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D E C I S I O N
of 7 October 1999

Case Number: T 0010/97 - 3.4.2

Application Number: 86303459.1

Publication Number: 0201323

IPC: G03H 1/02, G06K 19/08, B42D 15/02, B42D 3/08

Language of the proceedings: EN

Title of invention:
Article incorporating a transparent hologramm

Patentee:
Dai Nippon Insatsu Kabushiki Kaisha

Opponent:
De La Rue Holographics Ltd
Landis & Gyr Technology Innovation AG

Headword:
-

Relevant legal provisions:
EPC Art. 56, 123(2)

Keyword:
"Amendments - deleting compounds from a list - added subject-matter (no)"
"Inventive step - general technical knowledge"

Decisions cited:
T 0393/91, T 0288/92

Catchword:
-

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Case Number: T 0010/97 - 3.4.2

D E C I S I O N
of the Technical Board of Appeal 3.4.2
of 7 October 1999

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Decision under appeal: **Decision of the Opposition Division of the European Patent Office dated 17 October 1996 revoking European patent No. 0 201 323 pursuant to Article 102(1) EPC.**

Composition of the Board:

Chairman: E. Turrini
Members: S. V. Steinbrener
B. J. Schachenmann

Summary of Facts and Submissions

I. The appellant (= proprietor of the patent) lodged an appeal against the decision of the Opposition Division revoking European patent No. 0 201 323.

Two oppositions against the patent as a whole had been filed by the respondents (= opponents 01 and 02, respectively) and based on the grounds of lack of novelty and/or inventive step (Article 100(a) EPC), insufficiency of disclosure (Article 100(b) EPC) and inadmissible amendments (Article 100(c) EPC).

II. The oppositions *inter alia* referred to the following documents (using the numbering of the opposition proceedings):

D1: US-A-4 315 665

D2: US-A-3 703 407

D4: O.S. Heavens: "Optical Properties of Thin Solid Films", Butterworths Scientific Publications, London 1955, pages 161 to 170

D10: GB-A-2 093 404

D15: DE-A-33 33 220

D16: WO-A-83/00 395

D17: US-A-4 501 439

D18: GB-A-2 136 352

D19: O.S. Heavens: "Optical Properties of Thin Solid Films", Butterworths Scientific Publications, London 1955, pages 155 to 161

D22: US-A-3 858 977, and

D23: US-A-4 426 130.

In addition, the following textbook excerpt:

D24: CRC Handbook of Chemistry and Physics, 65th Edition 1984 - 1985, CRC Press, Boca Raton, Florida 1984, pages B-197 to B-202

was *inter alia* submitted by respondent 02 in the appeal proceedings.

III. In its revocation of the patent in suit, the Opposition Division held that the subject matter of claim 1 as amended in accordance with the sole request of the patent proprietor met the requirements of Articles 84 and 123(2) EPC, respectively. Furthermore, the ground for opposition according to Article 100(b) EPC was not considered justified. However, although in the Division's opinion the claimed subject matter was novel with respect to the available prior art, it was found to lack the inventive step required by Article 56 EPC in view of a combination of documents D18 and D15 or D18 and one of documents D1, D2 and D23.

IV. In the communication of 9 August 1999 pursuant to Article 11(2) of the Rules of Procedure of the Boards of Appeal, the Board pointed out that it seemed doubtful whether the limitation to "inorganic compound" in claim 1 of the appellant's respective requests submitted in the appeal proceedings could be considered originally disclosed. In the Board's provisional view,

the term "inorganic compound" extended far beyond the limited list of ferroelectric and dielectric materials referred to in the original application documents and, therefore, was not admissible under Article 123(2) EPC.

