

# **Dual Power Generation System for Automobile (Thermoelectric and Exhaust Gas Power Generation)**

A.Supernath Reddy<sup>1</sup>, E.Raja<sup>2</sup>, A.Adithya<sup>3</sup>, K.Naveen Prabhu<sup>4</sup>, Patrick Sam Rayner Philip<sup>5</sup>, M.Saddam Hussain<sup>6</sup> and Selva Ganesh<sup>7</sup>

<sup>1,3,4,5,6,7</sup> B.Tech Student, Department of Automobile Engineering, Bharath Institute of Science and Technology, Bharath University, Chennai, India.

<sup>2</sup> Professor, Department of Automobile Engineering, Bharath Institute of Science and Technology, Bharath University, Chennai, India.

**ABSTRACT:** The research work proposes and implements a thermoelectric and waste heat energy system for internal combustion engine automobiles, including gasoline vehicles and hybrid electric vehicles. The key is to directly convert the heat energy from automotive waste heat to electrical energy using a thermoelectric generator, which is then regulated by a DC–DC converter to charge a battery using maximum power point tracking. Hence, the electrical power stored in the battery can be maximized. Both analysis and experimental results demonstrate that the proposed system can work well under different working conditions, and is promising for automotive industry.

**KEYWORDS:** DC power, Generator, Ignition Delay, Exhaust emissions, Thermoelectric conversion.

## **I. INTRODUCTION**

It converts only about one-third of the energy in the fuel into mechanical power serving to actually drive the car. The rest is lost through heat discharged into the surroundings or, quite simply, leaves the vehicle as “waste heat”. Clearly, this offers a great potential for the further reduction of CO<sub>2</sub> emissions which the BMW Group’s engineers are seeking to use through new concepts and solutions.[1-3] The generation of electric power in the motor vehicle is a process chain subject to significant losses. Quite simply because the chemical energy contained in the fuel is first converted into mechanical energy and then, via an generator, into electric power.

Now the BMW Group’s engineers are working on a technology able to convert the thermal energy contained in the exhaust gas directly into electric power.[4] This thermoelectric process of recovering energy and generating power by means of semi-conductor elements has already been used for decades by NASA, the US Space Agency, in space probes flying into outer space.

Until just a few years ago, however, such thermoelectric generators (TEGs) were unsuitable for use in the automobile due to their low level of efficiency. But since significant progress has been made in materials research in recent times, the performance and output of such modules has increased significantly. To generate electric power in the vehicle a thermoelectric generator is integrated in the exhaust manifold. While the electric power such a system is able to generate is still relatively small at a maximum of 200 W, rapid progress in materials research already makes the ambitious objective of generating up to 1,000 W a realistic and by all means feasible proposition. [5-7]

This energy regeneration system also offers additional effects, such as providing the engine or the heating system with extra heat when starting the engine cold. Hence, the thermoelectric generator is an ideal partner for Brake

# International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 8, August 2015

Energy Regeneration, one of the features of BMW Efficient Dynamics. [8]For while Brake Energy Regeneration serves to supply energy in overrun and when applying the brakes, TEG offers its benefits when motoring is really fun, that is when accelerating and enjoying the power of the car. In future thermoelectric generators will be able to reduce fuel consumption under realistic, customer-oriented driving conditions by up to 5 per cent.

Refrigeration is the process of removing heat from a substance under controlled conditions. Refrigerator is a reversed heat engine or a heat pump which pumps heat from a cold body and delivers it to a hot body. [9]The substance which works in a heat pump to extract from a cold body and to deliver it to a hot body is called refrigerant. Refrigeration is accomplished by various methods, such as the vapour compression system, absorption system, steam jet refrigeration cycle. The vapour compression system of refrigeration cycle. The output of the engine exhaust gas is given to the input of the generator blades, so that the electrical energy produced. This electrical energy is used to store the battery. This power, the alternate power must be much more convenient in availability and usage.[10-11]

The next important reason for the search of effective, unadulterated power are to save the surrounding environments including men, machine and material of both the existing and the next fourth generation from pollution, the cause for many harmful happenings and to reach the saturation point. The most talented power against the natural resource is supposed to be the electric and solar energies that best suit the automobiles. The unadulterated zero emission electrical and solar power, is the only easily attainable alternate source.[12] Hence we decided to incorporate the solar power in the field of automobile, the concept of many Multi National Companies (MNC) and to get relieved from the incorrigible air pollution .The following are the advantages in our work

### ***Reduction of Delay Period***

Due to the average temperature in combustion chamber increases, the air temperature which is inducted into the chamber also increases which helps the fuel to attain self ignition temperature quickly and mixes with air readily and atomized easily.[13]

### ***Reducing the Emission***

As we know that if the delay period is lowered, the complete combustion occurs smoothly which results in reduction of emission.. The overall combustion is dominated by the controlled phase for combustion. The premixed combustion resulting from the shorter delay period, lower the CO, HC and SMOKE emission and even reduces the particulate emissions.

