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(72) Inventor; and
(71) Applicant : **BEN SHLOMO, Asher** [IL/IL]; Kfar Korazim, 12391 Kfar Korazim (IL).

(74) Agent: **GOLDMIND PATENTS**; Matam-Advance Technology Center, Building No. 30, P.O.B. 15006, 31905 Haifa (IL).

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(54) Title: SYSTEM FOR PROVIDING SOLAR HEATING FUNCTIONALITY TO A FLUID HEATING SYSTEM

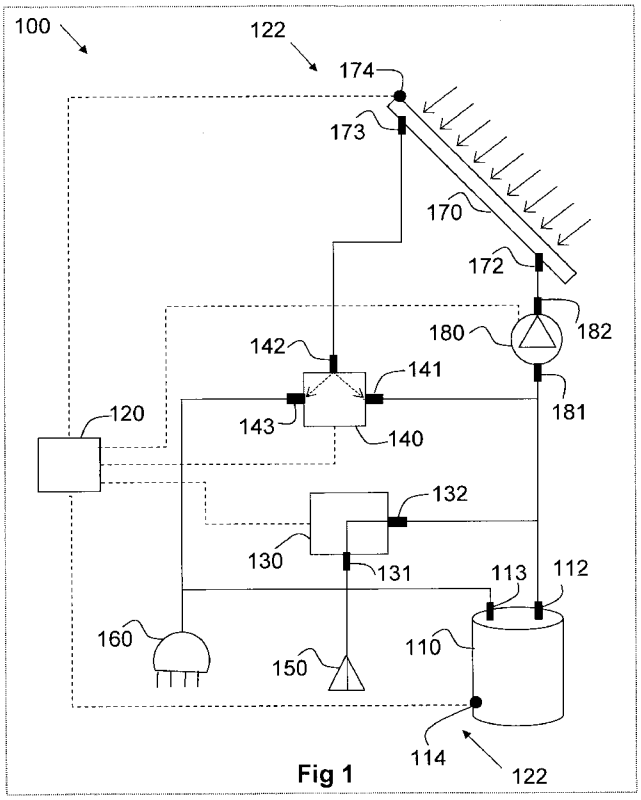

Fig 1

(57) Abstract: The present invention describes enhancement of non-solar water heating systems (such as systems that operate on gas, diesel fuel, or electricity energy) to work with solar heating panel as well. The retrofitable system addresses the need to provide a simple to install, cheap, and clean add-on solar panel and parts to existing non-solar based heating systems. The hot water extracted from the system has homogeneous temperature, and when water is not taken from the system the hot water are being collected in the existing boiler.

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— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

SYSTEM FOR PROVIDING SOLAR HEATING FUNCTIONALITY TO A FLUID HEATING SYSTEM

FIELD OF THE INVENTION

The present invention, in some embodiments thereof, relates to heating systems. More particularly, the present invention relates to a system for providing solar heating functionality to fluid heating systems previously configured to use other heating methods such as gas, fuel, or electrically heated systems.

BACKGROUND OF THE INVENTION

Existing systems for heating fluids such as water and the like may operate on gas, diesel fuel, electricity or solar energy. Due to the rising cost of gas, diesel fuel, and electricity it is desirable to use solar energy for heating. In addition, solar energy is a green resource and its use does not generate pollution. In order to save the cost of buying a new boiler it is desirable to convert existing heating system to operate on solar energy or even mix the existing method together with operation on solar energy, and thus save the cost of a new boiler.

A typical non-solar heating system typically uses a dual-pipeline boiler which is served by just two pipelines: a cold-water line and a hot-water line. In solar based systems the boiler requires two more pipelines connecting the boiler to the solar heating panels. Consequently, there is no simple way to use existing dual-pipeline boilers with solar heating systems.

If the inlet and outlet of the solar heating panels are connected directly to the cold-water line and hot-water line of the boiler, respectively, water would only flow through the system when water is drawn from the boiler. As a result hot water would remain in the solar panel for long periods of time and this would

prevent hot water from collecting in the boiler. This may even cause overheating and damage to the pipes in the solar panel. Furthermore, when hot water is drawn from the boiler, hot water from the solar panel may mix with water from the boiler resulting in the temperature of the water leaving the system being non-homogeneous. It will be appreciated that this would be most undesirable in many household settings such as during a shower or the like.

One suggested system for adapting a boiler based heating system to suit solar heating technologies is described in the French patent document FR2557959 to Geneve Philippe, titled "Simplified Solar Water Heater". Philippe suggests connecting a T-connector to the boiler inlet pipe in a way that reduces the diameter of the pipe. Such a pipe would impede the water flow and increase pressure needed for circulating the water in the system. Such a system is prone to build-up of lime scale inside the pipes. Furthermore, like similar commercial solutions, Philippe's solution involves making changes to the existing boiler by inserting a pipe into the boiler. It is noted that such a change to an old boiler is problematic as it may result in damage to boiler parts. Other solutions involve the addition of another boiler which would incur still more costs.

