Design and characterization of an electromagnetic energy harvester for vehicle suspensions

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The following are some patents.

1976792_ELECTRIC_SHOCK_ABSORBER
3941402_Electromagnetic_shock_absorber
4032829_Road_shock_energy_converter
5347186_Linear_motion_electric_power_generator
5818132_Linear_motion_electric_power_generator
6952060_Electromagnetic_linear_generator
7357229_Electromagnetic_shock_absorber
7362003_Coil_switching_circuit_for_linear_generation

Some more information concerning the harvesting of shock absorber energy.

electromagnetic energy harvester for vehicle suspensions
Regenerative Shock Absorber
Vehicle shock absorber recovers energy

A common method of energy harvesting involves the used of vibration.

5578877_Apparatus_for_converting_vibratory_motion
6897573_Electrical_voltage_generating_device
7569952_High_efficiency__inductive_vibration_energy_harvester

Energy harvesting from vibration
Getting Started with Vibration Energy Harvesting_V7

The following are some other new applications and patents.

6982497_Backpack_for_harvesting_electric
7168532_Wave_energy_converter__WEC__with_Magnetic_Braking
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Abstract

During the everyday usage of an automobile, only 10–16% of the fuel energy is used to drive the car—to overcome the resistance from road friction and air drag. One important loss is the dissipation of vibration energy by shock absorbers in the vehicle suspension under the excitation of road irregularity and vehicle acceleration or deceleration. In this paper we design, characterize and test a retrofit regenerative shock absorber which can efficiently recover the vibration energy in a compact space. Rare-earth permanent magnets and high permeable magnetic loops are used to configure a four-phase linear generator with increased efficiency and reduced weight. The finite element method is used to analyze the magnetic field and guide the design optimization. A theoretical model is created to analytically characterize the waveforms and regenerated power of the harvester at various vibration amplitudes, frequencies, equilibrium positions and design parameters. It was found that the waveform and RMS voltage of the individual coils will depend on the equilibrium position but the total energy will not. Experimental studies of a 1:2 scale prototype are conducted and the results agree very well with the theoretical predictions. Such a regenerative shock absorber will be able to harvest 16–64 W power at 0.25–0.5 m s^{-1} RMS suspension velocity.

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