



(86) Date de dépôt PCT/PCT Filing Date: 2009/10/01
(87) Date publication PCT/PCT Publication Date: 2010/04/08
(45) Date de délivrance/Issue Date: 2015/08/04
(85) Entrée phase nationale/National Entry: 2011/03/14
(86) N° demande PCT/PCT Application No.: US 2009/059294
(87) N° publication PCT/PCT Publication No.: 2010/040006
(30) Priorité/Priority: 2008/10/02 (US61/102,333)

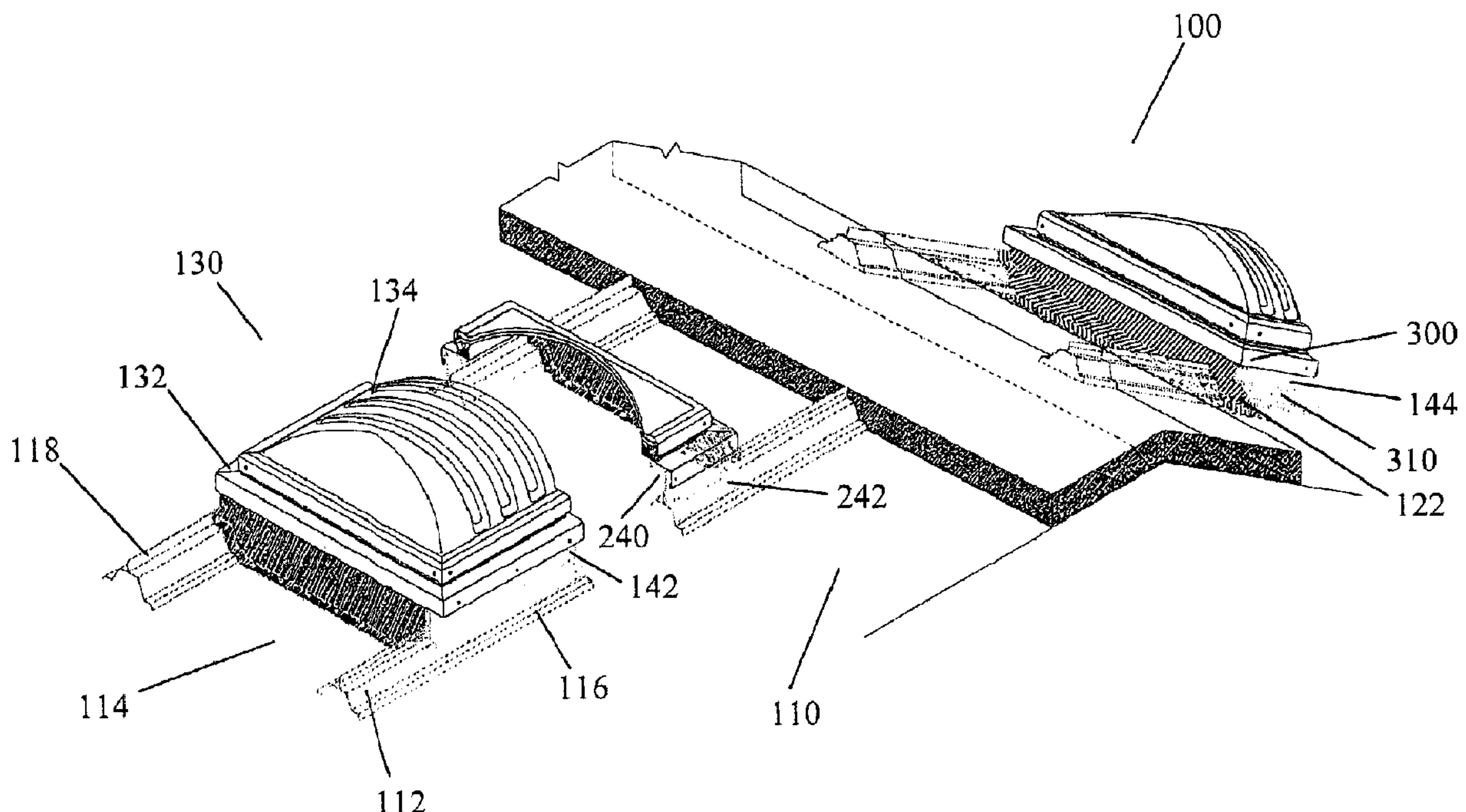
(51) Cl.Int./Int.Cl. *E04B 7/18* (2006.01),
E04D 13/03 (2006.01), *E04D 13/143* (2006.01),
E04D 13/17 (2006.01)

(72) Inventeurs/Inventors:
PENDLEY, TIMOTHY, US;
MCLAIN, MICHAEL J., US

(73) Propriétaire/Owner:
T&M INVENTIONS, LLC, US

(74) Agent: MACRAE & CO.

(54) Titre : STRUCTURE PORTANTE POUR STRUCTURES DE PENETRATION DE TOIT
(54) Title: SUPPORT FOR ROOF PENETRATING STRUCTURES



(57) Abrégé/Abstract:

The invention provides a system for installing a roof penetrating structure to a metal roof, the system comprising a rail and closure structure adapted to be supported by adjacent rib elevations of the roof, including an upper diverter for sealing a cut away portion of the rib structure to divert water away from the rail and closure structure, a lower closure closing off a lower end of the rail and closure structure, and a skylight, smoke vent, or other closure adapted to be supported on the rail and closure structure.



ABSTRACT

The invention provides a system for installing a roof penetrating structure to a metal roof, the system comprising a rail and closure structure adapted to be supported by adjacent rib elevations of the roof, including an upper diverter for sealing a cut away portion of the rib structure to divert water away from the rail and closure structure, a lower closure closing off a lower end of the rail and closure structure, and a skylight, smoke vent, or other closure adapted to be supported on the rail and closure structure.

SUPPORT FOR ROOF PENETRATING STRUCTURES

BACKGROUND OF THE INVENTION

FIELD OF THE INVENTION

The field of the invention is skylights and vent systems.

DESCRIPTION OF RELATED ART

Various systems are known for using curb construction for inserting skylights and smoke vents into roofs.

The most commonly used skylighting systems are those that incorporate translucent or transparent layers in a framework that penetrates the roof structure, so as to allow ambient daylight into the building.

In the past, roof penetrating installations have required a complex structure beneath the roofing panels in order to support a roof curb to which the skylight was attached. Conventional skylight curbs are generally in the form of a preassembled box structure, which is mounted within a roof cutout to the underlying building structural support system. The retrofitting of such curb systems into existing roof structure is problematic in that all known conventional structures have a strong tendency to leak water during rains due to installation details and complexities that are affected by installation techniques, or workmanship.

United States Patent No. 4,296,581, to Heckelsberg, issued October 27, 1981, provides an example of a roofing structure of the type that is constructed of a series of metal panels having flanges that interlock when the panels are laid side by side and which are subsequently tightly seamed together to convert the individual panels into an integrated roof forming membrane. This roofing structure is mounted to the purlins with clips and permits the panels to expand or contract in response to temperature and pressure changes.

United States Patent No. 4,703,596, to Sandow, issued November 3, 1987, and titled "Grid Skylight System", provides a grid skylight support apparatus that includes prefabricated grid row frames, each formed of connected beam supports which define a number of bays. Each bay has a skylight curb formed by upper flanges of the beam supports to receive a preassembled skylight unit. The sides of each grid row frame provide a mating edge that can register with the mating edges of adjacent other grid row frames during assembly. The skylights have peripheral support skirts that register upon each bay and a light-transmitting skylight panel to cover the peripheral support. Cross gutters on each grid row frame, which are positioned between adjacent skylights, extend at angles toward the mating edges of the grid row frame for carrying rainwater to a main gutter channel formed by field-assembly of the mating edges of two adjacent grid row frames. The main gutter channel includes a pair of longitudinally extending gutter sections, each of which have a main gutter channel surface with a lower elevation than the elevation of the cross flow channel. Fasteners assemble the grid row frame mating edges together and a continuous seal is provided to prevent rainwater leakage at the mating edges of adjacent grid row frames.

United States Patent Number 4,520,604, to Halsey et al., issued June 4, 1985, entitled "Skylight Structure", teaches a curb structure that is dimensioned to be passed through an opening in a roof and then attached in asserted moisture impervious relation to the roof from within a building interior. A skylight assembly including a frame and light transmitting member secured to the frame is dimensioned to be passed through the opening and attached in a sealing engagement to the curb structure from within the building interior for covering the opening. The skylight assembly is then secured to the rafters and headers at an interior location. The frame includes upper and lower clamping jaws and spaced fulcrum links attached to the jaws for clamping the light transmitting member thereto. The lower clamping jaws include a channel which engages and is interlocked with the curb structure.

Other skylight systems, as contemplated in United States Patent Number 4,470,230, by Weisner, provide a prefabricated skylight support curb that is formed to be a protective packaging for the skylight during shipment and then used as a curb for mounting the skylight on a roof. A prefabricated skylight support curb for supporting a skylight thereover has a bottom flange angled, upright sides, and a top lip round the top of the sides forming an opening through the curb. A skylight is adapted to cover the opening through the skylight support curb, and has a domed portion and a drip edge on the curb portion. The skylight curb portion is shaped to fit over a portion of the prefabricated skylight support curb angled upright portion and top lip. The skylight support curb is shaped to nest an accompanying skylight therein having the skylight curb portion adjacent to the interior of the skylight support curb angled upright walls to protect the skylight during shipping and storing.

Another skylight system, United States Patent Number 3,791,088, Sandow, et al., teaches prefabricated multiple dome units or skylights, where each multiple dome unit has several domes of transparent or translucent material mounted together on a common frame, and means are provided for assembling a plurality of such dome units into a composite thereof in a building, with the units lapped and interfitted so as to provide a continuous drainage system discharging to the exterior of the units in the composite assembly.

United States Patent Number 4,621,466, Sonneborn, et al., teaches a flashing frame for roof windows to be installed adjacent to each other with edges facing each other. Connecting flanges of the upper flashing members extend beneath the roofing and, if need be, lower flashing members and intermediary flashing members extend obliquely outwardly.

In today's world of mandated energy efficiency in all types of buildings, the metal building industry needs a more effective way to use skylights and smoke vents to transmit daylight into buildings. To ensure adequate daylighting, however, typical skylight and smoke vent installations require multiple roof penetrations that cut through and remove plural major elevations in standing seam and other roof panel profiles. These curbs create multiple opportunities for water to enter the interior of the building, due to multiple curb locations and the widths of the curbs, as well as the challenge to effectively seal the roof at the high ends of such curbs.

The traditional curb constructions and methods of attachment in most cases require a complicated support structure to be installed below the roof panel which can restrict movement associated with the thermal expansion and contraction of the metal roof due to temperature changes and the like.

None of the prior approaches have been able to provide an installation system for multiple skylights that accomplishes all the goals of economy and simplicity of installation and that will work equally well for new buildings and as a retrofit in existing buildings.

5

SUMMARY OF THE INVENTION

The invention provides a construction system for installing two or more adjacent closure members, such as skylights and/or smoke vents, end to end, onto the major rib elevation of a building's metal roof system panel and about
10 and over a roof-penetrating aperture. Numerous roof structures include such rib elevations, sometimes deemed "ribs" or "corrugations", including the standing seam, snap seam and "R" panel roof types. The rail and closure system of the invention is fastened to the rib structures of the metal roof panels above the water line, so that the skylight/vent system can move with the expansion and contraction of the roof.

The invention utilizes elements of the roof surface structure as an integral part of the skylight support structure.
15 In one embodiment, the system includes a rail and closure assembly adapted to be supported on a major rib elevation of a metal roof, proximate where the rib elevation has been cut to accommodate drainage. The balance of the rib is to provide structural support for the rail assemblies.

In some embodiments, the skylight/smoke vent system includes a skylight adapted to be supported on the rail and closure assembly, and a bearing plate structure for supporting and sealing the portion of the elevations that have
20 been cut away, thus preventing water accumulation at the surface, and thus preventing water egress into the building.

In some embodiments, the invention provides a skylight system, optionally including smoke vents or other gas exchange conduits such as a ventilating structure which uses a conduit which conveys a gas through an aperture in the roof.

In some embodiments, a bearing plate structure cooperates with the rail and closure assembly to close the cut
25 away portion to water egress.

In some embodiments, the invention provides a skylight system where the metal roof is selected from the group of roofs comprising a standing seam roof, an architectural standing roof and a snap seam roof.

In some embodiments, the invention provides a skylight system where the rib has been cut in only one location.

In some embodiments, the invention provides a skylight system where the standing seam roof has trapezoidal
30 rib elevations.

In some embodiments, the invention provides a skylight system where the ribs are about 24 inches to about 30 inches on center.

In some embodiments, the invention provides a skylight system where the metal roof is selected from the group of roofs comprising an architectural standing roof and a snap seam roof, and where the vertical rib configurations are
35 about 12 inches to about 18 inches on center.

In some embodiments, the invention provides a skylight system where the metal roof is an exposed fastener roof system.

In some embodiments, the invention provides a skylight system where the rib has been cut in two locations.

5 In some embodiments, the invention provides a skylight system having a trapezoidal or rectangular rib elevation 8 inches to 12 inches on center.

In some embodiments, the invention provides a skylight system where the exposed fastener roof is of the type having panels fastened directly to the roof purlin from the top side of the roof panel.

In some embodiments, the invention provides a skylight system where the system comprises two or more skylights supported end to end.

