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D E C I S I O N
of 26 November 1997

Case Number: T 0559/94 - 3.4.1

Application Number: 89120158.4

Publication Number: 0367209

IPC: H05B 3/86

Language of the proceedings: EN

Title of invention:
Electrically heatable transparency

Applicant:
PPG INDUSTRIES, INC.

Opponent:

-

Headword:

-

Relevant legal provisions:
EPC Art. 56

Keyword:
"Inventive step - yes after amendments"

Decisions cited:

-

Catchword:



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Boards of Appeal

Chambres de recours

Case Number: T 0559/94 - 3.4.1

D E C I S I O N
of the Technical Board of Appeal 3.4.1
of 26 November 1997

Appellant: PPG INDUSTRIES, INC.
One PPG Place
Pittsburgh
Pennsylvania 15272 (US)

Representative: Sternagel, Hans-Günther, Dr.
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Decision under appeal: Decision of the Examining Division of the
European Patent Office posted 23 February 1994
refusing European patent application
No. 89 120 158.4 pursuant to Article 97(1) EPC.

Composition of the Board:

Chairwoman: G. Davies
Members: U. G. O. Himmler
H. J. Reich

Summary of Facts and Submissions

- I. The European patent application 89 120 158.4 was refused by a decision of the Examining Division dated 23 February 1994, following two communications of the Examining Division dated 14 January 1993 and 24 September 1993. Furthermore, the applicant was informed of the Examining Division's intention to refuse the application in the course of a consultation by telephone on 2 February 1994. However, the applicant did not wish to make further amendments to the application as on file at that time.
- II. The reason given for the refusal was that the subject-matter of the independent claims 1 and 14 filed with letter of 13 May 1993 lacked an inventive step having regard to the state of the art disclosed in documents D1 = US-A-4 725 710, D2 = WO-A-88/06 095 and D3 = US-A-4 654 067.
- III. On 23 March 1994, the appellant filed an appeal against the decision, paying the appeal fee on the same day. It was requested to set aside the disputed decision and to grant a patent with the claims on file. In the event that this request should not be allowable, the appellant requested oral proceedings.

The statement of grounds of appeal was submitted on 22 June 1994. Together with the grounds of appeal the appellant filed a new set of claims 1 to 20 replacing the claims on file.

With a letter of 13 July 1994, the appellant filed a further set of claims 1 to 22 to replace the claims filed with the grounds of appeal.

IV. In a communication annexed to the summons to attend oral proceedings dated 21 August 1997, the Board expressed a provisional opinion stating that claim 1 as on file complied neither with Rule 29(1) EPC nor with Article 84 EPC. Further the Board was of the provisional opinion that the subject-matter of a claim 1 which no longer showed the above-mentioned deficiencies, would not appear to involve an inventive step, having regard to the state of the art of the documents D2 and D1.

V. In the reply to the communication of the Board, the appellant filed, by letter of 14 October 1997,

- new claims 1 to 22 as main request
- a further set of claims 1 to 19 as a first auxiliary request and
- a third set of claims 1 to 17 as a second auxiliary request.

VI. Oral proceedings were held on 26 November 1997 during which the subject-matter of the application was extensively discussed. The appellant's arguments in favour of inventive step concerning the subject-matter of claim 1 of the main request were as follows:

- The features of the preamble of claim 1 correspond to the state of the art as known from document D2. This document does not give any hint to the underlying problem and its solution according to the present application.
- The object of the present application is to minimize the danger of overheating during use of the transparency and thereby destroying the heatable transparency. In particular, this danger

exists in the regions where the electroconductive coating extends over portions of the ceramic band (cf. col. 2, lines 27-30 of the EP-A-0 367 209). Starting from this problem, the closest state of the art is document D1 which is concerned with the distribution of electrical energy and, thus, with the distribution of heat in one or more selected zones of an electrically heatable transparency.

- Starting from the point of concentrating more heat in the zone of the vision unit (cf. col. 3, lines 39-43 of D1), the overheating is omitted in document D1 by the structure of wide and narrow portions of the bus bars. Wide portions of the bus bars overlap into the conductive coating on the vision unit of the transparency and, therefore, the resistance in this region is low. Consequently, the current through this region is high and the electrical energy, and thus the heat, is concentrated in this region.
- On the other hand, in sections between narrow portions of the bus bars, the conductive coating also passes over the rough and sometimes pinholed exposed surface of the ceramic enamel, so that the resistance of the conductive coating across such areas is increased and, therefore, less of the electrical energy flows through these sections (cf. col. 6, lines 29-39 of D1).
- Summarizing the disclosure of document D1, the conclusion derived therefrom is that no overheating appears in the region where the conductive coating covers the ceramic enamel borders, because in these regions the energy flow is restricted in comparison to the regions of the wide bus bars.

