## B. High Pressure Apparatus

The high pressure system is shown schematically in Fig. 2-3. The hydraulic ram and the intensifier were obtained from Professor Bridgman. A hand pump is used to force oil into the intensifier cylinder. The intensifier compresses the pressure transmitting fluid, pentane, in the low pressure, high compressibility region. After a pressure of about 1500 kg/cm$^2$ is attained, the large hydraulic press is used to move the piston and piston head down the upper cylinder, compressing the pentane further. After the piston head has moved about 1/2 inch it is below the intensifier connection and the latter is no longer subject to high pressure.

The upper cylinder is connected to the beryllium copper bomb, suspended between the magnet pole pieces, by 1/8" O.D. x .020" I.D., stainless steel tubing. The bomb, Fig. 2-4, was used at pressures up to 15,000 kg/cm$^2$. It was eventually destroyed in an explosion and replaced by one of identical design. We believe pentane under high pressure leaked past the terminal plug and remained temporarily sealed in by the drive plug. Pressure was transmitted to the thin walled (3/8") portion of the bomb and ruptured it.

The sealing arrangement at both ends of the bomb is shown in Fig. 2-5. Initially we were able to seal both ends of the bomb using only lead and aluminum washers; eventually the packing hole belled out and we needed to add a cold rolled steel washer to seal reliably.

The terminal plug used was a modification of the design normally used in this laboratory. Because of the high sample currents we needed, larger cones and wires were used. The Bridgman tubing seal at the other end of the bomb needed to be almost completely within the .625 inch packing hole to prevent it from mushrooming or shattering under pressure. Detailed descriptions of the high pressure techniques used may be found in the literature [7,8].

The pressure was determined by measuring the change of resistance of a manganin coil on a bridge [9]. The gauge coil was calibrated against another manganin coil which served as a laboratory standard. At the conclusion of the measurements we checked our gauge against the mercury transition

at 7640 kg/cm$^2$ (at 0°C) and found a difference of 90 kg/cm$^2$. This error may be due to the fact that the manganin gauge was in the apparatus when the beryllium-copper bomb exploded and the resulting rapid pressure change may have altered the properties of the manganin slightly. The pressure measurements are therefore accurate to better than 1.5 percent. The techniques involved in the mercury calibration have been described by Bridgman [10].

## C. Sample Preparation

The alkali metals are highly reactive and very compressible; these characteristics made it difficult to prepare suitable samples of the alkalis. Since the alkalis react rapidly with oxygen, whenever possible, electrical measurements on them have been performed by enclosing them in glass. Hall effect samples have been made by forming thin molds of glass or quartz containing platinum electrodes and distilling the alkali metal into them [11, 12]. This procedure protects the surface of the sample and allows the metal to be purified by distillation. It is not, however, useful for pressure work. The glass constrains the alkali and prevents it from contracting freely under pressure. The pressure in the sample is not necessarily hydrostatic. Finally, pressure can break the contacts to the thin platinum electrodes.

Bridgman, in his work on the pressure dependence of the resistance of the alkali metals was able to make wires of alkalis and connections to them by means of spring clips [13]. This leaves the sample free to contract under pressure. The contacts obtained are not always reliable and may open under pressure. This technique is not useful for Hall measurements where the mounting must be such as to maintain the sample's shape and orientation under pressure. Furthermore, some attempts to make samples of this kind show it is extremely difficult to attach four spring clip contacts to a sample without tearing it.

The sample preparation method finally adopted represented several compromises. In order to expose the metal to the pressure fluid we had to accept some surface oxidation. In order to make reliable contacts and to keep the sample orientation fixed it was necessary to constrain the sample somewhat.