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(54) Title: SOLAR COOKING RANGE AND APPLIANCES

(57) Abstract: A set of solar cooking appliance having a solar heat collector filed with a first heat storage and conducting material and a solar cooking range filled with a second heat storage and conducting material. The solar cooking range having a heat insulated enclosed compartment and also having a cooktop. The cooking range having a set of cooking chambers which are in thermal contact with the first and second heat storage and conducting material for cooking food therein. The cooking appliance also having a group of removable parts that cover the cooking chambers separtely.

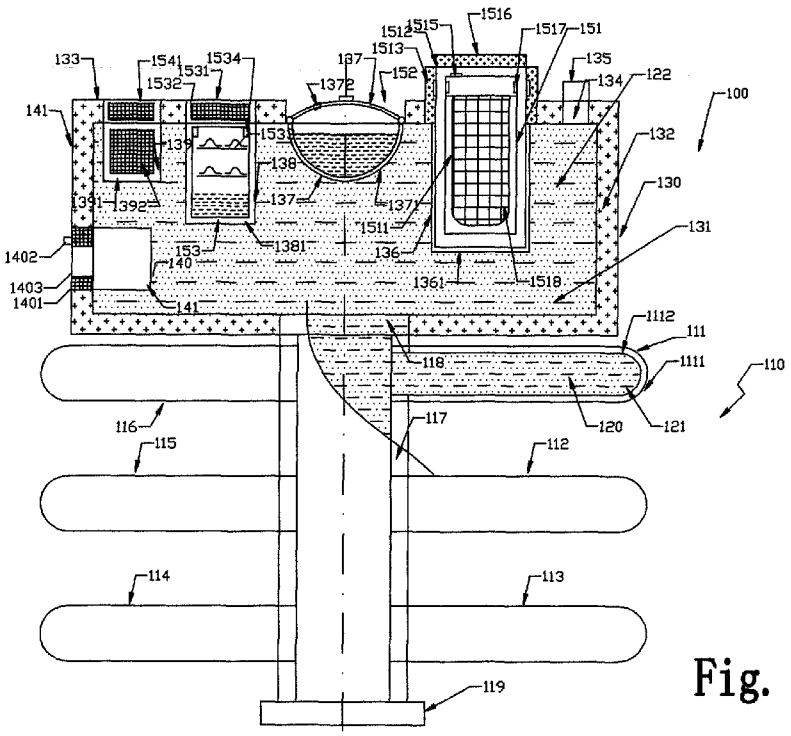

Fig. 1

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— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*

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SOLAR COOKING RANGE AND APPLIANCES

FIELD OF TECHNOLOGY

[001] The present disclosure relates to solar heat application field, especially relates to solar cooking appliances to cook the foods in a range that receives and stores solar heat from a solar heat collector. It also relates to solar heating water and an electric energy storage range.

BACKGROUND

[002] For all kinds of existing energy sources in the earth, solar energy is the most widespread, the richest and the most uniformly distributed energy source. Solar energy can be used very easily. It is available every day, everywhere and for every body.

[003] For all kinds of human energy consuming activities, food and beverage cooking is the most often activity and has the longest history. Every body in anywhere needs to cook the foods every day.

[004] It is very interesting and valuable topic to use solar energy for food cooking. There are many efforts in this field. (Please refer to the existing patents).

[005] The solar power on a unit earth area is not very large. The solar radiation intensity is varied from North to South and from morning to afternoon. It depends on the weather and is also different in four seasons, so that to develop a economic solar cooking appliance is always a challenge and need continue efforts.

[006] In view of these difficulties, some solar cooking appliances tried to make the sunlight receiving area as large as possible. But the heat insulation for the received heat is difficult. Some solar cooking appliances follow and focus the sunlight using expensive automation system and need additional power to run the system. Some solar cooking appliances also use the heat storage materials. The materials may be expensive and not easy to get.

[007] At present time, electric power demand management becomes more popular. One of the management methods is to store the electric heat at the lower power demand period for the use at the high demand period. The solar coking range of this invention can be large heat energy storage and has very good heat insulation, so it is also an electric heat storage container for electric demand management purpose.

[008] The present disclosure absorbs the historic experience and combines the new solar water heating technologies and developed a set of economic and practicable solar cooking appliances.

SUMMERY

[009] The object of this disclosure is to improve the existing technologies and provide a set of solar cooking appliances that is economy, easy to manufacture and use and high efficient. The invention takes following steps to overcome the difficulties of applying solar energy for food cooking:

[0010] To use the evacuated solar heat collector for optimum heat collecting;

[0011] To filled heat storage and conducting material in the evacuated solar heat collector for storing and keeping heat to provide a continue and stable cooking heat;

[0012] A light reflector focuses the surrounding light to the cooking appliances;

[0013] A sundial indicates the light direction, an adjustable and rotatable fixing and supporting trestle allows to receiving the highest solar power;

[0014] A electric power supply provides a backup power source when the solar power is not enough. Further more, the solar cooking appliances also provide backup or energy storage equipment at low electricity price period for cooking at electric power outage.

[0015] Following are the detailed summary of present disclosure.

In accordance with one aspect of the present disclosure there is provided a set of solar cooking appliances, comprising: a solar heat collector in which first heat storage and conducting material is filled, wherein solar heat is collected, stored in and transferring from; a solar cooking range filled with second heat storage and conducting material, connected with said solar heat collector, wherein the solar heat is received from said solar heat collector and stored for food cooking; the said solar cooking range having a heat insulated and enclosed compartment, wherein the heat storage and conducting material is filled; a set of cooking chambers arranged in said enclosed compartment and located in said head storage and conducting material having their tops on said cooktop; ahe heat-transferring medium connected said solar heat collector to said heat storage and conducting material in said solar cooking range and transferred the solar heat; a set of solar cooking utensils with a heat insulated lids, located in the cooking chambers of said solar cooking range, wherein the food is cooked; a group of removal parts that cover said cooking chambers one by one; a group of removal parts that insert said cooking chambers one by one; and, necessary accessories.

[0016] The said solar heat collector is a evacuated-tube solar heat collector or a group of evacuated-tube solar heat collectors; or a group of modular evacuated-tube solar heat collectors that mounted in a certain shape, e.g. in parallel row or column in full or partial cone-shaped; for safety reason, a evacuated toughened-glass tube solar heat collector or a transparent cover is suggested.

[0017] The said evacuated-tube solar heat collector may have one open end or two open ends. The said one or two open end(s) may be extended into the solar cooking range, or connected to the cooking range by heat transferring medium(s) or heat exchanger to transfer the solar heat to the solar cooking range.