There is a need for a retrofittable system for enhancing a standard heating system with solar heating functionality. The present invention addresses this need.

SUMMARY OF THE INVENTION

In accordance with a first embodiment, the present invention is directed to providing a solar enabling heating system for providing solar heating functionality to a base fluid heating system, wherein said base fluid heating system comprising at least one fluid reservoir having a cold fluid line in fluid communication with at least one fluid source and a hot fluid line in fluid communication with at least one fluid tap. The solar enabling heating system

comprising: a solar heater, having an inlet for connecting to the cold fluid line and an outlet for connecting to the hot fluid line; and at least one diverter valve configured to disconnect the fluid reservoir from said solar heater when fluid is drawn from the fluid reservoir via the fluid tap.

Optionally, the solar heater comprises at least one solar panel configured to heat fluid passing therethrough.

Preferably, the solar enabling heating system further comprising at least a first circulator pump configured to drive fluid from the cold fluid line through said solar heater.

Preferably, the solar enabling heating system further comprising at least one heat exchanger unit configured to transfer heat to a first fluid circulation loop from a second fluid circulation loop.

Preferably, the first fluid circulation loop is in fluid communication with the fluid reservoir. Preferably, the said first circulator pump configured to drive fluid from the cold fluid line of the fluid reservoir to said heat exchanger.

In accordance with another embodiment the solar enabling heating system has a second fluid circulation loop comprises a closed loop including a solar panel and a second circulator pump wherein said second fluid circulation loop contains a fluid selected from a group consisting of: water, antifreeze, oil-based solutions, water-based solutions and combinations thereof.

Preferably, in the solar enabling heating said diverter valve comprises a three way valve.

Preferably, the solar enabling heating system further comprising a control unit configured to activate at least one circulator pump.

Preferably, said control unit comprises: at least one flow switch configured to sense fluid flow into the system from the fluid source,
at least one temperature monitor configured to monitor the temperature of fluid within the fluid reservoir and the temperature of fluid within said solar heater.

Preferably, said control unit is configured to set said diverter valve to disconnect the fluid reservoir from said solar heater when fluid is drawn from the fluid reservoir via the fluid tap.

Preferably, said control unit is configured to activate at least one circulator pump when the fluid within said solar heater has a higher temperature than the fluid within the fluid reservoir.

Preferably, said control unit comprises a differential thermostat configured to control at least one of said circulator pump and said diverter valve.

Preferably, said control unit is configured to communicate with at least one of said circulator pump and a diverter valve using a communication means selected from a group consisting of: wired communication lines, WiFi technology, Bluetooth, and radio communication (RF).

Preferably, said temperature monitor comprises at least one computerized thermostat in the fluid reservoir.

In accordance with another embodiment, said temperature monitor comprises at least one thermostat in the fluid reservoir and at least one thermostat in said solar heater.

In accordance with other embodiments in the solar enabling heating system said fluid reservoir comprises at least one of a group consisting of: a boiler, a

swimming pool, a storage tank, a chemical storage vat, a fuel tank, a gas balloon and a dewer.

In accordance with other embodiments of the solar enabling heating system said fluid reservoir contains a fluid selected from a group comprising: water, oil, fuel, gas or combinations thereof.

BRIEF DESCRIPTION OF THE FIGURES

Some embodiments of the invention are herein described, by way of example only, with reference to the accompanying drawings. With specific reference now to the drawings in detail, it is stressed that the particulars shown are by way of example and for purposes of illustrative discussion of the preferred embodiments of the present invention only, and are presented in the cause of providing what is believed to be the most useful and readily understood description of the principles and conceptual aspects of the invention. In this regard, no attempt is made to show structural details of the invention in more detail than is necessary for a fundamental understanding of the invention, the description taken with the drawings making apparent to those skilled in the art how the several forms of the invention may be embodied in practice.

In the drawings:

Figure 1 is a schematic illustration of a solar enabled water heating system utilizing a solar heater in accordance with a first embodiment of the present invention;

Figure 2 represents the system of Fig. 1 in a first configuration in which the water tap is closed so that hot water does not leave the system;

Figure 3 represents the system of Fig. 1 in a second configuration in which the water tap is open, allowing hot water to flow out of the system, and

Figure 4 is a schematic illustration of a solar enabled water heating system in which the solar panel operates as part of a closed system in accordance with a second embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION AND FIGURES

Before explaining at least one embodiment of the invention in detail, it is to be understood that the invention is not necessarily limited in its application to the details set forth in the following description or exemplified by the examples. The invention is capable of other embodiments or of being practiced or carried out in various ways.

It will be appreciated that certain features of the invention, which are, for clarity, described in the context of separate embodiments, may also be provided in combination in a single embodiment. Conversely, various features of the invention, which are, for brevity, described in the context of a single embodiment, may also be provided separately or in any suitable sub-combination or as suitable in any other described embodiment of the invention. Certain features described in the context of various embodiments are not to be considered essential features of those embodiments, unless the embodiment is inoperative without those elements.

