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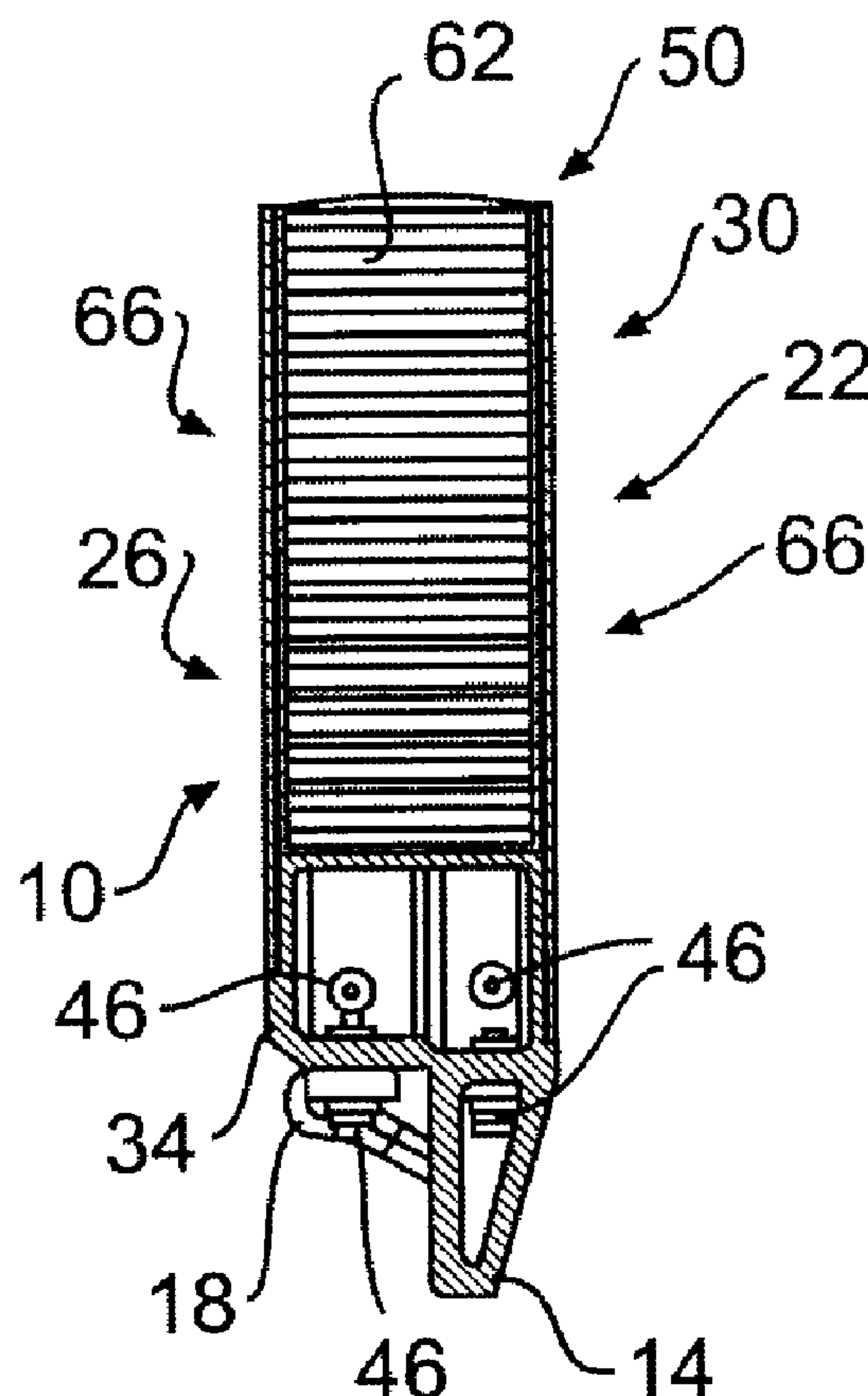
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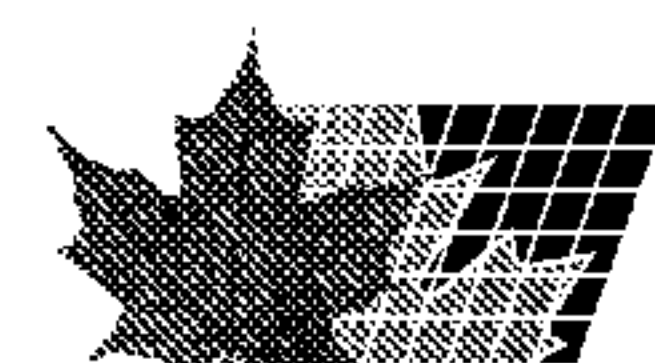
(54) Titre : PALLETTE DE CHARGEMENT ET SA METHODE DE FABRICATION

(54) Title: CARGO PALLET AND METHOD OF MANUFACTURE THEREOF



(57) Abrégé/Abstract:

A reinforced composite material cargo pallet including a core reinforced with two fused opposed layers of thermoplastic material and two opposed layers of aluminum is provided. The core, the layers of thermoplastic material and the two opposed layers of aluminum can be sized and designed to fit into a recess portion defined in the frame.



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**ABSTRACT**

2 A reinforced composite material cargo pallet including a core reinforced with two  
3 fused opposed layers of thermoplastic material and two opposed layers of  
4 aluminum is provided. The core, the layers of thermoplastic material and the two  
5 opposed layers of aluminum can be sized and designed to fit into a recess portion  
6 defined in the frame.

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# 1 CARGO PALLET AND METHOD OF MANUFACTURE THEREOF

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## 3 FIELD OF THE INVENTION

4 [01] This invention relates generally to a cargo pallet for moving objects. More  
5 precisely, the present invention relates to a reinforced composite material  
6 cargo pallet construction and assembly.

## 7 BACKGROUND OF THE INVENTION

8 [02] Cargo pallets are used in the transport industry to ship physical objects.  
9 They are generally used to secure physical objects thereon and provide a  
10 unified container format to handle. Cargo pallets carry physical objects in  
11 transit using various types of transportation. Cargo pallets are used in air cargo  
12 transportation where weight and stiffness is of significant importance. Legacy  
13 cargo pallets are made with materials that make them strong but heavy. It is  
14 therefore desirable to have a cargo pallet that is lighter to move and handle.

15 [03] One way to lighten cargo pallets is to use composites materials in their  
16 construction. Composite materials offer a better strength / weight ratio than  
17 most isotropic materials do. Composites materials are lighter than metals (eg.  
18 aluminum) because they are designed to provide material to sustain  
19 mechanical loads applied thereon. Generally, composite material products are  
20 strong in their overall chemical structure.

21 [04] The use of composite materials in cargo pallets raises some challenges.  
22 The junction between the cargo pallet frame, generally made of aluminum to  
23 sustain dents and shocks, and the remaining structure made of composite  
24 materials face a series of challenges to prevent weakening of the composite  
25 materials and to create a strong and durable structure. Maintenance and

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1 repairs that might be desirable over the life of a cargo pallet raise another set  
2 of considerations.

3 **[05]** Physical tests are performed on cargo pallets to ensure they meet each  
4 mandatory requirement. Some tests are adapted to verify if the cargo pallet  
5 resists impacts and supports a predetermined load. For example, aerospace  
6 standards require a cargo pallet to sustain direct local loads/stresses applied to  
7 some portions of the cargo pallet. The cargo pallet needs to sustain lifting  
8 significant loads and resists accelerations of many G-forces (1G being one  
9 time the Earth's gravity) without suffering significant damages.

10 **[06]** It is therefore desirable to find an improved composite material cargo pallet  
11 over the existing art. It is also desirable to find a composite material that is  
12 prone to support loads that must be supported by a cargo pallet. It is also  
13 desirable to provide an improved cargo pallet frame structure junction with  
14 composite materials portions to ensure a strong assembly and a significant  
15 cargo pallet useful life.

16 **[07]** Other deficiencies will become apparent to one skilled in the art to which the  
17 invention pertains in view of the following summary and detailed description  
18 with its appended figures.

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**MTC-025-016-009-CA1****1 SUMMARY OF THE INVENTION**

2 **[08]** The following presents a simplified summary of the invention in order to  
3 provide a basic understanding of some aspects of the invention. This summary  
4 is not an extensive overview of the invention. It is not intended to identify  
5 key/critical elements of the invention or to delineate the scope of the invention.  
6 Its sole purpose is to present some concepts of the invention in a simplified  
7 form as a prelude to the more detailed description of exemplary embodiments  
8 that is presented later.

9 **[09]** Therefore, the present invention improves at least some of the deficiencies  
10 associated with the drawbacks identified above in accordance with at least one  
11 embodiment of the present invention.

12 **[010]** The present invention provides a cargo pallet including composite materials  
13 therein in accordance with at least one embodiment of the present invention.

14 **[011]** The present invention provides a cargo pallet comprising a floor portion  
15 including composite material made of a plurality of parts joint together by sheet  
16 members in accordance with at least one embodiment of the present invention.

17 **[012]** The present invention provides a cargo pallet comprising a frame portion  
18 including a plurality of tabs assembled or removably attached thereon in  
19 accordance with at least one embodiment of the present invention.

20 **[013]** The present invention provides a cargo pallet including composite materials  
21 with a composite structure that is adapted to better sustain concentrated loads  
22 in accordance with at least one embodiment of the present invention.

23 **[014]** The present invention provides a cargo pallet floor structure including  
24 composite materials adapted to replace a balsa core in accordance with at  
25 least one embodiment of the present invention.

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- 1     **[015]** The present invention provides a variety of means to distribute stresses  
2         applied to a composite wall of a cargo pallet in accordance with at least one  
3         embodiment of the present invention.
- 4     **[016]** The present invention provides a reinforced junction portion between a  
5         frame portion and a composite floor portion of a cargo pallet that comprises a  
6         reinforcement member embedded therein in accordance with at least one  
7         embodiment of the present invention.
- 8     **[017]** The present invention provides a cargo pallet including a floor portion  
9         including composite material therein, the floor portion being covered by a  
10        metallic sheet member sized and designed to be strongly secured to the frame  
11        portion to increase its resistance to mechanical stress applied thereon and to  
12        distribute localized stresses in accordance with at least one embodiment of the  
13        present invention.
- 14    **[018]** The present invention provides a cargo pallet provided with adhesive  
15        between the composite materials portions, the covering sheet portion and the  
16        frame portion to improve cohesion thereof in accordance with at least one  
17        embodiment of the present invention.
- 18    **[019]** The present invention provides a cargo pallet comprising a frame including a  
19        plurality of frame members adapted to receive, in a cavity defined therein, a  
20        composite floor portion and at least one sheet of structural material in  
21        accordance with at least one embodiment of the present invention.

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1     **[020]** The present invention provides inserts disposed in a composite floor portion  
2         that are locally increasing the strength of the composite floor portion and  
3         facilitate the assembly of a frame thereto in accordance with at least one  
4         embodiment of the present invention.

5     **[021]** The present invention provides a reinforced composite floor portion structure  
6         adapted to be used in the construction of a cargo pallet that is using a skin  
7         fiber layer fused with a core portion (e.g. honeycomb core) of the composite  
8         floor core portion that increases the mechanical junction between the skin fiber  
9         layer and the core portion in accordance with at least one embodiment of the  
10        present invention.

11    **[022]** The present invention provides a method of manufacturing a reinforced  
12       composite floor portion adapted to be used in the construction of a cargo pallet  
13       that is using a skin fiber layer that is heated and partially melted before being  
14       compressed with a core portion that is also heated and partially melted to be  
15       fused with the skin fiber layer of the composite floor core portion that increases  
16       the mechanical junction between the skin fiber layer and the core portion in  
17       accordance with at least one embodiment of the present invention.

18    **[023]** The present invention provides a structure and a method of manufacturing a  
19       reinforced composite floor portion adapted to be used in the construction of a  
20       cargo pallet that is using an extended fiber portion of the composite floor  
21       portion to a surface and to cover edges of the composite floor core portion that  
22       increases the shear resistance between the composite floor portion and the  
23       frame in accordance with at least one embodiment of the present invention.

24    **[024]** The present invention provides a structure and a method of manufacturing a  
25       reinforced composite floor portion adapted to be used in the construction of a  
26       cargo pallet that is using a skin fiber layer including about 60% unidirectional  
27       fiberglass and about 40% polypropylene disposed and secured to at least one

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1 face of the floor in accordance with at least one embodiment of the present  
2 invention.

3 **[025]** The present invention provides a composite cargo pallet structure that has  
4 *limited humidity absorption and is fungus resistant in accordance with at least*  
5 *one embodiment of the present invention.*

6 **[026]** The present invention provides a composite cargo pallet that is adapted to  
7 limit liquid inclusion when there is an opening performed in the structure in  
8 accordance with at least one embodiment of the invention.

9 **[027]** The present invention provides a composite cargo pallet that substantially  
10 retains its dry weight even if used in a humid or wet environment in accordance  
11 with at least one embodiment of the invention.

12 **[028]** The present invention provides a termite-resistant cargo pallet in  
13 accordance with at least one embodiment of the invention.

14 **[029]** The present invention provides a substantially dimension-stable cargo pallet  
15 upon significant humidity variation in accordance with at least one embodiment  
16 of the present invention.

17 **[030]** The present invention provides a method of repairing a composite cargo  
18 pallet so that it substantially retains its dry weight even if used in a humid or  
19 wet environment after it has been punctured in accordance with at least one  
20 embodiment of the invention.

21 **[031]** The present invention provides a cargo pallet comprising a composite floor  
22 portion including a core and layers of composite material respectively disposed  
23 on opposed sides of the core, the layers of composite material being adapted  
24 to be fused with the core portion to establish a strong connection  
25 therebetween.

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1     **[032]** The present invention provides method of assembling a cargo pallet, the  
2         method comprising heating at least one side of a core; heating one side of a  
3         composite layer; and assembling the at least one heated side of the core with  
4         the heated side of the composite layer to fuse the core with the composite  
5         layer into a composite floor portion.

6     **[033]** To the accomplishment of the foregoing and related ends, certain illustrative  
7         aspects of the invention are described herein in connection with the following  
8         description and the annexed drawings. These aspects are indicative, however,  
9         of but a few of the various ways in which the principles of the invention may be  
10        employed and the subject invention is intended to include all such aspects and  
11        their equivalents. Other advantages and novel features of the invention may  
12        become apparent from the following detailed description of the invention when  
13        considered in conjunction with the drawings.

14     **BRIEF DESCRIPTION OF THE DRAWINGS**

15     **[034]** Figure 1 is a side elevation view of cargo pallet in accordance with an  
16         embodiment of the present invention;

17     **[035]** Figure 2 is a top plan view of cargo pallet in accordance with an  
18         embodiment of the present invention;

19     **[036]** Figure 3 is a side elevation view of cargo pallet in accordance with an  
20         embodiment of the present invention;

21     **[037]** Figure 4 is a side elevation section view of cargo pallet in accordance with  
22         an embodiment of the present invention;

23     **[038]** Figure 5 is a magnified side elevation view of a portion of a cargo pallet in  
24         accordance with an embodiment of the present invention;

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- 1     **[039]** Figure 6 is a magnified side elevation section view of a portion of a cargo  
2         pallet in accordance with an embodiment of the present invention;
- 3     **[040]** Figure 7 is a magnified section of a frame portion of a cargo pallet in  
4         accordance with an embodiment of the present invention;
- 5     **[041]** Figure 8 is a perspective view of a portion of a frame of a cargo pallet in  
6         accordance with an embodiment of the present invention;
- 7     **[042]** Figure 9 is a perspective view of a portion of a frame of a cargo pallet in  
8         accordance with an embodiment of the present invention;
- 9     **[043]** Figure 10 is a perspective view of a portion of a frame of a cargo pallet in  
10        accordance with an embodiment of the present invention;
- 11    **[044]** Figure 11 is a perspective view of a frame of a cargo pallet in accordance  
12       with an embodiment of the present invention;
- 13    **[045]** Figure 12 is a section view of a composite floor portion of a cargo pallet  
14       comprising a balsa core (left) and a honey comb core (right) in accordance with  
15       an embodiment of the present invention;
- 16    **[046]** Figure 13 is a magnified section of a cut frame and a portion of the exterior  
17       of a cargo pallet in accordance with an embodiment of the present invention;
- 18    **[047]** Figure 14 is a magnified schematic section of a frame of a cargo pallet with  
19       a fiber layers, core and frame assembly in accordance with an embodiment of  
20       the present invention;
- 21    **[048]** Figure 15 is a magnified schematic section of a frame of a cargo pallet with  
22       a fiber layers, core and frame assembly in accordance with an embodiment of  
23       the present invention;

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- 1     **[049]** Figure 16 is a magnified schematic section of a frame of a cargo pallet with  
2         a fiber layers, core and frame assembly in accordance with an embodiment of  
3         the present invention;
- 4     **[050]** Figure 17 is a perspective view of a composite floor portion of a cargo pallet  
5         with a fiber layers, core and frame assembly in accordance with an  
6         embodiment of the present invention;
- 7     **[051]** Figure 18 is a perspective view of a composite floor portion of a cargo pallet  
8         with a fiber layers, core and frame assembly in accordance with an  
9         embodiment of the present invention;
- 10    **[052]** Figure 19 is a perspective view of a composite floor portion of a cargo pallet  
11         with a fiber layers, core and frame assembly in accordance with an  
12         embodiment of the present invention;
- 13    **[053]** Figure 20 is a perspective view of a composite floor portion of a cargo pallet  
14         with a fiber layers, core and frame assembly in accordance with an  
15         embodiment of the present invention;
- 16    **[054]** Figure 21 is a magnified schematic section of a frame and composite floor  
17         portion with a fiber layers, core and frame assembly of a cargo pallet in  
18         accordance with an embodiment of the present invention;
- 19    **[055]** Figure 22 is a magnified schematic section of a frame and composite floor  
20         portion with a fiber layers, core and frame assembly of a cargo pallet in  
21         accordance with an embodiment of the present invention;
- 22    **[056]** Figure 23 is a magnified schematic section of a frame and composite floor  
23         portion with a fiber layers, core and frame assembly of a cargo pallet in  
24         accordance with an embodiment of the present invention;

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- 1     **[057]** Figure 24 is a magnified schematic section of a frame and composite floor  
2         portion with a fiber layers, core and frame assembly of a cargo pallet in  
3         accordance with an embodiment of the present invention;
- 4     **[058]** Figure 25 is a magnified schematic section of a frame and composite floor  
5         portion with a fiber layers, core and frame assembly of a cargo pallet in  
6         accordance with an embodiment of the present invention;
- 7     **[059]** Figure 26 is a magnified schematic section of a frame and composite floor  
8         portion with a fiber layers, core, inserts and frame assembly of a cargo pallet in  
9         accordance with an embodiment of the present invention;
- 10    **[060]** Figure 27 is a magnified schematic section of a frame and composite floor  
11         portion with a fiber layers, core, inserts and frame assembly of a cargo pallet in  
12         accordance with an embodiment of the present invention;
- 13    **[061]** Figure 28 is a magnified schematic section of a frame and composite floor  
14         portion with a fiber layers, core, inserts and frame assembly of a cargo pallet in  
15         accordance with an embodiment of the present invention;
- 16    **[062]** Figure 29 is a magnified schematic section of a frame and composite floor  
17         portion with a fiber layers, core, inserts and frame assembly of a cargo pallet in  
18         accordance with an embodiment of the present invention;
- 19    **[063]** Figure 30 is a magnified schematic section of a frame and composite floor  
20         portion with a fiber layers, core and frame assembly of a cargo pallet in  
21         accordance with an embodiment of the present invention;
- 22    **[064]** Figure 31 is a magnified schematic section of a frame and composite floor  
23         portion with a fiber layers, core and frame assembly of a cargo pallet in  
24         accordance with an embodiment of the present invention;

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- 1     **[065]** Figure 32 is a magnified schematic section of an isolated skin layer of a  
2         cargo pallet in accordance with an embodiment of the present invention;
- 3     **[066]** Figure 33 is a magnified schematic section of a frame and composite floor  
4         portion assembly of a cargo pallet in accordance with an embodiment of the  
5         present invention;
- 6     **[067]** Figure 34 is a schematic view of a portion of a composite wall member with  
7         reinforcements layouts therein in accordance with embodiments of the  
8         invention;
- 9     **[068]** Figure 35 illustrates a cargo pallet including a plurality of assembled floor  
10        portions in accordance with an embodiment of the invention;
- 11    **[069]** Figure 36 illustrates a cargo pallet including a plurality of assembled floor  
12        portions in accordance with an embodiment of the invention;
- 13    **[070]** Figure 37 illustrates a magnified portion of a cargo pallet including a plurality  
14        of assembled floor portions with expansion members (wedges) therebetween  
15        in accordance with an embodiment of the invention;
- 16    **[071]** Figure 38 illustrates a plurality of expansion members located in a cargo  
17        pallet including a plurality of floor portions in accordance with an embodiment  
18        of the invention;
- 19    **[072]** Figure 39 illustrates a cargo pallet including a plurality of floor portions in  
20        accordance with an embodiment of the invention;
- 21    **[073]** Figure 40 illustrates an elevational section view of a cargo pallet including a  
22        plurality of assembled floor portions in accordance with an embodiment of the  
23        invention;

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1     **[074]** Figure 41 illustrates a magnified portion of a section view of a cargo pallet  
2         including a plurality of expanded floor portions in accordance with an  
3         embodiment of the invention; and

4     **[075]** Figure 42 is a schematic view of an expansion member disposed between  
5         two floor portions in accordance with an embodiment of the invention.

6     **DESCRIPTION OF EMBODIMENT(S) OF THE INVENTION**

7     **[076]** The present invention is now described with reference to the drawings,  
8         wherein like reference numerals are used to refer to like elements throughout.  
9         In the following description, for purposes of explanation, numerous specific  
10        details are set forth in order to provide a thorough understanding of the present  
11        invention. It may be evident, however, that the present invention may be  
12        practiced without these specific details. In other instances, well-known  
13        structures and devices are shown in a schematic form in order to facilitate the  
14        description of the present invention.

15    **[077]** A cargo pallet adapted to be used, for example, in the aeronautical industry  
16        is illustrated in Figures 1 through Figure 4. Figure 1 is a side elevation view of  
17        an exemplary cargo pallet 10. The cargo pallet 10 has a relatively planar shape  
18        adapted to receive and secure thereon physical objects to be transported. The  
19        cargo pallet 10 periphery is equipped with a series of laterally extending tabs  
20        14 and a plurality of anchoring elements 18. The laterally extending tabs 14 are  
21        generally used to reinforce the cargo pallet 10 and also to act as a ramp, or a  
22        “ski-like” edge, when the cargo pallet 10 is moved on the ground or on the  
23        floor. The tabs 14 are also used to secure the pallet 10 on the floor of the  
24        vehicle, particularly the floor of an aircraft having proper standard securing  
25        equipment, during transportation. Tabs 14 are spaced apart from one another  
26        to allow securing anchoring elements 18 therebetween. The anchoring  
27        elements 18 are illustratively equidistantly disposed on the cargo pallet 10 in

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1 an exemplary configuration adapted to secure physical objects on the cargo  
2 pallet 10 from various directions thereof.

