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Experimental Study On Power Generation From Waste Heat Using Thermoelectric Generator In Vehicles

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Abstract - This project presents the investigation of power generation using the mixture of waste heat and thermo-electric generators. A majority of thermal energy within the industry is dissipated as waste heat to the environment. This waste heat are often utilized further for power generation. The related problems of worldwide warming and dwindling fuel supplies has led to improving the efficiency of any process being a priority. One method to enhance the efficiency is to develop methods to utilize waste heat that's usually wasted. Two promising technologies that were found to be useful for this purpose were thermoelectric generators and warmth pipes. Therefore, this project involved making a bench type, proof of concept model of power production by thermoelectric generators using heat pipes and simulated hot air.

Key Words: *Waste heat, waste heat Recovery, TEGs, Temperature Measurement, Voltage Measurement, Electricity etc.*

1. INTRODUCTION

In recent years, an increasing concern of environmental problems with emissions, especially heating and therefore the limitations of energy resources has resulted in extensive research into novel technologies of generating electrical power. Thermoelectric power generators have emerged as a promising alternative green technology thanks to their distinct advantages.

Previous research shows that TEG as a waste heat harvesting method is beneficial. Due to distinct benefits of thermoelectric generators, they have become a promising alternative green technology. Thermoelectric generator direct converts waste-heat energy into electric power where it's unnecessary to think about the value of the thermal energy input. The application of this technology also can improve the general efficiency the of energy conversion systems.

A thermoelectric power generator may be a solid state device that gives direct energy conversion from thermal energy (heat) thanks to a gradient into electricity supported "Seebeck effect". The thermoelectric power cycle, with charge carriers (electrons) serving because the working fluid, follows the elemental laws of thermodynamics and intimately resembles the facility cycle of a standard engine. Thermoelectric power generators offer several distinct advantages over other technologies.

They are extremely reliable (typically exceed 100,000 hours of steady-state operation) and silent operational since they need no mechanical moving parts and need considerably less maintenance;

- They are simple, compact and safe;
- They have very small size and virtually weightless;
- They're capable of operating at elevated temperatures;
- They're fitted to small-scale and remote applications
- Typical of rural power supply, where there is limited or no electricity;
- They are environmentally friendly;
- They are not position-dependent; and
- They are flexible power sources.

2. PROBLEM STATEMENT

Energy Intensive automobile require high temperatures to run the vehicles. There is often still heat 'energy' left as a byproduct of processing that is frequently simply wasted, vented through smokestacks, and into the air and created air pollution. To deal this waste heat power generation is very essential in every automobile.

- Industrial Manufacturing
- Automobile/vehicles
- Steel, Chemicals, Paper, Cement, Glass, Food Processing
- Oil and Gas Processing
- Gas Compressor Stations
- Refineries etc.

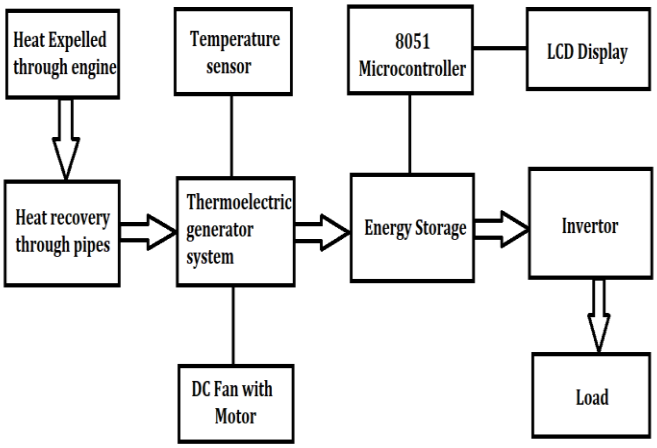
3. LITERATURE SURVEY

1. Basel I. Ismail*, Wael H. Ahmed. Thermoelectric Power Generation Using Waste-Heat Energy as an Alternative Green Technology, May 2020, Recent Patents on Electrical Engineering 2009, 2, 27-39
   In this paper, a background on the basic concepts of thermoelectric power generation is presented and recent patents of thermoelectric power generation with their important and relevant applications to waste-heat energy are reviewed and discussed.
2. 1PRASHANTHA.K, 2SONAM WANGO, SMART POWER GENERATION FROM WASTE HEAT BY THERMO ELECTRIC GENERATOR, Sep.-2018, International Journal of Mechanical and Production Engineering, ISSN: 2320-2092
   In this paper, The application of this option green technology in converting waste-heat energy directly into electrical power can too improve the overall efficiencies of energy conversion systems. Heat source which is need for this conversion is less when contrast to conventional methods.
3. M.F Remelia,b*,L. Kiatbodina, B.Singh a,b ,K.Verojporna, A.Datea,
   A.Akbarzadeha, Power generation from waste heat using Heat Pipe and
   Thermoelectric Generator, Aug 2017
   The 7th International Conference on Applied Energy – ICAE2015.
   This paper presents the investigation of power generation using the combination of heat pipes and thermo-electric generators. A majority of thermal energy in the industry is dissipated as waste heat to the environment.
4. Kewen Li1,2, Geoffrey Garrison3, Michael Moore3, Experimental Study on the Effects of Flow Rate and Temperature on Thermoelectric Power
   Generation, Feb 2019, 44th Workshop on Geothermal Reservoir Engineering
   Stanford University, SGP-TR-214

4. OBJECTIVE

1. To study the available literature and research on TEG application and its performance
2. To determine the appropriate suitable working of warmth Heat to electricity through TEG Module and collect the literature on the studies
3. To develop the experimental setup for the investigation
4. To conduct testing and sample run
5. To conduct final experimentation and compile
6. To analyse the Result.

