(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
18 January 2018 (18.01.2018)

WIPO | PCT

(10) International Publication Number
WO 2018/013066 A1

(51) International Patent Classification:
F24S 10/75 (2018.01) *F24S 80/457* (2018.01)
F24S 80/54 (2018.01)

(21) International Application Number:
PCT/UA2017/000072

(22) International Filing Date:
10 July 2017 (10.07.2017)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:

u 2016 07606	11 July 2016 (11.07.2016)	UA
a 2017 04594	11 May 2017 (11.05.2017)	UA

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(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:
— *with international search report (Art. 21(3))*
— *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))*

(54) Title: SOLAR COLLECTOR

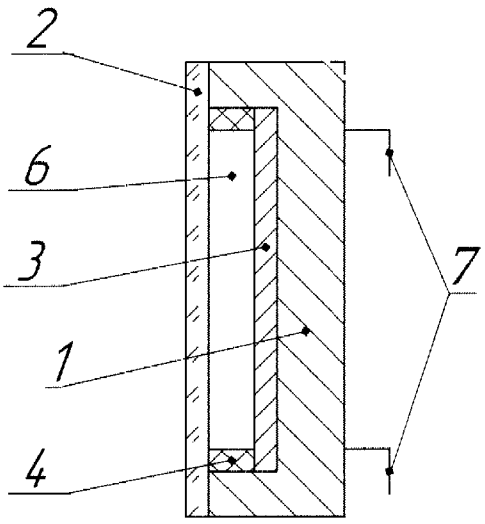

Fig.1

(57) Abstract: A solar collector, which can be used for heating interiors, supplying hot water and heating process water, comprises: an enclosure (1) made of a composite polymer material, a transparent coating (2), and a heat exchanger (3) provided with channels for a heat-transfer agent. The transparent coating (2) and the heat exchanger (3) are combined with each other along the perimeter by a distance frame (4) to create a hermetically sealed heating package, and the air is released from the inner space (6) of the heating package to obtain vacuum, or the air is replaced by an inert gas therein. The heat exchanger (3) is designed as a metal plate and inside it or on its surface, there are arranged tubes having channels for circulating a heat-transfer agent, which are combined to create a single closed system having an inlet and an outlet on the surface of the solar collector, the heat exchanger surface facing the sun is applied with a dark coating, and the heating package is arranged in the enclosure (1) made of a composite polymer material.

WO 2018/013066 A1

SOLAR COLLECTOR

The invention relates to heliotechnics, including solar collectors, and can be used for heating interiors, supplying hot water and heating process water.

There is known a solar thermal collector comprising a translucent cylindrical container, a heat-transfer agent duct integrated into a circulation circuit by a manifold equipped with a pump, a piping for hydraulically connecting the container closed cavity to the circulation circuit, and a feed conduit equipped with a pump. The container consists of two translucent cylindrical elements, namely the external and internal coaxially arranged ones that are connected to create the container closed cavity filled with water. The heat-transfer agent duct is arranged in the cavity of the container inner element, and this duct is hydraulically connected both to the closed cavity of the container and to the feed conduit for periodically refilling the container cavity with water [UA 19344 U, F24J 2/06, 2006].

The disadvantage of this solar thermal collector is its low efficiency caused by low-intensity of heating the inner heat-transfer agent.

There is known a solar vacuum collector of tubular type comprising a vacuum shell (enclosure) made of a transparent material that is fixedly mounted on a stand equipped with a pipe connecting the vacuum shell (enclosure) to a device intended for creating vacuum, and a receptacle of solar radiation formed as a tube coated with a selective material to absorb solar radiation, which is arranged along the axis of the vacuum shell (enclosure) and connected both to a duct for supplying a cold heat-transfer agent and also to a duct for taking a hot heat-transfer agent off. The receptacle tube is made of metal and manufactured in the form of a spiral-wound element located in the thin-walled corrugated metal pipe that follows the contour geometry of the receptacle spiral-wound element. To the bottom portion of the spiral-wound element, there is attached the duct for supplying the cold heat-transfer agent, and to the top portion of the receptacle, there is attached the duct for taking the hot heat-transfer agent off, which duct is located inside the spiral-wound element, while a half of the internal surface of the transparent vacuum shell(enclosure) is covered with a coating to reflect solar radiation [UA 24208 U F24J 2/24, 2007].

The disadvantage of the known vacuum solar collector of tubular type is its ability to generate only one type of energy that is heat, and as a result, its rather low efficiency.

