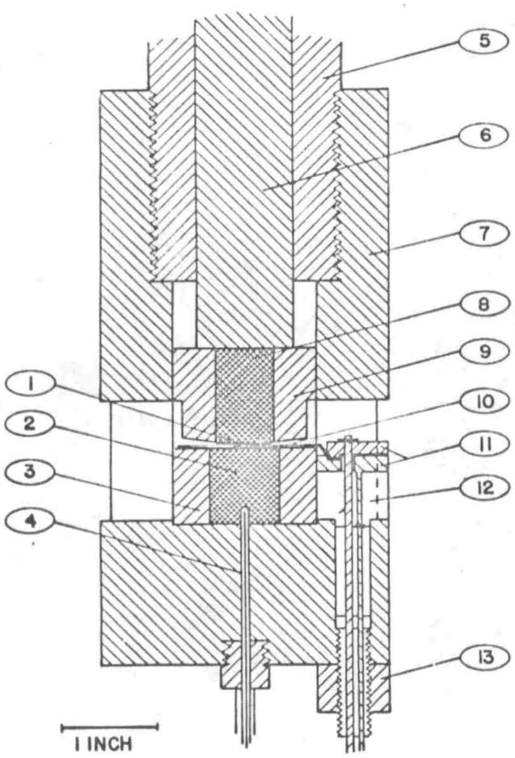

FIG. 2. Schematic diagram of high pressure head. (1) Sample cell (see Fig. 3 for detail), (2) combined pressure anvil and microwave cavity, (3) beryllium-copper binding ring for pressure anvil, (4) coaxial line for coupling microwaves, (5) beryllium-copper sleeve for coupling to hydraulic press, (6) beryllium-copper pressure ram, (7) beryllium-copper pressure head, (8) Bridgman-type tapered pressure anvil, (9) beryllium-copper binding ring for pressure anvil, (10) silver modulation strip (see Fig. 3), (11) modulation clamp (see Fig. 3), (12) plastic insulating support for modulation clamp, (13) locking nut for modulation clamp.

The upper anvil is of Bridgman's design.[5] A flat circular face of $\frac{3}{8}$-in. diameter is massively supported by tapering the anvil material at an angle of 6 to 12° out to a diameter of $\frac{1}{2}$ in. The length of the cylinder is 1 in. The material is hot-pressed alumina manufactured by Norton Company of Worcester, Massachusetts. This material, though stronger than the cold-pressed alumina, did not prove to be sufficiently pure for the microwave cavity and was therefore not used for the lower anvil.

Both anvils are supported by beryllium-copper (Berylco-25, The Beryllium Corporation of America, Reading, Pennsylvania) binding rings which have been hardened by heat treating. The wall thicknesses of the binding rings are $\frac{1}{2}$ in. for the upper anvil and $\frac{3}{8}$ in. for the lower anvil. The alumina is pressed into the binding ring against a tapered $\frac{3}{4}$° interference of 0.002 in., Molycote being used as a lubricant.

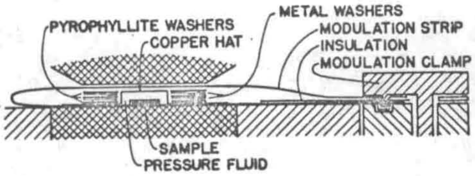

FIG. 3. Schematic detail of sample cell showing modulation system.

[5] P. W. Bridgman, Proc. Am Acad. Arts. and Science **81**, 165 (1952).

The anvils are placed in a pressure head as indicated in Fig. 2. Each of the three components of the pressure head assembly is fabricated from half-hard heat-treatable Berylco-25, beryllium-copper. The head is 3 in. in diameter. Clearance of 0.020 in. is allowed between the sleeve and the ram of the pressure head.

The pressure head assembly is coupled to a Rodgers 150-ton hydraulic cylinder press by means of a hard steel coupler screwed into a hard steel disk which is in turn bolted to the cylinder. The press and pressure head assembly are supported above the magnet by a heavy table.

Two pressure pumps are employed. A Sprague S-216c-150 with a pressure amplification of 160 to 1 is operated from compressed air for rapid pumping. A Pine Hydraulic hand pump, No. 1000, provides a vernier.

Microwave Bridge

The system employs a Varian V-4500-41A low-high power microwave bridge with a Varian V-K352s superheterodyne accessory. The latter was designed and built by Varian Associates to meet our requirements. The bridge supplies 200 to 400 mW of power at X band. Microwave coupling to the cylindrical alumina-filled cavity has been achieved both with a loop and with a straight probe. In the former case a $\frac{1}{16}$-in.-wide by $\frac{1}{4}$-in.-diam semicircular slot is cut into the bottom of the alumina to accommodate the loop which is the terminus of a conductor coaxial with a 0.118-in.-diam hole drilled through the bottom of the pressure head. An N-type coaxial connector at the bottom of the head facilitates coaxial coupling to the wave guide. Matching is achieved by means of a double stub tuner. When the TM_{112} mode is used, coupling is best achieved by means of a straight probe projecting about $\frac{1}{8}$ in. into a $\frac{1}{16}$-in.-diam vertical hole drilled midway between the axis and the wall of the cylindrical alumina cavity. In this case matching is accomplished by varying the distance the probe projects into the hole.

Magnetic Field System

The gross magnetic field is produced by a Spectromagnetic Industries model L12-A, 12-in. low-current magnet energized by a Varian V 2100B power supply. The air gap is 4 in. with homogeneity of approximately $\pm\frac{1}{2}$ G over a volume of 1 cu in. at the center. The EPR control system provides a linear sweep of several speeds. A proton resonance magnetometer is used to measure the magnetic field strength.