[0018] The said first and/or second heat storage and conducting material can be either one of a solid material including ore, metal, alloy, turves, soil, quartz sand, or graphite; or a liquid material including water, oil, petroleum including heating oil, fuel oil, transformer oil; cooking oil including colza oil, bean oil; or head storage chemical or phase change heat storage material, e.g. CaO plus H_2O or paraffin; or a combination material of two or more heat storage and conducting materials, e.g. oil filled in the quartz sand or plumbaginous paraffin (graphite and paraffin);

[0019] The said solar cooking range comprises a heat exchanger arranged in said enclosed compartment of solar cooking range, and surrounded by said heat storage and conducting material wherein; said heat exchanger having the ends connected to the fittings on the wall of said cooking range for receiving the solar heat from solar heat collector; the said solar cooking range may further comprises a heat insulated coating on the surface of said enclosed compartment or a removable heat insulation greatcoat; the said solar cooking range may also comprise a structure for breathing and expansion of the heat storage and conducting material within said enclosed compartment; said structure is a hole and fitting on the top of said enclosed compartment for open to atmosphere; or is a expansible subject located in said enclosed compartment, e.g. a piece of bubble plastic or a polymeric empty stomach ball;

[0020] The said heat insulated and enclosed compartment of solar cooking range is an airtight compartment with receiving fittings for receiving heat tubes from solar heat collector; It can be made by metal e.g. steal or copper; or by alloy e.g. stainless steal or aluminum alloy; or by heat resistant material, e.g. ceramic, concrete, brick or soil; The said heat insulated and enclosed compartment of solar cooking range wherein having a receiving fitting to receive a tube from a solar heat collector;

[0021] The said a group of cooking chambers wherein each cooking chamber is enclosed by heat conductive material, e.g. stainless steel or copper, for separating the heat storage and conducting material from the cooking utensil; The shapes of the said cooking chambers can in cylinder bucket shape or in hemisphere shape or others.

[0022] The said solar cooking range may include a build-in oven with door and watch window and a removable drawer filled with said heat storage and conducting material and located in said oven when the oven is out of service;

[0023] The said enclosed compartment of solar cooking range may comprises a hot water tube surrounded by heat storage and conducting material for using remaining heat to make hot water after coking; said water tube having one end connected to a inlet fitting and the opposite end connected to a outlet fitting on the wall of solar cooking range, said fittings are for receiving tubes from hot water appliance;

[0024] The said heat-transferring medium comprises a heat tube with or without the contacting fins, having its one end in said solar heat collector and another end extended into said solar heating range; or a group of heat tubes, wherein each tube connects said solar heating range with one solar heat collector respectively; or a metal conductor, e.g. copper or aluminum conductor; or a metal wall of said solar cooking range;

[0025] The said solar cooking utensils wherein each utensil can be inlayed fully in one of said cooking chamber in said solar cooking range and has the size and shape matched with the size and shape of at least one of said cooking chambers; wherein each utensil having a lower part and upper part, said lower part can be inlayed in one of said cooking chamber and having its size and shape matched with the size and shape of at least one of said cooking chambers, said upper part having a head insulation greatcoat;

[0026] The said solar cooking utensils comprise a cylinder container made of stainless steel or glass; or hemisphere container made of stainless steel or glass; and a two layer toughness glass lid;

[0027] The said a group of cooking chambers, wherein every cooking chamber has standard module size and shape; each of said utensil has a heat conductive coat having its inside size and shape matched with the outside size and shape of said utensil, and its outside size and shape matched the inside size and shape of said standard module cooking chamber in said solar cooking range; wherein each heat insulation part covers one top of said a group of cooking chambers, when the cooking chamber is either in use or out of service; each heat insulation part inserts and fully filled in one of said a group of cooking chambers when it is out of service;

[0028] The said accessories comprise a fixing and supporting trestle that arrange and support each part of the solar cooking appliances at a proper situation; the trestle has a structure that allows the adjustment to the incidence angle to the sun light for said solar heat collector and another structure that allows the adjustment to the direction of the solar heat collector to the sun light, e.g. a rotatable base. The said accessories further comprise a light reflecting object that focus the surrounding sun light to the solar heat collector; a sundial, e.g. a cone bar attached to the solar heat collector perpendicularly for indicate the incidence angle of sun light; a bag and/or membrane for wrap up or cover the food in the solar cooking appliance, e.g. metal, paper or plastic bag and membrane; a set of wheels;

[0029] In accordance with another aspect of the present disclosure there is provided a set of solar cooking appliances mainly use solar heat and use electricity as a backup power source. The above said solar cooking appliances further comprise: a set of electric power heat elements with power supply at the bottom of each cooking chamber and in the oven; the said an electric power heat element with power supply comprising: a power cable having very high heat-resistant temperature, the measurement and indication devices for measuring and indicating the solar cooking appliance's operating characteristic parameters, e.g. timing, temperature, pressure, moisture etc;

[0030] The said a set of solar/electricity solar cooking appliance further comprise a group of heat insulation coat for each solar cooking utensils having its inside size and shape matched with the outside size and shape of said utensil, and its outside size and shape matched with the inside size and shape of said cooking chambers in said solar cooking range, whatever said chamber is a standard module cooking chamber or not;

[0031] Other aspects and features of the present disclosure will become apparent to those ordinarily skilled in the art upon review of the following description of specific embodiments of the invention in conjunction with the accompanying figures.

BRIEF DISCRIPTION OF THE DRAWINGS

[0032] In the figures which illustrate exemplary embodiments of this invention:

[0033] Fig. 1 is schematic side view of a set of exemplary solar cooking appliances including a solar cooking range, a set of the cooking utensils and a solar heat collector filled with ;heat storage and conducting material;

[0034] Fig. 2 is a perspective view that illustrates schematically a set of solar cooking appliances including the backup electric heating elements, operation parameter indicating and controlling system;

[0035] Fig. 3 is a schematic exemplary diagrams illustrates different solar hear collectors filled with heat storage and conducting materials;

DETAILED DESCRIPTION

[0036] Referring to Fig. 1, a set of exemplary solar cooking appliances 100 is illustrated in schematic side view during use. Wherein the solar heat collector 110 is illustrated schematically in partial cross section and the solar cooking range 130 is illustrated schematically in vertical section. The solar cooking appliances 100 includes a solar heat collector 110 including the heat storage and conducting material 120 that filled in the solar heat collector 110; a solar cooking range130, the heat storage conducting material 122 that filled in the cooking range; the solar cooking utensils 151, 152, 153 and accessories.

