UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

CORETRONIC CORPORATION and
OPTOMA CORPORATION,

Petitioners,

- vs. -

MAXELL, LTD.,

Patent Owner

IPR2025-00475

DECLARATION OF DR. JOSE SASIAN
IN SUPPORT OF PETITION FOR INTER PARTES REVIEW
OF U.S. PATENT NO. 9,322,530

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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. 9,322,530 ("the '530 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, 3, 4, 7, and 9 of the '530 Patent are unpatentable.

4. I have been asked to provide my opinions regarding whether claims 1, 3, 4, 7, and 9 of the '530 Patent are unpatentable because they are anticipated and/or would have been 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, 3, 4, 7, and 9 would have been anticipated and/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 EX1011. 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 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).

b. 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.

c. 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

d. 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

e. 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.

f. 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 1011.

II. Information Considered

19. I have considered the following documents:

a. The '530 Patent (EX1001);

b. The prosecution history of the '530 Patent (EX1002);

c. U.S. Patent Publication 2011/0187999 to Hirata *et al.* ("Hirata") (EX1004);

d. U.S. Patent Publication 2009/0308852 to Alpay *et al.* ("Alpay") (EX1005);

e. U.S. Patent Publication 2012/0008098 to Akiyama ("Akiyama") (EX1006);

f. U.S. Patent Publication 2011/0044046 to Abu-Ageel ("Abu-Ageel") (EX1007);

g. U.S. Patent Publication 2011/0292349 to Kitano *et al.* ("Kitano") (EX1008);

h. U.S. Patent No. 8,783,886 to Huang ("Huang") (EX1009);

i. U.S. Patent Publication 2011/0234998 to Kurosaki ("Kurosaki") (EX1012);

j. U.K. Patent Publication GB2462805 to Cai *et al.* (EX 1013);

k. U.S. Patent No. 7,433,558 to Booth *et al.* (EX 1014).

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 '530 Patent.

III. Anticipation

21. I have been informed and understand that an anticipation analysis involves comparing a claim to the prior art to determine whether a POSITA would have understood the claimed invention is anticipated in view of the prior art, and in light of

the general knowledge in the art. I understand that to anticipate a claim, a prior art reference must disclose each and every claim limitation, either expressly or inherently.

IV. Obviousness

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:

a. 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,

b. 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,

c. 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,

d. 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,

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

f. 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

g. 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.

23. I have been further 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.

V. Claim Construction

24. 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. Independent claim 1 of the ’530 Patent reads:

> 1. A light source device, comprising:
>
> a plurality of excitation light sources which emit excitation light;
>
> a phosphor which changes the excitation light to fluorescent light;
>
> a dichroic mirror which transmits the excitation light and reflects the fluorescent light; and
>
> a condensing lens which condenses the excitation light transmitted through the dichroic mirror in an excitation light irradiation region on the phosphor,
>
> wherein the plurality of light sources are arranged so that each excitation light emitted from each of the plurality of light sources enters asymmetrically to a center of the condensing lens; and
>
> wherein when the excitation light irradiation region is a center and an incident angle to the excitation light irradiation region of any excitation light of each of the excitation light is an elevation angle θ,
>
> $\theta \neq 0$
>
> is satisfied.

25. Independent claim 9 recites:

> 9. A light source device, comprising:
>
> an excitation light source which emits excitation light;
>
> a phosphor which changes the excitation light to fluorescent light;
>
> a dichroic mirror which transmits the excitation light and reflects the fluorescent light; and
>
> a condensing lens which condenses the excitation light transmitted through the dichroic mirror in an excitation light irradiation region on the phosphor,
>
> wherein the excitation light sources are arranged so that when excitation light emitted from the excitation light source enters the excitation light irradiation

region and is reflected without being converted into fluorescent light, the unconverted excitation light is prevented from entering the excitation light source; and

wherein when the excitation light irradiation region is a center and an incident angle to the excitation light irradiation region of any excitation light of each of the excitation light is an elevation angle θ,

$\theta \neq 0$

is satisfied.

26. Claims 3, 4, and 7 all depend from Claim 1. Claim 3 recites:

3. The light source device according to claim 1, wherein when the excitation light irradiation region is a center, in an incident angle to the excitation light irradiation region of first excitation light of each of the excitation lights, an elevation angle is θm and an azimuth angle is φm, and in an incident angle to the excitation light irradiation region of second excitation light different from the first excitation light, an elevation angle is θn and an azimuth angle is φn, there is no pair of the excitation lights in which

$\theta m - 2° \leqq \theta n \leqq \theta m + 2°$, and $\varphi m + 178° \leqq \varphi n \leqq \varphi m + 182°$

are established.

