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Bezeichnung der Erfindung: Two-beam scanning optical system
Title of invention:
Titre de l'invention :

Klassifikation / Classification / Classement : G02B 27/17, H04N 1/04

ENTSCHEIDUNG / DECISION
vom / of / du 24 March 1988

Anmelder / Applicant / Demandeur : Hitachi Ltd. and Hitachi Koki Co., Ltd.

Patentinhaber / Proprietor of the patent /
Titulaire du brevet :

Einsprechender / Opponent / Opposant :

Stichwort / Headword / Référence :

EPÜ / EPC / CBE Article 56

Schlagwort / Keyword / Mot clé : Inventive step (yes)

Leitsatz / Headnote / Sommaire

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Case Number : T 295/86 - 3.4.1

D E C I S I O N
of the Technical Board of Appeal 3.4.1
of 24 March 1988

Appellant : Hitachi Ltd.
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Decision under appeal : Decision of Examining Division 041 of the European Patent Office dated 16 January 1986 refusing European patent application No. 82 110 165.6 pursuant to Article 97(1) EPC

Composition of the Board :

Chairman : K. Lederer
Members : J. Roscoe
E. Persson

Summary of Facts and Submissions

I. European patent application No. 82 110 165.6 filed on 4 November 1982 (publication No. 0 079 532) was refused by decision of the Examining Division 041 of the European Patent Office.

II. This decision was based on Claims 1 to 5 filed on 16 January 1986.

III. The reason given for the refusal was that the subject-matter of Claim 1 did not involve an inventive step having regard to US-A-4 002 829 (hereafter D1), and the routine knowledge of the skilled man.

IV. It was stated in the decision that D1 disclosed two two-beam scanning optical systems according to the precharacterising part of Claim 1. In both systems the recording and reading beams were combined by dichroic mirrors but separation of the beams was achieved by the dihedral mirror 42 in the system described with reference to Figs. 1 to 4 and in the Fig. 5 variant by a dichroic mirror. The passage at col. 4 line 64 to col. 5 line 9 of D1 taught another way of combining and separating two beams by using an inherent property of light for which beam splitters were available, i.e. the state of polarization and thus provided a substantial hint to use this property not only for combining laser beams in general but also for combining and separating the two beams in a device according to the preamble of Claim 1. The fact that diode lasers usually emitted linear polarized light rendered it even more obvious to utilise the polarization property for this purpose.

V. An appeal was lodged against the decision.

VI. In a communication of the Board sent with the summons to oral proceedings, attention was drawn to the following additional documents:

US-A-4 125 843 (D2),
Handbook of Optics by Driscoll and Vaughan, published in 1978, page 10-101 (D3), and page 597 of McGraw Hill Enc. of Science and Technology, Vol.8, 1977 (D4).

Furthermore, the provisional view was expressed that in the light of D1 and these additional documents the subject-matter of Claim 1 did not involve an inventive step.

VII. At the oral proceedings the Appellant presented a set of claims comprising a slightly revised Claim 1 and new pages 2, 2a, 3 and 4 of description to be substituted for the corresponding items originally filed and requested that the decision under appeal be set aside and a patent granted on the basis of the thus modified originally filed documents.

Claim 1, the only independent claim, reads as follows:

"A two-beam scanning optical system comprising:

a first laser light source (1) for emitting a recording laser beam,

a second laser light source (2) for emitting a reading laser beam,

a first optical means (3) for combining said recording and reading laser beams,

a second optical means (4) for scanning said combined laser beam,

a third optical means (6) for separating said combined laser beam emitted from said second optical means (4) into said recording and reading laser beams,

a fourth optical means (5) disposed between said second and third optical means (4, 6) for collecting said combined laser beam from said second optical means (4) such that said recording and reading laser beams respectively scan predetermined scanning planes

characterised in that

one of the recording laser beam and the reading laser beam is P-polarized and the other is S-polarized and said first optical means (3) and said third optical means (6) are polarization beam splitters which substantially transmit P-polarized laser beams and reflect S-polarized laser beams.

VIII. The arguments presented by the Appellant in his written and oral submissions can be summarised as follows.

The use of polarization beam splitters (hereafter PBS), to combine and subsequently separate read and write beams with mutually perpendicular planes of polarization was neither disclosed nor suggested by any of the cited documents. In D1 the PBS was simply used to combine two laser beams to form a single higher energy writing beam. Such use would not lead the skilled man to its use to combine the read and write beams, still less to subsequently separate them. Indeed it would be seen to be incompatible with their simultaneous use to form the combined write beam. The mere reference to PBS however,

illustrated that these were well known optical elements even at that time, and the fact that neither the authors of D1, who must be regarded as skilled in the art, though evidently aware of this, nor the authors of the later document DE-A-2 825 550 (D5) suggest to use them instead of or as an alternative to dichroic and dihedral mirrors was an indication that it was not obvious to do so.

