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D E C I S I O N
of 26 October 2000

Case Number: T 0368/99 - 3.4.2

Application Number: 90119036.3

Publication Number: 0427950

IPC: G03F 7/027

Language of the proceedings: EN

Title of invention:

A photosensitive resin composition for use in forming a relief structure

Patentee:

Asahi Kasei Kogyo Kabushiki Kaisha

Opponent:

POLYFIBRON TECHNOLOGIES, INC.

Headword:

-

Relevant legal provisions:

EPC Art. 54, 56

Keyword:

"Novelty - yes (main request) "

"Inventive step - no (main request) "

"Auxiliary request filed during oral proceedings (not admitted) "

Decisions cited:

T 0633/97

Catchword:



Case Number: T 0368/99 - 3.4.2

D E C I S I O N
of the Technical Board of Appeal 3.4.2
of 26 October 2000

Appellant:
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Decision under appeal: Decision of the Opposition Division of the
European Patent Office posted 12 February 1999
rejecting the opposition filed against European
patent No. 0 427 950 pursuant to Article 102(2)
EPC.

Composition of the Board:

Chairman: E. Turrini
Members: M. A. Rayner
B. J. Schachenmann

Summary of Facts and Submissions

I. The appellant (= opponent) has appealed against the decision of the opposition division rejecting the opposition against European patent No. 427 950 (application No. 90 119 036.3). Reference was made in the decision under appeal, *inter alia*, to the following documents:

D1: US-A-3 960 572 (& FR-A-2 218 352)

D2: US-A-4 139 436

D3: Polymer Photochemistry, 7 (1986), pp. 311-7

D4: Polymer, 1988, vol. 29, pp. 2033-40.

According to the minutes of the oral proceedings before the opposition division, the parties were informed that the patent proprietor (= respondent) would have an opportunity to file an auxiliary request in case the opposition division considered the subject-matter of claim 1 to lack novelty over document D1. In the decision under appeal, the opposition division found that claim 1 of the patent, having regard to document D1, represented a novel selection involving deciding to use an unsaturated monomer, selecting a prepolymer, an unsaturated monomer, an unsaturated amine and a specific amount of the latter. The novel selection addresses the problem of "tunnel phenomenon", which problem is not mentioned in any of documents D1 to D4, the selection thus being considered to involve an inventive step. In particular, the division drew attention to the compulsory use of a specific amount of unsaturated amine. Comparative examples showed that a saturated amine (an oxygen scavenger) added to the composition exemplified in document D1 did not solve the problem of tunnel phenomenon. According to document D4 a saturated and an unsaturated amine have the same effect so that no hint towards an unsaturated amine is

given. While document D2 discloses that unsaturated amine increases the polymerisation rate in general, nothing can be found about voids in the resulting polymer and the improved halftone quality does not allow the conclusion that voids are reduced as it only recites that finer halftone dots are obtained. Therefore it had not been shown that avoidance of the tunnel phenomenon could be considered a bonus effect of the increase in polymerisation rate.

II. The appellant requested revocation of the patent and oral proceedings should the board be unable to grant the request of the appellant in written proceedings. The respondent (= patentee) requested the board to dismiss the appeal of the appellant and on an auxiliary basis oral proceedings.

III. According to the appellant, no prepolymer selection has to be made as the conventional prepolymer is used, selection of unsaturated monomer is not necessary in reality and there is no doubt that document D1 explicitly teaches use of unsaturated amines together with urethane prepolymers. Therefore the only remaining question is whether the skilled person reading document D1 would use 0.1 to 5 parts by weight of an unsaturated amine relative to 100 parts by weight of the urethane prepolymer and use monomers according to (A)(b) in the amounts stated in claim 1. The answer to this question is yes. In particular, 0.1 to 5 parts by weight per 100 of unsaturated amine are based on resin component (A) (maximum $100+200=300$), i.e. up to a maximum of 15 parts per 100 of prepolymer. According to the examples in D1 (Tables 1 and 2) the monomers are almost used in these amounts. Further it is a matter of routine to select the amount and kind of addition polymerisable ethylenically unsaturated monomers. In relation to inventive step, the "tunnel phenomenon" is nothing more than an imperfection in the cured resin composition

