Instrument presentation

Closed-cycle cryostat

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What is Cryostat?

A cryostat (cryo meaning cold and stat meaning stable) is a device used to maintain very low or cryogenic temperatures of samples or devices.

Low temperatures may be maintained within a cryostat by using various refrigeration methods, most commonly using cryogenic fluid bath such as liquid helium.

Different types of Cryostat:

- Continuous-flow cryostat
- Bath cryostat
- Closed-cycle cryostat
- Multistage cryostats

Here I have discussed only about closed-cycle cryostat as it is used in our ice instrument to attain cryogenic temperatures.

Closed-cycle cryostat

Closed-cycle cryostats consist of a chamber through which cold helium vapour is pumped. An external mechanical refrigerator extracts the warmer helium exhaust vapour, which is cooled and recycled.

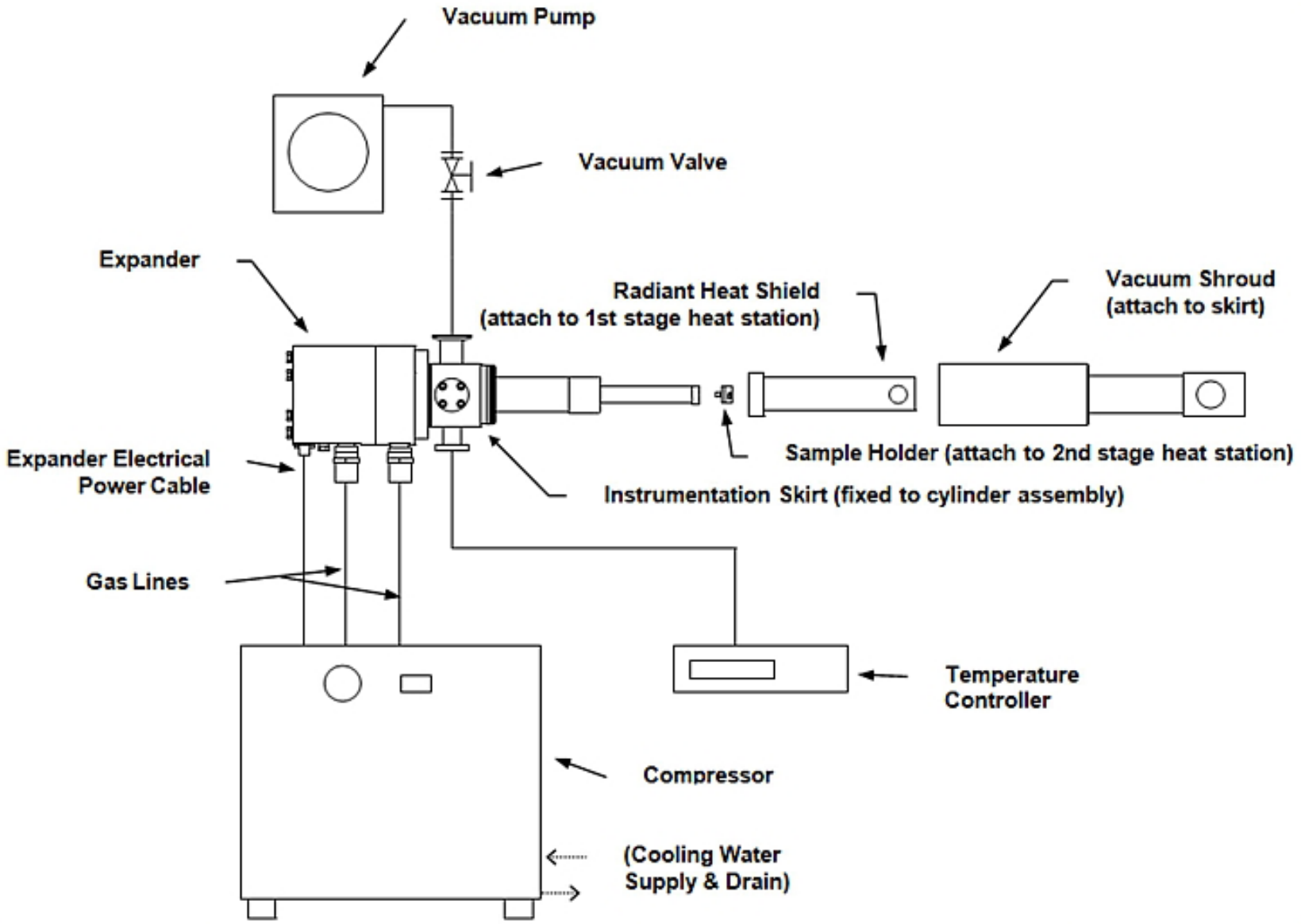
Closed-cycle cryostats consume a relatively large amount of electrical power, but need not be refilled with helium and can run continuously for an indefinite period. Objects may be cooled by attaching them to a metallic coldplate inside a vacuum chamber which is in thermal contact with the helium vapour chamber.

