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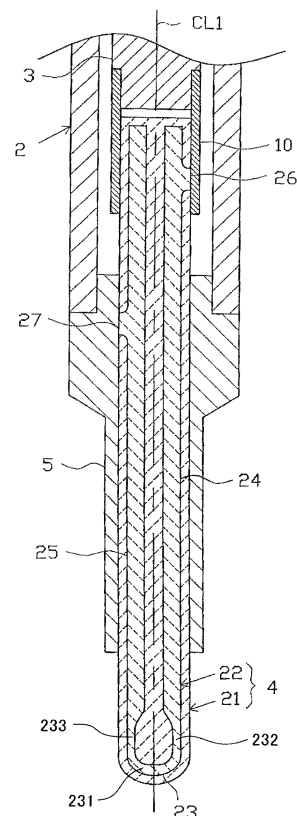
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(54) **Ceramic heater and manufacturing method therefor, and heating apparatus**

(57) A ceramic heater having a substrate and a heat-generating element. The substrate is formed from an electrically insulating ceramic and extends rearward from the forward end of the ceramic heater in the direction of the axis. The heat-generating element has a heat-generating portion formed from an electrically conductive ceramic which contains silicon nitride and an electrically conductive material, disposed in a forward end portion of the substrate, and having a shape resembling the letter U as viewed along the direction of the axis. The heat-generating portion has a fracture toughness of  $4.3 \text{ Mpa}\cdot\text{m}^{0.5}$  or more.

FIG. 3





## EUROPEAN SEARCH REPORT

 Application Number  
EP 12 19 9164

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Y	* paragraph [0022] - paragraph [0024]; figures 2,3,4 *	4	
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A	* column 4, line 3 - line 21; figures 1-3,7 * * EXAMPLE I; column 7, line 58, paragraph 56 *	6	
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A	* paragraphs [0065], [0075]; figures 3,8,9 *	6	
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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 8 August 2014	Examiner Tasiaux, Baudouin
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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## EUROPEAN SEARCH REPORT

Application Number  
EP 12 19 9164

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 8 August 2014	Examiner Tasiaux, Baudouin
<p>CATEGORY OF CITED DOCUMENTS</p> <p>X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document</p> <p>T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons &amp; : member of the same patent family, corresponding document</p>			

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**CLAIMS INCURRING FEES**

The present European patent application comprised at the time of filing claims for which payment was due.

☐ Only part of the claims have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due and for those claims for which claims fees have been paid, namely claim(s):

☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due.

**LACK OF UNITY OF INVENTION**

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

see sheet B

☒ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.

☐ As all searchable claims could be searched without effort justifying an additional fee, the Search Division did not invite payment of any additional fee.

☐ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:

☐ None of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims, namely claims:

☐ The present supplementary European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims (Rule 164 (1) EPC).



# **LACK OF UNITY OF INVENTION** **SHEET B**

Application Number

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The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

## 1. claims: 2, 3(completely); 1(partially)

Claims 2-3, in combination with Claim 1 whose subject-matter is known per se, relates to a ceramic heater, wherein the heat-generating element has electrically conductive lead portions connected to respective ends of the heat-generating portion, said lead portions located on the rear end side of the heat-generating portion, and a thickness of the heat-generating portion is equal to 30% or less than that of the lead portions.

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## 2. claims: 4(completely); 1(partially)

Claim 4, in combination with Claim 1 whose subject-matter is known per se, relates to a ceramic heater, wherein an energization control unit configured to adjust supply power to the heat-generating element, and adapted to control heat generation of the heat-generating portion through adjustment of the supply power, and wherein the energization control unit supplies power to the heat-generating element in such a manner as to raise a surface temperature of a heating portion of the substrate corresponding to the heat-generating portion from a room temperature to 1,000[deg.]C within one second.

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## 3. claims: 5, 6

Claims 5 and 6, describing a method of manufacturing a ceramic heater, said ceramic having a generic heat-generating portion, which does not have a priori a fracture toughness of 4.3 MPa.m<sup>0.5</sup> or more but wherein a portion of the green insulation body located around the prospective heat-generating portion has a relative density of 46.3% or more.

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**ANNEX TO THE EUROPEAN SEARCH REPORT  
ON EUROPEAN PATENT APPLICATION NO.**

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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.  
The members are as contained in the European Patent Office EDP file on  
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08-08-2014

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82