caused by incomplete curing consequent to oxygen inhibition. Document D2 teaches curing characteristics are better in compositions containing dialkyl aminoalkyl(meth)acrylate and smaller dots can be produced. This means that small dots, which, consequent to illumination intensity and direction differences, are produced more slowly than larger dots, can still be produced quickly enough to avoid being washed away, the latter occurring without unsaturated amine being present. Documents D3 and D4 teach a preference for using unsaturated amines, for example page 316 of document D3 explains that polymerisation rate is fast and the paragraph bridging the left and right columns of page 2039 of document D4 teaches that an unsaturated amine compound is advantageous.

- IV. According to the respondent, the prepolymer, though mentioned in document D1, results from a selection step. Document D1 does not state that unsaturated monomers are always used so that a polymerisable ethylenically unsaturated polymer is not an essential component, but an optional component. Tables 1 and 2 of document D1 show that the assertion of the appellants about the quantities of unsaturated amine are wrong. In particular in more than half of all the 140 cases in Tables 1 and 2 of document D1, a certain monomer is used in an amount as large as about 10 parts per weight or more relative to 100 parts per weight of prepolymer. With respect to inventive step, the assertions of the appellant give the false impression that the tunnel phenomenon (forming localised away from the surface) is the same as an ordinary incomplete curing (forming throughout a particular depth of the entire composition) of the photosensitive resin. The oxygen inhibition mechanism advanced by the appellants explains an ordinary incomplete curing rather well, but has nothing to do with the "tunnel phenomenon".

Document D2 relates only to preventing an ordinary incomplete curing. Document D3 has as its object a system not subject to oxygen inhibition, but contains no teaching about the "tunnel phenomenon". Document D4 may suggest that amines are useful for prevention of oxygen inhibition, but nothing more than this. Moreover document D4 considers unsaturated and saturated amines to be equivalent, contrary to test results filed before the first instance showing unsaturated amines did and saturated amines did not solve the problem of the "tunnel phenomenon".

- V. Oral proceedings were appointed consequent to the auxiliary requests of the parties. In an annex to the summons the board informed the parties that it was intended, if possible, to resolve all outstanding issues so that a decision could be taken at the end of the oral proceedings. The board commented that, if further observations in advance of the oral proceedings were to be filed, this should be done at least one month before the oral proceedings.
- VI. Twenty days before the oral proceedings, the respondent submitted by facsimile further test results comparing polyether urethane prepolymer and polyester-polyether urethane prepolymer without use of any amines, submitting that these showed the occurrence of the tunnel phenomenon does not depend on oxygen inhibition but on chemical species of the photosensitive resin.
- VII. During the oral proceedings, the appellant explained that in practice owing to the incoherent light source, a degree of undercutting was bound to result from the effect of rays of illuminating light which were off axis to the perpendicular to the light receiving surface of the composition. In the case of very fine structures, such undercutting on both sides results in transverse defects in lines or even that they are in

part or entirely washed away. This was why halftone quality was reduced. The prior art showed that there was a preference for unsaturated amine.

The respondent pointed out that document D1 was concerned neither with the tunnel phenomenon nor with acceleration of polymerisation. Moreover, the respondent stressed that a most important point in assessment of inventive step is that the tunnel phenomenon cannot be explained by oxygen inhibition. The effect depends on the chemical species of the photosensitive resin.

During presentation of the cases during the oral proceedings, the appellant stated that there was no objection to the board taking the tests comparing the prepolymers into account.

At the end of the discussion, immediately before the board indicated it would break for deliberation, the respondent requested admission of an auxiliary request with amended claims into the proceedings. The respondent explained that this request corresponded to that which had been offered to the opposition division, yet not in fact submitted. The appellant objected against introduction of amended claims at such a late stage of the proceedings.

