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Bezeichnung der Erfindung: Laminating process
Title of invention:
Titre de l'invention :

13

Klassifikation / Classification / Classement : G03F 7/16

ENTSCHEIDUNG / DECISION

vom / of / du 28 July 1988

Anmelder / Applicant / Demandeur :

Patentinhaber / Proprietor of the patent /
Titulaire du brevet : E.I. Du Pont de Nemours and Company

Einsprechender / Opponent / Opposant : BASF Aktiengesellschaft, Ludwigshafen

Stichwort / Headword / Référence :

EPÜ / EPC / CBE Article 56 EPC

Schlagwort / Keyword / Mot clé : Obvious use of known properties of a known material; inventive step (no)

Leitsatz / Headnote / Sommaire

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Case Number : T 91 /87

D E C I S I O N
of the Technical Board of Appeal 3.4.1
of 28 July 1988

Appellant : (Proprietor of the patent)
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Representative :
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Representative :

Decision under appeal : Decision of Opposition Division of the European Patent Office dated 24 November 1987 revoking European patent No. 0 040 843 pursuant to Article 102(1) EPC.

Composition of the Board :

Chairman : K. Lederer
Members : H. Reich
C. Payraudeau

Summary of Facts and Submissions

I. European patent 0 40 843 was granted on the basis of European patent application 81 103 966.8.

II. As a result of the opposition filed by the Respondent said patent was revoked by a decision of the Opposition Division. The revocation was based on the ground of lack of inventive step in the subject-matter of Claim 1, which was regarded as an obvious combination in an on-line-laminator of method steps, known per se from:

US-A-3 629 036 (document D1)
DE-B-1 522 515 (document D3), and
US-A-4 075 051 (document D4).

III. The Appellant (Patentee) lodged an appeal against this decision.

IV. Oral proceedings were held at the end of which the Appellant (Patentee) requested that the decision under appeal be set aside and that the patent be maintained on the basis of:

Claims : 1-4, handed over in the oral proceedings;
Description: pages 2 and 3, received on 28 May 1987; pages 4 to 11 as granted, however with deletion of Examples III to V on pages 9 and 10, and amendment from III into II on page 8, line 60, and from VI into III on page 10, line 63;
Drawings : Sheet 1/1 as granted.

The Respondent (Opponent) requested that the appeal be dismissed.

V. The sole independent claim of the now valid claims reads:

"1. A process for laminating a film supported photosensitive layer to a clean substrate surface of copper or aluminium by means of pressure, comprising the sequential steps of:

(a) rendering the substrate surface clean, as defined by the uniform water film test:

(b) within about 1 minute after rendering the substrate clean and immediately prior to lamination, applying a thin layer of water to form an interface between the substrate surface and the photosensitive layer:

(c) displacing the thin layer of water from the interface by absorption into the photosensitive layer during lamination; and

(d) within 30 seconds after lamination, removing the support for the photosensitive layer without delamination of the photosensitive layer from the substrate by bending the support back along a longitudinal axis of the photosensitive layer."

Claims 2-4 are dependent on Claim 1.

VI. The Appellant (Patentee) supported his request essentially by the following arguments:

(a) Document D4 does not incite a skilled person to use water as an interface layer (step b in Claim 1) between the substrate and the photosensitive layer in the laminating process known from document D1. In fact, document D4, (column 4, lines 62-63) only

teaches that water may be used to soften a non-tacky polyvinyl alcohol coating applied to the photoresist film. Document D4 does not disclose the use of pure water as softening agent for the photoresist film itself. There is no evidence in the prior art that pure water could be used as a softening agent for a dry photo-resist material.

(b) In the prior art there even existed a prejudice against the presence of water when laminating a photosensitive layer onto a substrate, because the article of I. Rapp in Galvanotechnik vol. 70, 1979, No. 10, pages 965-973 (document D5) clearly indicates on page 973, left column, point 4, that it is necessary to check before lamination whether the cleaned conductor plates are still humid.

(c) The process known from document D1 was not realisable in practice. The presence of a release layer 16 between the photoresist layer 15 and the support layer 14 shows that within supply roll 13 the direct contact of photoresist and support produces an adherence between resist and support such that during the unrolling part at least of the resist layer to be removed from the roll would remain adhered at the back surface of the support layer. Thus, no continuous photosensitive layer could be produced on the substrate surface. For the above mentioned reasons, the subject-matter of Claim 1 was not obvious with regard to documents D1 and D4.

