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D E C I S I O N
of 18 March 2004

Case Number: T 0661/01 - 3.4.3

Application Number: 93917069.2

Publication Number: 0649562

IPC: H01C 1/14

Language of the proceedings: EN

Title of invention:
Circuit protection device

Patentee:
RAYCHEM CORPORATION

Opponent:
Bourns Inc.

Headword:
-

Relevant legal provisions:
EPC Art. 56

Keyword:
"Inventive step (denied)"
"Closest state of the art document"

Decisions cited:
-

Catchword:
-

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Case Number: T 0661/01 - 3.4.3

D E C I S I O N
of the Technical Board of Appeal 3.4.3
of 18 March 2004

Appellant: (Opponent)
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Decision under appeal: **Decision of the Opposition Division of the European Patent Office posted 4 April 2001 rejecting the opposition filed against European patent No. 0649562 pursuant to Article 102(2) EPC.**

Composition of the Board:

Chairman: R. K. Shukla
Members: V. L. P. Frank
J. P. B. Seitz

Summary of Facts and Submissions

I. The appeal is against the decision of the Opposition Division rejecting the opposition against the European patent No. 0 649 562 according to Article 102(2) EPC.

The wording of the independent claim 1 as granted is as follows:

"1. A circuit protection device which has a resistance at 23°C of less than 50 ohms and which comprises
(1) a first laminar electrode (13),
(2) a second laminar electrode (15), and
(3) a laminar resistive element (61) which is composed of a PTC conductive polymer, and which has a first face to which the first electrode is secured and an opposite second face to which the second electrode is secured;
the device comprising
(a) a main portion (11, C-D) which comprises
(i) a main part of the first electrode (13),
(ii) a main part of the second electrode (15), and
(iii) a main part of the resistive element (61);
and
(b) a first connection leg (19) which extends away from the main portion and which comprises
(i) a first leg part of the first electrode (13) which is integral with the main part of the first electrode (13), and
(ii) a first leg part of the resistive element (61) which is integral with the main part of the resistive element (61);

said first connection leg (19) comprising

(i) a first distal sub-portion (21) which

(a) is spaced away from the main portion of the device,

(b) comprises a first distal sub-part of the first leg part of the first electrode (13),

(c) comprises a first electrical connector (51) which contacts the first distal sub-part of the first electrode (13) and extends at least to the second face of the laminar resistive element (61), and

(d) comprises a second residual conductive member (49) which is on the second face of the first leg part of the resistive element (61);

and

(ii) a first bridge sub-portion (25, D-E) which

(a) lies between the first distal sub-portion (21) and the main portion (11, C-D) of the device,

(b) extends across the width of the first connection leg, and

(c) does not include any part of the second electrode (15);

the second residual conductive member (49) being a member which is separated from the second electrode (15) and which, in the absence of the first-bridge sub-portion (25, D-E), would be integral with the second electrode;

whereby the device can be placed flat on a planar insulating substrate (9) having first and second appropriately spaced-apart metal conductors (41, 43) on the surface thereof, with the first electrical connector (51) against the first metal conductor (41);

and electrical connection can be made (a) between the first metal conductor (41) and the first electrode (13), through the first electrical connector (51), and (b) between the second conductor (43) and the second electrode (15)."

II. The opposition was directed against the patent as a whole and was based on the ground that the subject-matter of the patent did not involve an inventive step (Articles 100(a), 52(1) and 56 EPC).

The following prior art documents were *inter alia* cited in the opposition proceedings:

A5: US-A-4 924 204

A6: EP-A-0 308 306

A8: US-A-4 689 475

According to the decision under appeal it was not in dispute that document A5 represented the closest state of the art. The distinguishing features of the device according to claim 1 allowed the device to be 'surface mounted' on a substrate, namely to be directly mounted flat on the substrate with the two electrodes on the opposing faces of the resistive element being brought into electrical contact with the corresponding first and second metal conductors on the substrate. To make a PTC thermistor of the state of the art 'surface mountable' was, therefore, the objective technical problem addressed by the application in suit. This problem also corresponded to the one described in the originally filed application.

According to the Opposition Division, the direct combination of documents A5 and A6 did not result in the device as claimed, but further additional features had to be introduced which were neither disclosed in the documents of the state of the art nor belonged to the general background knowledge of the person skilled in the field, since document A6 did not disclose a residual conductive member which, in the absence of the bridge sub-portion, would be integral with the second electrode. These features were, moreover, not a casual consequence of using a particular fabrication technology but the result of selecting a structural design of the device that allowed to realize it according to a specific fabrication technology.

