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(54) Title: SOLAR PANEL ASSEMBLY WITH A MOUNTING STRUCTURE

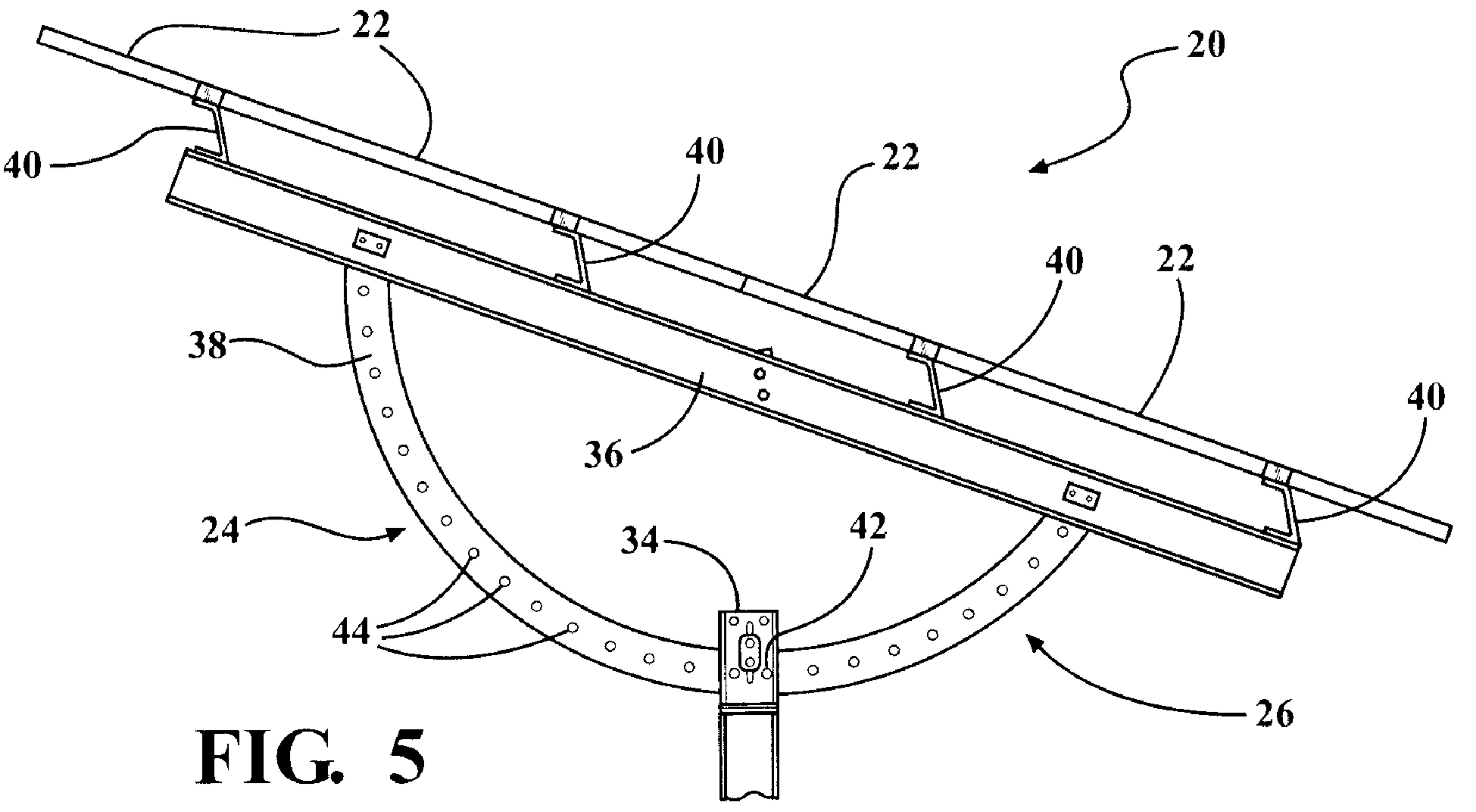

FIG. 5

(57) Abrégé/Abstract:
A solar assembly is provided for harnessing solar rays and generating electricity. The solar assembly includes at least one vertical leg extending in a vertical direction and having an upper attachment end. The assembly also includes at least one north- south rail and a plurality of east- west rails extending generally transversely to the north-south rail. A curved member interconnects the vertical leg with the north-south rail and extends through an arcuate shape. The solar assembly also includes a plurality of generally flat arrays of solar panels, such as photovoltaic panels, are coupled to the east- west members. The orientation of the solar panels relative to a base or the ground is dependent on the location along the curved member of the connection with the vertical leg.

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(54) **Title**: SOLAR PANEL ASSEMBLY WITH A MOUNTING STRUCTURE

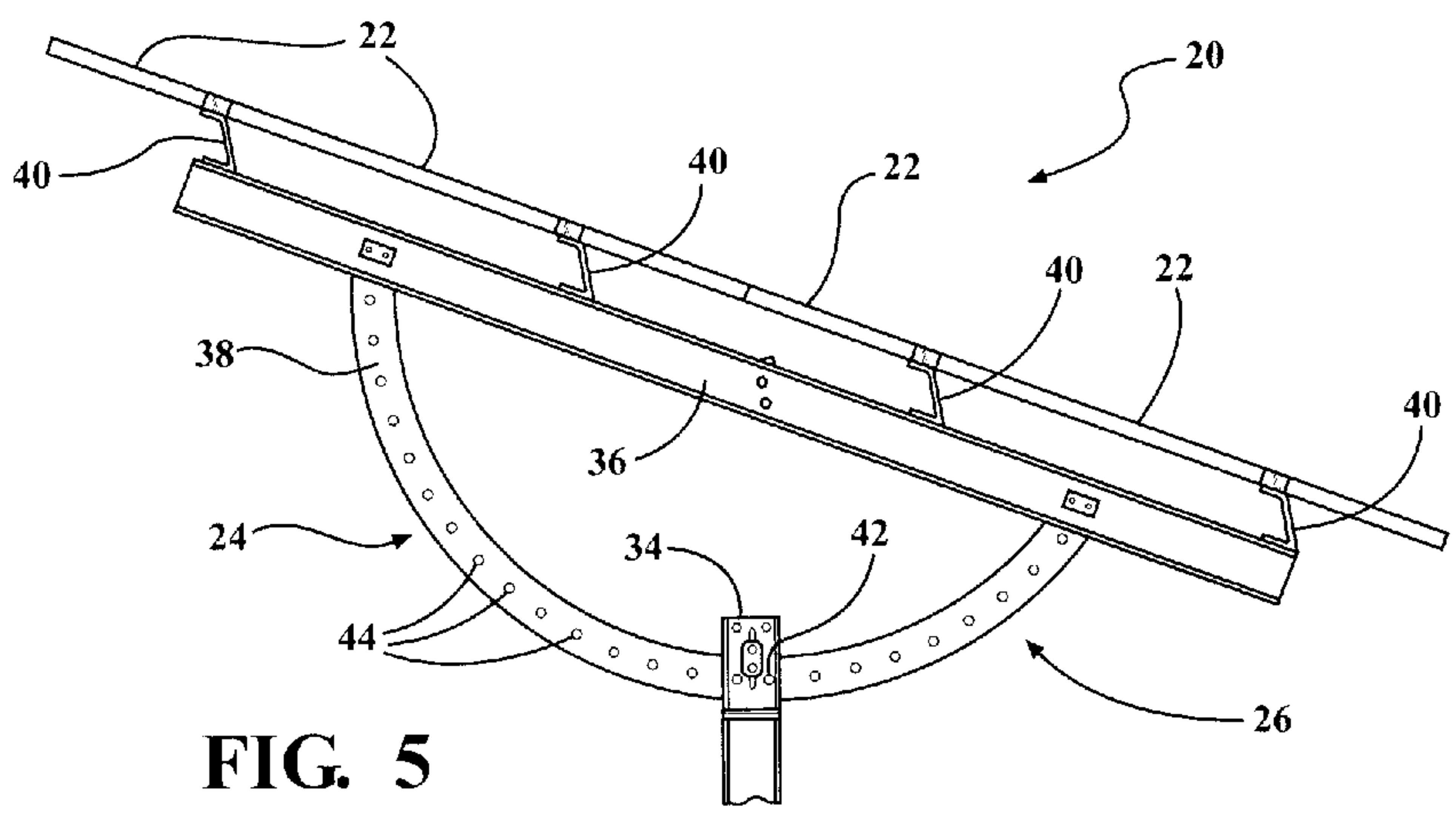

FIG. 5

(57) **Abstract**: A solar assembly is provided for harnessing solar rays and generating electricity. The solar assembly includes at least one vertical leg extending in a vertical direction and having an upper attachment end. The assembly also includes at least one north-south rail and a plurality of east- west rails extending generally transversely to the north-south rail. A curved member interconnects the vertical leg with the north-south rail and extends through an arcuate shape. The solar assembly also includes a plurality of generally flat arrays of solar panels, such as photovoltaic panels, are coupled to the east- west members. The orientation of the solar panels relative to a base or the ground is dependent on the location along the curved member of the connection with the vertical leg.

