

Characteristics of a Permanent Magnetic Bearing and a Pair of Superconductor Journal Bearings for 5 kWh SFES

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A permanent magnetic bearing (PMB) and a pair of superconductor journal bearings (SJBs) were designed and developed to levitate the spinning rotor of a 5 kWh superconductor flywheel energy storage system (SFES). The wheel system of the SFES, composed of a titanium shaft, an aluminum hub and two composite wheels, and weighing about 230 kg, is mainly suspended by a PMB, and an upper and lower SJB located at each end of the shaft provides the wheel system with stability. The repulsive force and attractive force according to distance between the stator and rotor of the PMB was measured using a universal testing machine, and the magnetic flux density distribution of the stator was also measured. In addition, dynamic and static loading tests were performed using a universal testing machine on the upper and lower SJBs, each composed of 8 superconductor bulks of size $40 \times 40 \times 15 \text{ mm}^3$, to measure pinning force, apparent stiffness, and hysteresis. The results were compared to the values derived from the frozen image method. Finally, the range of stability was predicted for the application of the PMB and SJBs to the SFES.

keywords : permanent magnetic bearing (PMB), superconductor journal bearing (SJB), superconductor flywheel energy storage system (SFES), pinning force, hysteresis