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ENGINE BATTERY HYPER- CHARGING FOR HYBRID CARS

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Abstract—In I.C Engines, the excess heat during the power stroke plays a vital role. Many new concepts are generated to cool the engine. This paper deals with usage of Excess heat from the cylinder of any engine there-by generating power using Thermo electric generators (TEG). The TEG's are used to generate electric power which can be stored in battery for the later consumption. Here we are going to deal with a hybrid engine.

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

I. INTRODUCTION

As much as 60 percent of energy is wasted as heat in I.C Engines. The nuclear power plants, chemical factories and automobiles all contribute to this waste heat. The Thermoelectric generators (TEGs) can be used to turn waste heat directly into electrical energy. The problem of searching energy sources, which are able to provide power supply in an autonomous mode, is very real. Using a principle of direct conversion of thermal energy into electric energy enables us to solve this task. A hybrid vehicle uses two or more distinct types of power, such as internal combustion engine plus electric motor .e.g. in diesel-electric trains using diesel engines and electricity from overhead lines, and submarines that use diesels when surfaced and batteries when submerged

II. ENGINE HEAT RECOVERY SYSTEM – METHODOLOGY

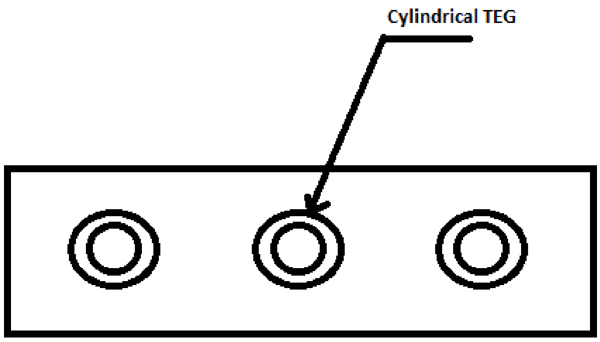


Fig.1 I.C Engine (3 Cylinder Inline Engine)

The cylinder walls are mounded with the thermoelectric generator. Thus the hot surface is facing inside of the cylinder, and the cold side is facing the outside of the cylinder. Thus while the working stroke, high heat is generated (liberated).This high heat with the temperature difference generated in the cylinder leads to the production of electric power in the TEG. Thus this high power got in the TEG should be stored in the battery.

A) Cylinder Thermo-generator Elements

Fig.2 Cylindrical Thermoelectric Element

A thermoelectric battery (TEB) is a device for direct conversion of thermal energy (isotope heat sources, organic fuel from gas main, etc.) into electrical energy. The cylindrical elements with radial heat transfer combine well with the pipe heat exchangers, which are widely used both in nuclear power and thermal technologies. Higher specific energy characteristics are archived in cylindrical constructions by virtue of weight reducing of design elements that generate a heat match between thermo-elements and heat supply and release facilities. In addition, the cylindrical thermoelectric generator, which is designed as a pipe heat exchanger ensures high electrical insulation resistance.

The pipe shaped thermoelectric batteries, as a rule are radial-ring. They are comprised of thermo elements formed as ring sectors, which are switched along external and internal surfaces. The heat resistance up to 1300 heat shifts has been confirmed by the bench tests. The TEB with this type of construction was used in an installation to provide electrical power and heat to the electrolytic protection systems, telemetry and radio relay systems arranged along gas mains. This installation has been successfully maintained. Presently RIF Corporation manufactures the radial thermoelectric batteries.

B) The TEB characteristics:

- Hot junctions temperature Th = 513 K;
- Cold junctions temperature Tc = 363 K;
- Temperature difference on junctions T = 150 K;
- Output electric power W = 29 W;
- Output voltage U = 3,5 V;
- Efficiency = 4.5% ;
- TEB weight = up to 1.5 kg.

