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D E C I S I O N
of 4 February 2002

Case Number: T 0345/00 - 3.2.5

Application Number: 91915016.9

Publication Number: 0543899

IPC: B41M 5/24

Language of the proceedings: EN

Title of invention:
Sub-surface marking

Patentee:
UNITED DISTILLERS PLC

Opponent:
LPKF Laser & Electronics GmbH
Fraunhofer-Gesellschaft zur Förderung der angewandten
Forschung e.V.

Headword:
-

Relevant legal provisions:
EPC Art. 54, 56

Keyword:
"Novelty main request (no)"
"Novelty and inventive step, first auxiliary request (yes)"

Decisions cited:
-

Catchword:
-



Case Number: T 0345/00 - 3.2.5

D E C I S I O N
of the Technical Board of Appeal 3.2.5
of 4 February 2002

Appellant I:
(Opponent 01)

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Decision under appeal:

Interlocutory decision of the Opposition Division
of the European Patent Office posted 1 February
2000 concerning maintenance of European patent
No. 0 543 899 in amended form.

Composition of the Board:

Chairman: W. Moser
Members: W. R. Zellhuber

P. E. Michel

Summary of Facts and Submissions

- I. The appellants I and II (opponents 01 and 02) lodged an appeal against the decision of the Opposition Division maintaining the European patent No. 0 543 899 in amended form.
- II. In the decision under appeal, it was held that the grounds for opposition submitted by the appellants under Article 100(a) EPC (lack of novelty, Article 54 EPC, and lack of inventive step, Article 56 EPC) did not prejudice the maintenance of the patent as amended.
- III. Oral proceedings were held before the Board of Appeal on 4 February 2002.
- (i) The appellants I and II requested that the decision under appeal be set aside and that the European patent No. 0 543 899 be revoked in its entirety.
- (ii) The respondent (proprietor of the patent in suit) requested
- (a) main request: that the appeals be dismissed;
or
- (b) first auxiliary request: that the decision under appeal be set aside and that the patent in suit be maintained on the basis of claims 1 to 17 filed as first auxiliary request on 4 January 2002; or

- (c) second auxiliary request: that the decision under appeal be set aside and that the patent in suit be maintained on the basis of claims 1 to 16 filed as second auxiliary request on 4 January 2002.

IV. Claim 1 of the main request reads as follows:

"1. A method of providing a body of material (14) with a sub-surface mark comprising the steps of directing at a surface of the body (14) a high energy density beam (12) capable of penetrating the material at least to the depth of the desired mark and bringing the beam (12) to a focus at a location spaced from the surface and within said material so as to cause localised ionisation of the material and the creation at said location of a mark in the form of an area of increased opacity to electromagnetic radiation substantially without any detectable change to the surface."

Independent claims 1, 5 and 14 of the first auxiliary request read as follows:

"1. A method of providing a body of material (14) with a sub-surface mark comprising one or more numerals, letters or symbols or a combination thereof representative of a desired indicium, the method comprising the steps of directing at a surface of the body (14) a high energy density beam (12) capable of penetrating the material at least to the depth of the desired mark, bringing the beam (12) to a focus at a location spaced from the surface and within said material so as to cause localised ionisation of the material and the creation at said location of a mark in the form of an area of increased opacity to

electromagnetic radiation substantially without any detectable change to the surface and moving the focus of the beam (12) relative to the body to be marked (14) so as to enable the mark to be of a predetermined shape."

"5. An apparatus in combination with a body of material (14), the apparatus being for providing the body of material (14) with a sub-surface mark comprising one or more numerals, letters or symbols or a combination thereof representative of a desired indicium, the apparatus comprising a laser (10) for creating a high energy density beam (12) capable of penetrating the material at least to the depth of the desired mark; means (44) for bringing the beam (12) to a focus at a location within said material and spaced from a surface thereof so as to cause localised ionisation of the material and the creation at said location of a mark in the form of an area of increased opacity to electromagnetic radiation substantially without any detectable change to the surface; and means (32) for moving the focus of the beam (12) relative to the body (14) so as to enable the mark to be of a predetermined shape."

