

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

CORETRONIC CORPORATION and
OPTOMA CORPORATION,

Petitioners,

- vs. -

MAXELL, LTD.,

Patent Owner

IPR2025-00941

**DECLARATION OF DR. JOSE SASIAN
IN SUPPORT OF PETITION FOR INTER PARTES REVIEW
OF U.S. PATENT NO. 7,159,988**

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I, Jose Sasian, declare as follows:

I. Introduction

1. I am an independent consultant. I am over eighteen years of age, and I would otherwise be competent to testify as to the matters set forth herein if I am called upon to do so.

2. I have prepared this Declaration for consideration by the Patent Trial and Appeal Board in the *Inter Partes* Review of U.S. Patent No. 7,159,988 (“the ’988 Patent”).

3. I provide this Declaration at the request of Coretronic Corporation and Optoma Corporation (collectively, “Petitioners”) in connection with the above-captioned *Inter Partes* Review. I have been informed and understand that Petitioners contend that claims 1, 7 and 8 of the ’988 Patent are unpatentable.

4. I have been asked to provide my opinions regarding whether claims 1, 7 and 8 of the '988 Patent are unpatentable because they would have been anticipated or obvious to a person of ordinary skill in the art ("POSITA") at the time of the alleged invention in light of the prior art. After careful analysis it is my opinion that the subject matter of claims 1, 7, and 8 are unpatentable as they would have been anticipated or obvious to a POSITA.

5. I am being compensated at my standard hourly rate of \$650 per hour. My compensation is not dependent on the outcome of, or any issue in relation to, the above-captioned *Inter Partes* Review. I have no interest in any of the parties.

6. In forming my opinions, I relied on my knowledge and experience in the field and on documents and information referenced in this Declaration.

7. My complete qualifications and professional experience are described in my *Curriculum Vitae*, a copy of which can be found in EX1003. The following is a brief summary of my relevant qualifications and professional experience.

8. I am not an attorney. As shown in my *Curriculum Vitae*, I have extensive academic and industry experience with optical engineering. Specifically, I have over thirty years of academic and industry experience in the field of optical sciences and optical engineering in general, including optical instrumentation, optical design, and optical fabrication and testing.

9. I am currently a full-time, tenured Professor of Optical Sciences at the

Wyant College of Optical Sciences at the University of Arizona in Tucson, Arizona, a position I have held since 2002. As a professor, I teach and perform research in the field of optical design. For example, I teach my students how to design lenses and mirrors and how to think about light so that they can design useful optical systems. As part of my academic and research responsibilities I am frequently involved with the design, fabrication, and testing of optical devices.

10. From 1995 to 2001, prior to receiving tenure, I was an Associate Professor of Optical Sciences at the University of Arizona. Prior to joining the University of Arizona faculty, I was a member of the technical staff of AT&T Bell Laboratories from 1990 to 1995. From 1984 to 1987, I was a Research Assistant, and from 1988 to 1990, I was a Research Associate, in the Optical Sciences Center at the University of Arizona. From 1976 to 1984, I was an optician at the Institute of Astronomy at the University of Mexico.

11. I received a Bachelor of Science degree in Physics from the University of Mexico in 1982, a Master of Science degree in Optical Sciences from the University of Arizona in 1987, and a Ph.D. in Optical Sciences from the University of Arizona in 1988. My research areas include optical design, fabrication, and testing of optical instruments, astronomical optics, diffractive optics, opto-mechanical design, light in gemstones, lithography optics, and light propagation.

12. At the University of Arizona, I have taught the courses Lens Design

OPTI 517 (1997-present), Introduction to Aberrations OPTI 518 (2005-present), Advanced Lens Design OPTI 696A (2008, 2012, 2017, 2021), Illumination Optics Seminar (1997-2000), Introduction to Opto-mechanics OPTI 690 (1998, 2001, 2003, 2004, 2005), Optical Shop Practices OPTI 597A (1996-present), and Optical Specification, Fabrication and Testing OPTI 415 (2023-present). In these classes, among other things, I teach students how to design optical systems for imaging and for uniform illumination, how to mount optical elements properly so that their physical integrity is preserved, and properly align and test optical systems.

13. I have directed several student reports, theses, and dissertations in the area of optical design. I have lectured regarding my work, and have published, along with students and colleagues, over one hundred scientific papers in the area of optics. These include technical papers, student reports and theses done under my direction, related to photographic optics and illumination. For example:

- a. Efficient EUV collector designs, USP 7,405,871, 2009
- b. Sukmock Lee, Byongoh Kim, Jiyeon Lee, and Jose Sasian, “Accurate determination of distortion for smart phone cameras,” Applied Optics, Vol. 53, Issue 29, pp. H1-H6 (2014).
- c. D. Reshidko and J. Sasian, “Role of aberrations in the relative illumination of a lens system,” - Opt. Eng. 55(11), 115105 (Nov 29, 2016). doi:10.1117/1.OE.55.11.115105.

- d. Jose Sasian, Dmitry Reshidko, and Chia-Ling Li, "Aspheric/freeform optical surface description for controlling illumination from point-like light sources," Opt. Eng. 55(11), 115104 (Nov 25, 2016). doi:10.1117/1.OE.55.11.115104
- e. Jieun Ryu, Jose Sasian, "Tolerancing a lens for LED uniform illumination," Proc. SPIE 10377, Optical System Alignment, Tolerancing, and Verification XI, 1037703 (22 August 2017); doi: 10.1117/12.2276864
- f. Lerner, S.A. and J. M. Sasian, "Optical Design Using Novel Aspheric Surfaces", SPIE Annual Meeting, San Diego, Proc. SPIE 4092, 17-25, August 2000.
- g. Lenny Laughlin and Jose M. Sasian, "Source modeling and calculation of mask illumination during extreme ultraviolet lithography condenser design," SPIE Proceedings Vol. 4832, 283-292, 2002.

14. Since 1995, I have been a consultant. My consulting has included designing lens or mirror systems for cell-phones, microscopes, projectors, telescopes, medical devices, optical displays, and high speed photography, as well as designing optical systems for uniform illumination. I hold patents and patent applications related to lens systems. I am familiar with electronic circuit boards and electronic test instruments. I also have worked with or designed with LEDs and other types of light sources, including light diffusers, for uniform illumination.

15. I have been a topical editor and reviewer for the peer-reviewed journals Applied Optics and Optical Engineering. I am a fellow of the International Society for Optics and Photonics (SPIE), a fellow of OPTICA (formerly the Optical Society of America), and a lifetime member of the Optical Society of India.

16. I have served as a co-chair for the conferences “Novel Optical Systems: Design and Optimization” (1997-2006), “Optical systems alignment, tolerancing, and verification” (2007-2021), and “International Optical Design Conference,” (2002). I have taught the course: Advanced Lens Design: Art and Science in Japan (2014, 2016, and 2017). I teach the short course Mirror System Design with Freeform Surfaces at the SPIE Symposium: <https://spie.org/education/courses/coursedetail/SC1272>.

17. I have been a co-editor of approximately 28 published conference proceedings from SPIE. I am the author of the book, “Introduction to Aberrations in Optical Imaging Systems,” by Cambridge University Press, 2013; and of the book “Introduction to Lens Design,” by Cambridge University Press, 2019. I am named as an inventor on approximately 18 U.S. patents, and on 3 U.S. patent applications.

18. A more detailed summary of my background, experience, and publications is contained in my CV attached hereto as Exhibit 1003.

II. Information Considered

19. I have considered the following documents:

- a. The '988 Patent (EX1001);
- b. The prosecution history of the '988 Patent (EX1002);
- c. US5,357,289A ("Konno") (EX1005);
- d. US3,963,337A("Lundberg") (EX1006);
- e. US5,302,983A ("Sato") (EX1007);
- f. US2002/0067467A1 ("Dorval") (EX1008);
- g. US6,028,715A ("Takamoto") (EX1009);
- h. US2002/0044263A1 ("Takeuchi") (EX1010);
- i. US5,422,691A ("Ninomiya") (EX1011);
- j. US6,808,271B1 ("Kurematsu") (EX1012);
- k. Optics, 2nd Edition ("Hecht") (EX1013);
- l. Projection Displays, 1st Edition ("Stupp") (EX1014);
- m. JPH05119283A ("Asakura") (EX1015).

20. In addition to the documents above, in forming the opinions expressed below, I have also considered:

- a. My own knowledge and experience, as described above and in my CV; and
- b. The level of skill of a POSITA at the time of the alleged invention of the '988 Patent.

III. Anticipation and Obviousness

21. I have been informed and understand that a claim is anticipated if each and every element of a claim is disclosed, either expressly or inherently, in a single prior art reference.

22. I have been informed and understand that a claim is obvious in light of the prior art if the difference or differences between the claimed subject matter and the prior art are such that the subject matter as a whole would have been obvious, at the time the invention was made, to a person having ordinary skill in the art. I have been informed and understand that the Supreme Court provided an outline for analyzing obviousness in which it rejected an earlier test in favor of an “expansive and flexible approach” using “common sense.” I have also been informed and understand that the Supreme Court explained that under the correct analysis, any need or problem known in the field of endeavor at the time of invention and addressed by the patent can provide a reason for combining the elements in the manner claimed. I have also been informed and understand that the Supreme Court explained that “[t]he combination of familiar elements according to known methods is likely to be obvious when it does no more than yield predictable results.” I further have been informed and understand that the Court pointed to other factors that may show obviousness. These factors include the following principles:

23. combination that unites old elements with no change in their respective functions is unpatentable. As a result, the combination of familiar elements

according to known methods is likely to be obvious when it does no more than yield predictable results,

24. a predictable variation of a work in the same or a different field of endeavor is likely obvious if a person of ordinary skill would be able to implement the variation,

25. an invention is obvious if it is the use of a known technique to improve a similar device in the same way, unless the actual application of the technique would have been beyond the skill of the person of ordinary skill in the art. In this case, a key inquiry is whether the improvement is more than the predictable use of prior art elements according to their established functions,

26. an invention is obvious if there existed at the time of invention a known problem for which there was an obvious solution encompassed by the patent's claims,

27. inventions that were “obvious to try” — chosen from a finite number of identified, predictable solutions, with a reasonable expectation of success — are likely obvious,

28. known work in one field of endeavor may prompt variations of it for use in either the same field or a different one based on design incentives or other market forces if the variations would have been predictable to one of ordinary skill in the art, and

29. an explicit teaching, suggestion, or motivation in the art to combine references, while not a requirement for a finding of obviousness, remains “a helpful insight” upon which a finding of obviousness may be based.

IV. Claim Construction

30. I have been informed and understand that, in an *inter partes* review, claim terms are construed according to their ordinary and customary meaning as understood by one of ordinary skill in the art in view of the specification and the prosecution history of the patent.

31. I have also been informed and understand that the U.S. patent law allows a patentee to claim an invention in functional rather than structural language. I understand that this form of claim drafting is referred to as “means-plus-function” claiming. I understand that means-plus-function claiming applies to functional claim elements that do not provide sufficient corresponding structure for performing the claimed function.

32. I have been informed and understand that the interpretation of claim language as a means-plus-function limitation is based on the following underlying factual questions: (1) whether the words of the claim are understood by POSITA to have a sufficiently definite meaning as the name for structure, and (2) what structure is disclosed in the specification for performing the claimed function. I understand the PTAB will determine whether a term or phrase is a means-plus-function claim

element. I am not providing an opinion on the legal question of whether any phrases are means-plus-function element; however, I have provided my opinions on the underlying factual determinations as to what a POSITA would have understood about specific claim terms and the content of the specification.

33. I have been informed and understand that the presence of the word “means” in a claim creates the presumption that the claim term is a means-plus-function claim term. Likewise, I understand that the absence of the word “means” in a claim creates the presumption that the claim term is not a means-plus-function claim term. I understand that the key inquiry for determining whether a claim term is a means-plus-function term is whether the words of the claim are understood by persons of ordinary skill in the art (POSITA) to have a sufficiently definite meaning as the name for structure.

34. I have been informed and understand that once a claim term is determined to be a means-plus-function term, then the function recited in the claim must be determined. I understand that the function of a means-plus-function claim term is defined by the words of the claim language. I also understand that a means-plus-function claim term may recite multiple functions, in which case, the corresponding structure in the specification must perform all the functions recited in the claim.

35. I have been informed and understand that, once the function of a claim

is determined, the structure, if any, in the specification corresponding to the claimed function must be determined, and that the means-plus-function element covers the corresponding structure.

36. Independent claim 1 of the '988 Patent reads:

1. A projection optical unit for enlarged projection of an image displayed by an image display element, comprising:

a first projection optical unit for forming a first enlarged image, said first projection optical unit having positive refractive power; and

a second projection optical unit positioned at an enlarged image side of said first projection optical unit in order to form a second enlarged image by further enlarging the first enlarged image obtained by said first projection optical unit, said second projection optical unit having positive refractive power;

wherein the first enlarged image is formed at the image display element side, rather than at said second projection optical unit,

a magnification $M1$ of the first enlarged image is smaller than a magnification $M2$ of the second enlarged image, and

said first projection optical unit includes an aperture stop that defines an F-value of said entire projection optical unit.

37. Independent claim 7 of the '988 Patent reads:

7. A projection image display apparatus, comprising:

an image display element; and

a projection optical unit for projecting, in an enlarged form and onto a projection screen, an image displayed by said image display element, wherein said projection optical unit includes

a first projection optical unit and a second projection optical unit, both arranged on an optical path ranging from said image display element to the screen,

said first projection optical unit being adapted to form a first enlarged image and having positive refractive power, and

said second projection optical unit being positioned at an enlarged image side of said first projection optical unit, being adapted to form a second enlarged image by further enlarging the first enlarged image obtained by said first projection optical unit, and having positive refractive power;

wherein the first enlarged image is formed at the image display element side, rather than at said second projection optical unit,

a magnification $M1$ of the first enlarged image is smaller than a magnification $M2$ of the second enlarged image, and

said first projection optical unit includes an aperture stop that defines an F-value of said entire projection optical unit.

38. Claim 8 depends from claim 7. Claim 8 adds the limitation “wherein an

optical-axis center of said projection optical unit is made eccentric with respect to a center of the screen.”

39. In my opinion, the claims of the '988 Patent use terms that have ordinary and customary meanings in the art, and do not use these terms inconsistently with those ordinary and customary meanings, except “projection optical unit”, “first projection optical unit”, “second projection optical unit”, and “the image display element side” recited in claims 1 and 7. Therefore, it is my opinion that no terms other than these terms identified above in this paragraph need an explicit construction.

40. In my opinion, the terms “projection optical unit”, “first projection optical unit”, and “second projection optical unit” have the same meaning, and they mean “a lens group having a positive refractive power and to form an enlarged image.”

41. Regarding “projection optical unit”, “first projection optical unit”, and “second projection optical unit”, even though the elements do not contain the word “means,” the terms by themselves do not have sufficiently definite meaning as the name for structure. I therefore believe that these terms meet the definition of a means-plus-function element and base my invalidity opinions on this understanding.

42. The specification of '988 Patent described the structure for projection optical unit as is a lens group having a positive refractive power. The specification

states that “In the present invention, the projection optical unit for providing an enlarged projection of the images displayed by image display elements is divided into two lens groups. One of the lens groups constitutes a first projection optical unit that forms a first enlarged image, and the other lens group constitutes a second projection optical unit that forms a second enlarged image . . . the second projection optical unit having positive refractive power.” EX1001, 7:8-14. In my opinion, therefore, these terms, each covers a lens group having a positive refractive power.

43. Regarding “the image display element side”, this term is vague and ambiguous because it is unclear whether it’s the first projection optical unit or the second projection optical unit that “the image display element side” is referring to. It is my opinion that, to the extent that the term “the image display element side” is amenable to construction, in light of the specification, the most reasonable interpretation is “a side after the image display element and before the second projection optical unit.”

V. Level of Skill in the Art

44. I have been informed that obviousness is considered from the perspective of a person of ordinary skill in the art (“POSITA”) at the time of the invention. I understand that several factors are considered in determining the level of ordinary skill in the art, including the educational level of active workers in the field, the types of problems encountered in the art, the nature of the prior art solutions

to those problems, prior art patents and publications, the activities of others, the sophistication of the technology involved, and the rapidity of innovations in the field. I have been informed that the filing date of the Japanese application to which the '988 Patent claims priority is November 28, 2003.

45. In my opinion, a POSITA at the time of the invention of the '988 Patent would have had a Ph.D. in electrical engineering, physics, optical sciences, optical engineering, or a related scientific or engineering field, and at least one to two years of work or research experience in optical engineering, optical design, or a related field. Alternatively, a POSITA could have had a Bachelor's degree in one of the foregoing areas and at least three to four years of work or research experience in optical engineering, optical design, optoelectronics, or a related field.

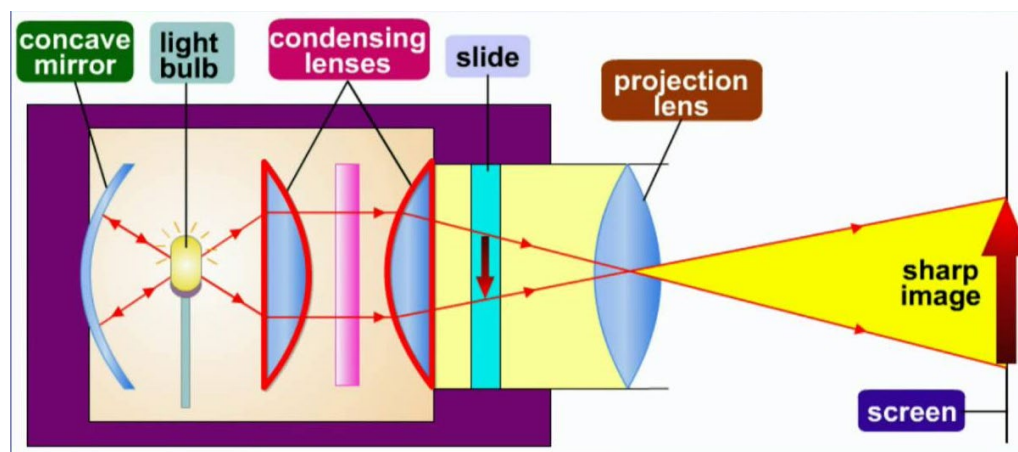
46. I met and exceeded the above qualifications for a POSITA as of at least November 28, 2003 (and thereafter), and consider myself to be a person with at least ordinary skill in the art of the '988 Patent. My experience working with undergraduate students, graduate students, postdoctoral fellows, industry professionals, and others in the relevant field provides me with significant insight on the knowledge of a POSITA.

VI. Background on Relevant Technology

47. I provide the following background information on technology relevant to the '988 Patent based on my general knowledge and experience in the fields of

optical engineering and optical science.

48. The development of optical projectors goes back to the Magic Lantern, which evolved into slide projectors, overhead projectors, and movie film projectors. With the advent of micro-photolithography, optical projectors further evolved as digital projectors, and complex projectors for the fabrication of micro-electronic circuits.

