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Datasheet for the decision of 11 January 2018

Case Number: T 1104/13 - 3.4.03

Application Number: 07110960.7

Publication Number: 1873843

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Language of the proceedings: EN

Title of invention:
Photovoltaic plant

Patent Proprietor:
Fototherm S.r.l.

Opponent:
Pirovano, Federico

Headword:

Relevant legal provisions:
EPC 1973 Art. 56, 113(1)
RPBA Art. 15(3), 15(5)

Keyword:
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Decisions cited:

Catchword:

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Case Number: T 1104/13 - 3.4.03

D E C I S I O N
of Technical Board of Appeal 3.4.03
of 11 January 2018

Appellant: (Patent Proprietor)	Fototherm S.r.l. Via Trieste, 2 33030 Gonars (UD) (IT)
Representative:	Petraz, Gilberto Luigi GLP S.r.l. Viale Europa Unita, 171 33100 Udine (IT)
Respondent: (Opponent)	Pirovano, Federico Via C. Battisti 38 20854 Vedano Al Lambro (MB) (IT)
Decision under appeal:	**Decision of the Opposition Division of the European Patent Office posted on 25 February 2013 revoking European patent No. 1873843 pursuant to Article 101(3)(b) EPC.**

Composition of the Board:

Chairman	G. Eliasson
Members:	M. Stenger
	C. Schmidt

Summary of Facts and Submissions

I. The appeal concerns the decision of the opposition division revoking European patent No. EP1873843 on the ground of lack of inventive step.

II. The following documents are referred to (where applicable, the labelling corresponds to the labelling by the Opposition Division):

O1: JOSEF SYDNEY COVENTRY: "A solar concentrating photovoltaic/thermal collector", THESIS SUBMITTED FOR THE DEGREE OF DOCTOR OF PHILOSOPHY AT THE AUSTRALIAN NATIONAL UNIVERSITY, 2004, pages i-xx table of content, pages 1-87, 100, 161-196, 257-261

O3: "THERMATTACH® T404, T405 and T412 - Thermally conductive adhesive tapes for heat sink attachment to ceramic or metal components", CHOMERICS TECHNICAL BULLETIN, no. 72, October 1999, pages 1-4

O16: DOUWE W. DE VRIES: "Design of a photovoltaic/ thermal combi-panel", 1998, EINDHOVEN TECHNICAL UNIVERSITY, table of contents and pages 1-2, 16-17, 22, 43, 53-54 and 97

O18: ZONDAG H. A. ET AL.: "The thermal and electrical yield of a PV-thermal collector", SOLAR ENERGY, PERGAMON PRESS OXFORD, GB, vol. 72, no. 2, 2002, pages 113-128

O22: TOM MARKVART & LUIS CASTAÑER: "Practical Handbook of Photovoltaics: Fundamentals and Applications", 2003, ELSEVIER, ISBN: 1856173909,

preface, table of contents, pages 174-183, Appendix C, Appendix D, Appendix E and Appendix F

O23: ANTONIO LUQUE and STEVEN HEGEDUS: "Handbook of Photovoltaic Science and Engineering", 2003, WILEY, ISBN: 0-471-49196-9, cover page, pages 1-27 and 291-306

O29: "THERMATTACH® Double-Sided Thermal Tapes Thermally Conductive Attachment tapes", pages 22 to 25, no publication date indicated

All these documents with the exception of O29 were already discussed during the first instance procedure.

III. With letter dated 11 December 2017, the appellant / patent proprietor filed O29 and two auxiliary requests. With date of 10 January 2018, the appellant indicated that he would not attend the oral proceedings scheduled for the 11 January 2018.

IV. The respondent / opponent sent two telefaxes on 4 November 2013 in reply to the notice/grounds of appeal. The first telefax was received at 16:26 and the second telefax was received at 16:42.
The respondent filed a third telefax on 9 January 2018, in response to the communication of the Board in preparation of oral proceedings and the submissions of the appellant dated 11 December 2017.

