US 20080244881A1

(19) **United States**

(12) **Patent Application Publication**

ZANTE

(10) **Pub. No.: US 2008/0244881 A1**

(43) **Pub. Date: Oct. 9, 2008**

(54) **FLEXIBLE HEIGHT-ADJUSTABLE C-CLIP FORCLAMPING SOLAR PANELS**

(76) Inventor: **Anthony A. ZANTE**, Fremont, CA (US)

Correspondence Address:
STAINBROOK & STAINBROOK, LLP
412 AVIATION BOULEVARD, SUITE H
SANTA ROSA, CA 95403 (US)

(21) Appl. No.: **12/098,339**

(22) Filed: **Apr. 4, 2008**

Related U.S. Application Data

(60) Provisional application No. 60/910,201, filed on Apr. 4, 2007.

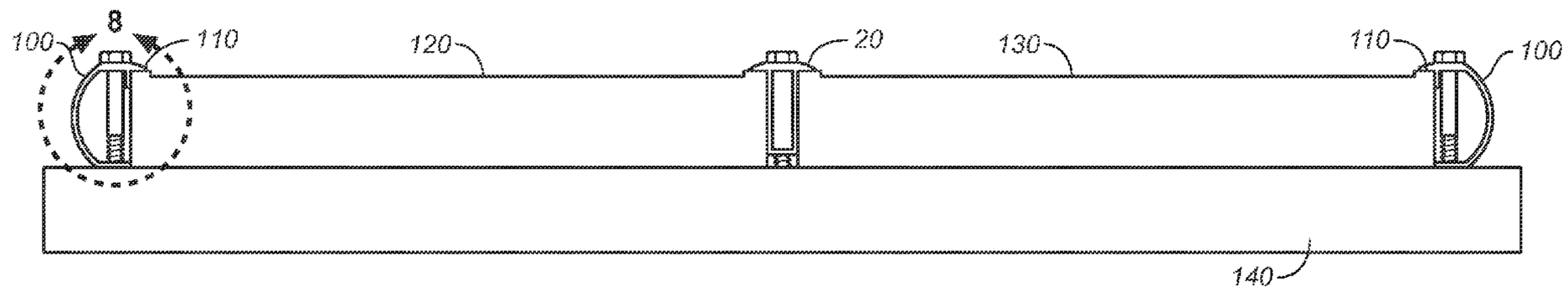
Publication Classification

(51) **Int. Cl.**
A44B 21/00 (2006.01)

(52) **U.S. Cl.** **24/530**

(57) **ABSTRACT**

A flexible height-adjustable C-clip for securing solar panels to a support structure, including a clamp body with lower planar surface-engaging portion and a through hole, an upper planar horizontal clamping portion substantially parallel with the lower planar surface-engaging portion and also having a lower through hole, and a flexible arcuate portion disposed therebetween. The C-clip includes panel-engaging stops that engage the side of the solar panel, align the C-clip perpendicular to the support surface, and maintain the alignment during tightening.



