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Design and Fabrication of Exhaust Gas Heat Recovery Power Generation System

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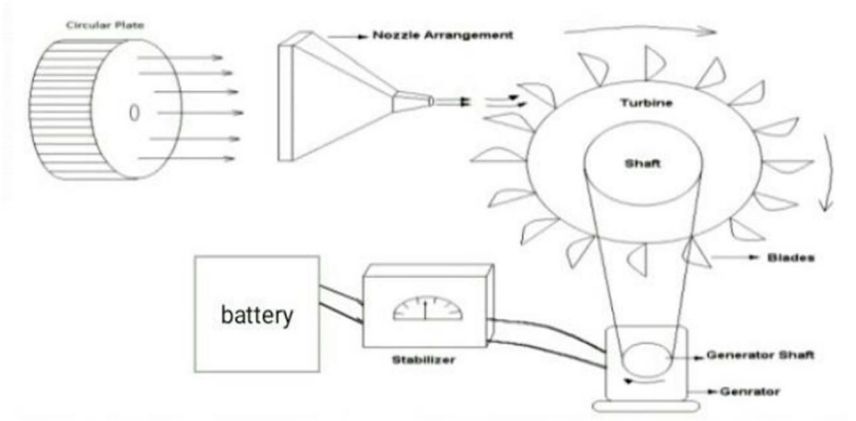
Abstract: ***This paper proposes and implements a waste heat energy recovery system for internal combustion engine automobiles, including gasoline vehicles. In modern days agricultural sector is plays an important role, so for that we need electrical energy for lighting effects in night times. The key is to directly convert the heat energy from automotive waste heat to electrical energy using a turbocharger, which is then regulated by a DC–DC Ćuk converter to charge a battery using maximum power point tracking. Hence, the electrical power stored in the battery can be maximized. The experimental results demonstrate that the proposed system can work well under different working conditions, and is promising for automotive industry.***
Keywords: Exhaust Gas, Turbocharger, Battery,

I. INTRODUCTION

In agricultural areas there was no power backup for night work so in the research article provides power with the help of exhaust gas produced from the internal combustion engine automobiles, including gasoline vehicles and hybrid electric vehicles. In this recovery system, turbo is the heart because it is the only manner convert the heat energy into the electrical energy. We can store the power to battery by a DC converter using maximum power point tracking. Hence, the electrical power stored in the battery can be maximized. Thus, the power has been generated without loss of any additional fuel and results demonstrate that the projected system can work well under different working conditions by varying the turbine fins shape and is promising for automotive industry.

II. EXPERIMENTAL SETUP

The experimental setup of exhaust gas heat recovery power generation system is connected to the exhaust manifold end and the flow of exhaust gases pass through this pipe and make the turbine to rotate at all operating conditions. Turbine rotates the shaft and which is connected to the generator or dynamo and the dynamo is twisted and makes the battery to charge and also power the auxiliary accessories such as air condition, lights and etc. The voltage from the generator is measured using multimeter and current is measured by placing the circuit which is connected to load, resistance, rheostat and ammeter. The experimental setup is made for this project and it deals a major role day today of automotive electronics. The turbine which is connected to generator which is opposite to the exhaust pipe. The setup is placed and distance from the exhaust manifold is 15cm to reduce the backpressure of the system. The whole setup which is placed at the end of the tail pope which is used to connect with generator. The generator is balanced by using four bolt joints and acts a prototype setup. The turbine housing is connected by the hand lever which is used to reduce the vibration during engine running and to withstand the backpressure at high engine revolution per minute.



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A. Components

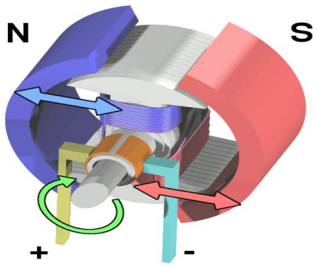
1) DC MOTOR
2) SILENCER
3) TURBINE
4) GENERATOR
5) LIGHTING SOURCE
6) CHARGEABLE BATTERIES

