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Bezeichnung der Erfindung: Optical system for scanning with laser beam
Title of invention:
Titre de l'invention :

Klassifikation / Classification / Classement : G02B 27/17

ENTSCHEIDUNG / DECISION
vom / of / du 1 July 1988

Anmelder / Applicant / Demandeur : Fujiphoto Film Co., Ltd

Patentinhaber / Proprietor of the patent /
Titulaire du brevet :

Einsprechender / Opponent / Opposant :

Stichwort / Headword / Référence :

EPÜ / EPC / CBE Article 56 EPC

Schlagwort / Keyword / Mot clé : Inventive step (No)

Leitsatz / Headnote / Sommaire

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Boards of Appeal

Chambres de recours

Case Number : T 310/87 - 3.4.1



D E C I S I O N
of the Technical Board of Appeal 3.4.1
of 1 July 1988

Appellant : FUJIPHOTO FILM CO., LTD.
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Decision under appeal : Decision of Examining Division 041
of the European Patent Office
dated 9 March 1987 refusing European
patent application No. 84 100 154.8
pursuant to Article 97(1) EPC

Composition of the Board :

Chairman : K. Lederer

Members : E. Turrini

C. Payraudeau

Summary of Facts and Submissions

- I. European patent application 84 100 154.8 (publication number 0 117 971) was refused by decision of the Examining Division.
- II. The reason given for the refusal was that the subject-matter of independent Claim 1 of the effective set of claims lacked an inventive step within the meaning of article 56 EPC.

In the Examining Division's opinion, the claimed subject-matter was distinguished from a device acknowledged in the specification as being part of the prior art in that the angle of an incident laser beam is adjusted with respect to the surface of a stimulable phosphor sheet so as never to be normal thereto, in order to avoid reflection of the laser beam along the same optical path back to the laser source. It was, however, part of the general knowledge in the art to slightly incline optical elements such as parallel plates having a reflective surface with respect to a light beam impinging thereon in order to avoid feedback reflection, as shown e.g. by the text book:

"Optik für Konstrukteure", Dr. H. Naumann, Wilhelm Knapp Verlag, Düsseldorf, 2nd Edition, 1960, pages 100 and 101 (document D3).

- III. The Appellant lodged an appeal against the decision.
- IV. In a communication of the Board, the Appellant's attention was further drawn to the content of the following documents, which had already been cited in the European search report:

EP-A-0 032 521 (D1); and
Patent Abstracts of Japan, Volume 6, No. 179, 14 September
1982 (D2).

- V. Oral proceedings were held before the Board on 1 July 1988, at the end of which the Appellant requested that the decision be set aside and that a patent be granted on the basis of the Claims 1 to 3, description pages 2 to 10 and one sheet of drawings all filed on 17 July 1987 (main request).

Claim 1 of the set of claims in accordance with the main request, which is equivalent in substance to Claim 1 of the set of claims on which the appealed decision was based, reads as follows:

"1. An optical system for scanning with a laser beam in a radiation image read-out system, which comprises a stimuable phosphor sheet (5a) carrying a radiation image stored therein, a gas laser beam source (1a) for emitting a gas laser beam which stimulates said stimuable phosphor sheet (5a) to release the radiation energy stored therein as light emission, scanning optical members (4a, 10, 3a) for scanning the surface of said stimuable phosphor sheet (5a) with said laser beam emitted from said gas laser beam source (1a), and a beam expander (2a) positioned between said scanning optical members (4a, 10, 3a) and said gas laser beam source (1) for adjusting the beam diameter of said laser beam, characterised in that the angle θ of the incident laser beam, which is directed by said scanning optical members (4a, 10, 3a) onto the surface of said stimuable phosphor sheet is adjusted with respect to the surface of said stimuable phosphor sheet to an appropriate angle so that the direction of said incident laser beam is always different from the direction normal to the surface of said stimuable phosphor sheet, whereby the laser beam

reflected by the surface of said stimuable phosphor sheet is prevented from being fed back along the same optical path as the optical path of said incident laser beam."

