

Synthetic Gems and simulants

- Synthetic gemstones have the same properties as natural gems, but they are created in a laboratory.
- Material that is used as a substitute for a gem material, but is of a different chemical composition is a "simulant".
- The best example of a simulant might be the substitution of Cubic Zirconium for diamond.

Synthetic gems

- There are quite a few methods for making synthetic gems and minerals.
- Not all synthetic minerals are used solely as gems for instance,
 - synthetic diamond can be coated onto windows to make them scratch resistant.
 - Synthetic sapphire is used for making watch bearings (jewels) that resist wearing.

7 Jewel watch



- They are watch jewels
- They are used as bearings
- They resist wear



Synthetic gems

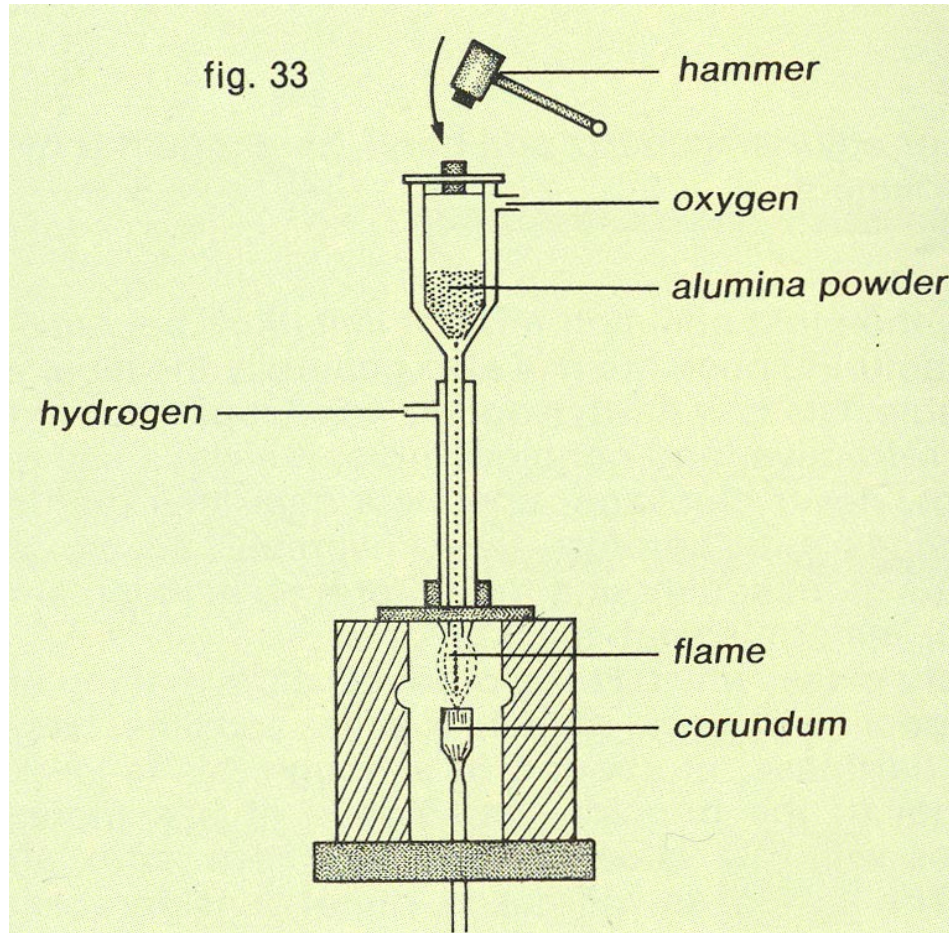
- Posses all the properties of natural stone
- The may be purer and look better
- They are cheaper than natural stones and some are mass produced.
- Everyone wants the real thing, but sometimes a good synthetic or simulant will suffice till the big bucks are available.