5. BLOCK DIAGRAM



6. WORKING

- In this project concept it invented exhaust gas-based thermoelectric power generator for an automobiles application.
- In this invention, the exhaust gas gases in the pipe provide the heat source to the thermoelectric power generator. So, this project proposes and implements a thermoelectric waste heat energy recovery system from the exhaust heat from the running machineries in automobiles.

- This waste heat is strike to thermoelectric generator system which convert into electricity using seeback effect. The key is to directly convert the heat energy from automobiles waste heat to electrical energy using a thermoelectric generator. This heat is measure with temperature sensor attached to it.
- In this project we are generating electrical power as non-conventional method by heat energy .Non-conventional energy systems.
- Non-conventional energy using is converting mechanical energy into the electrical energy. Here in this project a mechanical arrangement is made. Use of embedded technology makes this system efficient and reliable.
- Produce energy is passed through dc motor with turbine for representation purpose only.
- Same amount of electricity is stored in battery of capacity 12v.
- Controller based armament is made to monitor the voltage status of system.
- Inverter module is applied, which convert DC to AC. AC load is attached at the output of system.

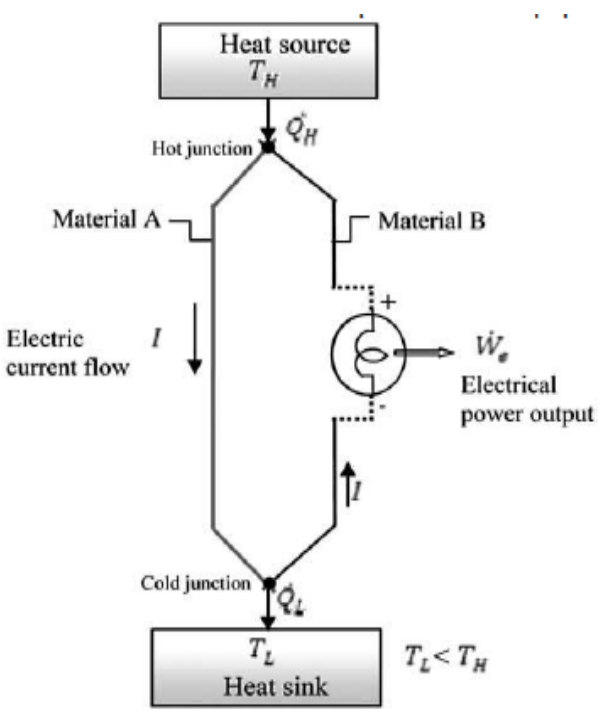


Fig. Working Principle

- TEG consists of one hot side and one cold side. The hot side with higher temperature, will drive electrons in the n-type leg toward the cold side with lower temperature, which cross the metallic interconnect, and pass into the p-type leg, thus developing a current through the circuit.
- If temperature difference is kept constant, then the diffusion of charge carriers will form a constant heat current, hence a constant electrical current.

7. ADVANTAGES

1. Electricity can used for many purposes
2. Efficient and eliminate the grid searching
3. Promising technology for solving power crisis to an affordable extent.
4. Clean, Noise less, Cost is less .
5. This is a Non-conventional system ,No fuel is require
6. Easy maintenance, portable, Charging time is less (maximum temp)
7. Simple in construction, Pollution free, Reduces transmission losses.
8. Wide areas of application# Required less space
9. It can be use at any time when it necessary.
10. Less number of parts required.

8. DISADVANTAGES

1. Improper variation of temperature gradient difference may damage the TEG, Complex design.
2. Need proper maintenance every time.

9. APPLICATIONS

1. Thermoelectric Generators are basically used in where the power production is less.
2. In many vehicles amount of heat is executed and been wastage. We can used this hear for electricity using TEG.
3. In automobile vehicle produce heat that can be used for generating electricity by using TEG.
4. Recharge the battery where ever waste heat is obtained.

5. Self-charging battery by fixing the TEG at radiator or two wheeler silencers pipe.

10. CONCLUTION

- Waste heat recovery entails capturing and reusing the waste heat from engine in automobile and using it for generating electrical work. It would also help to recognize the improvement in performance and emissions of the engine if these technologies were adopted by the production automobile.

- If this concept of thermoelectric system is taken to the practical level then there will be large amount of electricity can be generated, which will be used to run industrial load itself. Also large amount of wastage heat for pollution is also uses in this system in continue manner. And such automobile also somehow help to protect the environmental pollution.

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