When referring to these telefaxes, the page numbers of the letters will be used, not the page numbers of the telefaxes.

In all submissions, the respondent advanced arguments why the subject-matter of the claims of the requests were not new and/or inventive.

In the third telefax on 09.01.2018, the respondent indicated that he would not be present at the oral proceedings.

V. Oral proceedings were held on 11 January 2018 in the absence of both parties.

The appellant requested in writing that the decision under appeal be set aside and that the patent be maintained on the basis of claims 1 to 14 filed with telefax dated 5 August 2011, or, alternatively, on the basis of claims 1 to 14 of the first auxiliary request or on the basis of claims 1 to 13 of the second auxiliary requests, both auxiliary requests filed with letter dated 11 December 2017.

The respondent requested in writing that the appeal be dismissed.

VI. Claim 1 of the main request has the following wording (labelling added by the Board):

Photovoltaic plant comprising
(a) photovoltaic means able to be exposed to the solar rays in order to receive the relative solar radiance energy and to convert at least a part of said radiance energy into electric energy,

(b) said photovoltaic means comprising a plurality of photovoltaic cells (13) assembled on a panel (11) having a layer made of solar glass (14) with an external surface (12) able to be exposed to the sun's rays, and

(c) means to recover the heat energy (15) associated with said photovoltaic means (11) in order to recover

at least a part of said radiance energy not converted into electric energy by said photovoltaic means (11), wherein

(d) interface means is interposed between said photovoltaic means (11) and said heat energy recovery means (15) in order to optimize the heat conduction between said photovoltaic means (11) and said heat energy recovery means (15), and wherein

(e) said interface means comprises at least a first layer (19) of heat conductor material characterized in that

(f) said first layer (19) has an acrylic based chemical composition, in that

(g) between said solar glass (14) and said photovoltaic cells (13) a second layer (25) of ethyl-vinyl-acetate (EVA) is disposed and on the internal surface of said photovoltaic cells (13) a third layer (26) of ethyl-vinyl-acetate (EVA) is disposed and in that

(h) a fourth layer (27), made with a polyvinyl fluoride based film, is disposed on said third layer (26).

VII. Claim 1 of the first auxiliary request differs from claim 1 of the main request in that it comprises the additional feature that

(i) wherein said panel (11) consists of said solar glass (14), said second layer (25), said plurality of photovoltaic cells (13), said third layer (26) and said fourth layer (27)

VIII. Claim 1 of the second auxiliary request differs from claim 1 of the first auxiliary request in that it comprises, in feature (e), the additional requirement that

(e1) said heat conductor material is charged with TiO_2, graphite, SiC and Al_2O_3 in order to have good heat conductor characteristics

IX. The findings of the Opposition Division, as far as they are relevant to the present decision, may be summarised as follows.

The subject-matter of claim 1 was new compared to document O1, but not inventive in view of O1 combined with the widely used PV laminate disclosed in figure 10 of document O22 (see points 14.1, 14.6 and 15.1 to 15.3 of the contested decision).

X. The arguments of the respondent and the appellant with respect to novelty of the claims of the main request, as far as they are relevant to the present decision, can be summarised as follows.

(a) Layer structure/laminate

The respondent argued that O1 implicitly disclosed a glass and second, third and fourth layers (corresponding to a part of features (b) as well as features (g) and (h)) as defined in claim 1 of the main request, since O1 disclosed a standard photovoltaic panel integrated into a thermal collector and a standard photovoltaic panel always included these layers. He cited documents O22, O23 and O16 as support.

The appellant submitted that O1 failed to disclose the second, third and fourth layer of claim 1 at all and instead disclosed a completely different layer configuration involving an encapsulation with a silicone potting compound for protection purposes.

(b) Bonding/adhesive

The respondent argued that O1 disclosed the use of Chomerics tape for bonding photovoltaic laminates to the receiver/absorbing plate. Thus, O1 disclosed feature (f).