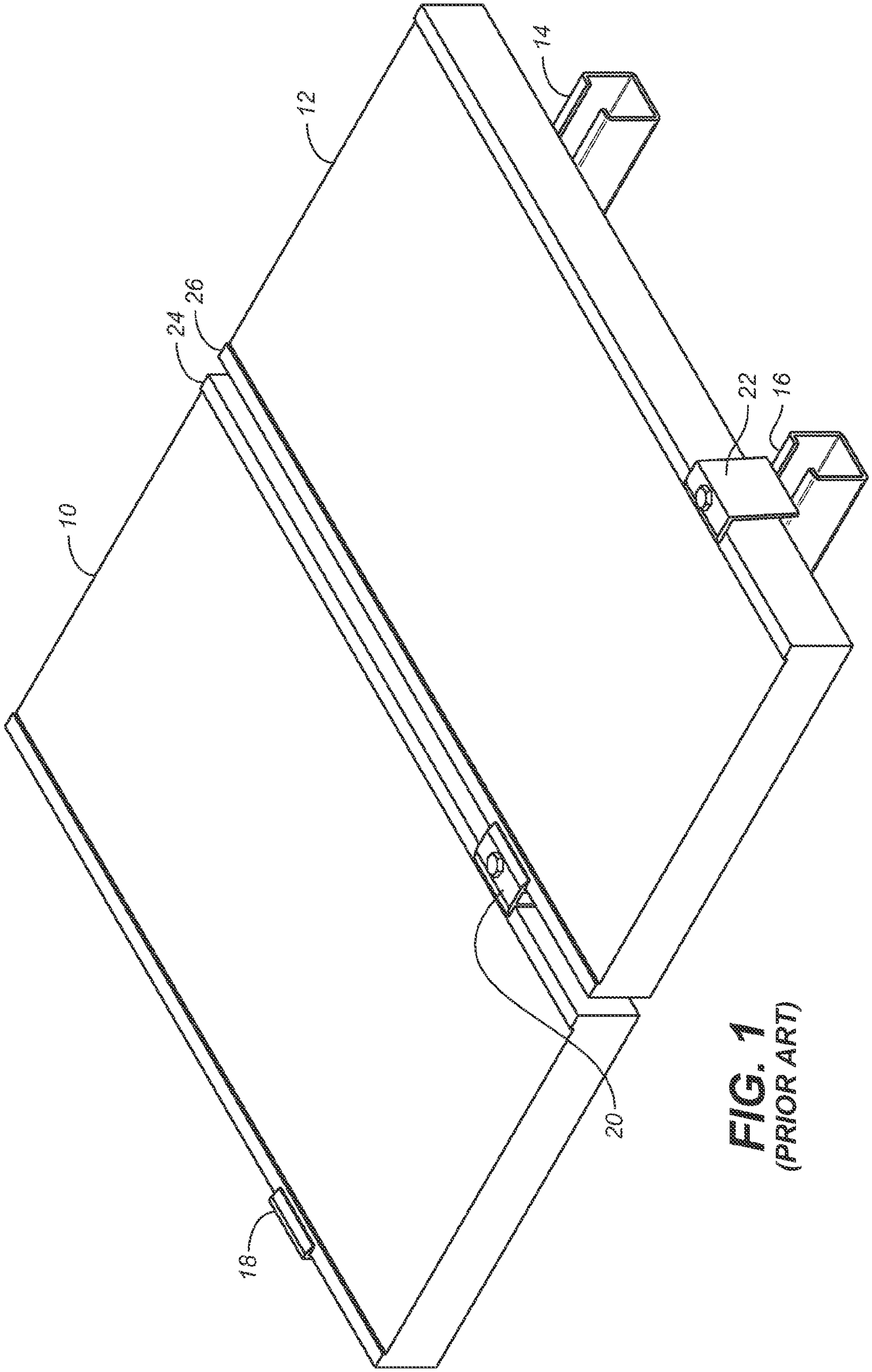


FIG. 1
(PRIOR ART)

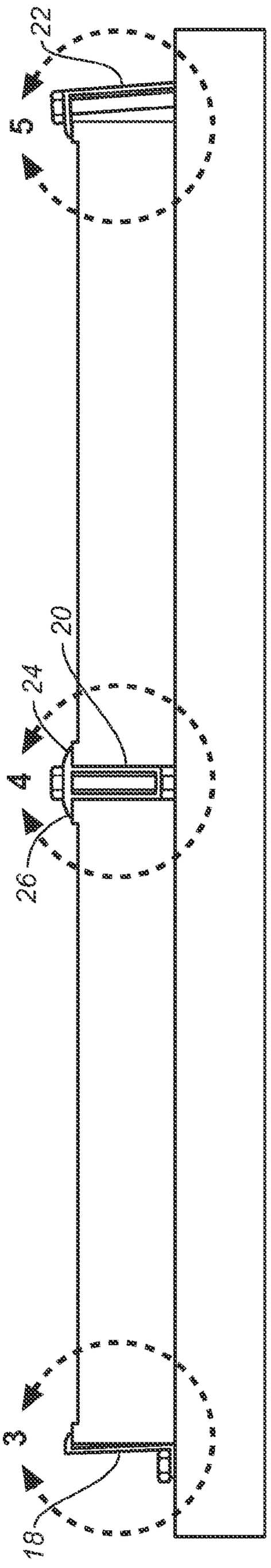


FIG. 2
(PRIOR ART)

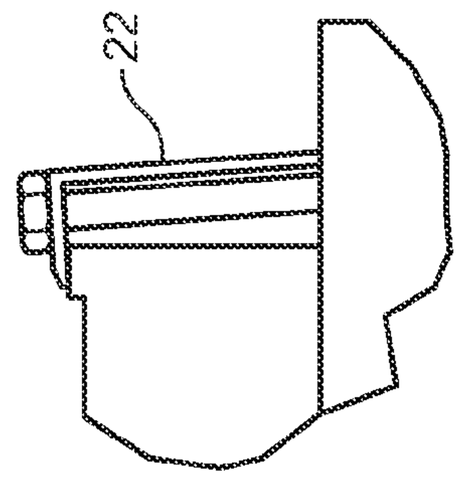


FIG. 5
(PRIOR ART)

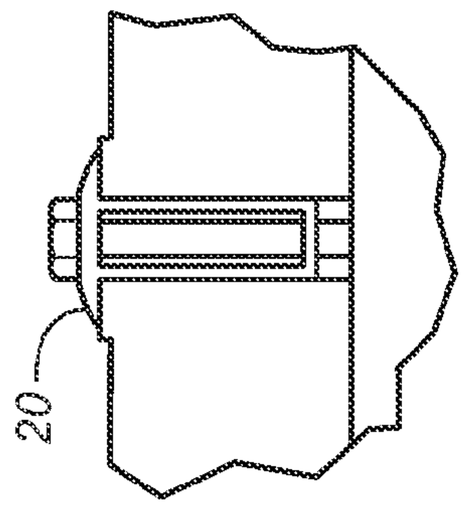


FIG. 4
(PRIOR ART)

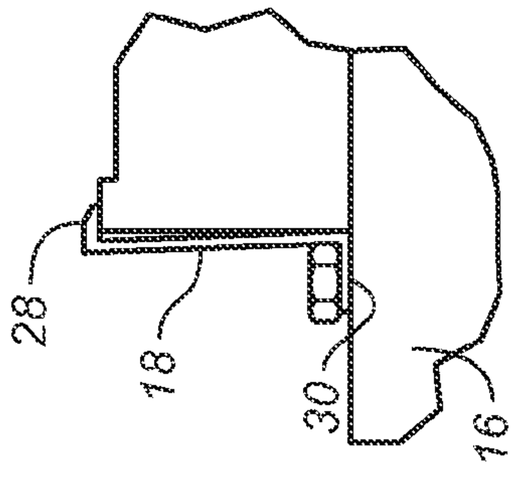


FIG. 3
(PRIOR ART)