The present invention provides a unique and novel system for providing non-solar enabled fluid heating systems with solar heating functionality. In the detailed description that follows, like element numerals are used to indicate like elements appearing in one or more of the figures.

The main idea of embodiments of the present solution is to have a combined heating system in which fluid flow to the user may be separated from the flow to the solar panel.

For clarity, embodiments described hereinbelow refer to simple boiler applications for heating water. It will be appreciated, however that other embodiments of the system may be applied to the heating of other fluids such as water based solutions, oils, fuels, gases and the like. Such fluids may be stored in various reservoirs such as boilers, swimming pools, storage tanks, chemical storage vats, fuel tanks, gas balloons and dewers.

Reference is now made to Figure 1 representing a water heating system 100 which uses a solar panel in accordance with a first embodiment of the present invention. The base system comprises a boiler 110 having a hot water line 113, and a cold water line 112; the system also comprises a cold water source 150 and water tap 160 for drawing hot water from the system as found in non-solar based systems.

In addition to the above components of the base system, embodiments of the solar enabling heating system 100 further include a solar heater consisting of: a solar panel 170, a controller 120, a circulator pump 180, a flow switch 130 and a diverter valve 140. These features may enhance the water heating system 100 by providing solar heating functionality as described below.

The solar panel 170 includes at least one panel-inlet 172 for introducing cold water and at least one panel-outlet 173 for delivering hot water to the boiler.

The controller 120 typically includes a differential thermostat control configured to receive input from a temperature monitor 122. According to some embodiments, the temperature monitor 122 may include at least one panel monitor 174, for monitoring the water temperature in the solar panel and at least one boiler monitor 114, for monitoring the water temperature in the boiler. Alternatively, the temperature monitor may include a single sensor for

monitoring the solar panel or the boiler. Various temperature monitors may be used for example thermometers, thermistors, temperature sensitive resistors, thermocouples and the like. In particular embodiments, a computerized "Virtual Thermostat" type HOT07C, may be configured to monitor fluid temperatures in the system.

The circulator pump 180 is configured and operable to urge water entering the pump 180 through pump-inlet 181 and exiting through pump-outlet 182. Thus the circulator pump 180 may drive the circulation of water through the system.

The flow switch 130 is provided for monitoring water flow through the system. Water is drawn through the flow switch 130 via a switch-inlet 131 to a switch-outlet 132. The flow switch 130 is configured to sense the water flowing through the system 100 when water is drawn from the system 100 through the water tap 160.

The diverter valve 140, sometimes referred to as the inverter valve, in the embodiment is a three way valve configured to direct water from valve-inlet 142 to either a first valve-outlet 141 or a second valve-outlet 143. In certain embodiments, the diverter valve 140 may provide a time delay of about 6 seconds or so as required.

Note that piping is provided to maintain fluid communication between the various components of the system 100 as outlined below:

- The cold-water line 112 of boiler 110 is connected via piping to the pump-inlet 181, to the switch-outlet 132 and to the first valve-outlet 141.
- The hot-water line 113 of boiler 110 is connected via piping to the water tap 160 as well as to the second valve-outlet 143.
- The cold water source 150 is connected via piping to the switch-inlet 131.
- The pump-outlet 182 is connected via piping to the panel-inlet 172. The panel-outlet 173 is connected via piping to the valve-inlet 142.

The controller 120 is configured to receive signals, typically from the flow switch 130 and the temperature monitor 122, and to control the circulator pump 180 and the diverter valve 140. Typically, electrical communication between these components is maintained via conducting wires. Alternatively, according to other embodiments, other communication protocols may be employed such as wireless communication, Bluetooth, WiFi, radio communication (RF) and the like.

Operation of circulator pump 180 may be controlled by the controller 120 and typically depends on the relative water-temperatures of the solar panel 170 and the boiler 110. Accordingly, a differential thermostat control 120 may be configured to send control signals to the circulator pump 180. Usefully, control signals may be used to activate the circulator pump 180 only when the water-temperature in the solar panel 170 as measured by the panel monitor 174 is higher than the water-temperature in boiler 110 as measured by boiler monitor 114. It is noted that when the water-temperature in the solar panel 170 is equal to or lower than the water-temperature in the boiler 110, the circulator pump 180 may usefully be rendered inactive.

Reference is now made to Figure 2 and to Figure 3 showing the system 100 of the first embodiments in two flow configurations. Figure 2 represents the system 100 in a first configuration in which the water tap 160 is closed. Figure 3 represents the system 100 in a second configuration in which the water tap 160 is open.

With particular reference to Figure 2, the system 100 of the first embodiment is shown in the first configuration. The tap 160 is closed so no water is drawn out of the system. In this configuration of the system 100, hot water in the solar panel 170 may be driven into the boiler 110 by the pump 180. Preferably, the system 100 is controlled such that water is only transferred into the boiler 110 when the panel water-temperature is higher than that of the boiler water-temperature.