Furthermore, the Board considered the contents of document D18 to come closest to the subject matter of an admissible claim 1, i.e. in substance claim 1 of the appellant's second auxiliary request. The differences of such subject matter with respect to the closest prior art and the technical effects associated with said differences should be discussed at the scheduled oral proceedings. This, in particular concerned the issue of whether or not the claimed solution was obvious from the remaining prior art disclosing the use of thin dielectric reflection films in similar structures (see in particular documents D1, D2, D10, D15, D16, D17, D23 and D24). Since such films and their properties seemed to be widely known, the Board, on a provisional basis, considered the existence of an inventive step questionable.

V. With a reply to the Board's communication, the appellant filed a new single request based upon the previously submitted second auxiliary request. Moreover, two comparative examples were filed by the appellant shortly before the oral proceedings.

VI. Oral proceedings requested by all parties on a subsidiary basis took place on 7 October 1999. During the oral proceedings, the appellant handed over two specimens of hologram articles allegedly manufactured in accordance with the above-mentioned comparative examples. At the end of the oral proceedings, the Board's decision was given.

VII. The appellant requested that the decision under appeal be set aside and that the patent be maintained as amended in the following version:

- claims 1 to 5 filed on 7 September 1999,
- description pages 3, 4, 7, 10, 18, 20, 24 filed on 7 September 1999
- all other pages and figures as granted.

VIII. The respondents requested that the appeal be dismissed.

IX. The wording of amended claim 1 according to the appellant's request on file at the time of the present decision reads as follows:

"1. An article comprising:
a substrate comprising a display portion (5) providing a first visible information pattern; and on the substrate,
a reflection hologram (1) whose holographic image provides a second visible information pattern, and said hologram comprises a layer (2) having a holographic image forming surface relief (3) such that the second information pattern of the holographic image is visible to the naked eye when the hologram is illuminated within the angle range in which reproduction of the hologram is possible, and the layer (2) is at least partly coated with a reflection-enhancing layer (4),
characterised in that
the relief layer (2) is a transparent layer at least partly coated with the reflection-enhancing layer (4) which is a thin transparent layer of Fe_2O_3, TiO_2, CeO_2, Ta_2O_5, ZnS, ZnO, CdO or Nd_2O_3 and has a thickness of 10 to 500 nm thereby reproducing the surface relief of the transparent relief layer (2), the difference between

the refractive index n_1 of the transparent relief layer (2) and the refractive index n_2 of the transparent reflection-enhancing layer (4) being not less than 0.5; and in that
the transparent relief and reflection-enhancing layers (2, 4) are disposed over the display portion (5) through an adhesive layer (32) so that the first information pattern is visible to the naked eye through the hologram."

Claims 2 to 5 are dependent on claim 1.

X. The appellant's arguments in support of its request may be summarised as follows:

The subject matter of claim 1 is based on original claim 46 and Table 1 of the application documents as filed. Although not all of the compounds listed there have been included in the present claim, the provisions of Article 123(2) EPC are met in that the claimed subject matter does not constitute an expansion of a generic term but only a restriction to examples which in the appellant's view appear to be safe from objections and might be accepted by the Board.

The comparative examples have been filed mainly to illustrate the objective problem existing with respect to document D18: as can be seen from the samples handed over at the oral proceedings, sample A manufactured in accordance with the patent in suit clearly shows a greater brightness of the holographic image. Therefore, the objective problem may be seen in improving the brightness of the holographic image without losing transparency.

An inventive step lies in the claimed solution, i.e. to apply a transparent reflection-enhancing layer with parameter values as indicated in claim 1. No prior art suggests a range of compounds with such values. In particular, document D16 disclosing a thin ZnS layer on a relief surface is directed to colour filters without mentioning holograms. The main aspect of D16 is to prevent the authenticating device from being photocopied. Moreover, Figure 5 of D16 clearly indicates that the prior art device is opaque at small viewing angles and becomes transparent at larger viewing angles only. Hence, in the present context of transparent devices, a skilled person would not turn to D16 with an expectation of success.

