GENERATION OF POWER FROM HOUSEHOLD WASTE HEAT

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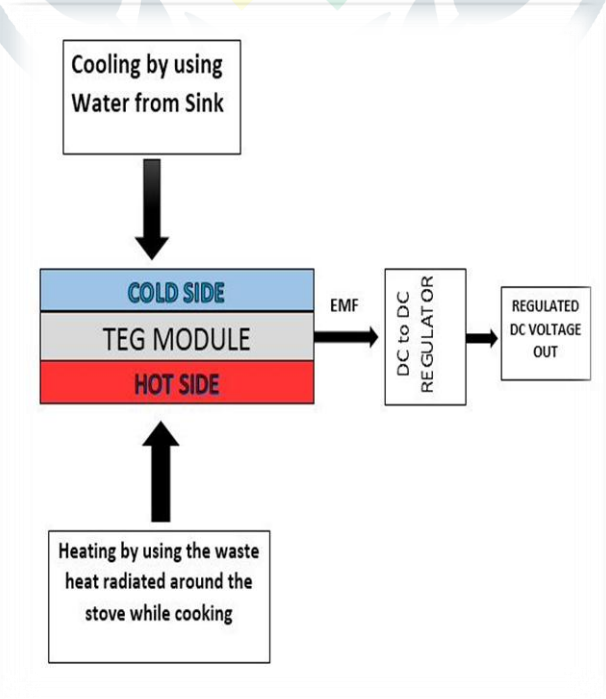
Abstract—This paper presents about the generation of power from household waste heat. With about one-third of the combusted fuel energy is being wasted in the exhaust gas as in the form of heat. So, by considering about these waste heats from various sources of a house-hold, thermoelectric power generation is an attractive option to improve fuel economy and to utilize the waste heat efficiently. In this project, we have planned to convert the waste heat which is emitted from house hold furnaces like L.P.G Stoves which is used for cooking into electricity directly. This is done by using a Peltier Module which acts like Thermoelectric Generator (TEG) Module. Due to the high temperature difference between two sides and by the Seebeck effect, an emf is induced in the external terminals of the module. The Direct current (D.C) is produced at the output terminals are regulated by a DC-DC Regulator of 5V, 1A. Finally, it can be used to charge up a battery or mobile phone or could be converted to AC by means of an Inverter circuit.

Keywords—TEG, Seebeck Effect, Waste Heat, DC-DC Regulator, Inverter

I. INTRODUCTION

Recently due to the rising costs and less available sources of traditional fuel reserves, mostly the fossil fuel, the conquest had begun looking for new and preferably renewable energy sources. Among them, are the solar and wind energy as most common. Other sources are of recent interests as well, as they contribute to not only generating power, but also to increasing overall system's Efficiency. The TEGs are solid-state devices engineered to generate electricity directly from heat that is known as Seebeck effect. Thermoelectric power generation is an alternative option to improve fuel economy. TEGs, which use the thermoelectric or Seebeck effect of semiconductors to convert heat energy to electrical energy, have existed for many years with the initial discovery of the thermoelectric effect being made. Due to the relatively low efficiency and high costs associated with the technology it has been limited to specialized military, medical, space and remote applications. [1] When recovering the waste heat in the exhaust ducts using TEG increases the efficiency of electrical machines, because the same amount of fuel input generates more power or less intake of fuel, has the same amount the generated electricity and thus less air pollution makes the system more sustainable. [2] To meet the future development in vehicle drive trains, the Institute of Vehicle Concepts of the German Aerospace Center (DLR) aims to prove, that exhaust heat recovery using a TEG is, even with more electrification, still a promising concept to increase the efficiency. [3] The related problems of global warming and dwindling fossil fuel supplies has led to improving the efficiency of any industrial process being a priority. The technology is by using heat pipes. [4] The temperature difference is ensured from solar energy that uses for heating process and sea that uses for cooling process. Solar collector tubes are used for concentrating solar radiation. Presented system is a conceptual design and a suitable system for any improvement. [5]