10 In some embodiments, the invention provides a skylight system, optionally including smoke vents, where each of the skylights is about 10 feet in length.

In some embodiments, the invention provides a skylight system where the rail and closure assembly moves with the rib elevation.

15 In some embodiments, the invention provides a skylight system where a lower closure of the skylight rail and closure assembly extends across the top of the metal roof panel profile.

In some embodiments, the invention provides a skylight system where the closure is configured to match the roof panel surface adjacent rib elevations for sealing.

In some embodiments, the invention provides a skylight system where the closure is pre-cut to match the roof surface and adjacent rib elevations for sealing.

20 In some embodiments, the invention provides a skylight system where the rail and closure assembly is fastened directly to the rib elevations using screws or rivets.

In some embodiments, the rail and closure assembly includes an extension which is effective to raise the height of the skylight and/or smoke vent.

25 In some embodiments, the invention provides a skylight system further comprising a safety security guard attached to the rail assembly.

In some embodiments, the invention provides a skylight system where the rail and closure assembly forms a water tight seal with the rib elevation.

In some embodiments, the invention provides a skylight system where the side rail elevation attaches to the outside of the rib elevation.

30 In some embodiments, the invention provides a skylight system where a portion of the adjacent rib elevation is cut away to accommodate drainage along the roof surface.

In some embodiments, the invention provides a skylight system where a portion of a length of only one adjacent rib elevation is cut away to accommodate drainage along the roof surface.

35 In some embodiments, the invention provides a skylight system where a portion of the length of each of two or more adjacent rib elevations is cut away to accommodate drainage along the roof surface.

According to one aspect of the present invention there is provided a construction system configured to be installed about an aperture in a metal roof, such metal roof comprising a plurality of roof panels, such roof panels having lengths and widths, panel flats extending across such panel widths, such roof panels being arranged side by side, edges of adjacent such roof panels meeting at elevated rib structure portions thereof, thereby to define elevated ribs, the construction system comprising a support structure having a length, and being configured to be supported by ones of such elevated ribs and to overlie a portion of such panel flat of a single such roof panel between adjacent such elevated ribs, the support structure comprising (i) first and second rails configured to be mounted to respective first and second ones of the ribs on opposing sides of such panel flat, (ii) an upper diverter configured to extend between the first and second rails across an upper end of the support structure and adjacent an upper end of such aperture, as well as through a cut away portion of a such rib, thus to divert water laterally away from the support structure and onto a such panel flat of a next-adjacent such roof panel, and (iii) a lower closure configured to extend between the first and second rails across a lower end of the support structure and adjacent a lower end of such aperture, thus to seal the lower end of the support structure against leakage of water.

According to further aspect of the present invention there is provided a building, comprising (a) a building structural support system; and (b) a roof supported by the structural support system, the roof comprising (i) a plurality of elongate roof panels arranged in side-by-side relationship, the roof panels having first lengths, defining opposing first and second ends thereof, and opposing first and second sides of the roof panels, the sides of the roof panels comprising elongate elevated rib structure portions thereof, the elevated rib structure portions, on a first the roof panel being joined with the elevated rib structure portions on adjacent the roof panels to form first and second elevated ribs, the roof panels further comprising panel flat portions between the elevated ribs, (ii) an aperture in the roof, the aperture being confined within the width of a single the roof panel, and (iii) a load support structure extending about such aperture in the roof, the load support structure having a second length defining third and fourth ends thereof, and a second width, corresponding directionally to the first lengths and the first widths of the roof panels, first and second elongate rails having lengths, and extending along the length of the load support structure, the load support structure spanning the flat portion of a single the roof panel, the first and second rails being mounted to respective the first and second elevated ribs adjacent such panel flat and on opposing sides of such panel flat.

According to another aspect of the present invention there is provided a building comprising (a) a building structural support system; and (b) a roof supported by the structural support system, the roof comprising (i) a plurality of elongate roof panels arranged in side-by-side relationship, the roof panels having first lengths, and opposing first and second sides of the roof panels, the sides of the roof panels comprising elongate elevated rib structure, the elevated rib structure on a first the roof panel being joined with the elevated rib structure on adjacent the roof panels to form elevated ribs at such joiners, the ribs having tops, the roof panels further comprising panel flat portions between the elevated ribs at elevations below the tops of the ribs, (c) first and second rails having second and third lengths corresponding directionally to the lengths of the roof panels, the first and second rails being mounted to such elevated ribs; and (d) a

downwardly-directed load mounted to the first and second rails and extending across a space between the first and second rails at an elevation above the elevation of a corresponding panel flat.

According to a still further aspect of the present invention there is provided an upper diverter configured to be mounted on a sloping roof of a building, the upper diverter having a first length and comprising: (a) a lower flange (410), the lower flange having a second length extending along a substantial portion of the first length of the upper diverter; and (b) an upstanding wall extending from the lower flange at a lower edge of the upstanding wall, and extending generally along the second length of the lower flange, the upstanding wall comprising an upper web (415) defining a first projected angle, having a first magnitude relative to the lower flange, and a diversion surface (420) defining a second included angle, greater than the first angle, relative to the lower flange.

According to another aspect of the present invention there is provided an upper diverter, configured to be mounted on a sloping roof of a building, the upper diverter having a first length and opposing first and second ends, and comprising: (a) a lower flange (410) extending along a substantial portion of the first length; and (b) an upstanding wall joining the lower flange at a lower edge of the upstanding wall, the joining extending generally along the second length of the lower flange, the upstanding wall having opposing first and second sides and extending upwardly from the joining to an upper edge of the upstanding wall, the upper edge of the upstanding wall having a third end corresponding to the first end of the upper diverter and a fourth end corresponding to the second end of the upper diverter, the lower flange being disposed on the first side of the upstanding wall, at least a portion of the upstanding wall, at the first end of the upper diverter, extending beyond the third end of the upper edge of the upstanding wall, a rib mating surface (440) being disposed on the first side of the upstanding wall and extending from a location at the fourth end of the upstanding wall, away from the upstanding wall, and upwardly above the lower flange, the rib mating surface having at least one panel thereof which is perpendicular to the upper edge of the upstanding wall.

These and other features and advantages of this invention are described in, or are apparent from, the following detailed description of various exemplary embodiments of the apparatus and methods according to this invention.

BRIEF DESCRIPTION OF THE DRAWINGS

A more complete understanding of the present invention and the attendant features and advantages thereof may be had by reference to the following detailed description when considered in conjunction with the accompanying drawings wherein various figures depict the components and composition of the multiple skylight system.

FIGURE 1 is a view showing the roof profile of a metal roof of the type known as the standing seam roof panel.

FIGURE 2 is a view showing the roof profile of a metal roof of the type known as an architectural standing seam roof.

FIGURE 3 is a view showing the roof profile of a metal roof of the type commonly referred to as a snap seam roof.

FIGURE 4 is a view showing the roof profile of a metal roof of the type commonly referred to as an exposed fastener roof panel.

FIGURE 5 is a view showing the roof profile of a metal roof of the type commonly known as foam core panel.

FIGURE 6 is a side view showing the major components of the system as installed in a metal roof.

FIGURE 7 is a top plan view of the installed system, showing the placement of skylights and the direction of water flow over the roof.

FIGURE 8 is a cross sectional view showing the connections of the skylight frame to the rail and closure structure, and the latter affixed over the surface of adjacent rib elevations of the metal roof.

FIGURE 9 is a perspective view partially cut away showing internal structure of the system as installed on the rib elevations of a metal roof.

FIGURE 10 is a perspective view of the upper diverter of the rail and closure structure.

FIGURE 11 is a top view of the upper diverter of the rail and closure structure.

FIGURE 12 is a front view of the upper diverter of the rail and closure structure.

FIGURE 13 is a perspective view of the lower closure member of the rail and closure structure.

FIGURE 14 is a top view of the lower closure of the rail and closure structure.

FIGURE 15 is a front plan view of the lower closure of the rail and closure structure.

DETAILED DESCRIPTION OF THE ILLUSTRATED EMBODIMENTS

The products and methods of the present invention provide a skylight rail and closure system for use in installing various roof penetrating structures in metal roofs. For purposes of simplicity, "roof penetrating structures" and "skylights" will be used interchangeably to mean various forms of roof structures installed for passage of light and/or ventilation to the interior of the building. In the case of roof ventilation, examples include simple ventilation openings, such as for roof fans, and smoke vents, which are used to allow the escape of smoke through the roof during fires.

The number of skylights can vary from one to many structures connecting end to end from one to as many as the building roof structure can support, limited only by the amount of support provided by the roof surface structure, which is left largely intact during the installation process.

The system utilizes the major rib structure in the roof as the primary support structure and water barrier to fasten the skylight assembly. Typical conventional skylight installations do not allow for continuous runs where skylights are mounted to each other end to end, but use a curb construction that is typically 2-3 times wider than the skylight support structure used in the present invention.

The present skylight system does not require a complex structure underneath the panels or a separate curb construction to support or attach the skylight. Rather the rail and closure structure of the invention is overlaid onto the roof system and allows for thermal expansion and contraction of the roof system members by utilizing the major profiles of the metal roof panel for support. This is accomplished through direct attachment of the rail assembly of a skylight of the invention, and a combination of the panel flat and major ribs for support and attachment of the skylight lens as part of the closure assembly.

In reference now to the figures, the system allows the installation of two or more adjacent skylights in an end to end fashion along the major rib structure of a building's metal roof panel profile.

The skylight systems may be applied to various types of ribbed roof profiles. Figure 1 is an end view showing the roof profile of a metal roof of the type known as the standing seam roof. These include the "standing seam" roof, which has trapezoidal major ribs 12 typically 24 inches to 30 inches on center. Each panel 10 also includes the panel flat 14, having a shoulder 16 and is seamed at adjacent panels forming a standing seam 18, which is folded over and seamed to prevent water from penetrating the roof at the standing seam.

Figure 2 is an end view showing the roof profile of a metal roof of the type known as an architectural standing seam roof, produced of a series of overlapping architectural standing seam panels 20. Each panel 20 comprises a panel flat 24, with an architectural standing seam 28 formed at the panel interconnections.

Figure 3 is an end view showing the roof profile of a metal roof of the type commonly referred to as an R panel or exposed fastener panel 30. Each panel has a rib 32, and panel flat 34. Adjacent R panels are secured to the roof through structural fasteners 35. At the shoulder 36, which is formed from overlapping regions, or at side lap 38, the adjacent panels are secured through stitch fasteners 39. The trapezoidal major ribs of the R panel roof are most typically formed at 8 inches to 12 inches on center.

Figure 4 is a view showing the roof profile of a metal roof of the type commonly referred to as a snap rib seam panel 40. Snap seam panels 40 have a panel flat 44 and a standing seam or snap seam 48 at adjacent panels.

Figure 5 is a view showing a roof profile of a metal roof of the type commonly referred to as using a foam core panel 50. Such roof has a rib 52, a liner panel 53, a panel flat 54 and a foam core 57. Side laps 58 are secured by a stitch fastener 59. Such roof panels are typically installed from the interior of the building.

A skylight/ventilation system of the invention includes a rail and closure assembly adapted to be supported by the major elevations, seams, rib structures, or other structural elements of conventional such roof profiles, where the standing structure of the roof system e.g. at seams which mount adjoining roof panels to each other, provides the support for the skylight/ventilation assemblies, and the skylight/ventilation assemblies are secured to the conventionally-existing elements of the roof structure through an opening formed in the intervening, non-structural roof flat region.

Turning now to Figure 6, there is shown two exemplified skylight assemblies 100 attached to a standing seam panel roof 110. While FIGURE 6 depicts such assembly, the components can be adapted, by shaping of the elements, for attachment to any roof system that has a profile which includes elevations which provide places for structural support of the respective skylight assemblies.

Looking again to the figures, particularly Figures 6 and 7 show a portion of such a standing seam panel roof 110, in dashed outline, having structural and other elements including a raised rib 112, a panel flat 114, shoulder 116 and standing seam 118. Also depicted are the ridge cap 120 of the roof structure, and a series of cutaway regions, or gaps 122 in the raised ribs 112, formed to accommodate the structure, as described more fully as follows.

Shown as part of the system, and exemplified in this case, is a skylight 130, generally comprising a skylight frame 132 and skylight lens 134. While the figures depict a skylight, it will be understood that the system could also be adapted for use with any number of roof penetrating structures, from various types of skylights to smoke vents or other ventilating structures, which can all be adapted to be supported on the rail and closure assembly system of the invention.

Again referring to Figures 6 and 7, the system includes a rail and closure structure 140, generally comprised of side rails 142 and 144, and upper diverter 146 disposed at the rib cutaway section, or gap 122. An upper diverter plate 148 can be located in gap 122 to carry water laterally across the width of the respective rib, to the panel flat 114 of the adjacent roof panel, thus to transport the water away from the skylight and to prevent the water from leaking through the roof.

Figure 7 shows how gap 122 in roof rib 112 allows water flow 200 along the roof surface, over plate 148, and down and away from the roof ridge cap 120.

Rail and closure assembly structure 140 also includes a lower closure 150 to close the roof penetration from the elements at the lower end of the e.g. skylight.

In reference now to Figure 8, there is shown a cross section through the skylight lens region 130 of the skylight assembly 100, showing the securement of the skylight assembly 100 to the standing seam panel roof 110. Figure 8 depicts the use of a rib 112 to support the side rails 142 and 144 on opposing sides of the rail and closure structure 140, and wherein the entireties of the rails are above the panel flat. It is seen that each rail 142 or 144, has a rail shoulder 242, and an upstanding web 238 extending upwardly above the rail shoulder and above the respective rib, to a bearing

surface/panel 240. The rail 142 or 144 is secured to the skylight frame 132 by fasteners 300, only one of which is shown, spaced along the length of the rib.

