FIG. 7

(FI) Abstract: A fixture (10) is used in assembly of a solar module assembly that includes at least one solar module (14), a rail (16), and adhesive (18) disposed between and adhesively connecting the rail (16) and the solar module (14). The fixture comprises support members (22) presenting a first support surface (26) contacting one of the rail or the solar module, and a plurality of risers (24) each extending from the support members and presenting a second support surface (30) spaced from the first support surface. The one of the rail or the solar module contacting the first surface defines a thickness between the first and second support surfaces. The first support surface is spaced from the second support surfaces a distance (DT) greater than the thickness (T) for spacing the rail and the solar module to limit deformation of the adhesive between the rail and the solar module during assembly of the rail and the solar module.
FIXTURE FOR ASSEMBLING A SOLAR MODULE ASSEMBLY

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] The subject patent application claims priority to and all the benefits of U.S. Provisional Patent Application No. 61/670,067 filed on July 10, 2012, which is herein incorporated by reference in its entirety.

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0002] The present invention generally relates to a fixture for assembling a solar module assembly. In particular, the fixture maintains a rail and a solar module spaced apart with adhesive disposed therebetween until the adhesive is cured.

2. Description of the Related Art

[0003] A solar module installation site includes a racking system for supporting a plurality of solar module assemblies. Each solar module assembly includes at least one solar module and a structure fixed relative to the solar module for hanging the solar module on the racking system.

[0004] The structure can be a frame that is mechanically fastened to the solar module. The frame typically includes members that are mechanically fastened to the solar module with the use of fasteners, clips, etc. The assembly of such hardware is time consuming and labor intensive. The assembly of the frame also adds unwanted handling of the solar module, which is typically delicate.

[0005] In the alternative to the frame, the solar module assembly can be frameless. In such a configuration, the solar module assembly includes at least one rail that extends across a back, i.e., the shade side, of the solar module. The rail can be fixed to the solar module with adhesive.

[0006] The thickness, width, and height of the adhesive between the rail and the solar module affect the durability of the solar module assembly. Specifically, a desired thickness, width, and height can be calculated depending upon the type of adhesive and the size of the solar module and the rail. This desired thickness, width, and height is calculated depending upon desired performance when the solar module assembly is subjected to forces, such as when subjected to wind, snow load, etc.

[0007] To adhere the rail to the solar module, the adhesive is typically applied to one of the rail and the solar module, which is then set on the other of the rail and
the solar module. As such, the adhesive is squeezed under the weight of the one of the rail and the solar module, which can lead to unwanted deformation of the adhesive. This unwanted deformation creates difficulties in achieving the desired thickness, width, and height of adhesive between the rail and the solar module. As such, there remains an opportunity to improve the assembly of the solar module assembly to control the thickness, width, and height of adhesive between the rail and the solar module.

SUMMARY OF THE INVENTION AND ADVANTAGES

[0008] The present invention includes a fixture for assembling a solar module assembly that includes at least one solar module, a rail, and adhesive disposed between and adhesively connecting the rail and the solar module. The fixture comprises support members for supporting one of the rail or the solar module. The fixture includes risers supported on said support members for supporting the other of the rail or the solar module. The support members presents a first support surface contacting the one of the rail or the solar module. The risers each extend from the support members and present a second support surface spaced from the first support surface and contacting the other of the rail or the solar module. The one of the rail or the solar module defines a thickness between the first support surface and the second support surfaces. The first support surface is spaced from the second support surfaces a distance greater than the thickness for spacing the rail and the solar module to limit deformation of the adhesive between the rail and the solar module during assembly of the rail and the solar module.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] 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:

[0010] Figure 1 is a perspective view of a plurality of fixtures of one embodiment located at a solar module installation site;

[0011] Figure 2 is a perspective view of a plurality of the fixtures of Figure 2 located at a factory;

[0012] Figure 3 is a top view of the one fixture shown in Figure 1;

[0013] Figure 4 is a perspective view of the fixture of Figure 3 on an assembly table;
Figure 5 is the perspective view of Figure 4 with rails inserted in the fixture;