Methods of production:

Flame Fusion or the Verneuil method

- Developed in the early 1900s, by August Victor Lewis Verneuil for production of ruby, and sapphire. It can also be used to make spinel, star rubies & sapphires, and simulants such as strontium titanate & rutile.
- Powdered material is melted as it drops through a flame. The melt falls onto a growing 'boule' crystal that is lowered as it grows. The carrot-shaped 'boule' can be several inches long and weigh a few hundred carats.

Verneuil Method





Boules and partly faceted stones

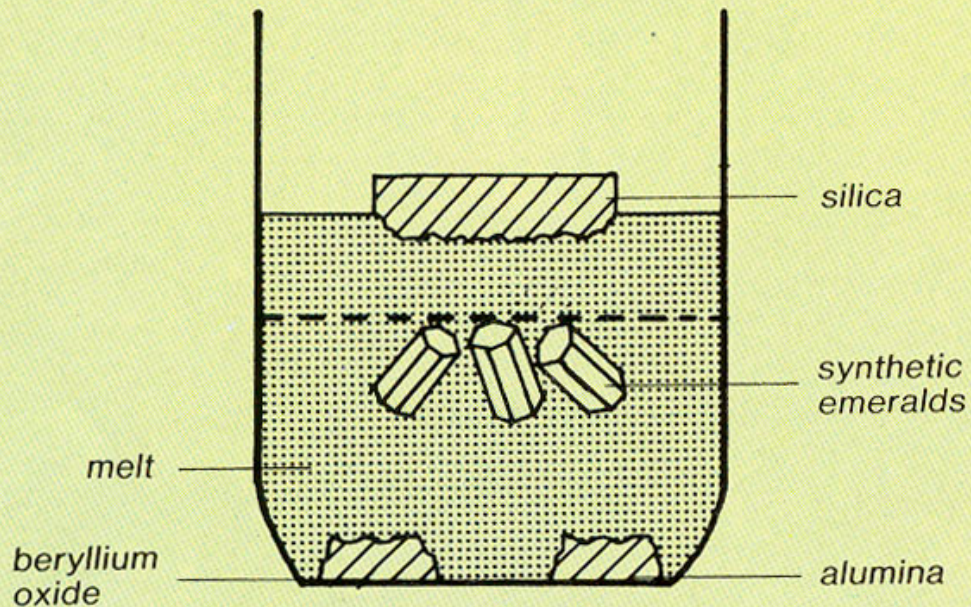


Flux Fusion

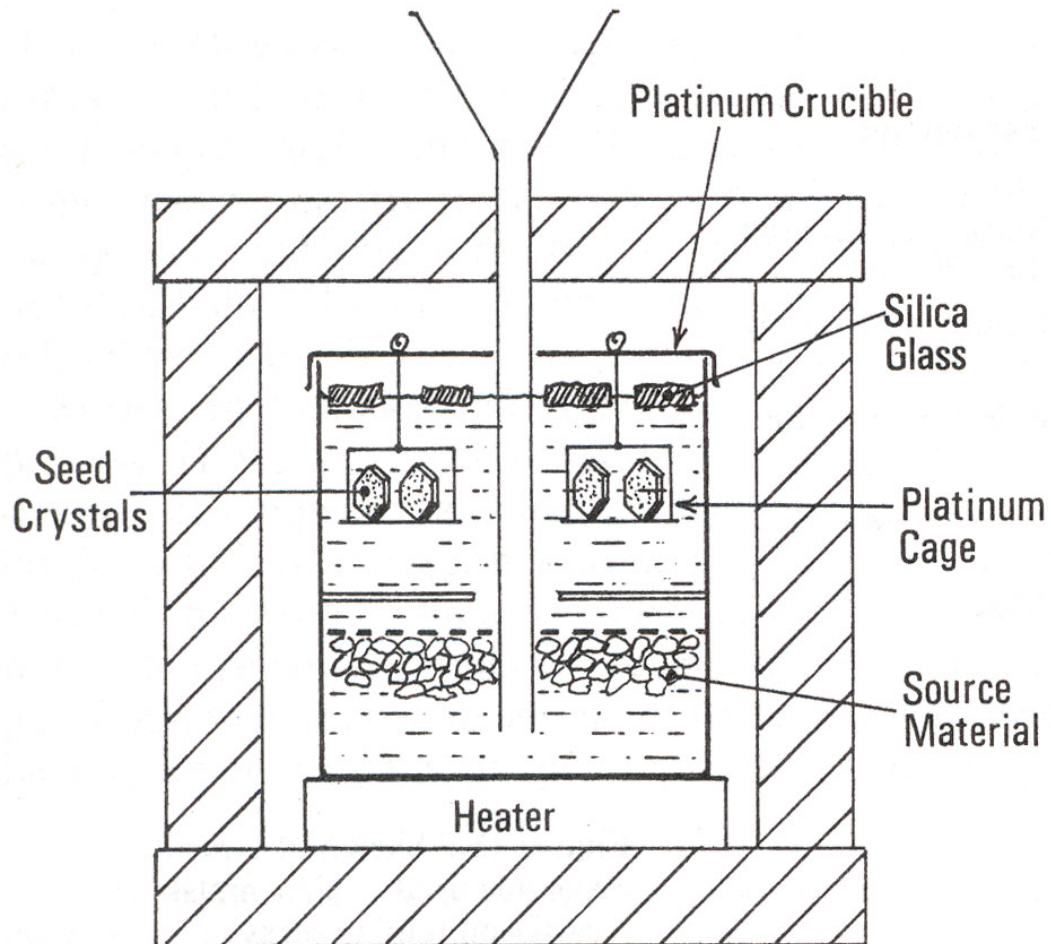
- Rocks and minerals melt at high temperature. Adding flux lowers their melting point and allows you to grow gems in the laboratory.
- Flux method is used to grow: Emeralds, Rubies, rarely Sapphires,

Flux Fusion in a Platinum Crucible

fig. 34

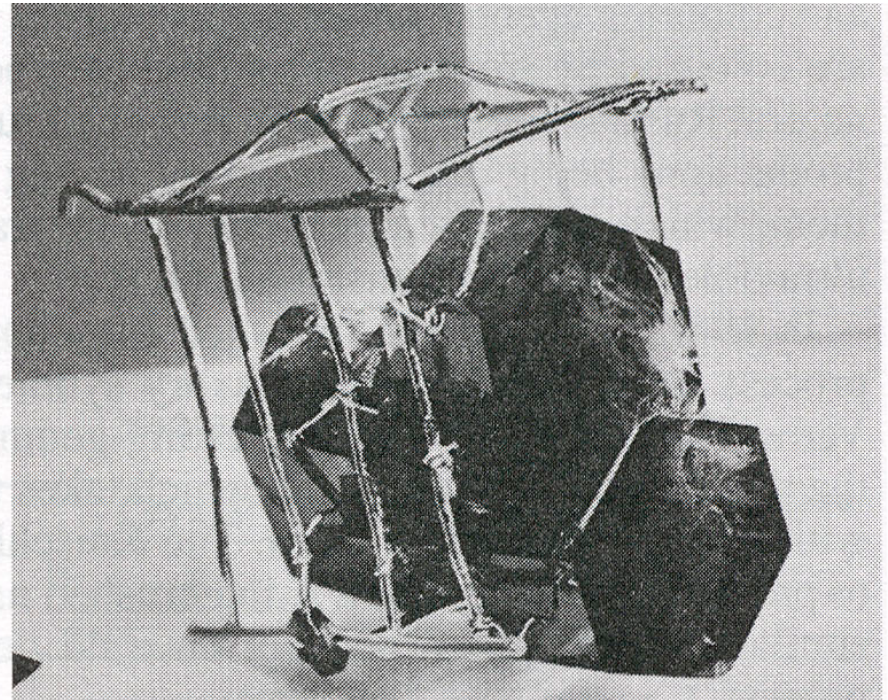
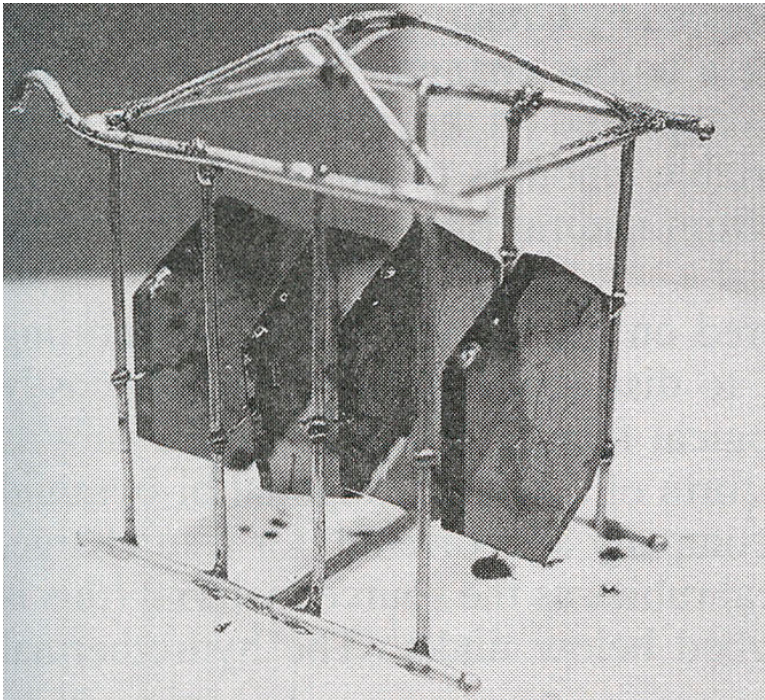


