Harvesting of Solar Energy Generation for Domestic Applications- A Novel Method

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Abstract **-- solar pv cells are commonly used to meet the power requirements of domestic needs and solar water heaters are used to meet the hot water demands. however, certain lacunae such as lesser conversion efficiency, space constraints are observed in this method of power generation and this paper aims to present a novel method of power generation wherein the concentrated solar energy being harvested by fresnel lens is transferred on to a metal tank to heat the water in it. the heated water is then used as a hot junction for a thermoelectric generator which converts thermal energy of heated water to electrical energy. the heated water can also be used for domestic purpose after the generation process. the prototype model is designed and developed and the experimental results are very promising showing an increased conversion efficiency of more than 10%.**

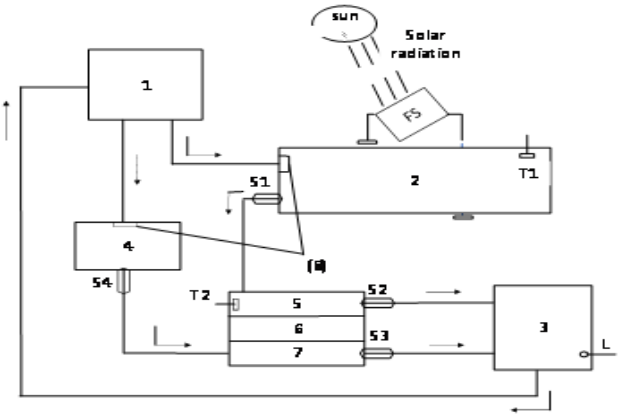
Keywords— ***Fresnal lens, Thermo-electric generator, Solar energy, Domestic applications.***

I. INTRODUCTION

Ever since the demand for the usage of electrical energy started growing beyond the generation expected from conventional type of energy resource, more thrust was given to alternative power sources of energy which are nonconventional.

In this direction much emphasis was laid to harvest wind and solar energy for power generation all over the world. It is quite well known that effective form of solar energy is being produced by means of PV cells which are more convenient and can be matched to the requirement of user. However it has to meet constraints like space, direction of the placing of the panel, disposal of same after serving its life to meet environmental obligations.

In case of domestic applications in towns, urban, semi-urban areas and pockets of some villages, solar PV cells are widely used to meet not only their energy requirements but also to pump the excess energy generated to the grid. To meet the domestic needs for hot water supply, solar PV cells are used exclusively branded as solar water heaters. But in case of rural areas because of the geographical location of the houses and their location situated far away from the grid, solar energy plays a very important role in meeting the power requirements and as well as lessening the burden on electricity supply corporation apart from helping curb distribution losses. A novel method of harnessing the solar energy without using PV cells is envisaged in this paper for collecting the solar radiation to heat a metal tank containing a water medium which in turn can be used for power generation as well as hot water requirements for meeting the domestic need. This method requires very less space compared to conventional PV system.



II. BLOCK DIAGRAM

Fig 1: power generator

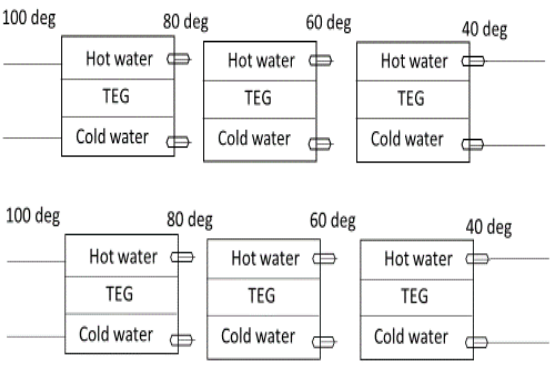


Fig 2: TEG arrangement for commercial power generation

III. METHODOLOGY

The diagram-1 represents arrangement of our invention. The solar radiation is being concentrated by Fresnel lens(FS) with the help of solar tracker to heat the module tank(2), which in turn heats the water in it(say 5 liters for experimental set up). The water to the module tank is being supplied by the main overhead tank and is controlled by the water level control inlet. The temperature of the water in the module tank is being governed by the temperature sensor(T1) and the temperature is displayed on the screen(say 100 deg C). A specified temperature of water(say 100 deg C)is fixed. The solenoid valve(S1) opens and a certain quantity(say ½ liter) of water flows to hot water compartment(7). The cooling system(4) provides cold water by extracting normal water from the overhead tank(1), the water level is being controlled by water level control inlet. The water is fed to the cold water compartment(5) from the cooling system and its quantity being controlled by (S4). The generation process is done by the thermo-electric generator(4), where the hot molecular ions from the hot water junction moves towards cold water junction and the ions get combined to generate electricity. Then it can be used for further usage and application.

