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ENGINE BATTERY SUPER CHARGING FROM EXHAUST GAS

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Abstract— ***This paper deals with usage of Exhaust gas from any engine there-by generating power using Thermo electric generators (TEG), turbocharger technology. Nowadays in automobile field many new innovating concepts are being developed. The electric power which is generated can be stored in battery for the later consumption. In this paper, I am demonstrating a concept of generating power in a moving vehicle by the usage of turbines, dynamo and TEG Elements.***

Keywords— ***Exhaust gas recovery, waste heat recovery, I.C Engine fuel economy, TEG Elements (Thermo-electric Generator), harnessing waste heat***

I. INTRODUCTION

We waste so much energy. As much as 60 percent of energy is wasted as heat. The nuclear power plants, chemical factories and automobiles all contribute to this waste heat. Thus Thermoelectric generators (TEGs) can be used to turn waste heat directly into electrical energy.

The material used is called skutterudite, which is a mix of minerals. Then other rare metals are added to it to make sure it’s a poor conductor. That way, the current is generated when the material is hot on one side and cold on the other. Ideally, it would reduce the amount of fuel used by five percent. It does this as it generates electricity to help power the car’s electrical system and charge its battery. The applications of the technology go beyond car exhaust. It could generate electricity in homes and power plants from waste streams.

II. EXHAUST GAS RECOVERY SYSTEM

A. Exhaust heat recovery system

In an engine, an exhaust heat recovery system turns thermal losses in the exhaust pipe into energy. This technology seems to be more and more of interest by car and heavy-duty vehicle manufacturers as an efficient way to save fuel and reduce vehicles’ CO_2 emissions. This technology can be used either on a hybrid vehicle or a conventional one: it produces either electric energy for batteries or mechanical energy reintroduced on the crankshaft.

B. Thermal losses in the exhaust pipe

Inside the exhaust pipe of an internal combustion engine, energy losses are various: thermal, kinetic, chemical and latent heat. Most important energy parts are located in the thermal and kinetic losses, the two others are negligible. Kinetic losses can be recovered through a turbocharger or a turbo-compound.

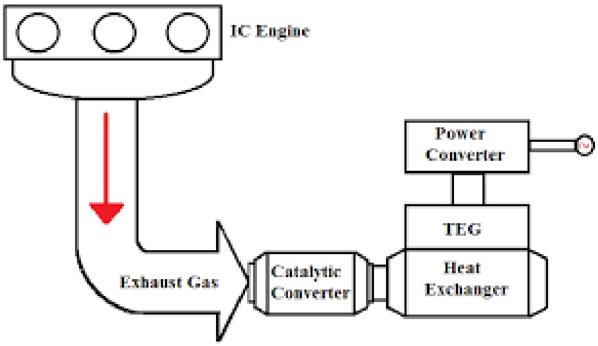
C. Exhaust heat recovery technologies

- TEG - Thermoelectric generator are another option to recover heat from the exhaust pipe to reduce vehicles fuel consumption.

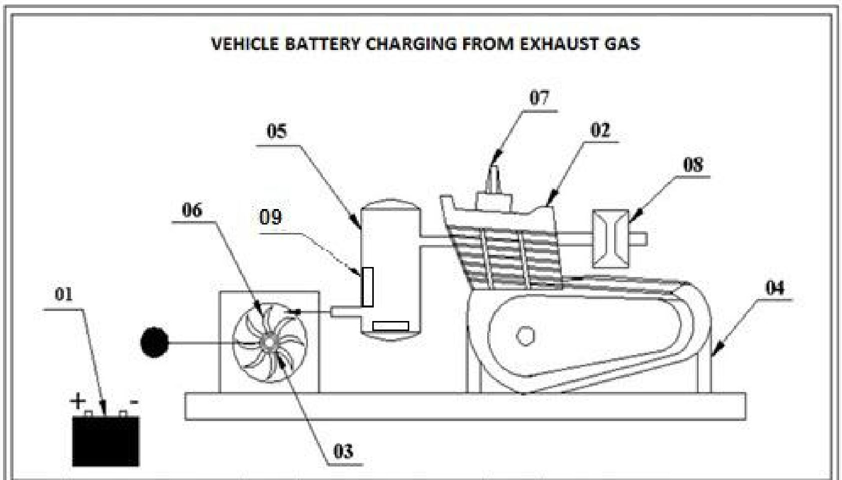
D. Exhaust gas Kinetic energy recovery technologies

Turbine is used to convert Kinetic Energy from the Exhaust Steam into electrical energy by using dynamo

III. METHODOLOGY



Heat Energy Recovery System.



