most easily recognized by noting that the right-hand side of (3) is the ratio of the thermal expansion at pressure P to that at atmospheric pressure, thus a quantity slightly less than unity. It is possible to estimate the initial decrease of $r_p(T,T_0)$ with pressure by differentiating Eq. (3) with respect to P and evaluating at $P=0$:

$$dr_p(T,T_0)/dP|_{P=0}=r_0(T,T_0)[2\gamma-\tfrac{4}{3}][K_{T_0}-K_T], \quad (4)$$

where K_T is the isothermal compressibility at temperature T.

2. Melting

The present theories of melting are only first-order approximations[13] which yield a form known as Simon's equation[14] for normal materials, i.e., those with a melting curve monotonically increasing with pressure. Simon's equation,

$$P_m/A+1=(T_m/T_{m,0})^c, \quad (5)$$

is an empirical relation containing two parameters, A and c. T_m is the melting temperature at pressure P_m and $T_{m,0}$ is the melting temperature at atmospheric pressure. Gilvarry[13] has derived an expression for "c using some simple assumptions about melting and his results are carried somewhat further by Babb.[15] In the latter's article, c is given by the formula

$$c=(f+\mu)/(f-1). \quad (6)$$

If f is assumed to be constant along the melting curve Babb shows that $f=2\gamma_{m,0}+\tfrac{1}{3}$. The quantity μ is to be obtained from the volume dependence of the Grüneisen constant using a relation proposed by Gilvarry:

$$(\gamma-\tfrac{1}{3})/(\gamma_0-\tfrac{1}{3})=(V/V_0)^\mu. \quad (7)$$

In order to determine μ and $\gamma_{m,0}$ one must know how γ varies with volume. Using the Dugdale-MacDonald formula[16] and shock compression data[17] the value of μ is estimated to be 7.99 for gold. Assuming that γ is a function of volume only and employing the expansion of gold to the melting point[18] one obtains $\gamma_{m,0}=4.43$. These values substituted into Eq. (6) predict $c=2.10$.

The parameter A can be written in terms of c by using the Clapeyron equation. Differentiating Eq. (5) with respect to T_m and evaluating the result at $T_m=T_{m,0}$ it follows that

$$dP_m/dT_m|_{T_{m,0}}\equiv P_0'=Ac/T_{m,0}=(L/T_{m,0}\Delta V), \quad (8)$$

where L is the latent heat and ΔV is the volume change

at fusion. Therefore $A=L/c\Delta V$ and Simon's equation becomes

$$P_m=(L/c\Delta V)[(T_m/T_{m,0})^c-1]. \quad (9)$$

Experimental results for $T_{m,0}$, L,[19] and ΔV,[20,21] at atmospheric pressure, are used in Eq. (9) thus leaving only one arbitrary parameter c to be empirically determined.

II. METHOD OF MEASUREMENT

The measurements were accomplished using a 600-ton tetrahedral anvil press[22] with a sample container of pyrophyllite in the form of a regular tetrahedron $1\tfrac{1}{4}$ in. on an edge. The gold was supplied by Nesor Alloy Products Company in the form of 99.999% pure wire 3 mils in diameter. The sample was constructed as shown in Fig. 1. The distance between the potential contacts was about 1 mm and the leads to these contacts were brought out of the pressure cell through 13-mil stainless-steel tubing. Pyrophyllite sleeves were put around the steel tubing and the thermocouple wire to keep them from breaking while the gaskets were forming. The BN served to insulate the gold and the thermocouple from the heater and also to spread the heat to make the temperature more uniform.

Measurements were made at a fixed ram loading while increasing the current through the heater strip and simultaneously recording the thermocouple emf and the resistance between the potential leads. A Kepco 100 A, 8 V, dc regulated power supply served as a source of heater power. The resistance between the potential leads was measured with a four-lead Keithley milliohm meter, the output of which was fed to one axis of a Moseley X-Y recorder. The other axis of the recorder monitored the thermal emf from the thermocouple junction. At the melting point the resistance of
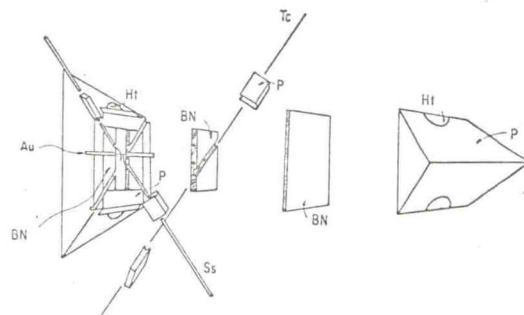

FIG. 1. High-pressure high-temperature sample chamber for resistance measurements in the tetrahedral anvil press. The lettered parts are: P, pyrophyllite; BN, boron nitride; Tc, thermocouple; Ss, stainless-steel tubes; Ht, heater tabs; Au, gold current leads.

[13] J. J. Gilvarry, Phys. Rev. 102, 308 and 325 (1956).
[14] F. Simon and G. Glatzel, Z. Anorg. Allgem. Chem. 178, 309 (1929).
[15] S. E. Babb, Jr., J. Chem. Phys. 38, 2743 (1963).
[16] J. S. Dugdale and D. K. C. MacDonald, Phys. Rev. 89, 832 (1953).
[17] J. M. Walsh, M. H. Rice, R. G. McQueen, and F. L. Yarger, Phys. Rev. 108, 196 (1957).
[18] O. H. Krikorian, University of California, Lawrence Radiation Laboratory Report UCRL-6132, 1960 (unpublished).

[19] Landolt-Börnstein Tables, edited by K. Schäfer and E. Lax (Springer-Verlag, Berlin, 1961), Vol. II, part 4, p. 243.
[20] L. Losana, Gazz. Chim. Ital. 68, 836 (1938).
[21] W. Krause and F. Sauerwald, Z. Anorg. Allgem. Chem. 181, 347 (1929).
[22] The press was similar to that described by J. D. Barnett and H. T. Hall, Rev. Sci. Instr. 37, 175 (1964).