3 **[078]** The cargo pallet 10 includes a bottom surface 22, adapted to face the  
4 ground, and an upper surface 26, as best seen in Figure 2, adapted to face up,  
5 support and secure thereon physical objects to be transported with the cargo  
6 pallet 10. The bottom surface 22 and the upper surface 26 are associated with  
7 a composite material floor 30 bordered by a frame 34. The frame 34 reinforces  
8 and protects the composite material floor 30 in addition to adding strength to  
9 the composite material floor 30. The frame 34 of the exemplary embodiments  
10 illustrated in Figure 1 through Figure 5 is composed of several individual frame  
11 members 38 secured together by a securing member 42. The frame members  
12 38 of the illustrative embodiment are manufactured with an aluminum extrusion  
13 process and at using light weight aluminum. The securing member 42 and the  
14 anchoring elements 18 are secured to the frame with rivets 46 or fasteners (not  
15 illustrated in the Figures). The individual frame members 38 are assembled in  
16 the corners of the cargo pallet 10 in the illustrated embodiment and can be  
17 alternatively assembled differently in other embodiments.

18 **[079]** The composite material floor 30 is made of several components 50 that will  
19 be discussed in details below. The section view of the composite material floor  
20 30 illustrated in Figure 4 depicts two illustrative portions 54, 58 where some  
21 components 50 are assembled to cover the entire surface of the composite  
22 material floor 30. It might be desirable to juxtapose some components 50 in the  
23 composite material floor 30 when components 50 are smaller than the entire  
24 surface of the floor 30 or when components 50 large enough to cover the entire  
25 surface of the floor 30 would likely be significantly more expansive. Using a  
26 plurality of components 50 would then likely be a less expansive option.

27 **[080]** Figure 6 depicts a section view of a portion of the cargo pallet 10. The  
28 bottom surface 22 and the upper surface 26 are separated by a foam core 60,

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1 or, preferably, a honeycomb core 62, and several layers of side materials 66  
2 adapted to form a strong unitary structure. Figure 6 also illustrates the  
3 fastening mechanism used to secure the anchoring element 18 to the frame  
4 34. One can appreciated from the embodiment of Figure 6 that rivets 46 are  
5 secured through a wall of the frame 34. Figure 5 more clearly shows the  
6 securing member 42 riveted to two adjacent frame members 38 to hold the  
7 frame members 38 together.

8 **[081]** We turn now to Figure 7 which shows a section view of a frame member 38.  
9 The embodied frame member 38 is manufactured with aluminum extrusion  
10 members and its shape includes hollowed portions 70 to reduce the amount of  
11 materials and provide a lightweight frame member 38. A series of radiuses 74  
12 are used to prevent stress concentrations on various portions of the frame  
13 member 38. A chamfer 39 is also used to remove unnecessary material from  
14 the frame member 38. Two opposite walls are provided with recessed portions  
15 82. These recessed portions 82 are adapted to receive side materials 66  
16 therein while keeping an even thickness over the entire surfaces 22, 26 of the  
17 cargo pallet 10 and more particularly on the sides of the frame members 38 to  
18 prevent having any protruding edges thereof.

19 **[082]** Tabs 14 are separated by openings 86 that are generally machined to  
20 further remove weight and define area over the sides of the cargo pallet to  
21 secure anchoring elements 18, not visible in Figure 8, or other elements.  
22 Figure 9 through Figure 11 illustrate a corner of the cargo pallet 10 with  
23 magnified details thereof.

24 **[083]** The “sandwich assembly” of a series of materials is illustrated in  
25 embodiments of Figure 12. In the embodiment on the left one can appreciate a  
26 foam core 60 between two sheets of aluminum 90 used as side material 66.  
27 The embodiment on the right uses a honeycomb core 62 secured between two  
28 sheets of aluminum 90 used as side material 66 protecting the core 62 from

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1 shocks and dents. The embodiments presented in Figure 12 are illustratively  
2 not using a plurality of side materials 66. A series of layers of various materials  
3 like fiberglass sheet, carbon fiber sheet or reinforced thermoplastic sheets are  
4 examples of materials usable therein. More complex arrangement of materials  
5 will be discussed below.

6 **[084]** The honeycomb core 62 used in embodiments therein has a property that  
7 prevents the honeycomb core 62 to absorb humidity and therefore prevents an  
8 increase in weight. The honeycomb core 62 does not significantly extend or  
9 retract in reaction to a temperature change. This is desirable to keep a  
10 significantly constant cargo pallet 10 dimension. Further, the honeycomb core  
11 62 resists termites. This is not the case for a balsa (wood) core that also  
12 significantly adds on weight when influenced by humidity. An alternate section  
13 view of a frame 34 and floor 30 panel is illustrated in Figure 13 where it is  
14 possible to see the interaction between the recessed portions 82 and the side  
15 material 66 of the floor 30 panel.

16 **[085]** Moving now to Figure 14, where an assembly embodiment having a tab 14  
17 assembled to the frame 34, as opposed to the previous embodiments  
18 displaying tabs 14 that are formed with the frame 34, can be appreciated. The  
19 assembled tabs 14 are secured to the frame 34 with a dovetail 94.  
20 Alternatively, fasteners could replace the dovetail 94.

21 **[086]** Figures 15 and 16 illustrate an embodiment assembly including a  
22 honeycomb core 62 surrounded by a coat of adhesive 98, a layer of reinforced  
23 thermoplastic material 102, another coat of adhesive 98 and a layer of sheet  
24 metal 106 that can be a sheet of aluminum 90. All this assembled, compressed  
25 and cured as illustrated in Figure 16 to provide a mechanically strong floor 30.  
26 The thermoplastic sheet material 102 could be replaced with fiberglass-  
27 polypropylene sheet material in another embodiment. Additionally, a layer of  
28 primer can be applied between the sheet metal 106, the reinforced

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1 thermoplastic sheet material 102 and the aluminum frame 34 to fuse both  
2 materials and obtain superior strength.

3 **[087]** The thermoplastic material 102 is generally applied on both sides of the floor  
4 30 to increase its strength. As it can better be appreciated from Figure 17  
5 through Figure 20, the thermoplastic material 102 can be assembled as a  
6 sheet material bonded on both sides of a honeycomb core 62. One  
7 embodiment provides an extended length 100 of the thermoplastic material  
8 102 on one side of the honeycomb core 62 that can be folded 114 on the side  
9 portion 118 of the core 62. The length 100 of the continuous extended length of  
10 the thermoplastic material 102 is adapted to cover the entire side portion 118  
11 of the core 62 in an embodiment. Other structural arrangements will be  
12 described in more details below.

13 **[088]** Another embodiment uses two skin layers of fiberglass and polypropylene  
14 sheet fused on each side of a honeycomb core 62. The skin layer is heated  
15 and partially melted. The honeycomb core 62 is also heated and partially  
16 melted on each side. The skin layers are then assembled on each side of the  
17 honeycomb core 62 and compressed together to fuse the materials at their  
18 melted boundary. The fused assembly provides significant strength given the  
19 thus created material continuity. A plurality of skin layers can be used and  
20 assembled to provide additional strength.

21 **[089]** The extended length of the thermoplastic material 102 adapted to cover the  
22 entire side portion 118 of the honeycomb core 62 is used to transfer the load  
23 and the shear forces between the honeycomb core 62 and the thermoplastic  
24 material 102 assembly to the frame 34. The extended sheet of thermoplastic  
25 material 102 is preferably disposed on the side of the floor 30 facing the  
26 ground such that a loaded cargo pallet 10 will increase tension on the  
27 extended sheet of thermoplastic material 102. The folded extended length 100  
28 of thermoplastic material being strongly connected to an adjacent side of the

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1 frame 34 to transfer the load of the cargo pallet 10 in shear to the frame 34  
2 increases the bond between the composite material floor portion 30 and the  
3 frame 34. The same extended length 100 can be provided on all sides of the  
4 honeycomb core 62 to equally transfer the load to their respective adjacent  
5 frame 34 as it can be appreciated in Figure 18. It can be appreciated from the  
6 embodiment illustrated in Figure 17 through Figure 20 that the thermoplastic  
7 material 102 can be replaced by other fiber charged plastic, polypropylene or  
8 fiberglass and resin without departing from the scope of the present invention.  
9 A preferred ratio of an embodiment of the invention is about 60% fibers and  
10 about 40% polypropylene. Also, the folded extended length 100 of  
11 thermoplastic material 102 is forming a radius 122 with the planar surface of  
12 the floor 30 to prevent damaging fibers therein. A portion 126 of the  
13 thermoplastic material 102 is removed to only leave sufficient material to cover  
14 the side portions 118 of the honeycomb core 62.

15 **[090]** Turning now to Figure 21 where one can appreciate an additional possible  
16 embodiment of the invention having a honeycomb core 62 and a layer of  
17 thermoplastic material 102 inserted in a recess portion 130 defined in the  
18 frame member 38. Sheets of aluminum 90 are disposed on each side of the  
19 floor 30; one is abutting the frame member 38 and the other aluminum sheet  
20 90 above is superposed to the frame 38. The recess portion 130 improves the  
21 load shear transfer between the honeycomb core 62 and the frame member  
22 38.

23 **[091]** Another embodiment is illustrated in Figure 22 where the honeycomb core  
24 62 and the two opposed layers of thermoplastic material 102 are inserted in the  
25 recess portion 130 while the two opposed sheets of aluminum 90 are disposed  
26 on opposite sides of the layers of thermoplastic material 102 and are received  
27 in respective recessed portions 82 of the frame member 38.

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- 1     **[092]** Both layers of thermoplastic material 102 can have their respective folded  
2         extended length 100 of thermoplastic material 102, as illustrated in Figure 23,  
3         in order to increase even more the load transfer between the honeycomb core  
4         62 and the frame member 38. The folded extended lengths 100 are folded one  
5         on top of the other to both interconnect the two layers of thermoplastic material  
6         102 together and seal the honeycomb core 62 with thermoplastic material 102.
- 7     **[093]** Figure 24 illustrates another possible embodiment substantially similar to  
8         the embodiment illustrated in Figure 23. This time, however, an additional  
9         mechanical fastening of the honeycomb core 62 and the floor portion with the  
10        frame member 38 is presented. In so doing, a fastener 134 is inserted in a hole  
11        provided through the frame member 38 and the layers of thermoplastic  
12        material 102 to reach a receiving member 138 disposed within the layers of  
13        thermoplastic material 102 next (or embedded in) the honeycomb core 62. The  
14        fastener 134 is then capable to further mechanically secure the honeycomb  
15        core 62 and the layers of thermoplastic material 102 to the frame 38. The  
16        receiving member 138 can be made of either plastic material or metallic  
17        material suitable to sustain the strength applied thereto by the treads of the  
18        fastener 134. The receiving member 138 has an other role as it acts as a  
19        shear-resistant element given its position aligned with the shearing plane  
20        defined by the edge of the frame member 38. The receiving member 138 has a  
21        mechanical resistance to shear that is greater than the resistance of the  
22        honeycomb core 62; it offers additional resistance to the assembly. The  
23        receiving member 138 can have a different shape and size adapted to support  
24        the load applied to the cargo pallet 10. A plurality of fasteners 134 can be used  
25        on the periphery of the frame 34.
- 26    **[094]** Both the layers of thermoplastic material 102 and the sheets of aluminum 90  
27        can abut the protruding sides 132 of the frame member 38 while the  
28        honeycomb core 62 is inserted inside the recessed portion 130 of the frame  
29        member 38 as it is exemplified in Figure 25.

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1     **[095]** Figure 26 illustrates a honeycomb core 62 with a length 100 of thermoplastic  
2         material 102 equipped with an insert 146 therein. The insert 146 can be a  
3         piece of plastic, nylon, wood, aluminum or it can be made with other materials  
4         adapted to be secured with the honeycomb core 62; it offers a transversal  
5         reinforcement thereof between the two surfaces 22, 26 of the cargo pallet 10.  
6         This is desirable to add additional transversal strength to use fasteners (not  
7         illustrated in the Figure) to tie and secure a plurality of layers of the cargo pallet  
8         10. The insert 146 can accommodate a hole 150 therein to allow a fastener  
9         therethrough. The fastener can be used through the frame 34, the  
10        thermoplastic material 102 to further secure the honeycomb core 62 to the  
11        frame 34 as it can be appreciated from Figure 29.

12    **[096]** Figure 27 depicts an example of an insert 146 located in the honeycomb  
13        core 62 and adapted to be inserted with the surrounding honeycomb core 62  
14        inside the recessed portion 130 of the frame 34 (not illustrated in Figure 27).  
15        The hole 150 in the insert 146 will be used in that embodiment to secure the  
16        portion of the honeycomb core 62 and a portion of the thermoplastic material  
17        102 to the frame 34 with a fastener (not illustrated). One can appreciate that  
18        the sheet of aluminum 90 ends before the side of the honeycomb core 62 and  
19        is adapted to abut the side of the protruding portion 130 extending from the  
20        frame 34 as it is visible in Figure 29.

21    **[097]** Figure 28 depicts an embodiment of the honeycomb core 62 and the  
22        thermoplastic material 102 sheets assembly with a plurality of inserts 146  
23        therein. This layout is configured to be secured to a peripheral frame 34 with  
24        fasteners (not illustrated) all around the floor assembly 30. Layers of aluminum  
25        sheet material 90 can be added on each side of the floor 30 illustrated in  
26        Figure 28. One can appreciated from Figure 28 that the corners 154 of the floor  
27        assembly 30 are provided with inserts 146 having a different shape. The corner  
28        inserts 158 are shaped in "L" to ensure a good connection on both sides of the  
29        corner of the floor assembly 30 and are also including a plurality of holes 150

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1        therein to receive a plurality of fasteners therethrough. Figure 29 depicts a  
2        section view of an exemplary assembly with an insert 146 with a fastener 162  
3        therein securing the frame 38 with the honeycomb core 62 and the associated  
4        layers of thermoplastic material 102.

5        **[098]** Figure 30 illustrates an embodiment of the invention using a frame 38 with  
6        recessed portions 82 on each side thereof adapted to accommodate the  
7        sheets of aluminum 90 disposed on each side thereof.

8        **[099]** Figure 31 illustrates an embodiment of the invention where the sheets of  
9        aluminum 90 are formed 166 with an embossed portion to fit into the recessed  
10       portion 130 of the frame 34. In this embodiment the honeycomb core 62 is also  
11       contracted at its end to provide enough space to fit the aluminum sheet 90, the  
12       thermoplastic material 102 sheet and the honeycomb core 62 assembly in the  
13       recessed portion 130 defined in the frame 38. It is possible to appreciate that  
14       the thermoplastic material 102 is also formed 166 to follow the assembly and  
15       allow an even exterior surface continuity between the aluminum sheet 90 and  
16       the exterior side of the frame 34. Figure 32, in turn, illustrates an isolated  
17       formed portion 166 of the aluminum sheet 90.

18       **[0100]**        A two-faced tape 170 is used in the embodiment of Figure 33 to  
19       further secure the thermoplastic material 102 to the honeycomb core 62.  
20       Alternatively, the two-faced tape 170 (sticky on both sides thereof) can be used  
21       to secure the sheet of aluminum 90 to the thermoplastic material 102. Also, the  
22       two-faced tape 170 can be used to secure the sheet of aluminum 90 to the  
23       thermoplastic material 102 and the two-faced tape 170 can be used to secure  
24       the sheet of aluminum 90 to the thermoplastic material 102 to the honeycomb  
25       core 62. An additional spacer 174 is also illustrated to provide a stronger  
26       fastening force to the anchoring elements 18 through the frame 34. What is the  
27       element drawn in the center of the additional spacer 174?

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- 1     **[0101]**       Additionally, Figure 34 illustrates that the frame 34 can be separated  
2       into two to facilitate the insertion of the honeycomb core 62 and the layers of  
3       materials 90, 102 therein. An embodiment separates 180 the frame 34 into two  
4       distinct frame portions, in the middle of two opposed frame members 38 and  
5       another embodiment separates the frame 34 in two 190 across the corners of  
6       the frame 34. The honeycomb core 62 and the layers of materials 90, 102 are  
7       fitted and pressed against the frame portions, or in a cavity defined therein, by  
8       securing the distinct frame portions together.
- 9     **[0102]**       Figure 35 provides another embodiment where a honeycomb core  
10      62, and its associated layers of materials 90, 102 are separated in smaller  
11      portions if they are too large to be manufactured in one piece, or if they are  
12      simply more expansive to manufacture in their complete size. Figure 35  
13      illustrates a cargo pallet 10 having a honeycomb core 62, with its associated  
14      layers of thermoplastic material 102, separated, for instance, in four floor  
15      portions 30.1, 30.2, 30.3 and 30.4. The floor portions 30.1 through 30.4 can  
16      conveniently be smaller than the complete size of the floor 30 because they  
17      are easier to manufacture in smaller sizes than in larger sizes. They can also  
18      be easier to install and secure into the circumventing frame 34.
- 19    **[0103]**       The present embodiment uses four floor portions 30.1 through 30.4  
20      having a similar size and a square shape, however, the floor portions 30.1  
21      through 30.4 could be manufactured with different sizes and have other  
22      suitable shapes without departing from the scope of the present disclosure.
- 23    **[0104]**       The floor portions 30.1, 30.2, 30.3 and 30.4 need to be expanded  
24      against the frame members 38 to ensure sufficient mechanical contact  
25      therewith. Wedges, or other suitable expansion members 200, are inserted and  
26      pressed between two adjacent floor portions 30.1, 30.2, 30.3 and 30.4 that  
27      create a pressure with the opposed floor portions 30.1, 30.2, 30.3, 30.4 against  
28      opposite frame members 38.

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1     **[0105]**       Figure 36 illustrates the magnified portion thereof illustrated in Figure  
2       37. One can appreciate from Figure 37 four expansion members 200 inserted  
3       between the floor portions 30.1, 30.2, 30.3, 30.4. Referring now to Figure 38  
4       illustrating isolated expansion members 200 without the floor portions 30.1,  
5       30.2, 30.3, 30.4. The layout of the floor portions 30.1, 30.2, 30.3, 30.4 is  
6       dictated by the shape and the number of the floor portions 30.1, 30.2, 30.3,  
7       30.4 and can be different from other floor portions 30.1, 30.2, 30.3, 30.4  
8       configurations (not expressly identified in the Figures although it is believed a  
9       skilled reader will understand they are components of the frame 30).

10    **[0106]**       Figure 41 is a magnified section view of a portion of the cargo pallet  
11       10 illustrated in Figure 39 and Figure 40. One can appreciate from Figure 41  
12       that an expansion member 200 is fitted between two floor portions 30.1 and  
13       30.2. The expansion members 200 are pressed into position between the floor  
14       portions 30.1 and 30.2, which are composed of their respective honeycomb  
15       core 62 and opposed layers of thermoplastic material 102. The expansion  
16       members 200, made of wood, plastic, aluminum or other suitable material, can  
17       extend through the thickness of the floor portions 30.1 and 30.2 and are cut  
18       204 after installation to ensure that they are properly fit in the floor 30. Once  
19       the expansion members 200 are cut, the sheet of aluminum 90 is secured over  
20       the layers of thermoplastic material 102, as it can be appreciated in Figure 41,  
21       to cover the junctions between the floor portions 30.1, 30.2, 30.3, and 30.4 the  
22       expansion members 200 to seal the floor 30 and increase the overall strength  
23       thereof. The sheet of aluminum 90 can be glued, secured with fasteners or  
24       rivets, as explained above, to the frame 34 to create a unitary assembly.

25    **[0107]**       Figure 42 is a magnified portion of two distinct floor portions with  
26       intervening expansion members 200 therebetween.

27    **[0108]**       The description and the drawings that are presented above are  
28       meant to be illustrative of the present invention. They are not meant to be

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- 1 limiting of the scope of the present invention. Modifications to the
- 2 embodiments described may be made without departing from the present
- 3 invention, the scope of which is defined by the following claims:

**MTC-025-016-009-CA1****1 [01] What is claimed is:**

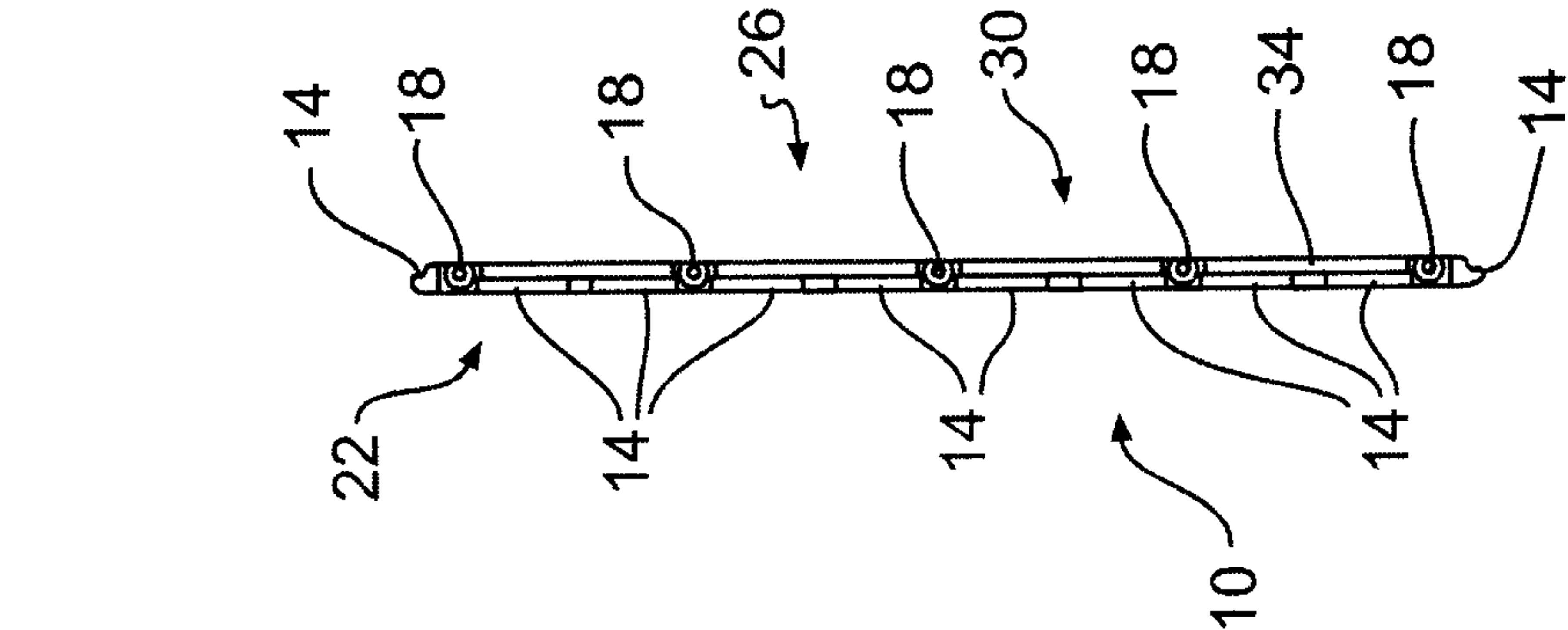
- 2 1. A cargo pallet comprising a composite floor portion including a core and  
3 layers of composite material respectively disposed on opposed sides of the core,  
4 the layers of composite material being adapted to be fused with the core portion to  
5 establish a strong connection therebetween.
- 6 2. The cargo pallet of claim 1, wherein the layers of composite material include  
7 fibers and thermoplastic materials.
- 8 3. The cargo pallet of any of claims 1 and 2, wherein the cargo pallet further  
9 comprises a frame made of extruded aluminum circumventing the floor portion.
- 10 4. The cargo pallet of claim 3, wherein the circumventing frame includes  
11 extending tabs assembled thereto.
- 12 5. The cargo pallet of any of claims 1 to 4, wherein at least one external skin  
13 extends substantially over at least one edge of the composite floor portion.
- 14 6. The cargo pallet of claim 5, wherein at least one of the layers of composite  
15 material includes a radius thereof substantially at an angular surfaces transition  
16 between surfaces.
- 17 7. The cargo pallet of any of claims 1 to 6, wherein at least one of the layers of  
18 composite material include glass fibers and polypropylene.
- 19 8. The cargo pallet of claim 7, wherein the at least one of the layers of  
20 composite material includes a ratio of about 60% fibers and 40% polypropylene.
- 21 9. The cargo pallet of any of claims 1 to 8, wherein the floor portion includes a  
22 plurality of sub floor portions adapted to be juxtaposed from one another in a  
23 substantially planar fashion.

