III. Experimental Results

A. The Hall Voltage and n^* vs. Pressure

The Hall effect data were taken by measuring the Hall voltage at fixed magnetic field (6310 gauss) and sample current (3 amperes) at approximately twelve points in the pressure range from 1 to 15,000 kg/cm^2. Only one value of the magnetic field was used since our earlier ac measurements had verified the anticipated linear relation between V_H and field. Figure 3-1 shows a typical voltage vs. field curve, obtained on sodium by the ac method. The thickness of the samples ranged from .007 inch to .050 inch. No absolute values of the Hall constants will be plotted on the pressure curves because they would depend on a relatively inaccurate thickness measurement and because our prime interest was in relative changes of the Hall constant. The temperature was slightly below room temperature, because the bomb was in contact with the cooled magnet yoke.

Although the curves we present are for dc measurements, in some cases there are also data available from the earlier ac measurements. The ac data were obtained by measuring V_H vs. field at a fixed pressure and plotting the slope of this curve vs. pressure. These data are discussed where applicable. The scatter on the ac data is generally greater than in the dc case. Furthermore, there is always a question as to whether the ac data is affected by spurious voltages induced by sample vibrations; such vibrations would be damped by the increased viscosity of pentane under pressure and could give a pressure dependent voltage. Much of the ac data were obtained on samples that had not been cleaned by melting and outgassing under vacuum and contained inclusions of oxide or gas. The dc data are based on cleaned samples, as free of oxide and large inhomogeneities as we could produce.

The lithium data are from the two best runs (those with the least scatter) out of four. The curve for one of these runs is shown in Fig. 3-2. The two runs were on different samples and gave Hall voltage decreases of 1.4 percent and 1.5 percent in 10,000 kg/cm^2. The slopes were obtained using a least squares fit.

If all four dc runs are considered, the average of the least square slopes gives a decrease of 1.9 percent in 10,000 kg/cm^2 with a root mean square deviation of .4 percent. The only ac data are based on measurements on unclean material and on curves with more scatter. Seven runs on five different samples give an average decrease of 3.5 percent in 10,000 kg/cm^2 with a root mean square deviation of .8 percent. The slopes of the individual curves were obtained from a straight line fitted by eye, rather than by least squares as in the case of the final dc data.

The sodium data are based on four runs on three different samples ranging in thickness from .007 inch to .026 inch. The average of the least square slopes is a decrease of 3.4 percent in 10,000 kg/cm^2. The root mean square of the deviations is .4 percent. A typical curve is shown in Fig. 3-3.

The ac data for cleaned sodium, based on three runs on two different samples, gives an average decrease of 3.3 percent in 10,000 kg/cm^2 with an rms deviation of .5 percent. The data on uncleaned sodium, based on three runs, gives a 4.7 percent decrease with an rms deviation of .6 percent. The slopes in the ac case again come from visual fits.

The data for two potassium samples are shown in Fig. 3-4. Despite many runs the curves for different samples did not agree. The curves are chosen to indicate the difference between data obtained from different samples and the approximate range of the value of V_H at 15,000 kg/cm^2. A total of twelve runs on seven samples was performed. Since some of the curves were not linear, the percentage decrease in V_H at 10,000 kg/cm^2 was used as a rather arbitrary way of characterizing them. The average decrease is 6.2 percent, with an rms deviation of 1.6 percent.

Twelve ac runs on seven samples of cleaned potassium yielded a decrease of 7.9 percent in 10,000 kg/cm^2 with an rms deviation of 2.9 percent. The lack of reproducibility between different samples makes it impossible to compare meaningfully the ac and dc data, other than to say they are not in gross disagreement.

The ac measurements at one point seemed to indicate a correlation between the size of the pressure effect and sample thickness. Accumulation of more data did not support this correlation. In Fig. 3-5 we show the percentage decrease in V_H in 10,000 kg/cm^2 vs. sample thickness for the twelve dc runs on potassium and for the four dc runs on sodium.