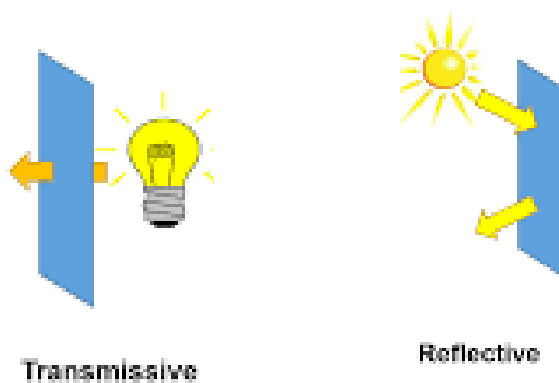


49. The main block elements of an optical projection system are a light source, a light condenser, a transparency, slide, or subject to be projected, a projection lens, and a screen. In all projectors, the efficient use of the available light is important. Much effort is put into minimizing light loss and minimizing loss of energy in the form of heat. In many cases, a fan is included to remove heat from the projector components.

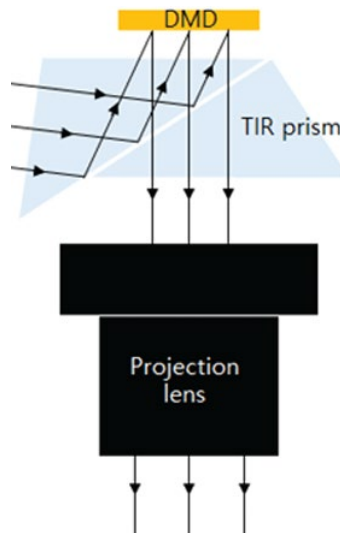
50. The condenser optics' function is to transmit as much light as possible from the light source to the slide or image display; the condenser must illuminate the slide, or image display, in a uniform manner.

51. The projection lens's function is to form an image of the slide, or image display such as a liquid crystal display (LCD) or digital micro-mirror display (DMD), on the screen. The image formed on the screen must be sharp, free of distortions, and have high contrast.

52. Early projectors used a transparency, film, or slide as the subject to be projected onto the screen. Modern digital projectors use a light valve instead. The light valve can be an LCD or a DMD. A light valve can, in addition, transmit or reflect light cast by the condenser optics.



53. Projectors that use a DMD image display work on reflecting light may require a prism to input the light from the condenser optics.



54. Because of the need to improve the light efficiency of projectors, reduce environmental impact, and lower cost, optical projectors have further evolved. The use of LEDs or lasers as the light sources has permitted this progress. The projection lens is often a multi-lens element so that sharp images can be cast at high contrast.

VII. U.S. Patent No. 7,159,988 (the “’988 Patent”)

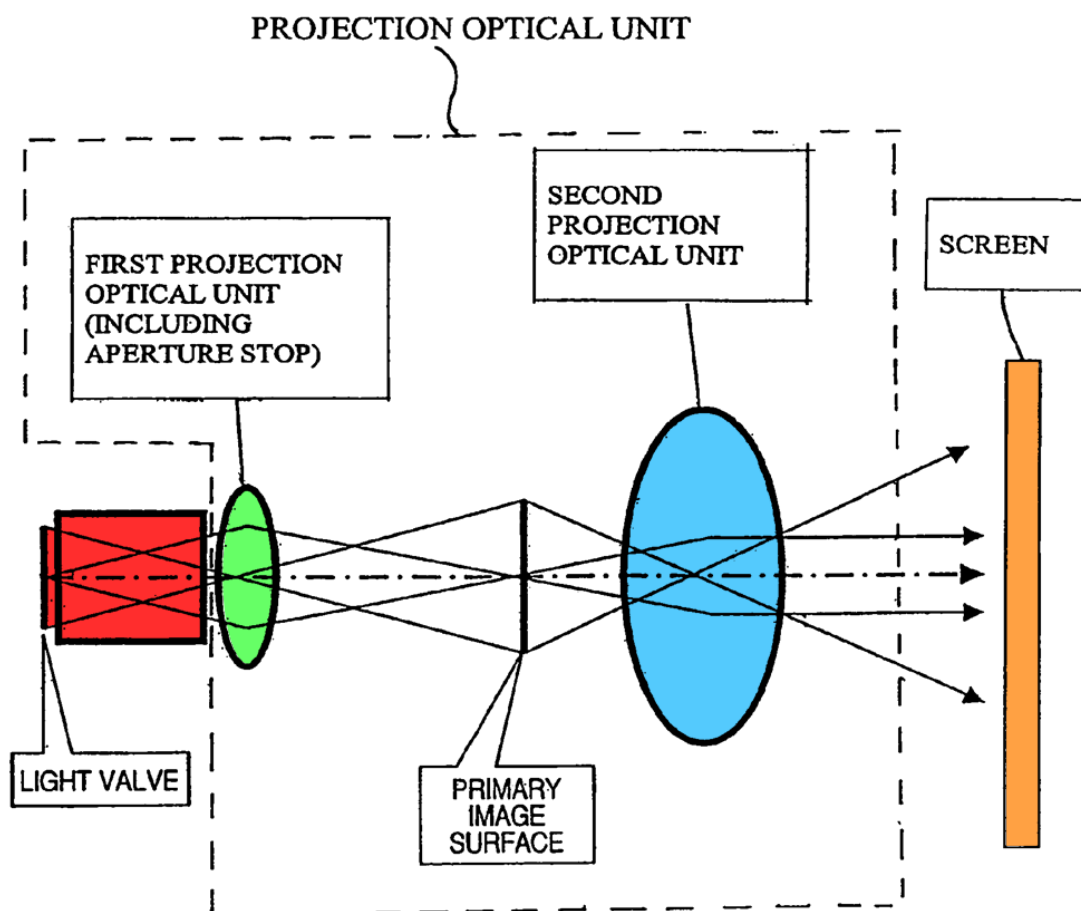
55. I have been informed and understand that the earliest priority date to which the Patent Owner may claim the ’988 Patent is entitled is November 28, 2003. For purposes of my analysis herein, I am assuming that the ’988 Patent is entitled to this priority date. I understand that all of the references discussed below qualify as prior art based on this assumed priority date of November 28, 2003.

56. The ’988 Patent describes a projection optical unit. EX1001, 2:40-3:4. The described projection optical unit includes an image display element, a first projection optical unit, a second projection optical unit, and a screen. The first projection optical unit is disposed between the image display element and the second

projection optical unit. The second projection optical unit is disposed between the first projection optical unit and the screen. The first projection optical unit being configured to form a first enlarged image by enlarging an image displayed by the image display element with a magnification $M1$. The second projection optical unit being configured to enlarge the first enlarged image onto the screen with a magnification $M2$. The magnification $M1$ is smaller than the magnification $M2$ and the first projection optical unit includes an aperture stop that defines an F-value of the entire projection optical unit. *Id.*

57. The '988 Patent's Fig. 1, annotated below, depicts an overview of an embodiment of the claimed projection optical unit.

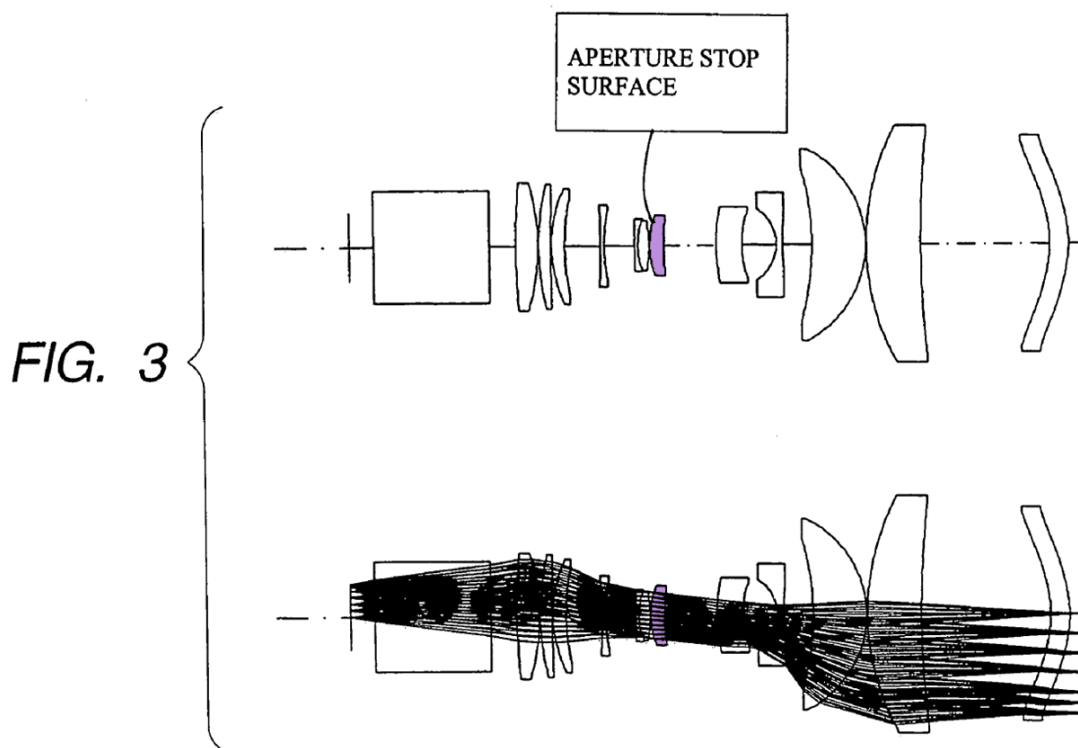
FIG. 1



58. This figure shows an image display element, i.e. the light valve, a first projection optical unit, a second projection optical unit, and a screen. EX1001, 7:4-23. The projection optical unit for providing an enlarged projection of the images displayed by image display elements is divided into two lens groups. *Id.* One of the lens groups constitutes a first projection optical unit that forms a first enlarged image; the other lens group constitutes a second projection optical unit that forms a second enlarged image by further enlarging the first enlarged image, and the second

projection optical unit has positive refractive power. *Id.*

59. The '988 Patent further discloses and claims the first projection optical unit includes an aperture stop that defines an F-value of said entire projection optical unit. *Id.*, abstract, 26:46-27:3. The aperture stop is shown in Fig. 3, annotated below:



60. The '988 Patent further states that “F2 (divergence angle of light rays) that is the F-value of the second lens group equals a value obtained by dividing F1, the F-value of the first lens group, by the magnification M1 of the first enlarged image. That is to say, $F2 = F1/M1$.” EX1001, 2:63-67.

61. The '988 Patent also discloses and claims a magnification M1 of the first enlarged image and a magnification M2 of the second enlarged image, where $M2 > M1$. EX1001, abstract. The '988 Patent discloses an example that the M1 is $3\times$

and the M2 is $27\times$, where M2 is greater than M1. “Although more specific data of the entire projection optical unit is described later herein, the first projection optical unit has a magnification of $3\times$ in Embodiment 1 and the second projection optical unit has a magnification of $27\times$ in Embodiment 1.” EX1001, 7:26-30.

62. The '988 Patent issued on January 9, 2007 from U.S. Patent Application No. 10/921,938, filed August 20, 2004. The patent claims foreign priority to Japanese Application No. 2003-398395, filed on November 28, 2003. EX1002. The claims of the '988 Patent were subjected to a restriction requirement that was mailed on April 17, 2006. The elected claims were allowed but the drawings were objected in an Ex Parte Quayle Action that was mailed on June 6, 2006. As relevant to this Petition, claims 1, 7, and 8 were allowed without any rejections or amendments via a Notice of Allowance that was mailed on August 29, 2006. EX1002 at page 28-33.

63. As discussed below, the claims of the '988 Patent are anticipated or recite nothing more than an obvious combination of optical and mechanical elements that had been used by POSITAs for many years prior to the filing of the '988 Patent.

VIII. Prior Art

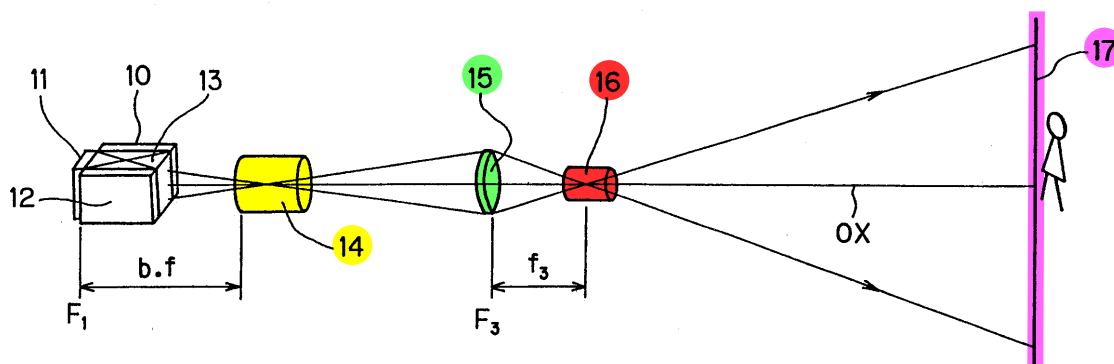
A. Konno (EX1005)

64. Konno was filed as U.S. Application No. 08/180,705 on January 13, 1994 and published as U.S. Patent No. 5,357,289A on October 18, 1994. EX1005. I understand that Konno is prior art to the '988 Patent and was not considered by the Examiner during prosecution of the '988 Patent.

65. Konno generally discloses a projector lens system. EX1005, title. The projector includes an optical lens system that includes a first lens group, a second lens group and a third lens group for projecting an image onto a screen as a magnified image. *Id.*, abstract.

66. Fig. 3 of Konno, annotated below, shows the overall arrangement of a projector in accordance with Konno's invention. EX1005, 6:46-56. Konno discloses the projector that includes a first lens group 14, a second lens group 15, a third lens group 16, and a screen 17. EX1005; 3:22-44.

Fig. 3



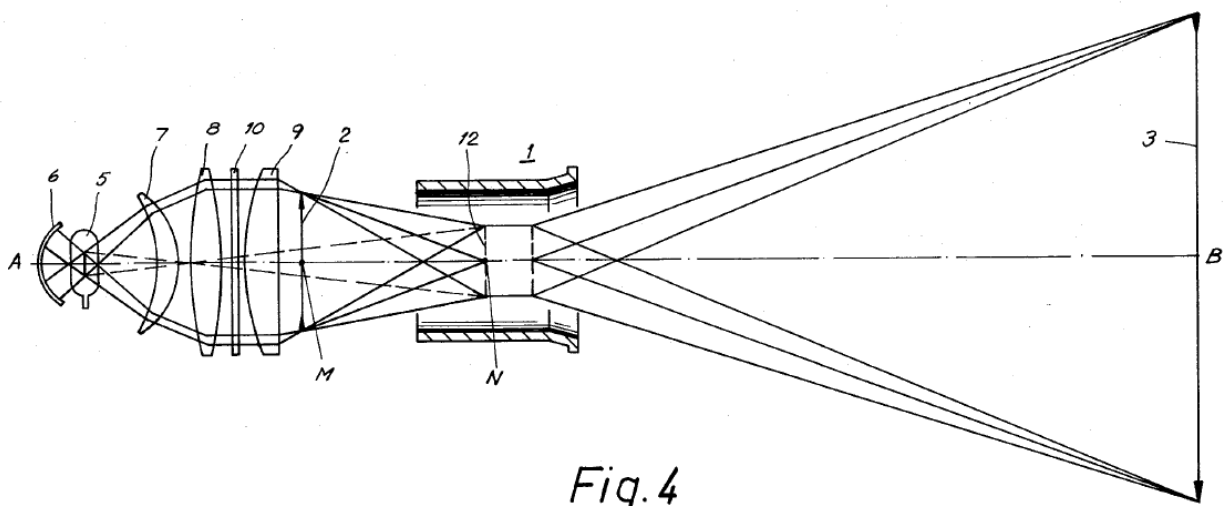
67. Konno explains that “[e]ach of the lights reflected from the image forming devices is incident to the tri-color separation and composition system 13 to compose a composite optical image beam, and the composite image beam is focused as a optical image on the second lens group 15 through the first lens group 14. The optical image on the second lens group 15 is projected on the screen 17 as a predetermined magnified picture through the third lens group 16.” EX1005; 3:53-61.

B. Lundberg (EX1006)

68. Lundberg was filed as U.S. Application No. 05/576,365 on May 12, 1975 and patented as U.S. Patent No. 3,963,337A on June 15, 1976. EX1006. I understand that Lundberg is prior art to the '988 Patent and was not considered by the Examiner during prosecution of the '988 Patent.

69. Lundberg generally discloses a still projector. EX1006, title. The still projector includes a compensation device acting in vertical direction compensating for the so-called Keystone-effect. *Id.*, 1:7-12.

70. Figs. 4 and 5 of Lundberg, reproduced below, show the ray paths through a still projector with a compensation device in accordance with Lundberg's invention. EX1006, 4:25-63. The optical axis of the still projector is adjustable to compensate the Keystone effect and have the projected image eccentric to the screen. *Id.*



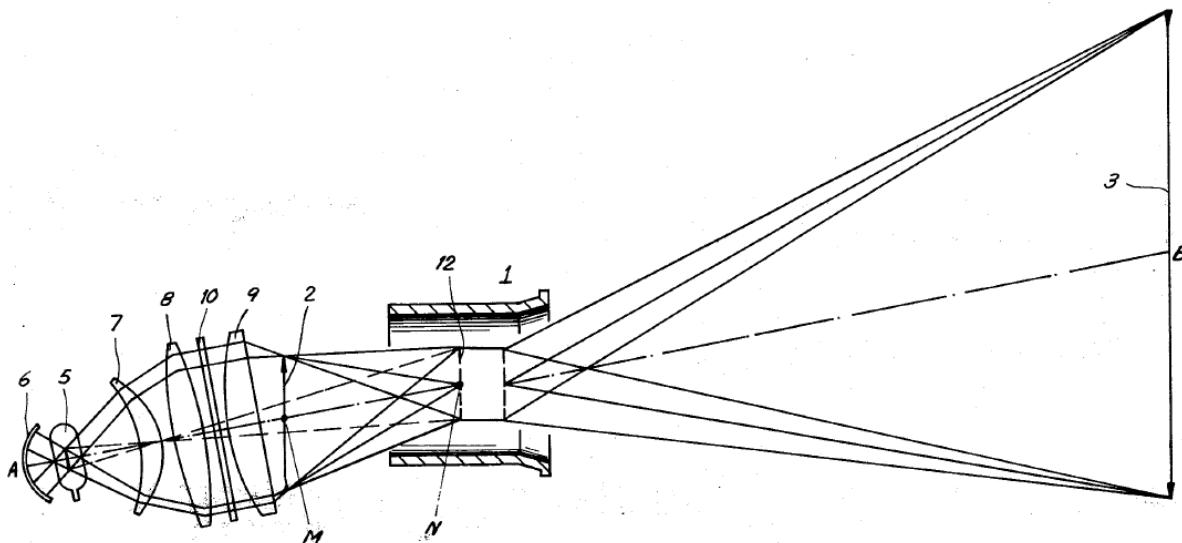


Fig.5

71. Lundberg explains that “[w]hen the lens 1 is displaced in parallel to compensate for the Keystone-effect from the normal case shown in FIG. 4 to a position deviating from the normal case, FIG. 5, the lighting means 5-10, coupled to the lens 1, automatically will turn so that the ray path always is centered on the exit pupil of the lens 1, located in the rear nodal plane 12.” *Id.*

C. Sato (EX1007)

72. Sato was filed as U.S. Application No. 988,974 on December 10, 1992, and patented as U.S. Patent No. 5,302,983A on April 12, 1994. EX1007. I understand that Sato is prior art to the '988 Patent and was not considered by the Examiner during prosecution of the '988 Patent.

