Adv Automob Eng 2016, 5:2(Suppl)
http://dx.doi.org/10.4172/2167-7670.C1.006

Experimental performance analysis of flywheel regenerative braking energy storage system for hybrid and electrical vehicles

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The most significant problem is short range in electrical and hybrid electric vehicles (EV, HEV). There are various studies about higher energy density battery technologies and higher efficient internal combustion engines to overcome range problem. In this study, the kinetic energy storage system designed and experimentally investigated to increase range of EV and HEV with available battery capacity. Traditional vehicles lose their kinetic energy as heat energy when they want to slow down. However, if vehicles do regenerative braking, they can store some part of this kinetic energy in energy storage system. But most of the recuperated energy is lost as heat in braking mode. In this study, a Flywheel Energy Storage System (FESS) is designed to store vehicle's kinetic energy, which occurs braking of the vehicle. Mathematical calculations, design of the FESS have been done in a scaled down laboratory prototype. Simulation and mechanical production stages of the prototype and preliminary test results are also included in the full paper. Flywheel is an energy storage system that stores the regenerated energy as kinetic energy on a high speed rotating mass. Vehicle's electric motor is operated as generator during braking. The regenerated energy is transferred to the FESS' Motor/Generator (M/G) unit during deceleration of the vehicle. M/G unit is operated as motor mode and energy is stored as kinetic energy by accelerating the FESS. Then the stored energy transferred the vehicle's DC bus operating M/G unit as generator mode when vehicle needs energy to accelerate the vehicle. Thus there is no loss of kinetic energy converted into heat energy from the vehicle during breaking, is stored to be used again in FESS.

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Power loss elimination during clutch engagement in an automobile

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A clutch is a machine member used to connect the driving shaft to a driven shaft, so that the driven shaft may be started or stopped at will, without stopping the driving shaft. During an automobile drive, one can observe that during every gear shift, there will be a speed fall after engaging the clutch. After disengagement, due to the inertia of the vehicle, the clutch shaft momentarily rotates at a higher speed compared to the flywheel. Then after engagement, the speed fall is mainly due to the engaging of low speed flywheel and relatively high speed driven member. By temporarily preventing the engagement of the flywheel and clutch till flywheel crosses the speed of clutch shaft, the speed drop during engagement can be eliminated. Proposed design deals with this concept, by adding a free wheel unit to the clutch shaft so as to eliminate the speed drop.

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