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D E C I S I O N
of 6 August 2005

Case Number: T 0529/03 - 3.4.2

Application Number: 97308602.8

Publication Number: 0840147

IPC: G02B 6/16

Language of the proceedings: EN

Title of invention:
Method and apparatus for making continuous chirped fiber bragg gratings

Applicant:
Lucent Technologies

Opponent:
-

Headword:
-

Relevant legal provisions:
EPC Art. 56

Keyword:
"Inventive step (main request: no; auxiliary request: yes)"

Decisions cited:
-

Catchword:
-

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Case Number: T 0529/03 - 3.4.2

D E C I S I O N
of the Technical Board of Appeal 3.4.2
of 6 August 2005

Appellant: Lucent Technologies

Representative: Schoppe, Fritz, Dipl.-Ing.

Decision under appeal: **Decision of the Examining Division of the European Patent Office posted 21 November 2002 refusing European application No. 97308602.8 pursuant to Article 97(1) EPC.**

Composition of the Board:

Chairman: A. G. Klein
Members: M. P. Stock
G. E. Weiss

Summary of Facts and Submissions

I. European patent application No. 97 308 602.8 (Publication No. EP 0 840 147 A) was refused by the examining division on the ground that the application did not meet the requirements of Articles 54(1) and 56 EPC because the subject-matter of the independent claims 1 and 4 then on file was not new and did not involve an inventive step, respectively. It was also noted that the subject-matter of independent claims 2 and 5 is patentable. *Inter alia* the following documents were cited:

D1: US-A-5 367 588

D2: EP-A-0 604 039

II. The applicant has appealed against the decision of refusal and requested to issue a communication under Rule 51(4) EPC on the basis of amended claims 1 to 5 according to a main request, or on the basis of amended claims 1 to 3 according to an auxiliary request. In his statement setting out the grounds of appeal he explained the subject-matter of claim 1 and discussed prior art approaches to implement chirped gratings. He noted that it was acknowledged by the examining division in their decision that the subject-matter of the previous filed claims 2 and 5, now claims 2 and 4 are patentable and that, therefore, the substantiation of the appeal can be restricted to a discussion of claim 1. With respect to the reasoning of the examining division he has presented the following arguments:

The examining division's position is that the method of claim 1 is not patentable over D1 in view of D2.

D1 presents in Figure 4 an idealized phase mask, which is chirped.

Applicants disagree with the view of the division that "it would be obvious to him (one skilled in the art) on the basis of his general knowledge relating to surface relief structures that a photolithographic process would be most likely suitable" and that the man skilled in the art would then turn to D2 and modify the process of D2 into the invention of claim 1.

It is the division rather than D1 that suggests the use of photolithography to make the D1 phase mask.

The division's allegation to use photolithography to make the D1 phase mask is in contradiction with the clear teachings of this document. As it is outlined in column 7, lines 31 to 33, the "intricate variations in pitch" can be written into the phase mask during its fabrication i.e. under computer control.

In the present technical field, this hint as to the method of manufacturing the phase mask is a clear indication to make use of electron beam lithography for producing the chirped grating under the computer control of the relative movement of the phase mask relative to the electron beam.

The "computer control" does not make any sense at all in connection with photolithography.

Given the very small spacings and even smaller variations in spacings in the crenelations of the phase mask, applicants respectfully submit that the man skilled in the art would turn not to photolithography but rather to the lithographic technique providing the highest state-of-the-art resolution, namely electron beam lithography. And the skilled man would discover, as applicants have pointed out, that even electron beam lithography can produce only a step-chirped grating, not a continuously chirped grating.

Moreover, even if the division's assumption were correct that the skilled man would turn to photolithography, he would not be led to D2. Photolithography, according to Webster's New Collegiate Dictionary (1981 edition), refers to lithography in which photographically prepared plates are used. Photolithography generally involves coating a planar substrate ("plate") with photoresist, exposing the photoresist through a mask, developing the photoresist and then etching the portions of the substrate uncovered by the development. D2, in contrast, pertains to forming index perturbations in an optical fiber rather than physical crenelations on a planar substrate (a phase mask). D2 does not coat the fiber with photoresist, does not develop photoresist and does not etch the fiber. D2 is not photolithography. D2 does not refer to phase masks or describe any method for making a phase mask. Thus D2 relates to a different product made by a different process.

To summarize, the only technique implicitly taught by document D1 for making the phase mask is electron beam lithography. Nothing in document D1 motivates a man

skilled in the present field to make use of some aspects of the technique described there for forming index perturbations in an optical fiber in order to manufacture a planar phase mask. Nothing in document D2 teaches to combine the technique for forming index perturbations within an optical fiber with any aspects of preparing planar substrates, like phase masks. Rather, as outlined above, documents D1 and D2 relate to fundamentally different techniques. Accordingly, the method of claim 1 is not rendered obvious by documents D1 and D2.