73. Sato generally discloses a projecting apparatus. EX1007, abstract. The projecting apparatus includes a first projecting system for projecting an object to form an intermediate image, and a second projecting system for projecting the

intermediate image formed by the first projecting system onto a screen in an enlarged fashion.

74. Fig. 1 of Sato, annotated below, shows the overall arrangement of a projector in accordance with Sato's invention. EX1007, 6:46-56. The projector includes an indicator 13, an auxiliary projecting lens 17, a projecting lens 14, and a projection screen 12. An indication image Ao of the indicator 13 is projected through the auxiliary projecting lens 17 to form a first projection image A1, which is further projected by the projecting lens 14 to form a screen projection image A2. *Id.*

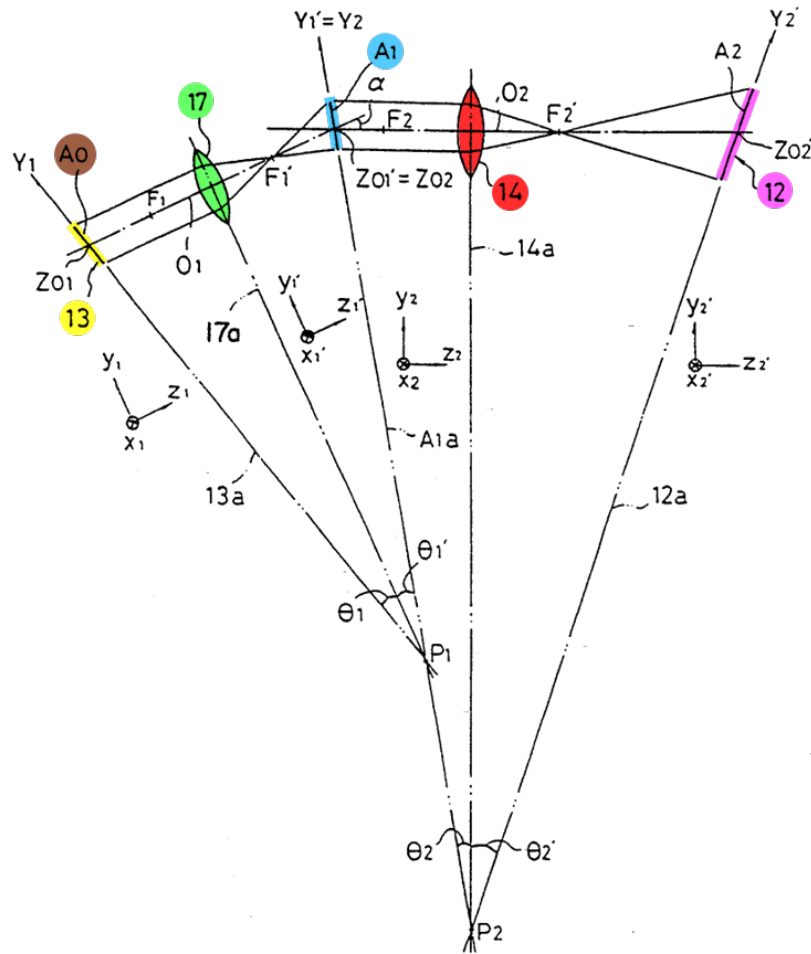


Fig. 1

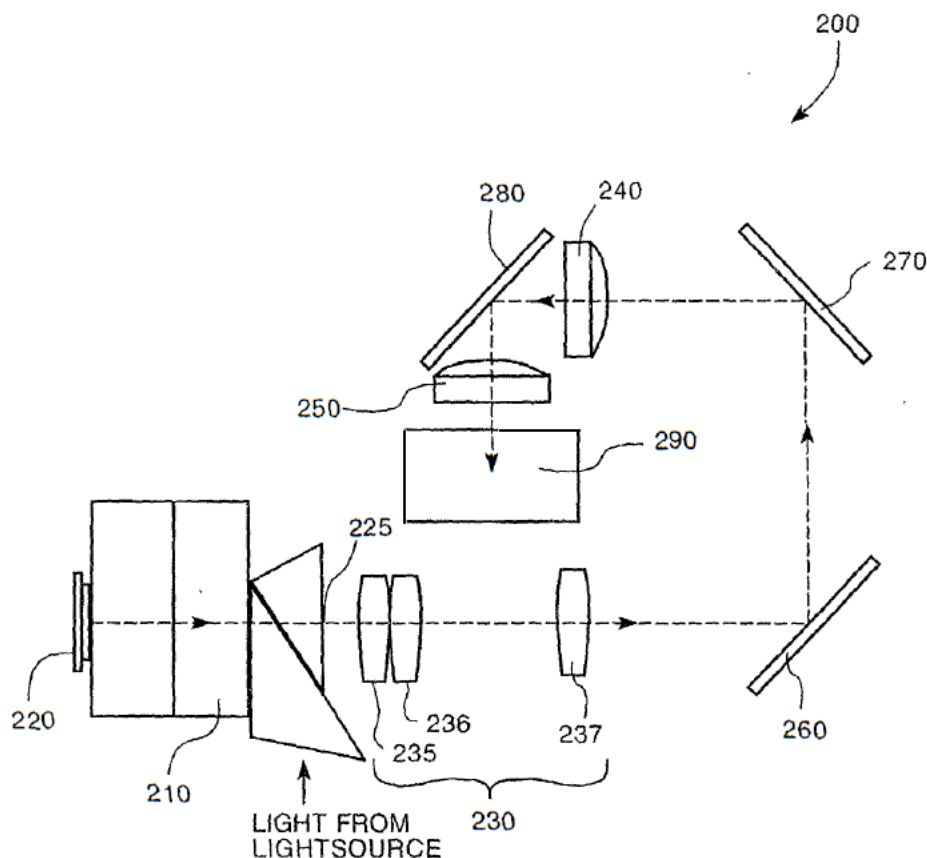
75. Sato explains that “[a] projector shown in FIG. 1, which shows an optical principle thereof according to the present invention, has a first optical system which projects an indication image A_0 of an indicator 13 (object to be projected), such as a liquid crystal display panel or the like through an auxiliary projecting lens 17 to form a first projection image (intermediate projection image) A_1 , and a second optical system which projects the first image A_1 onto a projection plane, such as a projection screen 12 from an inclined direction through a projecting lens 14 to form a screen

projection image A2.” *Id.*

D. Dorval (EX1008)

76. Dorval was filed as U.S. Application No. 09/948,060 on September 6, 2001 and published as U.S. Publication No. 2002/0067467 on June 6, 2002. EX1008. I understand that Dorval is prior art to the '988 Patent and was not considered by the Examiner during prosecution of the '988 Patent.

77. Dorval generally discloses a volumetric three-dimensional display that produces volume-filling imagery. EX1008, [0002]-[0003]. Figure 2B of Dorval, reproduced below, depicts a top-down view of a projection engine in accordance with Dorval's invention:



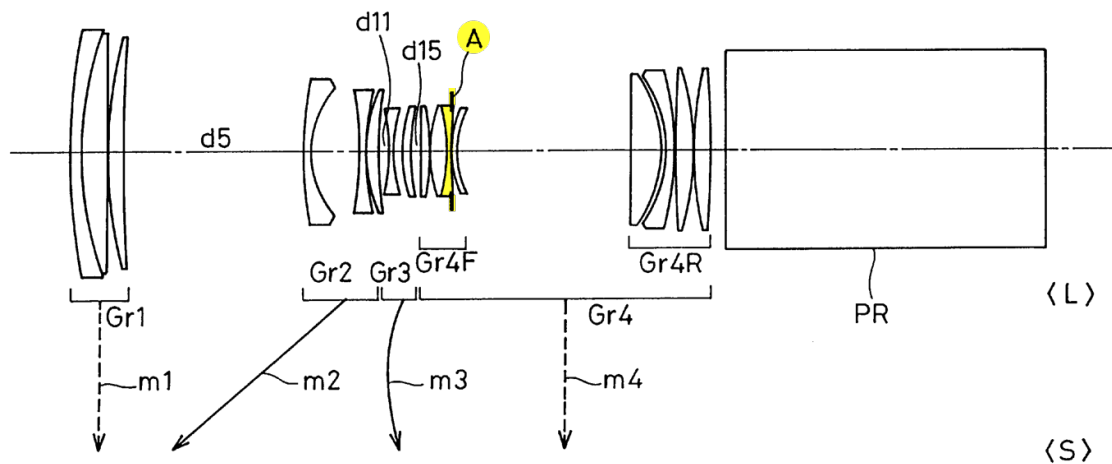
78. Dorval explains that “[t]he intermediate image, having 3.8× magnification is formed between two field lenses, 240 and 250, which are also doublet lenses.” EX1008, [0039]. In addition, Dorval further discloses that “[t]he projection system is designed to be highly compact so as to fit within a very limited space within casing 140 and dome 195, while at the same time providing the desired image magnification (i.e., about 20×) and resolution.” *Id.*, [0037].

E. Takamoto (EX1009)

79. Takamoto was filed as U.S. Application No. 08/978,239 on November 25, 1997 and patented as U.S. Patent No. 6,028,715A on February 22, 2000. EX1009. I understand that Takamoto is prior art to the '988 Patent and was not considered by the Examiner during prosecution of the '988 Patent.

80. Takamoto discloses a variable magnification optical system. EX1009, title. Particularly, Takamoto discloses “a variable magnification optical system suitable for use as a projection optical system in a projection apparatus (for example, a liquid crystal projector for projecting an image from a display device such as a liquid crystal panel onto a screen).” *Id.*, 1:7-11. Fig. 2 of Takamoto, annotated below, depicts a diagram showing the lens arrangement in an embodiment of Takamoto’s invention:

FIG. 2



81. Takamoto explains that “[i]n all of the first to fifth embodiments, the variable magnification optical system is constituted as a four-unit zoom lens system consisting of, from the enlargement (projection) side, a first lens unit Gr1 having a positive optical power, ... and that is a fourth lens unit Gr4 having a positive optical power and kept in a fixed position during zooming.” EX1009, 4:44-51.

82. Takamoto further discloses an aperture stop A within the fourth lens unit Gr4: “[i]n the first embodiment, the front lens unit Gr4F of the fourth lens unit Gr4 is composed of, from the enlargement side, ... an aperture stop A...” EX1009, 5:25-30.

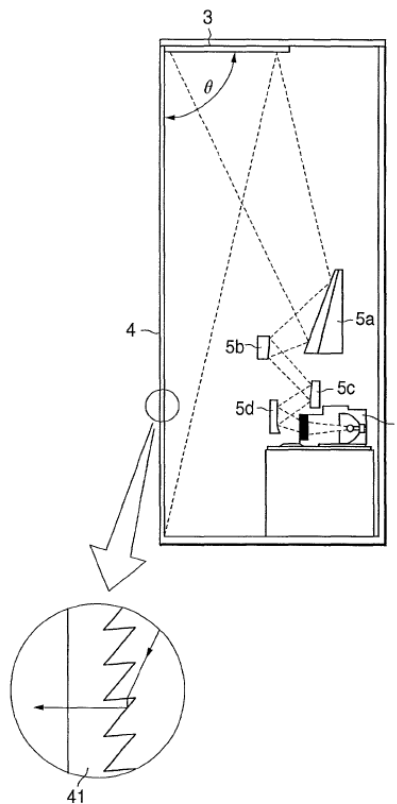
F. Takeuchi (EX1010)

83. Takeuchi was filed as U.S. Application No. 09/974,966 on October 12, 2001 and published as U.S. Publication No. 2002/0044263A1 on April 18, 2002. EX1010. I understand that Takeuchi is prior art to the '988 Patent and was not

considered by the Examiner during prosecution of the '988 Patent.

84. Takeuchi discloses “[t]he present invention relates to a rear projection television or rear projection display device and a projecting method thereof and, particularly, to a rear projection display device for enlarging and projecting an image on an image display element onto a projection screen.” EX1010, [0002].

85. Takeuchi’s Fig. 4, reproduced below, depicts a diagram showing a rear projection television in an embodiment of Takeuchi’s invention:



86. Takeuchi discloses “[a]n object of the present invention is to provide a rear projection television having a size, which is reduced by removing a skirt portion thereof and reducing a depth length thereof, and a projection method for use in the

rear projection television.” EX1010, [0016].

G. Ninomiya (EX1011)

87. Ninomiya was filed as PCT Application No. PCT/JP92/00307 on March 13, 1991 and entered the national stage in the United States as U.S. Patent Application No. 949,243. It was later published and patented as U.S. Patent No. 5,422,691 on June 6, 1995. EX1011. I understand that Ninomiya is prior art to the '988 Patent and was not considered by the Examiner during prosecution of the '988 Patent.

88. Ninomiya generally discloses a projection type displaying apparatus. EX1011, title. The projection type displaying apparatus includes a first projecting optical means that produces an intermediate image, and a second projecting optical means that projects the intermediate image on a screen. *Id.*, 4:35-49.

89. Fig. 22 of Ninomiya, annotated below, shows the overall arrangement of an oblique projection type optical system in accordance with Ninomiya's invention. EX1011, 10:41-54. The projection type optical system includes a light bulb 86, a first projection optical system which includes a first lens 80, a second lens 81, a third lens 82, and a fourth lens 83, an intermediate image plane 88, a second projection optical system 85, a screen 7, and an aperture stop 84. *Id.*

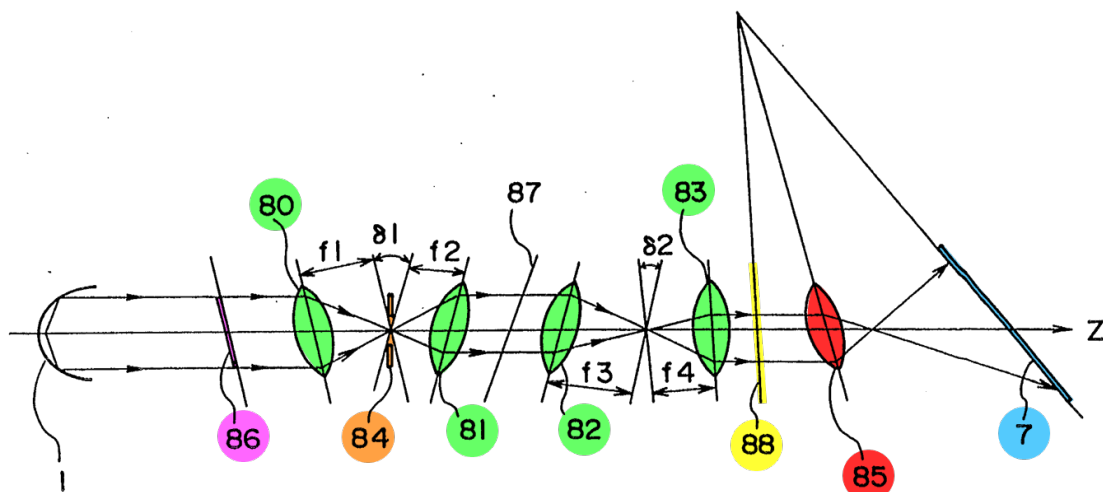


FIG. 22

90. Ninomiya explains that “[i]n FIG. 22, the optical axis of a first lens 80 of a first projection optical system, the optical axis of a second lens 81 thereof, the optical axis of a third lens 82 thereof, the optical axis of a fourth lens 83 thereof, the optical axis of an aperture stop mechanism 84, the optical axis of a second projection optical system 85, the normal of a light bulb 86, and the normal of a screen 7 are placed on the same plane. In the figure, reference numeral 87 is a first intermediate image plane. Reference numeral 88 is a second intermediate image plane.” EX1011, 10:45-54.

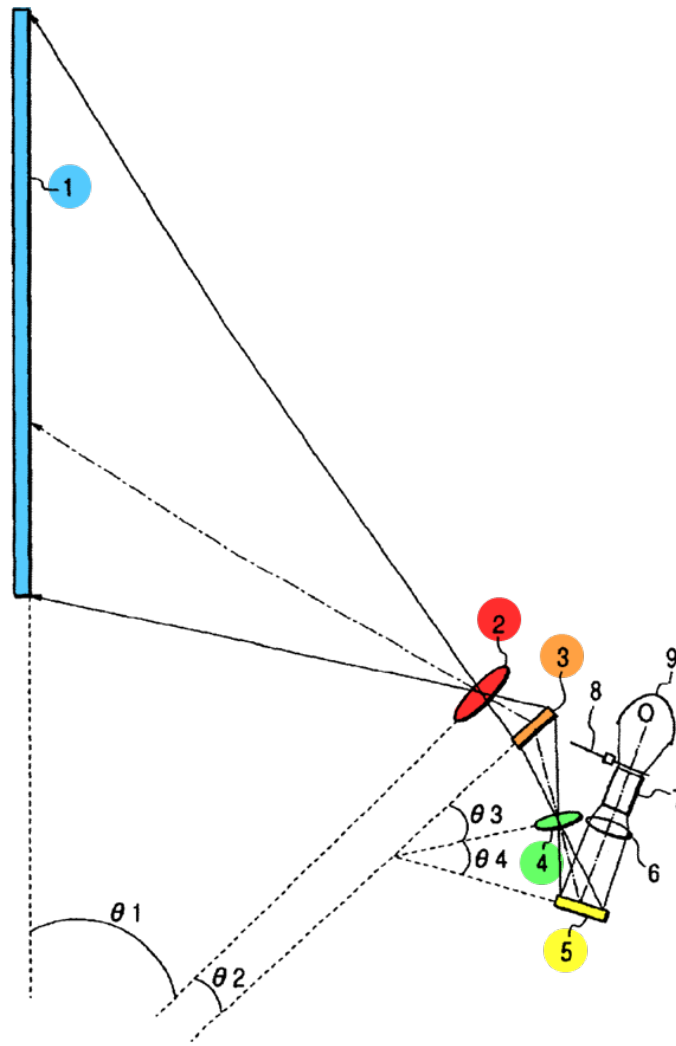
H. Kurematsu (EX1012)

91. Kurematsu was filed as U.S. Application No. 09/680,770 on October 6, 2000 and published as U.S. Patent No. 6,808,271B1 on October 26, 2004. EX1012. I understand that Kurematsu is prior art to the '988 Patent and was not considered by the Examiner during prosecution of the '988 Patent.