There is also known a solar vacuum collector of tubular type comprising a cylindrical vacuum shell (enclosure) made of a transparent material and equipped with a pipe connecting the vacuum shell (enclosure) to a device intended for creating vacuum, a receptacle of solar radiation, which is located in the vacuum shell (enclosure) and equipped with a duct for supplying a cold heat-transfer agent and also a duct for taking a hot heat-transfer agent off. The receptacle of solar radiation is designed as concentrically arranged tubes, the outer one of which is closed on both sides and coupled with a metal plate coated with a selective material to absorb solar radiation, which plate covers up the tube on its back side and is arranged in the centerline plane of the vacuum shell (enclosure), whereto there is attached the duct for supplying a cold heat-transfer agent, and the inner tube is at the top portion connected to the outer tube, and this inner tube is located in an additional vacuum shell (enclosure), and the lower portion of the inner tube is connected to the duct for taking a hot heat-transfer agent off. [UA 18057, F24J 2/00, 2006]

The disadvantage of this known solar collector is a small surface area of the solar radiation receptacle coated with a selective material absorbing solar radiation, and as a result, the availability of a rather low index of the collector efficiency.

There is also known a solar collector comprising a protective coating manufactured in the form of at least one corrugated and perforated sheet located above a solar energy absorber, which is formed with the use of corrugated sheets arranged with the possibility to connect to each other and create channels for fluid movement, thus the lower portions of the channels are fulfilled with the opportunity to provide for light absorption, and the upper portions of the channels are transparent [RU 1216517 C1, F24J 2/24, 1999].

The closest to the claimed invention is a solar thermal collector comprising a sealed enclosure, transparent coating, absorbing surface formed by absorbing tubes arranged in the enclosure in the same plane and provided with two parallel channels to let a heat-transfer agent flow, and heat insulation means disposed underneath thereof. The channels designed to let a heat-transfer agent flow are arranged along the long sides of the enclosure, and along the short sides of the same, there are mounted the tubes of larger diameters, which are combined with the absorbing tubes and the channels to let a heat-transfer agent flow. In this case, the

absorbing surface is formed by the tubes, channels, and jumpers located in the gaps between them, and the enclosure is manufactured hermetically sealed with a seal disposed between the above mentioned enclosure and the transparent coating [RU 2135908 C1, F24J 2/26, 1999].

The disadvantage of this known solar thermal collector, as well as the previous analogue, is an insufficient absorptive surface for solar radiation and, consequently, rather low efficiency thereof.

The basis of the claimed invention is a technical problem of creating a solar collector, which would have a large area of sunlight absorption and a high efficiency index, as well as the possibility to use it in a low temperature environment.

The specified technical problem has been solved owing to creating a solar collector, which as the analogues from the previous art comprises an enclosure, a transparent coating, and a heat exchanger provided with channels to let a heat-transfer agent flow through, but wherein, according to the invention, the transparent coating and the heat exchanger are combined with each other along the perimeter by a distance frame to create a hermetically sealed heating package, and the air is released to vacuum from the inner space of the heating package, or the air is replaced by an inert gas therein, the heat exchanger is designed as a metal plate having, and inside it or on its surface, there are arranged tubes having channels for circulating a heat-transfer agent, which are combined to create a single closed system having an inlet and an outlet on the surface of the solar collector, the heat exchanger surface facing the Sun is applied with a dark coating, and the heating package is arranged in the enclosure made of a composite polymer material.

The sealed heating package is manufactured in the form of a rectangle or square device.

The transparent coating can be made of glass.

The solar collector is manufactured separable with the possibility for the heating package to be removed from the solar collector enclosure.

The solar collector is provided with fasteners disposed on the enclosure.

The fact that the enclosure is made of a composite polymer material provides for isolating the heat exchanger from direct contact with the external air environment.

A transparent material (such as glass) provides for penetrating solar energy inside.

The metal plate has conductive properties.

The number of tubes and channels and their compactness maximum cover the area of the heat exchanger in order to provide the process of efficient heat take-off from the surface area with increasing the area of solar radiation absorption and, consequently, the solar collector coefficient of performance.

Applying a dark coating onto the heat exchanger surface facing the sun facilitates the process of collecting solar heat.

Combining the transparent coating and the heat exchanger along the perimeter by the distance frame to produce a sealed heating package and releasing the air to obtain vacuum therein, or replacing the air by an inert gas into the package was fulfilled to ensure that at low outdoor temperatures, there was neither direct contact of the heat exchanger with the environment, nor waste of the heat energy obtained from the Sun.