B. Dc Motor

An electric motor is an electrical machine that converts electrical energy into mechanical energy. Most electric motors operate through the interaction between the motor's magnetic field and electric current in a wire winding to generate force in the form of torque applied on the motor's shaft. An electric generator is mechanically identical to an electric motor, but operates with a reversed flow of power, converting mechanical energy into electrical energy. Electric motors can be powered by direct current (DC) sources, such as from batteries, or rectifiers, or by alternating current (AC) sources, such as a power grid, inverters or electrical generators. DC motors were the first form of motor widely used, as they could be powered from existing direct-current lighting power distribution systems. A DC motor's speed can be controlled over a wide range, using either a variable supply voltage or by changing the strength of current in its field windings. Small DC motors are used in tools, toys, and appliances. The universal motor can operate on direct current but is a lightweight brushed motor used for portable power tools and appliances. Larger DC motors are currently used in propulsion of electric vehicles, elevator and hoists, and in drives for steel rolling mills. The advent of power electronics has made replacement of DC motors with AC motors possible in many applications.

A DC motor is any of a class of rotary electrical motors that converts direct current (DC) electrical energy into mechanical energy. The most common types rely on the forces produced by magnetic fields. Nearly all types of DC motors have some internal mechanism, either electromechanical or electronic, to periodically change the direction of current in part of the motor.

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C. Silencer

Since the experiment is used to generate electricity from exhaust heat, for heat exhaust source an electric blower or silencer is used in this model experiment. The blower or silencer is used at a particular speed for the turbine to rotate and produce electricity.





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D. Wind Turbine

Wind power energy from the electric pump or silencer is collected using wind turbines. Instead of blowing air, however, turbines catch the air. When the blower blows, it makes the blades of the fan, called rotors, spin around, which moves the turbine on the inside and generates electricity. Basically, the wind does work on the turbine when it makes it spin. Work is an application of energy, which makes something move. The energy from the wind's work is taken by the turbine and converted into electricity and then it is stored.



E. Generator

In the experiment the generator is used to convert the mechanical energy from the turbine and convert it into a electrical energy and store it in the battery. In electricity generation, a generator is a device that converts motive power (mechanical energy) or fuel-based power (chemical energy) into electric power for use in an external circuit. Sources of mechanical energy include steam turbines, gas turbines, water turbines, internal combustion engines, wind turbines and even hand cranks. The first electromagnetic generator, the Faraday disk, was invented in 1831 by British scientist Michael Faraday. Generators provide nearly all of the power for electric power grids.

F. Lighting Source

The lighting source uses the energy converted by the generator which is stored in the battery and the lighting source is connected to it.

G. Rechargeable Battery

A rechargeable battery, storage battery, or secondary cell (formally a type of energy accumulator), is a type of electrical battery which can be charged, discharged into a load, and recharged many times, as opposed to a disposable or primary battery, which is supplied fully charged and discarded after use. It is composed of one or more electrochemical cells. The term "accumulator" is used as it accumulates and stores energy through a reversible electrochemical reaction.

Rechargeable batteries are produced in many different shapes and sizes, ranging from button cells to megawatt systems connected to stabilize an electrical distribution network. Several different combinations of electrode materials and electrolytes are used, including lead–acid, zinc–air, nickel–cadmium (NiCd), nickel–metal hydride (NiMH), lithium-ion (Li-ion), lithium iron phosphate (LiFePO4), and lithium-ion polymer (Li-ion polymer). Rechargeable batteries typically initially cost more than disposable batteries but have a much lower total cost of ownership and environmental impact, as they can be recharged inexpensively many times before they need replacing. Some rechargeable battery types are available in the same sizes and voltages as disposable types, and can be used interchangeably with them. Billions of dollars in research are being invested around the world for improving batteries and industry also focuses on building better batteries.



H. Waste Energy Recovery

Waste heat from the exhaust gas from the vehicle accounts for account for a considerable portion of the fuel energy that is not utilized, about 40% from figure (1.1). Therefore, a mean to improve to the fuel economy is to increase the overall efficiency of the power train by recovering waste heat from the exhaust gas of the vehicle. According to "1999 bosch automotive electric and electronics hand book" the average electrical power consumption of an automobile is about 600 watts. This load is carried by an in efficient engine/alternator system. The objective is to reduce the load on the alternator and consequently on the engine by converting the waste heat from the exhaust gas of the vehicle into electrical. Clarkson University has formed a team to design, build, test and simulate a proto type automotive exhaust thermoelectric generator (AETEG) that offsets the engine shaft power by converting the west heat into electrical energy. The AETEG work on the principle of thermoelectricity: when the junctions formed by joining two dissimilar current carrying conductors is known as thermoelectric couple. In a typical generator heat exchanger are used to transfer heat from the heat source and the sink to junction of the thermocouple. The heat exchanger are the thermoelectric couple unit is known as a thermoelectric generator(TEG).The AETEG has the vehicle exhaust gas as it sheet source and the engine coolant as heat sink. Thermoelectric conversion is a solid-state technology with no moving parts, which is simple and reliable.