S.NO	PART NAME	S.NO	PART NAME	S.NO	PART NAME
01	BATTERY	04	BASE FRAME	07	SPRAK PLUG
02	ENGINE	05	SILENCER	08	CARBURETOR
03	DYNAMO	06	TURBINE	09	THERMO - ELECTRIC GENERATOR

Vehicle Battery Super charging from Exhaust Gas

IV. DESCRIPTION OF EQUIPMENTS

A. Kinetic energy retrieval

1) Turbine: A steam turbine is a mechanical device that extracts kinetic energy from pressurized steam, and converts it into rotary motion. It has almost completely replaced the reciprocating piston steam engine primarily because of its greater thermal efficiency and higher power-to-weight ratio. Because the turbine generates rotary motion, it is particularly suited to be used to drive an electrical generator – about 90% of all electricity generation in the United States is by use of steam turbines. The steam turbine is a form of heat engine that derives much of its improvement in thermodynamic efficiency through the use of multiple stages in the expansion of the steam, which results in a closer approach to the ideal reversible process.

Energy provided for the turbine work is converted from the enthalpy and kinetic energy of the gas. The turbine housings direct the gas flow through the turbine as it spins at up to 250,000 rpm. The size and shape can dictate some performance characteristics of the overall turbocharger. Often the same basic turbocharger assembly is available from the manufacturer with multiple housing choices for the turbine, and sometimes the compressor cover as well. This lets the balance between performance, response, and efficiency be tailored to the application.

The turbine and impeller wheel sizes also dictate the amount of air or exhaust that can flow through the system, and the relative efficiency at which they operate. In general, the larger the turbine wheel and compressor wheel the larger the flow capacity. Measurements and shapes can vary, as well as curvature and number of A turbocharger's performance is closely tied to its size.Large turbochargers take more heat and pressure to spin the turbine, creating lag at low speed. Small turbochargers spin quickly, but may not have the same performance at high acceleration.To efficiently combine the benefits of large and small wheels; advanced schemes are used such as twin-turbochargers, twin-scroll turbochargers, or variable-geometry turbochargers

- *Principle of operation and design*

An ideal steam turbine is considered to be an isentropic process, or constant entropy process, in which the entropy of the steam entering the turbine is equal to the entropy of the steam leaving the turbine. No steam turbine is truly isentropic, however, with typical isentropic efficiencies ranging from 20–90% based on the application of the turbine. The interior of a turbine comprises several sets of blades, or buckets as they are more commonly referred to. One set of stationary blades is connected to the casing and one set of rotating blades is connected to the shaft. The sets inter mesh with certain minimum clearances, with the size and configuration of sets varying to efficiently exploit the expansion of steam at each stage.

2) Dynamo: Dynamo is an electrical generator. This dynamo produces direct current with the use of a commutator. Dynamo was the first generator capable of the power industries. The dynamo uses rotating coils of wire and magnetic fields to convert mechanical rotation into a pulsing direct electric current. A dynamo machine consists of a stationary structure, called the stator, which provides a constant magnetic field, and a set of rotating windings called the armature which turn within that field. On small machines the constant magnetic field may be provided by one or more permanent magnets; larger machines have the constant magnetic field provided by one or more electromagnets, which are usually called field coils.

