Trials@uspto.gov
571-272-7822

Paper 34
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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

CARL ZEISS SMT GMBH,
Petitioner,

v.

NIKON CORPORATION,
Patent Owner.

Case IPR2013-00363
Patent 7,348,575 B2

Before HOWARD B. BLANKENSHIP, SALLY C. MEDLEY, and MATTHEW R. CLEMENTS, *Administrative Patent Judges*.

CLEMENTS, *Administrative Patent Judge*.

FINAL WRITTEN DECISION
35 U.S.C. § 318(a) and 37 C.F.R. § 42.73

I. INTRODUCTION

Carl Zeiss SMT GmbH ("Carl Zeiss") filed a Petition requesting *inter partes* review of claims 55–67 of U.S. Patent No. 7,348,575 B2 (Ex. 1101, "the '575 patent"). Paper 3 ("Pet."). The Patent Owner, Nikon Corporation ("Nikon"), did not file a Preliminary Response. On December 16, 2013, we granted an *inter partes* review for all challenged claims on certain grounds of unpatentability. Paper 7 ("Dec. to Inst.").

After institution of trial, Nikon filed a Patent Owner Response (Paper 21, "PO Resp.") to which Carl Zeiss filed a Reply (Paper 26, "Reply").

Oral hearing was held on July 17, 2014.[1]

The Board has jurisdiction under 35 U.S.C. § 6(c). This Final Written Decision is issued pursuant to 35 U.S.C. § 318(a) and 37 C.F.R. § 42.73.

Carl Zeiss has shown by a preponderance of the evidence that claims 55–67 of the '575 patent are unpatentable.

A. The '575 Patent

The subject matter of the '575 patent "relates to a catadioptric projection optical system, exposure apparatus, and exposure method and, more particularly, to a high-resolution catadioptric projection optical system suitable for . . . [use] in production of semiconductor devices [and] liquid-crystal display devices . . . by photolithography." Ex. 1101, 1:18–23. In the production of semiconductor devices, photolithography uses a projection exposure apparatus to project an "image of a mask (or a reticle) through a projection optical system onto a wafer (or a glass plate or the like) coated

[1] A transcript of the oral hearing is included in the record as Paper 33 ("Tr.").

with a photoresist or the like." *Id.* at 1:27–32. As the dimensions of semiconductor devices shrink, the projection optical system of the projection exposure apparatus requires greater resolving power (resolution). *Id.* at 1:32–36. In order to satisfy the requirements for the resolving power of the projection optical system, it is necessary to shorten the wavelength of illumination light (exposure light) and to increase the image-side numerical aperture of the projection optical system. *Id.* at 1:37–41. It was known to increase the numerical aperture by putting a medium with a high refractive index, like a liquid, in the optical path between the projection optical system and the image plane. *Id.* at 1:55–58. However, there were known disadvantages to this approach. *Id.* at 1:59–67.

The '575 patent discloses systems and methods to provide a relatively compact projection optical system that is "corrected for various aberrations, such as chromatic aberration and curvature of field, and being capable of securing a large effective image-side numerical aperture while well suppressing the reflection loss on optical surfaces." *Id.* at 2:3–9. An object of the embodiment is to achieve a large numerical aperture, without increase in the scale of optical members forming a catadioptric projection optical system. *Id.* at 2:30–32. In order to achieve that object, a projection optical system according to a third embodiment is a catadioptric projection optical system for forming an image of a first surface on a second surface, the projection optical system comprising four units. *Id.* at 3:8–27; *see also id.* at 11:48–13:22. Figure 9 of the '575 patent is reproduced below:

Fig.9

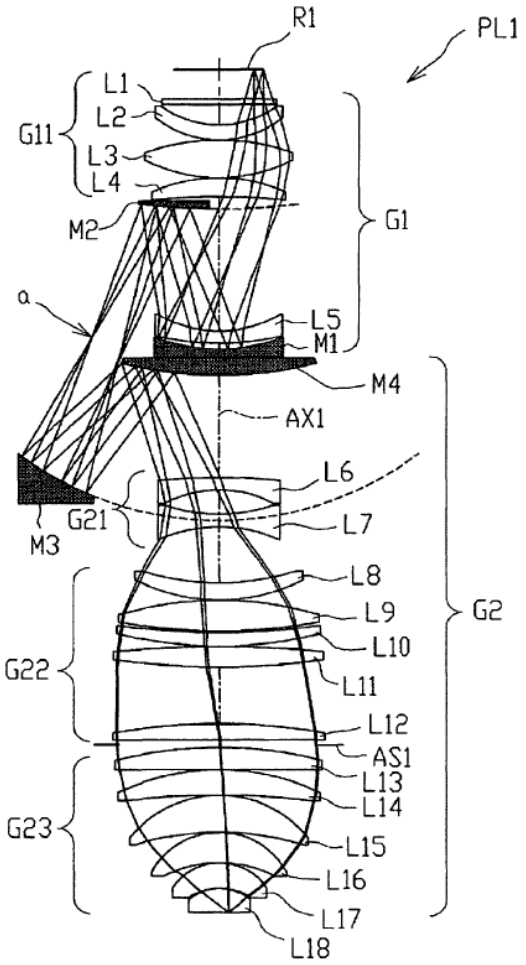

Figure 9 of the ’575 patent depicts an embodiment of the catadioptric projection optical system with four lens units. *Id.* at 4:31–33, 3:8–27. The lens unit G11 constitutes the first unit. *Id.* at 29:39–41. Negative meniscus lens L5, concave reflecting mirror M1, convex reflecting mirror M2, concave reflecting mirror M3, and convex reflecting mirror M4 constitute a second unit. *Id.* at 30:28–31. Lens unit G21 constitutes the third unit. *Id.* at 29:45–46. Lens unit G22, aperture stop AS1, and lens unit G23 constitute a fourth unit. *Id.* at 30:59–60.

B. Illustrative Claim

Claim 55 is illustrative and is reproduced below:

55. A catadioptric projection optical system, which forms an image of a first surface on a second surface, comprising:

a first unit disposed in an optical path between the first surface and the second surface and having a positive refractive power;

a second unit disposed in an optical path between the first unit and the second surface and comprising at least four mirrors;

a third unit disposed in an optical path between the second unit and the second surface, comprising at least two negative lenses, and having a negative refractive power; and

a fourth unit disposed in an optical path between the third unit and the second surface, comprising at least three positive lenses, and having a positive refractive power,

wherein an intermediate image is formed in the second unit and wherein an aperture stop is provided in the fourth unit.

C. Prior Art Supporting the Instituted Challenges

Carl Zeiss relies on the following prior art references, as well as the Declaration of Richard C. Juergens (Ex. 1116):

Mann	US 2005/0036213 A1	Feb. 17, 2005	Ex. 1110
Asai	Satoru Asai et al., *Resolution Limit for Optical Lithography Using Polarized Light Illumination*, 32 JAPAN J. APPL. PHYS. 5863-5866 (1993)	Dec. 1993	Ex. 1115

D. The Instituted Challenges of Unpatentability

We instituted trial based upon the following grounds:

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