92. Kurematsu discloses a projection type display apparatus. EX1012, title. The projection type display apparatus includes a first projection optical system for projecting light from an original picture and form an intermediate image and a second projection optical system for projecting the intermediate image on to a surface. *Id.*, abstract.

93. Fig. 1 of Kurematsu, annotated below, generally shows a basic optical system for a thin type of rear projection display apparatus in accordance with Kurematsu's invention. EX1012, 3:11-36. The projection display apparatus includes a DMD display device 5, a first projection optical system 4, a transmission type diffracting optical element 3 for an intermediate projected image to be formed on, a second projection optical system 2, and a screen 1. *Id.*

FIG. 1



94. Kurematsu explains that “[o]nly the display reflected light from the DMD display device 5 passes through the auxiliary projection lens 4, and by the imaging action of this auxiliary projection lens 4, the intermediate projected image thereof is formed on the transmission type diffracting optical element 3.” EX1012, 3:37-41. Further “the intermediate image is enlarged and projected onto the screen by the main projection lens 2”. *Id.*, 4:9-11.

IX. Analysis And Identification Of How The Claims Are Unpatentable

A. Konno anticipates, or renders obvious, Claims 1 and 7

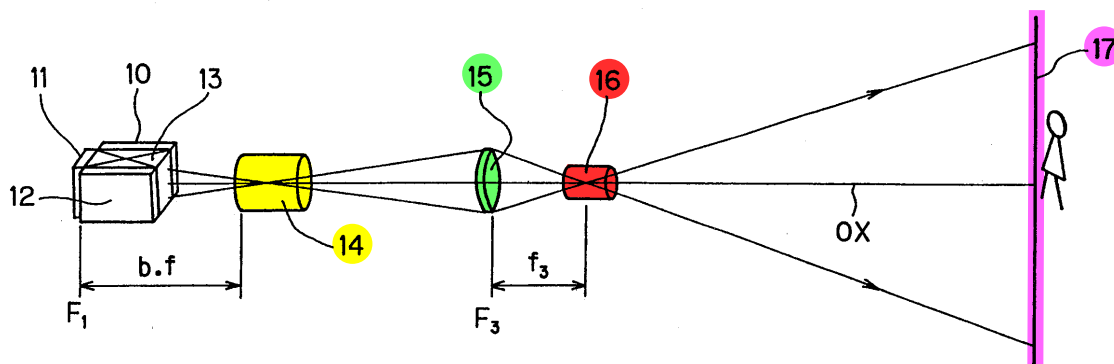
95. In my opinion and for the reasons explained below, Konno anticipates the subject matter recited by claims 1 and 7 of the '988 Patent, and/or renders them obvious.

1. Independent Claim 1

[1.0] A projection optical unit for enlarged projection of an image displayed by an image display element, comprising;

96. Konno discloses a projection optical unit for enlarged projection of an image displayed by an image display element. Konno's Fig. 3 is annotated below:

Fig. 3

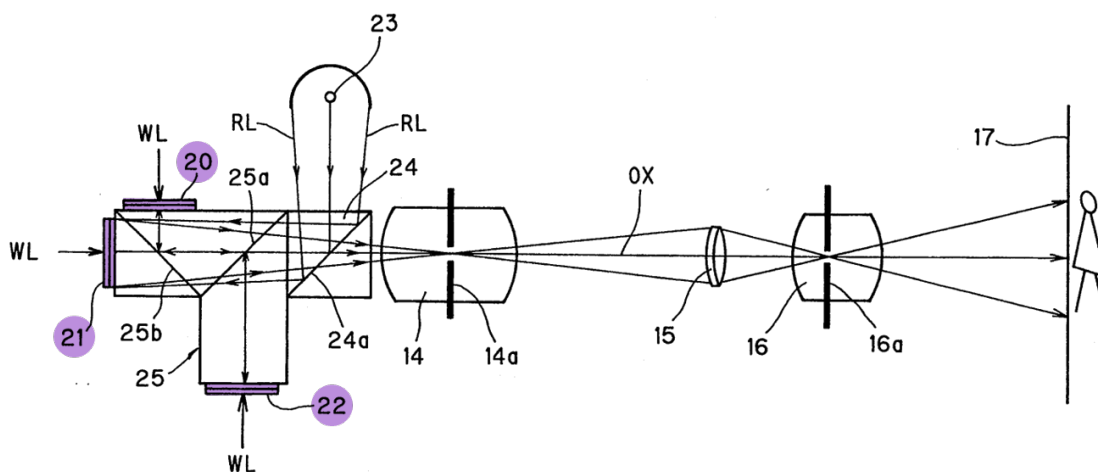


97. Konno teaches that “[t]he present invention relates to improvements of an image projector and more particularly to an image projector capable of displaying a high definition image in spite of a short projection length.” EX1005, 1:10-13. Further “[a] more specific object of the present invention is to provide an image projector *for projecting a magnified tri-color composite optical image on a screen.*”

Id., 2:33-35 (emphasis added).

98. The image display element was disclosed by Konno as it states that “[i]t should be also noted that, as described in the foregoing, *the light modulators 20, 21 and 22 are employed as image forming devices* in the embodiment of the present invention, but it is possible to employ such devices as *liquid crystal panels* which can modulate the light.” EX1005, 3:22-30 (emphasis added). A POSITA would have recognized that the light modulators 20, 21 and 22 or the liquid crystal panels disclosed by Konno is an image display element.

Fig. 4



[1.1] a first projection optical unit for forming a first enlarged image, said first projection optical unit having positive refractive power; and

99. Konno discloses that its projection optical unit includes a first projection optical unit for forming a first enlarged image, said first projection optical unit having positive refractive power.

100. Konno discloses “FIG. 3 is an explanatory view showing a basic

structure of an image projector according to the present invention, in which the numeral ... 14 a first lens group having a back-focal length 'b.f.' defined as a distance between a front surface of the first lens group and an object focal point 'F1'," EX1005, 3:22-30. Further, "if the composite optical image beam is focused on the second lens group 15 through the first lens group 14 as an optical image with a magnification of $\times 2$," *Id.*, 4:1-4. The first projection optical unit corresponds to "first lens group 14" shown in Konno's Fig. 3 above. Fig. 3 inherently discloses the first lens group 14 has positive refraction power. Moreover, a POSITA would also have understood that, since the first lens group projects a real magnified image of the object at field lens 15, it must have positive focal length, *i.e.*, positive refractive power. Further, lenses 14, 15, and 16 in Konno Fig. 4 are shown as convex lenses which a POSITA would have understood as having positive refractive power.

[1.2] a second projection optical unit positioned at an enlarged image side of said first projection optical unit in order to form a second enlarged image by further enlarging the first enlarged image obtained by said first projection optical unit, said second projection optical unit having positive refractive power;

101. Konno discloses that its projection optical unit includes a second projection optical unit positioned at an enlarged image side of said first projection optical unit in order to form a second enlarged image by further enlarging the first enlarged image obtained by said first projection optical unit, said second projection optical unit having positive refractive power.

102. Konno teaches that “FIG. 3 is an explanatory view showing a basic structure of an image projector according to the present invention, in which the numeral ... 16 a third lens group having an object focal point ‘F3’ and a focal length ‘f3’ for projecting a magnified image on a screen 17.” EX1005, 3:22-33. Further, Konno discloses “[t]he optical image on the second lens group 15 is projected on the screen 17 as a predetermined magnified picture through the third lens group 16.” *Id.*, 3:58-61. The second projection optical unit corresponds to “third lens group 16” shown in Konno’s Fig. 3 above. Fig. 3 inherently discloses the third lens group 16 has positive refraction power. Moreover, a POSITA would also have understood that the “third lens group” would have positive refractive power as claimed because it cast a magnified real image at the screen 17 of the image cast by the first projection unit at lens 15. Further, lenses 14, 15, and 16 in Konno Fig. 4 are shown as convex lenses which a POSITA would have understood as having positive refractive power.

[1.3] wherein the first enlarged image is formed at the image display element side, rather than at said second projection optical unit,

103. Konno discloses that the first enlarged image is formed at the image display element side, rather than at said second projection optical unit.

104. Konno teaches that “Each of the lights reflected from the image forming devices is incident to the tri-color separation and composition system 13 to compose a composite optical image beam, and *the composite image beam is focused as a optical image on the second lens group 15 through the first lens group 14.*”

EX1005, 3:53-58 (emphasis added). Konno's Fig. 3 above shows that second lens group 15, where the first enlarged image is formed at, is positioned between the first lens group and the third lens group. As the term "the image display element side" discussed in Section IV Claim Construction, the first enlarged image is formed at the image display element side as it is formed after the light modulators 20, 21 and 22 (corresponding to the image display element in the '988 Patent) and before the third lens group 16 (corresponding to the second projection optical unit in the '988 Patent). Further, the first enlarged image being formed at the second lens group 15 is consistent with the '988 Patent's specification. For example, regarding Fig. 1, the '998 patent teaches that an enlarged image is formed near a primary image surface in between the first and second projection units, a POSITA would have understood that the primary image surface as claimed in '988 patent is near or at a field lens. Further, a POSITA would have also understood that an enlarged image at the second lens group 15 between projection lenses 14 and 16 is also disclosed by Konno in Figs. 3 and 4, where a POSITA would have understood that the second lens group 15 is also a field lens.

[1.4] a magnification M1 of the first enlarged image is smaller than a magnification M2 of the second enlarged image, and

105. Konno discloses that a magnification M1 of the first enlarged image is smaller than a magnification M2 of the second enlarged image.

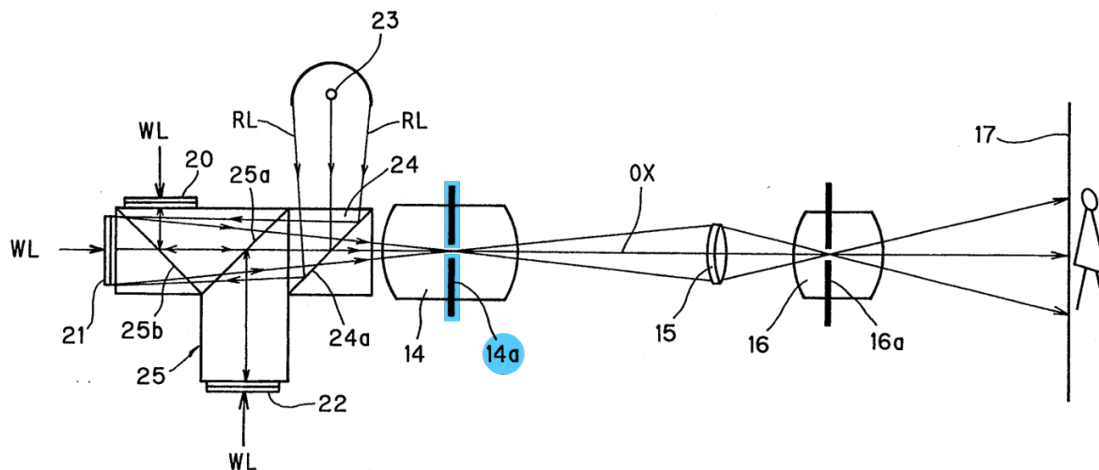
106. Konno discloses "if the composite optical image beam is focused on the

second lens group 15 through the first lens group 14 as an optical image with a magnification of $\times 2$,” EX1005, 4:1-4, and “[t]he optical image on the second lens group 15 is projected on the screen 17 as a predetermined magnified picture through the third lens group 16.” *Id.*, 3:58-61. The magnification M1 is equal to 2. Although Konno does not expressly disclose a number for the magnification M2 of the “third lens group”, it is inherently disclosed from Fig. 3. The predetermined magnified picture on the screen 17 is magnified from the optical image on the second lens group 15, and the magnification of the predetermined magnified picture on the screen 17 is larger than the magnification of the optical image on the second lens group 15. Moreover, a POSITA would also have recognized that the magnification of the “third lens group” of Konno must be greater than the magnification of the “first lens group” in order for the projector to perform its intended function of projecting an image onto a screen that is multiple times the size of the image on the display element, which also renders this element obvious in view of Konno. In addition, Fig. 3 of Konno shows that the distance from the third projection unit to the screen is many times the distance f_3 from lens 15 to lens 16; a POSITA would have understood that the ratio of these two distances gives the magnification of lens 16 and that person would have understood that the magnification of lens 16 is much larger than the magnification of lens 14 of $2\times$ as disclosed by Konno.

[1.5] said first projection optical unit includes an aperture stop that defines an F-value of said entire projection optical unit.

107. Konno discloses that the said first projection optical unit includes an aperture stop that defines an F-value of said entire projection optical unit. Konno's Figure 4 is annotated below:

Fig. 4



108. Konno discloses that “In FIG. 4, numeral ... 14a [indicates] an iris of the first lens group for controlling the light quantity”. EX1005, 5:15-23. A POSITA would have understood that “iris 14a” is an aperture stop because this iris is located where chief rays intersect the optical axis and controls the quantity of light. Therefore, a POSITA would have recognized that the “iris 14a” of the “first lens group 14” defines an F-value of said entire projection optical unit. Furthermore, A POSITA would have understood that an iris having a diameter of an opening that controls the light quantity also defines the F-value because the formula for F-value is $f/\# \equiv \frac{f}{D}$, where f is a focal length and D is a diameter of an aperture. EX1013,

Page 152. Konno teaches “The composite beam having passed through impinges on the first lens group 14 and forms an optical image in the second lens group 15 by being controlled a quantity of light with iris 14a.” EX1005, 5:54-59.

109. Konno also discloses an iris 16a at the third projection unit, and teaches “Further, the present invention enables to obtain a high definition image without decreasing brightness because the beam forming the image is converged on the entrance pupil of iris 16a of the third lens group 16 by the second lens group 15.” EX1005, 6:4-8. In view of this teaching a POSITA would have understood that iris 16a would not block converging light to achieve a high definition image without decreasing brightness, and so iris 14a defines the quantity of light and therefore defines the F-value of the entire projection unit. A POSITA would have understood that iris 16a would not have been set to decrease the definition or the image brightness from the first lens group.

110. In addition, a POSITA would have understood that iris 16a would not define the F-value of the entire projection system because, if iris 16a would define the F-value of the entire projection system, that would mean that iris 14a would allow to pass more light that would not be used to achieve the desired high luminance, high definition and image brightness, as this light would be blocked by iris 16a. Further, a POSITA would have known that any light passed by the first lens group that was not used for forming the final image, could lower the image contrast decreasing the

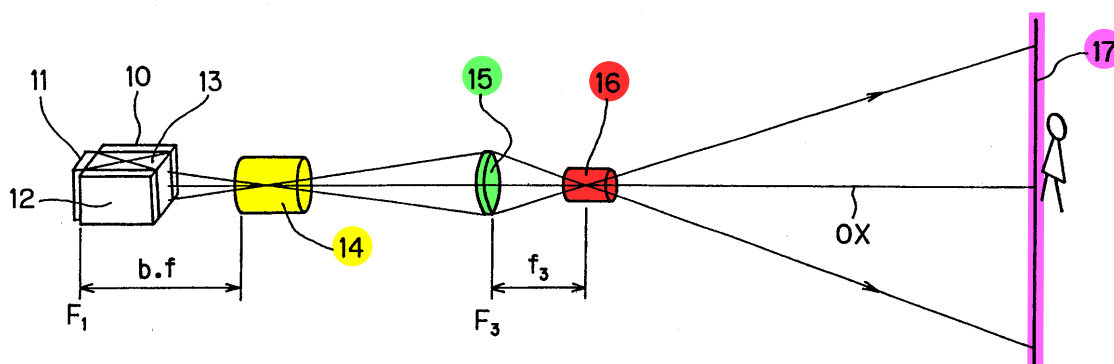
definition of the final image cast on the screen. Therefore, a POSITA would have understood that iris 14a defines the F-value of the entire projection unit. In addition, for optimum light quantity control it would have been obvious to set iris 14a to define the F-value of the entire projection unit.

2. Independent Claim 7

[7.0] A projection image display apparatus, comprising;

111. Konno discloses a projection image display apparatus. Konno's Figure 3 is annotated below:

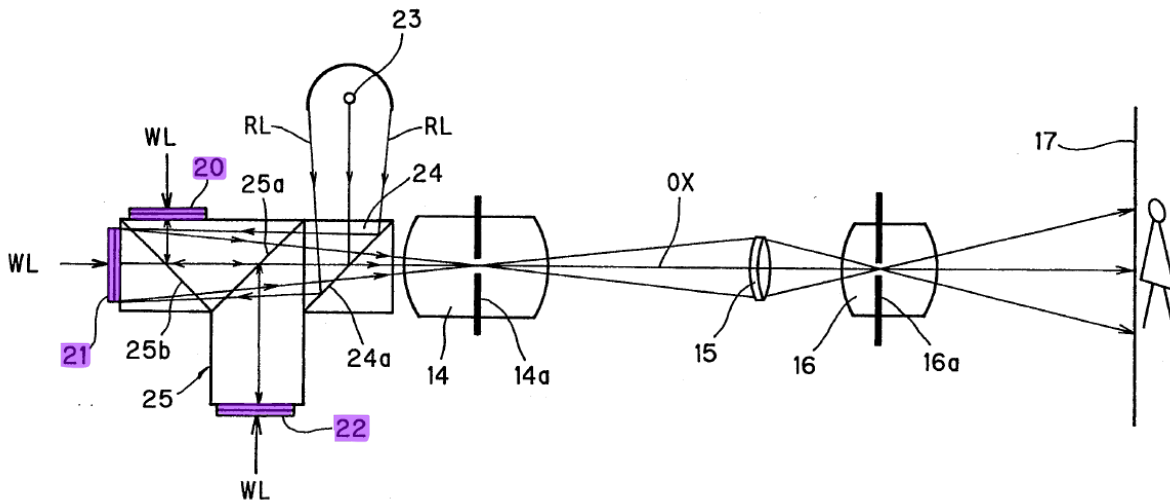
Fig. 3



112. Konno teaches that “[t]he present invention relates to improvements of an image projector and more particularly to an image projector capable of displaying a high definition image in spite of a short projection length.” EX1005, 1:10-13. Further “[a] more specific object of the present invention is to provide an image projector for projecting a magnified tri-color composite optical image on a screen.” *Id.*, 2:33-35.

[7.1] an image display element; and

113. Konno discloses that its projection image display apparatus includes an image display element. Konno's Figure 4 is annotated below:



114. The image display element was disclosed by Konno as it states that “[i]t should be also noted that, as described in the foregoing, *the light modulators 20, 21 and 22 are employed as image forming devices* in the embodiment of the present invention, but it is possible to employ such devices as *liquid crystal panels* which can modulate the light.” EX1005, 3:22-30 (emphasis added).