Therefore, the appellant concluded that the concept of

increasing the surface resistance of the electrically conductive coating covering the inner portion of the enamel ceramic border which is bonded to the glass substrate, by heating it at a sufficiently high temperature and for a sufficient length of time

is new and not obvious from the cited state of the art.

VII. Independent claims 1 and 13 as amended and filed during oral proceedings of 26 November 1997, forming the main request and the basis of the present decision read as follows:

Claim 1

"An electrically heatable transparency (20) comprising:

- a glass substrate (22);
- a border (32) bonded to a surface (30) of said glass substrate (22) extending around the periphery of said transparency (20);
- a pair of opposing bus bars (34, 36) spaced from each other and bonded to said border (32) so that the entire inner edges (38, 40) of said bus bars (34, 36) are positioned entirely on said border (32) and spaced from the inner edge of (42) of said border (32) providing an inner portion (44) of said border (32) which is not covered by said bus bars (34, 36); and
- an electroconductive coating (28) interconnecting said bus bars (34, 36) such that a portion of said coating (28) covers said glass substrate surface (30), said inner portion (44) of said border (32) and said bus bars (34, 36);

- at least one electroconductive lead (54, 56, 60, 62) electrically insulated from the coating (28) extending from one of said bus bars (34, 36) along a side portion of said transparency (20) and overlaying said border (32) such that said border (32) hides both of said bus bars (34, 36) and said lead (54, 56, 60, 62) when said border is viewed through said glass substrate (22),

characterized in that

said border (32) has been heated at a sufficiently high temperature and for a sufficient length of time to provide surface irregularities that result in an increased surface resistance of said coating (28) covering said inner portion (44) of said border (32), which increase is in the range of 50% or less than the surface resistance of said coating (28) covering said surface (30) of said glass substrate (22)."

Claim 13

"A method of fabricating a heatable transparency (20) comprising:

- cutting a glass substrate (22) to a desired shape;
- bonding an opaque border (32) to a surface (30) of said glass substrate (22) along the substrate's periphery;
- bonding a pair of opposing first and second electroconductive bus bars (34, 36) spaced from each other so that the entire inner edges (38, 40) of said bus bars (34, 36) are positioned entirely on said border (32) and spaced from the inner edge (42) of said border (32) providing an inner portion (44) of said border (32) which is not covered by said bus bars (34, 36);
- coating said substrate (22) with an electroconductive coating (28) having a predetermined surface resistance to electrically interconnect said bus bars (34, 36), such that a

portion of said coating (28) covers that glass substrate surface (30), said bus bars (34, 36), and said inner portion (44) of said border (32);
- providing at least one electroconductive lead (54, 56, 60, 62) electrically insulated from the coating (28) extending from one of said bus bars (34, 36) along a side portion of said transparency (20) and overlaying said border (32) such that said border (32) hides both of said bus bars (34, 36) and said lead (54, 56, 60, 62) when said border (32) is viewed through said glass substrate (32)

characterized by heating said border (32) at a sufficiently high temperature and for a sufficient length of time to provide surface irregularities that result in an increased surface resistance of said coating (28) over said inner portion (44) of said border (32), which increase is in the range of 50% or less than the surface resistance of said coating (28) covering said surface (30) of said glass substrate (22)."

Reasons for the Decision

1. The appeal complies with the requirements of Article 106 to 108 and Rule 64 EPC and is, therefore, admissible.
2. *Amendments and original disclosure*

The amendments introduced in claim 1 in comparison to the originally-filed claim 1 and the equivalent amendments in claim 13 concern the features that

(a) the substrate is a **glass** substrate;

- (b) the bonded border extends **around** the periphery of the transparency;
- (c) the **entire** inner edges of the bus bars are positioned entirely on the bonded border;
- (d) at least one electroconductive lead electrically insulated from the coating extends from one of the bus bars along a side portion of the transparency and overlays the border such that the border hides both bus bars and the lead when the border is viewed through the glass substrate;
- (e) the border has been heated at a sufficiently high temperature and for a sufficient length of time to provide surface irregularities that result in an increased surface resistance of the coating covering said inner portion of said border, which increase is in the range of 50% or less than the surface resistance of said coating covering said surface of said glass substrate.

