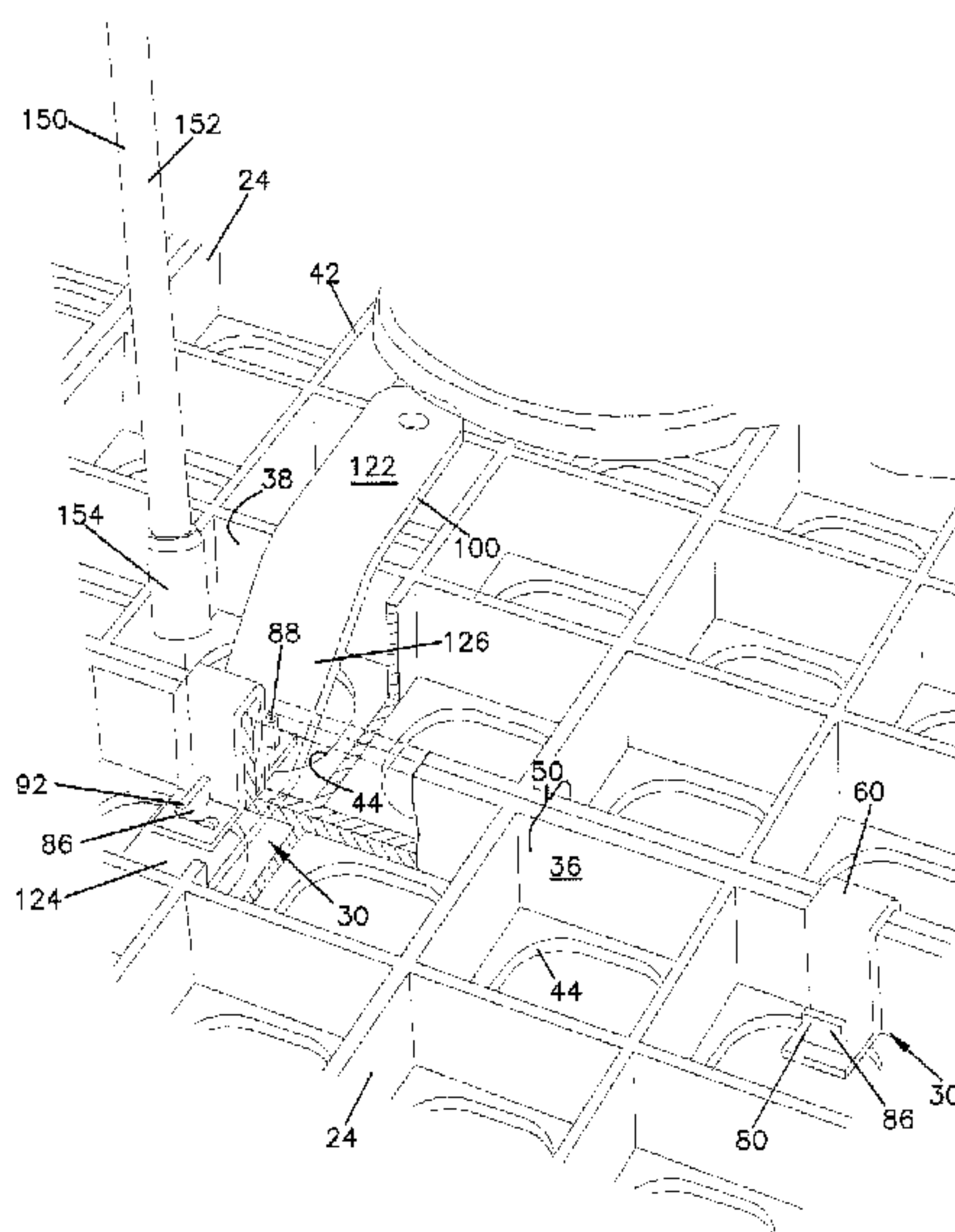




(86) Date de dépôt PCT/PCT Filing Date: 2008/01/22
 (87) Date publication PCT/PCT Publication Date: 2008/07/31
 (45) Date de délivrance/Issue Date: 2015/11/03
 (85) Entrée phase nationale/National Entry: 2009/07/21
 (86) N° demande PCT/PCT Application No.: US 2008/051682
 (87) N° publication PCT/PCT Publication No.: 2008/091879
 (30) Priorité/Priority: 2007/01/24 (US60/886,454)

(51) Cl.Int./Int.Cl. *E01C 5/00* (2006.01),
E01C 9/08 (2006.01), *E04B 1/61* (2006.01)
 (72) Inventeurs/Inventors:
RESTREPO, RICARDO SCHMALBACH, EC;
MANZANO, MARIO MORENO, EC;
SENF, DANIEL F., US;
BACH, GARY M., US
 (73) Propriétaire/Owner:
REYNOLDS PRESTO PRODUCTS INC., US
 (74) Agent: ROBIC

(54) Titre : SYSTEME DE CHAUSSEE POREUSE PORTABLE ET PROCEDE D'ASSEMBLAGE DE CE SYSTEME DE CHAUSSEE
 (54) Title: PORTABLE POROUS PAVEMENT SYSTEM AND METHOD FOR ASSEMBLING SUCH A PAVEMENT SYSTEM



(57) **Abrégé/Abstract:**

A portable porous pavement system includes a plurality of porous pavement units and a plurality of clamping devices, in which each of the porous pavement units is connected to an adjacent porous pavement unit by at least one clamping device. Each clamping device includes a first bracket and a second bracket. The first bracket defines a slot arrangement. The second bracket is in intimate communication with the slot arrangement of the first bracket. The second bracket has a twisted arrangement to secure the second bracket and the first bracket together. Two adjacent walls of two adjacent porous pavement units are sandwiched between the first bracket and the second bracket to secure the two adjacent porous pavement units together. A method for assembling a portable porous pavement system includes providing first and second porous pavement units; mounting a C-shaped clamp member over two adjacent walls of the first and second porous pavement unit; orienting the first and second porous pavement units with the C-shaped clamp member on a surface; providing a locking bracket having a U-shaped section extending between first and second slotted wings; mounting the locking bracket over the C-shaped clamp member by orienting the U-shaped section over the two adjacent walls, with the first arm going through the first slotted wing and the second arm going through the second slotted wing; and twisting the first arm and the second arm to secure the locking bracket and the C-shaped clamp member around the first and second porous pavement units.

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

(19) World Intellectual Property Organization
International Bureau(43) International Publication Date
31 July 2008 (31.07.2008)

PCT

(10) International Publication Number
WO 2008/091879 A1

(51) International Patent Classification:

E01C 5/00 (2006.01) *E04B 1/61* (2006.01)
E01C 9/08 (2006.01)

(21) International Application Number:

PCT/US2008/051682

(22) International Filing Date: 22 January 2008 (22.01.2008)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:

60/886,454 24 January 2007 (24.01.2007) US

(71) Applicant (for all designated States except US):
REYNOLDS CONSUMER PRODUCTS, INC.
[US/US]; 6603 West Broad Street, Richmond, VA
23230 (US).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **RESTREPO, Ricardo, Schmalbach** [CO/EC]; Hernandez De Giron 765 Y Pedregal, Quito (EC). **MANZANO, Mario, Moreno** [EC/EC]; De Las Gardenias 820 Y Av. Ei Inca, Quito (EC). **SENF, Daniel, F.** [US/US]; 3805 Woodside Court, Appleton, WI 54913 (US). **BACH, Gary, M.** [US/US]; 2232 East Cedar Ridge Drive, Appleton, WI 54915 (US).

(74) Agent: **BRUESS, Steven, C.**; Merchant & Gould P.c.,
P.o.box 2903, Minneapolis, MN 55402-0903 (US).

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, SV, 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, HR, HU, IE, IS, IT, LT, LU, LV, MC, MT, NL, NO, 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

