iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 6 **Issue:** III **Month of publication:** March 2018

DOI: http://doi.org/10.22214/ijraset.2018.3717

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 6.887
Volume 6 Issue III, March 2018- Available at www.ijraset.com

Power Generation from IC Engine Exhaust Gases

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Abstract: Here we are modifying an automobile's exhaust for producing power using turbines. Nowadays in automobile field many new innovating concepts are being developed. We are using the power from vehicle exhaust to generate the electricity which can be stored in battery for the later consumption. In this project, we are demonstrating a concept of generating power in a vehicle exhaust by the usage of turbine and thermos-electric module. Here we are placing a turbine in the path of exhaust in the silencer. An engine is placed in the frame along with exhaust manifold. The turbine is connected to a dc generator, which is used to generate power. Depending upon the airflow the turbine will start rotating, and then the generator will also start to rotate. A generator is a device which is used to convert the kinetic energy into electrical energy. A thermoelectric chip is placed on exhaust pipe with suitable clamping. Thermoelectric module consists of two dissimilar thermoelectric materials joined at their ends: an n-type (negatively charged); and a p-type (positively charged) semiconductors. A direct electric current will flow in the circuit when there is a temperature difference between the two materials. The generated power is stored to the battery. The rectified voltage can be inverted and can be used in various forms of utilities. The battery power can be consumed for the user's comfort.

Keywords: Peltier chip, Thermoelectric generator, DC generator, IC engine, Turbine, Frame.

I. INTRODUCTION

Energy conservation is a burning issue currently. There is a need for systems for generating electrical energy with high efficiency and minimum environmental pollution. Conventional coal and nuclear plants generally achieve only about 35 percent efficiency. By efficiency, there is meant the amount of electrical energy produced as a percentage of potential energy present in the fossil fuel burned in the power plant. All around the world, researchers are trying to find ways to reduce wastage of energy, either by improving the efficiency of the systems, or by recycling the wasted energy. A heat engine is a system that performs the conversion of heat or thermal energy to mechanical work. Examples of everyday heat engines include the steam engine, the diesel engine, and the gasoline (petrol) engine in an automobile. Heat engines are designed to produce useful work only. The efficiency of a modern internal combustion engine is about 37% in a normal passenger car spark ignition engine. The energy in the form of heat is rejected by means of exhaust, circulating cooling water, lubrication oil & radiation.

II. OBJECTIVES

Extracting of energy from waste gases of IC engine and thermoelectric modules.
Our fore most aim in selecting this project is to convert waste energy into usable energy.
Arriving at a standard design of the system which should be simple and easy to install to the existing vehicles.

III. METHODOLOGY

The waste exhaust gas from the vehicle which is at a certain pressure is passed through a device. Where the blower or turbine is placed to the nozzle from the IC engine, when the exhaust air hits the turbine it rotates. Turbine is connected to the dc generator helps to rotate simultaneously to generate electric city in terms of voltage. The exhaust heat from the silencer is directly converted to the electric power by Peltier chip. This chip works on see beck effect and converts heat energy into electrical energy.

A. Design calculations

1) Turbine

Number of Blades = 32
Diameter of the turbine = 15cm
Velocity = 8 m/s to 21.3 m/s
FORMULAE TO BE USED
Where Cp = Maximum power coefficient, ranging from 0.25 to 0.45

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2) Theoretical Calculation

Swept area by the turbine $A = \pi \times R^2$
$= 3.14 \times (0.075)2$
$= 176.625\text{x}10\text{-}4\ m^2$

Velocity of the turbine $V = (\pi \times D \times N)/60$
$= (3.14 \times 0.15 \times 600)/60$
$= 4.71$ m/s

Power available at the turbine $P = 1/2 \times \text{density} \times A \times V^3 \times Cp$
$=1/2 \times 1.23 \times 176.625\text{x}10\text{-}4 \times (4.71)3 \times 0.4$
$=0.454$ watts