The disclosure of document A8 was not considered in the decision under appeal, as the opponent's arguments on inventive step with respect to the independent claim were not based on this document in the opposition proceedings.

III. The opponent lodged an appeal on 5 June 2001, paying the appeal fee on the same day. The statement of the grounds of appeal was received on 8 August 2001. The appellant requested that the patent be revoked.

IV. The appellant (opponent) was not represented at the oral proceedings before the Board on 18 March 2004 as announced in his letter of 27 January 2004. The request for the revocation of the patent was maintained in the letter.

The respondent (patent proprietor) requested that the appeal be dismissed and the patent be maintained as granted.

V. The appellant argued essentially as follows:

– The technical problem underlying the contested patent having regard to document A5 as the closest state of the art is to make a polymer thermistor of the prior art 'surface mountable'. To this effect, in the device of the invention, the electrode contact to the upper major face is brought down to the lower face of the device such that surface mounting can take place.

– Document A6 discloses in Figure 7 a ceramic thermistor in which the contact to the upper electrode is brought down to the lower face by a conductive layer and an end cap. The direct combination of the disclosures of documents A5 and A6 results, therefore, in a thermistor in which the only difference with respect to the one specified in claim 1 lies in the absence of a second residual conductive member on the second lower face of the resistive element. The electrodes on a polymeric material are, however, laminated on the whole surface of it. It would, therefore, be obvious to remove the material of the electrode only at the unwanted portions. This process automatically leaves a second residual conductive member in place and no inventive step is related to the provision of it.

– Alternatively, document A8 could be considered as the closest state of the art, since it discloses a polymeric PTC element with two laminar electrodes covering its whole surface. As electric contacting means have to be provided on the electrodes, a person skilled in the art would have considered the disclosure of document A6 as suitable for providing a surface mountable PTC element based on the polymeric material disclosed in document A8.

VI. The respondent argued essentially as follows:

– Document A5 discloses a polymeric thermistor in which the electric contact to the electrodes laminated on the polymeric material is made by terminal members elastically clamping the thermistor element from opposite directions. This is done in order to prevent the loss of stability of the polymeric material which occurs in the prior art under the influence of the heat evolved during soldering of leads to the laminated electrodes. To provide an electrical connection as specified in the independent claim of the contested patent in the thermistor disclosed in document A5 would amount to a complete rejection of the essential teaching of document A5, i.e. electrically contacting the thermistor element by springs. Such a modification cannot be, therefore, regarded as obvious to a person skilled in the art. Moreover, it would not pose any difficulties to the skilled person to modify the thermistor disclosed in document A5 for making it surface mountable while retaining at the same time the elastic clamping of the electrodes.

– Document A6 relates to the automatic insertion of a ceramic thermistor to reduce the production costs of the associated circuits. The thermistor element is made of a ceramic perovskite material. However, it is difficult on these materials to provide a reliable ohmic electric contact. For this reason, an electric coating making good ohmic contact to the ceramic is formed on the ceramic slab and then an end cap which can easily be soldered to the circuit board is attached on this coating.

– However, ceramics and polymers which are suitable for a thermistor element are very different in their properties. These differences include inter alia the thermal expansion coefficient, processing methods, electroding, resistivity and capacitance. Polymeric and ceramic arts are, therefore, sufficiently different that a person skilled in one art would not take technical solutions from the other unless the prior art document in question was concerned expressly with a problem where the underlying technology was shared. This applies to a great extent to the technologies involved in manufacturing various products. For this reason, the ceramic and polymeric technologies cannot be regarded as 'neighbouring technical fields'.

Reasons for the Decision

1. The appeal is admissible.

2. The contested patent relates to a positive thermal coefficient (PTC) thermistor comprising a conductive polymer, i.e. a composition comprising a polymer with a dispersed particulate conductive filler, which is laminated between two electrode foils. The polymeric thermistors of the state of the art cannot be mounted flat on a printed circuit board and protrude from the board, as they have electrical terminals extending away from the major surfaces of the thermistor that are soldered to the circuit board (cf. column 1, lines 3 to 6 and 31 to 33 of the patent in suit). The patent, therefore, discloses a thermistor which can be mounted flat on a circuit board, i.e. a surface mounted device (SMD) design, allowing that the electric contact to both electrodes can be made on the same major surface of the thermistor.

3. *Closest state of the art*

3.1 It was common ground in the opposition proceedings that document A5 was the closest state of the art document (cf. point 3.1 of the Reasons of the decision under appeal). In the statement of grounds of appeal the appellant, however, argued that document A8 could also be regarded as the closest state of the art.