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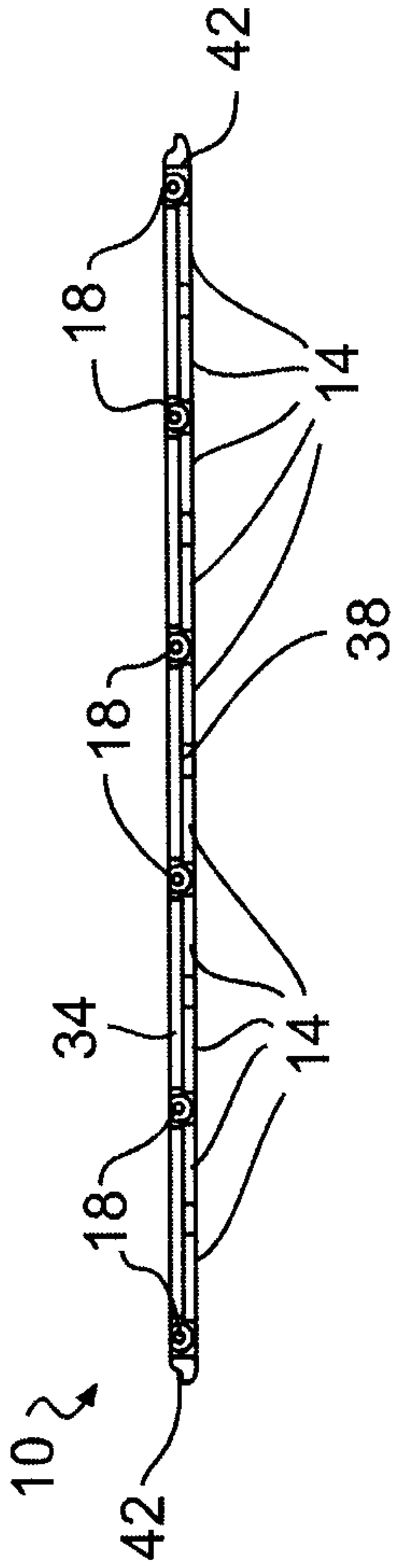
- 1 10. The cargo pallet of claim 9, wherein at least some of the plurality of floor  
2 portions is separated by a plurality of expansion members adapted to spaced apart  
3 adjacent floor portions against a circumventing frame.
- 4 11. The cargo pallet of any of claims 1 to 10, wherein the floor portion is  
5 covered by an additional sheet member.
- 6 12. The cargo pallet of any of claims 1 to 11, wherein the core is adapted to  
7 receive therein inserts adapted to distribute localized mechanical stresses applied  
8 to the floor portion.
- 9 13. A method of assembling a cargo pallet, the method comprising:  
10 heating at least one side of a core;  
11 heating one side of a composite layer; and  
12 assembling the at least one heated side of the core with the heated side of  
13 the composite layer to fuse the core with the composite layer into a composite floor  
14 portion.
- 15 14. The method of claim 13, further comprising assembling the composite floor  
16 portion with a frame member adapted to surround the composite floor portion.
- 17 15. The method of claim 14, wherein the composite floor portion is a plurality of  
18 floor portion, the method further comprising  
19 assembling at least two floor portions within the frame member and the  
20 composite floor; and  
21 inserting at least one expansion member between two adjacent floor  
22 portions to space apart the two adjacent floor portions.
- 23 16. The method of any of claims 13 to 15, further securing an additional layer of  
24 sheet material over the composite layer to protect the composite layer.

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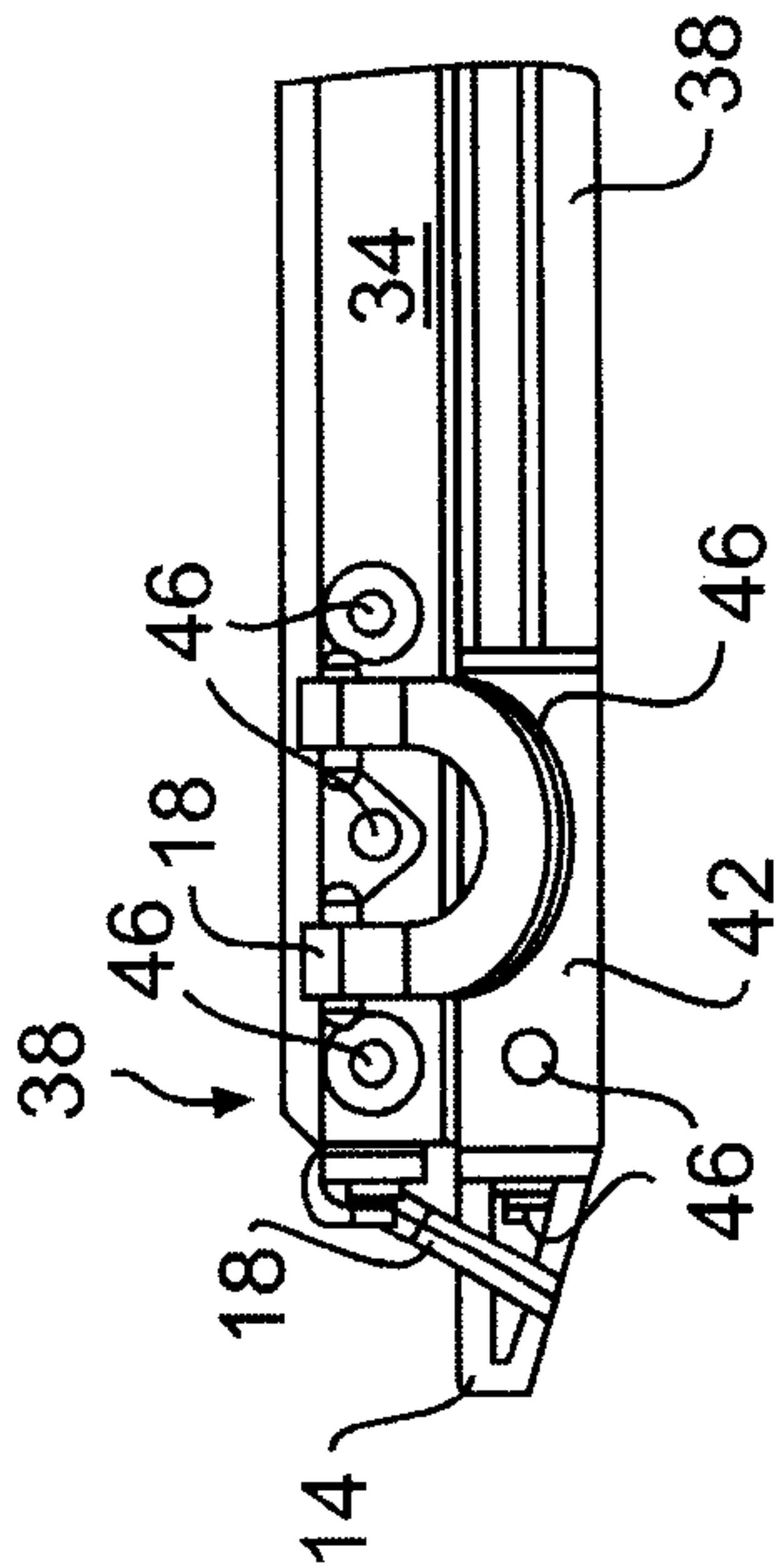
- 1 17. The method of any of claims 13 to 16, further including at least one insert  
2 inside the core.
- 3 18. The method of any of claims 13 to 17, further bending at least one side of  
4 the composite layer to cover at least one side of the core to transfer normal shear  
5 stress to the composite layer.
- 6 19. The method of claim 18, further bending at least one side of the composite  
7 layer to cover at least one side of the core to transfer normal shear stress to the  
8 composite layer.
- 9
- 10