Similar arguments hold with respect to documents D10, D15 and D23. D10 relates to diffractive-subtractive authenticating devices of the grating type. Although dielectric materials are mentioned for transmissive gratings, these are not preferred because of the relatively small difference in indices of refraction of dielectric materials practical for fabricating the prior art grating structures. Document D15 describes an authenticating device in accordance with US application Serial No. 387 614 only in relative terms without specifying suitable materials, differences in refractive indices or thickness ranges. Since the disclosure of D15 is deficient, it could only be considered enabling if the above-cited US application were prepublished which does not seem to be the case. Finally, document D23 also relates to grating structures and, as coating material on a photoresist substrate, only provides MgF_2 leading to $\Delta n=0.22$.

Document D1 discloses reflection-enhancing layers on holograms, however Δn being rather small ("more than 3%") in accordance with the desired application for sunglasses.

Although a refractive index difference between substrate and coating of at least 0.1 is preferred in document D2, this is not considered essential. Apart from arsenic sulphide, coating materials of low refractive index are suggested in the examples given in D2, from which examples a skilled person would not deviate. Moreover, the thickness values are not of the same order.

The disclosure of document D17 is entirely non-enabling since no parameter values and materials are disclosed. This document indicates that a decrease in Δn will reduce the detectability of the holographic image but is silent on the inverse effect.

Document D22, suggesting multiple interference layers to be used as filters, is not more relevant than the other prior art.

It is admitted that the properties of the claimed compounds *per se are* well-known from standard textbooks (see e.g. D19 or D24). However, this does not mean that the compounds must be considered to be obvious candidates for reflection layers in holograms. The reflectance curves shown in D19, which are based on theoretical calculations, do not directly lead to the additional features of claim 1 now under consideration, and are thus not relevant.

IX. The respondents advanced the following counter arguments:

Whereas respondent 02 had no objections under Article 123(2) EPC against present claim 1, respondent 01 took the view that the amended claim was not admissible if decision T 288/92 were followed. Although

all materials now included in the claim have been disclosed individually, these materials have not been originally identified as a group. Since no information on the rules of selection were given, and no real difference in properties is apparent from Table 1 of the patent in suit, the claimed subject matter is based on an arbitrary selection from a large group.

Both respondents considered the configuration of sample B submitted at the oral proceedings not to be in line with the teaching of document D18. However, since the holographic effect disappears in the left-hand portion of sample B where Δn is almost zero, and is clearly visible in the right-hand portion where Δn is about 0.4, this only shows that the present problem is indeed solved by increasing Δn, but does not give an answer to the question of whether or not the claimed solution is obvious. Moreover, the sample clearly demonstrates that the holographic effect is visible in air without any reflection-enhancing layer.

Having regard to the issue of patentability, respondent 01 considered document D18 to be the correct starting point. This prior art discloses a number of different constructions having no or only partial metallisation or making use of a refractive index effect. In accordance with D18, transparent holograms are achieved by either suppressing the metallisation or using a coating of different refractive index. The subject matter of claim 1 differs from the closest prior art by the specification of materials, thickness ranges and a lower limit for Δn. However, this information at school physics level is commonly available to a skilled person who would naturally be aware of refractive index effects (which already exist between the hologram and air), of a thickness range falling between the quarter

of a wavelength and the order of a wavelength (which corresponds to the height of the relief structure of holograms) and easily available materials meeting the requirements of refractive index and transparency. In particular, a skilled person would consider thin film design based on curves in standard textbooks, as e.g. document D19 referred to by the Board in the oral proceedings. Therefore, the claimed subject matter is obvious from document D18 and common general knowledge.

Furthermore, the problem recognised in the contested patent is considered to be due to a small value of Δn. The teaching of document D2 would be interpreted to imply that better results are achieved with increasing Δn. General aspects of the role of materials, thicknesses and refractive indices in designing interference layers for transparent authenticating devices are dealt with in document D22. As can be seen from document D16, ZnS has already been used in the claimed thickness range as a reflection-enhancing layer for similar authenticating devices of the colour filter type. Finally, a general awareness of using high Δn values must also be concluded from document D1, where the coating thickness falls within the claimed range since it follows the hologram relief structure.

