Ways to improve the efficiency of an automotive thermoelectric generator

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Contents:
- Efficient energy harvesting
- Thermoelectric arrays

Motivation

- Combustion engines are the main source of energy for many vehicles
- Around 90% of the transport power systems

Efficiency of modern ICE is about 30-40%

Methods

- Heat transfer modeling
- CFD simulation
- Analytical modeling

- Goal: Enact describing heat transfer & gas dynamics

Model input:
- Engine compression ratio
- Exhaust gas temperature
- Cooling mode (water or air)

Model results:
- Thermo-electric power
- Change of engine power

Application

- Gasoline engine VAZ 2111
- 106 HP (78 kW)
- 800-1800 rpm
- Max. torque, 144 Nm

Modeling was held in engine simulation tool "DIESEL-RK" (http://www.diesel-k.bmstu.ru) implemented a zero-dimensional multi-source mathematical model to calculate the heat (for petrol engines) used the Vibe law. Calculations were carried out on the external velocity characteristic model (at open wide throttle).

Influence of the contact thermal resistances on the (a) TEB power Web and (b) the increase in the ICE power $\Delta P_{\text{ICE}}$

(a) Actor = 6, 9, 12 and contact with technical gaps and hot contact with cast-iron; and (b) means polished contact surface, the experimental values are shown by a system

- Experimental stand
- Thermoelectric generator for automotive industry was tested on a test bed based on an ICE.
- The efficiency of a thermoelectric generator largely determined by the design of the heat exchanger, so you must carefully choose the method of heat exchange.

CONCLUSION

- The efficiency of a thermoelectric generator largely determined by the design of the heat exchanger, so you must carefully choose the method of heat exchange.
- The most rational design which provide the highest ratio $(N_{x} / N_{y}) / (1 / 2)$ is the design with – Ribs parallel to the gas flow direction and surface with fins. These structures are suitable for use in stationary plants and heavy transporting vehicles, since they can provide the greatest overall increasing of efficiency. Depending on the purpose of the thermoelectric generator it may be the use of other methods of enhancement of heat transfer.
- In the case of a thermoelectric generator for compact vehicles, such as motorcycles and cars, to provide reasonable efficiency with compact size and to reduce weight may be required structures, providing greater heat transition, even with larger gas-dynamic losses. In this case, the design can be modified to turbulators with pins and wave forming of the blades.
- It is desirable to develop a design of a TEG with variable internal forming to reduce the resistance at high exhaust velocities and increase the heat flux at small