27. Claim 4 recites:

4. The light source device according to claim 1, wherein the excitation light source is a solid light-emitting element.

28. Claim 7 recites:

7. A projection type video display device, comprising:

the light source device according to claim 1;

a video display element;

an illumination optical system which has a plurality of optical elements applying light from the light source device to the video display element; and

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a projection lens which enlarges and projects an optical image formed by the video display element.

29. In my opinion, the claims of the ’530 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. Therefore, it is my opinion that no terms need an explicit construction.

VI. Level of Skill in the Art

30. I have been informed that obviousness is considered from the perspective of a person of ordinary skill in the art 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 PCT application to which the ‘530 Patent claims priority is September 26, 2011.

31. In my opinion, a POSITA at the time of the invention of the ‘530 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

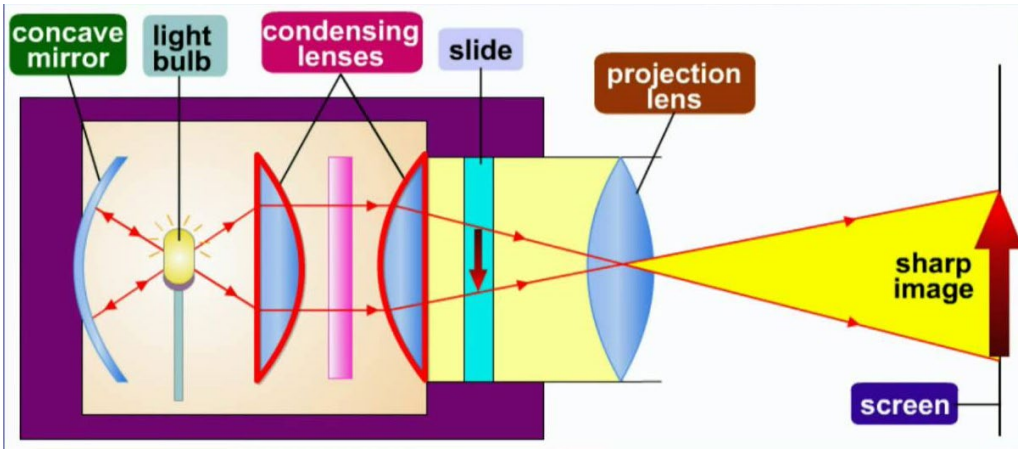
areas and at least three to four years of work or research experience in optical engineering, optical design, optoelectronics, or a related field.

32. I met and exceeded the above qualifications for a POSITA as of at least September 26, 2011 (and thereafter), and consider myself to be a person with at least ordinary skill in the art of the '530 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.

VII. Background on Relevant Technology

33. I provide the following background information on technology relevant to the '530 Patent based on my general knowledge and experience in the fields of optical engineering and optical science.

34. 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.



35. The main block components of an optical projector system are a light source, a light condenser, a transparency 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. Often a fan is included to remove heat from the projector components.

36. 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.

37. 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.

38. 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.

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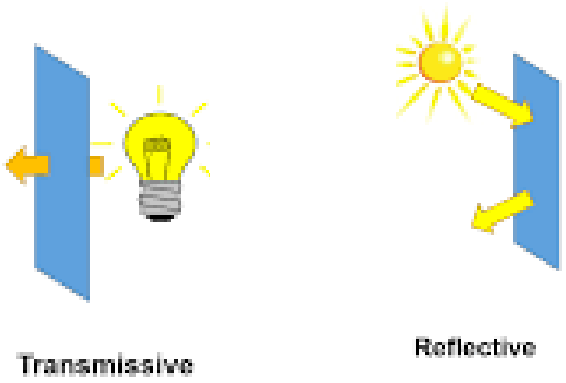
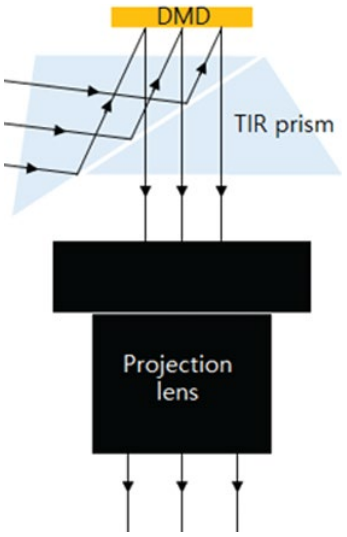


39. Projectors that use a DMD image display work on reflecting light and may require a prism to input the light from the condenser optics.



40. Because of the need to improve the light efficiency of projectors, reduce environmental impact, and reduce cost, optical projectors have further evolved. The use of LEDs or lasers as the light sources has permitted this progress.

41. As mentioned above, the efficient use of the light produced by the projector's light source is a major design and performance issue. Light that is not used

for the intended purpose and that degrades the performance of an optical system is known in the art as stray light.

