magnetic field. This induces spurious voltages in the system, since the sample with its associated Hall leads forms a closed loop vibrating in a magnetic field. These vibrations may be eliminated by clamping the sample rigidly. In our work we used originally a modification of Lavine's equipment. Considerable effort was spent in developing ways of mounting the sample that would eliminate vibrations. Unfortunately, clamping the sample to prevent vibrations conflicts with the requirement that a pressure sample be mounted in such a way as to leave it free to expand and contract. We were finally able to mount our specimens so as to prevent audible sample vibrations. When we encountered the problem of irreproducibility on samples of rubidium we decided to look for spurious ac voltages by doing a dc check measurement. The dc measurement on rubidium still gave results that varied from sample to sample. This difficulty was overcome when we prepared the sample so as to avoid oxidation, in the manner described below. The dc measurements generally gave less scatter on Hall voltage vs. pressure curves than the ac ones, although at least part of the difference may be due to the better sample preparation techniques used later in the experiment. However, the dc measurement also gave resistance as a function of pressure, while the ac one did not; in addition it was faster and more convenient to use and eliminated the possibility of spurious voltages due to vibrations. We finally adopted the dc measuring system to be described. The agreement between the ac and dc results will be discussed in Sec. III, but was fairly good.

3. Description of the dc measuring system.

Figure 2-1 shows a block diagram of the entire electrical system. The sample current of 3 amperes is provided by two six volt storage cells in parallel. Sample current was measured by a Weston model 931 ammeter. This meter could easily be read to 1/3 percent at full scale. The voltage produced at the Hall probes was measured by the Rubicon potentiometer and galvanometer amplifier described below.

The Rubicon No. 2767 microvolt potentiometer [3] is an instrument in which the spurious thermal electromotive forces originating within the instrument have been reduced to less than .01 microvolt. It incorporates a reversing key which instantaneously changes the polarity of the galvanometer connections. The potentiometer is adjusted until reversing the galvanometer connections produces no deflection at the detector. In this way the presence of constant thermal voltages in the detector circuit does not affect the potentiometer balance. Furthermore, the detector will see twice the out-of-balance voltage while the potentiometer is being balanced and the detector sensitivity is effectively doubled.

Use of the Rubicon potentiometer required that we have a detector which would resolve a voltage of .01 microvolt. To achieve this sensitivity we constructed the galvanometer amplifier pictured in Fig. 2-2. Light from the source, S, passes through the aperture, A, in the partition separating the light source from the rest of the galvanometer. It is focused onto the mirror of the primary galvanometer, G, by a double convex lens, L, reflected onto the plane mirror M, and forms a circular spot on the two matched "EEL" selenium photocells†, P_1 and P_2. The photocells are mounted on a modified microscope stage††, T, and can be moved in the direction of the arrows by turning the shaft R. The photocells are connected so that their voltages oppose and the output of the pair is fed to the secondary galvanometer. The shaft R is used to move the photocells until there is no deflection on the secondary galvanometer when there is no input to the system. A signal at the primary galvanometer G changes the light balance on the photocells and produces a deflection of the secondary galvanometer.

The galvanometer amplifier was built on a piece of 2 inch steel channel 24 inches long and was enclosed in aluminum. The light source, S, and its associated transformer, X, were separated from the rest of the system by an aluminum partition which prevented light from the source from reaching the photocells and also prevented convection currents from the light bulb from moving the galvanometer mirror. The primary galvanometer was supported

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† Electronic Equipment Limited, 101 Leadenhall St., London E.C. 3, England.

†† Micronta mechanical stage, available from Radio Shack, Inc. Boston, Mass.