In the following the disclosure of documents A5 and A8 will be presented:

3.1.1 Document A5 discloses that prior art thermistor elements tended to deteriorate so much as to result in a loss of stability under the influence of heat evolved during the soldering of the leads to the electrodes. It has been proposed, for this reason, to retain the thermistor element by means of a pair of terminal members elastically clamping the element from opposite directions while held in contact with the electrodes. However, when the thermistor is heated as a result of an overcurrent induced in the element during its operation, the element which is made from a polymeric material as its principal component, may soften to such an extent that the resilient forces exerted by the terminal members cause the element to deform at the contacting locations. In the worst case, this softening may lead to a short-circuiting between the opposite electrodes (cf. A5, column 1, line 36 to column 2, line 2; Figure 9).

Addressing the above mentioned problems of the state of the art, document A5 discloses a thermistor formed by a slab-shaped polymeric thermistor element having electrode layers formed on its two opposing major surfaces. Each one of the electrode layers comprises a non-electrode region 2a and 3a which is displaced in position with respect to the opposite non-electrode region. Two electric terminals 5 and 6, having an inwardly bent elastic tongue 5a and 6a, are elastically engaged to the electrode layers on each side of the element to contact the electrode on a region which is aligned with the non-electrode region of the opposite side. Should the thermistor be deformed as a result of self-heating, short-circuiting will not occur because the contacting region of each electrode layer is

opposite to the non-electrode region of the opposite electrode layer (cf. column 2, lines 14 to 68; column 3, lines 35 to 61 and Figures 1 to 3).

3.1.2 Document A8, on the other hand, discloses a thermistor made of a sheet of a conductive polymer 12 onto which electrodes are provided by metal foils 14 and 16 attached to both sides. To improve the adhesion to the polymer the metal surface has a microrough surface. This increased adhesion between the electrodes and the polymer composition allows a larger range of conductive polymers to be used in manufacturing the device. According to the example disclosed in this document nickel-plated steel leads were attached to each metal foil and the device was thereafter encapsulated by an epoxy resin (cf. column 1, lines 11 to 18 and 56 to 63; column 2, lines 53 to 55; column 3, lines 39 to 42; Figure 1).

3.2 The Board concurs with the respondent in that the skilled person would not disregard in document A5 the manner in which the electric terminals are provided on the thermistor, namely by elastically clamping the thermistor element between them, as this is the core of this document's contribution to the state of the art. When starting from document A5, the skilled person would have to ignore its contribution to the state of the art and make a completely new approach in the way of contacting the element to reach the structure claimed in the patent in suit. To disregard the essential teaching of document A5 would, therefore, amount to a hindsight analysis having the invention of the patent in suit in mind.

3.3 It remains therefore for the Board to consider document A8, which the appellant also relied on in the written statement, as another starting point for an assessment of inventive step.

4. *Inventive step*

4.1 The circuit protection device according to claim 1 of the patent in suit comprises a laminar polymeric thermistor element 61 having electrodes 13 and 15 laminated on its two major faces. These faces will in the following be called the upper and the lower face, as the device is to be mounted flat on a circuit board. A part of the metal foil of the lower face electrode, i.e. the bridge portion 25, is removed along the width of the thermistor element dividing the metal foil in two regions, a residual conductive member 49 and the proper lower face electrode 15. A U-shaped connection leg 51 extends from the upper face to the residual conductive member on the lower face along the edge of the thermistor element, providing an electric contact between this member and the upper face electrode 13. A solder joint 59 lies between the connection leg 51 and the upper electrode 13 and between the connection leg 51 and the residual conductive member 49. In this way, electric contact can be made to both electrodes 13 and 15 on the same face of the device, whereby the thermistor element can be mounted flat on the surface of the printed circuit board (cf. column 6, lines 14 to 38 and Figure 2 of the contested patent).

4.2 The circuit protection device according to claim 1 differs, therefore, from the thermistor disclosed in document A8 essentially in that:

(a) a part of the lower electrode is removed to form the non-conductive bridge portion and the residual conductive member, and

(b) a U-shaped connection leg provides the electric contact between this member and the upper electrode.

4.3 It follows that the technical problem objectively addressed by the patent in suit having regard to document A8 as the closest state of the art corresponds to the problem stated in the patent, namely to provide a polymeric thermistor which can be mounted flat on a circuit board and that does not protrude from the board more than is desirable (cf. column 1, lines 31 to 33 of the patent).

