US 20100206303A1

(19) **United States**
(12) **Patent Application Publication**
Thorne
(10) **Pub. No.: US 2010/0206303 A1**
(43) **Pub. Date: Aug. 19, 2010**

(54) **SOLAR CONCENTRATOR TRUSS ASSEMBLIES**

(75) Inventor: **Steve Thorne**, Berkeley, CA (US)

Correspondence Address:
TOWNSEND AND TOWNSEND AND CREW, LLP
TWO EMBARCADERO CENTER, EIGHTH FLOOR
SAN FRANCISCO, CA 94111-3834 (US)

(73) Assignee: **John Danhakl**, Pacific Palisades, CA (US)

(21) Appl. No.: **12/389,286**

(22) Filed: **Feb. 19, 2009**

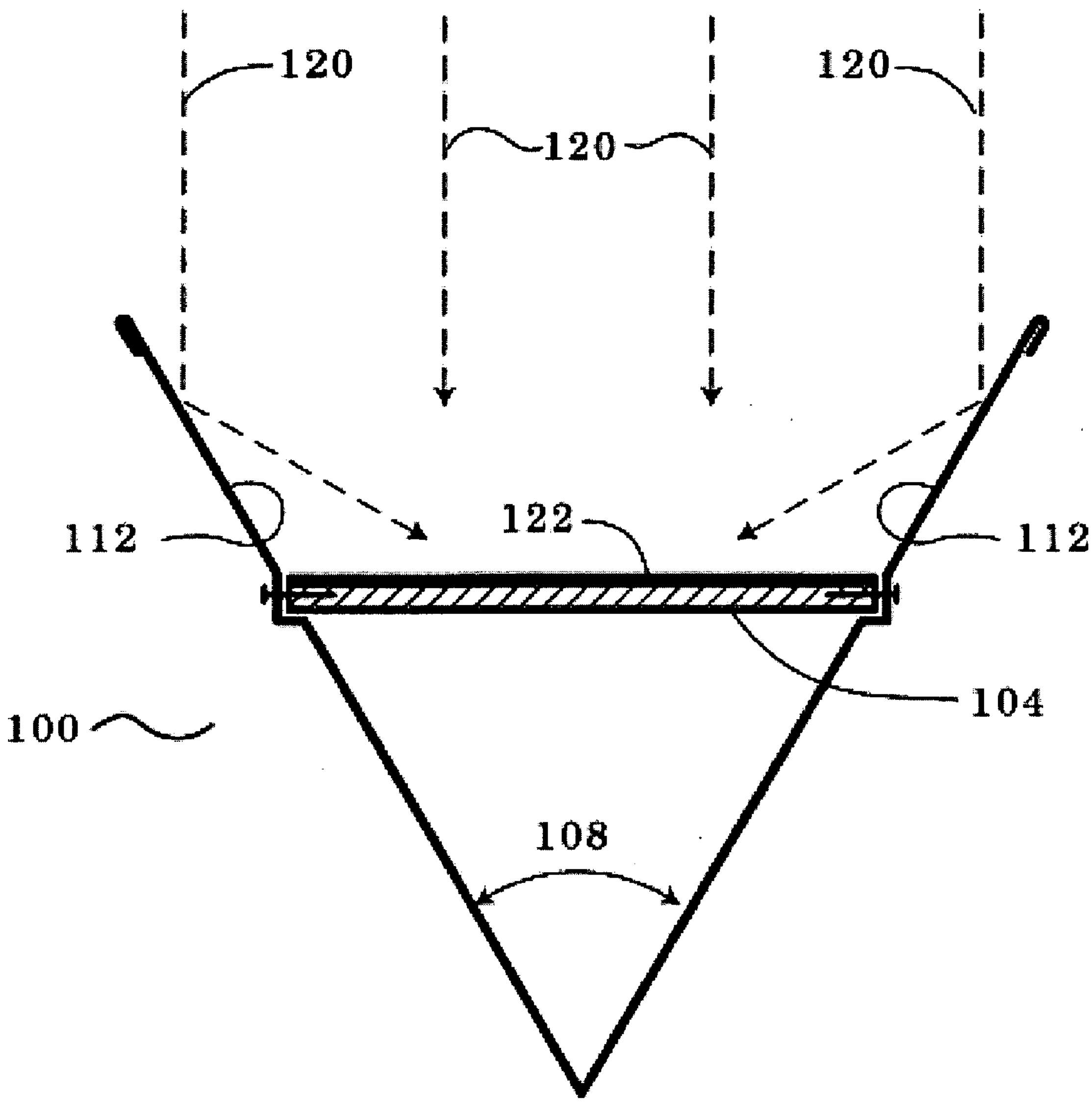
Publication Classification

(51) **Int. Cl.**
F24J 2/10 (2006.01)

(52) **U.S. Cl.** **126/696**

(57) **ABSTRACT**

Solar concentrator truss assemblies and arrays of solar concentrator truss assemblies are disclosed. The solar concentrator truss assembly has a V-shaped frame joined with a solar panel to form a triangulated truss. The solar concentrator truss assembly is lightweight and strong, and does not require extensive additional structural support for installation. The array of solar concentrator truss assemblies is motion controlled by a computer to move the array into preferable positions with regards to sunlight.



