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AN AUTOMATED ROTATING DUAL MODE SYSTEM FOR ENERGY PRODUCTION USING P/V CELLS

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***Abstract*— Nowadays the energy problem has peaked. The essence of the problem lies in the correlation between continuously decreasing energy reserves with continuously increasing energy demands. The current thesis presents an automated water heating system powered by the sun via a solar tracker that aims at heating not just running water but also the whole residence through underfloor heating. The system is capable of rotating its collectors, so that when the desired water and room temperature has been achieved, it can additionally produce electrical energy by means of polycrystalline silicon photovoltaic panels.**

***Keywords*— renewable energy forms, hot running water, solar tracker**

I. INTRODUCTION

The Sun radiates the almost inconceivable energy of approximately a hundred billion Watts towards the Earth. In terms of solar supply this amount equals to the production from a hundred million contemporary nuclear of fossil fuel stations. To put it differently, the Sun provides in one hour enough energy to meet the current energy demands of the Earth's population for a whole year.

The solar water heater is one of the first devices to exploit solar energy; it constitutes an active solar system for heating water by utilizing solar energy and is widely used in countries characterized by large periods of sunlight, e.g. in the Mediterranean. It is one of the "cleanest" and most efficient devices that use renewable energy sources. However, its technology remains stagnant for quite a few years – the only upgrade presented so far is the improvement of the collector and the upgrade in construction materials.

The automated system for water heating presented in this study is capable of understanding and adjusting to the needs of the residence. It is able to create electrical energy thus reducing its initial installation cost, while it is also able to inform the user in real time about the conditions and temperatures that take place inside the installation area.

II. DESCRIPTION OF THE PROBLEM

A conventional solar water heater is able to provide hot water, not taking any other parameters into account; i.e. tell if the desired temperature has been achieved or tell the current temperature of running water. Its orientation to the sun is fixed; as a consequence it functions only during the hours when the sun is facing it directly. Furthermore, the bulk size of its collector takes up a large area on the roof of a building.

A solar water heater with moving parts is able to track the sun's position from east to west and is consequently subjected to more hours of direct sunlight. The use of heat sensors allows it to switch its function to a photovoltaic panel for the production of electrical energy, when the desired temperature for running water has been achieved.

III. SYSTEM DESIGN AND CONSTRUCTION

The difficulty in the construction of the solar water heater with moving parts is that the collectors should rotate by 360˚ while having a central axis consisting of tightly sealed water pipes. Its construction combines the knowledge of photovoltaic systems with a solar tracker along with the knowledge of conventional solar water heaters. The frame of a solar water heater was built from scratch using with many solar collectors of a smaller surface but with the ability to rotate.

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Fig.1. Solar collector

The water heating pipes were placed in a longer distance compared to conventional pipes and function as the rotating axis of the collectors. Photovoltaic cells were placed in the back of the collectors for electrical energy to be produced when the controller switches functions between solar water heater and photovoltaic panel.

Fig.2. P/V rotary collector

Sensors for heat, sunlight and changeover switches were connected to a programmable logic controller (PLC) for managing all input and output signals.

Fig.3. PLC installation

Solar collector

Solar collectors are manufactured in a way that allows the installation to move from east to west. The collectors are part of a closed water circuit which gets heated by solar radiation and transfers heat to a hot water boiler.

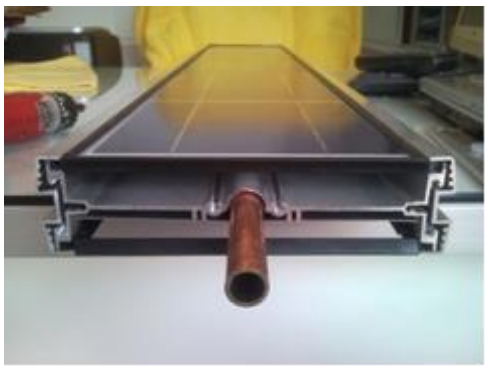

Fig.4. Cross Section of a Solar Collector

The presented solar collectors are distinct from conventional ones in that they are waterproof, as they possess moving parts inside of which there is hot water circulation. Airtight sealing of the whole installation, furthermore, takes advantage of the temperatures that develop inside it, for the additional heating of water. Another important factor is the contact of the water pipe with thermal conductive materials in order to facilitate the transfer of solar radiation to running water.

