VORTEX TUBE REFRIGERATOR

R434

Year 1
study

Features

- Demonstration of the ability to produce hot and cold air from a device with no moving parts.
- Safe and Suitable For Unsupervised Student Operation
- Does not involve any chemical refrigerants
- Responds Rapidly to Control Changes
- Negligible Operating and Maintenance Costs

Description

The Vortex Tube is an interesting device in which a compressed gas (usually air) is divided into two streams at a lower pressure. One of these streams is about 50K colder, and the other is about 50K hotter than the compressed gas supplied. It is an unusual method for producing cooling air. In this unit, a modified industrial Vortex Tube has been incorporated into a test unit with all the controls and instruments necessary to provide students with an appreciation of its characteristics and performance. The Vortex Tube consists of two joined and concentric cylindrical chambers of different diameters, open at their ends. Spaced around the circumference of the larger chamber and close to the junction with the smaller chamber, are nozzles arranged to discharge tangentially into the cylinder. When compressed gas is supplied to these nozzles, the jets discharge into the chamber at a near sonic velocity, and a forced vortex, rotating at approximately 500,000 rev/min, is created. The core of this vortex is cold and is extracted from the smaller end of the chamber, while the periphery which is hot, is extracted from the larger end. The ratio of cold and hot gas flow rates can be varied by a valve which controls the hot gas discharge. To avoid problems with frosting and flow meter errors, the hot and cold air streams are passed in opposite directions through a concentric tube heat exchanger. The air streams, now close to ambient temperature, pass through variable area flow meters to the atmosphere. A “balance valve” fitted in the outlet from the hot end of the vortex tube controls the proportions of the total air flow which passes from the “hot” and “cold” ends. Thermocouple sensors, with a selector switch incorporated into the digital display, allow the measurement of all important temperatures. Although no direct measurement of the refrigerating effect is made, the mass flow rate and the temperature of the cold air stream are directly measured. It is assumed that any cooling which can be done by this cold air as it returns to ambient temperature, is its refrigerating effect.

Related Laws/Applications

- Refrigeration
- Thermodynamics and Fluid Mechanics
- Plant and Process Engineering

Learning capabilities

- Demonstration of the ability to produce hot and cold air from a device with no moving parts.
- Production of performance curves for a vortex tube with:
- - Variation of inlet pressure
- - Variation of hot and cold gas ratios
- - Variation of gas (if available)
- Determination of refrigeration effect and comparison of this with the estimated power needed to drive the compressor.

Technical Specification

- Panel: High quality ABS.
- Vortex Tube: Rated at 300 litre free air per minute at 700 kNm-2 gauge.
- Pressure Regulator and Filter: To supply clean and pressure stable air.
- Heat Exchanger: Concentric tube, contra flow.
- Valves: Two, for isolation and balance.
- Flow: Two, variable area type flowmeters, calibrated for air up to 4gm s-1.
- Temperature: Digital Temperature Indicator, 0.1° resolution.
- Pressure: Ø100mm gauge – range 0 to 800 kN m-2.

What's in the Box?

- 1 x R434
- 1 x Reinforced hose
- 1 x Power lead
- Instruction manual
- Packing list
- Test sheet

Weights & Dimensions

- Weight: 29 kg
- Length: 710mm
- Width: 240mm
- Height: 710mm

Essential Services

- 220-240 Volts, Single Phase, 50Hz (With earth/ground).
- Line current up to 3.0A at 230v.
- 110-120 Volts, Single Phase, 60Hz (With earth/ground).
- Line current up to 6.0A at 110V.
- Compressed Air: 300 litre free air per minute supplied at 700 kN m-2 gauge.

Ordering information

To order this product, please call PA Hilton quoting the following codes:
R434/230
R434/115