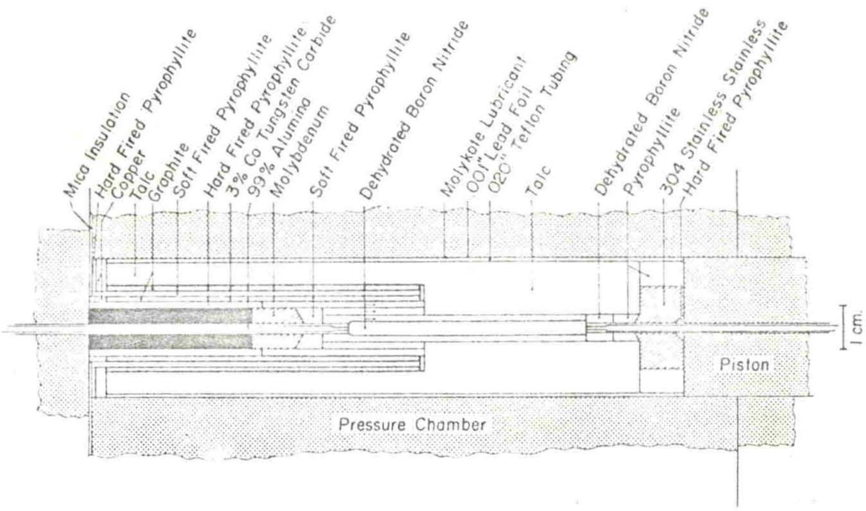

FIG. 3. Single-wire experiment pressure cell.

readings of Chromel–Alumel thermocouples and Pt–Pt10Rh thermocouples over a range of 50 kbar and to a temperature of 1200°C. However, evidence from our presently reported experiments and earlier evidence by Hanneman and Strong[2] suggest that the relative pressure effect which Bundy attempted to determine was masked by chemical contamination of his thermocouples and other decalibration effects at temperatures above several hundred degrees.

Hanneman and Strong[10,2] and Hanneman *et al.*[11] report results involving the intercomparison of two thermocouples. They measured the relative pressure effect for several pairs of thermocouples to 1200°C and 50 kbar. Their results are in reasonable agreement with results by Peters and Ryan,[12] Bell *et al.*,[7] and the relative effect as calculated from this work.

The difference in the effect of pressure on the emf of Chromel–Alumel thermocouples and Mo–Mo50Re has been reported by Stromberg and Stephens.[13]

Hanneman *et al.*[10,2,11] have also estimated the absolute effect of pressure on the emf of thermocouples. Their values were determined by intercomparing the temperatures of predicated phenomena at high pressure with the temperatures of the phenomena as observed by pressurized thermocouples. There are sizeable uncertainties associated with this procedure, however, and substantial disagreement exists between their estimated absolute corrections in the higher temperature–pressure regions and the directly measured values reported in this work. Wentorf[14] has measured absolute corrections for Pt–Pt10Rh to 50 kbar and 1100°C by the measurement of thermal noise. The results from this extremely difficult experiment are close to the estimates of Hanneman *et al.*, but show slightly larger corrections.

EXPERIMENTAL ASSEMBLY

Our single-wire experiment was conducted in an end-loaded piston-cylinder device. Measurements were made to 35 kbar and 1000°C. Figure 2 shows the ideal temperature and pressure distribution required to make the desired measurements. One portion of the wire in the chamber is subjected to pressure whereas the other portion sees no pressure as it extends down an axial hole through a tungsten carbide bushing. The bushing supports the pressure outside it and provides a 1-atm environment around the wires, well into the pressure cell. An internal resistance heater was used to generate a temperature maximum at the inside end of the carbide bushing where the high-temperature seal is located. Thus the wire is subjected to one temperature gradient at high pressure and an opposed gradient at 1 atm.

Ideally, the regions of temperature gradient should be isobaric. The regions of pressure gradients should be isothermal. The length of the pressure cell was extended from our normal 5.08 cm to 15.24 cm in order to permit more uniform temperature distribution within the pressure seals. The diameter of the cell was 3.18 cm. The design and construction of this relatively large 40-kbar-pressure vessel is discussed by Au and Getting.[15]

The detailed configuration of the pressure cell is shown in Fig. 3. Test wires passed through the full length of the pressure chamber, entering an axial hole in the piston at one end and leaving at the other end through a hole in the carbide end-load plate. In the pressure seals and the regions where the wires were at 1 atm, they were contained in a 6-hole 99% Al_2O_3 insulating tube. However, the Al_2O_3 insulating tube proved much too strong to permit uniform transmission of pressure to the wires in the high-pressure environment. Here the wires were embedded in binderless boron nitride previously dried at 500°C for 5 h. Several runs were made with silver chloride substituted for the BN in order to produce more nearly hydrostatic pressure on the wires. These experiments were limited to a maximum temperature of approximately 500°C by the melting of silver chloride.

A coaxial graphite heater was used to produce a temperature maximum at the hot seal where the wires leave the 1-atm environment and enter the high-pres-