42. In imaging systems, stray light can reduce the contrast of the projected image, create image artifacts such as ghost images, and produce glare. In infrared systems retroreflected stray light can produce the phenomenon of Narcissus in which a black spot appears at the center of the projected image. In illumination systems stray light can damage the optical components.

43. Well known methods for controlling stray light prior to the ’530 patent were the use of optical coatings to reduce Fresnel reflections, the use of baffles to block unwanted light, the use of apertures, the use of optical isolators like polarizing filters, the use of off-axis light propagation, and the use of eccentric apertures to provide a secondary path for light reflections. Eccentric or off-axis lens systems to manage light retroreflections were well known.

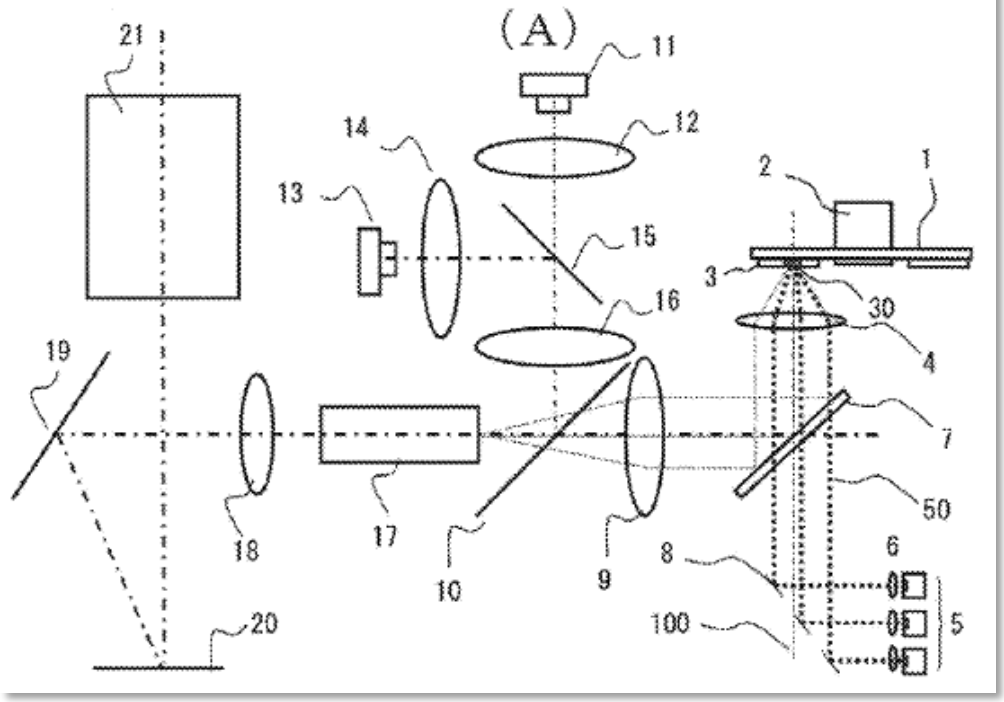
VIII. U.S. Patent No. 9,322,530 (the “’530 Patent”)

44. I have been informed and understand that the earliest priority date to which the Patent Owner may claim the ’530 Patent is entitled is September 26, 2011. For purposes of my analysis herein, I am assuming that the ‘530 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 September 26, 2011.

45. The ’530 Patent describes a light source device. EX1001, abstract. The light source device is provided with a plurality of excitation light sources emitting excitation light and a phosphor changing excitation light to fluorescent light, and the excitation light sources are arranged so that each excitation light emitted from each of the excitation light sources asymmetrically enters an excitation light irradiation region on a phosphor. *Id.* A mirror is installed on an optical path of unconverted excitation light reflected from the phosphor and returns the unconverted excitation light to the phosphor side, whereby the unconverted excitation light can be utilized as excitation light again. *Id.*

46. Figure 3(A) of the ’530 Patent, reproduced below, depicts a schematic configuration diagram of an embodiment of the claimed light source device and components working with that light source device as part of a projection type video display device.

FIG. 3

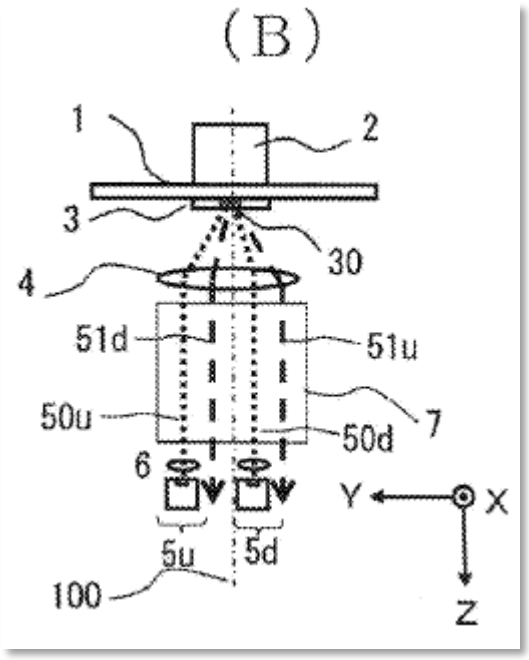


47. The figure shows an excitation light source group 5 that emits blue excitation light. EX1001, 18:5-8. The dichroic mirror 7 transmits blue light and reflects green light, meaning that the blue excitation light transmits through the dichroic mirror to be condensed by a condensing lens 4 onto a disk 1. *Id.*, 18:8-11.