The systems proposed in D1 had certain disadvantages. Dichroic mirrors could be used only with read and write beams of widely different wavelengths and that used to split the beam introduced aberrations into the transmitted beam as it passed obliquely through its thickness but not into the beam reflected from its front face. Correction of the aberrations could be achieved only by use of additional optical elements since compensating aberrations built into the elements in the shared path would lead to aberrations in the opposite sense in the reflected beam. On the other hand use of a dihedral mirror to split the beam required the combined beam to consist of two somewhat divergent sub-beams thus leading to off-axis aberrations and requiring very accurate positioning of the beam in relation to the apex of the mirror over the full width of the scan.

When PBS of conventional form as shown in the drawing of the present application were used however, the beams could be either of the same or different wavelengths, the positioning of the combined beam was not critical and both beams, which at the centre of scan entered and left the PBS normal to a face always followed paths of equal length through it and hence suffered the same aberrations.

The skilled man, if looking to improve the scanning system of D1, first had to recognise what the problems were and in which part of the system they arose and then look at

prior art systems offering a solution. He would not consider D2 to be relevant since it did not involve scanning in the sense of Claim 1 and D1 but merely a deflection system for describing patterns. Its optical system would thus not seem to be appropriate for a read write scanning system as used in D1. Moreover in D2 the two beams of different function finally emerging from PBS 19 were in fact identically and not differently polarized. There was furthermore no suggestion in D2 to combine the laser beams with a PBS, so that even were the skilled man to replace the common optical system of D1 by that of D2 he would not arrive at the invention. To do so he would have to select certain parts of the system of D2 and find substitutes for others. In the absence of any guidance from the cited documents such a selection could only be made with hindsight.

Reasons for the Decision

1. The appeal is admissible.

2. The current version of the claims, description and drawings does not offend against Article 123(2) EPC since it contains no subject-matter extending beyond the content of the application as filed. Claim 1 is, in substance, a combination of the original Claims 1 to 3 supplemented by information as to the role of the beams derived from the sole embodiment described, which also provides support for the remaining claims. The amendments made to the description, which were necessary to meet the requirements of Rule 27(1)(c) and (d) EPC likewise introduce no new matter.

Since a scanning optical system having the combination of features set out in the preamble of Claim 1 but lacking

its characterising features is disclosed in D1, which is in the opinion of the Board the closest prior art, the requirements of Rule 29(1)EPC are therefore also met by the claim.

3. Novelty

3.1 Following a thorough examination of the prior art documents on file the Board is satisfied that none of them discloses a two-beam scanning system comprising all the features of Claim 1.

3.2 D1 discloses various systems according to the preamble of Claim 1 but in none of these is a polarization beam splitter used either for combining reading and recording beams or for separating a combined beam into discrete reading and recording beams.

3.3 D2 discloses a two-beam optical system in which two mutually perpendicularly plane-polarized laser beams pass through a common beam deflecting and focussing system and are subsequently directed along different paths by a polarization beam splitter (polarizing cube 19). The two beams, originating from lasers 11, 20 of different wavelengths are initially directed along a common path of approach to the deflecting means by a structure consisting of two prisms 23, 15, which are separated along their mating surfaces by polarization layers (col. 4 lines 19-21). From the representation of this structure in the drawing and the knowledge that the beams 12 and 21 are "S" and "P" polarized respectively the skilled man would appreciate that these two prisms also act as a polarization beam splitter in the sense of Claim 1, albeit not of the same geometrical form as that used in the embodiment of the invention, and thus that, contrary to the view held by the Appellant the beams are not only

separated but also brought onto a common axis by a polarization beam splitter.

In this system, however, although one of the beams has a recording function the other is used not for reading but to serve as a pointer on a projection of an image recorded by the first beam.

3.4 D3 and D4 do not describe beam scanning systems at all.

3.5 Neither of the remaining documents cited on the European Search Report viz. D5 and US-A-4 212 018 (D6), both of which also disclose systems having the features of the preamble of Claim 1, makes any reference at all to the use of polarized light for any purpose. In both cases dichroic mirrors are used to combine and subsequently separate the reading and recording beams.

The subject-matter of Claim 1, and hence that of the remaining, dependent, claims is therefore novel. (Article 54 EPC).

4. Inventive step

4.1 To determine whether the claimed system involves an inventive step a comparison has first to be made between the results achieved by it and those produced by the closest prior art system. The Board considers this to be the system described with reference to Fig. 5 of D1, since not only does this have the combination of features set out in the preamble of Claim 1 but it also employs the same type of element both to combine and subsequently separate the read and write beams, albeit dichroic mirrors.

4.2 In the absence of any documentary evidence casting doubts on the validity of the advantages which the Appellant claims to be made available by the claimed system the Board accepts that in relation to this particular prior art the imaging ability of one of the scanning spots is enhanced. Therefore, the objective problem to be solved is that of providing a system affording the same advantage as the known system of having scanning elements shared by the read and write beams but able to provide a read beam scanning spot having improved imaging ability i.e. exhibiting less aberrations without serious reduction of that of the write beam.