Figure 6 is the perspective view of Figure 5 with a plurality of solar modules placed on the fixture;

Figure 7 is a cross-sectional view of a portion of Figure 6 along line 7 in Figure 6;

Figure 8 is a perspective view of another embodiment of the fixture that is arranged to orient the solar modules of the solar module assembly in a landscape orientation relative to the rails of the solar module assembly;

Figure 9 is a perspective view of another embodiment of the fixture;

Figure 10 is another perspective view of the fixture of Figure 8 with a plurality of solar modules placed on the fixture;

Figure 11 is the perspective view of Figure 9 with two rails placed on the fixture;

Figure 12 is a cross-sectional view of the fixture of Figure 11 along line 12 in Figure 11;

Figure 13 is a perspective view of the fixture of Figure 8 on a conveyor table at an end of a loading line;

Figure 14 is a perspective view of the fixture and conveyor table of Figure 13 with a plurality of solar modules disposed on the fixture.

DETAILED DESCRIPTION OF THE INVENTION

Referring to the Figures, wherein like numerals indicate like parts throughout the several views, a fixture 10, 110 for assembling a solar module assembly 12 is generally shown. More specifically, one embodiment of the fixture 10 is shown in Figures 3-7 and another embodiment of the fixture 110 is shown in Figures 9-12. The two embodiments are shown in the Figures for the purpose of non-limiting example.

As shown in Figure 1, the fixture 10, 110 can be used to assemble the solar module assembly 12 at a solar module installation site. Alternatively, as shown in Figure 2, the fixture 10, 110 can be used to assemble the solar module assembly 12 at a factory for subsequent shipment to the solar module installation site by, for example, semi-truck, train, etc. Figures 1 and 2 include the fixture 10 embodied in
Figures 3-7 merely for exemplary purposes and the fixture 110 embodied in Figures 9-12 can be used in the arrangement shown in Figures 1 and 2.

[0026] As shown in Figures 7 and 12, the solar module assembly 12 includes at least one solar module 14, a rail 16, and adhesive 18 disposed between and adhesively connecting the rail 16 and the solar module 14. In some embodiments, the solar module assembly 12 includes a plurality of solar modules 14, i.e., typically referred to in industry as a solar module panel. In such embodiments, when the solar module assembly 12 is assembled, the rail 16 extends between each of the solar modules 14 to connect the solar modules 14 together as a unit. With reference to Figure 1, the rail 16 is configured to connect to a racking system 20 of a solar module installation site to support the solar module assembly 12 on the racking system 20. The solar module assembly 12 is shown in the Figures to include two rails 16 and three or four solar modules 14 in a single column, however, the solar module assembly 12 can include any number of rails 16 and any number of solar modules 14 arranged in any number of columns. The solar module assembly 12 is shown in Figures 1-7 with the solar modules 14 arranged on the rails 16 in a portrait orientation, however, the solar modules 14 can be arranged in a landscape orientation, as shown in Figure 8, or any other orientation.

[0027] The adhesive 18 can be any type of adhesive. For example the adhesive 18 can be silicone such that the assembly of the solar module 14 and the rail 16 is further defined as silicone panelization. The silicone advantageously has excellent adhesion to glass and metals. The silicone is also flexible so as to absorb mismatches caused by differences coefficient of thermal expansion of different material and to reduce stress on the solar module 14. The silicone can also withstand wind load and snow load and adequately resists deterioration.

[0028] The silicone can be any type of silicone. Typically, the silicone is room-temperature vulcanizing silicone (RTV). The silicone can be, for example, a 1-part silicone or a 2-part silicone, as set forth further below. Specifically, the silicone can be, but is not limited to, that which is available under the tradenames PV-8301 Fast Cure Sealant, PV-8303 Ultra Fast Cure Sealant, or PV-8030 Adhesive from Dow Corning headquartered in Midland, MI, USA.

