Improving Fuel Efficiency in Present Day Vehicles

Neal Dandekar, Jennifer Gill, Craig Janeczek, Scott Turgeon
Advisor: Professor Brian Savilonis (Mechanical Engineering)

Abstract

In our study of applications of technologies designed to enhance fuel efficiency, we decided to perform an analysis of various systems. These systems included a wind turbine, regenerative braking, and Stirling engines. We performed a cost-benefit analysis for each of these systems. This analysis showed that the wind turbine was not feasible. It also showed that the regenerative braking system and Stirling engines are viable methods for increasing fuel efficiency.

Background

The problem facing American drivers is that the supply of oil is not meeting the demand, therefore inflating gas prices and making it difficult for the average person to afford to put gas in their car. Another problem plaguing American cities is the overwhelming presence of green house gases and other harmful pollutants from vehicles exhaust pipes. A new design for a car that is not as dependent on oil is crucial. Right now approximately 700,000 of the 230 million cars on the road have some kind electric motor that is used for propulsion. This is less than one third of one percent. In order for us to begin to make progress towards resolving these issues we must look to alternative energies for the solution.

Methodology

In order to improve automobile efficiency, we examined three technologies. It was necessary to examine the data to find which systems would be best for consumers. We investigated power outputs of current cars and waste energies produced to find energy available to harness. The technologies that we decided to focus our attention on were Stirling engines, regenerative braking and wind turbines. With these technologies we examined economic and fuel efficiency constraints to attain feasibility.

References

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Husain, Iqbal. Electric and Hybrid Vehicles : Design Fundamentals. New York: C R C P LLC, 2003.

"Stirling Engine." WADE. World Alliance for Decentralized Energy. 3 Dec. 2008 <http://www.localpower.org/deb_tech_se.html>.

Regenerative Braking

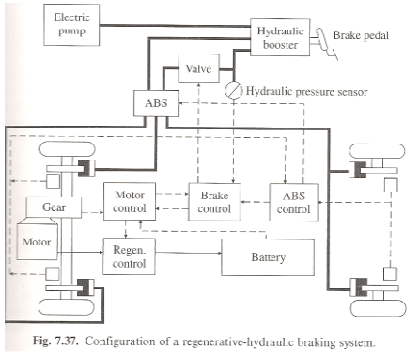
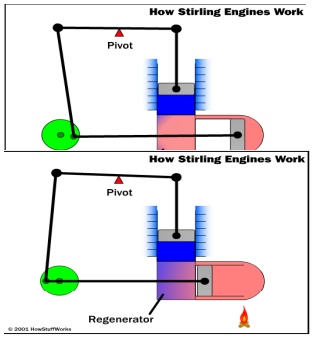


Fig. 7.37. Configuration of a regenerative-hydraulic braking system.

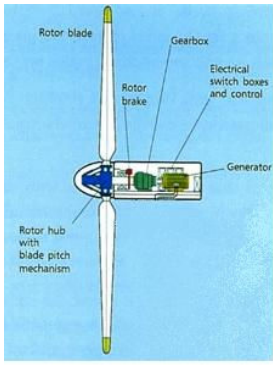
Regenerative Breaking features the exploitation of magnets in conjunction with a generator to harvest electricity from the kinetic energy found in the motion of wheels.

Stirling Engine



Stirling Engines utilize of the difference in temperature between engine and surroundings to generate electricity.

Wind Turbine



Wind turbines capture and convert kinetic energy found in the motion of the wind into electricity by the use of blades and a generator.

Analysis

Regenerative Braking

This system is currently being utilized in many hybrid electric cars today. According to Okan Tur's studies, the regenerative braking system reacts better in panic breaking situations, therefore it is a good choice for a primary braking system. Theoretically forty percent of the energy that would have been lost to forces such as friction and heat will be retrieved by this system. The regenerative braking system has been shown to increase the range of the vehicle by about ten to fifteen percent. Taking all of these facts into account, regenerative braking is a practical option for increasing the fuel efficiency. Based on a car decelerating from 60-0 mph in 3 seconds, we found that 13.7 kW could be obtained from this technology.

Stirling Engine

This is a logical technology to use because its power source is the car's engine itself. The engine's ability to run based only on a heat gradient allows for it to be placed on top of an internal combustion engine to produce electricity. The Stirling engine will absorb approximately 90% of the waste heat given off . Based on the materials that the engine is made up of it could have an operation efficiency of 20%. With the Stirling engine producing power, it would increase the fuel economy of the car. From data acquired, we found this system could produce a maximum of 7.1 kW based on a vehicle travelling one mile at 60 mph.

Wind Turbine

The idea for wind turbine supplementation of electric accessories in vehicles. However, based upon further study of the amounts of energy in the kinetic energy of the wind as well as size constraints on the turbine, we determined that operating at 100% efficiency, this system would only be able to produce a maximum of 221.5 W. We concluded that it would not be sensible in today's cars.