The transparent coating, which is tightly connected with the enclosure, increases the solar collector efficiency.

The main difference between the claimed solar collector and the prototype is that the heat exchanger of the claimed solar collector has a larger surface area for absorbing solar heat.

The invention is illustrated with the following drawings.

Fig. 1 shows a solar collector as assembled;

Fig. 2 shows a solar collector and a heating package removed from the solar collector.

The solar collector comprises an enclosure 1 made of a composite polymer material in the form of a rectangle or square, transparent coating 2 (such as glass), heat exchanger 3 in the

form of a metal plate, inside of which or on the surface thereof, there are located ducts with channels (not shown) for circulating a heat-transfer agent, which are combined to create a single closed system having an inlet and outlet on the surface of the solar collector. On the heat exchanger 3 surface facing the Sun, there is applied a dark coating to absorb solar heat.

Transparent coating 2 and heat exchanger 3 are combined with each other along the perimeter by distance frame 4 to create hermetically sealed heating package 5, and the air is released to vacuum from inner space 6 of the heating package, or the air is replaced by an inert gas.

The solar collector is provided with fasteners 7 disposed on enclosure 1.

The solar collector is used for conversing direct sunlight energy into heat resources.

In the solar collector, the heat-transfer agent is heated by falling sunlight that passes through the transparent upper part (glass) 2 without losing its heating properties and directly falls onto the heat exchanger 3 surfaces. The special dark coating applied onto the surface of the heat exchanger 3 faced the Sun also absorbs solar heat.

All the obtained heat is transferred by the heat-transfer agent through the inlet and outlet on the solar collector surface into the storage insulated tank or central heating system where it is distributed for domestic or commercial purposes.

Most often, the solar collector is installed on roof surfaces of inhabited and industrial constructions and oriented to the South direction.

CLAIMS

1. A solar collector, comprising enclosure, a transparent coating, and a heat exchanger provided with channels to let a heat-transfer agent flow through, *characterized in that* the transparent coating and the heat exchanger are combined with each other along the perimeter by a distance frame to create a hermetically sealed heating package, and the air is released from the inner space of the heating package to obtain vacuum, or the air is replaced by an inert gas therein, the heat exchanger is designed as a metal plate, and inside it or on its surface, there are arranged tubes having channels for circulating heat-transfer agent, which are combined to create a single closed system having an inlet and an outlet on the surface of the solar collector, the heat exchanger surface facing the Sun is applied with a dark coating, and the heating package is arranged in the enclosure made of a composite polymer material.

2. A solar collector as set forth in claim 1 *characterized in that* the sealed heating package is a package of a rectangular or square form.

3. A solar collector as set forth in claim 1 *characterized in that* the transparent coating is made of glass.

4. A solar collector as set forth in claim 1 *characterized in that* the solar collector is separable and the heating package is removable from the solar collector enclosure.