III. Claim 1 according to the main request, which is claim 1 underlying the appealed decision, supplemented by reference numerals 22, 23, 24, and 26, reads as follows:

"1. A method for making a continuous chirped phase mask comprising the steps of:
providing a substrate (23) of UV light transparent material, said substrate including a planar surface (22) coated with photoresist (Fig. 1, Block A);
exposing said photoresist to the pattern of light formed by the interference of a collimated beam (24) and a portion of said collimated beam reflected from a continuous curved mirror (26) (Block B);
developing said photoresist (Block C); and
etching said substrate (23) to produce a phase mask having a continuous chirped surface relief grating (Block D)."

Claims 1 to 3 according to the auxiliary request read as follows:

"1. Apparatus for making a continuous chirped phase mask from a substrate comprising:
a source of a collimated light beam (24);
a continuous curved mirror (26);
a substrate mount adjacent to said curved mirror for supporting said substrate (23), said curved mirror (26) and said substrate mount rotatably mounted with respect to said collimated beam (24), whereby the angle of incidence of said beam can be adjusted so that a first portion of said beam interferes with a second portion of said beam reflected from said mirror at the surface of said substrate disposed in said mount."

"2. Apparatus of claim 1 wherein said curved mirror (26) is a flexible curved mirror whose degree of curvature can be varied."

"3. A method for making a continuous chirped phase mask comprising the steps of:
providing a substrate (23) of UV light transparent material, said substrate including a planar surface (22) coated with photoresist;
exposing said photoresist to the pattern of light formed by the interference of a collimated beam (24) and a portion of said collimated beam reflected from a continuous curved mirror (26); the substrate (23) disposed on a substrate mount adjacent to said curved mirror for supporting said substrate, said curved mirror (26) and said substrate mount rotatably mounted with respect to said collimated beam, whereby the angle of incidence (α) of said beam can be adjusted so that a

first portion of said beam interferes with a second portion of said beam reflected from said mirror at the surface of said substrate disposed in said mount;
developing said photoresist; and
etching said substrate (23) to produce a phase mask (30) having a continuous chirped surface relief grating (32)."

Reasons for the Decision

1. A continuous chirped mask (41) with a planar substrate of UV light transparent material, as defined in claim 1 of the main request, is known from document D1, see Figure 4 with the description, column 6, lines 14 to 22. In accordance with the teaching of the present application, the known mask is used for writing chirped Bragg gratings in optical fibres, see D1, claims 1, 8 and 15.

2. A method for making the chirped mask is not described in detail in D1. It is only indicated, see column 7, lines 31 to 33, that "intricate variations in pitch can be written into the phase mask during its fabrication, e.g. under computer control". Even if this points towards electron beam lithography, as was assumed by the appellant, it can be formulated as an objective problem that the skilled person was obliged to look elsewhere in the technical field to find a teaching of an appropriate method.

3. Knowing that, in principle, any lithographic method used for forming a grating pattern on an article, can also be used for making a phase mask, the skilled

person would take D2 into consideration disclosing (see claims 1 and 10, column 4, lines 4 to 26, and Figures 2 and 3) a method for making a chirped grating comprising the steps of:

providing a substrate (photosensitive medium, e.g. fibre 18), said substrate including a surface coated with photoresist (see claim 10); exposing said photoresist to the pattern of light formed by the interference of a collimated beam (15) and a portion (16) of said collimated beam reflected from a continuous curved mirror (30); developing said photoresist; and etching said substrate (23) to produce an article having a continuous chirped surface relief grating. "Etching" is implicitly disclosed by "lithographically processing" mentioned in claim 10.

4. In view of the fact that the method described in D2 is fully compatible with the phase mask known from D1, it was obvious to the skilled person to apply this method for making a continuous chirped phase mask with a planar substrate of UV light transparent material and arrive thus at the subject-matter of claim 1 according to the main request.

5. The arguments submitted by the appellant in support of the main request, see item II above, are not accepted by the Board for the following reasons:

It can be left open whether D1 teaches electron beam lithography and whether this was suitable as a method for making a chirped phase mask. The skilled person looking for an appropriate method had to consider document D2 because it relates to chirped gratings. The

fact that in D2 these gratings form Bragg gratings in fibres makes it even more interesting for the skilled person as D1 (see item 1 above) uses the chirped mask for the same purpose. In this respect it is also not decisive whether the skilled person would consider photolithography and whether D2 employs photolithography, although D2 mentions in its claim 10 a photoresist, a substrate underlying the photoresist, developing the photoresist and lithographically processing the substrate.

6. Therefore, taking into due account the essential arguments of the appellant, the Board reaches the conclusion that the subject-matter of claim 1 according to the main request does not involve an inventive step within the meaning of Article 56 EPC. Therefore the main request is not allowable.

7. As regards independent claims 1 and 3 of the auxiliary request, the examining division has stated in their decision that the subject-matter of these claims is patentable. The Board has no reason to doubt this finding. The description, however still needs adaptation.

8. The Board, accordingly, deems it appropriate in the circumstances to make use of the discretion afforded to it under Article 111(1) EPC to remit the case to the first instance for adaptation of the description.

Order

For these reasons it is decided that:

The decision under appeal is set aside.

The case is remitted to the first instance with the order to grant a patent with the following claims and figures and a description to be adapted:

Claims: 1 to 3 according to the auxiliary request filed with letter of 29 August 2005;

Figures: 1 to 7 as originally filed.

The Registrar: The Chairman:

P. Martorana A. G. Klein