(d) Moreover, the Appellant's own manufacturing department had an internal prejudice against the teaching in step (b) of Claim 1. Document D5 on page 973, in the summary at the end of the right column, states that 80% of all manufacturing defects in the production of

printed circuits result from insufficient pre-cleaning. For this reason, a skilled person would carefully check the cleanliness of the substrate surface, and provide for a buffer stage between cleaning and lamination which needs much more time than the maximum of 1 minute claimed in step (b). In the prior art, a further delay before lamination is caused by the drying step after cleaning, such as for instance described in document D3, column 6 lines 41 and 42. There is no hint in the prior art inciting the skilled technician to give up this drying step and, moreover, to use part of the wash water itself as laminating aid, such as disclosed in the description of the impugned patent, page 3, lines 1-4. The function of the cleaning additive to the liquid laminating aid, which is applied by wick 9 of document D1, (see document D1, column 3, lines 44-46) does not result in a reliable cleaning effect, which could replace a separate pre-cleaning step of the substrate surface.

(e) The short time of "within 30 seconds" in step (d) of Claim 1 represents a surprising effect of the use of water as a laminating aid. In the prior art it was common practice to provide an aging step of some hours until an appropriate coherence and adherence were achieved, which allowed the peeling off of the support layer from the photosensitive layer without damaging the latter. There existed a prejudice in the prior art to peel off the support layer shortly after application of the known liquid laminating aids in form of organic solvents, in particular, because these solvents stay in the interface and impede the adherence of the resist to the substrate. The fact that water quickly diffuses into the resist without solvent-effect and thus enables an on-line peeling off

of the support layer within very short time would not have been foreseeable by a skilled person.

(f) The individual features of Subclaims 2 and 3 admittedly have been known per se but are patentable in combination with Claim 1. Moreover, the features in the characterising part of dependent Claim 4 represent non-trivial measures and are even the subject-matter of another patent of the Appellant. Although the optimum binding radius for trimming is not expressly given it could be easily found and would depend on the amount of polyethylene beads in the resist such as indicated in the description of the impugned patent, page 7, lines 52 and 53 and page 10, lines 64 and 65.

VII. The Respondent's submissions were essentially as follows:

(a) The subject-matter of Claim 1 would be obvious with regard to documents D1 and D4. Document D4 clearly discloses in column 3, lines 55-58, that aqueous solutions, e.g. basic solutions, are softening agents for photoresist films. In particular, a skilled person would be able to derive from the global information of document D4 that the explicit statement: "water itself will serve as the softening agent", in column 4, lines 62 and 63, relates clearly to the photoresist.

(b) The statement in document D5, page 973, left column, point 4, concerning the checking of remaining humidity on the cleaned substrate relates to the general art of surface cleaning and would not be specially associated by a skilled person with the lamination of photoresist-layers onto such surfaces. In particular, this statement does not at all represent a prejudice against the use of water as a laminating aid.

(c) The Appellant's argument in point VI-c above has no practical bearing, because at that time it was common knowledge to use silicone-impregnated support-layers to avoid any detrimental adherence between resist and support within a supply roll. The known release layer 16 was only applied in the alternative embodiment of the known process as represented in Fig. 2 of document D1, whereas the embodiment shown in Fig. 1 of document D1 used no release layer. The Respondent contested the Appellant's view, that the process as described in combination with Fig.1 of document D1 could not be realised in practice.

(d) The necessity of an extreme cleanliness of a metal surface before its lamination with a photosensitive layer is generally known in the art. Document D1 does not indicate in which way the pre-cleaning step is realised; however, a skilled person would laminate a metal surface as soon as possible after the cleaning step. The prior art surface drying by means of hot air blowers did only take a few seconds. Thus, nothing inventive can be seen in a time interval of less than 1 minute between the cleaning step and the formation of the liquid interface. The use of the water remaining on the metal after the last cleaning step as interface layer was not disclosed in the original application documents, because the original text, page 3, lines 17 to 26 as well as the granted text, page 3, lines 1-4, only mentioned liquids in general.

(e) It is contested that the Appellant's arguments in point VI-d above relate to technical facts which could demonstrate a prejudice against on-line peeling off of a support layer when using a liquid laminating aid.

(f) The features in the characterising part of Claim 4

represent only an inadmissible problem formulation for which no concrete solution is given.

Reasons for the Decision

1. The appeal is admissible.

2. There is no objection under Article 123(2) and (3) to the present version of Claim 1. No such objection has been raised by the Respondent either.

3. Novelty.

None of the documents referred to in the opposition proceedings describes a process for laminating a photosensitive layer to a clean surface of copper or aluminium, wherein a thin layer of water is applied to the cleaned metal surface to form an interface between the substrate surface and the photosensitive layer as laminating aid.

