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Home Made Electricity from Gas Stove

AP Rammohan[1], Manjunath Swamy HM[2]
[1,2]Galaxy Machinery Pvt Ltd, Bangalore, India.

Abstract:- Flame of the gas stove is the source of heat where only the upper surface of flame in contact with the vessel is utilized in conducting heat and the remaining part of the flame other than the upper region, surrounding the burner cannot be utilized for cooking. This heat is utilized in conversion of heat energy into electrical energy by "power cook from gas stove" product, Design and development of a "power cook from gas stove" product, based on seebeck effect principle, waste heat region of gas stove was done and experiment was carried out. Through the experiment, it was concluded that waste heat can be utilized by placing the product closer to the gas flame for better output, also we concluded that by increasing the temperature of heat absorber and decreasing the temperature of heat sink output voltage can be maximized. Hence the output is directly proportional to the heat absorber temperature and inversely proportional to the heat sink temperature together.

Keywords:- Electricity, Gas Stove, Seebeck Effect Principle, Thermoelectric Module, Waste Heat

I. INTRODUCTION

In recent years, energy costs have increased exponentially, due to more demand, though we have developed most advanced things with available energy sources, we have failed to notice that some forms of energy are wasted without utilization. The captured and reused waste heat energy is an emission free substitute for costly purchased fuels, gases or electricity.

Everyday heat is going wasted produced from sources include hot combustion gases, heated products in industrial processes, heat transfer from hot equipment surfaces, it also include all manner of human activities, natural systems and all organisms. Such heat instead of being "wasted" by release into the ambient environment can be utilized or reused without disturbing the ongoing process by adopting our "Innovative Project". In our project work we are introducing one such wonderful design of utilizing and converting waste heat into a productive end use.

As the electrical efficiency of thermal power plants, defined as the ratio between input and the output energy is typically around 30-45%. Such power stations or places where a large number of heat pumps are at work, where a significant amount of waste heat can be produced, may be looked upon as potential sources of heat, for devices which are capable of converting this heat energy into useful forms example electrical energy [1]. A different and possible way of reutilization of the wasted heat energy has been thought in our "Innovative Project". The adaptive technique of our design which when connected to the heat source, utilizes the waste heat for generation of electricity. We thought of adopting our design for gas stove waste heat in this project. Thermoelectric module has emerged as a promising alternative green technology due to their distinct advantages. The aim is to utilize waste heat from a flame of gas stove and convert it into electricity using "Seebeck Effect Principle". Using this principle of Seebeck effect, working of Thermoelectric Module (TEM) and waste heat region of gas stove a product was designed called "Power Cook from Gas Stove" (PCGS). The PCGS unit was developed and experimented successfully. The produced electricity is in the form of voltage; this voltage has been stored in battery which later can be used in running power devices of home appliances like Tube light, Exhaust fan, Computer, Mobile, UPS etc.

In this waste heat powered thermoelectric technology, it is unnecessary to consider the cost of the thermal energy input because the energy input cost is cheap or free [2, 3]. In fact, more recently, they can be used in many cases, such as those used in cogeneration systems [4], to improve overall efficiencies of energy conversion systems by converting waste-heat energy into electrical power [5]. In addition, in designing high performance thermoelectric power generators, the improvement of thermoelectric properties of materials and system optimization have attracted the attention of many research activities [6]. Moreover, cost-per-watt can be reduced by optimizing the device geometry, improving the manufacture quality, development of more advanced thermoelectric materials and its effective heating and cooling of heat absorber and heat sink respectively.

As the implementation of Seebeck effect principle is for gas stove which is a new source for waste heat utilization, the review of available literature information reveals that application of electricity generation from thermoelectric module was adopted for sources like automobile parts, IC engine, exhaust gas pipe and to obtain the output like its efficiency, amount of energy recovered, merits of thermoelectric power generation etc, which shows less innovation and research involved in it, rather than finding out what makes the system to yield more output like heat exchangers individual temperature change affect.

II. METHODOLOGY

A. Designing of PCGS

The Seebeck effect principle, working of thermoelectric module and waste heat region of gas flame are the main design considerations taken into account to decide the physical model of PCGS unit. Table I shows the specifications of elements of PCGS unit. The PCGS unit was designed and developed with essential elements like Heat absorber, Heat Sink and Thermoelectric Module and is fitted to domestic gas stove. The waste heat available from gas stove heat source, arrangement of 3 PCGS units and battery for electricity storage are shown in figure 1. Experiment was conducted for two gas regulations to analyse and improve performance.