[7.2] a projection optical unit for projecting, in an enlarged form and onto a projection screen, an image displayed by said image display element,

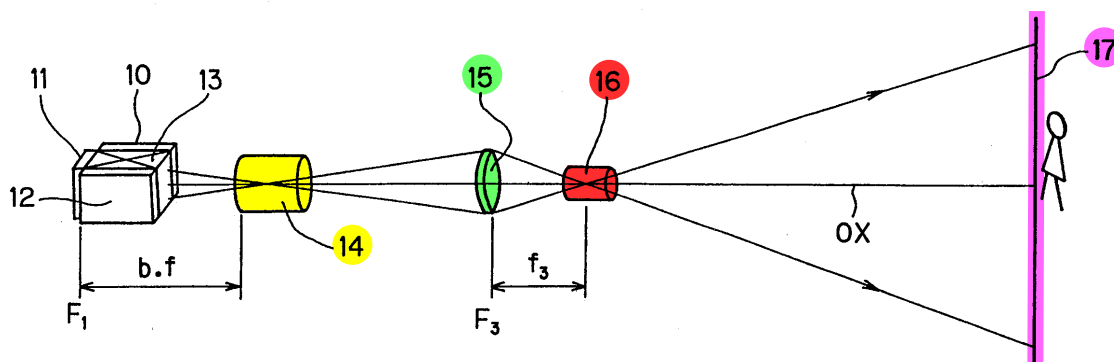
115. This element is disclosed by Konno, as analyzed for claim 1 in Section IX.A.1, *supra*.

[7.3] wherein said projection optical unit includes a first projection optical unit and a second projection optical unit, both arranged on an optical path ranging from said image display element to the screen,

116. Konno discloses that the said projection optical unit includes a first

projection optical unit and a second projection optical unit, both arranged on an optical path ranging from said image display element to the screen. Konno's Fig. 3 is annotated below:

Fig. 3



117. Konno discloses that “FIG. 3 is an explanatory view showing a basic structure of an image projector according to the present invention, in which ... [numeral] 14 [indicates] a first lens group having a back-focal length ‘b.f.’ defined as a distance between a front surface of the first lens group and an object focal point ‘F1’, ..., 16 a third lens group having an object focal point ‘F3’ and a focal length ‘f3’ for projecting a magnified image on a screen 17. Each of the lens groups 14, 15, and 16, the tri-color separation and composition system 13 and the Green image forming device 11 are provided along an optical axis OX.” EX1005, 3:22-44.

[7.4] said first projection optical unit being adapted to form a first enlarged image and having positive refractive power, and

118. This element is disclosed by or obvious in view of Konno, as analyzed for claim 1 in Section IX.A.1, *supra*.

[7.5] said second projection optical unit being positioned at an enlarged image side of said first projection optical unit, being adapted to form a second enlarged image by further enlarging the first enlarged image obtained by said first projection optical unit, and having positive refractive power;

119. This element is disclosed by or obvious in view of Konno, as analyzed for claim 1 in Section IX.A.1, *supra*.

[7.6] wherein the first enlarged image is formed at the image display element side, rather than at said second projection optical unit,

120. This element is disclosed by Konno, as analyzed for claim 1 in Section IX.A.1, *supra*.

[7.7] a magnification M1 of the first enlarged image is smaller than a magnification M2 of the second enlarged image, and

121. This element is disclosed by or obvious in view Konno, as analyzed for claim 1 in Section IX.A.1, *supra*.

[7.8] said first projection optical unit includes an aperture stop that defines an F-value of said entire projection optical unit.

122. This element is disclosed by Konno, as analyzed for claim 1 in Section IX.A.1, *supra*.

123. Thus, claims 1 and 7 are anticipated by Konno and/or obvious over Konno.

B. Konno in View of Lundberg Renders Claim 8 Obvious

124. In my opinion and for the reasons explained below, Konno, in view of Lundberg, renders obvious the subject matter recited by claim 8 of the '988 Patent.

125. As a threshold matter, a POSITA would have been motivated to further combine Lundberg with Konno, and would have had a reasonable expectation of success in making the combination. Both references are directed to optical systems that project light from an image-generating device onto a screen by way of groups of lenses. *See, e.g.*, EX1005, abstract; EX1006, abstract. Konno is directed to “an image projector for projecting a tri-color composite optical image on a screen as a magnified optical image.” EX1005, abstract. Lundberg is directed to “a still projector provided with a compensation device acting in vertical direction compensating for the so-called Keystone-effect.” EX1006, 9-12. Accordingly, the references are in the same field of endeavor and POSITAs would naturally have looked to all of them in their work of this area. Moreover, a POSITA would have understood that the teachings of Konno would have been compatible and operable in combination with the teachings of Lundberg to enhance Konno.

126. A POSITA would further have recognized that Lundberg specifically describes the benefits of having an adjustable optical axis in the vertical direction. In particular, Lundberg explains that “[w]hen the lens 1 is displaced in parallel to compensate for the Keystone-effect from the normal case shown in FIG. 4 to a position deviating from the normal case, FIG. 5, the lighting means 5-10, coupled to the lens 1, automatically will turn so that the ray path always is centered on the exit pupil of the lens 1, located in the rear nodal plane 12.” EX1006, 4:25-63. To a

POSITA, this would have been a matter of common sense to have some compensating devices to the Keystone-effect in a projector that is not perpendicularly aligned with the screen. A POSITA would thus have been motivated to take advantage of these benefits by combining Lundberg's disclosures with those of Konno. Particularly, it would have been obvious to a POSITA to recognize that, offsetting the lens relative to the centerline of the image would compensate for trapezoidal distortion (Keystone-effect). *See* EX1014, Section 7.6.4 at 146-150. I will now move on to discuss how these prior art references apply to claim 8 of the '988 Patent on an element-by-element basis.

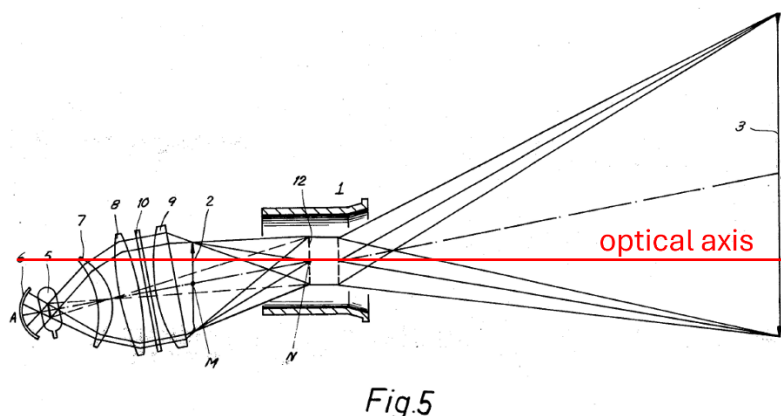
1. Dependent Claim 8

[8.0/8.1] The projection image display apparatus according to claim 7, wherein an optical-axis center of said projection optical unit is made eccentric with respect to a center of the screen.

127. Lundberg discloses a projection image display apparatus wherein an optical-axis of said projection optical unit is made eccentric with respect to a center of the screen.

128. Particularly, Lundberg disclose that "[t]he angular deviation γ , FIG. 3, amounts in practice usually to about 10° but may, in exceptional cases, be about 15° . In order not to unnecessarily render the still projector expensive and increase its dimensions, the compensation possibilities should preferably be limited to an angle about $\pm 15^\circ$ from the normal situation. The increases in cost and dimensions are then moderate." EX1006, 4:18-24. Further, Lundberg discloses "[w]hen the lens 1 is

displaced in parallel to compensate for the Keystone-effect from the normal case shown in FIG. 4 to a position deviating from the normal case, FIG. 5, the lighting means 5-10, coupled to the lens 1, automatically will turn so that the ray path always is centered on the exit pupil of the lens 1, located in the rear nodal plane 12.” EX1006, 4:25-63. A POSITA would have understood that the optical-axis center of the projection lens is made eccentric with respect to the center of the screen as shown below in the annotated Figure 5 of Lundberg.



129. Thus, Konno, in view of Lundberg, discloses or renders obvious each limitation of claim 8.

C. Sato in View of Dorval and Takamoto Renders Claims 1 and 7 Obvious

130. In my opinion and for the reasons explained below, Sato, in view of Dorval and Takamoto, renders obvious the subject matter recited by claims 1 and 7 of the '988 Patent.

131. As a threshold matter, A POSITA would have been motivated to

combine the teachings of Sato with the teachings of Dorval and Takamoto and would have had a reasonable expectation of success in making the combination.

132. All three of these references are directed to optical systems that enlargedly project an image onto a screen by way of groups of lenses. *See, e.g.*, EX1007, abstract; EX1008, abstract, [0008]; EX1009, abstract. Sato is directed to “[a] projecting apparatus having a first projecting system for projecting an object to be projected to form an intermediate image, and a second projecting system for projecting the intermediate image formed by the first projecting system onto a screen” where the image projected by the second projecting system is an enlarged image. EX1007, abstract. Dorval is directed to “systems and methods for producing three-dimensional volume-filling imagery. A volumetric display system produces a volume image by projecting a series of two-dimensional images onto a rapidly rotating projection screen.” where “the projection optic receives a light beam from the optical relay and projects the light beam onto the projection screen” EX1008, [0008], abstract. Takamoto is directed to “[a] variable magnification optical system for projecting images from a small-sized, high-resolution display device” where the system includes a first lens unit and a fourth lens unit both have positive optical power for forming an enlarged image on to a screen. EX1009, abstract, 1:7-12. Accordingly, the references are in the same field of endeavor and POSITAs would naturally have looked to all of them in their work of this area. Moreover, a POSITA

would have understood that the teachings of Sato would have been compatible and operable in combination with the teachings of Dorval and Takamoto to enhance Sato.

133. A POSITA would further have recognized that a volumetric display system as disclosed in Dorval would provide solutions for projecting an image onto a screen in an enlarged fashion. In particular, Dorval explains that “[t]he projection system is designed to be highly compact so as to fit within a very limited space within casing 140 and dome 195, while at the same time providing the desired image magnification (i.e., about 20×) and resolution.” EX1008, [0037]. A POSITA would thus have been motivated to take advantage of these solutions by combining Dorval’s disclosures with those of Sato to produce a compact projection system. A POSITA would have known that compact optical systems are preferred and are highly desirable.

134. Additionally, a POSITA would have recognized that Takamoto describes the benefit of having an aperture stop in the first projection optical unit. Takamoto explains that “[i]t is preferable, as in the first to fourth embodiments, to dispose an aperture stop A within the front lens unit Gr4F of the fourth lens unit Gr4 and substantially at the position of the front focal point of the rear lens unit Gr4R of the fourth lens unit Gr4.” EX1009, 9:11-33. Further “[i]n addition, since the front lens unit Gr4F, in which the aperture stop A is disposed, of the fourth lens unit Gr4 is kept in a fixed position during magnification adjustment, it is possible to keep the

reduction-side f-number constant during magnification adjustment.” *Id.* To a POSITA, the benefit of having an aperture stop in the first projection optical unit would have provided the first projection optical unit the ability to define the F-value of the entire system. Thus, a POSITA would have been motivated to take advantage of these benefits by combining Takamoto’s disclosure with those of Sato. Further, it would have been obvious to a POSITA to have an aperture stop in the first projection optical unit in order to control the illumination. Projection lens systems necessitate an aperture stop, as illustrated by Takamoto.

135. Ultimately, a POSITA would have been motivated to combine the teachings of Sato with those of Dorval and Takamoto, and would have recognized that combining these teachings would have produced predictable and operable results. I will now move on to discuss how these prior art references apply to claims 1 and 7 of the ’988 Patent on an element-by-element basis.

1. Independent Claim 1

[1.0] A projection optical unit for enlarged projection of an image displayed by an image display element, comprising;

136. Sato discloses a projection optical unit for enlarged projection of an image displayed by an image display element. Sato’s FIG. 1 is annotated below:

optical unit for forming a first image. Sato discloses “a first optical system which projects an indication image A₀ of an indicator 13 (object to be projected), such as a liquid crystal display panel or the like through an auxiliary projecting lens 17 to form a first projection image (intermediate projection image) A₁.” EX1007, 6:46-58.

139. The first projection optical unit corresponds to the “auxiliary projecting lens 17” shown in Sato’s Fig. 1 above. Sato inherently discloses said first projection optical unit having positive refractive power. Sato discloses “[t]he auxiliary projecting lens 17 which is made of a convex lens provided between the liquid crystal display panel 13 and the projecting lens 14.” EX1007, 9:14-18. A POSITA would have recognized that a convex lens has positive refractive power. Particularly, a POSITA would have known that positive refractive power is one of the properties of a convex lens because a convex lens causes parallel incident light rays to converge at a real focal point on the opposite side of the lens, resulting in a positive focal length. Given the standard optical relationship $P = 1/f$, where P is the refractive power in diopters and f is the focal length, a positive focal length directly corresponds to a positive refractive power.

140. Sato further discloses “[i]n case of a rectangular indication image A₀, as shown in FIG. 2a, the first projection image A₁ is distorted into a trapezoidal shape, as shown in FIG. 2b.” EX1007, 8:47-50. “The screen projection image A₁ shown in FIG. 2c *has magnifications slightly different from each other in the X and Y*

directions, with respect to the indication image A₀. Namely, the image is slightly extended in the longitudinal direction (Y direction)”. EX1007, 8:55-59.

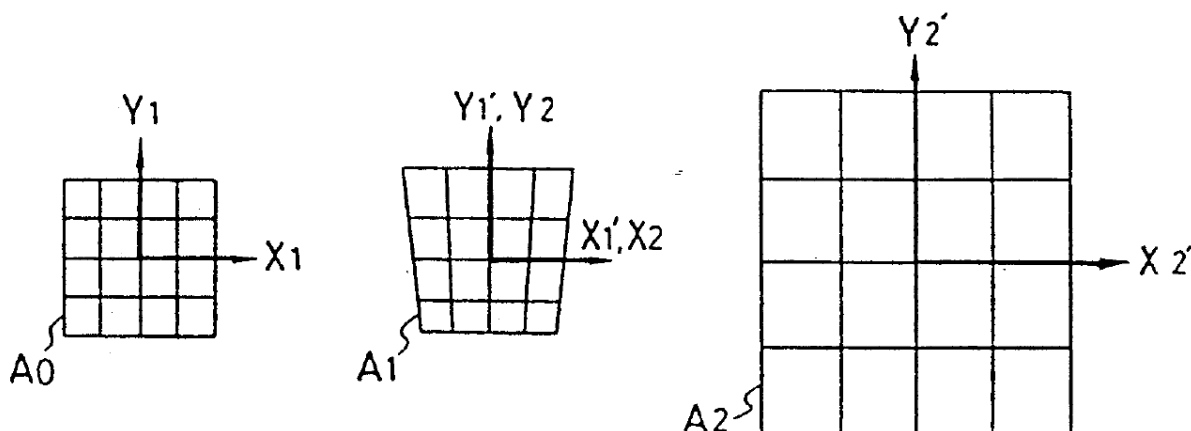


FIG. 2a FIG. 2b FIG. 2c

141. While Sato discloses the first projection optical unit forms a first image having magnifications slightly different from each other in the X and Y directions, with respect to the indication image A₀, Sato does not expressly disclose the extent of magnification of A₁. However, Dorval discloses such first image is an enlarged image.

142. Alternatively, Dorval discloses “[t]he intermediate image, having 3.8× magnification is formed between two field lenses, 240 and 250,” EX1008, [0039].

143. By referring to Dorval, as discussed in detail above, a POSITA would therefore have had a motivation to combine Dorval with Sato to obtain the first enlarged image and the first enlarged image is then further be magnified to obtain the second enlarged image so as to achieve the benefits of compactness. See ¶133,

supra.

[1.2] a second projection optical unit positioned at an enlarged image side of said first projection optical unit in order to form a second enlarged image by further enlarging the first enlarged image obtained by said first projection optical unit, said second projection optical unit having positive refractive power;

144. Sato discloses that its projection optical unit includes a second projection optical unit positioned at an enlarged image side of said first projection optical unit in order to form a second enlarged image by further enlarging the first enlarged image obtained by said first projection optical unit, said second projection optical unit having positive refractive power.

145. Sato discloses that “[a] projector shown in FIG. 1, which shows an optical principle thereof according to the present invention, has a first optical system which projects an indication image Ao of an indicator 13 (object to be projected), such as a liquid crystal display panel or the like through an auxiliary projecting lens 17 to form a first projection image (intermediate projection image) A1, and **a second optical system which projects the first image A1 onto a projection plane**, such as a projection screen 12 from an inclined direction **through a projecting lens 14 to form a screen projection image A2.**” EX1007, 6:46-58 (emphasis added). Further, Sato discloses that the screen projection image A2 is an enlarged image “**an enlarged screen projection image A2** which has an identical magnification in the X and Y directions and which is analogous to the indication image Ao of the indicator 13 can

be formed,” EX1007, 8:59-64 (emphasis added). The second projection optical unit corresponds to “projecting lens 14” shown in Fig. 1 of Sato above. As can be seen from Figs. 2(b) and Fig. 2(c) of Sato, a POSITA would have understood that the projection lens 14 further magnifies the image cast by the auxiliary projecting lens 17, and then cast a further enlarged image on the screen.

146. Because the shape of the projecting lens 14 is the same as the auxiliary projecting lens 17 as discussed above, a POSITA would have understood that the projection lens 14 is a convex lens and have positive refractive power. *See* ¶139 above, *supra*. Further, a POSITA would have known that to cast on the screen a real image from the intermediate real image A1, projection lens 14 must have positive refractive power, and that image would have been further enlarged to accomplish the function of the projector of casting a large image.

[1.3] wherein the first enlarged image is formed at the image display element side, rather than at said second projection optical unit,

147. Sato discloses that the first enlarged image is formed at the image display element side, rather than at said second projection optical unit.

148. Sato discloses that “it is possible to provide a first image forming plane (intermediate image forming plane) which forms a real image between the auxiliary projecting lens 17 and the projecting lens 14”. EX1007; 10:42-52. As the term “the image display element side” discussed in Section IV Claim Construction, Sato’s Fig. 1 above also shows that the intermediate image A1 is formed after the indicator 13

(corresponding to the image display element in the '988 Patent) and before the projecting lens 14 (corresponding to the second projection optical unit in the '988 Patent). In addition and as discussed above, this is consistent with the '988 specification.

[1.4] a magnification M1 of the first enlarged image is smaller than a magnification M2 of the second enlarged image, and

149. Sato discloses or combines with Dorval to disclose that a magnification M1 of the first enlarged image is smaller than a magnification M2 of the second enlarged image.

150. Sato discloses or combines with Dorval to disclose forming a first enlarged image, *see*, Section IX.C.1, Element 1.1, *supra*. Sato discloses forming a second enlarged image, *see*, Section IX.C.1, Element 1.2, *supra*. A POSITA would have understood from Figs. 2(a)-2(c) of Sato that a magnification M1 of the first enlarged image is smaller than a magnification M2 of the second enlarged image.