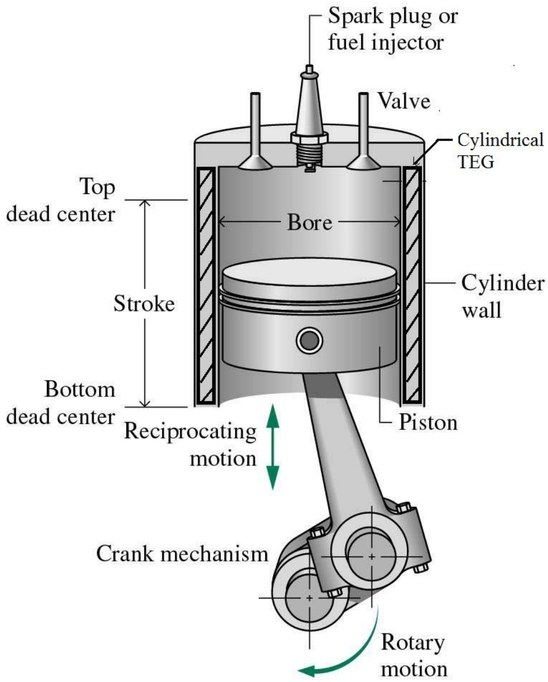
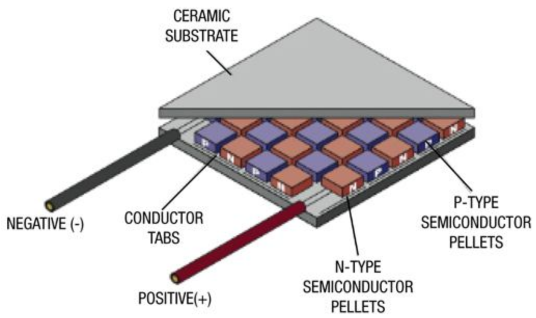


Fig.2 Engine Cross-section with Cylindrical TEG

III. DESCRIPTION OF EQUIPMENTS

A. 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.

1) 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 (Bi2Te3), lead telluride(PbTe), and silicon germanium (SiGe). These materials have very rare elements which make them very expensive compounds.

Positive(+) and Negative(-) terminals are connected to the battery terminals.

B. Electric vehicle batteries: The power generated from TEG's are stored in batteries for later use. Electric vehicle batteries are designed to give power over sustained periods of time. Traction batteries must be designed with a high ampere-hour capacity. Batteries for electric vehicles are characterized by their relatively high power-to-weight ratio, energy to weight ratio and energy density; smaller, lighter batteries reduce the weight of the vehicle and improve its performance. Rechargeable batteries used in electric vehicles include lead-acid , NiCd, nickel metal hydride, lithium ion, Li-ion polymer. The amount of electricity stored in batteries is measured in ampere hours or in coulombs, with the total energy often measured in watt hours.

Rechargeable traction batteries are routinely used all day, and fast–charged all night. Forklifts, for instance, are usually discharged and recharged every 24 hours of the work week.
The predicted market for automobile traction batteries is over $37 billion in 2020.

- **ENVIRONMENTAL IMPACT OF HYBRID CAR BATTERY**

The lithium-ion battery has attracted attention due to its potential use in hybrid electric vehicles. Hitachi is a leader in its development. In addition to its smaller size and lighter weight, lithium-ion batteries deliver performance that helps to protect the environment with features such as improved charge efficiency without memory effect. The lithium-ion batteries are appealing because they have the highest energy density of any rechargeable batteries and can produce a voltage more than three times that of nickel–metal hydride battery cell while simultaneously storing large quantities of electricity as well. The batteries also produce higher output (boosting vehicle power), higher efficiency (avoiding wasteful use of electricity), and provides excellent durability, compared with the life of the battery being roughly equivalent to the life of the vehicle. Additionally, use of lithium-ion batteries reduces the overall weight of the vehicle and also achieves improved fuel economy of 30% better than petro-powered vehicles with a consequent reduction in CO_2 emissions helping to prevent global warming.

1) Battery cost

BATTERY COST ESTIMATE COMPARISON

BATTERY TYPE	YEAR	COST ($/KWH)
LI-ION	2016	145
LI-ION	2014	200-300

BATTERY LONGEVITY ESTIMATE COMPARISON

BATTERY TYPE	YEAR OF ESTIMATE	CYCLES	MILES	YEARS
LI-ION	2016	>4000	1,000,000	>10
LI-ION			100,000	5
LI-ION			60,000	5

In October 2015, car maker GM revealed at their annual Global Business Conference that they expected a price of $145 per kilowatt hour for Li-ion cells entering 2016.