With the water source 150 disconnected (closed), the flow switch 130 senses no water flow. This is communicated to the controller 120 which, following a suitable delay, for example a delay of 6 seconds, sets the diverter valve 140 to allow water to flow from the valve-inlet 142 to the second valve-outlet 143. An activation signal may also be communicated to the circulator pump 180. Water is then circulated through the panel 170, from the cold water line 112 of boiler 110 via the panel inlet 172. The cold water flowing through the panel 170 may be heated by solar energy. The hot water flowing out of the panel-outlet 173 flows via the diverter valve 140, back to the hot-water line 113 of boiler 110. As noted above, the circulator pump 180 is typically activated only when the water-temperature in the solar panel 170 is higher than the water-temperature in the boiler 110.

When the flow switch 130 senses water flow into the system 100 from the source 150, then the controller 120 sets the diverter valve 140 to change the direction of water flow enabling flow from the valve inlet 142 to the first valve outlet 141. This prevents water from flowing from the solar panel 170 to the boiler 110. In this configuration water does not flow from the panel 170 to the boiler 110. Rather, if the circulator pump 180 is active water is circulated in a small loop through solar panel 170 and the diverter 140. This enables the boiler to operate independently from the solar panel for example when water is running through water tap 160. This brings the system 100 into the second configuration as presented in Figure 3.

Reference is now made to Figure 3 which represents the system 100 in the second configuration with the water tap 160 open. When the water tap 160 is opened water is drawn into the system 100 from the source 150. The flow switch 130 senses the flow and the controller 120 sets the diverter 140 to direct water to the first valve-outlet 141 if it is not already in this state. In this second configuration, water may be drawn from boiler 110 via the water tap 160 in a similar manner to the operation of a non-solar boiler. It is noted that,

in contradistinction to prior art solutions, the temperature of the water running from the water tap 160 of the system 100 in the second configuration is stable.

In other embodiments of the solar heating system, the system may be a closed system in which the liquid from the solar panel does not mix with the water in the boiler. It is noted that in a closed system additives material such as antifreeze liquid may be introduced into the liquid in the solar panel. Variously, the liquid may be an oil-based solution, a water-based solution or the like. Closed systems may use devices such as heat exchanger to transfer heat energy between the panel liquid and the boiler water.

Reference is now made to Figure 4 representing a closed solar water heating system 400 according to another embodiment. It is noted that similar numbers are used for similar components as those of the first embodiments shown in Figure 1. The closed solar water heating system 400 further includes a heat exchange unit 190 configured to transfer heat between two separate water (liquid) circulation loops each circulation loop being driven by a dedicated circulator pump 180, 195. It is noted that the second circulator 195 is configured to drive hot liquid from the solar panel 170 to the heat exchange unit 190 and may therefore be configured to operate when the liquid temperature in the solar panel 170 is higher than that of the water temperature in the boiler 110. The operation of pump 195 may also be regulated by control 120 in the same manner as pump 180.

A first heat exchange inlet 194 and a first heat exchange outlet 193 connect the heat exchange to a first water loop, which includes the water boiler 110. A second heat exchange inlet 191 and a second heat exchange outlet 192 connect the heat exchange to a second loop, which is a closed loop passing through the solar panel 170.

- The first loop is formed by piping connecting the pump-outlet 182 to the first heat exchange inlet 194 and piping connecting the first heat exchange outlet 193 to the valve inlet 142.

- The second loop is formed by piping connecting solar panel outlet 173 to the second heat exchange inlet 191, piping connecting the second heat exchange outlet 192 to a pump-inlet 197 associated with the second circulator pump 195; and piping connecting a pump-outlet 196 of the second circulator pump 195 to the panel inlet 172.

It will be appreciated that, in contradistinction to the prior art, water heating systems 100 and 400 may provide a stream of hot water which has a steady homogeneous temperature when required. At other times, when water is not drawn from the system, the hot water may be collected in the boiler.

It should be clear that the description of the embodiments and attached Figures set forth in this specification serves only for a better understanding of the invention, without limiting its scope as covered by the following Claims.

It should also be clear that a person skilled in the art, after reading the present specification can make adjustments or amendments to the attached Figures and above described embodiments that would still be covered by the following Claims.