The rail shoulder 242 is shaped to fit closely over the outside of the roof rib 112, and is secured to roof rib 112 by rivets 310, only one of which is shown, spaced along the length of the rib. The rail bearing surface 240, at the top of the rail, supports the skylight frame 132. A sealant 330 can be applied between bearing surface 240 and skylight frame 132, to seal against the passage of water or air across the respective joint.

It can be seen that the rail and closure structure 140 of the skylight assembly 100 can be produced to fit closely along the contour of the roof 110, and can be so configured to have end portions that match the contours of the respective ones of ribs 112. The various mating surfaces of the structure 140 and the roof 110 can be sealed in various ways known to the roofing art, including caulking or tape mastic, or various rubber fittings or inserts can be provided to be used to seal the open area of the panel roof.

In Figure 9, a partially cut away perspective view of the skylight assembly 100 is used to show support of the rail and closure system by standing seam panel roof 110, particularly the elevated rib 112 providing the structural support at the standing seams. In Figure 9, it is seen how the rail and closure system incorporates the structural profiles of the upper panels of metal roof structure above and below the skylights, and incorporates the elevations and ribs used in sealing adjacent panels, to provide the primary support for adjacent skylights. In this fashion, the system adopts various ones of the advantages of a standing seam roof.

Most standing seam roofs are seamed using various clip assemblies that allow the roof panels to float relative to each other, along the major elevation, namely along the joints which are defined at elevated ribs 112. Typically, the roof is fixed at eave and allowed to expand and contract relative to a ridge. Very wide roofs can be fixed at midspan and expand and contract relative to both the eave and ridge. The design of the skylight system of the invention takes full advantage of the floating features of contemporary roofing structures, such that when skylight assemblies of the invention are so secured to the respective rib elevations, the skylight assemblies, themselves, are able to draw strength from the structural load bearing capacities of the roof profile, and to float along with the roof panels to which they are mounted.

Figure 9 shows panel flat 114, rib 112 and shoulder 116, as well as standing seam 118. The ridge cap 120 is also shown, as well as the gap in the roof 122.

The skylight 130 is supported on the rail and closure structure 140, as previously described.

The rail and closure structure 140 is secured, by its side rails 142 and 144, by a series of fasteners 300 to the skylight frame 132 and frame 132 is secured to ribs 112 by a series of rivets 310.

In application, for a given skylight assembly 100 or strip of skylight assemblies 100, a single rib 112 is typically cut away to accommodate drainage at the high end of the closure structure (toward ridge cap 120). This is an important feature for standing seam, architectural standing seam and snap seam roofs. Two ribs may be cut for roofs having an "R" panel profile.

The retained portions of rib 112 serve as a beam to support the side rails 142 and 144 and to maintain a watertight seal at the joints between roofing panels, along the length of the assembly. Internal portions of ribs 112 may be removed to allow additional light from the skylight 130 to reach through the respective roof opening.

A single bearing plate structure 148 (FIGURE 7) is used for sealing to the roof panel and to the rail and closure structure 140 at the respective cut away rib. The bearing plate 148 also provides support to link adjacent rib elevations 112 to each other, and is typically produced of steel or other material sufficient to provide a rigid substructure to the skylight rail and closure structure.

The rail and closure structure 140 is shaped in such a manner that the skylight can be easily fastened directly to the rail portion, with rivets or fasteners such as screws and the like as illustrated at 310 in FIGURES 8-9. The rail and closure structure 140 may also be designed to accept a safety security guard before the skylight is installed.

Looking now to Figures 10 through 12, an upper diverter 146 provides closure of the roof penetration and diversion of water around the top of the assembly to an adjacent panel flat. Diverter 146 also provides a weather tight seal at the upper end of the assembly, with the plate 148 (not shown in Figures 11-13) in combination with conventional sealant materials. In reference to the side rails 142 and 144 of a standing seam panel roof 110, the diverter 146 generally fits the profile of the rib 112 at the region of the cut away gap 122. The side rails 142 and 144 abut the diverter 146 and the height of the diverter 146 closely matches the side rails in height. The upper flange 400 of diverter 146 acts with upper flanges 240 of side rails 142 and 144 to form the upper surface of the skylight frame, to which the skylight lens frame is mounted.

Lower flange 410 of diverter 146 runs along the panel flat 114. An upstanding wall 405 extends from lower flange 410 upwardly to upper flange 400. Upstanding wall 405 includes an upper web 415 defining a first projected angle with the lower flange, and a diversion surface 420 defining a second included angle, greater than the first angle, relative to the lower flange. Fastener holes 430 are spaced along the length of the lower flange.

At the closed rib end is a rib mating surface 440 and at the cut rib end, a rib sealing plate 450 extends through gap 122. As illustrated in FIGURE 10, mating surface 440 extends away from the upstanding wall, and upwardly above lower flange 410; and at least one panel of the mating surface is perpendicular to the upper edge of the upstanding wall.

Figures 13 through 15 show the lower closure 150 that is used to maintain a weather tight seal at the lower end of the assembly. Shown again in reference to the side rails 142 and 144 of a standing seam panel roof 110, the closure 150 is adapted to fit the profile of the rib 112. The side rails 142 and 144 abut the closure 150 and the height of the closure 150 matches the side rails in height.

Looking to the closure 150, it is seen to have an upper flange 500 and a lower flange 510, as well as a closure web 520. The lower flange 510 includes fastener holes 530.

The closure 150 also includes rib mating surfaces 540 and 550 to provide a tight fit along the ribs 112.

A chief aspect of the skylight assembly 100 is the reduction in the number of roof penetrations required to provide daylight to the interior of a structure, as fewer, longer cuts can be made along the roof elevations. This reduced number of openings in the roof can be maintained along a single rib, if desired, with one continuous opening versus a greater number of smaller openings, providing for an equal or greater quantity of ambient light being brought into the building.

In the case of standing seam roofs, the system provides the ability to remove only a portion of the bottom flat of the panel. This maintains the structural integrity of the roof in that multiple sections of major panel elevations in adjacent roof panels are not removed, as is done to accommodate a "typical" curb assembly which spans multiple roofing panels. Thus, the roof's structural integrity is not compromised to that extent and there are fewer potential areas for water infiltration, in that the upper reaches of the skylight panels can be mounted in the roof adjacent the ridge of the building and can extend to the eave, requiring water to be diverted only once near the ridge of roof plane and only across one panel flat.

To the limited extent that cutaways are made to the elevations/ribs, such cutaways extend only a minimal distance along the lengths of the respective roof panels, on the order of a few inches or less, solely for the purpose of allowing drainage of water past the upper ends of the strip skylights.

The rail elements of the skylight assemblies of the invention are designed to be installed to the outside of the major rib elevations for any of the aforementioned roof panel profiles.

The skylight assembly 100 is particularly useful for continuous runs, or strips, of skylights, where individual skylights are arranged end to end. Two adjacent runs of the rails can be affixed, as a collective load support structure, along a standing seam roof 110. Instead of producing skylight assemblies with diverters and lower closures, where adjacent skylights abut, the abutting skylight assemblies 100 are provided with upper and lower standing rib frames at adjacent ends of the adjacent assemblies 100.

As only one example, skylight assemblies 100 can be produced in units of up to 10 feet long, and connected in this fashion for as long as necessary, as each skylight assembly unit is supported by the primary rib of the roof panel profile. The standing rib elevation (the major corrugation) runs longitudinally along the length of the skylight assembly and receives the entire lengths of the sides of the collective skylight assemblies 100, regardless of the number of adjacent rails 142, 144 which are in abutting relation to each other over a given rib. No water can enter over the top of the rail and closure assembly.

Where the ridge cap has a configuration to fit the rib elevations (major corrugation) in the roofing panels, a portion of the rib may be cut out (approximately 2 inches long), allowing the water from the roof panel above to be diverted laterally sideways on to the next panel.

If desired, a simple rail enclosure extension can be used to increase the height or distance between an upper portion of the skylight frame and the roof panel, and can be adapted to simply lay over or attach to the top of the rail and closure assembly. Such an extension can be produced to rest along the upper flange of the rail and closure assembly, to effectively raise the height of the corresponding skylight or smoke vent to accommodate different skylight depths or other design features, or to accommodate snow conditions and the like. In this fashion, the rail and closure structure can be produced to a standard height, with varying extensions used to elevate the overall height of the structure for such varied purposes. Various forms for such an extension would be suitable, and the skilled artisan will understand various ways and means of designing and manufacturing these to accomplish the goal of added height to the skylight.

While this invention has been described in conjunction with the specific embodiments outlined above, it is evident that many alternatives, modifications and variations will be apparent to those skilled in the art. Accordingly, the preferred embodiments of the invention, as set forth above, are intended to be illustrative, not limiting. The scope of the claims should not be limited by the preferred embodiments set forth in the examples, but should be given the broadest interpretation consistent with the description as a whole.

THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. A roof adaptive system configured to be installed about an aperture in a metal roof, such metal roof comprising a plurality of roof panels, such roof panels having lengths and widths, panel flats extending across such panel widths, such roof panels being arranged side by side, edges of adjacent such roof panels meeting at elevated rib structure portions thereof, thereby to define elevated ribs, said roof adaptive system comprising:

a support structure having a length, and being configured to be supported by ones of such elevated ribs and to overlie a portion of such panel flat of a single such roof panel between adjacent such elevated ribs, said support structure comprising

- (i) first and second rails configured to be mounted to respective first and second ones of said ribs on opposing sides of such panel flat,
- (ii) an upper diverter configured to extend between said first and second rails across an upper end of said support structure and adjacent an upper end of such aperture, as well as through a cut away portion of a such rib, thus to divert water laterally away from said support structure and onto a such panel flat of a next-adjacent such roof panel, and
- (iii) a lower closure configured to extend between said first and second rails across a lower end of said support structure and adjacent a lower end of such aperture, thus to seal the lower end of said support structure against leakage of water.

2. A roof adaptive system as in Claim 1, a given said rail being configured to conform to at least a portion of a cross-section of a such rib structure, along the length of such elevated rib structure.

3. A roof adaptive system as in Claim 1, said rails being configured to conform to respective first and second rib structures on respective sides of such panel flat.

4. A roof adaptive system as in Claim 1 wherein said rails are configured to conform to outer surfaces of such roof panels at such rib structures on opposing sides of such panel flat, and wherein said rails move with such rib structures as such rib structures expand and contract.

5. A roof adaptive system as in Claim 1, said upper diverter having a transverse profile across the respective roof panel, which conforms to an upper surface profile of the respective such roof panel as is to be

- 13 -

spanned by said support structure, and which upper diverter closes off said support structure at the upper end thereof from intrusion of water inwardly, through said support structure and toward such aperture in such metal roof.

6. A roof adaptive system as in Claim 1 wherein said lower closure conforms to an elevated rib structure of the respective roof panel.

7. A roof adaptive system as in Claim 1, further comprising a closure member configured to be supported on, and to overlie, said support structure, said closure member being mounted to said support structure at locations along the length of said support structure.

8. A roof adaptive system as in Claim 1 wherein said closure member comprises a skylight assembly.

9. A roof adaptive system as in Claim 7 wherein said closure member comprises an operable vent which can be alternatively closed and opened to the outside environment.

10. A roof adaptive system as in Claim 7, an opening being defined in said closure member, such opening cooperating with a conduit which conveys a gas through an aperture in such roof.

11. A roof adaptive system as in Claim 1 wherein said rails mount to such elevated ribs such that said rails, at such ribs, are entirely above such panel flat of such single roof panel.

12. A roof adaptive system as in Claim 1 wherein said first and second rails mount to such ribs on opposing sides of such panel flat and above such panel flat.

13. A building, comprising:

- (a) a building structural support system;
- (b) a sloping metal roof supported by said building structural support system, said roof comprising a plurality of elongate metal roof panels arranged side by side, said roof panels having first lengths and first widths, edges of adjacent said roof panels meeting at elevated rib structure portions thereof, thereby to define first and second elevated ribs, said roof panels further comprising panel flats between said ribs, and
- (c) a roof adaptive system comprising
 - (i) an aperture in said roof, such aperture being confined within a given said roof panel,

- 14 -

- (ii) a support structure extending about such aperture, said support structure having a length and a width and comprising first and second rails mounted to first and second ones of said ribs which border the panel flat of the given said roof panel, said first and second rails being disposed on opposing sides of such aperture, and
- (iii) a gap extending across said first rib at an up-slope end of said support structure,

said support structure further comprising an upper diverter having first and second ends, said upper diverter extending from said second rail across the width of the given said roof panel to said first rail, thereby providing an upper end of said support structure, including said upper diverter extending through the gap, and thus extending across said first rib, at an elevation corresponding with an elevation of the respective said panel flats at such gap, and extending onto a next adjacent said roof panel, to a first end of said upper diverter, and

said support structure further comprising a lower closure extending from said second side rail, across the given said roof panel to said first side rail, thereby providing a lower end of said rail and closure structure, and

- (iv) a closure member supported by, said side rails, and overlying such aperture.

14. A building as in Claim 13, the second end of said upper diverter conforming to at least a portion of a profile of the rib structure of said second rib.

