PHYSICS

New Electron Furnace Heats to 4500° F., Half as Hot as Sun

Bombardment With Streams of Electrons Melts Iridium, Platinum, and Other Refractory Metals

A SCIENTIFIC furnace that utilizes electron bombardments to produce temperatures up to 4500 degrees Fahrenheit, half as hot as the sun, is being used at the Harvard graduate school of engineering to study the basic physical properties and possible industrial uses of 40 metals at present little understood and used.

In announcing the research program Harvard scientists pointed out that of the 55 metallic groups only 15 have been fully utilized by industry. From ancient times gold, silver, iron, copper, tin, zinc, lead and mercury have served in many ways. Within more recent years aluminum, antimony, bismuth, cadmium, chromium, cobalt and nickel groups have been added to the earlier list.

But there still remain 40 metal groups, whose alloy characteristics have yet to be studied, and whose possible industrial application is still in its infancy. Their development, scientists say, may mean as much to industry as the relatively recent development of such alloys as stainless steel, or the tungsten carbide used in high speed machinery.

The new furnace was invented by Dr. Ralph R. Hultgren, instructor in metallurgy, who has been constructing the apparatus during the past year. Chief feature of the new equipment is its ability to eliminate entirely the contamination, by carbon or other metals, which has marked other furnaces. The familiar carbon arc, for example, reaches as high temperatures as the electron furnace but is markedly inferior as an experimental device because carbon gets into the melted metal, and there is no way of keeping it out.

Much higher temperatures than 4500 degrees could easily be reached by the Harvard apparatus if better crucibles could be obtained to hold the metals under study.

Vanadium, titanium, columbium, zirconium and the platinum group, which have been very difficult to study previously because of their relatively high melting points, are among the rarer metals which the new furnace can melt into very pure alloys.

The electron bombardment principle which underlies the new apparatus has previously been utilized by scientists for intense heat in several other fields but the Harvard furnace marks its first application to metallurgy.

Experimental tests already conducted have witnessed the successful melting of iridium at 4230 degrees Fahrenheit, platinum at 3200 degrees, and palladium at 2790 degrees. Ruthenium was heated to 4400 degrees and while it "sintered" a little, it did not melt.

These preliminary experiments indicate that only six of the 55 metallic elements have melting points beyond the reach of the Harvard apparatus in its present state. These are carbon, melting at 6300 degrees Fahrenheit; tungsten at 6066 degrees; rhenium at 5400 degrees, tantalum at 5130 degrees, osmium at 4860 degrees and molybdenum at 4716 degrees.

The new furnace consists of a small cylindrical metal cup or crucible, about a half inch in diameter and height, and two filament wires on opposite sides of the crucible. The metal to be studied is placed in this cup and an airtight cylindrical hood, about 10 inches in diameter and 15 inches high, is placed over all the apparatus. A powerful vacuum pump reduces the pressure under this hood to about one billionth of ordinary atmospheric pressure.

The crucible is then raised to an electrical potential of 2500 volts. As in the ordinary vacuum tube, this causes electrons to flow from the wire filaments across the vacuum gap to strike the crucible.

The heat of the furnace is built up by the energy of these electrons, converted into heat upon hitting the crucible; a conversion precisely similar to the production of heat by hammering metal. Although the energy of each individual electron is infinitesimal, the cumulative pounding of millions of them attracted by the crucible charge produces intense heat.

Science News Letter, February 12, 1938