Fuel Preheating & Cooling using Peltier Module

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Abstract—The main aim of our project is to avoid the freezing of petrol in cold conditions and also preventing evaporation due to hot conditions using peltier module in the fuel tank. This helps in increasing the fuel efficiency of a petrol engine by maintaining the temperature of the inlet fuel. By preheating the fuel to a considerable amount, before supplying it to the carburetor, vaporisation of fuel inside the combustion chamber is done with ease and thereby complete combustion is achieved. As a result of complete combustion the fuel efficiency of petrol engine is increased considerably. Moreover, there will be no need of coolant or refrigerant to provide cooling effect. The density of petrol can be maintained at an optimum range.

Key words: Density, Fuel Tank, Peltier Effect, Petrol, Temperature

I. INTRODUCTION

In cold weather condition, temperature of the fuel inside the fuel tank will be very low. By using the peltier device, the temperature of the fuel inside the fuel tank can be increased to a desirable amount. In hot weather condition, there may be evaporation of fuel. The evaporation of the fuel can be reduced by using the same peltier device by changing its polarity using microcontroller unit. Peltier effect states that the passage of an electric current through the junction of two dissimilar metals can either cool or heat the junction depending on the direction of current. Heat generation or absorption rates are proportional to the magnitude of the current and also the temperature of the junction.

Peltier module is a solid state device, it has no moving parts. No gases, refrigerant or liquid is required to provide the cooling or heating effect. It is highly reliable. It provides no sound or vibration. It has a lifetime of more than 200,000 hours. It operates in any orientation. Precision temperature control is possible. It has the ability to produce heating or cooling effect depending on current direction. It provides high resistance to shock and vibration. It has the ability to operate in zero gravity and high-G level. It is small, lightweight package. An analog often used to help comprehend a peltier device cooling system is that of a standard thermocouple used to measure temperature. Thermocouples of this type are made by connecting two wires of dissimilar metal, typically copper/constantan, in such a manner so that two junctions are formed. One junction is kept at some reference temperature, while the other is attached to the object being measured. The system is used when the circuit is opened at some point and the generated voltage is measured. Reversing this train of thought, imagine a pair of fixed junctions into which electrical energy is applied causing one junction to become cold while the other becomes hot.

II. SYSTEM DESCRIPTION

The proposed system consists of various modules and components. The detailed description of the modules and components are as follows:

A. Microcontroller Unit

The Arduino Mega 2560 is a microcontroller board based on the ATmega2560. It has 54 digital input/output pins of which 15 can be used as PWM outputs. It has 16 analog inputs, 4 UARTs (hardware serial ports), a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. Microcontroller unit is used to provide the automatic heating and cooling effect, when there is a temperature difference.

B. Peltier Device

Peltier device is a heat pump, solid state devices without moving parts, fluids or gasses. The basic laws of thermodynamics apply to these devices just as they do to conventional heat pumps, absorption refrigerators and other devices involving the transfer of heat energy.

C. LM 35 Sensor

The LM35 temperature sensor is used to detect precise centigrade temperature. The output of this sensor changes describes the linearity. The o/p voltage of this IC sensor is linearly comparative to the Celsius temperature. The operating voltage range of this LM35 ranges from -55°C to +150°C and it has low-self heating. This is operated under 4 to 50 volts. Temperature sensor circuit has terminals such as two inputs like non-inverting (+) and inverting (-) and only one output pin. Operational amplifier IC741 is used as a non-inverting amplifier. The variation between the input terminals amplifies the circuit. The amount produced by IC2 amplifies in an amount to the temperature by 10 mV per degree. This unstable voltage is supply to a comparator IC 741. OP Amplifier is the most generally used electronic devices today. The IC 741 op-amp is one sort of differential amplifier. We have used IC741 as a non-inverting amplifier which means pin-3 is the input and the output is not inverted.
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D. Relay Module
Relay switches are used to open and close the circuits electromechanically or electronically. A relay module has an input signal pin which is connected to an analog input of arduino, a Vcc pin and a ground pin. Another side of it consists of three pins. Two types of connections are possible, they are provided by normally open circuit and normally closed circuit. In normally open circuit, the current flows when the coil is not energized. In normally closed circuit, the current flows only when the coil is energized. Here two relay switches are being used for switching the peltier device and another for changing polarity.

E. Petrol Fuel Tank
A fuel tank is usually made up of stamped steel or aluminium. We have used an existing fuel tank and made some modifications to place the peltier module. The temperature and density of petrol inside the fuel tank will be affected due to extreme weather conditions. This variation leads to decrease in fuel efficiency and life of engine components.

III. WORKING

A. Fuel Tank Modification
The peltier module is to place in the fuel tank to provide convective heat transfer over the fuel. To provide the convective heat transfer, the fuel tank is cut by a dimension of 30x30 mm by angle grinding process. The peltier device is placed over the cut portion of the fuel tank and it is be sealed by using thermally conductive epoxy.

B. Flow Diagram of the System

IV. RESULTS

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<tr>
<th>Serial no.</th>
<th>Set Point Temperature</th>
<th>Current Temperature</th>
<th>Time Taken in seconds</th>
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</thead>
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<td>24</td>
<td>3</td>
</tr>
<tr>
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<tr>
<td>3.</td>
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Table 1: Shows the Result between Temperature & Time Taken

<table>
<thead>
<tr>
<th>Serial no.</th>
<th>Set Point Temperature</th>
<th>Current Temperature</th>
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</tr>
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Table 2: Shows the Result between Temperature & Time Taken
V. CONCLUSION

The present invention provides a better solution for preventing freezing of fuel under extreme cold conditions and also evaporation under extreme hot conditions. Both these conditions is solved by using a small peltier module. It can also be employed in all weather conditions to maintain the optimum temperature and density range of the fuel. Maintaining the fuel at optimum range will enhance the working and life of the engine and its components. The results also provided less emissions due to complete burning of the fuel. There is a minimization of knocking by maintaining the optimum temperature of fuel by using the peltier device.

REFERENCES