



US 20120174910A1

(19) **United States**(12) **Patent Application Publication**  
**Gil et al.**(10) **Pub. No.: US 2012/0174910 A1**(43) **Pub. Date: Jul. 12, 2012**(54) **SOLAR FIELD AND METHOD FOR  
ASSEMBLING THE SOLAR FIELD****Publication Classification**(76) Inventors: **Ori Gil**, Petach Tikva (IL);  
**Shmulik Klapwald**, Jerusalem (IL);  
**Naim Levi**, Ramat Hasharon (IL);  
**Yigal Sharon**, Mevaseret Zion (IL)(51) **Int. Cl.**  
**F24J 2/04** (2006.01)  
**B21D 53/02** (2006.01)  
(52) **U.S. Cl.** ..... **126/634; 29/890.033**(21) Appl. No.: **13/376,482**(22) PCT Filed: **Jun. 8, 2010**(86) PCT No.: **PCT/EP10/57980**§ 371 (c)(1),  
(2), (4) Date: **Mar. 16, 2012****Related U.S. Application Data**(60) Provisional application No. 61/185,084, filed on Jun.  
8, 2009.**ABSTRACT**

A method for automatically assembling a solar field is provided with following steps: a) Providing at least one solar collector unit with a radiation concentrator collector including a radiation absorber with an absorber tube for a flow-through of a heat transfer medium and a parabolic mirror for focusing solar radiation onto the absorber tube of the radiation absorber for heating up the heat transfer medium flowing through the absorber tube; b) Transporting the solar unit to a target location of the solar field; and c) Assembling the solar unit on the target location of the solar field. Additionally a solar field with a plurality of prefabricated solar collector units is provided.