(54) Title: PORTABLE POROUS PAVEMENT SYSTEM AND METHOD FOR ASSEMBLING SUCH A PAVEMENT SYSTEM

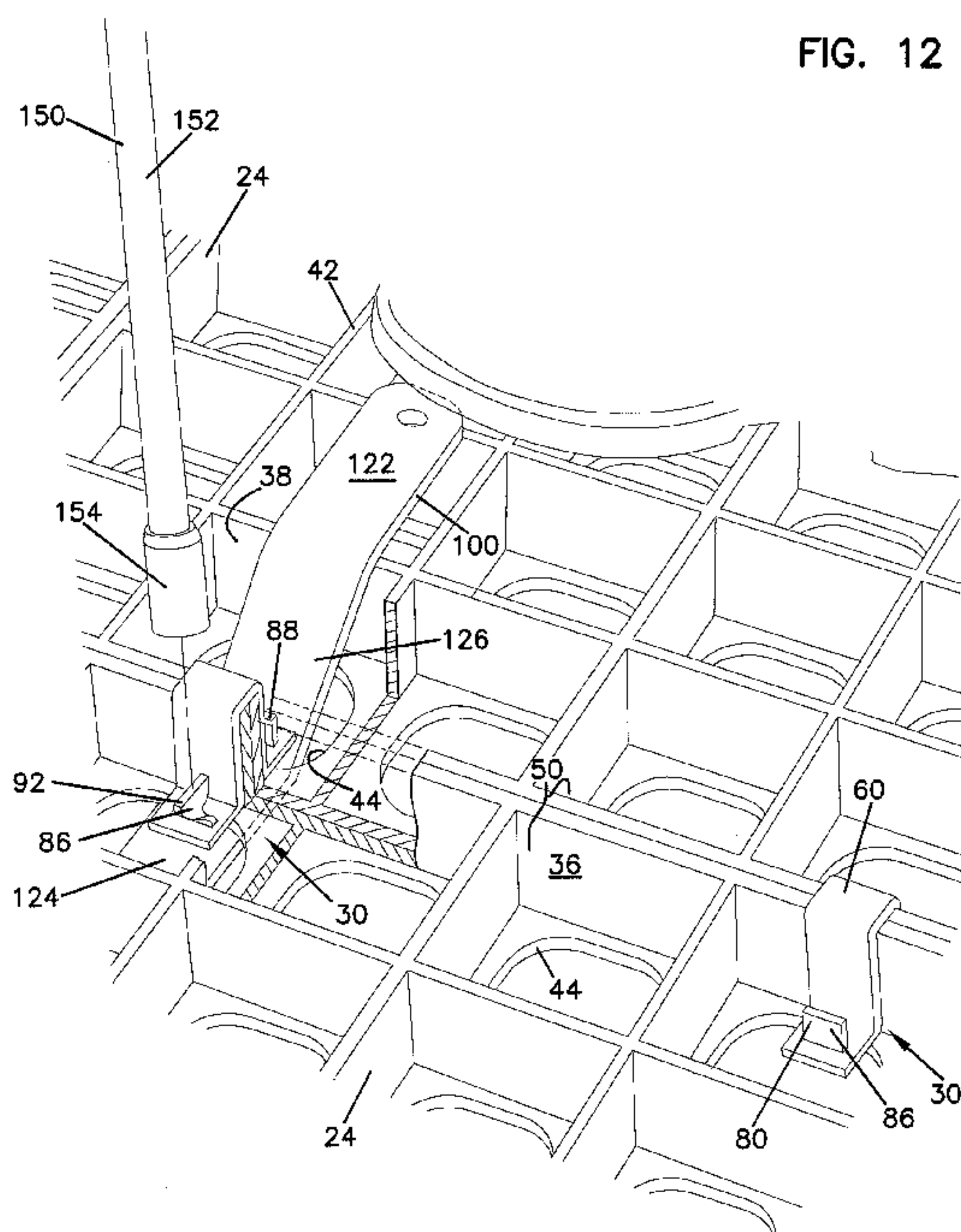


FIG. 12

(57) Abstract: A portable porous pavement system includes a plurality of porous pavement units and a plurality of clamping devices, in which each of the porous pavement units is connected to an adjacent porous pavement unit by at least one clamping device. Each clamping device includes a first bracket and a second bracket. The first bracket defines a slot arrangement. The second bracket is in intimate communication with the slot arrangement of the first bracket. The second bracket has a twisted arrangement to secure the second bracket and the first bracket together. Two adjacent walls of two adjacent porous pavement units are sandwiched between the first bracket and the second bracket to secure the two adjacent porous pavement units together. A method for assembling a portable porous pavement system includes providing first and second porous pavement units; mounting a C-shaped clamp member over two adjacent walls of the first and second porous pavement unit; orienting the first and second porous pavement units with the C-shaped clamp member on a surface; providing a locking bracket having a U-shaped section extending between first and second slotted wings; mounting the locking bracket over the C-shaped clamp member by orienting the U-shaped section over the two adjacent walls, with the first arm going through the first slotted wing and the second arm going through the second slotted wing; and twisting the first arm and the second arm to secure the locking bracket and the C-shaped clamp member around the first and second porous pavement units.

WO 2008/091879 A1

PORTABLE POROUS PAVEMENT SYSTEM AND METHOD FOR ASSEMBLING SUCH A PAVEMENT SYSTEM

Technical Field

This disclosure relates to porous pavement system components and methods of use. In particular, it concerns a system including a plurality of porous pavement units connected together by a plurality of a particular type of clamping device.

Background

The need for an effective soil strength improvement system capable of taking heavy loads and stabilizing poor soils has existed for many years. In certain applications, for example, during petroleum exploration, heavy equipment and materials need to be transported in remote areas that do not necessarily have roads or good supportable soil. Some solutions used in the past have used wood planks to support the loads in areas where the ground is of bad quality. The wood planks need to be stabilized and/or connected together, and it has been found that this is a time-intensive and laborious process. When the work activity is completed, it can be a time-intensive process to disassemble and remove any materials that are not biodegradable, such as nails or other metal stakes. Improvements in systems for quickly installing and removing these types of pavement systems are desirable.

The assignee, Reynolds Consumer Products, Inc. d/b/a Presto Products of Appleton, Wisconsin, has produced a product sold under the tradename

GEOBLOCK®. The GEOBLOCK® porous pavement system provides vehicular and pedestrian load support over grass areas while protecting the grass from the harmful effects of traffic. The unit is made from polyethylene, usually recycled polyethylene. Each unit includes intersecting walls defining a plurality of cells.

5 These units are typically transported to the region where they will be installed. The units are assembled and connected together. Once installed, heavy equipment can be driven over them, and the soil or ground is not torn up and subject to unnecessary erosion or depletion. Improvements in assembly and disassembly are desirable.

Summary of the Disclosure

10 In general, a portable porous pavement system includes a plurality of porous pavement units and a plurality of clamping device, in which each of the porous pavement units is connected to an adjacent porous pavement unit by at least one clamping device. Each porous pavement unit includes intersecting walls defining a plurality of cells. Each clamping device includes a first bracket and a

15 second bracket. The first bracket defines a slot arrangement. The second bracket is in intimate communication with the slot arrangement of the first bracket. The second bracket has a twisted arrangement to secure the second bracket and the first bracket together. Two adjacent walls of two adjacent porous pavement units are sandwiched between the first bracket and the second bracket to secure the two adjacent porous

20 pavement units together.

A method for assembling a portable porous pavement system includes providing first and second porous pavement units, each porous pavement unit including intersecting walls defining a plurality of cells, and each porous pavement unit defining a mounting side and a user side. Next, is mounting a C-

25 shaped clamp member over two adjacent walls of the first and second porous pavement unit. The C-shaped clamp member includes first and second arms joined by a base member. The two adjacent walls of the first and second porous pavement units are between the first and second arms of the C-shaped clamp member. The base member of the C-shaped clamp member is against the mounting side of the

30 porous pavement units. Next, is the step of orienting the first and second porous pavement units with the C-shaped clamp member on a surface, such as ground, with a free end of the first and second arms pointing away from the surface. The

mounting side of the first and second porous pavement units is against the surface, while the user side of the porous pavement units is oriented away from the surface. The method next includes the step of providing a locking bracket having a U-shaped section extending between first and second slotted wings. Next, is the step of

5 mounting the locking bracket over the C-shaped clamp member by orienting the U-shaped section over the two adjacent walls, with the first arm going through the first slotted wing and the second arm going through the second slotted wing. Next, is the step of twisting the first arm and the second arm to secure the locking bracket and the C-shaped clamp member around the first and second porous pavement units.

10 The method includes the step of using a tool to twist the first arm and the second arm. The tool can include a torsion wrench having a neck with a head and a bar extending from the neck. The head defines a cavity shaped to receive the individual free end of the first and second arms.

The method also includes, before the step of twisting, inserting a

15 lifting lever between the surface (such as the ground) and the base member of the C-shaped clamp member. The lifting lever extends from the base member of the C-shaped clamp member, through a cell of one of the porous pavement units, to the user side of the first and second porous pavement units. After inserting, a person can step on a section of the lifting lever on the user side of the first and second porous

20 pavement units.

Brief Description of the Drawings

FIG. 1 is a schematic illustration of a portable porous pavement system installed and in use;

FIG. 2 is a top plan view of a plurality of individual porous pavement

25 units, which are connected together and comprise the grid system illustrated in FIG. 1;

FIG. 3 is a schematic, exploded, perspective view of a clamping device connecting together two porous pavement units;

FIG. 4 is a perspective view of a portion of two porous pavement

30 units connected together with a pair of clamping devices;

FIG. 5 is a side-elevation view of a first bracket of the clamping device;

FIG. 6 is a side-elevation view of a second bracket of the clamping device;

FIG. 7 is a top plan view of the first bracket used in the clamping device;

5 FIG. 8 is a top plan view of the second bracket used in the clamping device;

FIG. 9 is a perspective view of a lifting lever used to install the porous pavement system of FIG. 1;

FIG. 10 is a side-elevation view of the lifting lever of FIG. 9;

10 FIG. 11 is a schematic, perspective view of one step of the method of connecting together two porous pavement units using the connector arrangement, lifting lever and a torsion wrench.

FIG. 12 is an enlarged perspective view of the system shown in FIG. 11, after one of the arms of the second bracket is twisted by the torsion wrench; and

15 FIG. 13 is a schematic, perspective view of the torsion wrench used in the method of assembly.

Detailed Description

FIG. 1 illustrates a portable porous pavement system 20. The system 20 includes a grid 22 made from a plurality of individual porous pavement units 24 (FIG. 2) secured or connected together by a plurality of clamping devices 30 (FIG. 3). In FIG. 1, a truck 32 is illustrated driving on the grid 22. The grid 22 is oriented on a surface 34, which will typically be ground or soil. In many typical applications, it will be desirable to transport heavy equipment into an area that does not have roads or stable soil. In such applications, a plurality of the porous pavement units 24 are assembled into the grid 22 and secured together by the clamping device 30. In such systems, the grid 22 is quickly and easily assembled and is able to be quickly and easily disassembled.

FIG. 2 shows typical porous pavement units 24 usable in the system 20. The porous pavement units 24 are portable in that they are of a size that can be easily stacked onto pallets and moved. In the example shown, each porous pavement unit is approximately 1.0 m x 0.5 m, although other sizes are usable. Each of the porous pavement units 24 has a depth of at least 25 mm, typically 50 mm, and a

nominal coverage area of at least 0.25 m² and typically 0.5 m². As can be seen in FIG. 2, each of the porous pavement units 24 is made of a matrix or grid of intersecting walls 36. The intersecting walls 36 define a plurality of cells 38.

Each of the porous pavement units 24 has a mounting side 40 and an
5 opposite user side 42. The mounting side 40 is the side that is in contact with the ground surface 34. The user side 42 is the side that is open to the surrounding environment and is the side that is exposed to the heavy equipment, such as truck 32 (FIG. 1). In FIG. 2, the user side 42 is the side that is in view. Further, FIG. 4 shows portions of two porous pavement units 24 with the user side 42 in view.

10 Each of the cells 38 defined by the walls 36 has an aperture 44 (FIGS. 2 and 4), which is depicted as circular. The apertures 44 are defined by a planar wall 46. An opposite side of the planar wall 46 is the mounting side 40. Extending perpendicular from the planar wall 46 are the walls 36. The walls 36 form rectangles, in the embodiment shown, squares in which free ends 52 (FIG. 3) define
15 and form the user side 42.