### ***Reduction in Noise level***

It is clear that the overall combustion is dominated by the controlled phase of combustion. So the abnormal pressure rise due to uncontrolled combustion is minimized and the knocking is reduced. This helps engine to run smoothly without noise. Fuels with higher viscosity can be used and the air inducted during the suction stroke is exposed to the walls of the combustion chamber. This raises the air temperature that helps the atomization and mixing fuels. So, the fuels with high viscosity can also be used.[14]

### ***Increase in thermal efficiency***

The conduction through the piston is desirably reduced. This increases the thermal efficiency of the cycle..

## **II.GENERATOR**

Basic Operation of a DC Generator A single conductor, shaped in the form of a loop, is positioned between the magnetic poles. [15]As long as the loop is stationary, the magnetic field has no effect (no relative motion). If we rotate the loop, the loop cuts through the magnetic field, and an EMF (voltage) is induced into the loop. When we have relative motion between a magnetic field and a conductor in that magnetic field, and the direction of rotation is such that the conductor cuts the lines of flux, an EMF is induced into the conductor. The magnitude of the induced EMF depends on the field strength and the rate at which the flux lines are cut. The stronger the field or the more flux lines cut for a given period of time, the larger the induced EMF.

# International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 8, August 2015

$$E_g = KFN$$

Where

$E_g$  = generated voltage

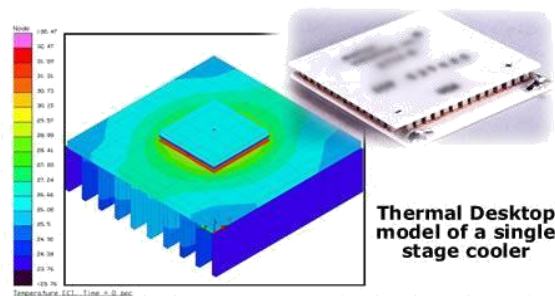
K = fixed constant

F = magnetic flux strength

N = speed in RPM

The direction of the induced current flow can be determined using the "left-hand rule" for generators. This rule states that if you point the index finger of your left hand in the direction of the magnetic field (from North to South) and point the thumb in the direction of motion of the conductor, the middle finger will point in the direction of current flow.

## III.BEARING WITH BEARING CAP



Ball and roller bearings are used widely in instruments and machines in order to minimize friction and power loss. While the concept of the ball bearing dates back at least to Leonardo da Vinci, their design and manufacture has become remarkably sophisticated. This technology was brought to its present state of perfection only after a long period of research and development. The benefits of such specialized research can be obtained when it is possible to use a standardized bearing of the proper size and type.

However, such bearings cannot be used indiscriminately without a careful study of the loads and operating conditions. In addition, the bearing must be provided with adequate mounting, lubrication and sealing

## 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	:	0.98kg-m at

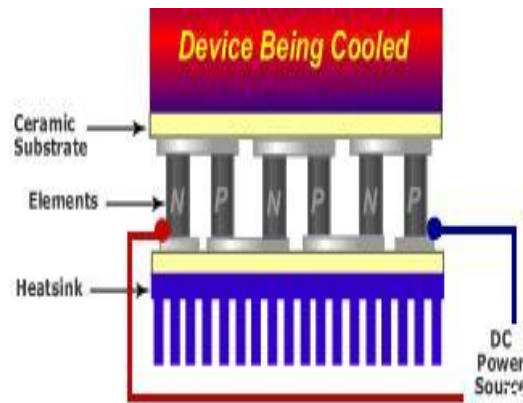
# International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 8, August 2015