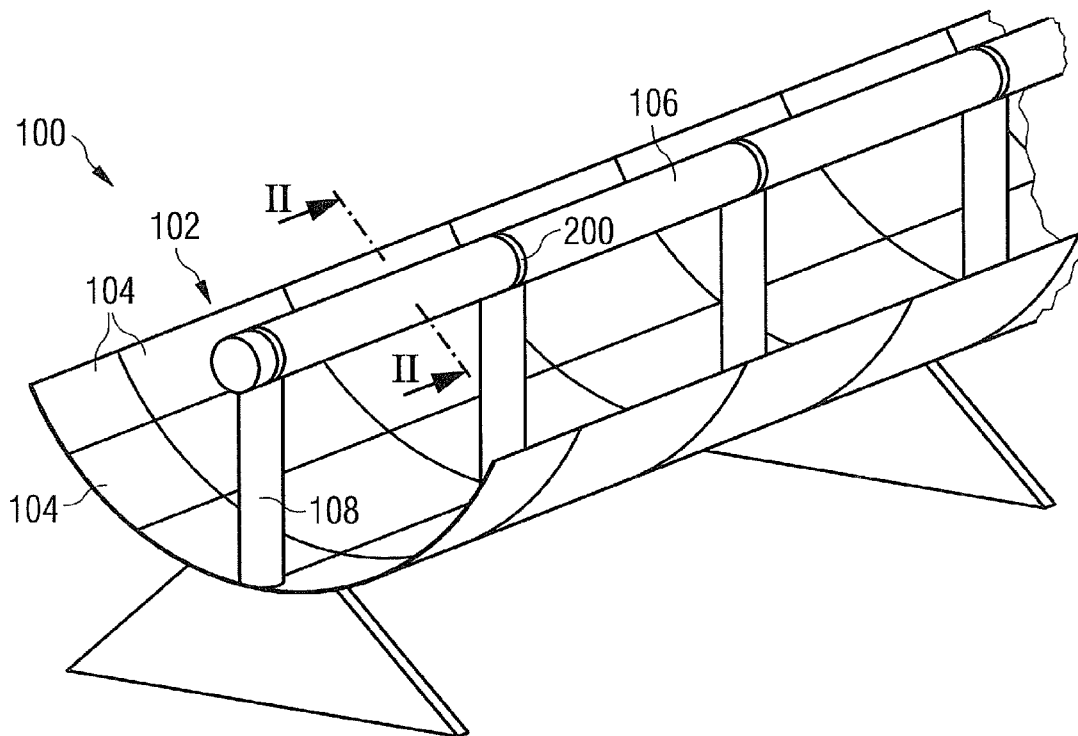


FIG 1

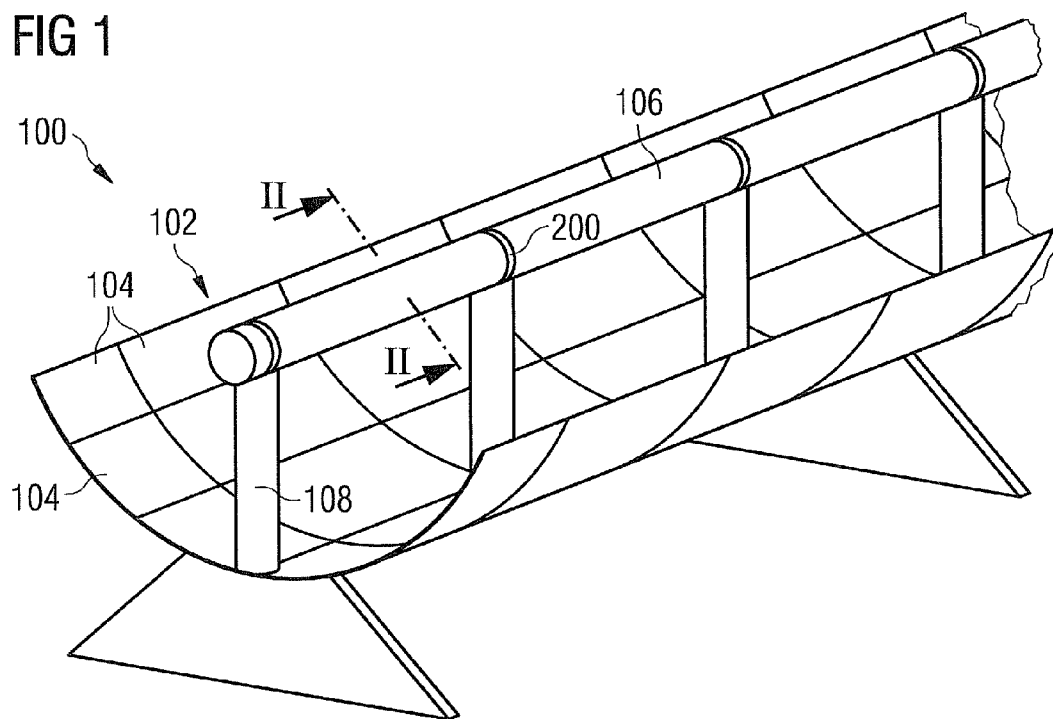
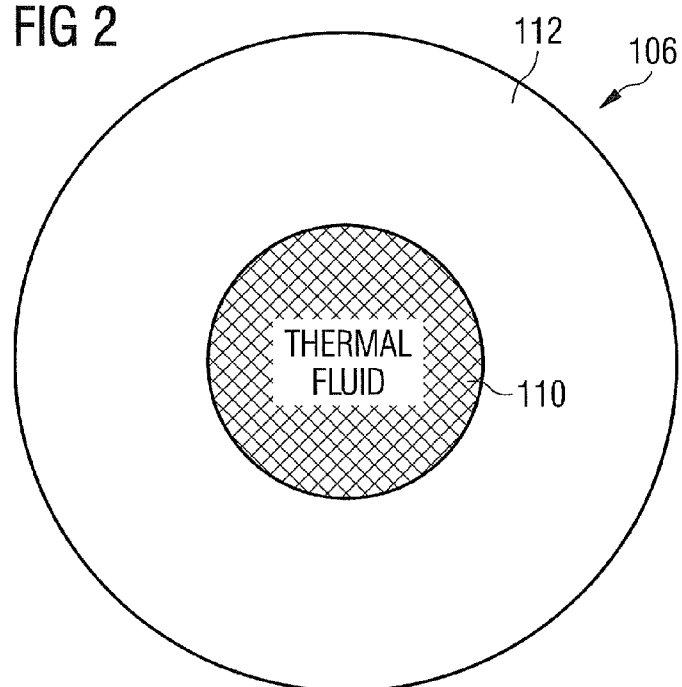