Each of the porous pavement units 24, in typical embodiments, will have at least 30 cells 38, typically 70-80 cells. Each porous pavement unit 24 is made from a non-metal material, for example, up to 100 % recycled polyethylene has been found to be useful. Such a material will result in porous pavement unit 24
20 as having a weight of not greater than 10 kg, typically 4-5 kg. Each porous pavement unit will have a minimum crush strength of 2000 kPa and a minimum flexural modulus of 200,000 kPa. Typical implementations will include the material for the porous pavement unit 24 as having a crush strength of at least 2900 kPa and flexural modulus of 220,000-260,000 kPa. Each cell 38 has a size of about 60-100 mm x 60-
25 100 mm, typically, about 78-82 x 78-82 mm. The open area of the user side 42 is at least 60%, typically 85-95%, and in one application, about 87%. The bottom open area is at least 25%, typically 30-50%, and in one application about 40%.

In FIG. 2, four porous pavement units 24 are shown. These porous pavement units 24 are secured together at joints 50 using the clamping device 30.
30 FIG. 4 illustrates two of the porous pavement units 24 secured together at two adjacent walls 36 with two clamping devices. In FIG. 3, the clamping device 30 is shown in an exploded view during a step of connecting two adjacent porous pavement units together 24.

In general, each clamping device 30 will include a first bracket and a second bracket that fit together in order to secure the two adjacent porous pavement units 24 together at joints 50. As embodied herein, a first bracket is shown at 60, and a second bracket is shown at 80.

5 In reference now to FIGS. 3, 5, and 7, the particular embodiment of first bracket 60 illustrated in the drawings includes a U-shaped section 62 extending between first and second wings 64, 66. As can be seen in the drawings, the first and second wings 64, 66 are generally flat extensions projecting from the open end of the U-shaped section 62. The first bracket 60 further includes a slot arrangement 70.
10 In the embodiment shown, the slot arrangement 70 comprises a first slot 72 defined by the first wing 64 and a second slot 74 defined by the second wing 76.

Attention is directed to FIG. 7. Each of the first and second slots 72, 74 has an aspect ratio of length to width of a particular range. The aspect ratio selected is a ratio that will allow the first bracket 60 to engage the second bracket 80
15 in such a way that it is easy and quick to assemble and then be easily and quickly secured together. In general, it has been found that the aspect ratio of length to width for each of the first and second slots 72, 74 should be greater than 1. In many useful applications, the aspect ratio of length to width will be in the range of 2-5, and in the particular embodiment illustrated, the aspect ratio used will be 3-4, for example,
20 about 3.25.

In the embodiment shown in FIG. 7, each of the first and second slots 72, 74 is rectangular having a greater length than width. In other embodiments, the first and second slots 72, 74 can be non-rectangular, including a regular or irregular polygon, oval, ellipse, or irregular shape. For any of these shapes, it is useful to have
25 an aspect ratio that is greater than 1, in which the aspect ratio would be the shortest length compared to the greatest width compared to the useful part of the slot. In FIG. 7, each of the slots 72, 74 has a length illustrated as 13 mm and a width illustrated as 4 mm.

Referring now to FIG. 5, other details of the first bracket 60 are
30 shown. The U-shaped section 62 includes first and second legs 67, 68 joined by a connecting section 69. The inner dimension between the first and second legs 67, 68 in the embodiment shown is 15 mm, while the length of the connecting section 69 is illustrated as 20 mm. The connecting section 69 is generally parallel to the first and

second wings 64, 66. As can be seen, the first and second wings 64, 66 each have a length of about 20 mm. The height of the first and second legs 67, 68 is about 45 mm. In FIG. 7, it can be seen that the overall length from free end 63 of the first wing 64 and free end 65 of wing 66 is about 59 mm. The overall width of the first
5 bracket 60, in the embodiment shown, is about 25 mm.

It should be understood that while these dimensions are typical, usable dimensions, embodiments of the first bracket 60 can be modified in a variety of dimensions depending upon the particular design goals, materials used, and other factors.

10 In reference now to FIGS. 3, 6, and 8, further details of the second bracket 80 are illustrated. In the embodiment shown, the second bracket 80 engages the first bracket 60 such that it is in intimate communication with the slot arrangement 70 of the first bracket 60. The second bracket 80 further includes a twisted arrangement 82 (FIG. 4) to secure the second bracket 80 and the first bracket
15 60 together. In FIGS. 3 and 4, it can be seen how two adjacent walls 36 of two adjacent porous pavement units 24 are sandwiched between the first bracket 60 and the second bracket 80 to secure the two adjacent porous pavement units 24 together.

In the embodiment shown, the second bracket 80 of each clamping device 30 includes a C-shaped member 84 defined by first and second generally
20 parallel arms 86, 88 with a base member 90 joining the first and second arms 86, 88. In the embodiment shown in FIG. 6, usable dimensions are illustrated. Again, these dimensions are examples only and a variety of dimensions are usable. In the embodiment shown, the base member 90 has an inside length between the first and second arms 86, 88 of 37 mm, and an outside length including the first and second
25 arms 86, 88 of about 43 mm. Each of the first and second arms 86, 88 has a height of about 25 mm and a width of about 11 mm.

The shape of the first and second arms 86, 88 is selected to be of a size and shape such that they can be received by the slots 72, 74. As such, the general cross-sectional shape of each of the arms 86, 88 will have an aspect ratio
30 that is compatible with the aspect ratio of the slots 72, 74. This is explained further below.

The twisted arrangement 82 includes a first twisted section 92 defined by the first arm 86 and a second twisted section 94 defined by the second

arm 88 (FIGS. 4 and 12, with FIG. 12 showing first twisted section 92 only). By comparing FIGS. 3, 4, and 12, it should be appreciated that in use, the first arm 86 extends through the first slot 72 of the first wing 64, with the first twisted section 92 and the base member 90 of the C-shaped member 84 being on opposite sides of the
5 first wing 64. The second arm 88 extends through the second slot 74 of the second wing 66, with the second twisted section 94 and the base member 90 of the C-shaped member being on opposite sides of the second wing 66. As such, the first and second twisted sections 92, 94 lock the second bracket 80 to the first bracket 60, with the walls 36 of the porous pavement units 24 trapped therebetween.

10 Therefore, it should be appreciated that the relationship of the geometry of the cross-section of the first and second arms 86, 88 relative to the geometry of the first and second slots 72, 74 results in the first and second arms 86, 88 being able to be twisted in a way that will prevent the first and second arms 86, 88 from backing out of the first and second slots 72, 74 and, thus, locking the second
15 bracket 80 to the first bracket 60. In the embodiment shown, the cross-sectional shape of the first arm 86 and second arm 88 is rectangular having a width less than 4 mm, for example, in the embodiment shown, 2 mm, and a length less than 13 mm, for example, in the embodiment shown 11 mm. This gives the first and second arms 86, 88 a cross-section having an aspect ratio of length to width of greater than 1, for
20 example, 3-8, and in the embodiment shown, 5.5.

While a variety of materials are useful, it has been found useful for the first and second brackets 60, 80 to be made of a strong, durable, tough material such as steel. Other materials can be used.

To assemble the system 20, there will typically be several clamping
25 devices 30 utilized, including at least one, and typically more than one clamping device 30 to secure together two adjacent porous pavement units 24. In FIG. 3, it can be seen how the second bracket 80 is arranged against the ground or surface 34 (FIG. 1) and facing and against the mounting side 40 of the porous pavement units 24. Thus, the base member 90 of each of the second brackets 80 is between the
30 mounting side 40 of the porous pavement units 24 and the ground 34. Two adjacent walls 36 are lined up adjacent to each other as shown schematically by joints 50 in FIG. 2 and in FIG. 3 showing walls 36 back to back and adjacent to each other. The second bracket 80 is oriented such that the base member 90 bridges the joint 50

extending under the two adjacent walls 36, with the first and second arms 86, 88 pointing upwardly away from the ground surface 34 toward the user side 42 and, in the embodiment shown, through the apertures 44. The first bracket 60 is oriented such that the U-shaped section 62 defines a closed slot 76 defined by the first leg 67, 5 second leg 68, and connecting section 69. The closed slot 76 extends over and receives the joint 50 comprising the back to back walls 36 of the two adjacent porous pavement units 24. The free ends 52 of the walls 36 are the ends that define the user side 42. These free ends 52 will also be facing the closed portion of the closed slot 76 defined by the connecting section 69, when the first bracket 60 is 10 oriented over the joint 50.

To facilitate quick assembly and disassembly of the system 20, tools are useful. FIGS. 9 and 10 illustrate a lifting lever 100. Particular preferred techniques for using the lifting lever 100 are described below in connection with methods for assembly of the system 20. FIG. 9 shows the lifting lever 100 in 15 perspective view, while FIG. 10 shows the lifting lever 100 in a side elevation view. In general, the lifting lever 100 includes an extension 102 having first and second opposite surfaces 104, 106. The first and second surfaces 104, 106 have four side walls 110 joining them, including two elongated side walls 112, 114 and two end side walls 116, 118. It should be understood that, in general, the lifting lever 100 is 20 generally symmetrical.

Still in reference to FIGS. 9 and 10, the lifting lever 100 has an overall side profile that resembles a stretched out Z-shape. In particular, the lifting lever 100 includes a first section 122, a second section 124 generally parallel to the first section 122, and a connecting section 126 extending between the first section 25 122 and second section 124. In the embodiment shown, the connecting section 126 is angled at angle 130 relative to the second section 124 obtusely that is, greater than 90 degrees. Similarly, the connection section 126 is angled relative to the first section 122 at angle 132, which is greater than 90 degrees. In preferred embodiments, the first angle 130 and the second angle 132 are about the same.

30 In preferred implementations, the first section 122 will have a length between the end side wall 116 and bend 132 (bend 134 is where the connection section 126 begins) that is sufficiently long to support a portion of a human foot.

The reasons for this are explained below. A usable length would be at least 40 mm, typically 50-200 mm, for example, about 90-110 mm.

The second section 124 will typically have a length between end side wall 118 and bend 136 (bend 136 is where the connection section 126 begins) that is
5 sufficiently long to extend under and support the second bracket 80. The reasons for this are described below. Typically, this length will be about the same as the length of the first section 122 (although it does not have to be the same), and thus, will be at least 40 mm, typically 50-200 mm, for example about 90-110 mm.