CLAIMS

1. A solar enabling heating system for providing solar heating functionality to a base fluid heating system,
   said base fluid heating system comprising at least one fluid reservoir having a cold fluid line in fluid communication with at least one fluid source and a hot fluid line in fluid communication with at least one fluid tap,
   said solar enabling heating system comprising:
   a solar heater, having an inlet for connecting to the cold fluid line and an outlet for connecting to the hot fluid line; and
   at least one diverter valve configured to disconnect the fluid reservoir from said solar heater when fluid is drawn from the fluid reservoir via the fluid tap.
2. The solar enabling heating system of claim 1 wherein the solar heater comprises at least one solar panel configured to heat fluid passing therethrough.
3. The solar enabling heating system of claim 1 further comprising at least a first circulator pump configured to drive fluid from the cold fluid line through said solar heater.
4. The solar enabling heating system of claim 3 further comprising at least one heat exchanger unit configured to transfer heat to a first fluid circulation loop from a second fluid circulation loop.
5. The solar enabling heating system of claim 4 wherein said first fluid circulation loop is in fluid communication with the fluid reservoir.
6. The solar enabling heating system of claim 5 wherein said first circulator pump configured to drive fluid from the cold fluid line of the fluid reservoir to said heat exchanger.
7. The solar enabling heating system of claim 4 wherein said second fluid circulation loop comprises a closed loop including a solar panel and a second circulator pump.

8. The solar enabling heating system of claim 7 wherein said second fluid circulation loop contains a fluid selected from a group consisting of: water, antifreeze, oil-based solutions, water-based solutions and combinations thereof.
9. The solar enabling heating system of Claim 1, wherein said diverter valve comprises a three way valve.
10. The solar enabling heating system of claim 1 further comprising a control unit configured to activate at least one circulator pump.
11. The solar enabling heating system of claim 10 wherein said control unit comprises:

    at least one flow switch configured to sense fluid flow into the system from the fluid source,

    at least one temperature monitor configured to monitor at least one of the temperature of fluid within the fluid reservoir and the temperature of fluid within said solar heater.
12. The solar enabling heating system of claim 11 wherein said control unit is configured to set said diverter valve to disconnect the fluid reservoir from said solar heater when fluid is drawn from the fluid reservoir via the fluid tap.
13. The solar enabling heating system of claim 11 wherein the control unit is configured to activate at least one circulator pump when the fluid within said solar heater has a higher temperature than the fluid within the fluid reservoir.
14. The solar enabling heating system of claim 11 wherein said control unit comprises a differential thermostat configured to control at least one of said circulator pump and said diverter valve.
15. The solar enabling heating system of claim 10 wherein said control unit is configured to communicate with at least one of said circulator pump and a diverter valve using a communication means selected from a group consisting of: wired communication lines, WiFi technology, Bluetooth, and radio communication (RF).

16. The solar enabling heating system of claim 11 wherein said temperature monitor comprises at least one computerized thermostat for monitoring fluid temperature in at least one of the fluid reservoir and the solar heater.
17. The solar enabling heating system of claim 11 wherein said temperature monitor comprises at least one thermostat in the fluid reservoir and at least one thermostat in said solar heater.
18. The solar enabling heating system of claim 1 wherein said fluid reservoir comprises at least one of a group consisting of: a boiler, a swimming pool, a storage tank, a chemical storage vat, a fuel tank, a gas balloon and a dewer.
19. The solar enabling heating system of claim 1 wherein said fluid reservoir contains a fluid selected from a group comprising: water, oil, fuel, gas or combinations thereof.

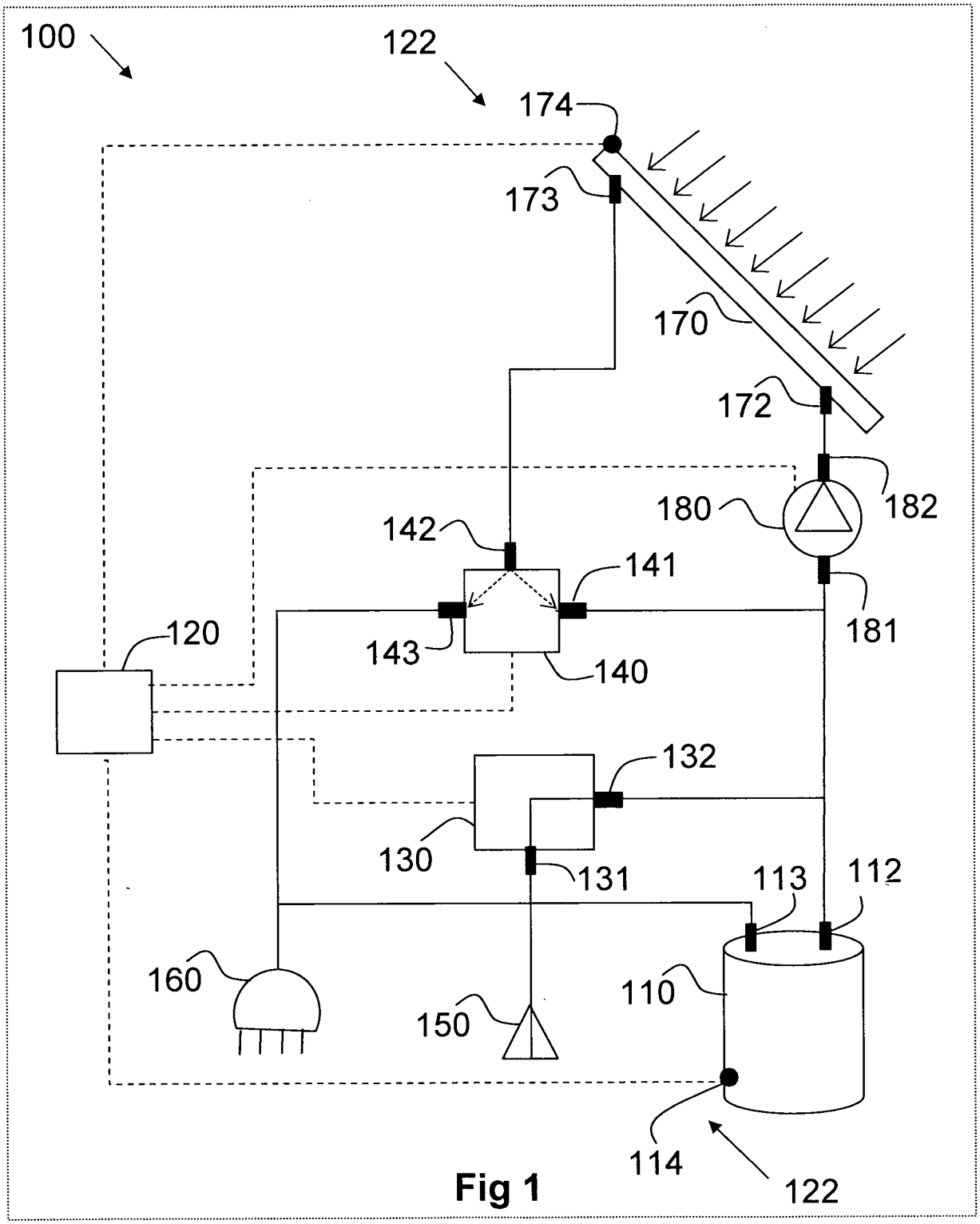
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Fig 1