Claims 2 and 3 are appended to independent Claim 1.

As respective first and second auxiliary requests, the Appellant requested a patent to be granted on the basis of either one of alternative sets of claims handed over during the oral proceedings. The set of claims in accordance with Appellant's first auxiliary request differs from the set of claims in accordance with his main request by the shifting of the features of Claim 1 relating to the beam expander from the preamble of the claim into its characterizing portion. The set of claims in accordance with Appellant's second auxiliary request differs from the set of claims in accordance with his main request in that Claim 1 has been redrafted in the one-part form.

VI. In support of the allowability of his requests, the Appellant essentially argued as follows:

The optical scanning device to which the present invention relates forms the core of a novel diagnostic system of substantial economic significance, which allows X-ray imaging of body portions at patient irradiation levels as low as 1% of the dosis required by standard equipment. Although the invention may appear, when considered separately, to provide only a minor contribution to the state of the art, it should not be overlooked that without a series of such seemingly minor improvements the system as a whole would not have met the considerable success it actually has.

Contrary to the statement erroneously made in the description of the present invention as originally filed,

optical laser scanning systems for reading out radiation images from a stimuable phosphor sheet, wherein a polarizer plate and a quarter wave plate are inserted in the path of the laser beam for preventing the incident beam from being reflected back to the laser source were not generally known at the priority date of the present application, but constituted internal prior art available to the Applicant only. The actually relevant prior art systems as disclosed for instance in document D1 did not include any means for avoiding such reflection.

Accordingly, to arrive at the claimed solution the skilled person had first to recognize that the inconsistencies which affected the images produced by the prior art systems actually originated from back-reflections of the laser beam from the phosphor sheet surface. This could not be considered as being obvious, because a number of other sources of error, such as unsteadiness of the laser power supply, might cause unstable laser operation. In addition, while semiconductor laser sources were known to be prone to unstable operation when part of the emitted laser beam is reflected back to the source, as evidenced for example by document D2, such unstable behaviour was not a commonly known drawback of gas lasers of the type included in the claimed apparatus. Also, the fact that the scanned phosphor sheets exhibited a reflectivity of no more than about 4% would have diverted the skilled person from suspecting back-reflection of being a substantial cause of laser instability.

Beyond the recognition of the actual cause of the defective working of the prior art system, arriving at the claimed invention still required a second step, namely the selection of a proper solution for avoiding back-reflection, which was not obvious to the skilled person either. Indeed, document D2 pointed away from the selected

solution by teaching the insertion of polarizer and quarter wavelength plates in the laser beam path for absorbing the portion of the beam reflected by the scanned object before it reaches the laser source, which is an expensive and complicated measure. Document D3 specifically aims at reducing parasitic reflections caused by the surface of optical lenses by cutting off the rays passing through the centre of the lenses, decentering or tilting the lenses or subjecting their surface to a special anti-reflective treatment. These solutions all suggested to act upon the optical lenses of the radiation image read out system, such as for example the output lens of the beam expander, rather than upon the phosphor sheet itself. In addition, still other ways of acting upon the phosphor sheet could be envisaged instead of the one defined in Claim 1, such as for example providing an anti-reflective coating on its surface as taught also by document D3. Thus, simply adjusting the angle of the incident laser beam with respect to the surface of the phosphor sheet in such a way that it is never normal thereto cannot be considered as an obvious means for avoiding back-reflection of the beam along the same optical path, the more so since such angular adjustment necessarily results in deformation of the shape of the spot formed by the scanning beam on the surface, which the skilled person would a priori consider unacceptable as resulting in an undue loss in quality of the images thus obtained. In response to an observation made in this respect by the Board during the oral proceedings, the Appellant submitted that, contrary to what is suggested by the schematic drawings of document D1, wherein the incident beam seems to be normal to the phosphor sheet only at one single point in the middle of each scanning line, and consequently to cause an apparently accepted spot deformation at every other point, the actual prior art scanning systems always include an additional

lens of complex shape inserted in the laser beam path in order to correct the spot shape along each scanning line.