The width of the lifting lever 100 between elongated side wall 112
10 and elongated side wall 114 will be selected to be narrow enough to fit within the cells 38, and in particular, the apertures 44. Thus, the width will be 25-60 mm wide, for example, 30-50 mm. The overall length of the wrench 100 will typically be at least 200 mm, typically, 220-500 mm, for example 280-320 mm. Methods for use of the wrench 100 are described below. In preferred embodiments, the wrench 100 is
15 made from steel.

A second tool, illustrated as a torsion wrench 150 is shown in FIGS. 11-13, and especially FIG. 13. The torsion wrench 150 includes a neck 152 having a head 154. The head 154 defines a receiving cavity 156 that is shaped with the same cross-sectional shape as the first and second arms 86, 88 and sized to be able to
20 receive, individually, the first and second arms 86, 88. Extending from the neck 152 is a grip bar 158. As can be seen in FIG. 13, the grip bar 158 forms the top of a T-shape, relative to the neck 152.

In the embodiment illustrated, the receiving cavity 156 has a rectangular cross-sectional shape. As mentioned above, the cavity is sized to be able
25 to receive, individually, the ends of the first and second arms 86, 88. In preferred arrangements, the shape of the receiving cavity will have an aspect ratio of length to width that is greater than 1, for example, in the range of 2-5.

In use, each of the free ends of the first and second arms 86, 88 are inserted into the receiving cavity 156 of the head 154. Then, the grip bar 158 can be
30 gripped at opposite sides 161, 162 from the neck 152 and rotated or twisted. In the embodiment illustrated, sides 161, 162 are equal in length. This rotation will translate into a rotational force on the ends of whichever arm 86, 88 is within the receiving cavity 156. Thus, the torsion wrench 150 creates the first twisted section

92 and second twisted section 94 by applying a rotational or torsion force to the first and second arms 86, 88 of the second bracket 80. One usable material for torsion wrench 150 is steel.

The lifting lever 100 is used before the step of twisting by inserting
5 the wrench 100 between the ground surface 34 and the base member 90 of the C-shaped clamp member 84, such that the second section 124 is between the ground surface 134 and the base member 90, with the connection section 126 extending through one of the apertures 44, and the first section 122 is exposed on the user-side 42 of the porous pavement unit 24. FIGS. 11 and 12 show the lifting lever 100
10 extending through a cell 38 of one of the porous pavement units 24 to the user side 42. After the lifting lever 100 is inserted, the first section 122 is stepped on by a person that is on the user side 42 of the porous pavement units 24. This provides a stability to then allow the torsion wrench 150 to be mounted over one of the arms 86, 88 and apply a twisting force to create one of the twisted sections 92, 94. The
15 lifting lever 100 may then be removed from the cell 88 and used again.

In FIGS. 11 and 12, two clamping devices 30 are visible, with one being shown just after first twisted section 92 has been created by the combination of torsion wrench 150 and lifting lever 100. The other clamping device 30 viewable in FIGS. 11 and 12 shows the first and second brackets 60, 80 engaged, but not
20 locked together with the twisted arrangement 82 in place.

A method of assembling the portable porous pavement system 20 should now be apparent. At least first and second porous pavement units 24 are provided. The C-shaped clamp member 84 is mounted over two adjacent walls 36 of the adjacent porous pavement units 24. The two adjacent walls 36 are between the
25 first and second arms 86, 88 of the C-shaped member 84, and the base member 90 of the C-shaped member 84 is against the mounting side of the porous pavement units 24. The porous pavement units 24 with the C-shaped clamp member 84 is mounted on surface 34, such as soil or ground, with the free ends of the first and second arms 86, 88 pointing away from the ground 34. The mounting sides 40 of the porous
30 pavement units 24 are against the ground surface 34.

Next, the first bracket, including locking bracket having the U-shaped section 62 extending between the first and second wings 64, 66 is mounted over the C-shaped clamp member 84 by orienting the U-shaped section 62 over the two

adjacent walls 36, with the first arm 86 going through the first slotted wing 64 and the second arm 88 going through the second slotted wing 66.

Next, the lifting lever 100 is inserted between the ground surface 34 and the base member 90 of the C-shaped clamp member 84, the lifting lever 100 extending from the base member 90 through the cell 38 of the porous pavement unit to the user-side 42. In particular, the section 122 extends under the base member 90 of the second bracket 80, the connection section 126 extends through the aperture 44, and the first section 122 extends over and above the user side 42.

Next, the user steps on the first section 122, which results in an upward force being exhibited on the base member 90 second bracket 80. This helps to stabilize the first and second brackets 60, 80 through the next method step.

The next step includes using the torsion wrench 150 to twist individually, the first arm 86 and second arm 88 to provide first twisted section 92 and second twisted section 94. In particular, the receiving cavity 156 is fitted over the free end of an individual first arm 86 or second arm 88, and then a rotational force is created by pressing on opposite sides 161, 162 of the grip bar 158. This results in a twisting force to be translated to the neck 152, 154 and then twist the first or second arm 86, 88.

After each of the first and second twisted sections 92, 94 are created, another clamping device can be secured by locking together the first bracket 60 and second bracket 80. The lifting lever 100 can be removed from the cell 38 and used at the next clamping device 30, while the torsion wrench 150 is removed for use at the next clamping device 30.

To disassemble the system 20, the above process is reversed. The twisted sections 92, 94 can be untwisted using the torsion wrench 150 to allow the first bracket 60 and second bracket 80 to be disassembled.

We claim:

1. A portable porous pavement system comprising:
 - (a) a plurality of porous pavement units; each porous pavement unit including intersecting walls defining a plurality of cells; and
 - (b) a plurality of clamping devices; each of the porous pavement units being connected to an adjacent porous pavement unit by at least one clamping device; each clamping device including:
 - (i) a first bracket defining a slot arrangement;
 - (ii) a second bracket in intimate communication with the slot arrangement of the first bracket;
 - (A) the second bracket having a twisted arrangement to secure the second bracket and the first bracket together; and
 - (iii) two adjacent walls of two adjacent porous pavement units being sandwiched between the first bracket and the second bracket to secure the two adjacent porous pavement units together.

2. A system according to claim 1 wherein:
 - (a) each of the porous pavement units has a nominal coverage area of at least 0.25 m²; a depth of at least 25 mm; at least 30 cells; and being made from a non-metal material having a crush strength of at least 2500 kPa and a flexural modulus of 200,000-300,000 kPa; and
 - (b) the first bracket of each clamping device includes:
 - (i) a U-shaped section extending between first and second wings;
 - (A) the slot arrangement comprising a first slot defined in the first wing and a second slot defined in the second wing;

- (c) the second bracket of each clamping device includes a C-shaped member having first and second arms with a base member joining the first and second arms; the twisted arrangement including a first twisted section defined by the first arm and a second twisted section defined by the second arm;
 - (i) the first arm extending through the first slot of the first wing; the first twisted section and the base member being on opposite sides of the first wing; and
 - (ii) the second arm extending through the second slot of the second wing; the second twisted section and the base member being on opposite sides of the second wing.
- 3. A system according to claim 2 wherein:
 - (a) the first and second slots each has an aspect ratio of length to width that is greater than 1.
- 4. A system according to claim 1 wherein:
 - (a) each of the porous pavement units has a nominal coverage area of 0.50 m²; a depth of 50 mm; 70-80 cells; weight of 4-5 kg; and being made from a polyethylene material having a crush strength of at least 2900 kPa and a flexural modulus of 220,000-260,000 kPa.
- 5. A system according to claim 1 wherein:
 - (a) each of the first bracket and second bracket comprise steel.
- 6. A method for assembling a portable porous pavement system; the method comprising:

- (a) providing first and second porous pavement units; each porous pavement unit including intersecting walls defining a plurality of cells; each porous pavement unit defining a mounting side and a user side;
 - (b) mounting a C-shaped clamp member over two adjacent walls of the first and second porous pavement unit; the C-shaped clamp member including first and second arms joined by a base member; the two adjacent walls being between the first and second arms; the base member being against the mounting side;
 - (c) orienting the first and second porous pavement units with the C-shaped clamp member on a surface with a free end of the first and second arms pointing away from the surface; the mounting side of the first and second porous pavement units being against the surface;
 - (d) providing a locking bracket having a U-shaped section extending between first and second slotted wings;
 - (e) mounting the locking bracket over the C-shaped clamp member by orienting the U-shaped section over the two adjacent walls, the first arm through the first slotted wing, and the second arm through the second slotted wing; and
 - (f) twisting the first arm and the second arm to secure the locking bracket and the C-shaped clamp member around the first and second porous pavement units.
7. A method according to claim 6 further including:
- (a) using a tool to twist the first arm and second arm.
8. A method according to claim 7 wherein:
- (a) the step of using a tool includes using a torsion wrench having a neck with a head and a bar extending from the neck; the head

defining a cavity shaped to receive the individual free ends of the first and second arms.

9. A method according to claim 6 further including:
 - (a) before the step of twisting, inserting a lifting lever between the surface and the base member of the C-shaped clamp member, the lifting lever extending from the base member of the C-shaped clamp member, through a cell of one of the porous pavement units, to the user side of the first and second porous pavement units.

10. A method according to claim 9 further including:
 - (a) after inserting the lifting lever, stepping on a section of the lifting lever that is on the user side of the first and second porous pavement units.

