VAPOUR JET REFRIGERATOR/HEAT PUMP

R853



Year 1
study

Features

- Enables demonstration and investigation of the combined Rankine and Vapour Compression Cycle
- Is an example of a refrigerator or heat pump driven by a Heat Input as opposed to the more usual work input
- Uses hot water as the ‘high grade’ heat source, thus limiting the maximum temperature to 100°C
- Evaporation and Condensation may clearly be seen through glass cylinders
- As a heat pump, the unit shows approximately the same primary energy ratio as a work-driven heat pump
- All important components are mounted on the front panel and quickly responds to a change in operating conditions.
- Optional Solar Panels available

Description

The unit may be regarded as a combined heat engine and a refrigerator/heat pump. The system powering the refrigerator/heat pump works on the well-known Rankine cycle (frequently used in steam power plants.) In this cycle the unit takes in heat at a very modest temperature (about 90°C) and rejects heat at the condenser temperature (about 30°C). The work output of this engine is in the form of the kinetic energy of a jet instead of shaft work as is normal with a Rankine cycle. The refrigerator/heat pump operates on the Vapour Compression Cycle and uses the output of the Rankine Cycle (i.e. the kinetic energy of the jet). It takes in heat at a low temperature in an evaporator and rejects heat at a higher temperature using the same condenser as the engine. Both the Rankine Power Plant Cycle and the Vapour Compression/Heat Pump Cycle are included in most courses of study for young engineers. The Hilton Vapour Jet Refrigerator/Heat Pump R853 demonstrates practically, the potential of combining these cycles so that a heat pump or refrigerator can be run from a heat output.

Related Laws/Applications

- Refrigeration & Air Conditioning
- Building Services
- Mechanical Engineering
- Plant and Process Engineering
- Energy Conservation
- Energy Management
- Chemical Engineering
- Food Technology
- Marine Engineering
- Agriculture Engineering

Learning capabilities

- Analysis of the combined Rankine and Vapour Compression Cycle.
- Demonstration of the characteristics of an ejector or thermo compressor.
- Production of performance curves as a refrigerator and comparison with ideal Rankine/Vapour Compression cycle.
- Production of performance curves as a heat pump and comparison with ideal Rankine/Vapour Compression Cycle.
- Investigation of entrainment mass ratio at various pressures.
- Demonstration of ‘adiabatic’ mixing of hot and cold vapour.
- Demonstration of ’adiabatic’ throttling.

Technical Specification

- Panel: High quality GRP.
- Steam Generator: Rectangular GRP insulated vessel fitted with 1.5kW immersion heater and containing the refrigerant vapour generator.
- Refrigerant Vapour Generator: stainless steel shell, Ø75mm x 200(L) mm, with sight glass and pre-heating coil.
- Ejector Nozzle: Convergent-divergent, throat diameter 1.7mm.
- Compressor Diffuser: With combining cone, parallel and divergent portions.
- Evaporator: Thick walled glass cylinder, incorporating a 500W heater controlled by a variable transformer and a float type expansion valve.
- Condenser: Thick walled glass cylinder fitted with water cooling coil. Surface area of coil: 0.1m2.
- Feed Pump:
- Throttle Valve: Manually adjustable to vary nozzle inlet pressure.
- Thermometer: Digital type K, 0.1°C resolution, 12 way selector connected to 9 thermocouples.
- Pressure Gauges:
- - Two, range 0 to 800 kNm-2 to indicate refrigerant vapour generator and nozzle inlet pressure.
- - Two, range – 100 to + 100 kNm-2 to indicate evaporator and condenser pressure.
- Flow Meter: Variable area glass tube type. Range 0 to 75g s-1.
- Voltmeter and Ammeter: To measure power input to evaporator. Ranges 0 to 250Vand 0 to 3A respectively.
- Pressure Relief Valves: Fitted to vapour generator, evaporator and condenser.
- High Pressure Cut Out: Fitted to vapour generator and condenser.
- Low Water Flow Switch: To switch off power supply if insufficient water flows through the condenser.
- Solenoid Valve: To isolate vapour generator from ejector, evaporator and condenser.
- High Temperature Cut Out: Fitted to all heater elements.
- All circuits are protected by a fuse.

Recommended Ancillaries

- F823S

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What’s in the Box?

- 1 x R853
- 1 x Transformer (115V only)
- 1 x 3m Reinforced PVC tubing
- 1 x 3m PVC tube
- 9 x Spare 'o' rings
- 1 x Power lead
- Instruction manual
- Packing list
- Test sheet

Weights & Dimensions

- Weight: 102 kg
- Weight: 106 kg (115V version)
- Length: 1060mm
- Width: 430mm
- Height: 925mm

Essential Services

- 2.5kW, 220-240 Volts Single Phase, 50Hz (With earth/ground).
- 2.5kW, 110-120 Volts Single Phase, 60Hz (With earth/ground).
- Water:
- - 250 litres / hour at 15m head.
- - Water temperature should not exceed 22°C if a useful range of test conditions are to be investigated.

Ordering information

To order this product, please call PA Hilton quoting the following codes:
R853/230
R853/115

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