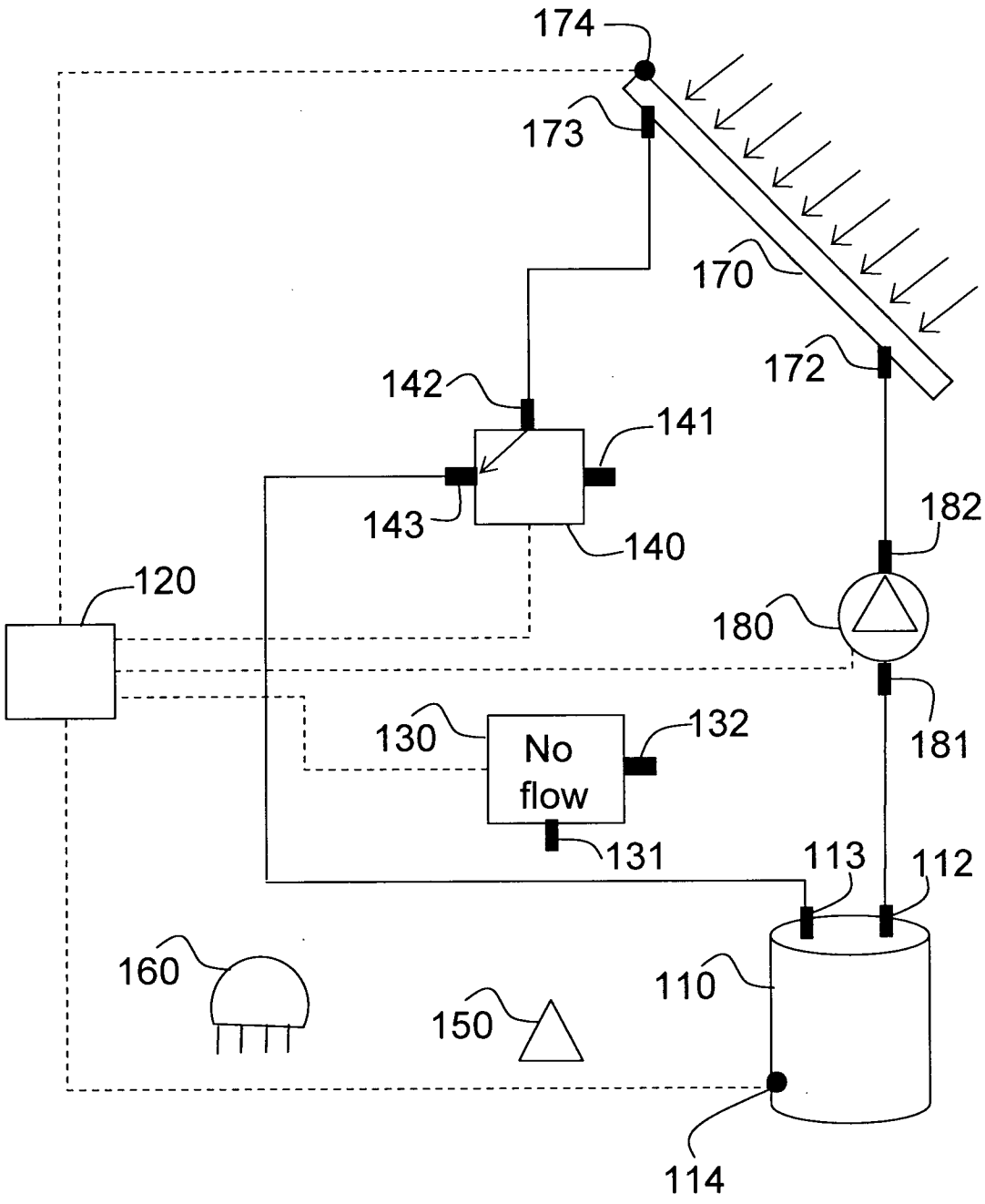
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Fig 2