WO 2013/056056 A1

SOLAR PANEL ASSEMBLY WITH A MOUNTING STRUCTURE

CROSS-REFERENCE TO PRIOR APPLICATION

[0001] This patent application claims the benefit of U.S. Provisional Patent Application Serial No. 61/547,147 filed October 14, 2011, entitled "Mounting Structure," the entire disclosure of the application being considered part of the disclosure of this application and hereby incorporated by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0002] The subject invention is related to a solar panel assembly, and more precisely to a solar panel assembly including a mounting structure for solar panels.

2. Description of the Prior Art

[0003] Solar power is becoming an increasingly popular alternative to fossil fuels for generating electricity. In general, solar power generators harness the potential energy of solar radiation and convert that potential energy into electricity. Some solar power generators utilize an array of mirrors which reflect and concentrate light into a small area. Heat from the reflected and concentrated light is then used to generate electricity in a manner similar to conventional power plants. Another type of solar power generator is a photovoltaic (PV) cell, which harnesses solar rays and directly converts solar radiation into electricity.

[0004] PV cells are typically arranged in one or more arrays which are supported by a mounting structure. For maximum effectiveness, the PV arrays must remain outdoors, and therefore, the PV arrays and mounting structure must be resistant to a wide range of environmental factors including, for example, high winds, rain, hail and large snow falls. Some mounting structures are designed to automatically reorient the PV arrays to "follow the sun" as it moves through the sky, thereby maximizing the solar rays harnessed. However, such mounting structures may not always be cost-effective. Therefore, most PV panels are mounted on a stationary mounting structure which orients the PV panels at a predetermined angle. While stationary mounting structures may be less costly than sun tracking mounting structures, a certain amount of potential energy is inherently lost due to seasonal changes of the earth's axis relative to the sun.

[0005] One type of mounting structure is generally shown in Figures 1-3. This mounting structure includes a vertical leg attached to a foundation piling and extending vertically upwardly therefrom. A north-south member is attached to the upper end of the vertical leg, and a pair of angled legs extend at opposite angles between the vertical leg and the north-south member to provide additional support for the north-south member. The angled legs have different lengths from one another such that the north-south member is oriented at a predetermined angle relative to the ground. A plurality of east-west members extend transversely to the north-south member, and the PV arrays are coupled to the east-west members. Because the angled legs of the mounting structure are not adjustable, the mounting structure is not easily adjustable to re-orient the PV arrays relative to the ground.

[0006] There remains a significant and continuing need for an improved mounting structure which is cheaper and easier to fabricate without compromising its ability to resist the outdoor environmental forces to which it is likely to be subjected.

SUMMARY OF THE INVENTION

[0007] At least one aspect of the present invention provides for a solar assembly for harnessing solar rays and generating electricity. The solar assembly includes a mounting structure with at least one leg extending generally upwardly to an upper attachment end. The mounting structure also includes a north south rail and a plurality of east-west rails which extend generally transversely to the north-south rail and are spaced from one another along the length of the north-south rail. A plurality of generally flat arrays of solar panels are coupled to the east-west rails and supported by the mounting structure. The north-south rail is coupled to the leg via a curved member which extends through an arcuate shape between spaced ends, each of which is coupled to the north-south rail. As such, the curved member is coupled to the upper attachment end of the leg at a location between the spaced ends.

[0008] Because of the curvature of the curved member, the orientations of the PV arrays relative to the base are dependent upon the location along the curved member of its connection to the upper attachment end of the leg. As such, mounting structures may be mass produced and individually configured to orient their respective arrays at different angles relative to the bases. This is advantageous because it may be desirable to orient the arrays of solar assemblies in different geographical locations to optimize power produced in each location. For example, the further away from the earth's equator that the solar assembly is going to operate, it may be desirable to orient the arrays at steeper angles. In other words, each mounting structure may be individually configured to optimize the angles of the PV arrays in a particular geographical location. This leads to significant cost savings through economies of scale. In contrast, many other known mounting structures are built in the factory to orient the PV arrays at a single, non-adjustable, angle relative to the base and significant and costly changes must be made to the manufacturing equipment to produce mounting structures that support PV arrays at different angles relative to the base.

[0009] The mounting structure of this aspect of the present invention is also advantageous because it includes fewer components than other known mounting structures. This leads to, among other things, material savings, weight savings, and labor savings during the assembly of the mounting structure in the field. Additionally, the mounting structure has very few joints which leads to improved durability. Even further, the arcuate shape of the curved member improves the structural integrity of the mounting structure. Depending on the type of connector employed to connect the north-south rail to the leg, the mounting structure may also be easier to adjust than other known mounting structures.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] Other advantages of the present invention will be readily appreciated, as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings wherein:

[0011] Figure 1 is a perspective and elevation view of a known mounting structure;

[0012] Figure 2 is a side view of the known mounting structure of Figure 1;

[0013] Figure 3 is a perspective and fragmentary view of the known mounting structure of Figure 1 and showing the interconnections of the vertical member, the angled members, the bracket, and the foundation piling;

[0014] Figure 4 is a perspective and elevation view of the first exemplary solar assembly;

[0015] Figure 5 is a side view of the solar assembly of Figure 4;

[0016] Figure 6 is another perspective and elevation view of the solar assembly of Figure 4;

[0017] Figure 7 is a perspective and elevation view of a second exemplary solar assembly;

[0018] Figure 8 is a perspective and elevation view of a mounting structure of a third exemplary solar assembly;

[0019] Figure 9 is a perspective and fragmentary view of the third exemplary mounting structure and showing the interconnection of a curved member and a north-south rail; and

[0020] Figure 10 is a perspective and fragmentary view of the third exemplary mounting structure and showing the interconnection of the curved member and the vertical leg.

DESCRIPTION OF THE ENABLING EMBODIMENT

[0021] Referring to the Figures, wherein like numerals indicate corresponding parts throughout the several views, a first exemplary embodiment of a solar assembly **20** for harnessing potential energy from solar rays and generating electricity is generally shown in Figures 4-6. The solar assembly **20** includes a plurality of solar panels arranged in a plurality of arrays **22** which are supported by a stationary (i.e., non-tracking) mounting structure **24**. In the exemplary embodiment, the solar panels are photovoltaic (PV) cells that are configured to receive solar radiation and convert it into electrical power. However, it should be appreciated that any other type of solar panel capable of converting potential energy from solar rays into electricity or into any other form of useable energy could alternately be employed.

