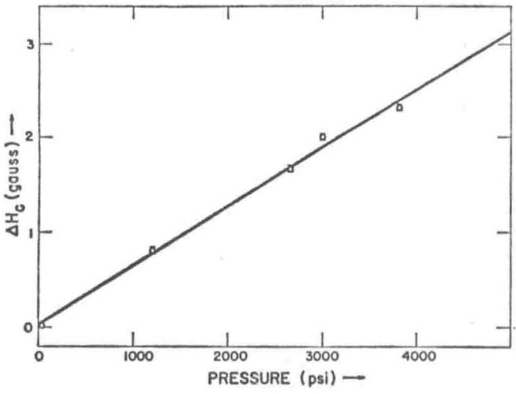

FIG. 3. Shift of critical field with pressure. Measurements at $T=6.86°$K, $H_c=72$ gauss when $P=0$.

the specimen despite the use of solid helium as the pressure fluid.

C. Specimens and Details of the Magnetic Transitions

The specimens used in this work were in the form of long thin cylinders. The samples used in the measurements near T_c were 5.5 cm long and 0.24 cm in diameter. The sample used for the low-temperature measurements was 5.1 cm long by 0.32 cm in diameter. All the samples were vacuum cast in graphite-coated glass tubes which were subsequently etched away. The cooling from the melt was done in a gradient furnace at a rate of about 20°C per hour. The Pb from which the samples were grown was nominally 99.999% pure, obtained from the American Smelting and Refining Company. Etching showed a grain size of about 1 cm.

The magnetic transitions in the measurements below 4.2°K showed the same type of hysteresis which has been discussed in some detail in recent articles from this laboratory. The hysteresis observed here is somewhat smaller in magnitude than in the best previous specimens[11] but is identical in all other respects. The H_c values at low temperatures were corrected for this effect in the manner described in previous articles by taking the average of the apparent H_c values observed in the S-N and N-S transitions.[11,12]

III. EXPERIMENTAL RESULTS

A. Measurements Near the Critical Temperature

Data obtained in a series of isothermal measurements at $T=6.86°$K are shown in Fig. 3. The pressure shift, ΔH_c, is defined by the equation

$$\Delta H_c(P,T)=H_c(0,T)-H_c(P,T), \tag{2}$$

and, as shown in Fig. 3, ΔH_c varies linearly with the applied pressure. When defined according to (2), ΔH_c is always positive since the application of pressure always reduced H_c under conditions of constant temperature. The equation of the line in Fig. 3, as determined by a least-squares analysis, is

$$\Delta H_c(P)=(0.04\pm0.03)+(6.18\pm0.10)\times10^{-4}P, \tag{3}$$

where ΔH_c is in gauss and P is in psi. This gives

$$(\partial H_c/\partial P)_{T=6.86°\mathrm{K}}=-(6.18\pm0.10)\times10^{-4}\ \text{gauss/psi}.$$

Extrapolation of $(\partial H_c/\partial P)_T$ to the value characteristic of T_c requires knowledge of the pressure and temperature dependence of H_c which is obtained experimentally in the following section. Discussion of this extrapolation and the calculation of dT_c/dP will be deferred until after the presentation of the results of the measurements at low temperatures.

B. Measurements Below 4.2°K

1. *Effect of Pressure on* H_0

The data in the liquid helium range were taken in a series of isobaric measurements. Since the pressure shifts are small, a convenient way to display the data is to subtract off the known critical field of lead at zero pressure. The difference, ΔH_c, is defined by Eq. (2) where $H_c(O,T)$ is the function reported by Decker *et al.*[12] The ΔH_c values are plotted in Fig. 4(a) and 4(b) from which it may be seen that, within the scatter, the points vary linearly with T^2. The solid lines shown on the figure were determined by a least squares analysis of the values obtained for each pressure.

The intercept at $T^2=0$ in Fig. 4 defines ΔH_0, the shift in the critical field at the absolute zero. The variation of H_0 with pressure is shown in Fig. 5. The equation of the straight line fitting the data is

$$\Delta H_0=(0.14\pm0.09)+(5.36\pm0.14)\times10^{-4}P\ \text{gauss}, \tag{4}$$

yielding

$$\begin{aligned} dH_0/dP&=-(5.36\pm0.14)\times10^{-4}\ \text{gauss/psi}\\ &=-(7.90\pm0.21)\times10^{-3}\ \text{gauss/atm}. \end{aligned}$$

2. *Effect of Pressure on the Electronic Specific Heat*

As first shown by Daunt and Mendelssohn,[13] it is possible to deduce γ, the temperature coefficient of the normal electronic specific heat, from knowledge of the limiting temperature variation of H_c as T approaches 0°K. The relevant equation is

$$\lim_{T\to0°\mathrm{K}}\frac{\Delta S}{v}=\gamma^*T=\left(\frac{\gamma}{v}\right)T=-\left(\frac{1}{4\pi}\right)\lim_{T\to0}H_c\left(\frac{\partial H_c}{\partial T}\right)_P, \tag{5}$$

where v is the molar volume of the superconductor.

At constant pressure the critical field of Pb can be accurately expressed as a polynomial in powers of T^2

[12] D. L. Decker, D. E. Mapother, and R. W. Shaw, Phys. Rev. **112**, 1888 (1958).

[13] J. G. Daunt and K. Mendelssohn, Proc. Roy. Soc. (London) **A160**, 127 (1937); also J. G. Daunt, A. Horseman, and K. Mendelssohn, Phil. Mag. **27**, 754 (1939).