The appellant submitted that document O1 did not disclose using the Chomerics and the Bergquist tape for bonding photovoltaic laminates to the absorber plate. Instead, the cells were bonded directly to the absorber plate.

(c) Absence of an extra-glazed configuration/air gap

The respondent submitted that the wording used in claim 1 did not necessarily imply that the solar glass was exposed *directly* to the sun's rays. It thus did not exclude configurations with air gap and additional cover glass (see page 9 of the first telefax). Thereby, the collector shown in figure 2-12 comprised all the features (a) and (b).

The appellant argued that the PV/T collector shown in figure 2-12 of O1 was provided with an air gap and an additional cover glass while such an extra-glazed configuration was excluded by claim 1.

XI. The arguments of the respondent and the appellant with respect to inventive step of the claims of the main

request, as far as they are relevant to the present decision, can be summarised as follows.

(a) Layer structure/laminate

The appellant submitted that the skilled person would have to completely modify the structure of the PV/T panel disclosed in O1 when trying to incorporate the teaching of O22, due to the completely different layer structure disclosed in O1. This would not be obvious to the skilled person (see letter dated 11 December 2017, page 5, paragraphs 2 and 3).
Further, starting from figure 2-12 of O1, the skilled person would always arrive at an extra-glazed configuration, which, by means of the higher operating temperatures involved, would dissuade the skilled person from using EVA in the laminate because of the relatively low melting temperature of EVA.

The respondent argued that the characterising part of claim 1 defining the laminate layer structure corresponded to the common general knowledge as disclosed in O22 (first telefax, page 11, antepenultimate paragraph, and second telefax, page 16).

(b) Bonding/adhesive

The appellant argued that adhesive tapes used only for bonding photovoltaic *cells* to the thermal receiver would not be considered for bonding *laminates* to the thermal receiver by the skilled person.
Further (see paragraph bridging pages 17 and 18 of the grounds for appeal), from the point of view of thermal conductance, O1 suggested that the AIT Coolbond tape

was even more suitable than the Chomerics and the Bergquist tape.
Finally, with respect to O29, the skilled person would not consider to use the Chomerics T404 tape disclosed in O1 to bond the fourth (plastics) layer to the thermal collector, since it was not suitable for bonding plastic encapsulated components (letter dated 11 December 2017, page 2, last three paragraphs).

The respondent submitted that the skilled person would use the acrylic adhesive that was used and tested in O1 (page 11, last paragraph of the first telefax).

(c) Absence of an extra-glazed configuration/air gap

The appellant submitted that providing a configuration without any air gap and additional front glass cover was not merely a design choice, but provided advantageous effects in terms of mechanical structure and resistance of the combined panel (fifth paragraph of page 3 in combination with the penultimate paragraph of page 4 of the letter dated 11 December 2017).

XII. The arguments of the appellant with respect to the first auxiliary request, as far as they are relevant to the present decision, can be summarised as follows.

The appellant submitted that although O22 disclosed a panel consisting only of the solar glass, the second layer, the plurality of photovoltaic cells, the third layer and the fourth layer as defined by claim 1 of the first auxiliary request, the skilled person would not have been motivated and would not have known how to modify the extra-glazed configuration combined panel of O1 to arrive at the subject-matter of claim 1 (see page

6, second paragraph of the letter dated 11 December 2017).

XIII. The arguments of the appellant and the respondent with respect to the second auxiliary request, as far as they are relevant to the present decision, can be summarised as follows.

The appellant argued that the presence of all the TiO_2, graphite, SiC and Al_2O_3 components in the heat conductor material of the adhesive acrylic based first layer was neither shown nor suggested by any of the cited prior art documents. Thereby, a bond to the thermoplastic fluoropolymer based film was created that provided galvanic insulation, stable mechanical adhesion and good heat conducting characteristics (section 2.2 of the letter dated 11 December 2017).

The respondent submitted that the Chomerics tape disclosed in O1 was loaded with Al_2O_3 (page 27 of the second telefax).