[0022] Referring now to Figure 5, the mounting structure **24** of the first exemplary embodiment includes a plurality of sub-assemblies **26** spaced from one another in a lateral direction, which is hereinafter referred to as an "east-west direction". Each sub-assembly **26** includes a vertical leg **28** which extends vertically upwardly from a base attachment end **30** coupled to a foundation piling **32** in a base (such as the ground or the roof of a building) to an upper attachment end **34**. Each sub-assembly **26** also includes a north-south rail **36** (or any other type of member) which extends in a longitudinal direction and is connected to the vertical leg **28** via a curved member **38**. A plurality of east-west rails **40** (or any other type of member) are coupled to the north-south rails **36** of adjacent sub-assemblies **26** and extend generally transversely between two or more north-south rails **36**. The east-west rails **40** are spaced from one another along the length of the north-south rails **36** and all extend in generally parallel relationship with one another. The east-west rails **40** could extend through any length and could interconnect any desirable number of sub-assemblies **26**. The exemplary embodiment includes four east-west rails **40** but it should be appreciated that the mounting structure **24** could include any desirable number of east-west rails **40**. In the exemplary embodiment, the north-south members are attached to the curved members **38** and to the east-west rails **40** via mechanical fasteners, such as bolts. However, it should be appreciated that these components could alternately be coupled together through any desirable process, such as other types of mechanical fasteners, spot welding, brazing, adhesives, etc. It should be noted that the north-south rails **36** and east-west rails **40** are referred to by the terms “north-south” and “east-west” respectively because this is the preferred directions in which they extend in the field so that the PV arrays **22** face generally south in the northern hemisphere or north in the southern hemisphere. However, it should be appreciated that these rails **36, 40** could be oriented in any desirable direction.

[0023] The vertical legs **28**, north-south rails **36**, east-west rails **40**, and curved members **38** are all preferably formed of aluminum or steel but could alternately be formed of any desirable metal or non-metallic material. Each of these components is also preferably shaped to have a generally C-shaped cross-section through a roll forming process. Such a process may be particularly advantageous in shaping the curved member **38** because the arcuate shape of curved member **38** may also be formed by roll forming. Additionally, with slight adjustments to the roll forming equipment, the curvature of the curved members **38** being produced can be adjusted. However, it should be appreciated that these components could be shaped to any desirable cross-section through any suitable process.

[0024] As best shown in Figure 5, the PV arrays **22** are generally flat and, because the exemplary north-south members are linearly shaped, are oriented in generally parallel relationship with one another. Although not shown, it should be appreciated that the north-south members could alternately be curved which would angle the PV arrays **22** both relative to the base and to one another. The PV arrays **22** are preferably coupled to the east-west rails **40** via mechanical fasteners but could be coupled to the east-west rails **40** through any desirable process such as, for example, adhesives, welding or brazing.

[0025] Referring still to Figure 5, the ends of the curved member **38** are spaced from one another along the north-south rail **36**, and the curved member **38** is coupled to the upper attachment end **34** of the vertical leg **28** at a location between the spaced ends. Because of the curvature of the curved member **38**, the orientations of the PV arrays **22** relative to the base are dependent upon the location along the curved member **38** of its connection to the upper attachment end **34** of the vertical leg **28**. As such, the mounting structures **24** may be individually configured to orient their respective PV arrays **22** at different angles relative to the bases. This is advantageous because it may be desirable to orient the PV arrays **22** of solar assemblies **20** in different geographical locations to optimize power produced in each location. For example, the further away from the earth's equator that the solar assembly **20** is going to operate, it may be desirable to orient the PV arrays **22** at steeper angles. In other words, the mounting structure **24** may be mass produced without changes to the manufacturing process, and each mounting structure **24** may be individually configured to optimize the angles of the PV arrays **22** in a particular geographical location. This leads to significant cost savings through economies of scale. In contrast, many other known mounting structures are built in the factory to orient the PV arrays at a single, non-adjustable, angle relative to the base and significant and costly changes must be made to the manufacturing equipment to produce mounting structures that support PV arrays at different angles relative to the base.

[0026] The curved members **38** are preferably coupled to the upper-attachment end of the vertical leg **28** through a non-permanent connector **42**. For example, in the first exemplary embodiment of Figures 4-6, the curved member **38** includes a plurality of sets of apertures **44** spaced from one another along its length. The exemplary connector **42** is a pair of bolts **42** or pins which are configured to couple the upper attachment end **34** to the curved member **38** at any of the sets of apertures **44**. As such, a person in the field may easily fasten the curved member **38** to the vertical leg **28** in such a way that the PV arrays **22** are oriented at an optimum angle relative to the base for that particular geographical location, i.e. at an angle that will maximize power generation. Additionally, since the connector **42** is not permanent, the orientations of the PV arrays **22** may be adjusted in the field, for example, between seasons to further increase the energy produced by the solar assembly **20**. However, it should be appreciated that the connection between the curved member **38** and the upper attachment end **34** of the vertical leg **28** could be any desirable type of permanent or non-permanent connection.

[0027] The first exemplary embodiment of the mounting structure **24** is also advantageous because it includes fewer components than other known mounting structures. This leads to, among other things, material savings, weight savings, and labor savings during the assembly of the mounting structure **24** in the field. Additionally, the mounting structure **24** has very few joints which leads to improved durability. Even further, the arcuate shape of the curved member **38** improves the structural integrity of the mounting structure **24.**

[0028] The curved member **38** preferably extends through an arc of greater than ninety degrees (90°) and most preferably greater than one hundred and sixty degrees (160°) to provide for a large range of different possible orientations of the PV arrays **22** relative to the base.

[0029] Referring now to Figure 7, a second exemplary embodiment of the solar assembly **120** is generally shown. All of the components of the mounting structure **124** are similar to the first embodiment described above except for the curved member **138**. In the second exemplary embodiment, the curved member **138** includes linear sections adjacent each of the spaced ends. This embodiment illustrates that the curvature of the curved member **138** does not have to be constant throughout its length. It should be appreciated that the curved member **138** could have a range of different curvatures and shapes.

[0030] Referring now to Figures 8, a mounting structure **224** of a third exemplary embodiment of the solar assembly is generally shown. In the third exemplary embodiment, all of the components are similar to the first exemplary embodiment discussed above with the exception of the curved member **238** and the connector **242**. Specifically, the curved member **238** of this embodiment has an elongated tubular shape and the connector **242** includes a pair of plates **246** spaced from one another at the upper attachment end **34** of the vertical leg **28**. Each plate **246** includes a plurality of back apertures **248** spaced vertically from one another and a plurality of front apertures **250** spaced vertically from one another. In the field, a person may use a pair of pins or bolts **252** to connect the curved member **238** to any of the front apertures **250** and to any of the back apertures **248**. Different combinations of the back and front apertures **248, 250** will determine the orientation of the north-south rail **36** and also the PV arrays (not shown in this Figure) relative to the base. In other words, a person may quickly set up the mounting structure **224** such that the PV arrays are oriented at an angle relative to the base that is optimized for a particular geographical location. It should be appreciated that the tubular curved member **238** could alternately be coupled to the vertical leg **28** through a range of different connectors.

[0031] Referring now to Figure 9, a sleeve **252** is attached to each end of the tubular curved member **238** of the third exemplary embodiment. This sleeve **252** may receive a bolt, a screw, or any other type of fastener to interconnect the tubular curved member **238** with the north-south rail **36**. The sleeve **252** is preferably metal-inert gas (MIG) welded to the end of the tubular curved member **238**. However, it should be appreciated that the sleeve **252** could be connected to the tubular curved member **238** through, for example, other types of welding, adhesives, brazing, etc. Alternately, other fastening mechanisms could be used to connect the tubular curved member **38** with the north-south rail **36**.

[0032] Obviously, many modifications and variations of the present invention are possible in light of the above teachings and may be practiced otherwise than as specifically described while within the scope of the appended claims.

CLAIMS

What is claimed is:

Claim 1. A solar assembly for harnessing solar rays and generating electricity, comprising:

at least one leg extending upwardly and having an upper attachment end;

a north-south rail;

a plurality of east-west rails extending generally transversely to said north-south rail and spaced from one another along the length of said north-south rail, and wherein said east-west rails extend in generally parallel relationship with one another;

a plurality of generally flat arrays of solar panels coupled to said east-west rails; and

a curved member extending through an arcuate shape between spaced ends coupled to said north-south rail, and wherein said curved member is coupled to said upper attachment end of said leg at a location between said spaced ends.

