centre for concepts in mechatronics

Flywheels as high power storage devices for mobile applications

Abstract

Flywheel energy storage enables brake energy recovery and load leveling in vehicular drive systems. This allows for energy efficient vehicles of high quality that are able to meet strict emission limits while providing a standard of performance expected of modern electrified systems without involving electric supply infra structure.
Also other equipment with dynamic load profiles like hoisting and lifting equipment can profit from load leveling resulting in considerable energy and emission reduction and ultimately lower life cycle costs.
This is enabled by a modular hybrid power system in which all components of the system are built up around a common DC-bus. The Prime Mover Unit (PMU) covers the average power demand of the load cycle. The flywheel is of paramount importance to maximize the drive train efficiency by providing load leveling of the PMU and by enabling regenerative braking.
The proposed flywheel system, composed of an advanced flywheel-motor/generator-unit with associated power electronics and control, is designated as EMAFER: Electro Mechanical Accumulator For Energy Re-use. The EMAFER has high power density, high turnaround efficiency, long cycle life and is intrinsically safe, all key requirements for the transportation application.

The modular hybrid electric power system can in general be readily adapted to all kinds of urban vehicles ranging from buses and delivery vans to light rail vehicles, allowing them to operate clean, silent and energy efficient without external power supply. This will be of particular interest to cities proposing low or zero emission zones without incurring the heavy investment costs and/or visual intrusion of overhead supplies. Moreover up to 40% energy saving is enabled. For the crane application energy savings of even 60% are possible due to the stronger duty cycle.
The environmental quality of many urban centers could thus be considerably improved without major infrastructure costs and at reduced energy consumption.

Nuenen, The Netherlands, October 2006

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