Reasons for the Decision

1. Procedural matters

The appellant submitted the claims according to the first and the second auxiliary request in response to the summons to oral proceedings before the Board.
The respondent filed new submissions (arguments and new passages of previously cited documents) two days before the date of oral proceedings.
Both appellant and respondent, although duly summoned, were not represented at the oral proceedings.

The proceedings were however continued without the parties in accordance with Rule 71(2) EPC 1973. Since the parties were not present at the oral proceedings, the Board may rely on their written submissions according to the provisions of Article 15(3) RPBA.

According to the case law of the Boards of Appeal, an appellant who submits amended claims shortly before the oral proceedings and subsequently does not attend these proceedings must expect a decision based on objections which might arise against such claims in his absence (see Case Law of the Boards of Appeal, 8th edition 2016, IV.E.4.2.6 d), page 1137, last paragraph).

In the case at hand, the appellant had to expect a discussion during oral proceedings on inventive step of the subject-matter of its newly filed claims, in particular because lack of inventive step was already discussed previously in relation to the main request. By not attending the oral proceedings, the appellant gave up voluntarily the opportunity to further comment on this issue.
Consequently, the Board saw no reason for a delay in view of Article 113(1) EPC 1973. The case was ready for decision in the sense of Article 15(5) RPBA.

The arguments and new passages submitted in the third telefax by the respondent were filed very late (two days before the date of the oral proceedings). Since they were furthermore not more relevant than the other submissions by the respondent already on file, they were not taken into account by the Board.

2. Document O1

Document O1 concerns a Combined Heat And Power Solar (CHAPS) collector which produces photovoltaic electric

power and solar thermal power at the same time. This is achieved by arranging photovoltaic cells above and bonding them to a thermal absorber system that is coupled to a heat transfer fluid (e.g., water or air) used to collect heat from the absorber system. At the same time, the photovoltaic cells are cooled, which is beneficial for their electrical efficiency. Such a system inherently requires a good heat transfer between the photovoltaic cells and the thermal absorber.
In document O1, an overview over some common combined photovoltaic and thermal systems (PV/T systems) is given and a plurality of more specific configurations is discussed.

3. Main request, claim 1

3.1 Novelty, document O1

3.1.1 It was not disputed that the commonly known configuration of a PV/T system shown in figure 2-12 of document O1 comprises, in the wording of claim 1, a:

Photovoltaic plant (*Water cooled PCV/T*) comprising
(a') photovoltaic means (*Laminated PV cells*) able to receive the relative solar radiance energy and to convert at least a part of said radiance energy into electric energy,

(b') said photovoltaic means comprising a plurality of photovoltaic cells (*PV cells*) assembled on a panel (*Laminated PV cells*), and

(c) means to recover the heat energy associated with said photovoltaic means in order to recover at least a part of said radiance energy not converted into

electric energy by said photovoltaic means (*Absorber plate, soldered to tube*), wherein

(d) interface means (*adhesive*) is interposed between said photovoltaic means and said heat energy recovery means in order to optimize the heat conduction between said photovoltaic means and said heat energy recovery means (this aim is inherent to any combined PV/T system, see also O1, page 84, first sentence), and wherein

(e) said interface means comprises at least a first layer (*adhesive*) of heat conductor material.

The Board agrees therewith.

3.1.2 Disputed points:
The parties were of different opinions with respect to three feature groups (A), (B) and (C), namely:

Feature group (A) relating to the laminate disclosed in figure 2-12, and comprising, in the wording of the claim, the features that

(b'') the panel of solar cells has a layer made of solar glass,
(g) between said solar glass and said photovoltaic cells a second layer of ethyl-vinyl-acetate (EVA) is disposed and
on the internal surface of said photovoltaic cells a third layer of ethyl-vinyl-acetate (EVA) is disposed,
(h) a fourth layer, made with a polyvinyl fluoride based film, is disposed on said third layer,

Feature group (B) defining the adhesive disclosed in figure 2-12 and consisting, in the wording of the claim, of the feature that

(f) said first layer has an acrylic based chemical composition,

Feature group (C), concerning whether an extra-glazed configuration like the one shown in that figure would fall under the terms of claim 1, and comprising, in the wording of the claim, the features that:

(a''), (b''') the photovoltaic means and the external surface of the solar glass are able to be exposed to the solar rays.