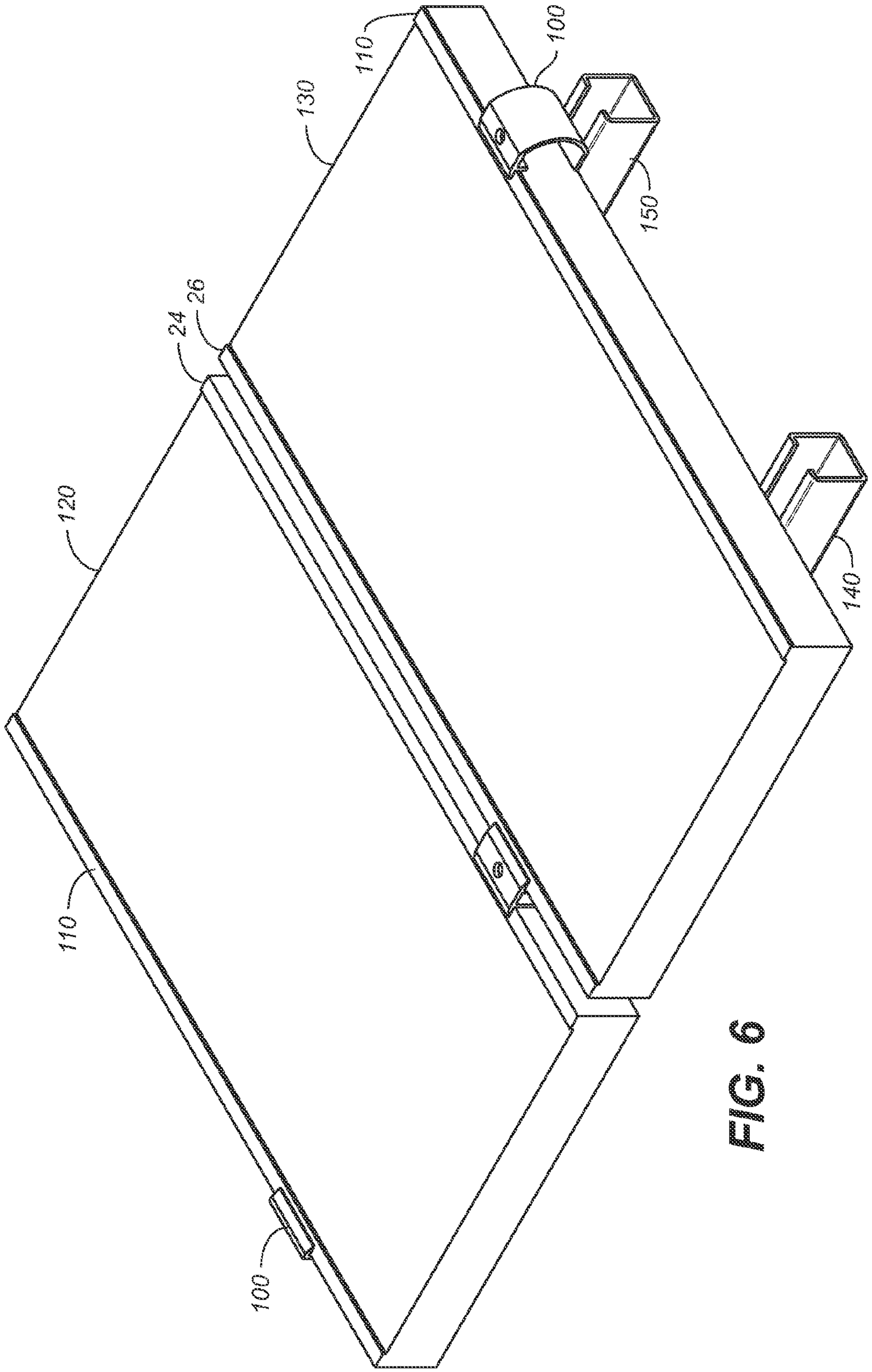


FIG. 6

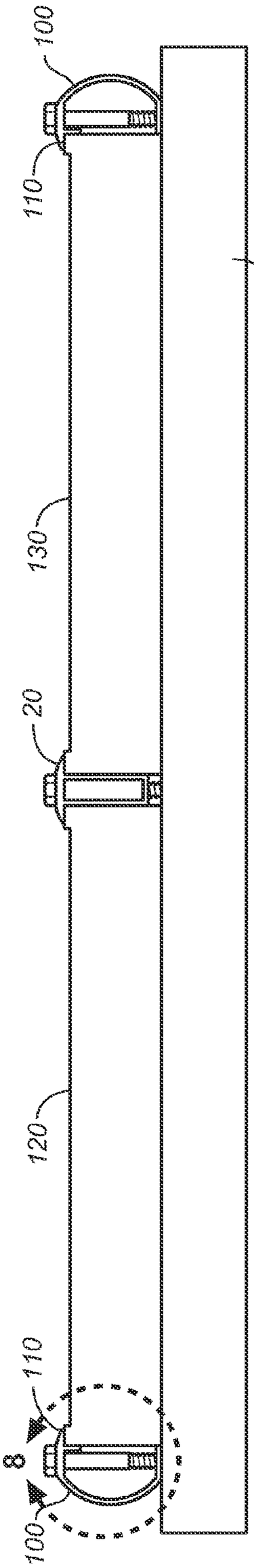

100
110
140
130
20
120
8
110
100

FIG. 7

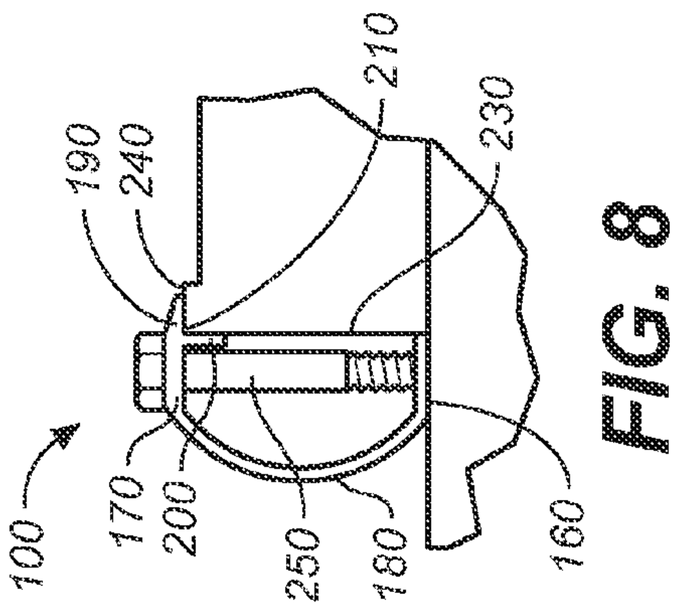

190
240
210
230
170
200
250
180
160
100

FIG. 8

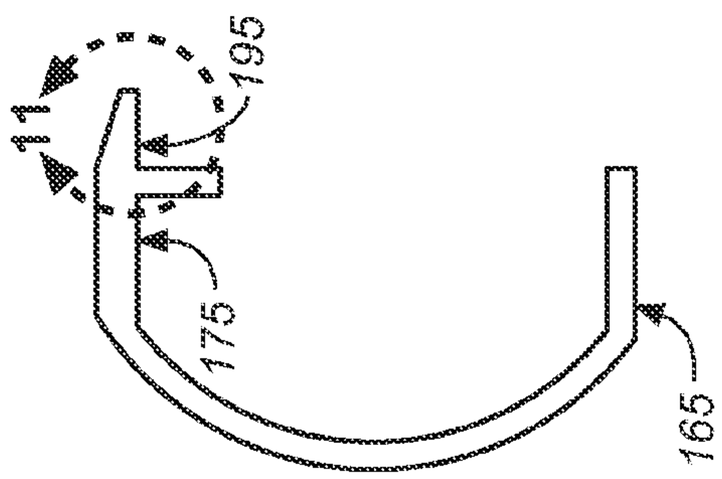


FIG. 12

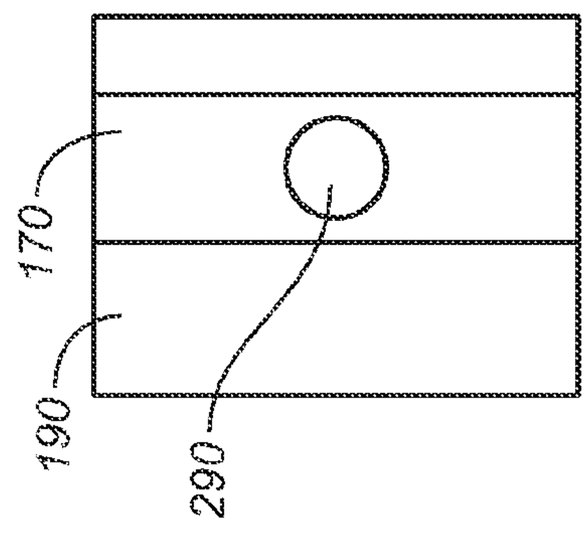


FIG. 10

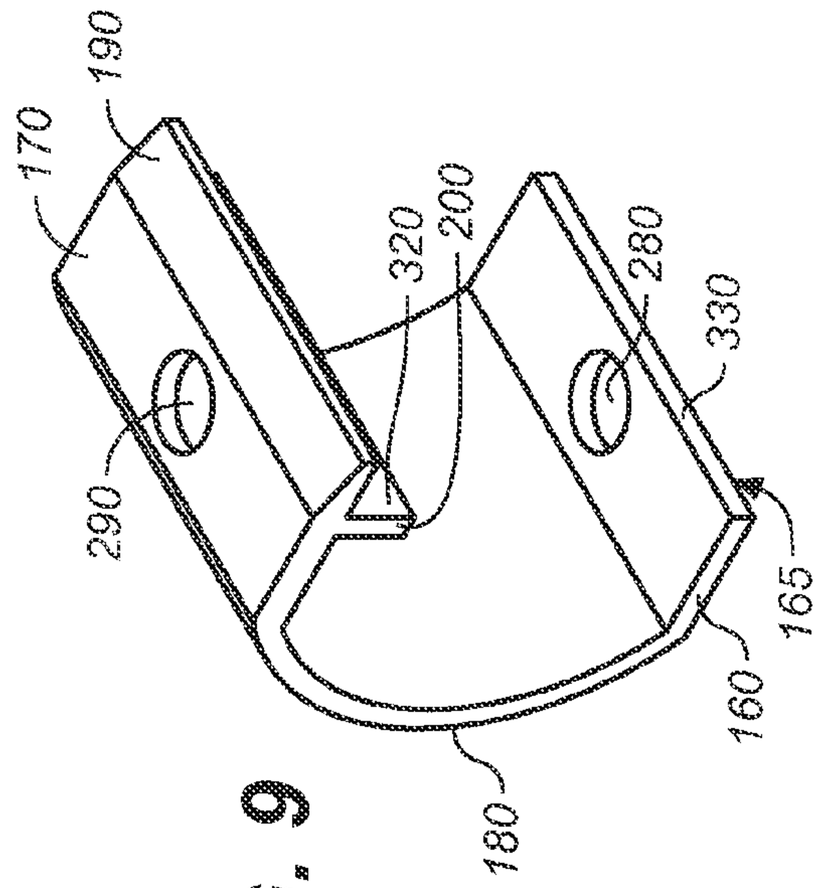


FIG. 9

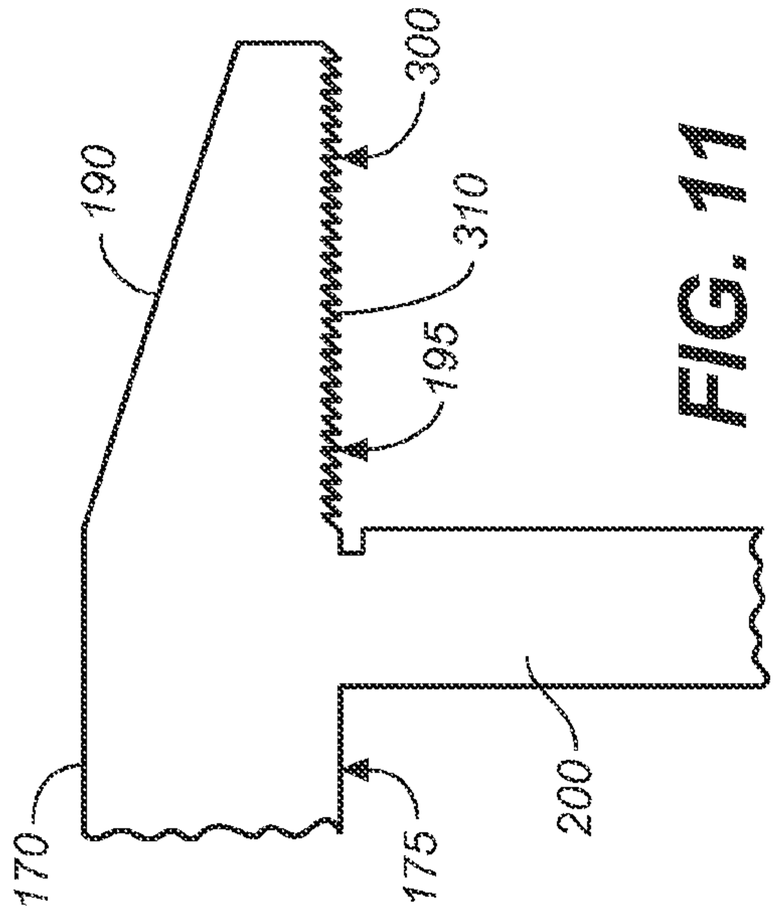


FIG. 11

FLEXIBLE HEIGHT-ADJUSTABLE C-CLIP FORCLAMPING SOLAR PANELS

CROSS REFERENCES TO RELATED APPLICATIONS

[0001] The present application claims the benefit of the filing date of U.S. Provisional Patent Application No. 60/910,201, filed Apr. 4, 2007 (Apr. 4, 2007).

SEQUENCE LISTING

[0002] Not applicable.

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

[0003] Not applicable.

THE NAMES OR PARTIES TO A JOINT RESEARCH AGREEMENT

[0004] Not applicable.

INCORPORATION-BY-REFERENCE OF MATERIAL SUBMITTED ON A COMPACT DISC

[0005] Not applicable.

BACKGROUND OF THE INVENTION