[0029] During assembly, the fixture 10, 110 spaces the rail 16 and the solar module 14 apart by a distance $D_1$ with the adhesive 18 extending along the distance
between the rail 16 and the solar module 14. The adhesive 18 is in an uncured state when the solar module 14, rail 16, and adhesive 18 are assembled together on the fixture 10, 110. In the uncured state, the adhesive 18 is deformable relative to the rail 16 and the solar module 14, e.g., is flowable. In a cured state, the adhesive 18 is typically solidified relative to the uncured state and typically maintains its shape between the rail 16 and the solar module 14. The "cured state" is used herein to refer to any partially or fully cured state in which the adhesive 18 is solidified relative to the uncured state.

During assembly, the rail 16 and the solar module 14 squeeze the adhesive 18 therebetween and the adhesive 18 deforms between the rail 16 and the solar module 14. The fixture 10, 110 properly spaces the rail 16 and the solar module 14 apart by the distance D₁ such that the adhesive 18 can cure along the distance D₁. In other words, the fixture 10, 110 prevents excessive deformation of the adhesive 18 under the weigh of the rail 16 or solar module 14, i.e., limits adhesive 18 squeeze-out. As such, a desired thickness, width, and height of the adhesive can be easily controlled while the adhesive 18 is cured, i.e., the fixture 10, 110 holds the rail 16 and the solar module 14 such that the desired thickness, width, and height of the adhesive 18 is achieved when the adhesive 18 is cured. This desired thickness can be calculated depending upon desired performance when the solar module assembly is subjected to forces, such as when subjected to wind, snow load, etc.

The fixture 10, 110 includes a support members 22 for supporting one of the rail 16 or the solar module 14 and the fixture 10, 110 includes a plurality of risers 24 for supporting the other of the rail 16 or the solar module 14. The support members 22 and the risers 24 are typically elongated members that are affixed to each other in any suitable fashion. The support members 22 and the risers 24 are typically formed of metal or other suitable material that provides suitable rigidity.

The support members 22 present a first support surface 26 contacting the one of the rail 16 or the solar module 14. In the embodiment shown in Figures 3-7, the first support surface 26 of the support members 22 contact and support the rail 16. In the embodiment shown in Figures 9-12, the first support surface 26 contacts and supports the solar module 14. Although not shown in Figures 3-7, the support
members 22 and/or the risers 24 can include handles 28 for manually lifting and moving the fixture 10.

[0033] The risers 24 each extend from the support members 22. The risers 24 present a second support surface 30 spaced from the first support surface 26 of the support members 22. The first support surface 26 contacts one of the rail 16 or the solar module 14, as set forth above, and the second support surface 30 contacts the other of the rail 16 or the solar module 14. In the embodiment shown in Figures 3-7, the second support surfaces 30 of the risers 24 contact and support the solar module 14. In the embodiment shown in Figures 9-12, the second support surface 30 contacts and supports the rail 16.

[0034] The one of the rail 16 or the solar module 14 identified above, i.e., the rail 16 in the embodiment of Figures 3-7 or the solar module 14 in the embodiment of Figures 9-12, defines a thickness T. The thickness T of the one of the rail 16 or the solar module 14 extends from the first support surface 26 toward the second support surfaces 30. The first support surface 26 is spaced from the second support surfaces 30 a total distance D_T greater than the thickness T for spacing the rail 16 and the solar module 14 to limit squeeze-out of the adhesive 18 from between the rail 16 and the solar module 14 during assembly of the rail 16 and the solar module 14. Specifically, the total distance D_T is equal to the thickness T plus the distance D_1 between the rail 16 and the solar module 14. For example, in the embodiment of Figures 3-7, the total distance D_T is equal to the thickness T of the rail 16 plus the distance D_1 between the rail 16 and the solar module 14. In the embodiment of Figures 9-12, the total distance D_T is equal to the thickness T of the solar module 14 plus the distance D_1 between the solar module 14 and the rail 16.

[0035] The first support surface 26 typically extends in a plane P^1. The second support surfaces 30 of the risers 24 are typically spaced from each other in a common plane P_2. Typically the plane P_1 and common plane P2 are parallel with each other. As such, in the embodiment of Figures 3-7, the rail 16, which rests on the first support surface 26 in the plane P^1, and the solar module 14, which rest on the second support surfaces 30 in the common plane P2, are supported and adhered parallel to each other. In the embodiment of Figures 9-12, the solar module 14, which
rests on the first support surface 26 in the plane $P_1$, and the rail 16, which rests on the second support surfaces 30 in the common plane $P_2$, are supported and adhered in parallel to each other.