48. Disk 1 is a rotation-controllable circular base material, coated with a green phosphor 3, with a rotation element 2 as a center axis. *Id.*, 18:15-18. Green light generated by excitation of the green phosphor 3 that has been transmitted through the condensing lens 4 is reflected by the dichroic mirror 7 to transmit through another condensing lens 9 and thus enter another dichroic mirror 10. *Id.*, 18:18-23. This green

light then travels through a number of optical elements, ultimately reaching video display element 20 and entering through a projection lens 21. *Id.* 18:59-19:15.

49. Figure 2(B) reproduced below, depicts an alternative embodiment of the claimed light source device.



50. The figure shows a configuration where the excitation light sources 5u, 5d are arranged asymmetrically to the optical axis 100. *Id.*, 5:29-36. In this arrangement, excitation light 50u, 50d not converted by the phosphor 3 (labeled 51d and 51u) does not return along the same path as excitation light 50u and 50d. *Id.*, 5:46-57. According to the ’530 Patent, ensuring that this unconverted light does not travel along the reverse path as the excitation light improves the output and life of the excitation light sources. *Id.*, 6:4-9.

51. The ’530 Patent issued on April 26, 2016, originally from PCT Application No. PCT/JP2012/074617, filed on September 26, 2012. That application entered the national stage in the United States as U.S. Patent Application No. 14/240,799, on February 25, 2014. EX1001, cover.

52. In an Office Action dated September 4, 2015, the Examiner rejected pending claims 1, 2, 5-9, and 12 and objected to claims 3, 4, 10, and 11. EX1002, 065. Claims 1, 6, and 7 were rejected under pre-AIA 35 U.S.C. § 102(e) as being anticipated by U.S. Patent No. 8,783,886 to Huang, Claims 2 and 8 were rejected under 35 U.S.C. § 102(e) as being anticipated by Patent Pub. No. US2011/0292349 to Kitano et al., and Claims 9 and 12 were rejected under pre-AIA 35 U.S.C. § 103(a) as being obvious over Huang in view of Komatsu. *Id.*, 067-72. Claim 5 was rejected under 35 U.S.C. § 112. *Id.*, 066-67. In addressing, Claims 3, 4, 10, and 11, the Examiner indicated that these claims were objected to as being dependent upon a rejected independent claim but that if the claims were written in independent form, they would be allowable. *Id.*, 072-73. Regarding Claim 4 in particular, the Examiner stated that the prior art does not teach “when the excitation light irradiation region of any excitation light of each of the excitation lights is an elevation angle theta, and the condition theta is not equal to zero is satisfied.” *Id.*, 072.

53. The Applicant Amended its Claims on November 9, 2015, to incorporate into the independent claims those limitations that the Examiner had indicated were not

present in the prior art. *Id.*, 046-53. The Examiner issued a Notice of Allowance on January 13, 2016. *Id.*, 029-33.

