AQ02

Conducted EMI Reduction on the Pulse Tube Cryocooler

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Instead of using liquid helium for operating the SQUID systems [1], a refrigerator such as pulse tube cryocooler may be used. In the pulse tube cryocooler, helium gas flows in and out of the compressor and the valve motor via stainless hoses [2]. The valve motor is driven by a three phase inverter with 10 kHz switching frequency where harmonics reach up to around 20 MHz and generates switching noise currents conducted via hoses. The noise currents cause a critical interference to the operation of the SQUID sensor installed on the 4 K stage of the pulse tube cryocooler. In order to solve this problem, paths of conducted noises are analyzed (Fig. 1) with current transformer sensors. Each current transformer sensor consists of a frame which have inside diameter of 5 cm, 30 layers of Metglas 2714A amorphous ribbon (5 cm in width and 20 μm in thickness), and 72 turns of secondary coil, where the primary coil is a conducting path carrying noise current. We observed that large part of the unbalanced three-phase current flows in the neutral line, however a part of it leaks out into the flexible stainless hoses as a common mode. Fig. 2 shows waveforms of currents causing common mode noise before and after using a copper mesh jacket treatment. It is found that common mode current can be reduced by a factor of six. Finally, the SQUID operates normally as drawing an ideal demonstration.

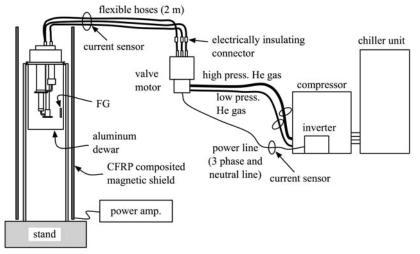

Fig. 1. Schematic diagram of the separate valve motor type 4 K pulse tube cryocooler system.

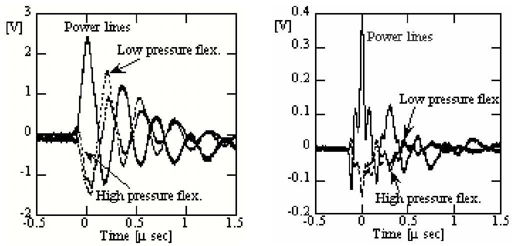

Fig. 2. Temporal shapes of the conducted noise currents through the power lines and the high and low pressure flexible hoses (right), Conducted noise currents measured after treatment (left).

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AQ03

Vibration Suppression of Flexible Beam Using Electromagnetic Shunt Damper

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In this paper the electromagnetic shunt damper was newly employed for the vibration suppression of the flexible structures. The electromagnetic shunt damper consists of a coil and a permanent magnet. The ends of the coil were connected to the RLC shunt circuit. The numerical solutions of the resonant frequency of the shunt circuits were calculated by using a commercial program, Pspice. The vibration and damping characteristics of the flexible beams with the electromagnetic shunt damper were investigated by tuning the circuit parameters. Also, the effect of the magnetic intensity on the shunt damping was studied with the variation of the gap between the aluminum beam and the permanent magnet. Present results show that the magnet shunt damper can be successfully applied to reduce the vibration of the flexible structures.

The possibility to dissipate the mechanical energy with a piezoelectric material shunted with passive electrical circuits is investigated by Hagood et al [1]. Fung et al. [2] developed an electromagnetic actuator for the vibration control of a cantilever beam with a tip mass. Recently, Bae, Kwak and Inman [3] developed a new eddy current damper system with a fixed copper conductive plate and flexible linkage attached to the tip of the beam.

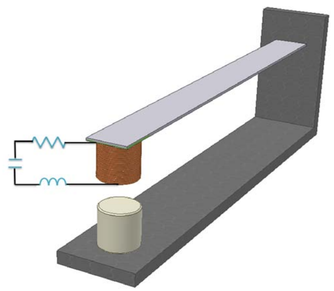

Fig. 1. Schematic showing of electromagnetic shunt damper.

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