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Review on Modification and Analysis of Air Filters

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ABSTRACT

Internal combustion Engines converts only a small portion of heat energy into useful work resulting in a very low thermal efficiency. Most of the heat energy is lost in forms of cooling, exhaust gas, friction and unaccounted losses. Though energy lost in exhaust gas can be recovered by using thermoelectric generators (TEGs, also known as peltier element), which converts heat into electrical energy. A model has been prepared which helps TEG to extract heat from exhaust gas efficiently. This electrical energy obtained is used for powering hybrid drive.

Keywords— thermoelectric generator (TEG), exhaust heat.

1. INTRODUCTION

This project is to recover the heat energy which is wasted in the exhaust of an IC engine. Heat pipe is employed to effective transfer of heat from engine to TEG unit. Heat pipes are chosen to ensure effective heat transfer without major losses. Up to three pairs of TEG units are proposed to be used for power generation. The residual energy thus obtained can be used in hybrid drives so that fuel consumption can be reduced to acceptable levels in automobiles.

2. PRINCIPLES

2.1 Thermoelectric generator (TEG)

TEG unit is a simple Peltier element which works on the principle of Seeback effect. When temperature difference is provided between the junctions an EMF is produced which can be stored or used for any useful purpose. The theory and operation of thermoelectric based systems have been developed for many years back. TEG is based on “Seebeck effect” invented by Thomas Seebeck in 1821. When a difference in temperature is set up between a hot and a cold junctions of two dissimilar materials (metals or semiconductors) an EMF is produced between them, i.e., Seebeck voltage. Based on this Seebeck effect, thermoelectric devices can act as electrical power generators.

2.2 Heat Transfer by Conduction and convection

A physical law for heat transfer by conduction was given by Fourier (1822) according to which the rate of heat conduction is proportional to the area measured normal to the direction of heat flow and to the temperature gradient in that direction. Convection is the heat transfer due to bulk movement of molecules within fluids such as gases and liquids, including molten rock. Convection takes place through advection, diffusion or both.

3 PROJECT DESCRIPTION

The project is about Heat Energy Recovery for hybrid drive which can self charge at a minimum percentage. This project is more portable and compact TEG that can be and used on a exhaust pipe since we have the source of heat needed to convert. This energy produced by the waste heat will used to charge rechargeable batteries. This concept, from waste heat will produces electrical energy as a renewable energy.

3.1 Existing Model

In previous systems, TEG is placed in modified head, which acts as both heat source as well as heat sink. Another version used heat pipes in exhaust pipes to trap heat and provide hot junction for TEG. In other systems the heat from the exhaust is transferred to the TEG with a heat pipe.

3.2 Experimental Method

In experimental setup the TEG is sandwiched between aluminum block from the exhaust of the engine, and a heat sink with fins. The aluminum block gets the heat from the exhaust pipe. The hot junction of the peltier is kept on the aluminum block. The cold junction is kept on the heat sink.

3.3 Material properties

Material used for block and its properties is discussed below

Table 1. Material Properties

Properties	
Name	Aluminium 1060Alloy
Thermal conductivity	200 W/(m.K)
Specific heat	900 J/(kg.K)
Mass density	2700kg/m^3

3.4 TEG Specifications

Technical details of TEG unit used is given below,

Table.2. TEG Specifications

Dimension	40x40x3.8mm
Max. temperature	138oc
Material	Al2o3
Delta T max	68oc
P-N junction	127 couples

4. MODEL DESIGN

Modified exhaust pipe and TEG with source and sink assembly is shown below in Fig.1.

Fig. 1. Layout of our Heat Recovery System

It would be a effective way to transfer heat in smaller IC engines in which temperature will be not as high as in larger counterparts

5. ANALYSIS

Temperature distribution and heat flux study in steady state conditions are done in ANSYS R17.2 and the study results are as follows

5.1 Temperature Distribution

Study is done for ambient air temperature of 31^{o}c and 150^{o}c at inside. It can be seen that a maximum of 131^{o}c is obtained on the block. The distribution is shown in fig.2. below

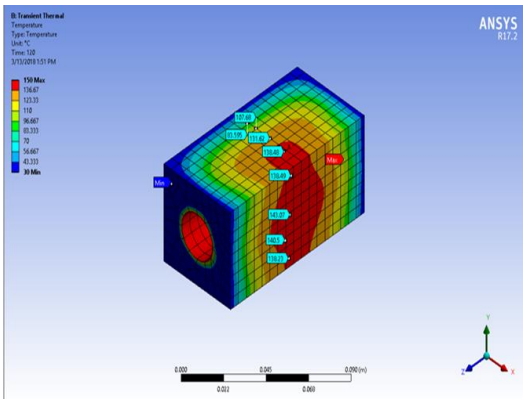

Fig. 2. Temperature Distribution

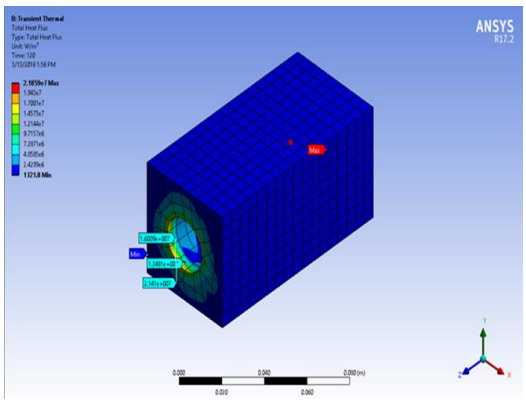

Fig. 3. Heat Flux

5.2 Heat Flux

Heat flux for the same block is studies and results are shown in fig.3.

5.3 Study results

Based on the above two studies it is concluded that it is feasible to use this block design for heat transfer purpose in thermo electric power conversion.

6. EXPERIMENTAL SETUP

TEG units are arranged two per face as per the model and are connected in parallel. One face of block is used for mounting purposes. Test is conducted with an 110cc SI engine,whose exhaust pipe is modified. Setup is shown in fig.4.

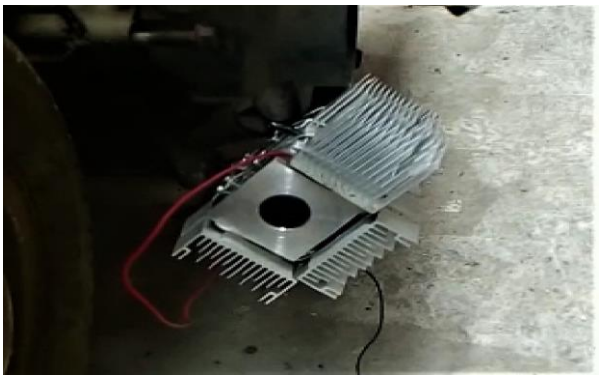

Fig.4. Experimental setup

6.1 Experimental results

Results of our experimental setup are tabulated below

Table.3. Results

Voltage obtained	3V
Current obtained	2.5A
Power rating	7.5W

7. CONCLUSION

This project concludes with an updated concept of electric power generation from waste heat in the exhaust pipe using a combination of aluminum heat block and thermoelectric generator with reference into key performance parameters such as maximum power output and heat transfer rate.

Advantages

There are more advantages in our project. Some are listed below,

- It uses residual power to run the vehicle
- It will also provide cooling for engine.

Disadvantages

For everything there will be an disadvantage in it. Similarly in our project also there is disadvantage, which is as follows,

- It can prevent engine from starting in cold start conditions.
- It will add some additional weight to vehicle. Table Type Styles.

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