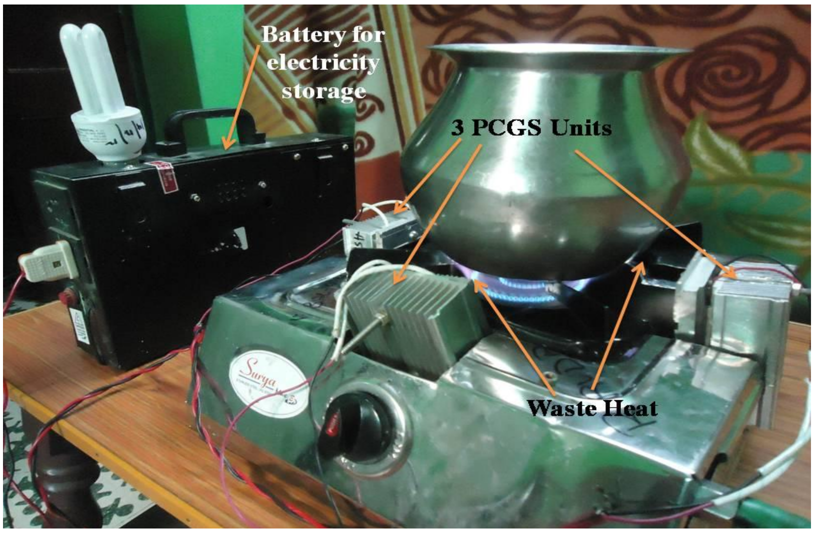


Fig.1 Arrangement of PCGS

Table I: Specifications of Elements of PCGS Unit

Elements	Millimeter (mm)			Material
	Length	Thickness	Breadth	
Heat Absorber	80mm	7mm	75mm	Aluminium
Heat Sink	80mm	35mm	75mm	Aluminium
Heat Sink Fins	80mm	2mm	35mm	Aluminium alloys 6061 and 6063 are commonly used
Thermoelectric Module	45mm	2mm	45mm	Ceramic plates as outer walls are of alumina and semiconductor elements are of silicon-germanium, lead telluride based alloys.

B. Working Process of PCGS

The working principle & arrangement of PCGS is schematically represented in the figure 2. When Gas stove is turned on the heat energy from flame of the gas stove is dissipated to the surrounding this heat get absorbed by the aluminum plate (heat absorbing part) which is placed closer to the burner. The absorbed heat is conducted from aluminium plate to one side of TEM; the other side of TEM is coupled with heat sink integrated with fins. The TEM is kept in between the heat absorber and heat sink, so that it should get heated on one side and cooled on other side to achieve Seebeck effect principle and in mean while the voltage. Table II shows summary of the parameters and dimensions of PCGS unit.

