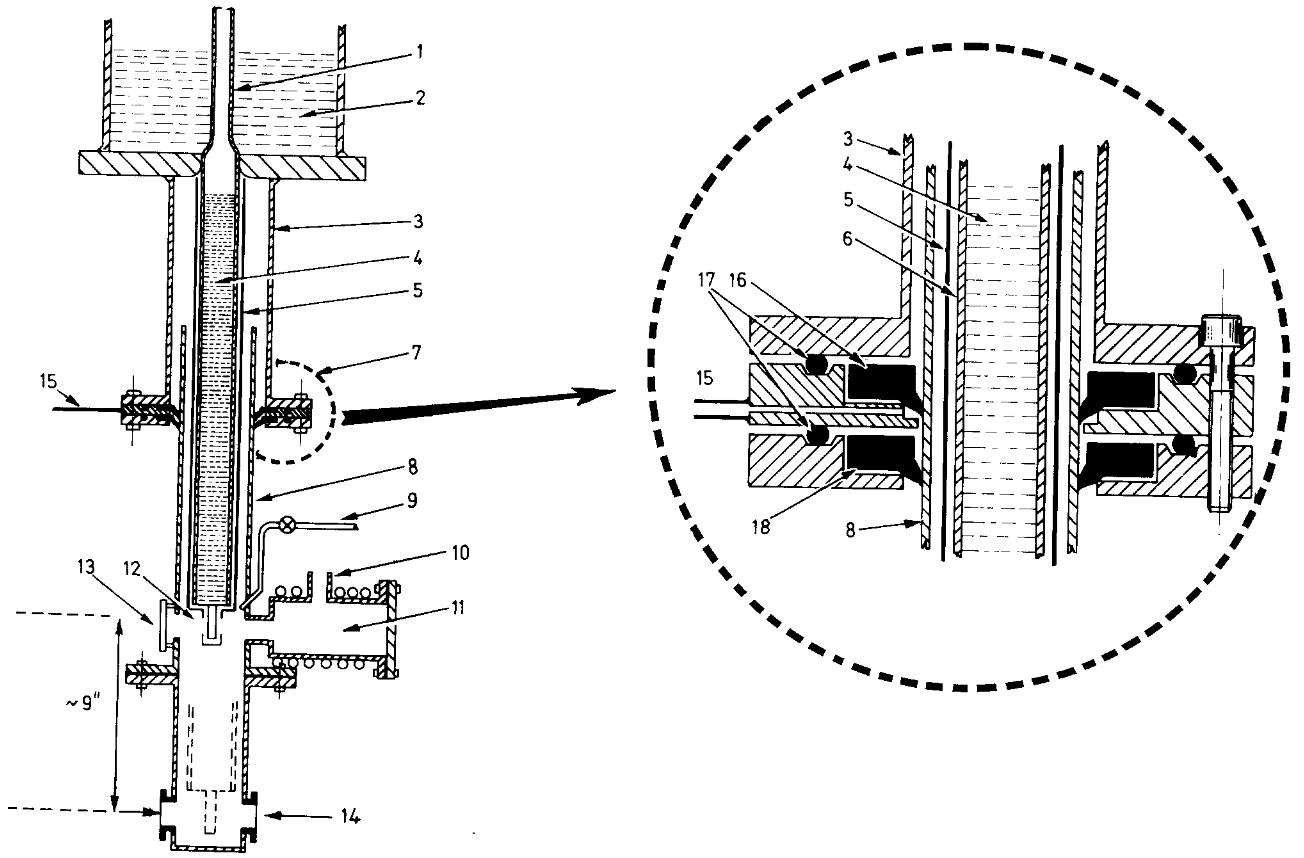

1 hydrogen filling tube
2 liquid nitrogen
3 outer jacket, A
4 liquid hydrogen
5 radiation shield
6 stainless steel tube
7 vacuum seal arrangement
8 outer jacket, B
9 spray-on tube
10 pumping line
11 furnace
12 sample window
13 window
14 optical window
15 pumping line
16 hat packing, C_2
17 O-ring
18 hat packing, C_1

Figure 1. Scheme of apparatus

observed during the operations described above. However, as a precaution it is recommended that the space between C_1 and C_2 be evacuated in case leakage develops in C_1 during an experiment. The method of raising and lowering is achieved by use of a rack and pinion mechanism.

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A transfer tube for gas cryostats

W. HUPPMANN and F. STANGLER

A LOW and very continuous flow (about 0·5 to 5 l He/h) of refrigerant is essential for the operation of gas cryostats. These cryostats are commonly mounted directly on the storage vessel to avoid losses of refrigerant during transfer.[1–3] Sometimes however it becomes impossible to set up the cryostat on the container and then a transfer tube is necessary, the losses of which must be extremely low (say 0·1 l He/h), otherwise the operation of the gas cryostat will be expensive or impossible for certain temperatures.

The main losses of vacuum jacketed transfer tubes arise from radiation. The amount of heat influx by radiation is determined essentially by both the surface area and surface texture of the helium line, and by the temperature of the surrounding tube. To get a transfer tube with extremely low losses our construction shows the following features.