3.1 In the lamination method known from document D1 the laminating aid is an organic resist solvent. In the lamination method known from US-A-4 069 076 (document D2) the laminating aids are organic solvent or non-solvent swelling agents (Claim 1 and column 4, lines 30-39), which also soften the resist-layer (column 2, lines 60-64).

3.2 In the lamination method known from document D3, the photosensitive layer is laminated onto the dry substrate surface without any liquid laminating aid.

3.3 The lamination process according to document D4 relates as well to laminating the photosensitive layer onto a dry metal substrate surface. After this dry lamination step

water is used as one of the indicated softening agents for the already laminated photosensitive layer in order to allow a clean self-trimming along the edges of the substrates in an on-line-process.

The invention claimed in Claim 1 is therefore novel.

4. Inventive Step.

4.1 The prior art which comes nearest to the subject-matter of Claim 1 is that known from document D1. Document D1, in particular in Figures 1 and 2 with the corresponding description, discloses:

"A process for laminating a film supported photosensitive layer (14, 15) to a clean surface of copper (1-3; column 3, lines 10-12) by means of pressure (11, 12) comprising the sequential steps of:

(a) rendering the substrate surface clean (column 3, lines 47-54);

(b) after rendering the substrate clean and immediately prior to lamination applying a thin layer of "a liquid" (7 in Fig. 2; column, 3, lines 57-59) to form an interface between the substrate surface and the photosensitive layer;

(c) displacing the thin layer of "the liquid" from the interface by absorption into the photosensitive layer during lamination (column 5, lines 56-62); and

(d) removing the support (14) from the photosensitive layer without delamination of the photosensitive layer from the substrate by bending (17) the support along a longitudinal axis of the photosensitive layer."

4.2 The aim indicated in the description of the impugned patent, page 1, lines 29 and 30, to obtain a more precise and uniform lamination for allowing the production of printed circuit boards with a high line density, is in the Board's view already achieved by the method known from document D1 based on the following effects of interface layer 7: avoiding trapped air pockets (column 3, lines 53), preventing wrinkling (column 5, line 56) and softening the resist to increase its plasticity in order to obtain a good microbonding (column 5, line 59). Also the necessity of a complete intermediate layer displacement is known (column 3, line 25, and column 5, lines 59-61).

Therefore, the objectively assessed technical problem underlying the subject-matter of the patent is to be seen as being to provide an alternative process to the process of document D1. In the mere recognition of a need for alternatives to the known process no contribution to inventive step can be seen. It is the constant endeavour of the skilled man to provide alternatives from which a choice can be made to meet the particular circumstances in any application.

4.3 The process claimed in Claim 1 differs from that known from document D1 in the following characteristics:

4.3.1 the substrate may alternatively consist of "aluminium";

4.3.2 the liquid of the interface formed in step (b) and displaced in step (c) is "water";

4.3.3 the liquid interface is formed in step (b) "within about 1 minute" after rendering the substrate clean;

4.3.4 the support is removed in step (d) "within 30 seconds after lamination" of the photosensitive layer.

4.4 A aluminium substrate surface laminated with a photosensitive layer according to distinctive feature 4.3.1 is known from document D3 (column 7, lines 45, 46; Claim 4). The Board regards it as obvious to apply the process known from document D1 with a liquid interface also in laminating a photosensitive layer onto an aluminium surface. A skilled person is considered to be able to foresee that the advantageous effects of a liquid interface which appear on a copper surface should possibly also be obtained on an aluminium surface. The Appellant has not submitted any argument in favour of a different assessment of this feature either.

4.5 Thus, it remains to be examined, whether the purely procedural distinctive features 4.3.2 -4.3.4, which form the core of the solution to the above defined problem imply an inventive step:

4.5.1 In the process known from document D1 the "liquid" of the interface between the substrate and the photosensitive layer is known to produce a softening effect (col. 5, line 56) in the photosensitive layer. "Water" (distinctive feature 4.3.2) is known to be a softening agent for a photosensitive layer from document D4, in particular column 4, lines 57-64.

The Board can not follow the Appellant's arguments summarised in points VI-a to c above.

(a) In the particular embodiment described in document D4, column 4, lines 57-64, a solution of polyvinyl alcohol in water is applied to the surface of the photosensitive layer after removal of a coversheet.

The polyvinyl alcohol forms a non-tacky layer on top of the photosensitive layer and the water itself in which the polyvinyl alcohol is dissolved serves as a softening agent for the photosensitive layer in order to prepare it for a self trimming step (col. 4, lines 50-53).