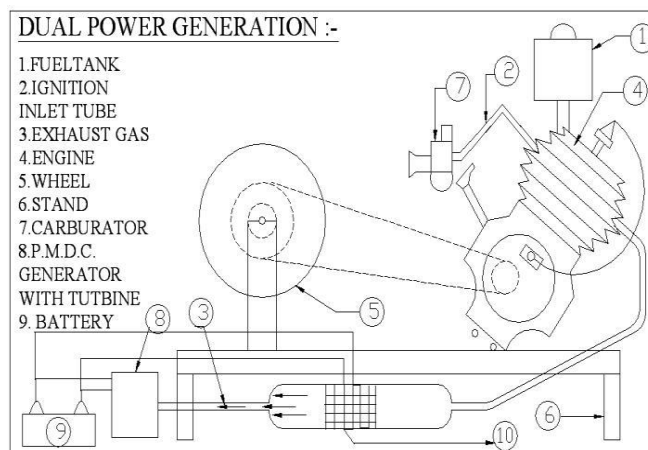
5,500RPM

**Fig.1 Thermal Desktop Model of Single Stage Cooler**



## EXHAUST GAS:

Waste heat is heat, which is generated in a process by way of fuel combustion or chemical reaction, and then “dumped” into the environment even though it could still be reused for some useful and economic purpose. The essential quality of heat is not the amount but rather its “value”. The strategy of how to recover this heat depends in part on the temperature of the waste heat gases and the economics involved. Large quantity of hot flue gases is generated from Boilers, Kilns, Ovens and Furnaces. If some of this waste heat could be recovered, a considerable amount of primary fuel could be saved. The energy lost in waste gases cannot be fully recovered. However, much of the heat could be recovered and loss minimized by adopting following measures as outlined in this chapter



**Fig.3 Schematic Representation of Dual Power Generation**

# International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 8, August 2015

## High Temperature Heat Recovery

It gives temperatures of waste gases from industrial process equipment in the high temperature range. All of these results from direct fuel fired processes.

Depending upon the type of process, waste heat can be rejected at virtually any temperature from that of chilled cooling water to high temperature waste gases from an industrial furnace or kiln. Usually higher the temperature, higher the quality and more cost effective is the heat recovery. In any study of waste heat recovery, it is absolutely necessary that there should be some use for the recovered heat. Typical examples of use would be preheating of combustion air, space heating, or pre-heating boiler feed water or process water. With high temperature heat recovery, a cascade system of waste heat recovery may be practiced to ensure that the maximum amount of heat is recovered at the highest potential. An example of this technique of waste heat recovery would be where the high temperature stage was used for air pre-heating and the low temperature stage used for process feed water heating or steam raising.

### Heat Losses – Quantity

In any heat recovery situation it is essential to know the amount of heat recoverable and also how it can be used. An example of the availability of waste heat is given below:

- Heat recovery from heat treatment furnace

In a heat treatment furnace, the exhaust gas gases are leaving the furnace at 900°C at the rate of 2100 m<sup>3</sup>/hour. The total heat recoverable at 180oC final exhaust gas can be calculated as

$$Q = V \times \rho \times C_p \times \Delta T$$

Q is the heat content in kCal

V is the flow rate of the substance in m<sup>3</sup>/hr

$\rho$  is density of the flue gas in kg/m<sup>3</sup>

$C_p$  is the specific heat of the substance in kCal/kg oC

$\Delta T$  is the temperature difference in °C

$C_p$  (Specific heat of flue gas) = 0.24 kCal/kg/oC

Heat available

$$(Q) = 2100 \times 1.19 \times 0.24 \times (900-180) = 4, 31, 827 \text{ kCal/hr}$$

By installing a recuperate, this heat can be recovered to pre-heat the combustion air. The fuel savings would be 33% (@ 1% fuel reduction for every 22 oC reduction in temperature of flue gas.

## Medium Temperature Heat Recovery

The following Table 8.3 gives the temperatures of waste gases from process equipment in the medium temperature range. Most of the waste heat in this temperature range comes from the exhaust gas of directly fired process units. Depending upon the type of process, waste heat can be rejected at virtually any temperature from that of chilled cooling water to high temperature waste gases from an industrial furnace or kiln. Usually higher the temperature, higher the quality and more cost effective is the heat recovery. In any study of waste heat recovery, it is absolutely necessary that there should be some use for the recovered heat.

## IV.CONCLUSION

In this work we understand a exhaust gas velocity or flow of power generation. Thus the eco-friendly power generation method can be implemented for domestic and commercial use at an affordable cost. Since this system requires less power input, it can also be used as a power generator. The thermoelectric generator can be used in remote areas where power source is not possible to get.

## REFERENCES

1. C. Hochgrat, M. Ryan, and H. Wiegman, "Engine control strategy for a series hybrid electric vehicle incorporating load-leveling and computer controlled energy management," Tech. Rep. SAE 960230, 1996.

