Public Abstract

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Graduation Term: Winter
Graduation Year: 2006

Title: Theoretical and Experimental Investigation of Oscillating Heat Pipes

The oscillating motions occurring in an oscillating heat pipe may result from: 1) the oscillating pressure existing in the evaporators of the heat pipe; 2) a slug flow or bubble-train flow existing in the adiabatic section of the heat pipe, which actually is a mass-spring system (vapor bubbles as gas springs and incompressible liquid plugs as pistons) and 3) a wavy pressure distribution along the meandering channel of the heat pipe existing between the evaporator and condenser of the heat pipe.

Utilizing the sawtooth alternating component of pressure drop as the excitation of the oscillating motion, a mathematical model describing the oscillation characteristics of slug flow of vapor bubbles and liquid plugs in capillary tubes is presented including the effects of capillary forces, gas spring constants, dimensions, gravitational forces, and initial pressure distributions of working fluids. The model considers the vapor bubble as the gas spring for the oscillating motions in the capillary tubes.

The five-turn oscillating heat pipe with Acetone as the working fluid can function well in a vertical position where the evaporator was at the bottom of the heat pipe. At the horizontal position, the heat pipe did not function. A thermal resistance of 0.5 k/w is obtained for the current heat pipe. Water cannot be used as the working fluid of the current oscillating heat pipe. The average frequency of slug flow in the adiabatic section of the heat pipe is about 2.0-10.0 Hz.