[0036] Guides 38 extend from the first support surface 26 for aligning the rail 16 on the first support surface 26. In other words, as best shown in Figure 5, pairs of guides 38 are spaced along the first support surface 26 for receiving the rail 16 therebetween. A space $S$ between each of one pair of guides 38 is approximately equal to a width of the rail 16 such that the rail 16 is firmly held between the pair of guides with limited play. The guides 38 can be adjustably connected with the first support surface 26 for selectively adjusting the space $S$. Specifically, the guides 38 can be moved between a locked position in which the guides 38 are affixed to the first support surface 26 and an unlocked position in which the guides 38 are movable relative to the first support surface 26. The guides 38 can, for example, be adjustably connected with the first support surface 26 with threaded fasteners (not shown).

[0037] The risers 24 can include an elongated member 25 and can include shims 27 removably engaged with the elongated member 25. The shims 27 are shown in Figures 4 and 7 for example. In the event the risers 24 include shims 27, the shims 27 present the second support surface 30 when engaged with the elongated member 25 for selectively adjusting the total distance $D_T$ between the first support surface 26 and the second support surface 30. Alternatively, as shown in Figures 3, 5, and 8, in the absence of shims 27, the elongated member 25 defines the second support surface 30.

[0038] The shims 27 can be threadedly engaged with the elongated members 25. As such, the height of the shims 27 relative to the elongated members 25 can be adjusted to vary the total distance $D_T$ between the first support surface 26 and the second support surface 30. For example, the height of the shims 27 relative to the elongated members 25 can be adjusted to accommodate different styles of rails 16 having different thicknesses $T$. As another example, the height of the shims 27 relative to the elongated members 25 can be adjusted to vary the distance $D_j$ along which the adhesive 18 extends between the rail 16 and the solar module 14. Alternatively or in addition, one set of shims 27 can be replaced with another set (not
shown) of shims 27 of varying thickness for adjusting the total distance $D_T$ and/or the distance $D_1$.

[0039] In a configuration where the solar module assembly 12 includes a plurality of solar modules 14, the fixture 10 can include gap spacers 29 extending from at least one of the support members 22 and the spacers 24 for spacing adjacent solar modules 14. The gap spacers 29 can be adjustable to adjust spacing between adjacent solar modules 14. The gap spacers 29 can also be removable, i.e., removably attached to the support members 22 and/or spacers 24 with threaded fasteners (not shown), so that gap spacers 29 of varying widths can be interchangeably mounted to the support members 22 and/or spacers 24 to adjust spacing between adjacent solar modules 14.

[0040] The fixture 10 can include alignment pegs 31 extending from at least one of the support members 22 and the risers 24 for aligning the solar modules 14 on the fixture 10. Specifically, the alignment pegs 31 abut a perimeter of the solar modules 14. The alignment pegs 31 are spaced from each other such that a solar module 14 fits between the alignment pegs 31 with a perimeter of the solar module 14 abutting the alignment pegs 31. The alignment pegs 31 can be adjustable to adjust to solar modules 14 having perimeters of varying size and shape. For example, the alignment pegs can be adjustably attached to the support members 22 and/or spacers 24 with threaded fasteners (not shown).

[0041] As set forth above, another embodiment is shown in Figures 9-12. The support member 22 is in the form of a frame. The support member 22 includes base members 42 and cross-members 44. The base members 42 typically define a perimeter of the support member 22 and typically define the perimeter to be rectangular in shape. The cross-members 44 extend between the base members 42. The base members 42 are typically recessed relative to the cross-members 44. For example, the cross-members 44 can be mounted to a top of the base members 42 as shown in Figure 8. The base members 42 and the cross-members 44 can be joined in any fashion.