3.1.3 Feature group (A), layer structure/laminate (see point X (a))

The Board concurs with the respondent in that documents O22 (page 175) and O16 (table 3.2) disclose that the succession of layers *glass/EVA/photovoltaic cells/EVA/ TEDLAR film* is one of the standard configurations of photovoltaic laminates. Further, document O23 contains similar information, with the exception of a TEDLAR film used as back layer (section 7.8.2).

However, other layer configurations are also known for encapsulating photovoltaic cells. Document O1 discloses at least one of them, involving silicone pottant (see figure 4-7 on page 46). Document O22 mentions the use of polyvinyl butyral as encapsulant (see section 4, page 175, first sentence). Finally, document O23 also discloses other configurations (see last paragraph of section 7.8.3).

Thus, contrary to the respondent's argument, O1 does not directly and unambiguously disclose *glass/EVA/photovoltaic cells/EVA/TEDLAR film* laminates, and thereby also not features (b''), (g) and (h).

3.1.4 Feature group (B), bonding/adhesive (see point X (b))
The Board notes that O1 generally discloses that Chomerics tape was used in previous CHAPS receivers on pages 46 and 86, as pointed out by the respondent. These passages, however, do not indicate whether the Chomerics tape was used in these previous CHAPS receivers to bond photovoltaic *cells* or photovoltaic *laminates*.
The other passages of O1 relating to (the suitability of different materials for) bonding explicitly mention only photovoltaic *cells* and do not refer to photovoltaic *laminates* (sections 5.5 and 5.5.1, pages 84 to 87, and section 7.3.5.2, page 172).

Thus, contrary to the respondent's argument concerning the bonding/adhesive, O1 does not directly and unambiguously disclose bonding of photovoltaic *laminates* to a receiver/absorbing plate by means of a Chomerics tape, as pointed out by the appellant (see paragraph bridging pages 4 and 5 of the grounds for appeal).
Consequently, O1 does not disclose feature (f) in a direct and unambiguous manner.

3.1.5 Feature group (C), absence of an extra-glazed configuration/air gap (see point X (c))
The Board notes that in the description of the patent opposed, the wording *surface exposed to the sun* is also used for objects such as a roof or a terrace (see [35]), which are normally *directly* exposed to the sun's rays.

The Board thus concurs with the appellant in that features (a'') and (b''') of claim 1 have to be interpreted, in view of the overall content of the opposed patent, as meaning a *direct* exposure to the sun. Consequently, the PV/T collector shown in figure 2-12 does not comprise these features.

3.1.6 Thus, the subject-matter of claim 1 of the main request differs from the PV/T-panel shown in figure 2-12 of O1 by (all) the disputed features (b''), (g), (h), (f), (a'') and (b''') mentioned above, corresponding to feature groups (A), (B) and (C) and is thus new according to Article 54(1) and (2) EPC 1973.

Thus, the Board arrives at the same conclusion as the Opposition Division (see sections 14.1 and 14.6 of the contested decision).

3.2 Inventive step

3.2.1 Closest prior art

Document O1 is directed at the same purpose as the patent opposed, that is, the provision of a combined photovoltaic and thermal solar collector. The water cooled PV/T collector shown in figure 2-12 comprises most of the features defined in claim 1 and is thus suitable to be taken as representing the closest prior art.

The Board notes that this is in accordance with one of the approaches taken by the Opposition Division.

3.2.2 Differences/purposes and effects

The subject-matter of claim 1 of the main request differs from the PV/T system shown in figure 2-12 of O1, as discussed above, by the three groups of features (A), (B) and (C).

