

Design and Fabrication of a Prototype Eddy Current Brake for High Pressure Ratio Cryogenic Helium Turbine

Abstract

Project definition/objectives: Cryogenic helium turbines have contactless gas bearings with eddy current brakes for better control of speeds. Here, an eddy current brake (ECB), its housing and water cooling have been considered for design to control the speed. In this design a high pressure ratio turbine will be considered. The shaft in the bearing and brake will be vertical and clearance between shaft and its housing is of few tens of microns. To produce magnetic field, a coil with large no. of turns of current carrying wire around the shaft will be there. A current of few amperes can generate good braking force. The shaft transfers the energy of the expander to the eddy current brake and this energy is further removed by cooling water. This project work will involve detailed design and optimization of different electrical, mechanical and thermal aspects of brake. Its manufacturing process, assembly and disassembly procedure will be worked out. Based on this design, a prototype ECB will be manufactured to dissipate shaft power of about 1 kW, where rotational speed will be few tens of thousands of RPM. For test of ECB, shaft will be powered by a motor. This prototype ECB will be designed for turbine having shaft power of ~1 kW, which has process flow condition of ~45 g/s helium flow rate with inlet pressure ~6 bar and temperature ~15 K and outlet pressure ~1.3 bar and temperature ~10 K.

Works of this project:

1. Study the turbines and its ECB of existing HRL plant at IPR.
2. Develop the design and analysis method and find optimum parameters of parts of ECB.
3. Prepare drawing and documentation for a prototype.
4. Get various parts fabricated using CNC machine.
5. Do the assembly of different parts and check if all have required tolerances.
6. Make a report of above works.

Required Period of work: About 9 months

Project outcome: Design methodology, optimized dimensions, a prototype brake and a report.

Academic Project Requirements:

1) Required No. of student(s) for academic project: 1

2) Name of course with branch/discipline: M.E./M.Tech Mechanical Engineering

3) Academic Project duration:

(a) Total academic project duration: 38 Weeks

(b) Student's presence at IPR for academic project work: 3 Full working Days per week

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