[0042] In the embodiment shown in Figures 9-12, the cross-members 44 define the first support surface 26. As shown in Figures 9-11, the solar module 14
contacts the first support surface 26. The risers 24 extend from the cross-members 44 and typically extend from the first support surface 26.

[0043] The risers 24 present the second support surface 30 and the rail 16 contacts the second support surfaces 30 of the risers 24. In other words, during assembly of the solar module assembly 12 in Figures 9-12, the solar module 14 rests on the first support surface 26 of the cross-members 44 and the rail 16 rests on the second support surfaces 30 of the risers 24.

[0044] In embodiments including a plurality of solar modules 14, when the solar modules 14 are disposed on the first support surface 26, the risers 24 extend from the support members 22 between adjacent solar modules 14. The risers 24 space adjacent solar modules 14 from each other. Specifically, the risers 24 have a width $W_S$ and space adjacent solar modules 14 apart by the width $W_S$.

[0045] With continued reference to embodiments including a plurality of solar modules 14, the risers 24 are removable from the support members 22. In one embodiment, a kit (not shown) can include the support members 22 of Figures 9-12 and a plurality (not shown) of riser sets. Each set includes risers 24 of a common width $W_S$ and the width $W_S$ of the risers 24 varies between the riser sets. As such, the width $W_S$ between adjacent solar modules 14 can be adjusted by assembling the appropriate riser 24 set on the support members 22. The sets of risers 24 are typically identical with the exception of the varying width $W_S$ between each set.

[0046] The risers 24 are adjustable between an engaged position fixed in position relative to the support members 22, e.g., relative to the cross-members, and a disengaged position in which the risers 24 are adjustable relative to the support members 22, e.g., relative to the cross members, to accommodate for solar modules 14 of varying size. In other words, the risers 24 can be adjusted to the disengaged position and adjusted relative to the support members 22 such that the risers 24 are spaced apart to accommodate solar modules 14 of a selected size. When spaced appropriately, the risers 24 are adjusted to the engaged position before the fixture 10, 110 is used in assembly of a solar module assembly 12.

[0047] As one example, with reference to Figures 9 and 10, the risers 24 each include at least one arm 46 extending from the second support surface 30 with the arm 46 slideably engaged with the support members 22 when the riser 24 is in the
disengaged position. With continued reference to Figures 9 and 10, each riser 24 includes a base 48 that presents the second support surface 30. The risers 24, for example, typically include two arms extending from the base 48 to define a U-shape.

[0048] Each riser 24 includes at least one engagement member 50 that is adjustable between the engaged position and the disengaged position. The engagement member 50 is typically supported by the arm 46 of the riser 24. The engagement member 50, for example, can be a threaded fastener, e.g., a set screw, extending through and threadedly engaging the arm 46. In such an embodiment, the threaded fastener can be tightened relative to the cross-member 44 to engage the cross-member 44 in the engaged position and can be loosened relative to the cross-member 44 in the disengaged position.

[0049] With reference to Figure 12, each of the fixtures 110 includes a plurality of feet 52 and the feet 52 extend from the support members 22 for supporting the support members 22. The feet 52 are configured such that the feet 52 can rest on a surface, e.g., the ground, and such that a plurality of fixtures 110 can be arranged in a stack 54. The feet 52 are shown in the embodiment of Figures 9-12, however, the feet 52 can also be included in the embodiment of Figures 3-7.

[0050] Each foot 52 includes a housing 56 defining a cavity 57 and a projection 58 extending from the housing 56. The projections 58 and the cavities 57 have corresponding configurations such that the cavity 57 of any fixture 110 can receive the projection 56 of any other fixture 110. For example, each cavity 57 can have a size and/or shape corresponding to each projection 56 for receiving one projection 56 of an adjacent fixture 110 when multiple fixtures 110 are stacked in the stack 54.