3) Experimental Calculation

Power generated (Idling) Pg = V x I
= 3 x 12 x 10-3
= 0.036 watts

Power generated (Full Throttle) Pg = V x I
= 19 x 12 x 10-3
= 0.228 watts

4) Peltier Chip

Power generated from Peltier chip = 0.1 watts

B. Turbine Design

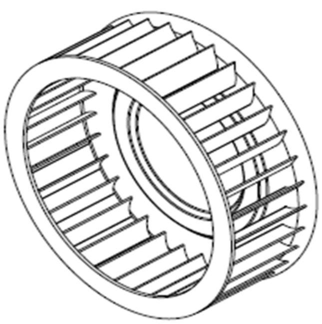

Fig.3.1 Isometric View of turbine

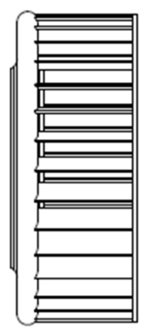

Fig.3.2 Front View of turbine

C. Casing Design

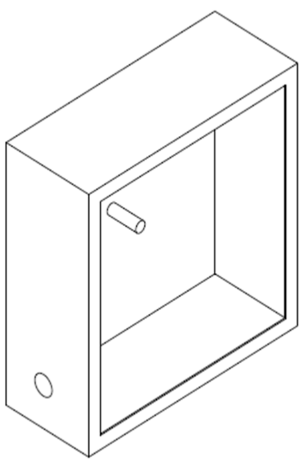

Fig.3.3 Isometric View of casing

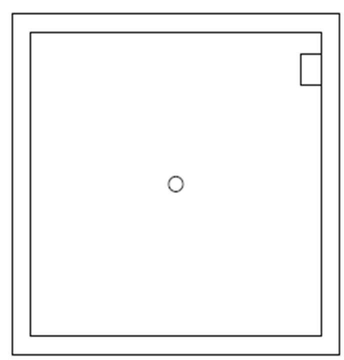

Fig.3.4 Front View of casing

D. Frame Design

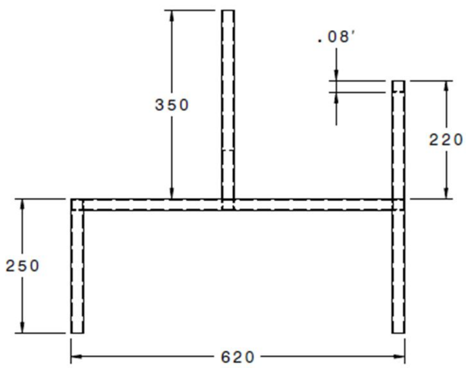

Fig.3.5 Front View of frame

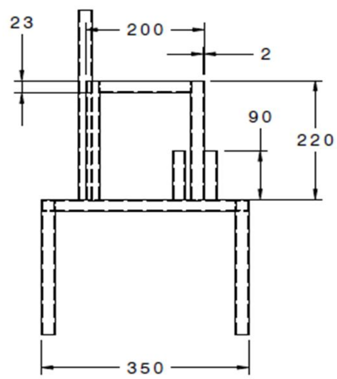

Fig.3.6 Side View of frame

All dimensions are in millimetres.