Respondent 02 also held that the claimed subject matter was obvious from a combination of document D18 and common general knowledge. In particular, the embodiment at page 5, lines 95 ff of D18 comprises two patterns at two different levels in the layered structure, i.e. an upper modifying hologram over a lower principle hologram, which patterns should both be visible. According to D18, the upper pattern is coated with a thin film having different refractive index. It is

entirely clear to a skilled person that the transparency of the modifying hologram must be increased if the principle hologram is not sufficiently visible, and must be reduced if the modifying hologram is hardly visible. Therefore, no inventive contribution can be seen in formulating the present problem.

The claimed solution is also obvious to a skilled person, i.e. an optics physicist in the present case. The effect of Δn in thin film layered structures, as e.g. filters, gratings or holograms, is common general knowledge in the context of index matching. As can be seen from document D19, the possible thickness range for antireflection coatings extends from about 10 nm to about one wavelength. Suitable materials for vapour deposition are available from literature, the claimed materials do not show any additional particular effect.

Moreover, a skilled person starting from document D18 would take account of document D16 relating to similar devices in the technical field of optical security elements. This document should be regarded together with cross-referenced documents D10 and D15 as one item of prior art. As can be seen from Figure 4a and associated text of D16, film thicknesses and Δn values fall within the claimed ranges. In addition, the coating material provided in an embodiment according to Figure 4a is ZnS, i.e. a member of the group set out in claim 1.

Reasons for the Decision

1. *Admissibility of appeal*

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

2. *Admissibility of amendments*

In the Board's view, the subject matter of claim 1 is based on original claim 46, page 12, line 12, page 19, lines 1 and 2, Table 1 and Figures 12 to 15 and associated text of the application documents as filed, and thus admissible.

This finding does not comply with the opinion of respondent 01 who considered claim 1 to be based on an inadmissible selection and referred to decision T 288/92 in this context. It is true that not all the compounds listed in original claim 46 and Table 1 have been included in amended claim 1. However, the Board does not consider the finding of decision T 288/92 to be directly applicable to the present case since the claimed group of compounds is not obtained by restricting an originally disclosed generic definition of a substituent in a generic formula to a specific one selected from worked examples, but by deleting some members from a list of individualised equally useful compounds in order to improve the chances of patentability over the available prior art. In the Board's view, such deletions must be considered admissible in accordance with the case law of the boards of appeal (see decision T 393/91, not published in OJ EPO; point 2.2 of the reasons). For the remaining compounds, a particular technical effect has neither been disclosed nor alleged.

3. *Patentability*

3.1 Novelty

The Board is convinced that the prior art identified does not anticipate the claimed subject matter. In fact, novelty has not been at issue in the present appeal proceedings.

3.2 Inventive step

3.2.1 There has been consent among the parties that document D18 comes closest to the subject matter of claim 1. The Board shares the view of respondent 01 that basically three different embodiments are disclosed in this prior art: a one-layered plastics structure with or without metallisation and a two-layered plastics structure which may be coated with a transparent ink. In the present context, the Board considers it appropriate to start from the first embodiment of D18, i.e. the metallised one-layered plastics structure which - as an option - may be partially de-metallised.

Document D18 thus discloses an article comprising a substrate (e.g. surfaces 74 in Figure 9) and on the substrate a reflection hologram (Figure 9: 72) whose holographic image provides a (second) visible information pattern (see D18, the abstract). The hologram comprises a layer ("thermoplastic inks") having a holographic image forming surface relief ("embossed" surface), and the layer is at least partly coated with a reflection-enhancing layer ("partial metallisation"); see D18, the abstract and page 2, lines 49 to 68.

