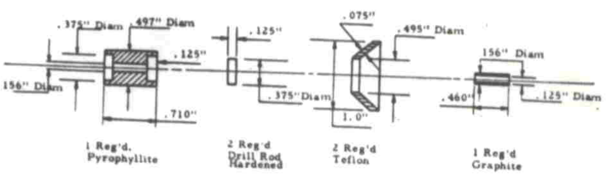

FIG. 2. Dimensions of sample cell parts.

have been estimated from power consumption, using the melting temperature of nickel as the upper calibration point. The apparatus has been operated without failure for periods over one hour at a pressure of 100 000 kg/cm² simultaneously with temperatures above 3000°C, by applying coolant to the support rings.

Perhaps the most outstanding characteristic of successful equipment designed to reach very high pressures and temperatures is that of apparent simplicity, exemplified by the Bridgman anvil[3] and its modifications. However, success or failure is often contingent on details of construction, such as a few degrees of angle, choice of a correct grade of steel or a fraction of a percent of interference in a set of supporting members, to mention but a few critical items. Part of the fascination of high pressure research is associated with finding solutions to such problems. Details of the present apparatus will be presented under four headings: (1) the compressible gasket and its geometry, (2) decompression caps, (3) stressed core components, and (4) binding rings.[4]

COMPRESSIBLE GASKET

Probably the principal difficulty associated with the compressible gasket geometry is that of obtaining sufficient relative motion of the compressing parts if a large sample volume is desired. Hall has solved this by using a three-dimensional compression with multiple anvils in his tetrahedral device.[5] The "Belt" apparatus,[1] also designed by Hall, involves thick pyrophyllite and steel gasketing and an "angular advantage." In the case of the present apparatus, as shown in Figs. 1 and 2, the action of the plastic gasket can best be described as one of consolidating the otherwise unsupported portion of the pyrophyllite pressure transmitting cylinder during its collapse as the load is applied. Without the consolidation gasket, the pyrophyllite crumbles and spreads out into a very thin layer which will permit only very little relative motion of the rams, and hence very little compression of the sample region. With the use of the plastic gasket, only a slight lateral extrusion of the pyrophyllite takes place and by proper choice of the overlength of the pressure transmitting cylinder, a thick, easily compressible gasket of pyrophyllite forms during the early stages of the compression. A pyrophyllite cylinder 0.710 in. in length has been satisfactory (but perhaps not optimum) on a vessel with a bore $\frac{1}{2}$-in. in diameter and $\frac{1}{2}$-in. long.

In the present apparatus, the plastic gaskets reduced the press load necessary to reach the Bi I→II transition from 110 tons to less than 65 tons. (A further reduction was effected by the decompression caps to be discussed.) In many hours of operation at 100 000 atm and 3000°C, no gasket blowouts have occurred. A set of trials using steel rams and dies made with the core half-angle θ taking values between 25 and 55°, showed less than a 10% variation in the press load required to reach the Bi I→II transition indicating that using the present plastic gasketing, the system is not especially sensitive to the angle for pressures over the 25 000 atm range at least. The set in use at present has a cone half-angle 40°. The materials used as consolidation gaskets have been Teflon or polyethylene. Nylon, Plexiglas, and phenol-formaldehyde resin have been found unsuitable as gaskets because they do not extrude. They have been found to compress initially, then to rupture with explosive violence when the load reaches a critical value. Extrusion of the Teflon or polyethylene yields a desirable graded pressure distribution along the cone elements, helping support the rams and providing axial clamping of the die. Also, with the use of a vertically acting press, the locating and orienting effect of the gaskets makes any auxiliary guidance for the die and its support rings unnecessary, considerably simplifying operation of the unit.

Since Lloyd, *et al.*[6] report difficulties with pyrophyllite gasket extrusion on their tetrahedral anvil device, it is probable that using extrudable plastic consolidation gaskets along the edges of the pyrophyllite tetrahedron could be advantageous on such devices.

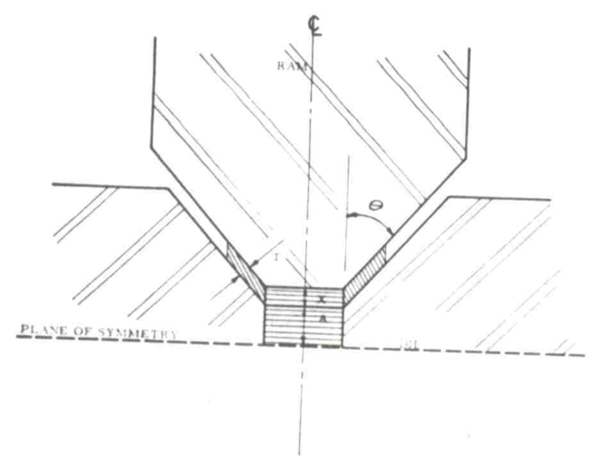

FIG. 3. Core of modified Bridgman anvil device showing critical parameters.

[4] Dr. Jones contributed the tapered ram design and binding ring design reported in this paper. Subsequent studies and developments here reported are the work of Dr. Daniels.

[5] H. Tracy Hall, Rev. Sci. Instr. **29**, 267 (1958).

[6] E. C. Lloyd, U. O. Hutton, and D. P. Johnson, J. Research Natl. Bur. Standards **63C**, 59 (1959).