

The opinion in support of the decision being entered today
and is *not* binding precedent of the Board.

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte YANHUA SHIH,
MILENA D'ANGELO,
and MARIA CHEKHOVA

Appeal 2007-0465
Application 10/146,813¹
Technology Center 2800

Decided: June 28, 2007

Before LEE E. BARRETT, HOWARD B. BLANKENSHIP, and
JAY P. LUCAS, *Administrative Patent Judges*.

BARRETT, *Administrative Patent Judge*.

DECISION ON APPEAL

This is a decision on appeal under 35 U.S.C. § 134(a) from the final rejection of claims 1-7. Claims 8-17 have been canceled. We have jurisdiction pursuant to 35 U.S.C. § 6(b).

We affirm-in-part.

¹ Application for patent filed May 17, 2002, entitled "Multi-Photon Imaging and Quantum Lithography," which claims the priority benefit U.S. Provisional Application 60/292,265, filed May 18, 2001.

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BACKGROUND

The invention relates to a system for producing entangled photons for use in lithography.

Claim 1 is illustrative:

1. A microscopic image product comprising:

a light source that produces light that is made of entangled photons.

THE REFERENCE

Williams

US 6,630,290 B2

Oct. 7, 2003

THE REJECTION

Claims 1-7 stand rejected under 35 U.S.C. § 102(e) as being anticipated by Williams.

DISCUSSION

Claims 1-3 and 5-7

Arguments and rejection

Appellants argue that Williams merely discloses an interferometer that uses entangled photons to produce only straight line or circular interference patterns (Br. 9). Appellants argue that "Williams does not disclose a **microscopic image product** that comprises a light source that produces light made of entangled photons" (Br. 9).

The Examiner finds that Williams produces a microscopic image product, not merely an interference pattern. The Examiner refers to pattern 142 in Figure 1 and the statements that the system "images interferometric lines" (col. 7, ll. 10-11) and that "[a]ccording to the present system, the classical optical beam is replaced by a quantum stream of n entangled protons" (col. 6, ll. 51-53). (Answer 5-6.) The Examiner finds that although Williams does not mention "microscopic image," a photon is of microscopic scale, and any image created by a particle of microscopic size is a microscopic image product (*id.* at 6).

Appellants argue that the interference pattern 142 cannot be considered an image product (Reply Br. 5). It is argued that the statement at column 7 that interferometric lines are images does not disclose a microscopic image product (*id.*). It is argued that it is well known that an interferometer produces only straight lines or circles and Williams cannot produce complex image patterns (*id.*). It is argued that the Examiner admits that Williams does not explicitly mention a "microscopic image" and "it is clear that there is no explicit disclosure of an image product as only interference patterns are disclosed" (Reply Br. 6).

Claim interpretation

Proper claim interpretation necessarily precedes a determination of patentability. *See Gechter v. Davidson*, 116 F.3d 1454, 1457, 43 USPQ2d 1030, 1032 (Fed. Cir. 1997) ("Implicit in our review of the Board's anticipation analysis is that the claim must first have been correctly

construed to define the scope and meaning of each contested limitation.").

We see at least four claim interpretation issues with respect to claim 1: (1) what is meant by a "microscopic image product"; (2) what is meant by "image"; (3) whether the preamble limits the claim; and (4) whether claim 1 is an impermissible "single means" claim.

(1)

The Specification and claims state "a microscopic image product comprising a light source that produces light that is made of entangled photons" (Specification 5; claim 1), "the image product comprises a lithography microscope" (Specification 6; claim 2), and "the image product further comprises an optical imaging device for making reduced-size image" (Specification 6; claim 3). It appears that the Specification intends the "microscopic image product" to be the system which produces the image. However, Appellants also argue that "there is no explicit disclosure of an image product [in Williams] as only interference patterns are disclosed" (Reply Br. 6), which suggests that Appellants consider the "product" to be the actual "image" rather than the device which produces the image.