The Board notes that the purpose of feature group (A) is to protect the PV cells, while the purpose of feature group (B) is to provide a fixation that can withstand diurnal cycles in spite of thermal mismatch while providing a good heat conduction.
Feature group (C), finally, has the effect that heat losses at the surface of the PV panel are reduced, i.e., the electrical efficiency of the combined PV/T collector is favoured over its thermal efficiency.

Thus, each of these feature groups fulfills a different purpose/achieves a different technical effect in the photovoltaic plant into which they are integrated. For the purpose of assessing inventive step, they can thus be treated separately.

3.2.3 Feature group (A), layer structure/laminate (see point XI (a))
The PV cell laminate of the PV/T system shown in figure 2-12 is not specified in O1. Thus, in order to put into practice that system, the skilled person would have to solve the problem of finding a suitable PV cell laminate.

When looking for such a suitable PV cell laminate, the skilled person would as a matter of course consider the generally known photovoltaic laminates. Document O22 discloses that a *glass/EVA/photovoltaic cells/EVA/ TEDLAR film* sandwich is one of the most commonly used photovoltaic laminate configurations (page 175, lines 1 to 3 and figure 10).

Concerning the appellant's argument that the skilled person would have to modify the layer structure disclosed in O1 completely in order to use the laminate

mentioned in O22, the Board concurs with the appellant insofar as this argument might apply to the collectors disclosed in figures 2-15 and 4-7 of O1 which disclose a specific layer structure involving silicon pottant. However, the PV/T system with the common configuration shown in figure 2-12 does not define any specific layer structure the skilled person would have to modify.

Concerning the appellant's argument relating to the use of an EVA-containing laminate in an extra-glazed PV/T-panel, the Board notes that O16 explicitly discloses an extra-glazed configuration of a PV/T combi-panel (see figure 1.1) where a photovoltaic laminate including EVA is actually used (see table 3.2). Thus, the appellant's argument that the working temperatures in an extra-glazed configuration would exclude the use of EVA in the PV cell laminate is not applicable.
Therefore, the extra-glazed configuration of the PV/T system shown in figure 2-12 of O1 would, contrary to the appellant's argument, not dissuade the skilled person from using an EVA-based photovoltaic laminate in that system.

To conclude, a *glass/EVA/photovoltaic cells/EVA/TEDLAR film* sandwich is one of the most commonly used photovoltaic laminates and the configuration of the PV/T system disclosed in figure 2-12 of O1 would not dissuade the skilled person from using such a sandwich in that configuration. The skilled person would thus readily use the laminate shown in figure 10 of O22 in the PV/T system shown in figure 2-12.
The Board notes that this laminate comprises the solar glass and the second, third and fourth layers defined in features (b'), (g) and (h) of claim 1 (a TEDLAR film being based on polyvinyl fluoride).

Therefore, the skilled person would arrive at a PV/T system as shown in figure 2-12 of O1 further including differentiating features (b'), (g) and (h)/ feature group (A) without the exercise of an inventive activity.

3.2.4 Feature group (B), bonding/adhesive (see point XI (b))
To implement the PV/T-system represented in figure 2-12, the skilled person would further have to choose an appropriate adhesive.

The Board notes that a combined PV/T collector with the PV *cells* bonded directly to the thermal collector will be subject to the same environmental conditions as a combined PV/T collector where a PV *laminate* is bonded to the thermal collector. That is, in both cases, similar constraints with respect to exposure to solar rays, mechanical stress during diurnal cycles and the necessity of a good heat conduction will have to be met by the adhesive used.
Thus, bonding PV laminates to a thermal collector is a task that is very similar to bonding PV cells directly to a thermal collector. The skilled person would thus, contrary to the argument brought forward by the appellant, readily consider to use the same adhesive in both cases.

Document O1 itself discloses a plurality of adhesives (see table 5-1 on page 85) and gives the skilled person the hint that the Chomerics and the Bergquist tapes could in principle be suitable candidates for an application in CHAPS collectors / combined PV/T collectors (page 46: *A double-sided adhesive tape made by Chomerics has been used for the CHAPS receivers up to date.*; page 86: *Early CHAPS receivers employed the*

Chomerics tape. However, in recent development the Bergquist tape has been used.).