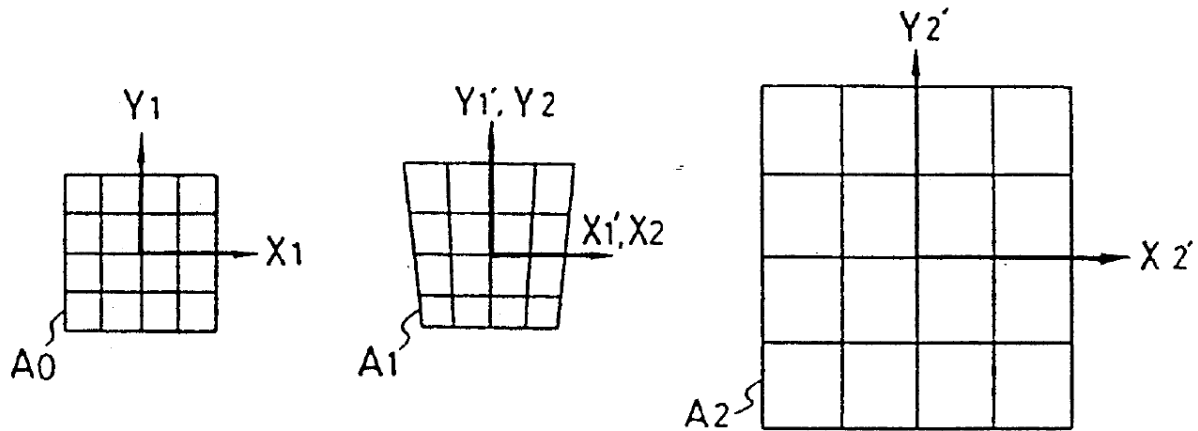


FIG. 2a FIG. 2b FIG. 2c

151. Alternatively, Dorval discloses “[t]he intermediate image, having $3.8\times$ magnification is formed between two field lenses, 240 and 250,” EX1008, [0039]. Further Dorval discloses “[t]he projection system is designed to be highly compact so as to fit within a very limited space within casing 140 and dome 195, while at the same time providing the desired image magnification (i.e., about $20\times$) and resolution.” *Id.*, [0037]. The magnification M1 corresponds to $3.8\times$ magnification of Dorval and the magnification M2 corresponds to about $5.3\times$ (i.e. $20\times/3.8\times$) magnification of Dorval.

152. By referring to Dorval, as discussed in detail above, a POSITA would therefore have had a motivation to combine Dorval with Sato to obtain the first enlarged image and the first enlarged image is then further magnified to cast the second enlarged image so as to achieve the benefits of compactness. *See* ¶133, *supra*. In addition, since Sato does not provide values for the magnification of the first

projection lens, i.e. M1, a POSITA in practicing Sato, would have had the need to know workable values for M1 and would have looked for references to provide a guideline into typical values for M1 and M2; that POSITA would have at least considered Dorval.

[1.5] said first projection optical unit includes an aperture stop that defines an F-value of said entire projection optical unit.

153. Takamoto discloses that the said first projection optical unit includes an aperture stop that defines an F-value of said entire projection optical unit.

154. Takamoto generally states that “[i]t is preferable, as in the first to fourth embodiments, to dispose an aperture stop A within the front lens unit Gr4F of the fourth lens unit Gr4 and substantially at the position of the front focal point of the rear lens unit Gr4R of the fourth lens unit Gr4.” EX1009, 9:11-33. Takamoto further discloses “[s]uch arrangement of an aperture stop A makes it possible to realize an optical system that is telecentric toward the reduction side.” *Id.* And “[i]n addition, since the front lens unit Gr4F, in which the aperture stop A is disposed, of the fourth lens unit Gr4 is kept in a fixed position during magnification adjustment, it is possible to keep the reduction-side f-number constant during magnification adjustment.” *Id.*

155. Further, it would have been obvious for a POSITA to place an aperture stop at the auxiliary projection lens 17 to control the amount of light, and therefore to control the f-value of the entire projection optical unit. A POSITA would have known that projection optics require of an aperture stop and would have at least

considered placing the aperture stop at the first projection unit, which in turns would have defined the f-number of the entire projection unit.

156. By referring to Takamoto, as discussed in detail above, a POSITA would therefore have had a motivation to combine Takamoto with Sato to obtain the first enlarged image and the first enlarged image is then further be magnified to obtain the second enlarged image so as to achieve the benefits of compactness. *See* ¶134, *supra*.

2. Independent Claim 7

[7.0] A projection image display apparatus, comprising;

157. Sato discloses a projection image display apparatus. Sato's FIG. 1 is annotated below:

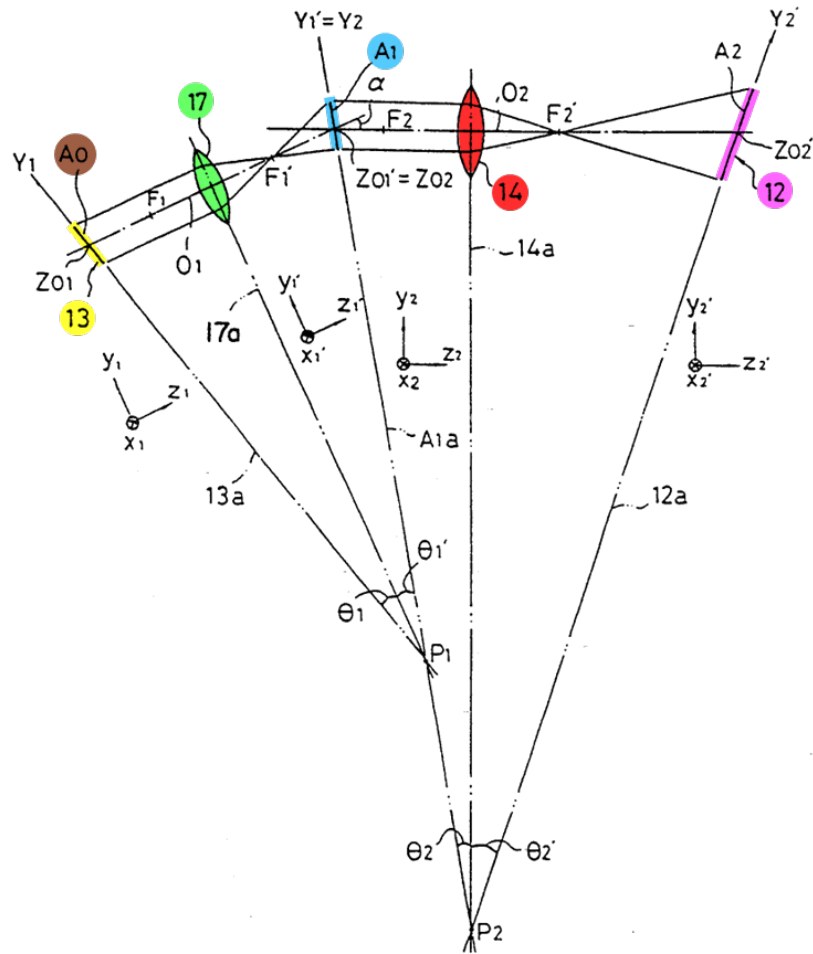


Fig. 1

158. Sato discloses that “[t]he present invention relates to a projector and more precisely it relates to an apparatus for enlarging and projecting an image of an object, such as liquid crystal panel, Braun tube, original picture film, or a testpiece.” EX1007, 1:12-15.

[7.1] an image display element; and

159. Sato discloses that its projection image display apparatus includes an image display element.

160. Sato discloses “[a] projector shown in FIG. 1, which shows an optical principle thereof according to the present invention, has a first optical system which projects an indication image Ao of *an indicator 13 (object to be projected), such as a liquid crystal display panel* or the like through an auxiliary projecting lens 17 to form a first projection image (intermediate projection image) A1,” EX1007, 6:46-58 (emphasis added). A POSITA would have recognized that a liquid crystal display panel as disclosed by Sato is an image display element.

[7.2] a projection optical unit for projecting, in an enlarged form and onto a projection screen, an image displayed by said image display element,

161. This element is disclosed by Sato, as analyzed for claim 1 in Section XI.C.1, *supra*.

[7.3] wherein said projection optical unit includes a first projection optical unit and a second projection optical unit, both arranged on an optical path ranging from said image display element to the screen,

162. This element is disclosed by Sato, as analyzed for claim 1 in Section IX.C.1, *supra*.

[7.4] said first projection optical unit being adapted to form a first enlarged image and having positive refractive power, and

163. This element is disclosed by Sato or by combining Sato and Dorval, as analyzed for claim 1 in Section IX.C.1, *supra*.

[7.5] said second projection optical unit being positioned at an enlarged image side of said first projection optical unit, being adapted to form a second enlarged image by further enlarging the first enlarged image obtained by said first projection optical unit, and having positive refractive power;

164. This element is disclosed by Sato, as analyzed for claim 1 in Section IX.C.1, *supra*.

[7.6] wherein the first enlarged image is formed at the image display element side, rather than at said second projection optical unit,

165. This element is disclosed by Sato, as analyzed for claim 1 in Section IX.C.1, *supra*.

[7.7] a magnification M1 of the first enlarged image is smaller than a magnification M2 of the second enlarged image, and

166. This element is disclosed by Sato or by combining Sato and Dorval, as analyzed for claim 1 in Section IX.C.1, *supra*.

[7.8] said first projection optical unit includes an aperture stop that defines an F-value of said entire projection optical unit.

167. This element is disclosed by combining Sato and Takamoto, as analyzed for claim 1 in Section IX.C.1, *supra*.

168. Thus, Sato, in view of Dorval and Takamoto, discloses or renders obvious each limitation of claims 1 and 7.

D. Sato in View of Dorval, Takamoto, and Takeuchi Renders Claim 8 Obvious

169. In my opinion and for the reasons explained below, Sato, in view of Dorval, Takamoto, and Takeuchi, renders obvious the subject matter recited by claim 8 of

the '988 Patent.

170. As a threshold matter, a POSITA would have been motivated to further combine Takeuchi with the combined system of Sato, Dorval, Takamoto, and would have had a reasonable expectation of success in making the combination.

171. All references are in the same field of endeavor and POSITAs would naturally have looked to them in their work. As Takeuchi explains, there are significant benefits to make the optical axis center of the projection optical unit eccentric with respect to a center of the screen. *See* EX1010, [0028]. For example, Takeuchi discloses that by having a center of the focused image that is different in position from the optical axis, and by having the optical axis of the light beam slanted to the screen, the distance between the screen and the optical axis can be reduced, and in turn, realize a compact design of the projection system. A POSITA would thus have been motivated to combine Takeuchi's teachings with those of Sato, Dorval, Takamoto. I will now move on and discuss how these prior art references apply to claim 8 of the '988 Patent on an element-by-element basis.

1. Dependent Claim 8

[8.0/8.1] The projection image display apparatus according to claim 7, wherein an optical-axis center of said projection optical unit is made eccentric with respect to a center of the screen.

172. Takeuchi discloses a projection image display apparatus wherein an optical-axis of said projection optical unit is made eccentric with respect to a center of the screen. For example, Takeuchi disclose this limitation by stating that "the

present projection method is featured by that a center of the focused image is different in position from the optical axis of the focusing optical system.” EX1010, [0028], i.e. the optical-axis center of said projection optical unit is made eccentric with respect to a center of the screen.

173. Thus, Sato, in view of Dorval, Takamoto, and Takeuchi, discloses or renders obvious each limitation of claim 8.

E. Ninomiya in View of Dorval Renders Claims 1 and 7 Obvious

174. In my opinion and for the reasons explained below, Ninomiya, in view of Dorval, renders obvious the subject matter recited by claims 1 and 7 of the '988 Patent.

175. As a threshold matter, a POSITA would have been motivated to combine the teachings of Ninomiya with the teachings of Dorval, and would have had a reasonable expectation of success in making the combination. Both references are directed to optical systems that enlargedly project an image onto a screen by way of groups of lenses. *See, e.g.*, EX1011, abstract, 14:31-34; EX1008, abstract, [0008]. Ninomiya is directed to “[t]he present invention relates to a projection type displaying apparatus for displaying video images, computer images, and so forth, in particular, relates to a projection type displaying apparatus for obliquely projecting these images from the rear of a screen with a liquid crystal light bulb or the like.” EX1011, 1:6-11. And “when an image formed by a liquid crystal or the like is

projected by using the above-mentioned lighting unit, an enlarged projection image with an even brightness can be obtained.” *Id.*, 14:31-34. Dorval is directed to “systems and methods for producing three-dimensional volume-filling imagery. A volumetric display system produces a volume image by projecting a series of two-dimensional images onto a rapidly rotating projection screen.” where “the projection optic receives a light beam from the optical relay and projects the light beam onto the projection screen” EX1008, [0008], abstract. Moreover, a POSITA would have understood that the teachings of Ninomiya would have been compatible and operable in combination with the teachings of Dorval to enhance Ninomiya.

176. A POSITA would further have recognized that a volumetric display system as disclosed in Dorval would provide solutions for projecting an image onto a screen in an enlarged fashion. In particular, Dorval explains that “[t]he projection system is designed to be highly compact so as to fit within a very limited space within casing 140 and dome 195, while at the same time providing the desired image magnification (i.e., about 20×) and resolution.” EX1008, [0037]. A POSITA would thus have been motivated to take advantage of these solutions by combining Dorval’s disclosures with those of Ninomiya to produce a compact projection system. Thus, a POSITA would have been motivated to take advantage of these benefits by combining Dorval’s disclosure with those of Ninomiya.

177. Ultimately, a POSITA would have been motivated to combine the

teachings of Ninomiya with Dorval, and would have recognized that combining these teachings would have produced predictable and operable results. I will now move on and discuss how these prior art references apply to claims 1 and 7 of the '988 Patent on an element-by-element basis.

1. Independent Claim 1

[1.0] A projection optical unit for enlarged projection of an image displayed by an image display element, comprising;

178. Ninomiya discloses a projection optical unit for enlarged projection of an image displayed by an image display element. Ninomiya's FIG. 22 is annotated below:

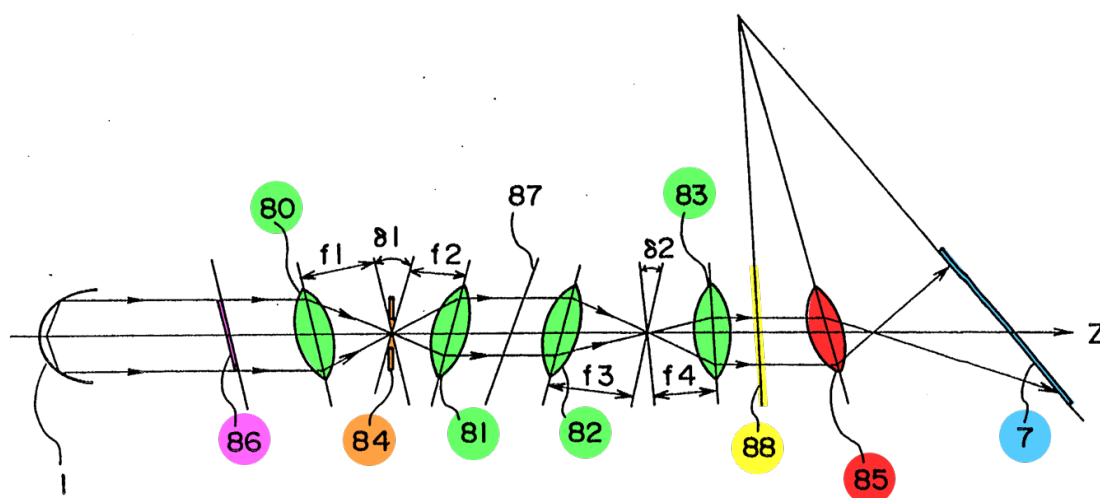


FIG. 22

179. Ninomiya teaches “a projection type displaying apparatus for displaying video images, computer images, and so forth, in particular, relates to a projection type displaying apparatus for obliquely projecting these images from the rear of a

screen with a liquid crystal light bulb or the like.” EX1011, 1:6-12. Further, Ninomiya states “when *an image formed by a liquid crystal* or the like is projected by using the above-mentioned lighting unit, *an enlarged projection image* with an even brightness can be obtained.” *Id.*, 14:31-34 (emphasis added). A POSITA would have recognized that the liquid crystal panel disclosed by Ninomiya is an image display element.

[1.1] a first projection optical unit for forming a first enlarged image, said first projection optical unit having positive refractive power; and

180. Ninomiya discloses that its projection optical unit includes a first projection optical unit for forming a first image.

181. Ninomiya discloses “[t]he first lens 80 of the first projection optical system and the second lens 81 thereof are inclined by an angle $\delta 1$ to each other. ... in addition, the third lens 82 of the first projection optical system and the fourth lens 83 thereof are inclined by an angle $\delta 2$ each other.” EX1011, 10:62-11:5. Further, Ninomiya discloses “[a]n image on the light bulb 86 passes through the first lens 80 of the first projection optical system, the second lens 81 thereof, and the aperture stop mechanism with the shape as shown in FIG. 23 (A). Thus, an image with a trapezoidal distortion is formed on the first intermediate image plane 87. Thereafter, the first intermediate image passes through the third lens 82 of the first projection optical system and the fourth lens 83 thereof. Thus, a second intermediate image with a trapezoidal distortion is formed on the second intermediate image plane 88.”

EX1011,11:17-27.

182. A POSITA would have understood that the first projection optical unit corresponds to the “first projection optical system” as disclosed in Ninomiya which includes “a first lens 80, a second lens 81, a third lens 82, and a fourth lens 83” and shown in Ninomiya’s Fig. 22 above. As such, the first image is disclosed by Ninomiya as the second intermediate image formed on the second intermediate image plane 88.

183. Ninomiya inherently discloses said first projection optical unit having positive refractive power. A POSITA would have recognized that, the arrangement of the lenses disclosed by Ninomiya as shown in Ninomiya’s Fig. 22 is similar to the arrangement of the lenses disclosed by Asakura’s Fig. 8. *See*, EX1015, Fig. 8. Asakura was filed as Japanese Application No. 1991-283255 on October 29, 1991, and published as Japanese Publication No. 1993-119283 on May 18, 1993. Asakura and Ninomiya are in the same field of endeavor, as such, POSITAs would naturally have looked to all of them in their work of this area. Asakura discloses “[t]his invention, in order to achieve aforementioned objective, should be constituted of ***five lens groups with positive refractory power***”. *Id*, [0008]. Therefore, a POSITA would have recognized that, the lens groups disclosed by Ninomiya would have positive refractive power in a similar manner as disclosed by Asakura.

184. As would also have been recognized by a POSITA, Ninomiya’s Fig. 22

shows that each of the first to fourth lens are convex lenses, and a POSITA would have recognized that a convex lens has positive refractive power.

