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## (54) Electrical resistance heating element.

(57) The invention is for an electrical resistance heating element, mainly for use in cooker hot-plates. The objective of the invention is to achieve a rapid heating and an advantageous heat distribution over the heated surface. A further objective of the invention is to obtain, in some applications, a light signal indicating a hot surface. This is achieved thereby that the element comprises at least two parts made from different materials (1,2) and having different temperature factors. A prefered embodiment of the invention is a combination of one metallic and one metallic-ceramic material.

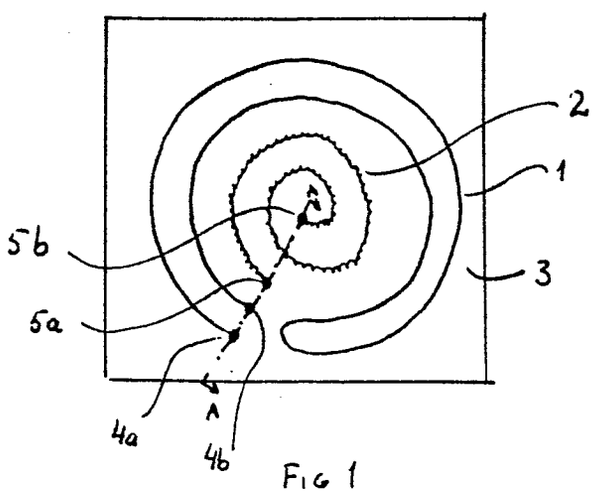


Fig 1

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# ELECTRICAL RESISTANCE HEATING ELEMENT.

This invention is for an electrical resistance heating element. The invention also is for a cooker hot-plate or the like where one or more elements according to the invention are being used.

Various ways of using electrical resistance elements for hot-plates and other heating purposes are known. Electrical stoves for household use comprise different kinds of hot-plates. Most important are massive plates, tubular plates and glass hot-plates. In all of these heating is by means of metallic resistance elements which on the first two cases are enclosed in a plate or tube and surrounded by insulating material while in the case of glass hot-plates the element is positioned on an insulating material and radiates heat towards the glass plate which is above the element at a suitable distance.

There is a need to improve certain properties of resistance elements for these and other applications. Compared to previously known hotplates and mainly previously known glass hot-plates the purpose of the present invention is to obtain, in addition to the heating, a light signal which indicates a hot surface. Another object of the invention is to obtain this light signal in connection with the heating without any delay. A further objective of the invention is to obtain faster heating compared to previously used elements. Also a further objective of the invention is to obtain such a heat distribution from the heating element that an equal heating all over the surface of a pan or the like is achieved.

An electrical resistance heating element according to the invention is characterized in that it comprises at least two parts made from different materials. These materials shall be such that at least one part of the element is made from a material having a small temperature factor and at least one part is made from a material having a greater, positive temperature factor. The parts are electrically connected to each other and preferrtably at least two parts from different materials are connected in series to each other.Temperature factor ($c_T$) means the ratio of a the electrical resistance of a material at one temperature and the resistance of the same material at another,lower temperature. Depending on whether the resistance of the material increases or decreases as the temperature is increased the temperature factor can be positive or negative. Examples of materials having a small positive temperature factor are alloys of nickel-chromium or iron-chromium-aluminium, the temperature factor mostly being not greater than 1.2 in the temperature interval 0-1200°C. The temperature factor for this kind of materials is generally positive and the numerical value of any possible negative factor is small. Materials having a great temperature factor are e. g. molybdenum, tungsten and molydenumdisilicide. At an increase of the temperature from ambient to 1200°C the temperature factor for molybdenumdisilicide resistance elements is about 10. Variations may occur depending upon the exact composition of the material, possible additives, porosities etc. Corresponding values for molybdenum and tungsten are 5-7.

