Diamond growth is reported to occur as epitaxial thin films on diamond substrates.

Instrumentation

Thus far, with the exception of the epitaxial film process, concurrent pressures and temperatures of at least 45 kilobars[1] and 1150° C., respectively, have been found necessary to effect diamond growth. Figure 1 provides a schematic summary of the principal types of instruments which have proven capable of primary diamond synthesis.

Figure 1(a) illustrates the now famous "Belt" high pressure-high temperature apparatus of the General Electric Company (Hall, 1960). This type of device produced the first synthetic diamond. It is still one of the most effective pressure vessels available today. Its principal design feature for generating high pressures is the compressible preformed conical gasket.

Figure 1(b) shows a cross sectional schematic of the "Supported Stepped Piston-Cylinder" chamber of the U. S. Army Electronic Research and Development Laboratory (Giardini and Tydings, 1959 and 1961). This device is capable of generating sustained pressures and temperatures to 100 kilobars and 2500° C., respectively. It has been used for most of the work on diamond reported herein.

Figure 1(c) provides a perspective schematic of H. T. Hall's "Multi-Anvil" pressure apparatus of tetrahedral configuration (Hall, 1958). This device normally functions on the principle of an extruded compressible gasket. It recently has been observed, however, that preformed compressible gaskets provide superior performance.[2] Sample deformation normally encountered is markedly reduced because of the diminished displacement of compressible solid from the pressure cavity.

Figure 1(d) presents a cross section of the "Girdle" chamber developed by the Battelle Memorial Institute (Wilson, 1960). Although similar to the "Belt" in geometrical appearance, this device utilizes the elasticity of multiple steel binding rings in place of the compressible gasket principle.

Figure 1(e) illustrates the "Multi-Anvil" device of cubic configuration first used by Allmänna Svenska Elektriska Aktiebolaget (Liander and Lundblad, 1960), and recently developed into a self-contained unit by Barogenics, Inc. (Zeitlin *et al.*, 1961). A structural framework supports and directs six centrally converging hydraulically powered anvils oriented

[1] 1 bar = 1.0197 kg/cm² = 0.9869 atmospheres = 14.5038 psi. = 1×10^6 dynes/cm².

[2] Based on work conducted at this laboratory with 2000 ton force capacity multi-anvil devices. Preformed gaskets should be an integral part of the compressible solid workpiece rather than attached thereto.

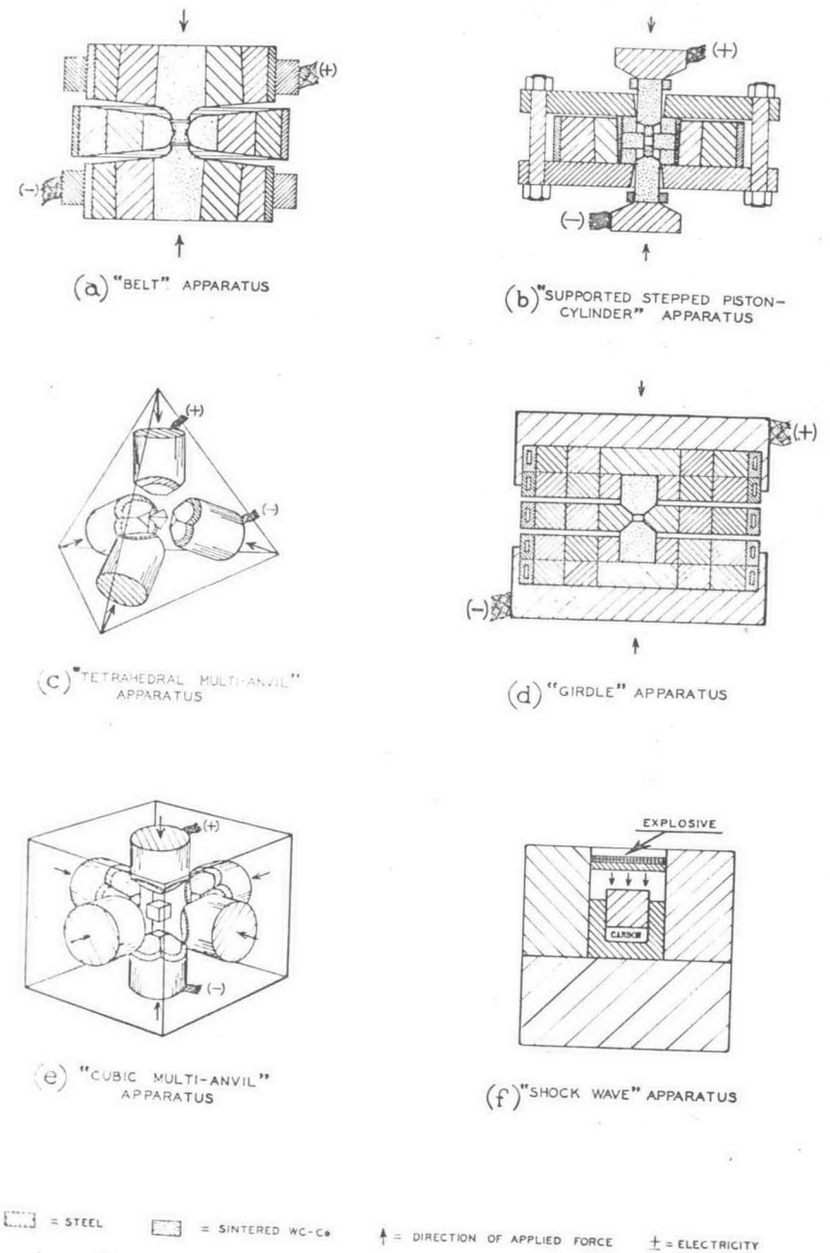

FIG. 1. A schematic summary of high pressure-high temperature apparatus capable of synthesizing diamond.