The Examiner apparently interprets "microscopic image" to modify the term "product," where the image is the interference lines. *See Answer 5* ("The Examiner takes the position that Williams does produce a microscopic image product (figure #1, item #142, column #7, lines 8-11)").

This Examiner's interpretation is a more reasonable interpretation of "microscopic image product" than Appellants' apparent position. The

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"product" is the photoresist 145 which contains a "microscopic image" consisting of the interference lines pattern 142. If Appellants intent is to claim the system which produces the image, it seems that "a microscopic imaging product" or "a product for producing a microscopic image" is more accurate than a "microscopic image product." However, the Examiner's apparent interpretation of "microscopic image product" does not account for the structure of the "light source" which manifestly cannot be part of the image. Although the term "microscopic image product" renders the claims somewhat indefinite, and should be clarified, we assume for purposes of this appeal that a "microscopic image product" is a product (device) which produces a microscopic image.

(2)

Appellants imply that an "image" has to be a two dimensional image because, in Williams, the "interferometer produces only straight lines or circles" (Br. 9) and Williams "cannot produce complex image patterns" (Reply Br. 5). However, Appellants have not said why an "image" cannot be a straight line or circle. We interpret an "image" to be broad enough to include just straight lines or circles. Note that Figure 1 of Williams specifically labels the "image." Note also that the claims do not require a product that is an image of something else, such as a mask.

(3)

Although the claim preamble must be read in context of the entire claim, if the body of a claim fully and intrinsically sets forth all of the

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limitations of the claimed invention, and the preamble merely states, for example, the purpose or intended use of the invention, rather than any distinct definition of any of the claimed invention's limitations, then the preamble is not considered a limitation and is of no significance to claim construction. *Pitney Bowes, Inc. v. Hewlett-Packard Co.*, 182 F.3d 1298, 1305, 51 USPQ2d 1161, 1166 (Fed. Cir. 1999).

The body of claim 1 is complete in itself and does not refer to or otherwise breathe life and breath into the preamble. Accordingly, the preamble is merely a statement of the environment and is not a claim limitation. Nevertheless, we consider the preamble because it has been addressed by the Examiner.

(4)

Although the issue was not raised by the Examiner, at least claim 1 should be interpreted as a forbidden "single means" claim. Since we affirm the prior art rejection of claim 1, we will not enter a new ground of rejection and leave the issue to be addressed in any further prosecution.

"An element in a claim for a combination may be expressed as a means . . . for performing a specified function" 35 U.S.C. § 112, ¶ 6. However, a claim to a single means is forbidden and should be rejected under § 112, ¶ 1. "The long-recognized problem with a single means claim is that it covers every conceivable means for achieving the stated result, while the specification discloses at most only those means known to the inventor." *In re Hyatt*, 708 F.2d 712, 714, 218 USPQ 195, 197 (Fed. Cir.

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1983). That is, a single means claim is unpatentable under § 112, ¶ 1, because it reads on subject matter for which the specification is not enabling.

Claim 1 requires only "a light source that produces light that is made of entangled photons." This is a means-plus-function limitation because no structure is recited that would perform the function of "produces light that is made of entangled photons"; the term "source" is equivalent to a "means" because it does not recite any structure. The "light source" is not part of a combination. Claim 1 is interpreted to be an improper single means claim.

Analysis

Appellants do not argue any of claims 2, 3, or 5-7 separately. Thus, claims 2, 3, and 5-7 stand or fall with the rejection of claim 1.

Williams discloses a device that can image lines of a size of 50 nm into photoresist (col. 7, ll. 30-32). Quantum lithography allows writing evenly spaced lines with sub-wavelength resolution. The patterned photoresist is a "product" (a thing) having lines which are a "microscopic image." Williams also discloses a "product" (a structure) that produces a "microscopic image," i.e., a "microscopic image product" as we interpret the term for this appeal. The fact that the image in Figure 1 consists only of lines does not preclude it from being an "image." "Image" does not require an arbitrary two-dimensional image, nor an image of something else.