[0037] Solar heat collector may be any kind of solar heat collector that can heat the heat storage and conducting material 120 or 122 to the temperature higher than the water boiling temperature. In Fig. 1, the solar heat collector is a group of modular evacuated-tube solar heat collectors 111, 112, 113, 114, 115 and 116 that extended their one open ends into a conflux tube 117 and are mounted in a parallel row having two ends 118 and 119. Depending on cooking requirement, the group of modular evacuated-tube solar heat collectors may be mounted in other shapes like a cone column etc. The number of the tubes may be from 1 to many. It is also depended on the cooking demand. The one end 119 of the solar heat collector 110 is closed and another end 118 is an open end and extended into the enclosed compartment 131 of the solar range 130.

[0038] The evacuated-tube solar heat collectors 111, (112-116 are the same), has transparent outer layer 1111 and inner layer 1112 and evacuated in between. The inner layer 1112 has a heat absorbing coating that does not show in the Fig. The evacuated-tube solar heat collector can be purchase in market for solar heating water.

[0039] The solar heat collector that can be used for solar cooking appliance can be in many different structures such. They will be illustrated schematically in Fig. 3.

[0040] The evacuated-tube solar heat collector is made of glass. In case the glass tube is broken, the glass piece is dangers for the user. So the solar heat collector has a transparent plastic cover for safety reason. (It is not shown in Fig. 1). The transparent plastic cover can be either the mantles for each tube or a protective cover for an entire collector panel. But the plastic protective mantles may reduce the efficiency of the solar heat collector. So an evacuated toughened-glass tube solar heat collector is a better solution.

[0041] The heat storage and conducting material 120 is field in the solar heat collector 110. In this case it is sand. The heat storage and conducting material 122 is field in the enclosed compartment 131 of the solar cooking range 130. In this case, it is sand too. A heat transferring material 121 is filled in both solar heat collector 110 and solar cooking range 130. In this case it is heating oil. The heating oil 121 transfers the solar heat by liquid circulating. In fact, we can also treat heating oil as a heat storage and conduction material. In this case, the heat storage and conducting material 120 and 122 are a combination material of sand and heating oil.

[0042] The requirements of heat storage and conducting material are as following: high ratio heat capacity, high heat conductivity, safe for use, cheap and easy to get. So it is not necessary for the solar heat collector 110 to use only the materials mentioned above. There are many materials can become the heat storage and conducting materials whatever it is solid, liquid, chemical material or it is a combination of above mentioned materials. Each material has its advantages and disadvantages need us to consider. Following are some examples:

[0043] The quartz sand is a kind of ore. It is a safe, cheap, easy to get material, but its heat conductivity is low.

[0044] Graphite is a kind of ore too. It has good heat conductivity, but is more expensive than quartz.

[0045] Coal and turves are two kinds of fossil and have good heat conductivity, but their ratio heat capacity is not very good.

[0046] Metal (e.g. steel or copper) and alloy (stainless steal or aluminum alloy) have a good heat conductivity and are easy to manufacture in different shapes, but they are expensive.

[0047] Sand and soil are easy to get and very cheap, but the components of sand and soil are varied from one place to another;

[0048] Water and oil are two typical liquid heat storage and conducting materials. The flowing liquid transfers the heat easily. The boiling temperature of water is lower than many oils. The water under high pressure can have high boiling temperature for using in solar cooking appliances.

[0049] Many kind of cooking oils such as colza, bean oil, peanut oil, tea-seed oil are safe for eat. They have the temperature higher than water boiling temperature. They are good to be the heat storage and conducting materials. But they are expensive and are the human food, so they should not be used widely.

[0050] The petroleum and its products such as heating oil, fuel oil, transformer oil and diesel have much higher boiling temperature than water. They are cheaper than cooking oils and are good heat transferring materials too. One of the disadvantages of these kinds of oils is not safe when the solar cooking appliance has an electric heat element. Further more some volatilized materials of these kinds of oils may be not good for hearth.

[0051] Some chemical or phase change heat storage materials may also be considered. For example, to add the water in Cao and to melt the paraffin by heating it are the ways to store the heat.

[0052] The combination of two kinds of above mentioned materials are often used. For example plumbaginous paraffin (graphite and paraffin) have good heat conductivity from graphite and phase change heat capability from paraffin. To fill the oil into san, like this case did, not only save the oil and make it more safety, but also have good heat transferring capability from the oil flow.

[0053] Referring to Fig. 3, a set of exemplary solar heat collectors are illustrated schematically in vertical sections.

[0054] Fig. 3 A is a schematic vertical section view of an evacuated-tube solar heat collector filled with liquid heat storage and conduction material, e.g. water or oil. In some cases, water can also be a heat transferring medium for food cooking.

[0055] Fig. 3 B is a schematic vertical section view of an evacuated-tube solar heat collector filled with solid heat storage and conduction material, e.g. ore stone or turves.

[0056] Fig. 3 C is a schematic vertical section view of an evacuated-tube solar heat collector filled with sand and having a heat tube or a heat conductor as the heat transferring medium.

[0057] Fig. 3 D is a schematic vertical section view of an evacuated-tube solar heat collector filled with a combination of solid and liquid heat storage and conducting materials, e.g. quartz sand and cooking oil;

[0058] Fig. 3 E is a schematic partial vertical section view of a group of modular evacuated-tube solar heat collectors that mounted in a vertical parallel raw;

[0059] Fig. 3 F is a schematic partial vertical section view of a group of modular evacuated-tube solar heat collectors that mounted in a horizontal parallel raw;

[0060] When set up a solar cooking appliance, not only these kinds of solar heat collectors but also more kinds of their varieties and combinations can be selected and used.

[0061] The solar range 130 includes an enclosed compartment 131 wherein the heat storage and conducting material is filled, the heat insulation layer 132, cooktop 133, a hole 134 on the cooking top with a fitting 135. Within the range 130, several chambers are arranged. They are 136, 137, 138 and 139.

[0062] The heat storage and conducting material has been discussed in details before. They can be used in the heat range too. The enclosed compartment 131 is closed by metal, e.g. stainless steel plate. It also can be steel, copper or aluminum alloy. They are easy for processing and easy to make an airtight box. It is important for use as a liquid container.

[0063] For the economy reason, a cheaper material such as ceramic, concrete, brick or even soil can replace the metal material.

[0064] The heat-insulated layer on the surface of the solar cooking range is a heat-insulated coating, e.g. ceramic coating in this case. It also can be a removable heat insulated greatcoat.

[0065] A cooktop 133 covers the top of the range on the surface of the heat insulation coat.

[0066] A smaller closed part 140, usually named as oven, is located in the solar cooking range 130. The oven 140 is closed by heat conductive metal 141, e.g. stainless steel or copper sheet, and surrounded by heat storage and conducting material 122 (not shown in Fig.). The oven 140 has a heat insulated door 1401 with a watching eye 1403 at a side wall of said solar cooking range and a handle 1402.

[0067] The oven 140 further includes a removable drawer (not shown in Fig. 1) filled with heat storage and conducting material 122. It locates in the oven 140 when the oven is out of service for adding the heat capacitance of the range.

