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(54) **Method for assembling an electrical device**

(57) The present invention relates to a method for assembling an electrical device comprising the steps of:

- positioning a first electrical element on a support,
- positioning a second electrical element in electrical contact with the first electrical element, and
- fixing the first and second electrical element on each other, wherein
- the method comprises the step of:

- prior to the positioning of the second electrical element on the first electrical element dispensing a liquid between the connecting services of the said elements in order to thereby create a suction effect the services to provide said fixing between the first and the second electrical element.

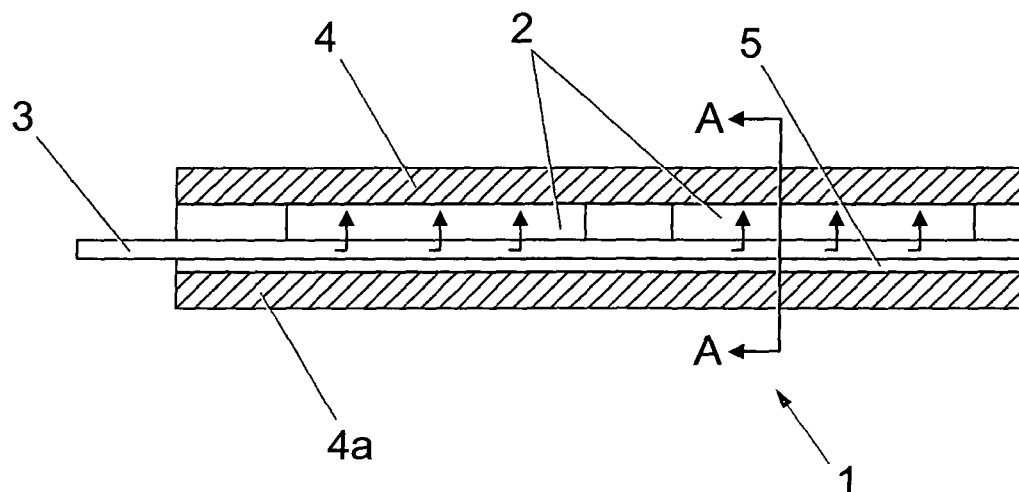


Fig. 1

Description

[0001] The present invention relates to a method for assembling an electrical device comprising the steps of:

- positioning a first electrical element on a support,
- positioning a second electrical element in electrical contact with the first electrical element, and
- fixing the first and second electrical element on each other sufficiently to permit further assembly of the electrical device without movement of the first electrical element with respect to the second electrical element.

[0002] The method according to the introduction is known in the prior art. The method is, for instance, used for assembling a heater element of an electric heater, each heater element comprising a contact sheet and one or more PTC elements.

[0003] In order to assemble a heater element, according to the prior art, the PTC elements are positioned on the contact sheet and fixed to the contact sheet by means of an adhesive, such as a glue. The use of such an adhesive on the PTC elements brings the risk of leaking glue and/or sealing material between the PTC element surface and the contact sheet. This leakage may influence the electrical and thermal contacts of the PTC elements to the contact sheet. This is undesired.

[0004] In case an adhesive is used to fix the PTC elements on top of the electrical sheet, the adhesive must resist to relatively high temperatures because the adhesive is in direct contact with the PTC element, which can reach temperatures up to 180°. The adhesive must also resist to high mechanical stresses because of the thermal expansion of the PTC element and the surrounding devices which may lead to cracking in the adhesive material.

[0005] With regard to the above, it is an object of the present invention to provide a method for assembling an electrical device wherein the use of adhesive can be avoided whilst fixing the first electrical element on top of a second electrical element.

[0006] This object is achieved in that the method for assembling an electrical device comprises the step of:

- prior to the positioning of the second electrical element on the first electrical element dispensing a liquid between the connecting surfaces of the said elements in order to thereby create a suction effect between said surfaces to provide said fixing between the first and the second electrical element.

[0007] Because of the presence of a liquid, dispensed in the form of a very thin layer, between the connecting surfaces of the first and the second electrical element, a suction effect due to surface tension will be created to fix the two opposite electrical elements on each other sufficiently

to hold the elements in place during further assembly of the device. This means that the electrical elements can be maintained in position, one upon the other, during further assembly of the device without the need of additional elements such as plastic frames and/or adhesive material.