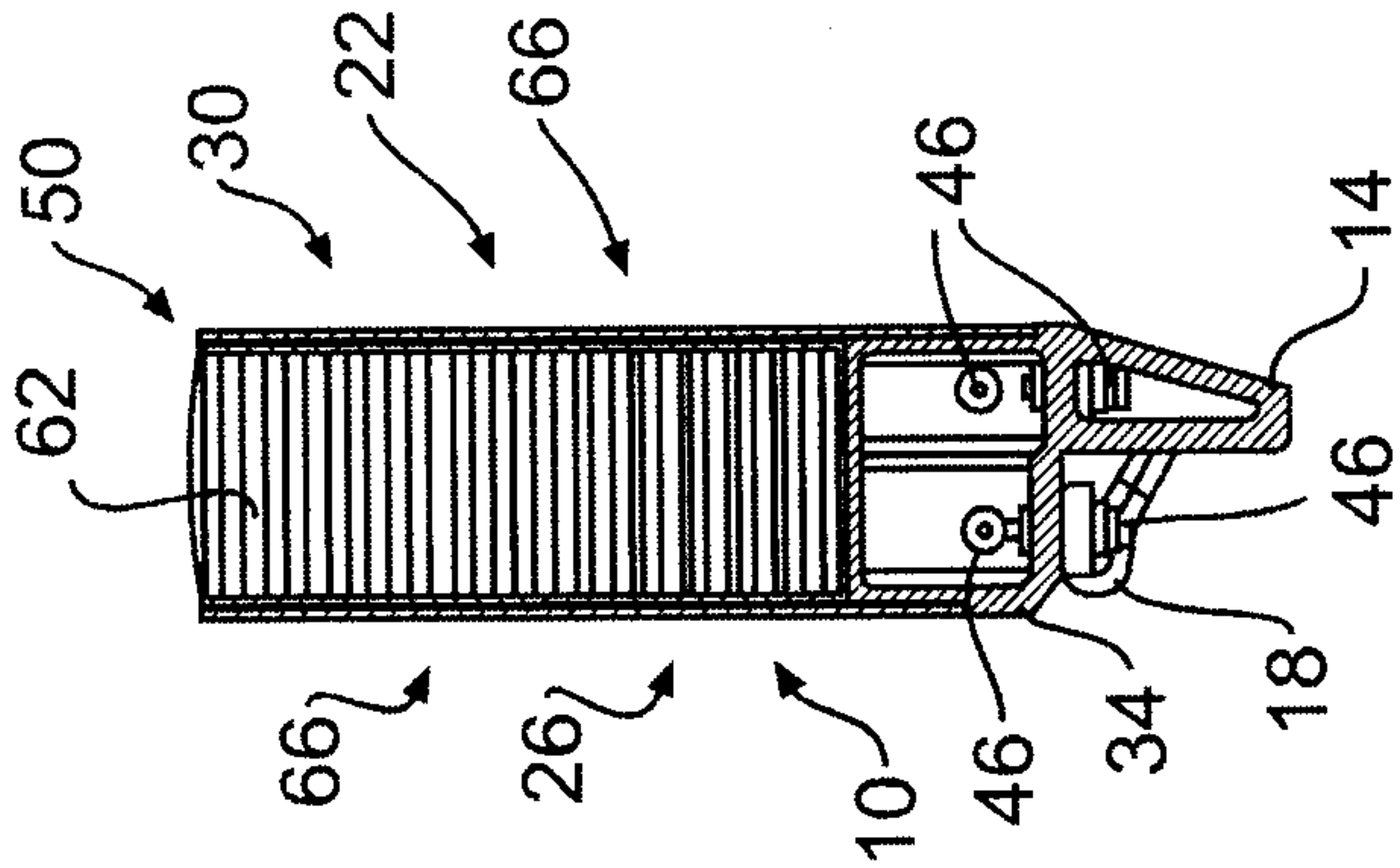
**FIG. 1**



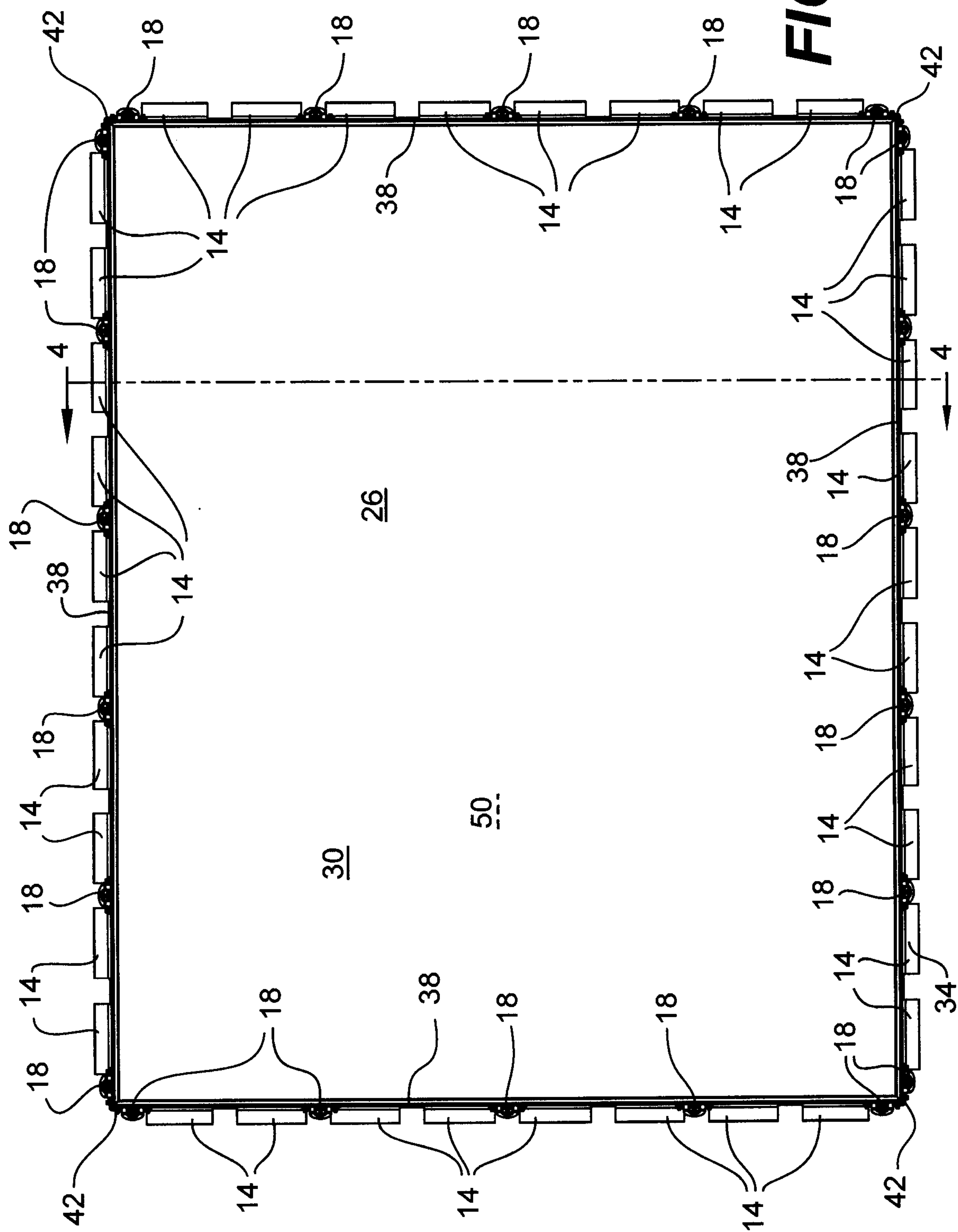
**FIG. 3**



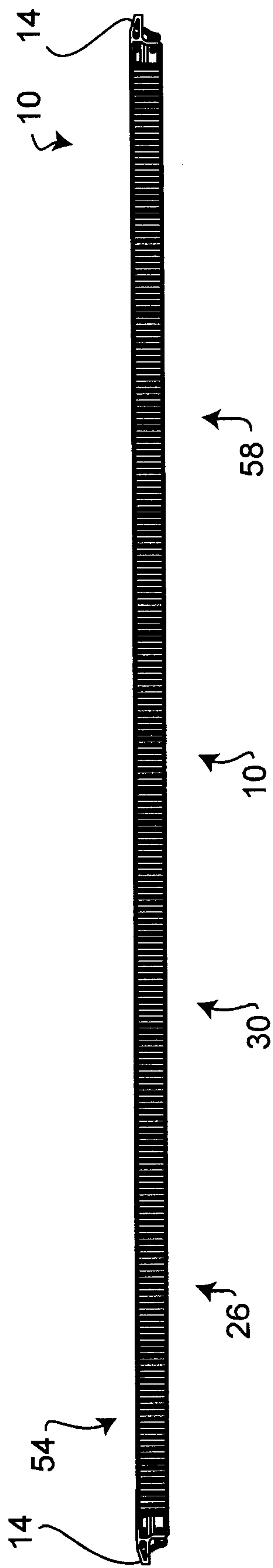
**FIG. 5**



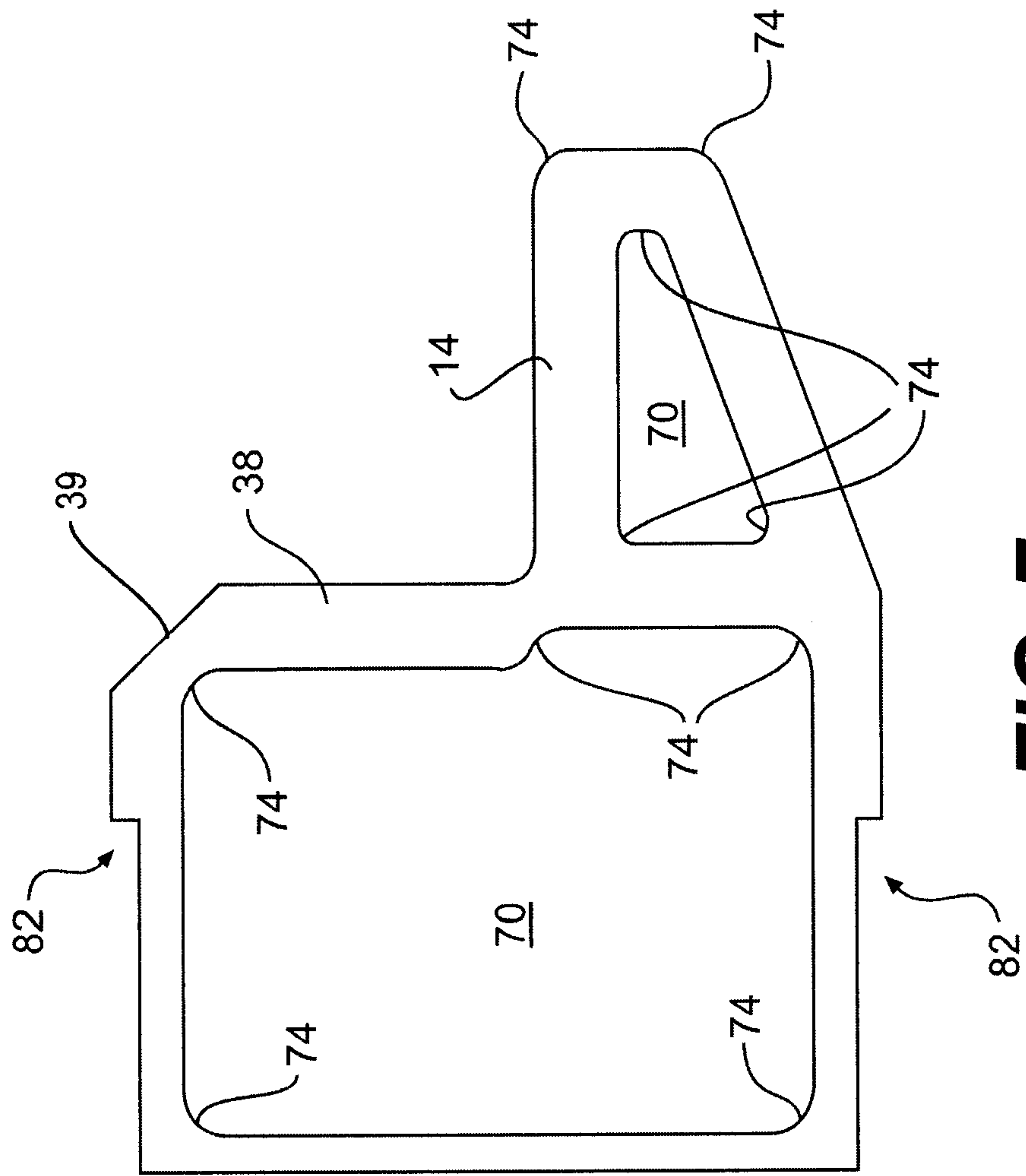
**FIG. 6**



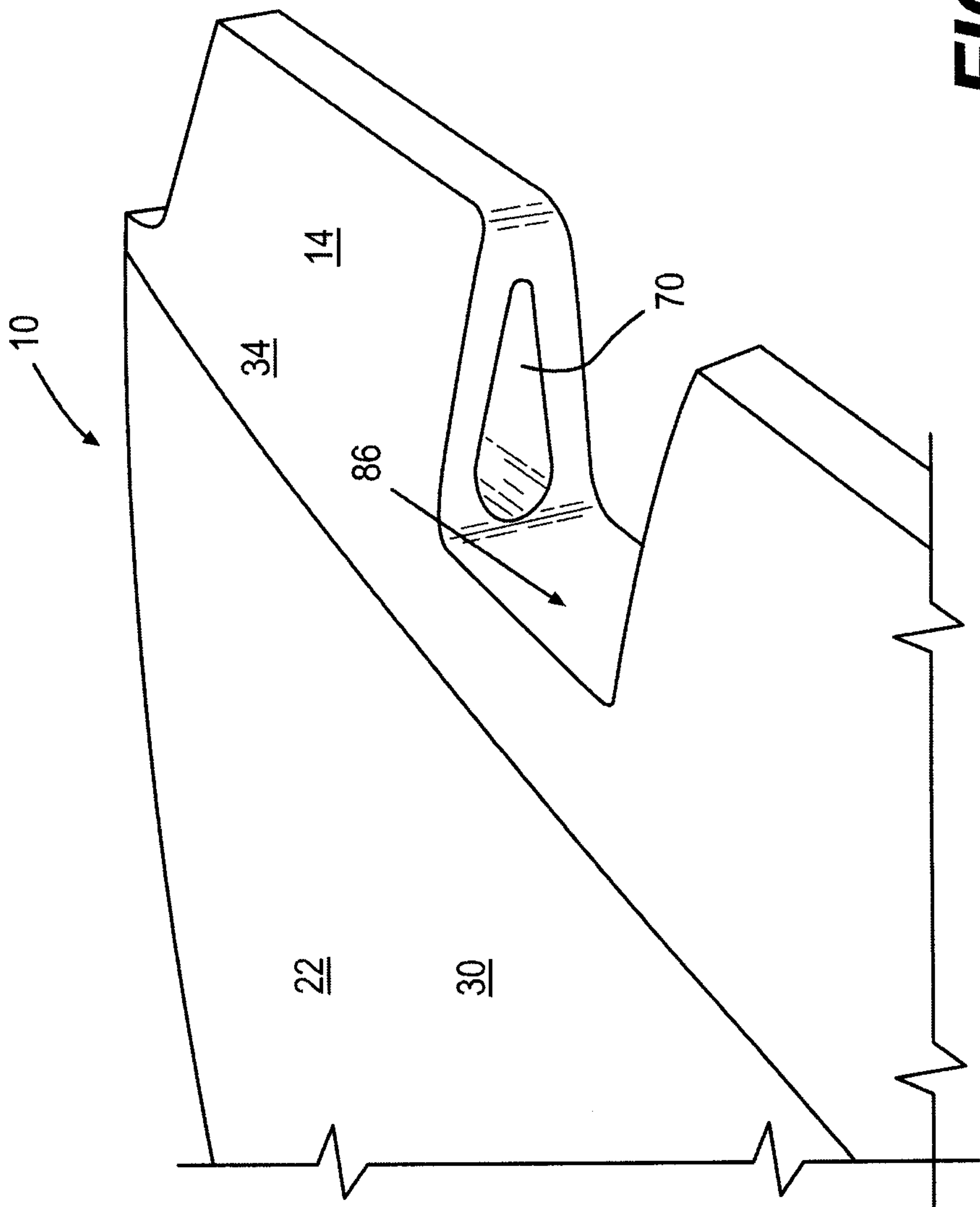
**FIG. 2**



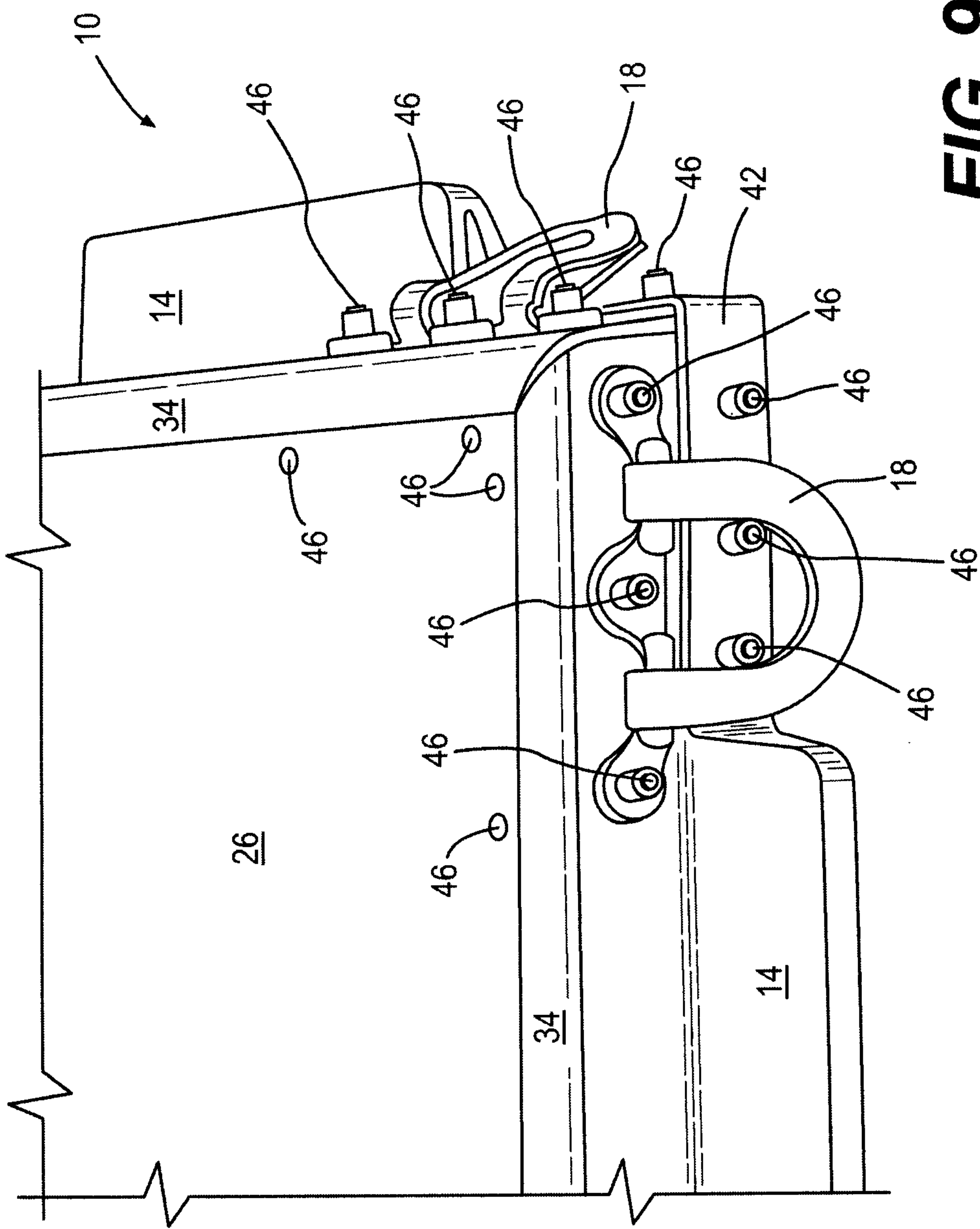