185. Further a POSITA would have understood the lenses 80 and 81 form a relay, i.e., a projection lens, that casts a real intermediate image 87, and that lenses 82 and 83 form a second relay that forms a second intermediate image 88. Such a POSITA would have known that both relays, i.e. projection lenses, have positive refractive power to be able to cast real images 87 and 88 as shown in Ninomiya figure 22.

186. While Ninomiya discloses the first projection optical unit forms the first image, Ninomiya does not expressly disclose forming the first enlarged image. However, Dorval discloses such first image is an enlarged image. Dorval discloses “[t]he intermediate image, having $3.8\times$ magnification is formed between two field lenses, 240 and 250,” EX1008, [0039].

187. By referring to Dorval, as discussed in detail above, a POSITA would therefore have had a motivation to combine Dorval with Ninomiya and obtain a first enlarged image and this first enlarged image further be magnified to obtain a second enlarged image so as to achieve the benefits of compactness taught by Dorval. *See* ¶176, *supra*.

[1.2] a second projection optical unit positioned at an enlarged image side of said first projection optical unit in order to form a second enlarged image by further enlarging the first enlarged image obtained by said first projection optical unit, said second projection optical unit having positive refractive power;

188. Ninomiya discloses that its projection optical unit includes a second projection optical unit positioned at an enlarged image side of said first projection optical unit in order to form a second enlarged image by further enlarging the first enlarged image obtained by said first projection optical unit, said second projection optical unit having positive refractive power.

189. Ninomiya discloses that “the second intermediate image passes through the second projection optical system 85. Thus, an image without a trapezoidal distortion is formed on the screen 7.” EX1011, 11:28-31. Further, Ninomiya discloses “when an image formed by a liquid crystal or the like is projected by using the above-mentioned lighting unit, *an enlarged projection image* with an even brightness can be obtained.” EX1011, 14:31-34 (emphasis added). The second projection optical unit corresponds to “the second projection optical system 85” shown in Fig. 22 of Ninomiya above.

190. As shown in Fig. 22, the image formed on the screen 7 is larger than the second intermediate image formed on the second intermediate image plane 88, thus Ninomiya discloses or inherently discloses the feature of forming a second enlarged image by further enlarging the intermediate image. The function of the projector is

to cast a large image on the screen, i.e., a projection screen that is multiple times the size of the intermediate image at the second intermediate image plane 88, and so the second projection unit must have a larger magnification than the first projection unit.

191. As discussed above, Ninomiya inherently discloses said second projection optical unit having positive refractive power. *See* ¶¶183-184, *supra*. As would have also recognized by a POSITA, Ninomiya's Fig. 22 shows that the fifth lens (the second projection optical system 85) is a convex lens, and a POSITA would have recognized that a convex lens has positive refractive power because it cast a enlarged real image on the screen from the intermediate image at the second intermediate image plane 88.

[1.3] wherein the first enlarged image is formed at the image display element side, rather than at said second projection optical unit,

192. Ninomiya discloses that the first enlarged image is formed at the image display element side, rather than at said second projection optical unit.

193. Ninomiya discloses “[t]he light bulb 2 has a construction where grid shaped electrodes are disposed on a liquid crystal so as to control the transmittance of each picture element.” EX1011, 10:57-59.¹ A POSITA would have recognized that a light bulb having grid shaped electrodes disposed on a liquid crystal as disclosed by Ninomiya is an image display element.

¹ A typographical error appears in Ninomiya where “light bulb 2” should read as light bulb 86” as shown in Fig. 22.

194. Ninomiya discloses that “second intermediate image with a trapezoidal distortion is formed on the second intermediate image plane 88. Next, the second intermediate image passes through the second projection optical system 85.” EX1011; 11:25-29. As the term “the image display element side” discussed in Section IV Claim Construction, Ninomiya’s Fig. 22 above also shows that the second intermediate image plane where the second intermediate image (corresponding to the first image in the ’988 Patent) is formed after the light valve, i.e. an LCD, 86 (corresponding to the image display element in the ’988 Patent) and before the second projection optical system (corresponding to the second projection optical unit in the ’988 Patent) as discussed for previous grounds, this is consistent with the ’988 specification.

[1.4] a magnification M1 of the first enlarged image is smaller than a magnification M2 of the second enlarged image, and

195. Ninomiya combines with Dorval disclose that a magnification M1 of the first enlarged image is smaller than a magnification M2 of the second enlarged image.

196. Ninomiya combines with Dorval disclose forming a first enlarged image, *see*, Section IX.E.1, Element 1.1, *supra*. Ninomiya discloses forming a second enlarged image, *see*, Section IX.E.1, Element 1.2, *supra*. While Ninomiya does not expressly disclose a magnification M1 of the first enlarged image is smaller than a magnification M2 of the second enlarged image, Dorval discloses “[t]he intermediate

image, having $3.8\times$ magnification is formed between two field lenses, 240 and 250,” EX1008, [0039]. Further Dorval discloses “[t]he projection system is designed to be highly compact so as to fit within a very limited space within casing 140 and dome 195, while at the same time providing the desired image magnification (i.e., about $20\times$) and resolution.” *Id.*, [0037]. The magnification M1 corresponds to $3.8\times$ magnification of Dorval and the magnification M2 corresponds to about $5.3\times$ (i.e. $20\times/3.8\times$) magnification of Dorval, where M2 is greater than M1. In addition, since Ninomiya does not provide values for the magnification of the first projection lens, i.e. M1, a POSITA in practicing Ninomiya, would have had the need to know workable values for M1 and would have looked for references to provide a guideline into typical values for M1; that POSITA would have at least considered Dorval. Further, to perform the intended function the projector must cast an enlarged image at the large screen, i.e. Figs. 12 and 45, that is multiple times the size of the intermediate image at 88, and so the second projection unit must have a larger magnification than the first projection unit.

[1.5] said first projection optical unit includes an aperture stop that defines an F-value of said entire projection optical unit.

197. Ninomiya discloses that the said first projection optical unit includes an aperture stop that defines an F-value of said entire projection optical unit.

198. Ninomiya’s Fig. 22 above shows an aperture stop mechanism 84. Ninomiya discloses “[t]he aperture stop mechanism is disposed at the position where

the focal plane of the first lens 80 and the focal plane of the second lens 81 are intersected on the axis Z.” EX1011, 10:68-11:3. Further, Ninomiya discloses “[l]ike the above-mentioned embodiments, the aperture stop mechanism stops vertical rays of light with a low resolution which are radiated from the light source 1 shown in FIG. 22.” *Id.*, 11:36-39.

199. As discussed in detail above, A POSITA would have recognized that the aperture stop mechanism of Ninomiya having a diameter of an opening defines the F-value of said entire projection optical unit as the aperture stop mechanism affects the amount of lights passing through. *See* ¶108, *supra*.

2. Independent Claim 7

[7.0] A projection image display apparatus, comprising;

200. Ninomiya discloses a projection image display apparatus. Ninomiya’s FIG. 22 is annotated below:

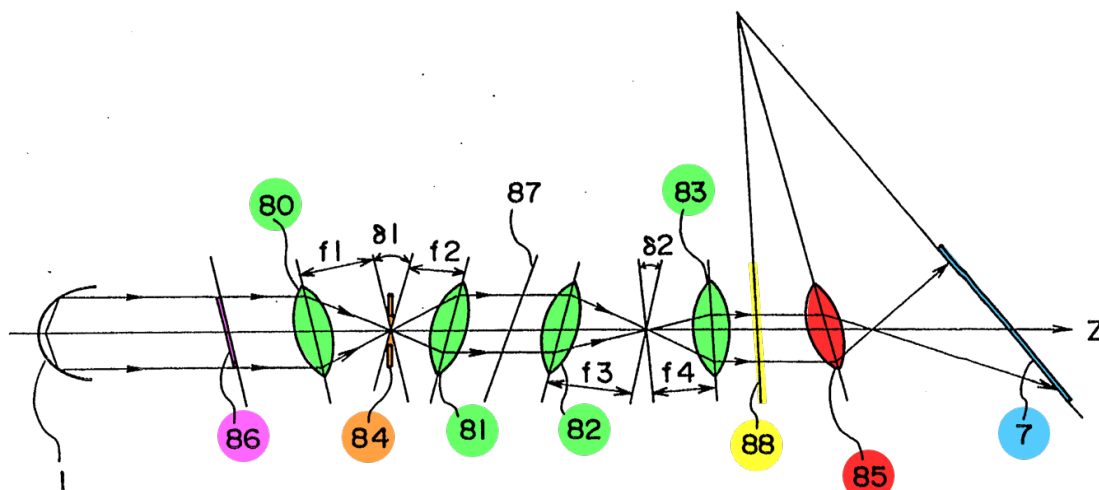


FIG. 22

201. Ninomiya teaches “a projection type displaying apparatus for displaying video images, computer images, and so forth, in particular, relates to a projection type displaying apparatus for obliquely projecting these images from the rear of a screen with a liquid crystal light bulb or the like.” EX1011, 1:6-12.

[7.1] an image display element; and

202. Ninomiya discloses that its projection image display apparatus includes an image display element.

203. Ninomiya discloses “[t]he light bulb 2 has a construction where grid shaped electrodes are disposed on a liquid crystal so as to control the transmittance of each picture element.” EX1011, 10:57-59. A POSITA would have recognized that a light bulb having grid shaped electrodes disposed on a liquid crystal as disclosed by Ninomiya is an image display element.

[7.2] a projection optical unit for projecting, in an enlarged form and onto a projection screen, an image displayed by said image display element,

204. This element is disclosed by Ninomiya, as analyzed for claim 1 in Section IX.E.1, *supra*.

[7.3] wherein said projection optical unit includes a first projection optical unit and a second projection optical unit, both arranged on an optical path ranging from said image display element to the screen,

205. This element is disclosed by Ninomiya, as analyzed for claim 1 in Section IX.E.1, *supra*.

[7.4] said first projection optical unit being adapted to form a first enlarged image and having positive refractive power, and

206. This element is disclosed by combining Ninomiya and Dorval, as analyzed for claim 1 in Section IX.E.1, *supra*.

[7.5] said second projection optical unit being positioned at an enlarged image side of said first projection optical unit, being adapted to form a second enlarged image by further enlarging the first enlarged image obtained by said first projection optical unit, and having positive refractive power;

207. This element is disclosed by Ninomiya, as analyzed for claim 1 in Section IX.E.1, *supra*.

[7.6] wherein the first enlarged image is formed at the image display element side, rather than at said second projection optical unit,

208. This element is disclosed by Ninomiya, as analyzed for claim 1 in Section IX.E.1, *supra*.

[7.7] a magnification M1 of the first enlarged image is smaller than a magnification M2 of the second enlarged image, and

209. This element is disclosed by combining Ninomiya and Dorval, as analyzed for claim 1 in Section IX.E.1, *supra*.

[7.8] said first projection optical unit includes an aperture stop that defines an F-value of said entire projection optical unit.

210. This element is disclosed by Ninomiya, as analyzed for claim 1 in Section IX.E.1, *supra*.

211. Thus, Ninomiya, in view of Dorval discloses or renders obvious each limitation of claims 1 and 7.

F. Ninomiya in View of Dorval and Takeuchi Renders Claim 8 Obvious

212. In my opinion and for the reasons explained below, Ninomiya, in view of Dorval and Takeuchi, renders obvious the subject matter recited by claim 8 of the '988 Patent.

213. As a threshold matter, a POSITA would have been motivated to further combine Takeuchi with the combined system of Ninomiya and Dorval, and would have had a reasonable expectation of success in making the combination. All references are in the same field of endeavor and POSITAs would naturally have looked to them in their work. As Takeuchi explains, there are significant benefits to make the optical axis center of the projection optical unit eccentric with respect to a center of the screen. *See* EX1010, [0028]. For example, Takeuchi discloses that by having a center of the focused image that is different in position from the optical

axis, and by having the optical axis of the light beam slanted to the screen, the distance between the screen and the optical axis can be reduced, and in turn, realize a compact design of the projection system. A POSITA would thus have been motivated to combine Takeuchi's teachings with those of Ninomiya and Dorval. I will now move on and discuss how these prior art references apply to claim 2 of the '988 Patent on an element-by-element basis.

1. Dependent Claim 8

[8.0/8.1] The projection image display apparatus according to claim 7, wherein an optical-axis center of said projection optical unit is made eccentric with respect to a center of the screen.

214. This element is disclosed by Takeuchi, as analyzed for claim 8 in Section IX.D.1, *supra*.

215. Thus, Ninomiya, in view of Dorval, and Takeuchi, discloses or renders obvious each limitation of claim 8.

G. Kurematsu in View of Dorval and Takamoto Renders Claims 1, 7, and 8 Obvious

216. In my opinion and for the reasons explained below, Kurematsu in View of Dorval and Takamoto, renders obvious the subject matter recited by claims 1, 7, and 8 of the '988 Patent.

217. As a threshold matter, a POSITA would have been motivated to combine the teachings of Kurematsu with the teachings of Dorval and Takamoto, and would have had a reasonable expectation of success in making the combination. All three

of these references are directed to optical systems that enlargedly project an image onto a screen by way of groups of lenses. *See, e.g.*, EX1012, abstract, 4:9-11; EX1008, abstract, [0008]; EX1009, abstract. Kurematsu is directed to “a projection type display apparatus for obliquely projecting an original image onto a screen includes a first projection optical system for projecting light from an original picture and forming an intermediate image having trapezoid distortion caused therein, a second projection optical system for obliquely projecting the light from the intermediate image onto a surface for projection so as to cause converse trapezoid distortion, and re-imaging it” where the image projected by the second projecting system is an enlarged image. EX1012, abstract, 4:9-11. Dorval is directed to “systems and methods for producing three-dimensional volume-filling imagery. A volumetric display system produces a volume image by projecting a series of two-dimensional images onto a rapidly rotating projection screen.” where “the projection optic receives a light beam from the optical relay and projects the light beam onto the projection screen” EX1008, [0008], abstract. Takamoto is directed to “[a] variable magnification optical system for projecting images from a small-sized, high-resolution display device” where the system includes a first lens unit and a fourth lens unit both have positive optical power for forming an enlarged image on to a screen. EX1009, abstract, 1:7-12. Accordingly, the references are in the same field of endeavor and POSITAs would naturally have looked to all of them in their work

of this area. Moreover, a POSITA would have understood that the teachings of Kurematsu would have been compatible and operable in combination with the teachings of Dorval and Takamoto to enhance Kurematsu.

218. A POSITA would further have recognized that a volumetric display system as disclosed in Dorval would provide solutions for projecting an image onto a screen in an enlarged fashion. In particular, Dorval explains that “[t]he projection system is designed to be highly compact so as to fit within a very limited space within casing 140 and dome 195, while at the same time providing the desired image magnification (i.e., about 20×) and resolution.” EX1008, [0037]. A POSITA would thus have been motivated to take advantage of these solutions by combining Dorval’s disclosures with those of Kurematsu to produce a compact projection system. A POSITA would have known that compact optical systems are preferred and are highly desirable.

219. Additionally, a POSITA would have recognized that Takamoto describes the benefit of having an aperture stop in the first projection optical unit. Takamoto explains that “[i]t is preferable, as in the first to fourth embodiments, to dispose an aperture stop A within the front lens unit Gr4F of the fourth lens unit Gr4 and substantially at the position of the front focal point of the rear lens unit Gr4R of the fourth lens unit Gr4.” EX1009, 9:11-33. Further “[i]n addition, since the front lens unit Gr4F, in which the aperture stop A is disposed, of the fourth lens unit Gr4

is kept in a fixed position during magnification adjustment, it is possible to keep the reduction-side f-number constant during magnification adjustment.” *Id.* To a POSITA, the benefit of having an aperture stop in the first projection optical unit would have provided the first projection optical unit the ability to define the F-value of the entire system. Thus, a POSITA would have known that in a projection system there must be a stop aperture to control the quantity of light and would have been motivated to take advantage of the aforementioned teachings by combining Takamoto’s disclosure with those of Kurematsu. *Id.*

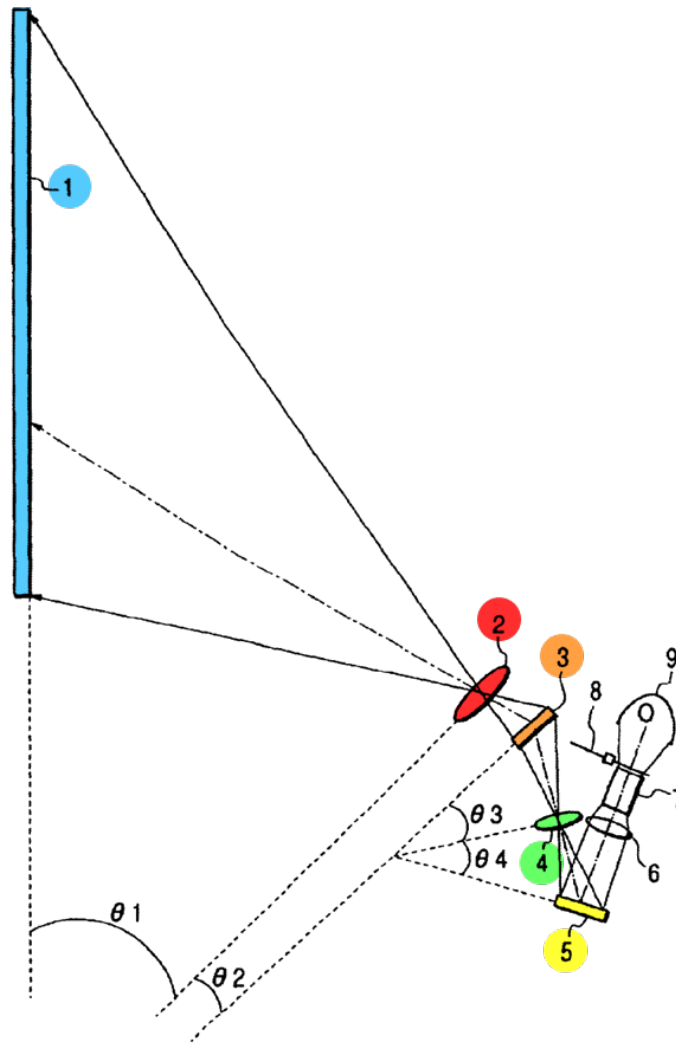
220. Ultimately, a POSITA would have been motivated to combine the teachings of Kurematsu with those of Dorval and Takamoto, and would have recognized that combining these teachings would have produced predictable and operable results. I will now discuss how these prior art references apply to claims 1, 7, and 8 of the ’988 Patent on an element-by-element basis.

1. Independent Claim 1

[1.0] A projection optical unit for enlarged projection of an image displayed by an image display element, comprising;

221. Kurematsu discloses a projection optical unit for enlarged projection of an image displayed by an image display element. Kurematsu’s FIG. 1 is annotated below:

FIG. 1



222. Kurematsu discloses that “[o]nly the display reflected light from the *DMD display device 5* passes through the auxiliary projection lens 4, and by the imaging action of this auxiliary projection lens 4, the intermediate projected image thereof is formed on the transmission type diffracting optical element 3.” EX1012, 3:37-41 (emphasis added). A POSITA would have recognized that the DMD disclosed by Kurematsu is an image display element.

