

IV. LOW-TEMPERATURE PHYSICS

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A. HELIUM LIQUEFIERS

The liquefiers have been moved to the new location of the Low-Temperature Laboratory where an adequate surrounding area allows for much easier operation than did the cramped conditions which existed in the old laboratory. The liquefiers and their compressors are on a concrete floor which eliminates much of the vibration experienced in the former location.

There are now two independent liquefying setups. The plumbing is so arranged (as shown in Figure IV-1) that any of the integral parts may be shifted from one setup to the other by means of the valving. If trouble should develop in a manifold, clean-up pot, gas holder or compressor during a run, the other manifold, clean-up pot, gas holder or compressor can be substituted within a few minutes so that the run may continue. Obviously, if both liquefiers were operating simultaneously, or if trouble should develop in a liquefier itself, such a substitution could not be accomplished.

Moving the liquefiers on to a concrete floor presented the problem of placing tall dewars under the existing liquid draw-off tubes. In the former location a hole was cut in the wood floor and the dewars were lowered and raised through this hole. To avoid cutting a hole in the concrete floor, the end of the draw-off tube was raised. Now, at this raised height, it is much easier to hold the dewars into which the liquid helium is transferred.

The number two liquefier has continued to be adequate for supplying the demands for liquid helium during this transition period.

It is interesting to note that this liquefier has now been operating since August of last year with uninterrupted service. In this year of trouble-free running it has produced liquid helium ninety-four times. It must be pointed out that both the careful operation of the liquefier, and the engineering and manufacture by Arthur D. Little, Inc. have combined to make this record possible.

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B. SECOND SOUND VELOCITY

Apparatus has been designed and constructed for measuring the variation of the velocity of second sound with the change in both temperature and