The Board concurs with the appellant that O1 indicates that the thermal conductivity of the AIT Coolbond is much higher than the thermal conductivities of the Chomerics and the Bergquist tapes. However, O1 also indicates that the cost of the AIT tape is much higher than the cost for the other tapes (page 86, last paragraph). The skilled person would thus consider the trade-off between suitability and cost when choosing between these three types of tape.
Further, document O1 states that the UV tolerance of the AIT Coolbond is unknown (page 87, first paragraph). This would even dissuade the skilled person to use the AIT Coolbond for a solar collector which is by definition exposed to ultraviolet radiation from the sun.

The Board thus agrees with the respondent that the skilled person would therefore, in view of O1, as a matter of course consider to use any one of the Chomerics and the Bergquist tapes rather than the AIT tape for the purpose of bonding the PV cell laminate of figure 2-12 to the absorber of the same figure. Both of these adhesive tapes comprise a layer having an acrylic based composition (see table 5-1 of O1).

Concerning the appellant's argument that the Chomerics T404 tape was not suitable for plastic attachment, the Board notes that there is no disclosure in O1 that would in any manner dissuade the skilled person from using the proposed tapes for bonding photovoltaic *laminates* to the receiver. It would thus be natural for the skilled person to test the adhesives suggested in

O1 as argued above, before consulting any further documents.
Nevertheless, the Board notes that O29 introduced by the appellant is not provided with any apparent publication date, and therefore, it is not proven that the skilled person could have consulted O29 at the priority date of the opposed patent (26 June 2006).

To summarise, document O1 discloses that the acrylic based Chomerics T404 and Bergquist tapes listed in table 5-1 are suitable for use in a combined PV/T collector and nothing in this document would dissuade the skilled person from using these tapes to bond a PV laminate to the thermal collector. The skilled person would thus naturally consider to use any one of these two tapes for the purpose of bonding the PV cell laminate of figure 2-12 to the absorber of the same figure.

The Board thus concludes that the skilled person would, without using inventive skills, also incorporate differentiating feature (f) / feature group (B) into the PV/T system shown in figure 2-12 when implementing that system.

3.2.5 Feature group (C), absence of an extra-glazed configuration/air gap (see point XI (c))
The trade-off between electrical and thermal efficiency depending on the operating temperature and thus on the presence of an air gap and an additional glass cover. The extra-glazed configuration which reduces heat losses was well known at the priority date of the patent opposed, see, e.g., O1, page 165, second paragraph, pages 169 to 171 and pages 173 to 174. Further, both O16 and O18 not only explicitly disclose PV/T collectors with the extra-glazed configuration,

but also suggest configurations *without* air gap and additional cover glass (O16 explicitly mentions *uncovered panels* in the table of contents on page 8 of O16, section 2.3.2, while O18 mentions the extra-glazed configuration as only one of a plurality of possibilities, see the passage in column two on the first page:- *for the case in which the panel has an additional glass cover to reduce the heat loss to the environment* -).
This emphasises that the mentioned trade-off was not only known in a general manner, but even *investigated* before the priority date of the opposed patent.

The argument brought forward by the appellant is based on an alleged incompatibility between an extra-glazed configuration and the use of EVA in a PV laminate and was already discussed with respect to differentiating feature group (A).

Thus, providing a PV/T system with an air gap and additional cover glass or not has to be considered to be the result of an obvious design choice by the skilled person, using his general knowledge and taking into account the generally known trade-off between electrical and thermal efficiency.

Therefore, providing an extra glazed configuration as in figure 2-12 of O1 or not according to features (a'') and (b''') of claim 1 / feature group (C) can not justify the acknowledgement of an inventive step according to Article 56 EPC 1973.