The attention of the Board was further drawn to the content of the Guidelines for Examination at the EPO, Part C, Chapter IV, paragraph 9.9, which state inter alia that the examiner should avoid ex post facto analysis and seek to make a "real life" assessment of all relevant factors, and to several earlier decisions of the Boards of Appeal, which in similar cases admitted the patentability of apparently simple technical solutions (T 2/83, OJ EPO 1984, 265; T 106/84 OJ EPO 1985, 132; and T 9/86 OJ EPO 1988, 12).

Reasons for the Decision

1. The Appeal is admissible.
2. Main request.
 - 2.1. There are no objections on formal grounds to the current version of the application documents. In particular, they are adequately supported by the application documents as originally filed as required under Article 123(2) EPC.
 - 2.2. Novelty.
 - 2.2.1 Document D1 discloses an optical system for scanning with a laser beam in a radiation image read-out system, which comprises a stimuable phosphor sheet 4 carrying a radiation image stored therein, a gas laser beam source 1 for emitting a gas laser beam which stimulates said stimuable phosphor sheet 4 to release the radiation stored therein as light emission, scanning optical members 3 for scanning the surface of said stimuable phosphor sheet with said laser beam emitted from said gas laser beam source as

defined in the preamble of Claim 1 (see Figure 1 and corresponding portion of the description; page 5, lines 24 and 25).

The subject-matter of Claim 1 differs from this known device in that it additionally comprises a beam expander as further defined in the preamble of Claim 1, and in that the angle of the incident laser beam with respect to the surface of the stimuable phosphor sheet is adjusted in such a way that the direction of the incident laser beam is always different from the direction normal to that surface, as defined in its characterizing portion. In contrast thereto, the incident laser beam in the apparatus known from document D1 appears to be normal to the surface of the stimuable phosphor sheet when it is in the middle portion of its scanning path on the sheet (see Figures 1 and 3).

2.2.3 Document D2 discloses an optical system for scanning the surface of an object 5 with a laser beam comprising a laser beam source 1, scanning optical members 3, and means (polarizing plate 6, quarter wavelength plate 7) for preventing return of the reflected laser beam to the laser beam source and, consequently, for eliminating fluctuation therein and providing stable laser beam scanning (abstract; Figure).

The subject-matter of Claim 1 differs from the device shown in document D2 essentially in that it comprises a gas laser instead of a semiconductor laser and an additional beam expander, in that the scanned object is specified to be a stimuable phosphor sheet and in that back-reflection of the laser beam is obviated by properly adjusting the direction of the incident beam with respect to the phosphor sheet, and not by inserting a polarizing and a quarter wavelength plate in the laser beam path.

- 2.2.4 Document D3 does not relate to laser beam scanning systems. It discloses that very thin lenses, parallel plates and filters may be slightly tilted in order to suppress parasitic reflection on their surfaces (see page 100, Figure 146, page 101, lines 11 and 12).
- 2.2.5 The remaining cited documents do not come closer to the subject-matter of Claim 1.
- 2.2.6 Since the search performed under Article 92 EPC did not reveal any prior art document disclosing the use of optical elements such as a polarizing plate and a quarter wave plate to prevent return reflection from a stimuable phosphor sheet in a radiation image read-out system, the Appellant's submission that such use was merely in-house prior art and was not made available to the public at the priority date of the present patent application is accepted by the Board. Such use therefore is not considered to form part of the prior art.
- 2.2.7 For the above reasons, the subject-matter of Claim 1 is considered to be novel within the meaning of Article 54 EPC.

2.3. Inventive step.

- 2.3.1 As shown in paragraph 2.2.1. above, the subject-matter of Claim 1 differs from the apparatus disclosed in document D1, which, in the Board's opinion, forms the nearest prior art, by
- (a) the additional provision of a beam expander; and
 - (b) a specific angular arrangement of the phosphor sheet surface relatively to the direction of the incident laser beam.