Hydrothermal Bomb



Synthetic Hydrothermal Emeralds

- Page 179 of Read Gilson synth emerald



Hydrothermal crystals are well formed



Diamonds (High temperature high pressure method)



A hydraulic press is used



The first commercial synthetic diamonds were industrial



- Diamond drill bit

High pressure and high temperature (HPHT diamonds)

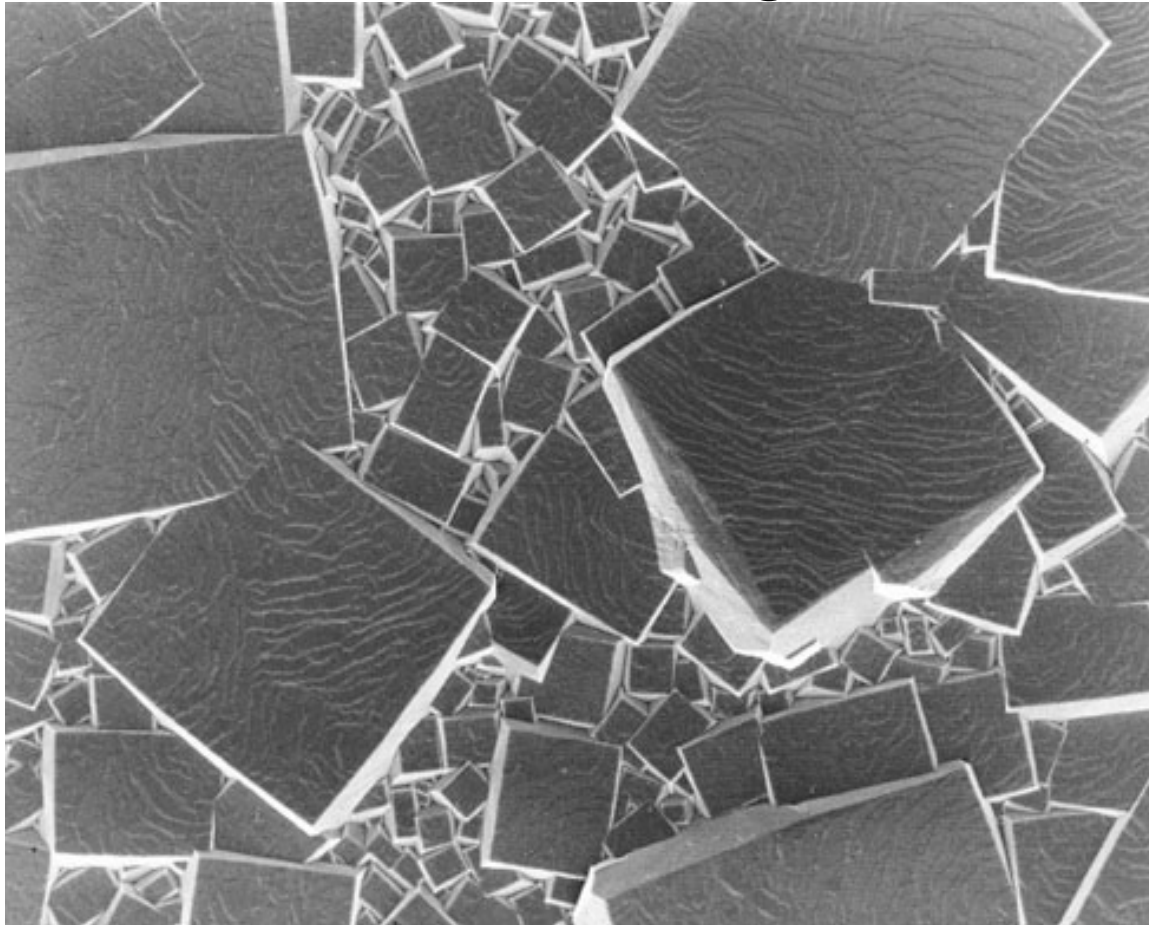
- This method is the classic method first used by GE in 1954 to create industrial diamonds and led to the creation of gem grade diamonds by around 1970.