A resistance element according to the invention comprises, as mentioned above, at least two parts which are electrically connected to each other. The connection can be direct without any intermediate connection means but for many applications materials are used which have such pro perties that a immediate connection of the materials is improper. The materials are then connected to each other through a connector having a low electrical resistance. Such connentors can be made from conventional electrical conductors such as copper, aluminium and some iron alloys or they can be made from the same kind of material as the resistance elements but with a larger cross sectional area and thus lower electrical resistance per unit length. A resistance element according to the invention thus comprises a plurality of parts that are connected to each other and jointly operate to heat a certain surface or object.

The invention will below be described by means of the figures and example, however without being limited to these embodiments.

A resistance element according to the invention is shown in figure 1 and figure 2 shows how the parts of the element are connected to each other and an outside voltage source. The resistance element has two parts, one part made from metal-ceramic material (1), another part made from metallic material (2). Both parts of the element have connection ends (4a,4b,5a,5b). The parts of the element are resting on a board of insulating material.

It is suitable to select the two materials of the resistance element so that the material (1) which forms the outer shape of the element has a temperature factor such that $5<c_T<15$ while the inner part of the element (2) is made from a material such that $-1.25<c_T<1.25$ in the temperature interval 0-1200°C. The elements are preferably of such dimensions that at ambient temperature the ratio of the resistance of the two materials is $1:25<R_1:R_2<1:5$ where $R_1$ is the resistance of the material having the greater $c_T$ and $R_2$ is the resistance of the material having the smaller $c_T$. The ratio at the operating temperature is preferrably $1:5<R_1:R_2<1:1$. The maximum

working temperature of the parts of the resistance element will only in exceptional cases be more than 1000°C even though the materials of the element can be used at higher temperatures. By choosing materials and dimensions of the parts of the element as said above one will achieve the advantages wanted such as rapid heating up,rapid control respons, a "light signal" corresponding to the temperature and a controlled heat distribution over the heated surface.

The parts of the element as shown in the figures have connection parts made from the same materials as the parts of the element but the cross sectional area is larger. In order to form an element according to the invention the two parts of the element are connected to each other by a connector (7) made from a material having a low electrical resistance. The leads to the parts of the element are so designed that they will have a low temperature at the point of connection. The connector may thus be made from e. g. aluminium or copper and connection may be by means of soldering or a mechanical clamp. It is also possible to design a connector so that its heat conducting capacity is relatively high and it can then be directly connected to the element without the use of a special connector. The parts of the element may also be connected via a special connection box. This can be especially suitable is one wants to change the way the parts of the element are connected to each other for control purposes.

Example

A resistance element is made from two parts as shown in figure 1. The outer part is made from a molybdenumdisilicide based material, availab le under the name KANTHAL SUPER, in the form of a wire having a diameter of .5 mm and a total length of 750 mm. The inner part of the element was made from a iron-chromium-aluminum-alloy available under the name KANTHAL. It was in the form of a wire having a diameter of .75 mm and coiled to a spiral with a diameter of 5 mm. The total length was 6 m. At ambient temperature the resistance of the outer part was 1 ohm, of the inner part 18 ohms. The element was connected to a 220 volts source. The outer part of the element was thereby heated and illuminated within 2 seconds. Due to the low resistance of this material at ambient temperature the current was high immediately after switching on. The current then decreases rapidly as the resistance increases as a result of the increasing temperature. When the working temperature was reached the resistance of the outer part of the element was 10 ohms and of the inner part 19 ohms, corresponding to temperature factors $c_T = 10$ and $c_T = 1.1$ respectively.

## Claims

1. Electrical resistance heating element comprising at least two parts made from different materials and having different temperature factors characterized in that one material is metallic, its temperature factor $c_T$ being $-1.25 < c_T < 1.25$ and that the second material is metallic or metal-ceramic, its temperature factor being $c_T > 5$ for a change of temperature from 0 to 1200°C.