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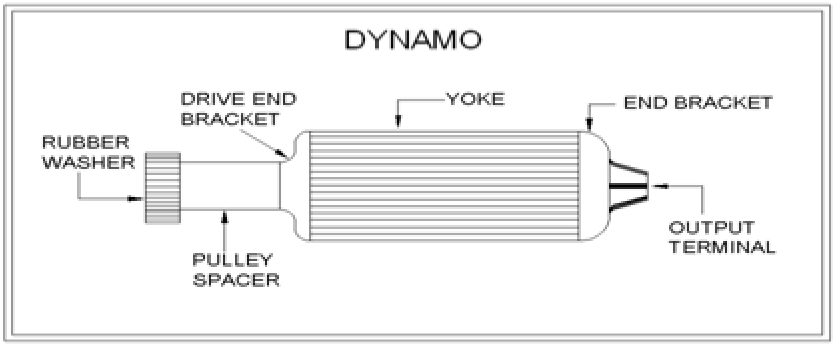
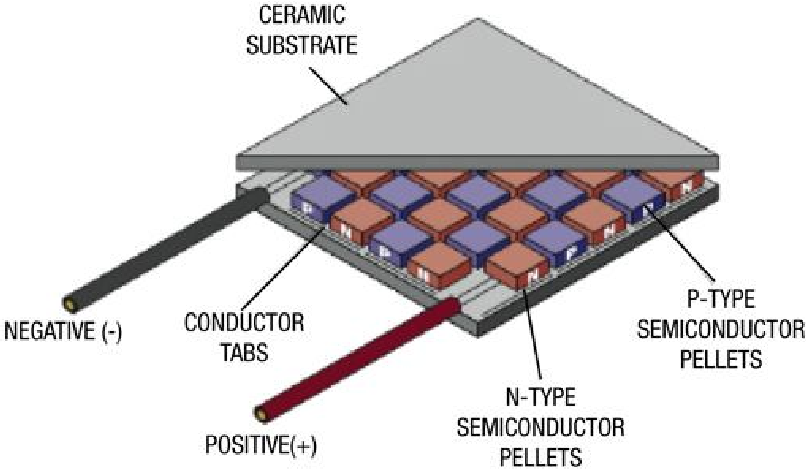
The commutator was needed to produce direct current. When a loop of wire rotates in a magnetic field, the potential induced in it reverses with each half turn, generating an alternating current. However, in the early days of electric experimentation, alternating current generally had no known use. The few uses for electricity, such as electroplating, used direct current provided by messy liquid batteries. Dynamos were invented as a replacement for batteries. The commutator is a set of contacts mounted on the machine's shaft, which reverses the connection of the windings to the external circuit when the potential reverses, so instead of alternating current, a pulsing direct current is produced.



Dynamo

B. Thermal energy retrieval

1) Thermoelectric generator: Thermoelectric generator TEG (also called Seebeck generators) are solid state devices that convert heat (temperature differences) directly into electrical energy, using a phenomenon called the Seebeck effect (a form of thermoelectric effect). Thermoelectric generators function like heat engines, but are less bulky, have no moving parts. However, TEGs are typically more expensive and less efficient.



Thermoelectric Generator

Thermoelectric generators could be used in power plants in order to convert waste heat into additional electrical power and in automobiles as automotive thermoelectric generators (ATGs) to increase fuel efficiency.

- Construction

Thermoelectric power generators consist of three major components: thermoelectric materials, thermoelectric modules and thermoelectric systems that interface with the heat source.

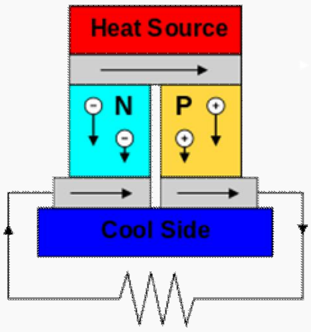
2) Thermoelectric materials: Thermoelectric materials generate power directly from heat by converting temperature differences into electric voltage. These materials must have both high electrical conductivity and low thermal conductivity to be good thermoelectric materials. Having low thermal conductivity ensures that when one side is made hot, the other side stays cold, which helps to generate a large voltage while in a temperature gradient. The measure of the magnitude of electrons flow in response to a temperature difference across that material is given by the Seebeck coefficient. The efficiency of a given materials to produce a thermoelectic power is governed by their “figure of merit” z. For many years, the main three semiconductors known to have both low thermal conductivity and high power factor were bismuth telluride (Bi_2Te_3), lead telluride(PbTe), and silicon germanium (SiGe). These materials have very rare elements which make them very expensive compounds.

Today, the thermal conductivity of semiconductors can be lowered without affecting their high electrical electrical properties using nanotechnology. This can be achieved by creating nanoscale features such as particles, wires or interfaces in bulk semiconductor materials. However, the manufacturing processes of nano-materials is still challenging.

Only a few known materials to date are identified as thermoelectric materials. Most thermoelectric materials today have a ZT value of around unity, such as in Bismuth Telluride (Bi_2Te_3) at room temperature and lead telluride (PbTe) at 500-700K. However, in order to be competitive with other power generation systems, TEG materials should have ZT of 2-3 range. Most research in thermoelectric materials has focused on increasing the Seebeck coefficient (S) and reducing the thermal conductivity, especially by manipulating the nanostructure of the thermoelectric materials. Because the thermal and electrical conductivity correlate with the charge carriers, new means must be introduced in order to conciliate the contradiction between high electrical conductivity and low thermal conductivity as indicated.