**FIG. 4**



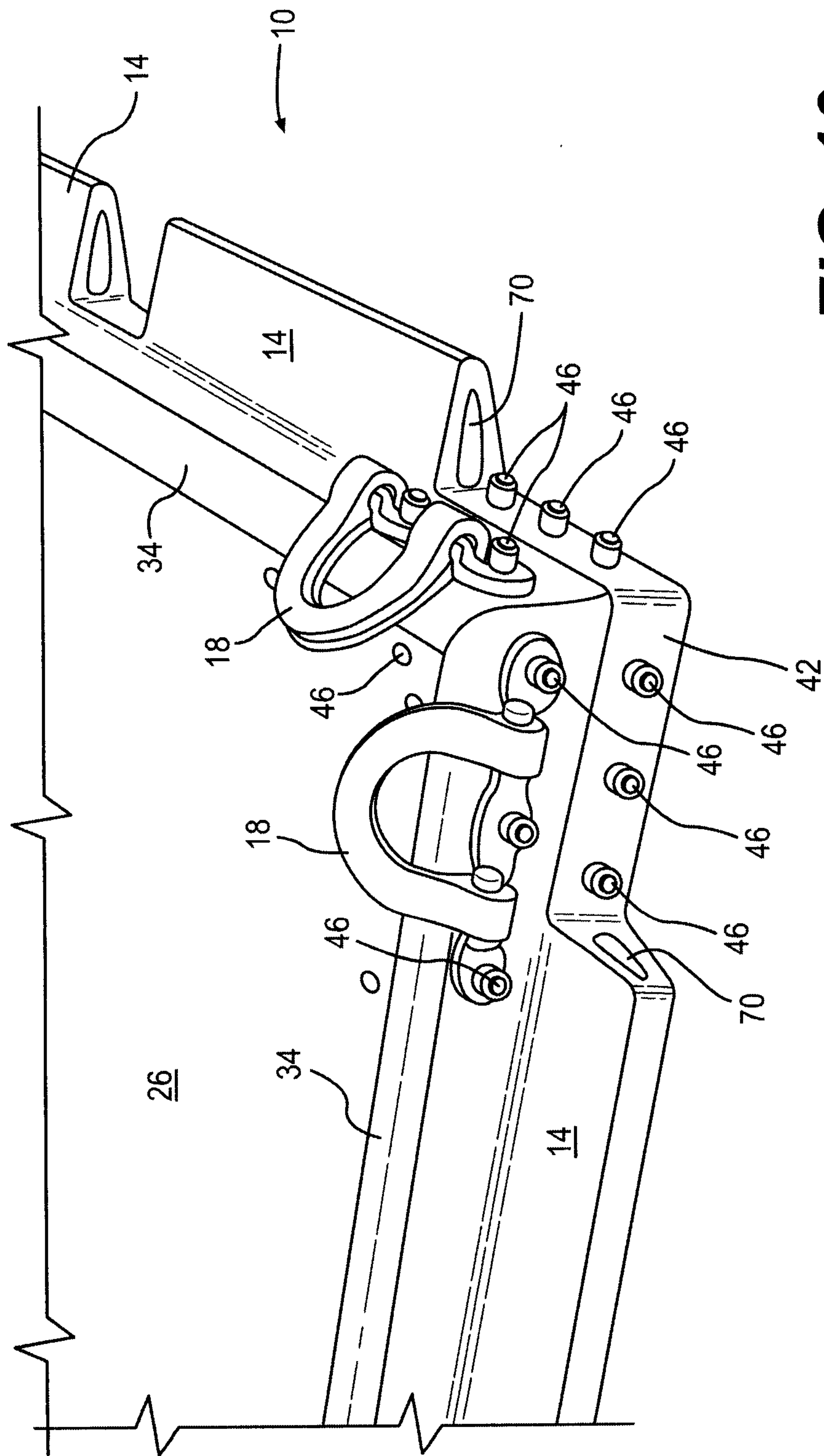
**FIG. 7**



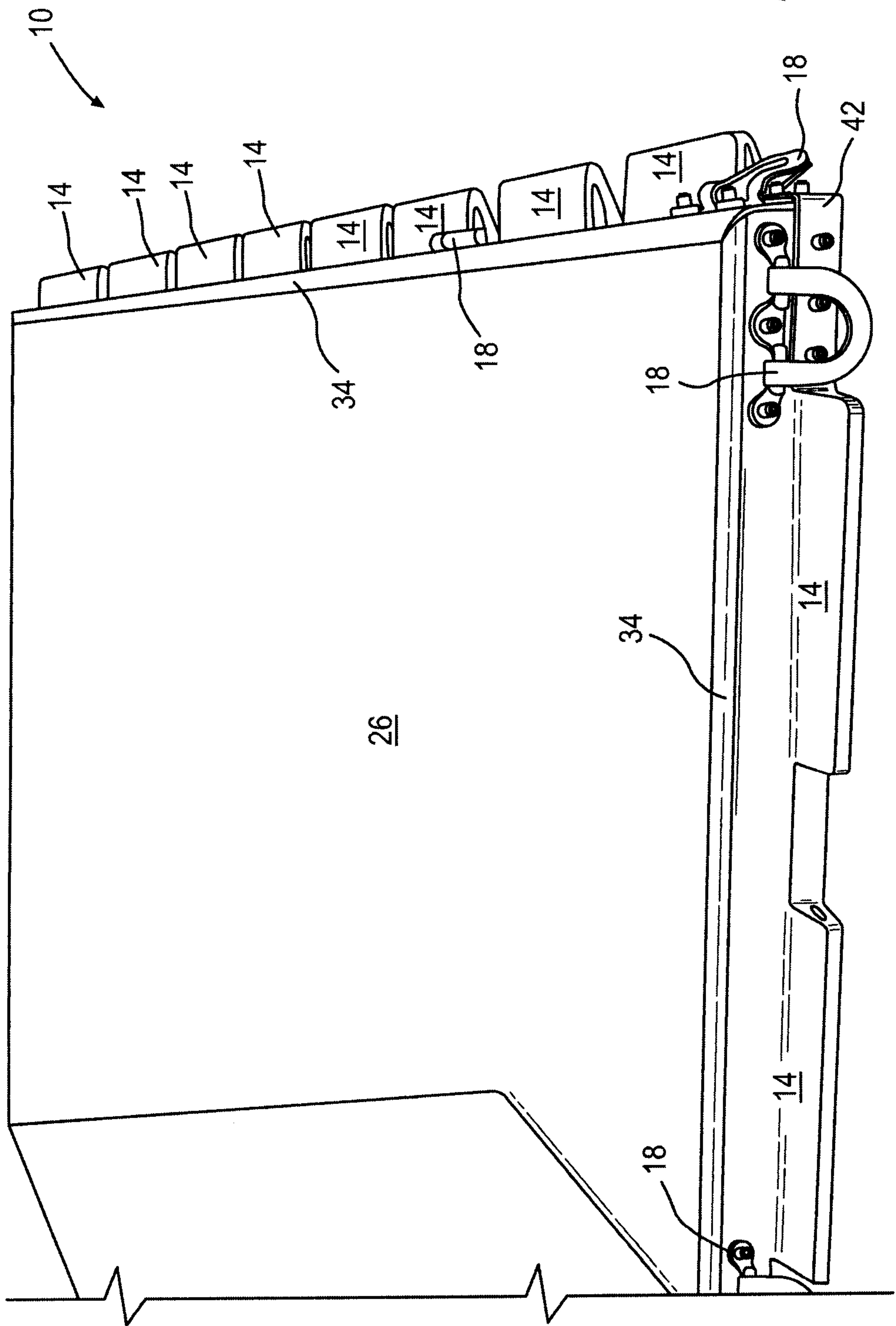
**FIG. 8**



**FIG. 9**



**FIG. 10**



**FIG. 11**

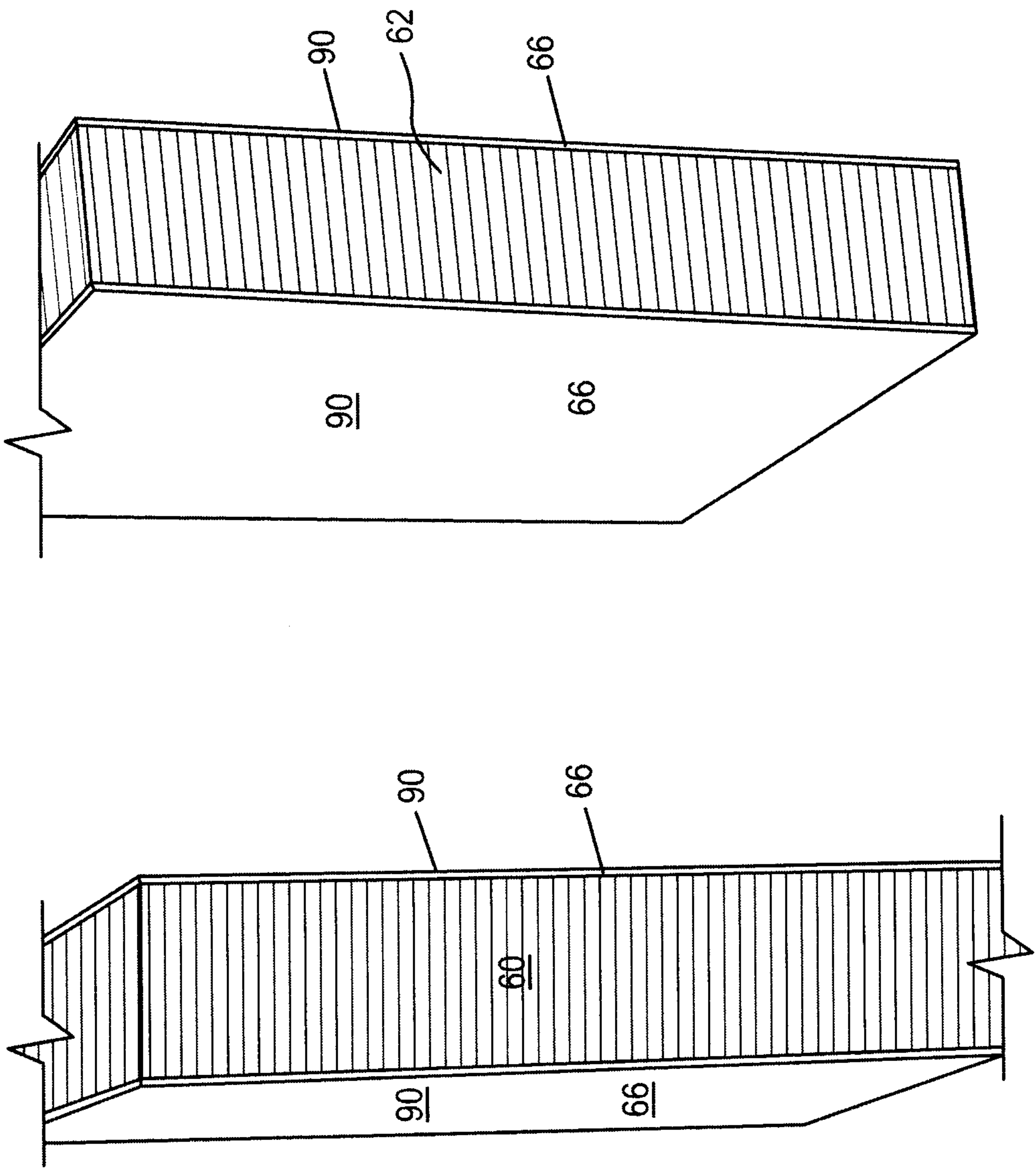
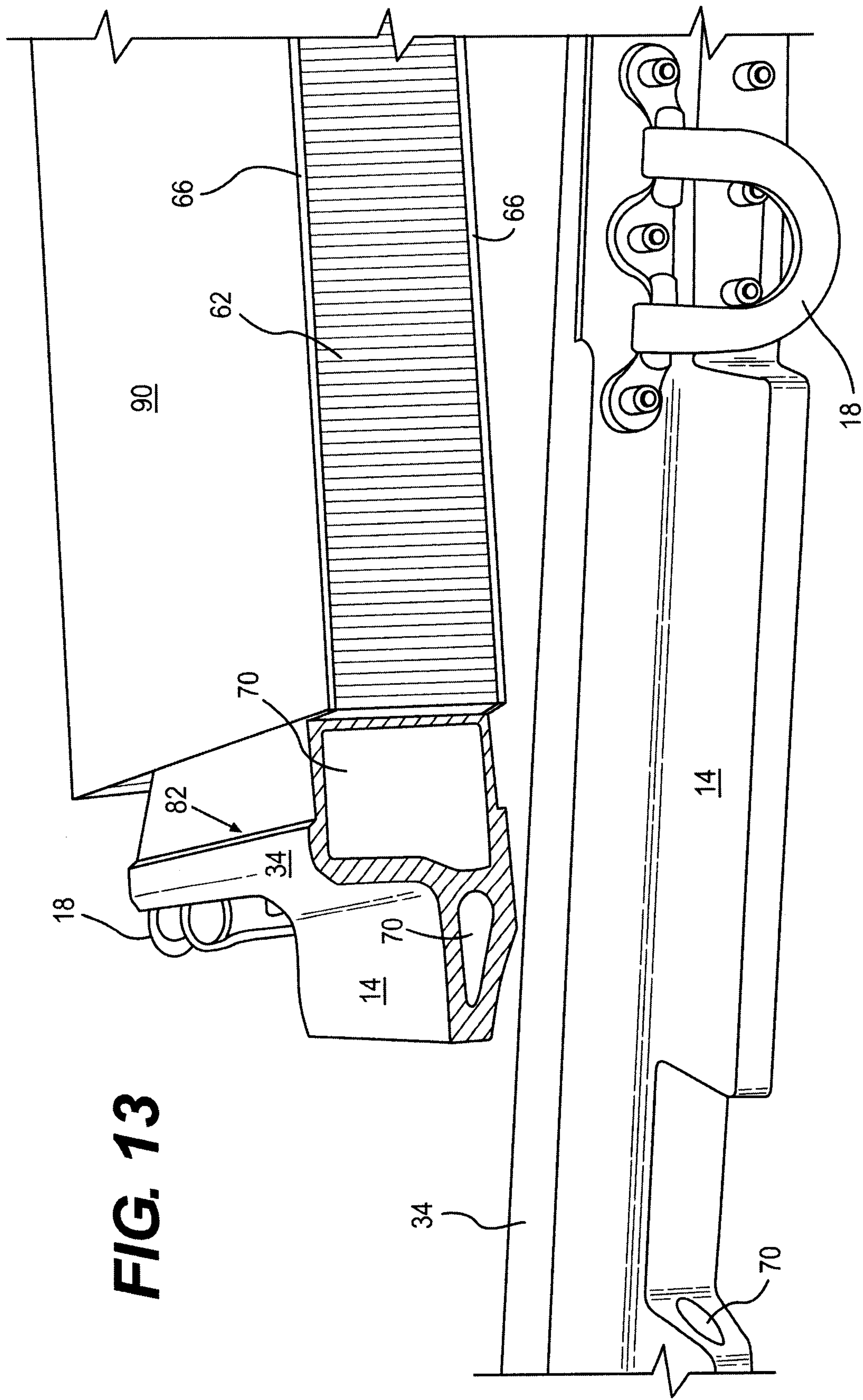
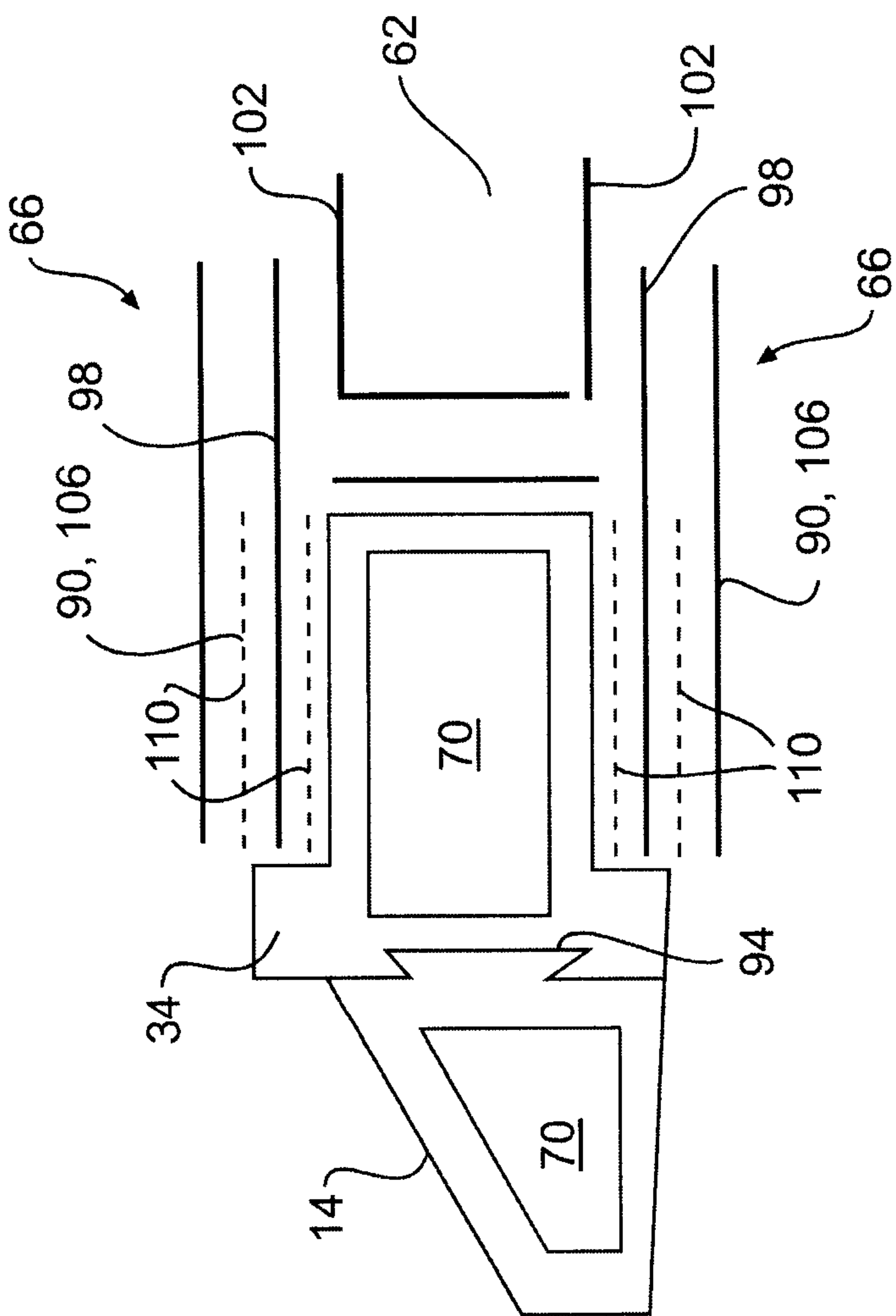
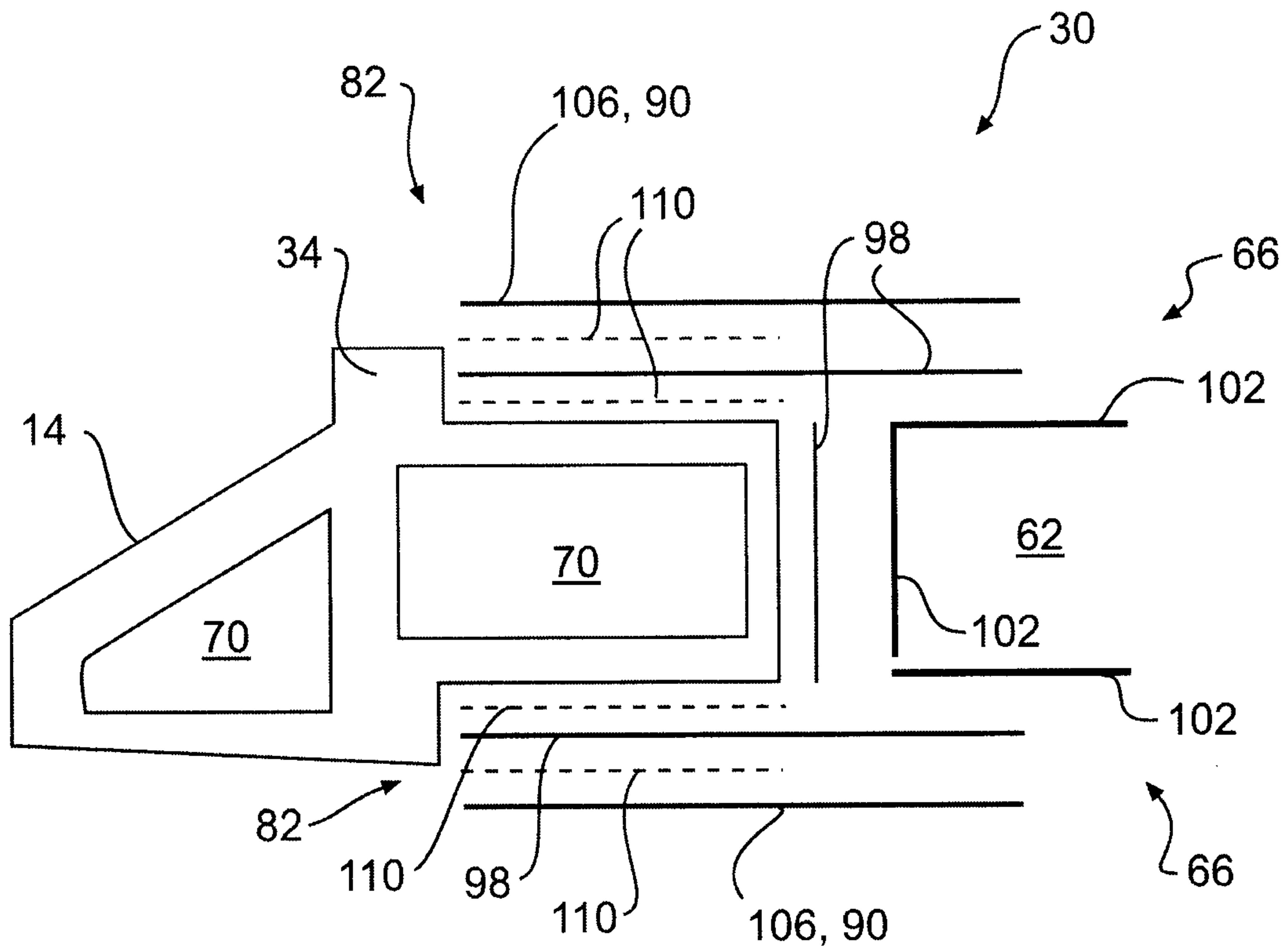