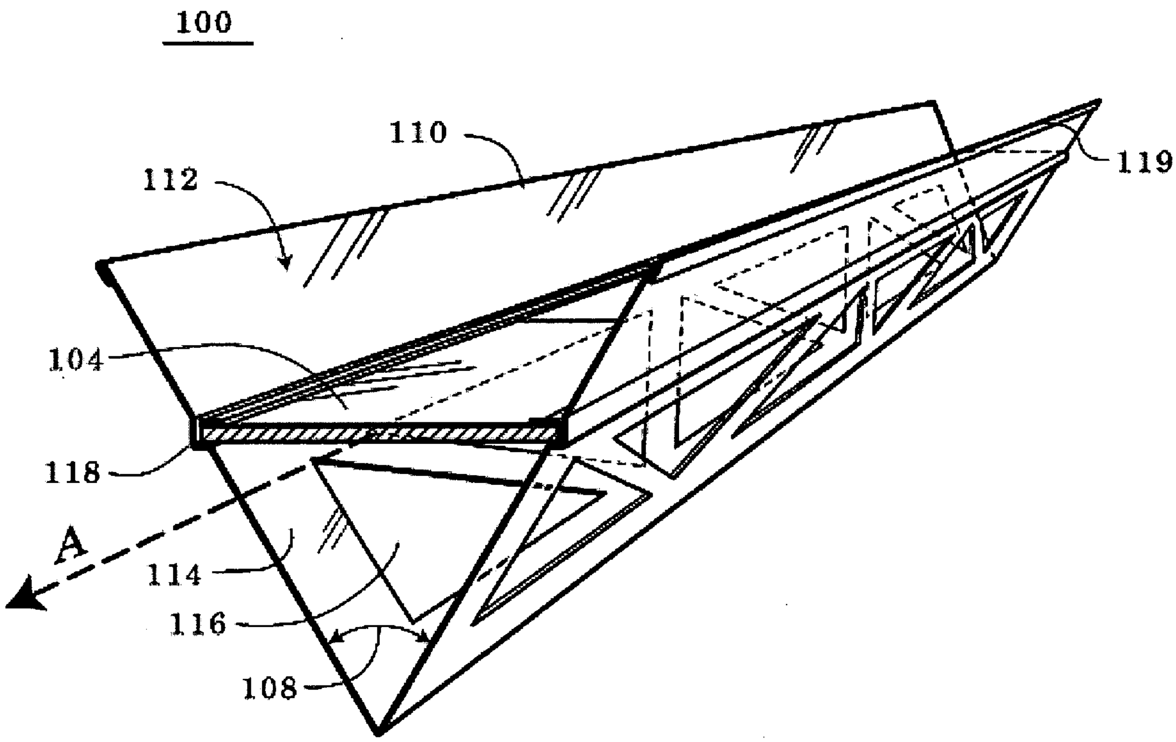


FIG. 1A

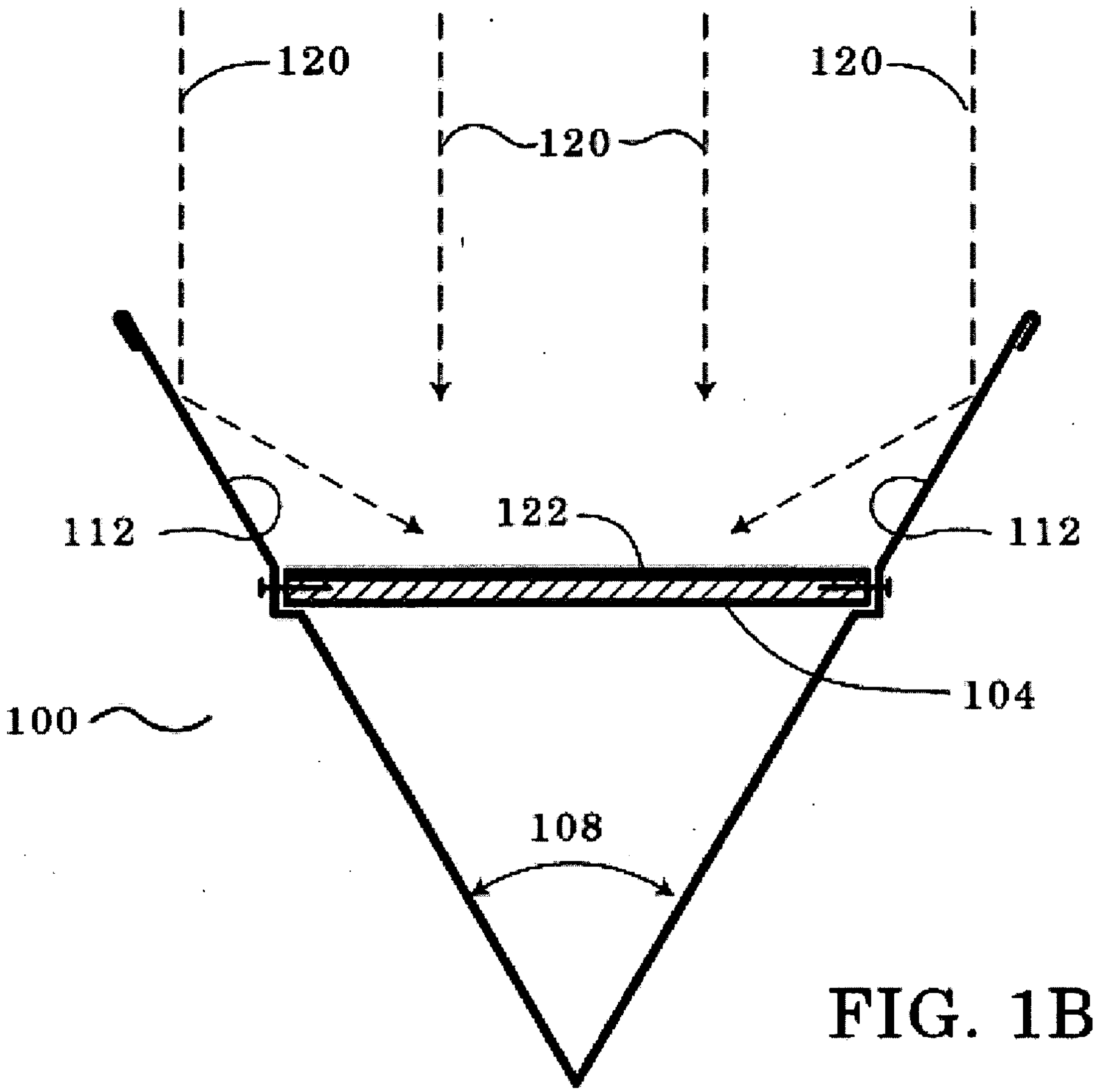


FIG. 1B

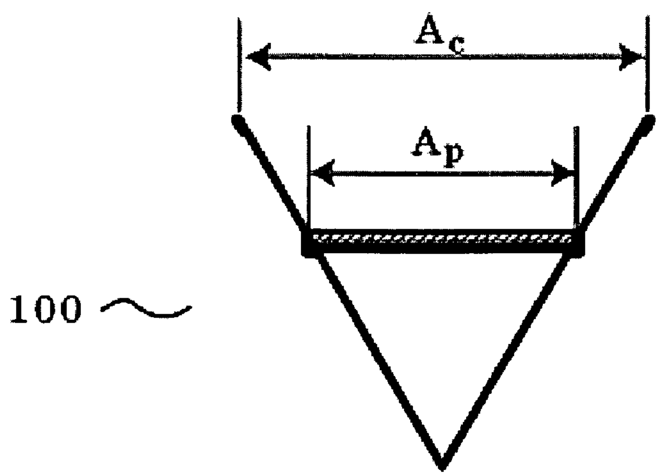


FIG. 1C

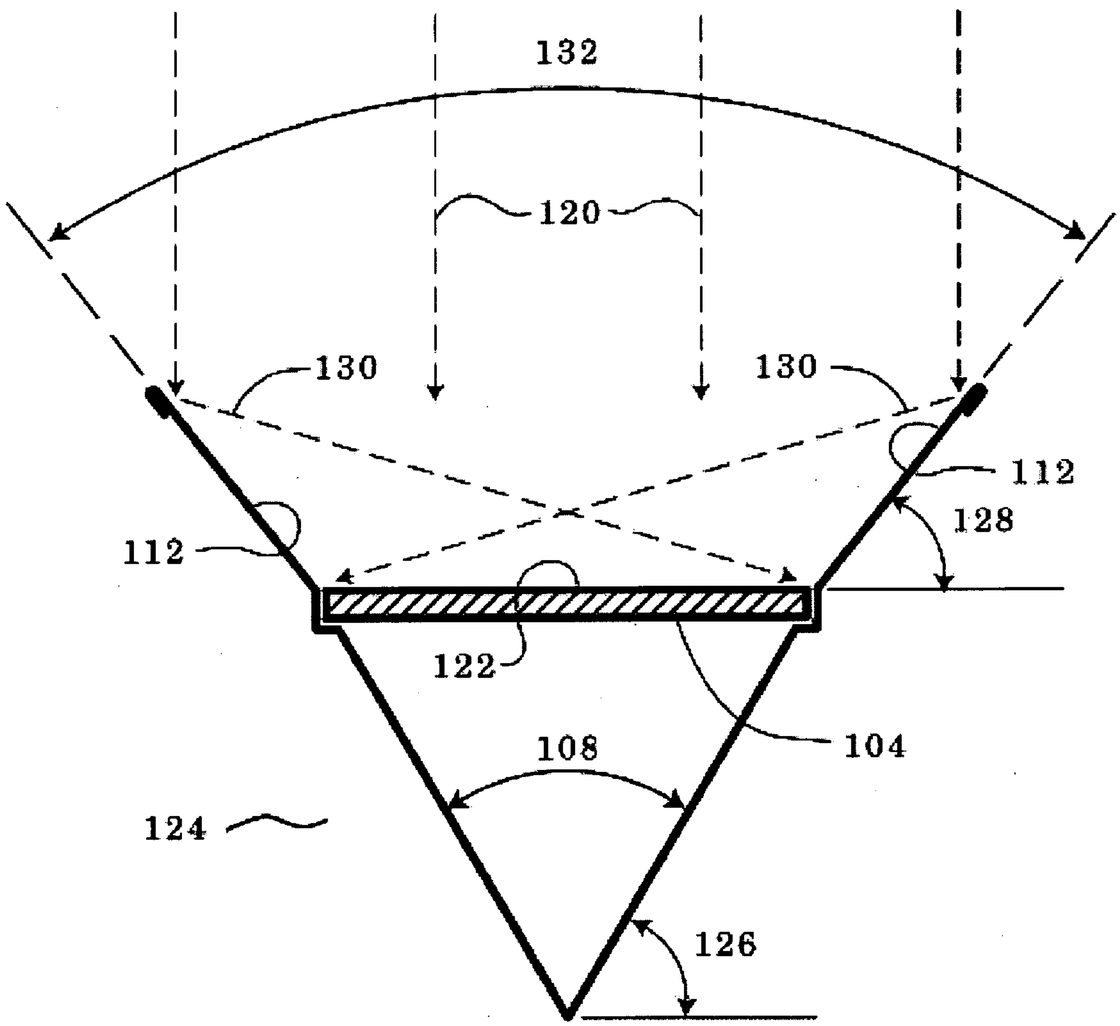


FIG. 1D

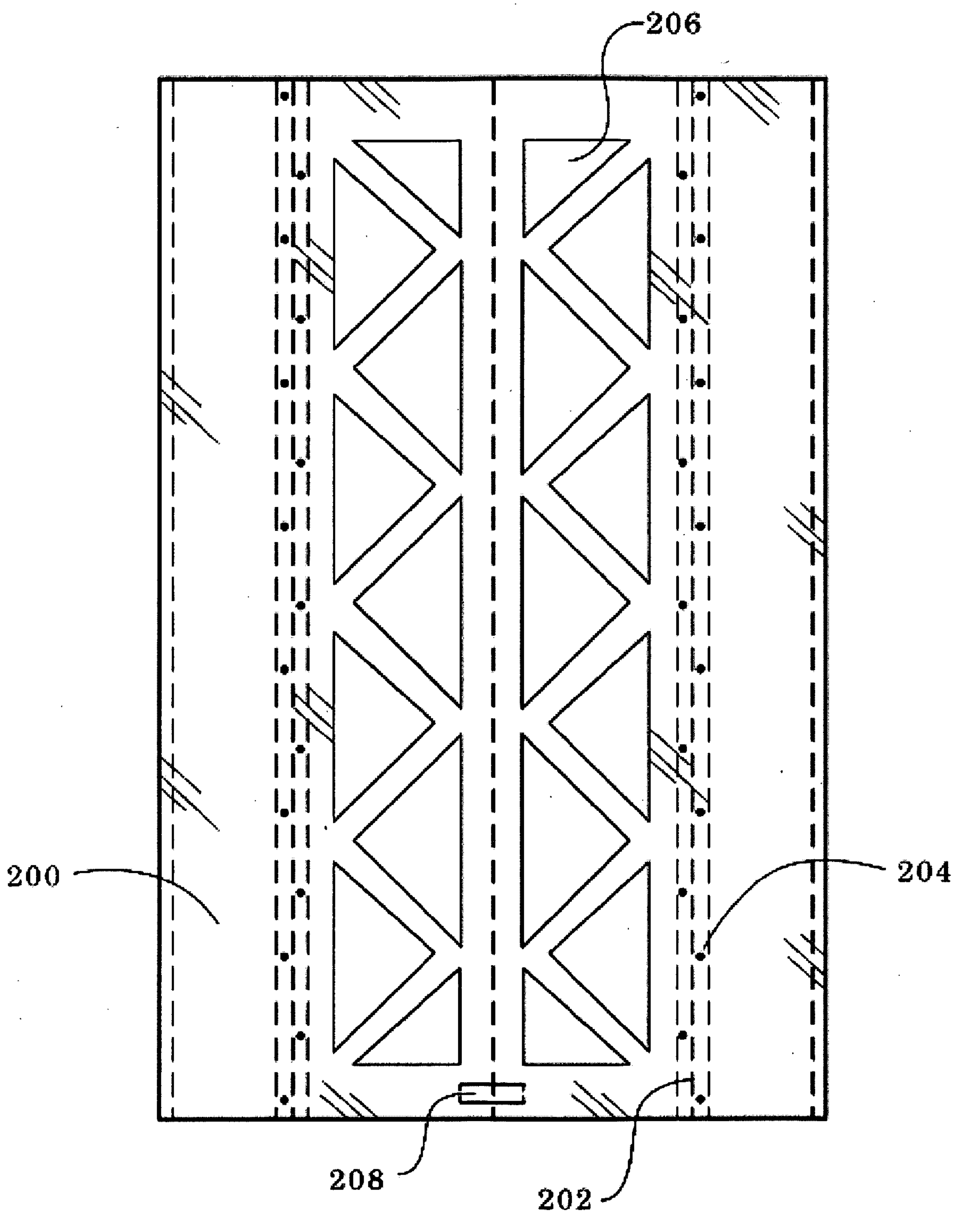


FIG. 2A

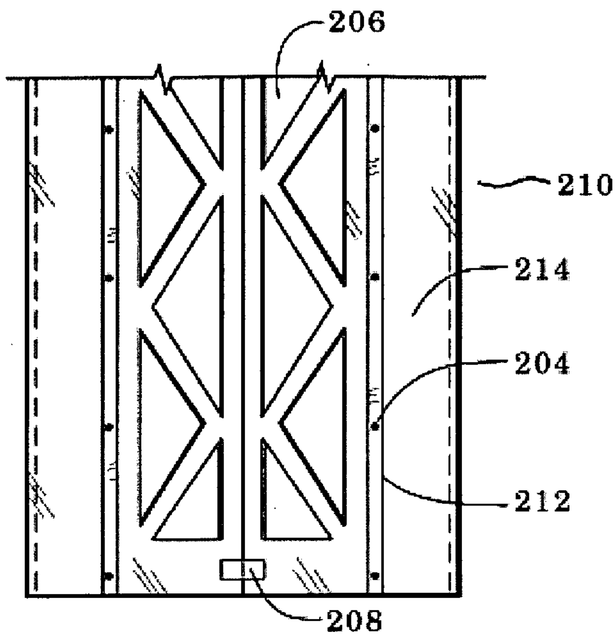


FIG. 2B

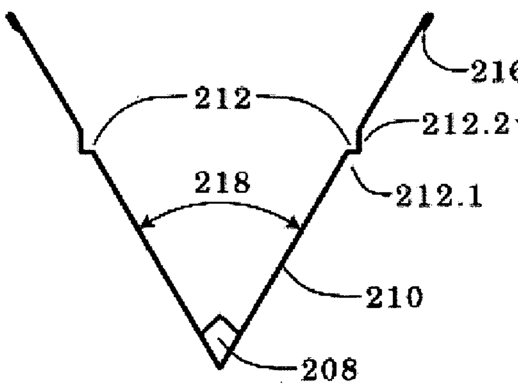