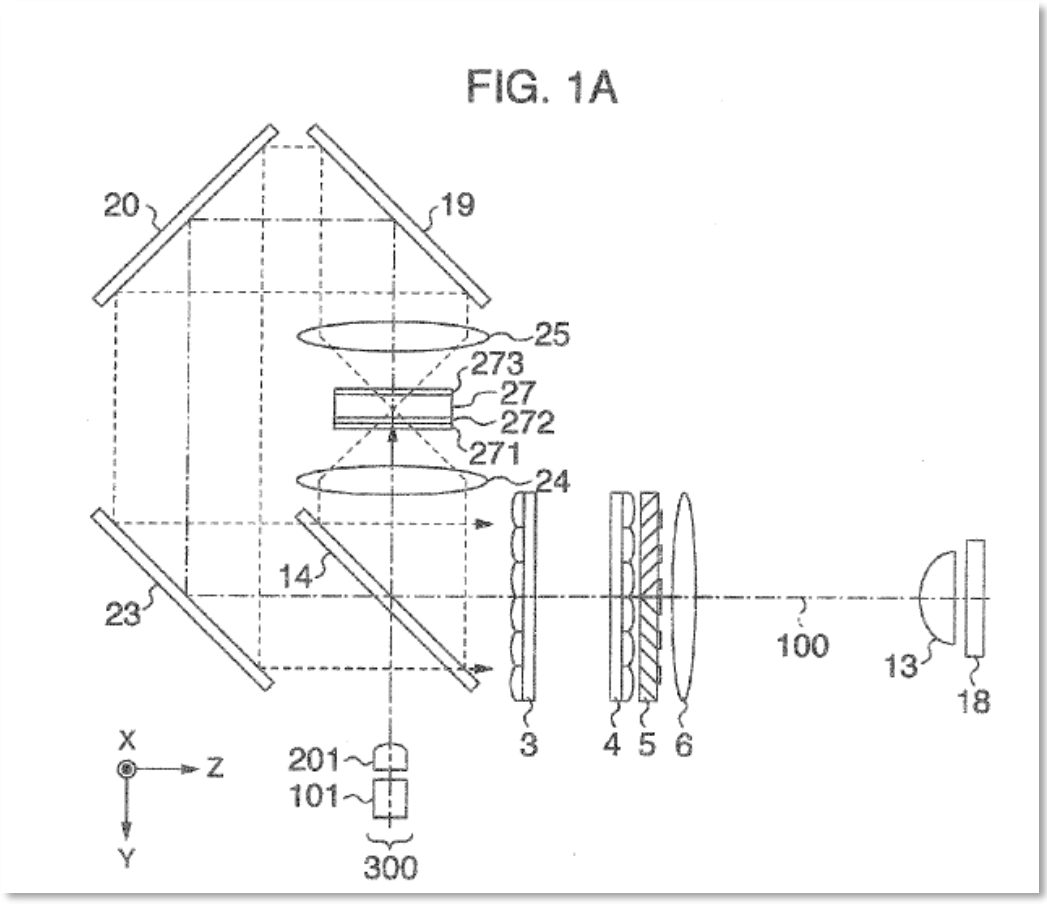
54. As discussed below, the claims of the ’530 Patent recite nothing more than an obvious combination of optical elements that had been used by a POSITA prior to the filing of the ’530 Patent.

IX. Prior Art

A. Hirata (EX1004)

55. Hirata is based on an application filed October 25, 2010, and published on August 4, 2011. EX1004. I understand that Hirata is prior art to the ’530 Patent.

56. Hirata discloses a projection type display apparatus that incorporates a light source device. EX1004, abstract. Figure 1A depicts an embodiment of the invention described therein.



EX1004, Fig. 1A.

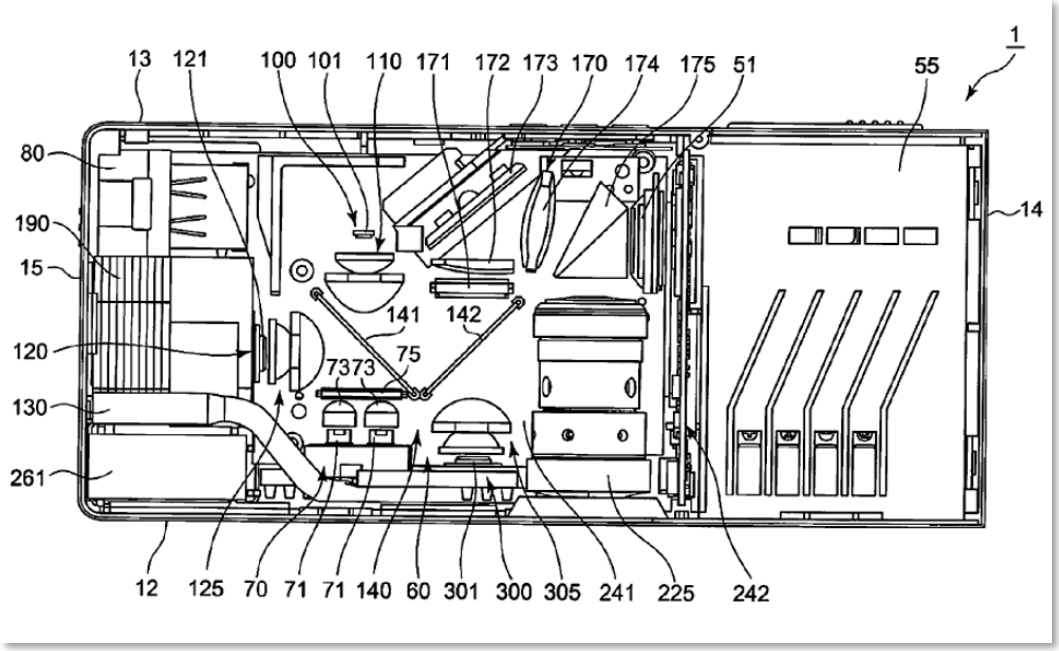
57. As shown in Figure 1A, Hirata discloses an excitation light source device 300 that includes a blue excitation light source 101 for phosphor excitation. EX1004, [0090]. Though only one excitation light source is shown in Figure 1A, Hirata makes clear that the invention described therein can comprise a plurality of excitation light sources that each emit excitation light. EX1004, Fig. 1B, [0094]. Excitation light from the excitation light source 101 excites a yellow phosphor 271, which then emits yellow light. EX1004, [0088], [0091].