[0006] 1. Field of the Invention

[0007] The present invention relates generally to fasteners, and more particularly to shaped metal fasteners configured to function as clips or clamps, and still more particularly to a C-shaped flexible height metal fastener.

[0008] 2. Discussion of Related Art including information disclosed under 37 CFR §§1.97, 1.98

[0009] Metal angles, clips and straps are well known in the art and have long served as construction connectors for such purposes as post caps, hangers, angled connectors, ridge rafter connectors, stiffener clips, foundation anchors, header hangers, shoe stops, mending plates, strap ties, tie plates, and so forth. Formed metal clamps are also quite well known, and numerous shapes have been devised and adapted for use in myriad fastener applications. Clips and clamps in particular are routinely denominated according to the resemblance their profile view bears to a letter in the alphabet. Thus, we have T-clips, L-clips, Z-clips, and so on. Exemplary apparatus are shown in FIGS. **1-5**, which illustrate several of the clips employed in the prior art.

[0010] In the context of photovoltaic module (solar panel) installation, panels are customarily attached to building rooftops and other surfaces using some kind of clamping method. The method is generally selected to provide a variety of clamping characteristics, including ease of installation, ease of replacement and adjustment, sufficient binding power to resist high wind loads, and so on. The clamping methods commonly practiced employ edge clamps that bolt into structural members, such as common commercial strut channels.

[0011] At present, there are a variety of clamps employed in such conventional methods. Referring now to FIGS. **1-5**, there is illustrated two solar panels **10**, **12**, attached in a side-by-side configuration on parallel strut channels, **14**, **16**. The clamp members employed include a Z-clip **18**, a T-clip **20**, and an L-clip **22**.

