tio decreased nonexponentially and more slowly with a thermal time constant of about 1.5 s. The rapid thermal response is attributed to the low heat resistance between the thermistor element and the metal housing.

The authors wish to thank Dr. K. Iga for helpful discussions.

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Vacuum insulated siphon for a continuously filled cold plate

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(Received 28 November 1983; accepted for publication 12 March 1984)

The construction of a vacuum insulated siphon for filling the cold plate of a dilution refrigeration cryostat is described. The siphon allows the pickup of liquid helium from the main liquid-helium bath at a level 30 cm below the main flange of the dilution refrigeration insert.

The use of continuously filling pumped ^{4}He chambers (cold plates) for the first stage of cooling below 4.2 K is now standard practice in dilution refrigerator cryostats.[1] We detail in this note a modification to a standard SHE model 420[2] dilution refrigerator insert which allows us to operate the cold plate in the continuously filling mode when the ^{4}He bath level falls to ~30 cm below the 4.2-K flange.

It has been a common experience that the cold plate warms above 2.5 K on these refrigerators when the bath level drops below the main vacuum flange. Depending on the circulation rate of the ^{3}He/^{4}He dilution refrigerator, the back pressure at the mechanical pump outlet rises quite dramatically due to the higher condensation pressure of the ^{3}He and can lead to an exclusion of the phase boundary from the mixing chamber. Consequently, the bath level has to be topped off much more frequently with attendant disturbances to experiments in progress. The loss of cooling power at the cold plate was seen regardless of whether a siphon tube of copper or Teflon was attached to the inlet line, indicating that vaporization of the incoming helium stream was probably occuring at the passage through the vacuum flange.

We find that a simple vacuum insulated siphon can be used to insulate the helium fill line. The siphon (Fig. 1) was constructed of thin wall stainless-steel tubing with a 3.175-mm o.d. × 0.254-mm wall thickness outer tube (I), and 1.65-mm o.d. × 0.254-mm wall thickness inner tube (J) arranged concentrically. Brass sleeves (E) and (F) were silver soldered to the ends of the outer and inner tubes, respectively. Thermal isolation of the inner tube was ensured by installing 20, 2.38-mm-diam Teflon balls[3] (D) with holes drilled through to fit the inner tube closely. The tubes were then fitted together, filled with water, cooled with liquid nitrogen to freeze the water, and bent around a 5-cm-diam mandrel

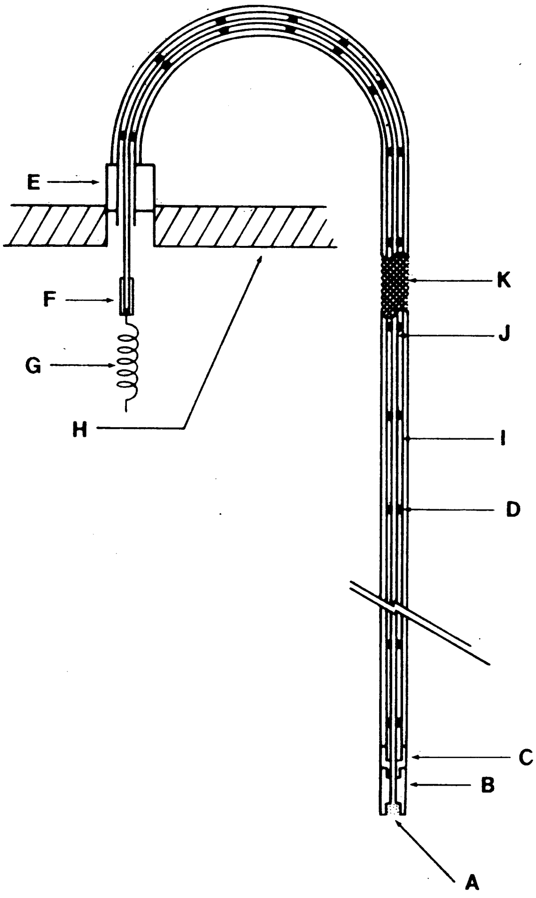

FIG. 1. Detail of the siphon construction. A—copper sinter; B—holder for sinter; C—end cap; D—Teflon ball spacer; E—feedthrough; F—termination; G—flow impedance; H—4.2 K flange; I—outer tube; J—inner tube; K—braid for heat sinking.