Claim 2. The solar assembly as set forth in claim 1 further including at least one connector configured to couple said upper attachment end of said leg more than one location along said curved member and wherein the orientations of said PV arrays is at dependent on the location of the connection between said curved member and said upper attachment end of said leg

Claim 3. The solar assembly as set forth in claim 1 wherein said at least one connector is a plurality of mechanical fasteners and wherein said curved member includes at least two sets of apertures spaced from one another and being configured to receive the mechanical fasteners and wherein each set of apertures defines a location for coupling said curved member to said upper attachment end of said leg.

Claim 4. The solar assembly as set forth in claim 3 wherein said curved member extends through an arc of greater than one hundred and sixty degrees (160°).

Claim 5. The solar assembly as set forth in claim 1 wherein said curved member is generally tubular

Claim 6. The solar assembly as set forth in claim 5 wherein said connector includes a pair of plates spaced from one another and at least one mechanical fastener for connecting said curved member to said plates

Claim 7. The solar assembly as set forth in claim 6 further including a sleeve coupled to each end of said curved member

Claim 8. The solar assembly as set forth in claim 1 wherein said curved member includes a generally linear section adjacent each of said spaced ends

Claim 9. The solar assembly as set forth in claim 1 wherein said north-south rail extends generally linearly

Claim 10. The solar assembly as set forth in claim 9 wherein said east-west rails extend generally linearly.