VIII. Claim 1 (for Contracting States: DE, FR, GB, IT, NL, BE) is worded as follows:

A photosensitive resin composition for use in forming a relief structure, comprising:

(A) a liquid photosensitive resin component comprising:
(a) 100 parts by weight of a urethane prepolymer comprising a plurality of diol segments linked through a urethane linkage and having an addition-polymerizable ethylenically unsaturated group at both terminals

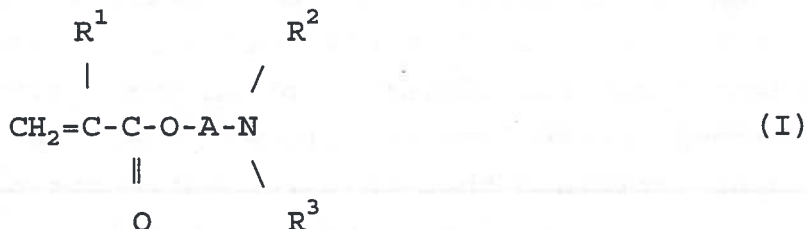
thereof, said plurality of diol segments comprising at least one polyoxyalkylene diol segment and at least one saturated polyester diol segment, said urethane prepolymer having a number average molecular weight of from 2.0×10^3 to 3.0×10^4 , and

(b) 10 to 200 parts by weight, relative to 100 parts by weight of said urethane prepolymer (a), of an addition-polymerizable ethylenically unsaturated monomer,

(B) 0.1 to 10 parts by weight, relative to 100 parts by weight of said resin component (A), of a photopolymerization initiator,

(C) 0.01 to 5 parts by weight, relative to 100 parts by weight of said resin component (A), of a thermal polymerization inhibitor; and

(D) 0.1 to 5 parts by weight, relative to 100 parts by weight of said resin component (A), of at least one unsaturated amine compound represented by the formula:



wherein R^1 represents a hydrogen atom or a methyl group, R^2 and R^3 each represent an alkyl group, and A represents a straight chain or branched alkylene group.

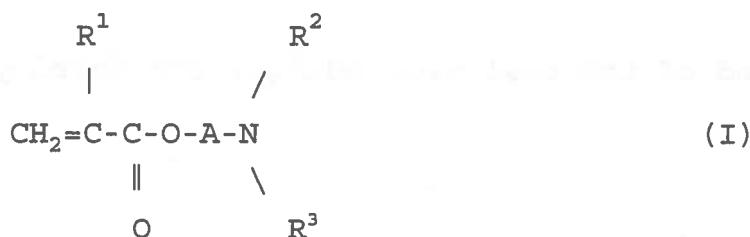
Claim 1 (for Contracting State: ES) is worded as follows:

A process for producing a photosensitive resin composition for use in forming a relief structure, which comprises blending the following components (A), (B), (C) and (D):

(A) a liquid photosensitive resin (the remainder of claim 1 is as claim 1 for Contracting States: DE, FR, GB, IT, NL, BE).

Claim 1 of the auxiliary request is worded as follows:

The use of at least one unsaturated amine compound represented by the formula



wherein R¹ represents a hydrogen atom or a methyl group, R² and R³ each represent an alkyl group, and A represents a straight chain or branched alkylene group, for suppressing the tunnel formation in a relief structure obtained from a photosensitive resin composition for use in forming a relief structure, comprising:

- (A) a liquid photosensitive resin component comprising:
 - (a) 100 parts by weight of a urethane prepolymer comprising a plurality of diol segments linked through a urethane linkage and having an addition-polymerizable ethylenically unsaturated group at both terminals thereof, said plurality of diol segments comprising at least one polyoxyalkylene diol segment and at least one saturated polyester diol segment, said urethane prepolymer having a number average molecular weight of from 2.0 x 10³ to 3.0 x 10⁴, and
 - (b) 10 to 200 parts by weight, relative to 100 parts by weight of said urethane prepolymer (a), of an addition-polymerizable ethylenically unsaturated monomer,

(B) 0.1 to 10 parts by weight, relative to 100 parts by weight of said resin component (A), of a photopolymerization initiator, and

(C) 0.01 to 5 parts by weight, relative to 100 parts by weight of said resin component (A), of a thermal polymerization inhibitor;

said compound of formula I being added to said photosensitive resin composition in an amount of 0.1 to 5 parts by weight, relative to 100 parts by weight of said resin component (A).