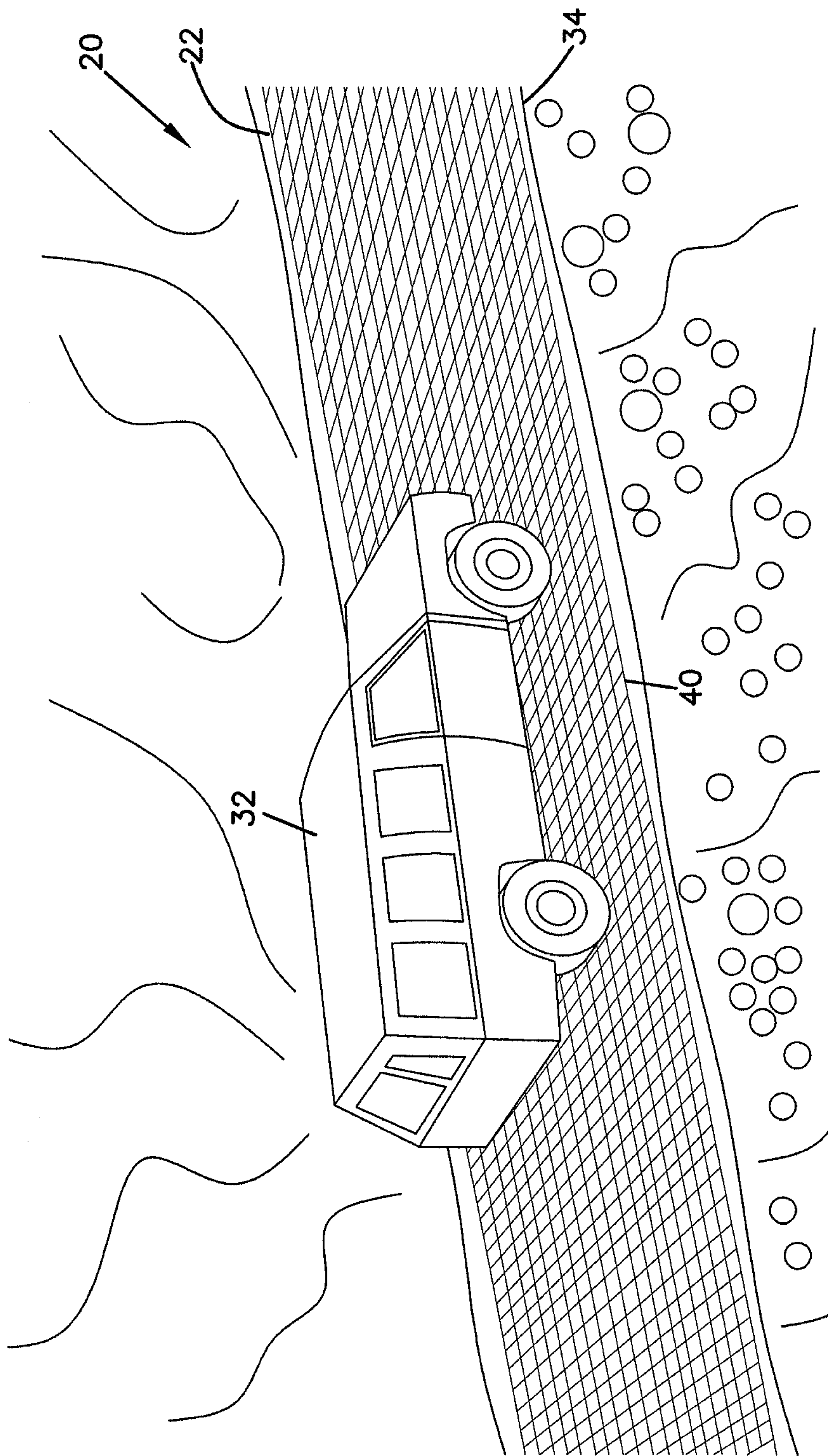


FIG. 1

FIG. 2

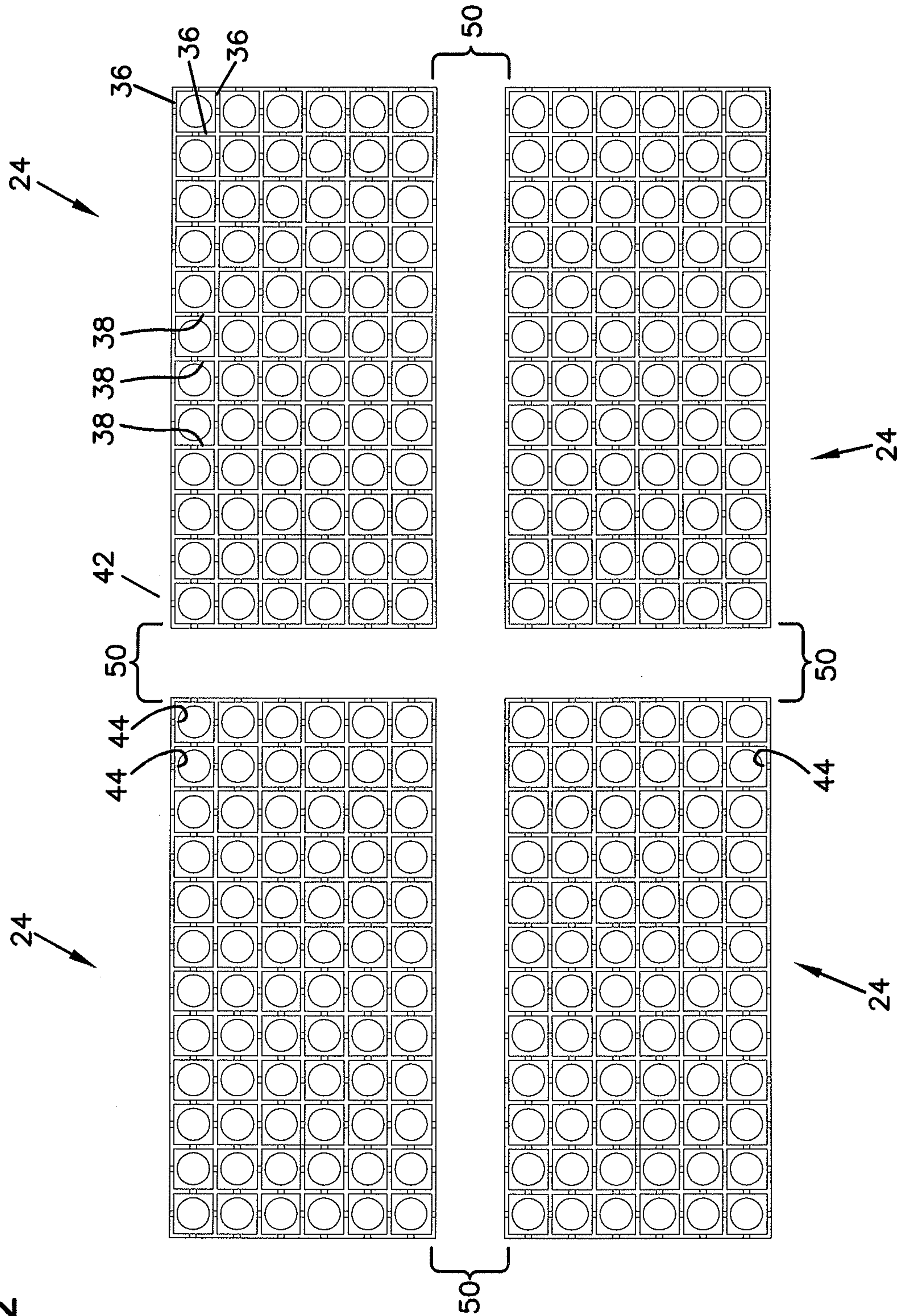


FIG. 3

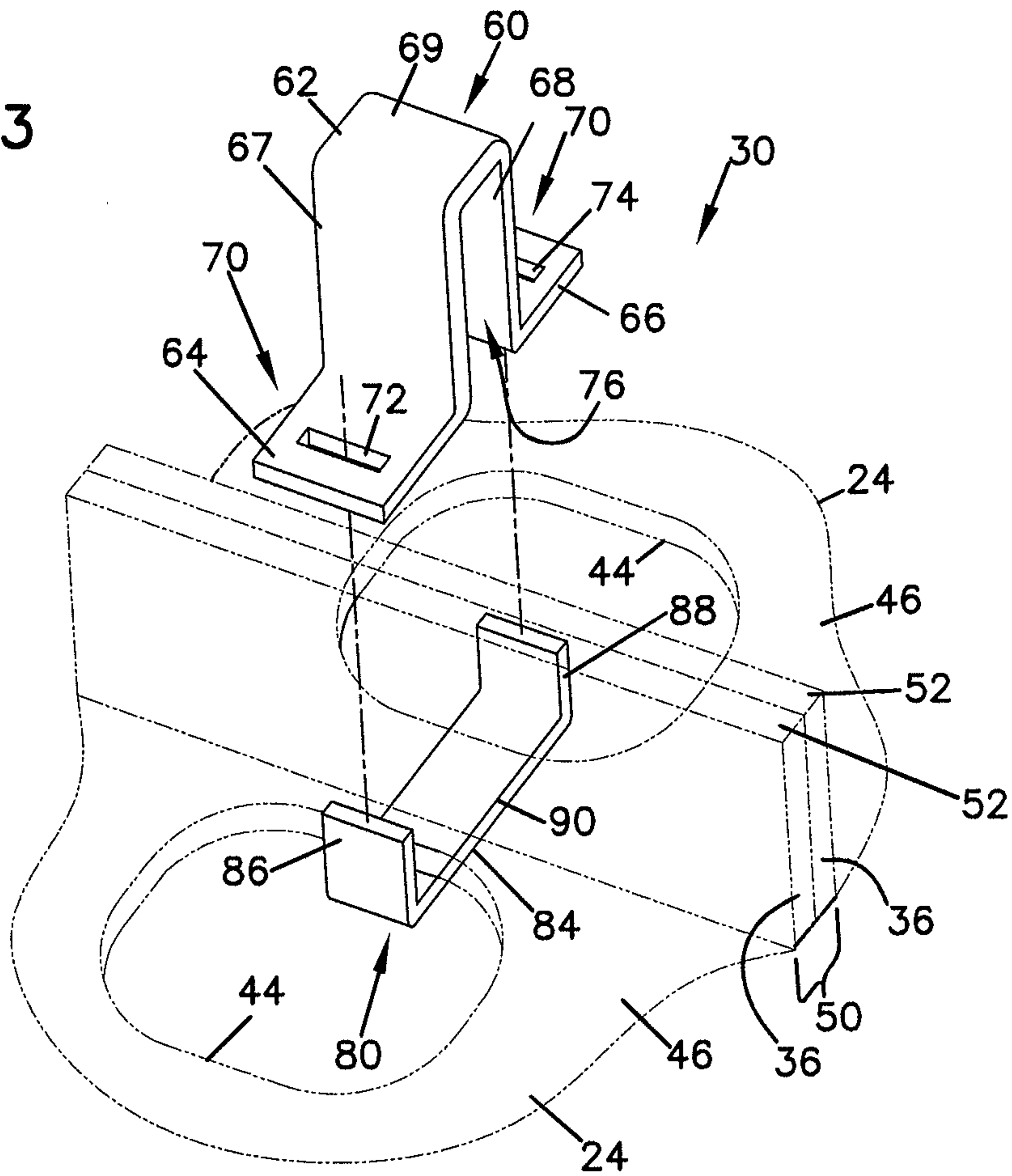


