United States Patent

Nicholds

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[45] Feb. 29, 1972

[54] COOLING APPARTUS OF THE JOULE THOMSON TYPE

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[21] Appl. No.: **11,432**

[52] **U.S. Cl.** **62/514**

[51] **Int. Cl.** **F25b 19/00**

[58] **Field of Search** 62/514

[56] **References Cited**

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Primary Examiner—Meyer Perlin

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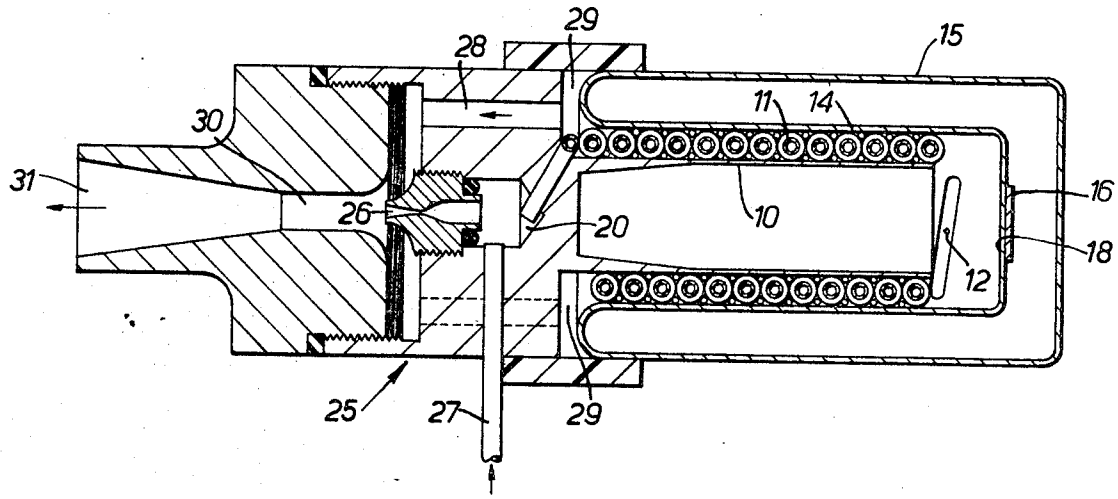
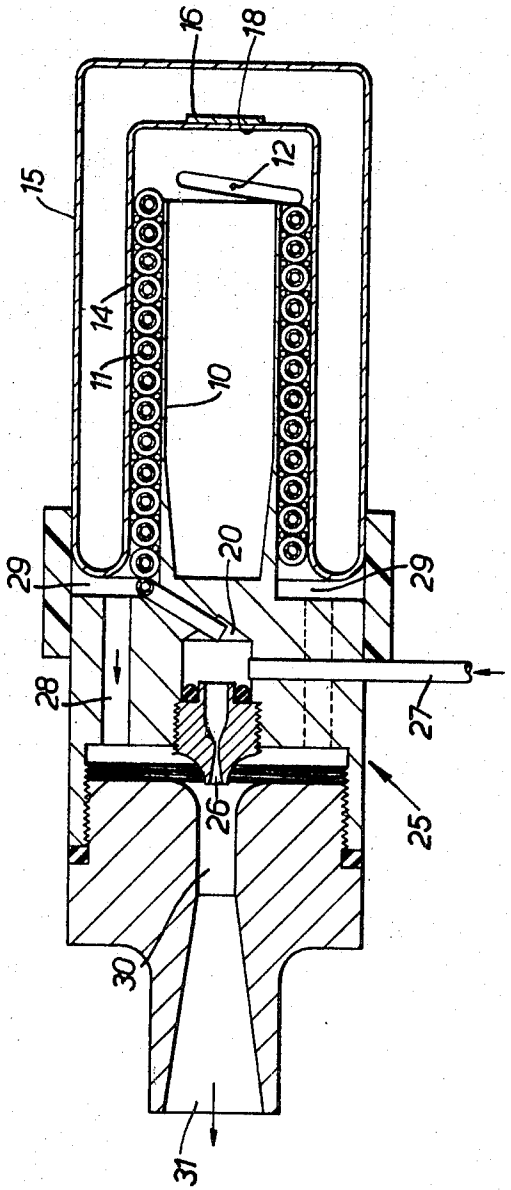
[57] **ABSTRACT**

In a Joule Thomson high-speed cooler, refrigerant from a supply in the form of gas under pressure flows through one path of a heat exchanger, and after expansion through a nozzle returns through the other path to a gas outlet, cooling the incoming gas. In addition gaseous refrigerant is bypassed from the supply to an ejector serving to induce a suction at the gas outlet.

4 Claims, 1 Drawing Figure





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COOLING APPARTUS OF THE JOULE THOMSON TYPE

This invention relates to cooling apparatus of the Joule Thomson type in which cooling is produced by expansion, through a nozzle, of a working fluid from a supply in the form of gas under pressure, which before expansion is at a temperature below its inversion temperature, so as to produce a supply of liquefied fluid in a container.