FIG 2



## SOLAR FIELD AND METHOD FOR ASSEMBLING THE SOLAR FIELD

### FIELD OF THE INVENTION

**[0001]** This invention relates to a solar field and a method for assembling the solar field.

### BACKGROUND OF THE INVENTION

**[0002]** Amid concerns over global warming, and forecasts of both the depletion of non-renewable energy sources and rising power demand, suppliers of energy are increasingly seeking alternative primary sources of energy. One such source of energy is solar energy, and one way of utilizing solar energy is with a solar thermal power plant.

**[0003]** One type of solar power plant comprises a solar field which utilizes a "radiation concentrator collector" which concentrates the solar radiation by focusing it onto a smaller area, e.g., using mirrored surfaces or lenses. In this system, a reflector, which is typically parabolic, receives and reflects (focuses) incoming solar radiation onto a radiation absorber, which is formed as a tube. The tube radiation absorber is concentrically surrounded by a treated glass enclosure tube to limit the loss of heat. The collector system further includes means to track the sun.

**[0004]** The tube radiation absorber is made of metal with a coating having a high solar radiation absorption coefficient to maximize the energy transfer imparted by the solar radiation reflecting off the reflector. A heat transfer medium (e.g. heat transfer fluid (HTF), which is typically a liquid such as oil, flows within the tube radiation absorber.

**[0005]** The thermal energy is transported by the HTF to provide energy to, e.g., a thermal-electric power plant to drive one or more power-generation systems thereof, in order to generate electricity in a conventional way, e.g., by coupling the axle of each of the turbines to an electric generator. One such example of a thermal-electric power plant is a steam-electric power plant, which uses thermal energy provided thereto to produce steam to drive turbines thereof, which in turn drive a generator, thus generating electricity.

**[0006]** Throughout the solar field, the HTF flows within a tube, which is partially constituted by the tube radiation absorber. The entire length of the tube should be designed so as to limit thermal losses therefrom. Along much of its length, it is surrounded by a tube or pipe of a larger diameter, with the space therebetween being evacuated in order to limit heat loss due to convection.

### SUMMARY OF THE INVENTION

**[0007]** It is an object of the invention to provide an easy and cheap method for building up a solar field. A further object of the invention is a solar field which can be cheaper manufactured with respect to solar fields of the state of the art.

**[0008]** These objects are reached by the claims.

**[0009]** According the invention a method for automatically assembling a solar field, the method comprising following steps: a) Providing at least one solar collector unit with a radiation concentrator collector comprising a radiation absorber with an absorber tube for a flow-through of a heat transfer medium and a parabolic mirror for focusing solar radiation onto the absorber tube of the radiation absorber for heating up the heat transfer medium flowing through the absorber tube; b) Transporting the solar unit to a target loca-

tion of the solar field; and c) Assembling the solar unit on the target location of the solar field.

**[0010]** The providing the solar unit comprises a manufacturing of the solar unit. The location of the manufacturing differs from the location of usage of the solar unit.

**[0011]** In a preferred embodiment a solar collector unit is used having a tube support for supporting the absorber tube and/or having a reflector support for supporting the parabolic mirror and/or having a mirror tracker for tracking the parabolic mirror based on the beaming direction of the radiation of the sunlight.

**[0012]** In a further preferred embodiment a checking of the solar collector unit is carried out before the transporting the solar unit to the target location. The checking the solar collector unit includes preferably a measuring of at least one characteristic of the absorber tube and/or a measuring of at least one characteristic of the parabolic mirror. E.g. such characteristics are the absorptivity of the absorber tube for sunlight or a reflectivity of the parabolic mirror for the sunlight. A testing of the solar units is executed before they are installed. By this cost can be saved due to that fact that just tested solar units are used for the solar field.