Elements 99 and 100 in Williams are a "light source that produces light that is made of entangled photons." Thus, Williams discloses all of the limitations of claim 1.

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Appellants' argument that "Williams does not disclose a **microscopic image product** that comprises a light source that produces light made of entangled photons" (Br. 9) is just a conclusion without any reasoning. Similarly, Appellants' argument that the statement at column 7 of Williams, that interferometric lines are images, does not disclose a microscopic image product (Reply Br. 5), presents no reasons. To the extent Appellants imply that Williams does not disclose a microscopic image product because an interferometer produces only straight lines or circles, and Williams cannot produce complex image patterns (Reply Br. 5), the "images" in claim 1 are not recited to be any special shape and are met by the lines in Williams. Appellants have failed to establish that claim 1 is not anticipated.

For the reasons stated above, the anticipation rejection of claims 1-3 and 5-7 is sustained.

Claim 4

Arguments and rejection

Appellants argue (Br. 10) that claim 4 is separately patentable because Williams does not disclose "a first set of lenses that makes a Fourier transform of a semiconductor design pattern; and a second set of lens [sic] that retransforms the Fourier transform to a reduced-size pattern."

In the statement of the rejection, the Examiner refers to elements 122 and 130 and column 4, lines 54-63. In the response to the arguments section of the Examiner's Answer, the Examiner provides an extensive discussion of Fourier domain analysis (Answer 6-7).

Analysis

The Examiner's discussion fails to show where Williams discloses "a first set of lenses" and "a second set of lens [sic]." The interferometric system of Williams does not use lenses. The rejection of claim 4 is reversed.

Comment on claim 4

Appellants' Specification is mostly devoted to showing that N photon entangled light of wavelength λ results in a spatial resolution equivalent to using a classical light of wavelength λ/N . Appellants admit that it was well known that in a lithography microscope using classical light, a first lens makes a Fourier transform of the object, and a second lens transforms it back to a reduced size image (Specification, page 10 § I.B; Figure 4). Appellants' invention of claim 4 appears to involve no more than replacing a conventional light source in a lithography microscope with an N photon entangled light source. The sole disclosure of the structure is "Figure 5 shows a simple example setup for a semiconductor manufacturing system using quantum-entangled light" (Specification, page 15), where Figure 5 is the same as Figure 4 except for the light source. It must be assumed that everything about Figure 5 is conventional, except the light source, since no details of the setup are disclosed.

Williams discloses that an entangled photon source can be used to retrofit an existing lithographic system to obtain better etching results (col. 2, ll. 42-52) and "[a]ccording to the present system, the classical optical beam is replaced by a quantum stream of n entangled photons" (col. 6,

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ll. 51-53). Thus, Williams expressly suggests replacing a classical light source with an entangled photon source to obtain better resolution. Since Appellants appear to have merely replaced the classical light source in the conventional lithography microscope prior art at page 10 of the Specification, with an entangled photon light source, an obviousness rejection should be considered.

In addition, the Examiner should consider the relevance of the paper by Xiaolan Chen and S.R.J. Brueck, *Imaging interferometric lithography: A wavelength division multiplex approach to extending optical lithography*, J. Vac. Sci. Technol. B 16(6), Nov./Dec. 1998, pp. 3392-3397, which shows an imaging interferometric lithography optical system in Figure 1 using a Fourier transform lens pair. This paper discusses integrating optical and interferometric lithographies to provide arbitrary pattern capability.

CONCLUSION

The rejection of claims 1-3 and 5-7 is affirmed.

The rejection of claim 4 is reversed.

No time period for taking any subsequent action in connection with this appeal may be extended under 37 C.F.R. § 1.136(a)(1)(iv) (2006).

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AFFIRMED-IN-PART

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Attachment:

Xiaolan Chen and S.R.J. Brueck, *Imaging interferometric lithography: A wavelength division multiplex approach to extending optical lithography*, J. Vac. Sci. Technol. B 16(6), Nov./Dec. 1998, pp. 3392-3397.

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