1. For the transfer line a polished capillary tube of small diameter is used, the dimensions of which are given by the required helium flow.

2. For further reduction of radiation, a radiation shield is inserted between transport line and outer wall.

The scheme of construction is seen in Figure 1. The liquid helium is flowing through the capillary tube, A, (stainless steel 0·8 × 0·15 mm, i d 0·5 mm, maximum

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flow ~ 1 l He/h at a pressure difference of 1 atm). In those sections where the outer wall, B, has a temperature T > 80 K (sections a b, b c), radiation shield tubes, C, (copper) are mounted around the inner tube, A. These radiation shield tubes are in thermal connexion with a liquid nitrogen reservoir of two litres capacity (24 hours of operation), and have therefore a temperature near 80 K. By using liquid nitrogen as coolant for the shield C, the whole cooling capacity of the liquid helium becomes effective in the cryostat. The efficiency is therefore greater than in transfer tubes, in which the radiation shield is cooled by a backstream of helium from the cryostat.[2] Moreover our construction has the advantage that the capillary tube, A, is shielded against the warm zones of the storage vessel. At the point a the radiation shield, C, is in contact with the outer wall, B, and hence the losses of liquid helium by heat influx into the container are reduced. The outer wall, B, is a thin walled German silver tube; within the helium container (space d) it is a thick walled copper tube. This latter tube has a uniform temperature (4–5 K) and therefore the radiation to the tube, A, is independent of the level of liquid helium in the container. For regulation of helium flow different capsules with special orifices can be fixed at d. At junction D, the transfer tube is evacuated (10^{-6} torr).

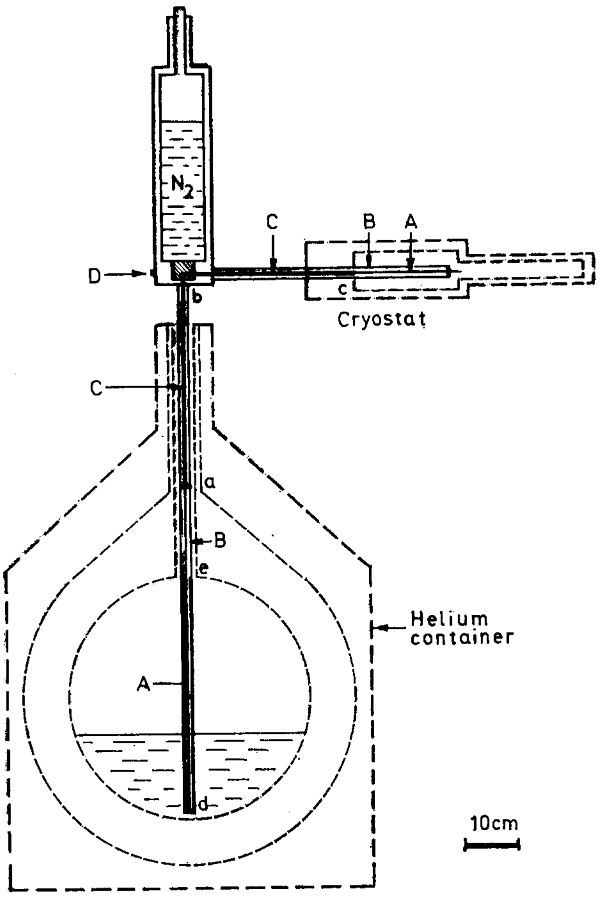

Figure 1. Schema of the transfer tube

At a continuous flow of about 0·4–0·8 l He/h the losses of the transfer tube are smaller than 0·1 l He/h. Experiments, in which the described transfer tube was used in connexion with a gas cryostat, will be published elsewhere.[4]

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LETTER TO THE EDITORS

Comments on 'The cause of explosions in reactor cryostats for liquid nitrogen'

I was interested in the note (Cryogenics **9** (April 1969) p. 131) by Messrs C. W. Chen and R. G. Struss, on the cause of explosions in reactor cryostats for liquid nitrogen.

They report that irradiated HPOF containing NO or NO_2 gave no explosion after the addition of AN, while irradiated liquid nitrogen containing oxygen did. While O_3 formation may be the cause, the formation of a reactive nitrogen oxide is, I think, more likely to be responsible.

In industrial low temperature units for the separation of coke oven gas or convert gas, heavy explosions occurred when these gases contained traces of NO and oxygen.[1] The oxidation of NO has a negative temperature coefficient and its mechanism seems to be still not fully explained. It seems that an intermediate nitrogen oxide is formed which is stable only at low temperatures. In the presence of reactive organic compounds, for example, cyclopentadiene, highly explosive compounds are formed at low temperatures. The small oxygen contents of these gases make O_3 formation unlikely.

Irradiation of liquid nitrogen containing even only traces of oxygen may also result in the formation of such reactive nitrogen oxides. These, and for this matter O_3, will, at the low concentrations involved, hardly explode on their own account but the simultaneous presence of 'some detrimental organic material' may be necessary and even traces of this should be sufficient.

British Oxygen Co. Ltd.,
Great West Road,
Brentford, Middx., UK.

P. M. Schuftan
14 March 1969

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