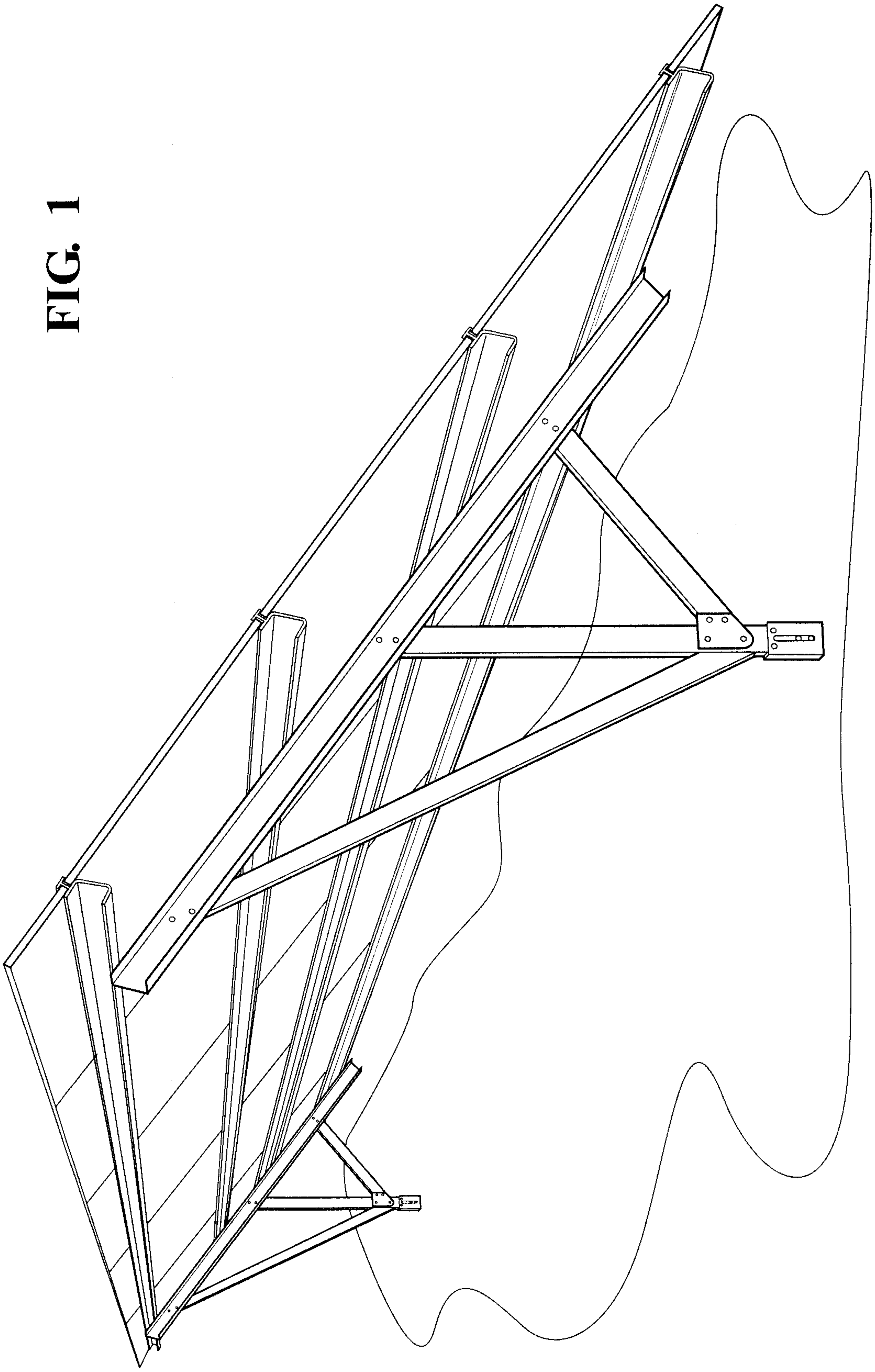

FIG. 1

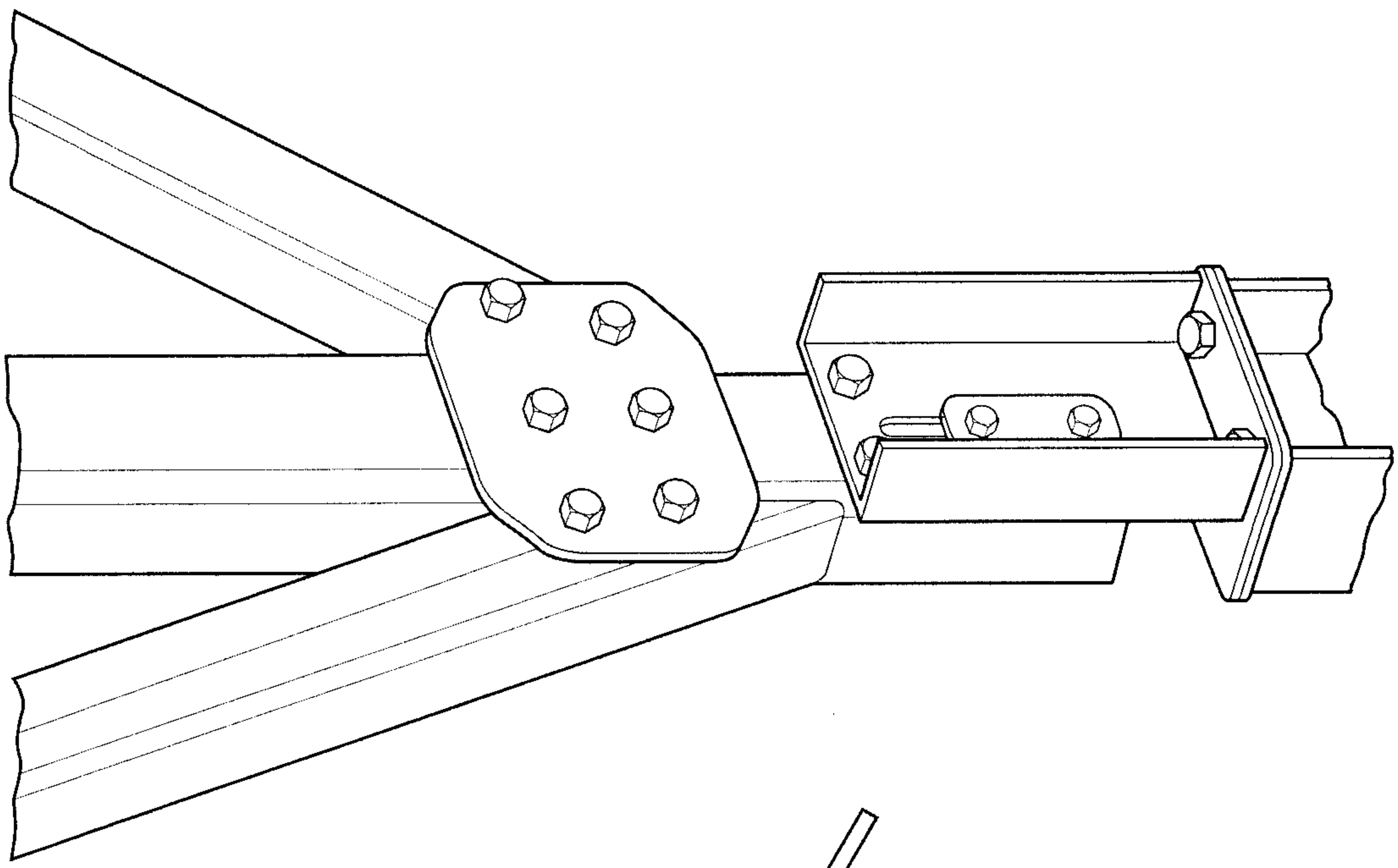

FIG. 3

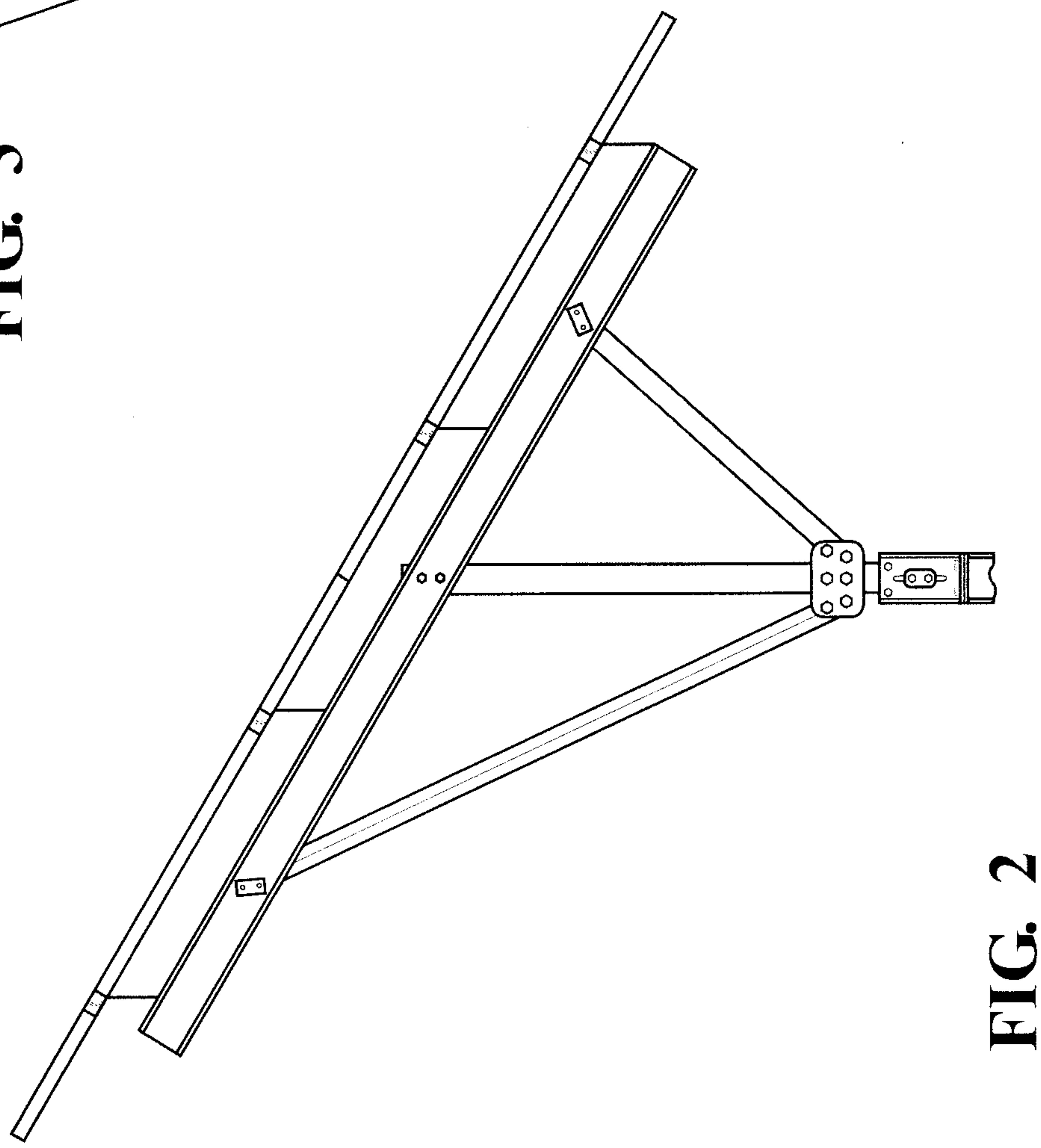

FIG. 2

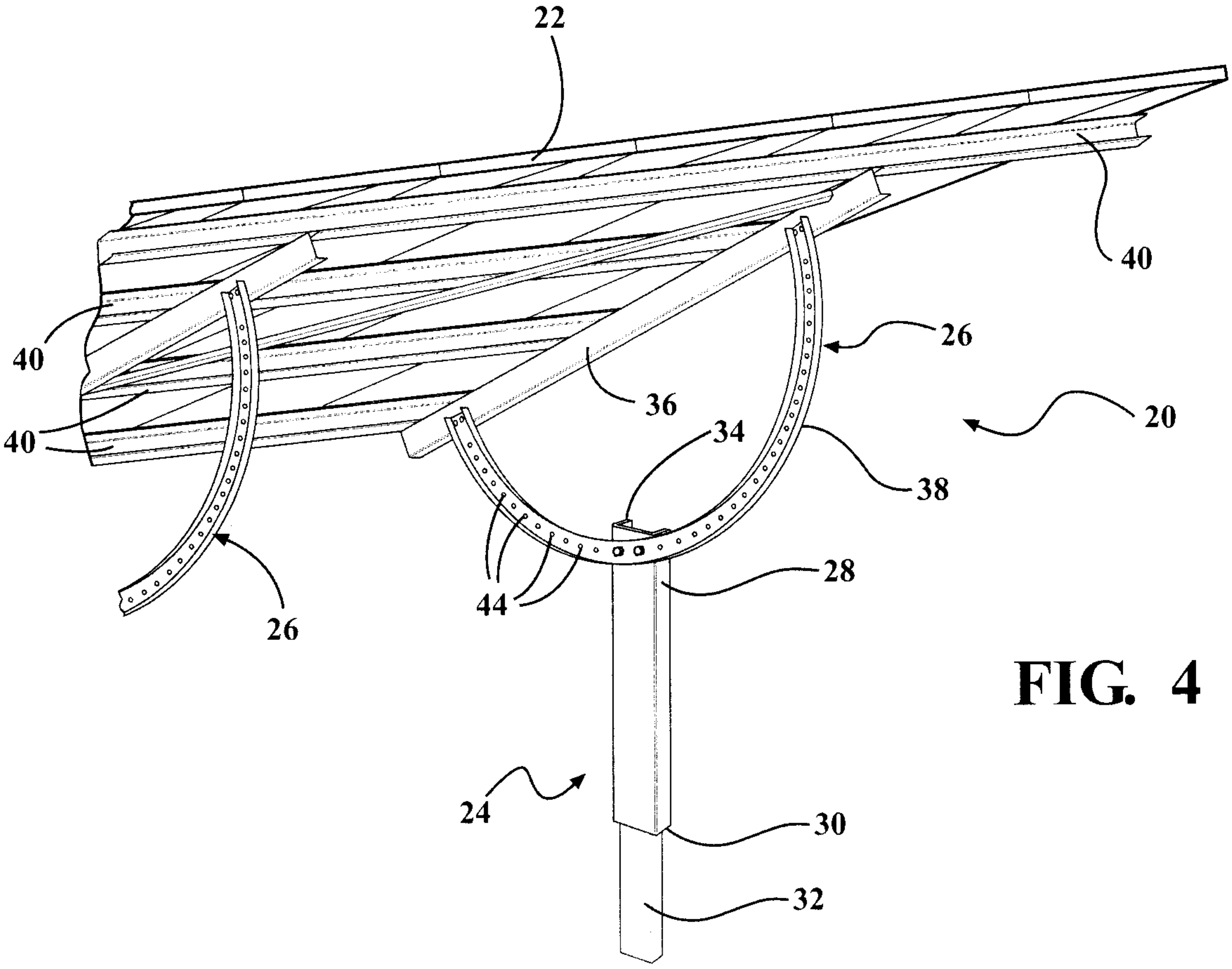
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FIG. 4