[0012] These views show that a T-clip grips the interior edges **24**, **26** of adjacent panels. The T-clip is sized to be slightly shorter than the height of the panel to ensure proper clamping action.

[0013] Referring now to FIG. **3**, using prior art techniques panel edges are often clamped using a Z-clip. The Z-clip clamps the top of the panel edge with its upper lip **28** while the lower lip **30** is bolted to the strut channel **16**. It, too, is sized slightly short of the height of the panel to ensure adequate clamping force. This clip has a tendency of allowing lateral migration of the panel, however, and this can lead to a total failure of the attachment.

[0014] Alternatively, panel edges may be clamped using an inverted L-clip **22**, such as that shown in FIG. **4**. This style of clamp includes an upper leg disposed over the upper surface of the edge of the panel. A bolt is passed through a through hole in the horizontal upper leg and extending proximate the vertical leg and into the groove of the strut channel, where it is secured by a nut. Accordingly, the end of the vertical leg rests against the strut and can be pivoted to ensure proper clamp height position. However, like the Z-clip, this type of clamp is also somewhat unstable and does not allow uniform loading on the edge of the module unless the height of the module and the clamp perfectly match. This can concentrate forces on clamped edge of the module.

[0015] In summary, due to variations in solar panel module thickness it is difficult to provide uniform clamping using the conventional apparatus. Simply stated, the clamps do not squarely clamp the module and provide poor gripping or impose potentially damaging stress concentrations.

[0016] The foregoing prior art devices reflect the current state of the art of which the present inventor is aware. Reference to, and discussion of, these devices is intended to aid in discharging Applicant's acknowledged duty of candor in disclosing information that may be relevant to the examination of claims to the present invention, when such claims are submitted in a successor application. However, it is respectfully submitted that none of the above-indicated clamping devices anticipate or render obvious C-shaped clamping apparatus of the present invention as described herein.

[0017] There remains a need, therefore, for a clamp that has a degree of height adjustability without sacrificing clamping effectiveness.

BRIEF SUMMARY OF THE INVENTION

[0018] The present invention is a flexible C-clamp for clamping the outside edges solar panels. The C-clip includes a lower horizontal leg and an upper horizontal leg, and a flexible arcuate portion disposed therebetween. The upper horizontal leg extends integrally in a beveled terminal, and a vertical flange depending downwardly from the underside of the upper horizontal leg forms a corner in which to secure the upper edge of a solar panel side.

[0019] A bolt is passed through the upper and lower horizontal legs to attach the clip to a strut channel or other support structure. The exterior side of the vertical flange aligns with the outside edge of the lower horizontal leg, and both cooperate to work as stops against which the panel side is approximated. This brings the clip into vertical alignment, such that while the C-clip flexes when tightened down, it maintains engagement with the solar panel side.

[0020] It is therefore an object of the present invention to provide a new and improved clamp adapted for clamping planar panels to support structures.

[0021] It is another object of the present invention to provide a new and improved pre-loaded clip which facilitates the rapid installation of panels on support rails.

[0022] A further object or feature of the present invention is a new and improved clamp that is placed into a perpendicular relationship with a support surface when engaging the side of a panel and which includes structure to maintain the perpendicular orientation during clamp tightening.

[0023] A still further object of the present invention is to provide a clamping device that greatly reduces the potential for damage to solar panel modules caused by faulty clamping procedures.

[0024] An even further object of the present invention is to provide a novel flexible height-adjustable C-clip that is inexpensive in manufacture.

[0025] The foregoing summary broadly sets out the more important features of the present invention so that the detailed description that follows may be better understood, and so that the present contributions to the art may be better appreciated. There are additional features of the invention that will be described in the detailed description of the preferred embodiments of the invention which will form the subject matter of the claims appended hereto.

[0026] Accordingly, before explaining the preferred embodiment of the disclosure in detail, it is to be understood that the disclosure is not limited in its application to the details of the construction and the arrangements set forth in the following description or illustrated in the drawings. The inventive apparatus described herein is capable of other embodiments and of being practiced and carried out in various ways.

[0027] Also, it is to be understood that the terminology and phraseology employed herein are for descriptive purposes only, and not limitation. Where specific dimensional and material specifications have been included or omitted from the specification or the claims, or both, it is to be understood that the same are not to be incorporated into the appended claims.

[0028] As such, those skilled in the art will appreciate that the conception, upon which this disclosure is based may readily be used as a basis for designing other structures, methods, and systems for carrying out the several purposes of the present invention. It is important, therefore, that the claims are regarded as including such equivalent constructions as far as they do not depart from the spirit and scope of the present invention. Rather, the fundamental aspects of the invention, along with the various features and structures that characterize the invention, are pointed out with particularity in the claims annexed to and forming a part of this disclosure. For a better understanding of the present invention, its advantages and the specific objects attained by its uses, reference should be made to the accompanying drawings and descriptive matter in which there are illustrated the preferred embodiment.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

[0029] The invention will be better understood and the objects and advantages of the invention will become apparent when consideration is given to the following detailed description thereof. Such description makes reference to the annexed drawings wherein:

[0030] FIG. **1** is a perspective view showing a solar panel clamped to conventional commercial strut channel using prior art T-clips, L-clips, and Z-clips;

[0031] FIG. **2** is a schematic side view in elevation showing the panel and prior art clamping apparatus of FIG. **1**;