The use of beam expanders is well-known for shaping laser beams produced by gas lasers, as admitted also in the description (page 5, lines 15 to 24). Accordingly, feature (a) cannot be regarded as providing a support to an inventive step within the meaning of Article 56 EPC. Neither did the Appellant submit any argument supporting that feature (a) contributes to the patentability of Claim 1.

2.3.2 Starting from the radiation image read-out system known from document D1, and having regard further to the positive effect of feature (b) on the oscillation of the gas laser tube as put forward by the Appellant, the objectively assessed technical problem to which the measure defined by feature (b) affords a solution, is to improve the stability of the laser source, i.e. to avoid fluctuation of its output, in order to increase image quality (description, page 6, third paragraph).

2.3.3 Since, according to document D1 (page 2, lines 22 to 29) fluctuations of the laser source output have already been recognized as a serious problem in obtaining high quality images from prior art systems, including those using gas lasers, the above mentioned problem of how to avoid such damaging fluctuations of laser output is considered selfevident.

2.3.4 An obvious prerequisite for devising a suitable solution to the above defined technical problem is a thorough investigation of the possible causes of laser instability. Whilst it is not denied that fluctuations in the power supply to the laser source is a major and well-known cause of instability, the skilled person cannot reasonably be expected not to envisage other possible causes as well.

Since document D2 clearly teaches that light reflected back by the surface of a scanned object results in instable operation of a laser source, he would at least contemplate whether a similar effect may intervene also in the apparatus known from document D1. This hypothesis can be readily ascertained by simple routine tests such as for example, inserting a polarizing and a quarter wavelength plate in the path of the laser beam as shown in document D2 and analysing the images thus obtained, or, alternatively, observing the behaviour of the source when the laser beam is not allowed to impinge on a reflective surface. For these reasons, the Board is convinced that recognizing that back-reflection by the phosphor sheet causes instability of the laser source of document D1 does not by itself go beyond the competence of a specialist of laser equipment exercising normal skills and performing routine tests to find out the origin of troubles observed in the operation of such equipment.

In addition, it is observed that in the arrangement disclosed in document D1 the laser beam is normal to the surface of the phosphor sheet only in the middle portion of each of its scanning paths and, consequently, back-reflection is limited to these specific portions of the phosphor sheet. It may therefore be expected that the arrangement of document D1 leads to a characteristic pattern of inconsistencies in the middle of the resulting image, which was not denied by the Appellant. Such characteristic pattern, however, reveals an adverse effect that is related to the laser beam position when it passes the middle of its scanning path, which further facilitates recognition of back-reflection as the cause of image inconsistencies.

The Appellant's arguments in favour of an inventive step being involved in recognition of back-reflection as a cause

of laser instability were not found convincing. In particular, in the absence of any evidence to the contrary, it is not seen why the skilled person would assume the effect of back-reflection on the operation of a laser as described in document D2 to be specific only to semiconductor lasers and a priori reject the possibility of the same problem affecting also gas lasers of the type included in the apparatus of document D1. Also, the skilled person is not considered to have been diverted from envisaging the eventuality of such effect in view of the low reflectivity of the phosphor sheet, since it is well known that laser oscillation is a non-linear phenomenon and that minor perturbations may have appreciable effects on such phenomena. In addition, having regard to the paramount importance of laser stability for obtaining high quality images, the skilled person would not leave out of consideration a possible source of instability merely because he expects its contribution to instability to be slight only.

- 2.3.5 Having thus recognized back-reflection as a cause of laser instability, the skilled person would indeed seek an appropriate means for preventing the incident laser beam from returning back to the laser source.

The awareness that back-reflection of a light beam impinging on a plane surface can be avoided by simply adjusting the direction of the incident light beam relatively to the surface in such a way that it is different from the normal to the surface does not result only from the disclosure of document D3 (page 100, Figure 146), but it must be regarded as well as being part of the general knowledge of any person of elemental technical sense. The Board therefore sees no convincing reason why applying such a well-known principle to avoid back-reflection in the apparatus disclosed in document D1, thus

arriving at the alleged invention, would go beyond the normal competence of the skilled person.