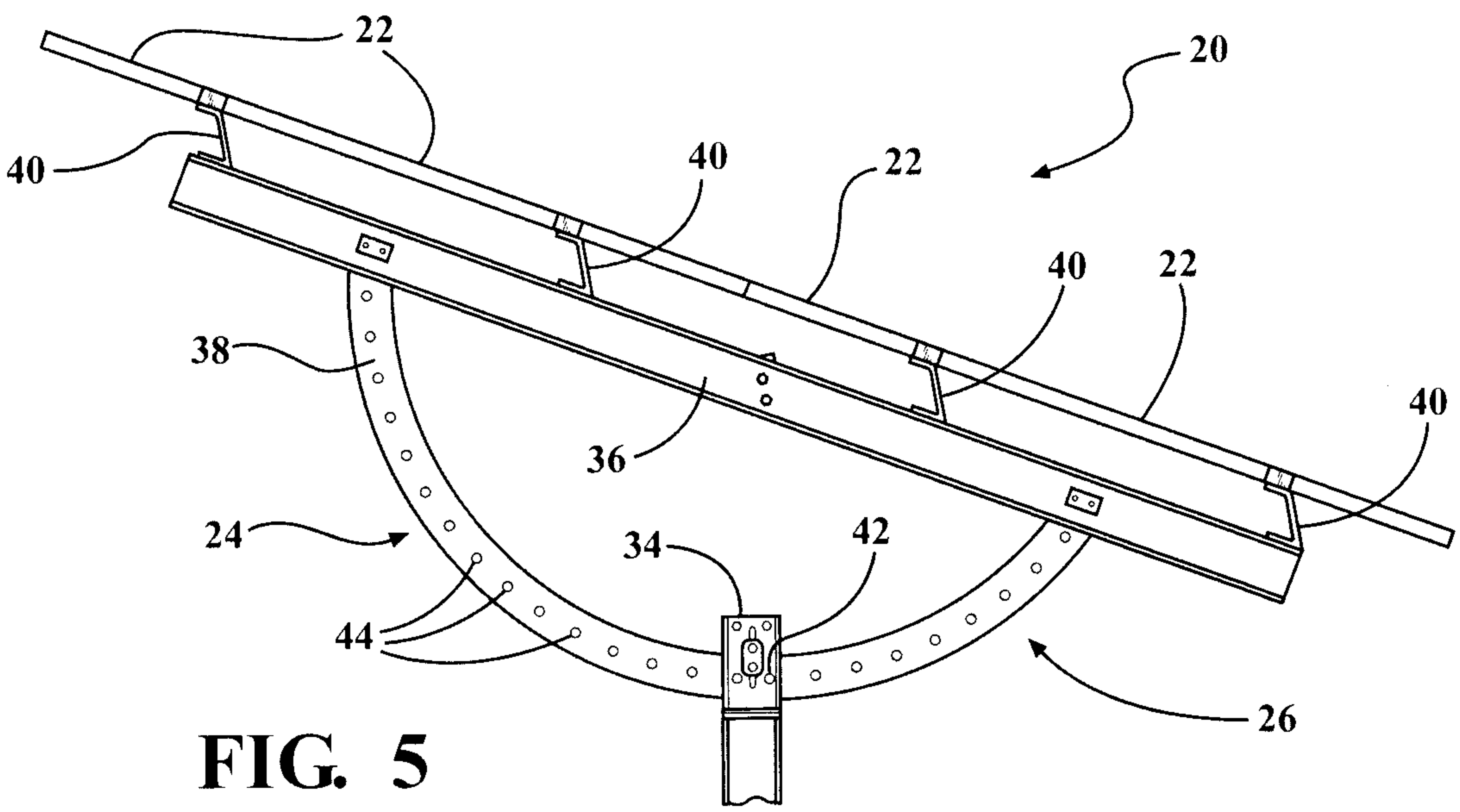
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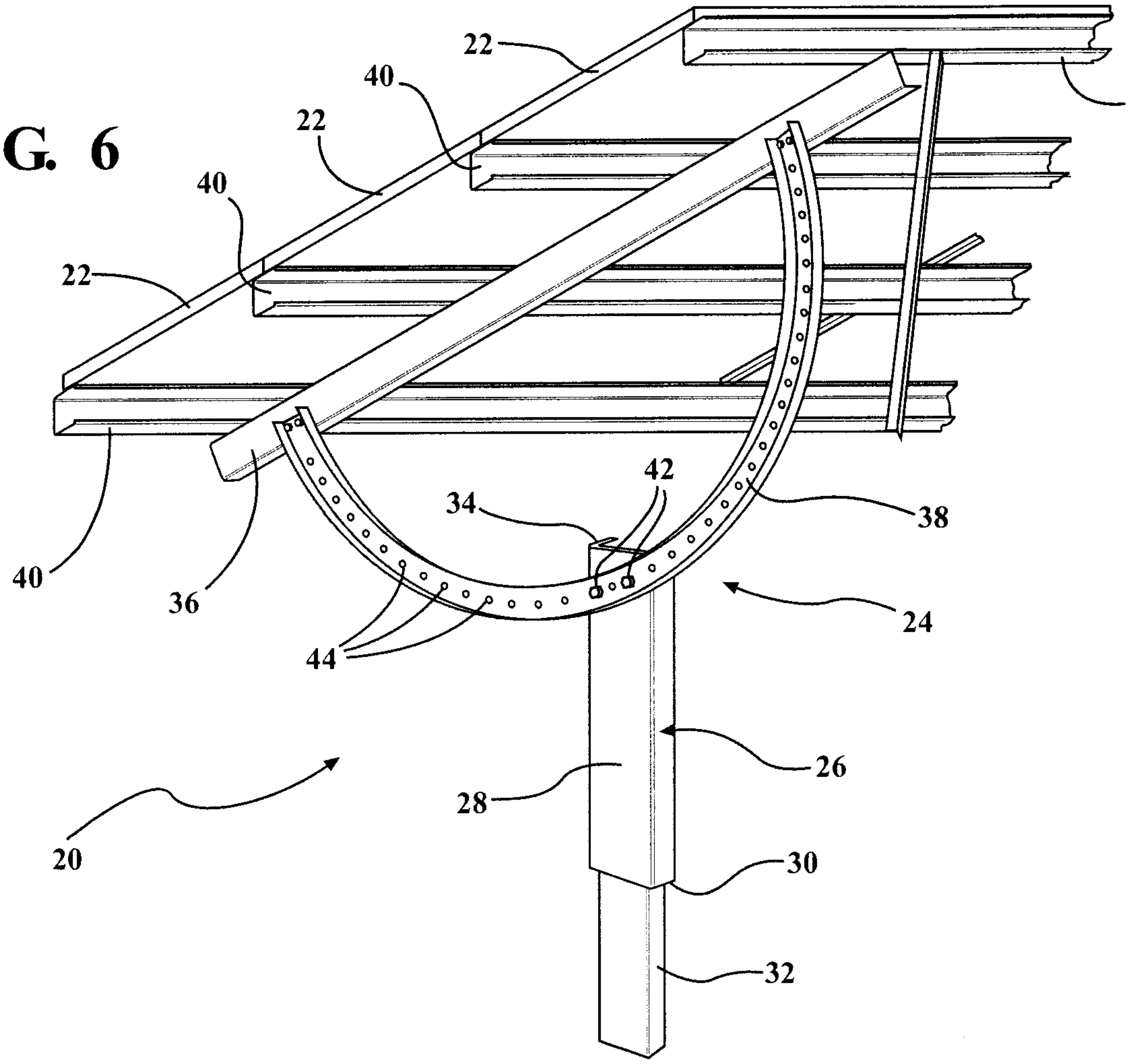
FIG. 5

