Thermal Energy Harvesting Application in Vaporized-Liquid-Powered Closed-Loop-Turbine for Solar Electric Power Generation

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Abstract

Since 2013, Solar energy has ranked either first or second in capacity added in USA. This research aims to design an innovative closed-loop method of generating renewable energy by using solar heat to vaporize liquid at produced at lower temperature than water in an airtight chamber to be used in a turbine for electric power generation. Our design will be a self-sustained power system and also environmentally safe.

Introduction

The research project will employ black body effect on the surface of a vaporizer allowing an idealized physical surface to absorb all incident electromagnetic radiation (light) incident on it regardless of frequency or angle of radiation to gasify a methane or ethane-based hydrocarbon with boiling point and specific heat greater than that of water to produce between 125 – 250 psi of continuous gas pressure to drive the turbine bladesand consequently the generator.

Project Description

A power system was designed modularly as shown in Figure 1 to include a black body vaporizer and condenser with their respective sensors (Figure 2), the turbine-coupling-generator arrangement, recycler, Arduino based control and it's safety system as well as control valve arrangements. The control and safety system is based on the Arduino platform deployed on an Arduino Mega2560 using input parameters from the pressure and temperature sensors at various setpoints to control the actuation and deactivation of valves to control fluid flow.

Summary and Conclusion

In our prototype design, a little quantity of our fluid will be added into the Black Body Vaporizer where absorbed heat from the sun will cause the liquid to vaporize and create an increased temperature and pressure in the vaporizer. At a certain pressure, denoted High Pressure (P_{HH}), the vaporizer outlet valve, CV2,is actuated and releases high pressure gas into the turbine across the turbine blades creating rotational motion on the shaft which drives the generator through the coupling as shown in Figure 1. The turbine outlet valve, CV3 allows spent gas flow into the condenser where it cools and liquefies. Once cooled and liquefied, pressure created in the boiler is multiplied using our novel recycling process (recycler) and used to overcome the already existent pressure in the boiler to return condensed fluid into the boiler for a continuous repeat process. The entire system is continuously monitored and can be controlled remotely using the added Bluetooth and Wireless functionality from any Bluetooth and Wi-Fi

enabled device. All control functions are carried out utilizing at most 10% of all generated power for increased power efficiency.

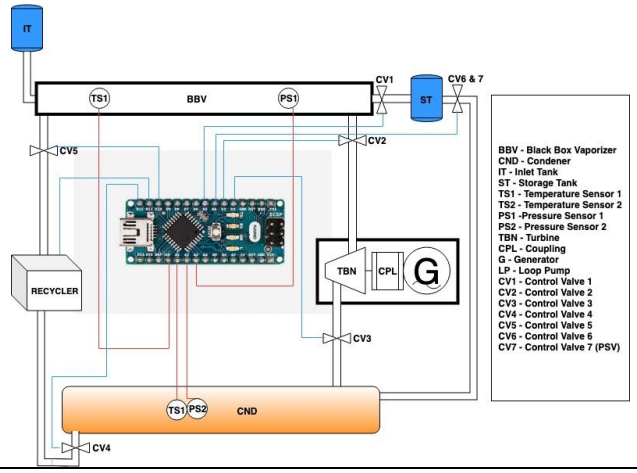

Figure 1: General Representation of Power System

Figure 2: Pressure Sensor and Tank Outlet Ports

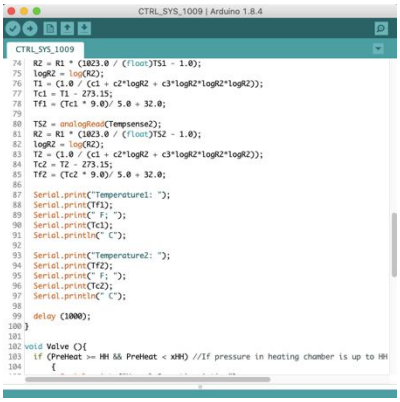

Figure 3:Part of Control System Arduino Code

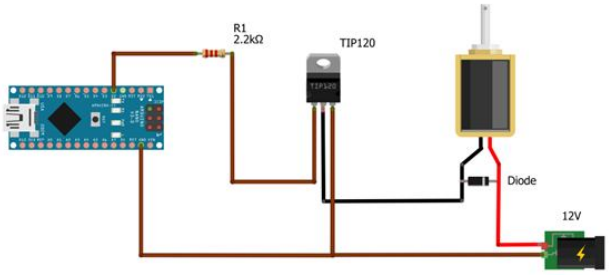

Figure 4: 12v Solenoid Valve Circuit Diagram

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