"14. A marked body of glass material (14) in which the mark comprises an internal zone of damage as a result of localised ionisation, the mark comprising one or more numerals, letters or symbols or a combination thereof representative of a desired indicium, the mark being spaced from a surface of the body (14) and in the form of an area of increased opacity to electromagnetic radiation substantially without any detectable change to the surface."

V. In the course of the appeal procedure, the following documents have, *inter alia*, been referred to:

D4: DD-A 237 972;

A1: NBS Special Publication 435, "Laser Induced Damage In Optical Materials: 1975"; issued April 1976;

A2: US-A 3,715,734;

A3: Roger M Wood, "Laser Damage in Optical Materials", 1986;

A5: DE-A 34 25 263;

A7: "Laserinduzierte Modifikationen in transparenten Dielektrika (Glas)", expert opinion by Dr rer. nat David Ashkenasi and Dr rer. nat. Arkadi Rosenfeld, drawn up on 29 May 2000.

VI. In the written and oral procedure, appellants I and II argued essentially as follows:

- (i) The subject-matter of claim 1 according to the main request was not novel with regard to the prior art as disclosed in documents D4, A2 or A1.

Document D4 disclosed a method of providing a body with a sub-surface mark using a focussed laser beam. The mention of a threshold intensity above which marking occurred and the mention of a peak power of 50 kW of Q-switched pulses, which represented a power density of 10^7 W/cm², showed that the marks were created by localised ionisation.

Document A2 disclosed the creation of cracks within a block of glass using a focussed laser beam which required localized ionisation of the glass material.

Document A1 disclosed a process of providing marks within a material such as glass using a pulsed and focussed laser beam causing localised ionisation of the material.

- (ii) The subject-matter of claims 1 and 5 of the first auxiliary request was not novel with regard to the prior art as disclosed in documents D4 or A2.

Documents D4 and A2 both disclosed the feature of forming marks comprising one or more numerals, letters or symbols, or a combination thereof representative of a desired indicium which in turn required providing means for moving the focus of the beam relative to the body to be marked so as to enable the mark to be of a predetermined shape. Furthermore, document D4 referred to a focussing optic for controlling the location of the focus in order to create three-dimensional structures.

The supplemental features of claims 1 and 5 of the first auxiliary request were thus already disclosed in documents D4 and A2.

- (iii) As regards the question of inventive step, document D4 disclosed irreversibly creating indicia of high resolution in transparent material such as plastics material. Furthermore, document A2 disclosed creating marks in glass

materials, the marks representing areas of reduced optical transparency due to microcracks caused by a focussed laser beam.

A skilled person, looking for mechanisms responsible for the creation of such marks in materials, would take note of document A1, and would consider using the process disclosed in document A1 for providing marks comprising numerals, letters or symbols representative of a desired indicium.

Furthermore, it had been obvious for a person skilled in the art to use the method of providing sub-surface marks, which is disclosed in document D4 in connection with creating marks in plastics material, for the purpose of creating marks in glass material. Obvious applications were, for example, car windows.

Since the formation of marks in glass materials by localized ionisation was known, cf. documents A1 and A3, a person skilled in the art would consider using that process for creating marks comprising numerals, letters or symbols representative of a desired indicium in materials such as glass.

Therefore, the subject-matter of claim 1 according to the first auxiliary request did not involve an inventive step.

- (iv) As the creation of marks comprising numerals, letters or symbols representative of a desired indicium obviously required an apparatus

comprising means for moving the focus of the laser beam relative to the body to be marked, the subject-matter of claim 5 according to the first auxiliary request did not involve an inventive step either.

- (v) The subject-matter of claim 14 according to the first auxiliary request also did not involve an inventive step, since a body according to that claim was the obvious result of the application of the method according to claim 1 of the first auxiliary request.

VII. In the written and oral procedure, the respondent argued essentially as follows:

- (i) The subject-matter of claim 1 of the main request was novel.

Documents D4 and A2 concerned methods for providing marks using thermal processes. Thermal processes and localised ionisation were two different types of interaction. The latter required high power densities combined with short pulse durations, as pointed out in the patent in suit, column 4, lines 39 to 44 and document A7, page 2, first paragraph. Documents D4 and A2 were silent about the pulse duration of the laser beam and about forming marks by localised ionisation of the material.