FIG. 9

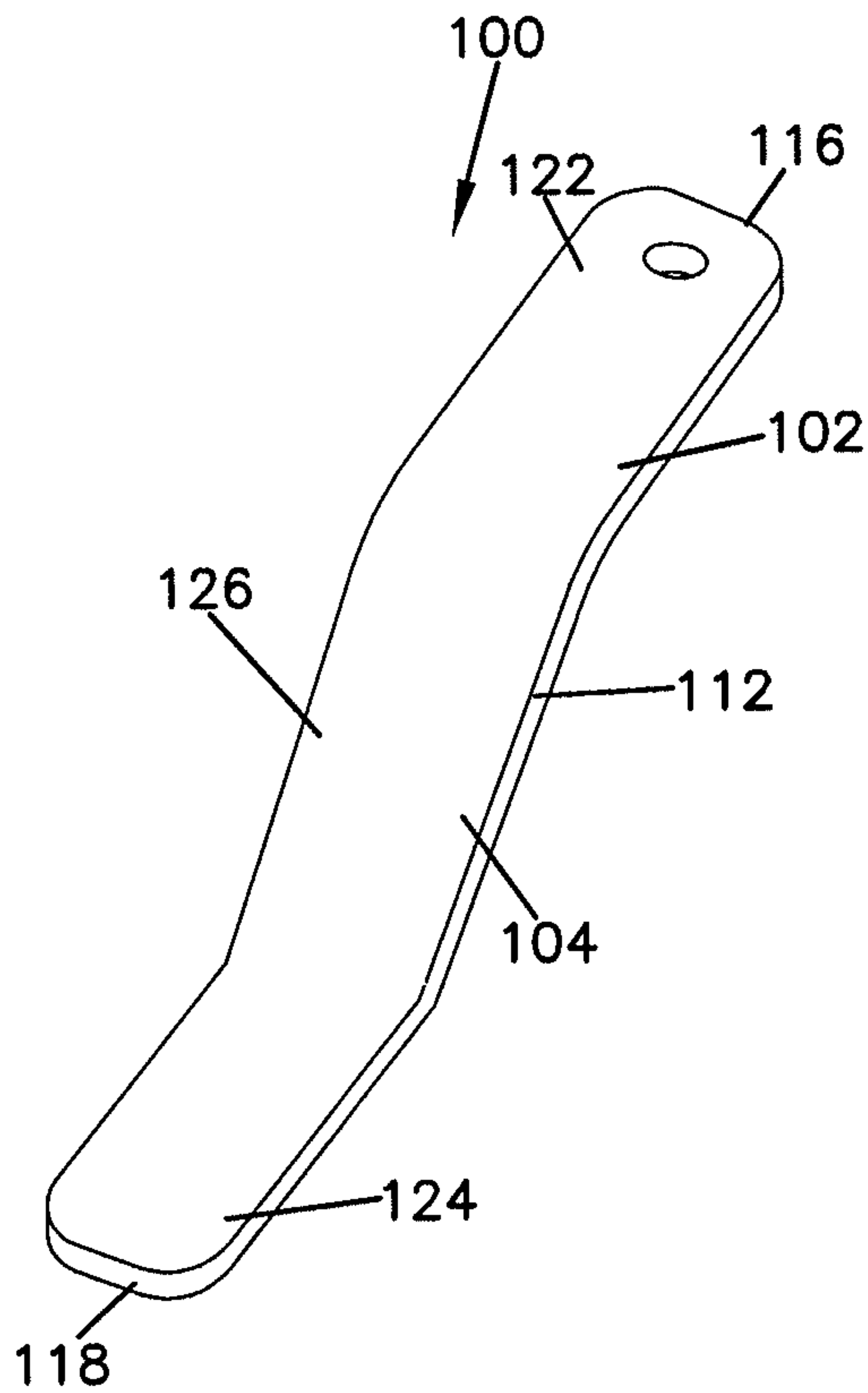


FIG. 4

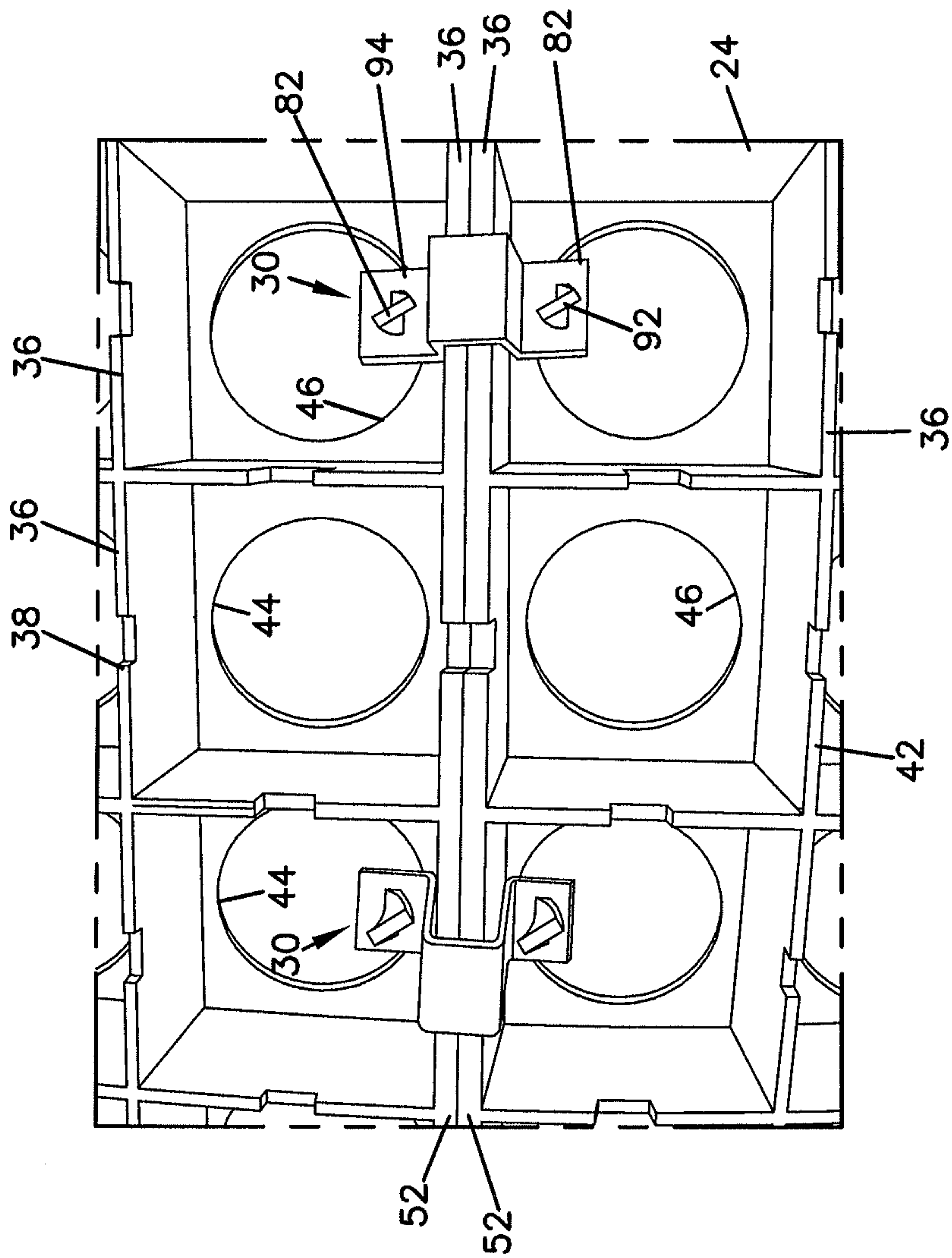


FIG. 5

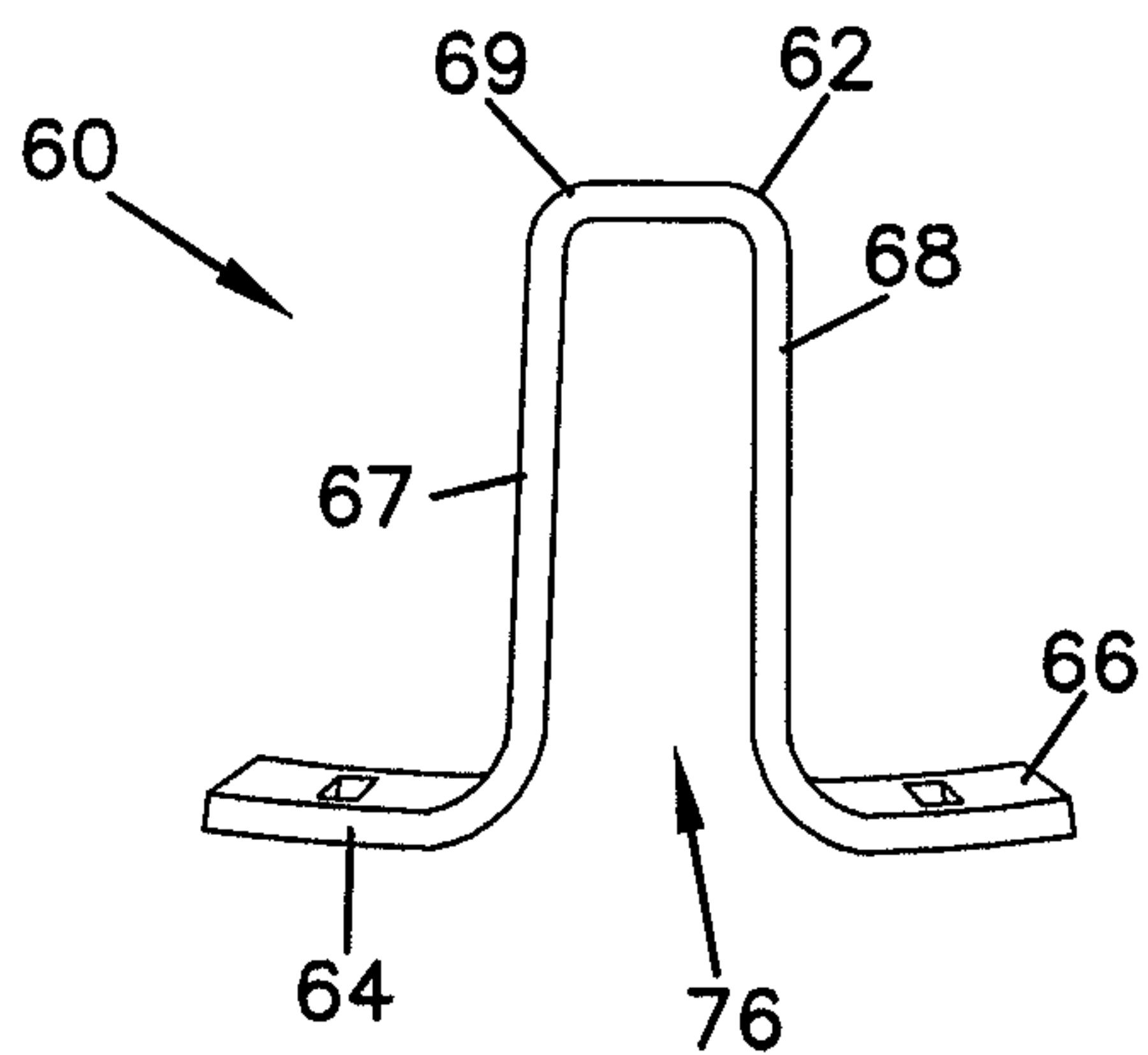