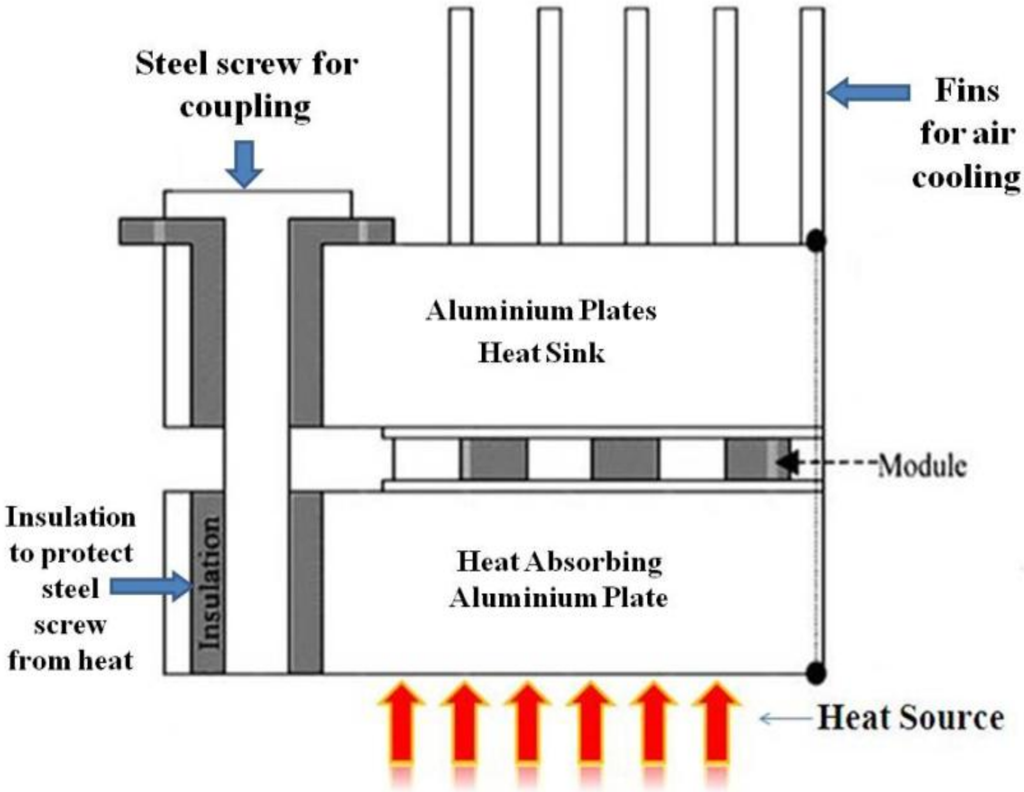


Fig. 2 Arrangement of PCGS Unit

Table II: Summary of the parameters and dimensions of PCGS unit

Parameter	**Dimension / Type / Value**
PCGS adopted	55mm Orthogonal / Perpendicular from the circumference of burner
Type of Heat Absorber	Flat Faced
Type of Heat Sink	Cube Shaped with fins
Type of Fins	Integer type straight fins

III. EXPERIMENT OF PCGS

After the completion of assembly of PCGS product onto the gas stove, experiment was conducted for two different gas regulations, one is for medium and the other at high gas regulation, during high gas regulation the gas stove knob is rotated full to allow maximum possible amount of gas to the burner. The output voltage obtained from all 3 units for medium and high gas regulations with respect to gas flame temperature, heat absorber temperature and heat sink temperature of thermoelectric module is explained as below. For the measurement of temperature, thermometer and for voltage and current multimeter was used.

A. Medium Gas Regulation

In both 1st and 2nd iteration the 3 PCGS products were located at 55mm from the gas stove burner at 3 sides as shown in the figure 3. The 1st iteration was carried out for medium gas regulation; here the gas knob was turned at certain point indication for medium, to allow medium amount of gas regulation from the cylinder to the burner. For the experiment purpose a vessel containing water was placed over the gas stove and gas flame temperature was measured after ignition with the help of thermometer, for every five minutes the heat absorber and sink temperature was measured accordingly the output voltage and current was measured using multimeter. It was observed that the gas flame temperature was increasing for every five minutes, after several times the temperature remained constant, and it was 130°C of gas flame temperature. The readings obtained for the 1st iteration are shown in table III.