In particular, the substrate may be a document comprising a display portion providing a first visible information pattern ("indicia"); see D18, page 5, lines 40 to 54. Furthermore, it must be assumed that the second information pattern of the holographic image is visible to the naked eye when the hologram is illuminated within the angle range in which reproduction of the hologram is possible (see D18, page 6, lines 20 to 27).

Moreover, as can be seen from the passages cited above, the known relief layer is also a transparent layer at least partly coated with the reflection-enhancing layer, and the transparent relief is disposed over the display portion through an adhesive layer so that the first information pattern is visible to the naked eye through the hologram (see D18, page 2, lines 85 to 108 and page 5, lines 40 to 63).

Therefore, the subject matter of claim 1 differs from the closest prior art in that

(i) the reflection-enhancing layer is a thin transparent layer of Fe_2O_3, TiO_2, CeO_2, Ta_2O_5, ZnS, ZnO, CdO or Nd_2O_3;

(ii) the transparent reflection-enhancing layer has a thickness of 10 to 500 nm thereby reproducing the surface relief of the transparent relief layer;

(iii) the difference between the refractive index n_1 of the transparent relief layer and the refractive index n_2 of the transparent reflection-enhancing layer is not less than 0.5; and

(iv) the transparent reflection-enhancing layer is disposed over the display portion.

In this prior art, the reflection-enhancing layer is a metallisation, the thickness of which is not specified. From the fact, that it is to be removed to make the underlying indicia portion visible, it must however be concluded that the prior art metallisation is opaque.

Thus, a skilled person learns from document D18 to remove portions of an opaque reflection-enhancing layer in order to allow visibility of an underlying information pattern through the hologram. In the absence of any reflection-enhancing layer, the holographic effect will normally be expected to still exist on the de-metallised portions of the hologram, but to be relatively weak (see D18, page 2, lines 64 to 68 and 85 to 88 relating to a hologram device without any metallisation; see in this context also the prior art acknowledged in the contested patent, page 3, lines 17 to 23).

3.2.2 By providing the claimed transparent reflection-enhancing layer on the transparent relief layer, the brightness of the holographic image will be increased, while the transparency, and hence the visibility of the underlying information pattern, will not be lost altogether, as the appellant has pointed out at the oral proceedings.

Therefore, when starting from document D18 the objective problem solved by the subject matter of claim 1 may be seen in achieving these effects.

The Board agrees with the parties that recognition of this problem does not require inventive skill since the physical phenomena will become necessarily apparent when the prior art teaching is put into practice, and

it depends on the circumstances whether or not a skilled person will be satisfied with the high holographic image contrast existing in the prior art between metallised and de-metallised relief portions.

3.2.3 In the Board's view the claimed solution is obvious from common general knowledge. A skilled person, i.e. an optics physicist or an optical engineer, must be considered to be well-aware of the fundamentals of reflectance and transmittance of thin films (see e.g. document D22, column 1, line 43 to column 2, line 2). If partially transparent reflecting films are required, basically two conventional options exist: either to use absorbing very thin semi-transparent metal films or to use non-absorbing thin transparent dielectric films (see e.g. documents D19 being a standard textbook, sections 6.2(a) and (c), and D1, column 3, lines 23 to 36).

The reflectance of thin dielectric films may be tailored in accordance with classical calculations and experiments. The result of such calculations can, e.g., be seen from Figure 6.1 of document D19 for the simple case of a thin coating on a plane-parallel substrate. The reflectance of a coating layer depends on the refractive indices of layer and substrate and is a function of the layer thickness. For a film of index higher than that of the substrate, an enhanced reflectance results, the maxima being at an optical layer thickness $n \cdot d$ of $(2m+1)\lambda/4$. Furthermore, the higher the index difference Δn, the higher is the reflectance value. Thus, using the terminology of the patent in suit, for a substrate with $n_1 = 1.5$ (e.g. glass or resin), a coating with $n_2 = 2.0$ ($\Delta n = 0.5$) and an optical thickness of $\lambda/4$ will result in a reflectance of more than 20% in air as compared to

about 4% without that coating or about 12% for Δn = 0.25. These results of straightforward calculations are confirmed by experimental curves as, e.g., the curves for ZnS (which is one of the compounds listed in claim 1 and has n_2 = 2.1 according to the patent in suit) shown in Figure 6.2 of D19: increase of reflectance from about 10% to more than 30% at λ = 546.1 nm for film thicknesses from about 100 nm to about 600 nm.