Document A1 related to localised ionisation. However, it concerned an academic study on damage mechanisms which might be caused by a laser beam in optical components. There was no disclosure of

any ability to form a mark at a specific depth and a specific location. Document A1 thus disclosed neither the step of directing a high energy density beam to the depth of the desired mark nor the steps of bringing the beam to a focus at a location spaced from the surface and of creating a mark at that location.

- (ii) The subject-matter of claims 1, 5 and 14 of the first auxiliary request was novel with regard to the cited prior art, because neither document D4 nor document A2 disclosed forming marks by localised ionisation. Moreover, document D4 did not refer to glass. Document A1 did not disclose forming marks comprising one or more numerals, letters or symbols, or a combination thereof, representative of a desired indicium.
- (iii) The subject-matter of claims 1, 5 and 14 of the first auxiliary request had not been obvious with regard to the cited prior art, in particular, with regard to the prior art as disclosed in combination in documents D4 and A1 or A3.

Document D4, which represented the closest prior art, disclosed a method for providing marks in plastics material using thermal processes. The object underlying the patent in suit was regarded as being to provide a method of making marks which is not restricted to the use of a specific material.

The invention according to the patent in suit suggested bringing a high energy beam to a focus at a location spaced from the surface and within

the material so as to cause localised ionisation of the material and the creation at that location of a mark in the form of an area of increased opacity.

That solution had not been rendered obvious by the prior art.

Whilst document D4 concerned the creation of marks comprising numerals, letters and/or symbols by irreversibly thermally modifying the material, documents A1 and A3 concerned the problem of avoiding any damage or modification caused by high energy laser beams in the material. Accordingly, the teachings of, on the one hand, document D4, and, on the other, documents A1 and A3 were incompatible, and there existed a prejudice against a combination of the teachings of documents D4 and A1 or A3.

Furthermore, document D4 suggested the formation of marks of high resolution and concerned a commercially applicable method at acceptable speeds, whereas document A1 showed, within the framework of a noncommercial academic study, the creation of long tracks without the ability to control either the location or the shape of the mark. Document A1 further used laser pulses in the range of picoseconds.

Thus, there had been no motivation for a person skilled in the art to disregard the teaching of document D4 and consider creating marks comprising numerals, letters or symbols by localised ionisation thus losing resolution and

the ability to predict the shape of the mark. It had thus not been obvious to combine, on the one hand, the teaching of document D4 and, on the other, that of documents A1 or A3.

- (iv) The subject-matter of claim 1 according to the first auxiliary request also had not been obvious with regard to the further cited prior art.

Document A2 suggested creating marks by carbonising plastics material or by forming cracks in glass material, which, according to document A3, pages 22 and 32, were thermal processes. Document A5 suggested the creation of marks by a chemical transformation in absorption centres of the dyed glass material. Neither of these documents thus suggested creating marks comprising numerals, letters and/or symbols by bringing a laser beam to a focus so as to cause localised ionisation of the material.

For the same reasons, it had not been obvious to provide an apparatus according to claim 5 or a body according to claim 14 of the first auxiliary request.

Reasons for the Decision

1. *Main request*

Novelty

Document A1 concerns a study of laser-induced damage in transparent solids with picosecond pulses. In order to

study the bulk dielectric properties of transparent solids, a pulsed laser beam was directed at a surface of the transparent body and the beam was brought to a focus at a location spaced from the surface and within said material, cf. pages 321 and 322, in particular, page 321, chapter 2, "Experiment", second paragraph and page 327, Figure 1. "The procedure involved firing pulses into each sample while recording various signals and visually monitoring damage spark occurrence as the pulse power was brought up through the threshold level", cf. page 322, second paragraph. The data indicated that avalanche ionisation is the damage mechanism, cf. page 321, first paragraph.

Accordingly, the process disclosed in document A1 comprises the step of creating desired marks by bringing the laser beam to a focus at a location spaced from the surface so as to cause localised ionisation of the material and the creation at that location of a mark in the form of an area of increased opacity to electromagnetic radiation substantially without any detectable change to the surface, cf. pages 327 to 330, Figures 1, 2, 8 and 9.