Major components of Closed-cycle cryostats :

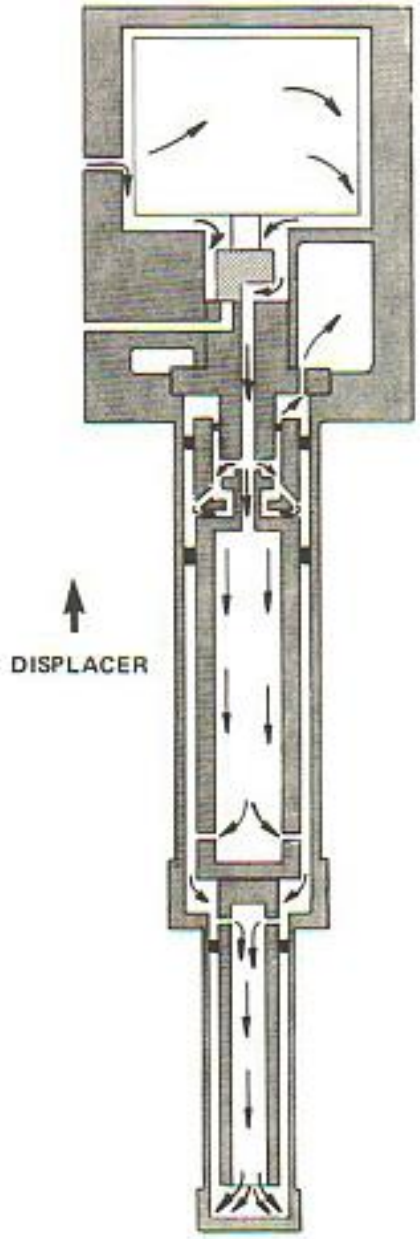
- Expander
- Compressor
- Vacuum shroud
- Radiation shield

