

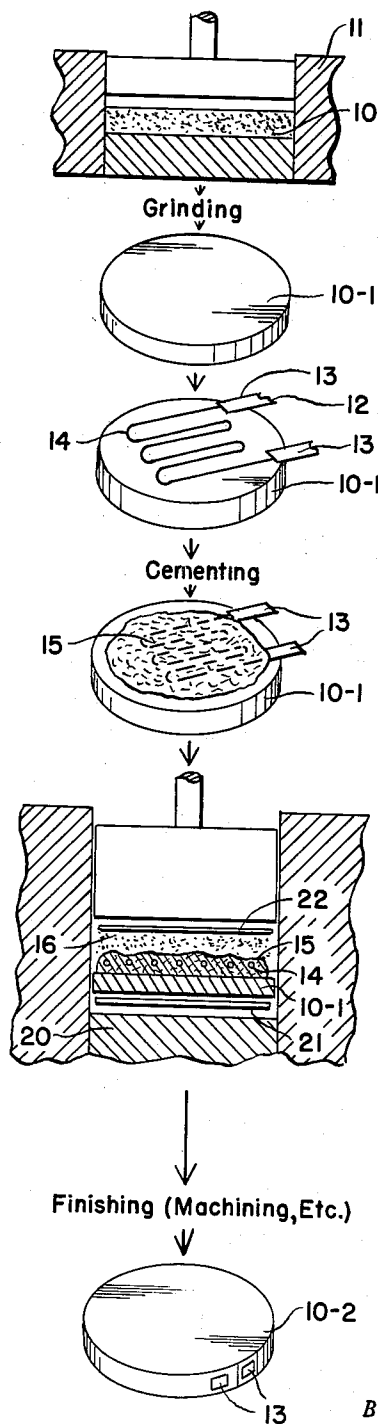
Jan. 7, 1964

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3,117,174

PROCESS FOR PRODUCING A CERAMIC-EMBEDDED WIRE STRUCTURE

Filed June 19, 1961



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3,117,174

PROCESS FOR PRODUCING A CERAMIC-EMBEDDED WIRE STRUCTURE

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Filed June 19, 1961, Ser. No. 117,862
1 Claim. (Cl. 264-263)

This invention relates to a process for making ceramic embedded wire structures and more particularly to protected temperature sensing elements such as thermocouples.

Among the objects of the invention is to provide a method of making a temperature sensing element or similar wire structure which is substantially completely protected by a cover of an inert, corrosive resistant and refractory material.

Among other objects of the invention is to provide a method of making such a ceramically protected wire structure.

The objects of the invention are attained by preparing at partially compacted and hot-pressed blank form of refractory material, machining the blank to provide a smooth or an interfitting face for the temperature sensing element, cementing the temperature sensing element to the blank form with a slip prepared of refractory material which is preferably similar to the refractory material of the blank form, transferring the blank and temperature sensing element to a mold together with additional powdered refractory material and hot pressing to produce a compact product with the temperature sensing element embedded therein. After hot-pressing, the exterior of the device may be machined to final form.

The refractory material employed may be any known refractory material available in powder form. For example, Al_2O_3 , BeO or mixtures thereof are very satisfactory. The material should have a very fine size — 325 mesh, for example (less than 40–44 microns) and should be capable of withstanding temperatures of at least 1200–2000° C. and be inert in oxidizing or reducing atmospheres at said high temperatures.

The first pressing is to about 50–70% of theoretical density (preferably about 60%) and is conducted at a temperature of about 1200° C.

Any type of temperature sensitive or thermocouple material may be sealed by the process. For example, the sensing element may comprise wires or strips of tungsten, rhodium, iridium, platinum, tantalum, molybdenum and alloys of these metals. A thermocouple, of course, will include two metals or alloys of different composition. Molybdenum strip provides very satisfactory leads for the embedded elements.

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The cement for the temperature sensing element may be a slip made up of a refractory powder similar to that of the blank with sufficient liquid such as water to form a paste.

The final hot pressing is carried out at about 1600°–1800° C. and about 2000 p.s.i. pressure. A graphite die is satisfactory for such hot pressing to provide a product which is at least about 97% of theoretical density.

The FIGURE of the drawing illustrates the process.

As shown in the drawing, a blank disk 10 is preliminarily hot-pressed in a mold 11 to about 60% of theoretical density. The disk 10-1 is next ground flat or otherwise prepared for receiving the temperature sensing element 12 which may be made up of the wires 14 and the leads 13. The sensing element 12 is cemented in place by slip 15. The blank 10-1 with the sensing means 12 cemented in place by the slip 15 is transferred to graphite mold 20, additional refractory powder 16 is filled in over the cemented wire elements and the layers are pressed at about 2000 p.s.i. while heated to 1700° C. to provide a product of substantially theoretical density (no voids). In order to protect the device during the molding operation from contamination by the rams of the mold, etc., protective foils of molybdenum 21 and 22 may be provided between the rams and the material being molded.

After removing from the mold, the finished article 10-2 may be machined to shape.

We claim:

Process for the manufacture of ceramically-embedded wire structures comprising
molding powdered refractory material under heat and pressure to provide a blank of 50–70% of theoretical density,
providing a wire structure to be protected by embedding and cementing the same to said blank with a slip of said powdered refractory material,
molding said blank together with the wire structure, the cement and additional powdered refractory material under heat and pressure sufficient to produce a composite body of at least about 97% of theoretical density.

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