**[0013]** In a further preferred embodiment a plurality of solar collector units are provided and assembled together at the target location of the solar field. Especially all of the solar units of a solar field are manufactured and tested before the solar field is built up with them.

**[0014]** For the transporting the solar units in principle different transport vehicles can be used. But special designed transport vehicle for the transporting the solar collector unit are preferred. The vehicles are designed such that the solar units can be supported in a save way.

**[0015]** According to another aspect of the invention a solar field with a plurality of prefabricated solar collector units is provided. The solar collector unit are assembled together, wherein each of the solar units comprises a radiation concentrator collector comprising a radiation absorber with an absorber tube for a flow-through of a heat transfer medium and a parabolic mirror for focusing solar radiation onto the absorber tube of the radiation absorber for heating up the heat transfer medium flowing through the absorber tube.

### BRIEF DESCRIPTION OF THE DRAWINGS

**[0016]** Further features and advantages of the invention are disclosed by the description of exemplary embodiments with reference to the schematic drawings.

**[0017]** FIG. 1 is a perspective view of a typical solar concentrator as part of a solar thermal power plant;

**[0018]** FIG. 2 is a cross-sectional view of the heat collecting element (HCE) taken along line II II in FIG. 1;

### DETAILED DESCRIPTION OF THE INVENTION

**[0019]** As illustrated in FIGS. 1, there is provided a solar concentrator **100** built up by a plurality of solar collector units. The solar concentrator **100** is part of a solar thermal power plant (not illustrated) and comprises a reflecting surface of a mirror **102**, which may comprise a plurality of light concentration devices (LCDs) **104**. The reflecting surface **102** extend linearly and/or along a curved path dozens of meters, and has a parabolic cross-section. The mirror is a parabolic mirror. As such, a tracking mechanism (tracker, not illustrated) is provided in order to ensure that the reflecting surface **102** faces the sun, thereby concentrating solar radiation

impinging thereupon toward its geometric focus. A heat collection element (HCE, absorber tube of the radiation absorber) **106** is provided along the focus of the parabola of the reflecting surface **102**, thus receiving the concentrated solar radiation.

**[0020]** As seen in FIG. 2, the HCE **106** comprises a tube radiation absorber (TRA) **110** through which a thermal fluid flows, surrounded by a glass tube **112** along its length. This tube is called UVAC (Universal Vacuum Air Collector). A thermal fluid, which is used to heat a working fluid in a separate loop to drive a power-generation cycle, flows within the TRA. The thermal fluid is heated by the concentrated solar radiation. The space between the TRA **110** and the glass tube **112** is evacuated in order to minimize heat loss due to cooling of the thermal fluid within the TRA by convection. Each end of the glass tube **112** may be enclosed by flexible external shield member (not illustrated).

**[0021]** HCE support posts (absorber supports) **108** are provided, e.g., at regular intervals along the length of the HCE, to maintain the position of the HCE **106** at or near the focus of the parabola of the reflecting surface **102**. They are designed to pivot about a bottom end thereof, in the direction along which the HCE extends.

**[0022]** The solar collector unit (solar field basic component) is approximately 12 meters long and 5.7 meters wide and consists of a main torque tube, a reflector support, and reflectors. For example eight solar collector units are assembled together to form a solar collector assembly (SCA). Metal base columns are based on a concrete foundation and holding the parabolic mirrors. A drive pylon is where the hydraulic system is located in order to rotate the solar complete collector assembly according to the sun's movement. All electrical & communications panels are mounted on these pylons.

**[0023]** By the invention the solar field as a part of a complete power plant can be assembled automatically.

**[0024]** The parabolic mirrors (parabolas) and the triple UVACs will be assembled at the site, i.e., at the Portable Assembly Building (PAB), and will be dispatched to the Solar Field, to be installed according to a construction plan. The construction plan defines a dispatch of the other components of the solar field as well (pylons, crossover-pipes, ball joints, risers) so as to coordinate the timing of their arrival to their location in the solar field and their installation. The parabolas delivered at the outlet of the PAB will be transported to the solar field on a specially designed parabola carrying cart (transport vehicle).