FIG. 12

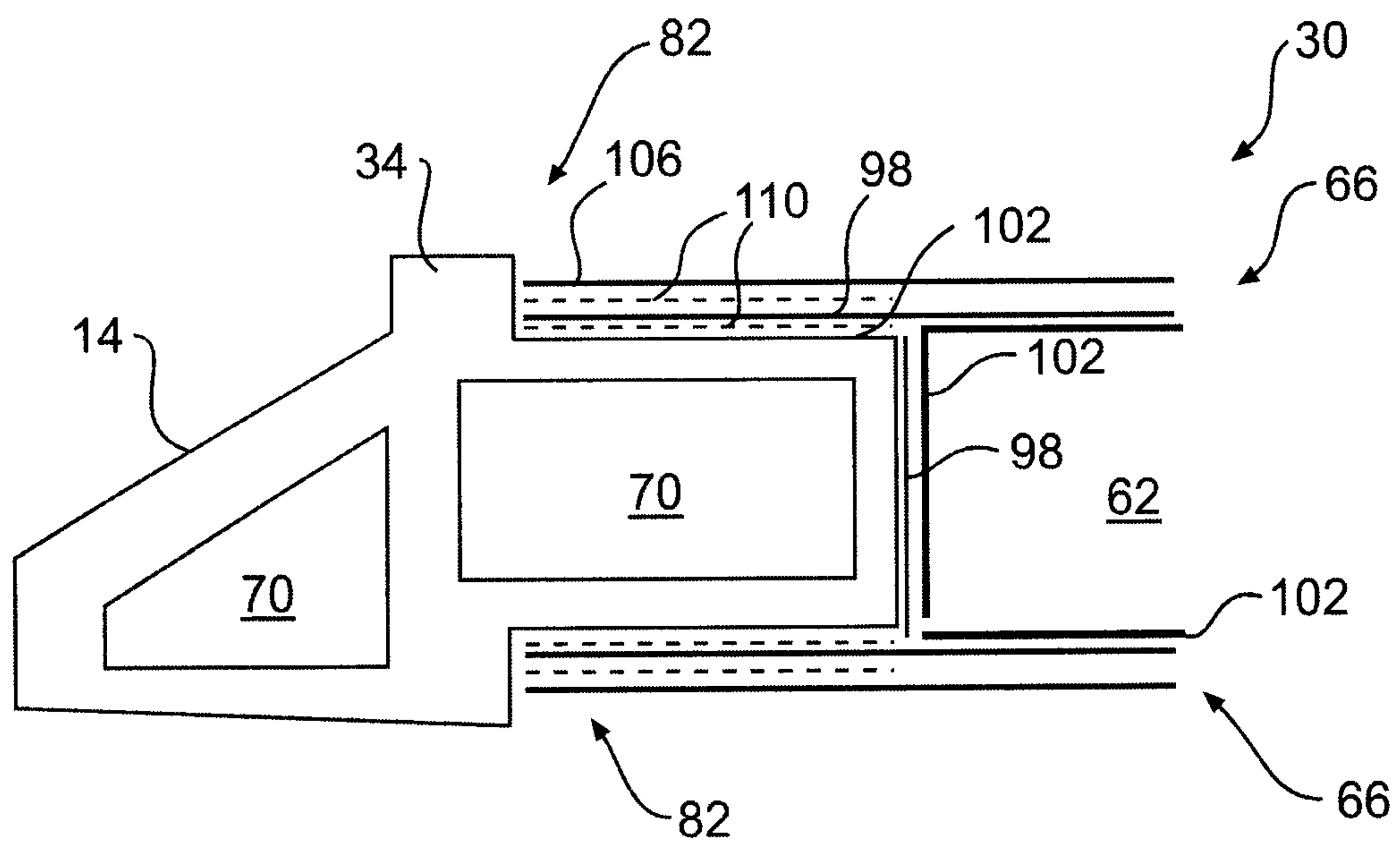




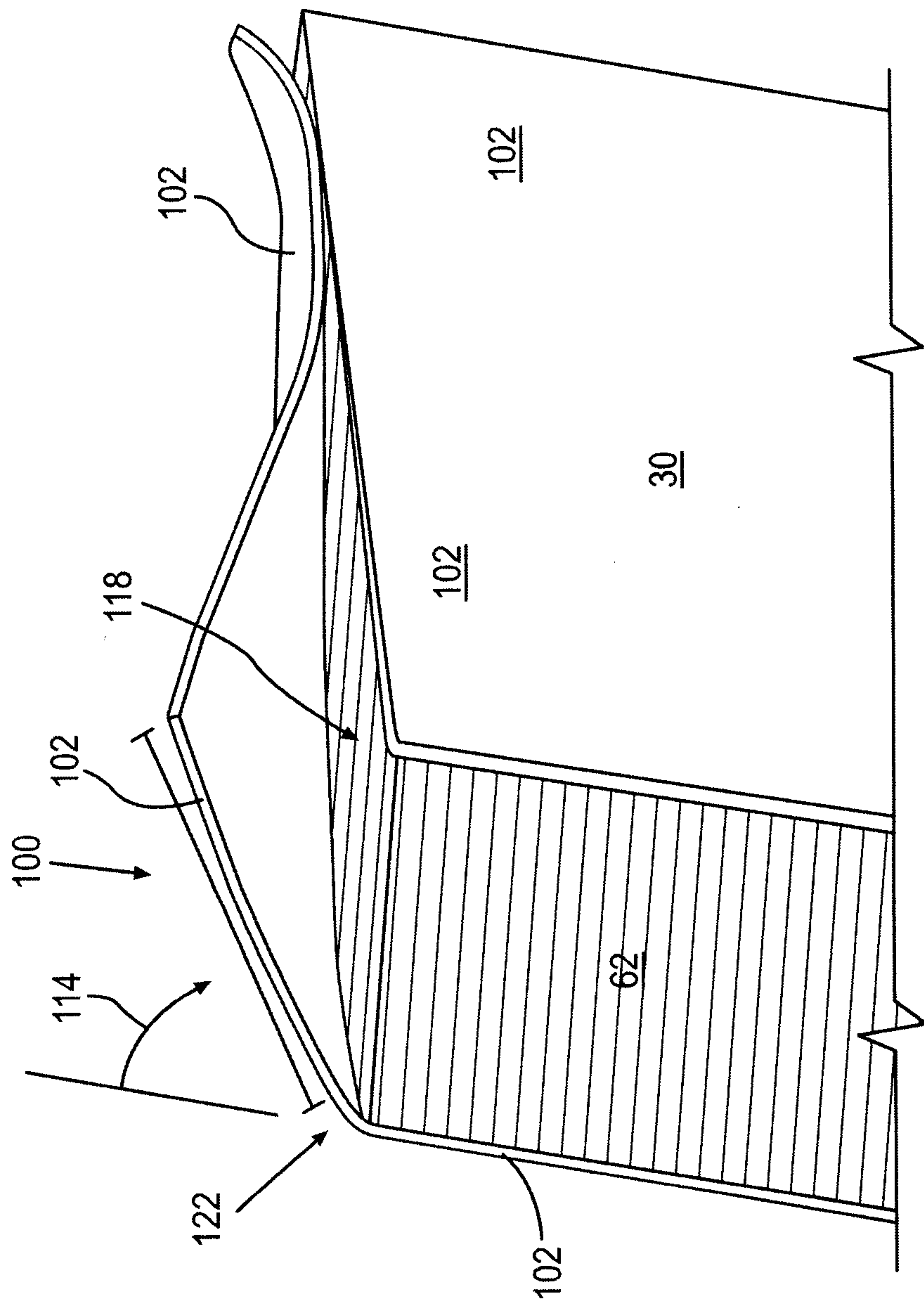
**FIG. 14**



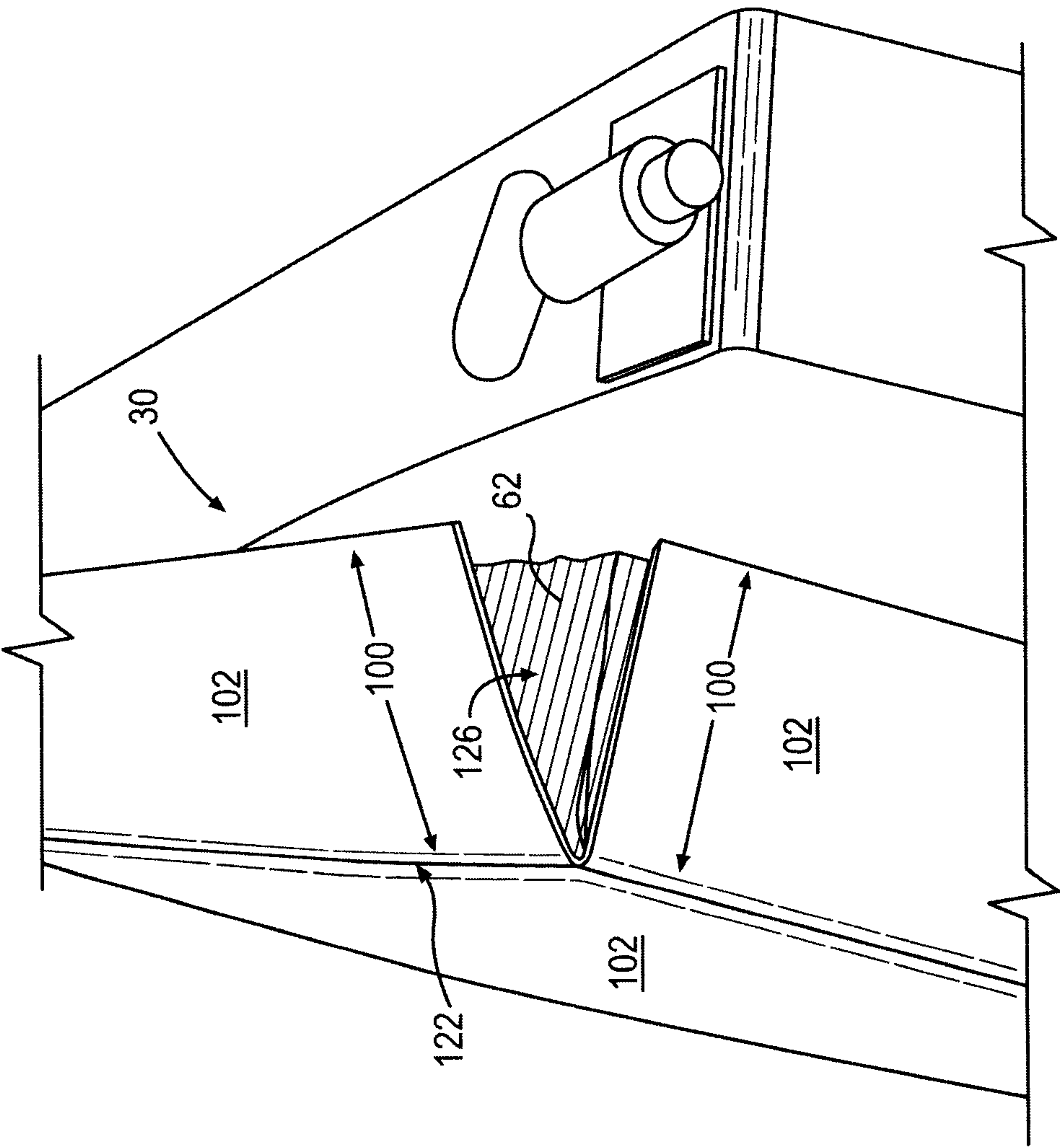
**FIG. 15**



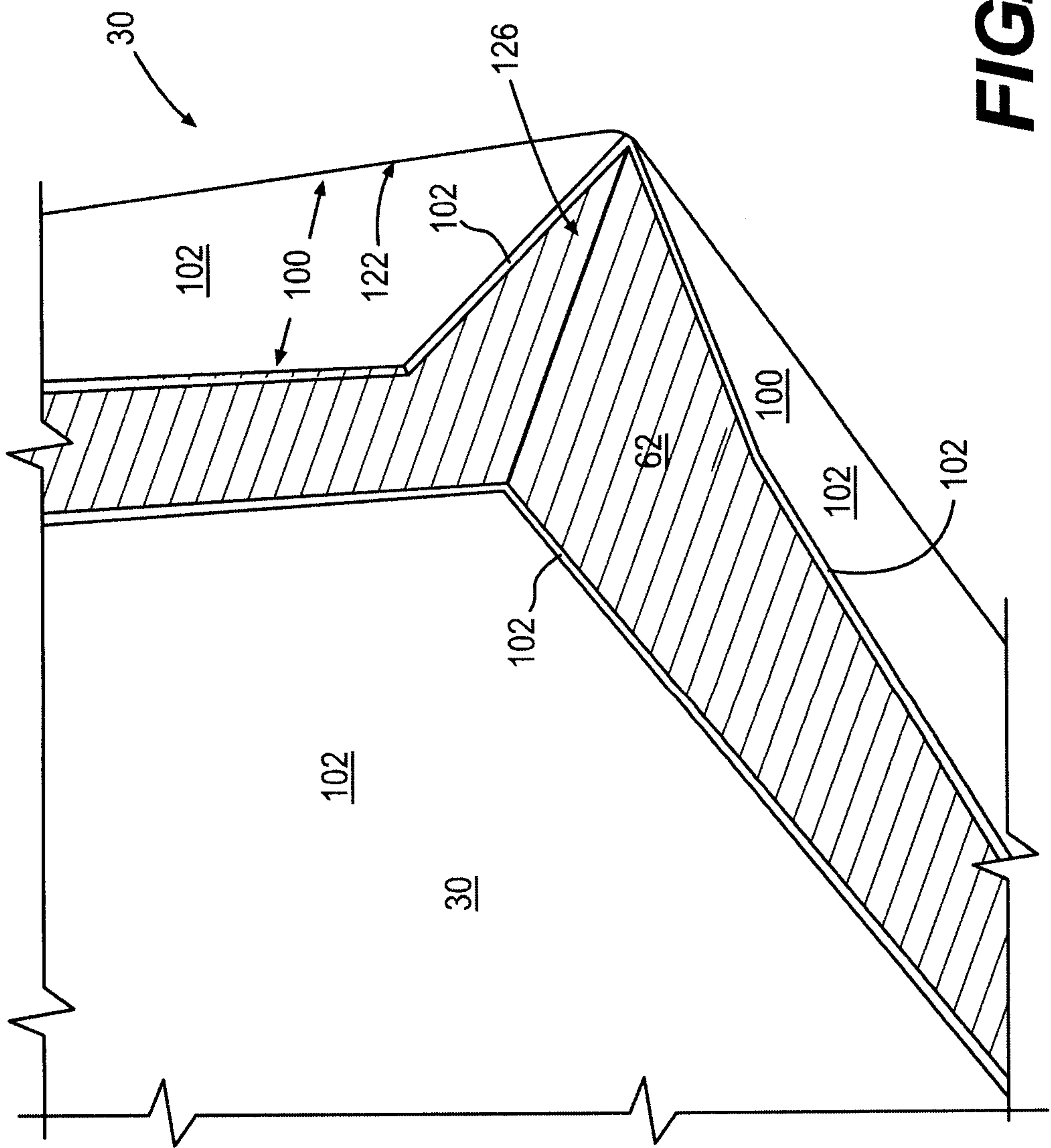
**FIG. 16**



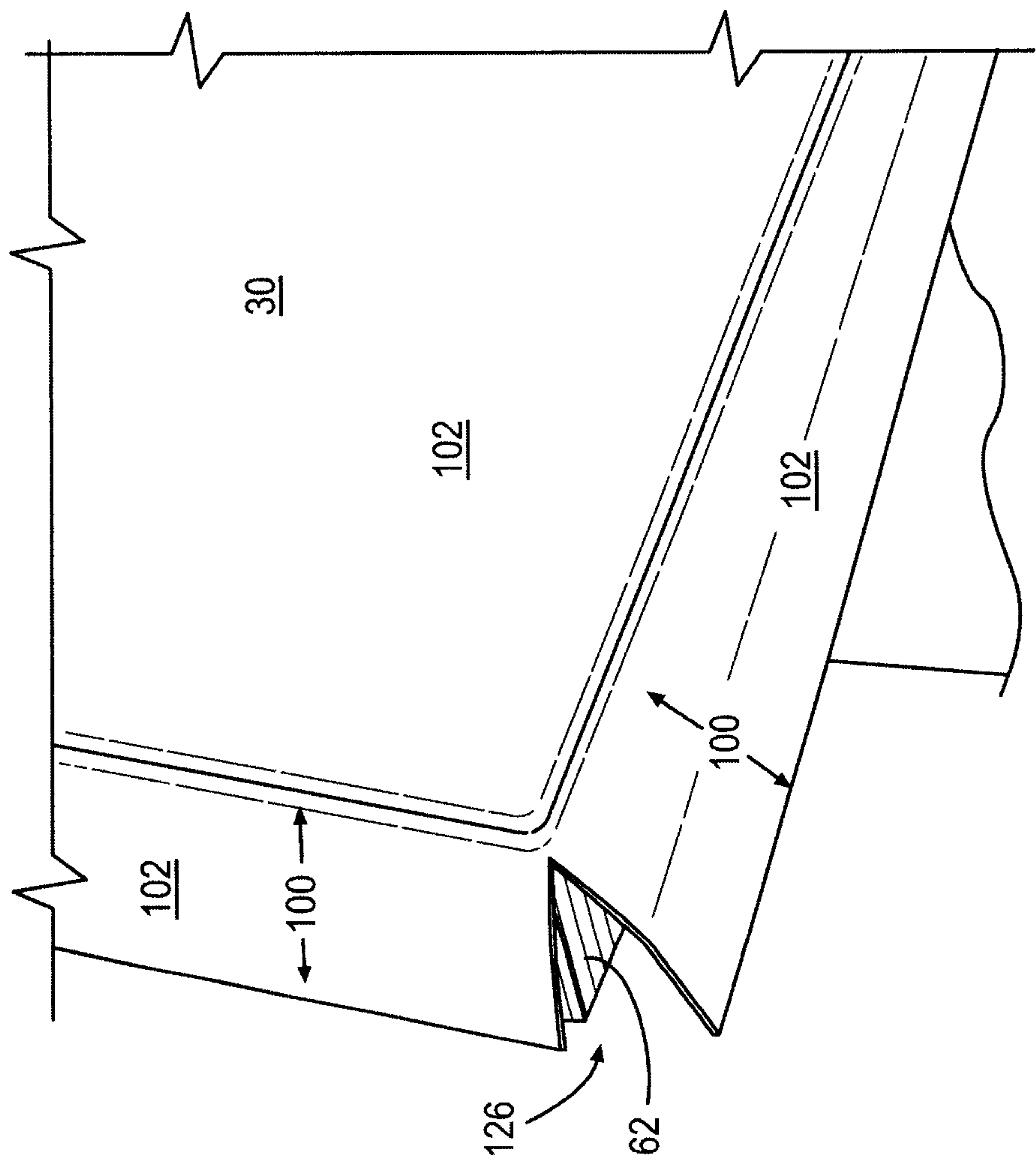
**FIG. 17**



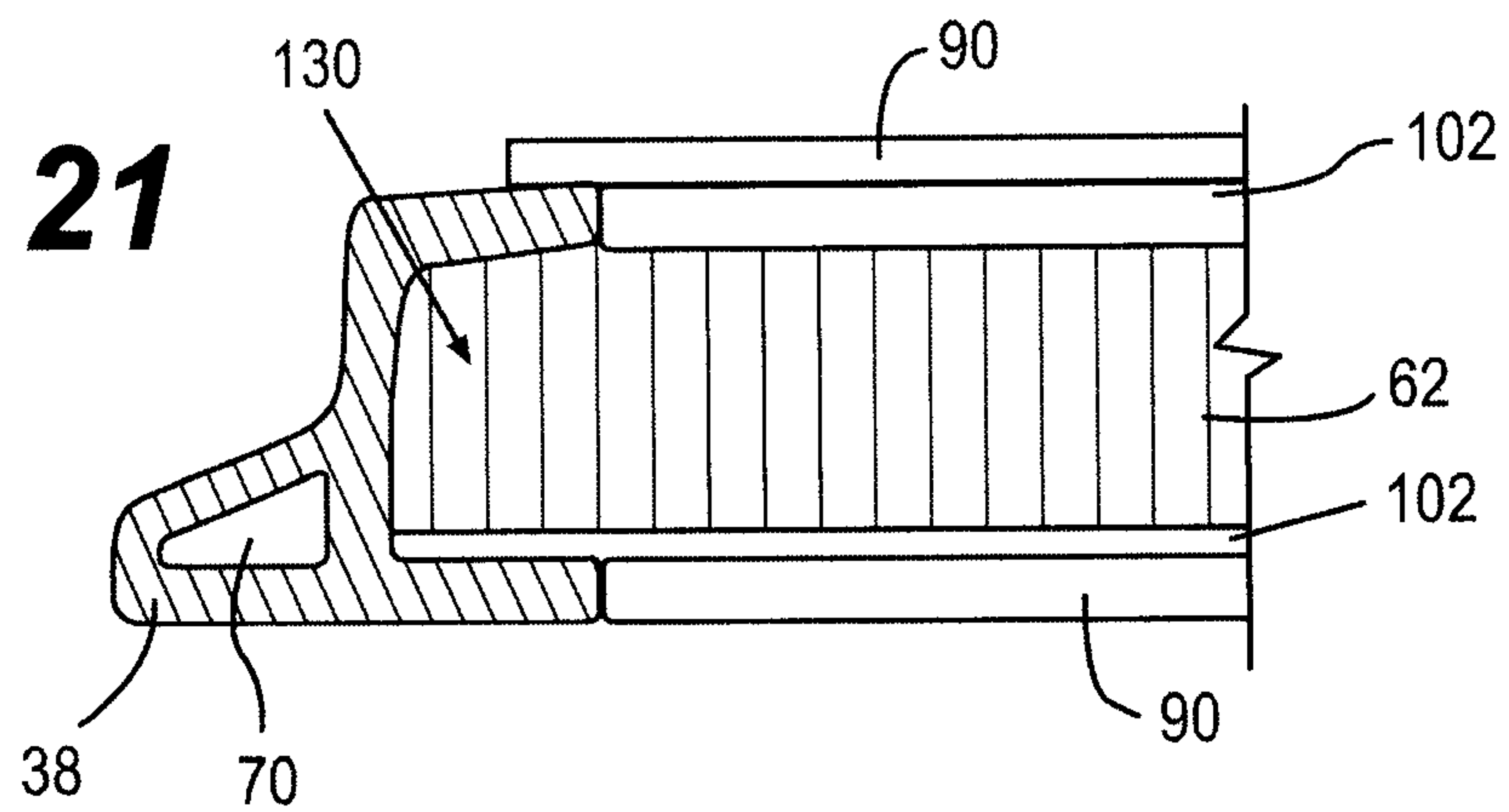
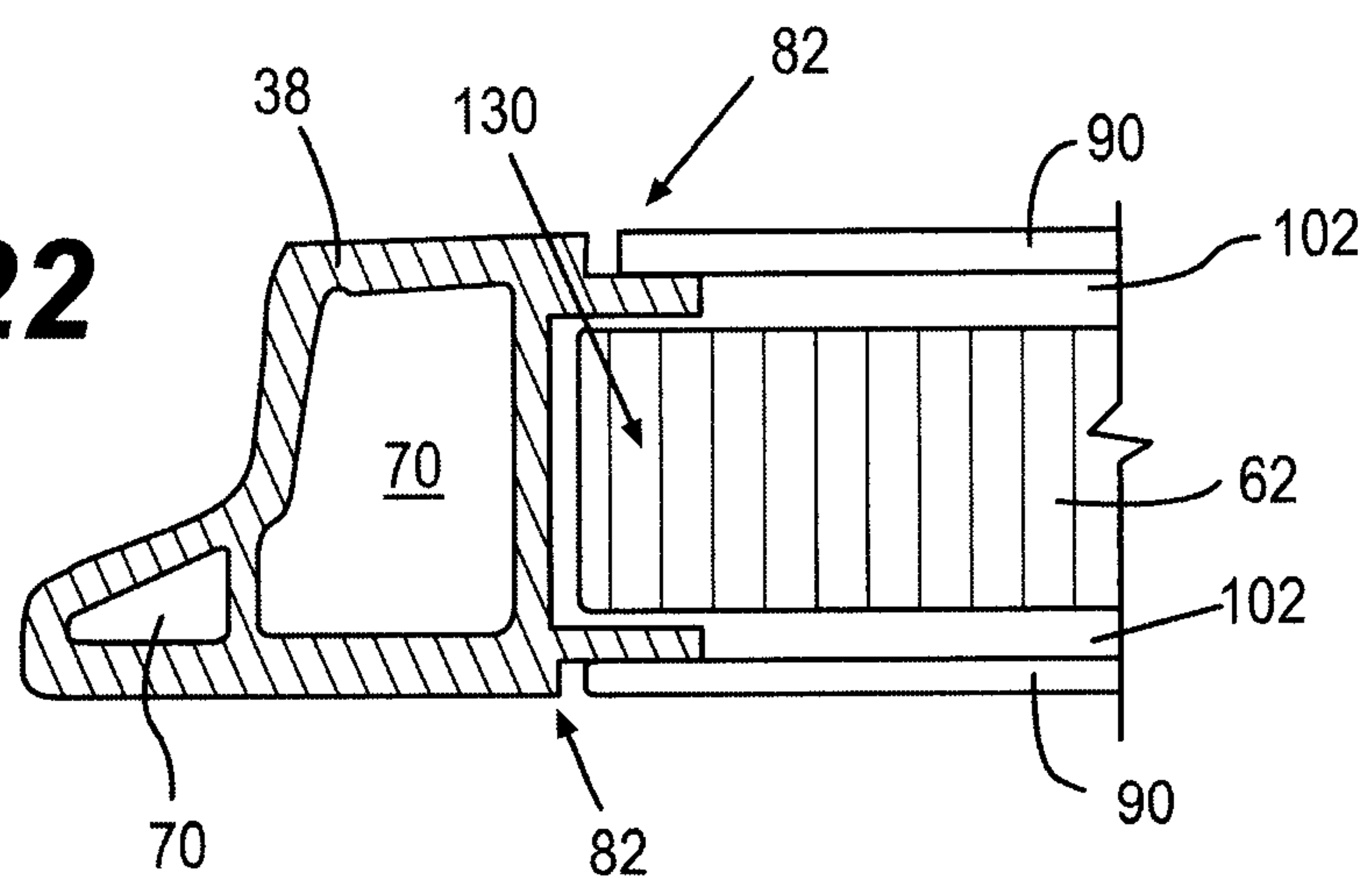
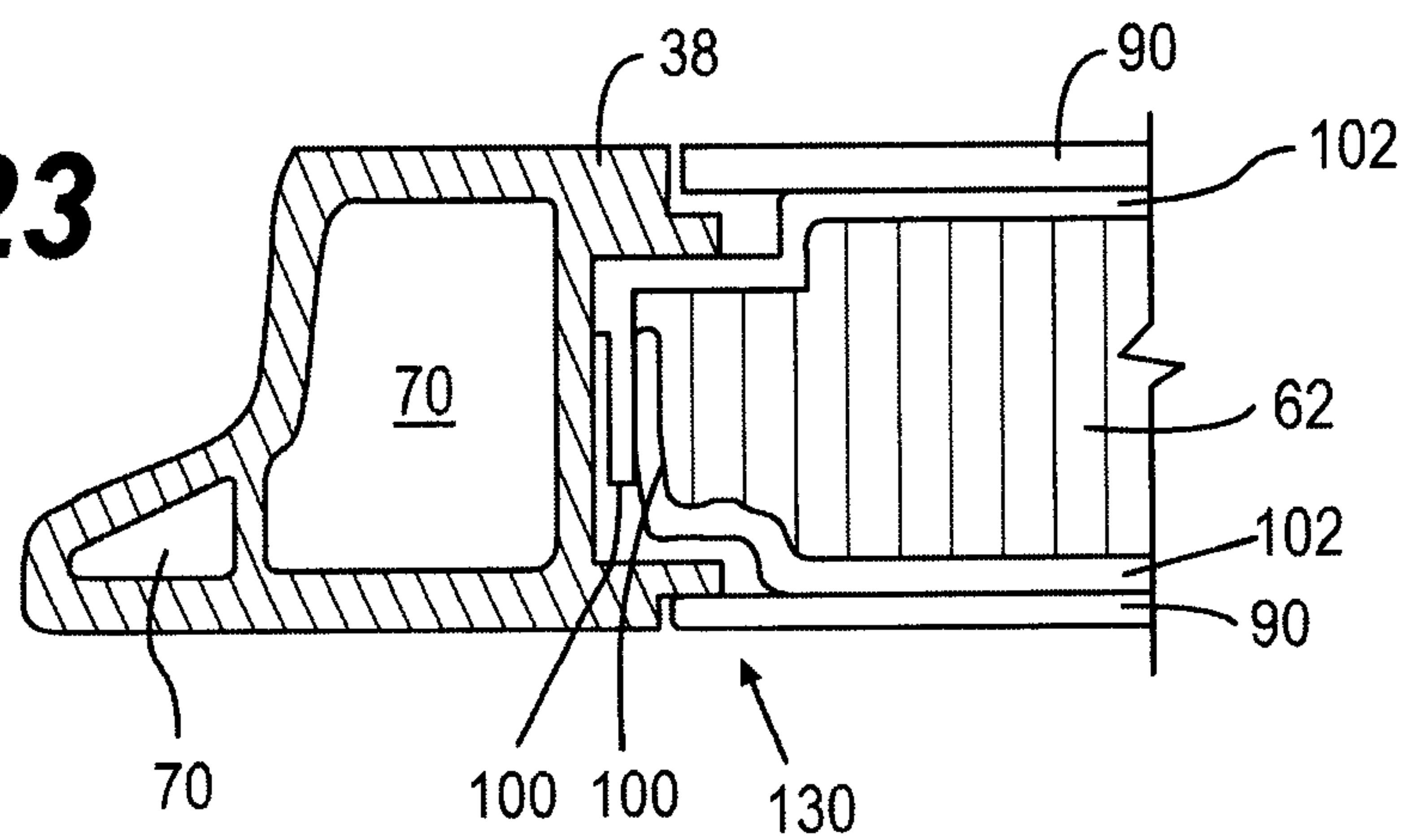
**FIG. 18**

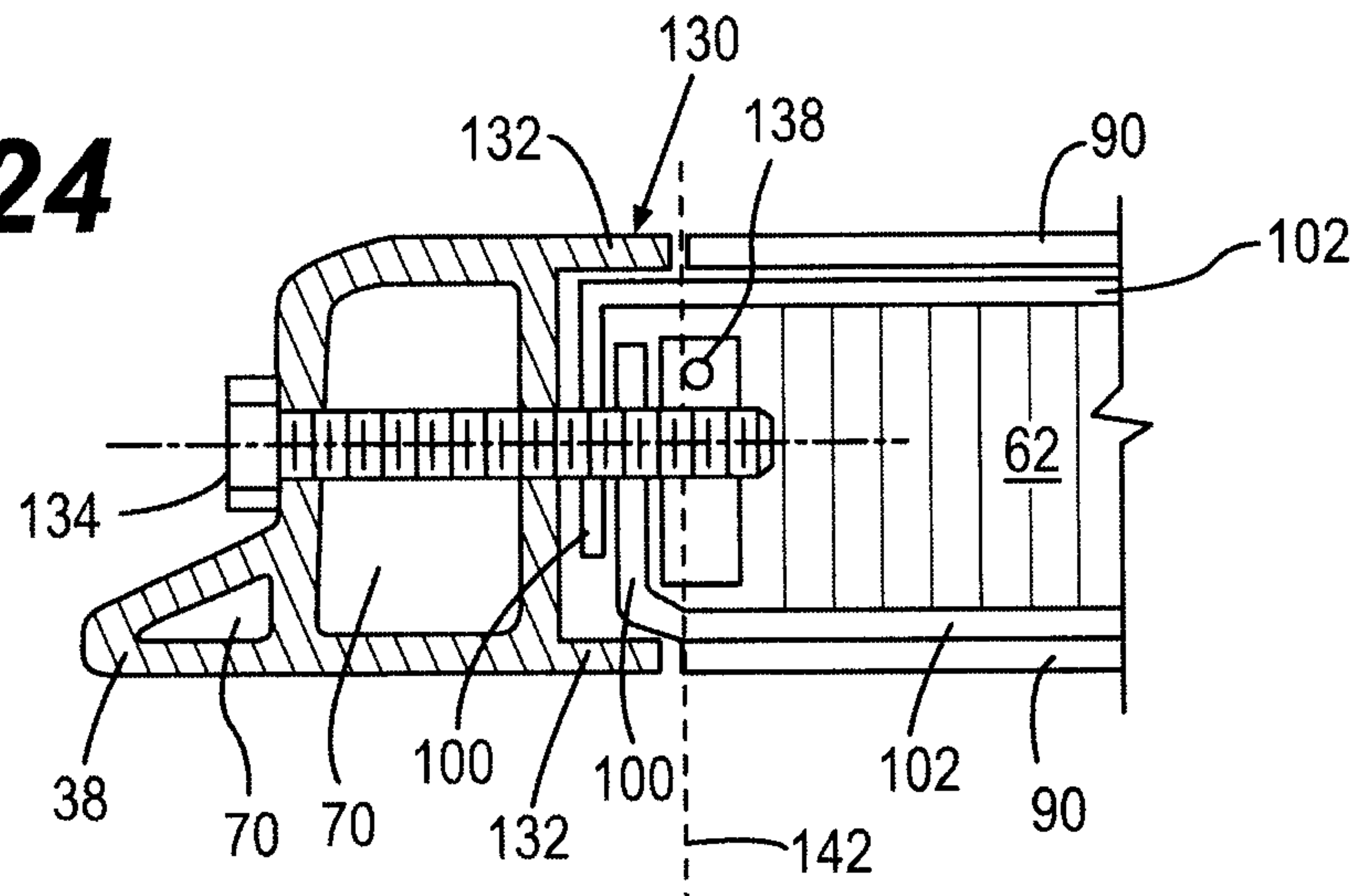
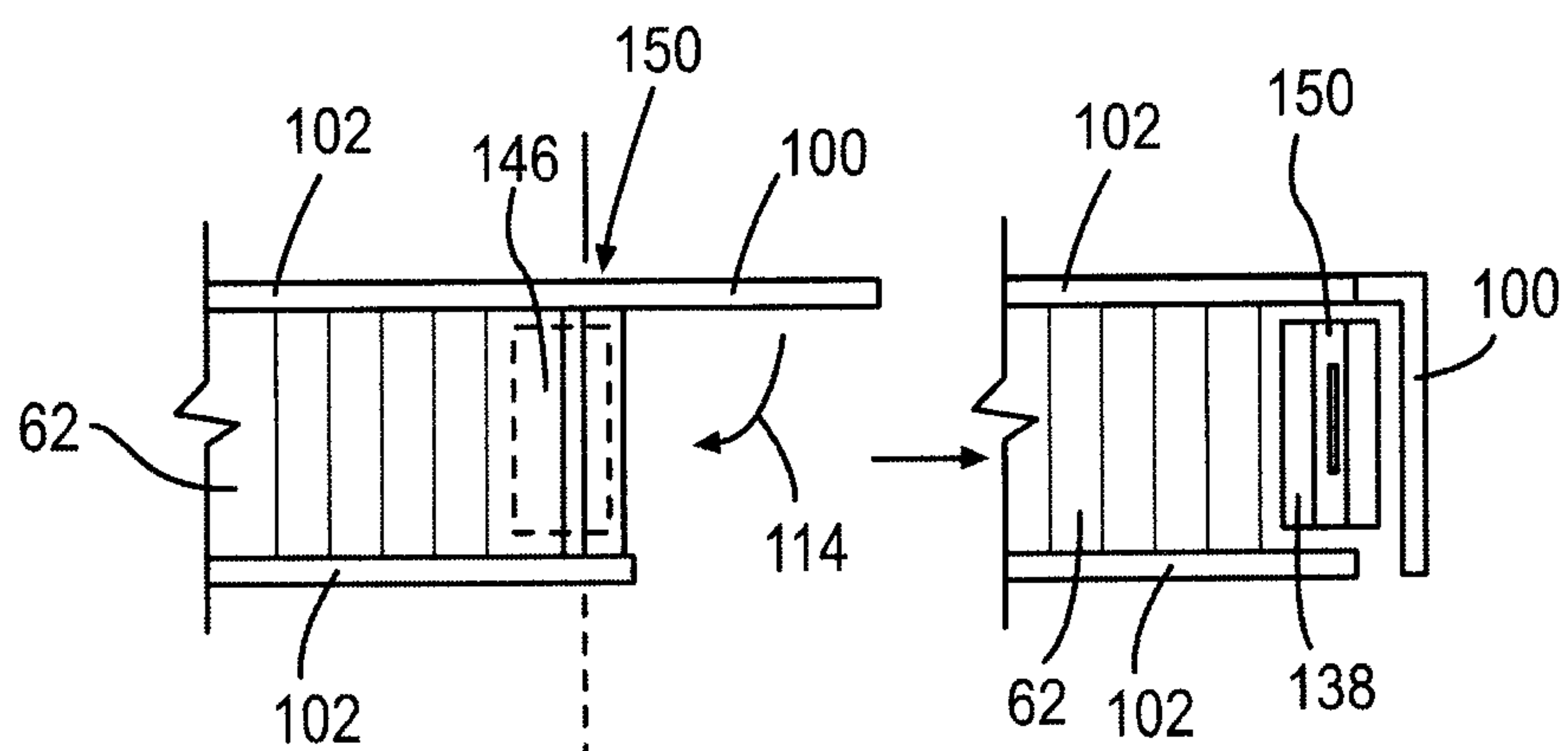
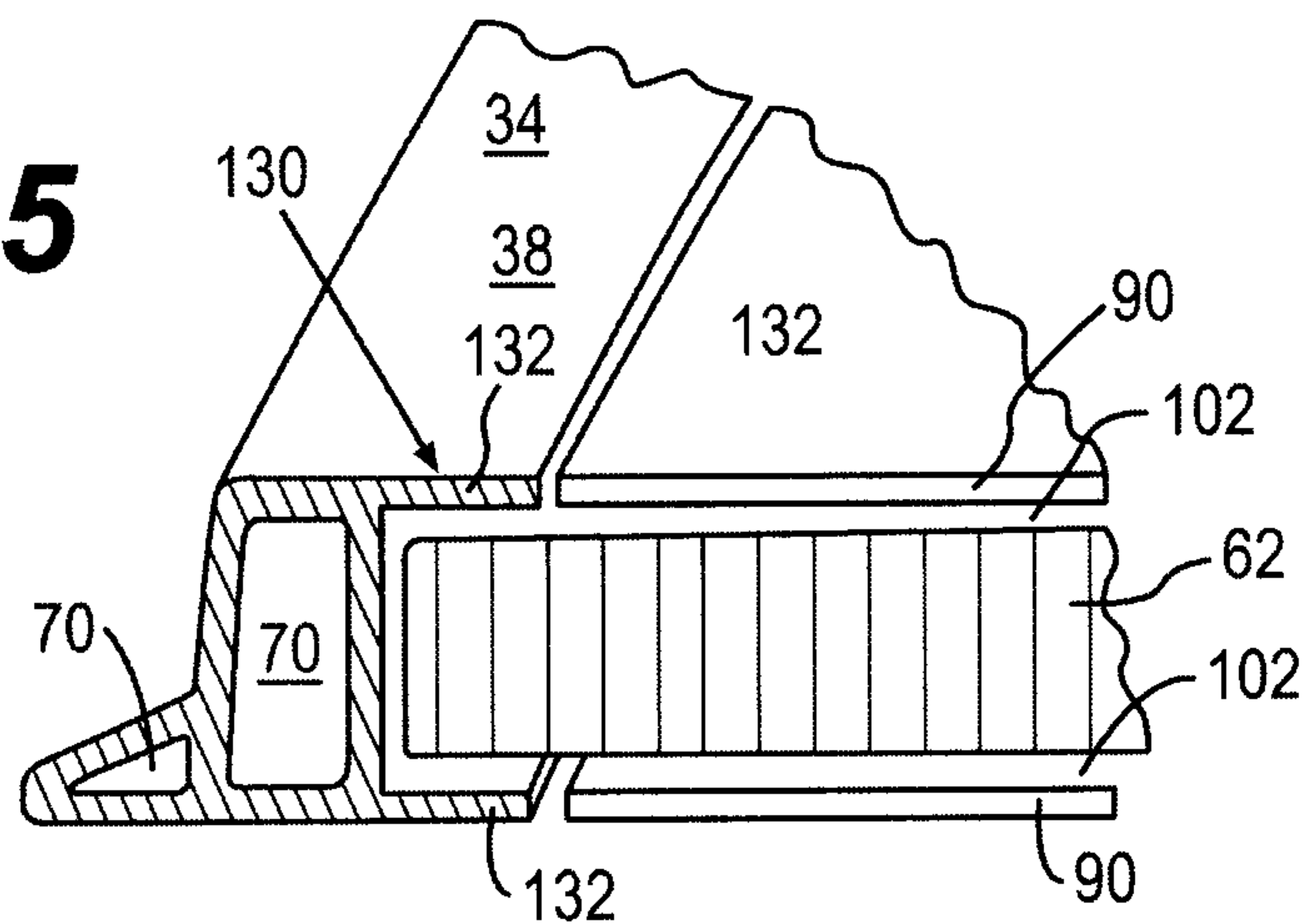