The generation is done till the temperature of the hot water reduces (say 80 deg C) which is indicated by (T2). As soon as the temperature is reduced, the solenoid valves S2 and S3 open and the water flows to the tank (3) which contains the motor. As soon as the hot and cold water compartments are empty the valves S2 and S3 gets closed, which in turn makes S1 and S4 to open. The water in the tank (3) is then pumped back to the main overhead tank by a motor after a preset particular level is reached. The water level is shown by level sensor (L). The governing functionalities of all the sensors used is been done with the help of relays and microcontroller.

The block diagram -2 represents the arrangement of the thermo electric generator for the commercial purpose. As the generation with one TEG is less, here the combination of TEGs are used for obtaining more power. The TEGs are connected in combination and the combination is governed by a tuner. As there are six TEGs, if there is malfunctioning of any generator, there might be an ambiguity in consumer. So a tuner is provided to ensure the outpour of every generator. If there is less power generation in from any of the TEG, then it can be replaced. The generation takes place in three generators connected in series, the hot water from module tank (100 deg C) is fed to the TEG where the generation takes place till 80 deg C, as soon as it reaches 80 deg C, the water moves to next TEG and generation is carried out till temperature is 60 deg, then the water moves to next generator there the generation is done till temperature is 40 deg C. the 40 deg temperature water is fed to the tank with motor. Like this the generation takes place in three more generators connected in series. Then the two series combinations is connected in parallel. Hence the hot water is completely used to generate electricity from 100 deg to 40 deg.

IV. ADVANTAGES

- Harness solar energy without using PV cells.
- Meets the power needs for domestic applications in a cost effective way which is simple in design.
- Provision of hot water for domestic purpose
- Minimizes the space requirement for power generation as compared to solar PV cells.
- Minimizes the usage of water for maintenance purpose as compared to solar PV system.

V. LIMITATION

Requires maintenance of the Fresnel lens for more efficiency.

VI. FUTURE SCOPE

- This System Can Be Efficiently Used In The Urban And Rural Areas For Continuous Power Supply.
- People Can Have An Access To Their Power Requirements Independently.
- The Electric Power Generation Helps for Requirements in Hybrid Vehicles.
- Solar Water Heaters Can Be Replaced.

VII. INFERENCES

In spite of the limitations, using this system can help people to access the power requirements continuously. It is the novel method of power generation which does not have an adverse effect on environment.

The main plus point is we can successfully generate the power based on requirement and the capacity at a less cost compared to solar PV cells. The conversion efficiency of power generation in this method is found to be more than 10% improvement as compared to power generation form solar PV cells. Provision for hot water is a huge added advantage, so that the solar water heaters can be replaced by the same system and the burden for the consumers to buy water heater is avoided. The consumer may not have an idea about the usage of this module as this system is completely automatic as it is controlled by microcontroller.

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REFERENCES

[1] Prashantha k, Sonam Wango, “Smart Power Generation from Waste Heat by Thermo Electric Generator”. International Journal Of Mechanical and Production Engineering,ISSN:2320-2097, SEP-2016.

[2] “US light house society news about Fresnel lens”. (March 14,2018) Article by- Keeper Kate.

[3] "Thermoelectric Power Generation from bio mass, cook stove: a waste heat to energy conversion "(ICEMS-2014) Author: Makena Harish, Damodara Reddy

[4] "Study of TEG for Harnessing The Heat Energy Wasted From Automobiles And Thermal Power Plant" Authors: Vishal V ,Jagtap Amrutha B (International journal on recent and innovation trends in computing and communication.)Aug-2016.

[5] "Self Electricity Generation and Energy Saving By Solar Using Programmable System on Chip(PSoC)" Author: Mr. Deshmukh P.R ,Mr Kolkure V.S (The international journal of engineering and science)-2014.

[6] "Waste heat energy harvesting using thermo electric generator" Author:A.Jacks delightus peter, Balaji D, D Gowrishankar. (IOSR journal of engineering)-July 2013.

[7] Sunita Rani , Shavet Sharma, "A Novel Method for Solar Energy Harvesting Method Based On Optimization".