- The GE engineers made diamonds from peanut butter!

Chemical vapor deposition method (CVD)

- This method is often used for depositing a thin layer of diamond on cutting tools or other objects that need a hard surface.
- The term vapor implies a gaseous phase and the gas used is often methane (CH_4).
- There is no need for high pressure, but temperatures are moderately high, between 750-1,000°C.

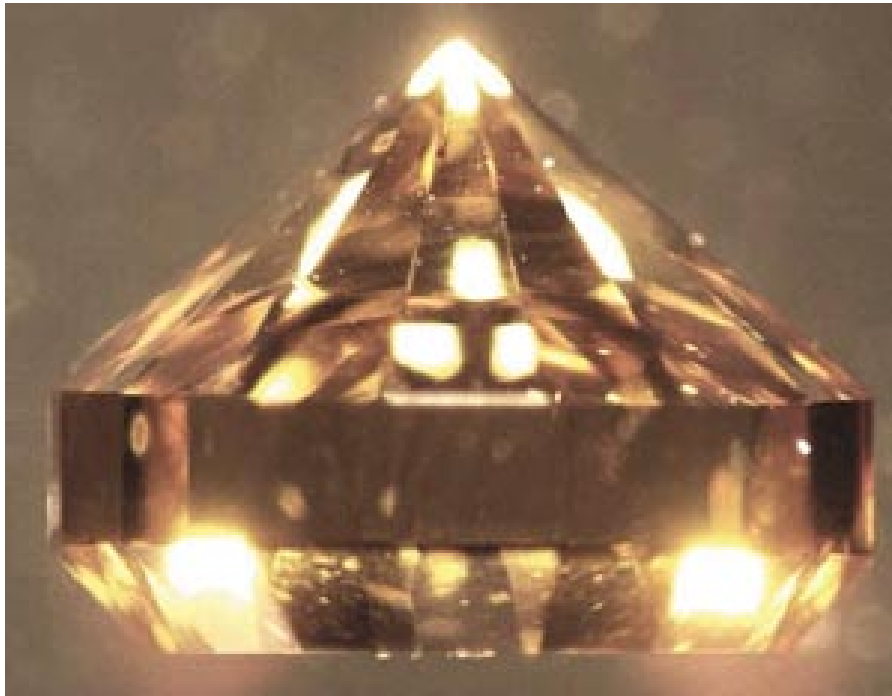
CVD method (Cont...)

