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Thermoelectric Power Generation from Waste Heat

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Abstract: *The current worldwide trend of increasing transportation is responsible for increasing the use of internal combustion engines. I.C engines, the devices with a high energy usage and low efficiency because a high amount of the energy produced during combustion is lost in the exhaust and in the coolant of the engine in the form of heat. As a huge amount of energy is lost, there is an urgent need to design advice to trap this loss. This paper proposes and implements a waste heat recovery system using a thermoelectric generator (TEG) designed for four strokes I.C. engine. The system converts the waste heat from the exhaust manifold into electrical energy using a TEG. The output is then boosted by a Joule Thief converter to run the required load or to charge a battery. The experimental results demonstrate that the proposed system recovers a considerable amount of waste heat which can be used to power some auxiliary automobile devices.*

Keywords: IC Engine, Heat Energy Recovery, Silencer Bend Pipe, TEG, Electric Load, etc.

I. INTRODUCTION

There is no system which converts total input energy into output energy practically, there are some losses. In the universe there is no system which is 100% proficient, due to losses system effectiveness decreases in real practices. Automobile sector are an example of high energy usage with low competence. It has 30% efficiency and roughly 75% of the energy produced during combustion and roughly 75% of the energy produced during combustion is lost in the exhaust or engine coolant in the form of heat. If this energy is tapped and transformed into functional energy, the overall efficiency of an engine can be improved. Thermoelectric technology can be used to generate electrical power from waste heat. Thermoelectric generator utilizes the See beck effect which was first observed in 1821.

Thermoelectric generator practically came into existence in 1960 which were developed appreciably and since then number of manufacturers are now marketing thermoelectric modules for power generation, heating and cooling applications. Constant research and advances in thermoelectric materials and manufacturing techniques, enables the technology to make an increasing effort to address the growing low power energy sources typically used in energy harvesting and scavenging systems. Thermoelectric generator can be used to generate a small amount of electrical power, typically in the microwatt (μW) range, if a temperature difference is maintained between two terminals of a thermoelectric generator.

The hotness of exhaust gas pipe of an engine is very high when exhaust gases are flowing through it and that is around 200oC to 300oC. Thermoelectric generator is model for such applications as they are small, with no moving parts and relatively efficient at this temperature. Thermoelectric generator is basically solid-state devices that are used to convert thermal energy from temperature gradient to electrical energy. By using waste thermal energy through IC engines exhaust to charge the battery instead of using an alternator the overall fuel economy can be increased by 10%.

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II. LITERATURE SURVEY

"Smart power generation from waste heat by thermo electric generator'' by prashantha.k, sonam wango at IJMAPE on 2016. Generating electricity in present there is a shortage of fossil fuel, oil, gas, etc. burning of these fuels causes environmental problem like radio activity pollution, global warming etc. So that these (coal, oil, gas) are the limiting resources hence resulting new technology is needed for electricity generation, by using thermoelectric generators to generate power as a most promising technology and environmental free and several advantages in production. Thermoelectric generator can convert directly thermal (heat) energy into electrical energy. In this TEG there are no moving parts and it cannot be producing any waste during power production hence it is considered as a green technology.

Thermoelectric power generator converts direct waste heat in to generate electricity by this it eliminated emission so we can believe this green technology. Thermoelectric power generation offer a potential application in the direct exchange of waste-heat energy into electrical power where it is unnecessary to believe the cost of the thermal energy input. This method will have a maximum outcome. The application of this option green technology in converting waste-heat energy directly into electrical power can to improve the overall efficiencies of energy conversion systems. Heat source which is need for this conversion is less when contrast to conventional methods. By using this energy is used to charge the mobile electronics.

Present method for electricity generation is converting thermal energy into mechanical energy by turbine then into electricity by using generator. Burning of these fuels causes environmental problem like radio activity pollution, global warming. Hence (coal, oil, gas) are the limiting resources resulting new technology is needed. The project paper is tested and implemented. The system gives the best economical pollution free, required energy solution to the people. Two power generators have been built using TEG modules and tested. The power of the first one could reach about 500 W (predicted using experimental data) with a temperature difference of about 200°C between hot and cold sides.

"Design and Fabrication of Silencer Waste Heat Power Generation System Using Thermo-Electric Generator'' by M G Jadhav and J S Sidhu at IJDME on 2015. The current worldwide trend of increasing transportation is responsible for increasing the use of internal combustion engines. I.C engines, the devices with a high energy usage and low efficiency because roughly 75 % of the energy produced during combustion is lost in the exhaust and in the coolant of the engine in the form of heat. As a huge amount of energy is lost, there is urgent need to design a advice to trap this loss. This paper proposes and implements a waste heat recovery system using a thermoelectric generator (TEG) designed for four strokes I.C. engine. The system converts the waste heat from the exhaust manifold into electrical energy using a TEG.

The output is then boosted by a Joule Thief converter to run the required load or to charge a battery. The experimental results demonstrate that the proposed system recovers considerable amount of waste heat which can be used to power some auxiliary automobile devices. This project aims to find a possible way to recover the waste heat from the exhaust of I.C. engine as well as to design and fabricate one such system to serve the aim. Experimentally it is found that when two thermoelectric generators are connected in series. This generated power either directly used to run some auxiliary devices of an automobile or may be stored in the battery and used later. These auxiliary loads can be supplemented from battery to this system thereby reducing load on alternator. The study also investigates the effect of engine speed on temperature difference and voltage generated. The engine performance is unaffected by the designed system because heat extracted from the surface of the bend-pipe of the exhaust manifold which does not affect the working of engine.

III. CONCLUSION AND DISCUSSION

Thus, from above research we concluded that,

1. The power loss from engine can be converted into some useful energy by using the Thermo-Electric generator module, Thermo-Electric cooling module.

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2. Thus, we can operate any electric device from the power generated in the above experiment.
3. Thus, the bulky and power consuming AC can be replaced by the light weight and less power consuming thermo electric Peltier module.
4. Thus, the thermal efficiency of engine increase with decrease in power loss due to heat.
5. The costlier cooling system is also replaced by the cheaper system.

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