It will be appreciated that the term nozzle is used herein to cover any conventional or preferred static device permitting expansion of gas, whether it be a plain orifice, a specially shaped nozzle, or a number of orifices whether alone or associated with a porous plug or membrane.

According to the present invention the apparatus includes means for bypassing gaseous refrigerant from the supply and utilizing the energy of such refrigerant to induce a suction at the gas outlet of the refrigerator. The means for producing a suction conveniently comprise an ejector.

The apparatus may comprise a heat-exchanger comprising two paths in one of which gas from the supply travels to the expansion nozzle being progressively cooled, while in the other gas expanded through the nozzle returns to the gas outlet, cooling the incoming gas.

The invention is particularly, though not exclusively, concerned with small high-speed coolers which are intended on each operation (or on their only operation) to produce low temperature, possibly of the order of that of liquid air, within quite a short time, for example, a few seconds, and to maintain the temperature also for a relatively short time, perhaps of the order of a minute or two.

In such coolers the size of the expansion nozzle is frequently increased, as compared with what would be employed for a continuously operating cooler, in order to increase the mass flow rate. This, however, is liable, especially in the case of a cooler of very small size, to increase the back pressure by something of the order of one atmosphere. Using nitrogen, for example, as refrigerant this may raise the boiling point by perhaps 10° C. or more. The arrangement in accordance with the invention, by reducing the outlet pressure of the cooler, not only lowers the boiling point of the nitrogen but also increases the flow through the cooler. This is achieved without any increase in the size or weight of the cooler although naturally at the expense of some addition to the amount of compressed gas required.

The discharge from the ejector may be at atmospheric pressure or alternatively it may be at a higher pressure. In the latter case the exhaust pressure may be employed to perform a useful function, for example to blow off the protective nose cone, shutter or other cover sometimes employed to protect an infrared seeking device from the effects of weather prior to launch.

A specific embodiment of the invention will be described by way of example with reference to the accompanying drawing

which is a diagrammatic sectional elevation of a cooler incorporating an ejector unit.

The cooler includes an annular heat exchanger comprising a tubular body **10** around which is helically wound a finned inlet tube **11**. The external wall of the heat exchanger is afforded by the inner wall **14** of a Dewar flask **15**, located round the finned coil **11**, and the space between the body **10** and the wall **14** provides a path for exhaust gas flowing past the fins to cool the incoming high-pressure refrigerant within the tube **11**. The cold end of the external tube **14** is closed to form a reservoir **18** in which the liquid refrigerant can accumulate and which is in heat-exchange relationship with a load **16**, such as a radiation detector. The upper end of the helical finned tube **11** communicates with a central bore **20** near the warm end of the body to which working fluid under pressure is supplied through a lateral supply pipe **27**.

At its cold end the helical heat-exchanger tube **11** communicates with an expansion nozzle **12**.

The cooler is provided with an ejector unit **25** having an ejector nozzle **26** connected to the bore **20**, a suction inlet **28** connected to the gas outlet **29** from the cooler, and an exhaust **30** to atmosphere connected to a diffuser **31**.

Thus, when the gas is turned on, a portion of it will flow through the cooler in the usual manner while a further portion will flow through the nozzle **26** of the ejector unit **25** to produce a suction at the outlet **29** of the cooler. In other respects the operation of the cooler is similar to those described in the prior specifications referred to above.

It will be appreciated that the invention is not limited to the details of the embodiment specifically described. Thus the cooler may be as in any of the embodiments described in the specifications referred to above, in many of which the expansion orifice forms a seating for an automatic regulating valve.

What we claim as our invention and desire to secure by Letters Patent is:

1. Cooling apparatus of the Joule Thomson type in which cooling is produced by expansion, through a nozzle, of a working fluid from a supply in the form of gas under pressure, which before expansion is at a temperature below its inversion temperature, including means for bypassing gaseous refrigerant from the supply and utilizing the energy of such refrigerant to induce a suction at the gas outlet of the refrigerator.

2. Apparatus as claimed in claim **1** in which the means for producing a suction comprise an ejector.

3. Apparatus as claimed in claim **2** in which the ejector is an expansion nozzle for producing an exhaust at superatmospheric pressure.

4. Apparatus as claimed in claim **1** comprising a heat exchanger comprising two paths in one of which gas from the supply travels to the expansion nozzle being progressively cooled, while in the other gas expanded through the nozzle returns to the gas outlet, cooling the incoming gas.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,645,113 Dated February 29, 1972

Inventor(s) KENNETH E. NICHOLDS

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

In the heading of the patent insert:

"Claims priority application Great Britain February 17, 1969, 8468/69."

Signed and sealed this 24th day of October 1972.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents

FORM PO-1050 (10-69)

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* U.S. GOVERNMENT PRINTING OFFICE : 1969 O—366-334.