2) *Merits*

- Light weight, high capacity and density
- No explosion or burning risk
- International standard safety performance, Low self-discharging rate, Highly endurable batteries with less than 3% self discharge rate per month, High end consistency
- Able to freely assemble and flexible usage
- Custom-made battery size, shape and capacity, Environment friendly

3) *Future:* Battery-operated vehicles are projected to have annual sales in 2020 of 100,000 units in the U.S. and 1.3 million worldwide — 1.8 percent of the 71 million cars expected to be sold in 2020. Another 3.9 million plug-ins and hybrids will be sold worldwide, bringing the total electric and hybrid market to about 7 percent of all cars sold in 2020.

IV. HYBRID ELECTRIC VEHICLE

A) *Environmental Issue*

1) *Fuel consumption and emissions reductions:* The hybrid vehicle typically achieves greater fuel economy and lower emissions than conventional internal combustion engine vehicles (ICEVs), resulting in fewer emissions being generated. These savings are primarily achieved by three elements of a typical hybrid design:

   1. Relying on both the engine and the electric motors for peak power needs, resulting in a smaller engine size more for average usage rather than peak power usage. A smaller engine can have less internal losses and lower weight.
   2. Having significant battery storage capacity to store and reuse recaptured energy, especially in stop-and-go traffic typical of the city driving cycle.
   3. Recapturing significant amounts of energy during breaking that are normally wasted as heat. This regenerative braking reduces vehicle speed by converting some of its kinetic energy into electricity, depending upon the power rating of the motor/generator;

These features make a hybrid vehicle particularly efficient for city traffic where there are frequent stops, coasting and idling periods. In addition noise emissions are reduced, particularly at idling and low operating speeds, in comparison to conventional engine vehicles.

2) *Hybrid vehicle emissions*

Hybrid vehicle emissions today are getting close to or even lower than the recommended level set by the EPA (Environmental Protection Agency). The recommended levels they suggest for a typical passenger vehicle should be equated to 5.5 metric tons of carbon dioxide. The three most popular hybrid vehicles, Honda Civic, Honda Insight and Toyota Prius, set the standards even higher by producing 4.1, 3.5, and 3.5 tons showing a major improvement in carbon dioxide emissions. Hybrid vehicles can reduce air emissions of smog-forming pollutants by up to 90% and cut carbon dioxide emissions in half.

B) *Charging*

The optimum charging window for Lithium ion batteries is 3-4.2 V. Recharging with a 120 volt household outlet takes several hours, a 240 volt charger takes 1–4 hours, and a quick charge takes approximately 30 minutes to achieve 80% charge. 3 important factors- distance on charge, cost of charging, and time to charge

C) Hybrid Electric Vehicle Working

Hybrids-Electric vehicles (HEVs) combine the advantage of gasoline *engines* and electric *motors*. The key areas for efficiency or performance gains are regenerative braking, dual power sources, and less idling.

- Regenerate Braking**:** The drive train can be used to convert kinetic energy (from the moving car) into stored electrical energy (batteries). The same electric motor that powers the drivetrain is used to resist the motion of the drivetrain. This applied resistance from the electric motor causes the wheel to slow down and simultaneously recharge the batteries.
- Dual Power: Power can come from either the engine, motor or both depending on driving circumstances. Additional power to assist the engine in accelerating or climbing might be provided by the electric motor. Or more commonly, a smaller electric motor provides all of the power for low-speed driving conditions and is augmented by the engine at higher speeds.
- Automatic Start/Shutoff: It automatically shuts off the engine when the vehicle comes to a stop and restarts it when the accelerator is pressed down. This automation is much simpler with an electric motor. Also see dual power above.

V. CONCLUSION

I am placing a cylindrical TEG in the cylinder wall of the engine. TEG generates power in terms of temperature difference. 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. The thermo electric generator placed in the exhaust system is the earlier paper, and why not in the Engine cylinder was my question, which leads to this paper.

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