Consequently, the subject-matter of claim 1 according to the main request is not novel within the meaning of Article 54 EPC. The main request of the respondent is thus not allowable.

2. *First auxiliary request*

2.1 Amendments

The subject-matter of amended claim 1 is based on the disclosure of claims 1, 4 and 6 and the description,

page 4, second paragraph of the application as filed.

The subject-matter of amended claim 5 is based on the disclosure of claims 7, 9 and 13, the description, page 4, second paragraph and page 5, second paragraph of the application as filed.

The subject-matter of amended claim 14 is based on the disclosure of claims 19, 20, 21 and 24, the description, page 4, second paragraph and page 5, second paragraph of the application as filed.

These amendments, on the one hand, do not add subject-matter to the content of the application as filed, and, on the other, restrict the scope of protection of the respective claims as granted. Therefore, the amended claims do not contravene Articles 123(2) and (3) EPC.

2.2 Novelty

- 2.2.1 The subject-matter of claims 1 and 14 is novel with regard to the prior art as disclosed in documents A1 and A3, because these documents do not disclose the creation of marks comprising one or more numerals, letters or symbols, or a combination thereof representative of a desired indicium.

Document A1 makes mention of the possibility of moving the samples between the shots so that each pulse sampled a new volume element. However, the means for moving the samples are not further described. Document A1 thus does not disclose an apparatus comprising means suitable for creating marks comprising one or more numerals, letters or symbols, or a combination thereof representative of a desired indicium, and for moving

the focus of the beam relative to the body so as to enable the mark to be of predetermined shape. Document A3 does not disclose an apparatus comprising means for moving the focus of a laser beam relative to a body at which the laser beam is directed.

Therefore, neither document A1 nor document A3 discloses an apparatus as claimed in claim 5.

2.2.2 Documents D4, A2 and A5 disclose the creation of sub-surface marks comprising numerals, letters or symbols using a focussed laser beam.

However, an essential feature of the claims 1, 5 and 14 consists in that sub-surface marks comprising indicia are created by bringing a high energy density beam, in particular a laser beam, to a focus so as to cause localised ionisation. According to the patent in suit, cf. column 4, lines 3 to 44, there are different types of interaction between a laser radiation and a body of material, such as photochemical interactions, thermal interactions and ionising interactions. For localised ionisation of the material the beam must possess sufficient energy to cleave molecular bonds and create a plasma at the point of focus, cf. column 4, 24 to 27 of the patent in suit. A laser having a power density at the focus of at least 10^7 W/cm² and pulsed with a pulse duration of no more than 10^{-6} seconds is regarded as being sufficient to induce localised ionisation of the material at the focus of the beam, cf. column 4, lines 39 to 44 of the patent in suit.

2.2.3 None of documents D4, A2 and A5 explicitly discloses creating marks caused by localised ionisation. Moreover, it is also not directly and unambiguously

derivable from the disclosure of these documents that the marks are produced by using the process of localised ionisation.

Document D4 discloses the use of a continuously emitting acoustooptically Q-switched Nd-YAG laser, the peak intensity of Q-switched pulses attaining 50 kW. However, it is silent about the pulse duration. Consequently, document D4 does not disclose a process wherein all the conditions are met for the marks being created by localised ionisation. The mention of an intensity threshold level in document D4 cannot be regarded as being an indication of the occurrence of ionising interaction, since such intensity thresholds also exist with respect to thermal absorption, cf. document A3, page 13, last paragraph.

Document A2 relates to a process of marking plastics or glass material wherein the plastics material is locally carbonised and thus thermally modified, whereas glass or quartz locally lose their full transparency by the formation of cracks, cf. column 1, line 61 to column 2, line 3. The document is silent about any pulse power density of the laser and any pulse duration. Thus it cannot directly and unambiguously be concluded that the formation of cracks in glass are the result of localised ionisation. Moreover, according to document A3, page 13, last paragraph, "Bulk absorption can be produced by the presence of impurities, colour centres, conduction electrons or by the lattice and can cause laser damage by heating and consequent melting or fracture of the irradiated area." Thus, the creation of microcracks does not necessarily require localised ionisation of the material.