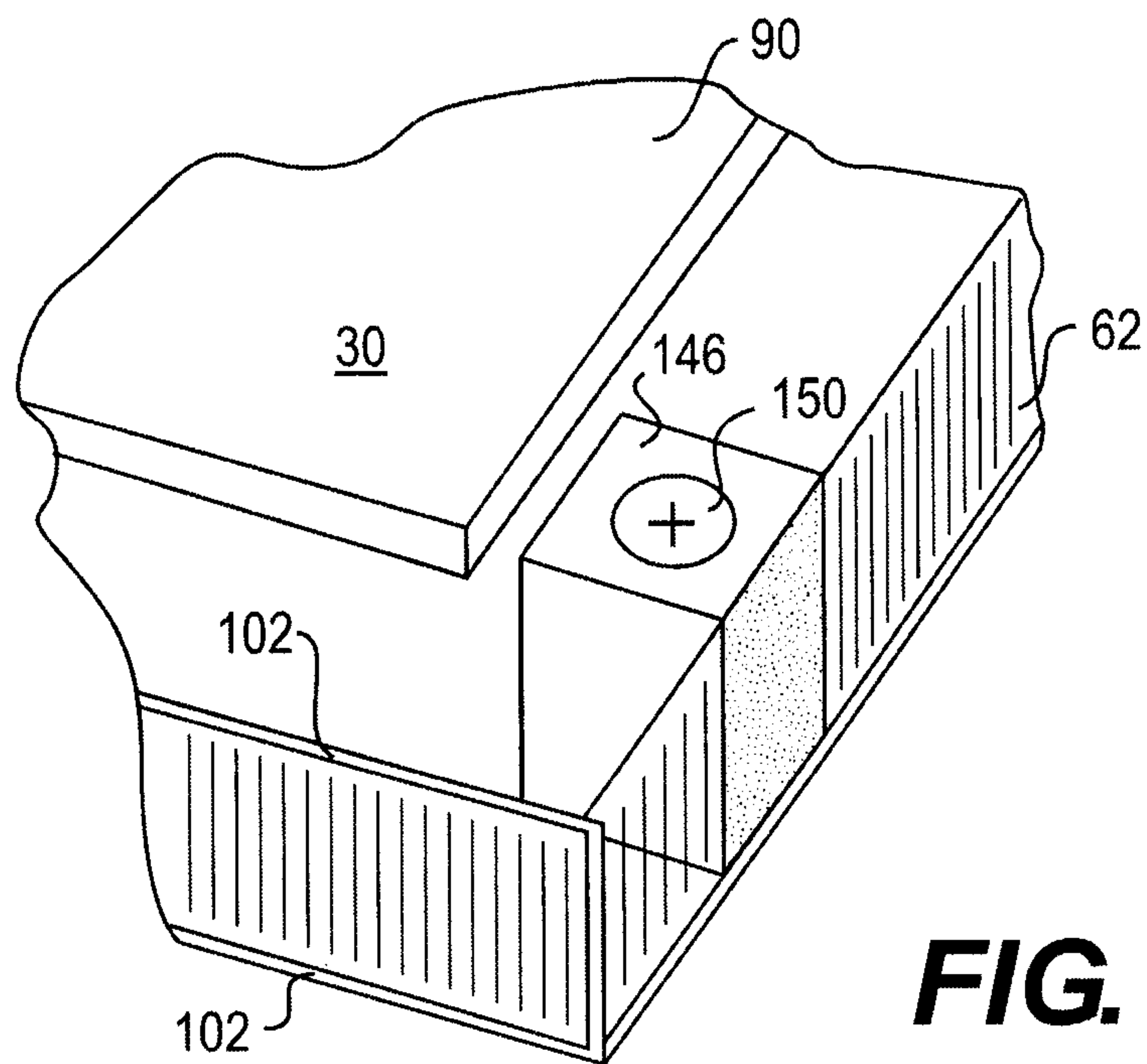
**FIG. 19**



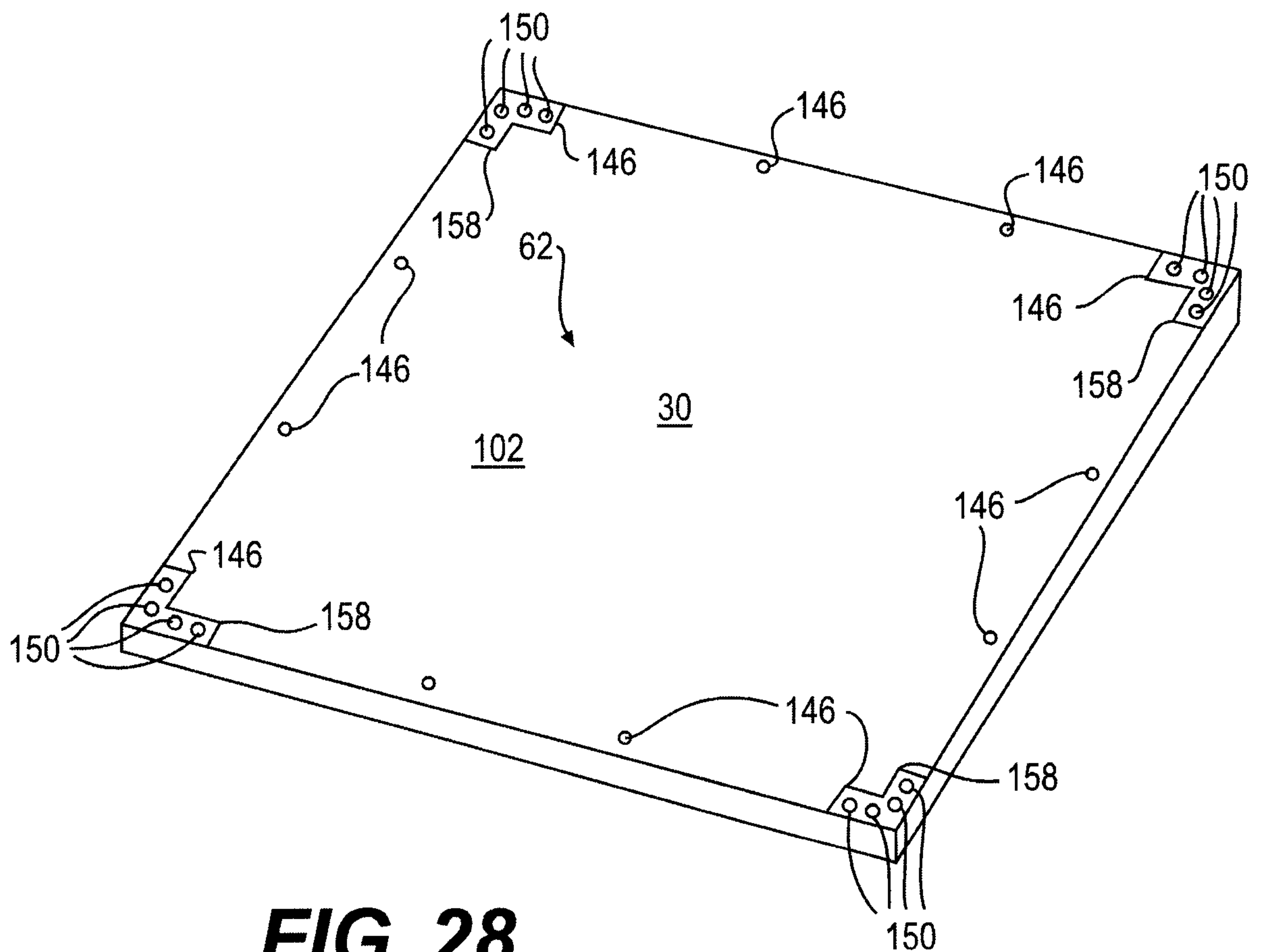
**FIG. 20**

**FIG. 21****FIG. 22****FIG. 23**

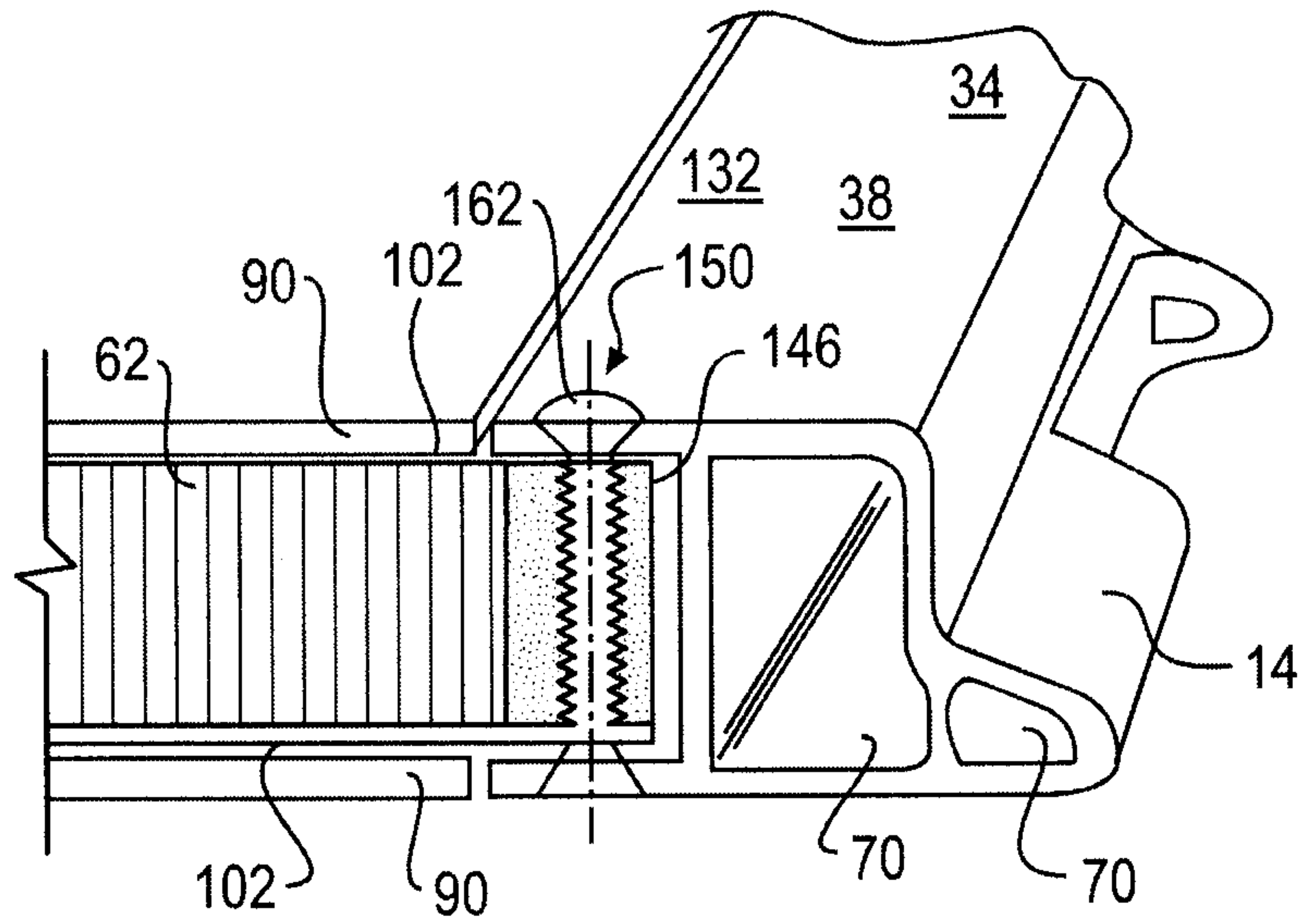
**FIG. 24****FIG. 25****FIG. 26a)****FIG. 26b)**