[0068] In the solar cooking range 130, there are chambers 136, 137, 138, 139 wherein the cooking utensils are mosaiced for food cooking. These charmers are formed within the heat storage and conducting material 122. In Fig. 1, we can see that the walls 1361, 1381 and 1391 of chambers 136, 138 and 139 are in cylinder bucket shape, and 1371 is in hemisphere shape. The chambers have their open tops on the cooktop 133. The cooking chambers 136, 137, 138, 139 are enclosed by heat conductive material, e.g. stainless steal or copper for separating the heat storage and conducting material from the cooking utensil. The removable parts 1516, 1521(not shown in Gig.1), 1531, 1541 cover the chambers 136, 137, 138 and 139 for heat insulation purpose. There are four heat insulation blocks prepared for each chamber (in Fig.1 only 1392 is shown). They are prepared for inserting in the chambers when some cooking chambers are out of service. The heat insulation block is taken out when a chamber is in use.

[0069] In Fig.1, the coking utensils 151, 152, 153 at the solar cooking range 130 are the representatives of the solar cooking utensils.

[0070] The utensil 151 is a deep fryer in cylinder bucket shape. A fry basket 1518 is located inside of the utensil. Its lower part inlays in cooking chamber 136 and its wall 1511 has a closed heat connection with the chamber wall 1361. The upper part of utensil 151 is heat insulated by a heat insulation greatcoat 1513. A heat insulation cover 1516 covers the lid 1515. There is a detachable handle 1517 inside of utensil 151.

[0071] The utensil 152 is a pot or wok in hemisphere shape to match the size and shape of the chamber 1371. It is inlayed fully in the chamber 137. It has a two layers toughness glass lid 1373 with a hole 1372 for steam leaking.

[0072] The utensil 153 is a steamer in cylinder bucket shape. A two layers steamer basket 1533 is arranged within the steamer. It inlays in cooking chamber 138 and has a closed heat connection with the chamber wall 1381. A heat insulation cover 1531 covers the lid 1532. There is a detachable handle 1534 inside of utensil 153.

[0073] Based on above detailed descriptions, we can find that common features of these solar cooking utensils are as follows:

A. The body of the utensil is mainly in cylinder bucket shape or in hemisphere shape.
B. The utensils are inlayed fully or partially in the cooking chambers of solar cooking range and have a closed heat connection with the chamber walls.
C. The utensil's parts are heat insulated that are out of the chamber,.
D. The lid of the utensil is heat insulated, either by a cover or has two layers.

[0074] In this case, the heat transferring medium is heating oil 121 as mentioned before. One open end 118 of solar heat collector 110 is extends into solar cooking range 130. The heat transferring material, heating oil 121 is connected and submerged in the sands 120 and 122. It transfers the solar heat from 121 to 122. Further more, the liquid heat transferring medium heating oil circulates automatically in solar heat collector 110 and

the enclosed compartment 131 of range 130. The oil is a very efficient heat-transferring medium.

[0075] In other cases, the solar heat collector may be a mounted panel. It may have two ends are extended into the range. It may also connect the one end or two ends through conduit(s) with the range and transfer the solar heat from solar heat collector 110 to solar cooking range130.

[0076] Fig. 2 is a perspective view that illustrates schematically a set of alternative solar cooking appliances 200 including the backup electric heating elements, operation parameter indicating and controlling system;

[0077] Referring to Fig. 2, a set of solar cooking appliances include a solar heat collector 210, a solar cooking range 230, two liquid conduits 215 and 216 connect the solar heat collector 210 with the heat exchanger 225 that is equipped in the solar cooking range 230. The pump and other accessories are not show in Fig.3.

[0078] The solar heat collector 210 is a panel mounted by 5 evacuated-tube solar heat collectors having its inlet 211 and outlet 212. The solar heat storage and conducting material 220 is filled in the solar heat collector 210. In this case it is sand.

[0079] The solar cooking range 230 includes an enclosed compartment 231 with heat insulation coat. The solar heat storage and conducting material 222 is filled in the solar cooking range 230. In this case it is turves. Both sand and turves are not shown in Fig.2. An oven 232 is arranged in 231 with a handle 2321 and a watching eye 2322. Two electric heat elements (not show in Fig. 2) are equipped in the oven 232.

[0080] The oven 232 further includes an equipped upper electric heat element and/or a lower equipped electric heat element with power supply as a backup energy source. (not shown in Fig.2)

[0081] Three chambers 233, 234 and 235 are located in the solar cooking range 230 and surrounded by the heat storage and conducting material 222, i.e. turves. Three electric heat elements 267, 268 and 269 are equipped in the bottoms of the chambers 233, 234 and 235 respectively. The electric heat elements 267, 268 and 269 have their power supply, switchers 261, 262, and 263. They also have operation characteristic rotate indication devises 264, 265 and 266 and control system. The switchers 261, 262, and 263 and the operation feature characteristic rotating indicators 264, 265 and 266 including control system are arranged on the control panel 260.

[0082] Three chambers 233, 234 and 235 have the standard module size and shape. Each solar cooking utensil that used for the solar coking range 230, has a heat conductive coat having its inside size and shape matched with the outside size and shape of said utensil, and its outside size and shape matched the inside size and shape of said standard module cooking chamber in said solar cooking range. So that even each utensil may have different shape and size, when the food is cooked, every utensil with its coat can be

located in any one of the standard chamber in the range 230. Further more each solar cooking utensil that used for the solar coking range 230, has a heat insulation coat having its inside size and shape matched with the outside size and shape of said utensil, and its outside size and shape matched the inside size and shape of said standard module cooking chamber in said solar cooking range. So that when the electric heat element is in operation, the heat element heats the utensil and cooks the food only. The electric power does not need to heat all the heat storage and conducting material in the solar cooking range 230.

[0083] A heat exchanger e.g. a fin tube 225 locates in the solar cooking range 230 and has two fittings 2251 and 2252 on the surface of the solar cooking range. The conduit 215 has one end connects to the fitting 2251 and the opposite end connects to an end 211 of the solar heat collector 210. The fitting 2252 connects to an end of the conduit of 216. The opposite end of 216 connects the end 212 of solar heat collector 210.

[0084] The liquid heat transferring medium, e.g. fuel oil, is filled in heat exchanger 225, conduits 215 and 216. It is permeated in the sand within solar heat collector 210. So the fuel oil is also the heat storage and conducting material of solar heat collector 210. The other accessories to circulate the liquid such pump are not discussed and shown in the Fig.2.