3.2.6 To conclude, the skilled person would arrive at the subject-matter of claim 1 without exercising an inventive activity according to Article 56 EPC 1973 by combining the common PV/T collector shown in figure

2-12 of O1 with the standard PV laminate comprising a *glass/EVA/photovoltaic cells/EVA/TEDLAR film* sandwich structure as disclosed in O22 and using his common general knowledge for choosing one of the acrylic based adhesives listed in table 5-1 of O1 for bonding the standard PV laminate to the thermal receiver.

The Board, when taking document O1 as the closest prior art, thus arrives at the same conclusion as the Opposition Division (see section 15.3. of the contested decision).

4. First auxiliary request, claim 1 (see point XII)

Claim 1 of the first auxiliary request differs from claim 1 of the main request by feature (i), i.e., that the panel consists of (only) the solar glass, the second layer, the plurality of photovoltaic cells, the third layer and the fourth layer.

The Board notes that this corresponds to the layer structure of the photovoltaic laminate disclosed in O22, which does not comprise any other layers, either. This was conceded by the appellant.
The appellant's argument that the skilled person would not have been motivated and would not have known how to modify the extra-glazed combined PV/T panel of O1 to arrive at the subject-matter of claim 1 of the first auxiliary request corresponds essentially to the argument brought forward for the main request.
Thus, corresponding reasons as for claim 1 of the main request apply.

Consequently, the subject-matter of claim 1 of the first auxiliary request lacks an inventive step for the same reasons as given for the main request.

5. Second auxiliary request, claim 1 (see point XIII)

Claim 1 of the second auxiliary request differs from claim 1 of the first auxiliary request by the additional feature (e1), i.e., that the heat conductor material defined in feature (e) is charged with TiO_2, graphite, SiC and Al_2O_3 in order to have good heat conductor characteristics.

The Board agrees with the appellant that the presence of all the TiO_2, graphite, SiC and Al_2O_3 components in the heat conductor material of the adhesive acrylic based first layer is not disclosed in any of the cited prior art documents.

The Board notes, however, that it is a generally known procedure to provide bi-adhesive tapes with a thermally well-conducting filler in order to improve the heat conducting characteristics of the tapes. Aluminium oxide is one of the most popular fillers for that purpose, but other materials are used as well.
For example, O1 mentions aluminium oxide used as filler in the Chomerics T404 film. O1 further indicates that aluminium nitrite is used as a filler in the AIT Coolbond film (table 5-1 on page 85).
Document O3, relating to the T404 film and other Chomerics THERMATTACH tapes, also refers to the use of aluminium oxide as filler and mentions additionally titanium diboride (page 1, leftmost column).

Further, TiO_2, graphite and SiC all conduct heat relatively well and have thus to be considered to be materials that are generally suitable to be used as fillers for enhancing the heat conductivity of adhesive tapes.
The Board notes that according to the opposed patent, the only technical effect caused by the fillers TiO_2, graphite, SiC and Al_2O_3 in the first layer is to provide a good heat conduction (see [21] and [41]). The other effects (galvanic/electrical insulation, stable mechanical adhesion) mentioned in the argumentation by the appellant are not apparent from the patent opposed and would not appear to be the direct result of the fillers.

The aim of having a good heat transfer in the material joining the cells to the thermal collector is inherent in combined PV/T systems, see, e.g., O1, page 84, first paragraph. The skilled person would therefore explore various manners to further improve that heat transfer, and the provision of a plurality of fillers that are all individually suitable to increase the heat conduction capability of the adhesive/first layer has to be regarded as the result of routine trial and error not justifying the acknowledgement of an inventive step.

Consequently, charging the adhesive film/the heat conductor material with TiO_2, graphite, SiC and Al_2O_3 and thus feature (e1) can not justify the acknowledgement of an inventive step, either.

6. The subject-matter of the independent claims of all requests lacks an inventive step according to Article 56 EPC 1973. Thus, the appeal must fail.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

S. Sánchez Chiquero G. Eliasson

Decision electronically authenticated