Document A5 discloses the formation of marks in dyed glass or plastics material using a continuously emitting laser causing a thermochemical reaction in absorption centres of the material.

- 2.2.4 To sum up, the cited prior art discloses neither a method comprising all the features of claim 1, nor an apparatus in combination with a body of material suitable for providing marks representative of a desired indicium caused by localised ionisation, nor a marked body of glass material in which the mark which is representative of an indicium comprises an internal zone of damage as a result of localised ionisation.

The subject-matter of independent claims 1, 5 and 14 is thus novel within the meaning of Article 54 EPC.

2.3 Inventive step

- 2.3.1 Document D4, which represents the closest prior art, suggests using a continuously emitting Q-switched laser for creating marks in a, preferably coloured, plastics material. The object underlying the patent in suit may be seen in providing a method for creating sub-surface marks comprising letters, numerals and/or symbols in bodies of various materials.

With regard to the solution suggested in the patent in suit, the question to be answered is whether it was obvious to use a high energy density beam (laser) device and a body of material in such a way that the inscription of indicia is carried out by bringing the laser beam to a focus so as to cause localised ionisation.

2.3.2 As shown above, only documents A1 and A3 refer to the process of localised ionisation. However, these documents concern studies on laser induced damage in optical materials. The background of these studies is to avoid damage in laser devices and to provide a quantitative basis for improvements leading to the design of damage free systems, cf. document A3, preface, page x, first paragraph.

Documents A1 and A3 thus do not relate to the object underlying the patent in suit, and, consequently, they do not suggest using the process of localised ionisation for the inscription of numerals or letters in a body.

Furthermore, document A1, cf. page 330, Figure 8 shows that localised ionisation leads to the formation of long tracks within the body, which obviously do not appear to be suitable for the creation of sharply limited structures or the creation of marks in thin-walled bodies such as glass bottles. There is further no reference to any ability to control or to predict the form of deformation caused by the localised ionisation. Therefore, there is also no hint that the process of localised ionisation might be suitable for the creation of marks representative of a desired indicium.

Accordingly, a person skilled in the art also would not consider using that process for providing inscriptions in a glass body, although there might be a desire for marking such bodies. Furthermore, document A3 refers to alternative, thermal processes which may cause damage in optical materials including glass. According to that document, cf. page 13, chapter 1.2 "Thermal

absorption", in particular, lines 1 to 3 of paragraph 1.2.1 on page 13, impurities and colour centres may cause laser damage by heating and consequent melting or fracture of the irradiated area. Thus, localised ionisation is not a necessary process for marking glass materials.

This is not in contradiction to the expert's opinion expounded in document A7, which postulates that localised ionisation is a necessary prerequisite for providing structures in glass materials. The subject of that opinion concerns the interaction between laser and glass having a low, negligible absorption coefficient. In such systems, free electrons had to be produced for attaining a sufficient absorption for creating laser induced structures, cf. page 2, first and second paragraph.

To sum up, there was no motivation for a person skilled in the art to abandon the concepts of documents D4, A2 or A5, which allow the formation of three-dimensional sub-surface structures and marks of predetermined shape at a high resolution, cf. document D4, page 2, lines 14 to 18, and to make a step towards a system which requires substantial changes of the laser device (high pulse power densities, short pulse durations) and includes the risk of damage of optical components of the system. These documents further disclose the formation of marks as an effect to be avoided and are silent about any ability to create marks of predetermined shape.

The subject-matter of claim 1 thus involves an inventive step within the meaning of Article 56 EPC. For the same reasons, the subject-matter of independent

claims 5 and 14 also involves an inventive step. The subject-matter of claims 2 to 4, 6 to 13 and 15 to 17 which are appendant to the claims 1, 5 and 14, respectively, similarly involves an inventive step.

The first auxiliary request of the respondent is thus allowable. Consequently, the second auxiliary request of the respondent had not to be considered.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.
2. The case is remitted to the first instance with the order to maintain the patent on the basis of the following documents:
 - (a) claims 1 to 17 filed as first auxiliary request on 4 January 2002;
 - (b) description, pages 2 to 6 submitted during oral proceedings;
 - (c) drawings, Figures 1 and 2 as granted.

The Registrar:

The Chairman:

M. Dainese

W. Moser