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Early 1960s

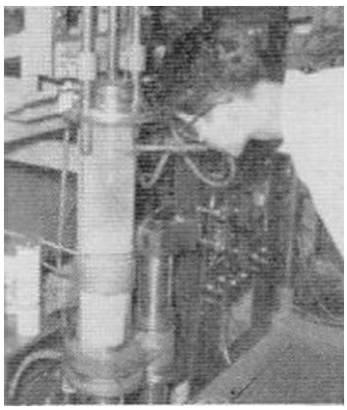
Start of using the CZ method to manufacture crystal silicon for silicon transistors

~ Process Technology ~

Japan was the world leader in the production of germanium transistors in the 1950s, but the United States led in silicon transistors which had better temperature characteristics than germanium transistors. In the 1960s the manufacture of silicon transistors was started also in Japan. For that purpose, high purity silicon crystals were necessary, and each company developed silicon crystal pulling equipment in-house and worked on the manufacture of silicon transistors.

High purity silicon crystals were manufactured in vertical type furnaces called CZ (Czochralski) method, unlike the horizontal type method of germanium crystals. In the CZ method, a small silicon crystal serving as a seed is immersed in the molten silicon, and while rotating, it is gradually pulled up to form a cylindrical crystal. A disc-like single crystal silicon called a wafer is then made by slicing the single crystal cylinder, and transistors and ICs are fabricated on it. At the beginning, the diameter of the wafer was about 1 inch (about 25 mm), because only small diameter crystals could be pulled, but it was gradually increased by the technology improvement, and in the latter half of the 1990s wafers with the diameter of 300 mm were mass-produced.
Since the 1960`s, Japanese material manufacturers such as Osaka Titanium and Komatsu Electron Metals started manufacturing and selling polycrystalline silicon which is the raw material for silicon single crystals. In 1960, Komatsu Electronic Metals also produced CZ single crystal samples.

Silicon single crystal ingot pulled by Toshiba in 1956



Example of in-house pulling equipment