58. Also as shown in Figure 1A of Hirata is a dichroic mirror 14 that transmits blue excitation light from excitation light source 101 and reflects yellow light from yellow phosphor 271. EX1004, [0090]. After transmission through the dichroic mirror 14, the blue excitation light is focused by a focusing lens 24 onto the yellow phosphor 271. EX1004, [0090], [0094]. Yellow light emitted from the yellow phosphor is reflected or transmitted by various other elements depicted in Figure 1A, ultimately reaching a liquid-crystal display element 18. EX1004, [0020].

B. Kurosaki (EX1012)

59. Kurosaki is based on an application filed March 24, 2011, and published on September 29, 2011. EX1012. I understand that Kurosaki is prior art to the '530 Patent.

60. Kurosaki discloses a projection type video display device in the form of projector 1 as depicted in Kurosaki's Figure 3:



EX1012, Fig. 3; *see also id.*, [0022]. Projector 1 includes a light source device in the form of light source unit 60, which further includes an excitation light shining unit 70 that includes two excitation light sources 71. EX1012, [0023], [0041]. Each excitation light source 71 is a blue laser that emits a laser beam as excitation light. EX1012, [0041]-[0042].

61. Projector 1 also includes a luminescent plate 101 that "generates green luminescent light by use of a laser beam emitted from excitation light source 71 as excitation light and emits this green luminescent light[.]" EX1012, [0041]-[0042]. "A front surface of the luminescent plate 101 is formed into a reflecting plane, and a rectangular luminescent material layer is laid on the reflecting plane." EX1012, [0024]. *See* also *Id.*, [0042]. A POSITA would understand that the luminescent material layer could be a phosphor. Projector 1 also includes a dichroic mirror 141 that transmits

excitation light and reflects fluorescent light and a condensing lens (collective lens 110) that condenses excitation light transmitted through the dichroic mirror to an excitation light irradiation region on luminescent plate 101. EX1012, [0025], [0044]. In this arrangement, light from the luminescent plate 101 is reflected or transmitted by various other elements depicted in Figure 3, ultimately reaching a display device 51, which may comprise a Digital Mirror Device (DMD). EX1012, [0038].

C. Alpay (EX1005)

62. Alpay is based on an application filed September 12, 2008, and published on December 17, 2009. EX1005. I understand that Alpay is prior art to the '530 Patent.

63. Alpay discloses systems and methods for reducing back-reflections in laser processing systems. EX1005, abstract. Figure 3 depicts an embodiment of the invention described therein.

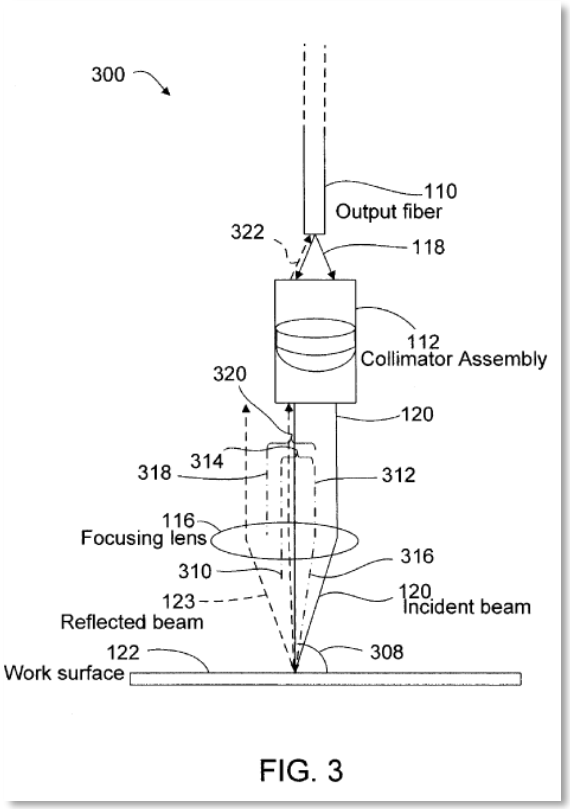


FIG. 3

EX1005, Fig. 3.