FIG. 6

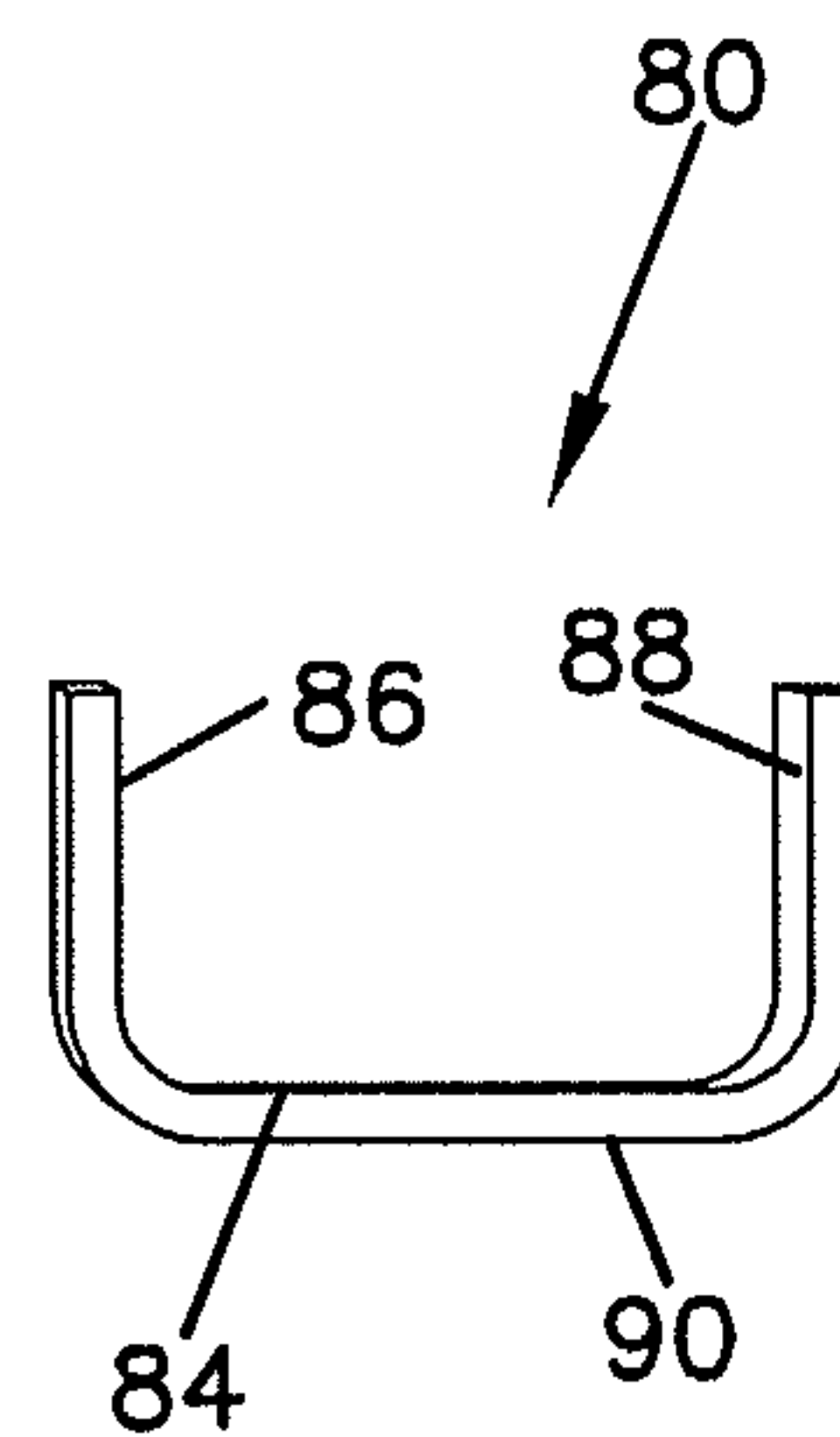


FIG. 7

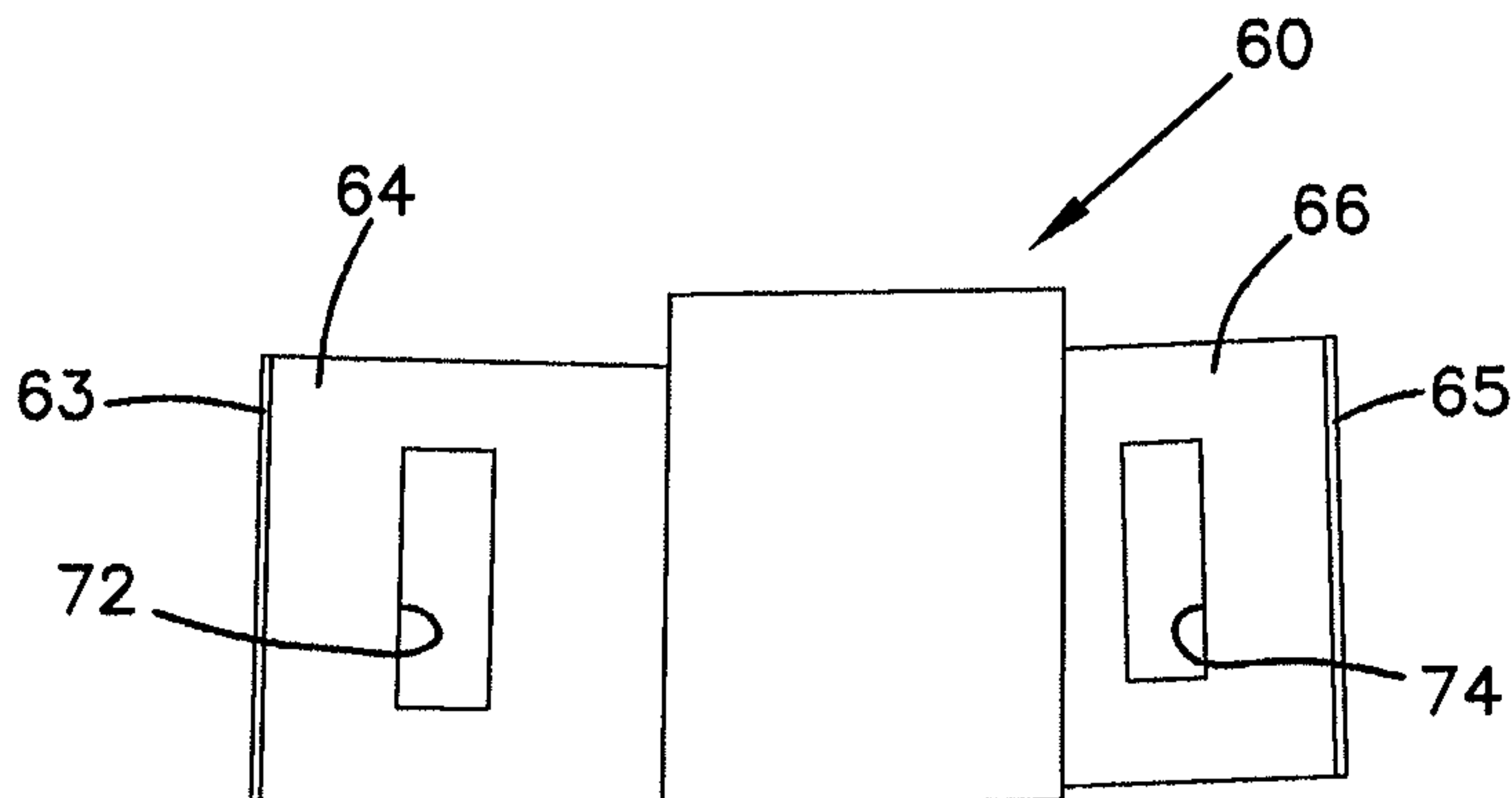


FIG. 8

