WHAT IS JOULE THOMSON COOLING?

WHAT IS IT?

Joule-Thomson cooling occurs when a non-ideal gas expands from high to low pressure at constant enthalpy. The effect can be amplified by using the cooled gas to pre-cool the incoming gas in a heat exchanger.

This can be understood by referring to the Temperature vs. Entropy diagram for nitrogen shown in Figure 1. Nitrogen at 100 atmospheres in pressure (atm.) passes down a counter-current heat-exchanger from A to B. At B it is allowed to expand through a valve or restricting capillary where it cools by the Joule-Thomson effect. The cold gas then passes back up the exchanger from D to E.

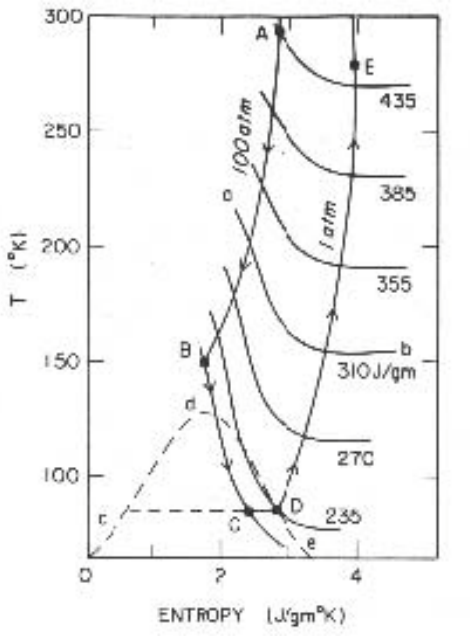

FIGURE 1. Temperature versus Entropy Diagram for Nitrogen Gas.

This can be used in refrigeration as shown in Figure 2. Here a compressor compresses the gas to high pressure, forcing it through the filter-dryer, down the counter-current heat exchanger, then through the JT valve where it expands and cools. Eventually the gas liquefies and collect in the reservoir. The evaporated vapor passes back up the heat exchanger, pre-cooling the incoming gas, then returns to the compressor, and the cycle is repeated.

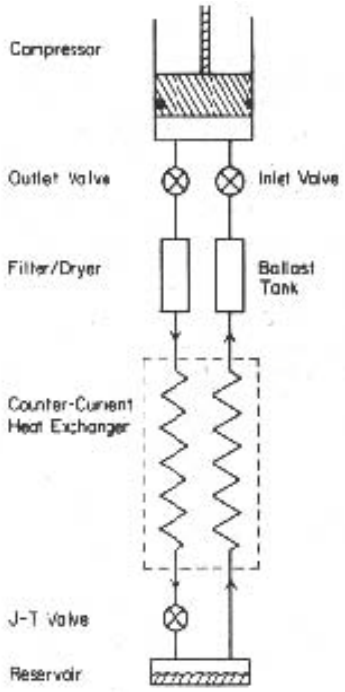

FIGURE 2. Schematic of a Joule Thomson Refrigerator

Miniature Joule Thomson refrigerators have been used for the past several decades, primarily for the cooling of infra-red detectors for night vision. Microminiature refrigerators were developed at MMR Technologies, Inc. These are miniature coolers further reduced in size by two orders of magnitude. This was made possible by the development of photolithographic techniques at MMR for the fabrication of the micron size channels needed for the tiny heat exchangers for these devices. (See, W.A. Little, Review Scientific Instruments 55, 661 (1984)). The low gas consumption, low cost of operation, and absence of maintenance of the microminiature refrigerators has made them attractive for incorporation in a wide range of laboratory instruments.

These instruments are now commercially available from MMR Technologies.

FURTHER QUESTIONS

If you have further questions, please do not hesitate to contact MMR Technologies, Inc.:

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