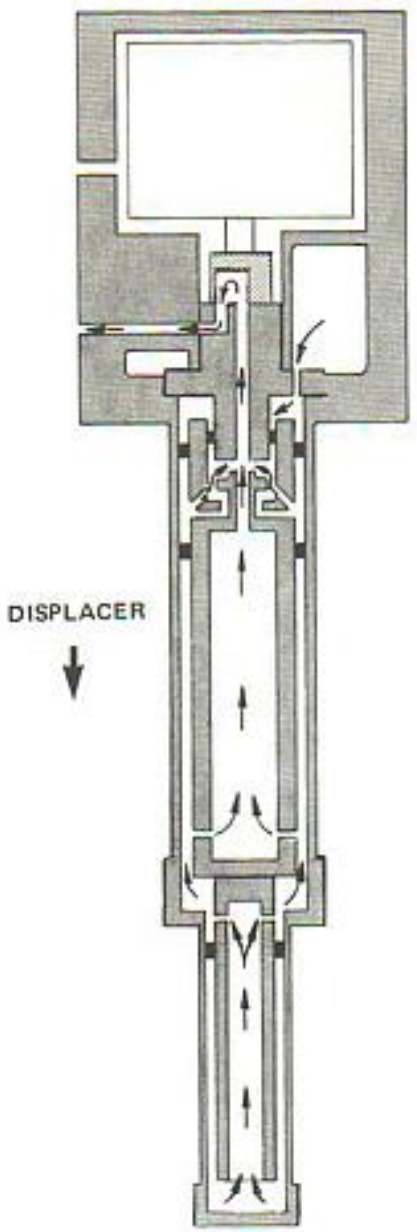
Fig 1: Typical closed cycle cryostat

Operating principle



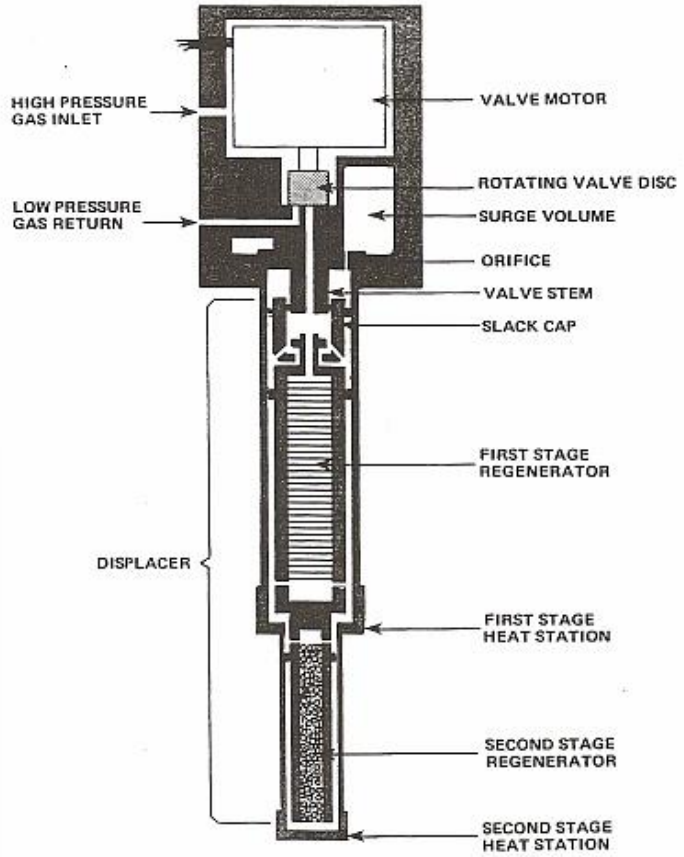
Operating principle





Expander or cold head

- The expander, commonly referred to as the cold head or cold finger.
- It is connected to a compressor by two gas lines and an electrical power cable. One of the gas lines supplies high pressure helium gas to the expander, the other gas line returns low pressure helium gas from the expander.
- This is the heart of the system and is available in a range of sizes.



Compressor

- The compressor provides the necessary helium gas flow rate at the high and low pressure for the expander to convert into the desired refrigeration capacity.
- Two gas lines are connected to it. One of the gas lines supplies high pressure helium gas to the expander, the other gas line returns low pressure helium gas from the expander.

Vacuum shroud

- Vacuum shrouds are constructed from Stainless Steel or Aluminium.
- The vacuum shroud surrounds the cold end of the expander in vacuum limiting the heat load on the expander caused by conduction and convection.
- A typical vacuum shroud will be mounted on the cryo-cooler using double O-Rings for vacuum seal.

Radiation shield:

- The radiation shield is actively cooled by the first stage of the expander and insulates the second stage from the room temperature thermal radiation being emitted from the vacuum shroud.
- It is usually made of high purity copper (nickel plated for durability and low emissivity) or aluminium.

Thank You