III. RESULT AND DISCUSSION

One of the most important phases of conducting research is the choice of a suitable problem. Beginners are likely to select a problem that is much too broad in scope. This possibly could be the result of the researcher's lack of understanding of the nature of research and the process of problem- solving activity. This may also be brought about by the researcher's enthusiasm and desire to solve a problem immediate. On the part of the professional researchers, they are aware that research is quite a tedious task, painfully slow, but greatly spectacular towards the end. They realize that the process of problem solving in research is one that requires a lot of patience, being aware that research is such a very difficult task. It has been claimed by Leedy (1988) that the problem is the axial center around which the whole research effort turns, hence, it is but important that the statement of the problem must be expressed with utmost verbal precision. Then, the problem is fractionated into more manageable sub problems. After finding the problem following point we have analysis as problem of our project to picare as follows: -

1) Firstly, we close a suitable place to fit the module no loss where we get accurate reading, high efficiency and no loss of exhaust.
2) After finding the suitable place we place the heat sink on it in the opposite direction so that heat carrying is would occur in huge amount.
3) In the cold side if we are the atmospheric air to keep cold, we can't get temperature deferent in high amount for getting high temperature different are use water block to get high output gain. (Heat carrying capacity of water is more than atmospheric air)
4) For the flow of water into water block we are water pump which is use to flow water continuously.
5) The water block is getting hot as the flow of exhaust increases reduce the temperature of water block, we are use the heat sink with a fan which is mount on the top of heat sink.
6) For the working of fan, we need some input source of energy so we use energy which comes out from TEG. We connect the booster circuit to TEG to increase or step up the voltage to 12V after this we change the battery to run the fan.
7) While we were using digital multi meter for measuring of current we can't get accurate value so fix this problem we connect an ampere meter. This is connected in series to the circuit and gets accurate value.
8) For getting higher temperature from exhaust for getting high voltage we use the accelerator into high range

A. Design and Calculation

1) Specification of Two Stroke Petrol Engine

Type: Two Strokes
Cooling System: Air Cooled Bore/Stroke: 50 X 50 mm
Piston Displacement : 98.2 CC
Compression Ratio: 6.6: 1
Maximum Torque: 0.98 Kg-m at 5,500rpm

2) Calculation

Compression ratio = (Swept Volume + Clearance Volume)/ Clearance Volume
Here,
Compression ratio = 6.6:1: 6.6 = (98.2 + Vc) / V * c Vc = 19.64

3) Assumption

1. The component gases and the mixture behave like ideal gases.
2. Mixture obeys the Gibbs-Dalton law Pressure exerted on the walls of the cylinder by air is P.

P = (MRT)/V

Here,

M = m/M= (Mass of the gas or air)/ (Molecular Weight) R= Universal gas constant-8.314 KJ/Kg mole K.

T1 = 303 K

V1=V=253.28x106

Here,

Density of air at 303ºK = 1.165 kg/m³

V mole = 22.4 m³/Kg-mole for all gases.

Molecular weight of air = 1.165 x 22.4

P = {[(mV/(1.165 x 22.4)] x 8.314 x 303}/253.28 x 10⁻

P = 381134.1 m

Let Pressure exerted by the fuel is P.

P = (M R T)/V

Density of petrol = 800 Kg/m³

P= {[(M)/(800 x 22.4)] x 8.314 x 303}/(253.28 x 10⁻

P = LM324.02 m

Therefore Total pressure inside the cylinder,

PT = P + P = 1.01325 x 100 KN/m²

381134.1 m + LM324.02 m=1.01325 x 100

IV. FUTURE SCOPE

As far as safety and cost is concerned while designing a Body armor, infusing CNT-HDPE composite with other fibers as hybridization will results in better enhancements for armor along with better performance in lighter weight. Furthermore, researchers should give their interest in the field of safety and protection by using Nano-composites as a substitutes for existing materials.