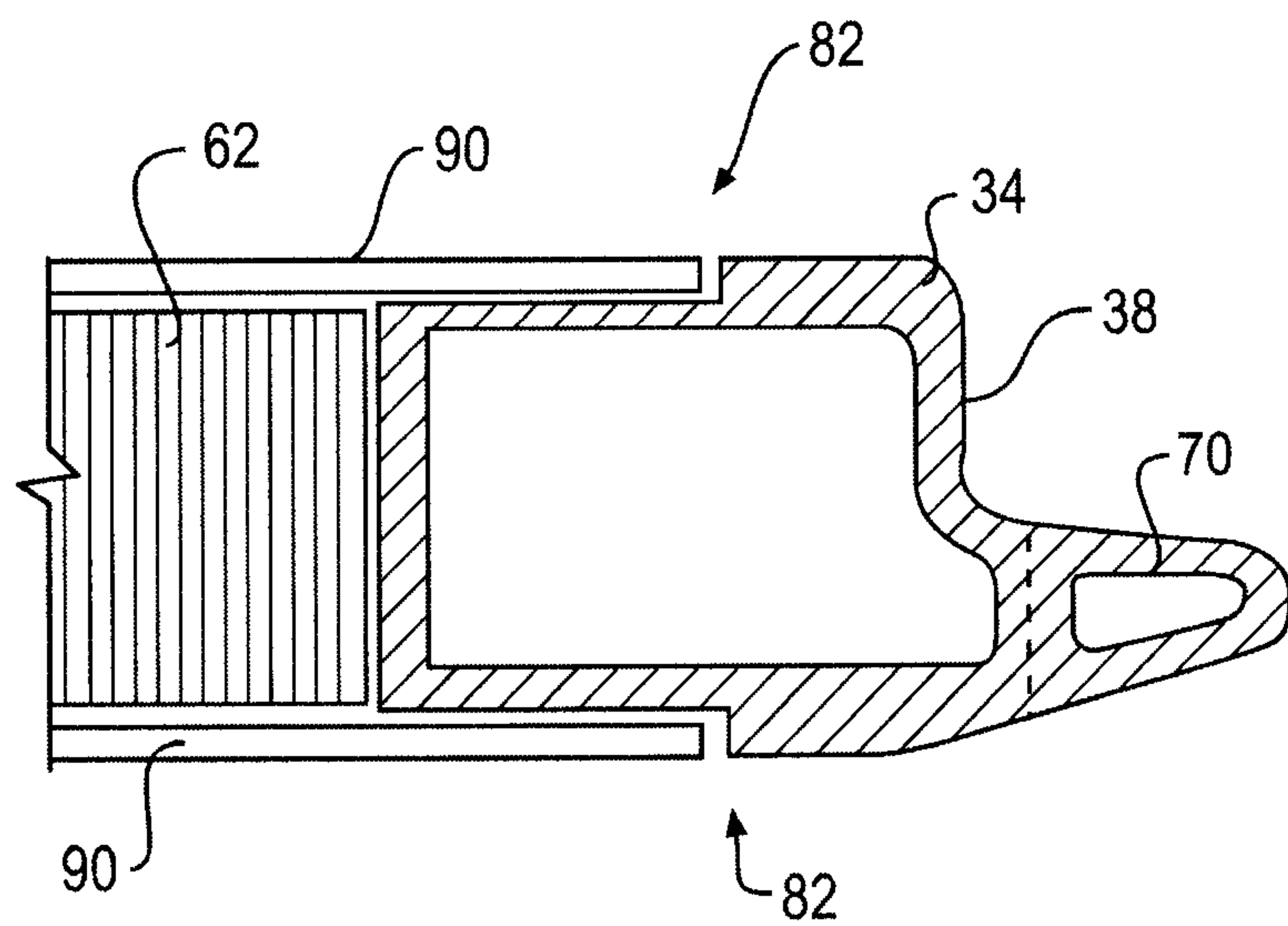
**FIG. 27**



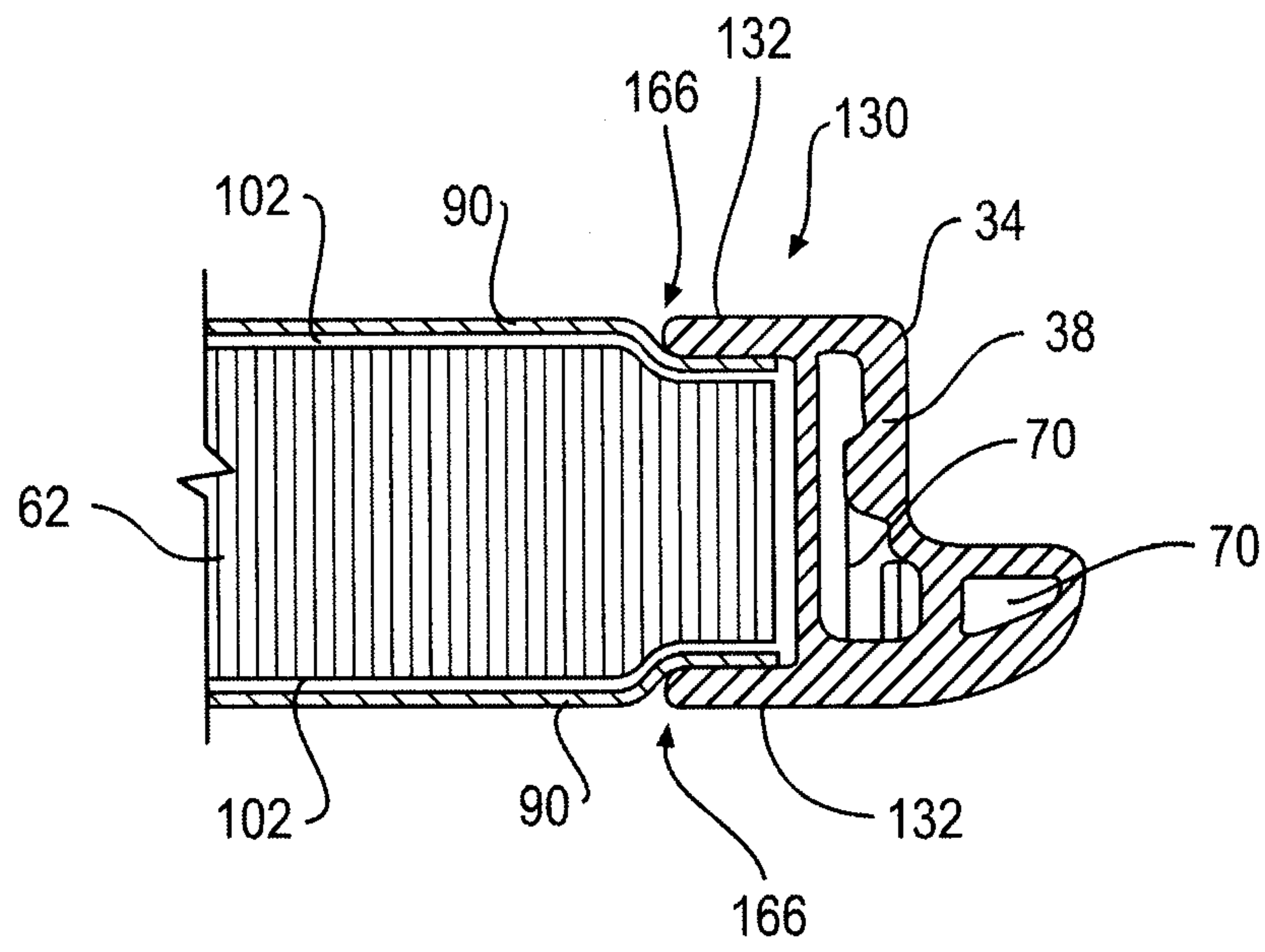
**FIG. 28**



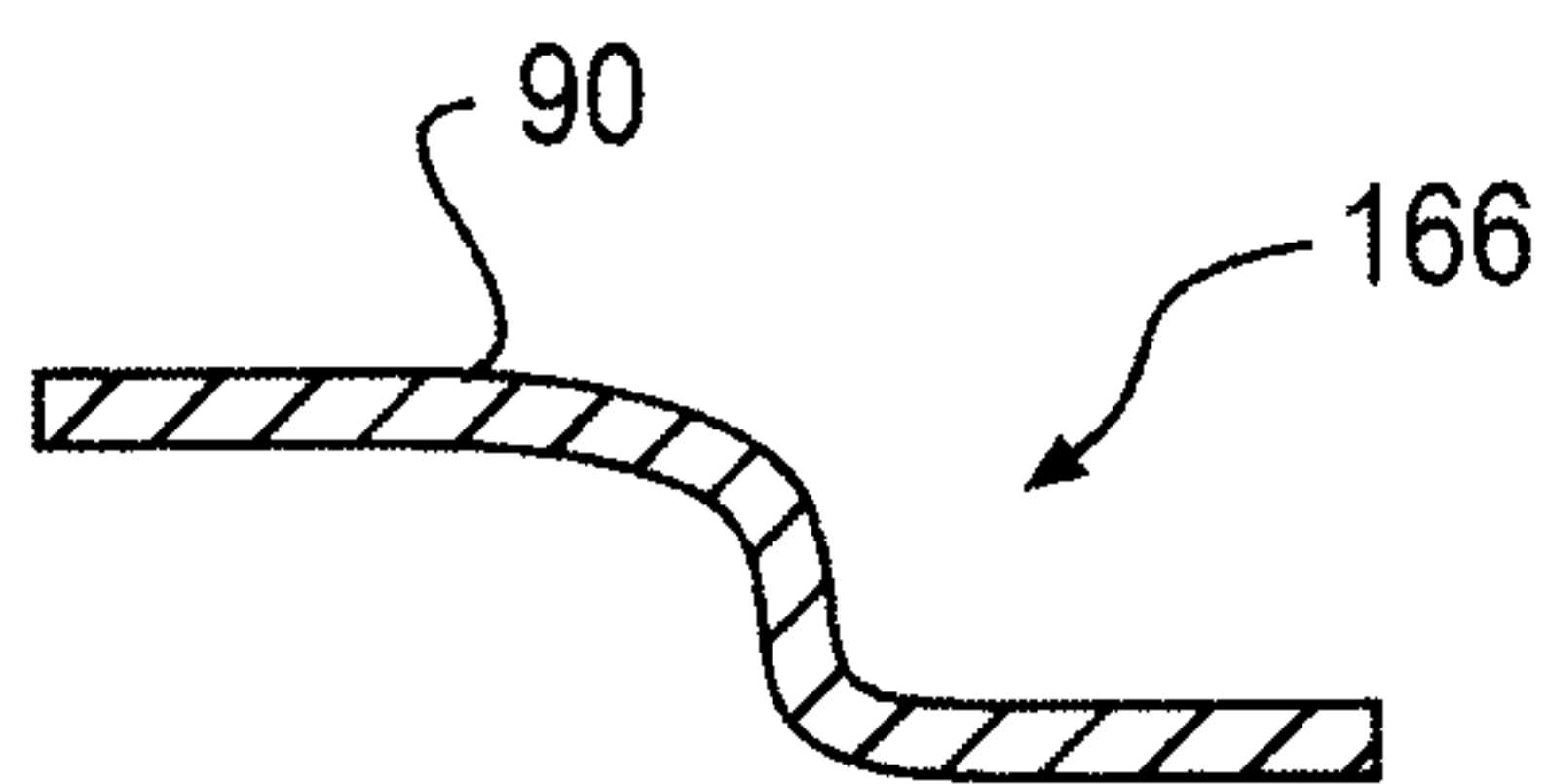
**FIG. 29**



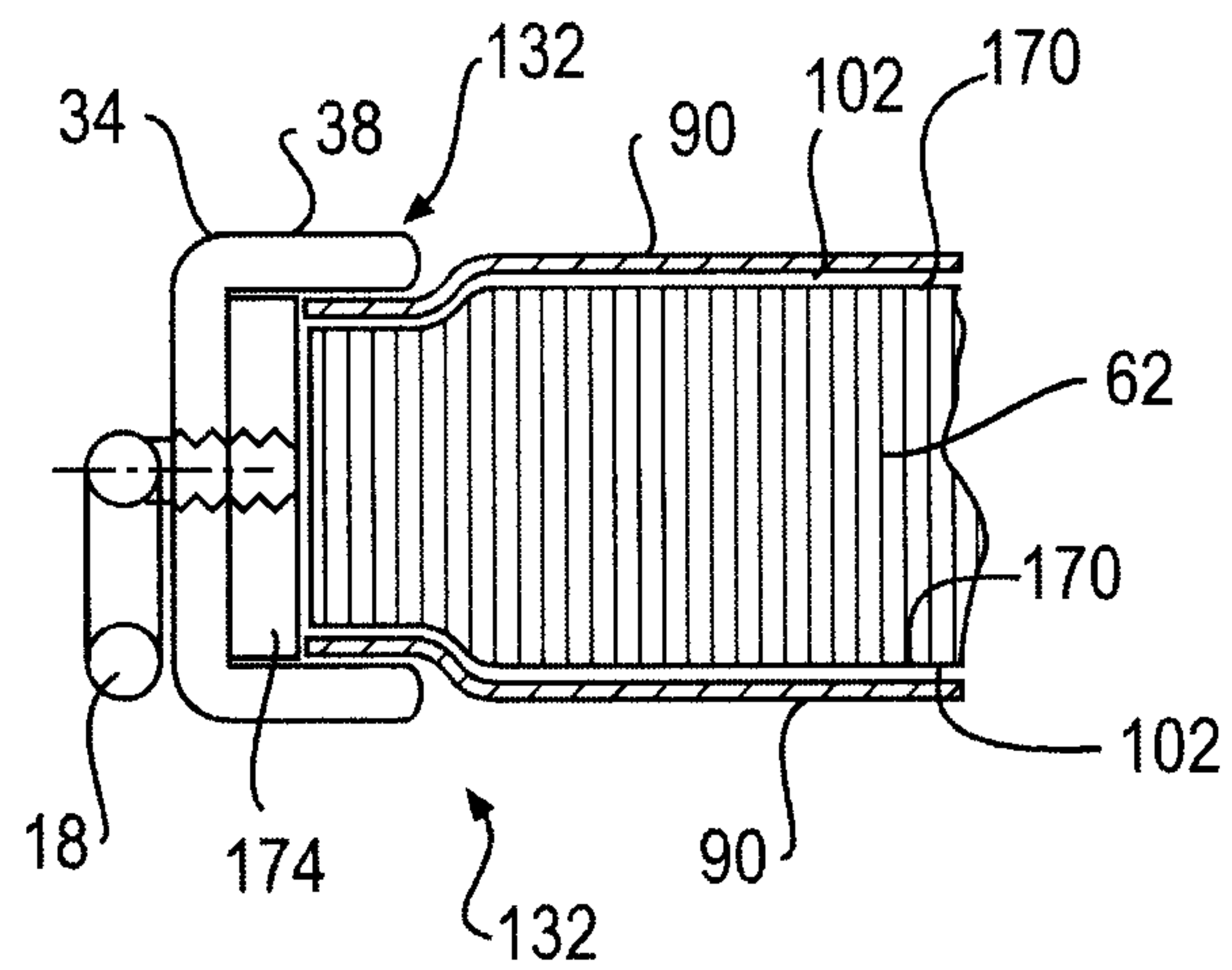
**FIG. 30**



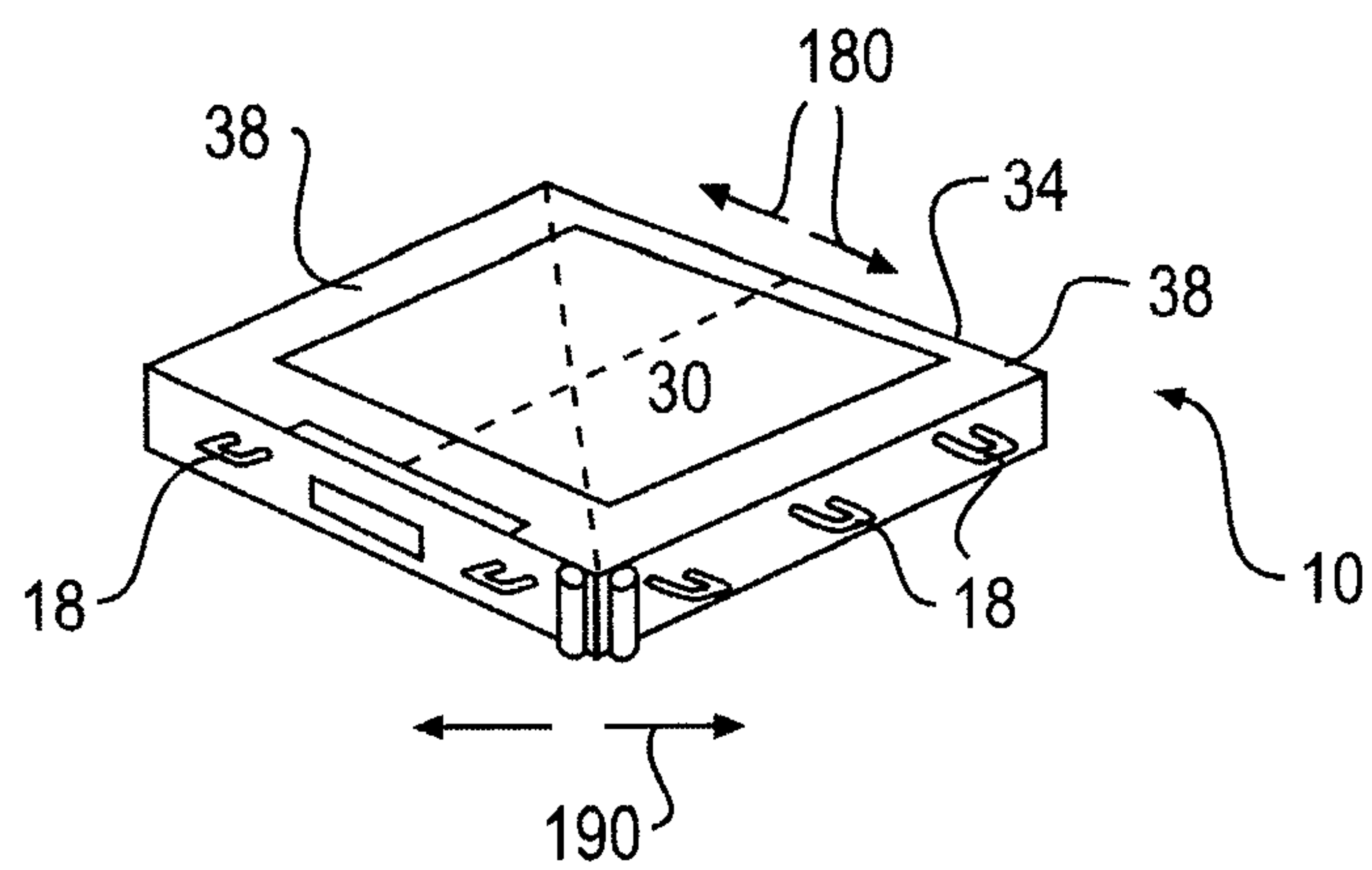
**FIG. 31**



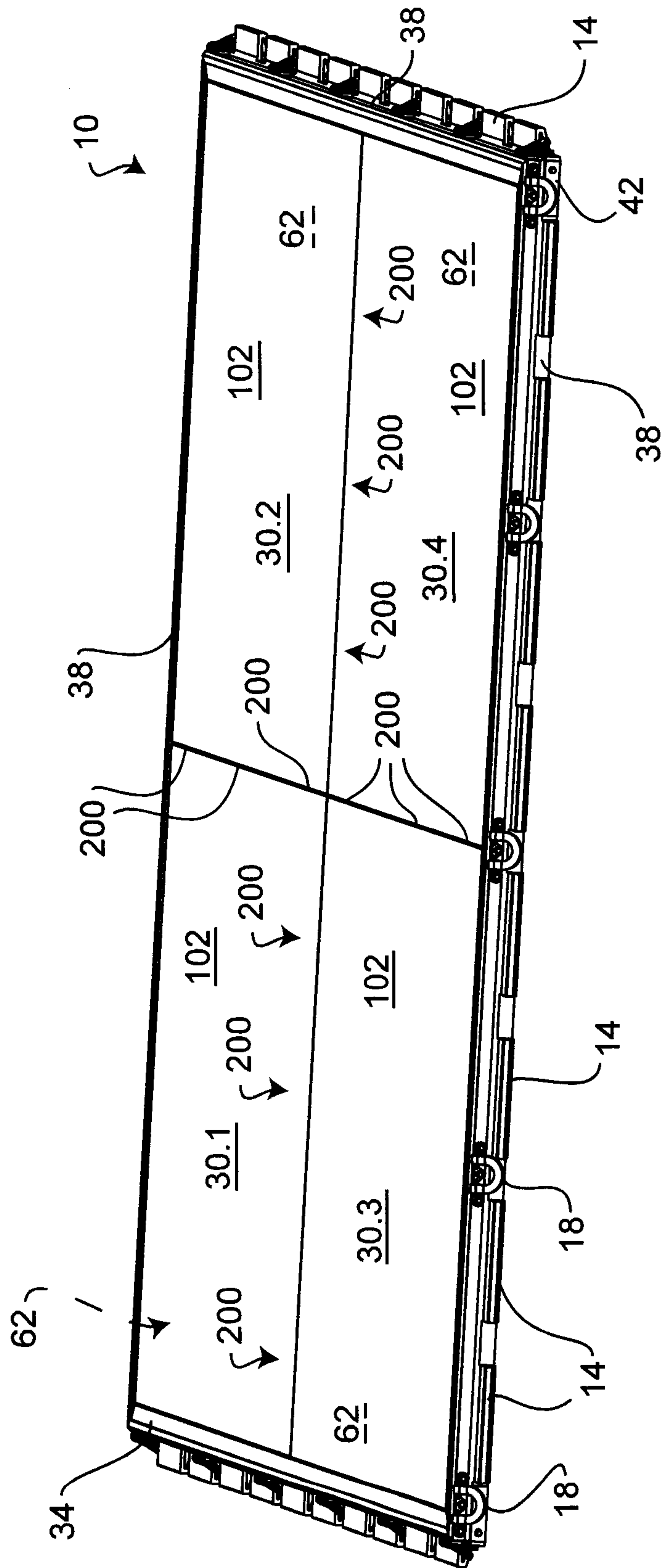
**FIG. 32**



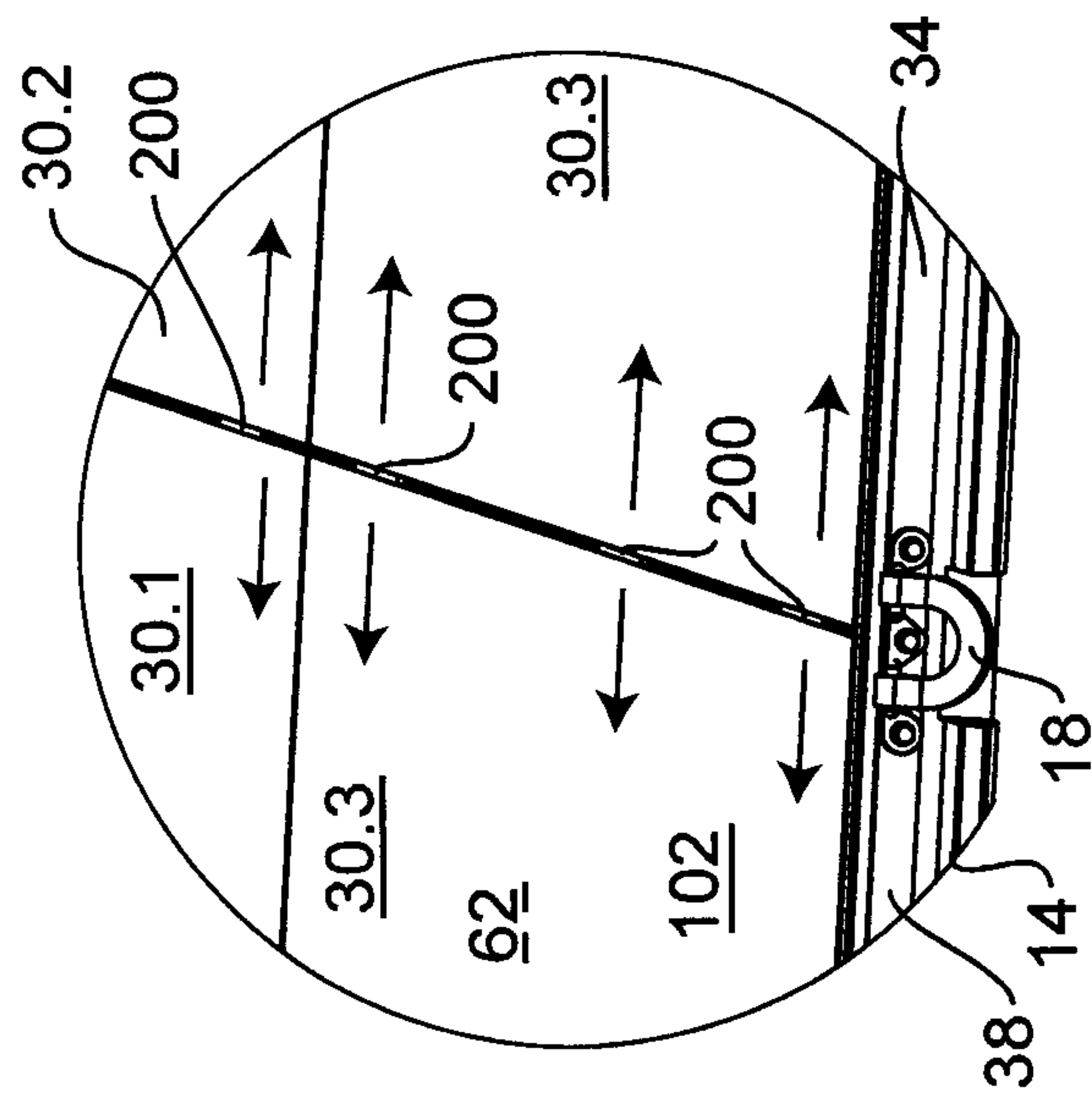
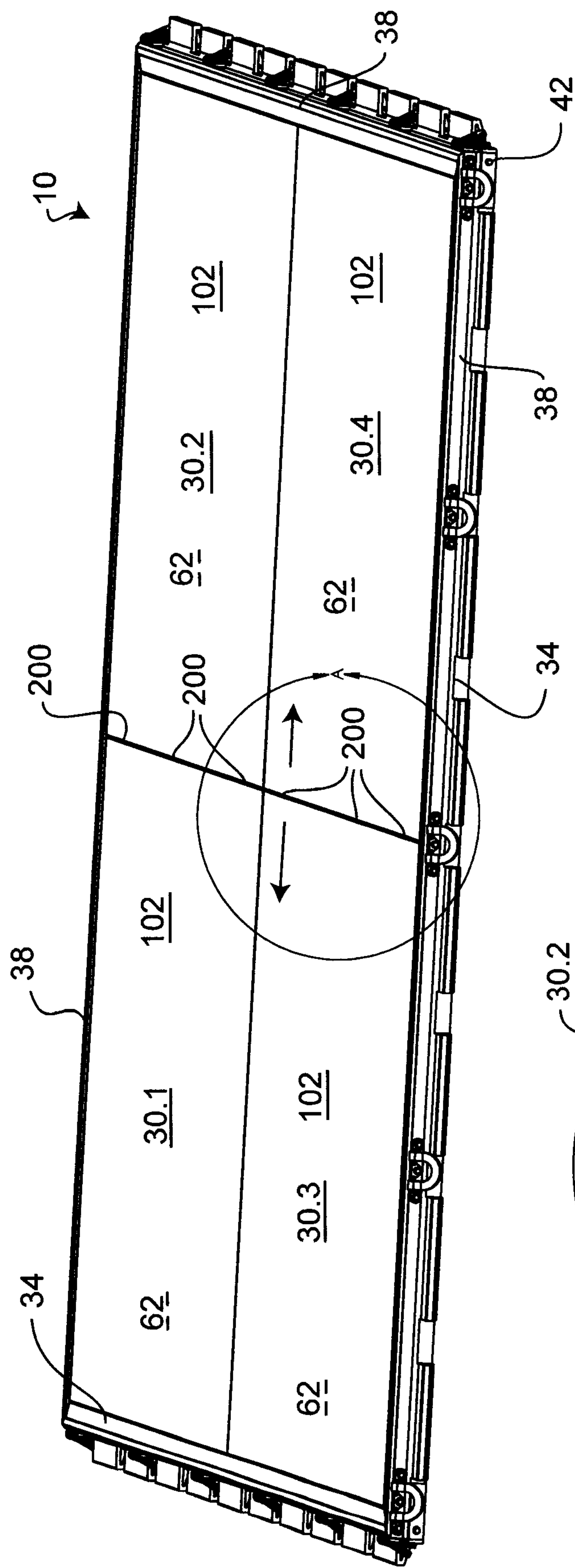
**FIG. 33**



**FIG. 34**



**FIG. 35**



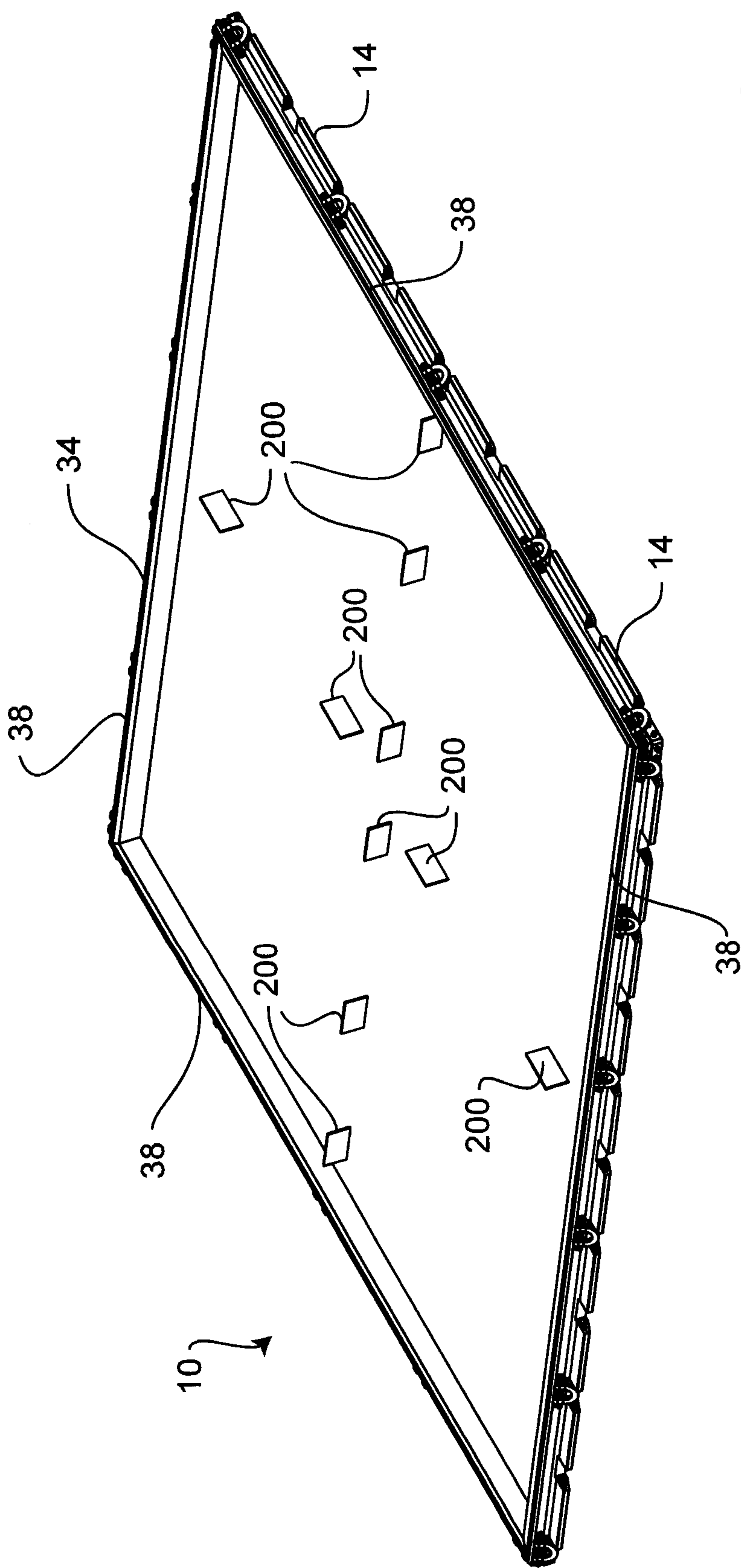
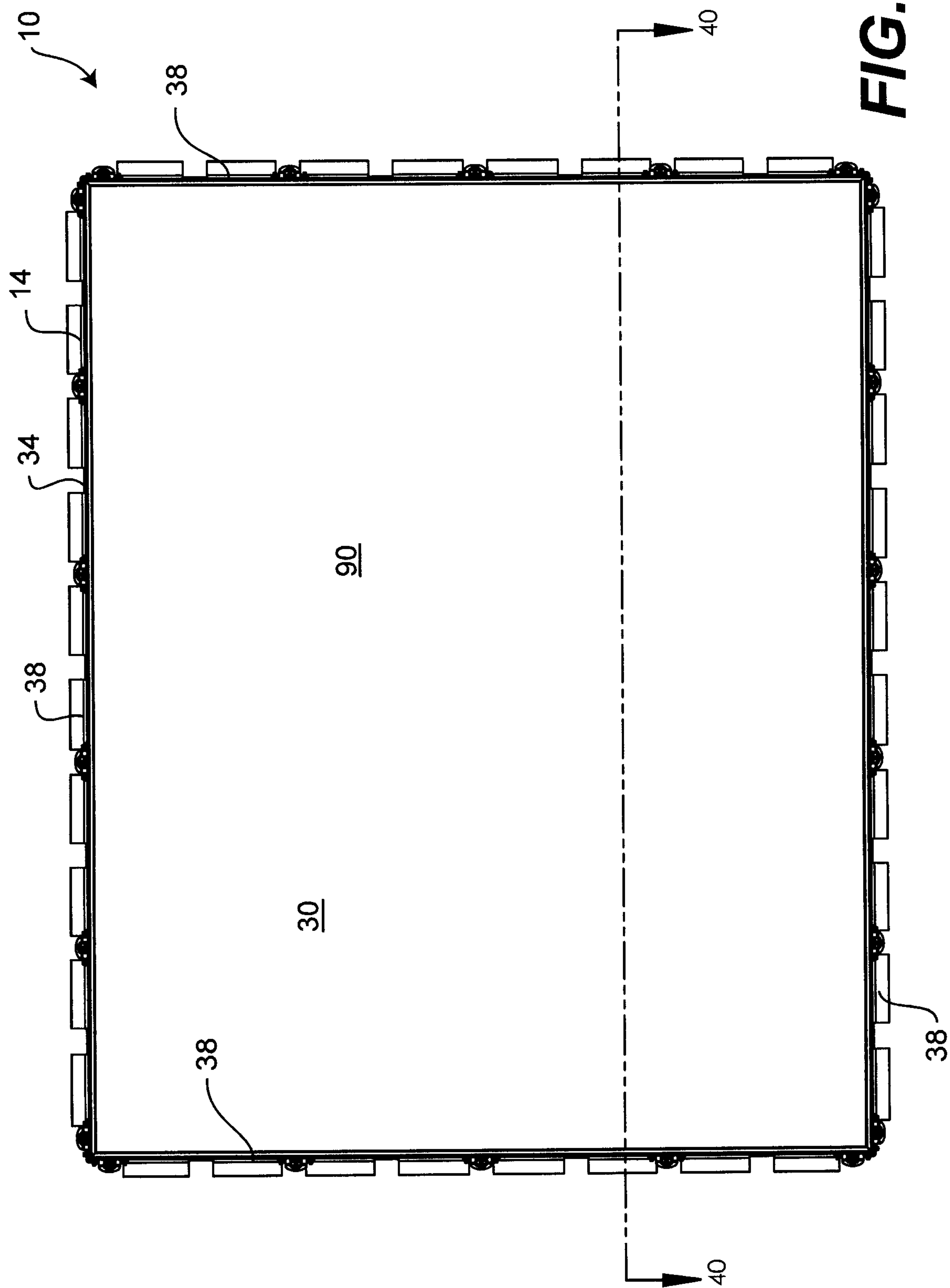


FIG. 38



**FIG. 39**