15. A building as in Claim 13 wherein said support structure comprises at least first and second said closure members in end-to-end relationship to each other and overlying a single such aperture, said first and second closure members extending along first and second different lengths of such aperture and overlying first and second different portions of an area of such single aperture.

16. A building as in Claim 13 wherein a given said rail is fastened only to rib structure of a next adjacent said roof panel, and a lower edge of the given said rail, along an entire length of the respective said rail, is above, and displaced from, the panel flat of such next adjacent roof panel.

17. A building as in Claim 13 wherein said rails comprise upstanding webs extending upwardly from said first and second ribs.

18. A building as in Claim 13 wherein said lower closure has a profile which corresponds to at least a portion of a profile of a said rib.

19. A building as in Claim 13, said closure member comprising a skylight lens assembly.

- 15 -

20. A building as in Claim 13 wherein said first rail comprises a rail shoulder mounted to said first rib, and an upstanding web extending upwardly above said rail shoulder and above said first rib to a bearing surface of said first rail, said closure member being received on said bearing surface.

21. A building as in Claim 13 wherein said support structure is secured only to said roof panel structure, and thus is carried by and moves, in expansion and contraction related to temperature changes, with underlying said roof panel structure.

22. A building as in Claim 13 wherein said closure member comprises a skylight lens disposed above said first and second ribs.

23. A building as in Claim 13 wherein said rails comprise upstanding webs extending upwardly above said ribs.

24. A building as in Claim 13 wherein said lower closure extends to an elevation above said first and second ribs.

25. A building as in Claim 13 wherein said upper diverter extends to an elevation above said first and second ribs.

26. A building as in Claim 13 wherein a lower edge of a given said rail, along an entire length of the respective said rail, is at an elevation above, and displaced from, the panel flat of the next adjacent said roof panel.

27. A building as in Claim 26, said closure member comprising a skylight lens assembly disposed at an elevation above said first and second ribs.

28. A roof adaptive system configured to be installed about an aperture in a sloping metal roof, such metal roof comprising a plurality of roof panels having lengths and widths, said roof panels being arranged side by side, edges of adjacent such roof panels meeting at elevated rib structure portions thereof, thereby to define elevated ribs, and panel flats being disposed between such ribs, said roof adaptive system comprising a rail and closure structure having a length, and being configured to be supported by adjacent ones of the elevated ribs and to extend

- 16 -

about such aperture and to span the panel flat portion of a single such roof panel, which panel flat is between adjacent ones of such ribs, said rail and closure structure comprising

- (a) first and second rails, having lengths, and being configured to be mounted to respective first and second ones of such adjacent ribs on opposing sides of such single panel flat;
- (b) an upper diverter configured to extend from said first rail to said second rail across an upper end of such aperture; and
- (c) a lower closure configured to extend from said first rail to said second rail across a lower end of such aperture.

29. A roof adaptive system as in Claim 28, wherein each said rail overlies a such rib, and wherein a lower edge of a respective said rail is above, and displaced from, an elevation of the panel flat of an underlying such roof panel, and wherein an upstanding web of said rail extends upwardly above such rib.

30. A roof adaptive system as in Claim 28, further comprising a cover configured to be supported on said rail and closure structure, and to overlie such aperture above said first and second ribs.

31. A roof adaptive system as in Claim 30 wherein a said rail comprises a mounting flange adapted to be mounted to an upper surface of such rib, and an upstanding web extending upwardly from said mounting flange and above such rib.

32. A roof adaptive system as in Claim 31, said upper diverter having first and second opposing ends, the first such end being configured to extend through a gap in the first rib and onto a next adjacent roof panel at an elevation of a respective panel flat of such next adjacent roof panel, the second end of said upper diverter being configured to conform to at least a portion of the rib structure of such second rib.

33. A roof adaptive system as in Claim 31, said cover being adapted to be mounted to said support structure and wherein said cover comprises a skylight lens which, when so mounted, is disposed above such first and second ribs.

34. A roof adaptive system as in Claim 28 wherein said lower closure has a profile which corresponds to at least a portion of a profile of an upper surface of such elevated rib structure.

- 17 -

35. A roof adaptive system for use on a metal panel roof, such roof comprising at least one roof eave, a roof ridge, roofing panels extending from the at least one roof eave to the roof ridge, said roofing panels forming a roof having rib elevations extending in parallel relation from the roof eaves toward the roof ridge and panel flats between said rib elevations, and a roof penetration in at least one panel flat of the roof between two of the rib elevations, said roof adaptive system comprising:

side rails mounted directly to the rib elevations adjacent said roof penetration,

wherein each side rail has a length and is comprised of

an upstanding riser portion,

an upper flange extending from said upstanding riser portion, and

a bottom shoulder structure for engaging the rib elevation of the roof adjacent such roof penetration over the length of said side rail,

and the riser portion of said side rail extends upwardly from the rib elevation over the length of said side rail,

wherein, when said side rails are so mounted to said rib elevations, said side rails extend in the directions of

said rib elevations and engage said rib elevations over substantially the entire lengths of said side rails,

and wherein said rib elevations provide structural support for said side rails over substantially the entire lengths of said side rails, and

a skylight or other structure mounted to said side rails over said roof penetration.

36. The roof adaptive system of claim 35 wherein the rib elevations of the roof adaptive system have a cross-sectional profile, and wherein the bottom shoulder structure of each side rail is shaped to mate with the rib elevation to which said side rail is attached over at least a portion of the cross-sectional profile of the rib elevation to which said side rail is attached.

37. The roof adaptive system of claim 36 wherein each said rib elevation has an outside facing away from the roof penetration and an inside facing toward said roof penetration, and wherein the bottom shoulder structure of each side rail is attached to and mates with the outside of the respective rib elevation.

38. The roof adaptive system of claim 35 wherein the roof is a standing seam metal panel roof, and wherein the bottom shoulder structure of each side rail is attached to and mates with only one side of the respective rib elevation.

- 18 -

39. The roof adaptive system of claim 35 wherein the upstanding riser portion of each of said side rails has a top end and a bottom end and wherein said bottom shoulder structure extends from the bottom end of the respective riser portion.

40. The roof adaptive system of claim 35 wherein said upstanding riser portion has a top end and a bottom end and wherein said upper flange extends from the top end of the respective riser portion.

41. The roof adaptive system of claim 35 wherein said upstanding riser portion has a first side and a second side, and wherein the upper flange extends laterally from the first side of said riser portion and the bottom shoulder structure extends laterally from the second side of said riser portion.

42. The roof adaptive system of claim 35 wherein the riser portion of each said side rail is in the form of a substantially continuous riser wall extending along the top of the respective rib elevation.

43. A roof adaptive system for mounting a skylight or other load on a metal panel roof system having panel flats, and rib elevations extending upwardly from such panel flats, said roof adaptive system comprising first and second side rails for supporting opposing sides of such skylight or other structure, each of said side rails having a profile configured to attach to a such rib elevation and to provide structural support for the skylight or other load along substantially an entire length of such skylight or other load, a said side rail comprising:

- (a) an upstanding riser;
- (b) an upper flange extending from said upstanding riser;
- (c) a bottom shoulder structure extending from said upstanding riser, said bottom shoulder structure comprising a first shoulder element attached directly to said upstanding riser, said first shoulder element extending along the length of said side rail, and laterally away from said upstanding riser, said first shoulder element having a first surface facing in a first direction having a downwardly-directed component, said bottom shoulder structure further comprising a second shoulder element attached directly to said first shoulder element, said second shoulder element extending in a second single direction, different from the first direction; and
- (d) upper and lower end elements connected to said first side rail and extending across and above the respective said panel flat, and connected to said second side rail.

- 19 -

44. A roof adaptive system as in Claim 43, said roof adaptive system enclosing an area of such roof and being adapted to support a such load mounted thereon while closing off access to the area underneath such load.

45. A building, comprising:

- (a) a building structural support system;
- (b) a sloping roof supported by said building structural support system, said roof comprising a plurality of elongate roof panels arranged side by side, said roof panels having first lengths, first widths, and opposing first and second sides, said sides of said roof panels comprising elongate elevated rib structure, the elevated rib structure on a given said roof panel being joined with the elevated rib structure on adjacent said roof panels to form first and second elevated ribs at such joiners at the opposing first and second sides of said roof panels, and a panel flat between said first and second ribs, and
- (c) a roof adaptive system comprising
 - (i) an elongate aperture confined within said given roof panel, such aperture having an aperture length extending along the length of the given said roof panel,
 - (ii) a rail and closure structure extending about such aperture, and comprising
 - A. first and second side rails having first and second rail lengths, the full lengths of said first and second side rails overlying and being mounted to, and bearing down on, said first and second ribs,
 - B. an upper diverter extending from said second side rail across the width of the given said roof panel to said first side rail, thereby providing an upper end of said rail and closure structure,
 - C. a lower closure extending from said second side rail across the given said roof panel to said first side rail, thereby providing a lower end of said rail and closure structure, and
 - (iii) a cover secured to said rail and closure structure and disposed above said panel flat, and extending from said first side rail to said second side rail, and from said upper diverter along the length of said aperture.

46. A building as in Claim 45, comprising a plurality of said covers secured to said rail and closure structure, and extending over such aperture in said given roof panel, said covers extending from said first side rail to said second side rail, a first said cover extending from said upper diverter to an intermediate location along the length

- 20 -

of the aperture, and a second cover extending from such intermediate location away from said upper diverter and toward said lower closure.

47. A building as in Claim 45, beam strength of said rib structure providing primary support to said rail and closure structure, supporting said rail and closure structure above said panel flat.

48. A building as in Claim 47, said cover overlying said rail and closure structure.

49. A building as in Claim 47, said cover extending upwardly above said first and second ribs.

50. A building as in Claim 45 wherein said rail and closure structure is secured to, and thus is supported only by, underlying said roof panel structure.

51. A building as in Claim 45 wherein a said rail comprises a mounting flange mounted to a said rib, and an upstanding web extending upwardly from said mounting flange and above said rib.

52. A building, comprising:

(a) a building structural support system;

(b) a sloping roof supported by said building structural support system, said sloping roof comprising a plurality of elongate roof panels arranged side by side, said roof panels having lengths, edges of adjacent said roof panels meeting at elevated rib structure portions thereof, thereby to define elevated roof panel ribs, panel flats being disposed between said elevated roof panel ribs; and

(c) a roof adaptive system comprising

(i) an aperture in said roof, such aperture having a length, first and second ones of said ribs extending alongside such aperture, and

(ii) a load support structure extending about such aperture, said load support structure comprising

A. first and second elongate rails extending alongside such aperture, first and second ones of said roof panel ribs underlying, and supporting, said first and second rails along full lengths of said first and second rails, and