**[0025]** The SCA includes metal parts manufactured in standard process of steel structure. The driving system is installed in an assembly line. The final station includes a set of tests to inspect and run a solar collector unit, to ensure the required performance of the solar collector unit.

**[0026]** The optical accuracy achieved by drilling holes and mounting the drilled parts in the automatic assembly line.

**[0027]** The line includes special equipment that has been developed for mounting the parabola components. In the end of the line a measurement station inspects the final parabola accuracy.

**[0028]** A special gripper developed to transfer the parabola from the line to the wagon and later to lift it onto the SCA.

**[0029]** In contrary to existing methods which are mainly done by hand using conventional tools, the method concerning the invention uses specially designed tools and vehicles which offer several advantages:

- [0030]** higher precision;
- [0031]** better quality assurance;
- [0032]** faster assembly time;
- [0033]** less manpower;
- [0034]** lesser chance for human errors;
- [0035]** lesser depreciation;
- [0036]** less sensitive to weather conditions;
- [0037]** more flexible in the assembly process;
- [0038]** better control in the assembly process;
- [0039]** better control on the whole process (project schedule, parts flow, inventory management, etc.);
- [0040]** efficient logistic of the assembling;
- [0041]** safeness of the whole process;
- [0042]** reliability of the manufacturing method and reliability of the resulting solar field.

**1-7.** (canceled)

**8.** A method for automatically assembling a solar field, the method comprising:

- a) providing at least one solar collector unit with a radiation concentrator collector comprising a radiation absorber with an absorber tube for a flow-through of a heat transfer medium and a parabolic mirror for focusing solar radiation onto the absorber tube of the radiation absorber for heating up the heat transfer medium flowing through the absorber tube;
- b) transporting the solar unit to a target location of the solar field;
- c) assembling the solar unit on the target location of the solar field; and
- d) checking of the solar collector before the transporting the solar unit to the target location.

wherein the checking the solar collector unit includes:

- measuring of at least one characteristic of the absorber tube and/or
- measuring of at least one characteristic of the parabolic mirror.

**9.** The method according to claim **8**,

wherein the at least one solar collector unit includes a tube support for supporting the absorber tube and/or having a reflector support for supporting the parabolic mirror and/or having a mirror tracker for tracking the parabolic mirror based on the beaming direction of the radiation of the sunlight.

**10.** The method according to claim **8**,

wherein a plurality of solar collector units are provided and assembled together at the target location of the solar field.

**11.** The method according to claim **9**,

wherein a plurality of solar collector units are provided and assembled together at the target location of the solar field.

**12.** The method according to claim **8**,

wherein a special designed transport vehicle is used for the transporting the solar collector unit.

**13.** The method according to claim **9**,

wherein a special designed transport vehicle is used for the transporting the solar collector unit.

**14.** A method for automatically assembling a solar field, the method comprising:

- a) providing at least one solar collector unit with a radiation concentrator collector comprising a radiation absorber with an absorber tube for a flow-through of a heat transfer medium and a parabolic mirror for focusing solar

radiation onto the absorber tube of the radiation absorber for heating up the heat transfer medium flowing through the absorber tube;

- b) transporting the solar unit to a target location of the solar field; and
- c) assembling the solar unit on the target location of the solar field, wherein a special designed transport vehicle is used for the transporting the solar collector unit.

**15.** The method according to claim **14**,

wherein the at least one solar collector unit includes a tube support for supporting the absorber tube and/or having a reflector support for supporting the parabolic mirror and/or having a minor tracker for tracking the parabolic mirror based on the beaming direction of the radiation of the sunlight.

**16.** The method according to claim **14**, further comprising: checking of the solar collector before the transporting the solar unit to the target location.

**17.** The method according to claim **16**,

wherein the checking the solar collector unit includes:

- measuring of at least one characteristic of the absorber tube and/or
- measuring of at least one characteristic of the parabolic mirror.

**18.** The method according to claim **8**,

wherein a plurality of solar collector units are provided and assembled together at the target location of the solar field.

\* \* \* \* \*