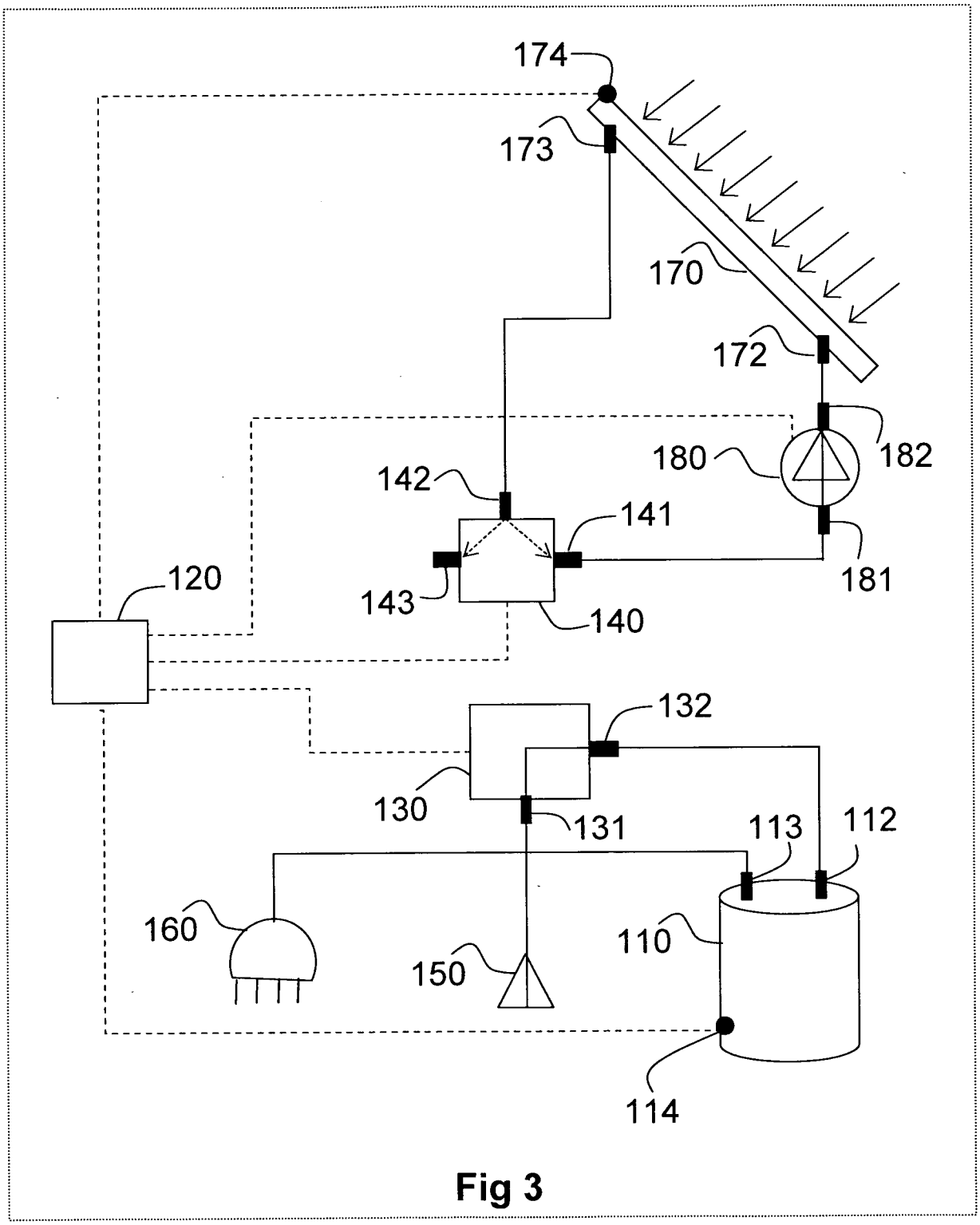
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Fig 3