IV. FABRICATED MODEL

Fig.4.1 Front View

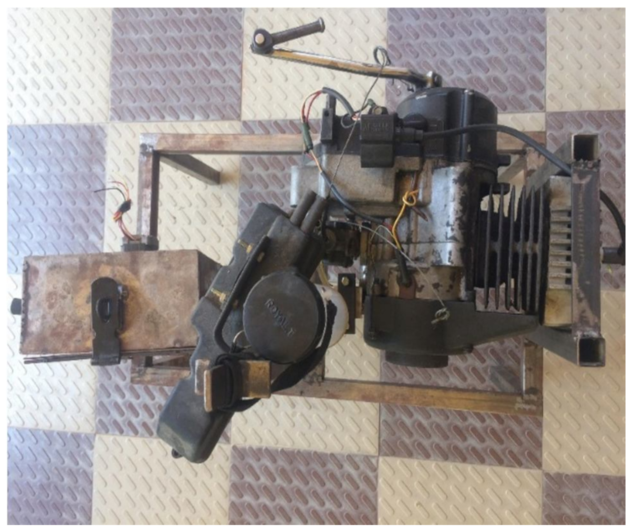

Fig.4.2 Top View

V. RESULTS

GRAPHS

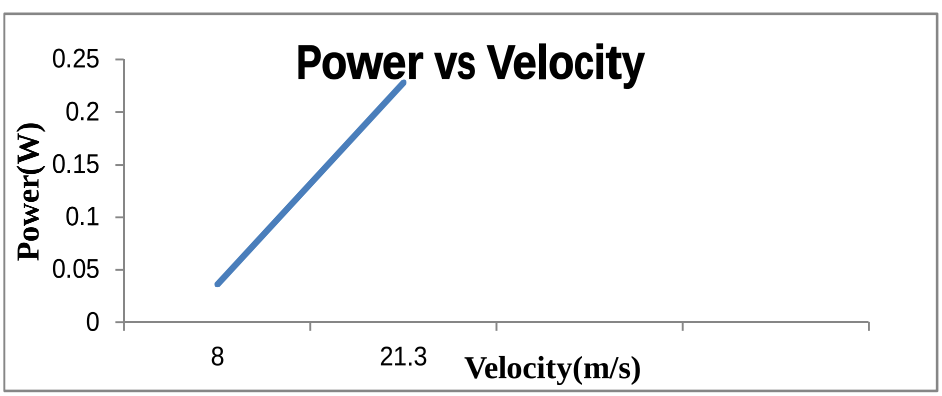

Fig.5.1 Power vs velocity Graph

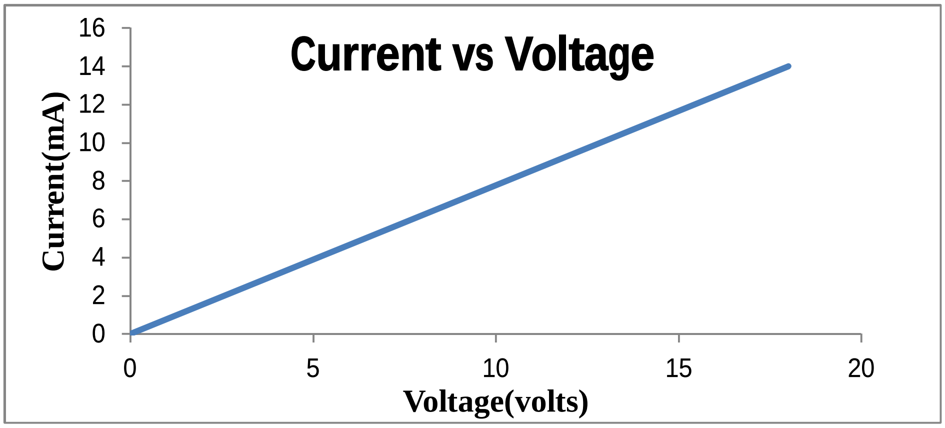

Fig.5.2 Current vs Voltage Graph

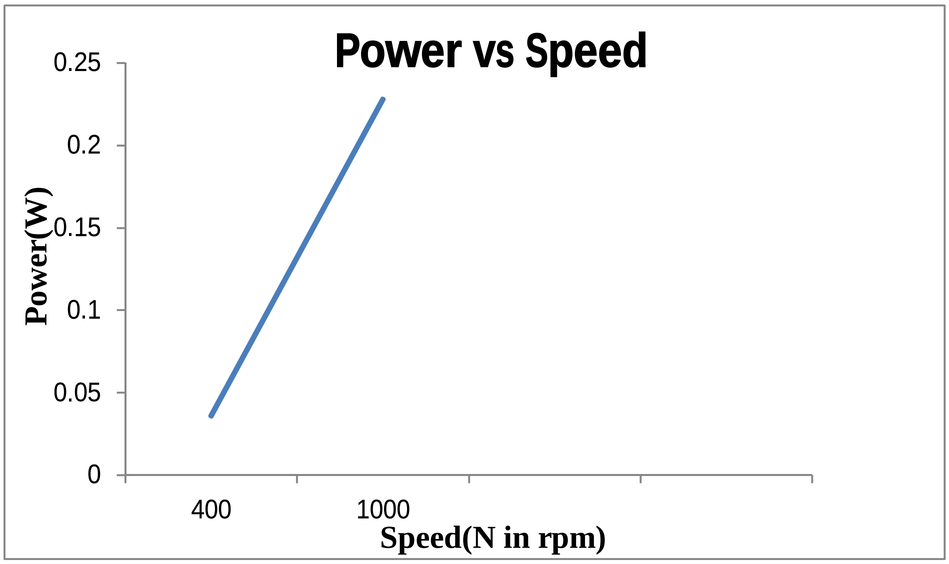

Fig.5.3 Power vs Speed Graph

VI. CONCLUSION

Above are the graphs plotted for obtained and calculated values. From the figures 7.1 and 7.3 it can be inferred that power is directly proportional to velocity of exhaust gases and speed of turbine rotating. But speed of turbine disc directly depends on the velocity of exhaust gases. By this it can be concluded that power generated by dc generator is dependent on velocity of exhaust gases. The obtained voltage as measured multiple times was about 18 volts and 12 mA. The current can be improved with a step-up transformer without affecting the voltage. The voltage produced was 3 volts and 0.3 mA (0.1watts) and in real time application in industries a bigger TEG with more capacity (up to 45 watts) can be used. It was observed that in our current project there was no much temperature difference and the surrounding area of exhaust pipe would also get the heat due to convection, dropping the temperature difference of two sides of the chip.

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