FIG. 2C

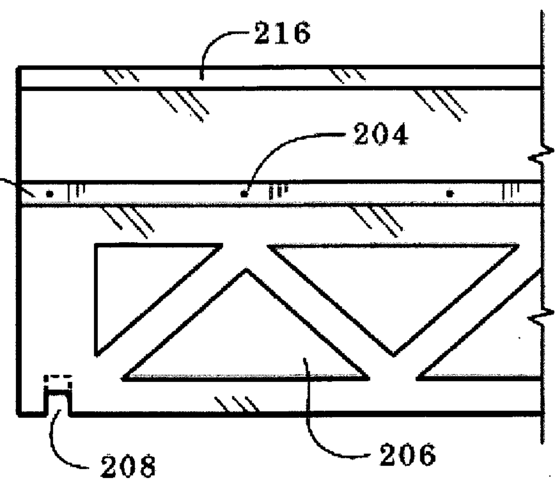


FIG. 2D

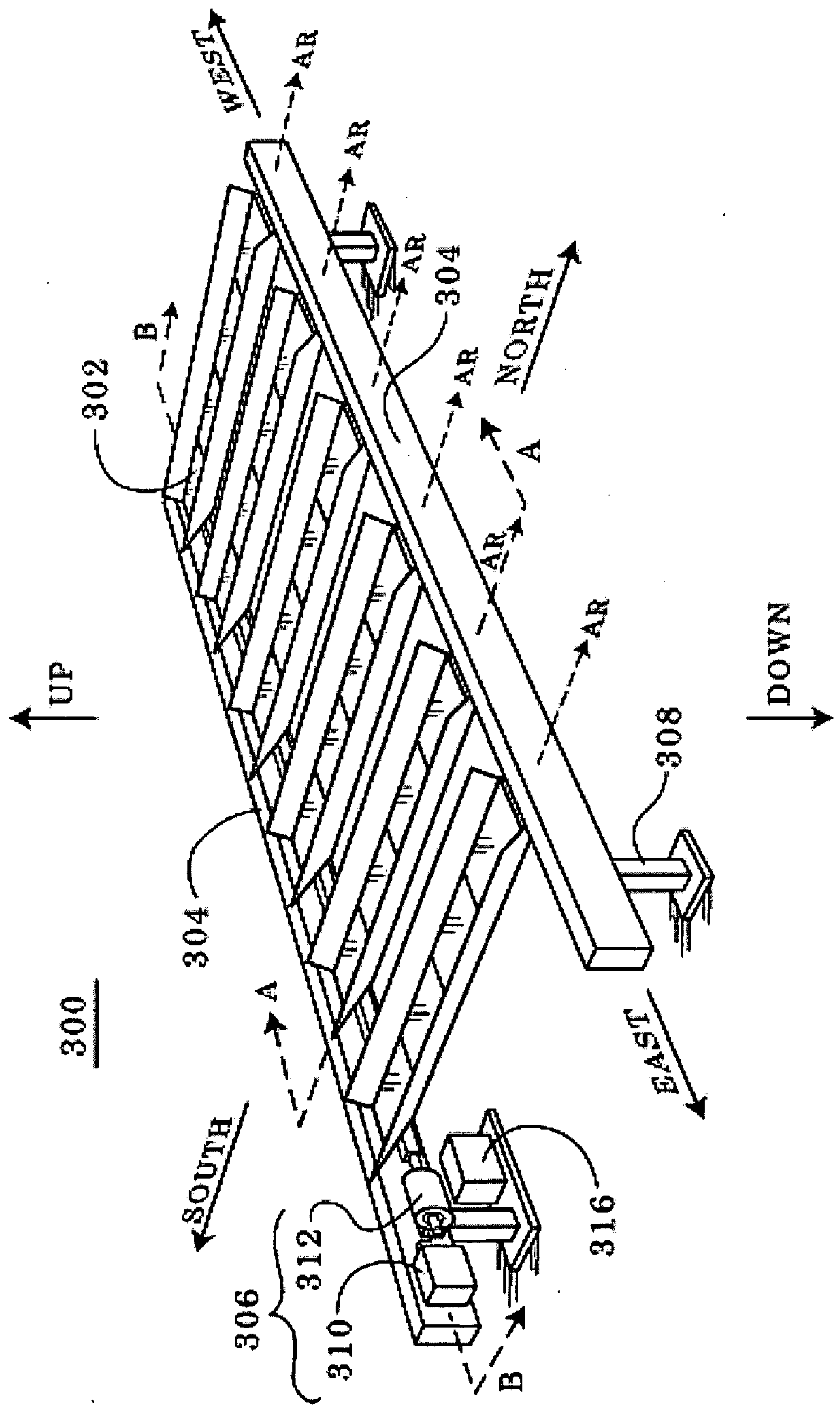

WEST
AR
NORTH
EAST
SOUTH
UP
DOWN
A
B
300
302
304
306
308
310
312
316

FIG. 3A

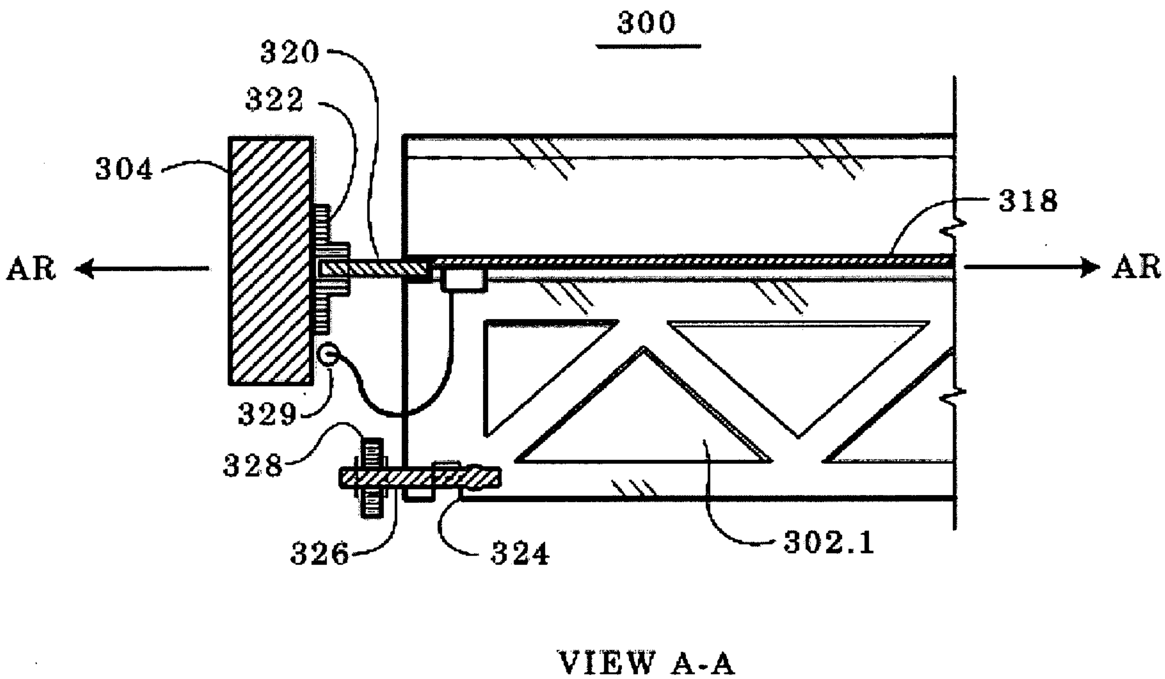
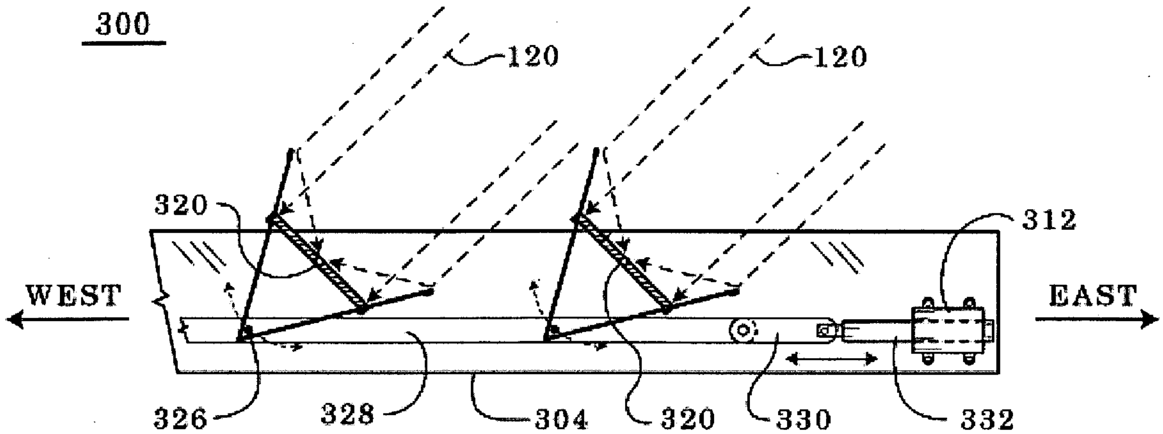
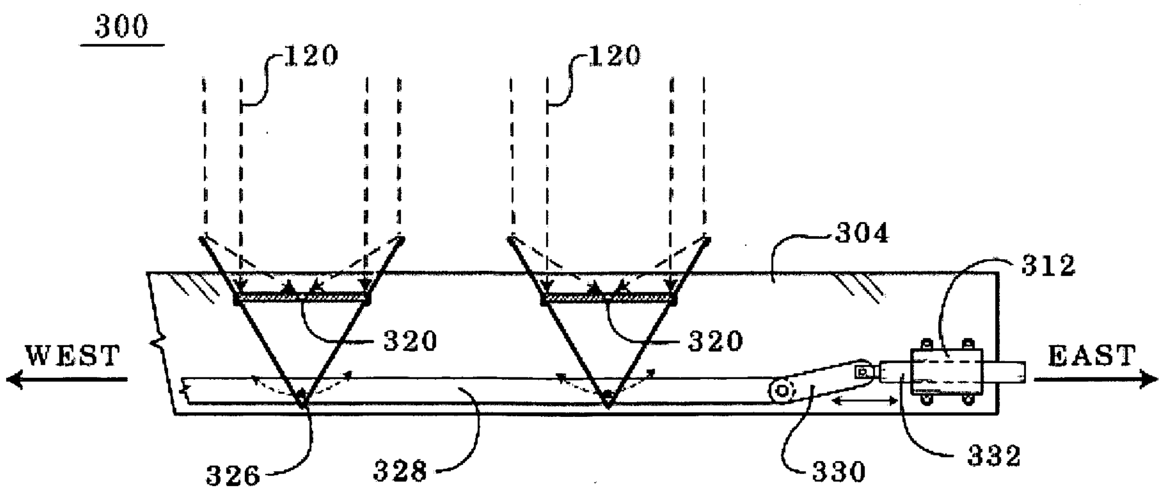


FIG. 3B



VIEW B-B

FIG. 3C



VIEW B-B

FIG. 3D

SOLAR CONCENTRATOR TRUSS ASSEMBLIES

BACKGROUND OF THE INVENTION

[0001] The present invention generally relates to devices and systems for moveable solar panels. More particularly, the invention relates to solar concentrator truss assemblies and arrays of computer controlled solar concentrator truss assemblies.

