Thermoelectric Generator Designed for Vehicles

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Abstract: This device is designed to recover the heat energy in automobile exhaust gas. In the re-layout of the exhaust pipe, each exhaust branch pipe is reorganized to connect to a heat collecting box, which is used as the heat source of the thermoelectric module (TEM)—the main element of this device. This device realizes the magic of changing wasted heat into electricity. Control plate is installed in the exhaust pipe in order to adjust the flow rate and enhance the overall performance of the thermoelectric generation system consequently.

1. Background and Purpose

Automobile industry and automobile market keep rapid and steady development in a worldwide range，consuming huge amount of fuel energy. However, based on the existing technology, fuel energy is not fully utilized in vehicles and 40% of fuel energy dissipates in the form of exhaust gas. Through thermoelectric generation, the heat of exhaust gas can be converted into electric energy, so that the fuel economy of automobiles can be enhanced.

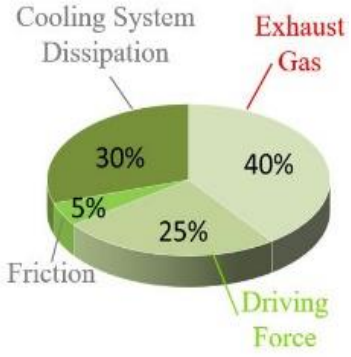

Fig.1 Energy Distribution in Vehicles.

2. Concept and Idea

The working process of thermoelectric generation covers the following 4 steps:

Step 1: Exhaust gas from exhaust system of vehicles flows into device and heats the heat collecting box. Heated heat collecting box then becomes the ‘heat source’.

Step 2: When the vehicle is running, natural wind flows through the cooling fins and takes heat away. Cooling fins then become the ‘cold source.

Step 3: With the heat source and cold source got from Step 1 and Step 2 respectively, TEMs start to generate electricity.

Step 4: Electricity produced by TEMs then will be gathered properly and be used to support vehicle appliances or charge on-board battery.

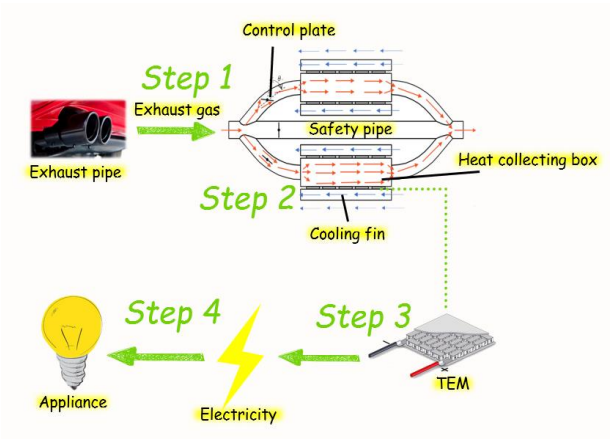

Fig.2 Generation Process.

3. Design and Functions

3.1 Small-Scale Model

Fig.3 shows a 1 to 10 small-scale model of thermoelectric

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generator. This model uses a heat gun to produce heat flow (far less powerful than exhaust gas) and a mini-fan to simulate natural wind. It contains 4 TEMs and has been proved to be able to generate more than 20W electric power, which is enough to charge a phone.

3.2 On-Board Model

Fig.4 shows a real on-board device used in vehicles. It is equipped with 40 TEMs and could produce more than 200W electric power. The produced power can be used to fully charge an on-board battery within 3 hours or directly support some certain vehicle appliances.

Fig.3 Model Design and Layout.

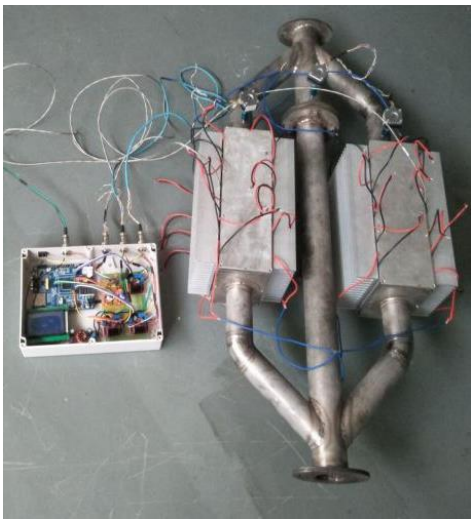

Fig.4 On-board Thermoelectric Generator.

4. Problems and Future Work

Problems:

- Energy conversion efficiency is still lower than other energy-saving methods (used in other fields).
- Energy loss during the process is still relatively high.

Future work:

- Heat-to-electricity conversion rate is ought to be enhanced by further polishing the structure and control strategy.
- The management of recovered energy is going to be further studied.