IX. At the end of the oral proceedings, the board gave its decision.

Reasons for the Decision

1. The appeal complies with the provisions mentioned in Rule 65(1) EPC and is therefore admissible.

Main request

2. *Novelty*

2.1 Document D1 relates to photosensitive compositions of polyester - polyether block polymer type having an addition polymerisable ethylenically unsaturated group at both terminals thereof as discussed in columns 7 and 8 of the reference. A large number of possible components for compositions, including unsaturated amine compounds of up to 120 parts by weight based on 100 parts prepolymer, for example as mentioned in column 10, lines 58-63, disclosing (N,N-dimethylamino)-methyl acrylate or methacrylate, 2-(N,N-dimethylamino)-ethyl acrylate or methacrylate or 2-(N,N-diethylamino)-

ethyl acrylate or methacrylate. Photopolymerisation initiators and thermal inhibitors are disclosed in column 8.

2.2 Document D2 relates to a liquid ethylenically unsaturated polyetherurethane composition, able to be polymerised to give a printing plate and the composition contains 0.5 to 15 percent of dialkyl amino-alkyl acrylate or methacrylate. Therefore, the subject-matter of claim 1 is novel over this disclosure by virtue for example of the use of a polyester-polyether prepolymer. Document D3 relates to photopolymerisation of the N,N-dialkylaminoethyl methacrylate-benzophenone system and is concerned with photoradical polymerisation systems that are not subject to oxygen inhibition. Document D4 relates to photopolymerisation of 1,6-hexanediol diacrylate with dioxybenzoin as photoinitiator. In the case of both document D3 and D4, use of unsaturated amine compounds is also disclosed. Documents D2 to D4 thus do not call into question the novelty of the subject-matter of claim 1 of the patent in dispute.

2.3 There has however never been any dispute between the parties that all the compounds present in claim 1 are disclosed in document D1. The dispute in relation to novelty revolves around whether a selection in relation to claim 1 to meet the wording of claim 1 is a novel selection, in particular with respect to (a) selecting a prepolymer, (b) deciding to use an unsaturated monomer, (c) selecting an unsaturated monomer, (d) an unsaturated amine and (e) a specific amount of the latter. Since a polyester-polyether prepolymer is very standard and is used in the majority of the examples according to document D1, the board considers such prepolymers to be the natural starting point in the teaching of document D1 without any novelty inducing selection step being necessary for their use. In

addition the paragraph bridging columns 11 and 12 specifically recites that the amount and kind of ethylenically unsaturated monomeric compounds are suitably selected. In other words the decision to use is taken. Moreover, since examples in document D1 use more than one monomer, the skilled person directly reworking the teaching of document D1 will also use more than one monomer, so that item (c) is known. The reference in column 9, lines 25-27 that the composition may contain at least one polymerisable ethylenically unsaturated monomeric compound in an amount of 0 to 120 parts by weight amounts to no more than leaving open the choice to anywhere in this range. An interpretation that the skilled person is taught to use 0 parts is out context. However, the board agrees with the respondent that a novel selection is necessary for selecting item (d), an unsaturated amine. The selection is also made for a purpose. With respect to the amount of unsaturated monomeric compound, the board finds the calculation of the appellant convincing and that of the respondent doubtful. This is because the calculation of the respondent does not mention the resin (up to 300 parts by weight), which is claimed, but only the prepolymer (100 parts by weight) and thus overlooks the upper limit for the unsaturated amine compound being 15 as opposed to 5 parts by weight. Thus the amount selected is per se not novel, simply the selection of the unsaturated amine.

3. *Inventive Step*

3.1 The closest prior art is, in agreement with the parties, represented by document D1 which therefore constitutes the starting point for assessing inventive step.

On the face of document D1 alone, while the skilled person could easily have selected at least one unsaturated amine compound according to formula I of claim in dispute, the board has not found any reason in document D1 indicating that he definitely would have done so. In fact, the unsaturated amines are not used in any of the examples.