0034-6748/84/071165-02$01.30

through 180°, thus permitting a smooth bend without kinking the stainless tubing. The water was removed and a brass end cap (C) soldered to the two tubes to terminate the end immersed in the helium bath. A filter consisting of a holder (B) and a sintered copper sponge (A) were attached to the end of the inner tube to prevent solid contaminates from entering the siphon. The siphon was then installed on the cryostat by soft soldering the sleeve (E) to the 4.2-K vacuum flange (H), and the existing flow impedance (G) was soldered into the termination (F). Finally, a length of copper braid (K) was slipped over the whole assembly to maintain the outer tube at 4.2 K. The space between the inner and outer tubes is open to the main vacuum can, and thus does not have to be separately evacuated.

With the siphon installed, care must be taken to adequately heat sink the ^{3}He return line for the dilution refrigerator, as well as the SQUIDs (if any) to maintain them at the bath temperature, as temperatures on the exterior of the main flange can rise appreciably above 4.2 K when they are exposed to ^{4}He gas.

A side effect noted in operation is the increased flow of liquid helium to the cold plate. Accordingly, the filling impedance was increased to 10^{11} cm^{-3} to reduce the throughput to $\sim$65 liquid cubic centimeters of ^{4}He/h, adequate to maintain a temperature of $\sim$1.5 K for ^{3}He circulation rates of 250 μmole/s, and for the initial condensation of the mixture of the dilution refrigerator.

In operation, no significant temperature variations with bath level are detected on a 470-Ω Speer resistor[4] mounted on the cold plate provided the cold plate remains full of liquid. However, we have found it necessary to heat the cold plate in order to maintain it empty so as to minimize vibrations traced to the evaporation of the liquid in the pumping line. These vibrations are found to interfere with the operation of our torsional oscillator experiments mounted below the mixing chamber.

We, therefore, maintain the cold plate at a temperature of 1.55 K by applying the appropriate electrical heater power. Under these circumstances as the bath level drops below the flange, the temperature of the cold plate is seen to rise to $\sim$1.6 K when the bath level is $\sim$15 cm below the flange.

The construction as presented in this note is simple enough to be completed in a few hours, and allows greater flexibility in the operation of the dilution refrigerator cryostat.

This work has been supported by the National Science Foundation through Grant No. DMR-8218279. One of us (JMP) is the recipient of an Alfred P. Sloan Foundation Research Fellowship.

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Amplification of picosecond pulses using a copper vapor laser[a)]

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(Received 15 February 1984; accepted for publication 12 March 1984)

This paper describes a novel laser system which can give picosecond pulses with greater than 1 MW of power and at a repetition rate of 5 kHz.

In this paper we describe a laser system capable of generating picosecond pulses with > 1-MW peak power at a 5-kHz repetition rate. Other laser systems for picosecond spectroscopy have generally fallen into one of two groups: one with large pulse energies at low repetition rates (> 1 MW at < 100 Hz) and the other using very small pulses at high repetition rates (< 3 kW at > 50 MHz). The large pulse experiments can create a transient population large enough to change the sample absorbance considerably, but often unwanted nonlinear effects accompany the extremely high intensities created by squeezing a large number of photons into a pulse of a few picoseconds duration. Lower intensities necessitate sensitive probing of the transient population with careful signal averaging. This need has led several research groups to develop the high-repetition rate systems using lock-in amplifiers and/or extremely high-frequency modulation with AM radio detection.[1–6] The low powers of the high-repetition rate systems severely limits the use of nonlinear optical techniques needed to obtain picosecond pulses with UV and VUV wavelengths. Tunable pulses with peak powers of greater than 1 MW have been available for several years using Nd:YAG laser pumped amplifiers at 10 Hz repetition[7–10] and more recently at 100 Hz using excimer laser pumped amplifiers.[11] In the system to be described here the