

IV. LOW-TEMPERATURE PHYSICS

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A. HELIUM LIQUEFIERS

On several occasions the liquefiers have been operated with the lower engine alone - letting the refrigeration from the liquid nitrogen's pre-cooling on the radiation shield be substituted for the upper engine. When this was done it was observed that the cooling-down time increased about three-quarters of an hour. Also the rate of liquefaction was lower. In reassembling the No. 1 liquefier the large or top engine will be omitted, and the inlet gas will be led through an eighteen-foot length of copper tubing which is coiled and which will be immersed in a bath of liquid nitrogen as shown in Fig. IV-1.

Such a scheme should truly substitute for the large engine and give the advantage of being able to maintain a pressure of 200 lbs/sq. in. on the lower engine and the Joule-Thomson valve. This scheme is applicable only where there is an ample supply of liquid nitrogen available at all times.

Figure IV-2 illustrates a vessel which has been constructed to hold liquid nitrogen and accommodate the intermediate supply dewar for liquid helium.

R. P. Cavileer, J. W. Toomey

The construction of the large helium liquefier and cyclic demagnetization apparatus is nearing completion. The liquefier has been operated for several hours and the various difficulties which have arisen are gradually being eliminated.

This construction has been supported separately by the Office of Naval Research, Contract No. N5ori-07823 Amend. 3, T.O. XXIII.

S. C. Collins

B. SECOND SOUND VELOCITY

The study of pressure dependence of second sound velocity in liquid helium II is temporarily delayed. This project will be taken over as a senior thesis in January. Several new projects are also planned as senior