[0002] A solar panel, such as a photovoltaic panel, apart from lesser reflections, can only make use of direct light energy which is incident to the surface of the solar panel. Thus, the amount of light energy to be converted by the solar panel is limited to the surface area of the solar panel. Solar concentrators, or Concentrating Solar Photovoltaics (CPV), may be used to further increase the amount of light energy received by a solar panel. A solar concentrator is commonly a highly reflective surface, such as a mirror, which is positioned to reflect light outside the area of the solar panel to the surface of the solar panel. Thus, by using a solar concentrator a solar panel can capture additional focused light energy which would otherwise be unavailable. To take further advantage of direct light energy, a solar panel and solar concentrator may be moveable, and positioned such that the solar panel is normal, i.e., perpendicular, to incoming light beams. However, solar panels will typically capture over 96% of light incident within 15 degrees of normal, thus, even a slight movement of a solar panel may be of great use. Solar concentrator systems are technologically divided by low, medium, and high concentration ratios. Low concentration solar concentrator systems have a solar concentration value in the range of 2-10 suns. For economic reasons, conventional silicon solar cells are typically used, and, at these concentrations, the heat flux is low enough that the cells do not need to be actively cooled. A system with a low concentration ratio can have a high acceptance angle and thus does not require active solar tracking. Medium concentration solar concentrator systems, with concentrations of 10 to 100 suns, require solar tracking and cooling, which makes them more complex. High concentration solar concentrator systems employ concentrating optics consisting of dish reflectors or Fresnel lenses that concentrate sunlight to intensities of 200 suns or more, which require high-capacity heat sinks to prevent thermal destruction and to manage temperature related performance losses.

[0003] Solar energy is an increasing popular form of energy use, as light energy is freely obtained, and also produces no pollutants. Many governments are also mandating laws which require the reduction of pollution causing energy plants, further making solar energy a viable option. However, costs of computer controlled moveable solar panel systems can make implementation unviable. Most solar panel systems are added to roofs of existing buildings, which were not designed to support continuous loads other than the weight of roofing material. Moveable solar panel systems are often complex, and heavy, and thus require reinforcement of the building structure for additional framing. Additionally, solar concentrators are often not integral to existing solar panels, thus, adding more installation and fabrication costs, weight, and complexity. Accordingly, many people are dissuaded from installing solar panel systems because the initial costs of installation are higher than potential energy savings.

[0004] Therefore, a need remains for moveable solar panel assemblies which incorporate solar concentrators, that do not suffer from the above-described shortcomings.

BRIEF SUMMARY OF THE INVENTION

[0005] The present invention relates to solar concentrator truss assemblies and solar concentrator arrays. In one embodiment a solar concentrator truss assembly has a generally V-shaped frame including an inner surface. The inner surface has a first and second concentrating portions. The inner surface has an unexposed portion located between the first and second concentrating portions. The solar concentrator truss assembly also has a solar panel having a sun-facing surface and a bottom surface. The solar panel is supported by the inner surface. The solar panel bridges the inner surface to form a truss with the generally V-shaped frame, such that the sun-facing surface and the first and second reflective portions are exposed to each other, and the bottom surface is exposed to the unexposed portion.

[0006] In one aspect, the first and second concentrating portions are separated by an angle ranging from 60 to 90 degrees.

[0007] In another aspect, the first and second concentrating portions have reflective adhesive films.

[0008] In yet another aspect, the generally V-shaped frame is constructed from a single piece of sheet metal.

[0009] In yet another aspect, the inner surface has shoulders to support the solar panel.

[0010] In yet another aspect, the solar panel is a stress bearing member.

[0011] In yet another aspect, the generally V-shaped frame additionally has at least one ventilation passage positioned below the bottom surface of the solar panel.

[0012] In yet another aspect, the solar panel additionally has an elongated axle extending past the generally V-shaped frame.

[0013] In yet another aspect, the generally V-shaped frame has a dowel socket located about the unexposed portion.

[0014] In another embodiment a solar concentrator array has a frame, including at least one elongated beam. The solar concentrator array also has a plurality solar concentrator truss assemblies. Each solar concentrator assembly has a generally V-shaped frame having an inner surface. The inner surface has first and second concentrating portions. The inner surface has an unexposed portion located between the first and second concentrating portions. The generally V-shaped frame has a socket. The solar panel has a sun-facing surface and a bottom surface. The solar panel bridges the inner surface to form a truss with the generally V-shaped frame, such that the sun-facing surface and the first and second reflective portions are exposed to each other. The solar panel has an elongated axle extending past the generally V-shaped frame. The axle is rotatably coupled to the at least one elongated beam. The solar concentrator array also includes a motion apparatus having a plurality of dowels. Each respective dowel is moveably coupled to a respective socket of a respective V-shaped frame for moving each respective solar concentrator assembly around a respective axle.

[0015] In one aspect, the frame additionally has a second elongated beam parallel to the at least one elongated beam. The axle of each respective solar concentrator assembly is additionally rotatably coupled to the second elongated beam.

[0016] In another aspect, each generally V-shaped frame is constructed from a single piece of sheet metal.

[0017] In yet another aspect, the first and second concentrating portions are separated by an angle ranging from 60 to 90 degrees.

[0018] In yet another aspect, the motion apparatus additionally has an elongated connecting rod coupled to a linkage, and a motor moveably coupled to the linkage.

[0019] In yet another aspect, the motion apparatus additionally has a motor moveably coupled to the plurality of dowels, and a computer assembly operationally coupled to the motor. The computer assembly is configured to store and execute instructions for controlling the movement of the motor.

[0020] In yet another aspect, the motion apparatus additionally has a directional light meter operationally coupled to the computer assembly. The directional light meter supplies a signal to the computer assembly. The signal is used to execute instructions for controlling the movement of the motor.

[0021] In yet another aspect, the computer assembly has stored data. The stored data is used to execute instructions for controlling the movement of the motor.

[0022] In yet another aspect, the stored data includes the location of the solar collector array, time, and date.

[0023] In yet another aspect, the solar concentrator array additionally has at least one inverter operationally coupled to the plurality of solar concentrator assemblies.

[0024] In yet another embodiment, a solar concentrator truss assembly includes a generally V-shaped frame formed from a single piece of sheet metal. The generally V-shaped frame has a first planar member and a second planar member separated by a 60 degree angle. The first planar member has a first inner surface, the first inner surface including a first unexposed portion and a first concentrating portion. The first planar member also has a first indented shoulder between the first unexposed portion and a first concentrating portion. The second planar member has a second inner surface. The second inner surface has a second unexposed portion and a second concentrating portion. The second planar member also has a second indented shoulder between the second unexposed portion and a second concentrating portion. The first and second inner surfaces are exposed to each other. The solar concentrator truss assembly also has a photovoltaic panel including a sun-facing surface, a bottom surface, a first photovoltaic end, a second photovoltaic end, and an elongated axle extending past the generally V-shaped frame. The first photovoltaic end is connected with the first indented shoulder. The second photovoltaic end is connected with the second indented shoulder. The sun-facing surface is exposed to the first and second reflective portions. The bottom surface is exposed to the first and second unexposed portions. The first and second concentrating portions each have reflective adhesive film disposed on them. The photovoltaic panel is a stress bearing member.

[0025] For a further understanding of the nature and advantages of the invention, reference should be made to the following description taken in conjunction with the accompanying figures. It is to be expressly understood, however, that each of the figures is provided for the purpose of illustration and description only and is not intended as a definition of the limits of the embodiments of the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0026] FIG. **1**A is a frontal perspective view of a solar concentrator truss assembly in accordance with one embodiment of the present invention.