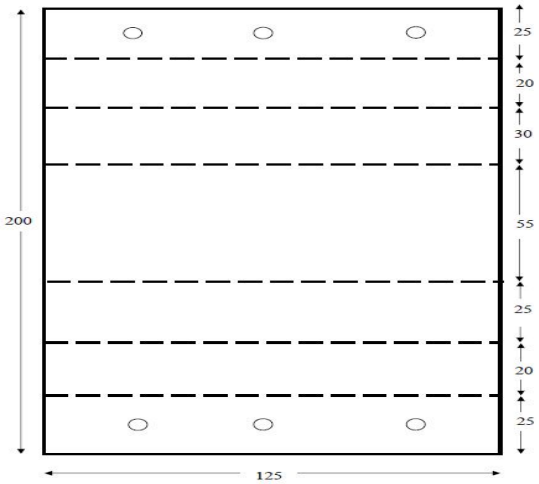
II. MODEL DESCRIPTION



"Fig. 1" Layout of the Project

Sheet Metal Fabrication

Sheet Metal plays an important role in this project as it provides essential support to Six Peltier modules. The design and fabricated Sheet metal is shown below.



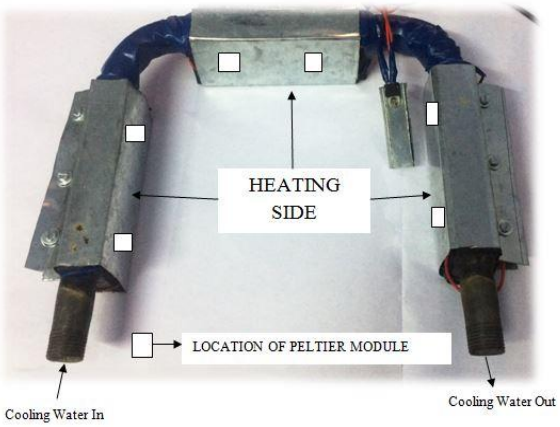
"Fig .2" Design of Sheet Metal

"Fig. 3" Fabricated Sheet Metal

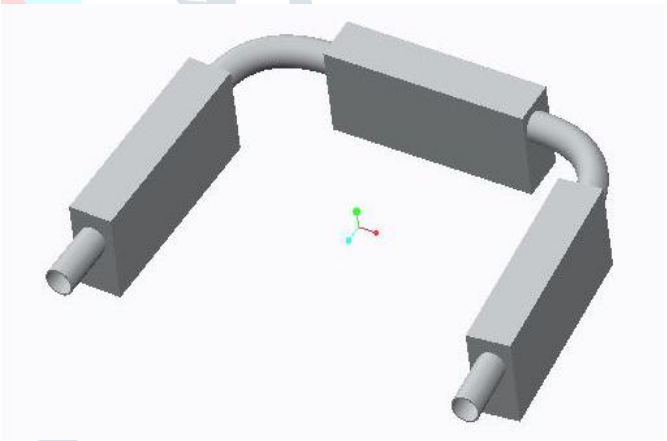
The Sheet Metal (For one part) is first marked with dimensions as shown in Fig.2 (All dimensions are in mm). Then it is cut according to the above dimensions using Sheet metal cutter. Similarly three parts are made. It is embedded with Thermal paste, Insulating rubber sheet and folded as shown in Fig .3.

Cooling Water Blocks

A Water block is the water cooling equivalent of a heat sink. It can be used on many different computer components, including the central processing unit (CPU). In our project we used three cooling blocks which is made from Rectangular Galvanized Iron Bars and connected with each other through GI pipes welded together which is kept around the burner of the stove. Each cooling block is surrounded by Peltier module as shown below in Fig.4. The Sheet Metal is then wrapped around each cooling block and fastened with bolts and nuts. At the two terminals of the cooling block pipe is connected. One end cooling Water is circulated from the sink tap water, other side is for drainage and it can be used for plants after cooling. As the entire cooling block is at certain distance from the stove burner there is no heat impact in the steel shield. For obtaining high power output the burner flame is increased at the same time we wrapped around the entire cooling block with insulation ropes. We used Multimeter for measuring voltage and current where as Thermometer is used to measure temperature differences.



"Fig.4" Welded cooling block showing module position



"Fig.5" Water block 3D Model

"Fig.6" Setup mounted on the Stove

III. EXPERIMENTAL PROCEDURE

- The Experimental Setup is placed surrounding the burner of gas stove as shown in Fig.6.
- The inlet and outlet of the custom cooling water block is connected with a hose from the tap or other cold water sources and to draining vessel respectively.
- Then in the case of charging up a mobile phone, the charger cable is connected with the USB Female Pin provided with the Setup.
- Then the stove is switched on during cooking.
- After a while, due to the continuous heating up, the sides of the burner, vessel and the setup will be get heated.
- Then slowly there occurs a temperature difference between the two sides of the modules. The hot side will be heated with the radiation from the burner of the stove and the cold side will be cooled by passing water through the cooling block.
- Due to the temperature difference in the Peltier module, there occurs an emf which generates voltage which is the phenomenon of Seebeck Effect.
- By increasing the Temperature difference we can obtain high Voltage Output.
- The Voltage is regulated and sent out through the USB for various purposes.