[0051] Figure 12, for example, shows the cavities 57 of a first fixture 111 of the stack 54 receiving the projections 58 of a second fixture 113 of the stack 54. With continued reference to Figure 12, the projections 58 of the second fixture 113 extend from the cavities 57 of the first fixture 111 a set distance $D_S$ to space the second fixture 113 from the solar module assembly 12 on the first fixture 111. The set distance $D_S$ is greater than a total thickness $T_T$ from the bottom surface of the fixture 110 to a top of the rail 16 such that the solar module 14 assemblies in the stack 54 are spaced from each other.
A method of assembling the solar module assembly 12 with the fixture 10, 110 is also shown in the Figures. One embodiment of the method includes use of the fixture 10 of Figures 3-7 and another embodiment of the method includes use of the fixture 110 of Figures 9-12. With reference to the embodiment of Figures 3-7, the method includes placing one fixture 10 on an assembly table 70, as shown in Figure 4 and subsequently inserting the rail 16 into the fixture 10. Specifically, the method includes inserting the rail 16 onto the first support surface 26 of the fixture 10.

With continued reference to the embodiment of Figures 3-7, the method typically includes applying the adhesive 18 to the rail 16 prior to inserting the rail 16 into the first support surface 26. The adhesive 18 can be applied, for example, with an automated applicator 60, as shown in Figures 1 and 2. In such a scenario, the rail 16 is placed in predetermined location in the automated applicator 60 and the automated applicator 60 automatically applies adhesive 18 to the rail 16. The rail 16 is then removed from the automated applicator 60 and inserted into the fixture 10.

The method includes contacting the solar module 14 with the second support surface 30 of the fixture 10 while the adhesive 18 is in the uncured state. When contacted with the second support surfaces 30, the solar module 14 contacts the uncured adhesive 18 on the rail 16.

The step of contacting the solar module 14 with the second support surface 30 is typically achieved by lowering the solar module 14 onto the second support surface 30 manually, i.e., by hand, or automatically with the use of machinery. Alternatively, the method includes staging the solar module 14 relative to the fixture 10. i.e., aligning the solar module 14 in the proper location relative to the fixture 10, with the use of a conveyor table 62, as shown in Figures 13 and 14. The conveyor table 62 shown in Figures 13 and 14 is shown with the fixture 110 of Figures 9-12, however, the conveyor table 62 shown in Figures 13 and 14 can alternatively be used with the fixture 10 of Figures 3-7.

The conveyor table 62 is typically disposed at an end of a loading line 64 that supplies solar module 14 to the conveyor table 62. The loading line 64 is typically a conveyor belt. The conveyor table 62 includes at least one beam 66 that supports a plurality of rollers 68. The loading line 64 loads the solar module 14 on the rollers 68 and the solar module 14 is moved along the rollers 68 to stage the solar module 14 above the fixture 10. The solar module 14 can be manually staged relative
to the fixture 10, i.e., by hand, or can be automatically staged relative to the fixture 10 with the use of machinery. In embodiments including a plurality of solar modules 14, blocks (not shown) can also be disposed between adjacent solar modules 14 to properly space the solar modules 14 relative to each other.

[0057] With continued reference to the method associated with the fixture 10 of Figures 3-7, after the step of staging the solar module 14, the method includes raising the fixture 10 to contact the second support surfaces 30 of the risers 24 with the solar module 14. As the fixture 10 is raised, the solar module 14 contact the adhesive 18 on the rail 16. The fixture 10 can be manually raised by hand or can be automatically raised with the use of machinery.

[0058] With continued reference to Figures 3-7, the method includes stacking the fixture 10 on the stack 54 of fixtures, as shown in Figures 1 and 2. The adhesive 18 cures from the uncured state to the cured state, i.e., at least a partially cured state with the adhesive 18 solidified relative to the uncured state, while the solar module assembly 12 is on the fixture 10. The stack 54 of fixtures can be moved to an assembly position at the solar module installation site, with reference to Figure 1, or moved to a mode of transportation to the solar module installation site, with reference to Figure 2.