There is no technical necessity to provide a softening agent for polyvinyl alcohol being in solution but there is one for the underlying photosensitive layer in order to reduce its tensile or tear strength (column 4, lines 35-37).

(b) In the Board's view a humidity test to determine optimal working conditions of a cleaning machine -such as described in document D5, page 973, left column, lines 10-12 and point 4 - will not prejudice a skilled person against the use of a water interface in a lamination step; see point VI-b above. In respect to the lamination processes, document D5 only mentions roughness of the surface and the presence of remaining cleaning additives as having an effect on the bond (see pages 966 and 967).

Moreover, the Board considers that a skilled person would be able to recognise that the softening effect of water in a photosensitive layer is inherent to the water itself and not dependent on the particular site of its application. Thus, a skilled person would know that water does not only soften a photosensitive layer when applied on top of it for a subsequent self-trimming step, but also when applied as an interface layer during the lamination step itself. For these reasons, the Board takes the view that the use of the known softening properties of water in a photosensitive layer - as disclosed in document D4 -in

the method known from document D1 represents a mere analogous use of a known property of a known technical means, which use is not regarded to be inventive.

(c) The Board has no doubts that the method known from Fig. 1 of document D1 is realisable, in particular in view of the well known possibility to apply silicone on the surface of a support layer at the time the invention disclosed in document D1 was made and in the view of the clear disclosure of an embodiment without release layer in that document. Moreover, the imperfection which may exist in a supply roll of a photosensitive layer are not relevant to the subject-matter claimed in Claim 1 which does not include steps concerning the supply of the photoresist from a roll.

4.5.2 The Board is also convinced that a skilled person can easily determine the optimal time for forming the water interface according to feature 4.3.3, i.e. within 1 minute after cleaning, by simple trial and error. The results of the Appellant's experiments of 9 June 1983 received 10 July 1985 which show that the adhesion properties of a clean metal surface decrease with the duration of exposure to air, do not represent a surprising effect but are expected by a skilled person. Also the further arguments of the Appellant, in point VI-d above, invoking an internal prejudice in the Appellant's firm against use of water as an interface layer are in the Board's view no support for the inventive character of the teaching to provide the water interface "within 1 minute after cleaning". In the Board's view, the statement in document D5, page 973, right column, point 7 ("Summary"), concerning the importance of the quality of the precleaning step, would incite a skilled person to take samples but not to examine each individual substrate before lamination.

Thus, quality control does not necessarily result in practice in a delay of the lamination step nor does it make a buffer stage in the lamination process compulsory. Furthermore the Board sees no reasons to question the Respondent's statement that the prior art drying step only takes a few seconds. In order to be relevant, a prejudice against a certain technical measure has to be shown to be generally accepted in the art. However, even if such prejudice against an on-line-cleaning and lamination step had existed, it would have been overcome by the teaching of document D1 to clean the substrate surface even during application of the liquid interface (column 3, lines 44-50). Document D1 states explicitely that pretreating steps can be omitted. The argument concerning the use of part of the water applied in the precleaning step for the interface layer is not relevant to the subject-matter claimed in Claim 1. The question whether such use is effectively disclosed in the original application documents may thus remain open.

4.5.3 Also the time interval of 30 seconds or less between lamination of the photosensitive layer and delamination of its support (feature 4.3.4) can be found in the Board's view by simple trial and error. Very similar time intervals of 1 to 3 minutes are already used in the method known from document D2; see column 4, line 56. Moreover, an on-line delamination of the support layer is clearly known from Fig. 1 of document D1. Thus, the step of an on-line delamination of a support layer does not represent a measure which has only been rendered feasible by the use of a water interface.

The Board is convinced that the on-line-character of the method known from document D4 enables a skilled person to recognise that water can also be used in the on-line delamination process according to document D1 without

resulting in any delay in the delamination step following the lamination step. For these reasons the Appellant's arguments in point VI-e above are regarded not to be convincing.

4.6 For the reason set out in points 4.1 to 4.5.3 above, the subject-matter of Claim 1 does not involve an inventive step within the meaning of Article 56 EPC and consequently the maintenance of the impugned patent with Claim 1 is unallowable under Art. 100(a) EPC.

5. Claims 2-4 cannot be maintained because of their dependence of Claim 1. The Appellant has himself admitted that the features of Claims 2 and 3 were not per se inventive. The subject-matter of the characterising part of Claim 4, in the Board's view, is also obvious with regard to roller 28 and the acute angle formed by the coversheet 22 on both sides of roller 28 in Fig. 2 of document D4.

Order

For these reasons, it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

F.Klein K.Lederer

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