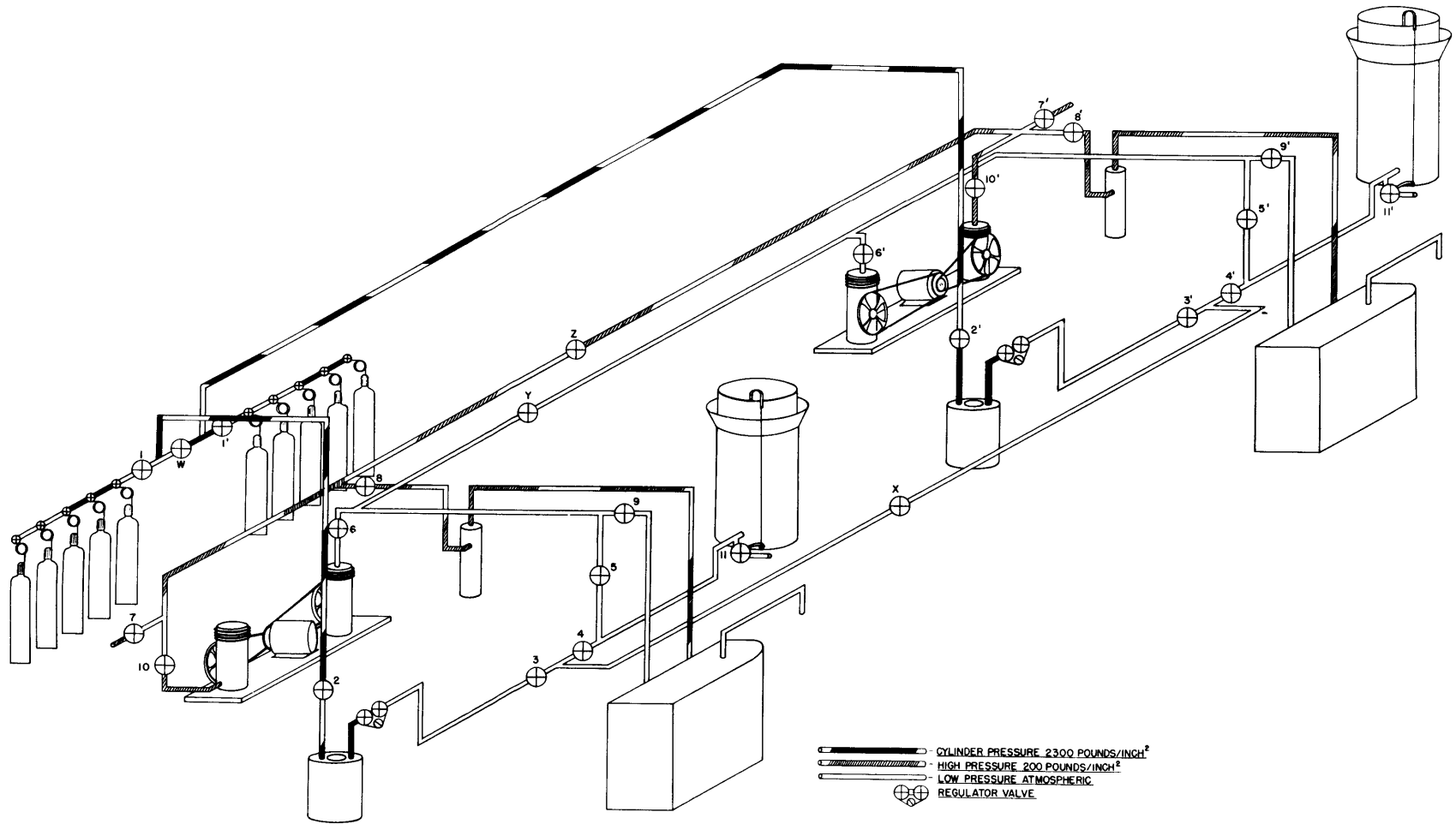


Fig. IV-1 Piping diagram for cryostats.

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pressure of liquid helium. A pulse method will be utilized as in previous work of this nature in the laboratory (1). Commercial helium tanks provide the pressure to a second-sound tube system immersed in a liquid helium bath. The previous timing arrangement has been considerably refined to give greater accuracy in case it is possible to obtain more exact square pulse signals. This system can measure velocities greater than 10 meters per second in order to cover the lower temperature range of the phenomenon. It is hoped that data can be obtained over part of the range measured by Peshkov (2) and can be extended through the rise in velocity.

R. D. Maurer

C. X-RAY STUDY OF SUPERCONDUCTORS

Two diffraction patterns have been taken of a lead wire sample maintained below the superconducting transition temperature. An exposure time of one hour gave sufficiently intense lines in the back reflection region. Since the sample temperature is dependent upon the level of liquid helium in the apparatus, it was necessary to add additional helium during the exposure by means of an auxiliary transfer dewar.

Due to the very limited amount of sample motion and to the properties of the lead itself, the diffraction lines in the first exposure were very speckled. By using a very broad sample, the lines were smoothed without any appreciable broadening in the back reflection zone.

Study of the exposures showed no change in the appearance of the 620 doublet below the transition temperature. The resolving power of the apparatus would allow a change in cell edge of about one part in one thousand to be detected, and it seems, then, that if any lattice change does take place, its magnitude is considerably smaller than the cell deformations in barium titanate.

It is planned, however, to continue the experiments using a slightly different x-ray wave length. This would allow study of a line other than 620 which might possibly be insensitive to a structural change of the type in question.

L. A. Siegel

D. INVESTIGATION OF DIPOLE INTERACTION THEORY IN CRYSTALS

Equipment has been built for an experiment to measure the magnetic moment of $\text{CsTi}(\text{SO}_4)_2 \cdot 0.12\text{H}_2\text{O}$ versus magnetic field near the temperature of absolute zero (0.01°K). This experiment will differentiate among three theories for dipole interaction in crystals. The theory of Sauer and Temperley (3) is based on nearest neighbor interaction and predicts a curve that is

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equal to zero until a critical field H_0 is reached where all the dipoles become aligned and the magnetization becomes saturated. A theory of Van Vleck (4) expands the partition sum of the crystal in inverse powers of the temperature, and the calculation of the interaction fails at low temperature where the interaction becomes appreciable. This theory predicts a linear relation between M and H until H_0 where the curve gradually levels off to a saturated magnetization. The theory of Luttinger and Tisza (5) reduces the problem of the dipole interaction in a crystal to the diagonalization of the quadratic form in the components of the dipole moments, of the dipole interaction energy and the reduction of any arbitrary dipole array into these diagonalized basic arrays. This theory predicts a linear relation from the origin until H_0 where the curve breaks abruptly and stays flat to infinite field. From the theories, H_0 should be somewhere between 50 and 150 oersteds.

The experiment should be completed within the next two months.

M. B. Prince

References

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