[0032] FIG. **3** is a detailed schematic side view in elevation showing the prior art Z-clip taken along detail line A of FIG. **2**;

[0033] FIG. **4** is a detailed schematic side view in elevation showing the prior art L-clip taken along detail line C of FIG. **2**;

[0034] FIG. **5** is a detailed schematic side view in elevation showing the prior art T-clip taken along detail line B of FIG. **2**;

[0035] FIG. **6** is a perspective view showing solar panels installed in a side-by-side configuration on strut channels using the flexible height-adjustable C-clip of the present invention;

[0036] FIG. **7** is side view in elevation thereof;

[0037] FIG. **8** is a detailed side view in elevation taken along detail line A of FIG. **7**;

[0038] FIG. **9** is a perspective view of the flexible height-adjustable C-clip of the present invention;

[0039] FIG. **10** is a schematic side view in elevation thereof, showing preferred material dimensions for an exemplary C-clip;

[0040] FIG. **11** is a detailed side view of the upper terminal portion of the C-clip taken along detail line A of FIG. **10**; and

[0041] FIG. **12** is a top plan view thereof.

DRAWING LEGEND

[FIGS. **6-12**]

[0042] **20** T-clip (conventional)
[0043] **100** flexible height-adjustable C-clip, generally
[0044] **110** outside edges of solar panels
[0045] **120** solar panel
[0046] **130** solar panel
[0047] **140** strut channel
[0048] **150** strut channel
[0049] **160** lower horizontal leg
[0050] **170** upper horizontal leg
[0051] **180** flexible arcuate portion
[0052] **190** beveled terminal finger
[0053] **200** vertical flange
[0054] **210** corner angle
[0055] **220** ridge
[0056] **230** solar panel side
[0057] **240** upper surface
[0058] **250** bolt
[0059] **260** edge of solar panel
[0060] **270** edge of solar panel
[0061] **280** through hole
[0062] **290** through hole
[0063] **300** under surface of terminal finger
[0064] **310** serrations
[0065] **320** exterior side of vertical flange
[0066] **330** outside edge of lower horizontal leg

DETAILED DESCRIPTION OF THE INVENTION

[0067] Referring now to FIGS. **6** through **12**, wherein like reference numerals refer to like components in the various views, there is illustrated a new and improved flexible height-adjustable C-clip particularly adapted for solar panel instal-

lation, generally denominated **100** herein. It will be understood, however, that the C-clip of the present invention would be suitable for use in clamping a variety of articles having generally planar sides proximate their edges.

[0068] Referring now specifically to FIGS. **6-8**, the various views show the inventive apparatus employed to clamp the outside edges **110** of two solar panels, **120**, **130**, installed in a side-by-side configuration on parallel strut channels, **140**, **150**, as would be common in rooftop solar panel installation. These views show that the flexible height C-clip generally includes a lower horizontal leg **160** having a substantially planar underside **165**, an upper horizontal leg **170**, and a flexible arcuate portion **180** disposed between the upper and lower horizontal legs. FIG. **8** shows that the upper horizontal leg includes a beveled terminal finger **190**, which combines with a vertical flange **200** disposed normal to, and depending downwardly from, the point at which the underside of the inboard portion **195** of the terminal finger and the underside **175** of the upper horizontal leg join. This forms a corner angle **210** in which to secure the ridge **220** defined by the junction of the solar panel side **230** and upper surface **240**. A bolt **250** is passed through the upper and lower horizontal legs inside the vertical flange to provide means to clamp the panel/clip assembly to the strut channels. A conventional T-clip **20** is employed to clamp the adjacent edges **260**, **270**, of the adjacent sides of the solar panels.

[0069] Referring next to FIGS. **9-12**, there is shown detail of the inventive clip. Here we see that the lower and upper horizontal legs **160**, **170** of C-clip **100** each include a through hole **280**, **290** for bolt insertion, as described above. The underside **300** of terminal finger **190** preferably includes serrations **310** or other surface topography to increase gripping strength when clamped. The exterior side **320** of vertical flange **200** is generally co-planar with the outside edge **330** of lower horizontal leg **160**, and together they function as panel stops, such that when the clip **100** is approximated to the side **230** of a solar panel module these surfaces will bring the C-clip into perfect perpendicular alignment with the surface onto which the panel is being installed. Further more, the C-clip will maintain engagement with the side of the panel and will maintain its perpendicular orientation, even as the C-clip flexes as a bolt is tightened during clamping.

[0070] FIGS. **10-12** show preferred dimensional specifications of an exemplary C-clip for a solar panel installation. It will be understood, however, that dimensional relationships may be varied according to the material employed in clip fabrication and according to the clamping needs to be addressed.

[0071] The inventive C-clip allows the flexibility needed to provide uniform force on solar panel module edges. The arcuate portion of the C-clip flexes to adjust to the height of the module, yet has sufficient rigidity to ensure that the flat edge of the clamp remains parallel with the module edge. Further, the C-clip is pre-loaded to a degree so that it will stay tight during motion of the system much like a spring washer. Accordingly, the C-clip of the present invention eliminates edge loading, incorrect clamp heights, the requirement of tight tolerances for clamp fabrication, and it maintains a spring loading on a clamped member. Furthermore, when heavy torque loads are placed on a fastener inserted through the C-clip, the arcuate portion of the clip will continue to flex and shift load from the panel surface so as to avoid damaging the panel by over-tightening.