In particular, whereas it is not denied that the prior art documents D3 and D2 may also have suggested other means for eliminating back-reflection, such as the deposition of a non-reflective coating on the phosphor sheet or the insertion of a polarizing and a quarter wavelength plate in the path of the laser beam, such means would obviously increase the complexity of the system and, consequently, the mere availability of these alternative, but more complex, solutions would certainly not divert the skilled person from testing a simpler one, unless there were strong reasons for him not to do so, which has not been demonstrated either.

In this respect, the alleged existence of a technical prejudice against inclining the direction of the incident beam relatively to the normal to the surface of the phosphor sheet cannot, in the absence of any evidence whatsoever from the Appellant, be admitted by the Board. Indeed, document D1 and document US-A-4 258 264 (D4) cited in the description of the present application lack any suggestion that, contrary to what is consistently shown in the drawings, the devices disclosed therein further require some special means to ensure that the laser beam always impinges on the phosphor sheet perpendicularly to its surface, as submitted by the Appellant. In addition, as a consequence of the small diameter of the beam and of the scanning spot on the phosphor sheet, the skilled person would indeed foresee that a slight deviation of the direction of the incident beam from the normal to the surface would be sufficient to avoid back-reflection into the laser source and, consequently, he would not expect the spot deformation induced by such slight deviation to be a priori unacceptable.

2.3.6 Neither could the remaining arguments put forward by the Appellant convince the Board of the non-evidence of the claimed subject-matter.

As concerns his statement that the invention is to be regarded as one only of a number of elemental improvements which altogether led to a successful and innovative diagnostic system, it should be noticed that only the technical or commercial merits of the invention which "can convincingly be related to one or more of the features included in the claim defining the invention" can be taken into consideration as an indication of inventive step as set out in the portion of the Guidelines cited by the Appellant himself. Therefore, the success of the composite system as a whole cannot support the patentability of the subject-matter of present Claim 1, which is directed to a single improvement only.

The Board was further unable to recognise any such similarity between the present case and those on which the decisions relied upon by the Appellant were based, which could lead it to reach a different conclusion. In particular, the circumstances which the Boards considered to justify the patentability of apparently simple inventions were: a simplification of design, a long-standing problem, a sharp change of direction in the art, an important and surprising advantage, commercial success which stems from the technical advantages related to the features claimed (T 106/84, points 8.3 to 8.7), the discovery of an unrecognized problem (T 2/83, point 6), or the very simplicity of the invention in a commercially important technical field (T 9/86, point 6). Such specific circumstances are clearly not met in the present case nor have been substantiated by convincing evidence.

2.3.7 The provision of a beam expander (feature "a" distinguishing the subject-matter of Claim 1 from that of document D1) does clearly not cooperate in any way with the specific angular arrangement of the phosphor sheet (feature "b"). Therefore, no inventive step can be seen in the simultaneous application of these features in an optical system according to document D1.

2.3.8 For the above reasons, the subject-matter of Claim 1 is not considered to involve an inventive step within the meaning of Article 56 EPC.

2.4 Claim 1, accordingly, is not allowable under Article 52(1) EPC.

Dependent Claims 2 and 3 are referred back to unallowable Claim 1 and are, therefore, not allowable either.

For these reasons, Appellant's main request is not allowable.

3. Auxiliary requests.

Claims 1 in accordance with Appellant's first and second auxiliary requests do not differ in substance from Claim 1 in accordance with his main request, since they include the same features, which have been merely re-arranged either in a slightly different two-part form (first auxiliary request) or in the one-part form (second auxiliary request).

These Claims 1 thus define the same subject-matter as Claim 1 of the main request which, as set out in point 2 above, does not involve an inventive step.

Therefore, the Claims 1, and the appendant Claims 2 and 3, in accordance with Appellant's first and second auxiliary requests, cannot be allowed either.

Consequently, these requests are not allowable.

Order

For these reasons, it is decided that:

the appeal is dismissed.

The Registrar:

The Chairman:

F. Klein

K. Lederer