- You can coat tools and glass with diamond



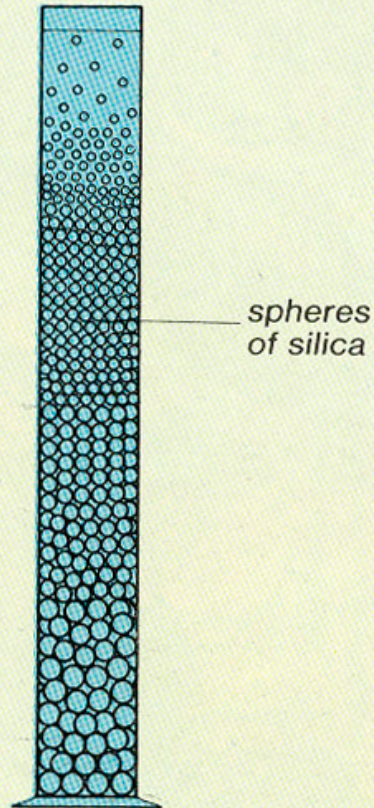
CVD creates diamonds fast

- A synthetic-cut single-crystal diamond, about 2.5 mm high, grown by chemical-vapor deposition at the Carnegie Institute.



Synthetic opal

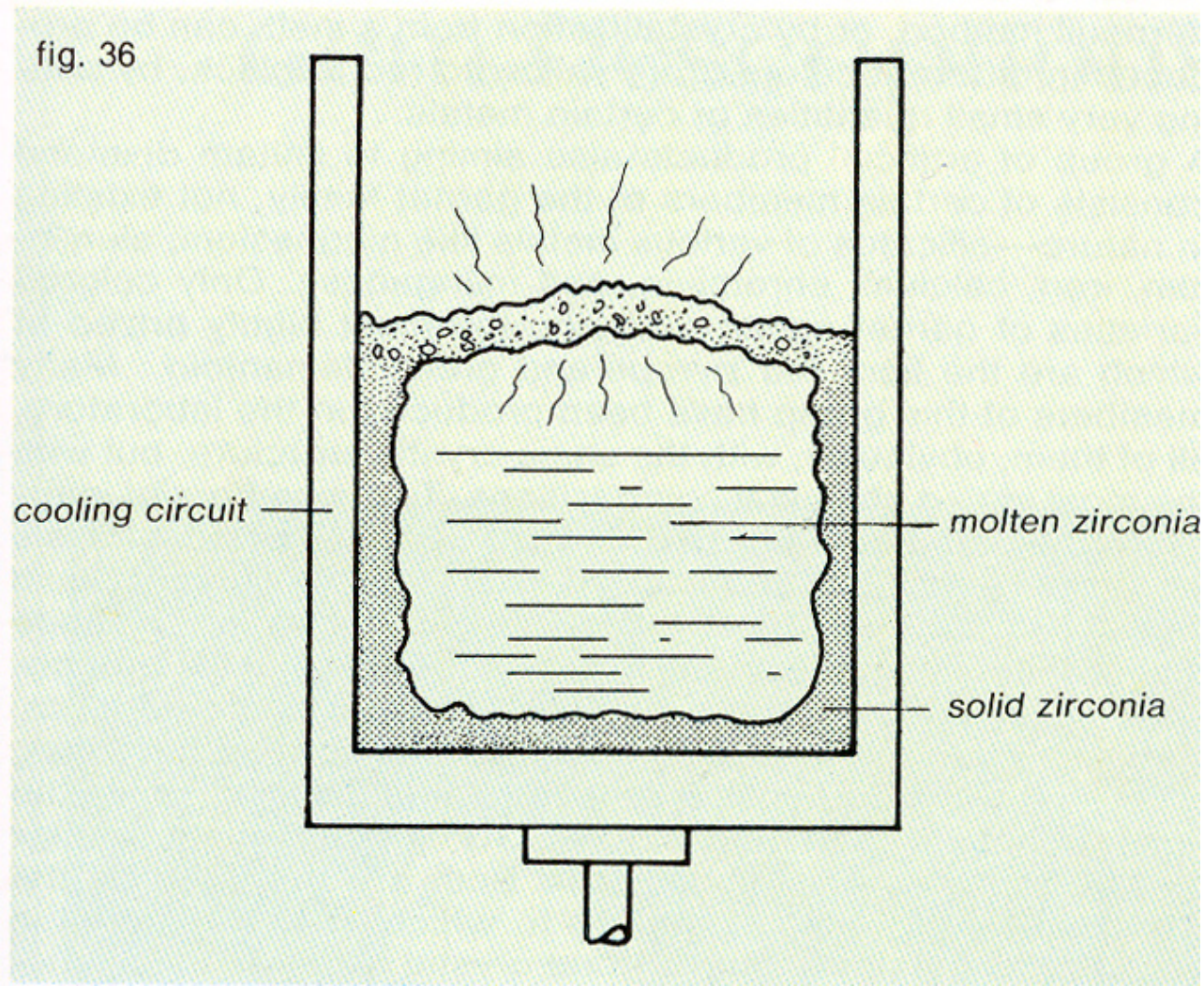
fig. 35



- Sphere of silica settle
- The composition of opal is $\text{SiO}_2 \cdot \text{H}_2\text{O}$
- After settling the spheres are fused by heating