[0027] FIGS. **1**B and **1**C are front views of the solar concentrator truss assembly in use, in accordance with one embodiment of the present invention.

[0028] FIG. **1**D is a front view of a solar concentrator truss assembly in accordance with one embodiment of the present invention.

[0029] FIG. **2**A is a top view of a flat metal sheet for forming a V-shaped frame in accordance with one embodiment of the present invention.

[0030] FIGS. **2**B, **2**C, and **2**D are partial-top, front, and partial-side views, respectively, of a formed V-shaped frame in accordance with one embodiment of the present invention.

[0031] FIG. **3**A is a perspective view of a solar concentrator array in accordance with one embodiment of the present invention.

[0032] FIG. **3**B is a partial cross-sectional view of the solar concentrator array of FIG. **3**A.

[0033] FIGS. **3**C and **3**D are partial cross-sectional views of a portion of the solar concentrator array of FIG. **3**A.

DETAILED DESCRIPTION OF THE INVENTION

[0034] The present invention relates to adjustable solar concentrator truss assemblies. The solar concentrator truss assembly includes a photovoltaic panel which can be preferably orientated to face towards the sun. The solar concentrator truss assembly utilizes a photovoltaic panel as a stressed member of the truss to form a light weight and low cost assembly. The light weight of the solar concentrator truss assembly enables mounting to a simple frame or directly to a parapet of a building. The solar concentrator truss assembly can include an axle for pivoting the solar concentrator truss assembly about an axis. A plurality of solar concentrator truss assemblies can be used in an array, with each solar concentrator truss assembly being moved in unison by a computer controlled motion mechanism. The details of the exemplary embodiments of the present invention are explained with reference to FIGS. **1**A-**3**C.

[0035] Solar Concentrator Truss Assembly:

[0036] FIG. **1**A shows a front perspective view of a solar concentrator truss assembly **100**. The solar concentrator truss assembly **100** includes a generally V-shaped frame **102** and a solar panel **104**. The V-shaped frame **102** and solar panel **104** form a structural truss configured as a triangular truss, thus, the solar panel **104** is a structural and stress bearing member of the truss. The truss configuration provides strength for long spans of the solar concentrator truss assembly **100** over an axis A. For some lengths, the solar concentrator truss assembly **100** can be strong enough to support its own cantilevered weight, as well as withstand compressive and buckling forces experienced from environmental forces. For example, the solar concentrator truss assembly **100** can be mounted only on one end to cantilever in free air. For some lengths, the solar concentrator truss assembly **100** can be strong enough to span long distances without buckling under its own weight. For example, the solar concentrator truss assembly **100** can be mounted only on both ends, thus, the truss requires no middle support, such as shown in FIG. **3**A as discussed below.

[0037] As disclosed herein, the solar panel **104** may include any energy transforming device which transforms light energy into a different form of energy, for example electrical energy or thermal energy. The solar panel **104** includes a panel frame capable of withstanding torsion, compression, and tension forces subjected from environmental conditions. In one example, the solar panel may be constructed as a conventional array of photovoltaic modules, and may additionally include an internal DC to AC inverter (not shown). The photovoltaic modules may be crystalline silicon modules, flexible thin film modules, rigid thin film modules, multijunction modules, or a combination thereof. The photovoltaic modules may also incorporate plastic luminescent solar concentrators or laminated glass luminescent solar concentrators for added efficiency. In some embodiments, the solar panel does not require a separate frame as the structure of the photovoltaic modules (e.g., laminated high strength glass) may be sufficiently rigid to act as a stress bearing member. The solar panel is not limited to photovoltaic technology and may be a solar thermal collector for heating a liquid, such as water or oil.

[0038] The generally V-shaped frame **102** is preferably constructed from a single piece of sheet metal with a central bend angle **108** of about 60 degrees for optimum truss strength, including acceptable tolerances, for example ±5 degrees. Alternatively, the generally V-shaped frame **102** may be formed from a thermoplastic polymer sheet or a molded thermoset polymer. The V-shaped frame **102** may also be formed from a single piece of sheet metal using common bending technology. Construction of the V-shaped frame is not limited to bending technology, for example, the V-shaped frame **102** may be formed from separate panels that welded, bonded, riveted, or bolted together to form the generally V-shaped frame **102**. The inner surface **110** of the V-shaped frame includes concentrating portions **112** which are exposed to a sun-facing portion of the solar panel. The concentrating portions **112** include or support adhesively applied reflective coatings for concentrating light to the solar panel. Commercially available high reflectivity (94%) films, such as boPET polyester, can be used. Alternatively, the concentrating portions **112** may include other reflective surfaces applied on top of or integrated with the inner surface **110**. Such other reflective surfaces include mirrors, reflective metallic coatings (e.g. chrome), or polished surfaces. The inner surface **110** of the V-shaped frame **102** also includes an unexposed surface region **114** beneath and facing the bottom surface of the solar panel **104**. For the purposes of this disclosure, "unexposed" regards portions of the inner surface **110** aside from the concentrating portions **112**. Thus, the unexposed surface region **114** may be exposed to direct or indirect sunlight, however, the unexposed surface region **114** does not concentrate light to the solar panel. The inner surface **110** of the V-shaped frame may include at least one opening **116** passing through the V-shaped frame to provide ventilation to the bottom of the solar panel **104** to prevent it from overheating, as the efficiency of a photovoltaic panel will reduce when overheated. The openings **116** also serve to lighten the V-shaped frame **102**, and reduce the effects of wind-borne aerodynamic forces. A cooling system (not shown), e.g., electric fans, may also be included in the unexposed surface region **114** to help manage transient thermal loads. A cooling system may not be required in parts of the world, or during times of the year, where sun intensity is low. The V-shaped frame **102** includes indented shoulders **118** for mounting the solar panel **104**. The shoulders **118** add rigidity to the V-shaped frame **102** and also provides attachment points and a support surface for the solar panel **104**. The V-shaped frame **102** includes hems **119** to help stiffen the concentrating portions **112**.

[0039] The solar concentrator truss assembly **100**, which is in the form of a braced truss includes many advantages. Less structural parts are needed, as the solar panel **104** is a stressed member of the truss. Accordingly, the solar panel **104** may include an axle (not shown), or other mounting device, for mounting the solar concentrator truss assembly **100** to a separate frame. The solar concentrator assembly is also simple to fabricate, as the V-shaped frame **102** may be simply scaled to accommodate off the shelf solar panels. Some examples of off the shelf photovoltaic panels are PV-UD185MF5 by Mitsubishi Solar and KD180GX-LP by Kyocera. Many other photovoltaic panels are available on the market.

[0040] FIGS. **1**B and **1**C shows a front view of the solar concentrator truss assembly **100** in use. The solar concentrator truss assembly **100** has been positioned to have the sun-facing surface **122**, of the solar panel **104**, be normal as possible to beams of light **120**. The concentrating portions **112** are shown to preferentially reflect beams of light **120** to the solar panel **104**. Accordingly, the concentrating portions **112** increase the amount of energy available to the solar panel **104**, resulting in greater energy output, as compared to a solar panel **104** without the concentrating portions. The performance of the solar concentrator truss assembly **100** may also be expressed as a ratio R, for example the total area of sunlight collected A_C or harvested divided by the area of the panel face A_P, or $R=A_C/A_P$. A_C may be the A_P plus the area of the concentrating portions **112**. In one embodiment, an preferred ratio R ranges from 1.2 to 2.0.

[0041] FIG. **1**D shows an alternative front view of a solar concentrator truss assembly **124** in use. The solar concentrator truss assembly **124** is constructed similarly to the solar concentrator truss assembly **100** shown in FIGS. **1A-1C**. Angle **108** is preferably 60 degrees for maximum truss strength, however, in some cases angle **108** may be larger than 60 degrees, for example, if the solar panel **104** is extremely wide. Thus, angle **108** may be larger than 60 degrees to reduce weight and space requirements for a wide solar panel **104**. Accordingly, corresponding angle **126** may also be less than 60 degrees. Alternatively, angle **108** may remain 60 degrees, however, angle **128** may be altered in increase reflectivity of the concentrating portions **112**. Angle **128** should generally be in the range of 45-60 degrees, as angles less than 45 degrees result in little to no light reflected **130** towards the solar panel **104**, and angles greater than 60 degrees do not optimally spread light across the solar panel **104**, accordingly, an angle of separation **132** between the concentrating portions may range from 60 to 90 degrees.