[0059] With reference now to the method associated with the fixture 110 of Figures 9-12, the method includes placing the solar module 14 on the fixture 110, as shown in Figure 9. Specifically, the method includes placing the solar module 14 in contact with the first support surface 26 of the fixture 110. The solar module 14 can be manually placed in contact with the first support surface 26, i.e., by hand, or can be automatically placed in contact with the first support surface 26 with the use of machinery. Alternatively, the method includes staging the solar module 14 relative to the fixture 110, i.e., to align the solar module 14 in the proper location relative to the fixture 110, with the use of the conveyor table 62, as shown in Figures 13 and 14. When staged with the conveyor table 62, the solar module 14 can be manually staged relative to the fixture 110, i.e., by hand, or can be automatically located relative to the fixture 110 with the use of machinery. In embodiments including a plurality of solar modules 14, blocks (not shown) can also be disposed between adjacent solar modules 14 to properly space the solar modules 14 relative to each other.
[0060] With continued reference to the method associated with the fixture 110 of Figures 9-12, after the step of staging the solar module 14, the method includes raising the fixture 110 to contact the first support surface 26s of the support members 22 with the solar module 14. The fixture 110 can be manually raised, i.e., by hand or can be automatically raised with the use of machinery.

[0061] In embodiments including a plurality of solar modules 14, the method includes inserting the risers 24 between adjacent solar modules 14 as the fixture 110 is raised. In other words, as the fixture 110 is raised, the risers 24 are extended upwardly between the solar modules 14 to present the second support surfaces 30 above the solar modules 14.

[0062] With continued reference to the embodiment of Figures 9-12, the method includes applying adhesive 18 to one of the rail 16 or the solar module 14. Typically, the adhesive 18 is applied to the solar module 14 after the solar module 14 is staged relative to the fixture 110 but alternatively the adhesive 18 can be applied to the solar module 14 before the solar module 14 is staged.

[0063] Alternatively, the adhesive 18 is applied to the rail 16. In such a scenario, the adhesive 18 can be applied, for example, with the automated applicator 60, as shown in Figures 1 and 2 and as set forth above.

[0064] With continued reference to the embodiment of Figures 9-12, the method includes contacting the rail 16 with the second support surface 30 of the fixture 110 while the adhesive 18 is in the uncured state. When contacted with the second support surfaces 30, the solar module 14 contacts the uncured adhesive 18 on the rail 16.

[0065] With continued reference to Figures 9-12, the method includes stacking the fixture 110 on the stack 54 of fixtures, as shown in Figure 12. The adhesive 18 cures from the uncured state to the cured state, i.e., at least a partially cured state with the adhesive 18 solidified relative to the uncured state, while the solar module assembly 12 is on the fixture 110. The stack 54 of fixtures can be moved to an assembly position at the solar module installation site, with reference to Figure 1, or moved to a mode of transportation to the solar module installation site, with reference to Figure 2.

[0066] The invention has been described in an illustrative manner, and it is to be understood that the terminology which has been used is intended to be in the nature
of words of description rather than of limitation. Many modifications and variations of the present invention are possible in light of the above teachings, and the invention may be practiced otherwise than as specifically described.
CLAIMS

What is claimed is:

1. A fixture for assembling a solar module assembly that includes at least one solar module, a rail, and adhesive disposed between and adhesively connecting said rail and said solar module, said fixture comprising:
   - support members for supporting one of said rail or said solar module; and
   - risers supported on said support members for supporting the other of said rail or said solar module;
   - said support members each presenting a first support surface contacting said one of said rail or said solar module;
   - said risers each extending from said support members and presenting a second support surface spaced from said first support surface and contacting the other of said rail or said solar module;
   - said one of said rail or said solar module defining a thickness between said first support surface and said second support surfaces; said first support surface being spaced from said second support surfaces a distance greater than said thickness for spacing said rail and said solar module to limit deformation of said adhesive between said rail and said solar module during assembly of said rail and said solar module.

2. The fixture as set forth in claim 1 wherein said second support surfaces are spaced from each other in a common plane.

3. The fixture as set forth in claim 1 further comprising a plurality of feet extending from said support members for supporting said support members.

4. The fixture as set forth in claim 1 wherein said at least one solar module is further defined as a plurality of solar modules and wherein said fixture further comprises gap spacers extending from at least one of said support members and said risers for spacing adjacent solar modules.