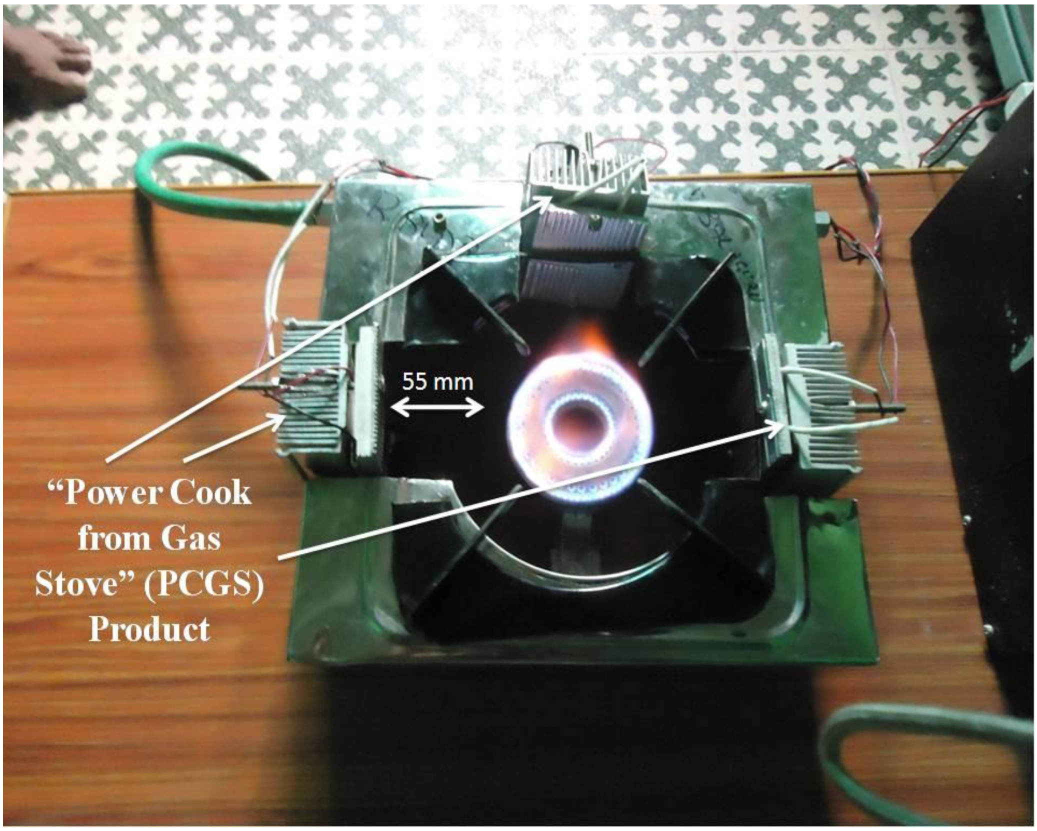


Fig. 3 Adoption of PCGS product on gas stove

Table III. Readings of 1st iteration

Gas Flame Temperature	Heat Absorber Temperature	Heat Sink Temperature	Output Voltage (Volts)	Output Current (Ampere)
130°C	101°C	72°C	6.5 V DC	6

It was observed that from heat source, the heat absorber absorbed 101°C and in heat sink due to fins air cooling action it absorbed 72°C and the output obtained was 6.5 volts DC and 6 amps. By observing the 1st iteration readings we repeated the experiment for high gas regulation to achieve maximum output.

B. High Gas Regulation

From the results of 1st iteration we decided to go for high gas regulation to increase the heat input in turn to achieve maximum output. In the 2nd iteration the PCGS unit was located at same distance from the burner at 3 sides. Here the gas knob was turned at the point indicating high to allow high gas regulation. During this iteration the same vessel with fresh water was placed, when the gas was turned ON it took 25 minutes to reach 160°C of constant gas flame temperature. The readings obtained for the 2nd iteration are shown in Table IV. Table V shows overall input and output readings.

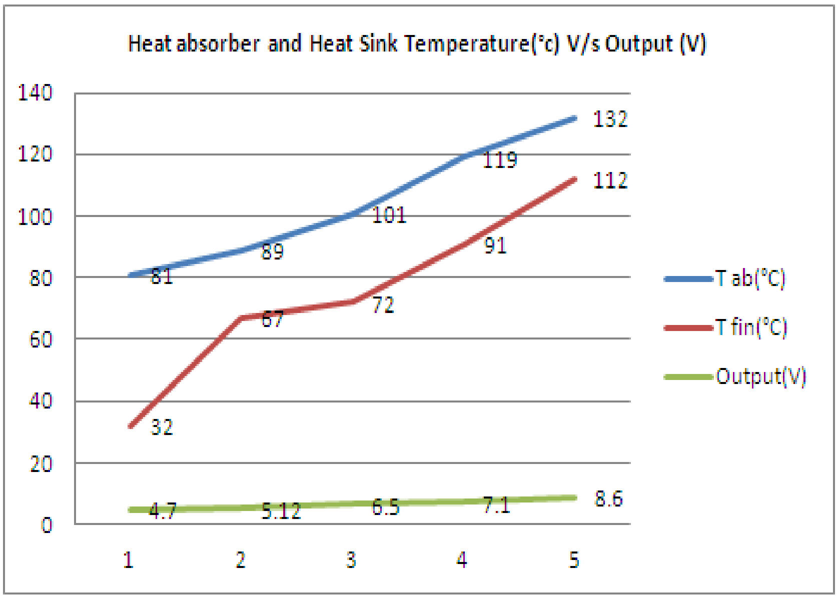
Table IV. Readings of 2nd iteration

Gas Flame Temperature	Heat Absorber Temperature	Heat Sink Temperature	Output Voltage	Output Ampere
160°C	132°C	112°C	8.6V DC	7