[0085] When the sunlight 201 shines on the solar heat collector, the collector absorbs the heat and stores the heat in the sand wherein. The heat transferring material, i.e. fuel oil pick up the heat and carry it through a close-loop 211-2251-2252-212-211 and transfers the heat to the turves in the solar cooking range 230. The cooking utensils 233, 234 and 235 pick up the solar heat through the heat connection between the walls of the chambers and utensils to cook the foods. When the solar power is not enough for the cooking, the electric heat elements 267, 268 and 269 as a backup power source provide the additional energy.

[0086] The solar cooking appliances 200 further include a fixing and supporting trestle 217 that arrange and support the five solar heat collectors at the proper locations and situations. It allows the adjustment of the incidence angle of the solar heat collector 210 to the sun light. Four wheels 271, 272, 273 and 274 are installed in the four bottom corners of the supporting trestle 217 for adjust the direction of the solar heat collector 210. A sundial (not shown in Fig. 2) is a cone bar. It attaches to the solar heat collector perpendicularly for indicating the incidence angle of sun light;

[0087] A light reflecting object (not shown in Fig. 2) is equipped under the evacuated-tube for focusing the surrounding sun light to the solar heat collector;

[0088] The solar cooking range 230 further includes an empty hot water tube buried in the heat storage and conducting material and has its inlet fitting 237 and out let fittings 238 at the wall of the range230. When the range is cooking, the tube is empty. After the cooking, cool water is flowed through the tube to use the remained heat in the range 230 for making hot water.

[0089] Based on above detailed descriptions and discussions of the samples, other modifications will be apparent to those skilled in the art and, therefore, the invention is defined in the claims.

I CLAIM:

1. A set of solar cooking appliances, comprising:

   a solar heat collector in which first heat storage and conducting material is filled, wherein solar heat is collected, stored in and transferring from;

   a solar cooking range filled with second heat storage and conducting material, connected with said solar heat collector, wherein the solar heat is received from said solar heat collector and stored for food cooking;

   the said solar cooking range having a heat insulated and enclosed compartment, wherein the heat storage and conducting material is filled; a cooktop covering the top surface of said solar cooking range;

   a set of cooking chambers arranged in said enclosed compartment and located in said head storage and conducting material;

   a heat-transferring medium connected said solar heat collector to said heat storage and conducting material in said solar cooking range and transferred the solar heat;

   a set of solar cooking utensils with a heat insulated lids, located in the cooking chambers of said solar cooking range, wherein the food is cooked;

   a group of removable parts that cover said cooking chambers one by one;

   a group of removal parts that insert said cooking chambers one by one; and

   the necessary accessories;

2. The said solar heat collector, according to claim 1, that is a evacuated-tube solar heat collector;

3. The said solar heat collector, according to claim 1, that is a group of evacuated-tube solar heat collectors;

4. The said evacuated-tube solar heat collectors; according to claim 2 and 3, having a open end extended into said solar cooking range;

5. The said evacuated-tube solar heat collectors; according to claim 2 and 3, having a open end heat connected with said solar cooking range by said heat-transferring medium;

6. The said solar heat collector, according to claim 1, that is a group of modular evacuated-tube solar heat collectors that mounted in a certain shape, e.g. in parallel row or column in full or partial cone-shaped;

7. The said solar heat collector, according to claim 6, having two open ends; said one of two open ends is closed and another one of two open ends is extended into said solar cooking range;

8. The said solar heat collector, according to claim 6, having two open ends; said one of two open ends is closed and the nother one of two open ends is connected with said solar cooking range by said heat-transferring medium;

9. The said solar heat collector, according to claim 6, having two open ends; said both two open ends are located into said solar cooking range;

10. The said solar heat collector, according to claim 6, having two open ends; said both two open ends are heat connected with said solar cooking range by said heat-transferring medium;

11. The said solar heat collector, according to claim 6, having two open ends; said both two open ends are connected with a heat exchanger located in said solar cooking range through two fittings and two connecting tubes;

12. The said evacuated-tube solar heat collector, according to claim 2, 3 and claim 6, that is a evacuated toughened-glass tube solar heat collector;

13. The said evacuated-tube solar heat collector, according to claim 2,3 and claim 6, further comprising a transparent plastic protective mantle for safety reason

14. The said first and/or the second heat storage and conducting material, according to claim1, that is a solid material, e.g. ore, metal or alloy;

15. The said first and/or the second heat storage and conducting material, according to claim1, that is a solid material, e.g. turves or soil;

16. The said ores heat storage and conducting material, according to claim 14, that is quartz sand or graphite;

17. The said first and/or the second heat storage and conducting material, according to claim1, that is a liquid material, e.g. water or oil;

18. The said first and/or the second solar heat storage and conducting material, according to claim1, that is cooking oil e.g. colza oil or bean oil;

19. The said oil heat storage and conducting material, according to claim17, that is petroleum or heating oil;

20. The said first and/or the second heat storage and conducting material, according to claim1, that is head storage chemical or phase change heat storage material, e.g. CaO plus H_2O or paraffin;

21. The said first and/or the second heat storage and conducting material, according to claim1, that is a combined material of two or more heat storage and conducting materials, e.g. oil filled in the quartz sand or plumbaginous paraffin (graphite and paraffin);

22. The said solar cooking range, according to claim 1, comprising a structure for receiving one end or two ends from a solar heat collector that extended the end(s) into the solar cooking range;

23. The said solar cooking range, according to claim 1, comprising a structure for connecting the cooking range with heat transferring medium(s) that transfer the solar heat to the solar cooking range.

24. The said solar cooking range, according to claim 1, wherein further comprising a heat exchanger arranged in said enclosed compartment of solar cooking range, and surrounded by said heat storage and conducting material wherein; said heat exchanger having the ends connected to the fittings on the wall of said cooking range for receiving the solar heat from solar heat collector;

25. The said solar cooking range, according to claim 1, having a heat insulated coating on the surface of said enclosed compartment;

26. The said solar cooking range, according to claim 1, having a removable heat insulation greatcoat;

27. The said solar cooking range, according to claim 1, further comprising a structure for breathing and expansion of the heat storage and conducting material within said enclosed compartment; said structure is a hole and fitting on the top of said enclosed compartment for open to atmosphere; or is a expansible subject located in said enclosed compartment, e.g. a piece of bubble plastic or a polymeric empty stomach ball;

28. The said heat insulated and enclosed compartment of solar cooking range, according to claim 1, that is an airtight compartment with receiving fittings for receiving heat tubes from solar heat collector;

29. The said heat insulated and enclosed compartment of solar cooking range, according to claim 1, that is made of metal e.g. steal or copper;

30. The said heat insulated and enclosed compartment of solar cooking range, according to claim 1, that is made of alloy e.g. stainless steal or aluminum alloy;

31. The said heat insulated and enclosed compartment of solar cooking range, according to claim 1, that is built by heat resistant material, e.g. ceramic or concrete;