The corresponding disclosure of these features can be found in

- (a) page 4, lines 12-19 of the original description and the original claim 12;
- (b) page 4, lines 33-34 of the original description, the original claim 11 and Figure 1;
- (c) page 5, lines 6-10 of the original description;
- (d) page 4, lines 33-37 of the original description, page 5, lines 15-23 and 26-27 of the original description and the original claim 11;

(e) page 6, lines 13-14 and page 6, line 35 to page 7, line 12 of the original description and the original claim 4.

Therefore the Board is satisfied that the current versions of claim 1 and claim 13 comply with Article 123(2) EPC.

The dependent claims 2 to 8 correspond to the original claims 5, 7, 13, 14, 8, 9, 10. Dependent claim 9 is based on page 10, lines 32-33 of the original description. The dependent claims 10 to 12, 14 and 16 to 22 correspond to the original claims 12, 2, 3, 17 and 18 to 21, 23 (in connection with the original description page 9, lines 23 to 27), 22 and 24. Dependent claim 15 is based on page 10, lines 32-33 of the original description.

3. *Novelty*

Novelty of the subject-matter of claims 1 and 13 was not in dispute as neither D1 nor D2 comprises all the features of either of these claims.

4. *Inventive step*

4.1 When the person skilled in the art is confronted with the problem of avoiding overheating, very different possibilities are offered by the general textbook knowledge of the person skilled in the art. One possible solution to the above problem could for instance be based on the common principle to reduce the dissipated power in the jeopardized region. This consideration would lead the skilled person to the well-known formula

$$P = U \times I = \frac{U^2}{R_{\text{total}}} = \frac{U^2}{R_{\text{VIS}} + R_{\text{CER}}}$$

wherein P is the dissipated power, U is the voltage across the pair of opposing bus bars, I is the current across the pair of opposing bus bars, R_{total} is the total resistance of the region between the pair of opposing bus bars which is composed of the resistance R_{VIS} being the resistance of the conductive coating **directly** applied to the glass substrate of the vision region, and R_{CER} being the resistance of the conductive coating applied to the ceramic enamel layer.

From this formula it is immediately clear that the resistance R_{CER} has to be increased in order to dissipate less energy in this region and thus to produce less heat in this region.

4.2 In order to increase the resistance there are known different possibilities:

- decreasing the thickness of the conductive layer,
- increasing the length between the bus bars and the conductive coating directly applied to the glass of the visible part of the windshield,
- increasing the specific resistivity of the material of the conductive coating,
- influencing the resistance of the region by the current density distribution via the dimension and the shape of the electrodes (bus bars) as known from document D1.

Thus, the skilled person would choose from one of these well-known possibilities to reduce the regional power dissipation in order to avoid overheating in this region.

- 4.3 Even if it is known from document D1 that the surface roughness of the enamel ceramic increases the resistance of the conductive coating on the enamel ceramic, the person skilled in the art would not try to **heat** this part "at a sufficiently high temperature and for a sufficient length of time" in order to get a higher resistance because, according to the textbook knowledge of the solid state physicist, a methodical heat treatment, also called "tempering", normally **decreases** the resistance and that would cause an increase of the dissipated power.

As neither document D1 nor any other document cited in the search report or during the examination procedure gives any hint as to the means by which and in which direction the resistance of the conductive coating covering the ceramic enamel border is influenced and whether it can be influenced at all, the Board considers it inventive to adopt a measure which the person skilled in the art would probably not have taken into account.

- 4.4 Consequently, in the Board's view, the subject-matter of claim 1 involves an inventive step.
5. The same considerations apply to the subject-matter of the independent claim 13 which refers to a method for making the transparency having the features of claim 1.
6. The dependent claims 2 to 12 and 14 to 22 concern particular embodiments of the subject-matter of claim 1 and claim 13 respectively; therefore they are allowable in accordance with Rule 29(3) EPC.

Order

For these reasons it is decided that:

1. The decision of the Examining Division is set aside.
2. The case is remitted to the department of first instance with the order to grant a patent on the basis of the following documents:

Description pages 1, 2, 2a, 2b, 2c, 2d and 3 to 12,
filed 26 November 1997,

Claims 1 to 22, filed 26 November 1997,

Drawings Figures 1 to 3, as originally filed.

The Registrar:

The Chairman:

M. Beer

G. Davies