[0008] In a preferred embodiment of the present invention the liquid is water.

[0009] To avoid any thermal effects and electrical resistance effect, it is preferred to use de-ionised water that is dispensed between the first and second electrical element. The advantage of using water, or de-ionised water, is that it does not require any constraining handling and the use of water is mostly inexpensive.

[0010] In case the electrical elements are not positioned in a correct way with respect to each other, the electrical elements can be repositioned or exchanged rapidly without any further complications.

[0011] According to the present invention, it is possible to place that the first and the second element in a climate chamber in order to evaporate the water between the connecting surfaces prior to using the electrical device.

[0012] Depending on the liquid used between the first and second electrical element, it might be preferred to first evaporate the liquid between the surfaces prior to the use of the electrical device.

[0013] In case the liquid used is water or de-ionised water, it is possible to immediately use the electrical device, whereby the water between the surfaces will evaporate and disappear creating a clean contact between the first and second electrical element, without running the risk of electrical and/or thermal resistance effect.

[0014] The present invention is specifically suited for assembling a heater element of an electric heater, the heater element comprising a contact sheet and at least one PTC element.

[0015] The present invention also relates to an electrical device assembled using the method of the invention.

[0016] The present invention will now be described with respect to the pending Figures, wherein:

Figure 1 shows an electrical heater assembled, using the method according to the present invention; Figure 2 shows, in cross-section, the electrical heater according to Figure 1 according to the line A-A.

[0017] In Figure 1, an electric heater element 1 is shown, having PTC elements 2 used to convert electrical energy in heat. The heater element 1 comprises a contact sheet 3 in order to transfer electrical energy to the PTC elements. The current flows from the contact sheet 3 through the PTC elements 2 towards the upper part of a tube 4. In order to avoid the electrical contact between the contact sheet 3 and the bottom part of the tube 4A, an insulator 5 is positioned in between the contact sheet 3 and the bottom part 4A of the tube 4.

[0018] The heater element 1 is shown in cross-section in Figure 2.

[0019] Figure 2 clearly shows the functioning of the insulation layer 5 separating the contact sheet 3 and the bottom part 4A of the tube 4.

[0020] In order to assemble the heater 1 according to Figures 1 and 2, the contact sheet is positioned on a first support. Thereafter a liquid is dispensed on the surface of the contact sheet prior to receiving PTC elements 2 on the contact sheet 3. Alternatively, the liquid may be dispersed on the connecting surface of the PTC elements.

[0021] The presence of the dispersed liquid will create a suction effect due to surface tension of the liquid as soon as the PTC element is placed on the contact sheet. This suction effect will assure a fixation of the PTC elements 2 on top of the contact sheet 3. This fixation is sufficient to permit the combination of contact sheet 3 and PTC elements 2 positioned on the sheet to be handled, without risking an undesired movement of the PTC elements 2 with respect to the contact sheet 3.

[0022] The combination of contact sheet 3 and PTC elements 2 is thereafter positioned with the insulation sheet 5 inside a tube 4. The presence of the tube 4 will thereafter provide a contact force in order to hold the PTC elements in place on the contact sheet 3. As soon as the tube 4 is placed around the assembly of PTC elements 2, the contact sheet 3 and insulation layer 5, the presence of the liquid is no longer required in order to provide the fixing between the PTC elements 2 and the contact sheets 3. That means that the liquid then is allowed to evaporate, leaving a clean contact without the risk of an electrical and/or thermal resistance effect on the contact between the PTC elements and the contact sheet 3.

[0023] The liquid in between the PTC elements 2 and the contact sheet 3 may evaporate during the first use of the electrical heater 1. Alternatively, the liquid may be evaporated in a conditioned environment, such as a climate chamber.

[0024] In the present text the wording "climate chamber" is used. "Climate chamber" refers to any space, open or enclosed, with a controlled temperature, suitable for advancing the evaporation of the liquid between the connecting surfaces of the first and second electrical element.

[0025] It should be understood that the method according to the present invention is not limited to the assembly of heater elements having PTC elements and contact sheets 3. The method according to the invention can be used for the assembly of any electrical device having first and second electrical elements which need to be located and held in place one upon the other during assembly.

port,

- positioning a second electrical element in electrical contact with the first electrical element, and
- fixing the first and second electrical element on each other, **characterised in that**,
- the method comprises the step of:
- prior to the positioning of the second electrical element on the first electrical element dispensing a liquid between the connecting surfaces of the said elements in order to thereby create a suction effect between said surfaces to provide said fixing between the first and the second electrical element.

