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**Vortex expansion devices for high temperature cryogenics**

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Proceedings of the 26th intersociety energy conversion engineering conference

1991

Citation

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Abstract

[en] Discovery of superconducting materials with critical temperatures significantly above the boiling point of liquid nitrogen has provided new interest in reliable, low cost methods of producing high temperature cryogenic refrigeration. This paper describes several promising methods which use vortex expansion devices. Vortex expansion devices referred to as vortex tubes are relatively well known and have been commercially available for over thirty years. Although vortex tubes do not have the overall efficiency of vapor cycle refrigeration units, they can produce cooling at -40 degrees F by expansion of 100 psig air at ambient temperature. Enhanced vortex devices have produced significantly lower temperatures and may represent a low cost method of providing refrigeration required for high temperature superconductor materials. As such devices are characterized as having no moving parts except for the low pressure compressor, they may also exceed reliability goals for high temperature cryogenic refrigeration systems. This paper presents an analysis of the thermodynamics of vortex expansion, evaluation of design limitations of vortex tube devices and resulting design enhancements, and results of experiments using the enhanced design including applications in both high and low temperature cyrogenic refrigeration systems. The term high temperature cyrogenic describes temperatures ranging from about the boiling point of liquid nitrogen, -320 degrees F (-195 degrees C), up to -58 degrees F (-50 degrees C), the generally defined upper limit of study referred to as cryogenics

-195°C
to
-50°C

Primary Subject

CONDENSED MATTER PHYSICS, SUPERCONDUCTIVITY AND SUPERFLUIDITY (G6412)

Secondary Subject

CLASSICAL AND QUANTUM MECHANICS, GENERAL PHYSICS (G1210), CLASSICAL AND QUANTUM MECHANICS, GENERAL PHYSICS (G1300)

Source

Anon; 575 p; ISBN 0-89448-163; 1991; p. 521-525; American Nuclear Society; La Grange Park, IL (United States); 26. intersociety energy conversion engineering (IECE) conference; Boston, MA (United States); 3-9 Aug 1991; CONF-910801--; American Nuclear Society, 555 North Kensington Ave., La Grange Park, IL 60525 (United States)

Record Type

Book

Literature Type

Conference

Country of publication

United States

Descriptors (DEI)

CRITICAL TEMPERATURE, CRYOGENIC STORAGE DEVICES, CRYOGENICS, EVALUATION, HIGH-TC SUPERCONDUCTORS, REFRIGERATION, THERMODYNAMICS

Descriptors (DEC)

COOLING, MEMORY DEVICES, PHYSICAL PROPERTIES, SUPERCONDUCTORS, THERMODYNAMIC PROPERTIES, TRANSITION TEMPERATURE

Reference Number**INIS Volume****INIS Issue**