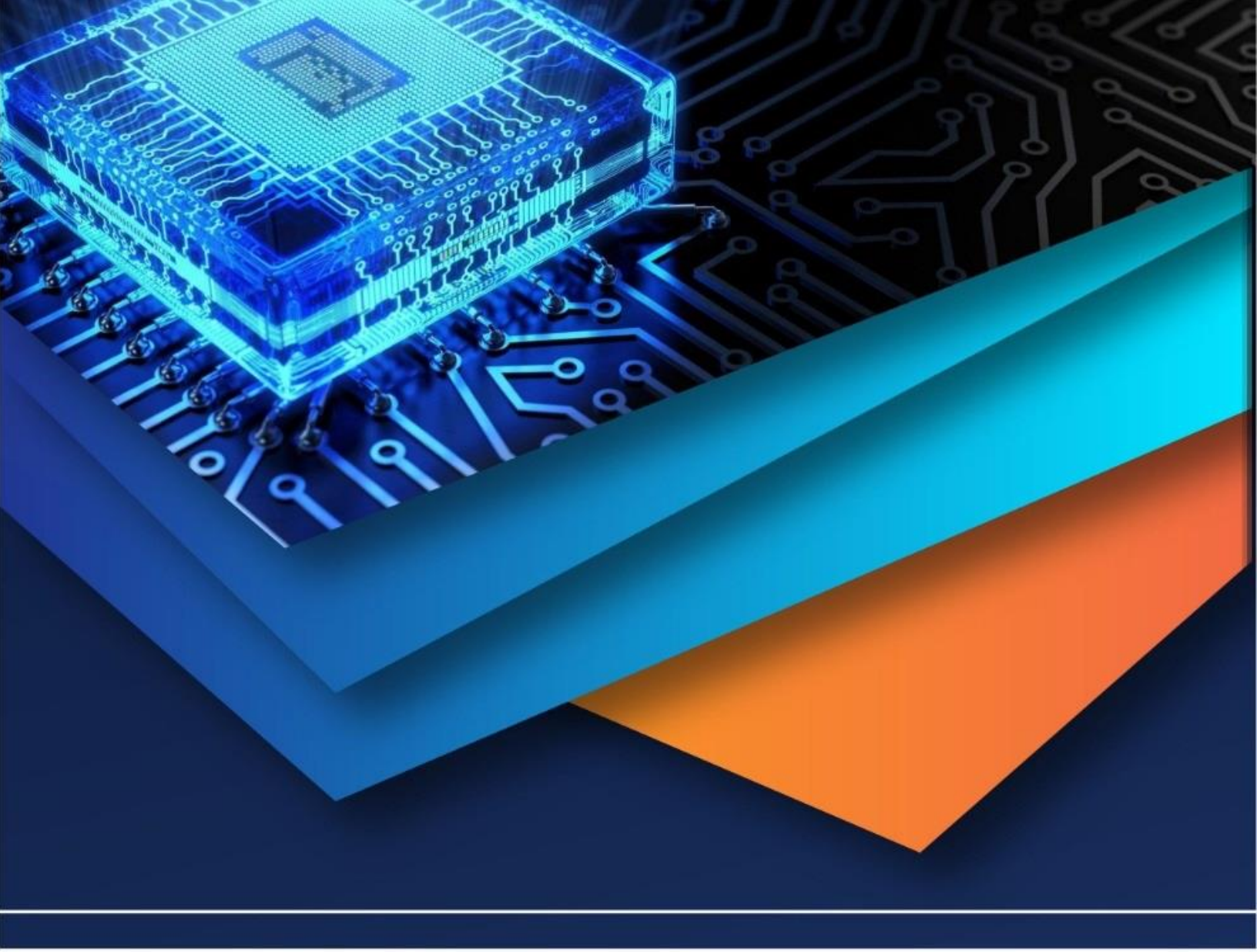
V. CONCLUSION

CNT-filled HDPE nano composites with 8 wt% and 10 wt% loadings are the most optimal concentrations, as they provide a good balance between mechanical properties and resilience of mechanical properties against UV exposure for the Ballistic layer. Good dispersion was achieved for nano composites up-to 10 wt.% CNT loading. The mechanical properties (elastic modulus and tensile strength) of all the un-weathered composites improved because of the presence of fibrous MWCNTs aligned with the direction of extrusion. For weathered composite samples, MWCNTs aided in suppressing the matrix damage, which resulted in superior mechanical properties as compared to neat HDPE. Little or no difference in mechanical properties (before and after weathering) was observed between 8 wt. % and 10 wt.% filled nano composites.

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