32. The said heat insulated and enclosed compartment of solar cooking range, according to claim 1, that is built by heat resistant material, e.g. brick or soil;

33. The said heat insulated and enclosed compartment of solar cooking range, according to claim 1, wherein having a receiving fitting to receive a tube from a solar heat collector;

34. The said a group of cooking chambers, according to claim 1, wherein each cooking chamber is enclosed by heat conductive material, e.g. stainless steel or copper, for separating the heat storage and conducting material from the cooking utensil;

35. The said cooking chamber, according to claim 1, that is a cooking chamber in cylinder bucket shape;

36. The said cooking chamber, according to claim 1, that is a cooking chamber in hemisphere shape;

37. The said enclosed compartment of solar cooking range, according to claim 1, further comprising a smaller closed part, usually named as a oven, wherein the food is cooked or heated, said oven is closed by heat conductive metal, e.g. stainless steel or copper sheet and surrounded by heat storage and conducting material; said oven having a heat insulated door with a watching eye at a side wall of said solar cooking range;

38. The said oven, according to claim 3 7 , further comprising one or two electric heat element(s) with power supply as a back up energy source;

39. The said smaller enclosed compartment or oven, according to claim 37, further comprising a equipped upper electric heat element and/or a equipped electric heat element with power supply as a back up energy source;

40. The said electric heat element, according to claim 37, wherein further comprising a operation characterizes parameter measuring, indicating and controlling system;

41. The said smaller enclosed compartment or oven, according to claim 37, further comprising a removable drawer filled with said heat storage and conducting material and located in said oven when the oven is not in use ;

42. The said enclosed compartment of solar cooking range, according to claim 1, wherein further comprising a hot water tube surrounded by heat storage and conducting material for using remaining heat to make hot water after coking; said

water tube having one end connected to a inlet fitting and the opposite end connected to a outlet fitting on the wall of solar cooking range, said fittings are for receiving tubes from hot water appliance;

43. The said heat-transferring medium, according to claim 1, that is a heat tube with or without the contacting fins, having its one end in said solar heat collector and the other end extended into said solar heating range;

44. The heat tube, according to claim 43, that is a group of heat tubes, wherein each tube connects said solar heating range with one solar heat collector respectively;

45. The heat-transferring medium, according to claim1, that is a metal conductor, e.g. copper or aluminum conductor;

46. The heat-transferring medium, according to claim1, that is a metal wall of said solar cooking range;

47. The said heat transferring medium, according to claim 1, that is a conduit connected liquid heat storage and conducting material in solar heat collector with same liquid heat storage and conducting material in solar cooking rang and allowed said liquid circulate in between.

48. The said heat transferring medium, according to claim 1, that is two heat insulated liquid conduits wherein each conduit having one end connects to one end of a two end solar heat collector, the two opposite ends of said conduits connect to two receiving fittings on a said solar cooking range and allow a liquid circulate in between of said solar heat collector, cooking range and two tubes;

49. The said heat transferring medium, according to claim 1, that is a couple liquid conduits, wherein one end of each conduit connects to one of two ends of a solar heat collector, the opposite ends of the two conduits are connected to two receiving fittings that connected to a liquid heat exchanger located in said solar cooking range wherein a solid heat storage and conducting material is filled; said solar heat collector , liquid heat exchanger and two conduits are formed as a closed loop wherein a heat storage and conducting medium is circulated;

50. The heat-transferring medium, according to claim 1, that is the same as a said heat storage and conducting material in said solar heat collector;

51. The heat-transferring medium, according to claim 1, comprising the same said heat storage and conducting material in solar heat collector, that extend into said solar cooking range;

52. According to claim 1,the said heat-transferring medium, , is said heat storage and conducting material in said solar heat collector , said heat storage and conducting

material is closely connected to said heat storage and conducting material in said solar cooking range;

53. The heat-transferring medium, according to claim 1, that is a combination of two or more heat-transferring mediums, e.g. heat tube within a solid material, e.g. quartz sand;

54. The said solar cooking utensils, according to claim 1, wherein each utensil can be inlayed fully in one of said cooking chamber in said solar cooking range and has the size and shape matched with the size and shape of at least one of said cooking chambers;

55. The said solar cooking utensils, according to claim 1, wherein each utensil having a lower part and a upper part, said lower part can be inlayed in one of said cooking chamber and having its size and shape matched with the size and shape of at least one of said cooking chambers, said upper part having a head insulation greatcoat;

56. The said group of solar cooking utensils, according to claim 1, comprising a cylinder container made of stainless steel or glass;

57. The said group of solar cooking utensils, according to claim 1, comprising a hemisphere container made of stainless steel or glass;

58. The said solar cooking utensils, according to claim 1, further comprising a two layer toughness glass lid;

59. A group of cooking chambers, according to claim 1, wherein every cooking chamber has standard module size and shape;

60. A group of solar cooking utensils, according to claim 1, wherein each of said utensil has a heat conductive coat having its inside size and shape matched with the outside size and shape of said utensil, and its external size and shape matched the internal size and shape of said standard module cooking chamber in said solar cooking range;

61. A set of removal parts, according to claim 1, wherein each heat insulation part covers one top of said a group of cooking chambers, when the cooking chamber is either in use or not in use ;

62. ?A set of removable parts, according to claim 1, wherein each heat insulation part inserts and fully filled in one of said a group of cooking chambers when it is out of service;

63. The said accessories, according to Claim 1, comprising a fixing and supporting trestle that arrange and support each part of the solar cooking appliances at a appropriate position ;

64. The said fixing and supporting trestle, according to Claim 63, comprising a structure that allows the adjustment of the incidence angle to the sun light for said solar heat collector;

65. The said fixing and supporting trestle, according to Claim 63 comprising a structure that allows the adjustment of the direction of the solar heat collector to the sun light, e.g. a rotatable base;

66. The said accessories, according to Claim 1, comprising a light reflecting object that focus the surrounding sunlight to the solar heat collector;

67. The said accessories, according to claim 1, comprising a sundial, e.g. a cone bar attached to the solar heat collector perpendicularly for indicate the incidence angle of sun light;

68. The said accessories, according to claim 1, comprising bag and/or membrane to wrap or cover the food in the solar cooking appliance, e.g. metal, paper or plastic bag and membrane;

69. The said accessories, according to claim 1, comprising a suitcase, wherein the solar cooking appliances are arranged and packaged to form a potable solar cooking appliances;

70. The said solar cooking range according to claim 1, further comprising a set of wheels;

71. A set of solar cooking appliances according to claim 1, further comprising a set of electric power heat elements with power supply at the bottom of each cooking chamber to form a solar cooking appliance fueled mainly solar energy and also fueled electric power as a back up energy source;