B. end closures, at upper and lower ends of said load support structure, extending between said first and second rails.

1/15

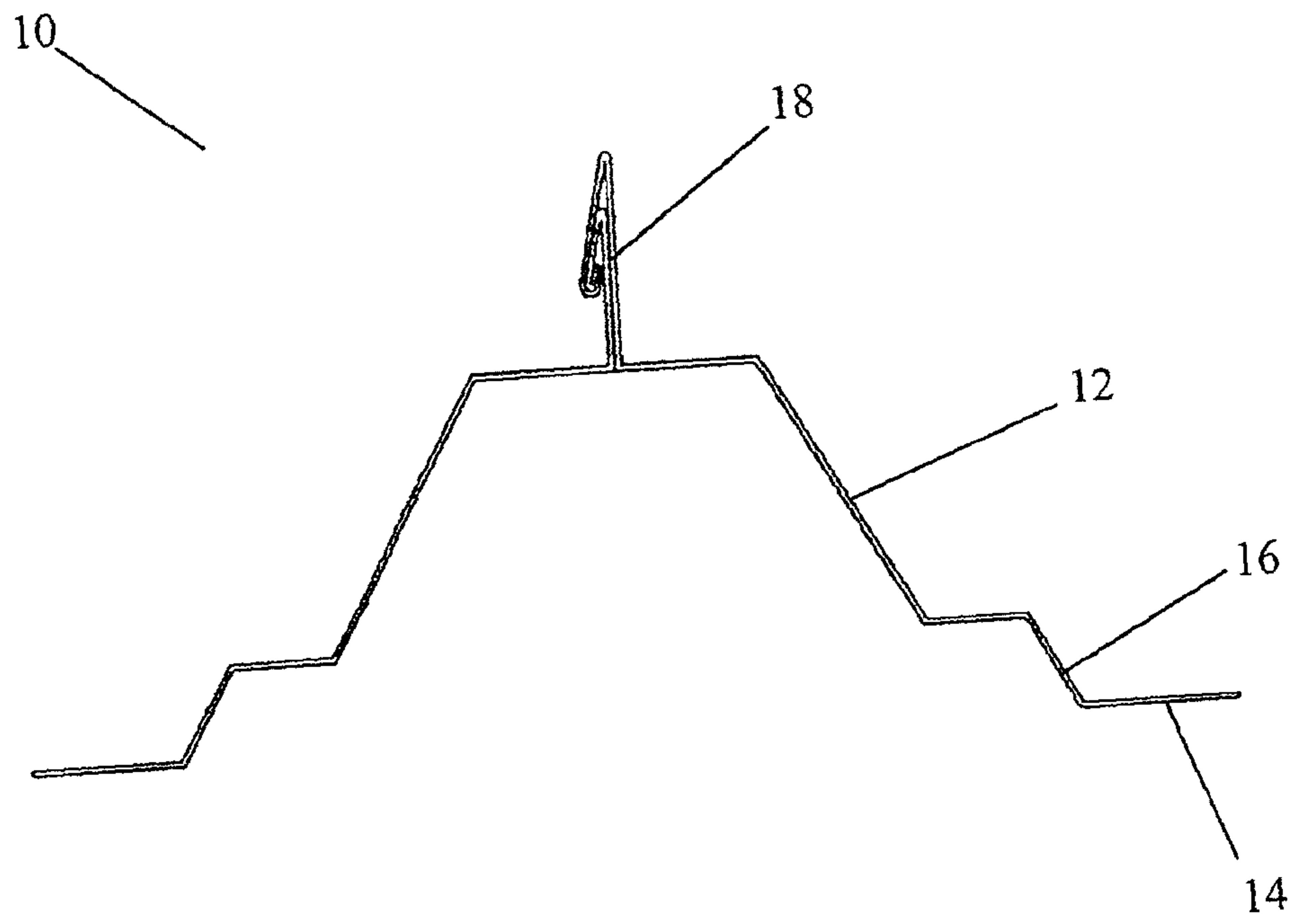


FIGURE 1

2/15

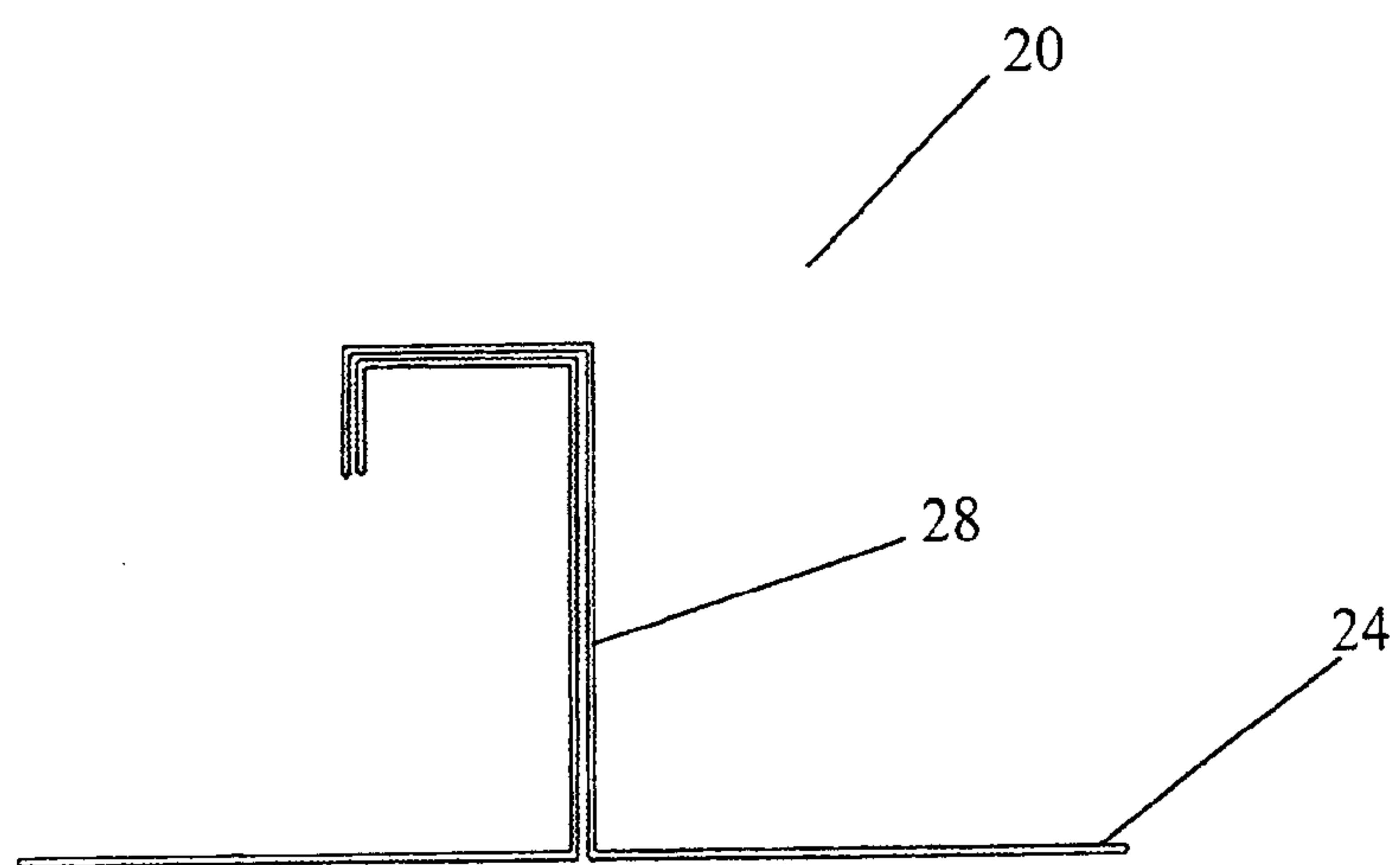


FIGURE 2

3/15

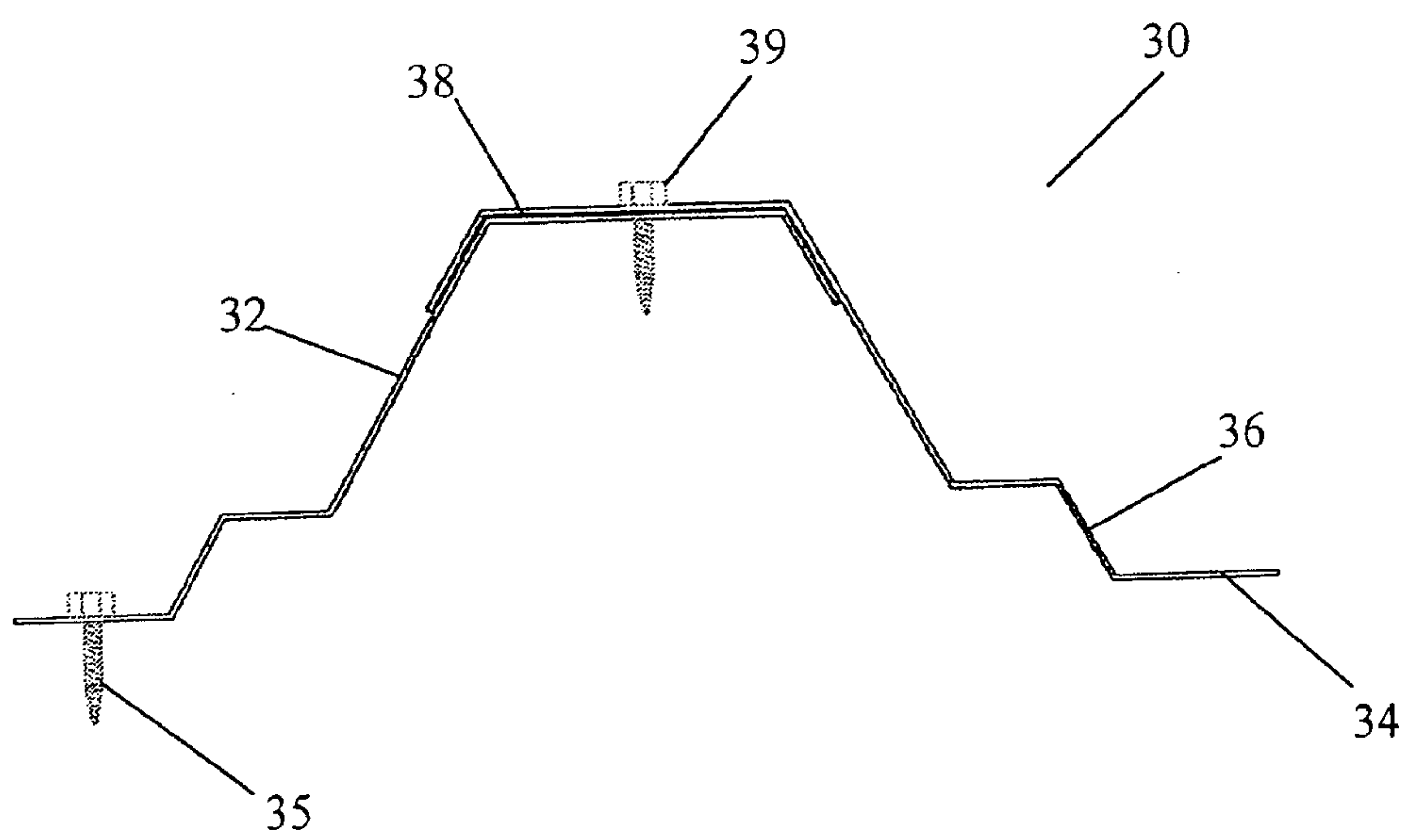


FIGURE 3

4/15