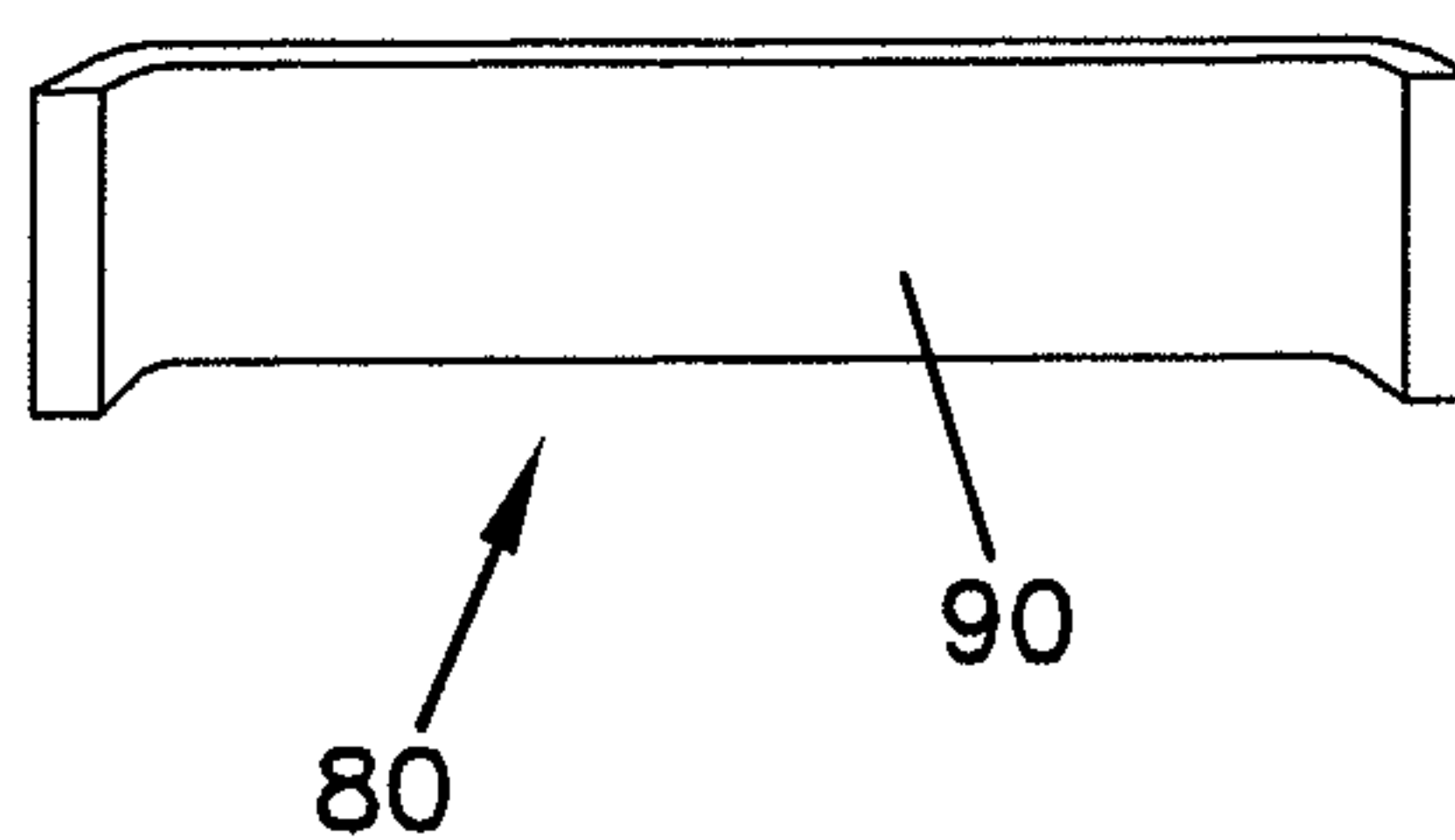


FIG. 10

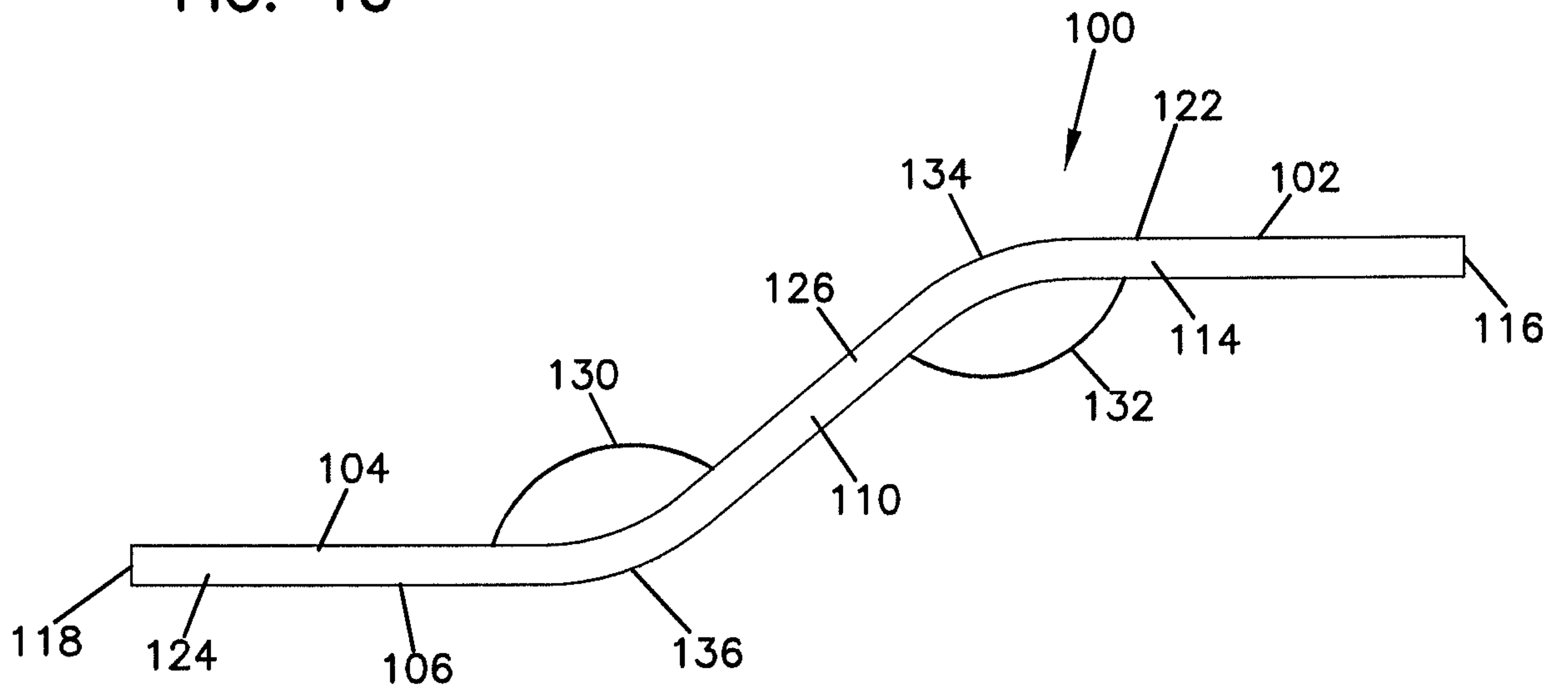


FIG. 11

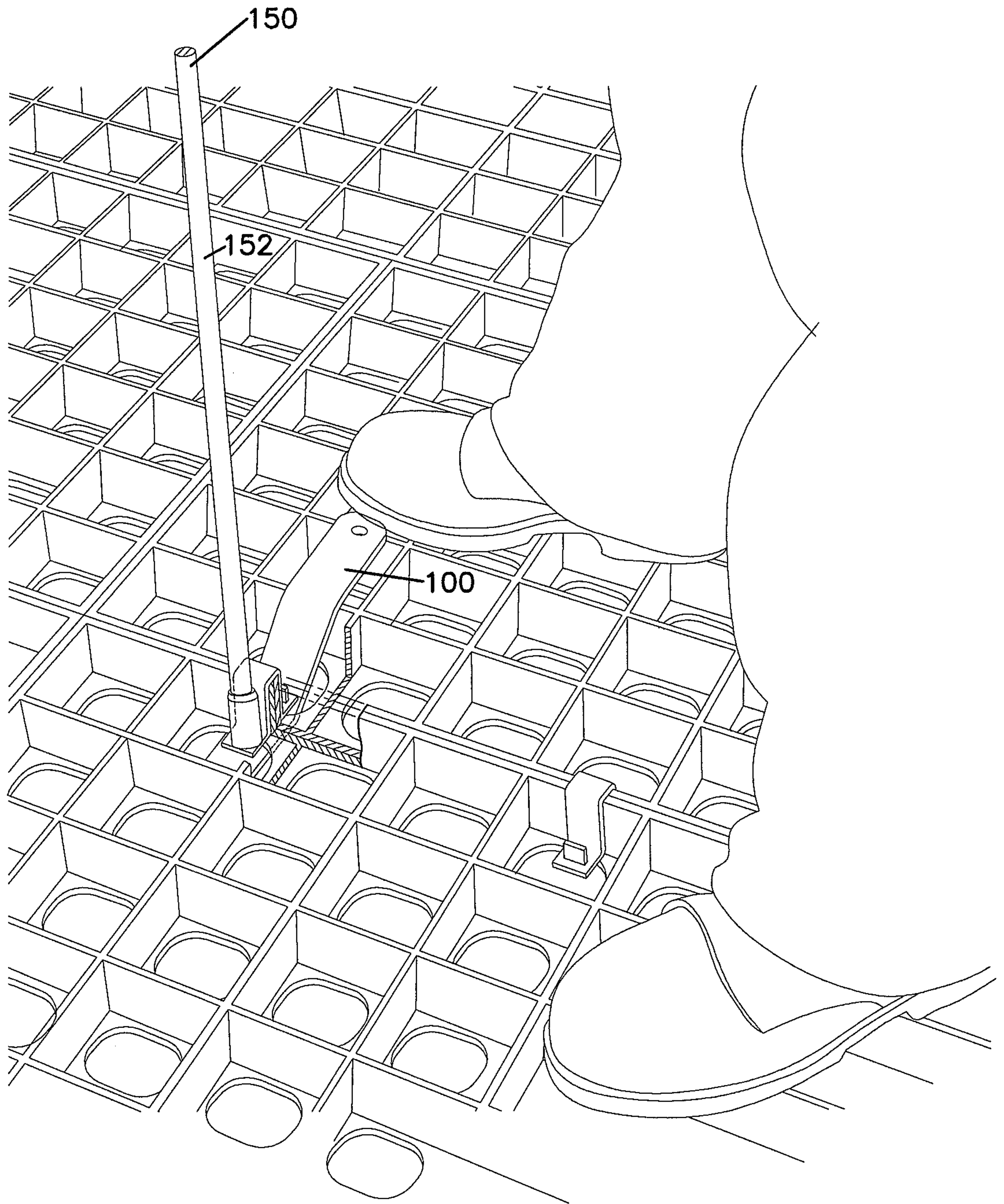


FIG. 13