2. Element according to claim 1 characterized in that the metal-ceramic material is based upon molybdenumdisilicide.

3. Element according to any of the preceding claims characterized in that the ratio of the resistance of the parts of the element is $1:25 < R_1:R_2 < 1:5$ at ambient temperature, where $R_1$ is the resistance of the material having the greater $c_T$ and $R_2$ is the resistance of the material having the smaller $c_T$.

4. Element according to claim 3 characterized in that $1:5 < R_1:R_2 < 1:1$ at the working temperature of the element.

5. Element according to any of the preceding claims being such that the element is made from a wire or a spiralized wire which is laid out in one plane to form a pattern characterized in that the outer contour of the pattern is given by the material having the greater $c_T$

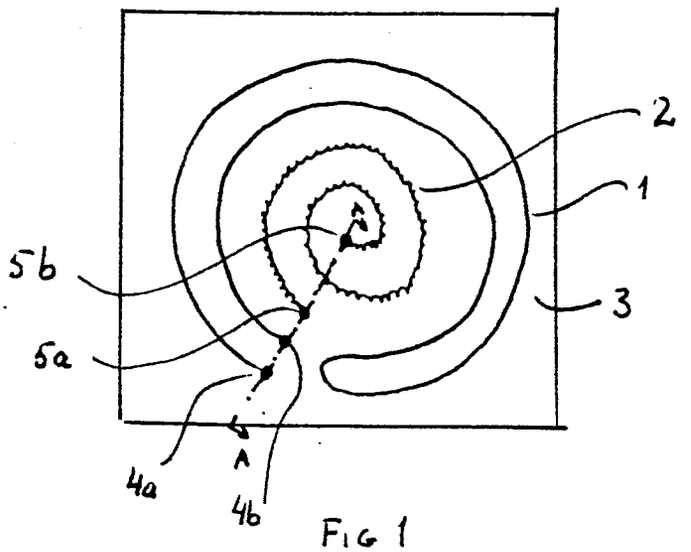


FIG 1

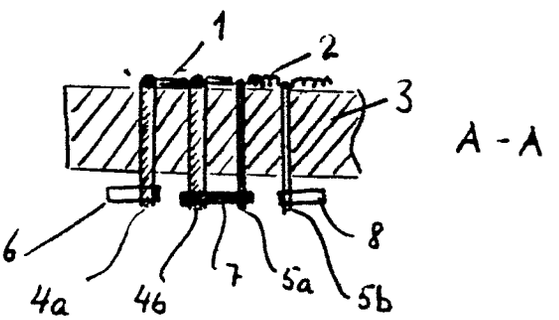


FIG 2

European Patent Office

# EUROPEAN SEARCH REPORT

Application number

EP 85 85 0239

## DOCUMENTS CONSIDERED TO BE RELEVANT

| Category | Citation of document with indication, where appropriate, of relevant passages | Relevant to claim | CLASSIFICATION OF THE APPLICATION (Int. Cl.4) |
|---|---|---|---|
| Y | US-A-3 912 905 (GILER) * Column 2, lines 6-12, 29-48; column 3, lines 23-33 * | 1,3,4 | H 05 B 3/74<br>H 05 B 3/12 |
| A | | 2,5 | |
| Y | GB-A- 825 049 (CYRIL LACY-HULBERT) * Page 1, lines 45-62; page 2, lines 12-47 * | 1,3,4 | |
| A | GB-A-1 273 023 (THE ELECTRICITY COUNCIL) * Page 1, lines 30-47; page 2, lines 46-53 * | 1 | |
| A | DE-A-2 210 651 (LICENTIA) | | TECHNICAL FIELDS SEARCHED (Int. Cl.4) |
| | | | H 05 B 3/00 |

The present search report has been drawn up for all claims

| Place of search | Date of completion of the search | Examiner |
|---|---|---|
| THE HAGUE | 18-03-1986 | RAUSCH R.G. |

CATEGORY OF CITED DOCUMENTS

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