223. Kurematsu teaches “a projection type display apparatus for obliquely

projecting an original image onto a screen includes a first projection optical system for projecting light from an original picture and forming an intermediate image having trapezoid distortion caused therein, a second projection optical system for obliquely projecting the light from the intermediate image onto a surface for projection so as to cause converse trapezoid distortion, and re-imaging it” EX1012, abstract. Further, Kurematsu states “the intermediate image is enlarged and projected onto the screen by the main projection lens 2”. *Id.*, 4:9-11.

[1.1] a first projection optical unit for forming a first enlarged image, said first projection optical unit having positive refractive power; and

224. Kurematsu discloses that its projection optical unit includes a first projection optical unit for forming a first image.

225. Kurematsu discloses “FIG. 1 generally shows a basic optical system for a thin type rear projection display apparatus according to an embodiment of the present invention. In FIG. 1, ... *reference numeral 4 denotes an auxiliary projection lens (a first projection optical system)*”. EX1012, 3:11-24 (emphasis added). Further, Kurematsu discloses “[o]nly the display reflected light from the DMD display device 5 passes through the auxiliary projection lens 4, and by the imaging action of this auxiliary projection lens 4, the intermediate projected image thereof is formed on the transmission type diffracting optical element 3.” EX1012, 3:37-41.

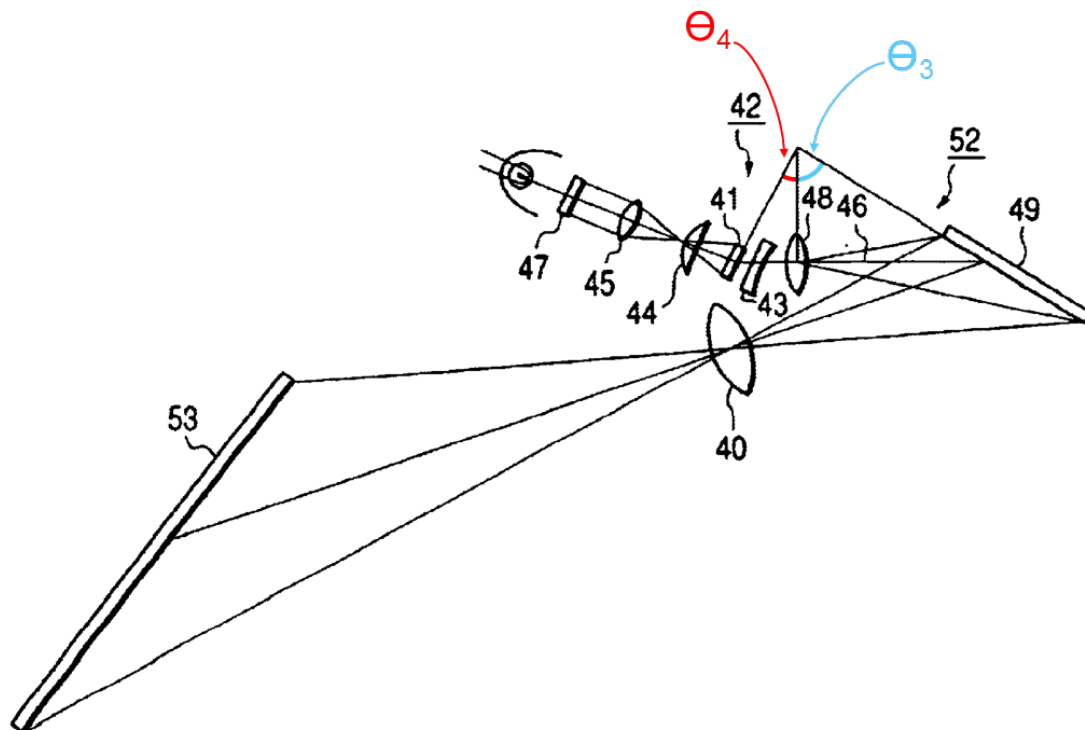
226. The first projection optical unit corresponds to the “first projection

optical system 4” as shown in Kurematsu’s Fig. 1 above. Kurematsu inherently discloses said first projection optical unit having positive refractive power. As discussed in detail above, it would have been recognized by a POSITA, Kurematsu’s Fig. 1 shows that the auxiliary projection lens 4 is a convex lens, and a POSITA would have recognized that a convex lens has positive refractive power. See ¶139 above, *supra*. Alternatively, Kurematsu in view of Takamoto also discloses the auxiliary projection lens 4 as the first projection optical unit having a positive refractive power. Takamoto discloses “[i]n all of the first to fifth embodiments, the variable magnification optical system is constituted as a four-unit zoom lens system consisting of, from the enlargement (projection) side, a first lens unit Gr1 having a positive optical power, ... and that is **a fourth lens unit Gr4 having a positive optical power** and kept in a fixed position during zooming.” EX1009, 4:44-51 (emphasis added). A POSITA would have understood that the auxiliary lens 4 produces a real image at 3, of the image displayed at DMD display device 5, and thus lens 4 must have positive refractive power.

227. Further, Kurematsu discloses a prior art Japanese patent JP2893877 in Fig. 6, annotated below; the corresponding tilt angles θ_3 and θ_4 from Fig. 1 of Kurematsu as applied to Fig. 6, show that θ_3 is larger than θ_4 . A POSITA would have understood that since θ_3 is shown larger than θ_4 , the auxiliary projection lens 4 is enlarging, as verified by the larger reflecting mirror 49 where an intermediate

image is formed on in relation to the smaller display 41 in Fig. 6. Therefore, a POSITA would have understood that Kurematsu discloses a first enlarged image.

FIG. 6 PRIOR ART



228. Alternatively, Kurematsu in view of Dorval also discloses that such first image is an enlarged image. Dorval discloses “[t]he intermediate image, having $3.8\times$ magnification is formed between two field lenses, 240 and 250,” EX1008, [0039].

229. By referring to Dorval, as discussed in detail above, a POSITA would therefore have had a motivation to combine Dorval with Kurematsu to obtain the first enlarged image and the first enlarged image is then further be magnified to obtain the second enlarged image so as to achieve the benefits of compactness. See

¶218, *supra*.

[1.2] a second projection optical unit positioned at an enlarged image side of said first projection optical unit in order to form a second enlarged image by further enlarging the first enlarged image obtained by said first projection optical unit, said second projection optical unit having positive refractive power;

230. Kurematsu discloses or in view of Takamoto discloses that its projection optical unit includes a second projection optical unit positioned at an enlarged image side of said first projection optical unit in order to form a second enlarged image by further enlarging the first enlarged image obtained by said first projection optical unit, said second projection optical unit having positive refractive power.

231. Kurematsu discloses that “FIG. 1 generally shows a basic optical system for a thin type rear projection display apparatus according to an embodiment of the present invention. In FIG. 1, ... *reference numeral 2 denotes a main projection lens (a second projection optical system)*”. EX1012, 3:11-24 (emphasis added). Further, Kurematsu discloses “[t]hat is, the intermediate image is enlarged and projected onto the screen by the main projection lens 2”. EX1012, 4:9-11. The second projection optical unit corresponds to “second projection optical system 2” shown in Fig. 1 of Kurematsu above.

232. Kurematsu inherently discloses said second projection optical unit having positive refractive power. As discussed in detail above, it would have been recognized by a POSITA, Kurematsu’s Fig. 1 shows that the main projection lens 2

is a convex lens, and a POSITA would have recognized that a convex lens has positive refractive power. *See* ¶139, ¶146, *supra*. Further a POSITA would have understood from Fig. 1 and from the working principle of the projector, that the main projection lens 2 has positive refractive power and necessarily has a larger magnifying power than the auxiliary projection lens 4 to achieve the intended function of projecting a large image.

233. In addition, Takamoto can also be combined with Kurematsu to teach the main projection lens 2 as the second projection optical unit having a positive refractive power. Takamoto discloses “[i]n all of the first to fifth embodiments, the variable magnification optical system is constituted as a four-unit zoom lens system consisting of, from the enlargement (projection) side, *a first lens unit Gr1 having a positive optical power*, ... and that is a fourth lens unit Gr4 having a positive optical power and kept in a fixed position during zooming.” EX1009, 4:44-51 (emphasis added).

[1.3] wherein the first enlarged image is formed at the image display element side, rather than at said second projection optical unit,

234. Kurematsu discloses that the first enlarged image is formed at the image display element side, rather than at said second projection optical unit.

235. Kurematsu discloses that “the intermediate projected image thereof is formed on the transmission type diffracting optical element 3.” EX1012; 3:39-41. As the term “the image display element side” discussed in Section IV Claim

Construction, Kurematsu's Fig. 1 above also shows that the transmission type diffracting optical element 3 where the intermediate image (corresponding to the first image in the '988 Patent) is formed is after the DMD display device 5 (corresponding to the image display element in the '988 Patent) and before the second projection optical system (corresponding to the second projection optical unit in the '988 Patent), which is consistent with the specification of the '988 patent.

[1.4] a magnification M1 of the first enlarged image is smaller than a magnification M2 of the second enlarged image, and

236. Kurematsu discloses or in view of Dorval discloses that a magnification M1 of the first enlarged image is smaller than a magnification M2 of the second enlarged image.

237. Kurematsu discloses or in view of with Dorval discloses forming a first enlarged image, *see*, Section IX.G.1, Element 1.1, *supra*. Kurematsu discloses forming a second enlarged image, *see*, Section IX.G.1, Element 1.2, *supra*. Further, from Fig. 1 and the intended function of the projector a POSITA would have understood that M2 is larger than M1.

238. Alternatively, Dorval also discloses “[t]he intermediate image, having 3.8× magnification is formed between two field lenses, 240 and 250,” EX1008, [0039]. Further Dorval discloses “[t]he projection system is designed to be highly compact so as to fit within a very limited space within casing 140 and dome 195, while at the same time providing the desired image magnification (i.e., about 20×)

and resolution.” *Id.*, [0037]. The magnification M1 corresponds to $3.8\times$ magnification of Dorval and the magnification M2 corresponds to about $5.3\times$ (i.e. $20\times/3.8\times$) magnification of Dorval.

239. By referring to Dorval, as discussed in detail above, a POSITA would therefore have had a motivation to combine Dorval with Kurematsu to obtain the first enlarged image and the first enlarged image is then further be magnified to obtain the second enlarged image so as to achieve the benefits of compactness. *See* ¶218, *supra*. In addition, since Kurematsu does not provide values for the magnification of the first projection lens, i.e. M1, a POSITA in practicing Kurematsu, would have had the need to know workable values for M1 and would have looked for references to provide a guideline into typical values for M1 and M2; that POSITA would have at least considered Dorval.

[1.5] said first projection optical unit includes an aperture stop that defines an F-value of said entire projection optical unit.

240. Takamoto discloses that the said first projection optical unit includes an aperture stop that defines an F-value of said entire projection optical unit.

241. Takamoto generally states that “[i]t is preferable, as in the first to fourth embodiments, to dispose an aperture stop A within the front lens unit Gr4F of the fourth lens unit Gr4 and substantially at the position of the front focal point of the rear lens unit Gr4R of the fourth lens unit Gr4.” EX1009, 9:11-33. Takamoto further discloses “[s]uch arrangement of an aperture stop A makes it possible to realize an

optical system that is telecentric toward the reduction side.” *Id.* And “[i]n addition, since the front lens unit Gr4F, in which the aperture stop A is disposed, of the fourth lens unit Gr4 is kept in a fixed position during magnification adjustment, it is possible to keep the reduction-side f-number constant during magnification adjustment.” *Id.*

242. Further, it would have been obvious for a POSITA to place an aperture stop at the auxiliary projection lens 4 to control the amount of light, and therefore to control the f-value of the entire projection optical unit. This would have resulted in optimum positioning of the aperture stop as discussed above.

243. By referring to Takamoto, as discussed in detail above, a POSITA would therefore have had a motivation to combine Takamoto with Kurematsu to obtain a first projection optic unit having a stop aperture in a projection system to control the quantity of light. *See* ¶219, *supra*.

2. Independent Claim 7

[7.0] A projection image display apparatus, comprising;

244. Kurematsu discloses a projection image display apparatus. Kurematsu’s FIG. 1 is annotated below:

97

[7.1] an image display element; and

246. Kurematsu discloses that its projection image display apparatus includes an image display element.

247. Kurematsu discloses “FIG. 1 generally shows a basic optical system for a thin type rear projection display apparatus according to an embodiment of the present invention. In FIG. 1, ... *reference numeral 5 designates a DMD display device*”. EX1012, 3:11-24 (emphasis added). A POSITA would have recognized that a DMD display device as disclosed by Kurematsu is an image display element.

[7.2] a projection optical unit for projecting, in an enlarged form and onto a projection screen, an image displayed by said image display element,

248. This element is disclosed by Kurematsu, as analyzed for claim 1 in Section IX.G.1, *supra*.

[7.3] wherein said projection optical unit includes a first projection optical unit and a second projection optical unit, both arranged on an optical path ranging from said image display element to the screen,

249. This element is disclosed by Kurematsu, as analyzed for claim 1 in Section IX.G.1, *supra*.

[7.4] said first projection optical unit being adapted to form a first enlarged image and having positive refractive power, and

250. This element is disclosed by Kurematsu or by Kurematsu in combination with Dorval and/or Takamoto, as analyzed for claim 1 in Section IX.G.1, *supra*.

[7.5] said second projection optical unit being positioned at an enlarged image side of said first projection optical unit, being adapted to form a second enlarged image by further enlarging the first enlarged image obtained by said first projection optical unit, and having positive refractive power;

251. This element is disclosed by Kurematsu, as analyzed for claim 1 in Section IX.G.1, *supra*.

[7.6] wherein the first enlarged image is formed at the image display element side, rather than at said second projection optical unit,

252. This element is disclosed by Kurematsu, as analyzed for claim 1 in Section IX.G.1, *supra*.

[7.7] a magnification M1 of the first enlarged image is smaller than a magnification M2 of the second enlarged image, and

253. This element is disclosed by Kurematsu or by combining Kurematsu and Dorval, as analyzed for claim 1 in Section IX.G.1, *supra*.

[7.8] said first projection optical unit includes an aperture stop that defines an F-value of said entire projection optical unit.

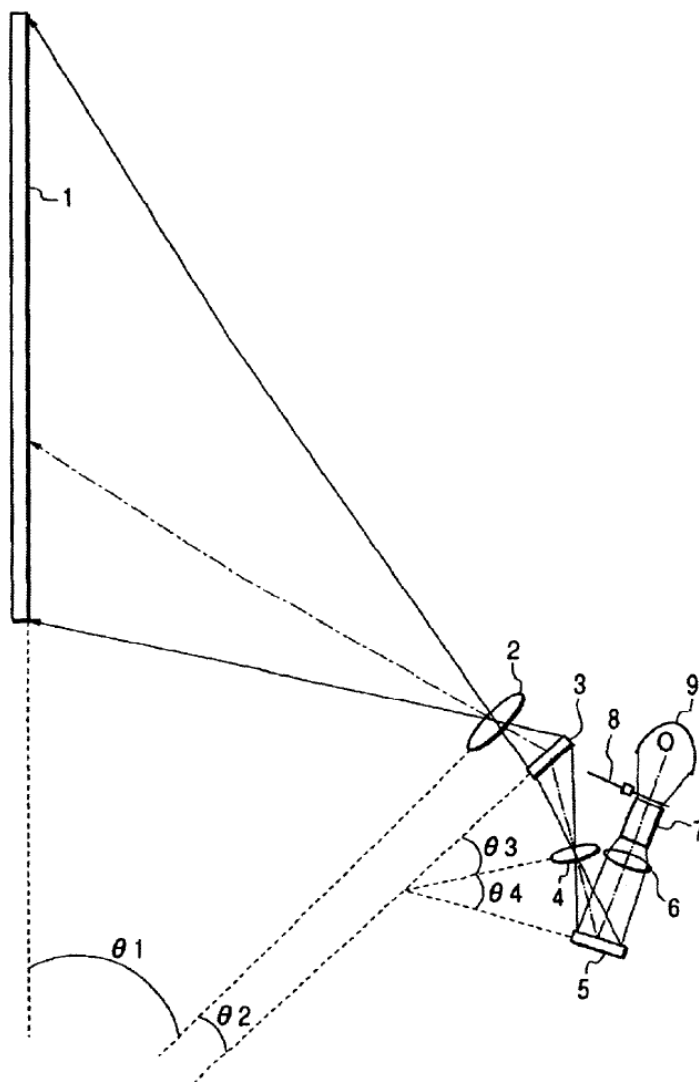
254. This element is disclosed by combining Kurematsu and Takamoto, as analyzed for claim 1 in Section IX.G.1, *supra*.

3. Dependent Claim 8

[8.0/8.1] The projection image display apparatus according to claim 7, wherein an optical-axis center of said projection optical unit is made eccentric with respect to a center of the screen.

255. Kurematsu discloses the projection image display apparatus wherein an optical-axis of said projection optical unit is made eccentric with respect to a center of the screen.

256. Kurematsu disclose that “the screen 1 and the light deflecting element 3 are installed while being tilted with each other relative to the optical axis of the main projection lens 2, and the tilt angles θ_2 and θ_1 thereof are also set in conformity to the Sheimpflug rule.” EX10012, 4:14-18. Further, Kurematsu’s Fig. 1, reproduced below, shows that the optical axis (dotted line) is eccentric with respect to the center of the screen.



257. Thus, Kurematsu, in view of Dorval, and Takamoto, discloses or renders

obvious each limitation of claims 1, 7, and 8.

X. Secondary Considerations

258. I have been informed and understand that certain factors may support or rebut the obviousness of a claim. I understand that such secondary considerations include, among other things, commercial success of the patented invention, skepticism of those having ordinary skill in the art at the time of the invention, unexpected results of the invention, any long-felt but unsolved need in the art that was satisfied by the alleged invention, the failure of others to make the alleged invention, praise of the alleged invention by those having ordinary skill in the art, and copying of the alleged invention by others in the field. I understand that there must be a connection between any such secondary considerations and the alleged invention. I also understand that contemporaneous and independent invention by others is a secondary consideration tending to show obviousness.

259. I am not aware of any secondary considerations that would make claims 1,7, and 8 of the '988 Patent nonobvious over the prior art considered herein. Regardless, any possible secondary considerations would not overcome the above-cited prior art, which clearly demonstrates that the subject matter of claims 1,7, and 8 of the '988 Patent would have been obvious to a POSITA as of November 28, 2003.

I hereby declare that statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true. Should further information become available to me as this matter proceeds, I may revise my opinions accordingly as necessary. I declare under penalty of perjury that the foregoing Declaration is true and correct. Executed on April 30, 2025.

By: 