[0042] V-Shaped Frame Construction:

[0043] FIG. **2**A shows a top view of a metal sheet **200** for forming a V-shaped frame. The metal sheet **200** shows preferential fold lines **202**, mounting holes **204**, optional cut outs **206**, and cuts **208** for a dowel socket. The flat metal sheet **200** may be formed from a variety of metals, for example, steel, stainless steel, and aluminum. The mounting holes **204** and optional cut outs **206** may be formed by laser or plasma cutting, stamping, drilling, or milling operations. The metal sheet **200** may also be formed from a pre-perforated sheet of metal, which includes a plurality of uniformly placed holes throughout the sheet of metal. A pre-perforated sheet of metal can remove the need for fabricating mounting holes **204**, and optional cut outs **206**, as the perforation promotes ventilation.

[0044] FIG. **2**B shows a partial top view of a V-shaped frame **210** formed from the metal sheet **200**. The V-shaped frame **210** may be formed from a conventional brake press, using manual or air bending. As shown, shoulders **212** have been formed in the region of the mounting holes **204** for bottom mounting of a solar panel. Concentrating portions **214**

of the V-shaped frame **210** may have reflective coatings adhesively applied. The V-shaped frame **210** may also include protective coatings, for example, paint, powder coating, ceramic coating, and chrome plating. Two parallel cuts for a dowel socket **208** are also provided.

[0045] FIG. 2C shows a front view of the V-shaped frame **210**. The V-shaped frame **210** includes hems **216** to help stiffen the concentrating portions **214**. The hems **216** may also include features (not shown) to prevent birds from resting on the hems **216** and potentially soiling the concentrating portions **214** or solar panel, for example, spikes or barbs. The V-shaped frame **210** includes a preferential bend **218** of 60 degrees, as shown. The shoulders **212** are shown to each include a bottom mounting surface **212.1** and side mounting surface **212.2** for mounting a solar panel. The dowel socket **208** is shown formed from folding the material between the two parallel cuts shown in FIG. 2B, into a diamond shape as shown. More than one dowel socket **208** may be provided.

[0046] FIG. 2D shows a partial side view of the V-shaped frame **210**. The side mounting surface **212.2** of the shoulder **212** is shown with mounting holes **204** for side mounting of a solar panel.

[0047] Solar Concentrator Array:

[0048] FIG. 3A shows a perspective view of a solar concentrator array **300**. The solar concentrator array includes a plurality of solar concentrator truss assemblies **302**, a frame **303**, and a motion apparatus **306**. The plurality of solar concentrator truss assemblies **302** share the construction of the various solar concentrator truss assemblies described herein. The frame **303** includes elongated beams **304** mounted to each side of the plurality of solar concentrator truss assemblies **302**. The beams **304** can be mounted to supports **308** for attachment to a roof or other supporting structure. Alternatively, the beams **304** can be mounted directly to, or integral with, a wall or parapet of a building structure, which removes the need for supports **308**. The strength of the plurality of solar concentrator truss assemblies **302** allows for great lengths to be spanned, and thus the solar concentrator array **300** may span an entire rooftop, from parapet to parapet, which prevents the need to puncture the roofs membrane with supports **308**. Although two beams **304** are shown, the stiffness of plurality of solar concentrator truss assemblies **302** requires only one beam **304**, thus, the plurality of solar concentrator truss assemblies **302** can be mounted only on one end to cantilever in free air. The beams **304** are preferably positioned in an east-west direction such that the plurality of solar concentrator truss assemblies **302** can tilt to follow the movement of the earth relative to the sun. The motion apparatus **306** includes a computer assembly **310**, a motor assembly **312**, and an optional DC/AC inverter **316** with associated wiring and electrical connections. The plurality of solar concentrator truss assemblies **302** each generally rotate in unison around a respective axis of rotation AR, which is generally orientated in a north-south direction.

[0049] The computer assembly **310** includes a processor, memory, and communications bus, all operationally connected to each other. The communications bus can be optionally connected to an external computer, server, or network of servers. The computer assembly **310** can be a general purpose computer or an embedded controller. The computer assembly **310** controls the motion of the plurality of solar concentrator truss assemblies **302** by controlling the motor assembly **312**. The plurality of solar concentrator truss assemblies **302** include respective solar panels, which are preferentially synchronized to be continuously or periodically moved to place solar panel surfaces into positions as normal to incoming sunlight as possible. The synchronization can be done using tables that maximize the incoming solar irradiation for the different times of day and year. The tables of solar irradiation angles are widely available. An example of such tables is given in Table 9.1.4 on page 9-13 of Marks' Standard Handbook for Mechanical Engineers by Eugene A. Avallone, Theodore Baumeister, Ali Sadegh, and Lionel Simeon Marks (McGraw-Hill Professional, 2006, ISBN 0071428674). Other synchronization methods can involve solar irradiation sensors or directional light meters operationally coupled to the computer assembly **310**, and capable of determining the angle of solar irradiation. An example of such a solar irradiation sensor capable of automatically determining its location through a Global Positioning System and then calculating the angle of solar irradiation is the Wheeler Sunpredictor™ by LISTECH from Windsor, Australia. Other devices for determining the angle of solar irradiation may also be used. Tabulated or measured values of the angle of solar irradiation can be uploaded to the communications bus, and stored as data on the memory. The data can be used by additional software stored on the memory to execute instructions by the processor to calculate the appropriate movement of the solar concentrator truss assemblies **302**. Alternatively, the computer assembly **306** may be controlled by a external computer communicating through the communications bus.

[0050] FIG. 3B shows a partial cross-sectional view A-A of a the solar concentrator array **300**. The view shows a drive side of a solar concentrator truss assembly **302.1** of the plurality of solar concentrator truss assemblies **302**. Each solar concentrator truss assembly **302.1** of the plurality of solar concentrator truss assemblies **302** shares the same construction as shown, which can also be mirrored to the other side of each solar concentrator truss assembly **302. 1**. The other side (not shown) of the solar concentrator truss assembly **302.1** looks similar except it does not generally include a dowel socket **324**, dowel **326**, connecting rod **328**, and conduit **329**, however, in some embodiments the other side (not shown) may be identical. The solar concentrator truss assembly **302.1** includes a solar panel **318** which acts as a stressed member of a truss. The solar panel **318** includes an axle **320** extending from the solar panel **318**, and rotatably coupled to the beam **304** by a bearing **322**. Accordingly, the solar concentrator truss assembly **302.1** may rotate about the axis of rotation AR of the axle **320**. The solar concentrator truss assembly **302.1** also includes a dowel socket **324** which is moveably coupled to a dowel **326**. The dowel **326** is further moveably connected to a connecting rod **328** which imparts motion to the dowel **326**, and further to the dowel socket **324**, to move the concentrator truss assembly **302.1** about the axle **320**. Energy collected by solar concentrator truss assembly **302.1** is conducted through power cables into conduit **329**.

[0051] FIGS. 3C and 3D shows a partial cross-sectional view B-B of a portion of the solar concentrator array **300**. FIG. 3C shows the plurality of solar concentrator truss assemblies **302** tracking the sun in a morning-time period, with the plurality of solar concentrator truss assemblies **302** generally facing eastwards. FIG. 3D shows the plurality of solar concentrator truss assemblies **302** tracking the sun in a noon-time period, with the plurality of solar concentrator truss assemblies **302** generally facing up. The plurality of solar concentrator truss assemblies **302** is shown, each solar concentrator truss assembly **302.1** moveably coupled to a dowel **326**. In simplistic terms, the movement of the plurality of solar concentrator truss assemblies **302** is generally described as a six-bar linkage, the links include the frame **303**, worm screw **332**, linkage **330**, connecting rod **328**, and at least two solar concentrator truss assemblies **302.1**, with the frame **303** being a fixed link. As the worm screw **332** moves in and out, the plurality of solar concentrator truss assemblies **302** tilt about respective axles **320**. FIG. **3**C shows the worm screw **332** extended towards the west which causes the linkage **330** to extend the connecting rod **328** and cause the plurality of solar concentrator truss assemblies **302** to face eastwards. FIG. **3**D shows the worm screw **332** generally centrally positioned which causes the linkage **330** to lower the connecting rod **328** and cause the plurality of solar concentrator truss assemblies **302** to face upwards. The worm screw **332** may also be extended towards the east which causes the linkage **330** to again raise the connecting rod **328** and cause the plurality of solar concentrator truss assemblies **302** to face westwards (not shown).