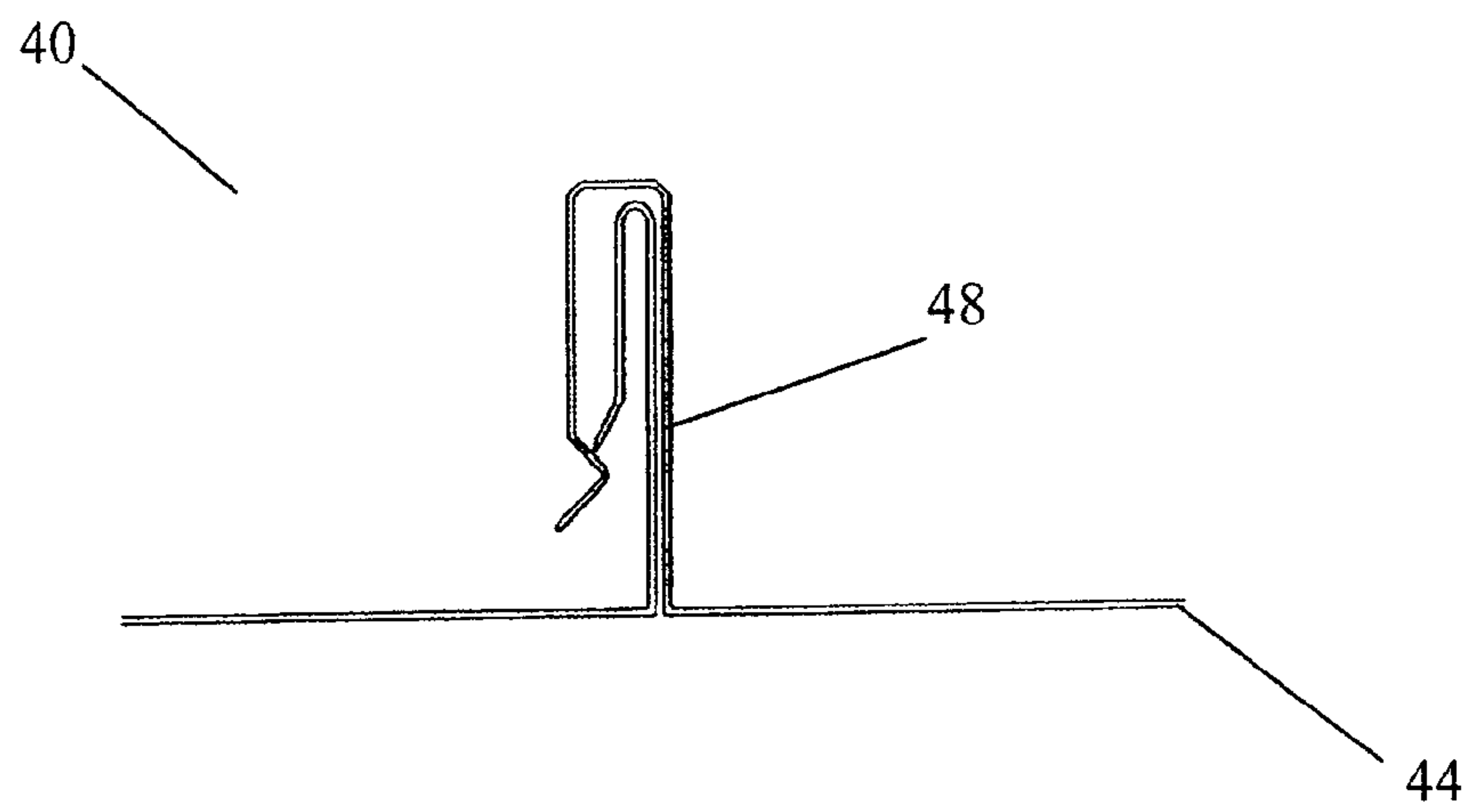


FIGURE 4

5/15

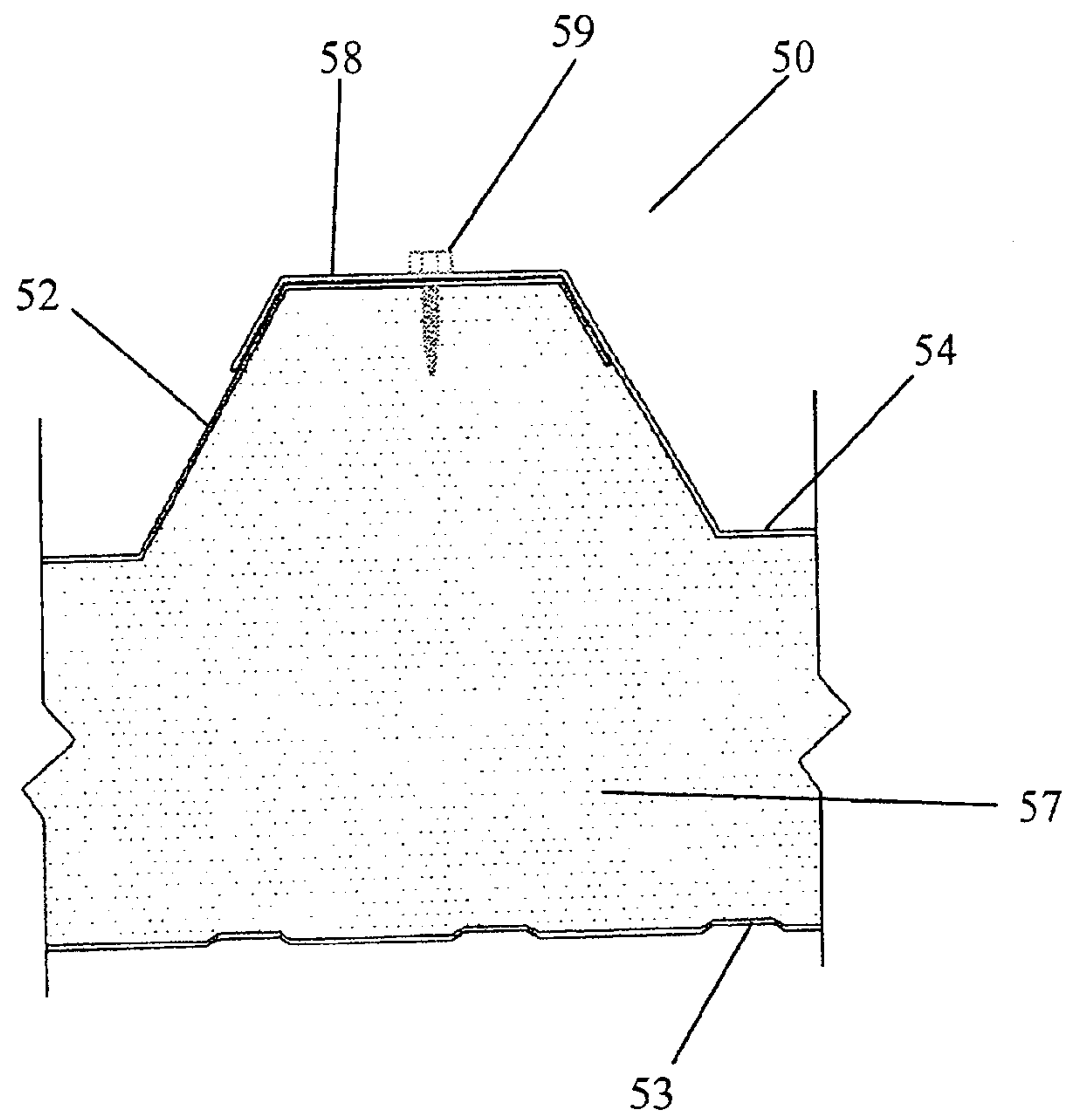


FIGURE 5

6/15

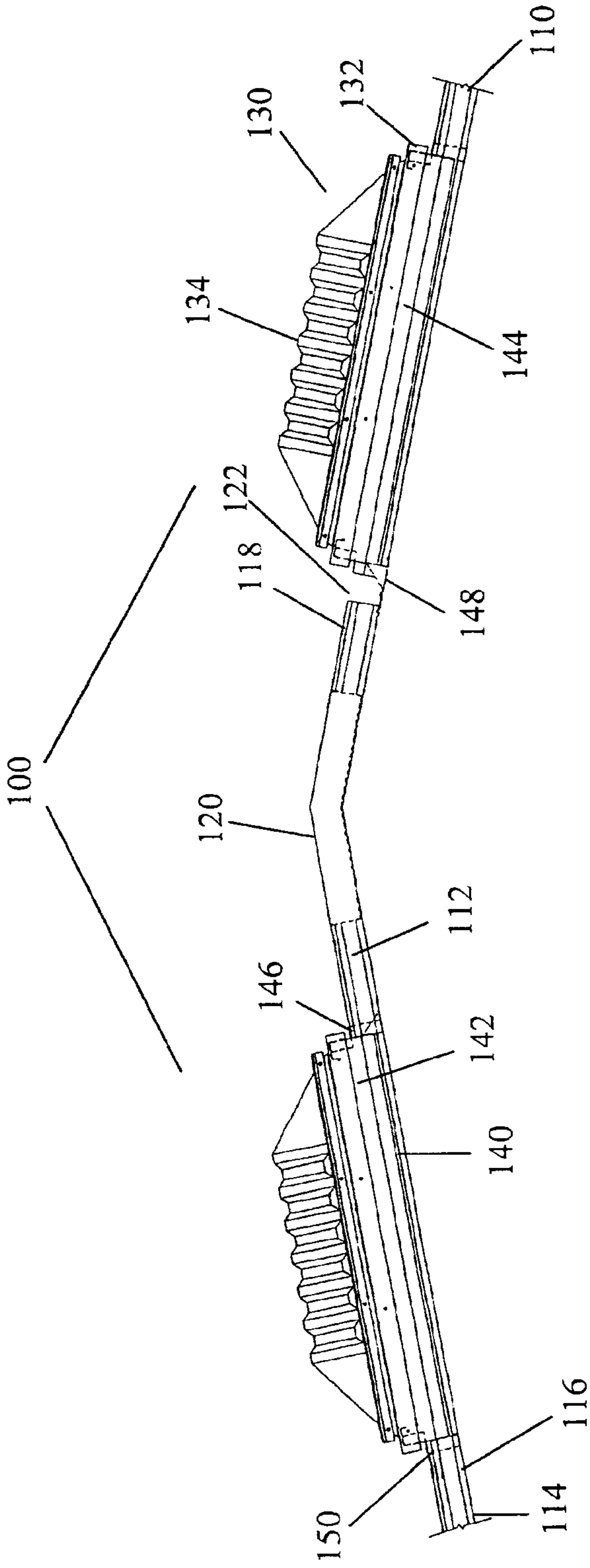


FIGURE 6

7/15

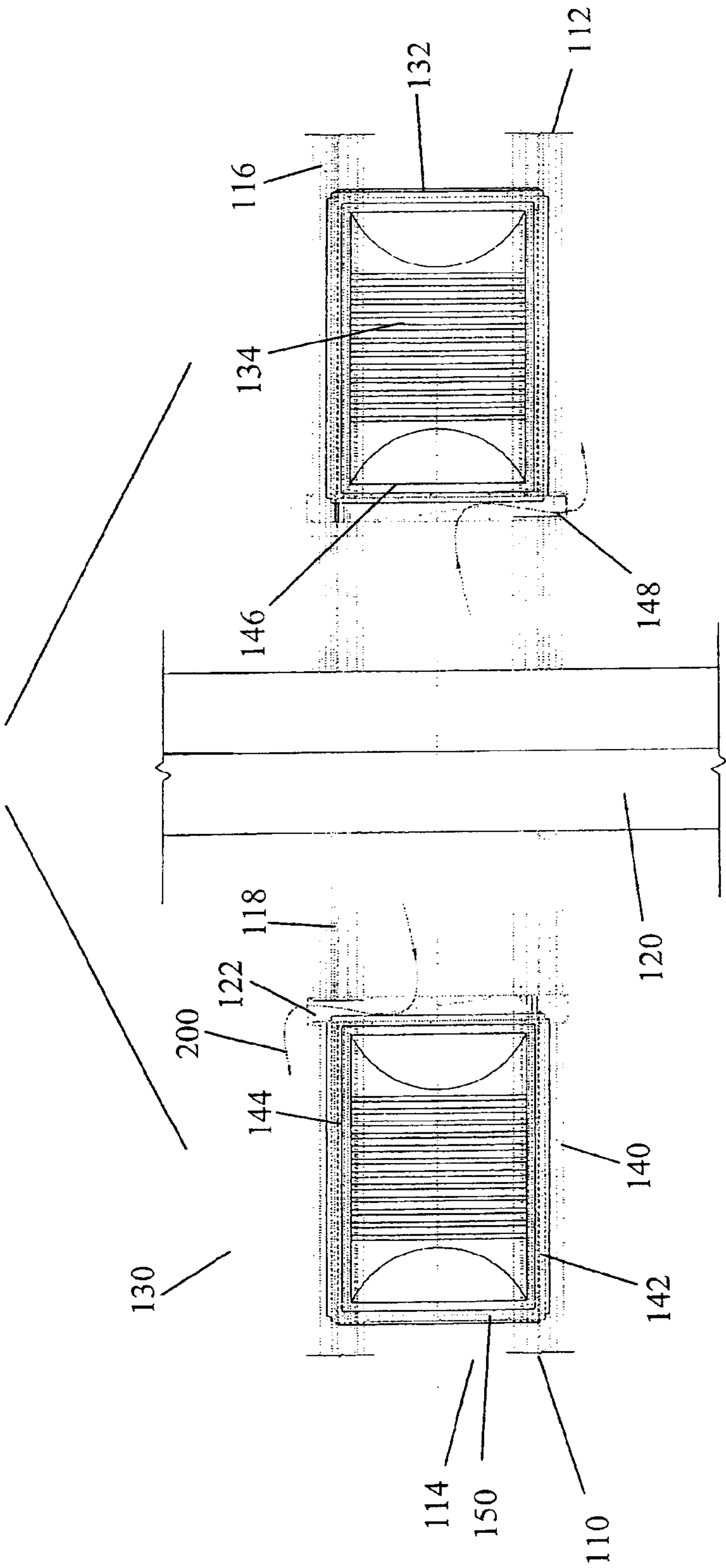


FIGURE 7

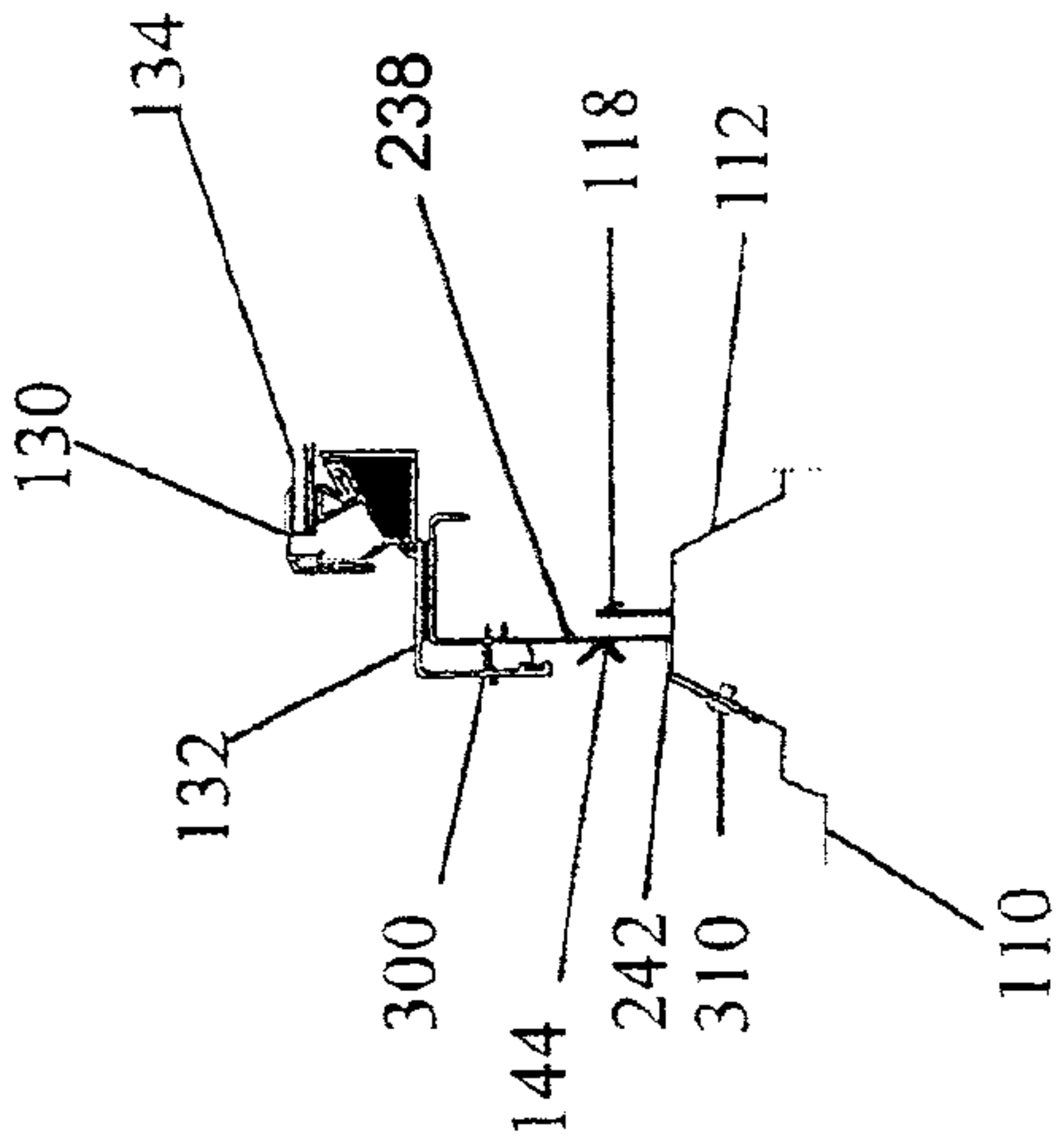
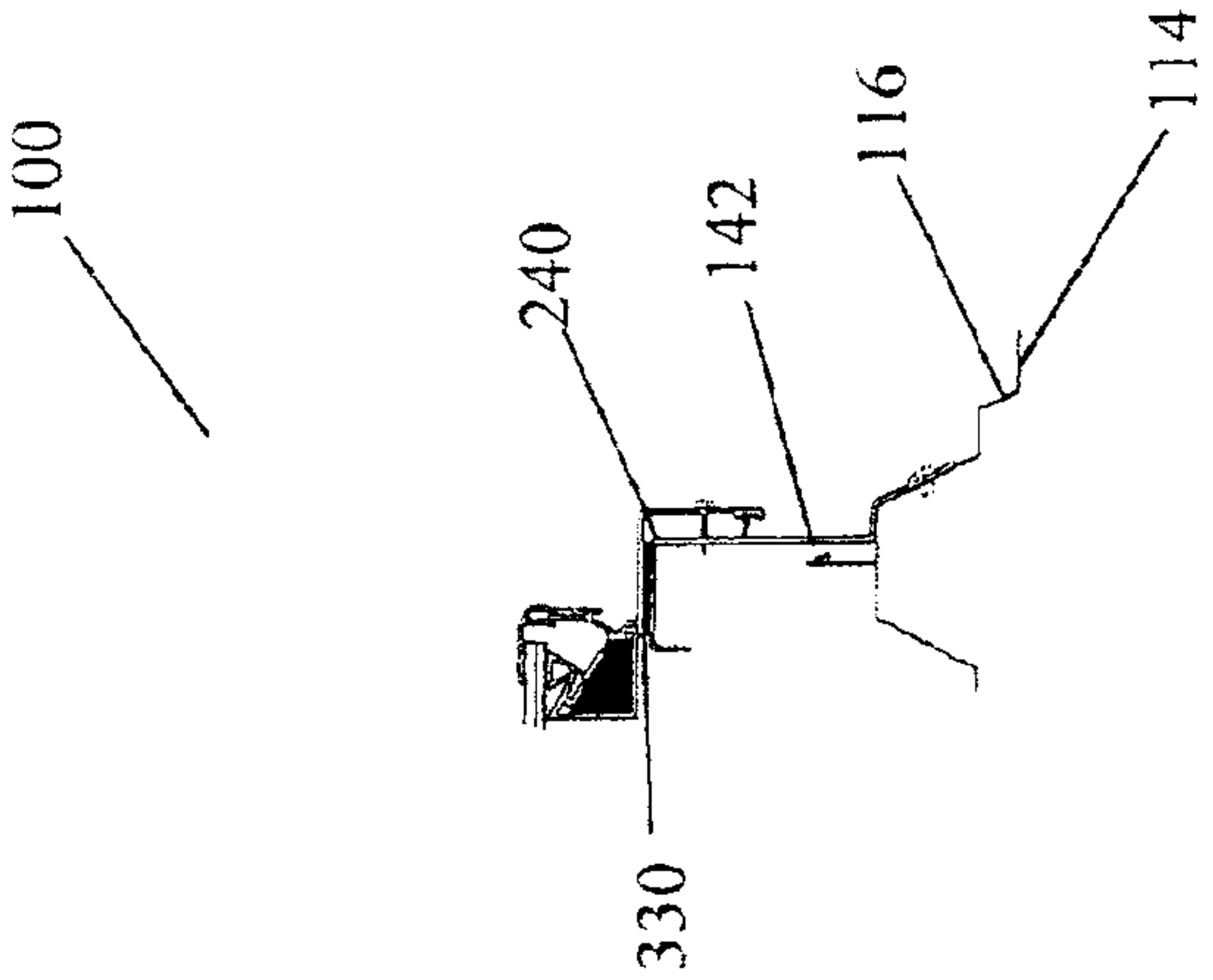