72. The said an electric power heat element with power supply, according to claim 69 and 64 comprising: a power cable having intensive heat-resistant temperature, the measurement and indication devices for measuring and indicating the solar cooking appliance's operating characteristic parameters, e.g. timing, temperature, pressure, moisture etc;

73. The said electric power heat element with power supply, according to claim 72, further comprising: a cooking control system for measuring, indicating and controlling the solar cooking appliance's operating characteristic parameters, e.g. timing, temperature, pressure, moisture etc;

74. The said accessories of a set of solar cooking appliance further comprising a group of heat insulation coat for each solar cooking utensils having its internal size and shape matched with the external size and shape of said utensil, and its external size and shape matched with the internal size and shape of said cooking chambers in said solar cooking range, whatever said chamber is a standard module cooking chamber or not;

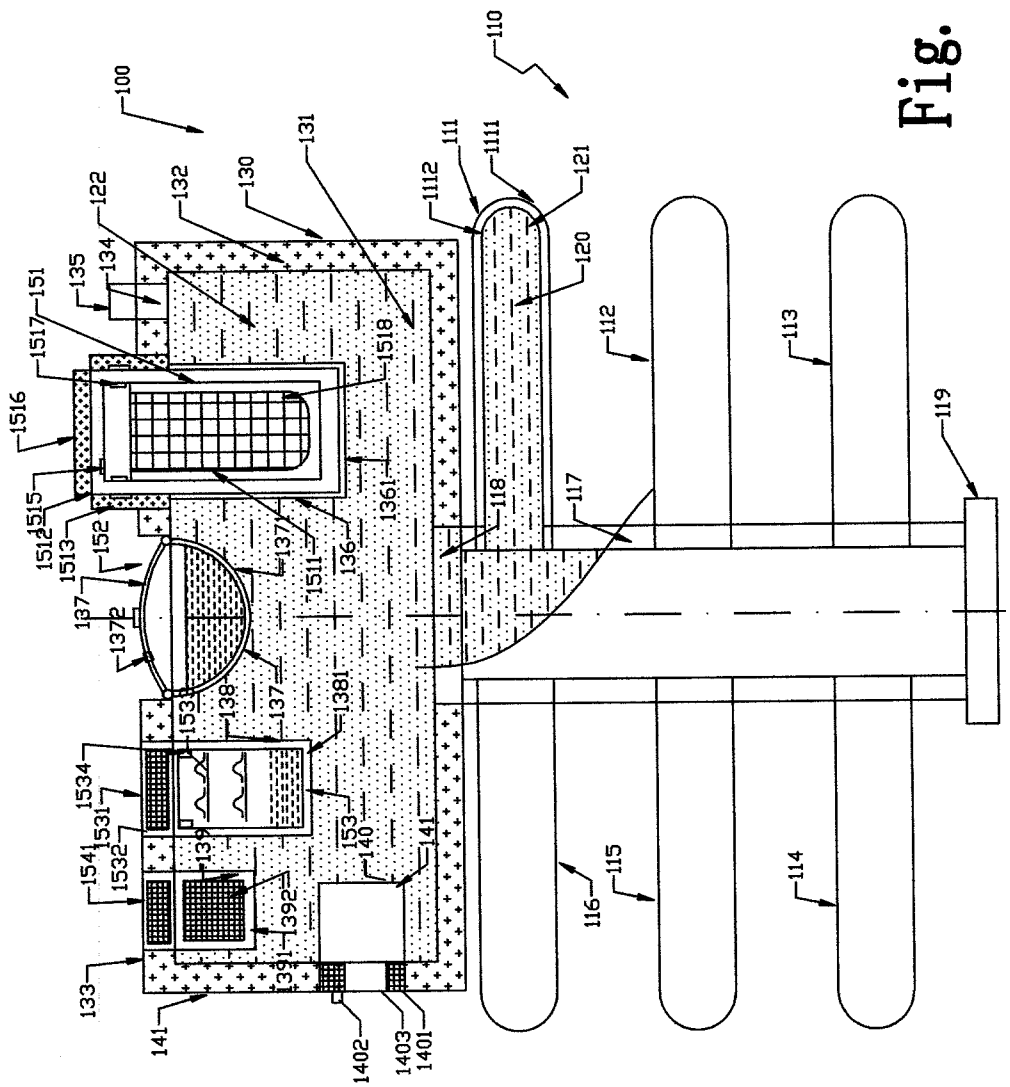
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Fig. 1

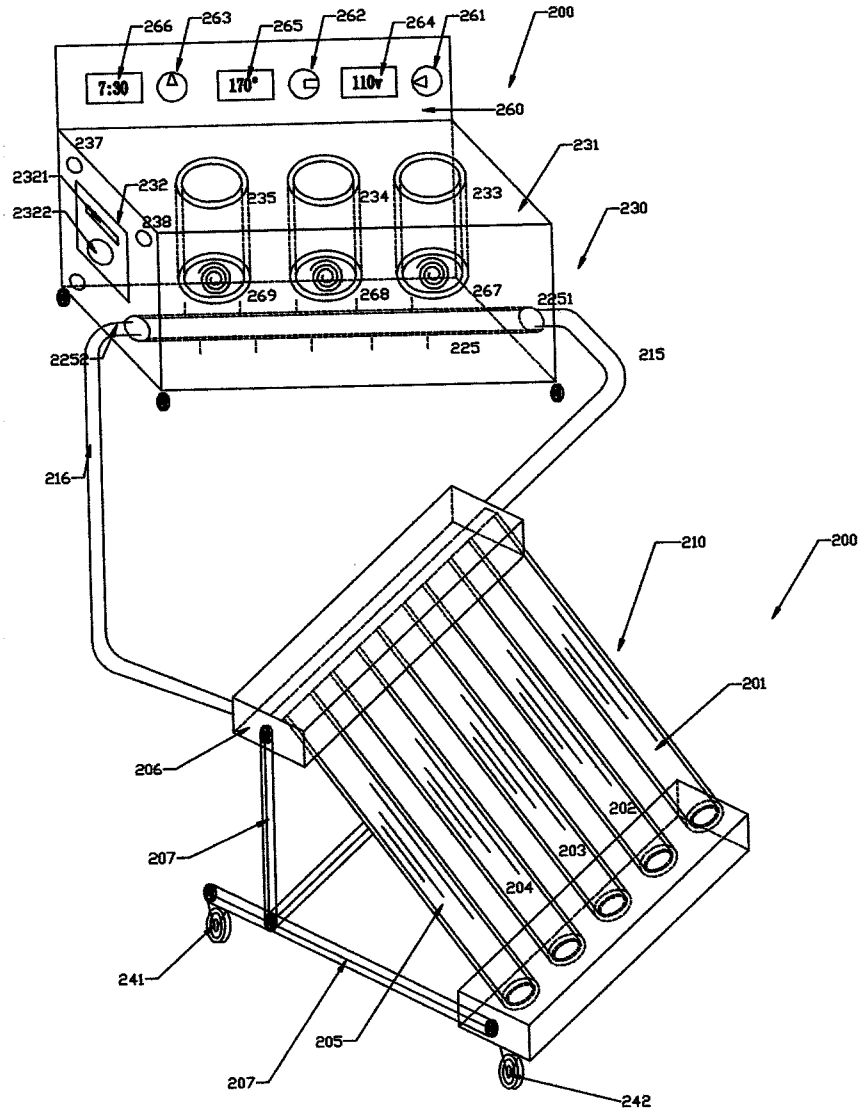
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Fig. 2