Cubic Zirconium (CZ)

Production of cubic zirconia by crystallization from a melt according to the "skull melt" process.



Cubic Zirconium (cont...)

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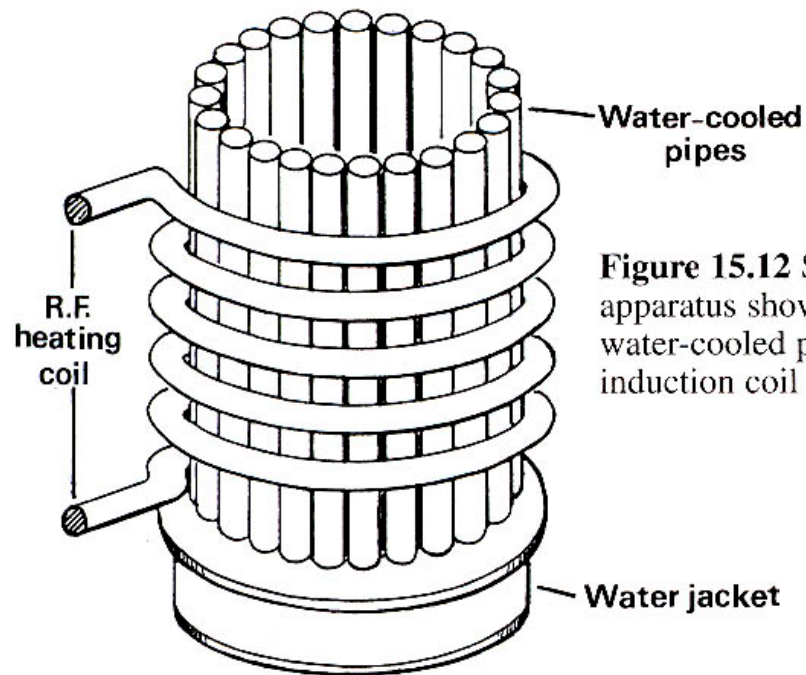


Figure 15.12 Sketch of a skull-crucible apparatus showing the vertical water-cooled pipes and the RF induction coil

CZ or pink diamond?



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