3.2 The purpose for which the unsaturated amine was selected, according to the patent, was to avoid the "tunnel phenomenon". Turning to the patent specification, the effect concerned is explained, for example with reference to Figure 2 and in line 30 on page 3 the term is explained as being "a hole formed in the relief portion". Furthermore, the tunnel phenomenon (the hole) occurs particularly with respect to relief portions having small width (see line 10 on page 3). In the course of the proceedings, the respondent further developed the definition of the tunnel phenomenon to be a localised phenomenon away from the surface of the composition. It therefore appears to the board that the most precise and for the patentee most favourable definition of the "tunnel phenomenon" might be along the lines of "a localised phenomenon in a photosensitive resin, which occurs away from the surface of the resin and takes the form of a hole where the width of the relief portions are small". However the claim is silent about any definition of and indeed any mention of the "tunnel phenomenon".

3.3 The proceedings have in this context also been concerned with incomplete curing due to oxygen inhibition. The parties agree both about the presence of this effect and also that it is per se known (see for example the first paragraph on page 2 of the letter of the appellant dated 26.09.2000 and the penultimate sentence on the first page of the letter of the respondent dated 06.10.2000). The board therefore

accepts that the skilled person would (not could) have been motivated to avoid this effect. However, the main line of argument of the respondent is that the "tunnel phenomenon" and "incomplete curing" are completely different and that therefore, teachings about the latter are not relevant to the former.

- 3.4 With respect to the location of the "oxygen inhibition" defect, explanations advanced by the parties include a first (respondent) that uniform defect formation occurs throughout the resin, a second (respondent) that formation occurs in the surface region and a third (appellant) that formation occurs away from the surface consequent to undercutting effects. The board has been persuaded by the submissions of the appellant in this respect, particularly that the curing is related to illumination intensity and direction, which cannot be entirely uniformly intense throughout the composition, leading to undercutting effects. By the same token the board is not convinced that oxygen inhibition occurs to the same extent throughout the resin. The board is also not convinced that oxygen inhibition occurs solely at the surface of the composition consequent to exposure to the atmosphere because the surfaces of the relief are not exposed to the atmosphere. The differing masking configurations which are possible can, in the view of the board, lead to sporadic isolated occurrences of undercutting effect in the form of holes at points, junctions and so on. Thus, the board has not found anything which would enable the skilled person to differentiate reliably such defects from the "tunnel phenomenon" defects. Even had the "tunnel phenomenon" been proven to be a separate differentiable phenomenon, the claim does not define subject-matter defining any such difference. In this connection, even had the term been introduced into the claim, the board observes that it would have expected complex issues of clarity and original disclosure to have arisen. Since this is not

the case, the board does not have to consider these issues.

3.5 In view of the foregoing, the objective problem addressed by the claimed subject-matter can, in the view of the board, be seen as the general problem of improving curing as compared to the teaching of document D1. Mitigating or solving difficulties relating to the so-called "ordinary incomplete curing", which is recognised as a problem by both parties, falls squarely within the objective general problem. It follows from this analysis that the main line of argument of the respondent that "ordinary incomplete curing" teachings are not relevant fails.

3.6 Documents D2 to D4 all lead in the direction of selecting one of the components meeting formula I of the claim in dispute from document D1 because of improved curing taught in these documents. In this respect, the board is persuaded by the arguments of the appellant in respect of document D2 concerning faster curing and consequent higher definition as finer structures are not washed away. The respondent itself reacted to these arguments by admitting that document D2 teaches that an ordinary incomplete curing can be prevented by the addition of a dialkyl amino alkyl (meth)acrylate to polyurethane resin composition. Document D3 also underlines the effectiveness of unsaturated amines in the last paragraph thereof. Moreover, the respondent has also explicitly submitted that the disclosure of document D4 may suggest that tertiary amines are useful for prevention of oxygen inhibition. Document D4 also concerns and recognises the importance of a methacrylate functionality, in particular, the paragraph bridging the left and right columns on page 2039 concerns N,N-dimethylaminoethyl methacrylate and recites that the DMAEMA cosynergist is capable of participating in the polymerisation process,

deemed indeed an important factor. The board thus does not doubt that an unsaturated amine is understood by the skilled person also from the teaching of document D4 to be preferred.