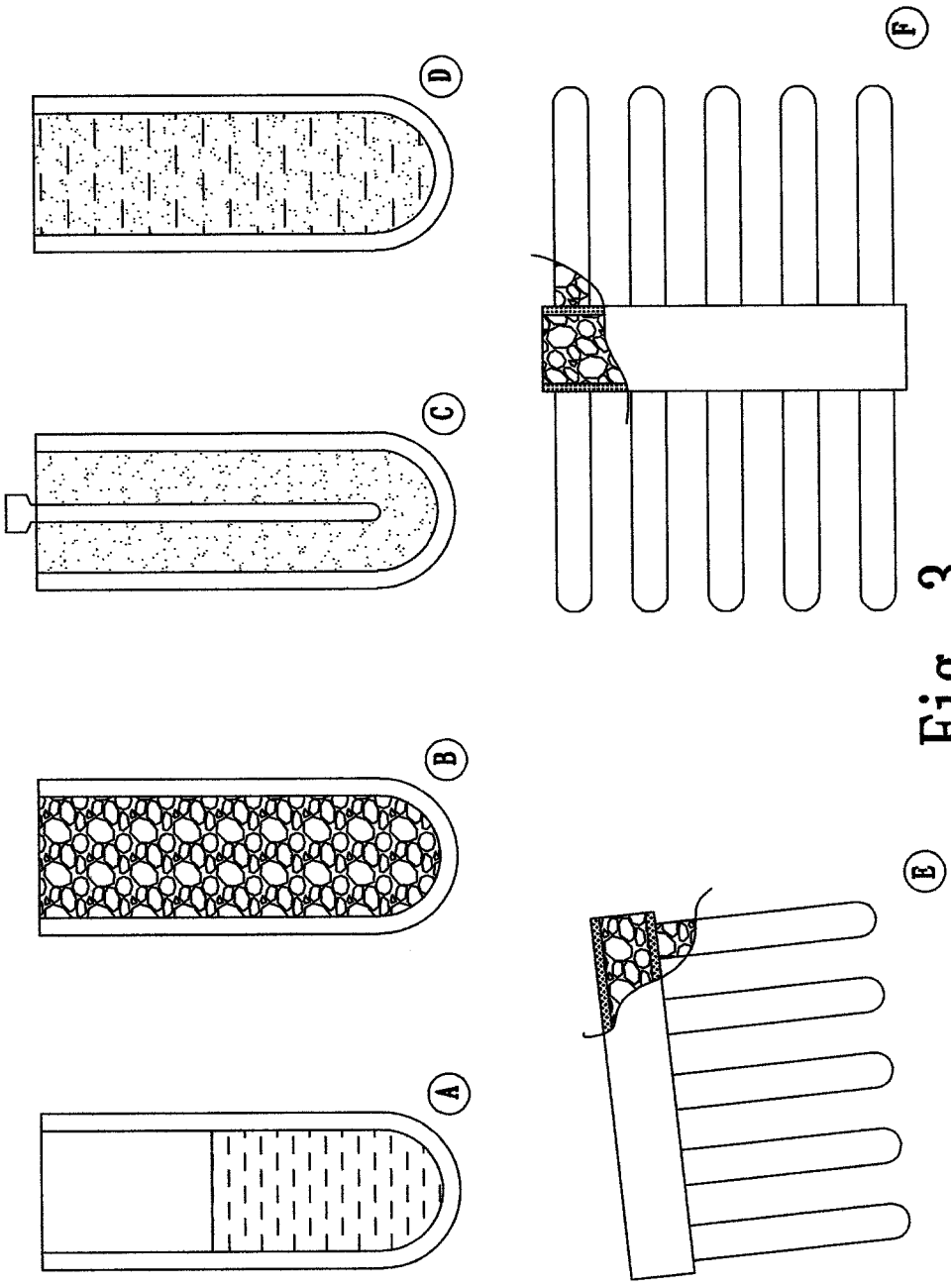

Fig. 3

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CA2010/001120

A. CLASSIFICATION OF SUBJECT MATTER
IPC: ***F24J 2/02*** (2006.01) , ***A47J 37/00*** (2006.01) , ***F24J 2/05*** (2006.01)
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)
IPC (2006.01): F24J and A47J

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic database(s) consulted during the international search (name of database(s) and, where practicable, search terms used)
Epoque (Epodoc), Canadian Patents Database (CPD), Internet

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	MULLER, DR. HEINZ-JOACHIM, "Solar Steam Cooker", 46th ANZSES (Australian and New Zealand Solar Energy Society) Conference [online], ISES-AP 2008 [retrieved on 12-10-2010]. Retrieved from the Internet: <URL: http://www.sun2steam.com.au/solarcooker/cooker.pdf>.	1-73
A	CN 201206904 Y (JINGTIAN, ZHAO et al.) 11 March 2009 (11-03-2009) *whole document*	1-73

[ ] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
26 October 2010 (26-10-2010)	2 November 2010 (02-11-2010)

Name and mailing address of the ISA/CA	Authorized officer
Canadian Intellectual Property Office Place du Portage I, C114 - 1st Floor, Box PCT 50 Victoria Street Gatineau, Quebec K1A 0C9 Facsimile No.: 001-819-953-2476	Kristian MacKenzie (819) 934-4267

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CA2010/001120

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of the first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons :

1. [ ] Claim Nos. :
because they relate to subject matter not required to be searched by this Authority, namely :

2. [X] Claim Nos. : 74
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically :

the claim is so poorly written that it is impossible to understand the scope of the claim.

3. [ ] Claim Nos. :
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows :

1. [ ] As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. [ ] As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.

3. [ ] As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claim Nos. :

4. [ ] No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claim Nos. :

Remark on Protest

[ ] The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

[ ] The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

[ ] No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CA2010/001120

Patent Document Cited in Search Report	Publication Date	Patent Family Member(s)	Publication Date
CN201206904Y	11-03-2009	CN201206904Y	11-03-2009