IV. RESULTS AND OBSERVATIONS

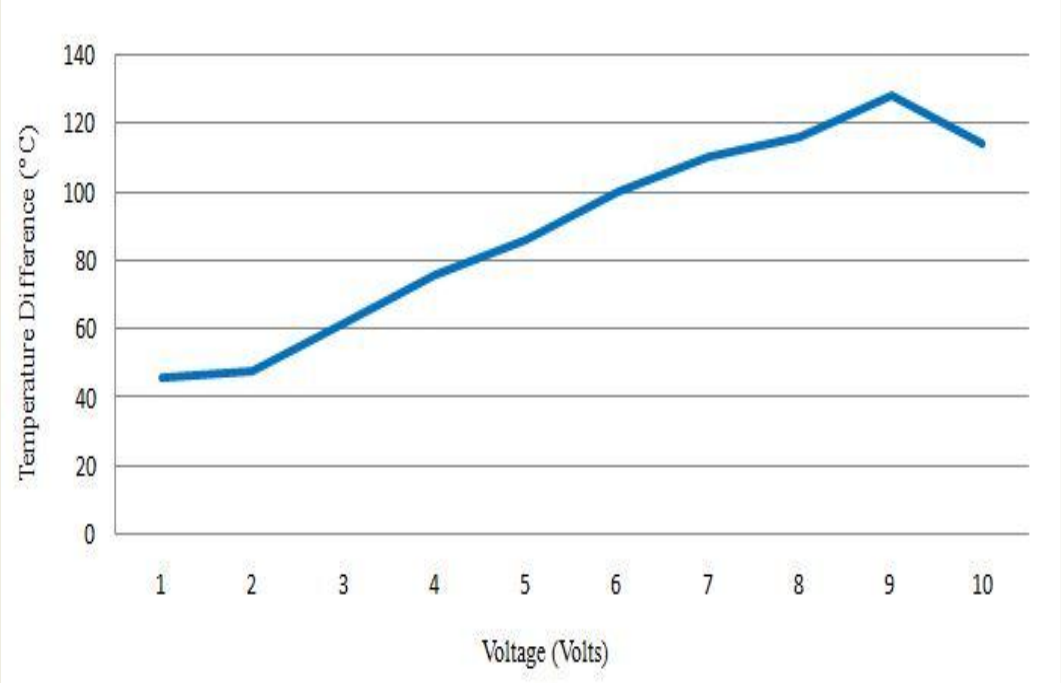
The following observations are noted while testing our project:

Observations

Trial No	Cold Side Temperature °C	Hot Side Temperature °C	Temperature Difference °C	Voltage (Volts)	Ampere (Amps)
1	30	76	46	1.6	0
2	32	80	48	2.8	0
3	34	96	62	3.7	0
4	34	110	76	4.5	0.4
5	34	120	86	5.2	0.5
6	34	134	100	6.4	0.7
7	32	142	110	7.0	0.8
8	34	150	116	8.7	1
9	34	162	128	9.4	1
10	34	178	114	10.2	1

"Table.1" Observations from Multimeter and Thermometer

Graph



"Fig. 7" Temperature Difference Vs Voltage Generated Graph

From the above table.1 the maximum voltage generated is **10.2 V**. As Temperature difference increases Voltage also increase Fig.7. So the Power generated can be calculated from the below relation.

Power Generated = Voltage×Current
P= V×I
From Observations,
V= 10.2V and I=1A
Then the Power generated is **10.2 Watts.**

V. CONCLUSION

Thus, the waste heat from the kitchen, i.e. the waste heat which is radiated around the burner side is converted into useful electricity directly without by any other mechanical Energy. This may be useful in areas where there may be some frequent power failures or for charging up mobile phone or other appliances with charging voltage range of about 5V, 1A. The waste heat is utilized well for a useful purpose. Also, another benefit is due to the circulation of water through the water block, the water out will be somehow hot. It is non-toxic and uncontaminated. So, after cooling it can be used for other purposes.

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