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IN VA-1

Superconductor Flywheel Energy Storage System

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A horizontal axle-type flywheel energy storage system was manufactured using high-Tc superconductor bearings. The system running in a vacuum chamber mainly consists of a composite flywheel rotor, superconductor bearings, a motor/generator and its controller. The present system was designed to have an energy storage capacity of 440 Wh at its operating speed of 40,000 rpm, which is way above two rigid body mode critical speeds. Rotordynamic analysis was performed on this system.

Vertical axis flywheel energy storage system was conceptualized, which uses a hybrid superconductor bearing set to carry the wheel part load. The hybrid bearing system consisted of a superconductor bearing and a permanent magnetic bearing. The flywheel was suspended by the permanent magnetic bearing and stabilized by the superconductor bearing. The models for permanent magnet parts of the bearing set were designed using numerical magnetostatic analysis tool. The vertical magnetic force characteristics of the bearing set were experimentally measured. The range of stable levitation was experimentally determined for the vertical magnetic force. A new type damper designed to provide essential damping for the permanent magnetic bearing was tested by an impact test. The damper using eddy current loss showed a good performance. These results were discussed in regard of application to the flywheel system with a passive hybrid superconductor bearing set.

Keywords: Flywheel; Energy Storage; Superconductor; Magnetic Bearing; Rotordynamics analysis