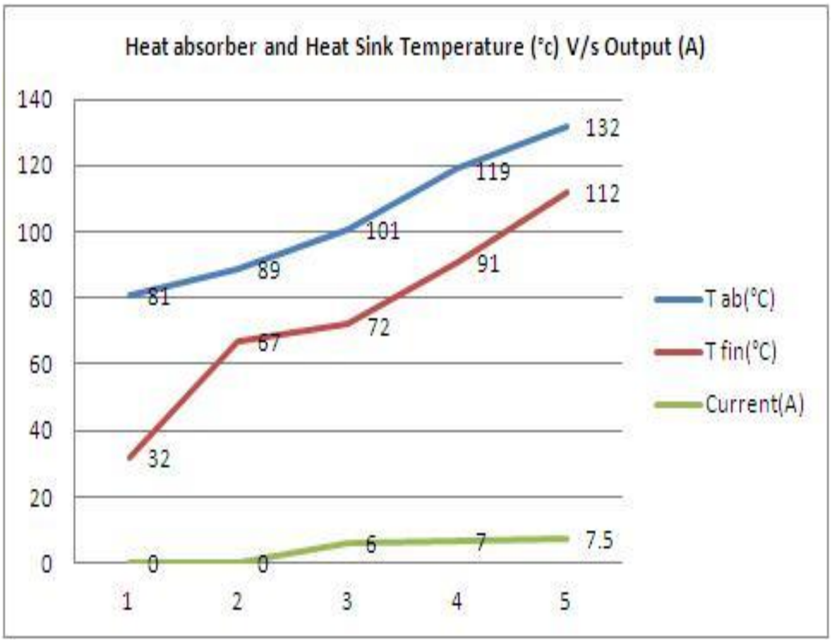
It was observed that from heat source, the heat absorber absorbed 132°C and in heat sink due to fins air cooling action it absorbed 112°C and the output obtained was 8.6 volts DC and 7 amps. The output voltage and output current obtained with respect to heat absorber and heat sink temperature is represented by graph 1 and graph 2 respectively.

Table V: Input and Output Readings.

Temperature		**Output**	
Heat Absorber	**Heat Sink**	**Current(ampere)**	**Voltage (DC)**
81°C	32°C	-	4.7
89°C	67°C	-	5.12
101°C	72°C	6	6.5
119°C	91°C	7	7.1
132°C	112°C	7	8.6



Graph1



Graph2

As per the observation of output voltage and current, the power calculation is done for high gas regulation as below:

Power = voltage x current
= 8.6 x 7
= 60.2 watts

From the experiment iterations, change in gas flame temperature from 130°C to 160°C, increase in heat absorber temperature from 101°C to 132°C, gradual increase in temperature of heat sink from 72°C to 112°C, placement of PCGS unit closer to the burner helped in arriving a maximum current of 7 amps and voltage of 8.6 volts DC. Thus the waste heat of 82.5% of gas flame temperature was utilized. Hence the innovative project of PCGS Product was worked out to obtain best possible results.

IV. CONCLUSIONS

In this project work the innovative product was designed, developed and assembled to carry out the experiment to analyze amount of utilization of waste heat and electricity generated by this design.
The following conclusions are drawn based on the experiment results of our project:

- By placing PCGS unit at 55mm from the gas stove burner, Output of 6.5 volts DC and 6 ampere can be obtained for medium gas regulation, and for high gas regulation 8.6 Volts DC and 7 ampere can be obtained from 3 units of PCGS with each 136 thermocouples.
- By increasing the heat absorber temperature of 23.5% and decreasing the heat sink temperature of 35.8% led to increase in output voltage by 21%.
- By increasing the heat absorber temperature and by decreasing heat sink temperature maximum output voltage can be obtained.
- Waste heat can be utilized by placing the product closer to the gas flame
- For medium and high gas regulation 77.7 % and 82.5 % of gas flame temperature was respectively utilized.

Hence the output voltage of PCGS unit is directly proportional to the heat absorber temperature and inversely proportional to the heat sink or heat rejector temperature.

ACKNOWLEDGMENT

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