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Photovoltaic collector

Water heating inside a conventional solar water heater does not have a temperature limit. Contrary, the presented installation utilizes heat sensors so that when the desired water temperature has been achieved, it can rotate its collectors in order to produce electricity, and vice versa. Polycrystalline silicon photovoltaic panels have been placed in the back of the collectors for the production of electrical energy; these frames possess a parallel connection that transforms electrical energy in Watt. The presented installation bears a total of four production units, each of which produces 20 Watt (80 Watt in total).

IV. ALGORITHM DESIGN AND COMPILING

The PLC is responsible for the function of all parts; it receives the signals from input sensors and reacts accordingly by activating the corresponding electric motor or circulator. During the phase of hot water production, the PLC receives signals from sunlight sensors and turns the solar collectors vertically towards the sun. As soon as water reaches the user-defined temperature, the PLC reads the solar sensors and rotates by 180˚thus turning the photovoltaic collectors vertically towards the sun.

The PLC is able to provide information about the function and temperature on demand, via text messages; it can also change the set-points or the function, upon user request.

The solar water heater with moving parts constitutes the latest development to technology that has been stagnant for a long period of time. The installation purports to be usable in the residence as it functions as a solar pergola that can cover a car inside the garage, a grill corner in the yard or even the terraces of the residence. Solar collectors are easy to clean since they can be rotated to the desired angle. There is no need to worry about breakage from extreme temperatures as the PLC can read the outdoor temperature and set the corresponding circulator in motion.

The presented equipment is expected not only to outweigh the initial cost of its purchase and installation, but also to reduce the electricity bill, especially when installed in a country residence; during the days when water has reached the desired temperature, it functions as a photovoltaic panel and returns electrical energy to the provider.

V. CONCLUSION

The usage of a solar water heater is the only viable alternative in times of political instability and energy crisis. Contemporary technology can make a solar water heater adapt to customized needs anywhere it is placed in order to carry out multiple functions by utilizing solar radiation; i.e. water heating, electrical energy production and space heating. This way the equipment complies with contemporary demands and reduces the cost of its purchase and installation.

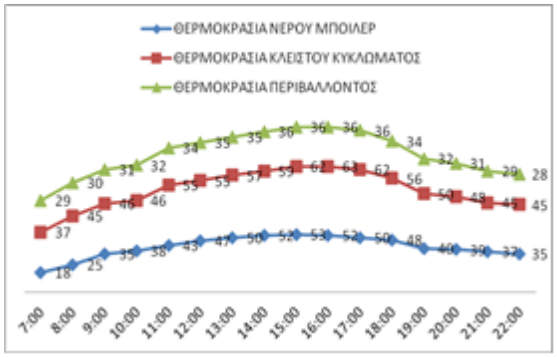

Fig.5. Conventional solar water heater

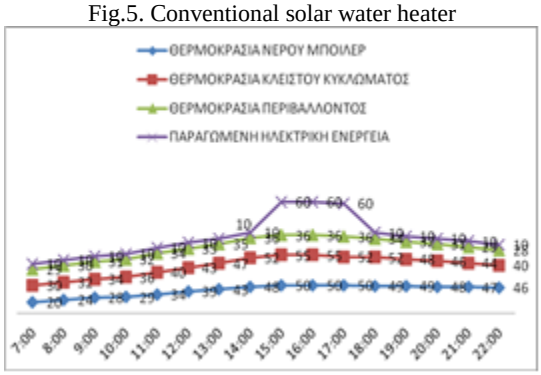

Fig. 6. Solar water heater with moving parts

As shown in the above figures , there is a faster production of hot water as well as a significant production of electrical energy in the second case.

For the above measurements, the equipment was installed in the residence of a family of four in a large urban center. The family's demands for hot water were covered completely and at a shorter time in comparison to the previously used conventional solar water heater. The total production of electrical energy amounted to 30000 Watt, approximately 500 Watt daily out of a total function of 60 days.

VI. REFERENCE

[1] Huld T., Cebecauer T., Šúri M., Dunlop E.D., "Analysis of one-axis tracking strategies for PV systems in Europe", Progress in Photovoltaics: Research and Applications , 18, 183-194, 2010.

[2] Cebecauer T., Šúri M., "Exporting geospatial data to web Tiled Map Services using GRASS GIS", OSGeo Journal, vol. 5, 2008

[3] http://re.jrc.ec.europa.eu/pvgis/apps4/pvest.php

[4] (access date: 27 November 2013)

[5] López A., I. Fernández, R. Martínez Farreres and I. Rodríguez Cabo, "Quality check protocol for control the losses of power on large associations of photovoltaic generators", Proceedings of the International Conference on Renewable Energies and Power Quality (ICREPQ'07)", Sevilla, March 2007.

[6] BCI, Failure Mode Study, 2010