Therefore, the Board is convinced that a skilled person faced with the problem of increasing the brightness of transparent hologram portions obtained in accordance with the teaching of document D18 would - as a familiar option - consider the use of transparent reflection-enhancing films either instead of said prior art metallisation or at least on said transparent hologram portions.

As can be seen from the discussion above, the claimed materials and parameter ranges closely correspond to those typically used in the field of reflection-enhancing films. Further transparent high index materials included in the claimed group are available from standard reference books as, e.g., document D24 (see pages B-198 and B-201: TiO_2; page B-199: Fe_2O_3; page B-201: ZnS; page B-202: ZnO). A particular technical effect associated with the claimed specific list of compounds has neither been disclosed in the contested patent nor been asserted by the appellant.

3.2.4 The above-defined common general knowledge is reflected and confirmed by various documents cited in the present proceedings and relating to reflection-enhancing layers on optical devices of hologram, grating or filter type including authenticating devices.

In the context of a two-layered plastics structure, document D18 already refers to the possibility of coating the upper "modifying" hologram with a transparent protective layer of a **different** refractive index to the transparent hologram relief layer (see D18, pages 5, lines 94 to 125; emphasis added by the Board). Similarly, document D2 provides a coating on a relief phase hologram, which completely fills the corrugations and has a different index of refraction. The greater Δn, the greater will be the intensity of the holographic image upon playback (see D2, the abstract and column 2, lines 56 to 66). This fact is also confirmed by document D17 which - on the contrary - proposes a relatively low Δn value of at most 0.2 for a protective layer in order to reduce the visibility of an optical microstructure, e.g. a hologram or diffraction grating, below the visibility limits of the human eye (see D17, Figures 1 and 2 and column 4, lines 7 to 16; an effect of this type seems to exist on the left-hand portion of sample B submitted by the appellant at the oral proceedings).

The necessity of having high Δn values for thin transparent reflection-enhancing layers reproducing relief structures is underlined in the cited documents as well or may easily be derived therefrom, be it for such layers on composite optical elements including holograms and having controllable light transmission and reflection characteristics (see document D1, column 3, lines 1 to 3 and 30 to 36 and claim 4), or for such layers on filters of the refractive diffraction grating type (see document D15, Figure 1b and associated text; document D16, in particular Figure 4a and associated text). Since the height of the holographic relief structure is of the order of 100 nm (see e.g. document D2, column 2, lines 21 to 24), the thickness of any conformable layer cannot be substantially higher. The appellant's additional

arguments with respect to documents D15 and D16 are not considered convincing since even without specifying concrete values D15 sufficiently indicates the respective requirements, whereas the transparency conditions of Figure 5 of D16 are due to the specific construction of this embodiment and therefore would not be generalised by a skilled person. Moreover, even this embodiment would allow visibility of the underlying information pattern through the filter, albeit at specific angles.

Finally, typical high index materials for reflective thin films comprise ZnS (see document D22, claim 4; document D16, page 22, lines 5 to 12), TiO_2 (see document D22, claim 4) or dielectric layers consisting of anorganic compounds in general (D15, page 10, last paragraph).

3.2.5 In consequence, the use of a transparent reflection-enhancing layer of the claimed type in case of insufficient visibility of transparent hologram portions over information patterns cannot be considered to involve the inventive step required by Article 56 EPC, and claim 1 is not allowable for this reason.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

P. Martorana E. Turrini