FIG. 6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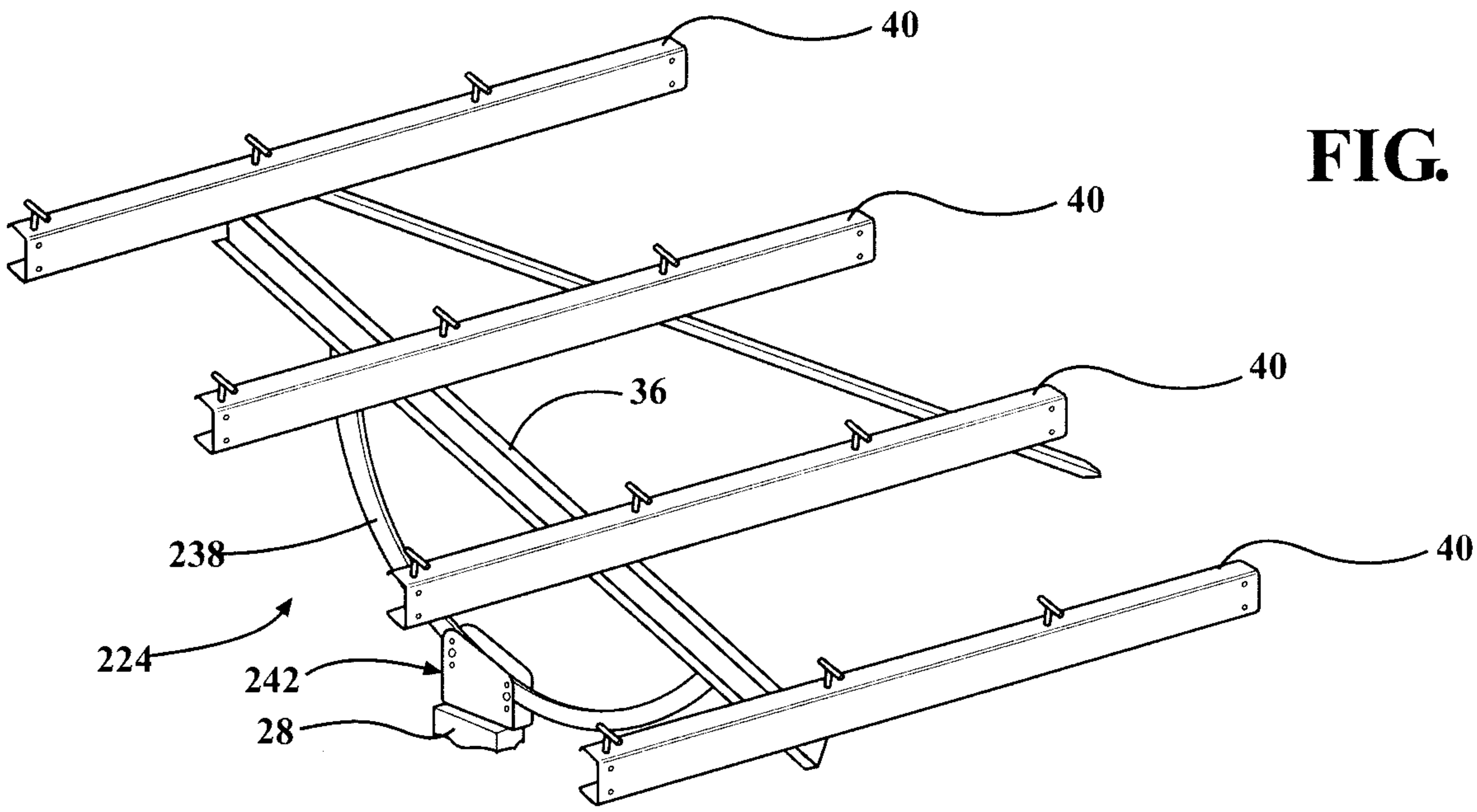
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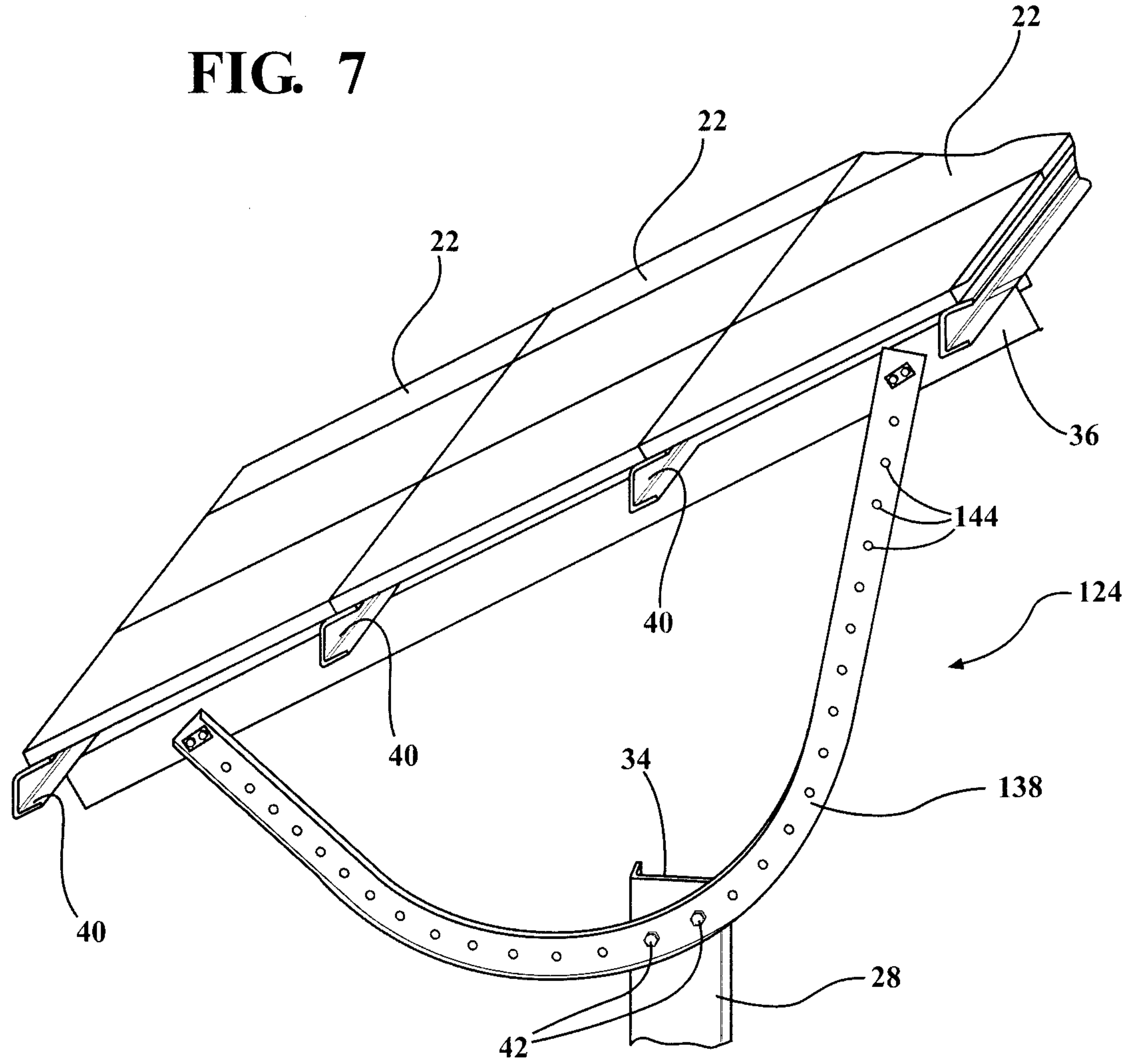
FIG. 8