2. A method according to claim 1, **characterised in that**, the liquid is water.
3. A method according to claim 1 or 2, **characterised in that**, the liquid is de-ionised water.
4. A method according to one of the preceding claims, **characterised in that**, the first and the second element are placed in a climate chamber in order to evaporate the water between the connecting surfaces thereof prior to using the electrical device.
5. A method according to one of the preceding claims, **characterised in that**, the first electrical element has the form of a contact sheet, wherein the second electrical element is a PTC-element.
6. An electrical device having a first and a second electrical element, wherein the electrical device is assembled using the method of one of the preceding claims.

Claims

1. A method for assembling an electrical device comprising the steps of:

- positioning a first electrical element on a sup-

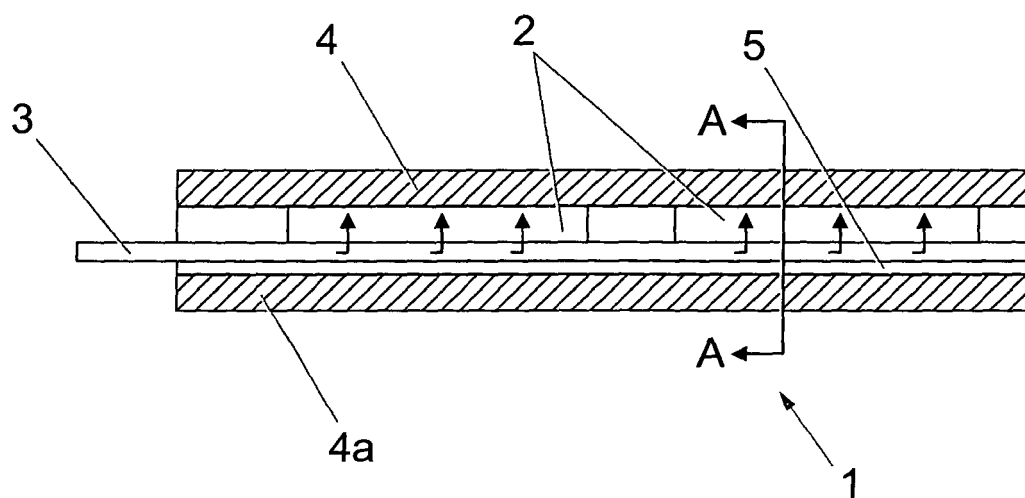


Fig. 1

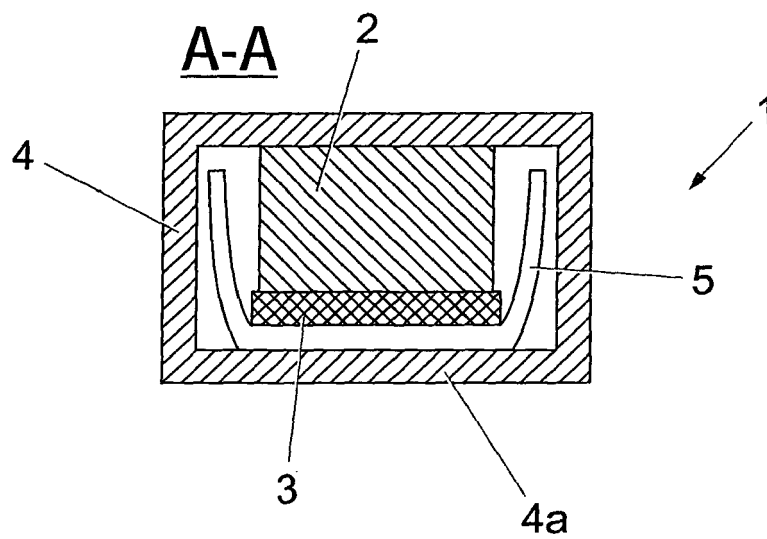


Fig. 2



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.7)
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			TECHNICAL FIELDS SEARCHED (Int.Cl.7)
			H05K H01C H05B
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 27 June 2005	Examiner Kyriakides, D
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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**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 04 25 7504

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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