# International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 8, August 2015

- [2]Sukumaran V.G., Bharadwaj N., "Ceramics in dental applications", Trends in Biomaterials and Artificial Organs, ISSN : 0971-1198, 20(1) (2006) pp.7-11.
- S. Barsali, M. Ceraolo, and A. Possenti, "Techniques to control the electricity generation in a series hybrid electrical vehicle," IEEE Transactions on Energy Conversion, vol. 17, no. 2, pp. 260–266, 2002.
- Selva Kumar S., Ram Krishna Rao M., Balasubramanian M.P., "Chemopreventive effects of Indigofera aspalathoides on 20-methylcholanthrene induced fibrosarcoma in rats", International Journal of Cancer Research, ISSN : 1811-9727, 7(2) (2011) pp.144-151.
- H. Ed Bargar, J. Li, D. J. Goering, and J. H. Lee, "Modeling and verification of hybrid electric HMMWV performance," in Proceedings of the 29th Annual Conference of the IEEE Industrial Electronics Society, pp. 939–944, November 2003.
- Menon R., Kiran C.M., "Concomitant presentation of alopecia areata in siblings: A rare occurrence", International Journal of Trichology, ISSN : 0974-7753, 4(2) (2012) pp.86-88.
7. S. Aoyagi, Y. Hasegawa, T. Yonekura, and H. Abe, "Energy efficiency improvement of series hybrid vehicle," JSAE Review, vol. 22, no. 3, pp. 259–264, 2001.
8. Rayen R., Hariharan V.S., Elavazhagan N., Kamalendran N., Varadarajan R., "Dental management of hemophiliac child under general anesthesia", Journal of Indian Society of Pedodontics and Preventive Dentistry, ISSN : 0970-4388, 29(1) (2011) pp.74-79.
9. N. Sadegh, B. Khan, and J. Meisel, "Optimization of the fuel consumption of a parallel hybrid electric vehicle," in Proceedings of the IEEE/ASME International Conference on Advanced Intelligent Mechatronics (AIM '05), pp. 128–133, July 2005.
10. Shanthi B., Revathy C., Devi A.J.M., Subhashree, "Effect of iron deficiency on glycation of haemoglobin in nondiabetics", Journal of Clinical and Diagnostic Research, ISSN : 0973 - 709X, 7(1) (2013) pp.15-17.
11. J. P. Gao, G. M. G. Zhu, E. G. Strangas, and F. C. Sun, "Equivalent fuel consumption optimal control of a series hybrid electric vehicle," Proceedings of the Institution of Mechanical Engineers, Part D: Journal of Automobile Engineering, vol. 223, no. 8, pp. 1003–1018, 2009.
12. A. M. Phillips, M. Jankovic, and K. E. Bailey, "Vehicle system controller design for a hybrid electric vehicle," in Proceedings of the IEEE International Conference on Control Applications, pp. 297–302, 2000.
13. F. R. Salmasi, "Control strategies for hybrid electric vehicles: evolution, classification, comparison, and future trends," IEEE Transactions on Vehicular Technology, vol. 56, no. 5, part 1, pp. 2393–2404, 2007.
14. H. D. Lee and S. K. Sul, "Fuzzy-logic-based torque control strategy for parallel-type hybrid electric vehicle," IEEE Transactions on Industrial Electronics, vol. 45, no. 4, pp. 625–632, 1998.
15. G. Rajagopalan, G. Washington, G. Rizzoni, and Y. Guezennec, "Development of fuzzy logic control and advanced emissions modeling for parallel hybrid vehicles," NREL Report SR-540-32919, 2003.
16. G.Mathubala , Dr.T.Jayadoss, Evaluation of Non-Conventional Fertilizers On The Growth Response of Zinnia Seedlings ,International Journal of Innovative Research in Science, Engineering and Technology, ISSN: 2319-8753, pp 8360-8376 , Vol. 3, Issue 1, January 2014.
17. G.Mathubala , S.Rosy Christy , Hazardous Materials - Restriction, International Journal of Innovative Research in Science, Engineering and Technology, ISSN: 2319-8753 , pp 4398-4400 , Vol. 2, Issue 9, September 2013.
18. G.Mathubala, Dr.V.Krishnasamy , KINETICS OF OXIDATION OF SCHIFF BASE BY CHLORAMINE –T CATALYSED BY MIXTURE OF Os ( VIII) AND Ru (III) – EFFECT OF OSMIUM TETRAOXIDE AND RUTHENIUM CHLORIDE , International Journal of Innovative Research in Science, Engineering and Technology , ISSN: 2319-8753 , pp 2756-2762, Vol. 2, Issue 7, July 2013 .
19. G.Mathubala, Dr.V.Krishnasamy , KINETICS OF OS( VIII ) CATALYSED OXIDATION OF BENZALDEHYDE ANILS BY PDC – STUDY OF THE EFFECTS OF SUBSTRATE , International Journal of Innovative Research in Science, Engineering and Technology , ISSN: 2319-8753 , pp 2467-2472 , Vol. 2, Issue 5, May 2013.
20. H.S.RUPA, Role of Human Resource Manager in Managing Stress of Employees in Manufacturing Concerns , International Journal of Innovative Research in Science, Engineering and Technology , ISSN: 2319-8753, pp 10234-10237, Vol. 3, Issue 3, March 2014.
21. G.Ayyapan, Chemo Informatics QSAR Analysis of Nitroaromatic Compounds Toxicity, International Journal of Innovative Research in Science, Engineering and Technology, ISSN: 2319-8753, pp 372-375, Vol. 2, Issue 2, February 2013.