FIGURE 8

9/15

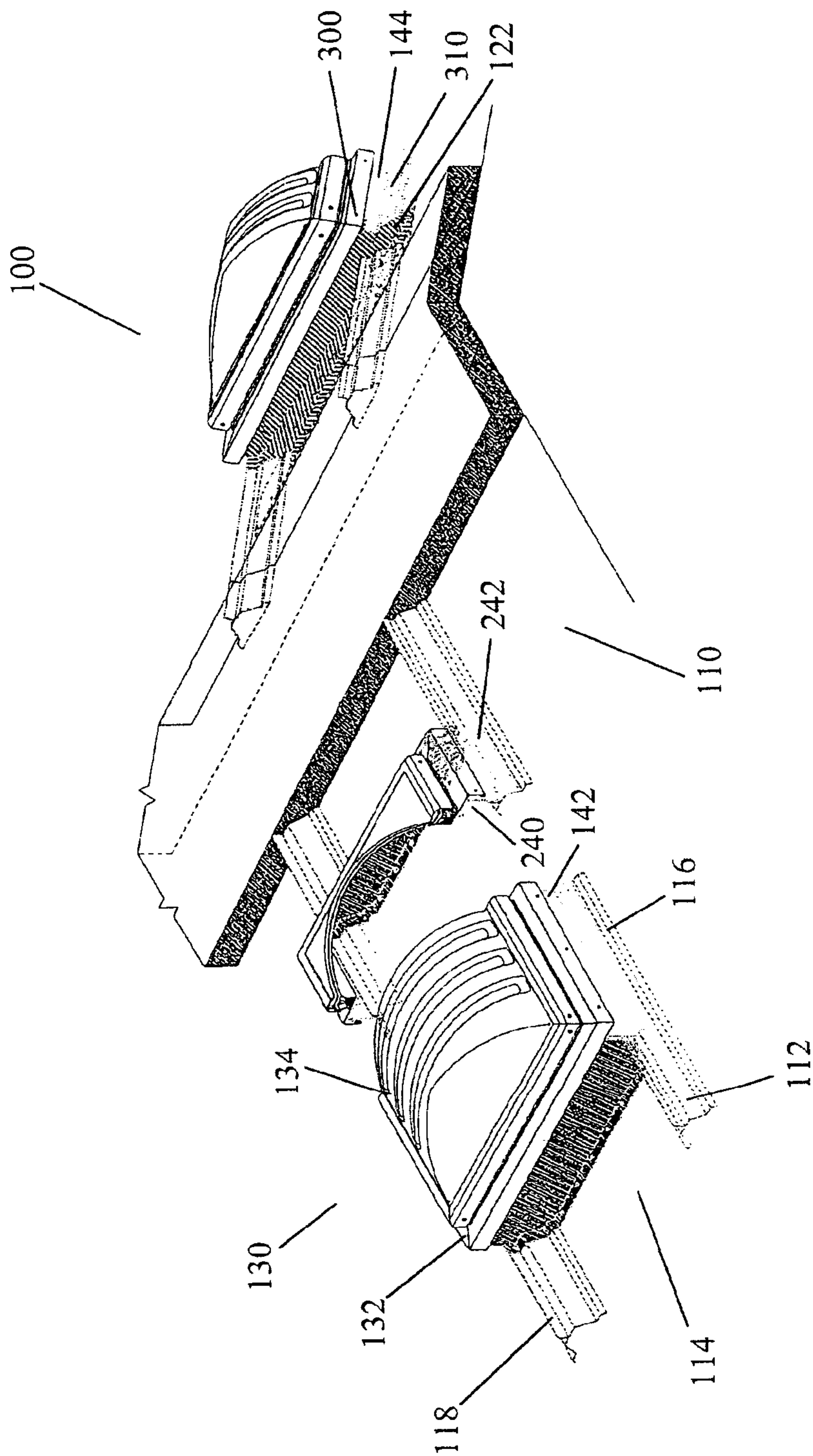


FIGURE 9

10/15

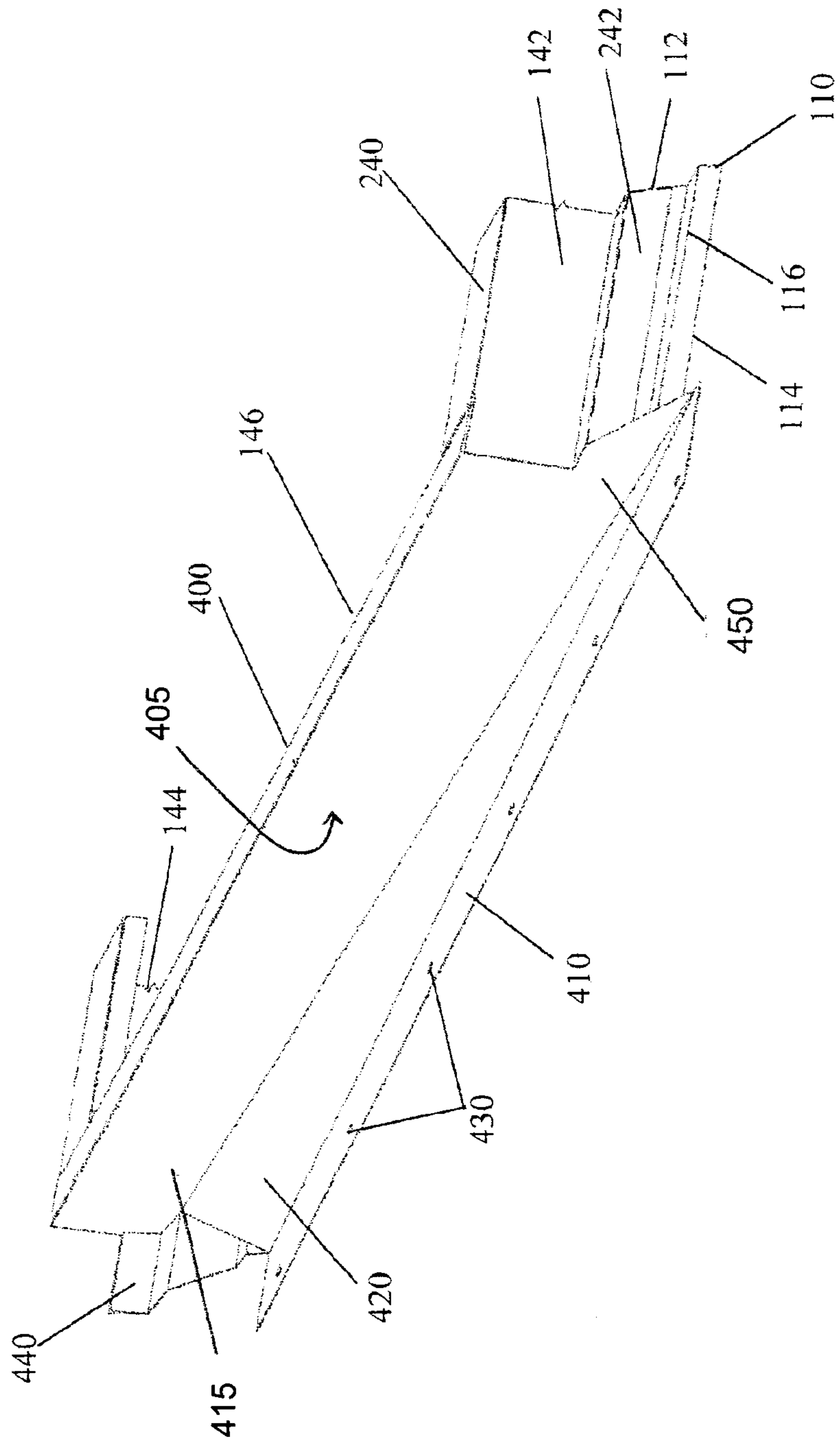


FIGURE 10

11/15

146

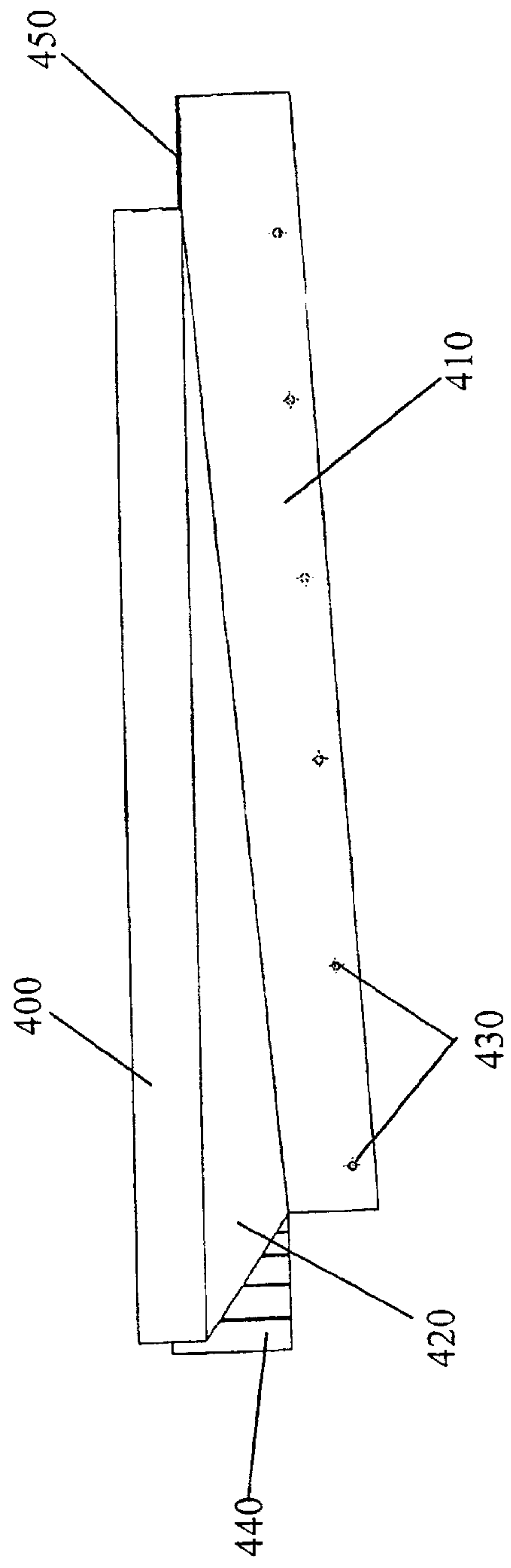


FIGURE 11

12/15

