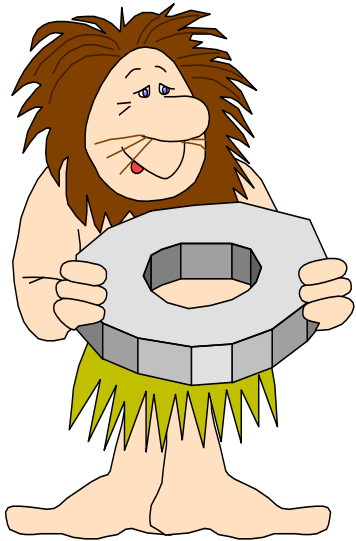


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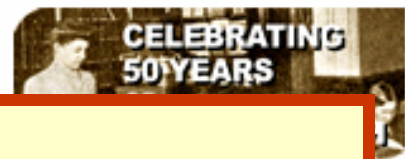
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
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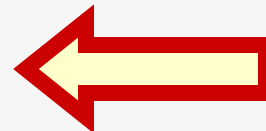
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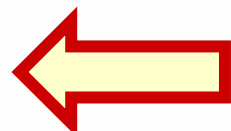
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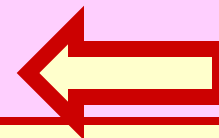
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United States Patent
Fanney, et al.

5,293,447
March 8, 1994



Photovoltaic *solar* water heating system



Abstract

A system for heating water using *solar* energy comprises a photovoltaic array, a water heater comprising a variable resistive load, and a controller for varying either the load characteristics of the resistive load or the power generating characteristics of the photovoltaic array, or both, to ensure maximum power transfer efficiency.

Inventors: **Fanney; A. Hunter** (Gaithersburg, MD); **Dougherty; Brian P.** (Silver Spring, MD)

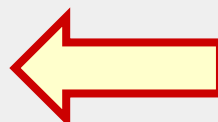
Assignee: **The United States of America as represented by the Secretary of Commerce** (Washington, DC)

Appl. No.: **892037**

Filed: **June 2, 1992**



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392/449; 136/248; 219/485; 219/508; 250/215; 323/906

Intern'l Class:

F24H 001/18; G05F 001/60

Field of Search:

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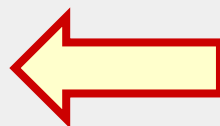
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5 5,896,281	Power conditioning system for a four quadrant photovoltaic array with an inverter for each array quadrant
6 5,677,833	Power conditioning system for a four quadrant photovoltaic array with an inverter for each array quadrant
7 5,608,385	Device for determining state of electricity generation of solar battery

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2566610	Dec., 1985	FR.	392/449.

Other References

"Remote Power Systems", p. 26, 1991; Atlantic **Solar** Products, Inc., 9351J iladelphia Rd, P.O. Box 70060, Baltimore, Md. 21237.

Primary Examiner: Reynolds, Bruce A.
Assistant Examiner: Jeffery, John A.
Attorney, Agent or Firm: de Angeli, Michael

Claims

What is claimed is:

1. Apparatus for heating water using energy of incident **solar** radiation, comprising:

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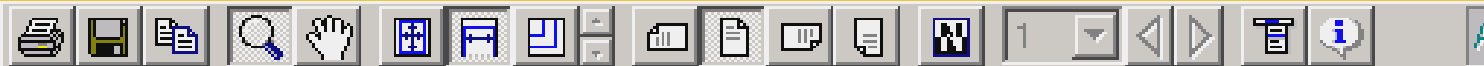
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US005293447A

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[11] Patent Number: **5,293,447**

Fanney et al.

[45] Date of Patent: **Mar. 8, 1994**

[54] PHOTOVOLTAIC SOLAR WATER HEATING SYSTEM

[75] Inventors: **A. Hunter Fanney, Gaithersburg; Brian P. Dougherty, Silver Spring, both of Md.**

[73] Assignee: **The United States of America as represented by the Secretary of Commerce, Washington, D.C.**

[21] Appl. No.: **892,037**

[22] Filed: **Jun. 2, 1992**

[51] Int. Cl.⁷ **F24H 1/18; G05F 1/60**

[52] U.S. Cl. **392/449; 219/508; 219/485; 250/215; 323/906**

[58] Field of Search **392/449, 468, 450-451; 323/906; 219/485, 488, 508, 509; 126/361, 615, 572; 315/149, 150, 152, 158, 159; 136/243; 250/215**

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Primary Examiner—Bruce A. Reynolds
Assistant Examiner—John A. Jeffery
Attorney, Agent, or Firm—Michael de Angeli

[57] **ABSTRACT**

A system for heating water using solar energy comprises a photovoltaic array, a water heater comprising a variable resistive load, and a controller for varying either the load characteristics of the resistive load or the power generating characteristics of the photovoltaic array, or both, to ensure maximum power transfer efficiency.

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



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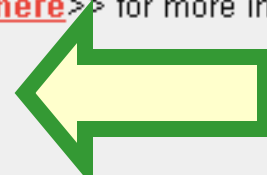
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- » Is the ECLA system updated, and if so, how can I get the updates?
- » What do the dots/boxes mean in front of the classifications found?