[0072] The principal intended use for the C-clip is for solar panel module installation. However, any of a number of other fields will benefit from use of the above-described apparatus. For instance, the C-clip can be employed for: (1) clamping other flat panels that cannot withstand concentrated point or edge loads; (2) clamping in circumstances in which a flexible clamp is needed to adjust to swelling or shrinking of clamped members; (3) clamping articles in dynamic environments where moving parts can cause fixed clamps to loosen; (4) clamping where it is desired to eliminate sharp corners; and (5) clamping where clamped members vary in height.

[0073] The inventive C-clip is very inexpensive in manufacture. It can be produced using aluminum extrusion fabrication. However steel, stainless steel, and plastics may also be used for the appropriate applications.

[0074] For objects requiring only light clamping, the C-clip may be fabricated with a thin wall thickness and nominal pre-loading, allowing a wide degree of height variation. As the required clamping forces become higher, the C-clip material thickness may be increased to reduce flexibility and increase clamping power. This incidental limitation can also be addressed by providing height sizes adapted to the contemplated use.

[0075] From the foregoing, it will be apparent that in its first and most essential aspect, the flexible height-adjustable C-clip of the present invention is adapted for securing planar panels to a support surface. This is due to its novel structural elements, which include a clamp body having a lower planar surface-engaging portion (the lower leg) with a lower through hole, an upper planar horizontal clamping portion substantially parallel with the lower planar surface-engaging portion (the underside of the upper leg) and having a lower through hole, and a flexible arcuate portion disposed between the upper and lower planar portions. The C-clip next includes panel-engaging stops, wherein the panel-engaging stops engage a side of the planar panel to be secured, align the C-clip body substantially perpendicular to the support surface prior to clamping, and maintain the substantially perpendicular alignment when tightening the clamp body. This reduces the vigilance and care typically required during clamping operations to ensure proper panel engagement and proper clamp alignment.

[0076] The above disclosure is sufficient to enable one of ordinary skill in the art to practice the invention, and provides the best mode of practicing the invention presently contemplated by the inventor. While there is provided herein a full and complete disclosure of the preferred embodiments of this invention, it is not desired to limit the invention to the exact construction, dimensional relationships, and operation shown and described. Various modifications, alternative constructions, changes and equivalents will readily occur to those skilled in the art and may be employed, as suitable, without departing from the true spirit and scope of the invention. Such changes might involve alternative materials, components, structural arrangements, sizes, shapes, forms, functions, operational features or the like.

[0077] Therefore, the above description and illustrations should not be construed as limiting the scope of the invention, which is defined by the appended claims.

What is claimed as invention is:

1. A flexible height-adjustable clamp for securing planar panels to a support surface,

comprising:

a clamp body having a lower planar surface-engaging portion with a lower through hole, an upper planar horizontal clamping portion substantially parallel with said lower planar surface-engaging portion and having a lower through hole, and a flexible arcuate portion disposed therebetween; and

panel-engaging stops, wherein said panel-engaging stops engage a side of the planar panel to be secured, align said clamp body substantially perpendicular to the support surface prior to clamping, and maintain the substantially perpendicular alignment when tightening said clamp body.

2. The apparatus of claim **1**, wherein said side stops comprise a planar edge on the outer end of said lower planar surface-engaging portion and a vertical flange depending downwardly from said upper planar horizontal clamping portion, wherein when said planar edge and said vertical flange are approximated to a substantially planar sides of a panel to be fastened to a generally planar surface and a fastener inserted through each of said upper and lower through holes, said clamp is maintained in a substantially perpendicular orientation in relation to the generally planar support surface during clamping.

3. The apparatus of claim **1**, wherein said arcuate portion is pre-loaded prior to clamping.

4. The apparatus of claim **1**, wherein said upper horizontal clamping portion comprises the underside of an upper leg.

5. The apparatus of claim **4**, wherein said upper leg terminates in a beveled finger.

6. The apparatus of claim **4**, wherein said side stops include a planar edge on an outer end of said lower planar surface-engaging portion and a vertical flange depending downwardly from said upper planar horizontal clamping portion, wherein when said planar edge and said vertical flange are approximated to a substantially planar side surface of the panel to be fastened to a generally planar surface and a fastener inserted through each of said upper and lower through holes, said clamp is placed into, and maintained in, a substantially perpendicular orientation during clamping.

7. A flexible height clamping apparatus for installing and securing solar panels on support structures, comprising:

a lower horizontal leg having a substantially planar underside, an outer edge, and a through hole;

an upper horizontal leg having a substantially planar underside and a through hole;

a flexible arcuate portion disposed between said upper and lower horizontal legs; and

a vertical flange disposed normal to and depending downwardly from said underside of said upper horizontal leg so as to form a corner angle in which to secure a panel at the edge formed by the junction of its side and upper surface.

8. The clamping apparatus of claim **7**, wherein said upper horizontal leg includes a terminal finger extending outwardly from said vertical flange.

9. The clamping apparatus of claim **8**, wherein said terminal finger is beveled.

10. The clamping apparatus of claim **8**, wherein said terminal finger includes an underside having surface topography to increase gripping strength.

11. The clamping apparatus of claim **7**, wherein said vertical flange has an exterior side generally co-planar with said outside edge of said lower horizontal leg, such that said vertical flange and said outside edge cooperate to function as panel stops, which, when approximated to the side of a solar panel module, will bring said C-clip into perpendicular alignment with the surface onto which the panel is being installed and will maintain engagement with the side of the panel and the perpendicular alignment during tightening during clamping.

* * * * *