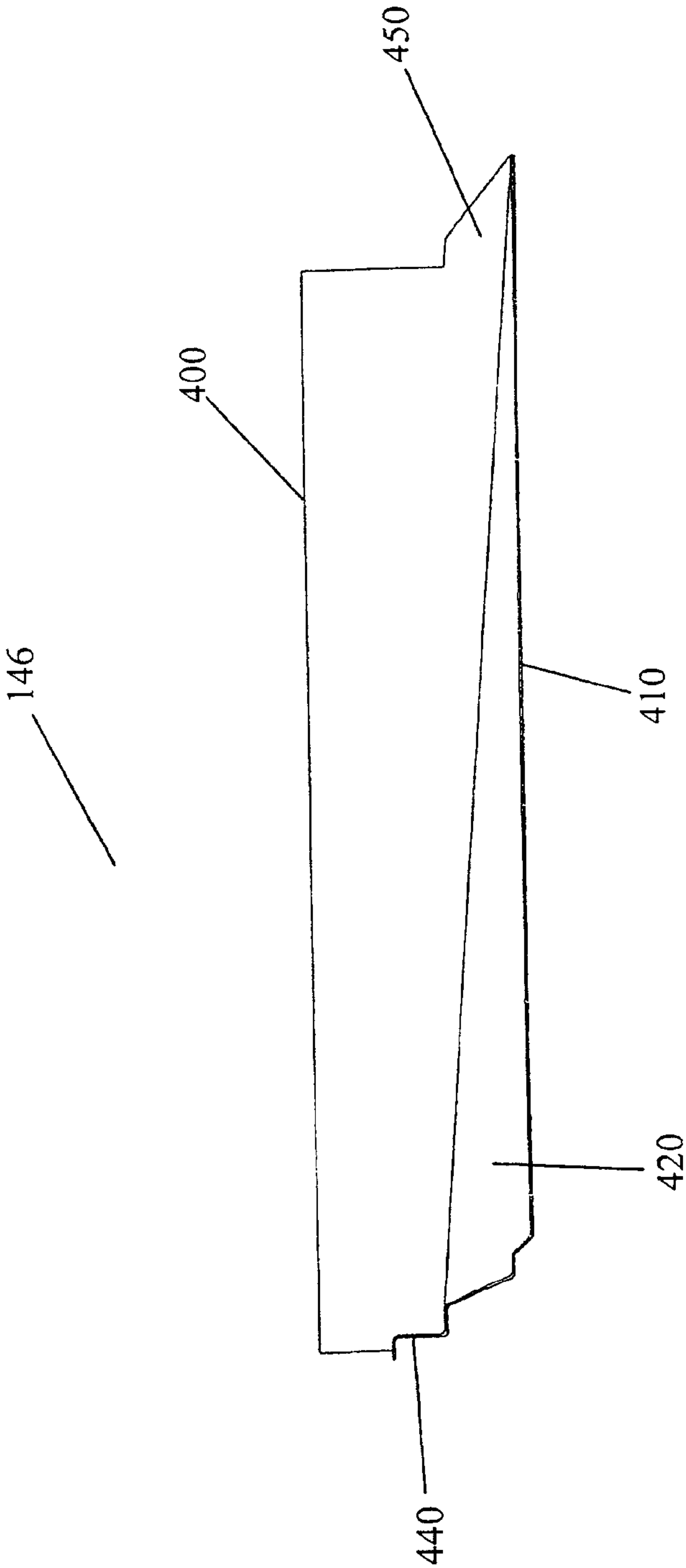


FIGURE 12

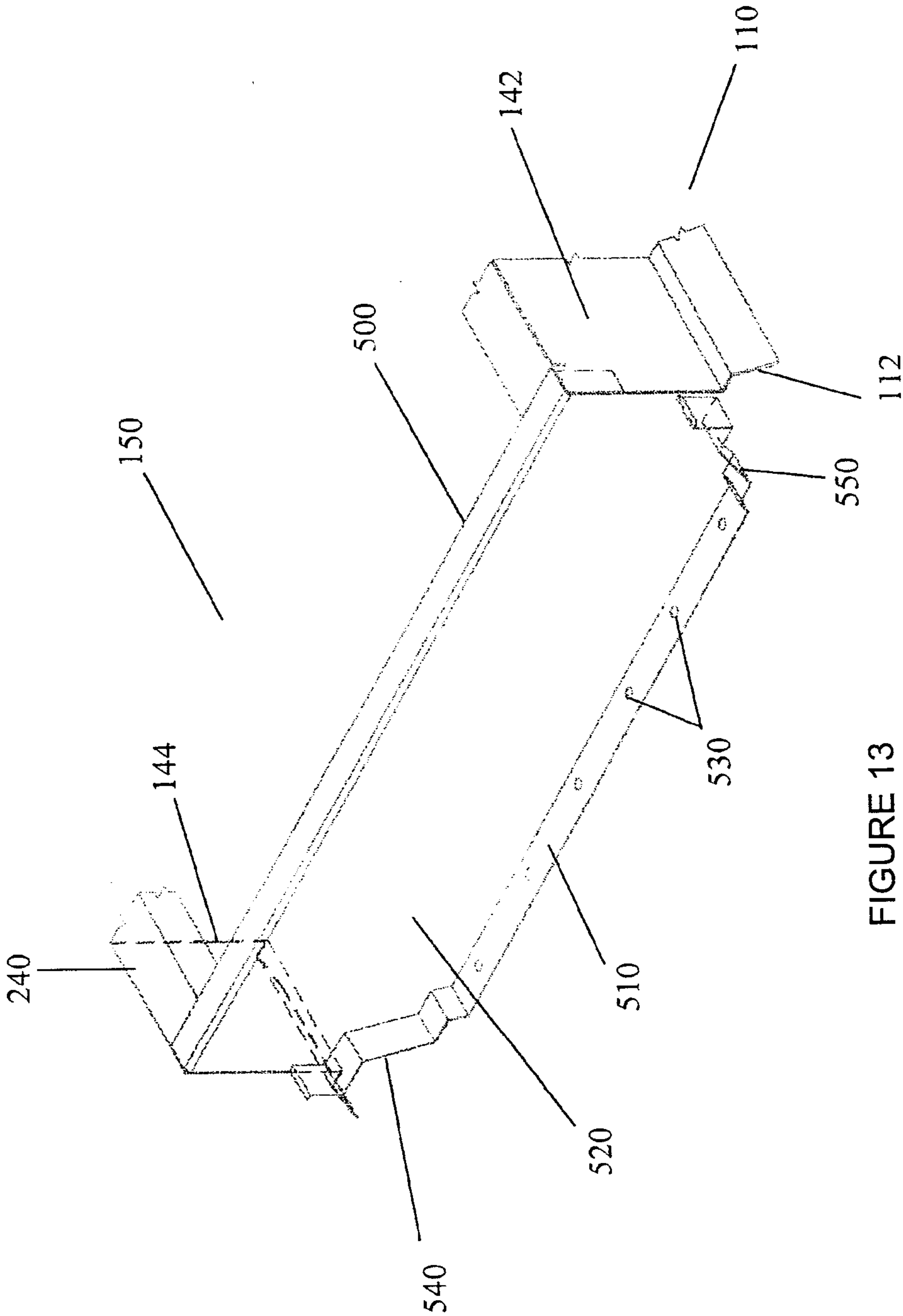


FIGURE 13

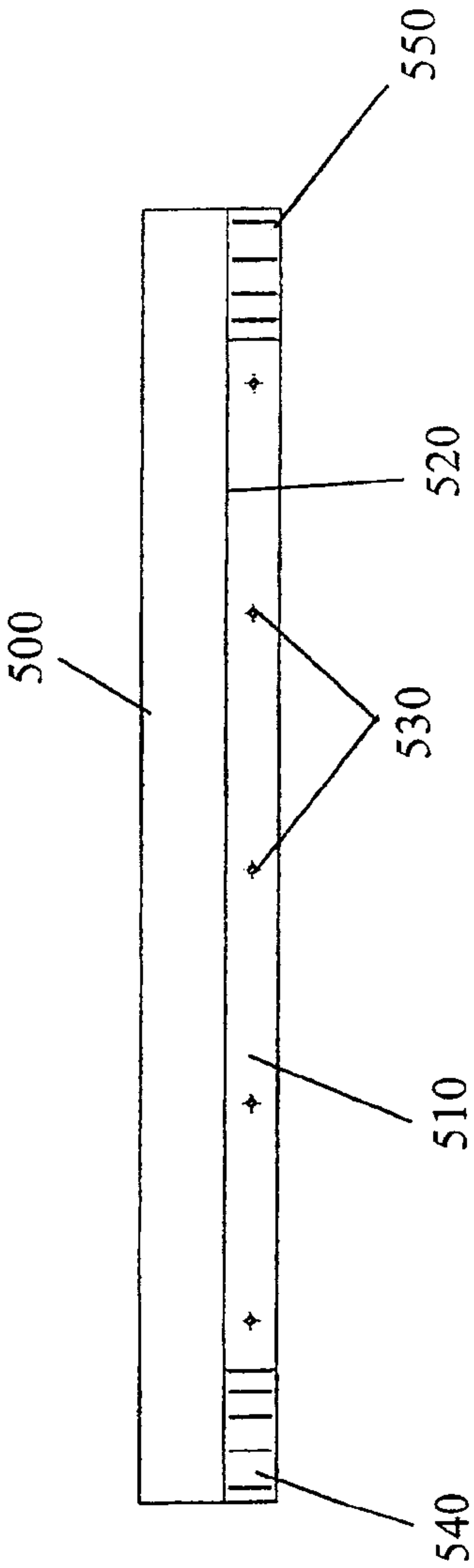


FIGURE 14

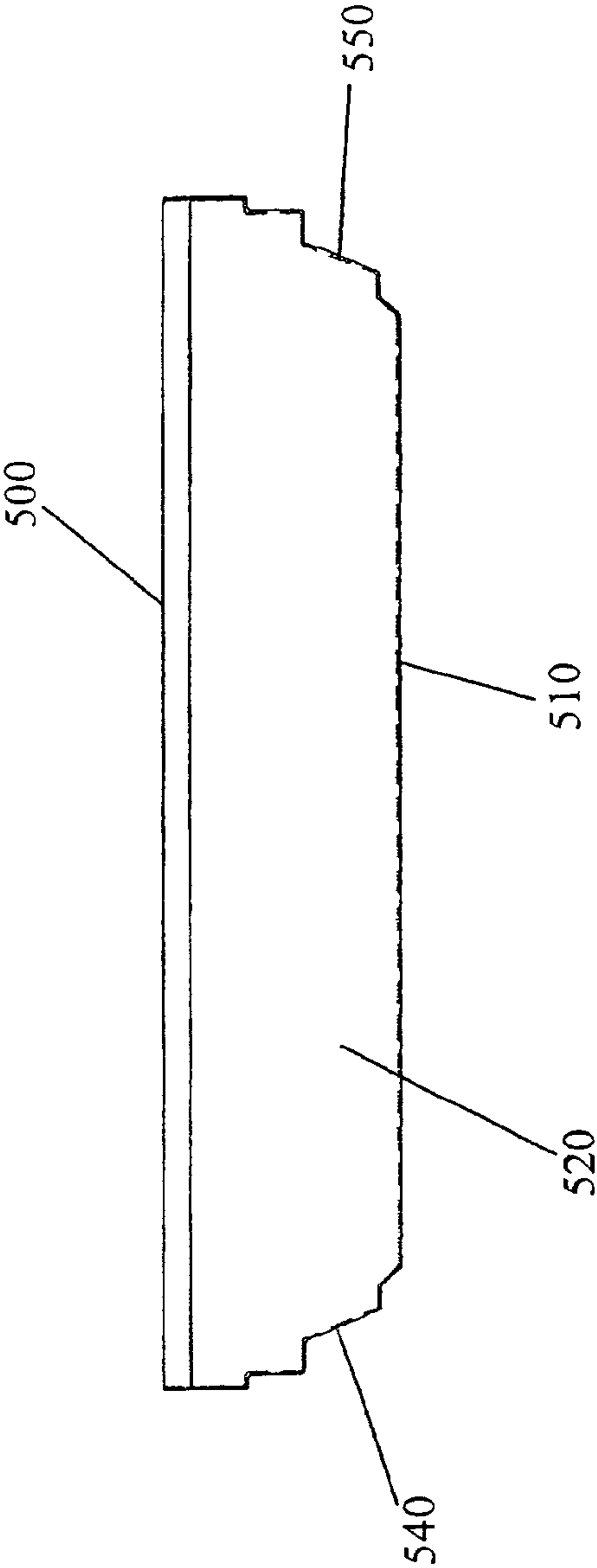


FIGURE 15