When selecting materials for thermoelectric generation, a number of other factors need to be considered. During operation, ideally the thermoelectric generator has a large temperature gradient across it. Thermal expansion will then introduce stress in the device which may cause fracture of the thermoelectric legs, or separation from the coupling material. The mechanical properties of the materials must be considered and the coefficient of thermal expansion of the n and p-type material must be matched reasonably well. In segmented thermoelectric generators, the material's compatibility must also be considered. A material's compatibility factor is defined as $s=((1-zT)^{1/2}-1)/(ST)$. When the compatibility factor from one segment to the next differs by more than a factor of about two, the device will not operate efficiently. The material parameters determining s (as well as zT) are temperature dependent, so the compatibility factor may change from the hot side to the cold side of the device, even in one segment. This behavior is referred to as self-compatibility and may become important in devices design for low temperature operation.

In general, thermoelectric materials can be categorized into conventional and new materials:



Thermoelectric Circuit

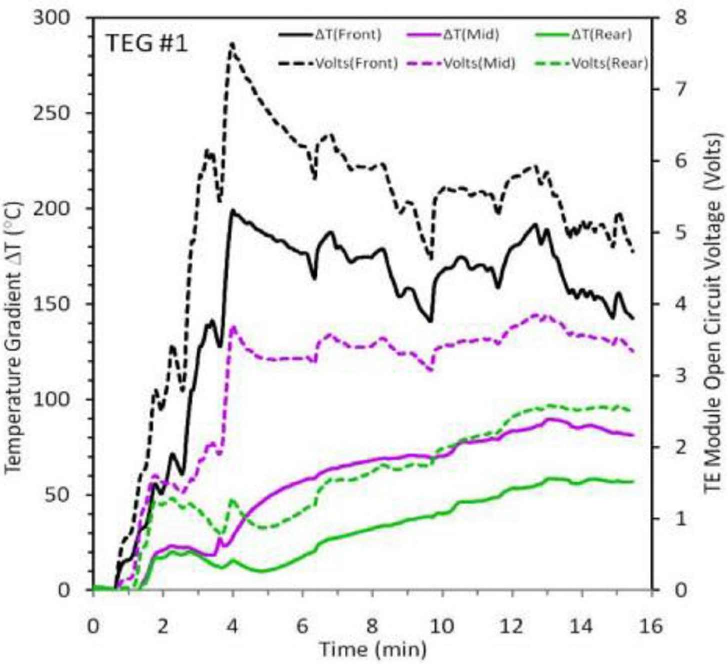
A thermoelectric circuit composed of materials of different Seebeck coefficient (p-doped and n-doped semiconductors), configured as a thermoelectric generator.

5.3.4 Thermoelectric module

A thermoelectric module is a circuit containing thermoelectric materials that generate electricity from heat directly. A thermoelectric module consists of two dissimilar thermoelectric materials joining in 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. Generally, the current magnitude has a proportional relationship with the temperature difference. (.i.e., the more the temperature difference, the higher the current.)

In application, thermoelectric modules in power generation work in very tough mechanical and thermal conditions. Because they operate in very high temperature gradient, the modules are subject to large thermally induced stresses and strains for long periods of time. They also are subject to mechanical fatigue caused by large number of thermal cycles.

Thus, the junctions and materials must be selected so that they survive these tough mechanical and thermal conditions. Also, the module must be designed such that the two thermoelectric materials are thermally in parallel, but electrically in series. The efficiency of thermoelectric modules are greatly affected by its geometrical design.



Temperature Gradient Vs Time Graph

TE module open circuit voltages are consistent with 50°C smaller ΔT than measured between the heat exchanger and the coolant.

V. CONCLUSION

I am placing a turbine in the path of exhaust in the silencer. An engine is also placed in the chassis of the vehicle. The turbine is connected to a dynamo, which is used to generate power. Depending upon the airflow the turbine will start rotating, and then the dynamo will also starts to rotate. A dynamo is a device which is used to convert the kinetic energy into electrical energy. The generated power is stored to the battery. It can be stored in the battery after rectification. The rectified voltage can be inverted and can be used in various forms of utilities. The battery power can be consumed for the users comfort.

TEG's are also used to convert the heat from the exhaust gases into electric power. TEG's are placed in the silencer cap.

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