5. The solar collector as set forth in claim 1 *characterized in that* fasteners are disposed on the enclosure.

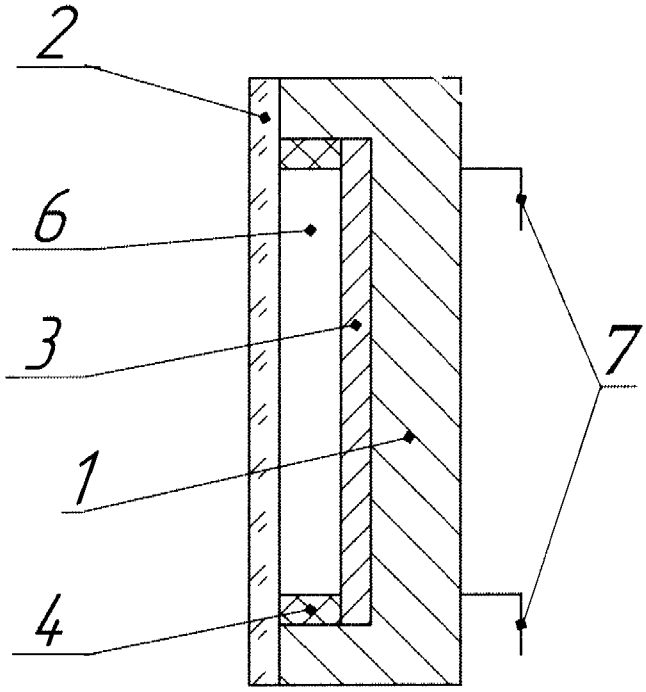

Fig.1

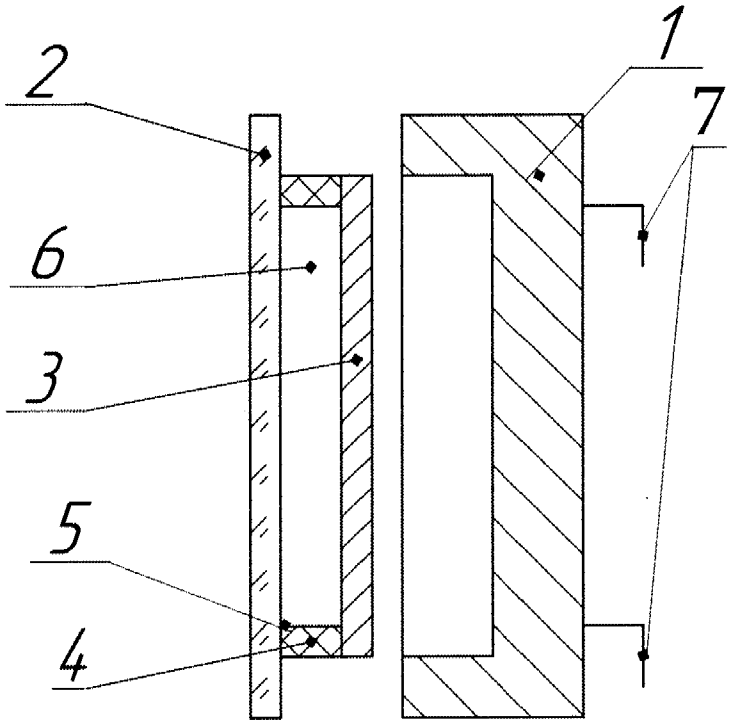

Fig.2.

INTERNATIONAL SEARCH REPORT

International application No
PCT/UA2017/000072

A. CLASSIFICATION OF SUBJECT MATTER
INV. F24S10/75 F24S80/54 F24S80/457
ADD.

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
F24S

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

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2009 162473 A (DAYEH UNIV) 23 July 2009 (2009-07-23) abstract; figures 1-7	1-5
Y	FR 2 606 495 A1 (CARASSUS GERARD [FR]; MARTIN JEAN PIERRE [FR]; CAVEL MICHEL DE [FR]) 13 May 1988 (1988-05-13) abstract; claim 1; figure 1	1-5
Y	US 2015/233606 A1 (PISCHOW KAJ A [FI]) 20 August 2015 (2015-08-20) paragraph [0027] - paragraph [0062]; figures 1-3	1-5
Y	US 2009/188489 A1 (BIHLER WILLI [DE]) 30 July 2009 (2009-07-30) paragraphs [0011], [0026]; figure 1	1-5

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

[X] See patent family annex.

* Special categories of cited documents :

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

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
9 November 2017	21/11/2017

Name and mailing address of the ISA/	Authorized officer
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1

Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No
PCT/UA2017/000072

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DE 299 18 781 U1 (GOLEBNIAK STEFAN [DE]) 30 December 1999 (1999-12-30) page 3, line 21 - page 6, line 28; figures 1-5	1-5
A	CH 699 462 A1 (PFEIFFER RETO [CH]) 15 March 2010 (2010-03-15) paragraphs [0003], [0009] - [0013]; figures 1-4	1-5

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/UA2017/000072

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP 2009162473 A	23-07-2009	JP 2009162473 A	23-07-2009
		TW 200930959 A	16-07-2009
FR 2606495 A1	13-05-1988	NONE	
US 2015233606 A1	20-08-2015	CN 104848571 A	19-08-2015
		EP 2908069 A1	19-08-2015
		JP 2015152303 A	24-08-2015
		US 2015233606 A1	20-08-2015
US 2009188489 A1	30-07-2009	CA 2671919 A1	21-12-2007
		CN 101501868 A	05-08-2009
		DE 102006027629 A1	27-12-2007
		EP 2033231 A1	11-03-2009
		US 2009188489 A1	30-07-2009
		WO 2007144113 A1	21-12-2007
DE 29918781 U1	30-12-1999	NONE	
CH 699462 A1	15-03-2010	NONE	