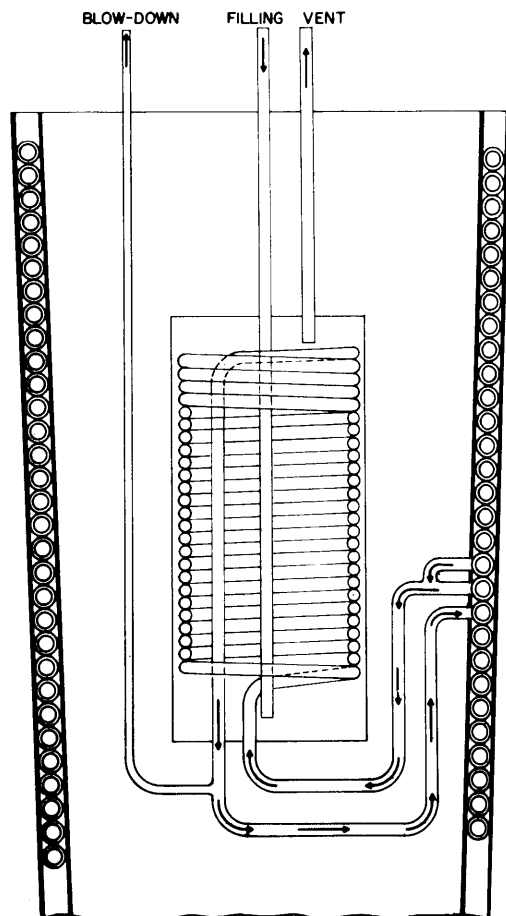


Fig. IV-1

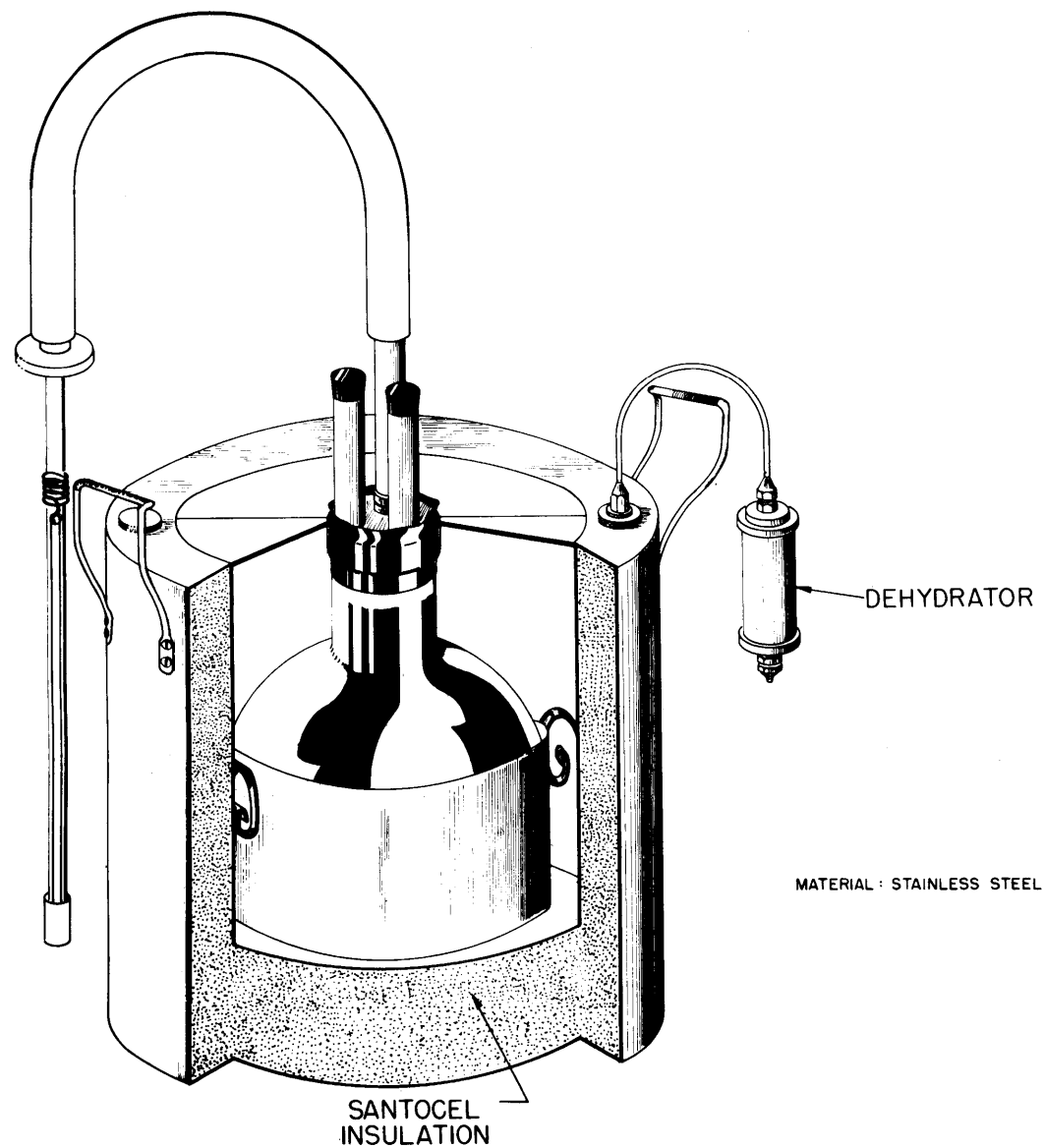


Fig. IV-2

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theses during the Spring Term, and will be reported in a later issue.

M. A. Herlin

C. X-RAY STUDY OF SUPERCONDUCTORS

Recent check experiments indicate that, during exposure, the lead sample was not always below the superconducting transition temperature. The apparatus is being redesigned to insure that the sample is at the temperature of the helium bath.

L. A. Siegel

D. INVESTIGATION OF DIPOLE INTERACTION THEORY IN CRYSTALS

Using a torsion balance system, preliminary measurements in the neighborhood of 1.1°K have been made of the magnetization curve of cesium titanium alum. These measurements indicate that the design of the experiment is satisfactory. Two runs have been made with the use of adiabatic demagnetization to reach the desired extremely low temperature of around 0.01°K . These were unsuccessful for several reasons, and measures are now being taken to eliminate the troubles. First, we believe that there is a radiative heat leak to the sample which will be overcome by silvering the sample capsule. Second, the transfer gas pressure will be increased to make the transfer of the heat of magnetization more efficient.

M. B. Prince

E. COOLING LIQUID HELIUM BY ADIABATIC DEMAGNETIZATION

The problem of the experimental behavior of liquid helium in the temperature range $0.1 - 0.9^{\circ}\text{K}$ is of considerable importance in the attempts to understand theoretically the mechanism behind its peculiar properties. Experiments have been begun with the objective of developing apparatus suitable for cooling the helium to these temperatures in sufficient quantities and for a sufficiently long time to allow the convenient performance of experiments on it.

The usual method of cooling liquid helium is by evaporation, which can, with practicable pumping speeds, get down to about 0.8 or 0.9°K . Below this, one must resort to the adiabatic demagnetization of a paramagnetic salt. Since the specific heats of most substances drop off as the cube of the temperature or faster in this region, the effect of heat leaks becomes very serious, and one must look for something which will serve as a "heat reservoir" to reduce the warming rate. Fortunately, there is a peak in the specific heat of a paramagnetic salt at a temperature corresponding to the Curie temperature (where the atomic magnetic moments freeze into a macroscopic alignment), and thus the same salt used for cooling can be used as the

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temperature reservoir. The immediate problem is to find a salt whose specific heat peak falls near the temperature desired, and is high enough so that it will serve as a reasonably good temperature reservoir. A partially dehydrated chromic sulfate has shown some promise in preliminary tests, but the choice of salt is as yet quite uncertain and must be the subject of considerable experimentation.

V. Mayper, Jr.

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