5. The fixture as set forth in claim 4 wherein said risers include an elongated member and shims removable engaged with said elongated member, said shims presenting said second support surface when engaged with said elongated member for selectively adjusting said distance between said first support surface and said second support surface.
6. The fixture as set forth in claim 2 wherein said feet each include a housing defining a cavity and a projection extending from said housing, said cavity having a shape corresponding to said projection for receiving a projection of an adjacent fixture when multiple fixtures are stacked.

7. A stack including a plurality of fixtures according to claim 1, each of said fixtures including a plurality of feet each including a housing defining a cavity and a projection extending from said housing, said projections and said cavities having corresponding configurations such that said cavities of a first fixture of said stack receive said projections of a second fixture of said stack.

8. The stack as set forth in claim 6 wherein said projections of said second fixture extend from said cavities of said first fixture a predetermined distance to space said second fixture from said solar module assembly on said first fixture.

9. The fixture as set forth in claim 1 wherein said risers extend from said first support surface.

10. The fixture as set forth in claim 1 wherein said risers are adjustable between an engaged position fixed in position relative to said support members and a disengaged position in which said risers are adjustable relative to said support members to accommodate for solar modules of varying size.

11. The fixture as set forth in claim 10 wherein said risers each include at least one arm extending from said first support surface with said arm slideably engaged with said support members when said riser is in said disengaged position.

12. The fixture as set forth in claim 1 wherein said rail contacts said first support surface and further comprising guides extending from said first support surface for aligning said rail on said first support surface.

13. A fixture for assembling a solar module assembly that includes at least one solar module, a rail, and adhesive disposed between and adhesively connecting said rail and said solar module, said fixture comprising:

   - support members presenting a first support surface with said solar module resting on and contacting said first support surface;
   - risers presenting a second support surface spaced from said first support surface with said rail resting on and contacting said second support surface, said solar module disposed between said first and second support surfaces;
said solar module defining a thickness between said first support surface
and said second support surfaces, said first support surface being spaced from said
second support surfaces a distance greater than said thickness for spacing said rail and
said solar module to limit deformation of said adhesive from between said rail and
said solar module during assembly of said rail and said solar module.

14. The fixture as set forth in claim 13 wherein said risers extend from said
first support surface and are adjustable between an engaged position fixed in position
relative to said support members and a disengaged position in which said risers are
adjustable relative to said support members to accommodate for solar modules of
varying size, said risers each including at least one arm extending from said first
support surface with said arm slideably engaged with said support members when said
riser is in said disengaged position.

15. A stack including a plurality of fixtures according to claim 13, each of said
fixtures including a plurality of feet each including a housing defining a cavity and a
projection extending from said housing, said projections and said cavities having
Corresponding configurations such that said cavities of a first fixture of said stack
receive said projections of a second fixture of said stack, said projections of said
second fixture extending from said cavities of said first fixture a predetermined
distance to space said second fixture from said solar module assembly on said first
fixture.
**A. CLASSIFICATION OF SUBJECT MATTER**

INV. F24J2/52

**ADD.**

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

F24J H01L B29C B29C F16B B23K B23Q

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

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<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
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<td>X</td>
<td>US 2012/097207 AI (SHUFFLEBOTHAM PAUL [US] ET AL) 26 April 2012 (2012-04-26) paragraphs [0023] - [0030], [0034] - [0037], [0042] - [0044]; figures</td>
<td>1,2,4,5,9,12,13</td>
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<td>paragraphs [0008] - [0013]; figures</td>
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<td>EP 1 813 738 AI (KYOCERA CORP [JP]) 1 August 2007 (2007-08-01) paragraphs [0046] - [0054], [0065], [0086]; figures</td>
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**X** Further documents are listed in the continuation of Box C. **X** See patent family annex.

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Date of the actual completion of the international search: 11 November 2013

Date of mailing of the international search report: 20/11/2013

Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016

Authorized officer: Ol iv eir a, Casimiro

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<td>US 5 276 957 A (MURPHY JOHN F et al) 11 January 1994 (1994-01-11) column 1, line 56 - column 3, line 25; claims 1-10; figures</td>
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