4.3 Although D1 itself contains no discussion of beam aberrations or how they can be avoided or eliminated a skilled man would, in the practical use of the system of Fig. 5 in a situation where the imaging ability of the read spot was critical, hardly fail to become aware of its shortcomings in this respect. Whether he would immediately identify the dichroic mirror 44 as a likely source of the aberrations is less certain. The Board is however, satisfied that his routine knowledge, reflected in the disclosure in the reference book D4, that optical aberrations are one of the undesirable effects of a thick beam splitting plate, would lead him to suspect this and to conduct routine investigations which would confirm the suspicion. D4 makes a proposal to tackle this problem by using thin pellicles instead, which clearly leads away from the invention, whereas D1 suggests nothing. The skilled man would, however, no doubt recognise that the alternative proposal in D1 to use a dihedral mirror to separate the read and write beams would not introduce aberrations into the read beam, or at least not for the same reason, providing a mirror was used having its reflective surface on the front face. Such a realisation

would however also lead him away from rather than towards the invention.

4.4 The sole reference in document D1 to polarization is in the passage at col. 4, line 64, to col. 5, line 8, the interpretation of which was a subject of dispute between the Examining Division and the Appellant (the Applicant). Having analysed this passage the Board concludes that when read as a whole what it means is that the energy level of the writing (recording) beam can be increased by combining the outputs of two small lasers of the same wavelength by making use of the fact that their output light is polarized and that different polarized beams can be combined by means of a polarization beam combiner having the characteristics indicated. There is absolutely no suggestion to subsequently separate the resulting combined beam, used for writing, into its differently polarized components nor would there appear to be any reason for doing so. Furthermore the passage does not state that the optical member used for combining the polarized source beams also serves to combine the composite writing beam with a reading beam and there is no indication that this latter beam is polarized at all. The view expressed by the Examining Division during the examination proceedings that the above literal interpretation of the passage would seem absurd to the skilled man, who would therefore put a totally different construction on it, cannot be followed. Even were the skilled man to consider the proposal to use two lasers when he could just as well use one of higher power as absurd, which the Board cannot accept, since it presupposes the availability of a whole range of lasers of powers appropriate to all applications, this would lead the skilled man to disregard the passage rather than to interpret it as meaning something totally different from what it says.

4.5 The Board is further unable to share the view of the Examining Division that the reference in D1 to use of what the skilled man would recognise to be a PBS for combining two laser beams to form a more energetic write beam would lead him to the idea that by employing differently polarized read and write beams and combining and separating them with PBS he would achieve a system with the advantage sought (cf. point 4.2 above), since the reference affords no indication that the element in question is an optical equivalent of the beam splitting mirror in D1, let alone that it has certain advantages over it. Furthermore the skilled man would be diverted from giving the matter full consideration by the fact that a write beam with two polarization components would effectively rule out the possibility of identifying the read and write beams by their polarizations.

4.6 D2 discloses the use of PBS both for bringing two differently polarized beams serving different functions on to a common axis, or at least on to parallel axes, to enable them to be deflected by a common optical system and for subsequently separating them.

However, the Board is of the opinion that, since aberrations are not discussed at all in this document, the skilled man looking for an improvement in that direction would therefore not find there any hint that substitution of PBS for each of the dichroic mirrors in Fig. 5 of D1, with an appropriate choice of laser beam polarizations would provide a solution to the objective problem posed.

Here, it is worth observing that in the system described in D2, although the beams 12, 21 on there first emergence from the DPS 19 have in fact traversed equal paths, the beam 21 passes twice through a quarter wave plate 29 to re-enter and be reflected in the PBS before emerging to

exercise its function. Accordingly it is apparent that the author of this document himself made no practical use of the fact that a PBS can provide beams of equal aberrations, the appreciation of which forms the basis of the present invention.

4.7 Although D3 discusses some properties of PBS it is not presented in a discussion dealing with optical aberrations nor does it make any reference to what happens to beams or rays obliquely incident on its faces. For this reason it would not in the Board's judgment lead the skilled man faced with the objective problem to modify the arrangement of D1 to produce the system claimed.

D4 which deals with beam splitters other than PBS can certainly not give any hint in the direction of the claimed invention.

4.8 Finally, D5 and D6 contain no discussion of beam aberrations or how they are to be avoided or compensated. For this reason and since as previously stated, they do not disclose the use of polarized light for any purpose they could not lead the skilled man to the claimed arrangement.

For the above reasons the subject-matter of Claim 1 is not only novel but is considered to involve an inventive step within the meaning of Article 56 EPC. Claim 1 is therefore allowable under Article 52(1), as are the remaining claims by virtue of their dependence on it.

Order

For these reasons, it is decided that:

1. **The decision under appeal is set aside.**

2. **The case is referred back to the first instance with the order to grant a European patent on the basis of the following documents:**

   Claims 1 to 5 as presented at the oral proceedings;
   Description pages 2, 2a, 3 and 4 as presented at the oral proceedings;
   Description pages 1 and 5 as originally filed;
   Drawings sheet 1/1 as originally filed.

The Registrar **The Chairman**

F. Klein **K. Lederer**