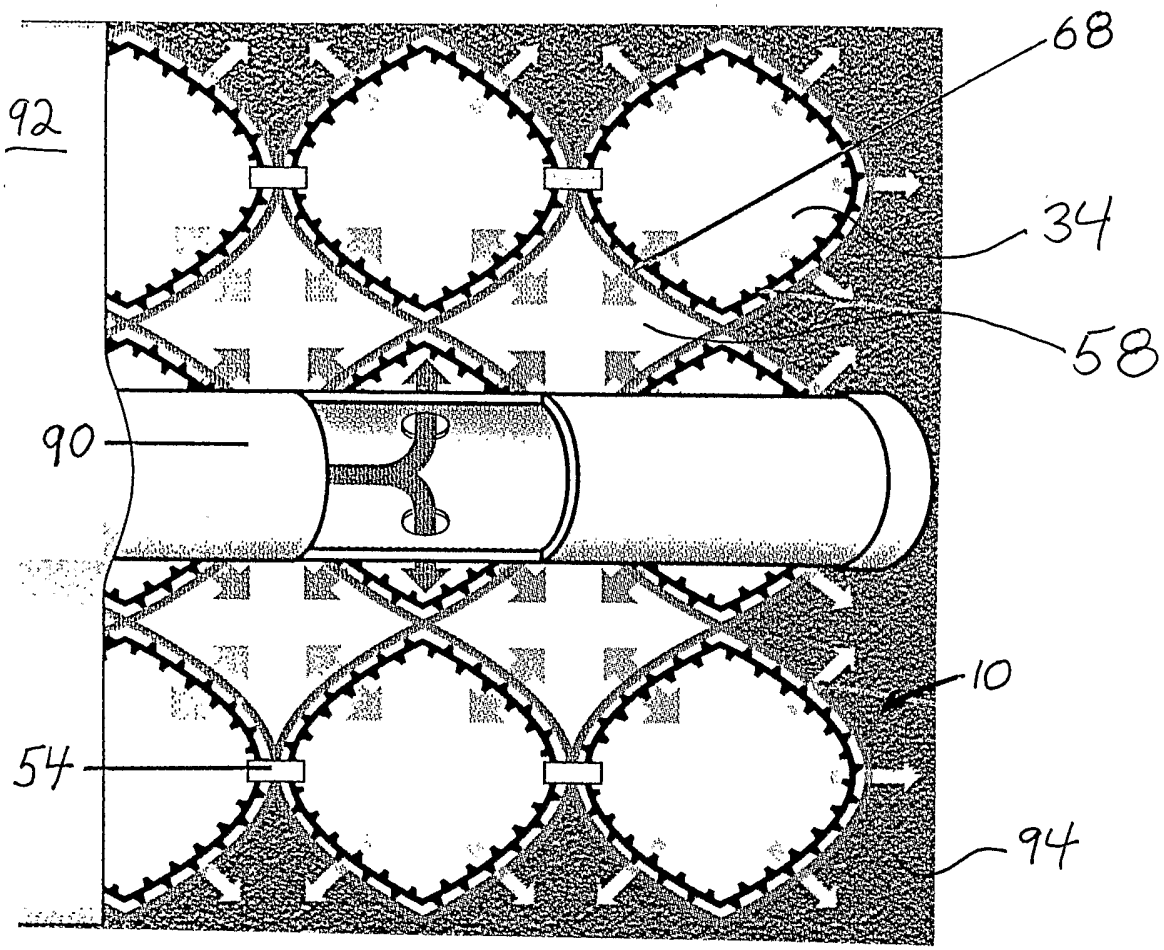


Figure 12

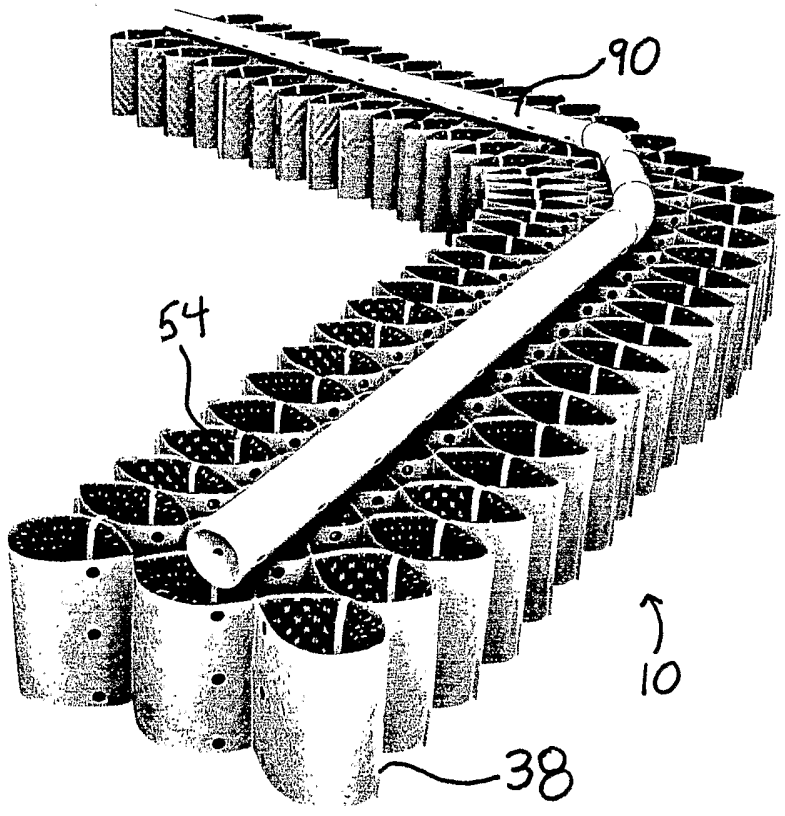


Figure 13