[0052] Each solar concentrator assembly **302.1** rotates about a respective axle **320** due receiving force from a respective dowel **326**. The dowels **326** are moveably connected to the connecting rod **328**, each dowel **326** being in a fixed relationship to each other. The connecting rod **328** is further moveably coupled to the linkage **330**. The linkage **330** translates linear motion imparted by motor assembly **312** into circular motion about each axle **320**. In use, the motor assembly **312** moves the worm screw **332** in a linear direction, for example, back and forth along the east-west direction as shown. The motor assembly **312** and axles **320** are fixed in location relative to the frame **303**, however, the worm screw **332**, linkage **330**, and connecting rod **328** (and dowels **326**) are moveable relative to the frame **303**. Thus, linear movement of the worm screw **332** causes the linkage **330** and connecting rod **328** (and dowels **326**) to move, and in turn cause the plurality of solar concentrator truss assemblies **302** to rotate in unison about each respective axle **320**. The pattern of movement is determined by the relationship between the dowels **326** and axles **320**. As the axles **320** are fixed relative to the frame **303**, each dowel **326** moves in a circular pattern about each respective axle **320**. The dowels **326** are fixed in location with respect to each other, thus, the circular movement of each dowel **326** causes the connecting rod **328** to maintain a horizontal attitude and "rock" back and forth. The motion of the plurality of solar concentrator truss assemblies **302** is generally limited to follow the movement of the earth relative to the sun, however, the plurality of solar concentrator truss assemblies **302** can be completely inverted to cause the solar panels to face down in inclement weather. The motor assembly **312** can be a worm driven gear box assembly having a high gear ratio. Many worm driven gear box assemblies that produce linear motion are available on the market. One example is Action Jac™ linear actuator by Nook Industries, Inc., Ohio. Other mechanisms for the motion apparatus **306** are possible. One example is an engagement of the gears on a driveshaft connected to respective gears on each solar concentrator truss assembly **302.1**. Another example is using a cam guide on the connecting rod **328** for each dowel, for example a groove machined in the cam guide or a mounted track. Thus, each dowel would follow a circular cam profile which further eliminates the need for the linkage **330**. Other examples of the mechanisms for adjusting the panel pivot angle are rack and pinion, belt and pulley, and hydraulic or pneumatic cylinder drives, or a combination of different mechanisms.

[0053] As will be understood by those skilled in the art, the present invention may be embodied in other specific forms without departing from the essential characteristics thereof. For example, the motion apparatus **306** may receive electrical energy directly from the photovoltaic panels. Furthermore, the frame **304** may host different numbers of photovoltaic panels having differing sizes. The frame **304** may also impart a second axis of motion, (e.g., tilt the about the east-west axis shown in FIG. **3**A) as described in co-assigned U.S. patent application Ser. No. 12/353,143, the entirety of which is incorporated by reference herein. Many other embodiments are possible without deviating from the spirit and scope of the invention. These other embodiments are intended to be included within the scope of the present invention, which is set forth in the following claims.

What is claimed is:

1. A solar concentrator truss assembly, comprising:

a generally V-shaped frame including an inner surface, the inner surface including a first and second concentrating portion, the inner surface including an unexposed portion located between the first and second concentrating portion; and

a solar panel including a sun-facing surface and a bottom surface, the solar panel received by the inner surface;

wherein the solar panel bridges the inner surface to form a truss with the generally V-shaped frame, such that the sun-facing surface and the first and second reflective portions are exposed to each other, and the bottom surface is exposed to the unexposed portion.

2. The solar concentrator truss assembly of claim **1**, wherein the first and second concentrating portions are separated from one another by an angle ranging from 60 to 90 degrees.

3. The solar concentrator truss assembly of claim **1**, wherein the first and second concentrating portions include reflective adhesive films disposed thereon.

4. The solar concentrator truss assembly of claim **1**, wherein the generally V-shaped frame is constructed from a single piece of sheet metal.

5. The solar concentrator truss assembly of claim **1**, wherein the inner surface includes shoulders complementary shaped to receive the solar panel.

6. The solar concentrator truss assembly of claim **1**, wherein the solar panel is a stress bearing member.

7. The solar concentrator truss assembly of claim **1**, wherein the generally V-shaped frame additionally includes at least one ventilation passage positioned below the bottom surface of the solar panel.

8. The solar concentrator truss assembly of claim **1**, wherein the solar panel additionally includes an elongated axle extending past the generally V-shaped frame.

9. The solar concentrator truss assembly of claim **1**, wherein the generally V-shaped frame includes an opening for a dowel socket in the unexposed portion.

10. A solar concentrator array, comprising:

a frame, including at least one elongated beam;

a plurality solar concentrator truss assemblies, each solar concentrator assembly including:

a generally V-shaped frame including an inner surface, the inner surface including a first and second concentrating portion, the inner surface including an unexposed portion located between the first and second concentrating portion, the generally V-shaped frame including a socket; and

a solar panel including a sun-facing surface and a bottom surface, the solar panel bridging the inner surface to form a truss with the generally V-shaped frame, such that the sun-facing surface and the first and second reflective portions are exposed to each other, the solar panel including an elongated axle extending past the generally V-shaped frame and rotatably coupled to the at least one elongated beam; and

a motion apparatus including a plurality of dowels, each respective dowel moveably coupled to a respective socket of a respective generally V-shaped frame for moving each respective solar concentrator truss assembly around a respective axle.

11. The solar collector array of claim **10**, wherein the frame additionally includes a second elongated beam parallel to the at least one elongated beam, wherein the axle of each respective solar concentrator assembly is additionally rotatably coupled to the second elongated beam.

12. The solar collector array of claim **10**, wherein each generally V-shaped frame is constructed from a single piece of sheet metal.

13. The solar collector array of claim **10**, wherein the first and second concentrating portions are separated from each other by an angle ranging from 60 to 90 degrees.

14. The solar collector array of claim **10**, wherein the motion apparatus additionally includes an elongated connecting rod coupled to a linkage, and a motor moveably coupled to the linkage.

15. The solar collector array of claim **10**, wherein the motion apparatus additionally includes a motor moveably coupled to the plurality of dowels, and a computer assembly operationally coupled to the motor, the computer assembly configured to store and execute instructions for controlling movement of the motor.

16. The solar collector array of claim **15**, wherein the motion apparatus additionally includes a directional light meter operationally coupled to the computer assembly, the directional light meter supplying a signal to the computer assembly, the signal used to execute instructions for controlling movement of the motor.

17. The solar collector array of claim **15**, wherein the computer assembly includes stored data, the stored data used to execute instructions for controlling movement of the motor.

18. The solar collector array of claim **17**, wherein the stored data includes a location of the solar collector array, time, and date.

19. The solar collector array of claim **10**, additionally comprising at least one inverter operationally coupled to the plurality solar concentrator assemblies.

20. A solar concentrator truss assembly, comprising:

a generally V-shaped frame formed from a single piece of sheet metal, and including a first planar member and a second planar member separated by a 60 degree angle,

the first planar member including:

a first inner surface, the first inner surface including a first unexposed portion and a first concentrating portion, and

a first indented shoulder between the first unexposed portion and a first concentrating portion,

the second planar member including:

a second inner surface, the second inner surface including a second unexposed portion and a second concentrating portion, and

a second indented shoulder between the second unexposed portion and a second concentrating portion,

the first and second inner surfaces being exposed to each other; and

a photovoltaic panel including a sun-facing surface, a bottom surface, a first photovoltaic end, a second photovoltaic end, and an elongated axle extending past the generally V-shaped frame,

the first photovoltaic end connected with the first indented shoulder,

the second photovoltaic end connected with the second indented shoulder,

the sun-facing surface being exposed to the first and second reflective portions, the bottom surface being exposed to the first and second unexposed portions,

wherein the first and second concentrating portions each include reflective adhesive film, and wherein the photovoltaic panel is a stress bearing member.

* * * * *