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G05F

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MECHANICAL ENGINEERING; LIGHTING; HEATING; WEAPONS; BLASTING ENGINES OR PUMPS

HEATING; RANGES; VENTILATING (protecting plants by heating in gardens, orchards, or forests [G13/06](#); baking ovens and apparatus [A21B](#); cooking devices other than ranges [A47J](#); forging [B2B21K](#); specially adapted for vehicles, see the relevant subclasses of [B60](#) to [B64](#); combustion apparatus in general [F23](#); drying [F26B](#); ovens in general [F27](#); electric heating elements and arrangements [H05B](#))

FLUID HEATERS, e.g. WATER OR AIR HEATERS, HAVING HEAT GENERATING MEANS, IN GENERAL (transfer, heat-exchange or heat-storage materials [C09K5/00](#); tube furnaces for thermal non-catalytic cracking [C10G9/20](#); devices, e.g. valves, for venting and aerating enclosures [F16K24/00](#); steam trap like apparatus [F16T](#); steam generation [F22](#); combustion apparatus [F23](#); domestic stoves or ranges [F24B](#), [F24C](#); domestic- or space-heating systems [F24D](#); furnaces, kilns, ovens, retorts [F27](#); heat-exchangers [F28](#); electric heating elements or arrangements [H05B](#))

Water heaters having heat generating means, e.g. boiler, flow- heater, water-storage heater ([F24H7/00](#), [F24H8/00](#) take precedence; details [F24H9/00](#); steam boilers [F22B](#); domestic stoves or ranges with additional provisions for heating water [F24B9/00](#), [F24C13/00](#))

Air heaters having heat generating means ([F24H7/00](#), [F24H8/00](#) take precedence; details [F24H9/00](#); domestic stoves or ranges with additional provision for convection heating of air [F24B](#), [F24C](#))

Fluid heaters using heat pumps

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Classification Search

Help

Quick Help

- » How many terms can I enter per field?
- » Can I search with a combination of words?
- » Can I use truncation or wildcards?
- » What are publication, application and priority numbers?
- » How do I enter publication, application and priority numbers?
- » What is the difference between the IPC and the ECLA?
- » Can I enter a date range?
- » How can I find out which is the most recent document available for a given country?

Advanced Search

1. Select database

Select the database in which you wish to search:

Select patent database:

Worldwide

2. Enter search terms

Enter keywords in English

Keyword(s) in title:	<input type="text" value="photovoltaic"/>	plastic AND bicycle
Keyword(s) in title or abstract:	<input type="text" value="solar AND heating"/>	hair
Publication number:	<input type="text"/>	WO03075629
Application number:	<input type="text"/>	DE19971031696
Priority number:	<input type="text"/>	WO1995US15925
Publication date:	<input type="text"/>	yyymmdd
Applicant:	<input type="text"/>	Institut Pasteur
Inventor:	<input type="text"/>	Smith

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Classification Search

Help

Quick Help

- » Why is the number of results sometimes "approximate"?
- » Why do I sometimes retrieve fewer results than with the old esp@cite10?
- » Why do I sometimes get results marked "no title found"?
- » Why should I tick the "In my patents list" box?
- » How do I get my browser to print the background colours?

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RESULT LIST

18 results found in the Worldwide database for:

"photovoltaic" in the title AND **"solar AND heating"** in the title or abstract

(Results are sorted by date of upload in database)

1 Photovoltaic cladding element for building has solar cells connected in strings protected against hot-spots by Schottky diode chips acting as bypass diodes

Inventor: REINICKE ALFRED (DE); BIERINGER ULRICH (DE) Applicant: SOLARNOVA SOLARTEC

EC: H01L31/05; H01L27/142

IPC: H02N6/00 ; H01L31/048 ; (

Publication info: **DE10019316** - 2001-10-31

2 Method for manufacturing photovoltaic element and corresponding cell, in particular for solar cells

Inventor: KUZNICKI ZBIGNIEW T; BAJARD JEAN

Applicant: DELTA SOLAR (FR)

EC:

IPC: H01L31/042 ; H01L21/324

Publication info: **FR2801726** - 2001-06-01

3 Recycling silicon photovoltaic modules

Inventor: ANISIMOV IGOR IVANOVICH (US); BOHLAND JOHN RAPHAEL (US) Applicant: FIRST SOLAR LLC (US)

EC: H01L31/048; H01L31/18C

IPC: H01L25/00

Publication info: **US6063995** - 2000-05-16

4 A method of making group IB-III-VIA compound semiconductor films and method of fabricating a photovoltaic device

Inventor: KAPUR VIJAY K (US); BASOL BULENT M (US); (+3) Applicant: INT SOLAR ELECTRIC T

EC: H01L31/032C; H01L31/0336C

IPC: H01L31/032

5 Photovoltaic solar water heating system

Inventor: FANNEY A HUNTER (US); DOUGHERTY BRIAN P (US)

Applicant: US ARMY (US)

EC: F24D17/00D2; F24D19/10C3S; (+1)

IPC: F24H1/18 ; G05F1/60

Publication info: **US5293447** - 1994-03-08

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