4.4 Document A6, however, discloses a surface mountable thermistor comprising a slab-shaped ceramic thermistor element. Electrodes 51 and 52 are provided on the upper and lower surfaces, respectively, so that they leave opposite end regions on each surface uncovered. A conductive layer 53 extends along the edge of the element from the upper electrode to the region at the lower surface left uncovered by the lower electrode. Finally, an end cap 55 is fitted onto this conductive layer. The reason presented in this document for providing a conductive layer and an end cap on top of it is that materials that make good ohmic contact to the ceramic are hard to solder. Consequently, a conductive layer making good contact to the ceramic is chosen and then an end cap that can easily be soldered to the circuit board is fitted onto this layer (cf.

column 1, lines 3 to 9; column 2, lines 18 to 36; column 4, lines 21 to 47 and Figure 7). The combined conductive layer 53 and end cap 55 fulfils, therefore, the same function as the U-shaped conductive leg according to the patent in suit, namely to permit that electric contact to the upper electrode is brought down to the thermistor's lower surface, so that the device is surface mountable.

4.5 The respondent has contended that the polymer and ceramic arts are sufficiently different that a person skilled in one art would not take technical solutions from the other unless the prior art in question concerned expressly a problem where the underlying technology was shared. These differences include inter alia the thermal expansion coefficient (CTE), processing methods, electroding, resistivity and capacitance. Ceramic materials, for example, have a smaller CTE than polymeric materials and, therefore, a higher thermal mismatch with respect to the circuit board, a fact that has to be taken into account in the design of the device. Moreover, the fabrication and processing techniques of ceramic and polymeric materials are quite different, as ceramics are sintered at high temperatures at which polymeric materials would be destroyed and the manner in which the electrodes are formed in these materials differs greatly. With ceramics a metallic paste is fired at high temperature to form a contacting layer on the material. With polymers, on the other hand, a metal foil or mesh is embedded into the surface of the material while the polymer is held close to its melting temperature. It follows from this difference in the electroding technology that in ceramics the electrodes are formed

at their final locations while for polymeric materials the electrodes formed from the embedded metal foil are patterned and etched at a later stage.

4.6 The Board concurs with the respondent in that the ceramic and polymeric arts are quite different in the aspects the respondent mentioned. However, the patent in suit does not address these aspects, i.e. the device's structural design or a choice of materials for the electrodes, but only relates to the manner in which the thermistor can be mounted flat on the surface of a circuit board. The problem underlying the contested patent is, therefore, how to provide an electric contact to the upper electrode of a thermistor lying flat on a circuit board. Although it is true that this problem can be solved in several ways, e.g. by soldering leads to both electrodes or providing resilient terminals which clamp the thermistor element between them and bending the leads or terminals so that they can be soldered to the circuit board, a skilled person would also recognize that the manner in which the contacts are provided in the ceramic thermistor disclosed in document A6 is also suitable for the polymer thermistor of document A8. The selection of the electrodes materials and the structural design of the device will have to be adapted to the particular situation of a polymeric thermistor. The person skilled in the art of polymer thermistors, however, is well aware of the specific requirements in this art. Moreover, as already mentioned, the patent in suit does not address these issues.

4.7 The Opposition Division considered in their decision that the presence of the residual conductive member 53 is the result of the selection of the device's structure so that it can be realized according to a specific, preferred technology applicable only to the polymeric art. The selection of this structure involved, in their view, an inventive step.

The Board, however, cannot follow this line of argument and considers that, as pointed out by the appellant, the residual conductive member is merely a consequence of the manner in which an electrode layer is provided on a conductive polymer, namely by attaching a metal foil or mesh on each side of the material, as disclosed for example in document A8. It would, therefore, be a logical consequence to remove the metal foil at the portions where it is not needed. This contrasts with the way the electrodes are provided on a ceramic thermistor, since in this case only the selected areas are covered by the metallic paste and then fired, and, therefore, no unwanted electrode regions exist.

The respondent has also argued in this respect that the presence of the residual conductive member improves the mechanical and electrical properties of the device. The Board, however, cannot recognize any substantial improvement of the device due to the residual conductive member. In particular, the respondent argued that no potential drop occurs across the distal region of the thermistor element, as its both faces are held at the same electric potential by the U-shaped connection leg (cf. Figure 2 of the contested patent). However, in the Board's view, the absence of the residual conductive member would not have substantially

affected the distribution of electric field across the distal region of the thermoelectric element, since the strongest electric field at any potential to which the thermistor is subjected is applied across the main region, i.e. the element's region between lines C and D in Figure 2.

5. For these reasons, in the Board's judgement, the circuit protection device according to claim 1 does not involve an inventive step in the sense of Article 56 EPC.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The patent is revoked.

The Registrar: The Chairman:

D. Meyfarth R. K. Shukla