3.7 The improvement in curing due to the presence of unsaturated amine taught by the prior art is also supported by the tests submitted by the respondent in the proceedings before the first instance, where resin type I with unsaturated amine did not have defects. While the further tests submitted by the respondent indicate the "tunnel phenomenon" does not occur in the example of implementing the teaching of document D1 with respect to compositions deriving from the particular teaching relating to synthesis 4, the board sees this as no more than illustrating the sporadic nature of incomplete curing defects. It cannot be considered persuasive against the weight of contrary teachings towards using unsaturated amines to mitigate the problem of oxygen inhibition in relation to incomplete curing. Thus, the board is convinced that it was obvious for the skilled person in the light of documents D2 to D4 and having regard to the test results submitted to select an unsaturated amine compound according to the teaching of document D1 without any inventive step.

3.8 The board has also considered whether perhaps an inventive step could be involved in the direction of the particular combination of compounds claimed and whether a very rigid novelty analysis divorced from the real teaching of document D1 could have lead in such a direction. For example, could document D1 be understood to teach that just one monomer should be used at high concentration and a polyester polyether urethane pre-polymer not used? In this context, the board revisited the issues involved in items (a), (c) and (d) in the novelty analysis in section 2 above

from the point of view of inventive step. The board had to conclude that the skilled person would surely have considered "more than one" monomer obvious in the light of the recitation of "at least one". Only an artificial analysis of the examples based on pre-runs might speak against this. The board cannot therefore take this track. Moreover, any chemist considers it obvious to avoid a high concentration of amine compound because of its unpleasant smell. Finally the prepolymer is very well known and would also have expected to be subject to incomplete curing defects. The board could not therefore find any inventive step in this direction, once the heart of the disclosure had been taken away by the failure of the main line of the respondent.

- 3.9 Therefore the subject-matter of the claims 1 according to the main request cannot be considered to involve an inventive step within the meaning of Article 56 EPC.

Admissibility of the auxiliary request

- 4.1 Although the possibility of filing an auxiliary request is mentioned in the minutes of the proceedings before the first instance, no such request was in fact filed. Therefore the first submission of the auxiliary request was that submitted at the end of the substantive discussion in the oral proceedings just as the board indicated that it would interrupt to deliberate on the cases of the parties preparatory to giving its decision. The substance of the case had already been dealt with at length at that time. Therefore, admission of the auxiliary request would have entailed reopening the discussion at that late stage by introduction of entirely new and complex legal issues of a more formal nature, for example of admissibility in the sense of Article 123 (for example because of change of category) of the amendments sought and of clarity in the sense of Article 84 EPC of the claims as amended (for example in

connection with the wording "tunnel phenomenon" as touched upon in point 3.4 above in the analysis of inventive step).

- 4.2 A complete substantive examination of the facts had already taken place before the first instance. The respondent had ample opportunity to present the auxiliary request in good time before the board, since according to the respondent's submissions, it had in fact been ready since the oral proceedings before the first instance. Accordingly, as the respondent nevertheless did not submit its request in good time, it ran the risk of this request not being taken into account.
- 4.3 The appellant was against admission of the auxiliary request and having regard to the very late stage of the proceedings and the complexity of the legal issues concerned, neither the board nor the appellant could have been clearly expected to deal with them without adjournment of the oral proceedings (see for example section 2 of the reasons for decision T 0633/97). Remission of the case to the first instance was also not appropriate because the "centre of gravity" had not changed during the appeal proceedings from that dealt with before the first instance, i.e. no fresh issue of substance had arisen, the request was simply extremely late. Consequently, the board came to the view that the risk of non admission run by the respondent was to be resolved to its disadvantage in the present case.

Order

For these reasons it is decided that:

1. The auxiliary request filed by the respondent is rejected as inadmissible.
2. The decision under appeal is set aside.
3. The patent is revoked.

The Registrar:

The Chairman:

P. Martorana

E. Turrini