FIG. 7



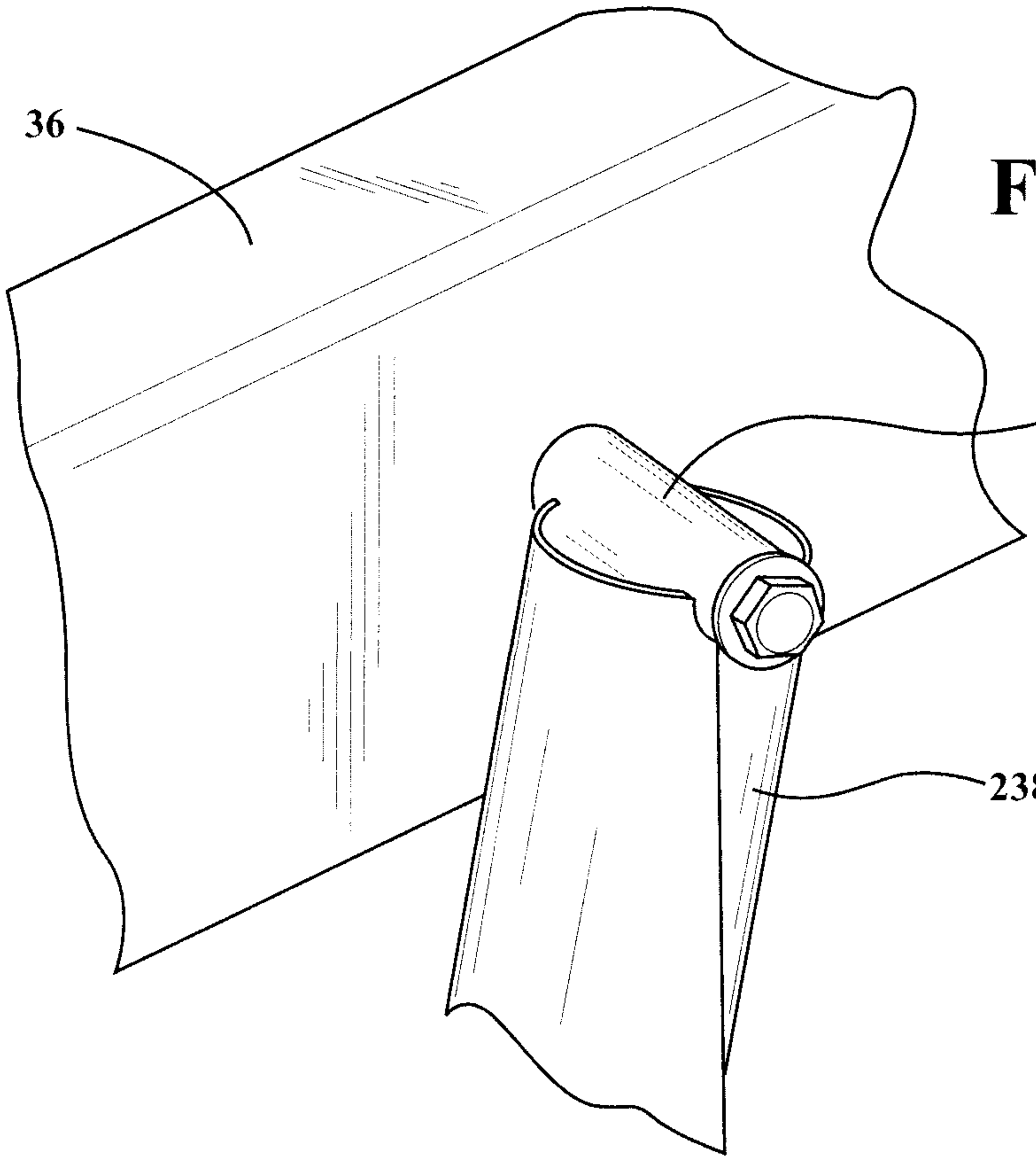


FIG. 9

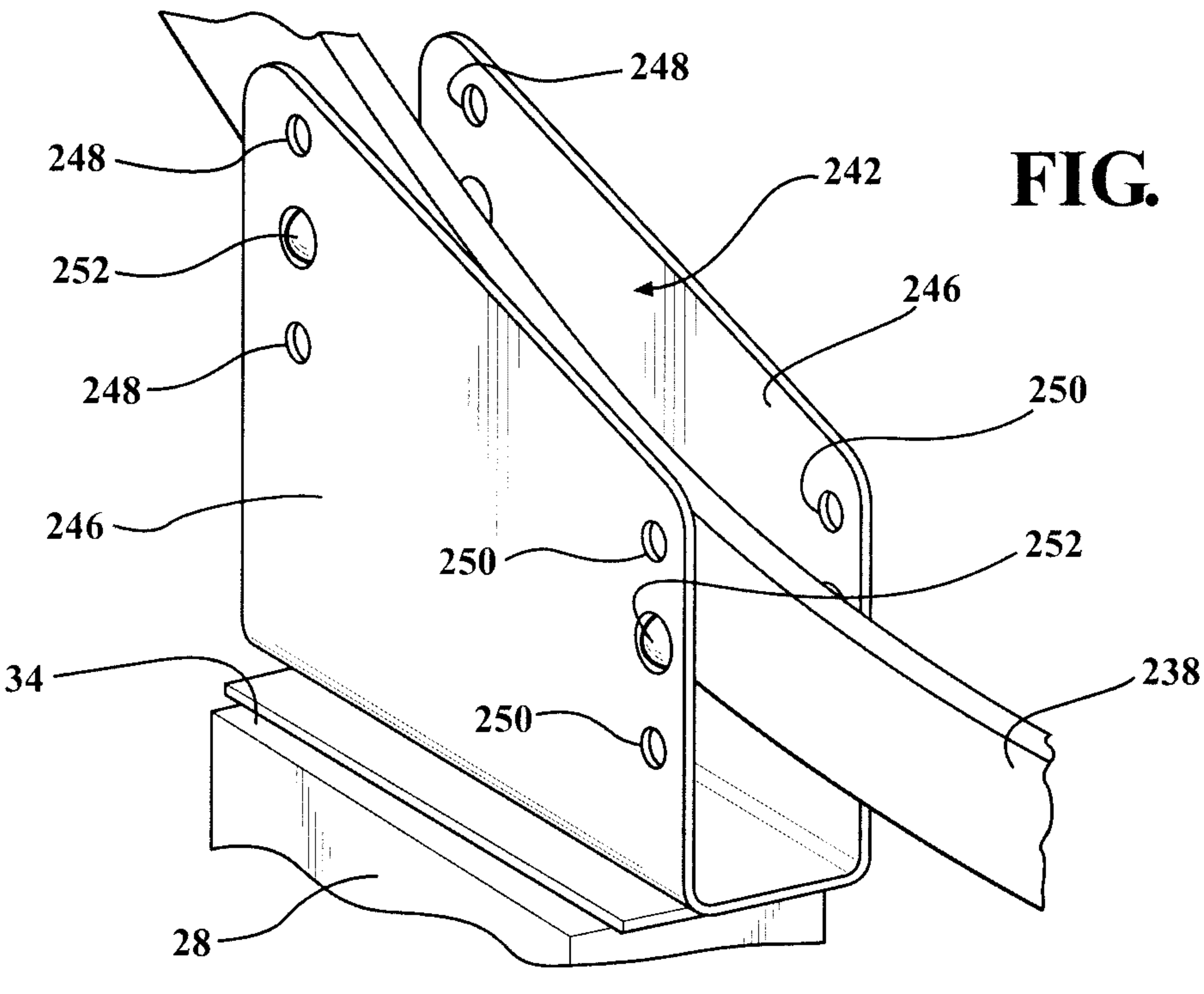


FIG. 10

FIG. 5