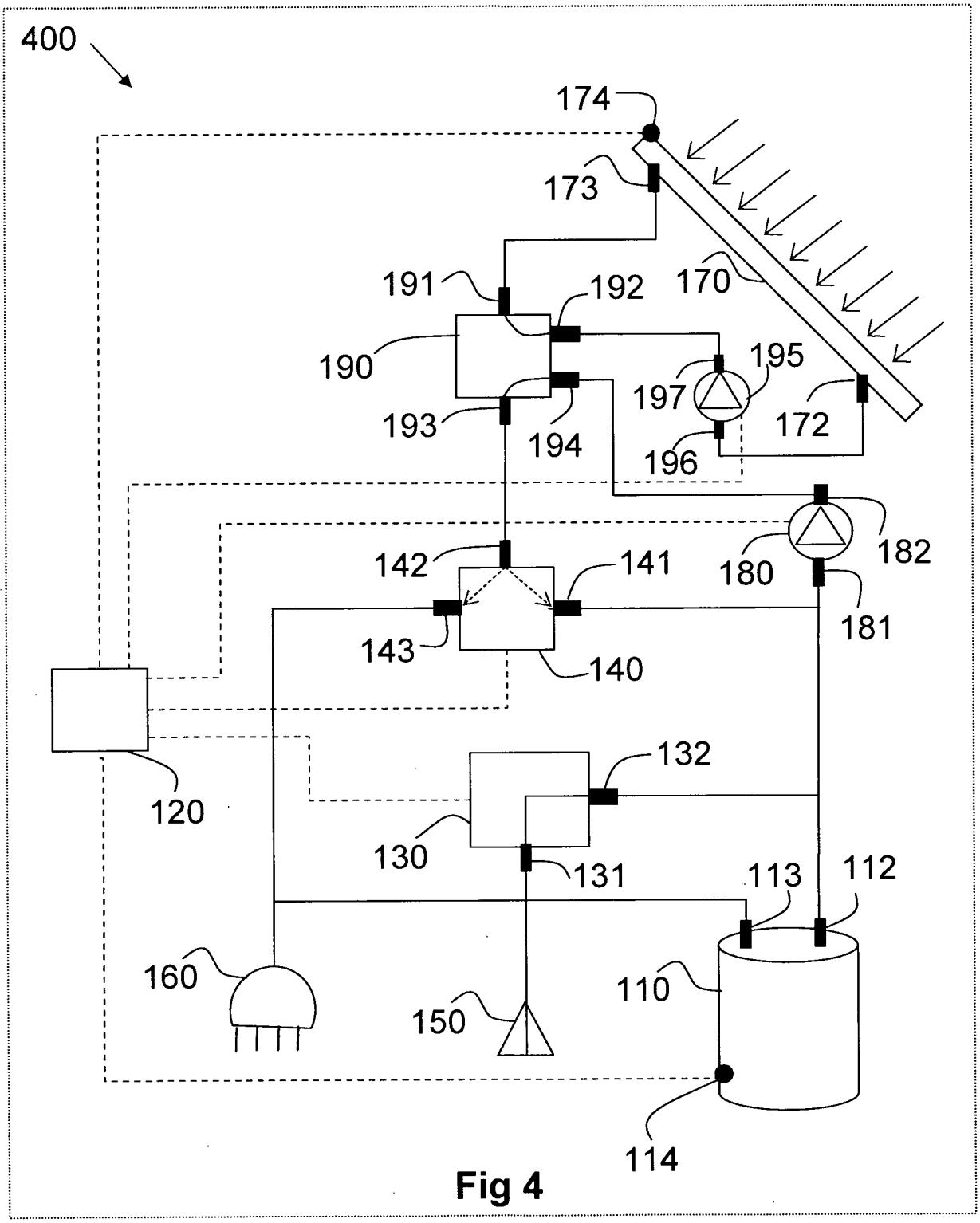
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Fig 4

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IL 09/00892

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - F24J 2/42 (2009.01)
USPC - 126/609
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(8) - F24J 2/42 (2009.01); USPC - 126/609

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
USPC - 126/617; 126/569

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
PubWEST (PGPB,USPT,EPAB,JPAB), GooglePatents Database, GoogleScholar Database (solar, heat, fluid, divert, valve, panel, circulate, pump, loop, heat exchanger, control, thermostat, switch, wired, wireless, communicate, Bluetooth, boiler, swimming pool, tank, balloon, dewer, water, oil, fuel, gas)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2005/0125083 A1 (Kiko) 09 June 2005 (09.06.2005) paragraphs 0116-0123, 0137, 0202, 0233, 0244-0247	1-19
Y	US 4,378,784 A (Frank) 05 April 1983 (05.04.1983) Figures 8, 9, column 4, line 11-14, line 39-68	1-19
Y	US 6,915,656 B2 (Ratliff) 12 July 2005 (12.07.2005) Figure 2, column 3, line 28-31, column 4, line 11-14, column 7, line 57-63	4-8

☐ Further documents are listed in the continuation of Box C. ☐

* 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
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"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
24 December 2009 (24.12.2009)	14 JAN 2010
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-3201	Authorized officer: Lee W. Young PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774