64. Alpay teaches an arrangement where excitation light emitted from a light source in the form of incident laser beam 120 enters asymmetrically to a center of a focusing lens 116. EX1005, [0028]. Alpay discusses the importance of this arrangement:

65. Generally, certain lasers may be sensitive to optical feedback such as a laser beam reflected back to the laser from a work surface. If such reflections are not properly blocked, e.g., if there is a return path for such reflections to couple back into an output fiber, it is possible that both the output fiber and gain fibers may be damaged. EX1005, [0003]. The arrangement of Figure 3 prevents this unwanted feedback by

providing an asymmetric arrangement provided by offset 314 between a first axis of propagation 312 of an incident laser beam 120 and the primary axis 310 of focusing lens 116 to reduce or prevent overlap between the reflected laser beam 123 and the incident laser beam 120. EX1005, [0027]-[0028]. "Thus, all or at least a substantial portion of the reflected laser beam 123 does not return through the collimator assembly 118 of output fiber 110." EX1005, [0029]. Alpay further teaches other additional solutions to prevent the remaining portion of the reflected laser beam from returning to the light source. EX1005, [0029]-[0031].

D. Akiyama (EX1006)

66. Akiyama is based on an application filed June 28, 2011, and published on January 12, 2012. EX1006. I understand that Akiyama is prior art to the '530 Patent.

67. Akiyama discloses a light source device and projector. EX1006, cover. Akiyama's Figure 2A depicts an embodiment of the invention described therein.

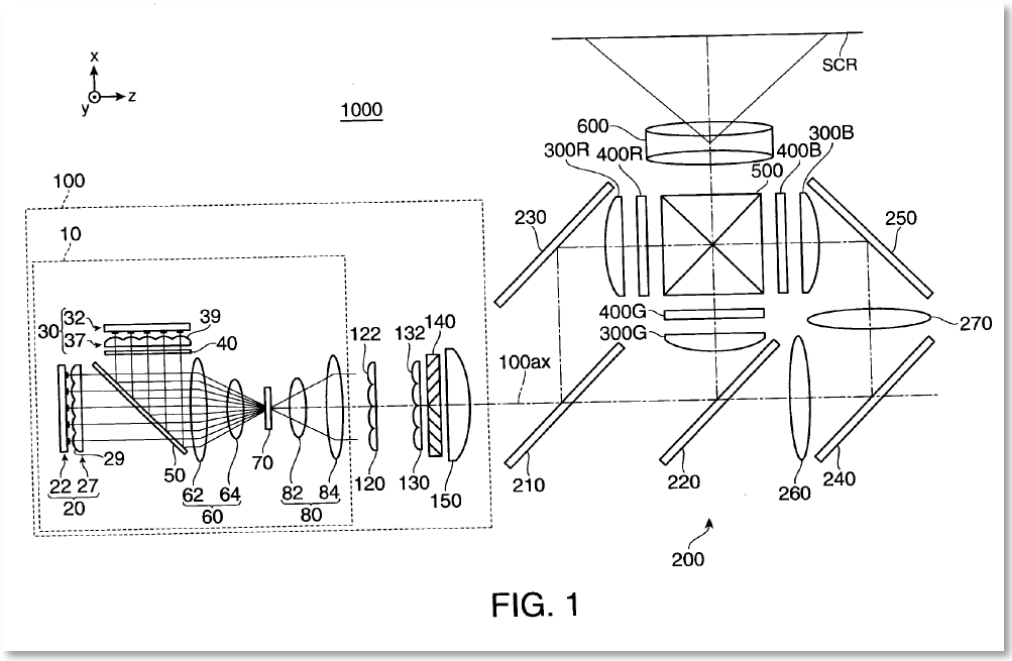


FIG. 1

EX1006, Fig. 2A.

68. Akiyama discloses a light source device and projector including an optical system 200, which comprises a plurality of optical elements, including dichroic mirrors 210, 220, reflecting mirrors 230, 240, 250, and relay lenses 260, 270. EX1006, [0089]. These optical elements apply light for a light source (illumination device 100) to video display elements (liquid crystal modulation devices 400R, 400G, 440B). EX1006, [0089].

E. Abu-Ageel (EX1007)

69. Abu-Ageel is based on an application filed April 21, 2010, and published on February 24, 2011. EX1007. I understand that Abu-Ageel is prior art to the '530 Patent.

70. Abu-Ageel discloses a high brightness light source and illumination system using that light source. EX1007, cover. Figure 3C depicts one embodiment of an illumination system as described by Abu-Ageel:

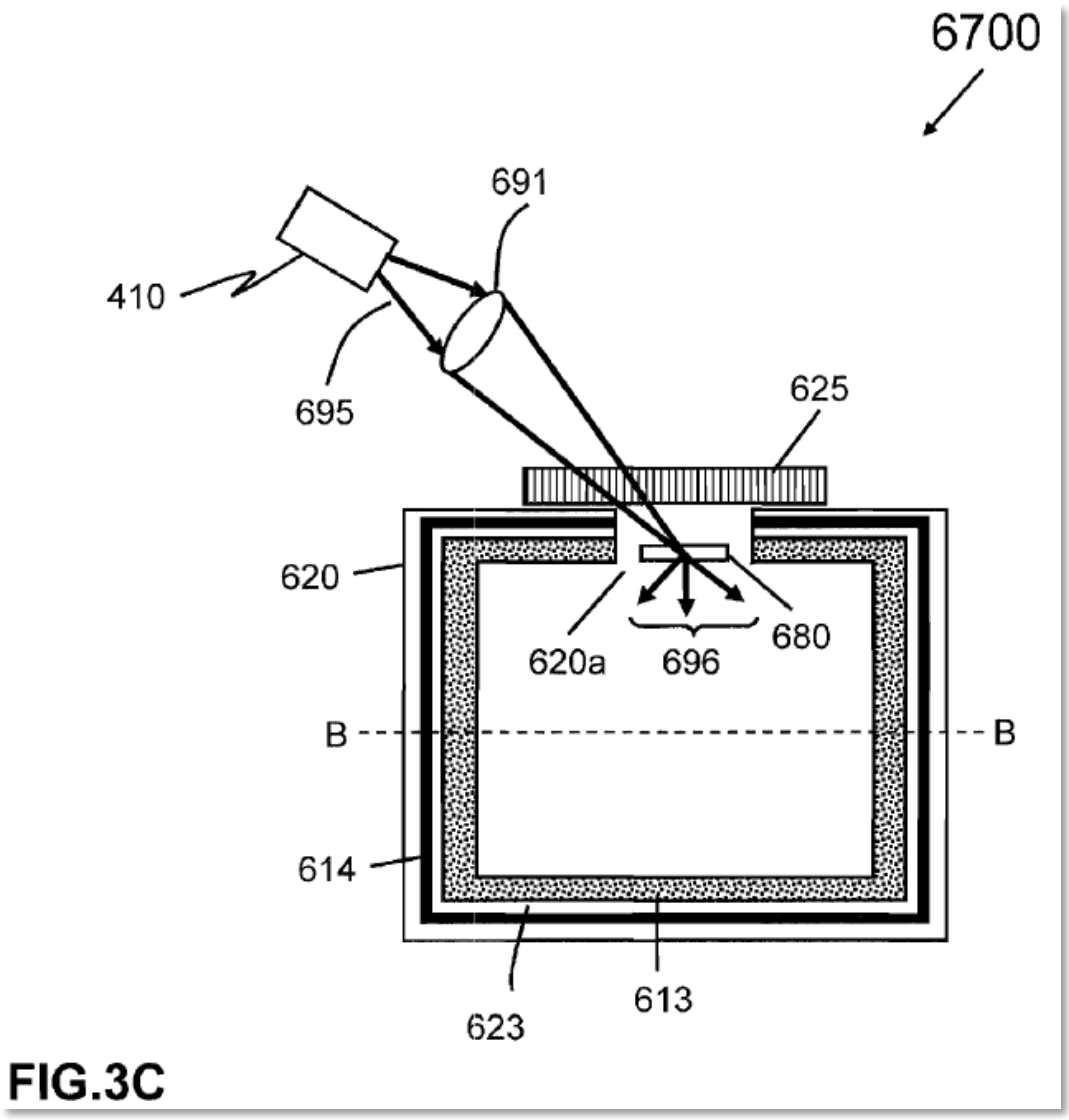


FIG.3C

EX1007, Fig. 3C.

71. Figure 3C depicts an illumination assembly 6700, which includes a violet laser 410,[1] a lens 691, an optical element 625, and a light envelope 620. EX1007, [0087]. The light envelope 620 further comprises an aperture 620a, a wavelength conversion layer (such as a phosphor) 613, a reflective coating 614, and a low-refractive index layer 623. EX1007, [0005], [0087]. Disposed just outside of aperture 620a is an optical element 625, which is preferably a coating that reflects non-converted light back into the light envelope. EX1007, [0087].

72. In operation, light 695 from violet laser 410 is focused by lens 691 through aperture 620a into light envelope 620. EX1007, [0087]. This light is converted by the wavelength conversion layer 613. EX1007, [0087]. Unconverted light is reflected back into light envelope 620 by optical element 625, which prevents unconverted light from reflecting back to violet laser 410. EX1007, [0087].

F. Huang (EX1009)

73. Huang is based on an application filed on June 27, 2011, published on July 19, 2012, and issued on July 22, 2014. EX1009. I understand that Huang is prior art to the '530 Patent.

74. Huang discloses an illumination system for use in a projection device. EX1009, abstract. Figure 3B depicts an embodiment of the invention described therein.

[1] In the portion of the specification of Abu-Ageel describing Figure 3C, this violet laser is mistakenly associated with label 411, which is not included in Figure 3C. *Compare* EX1007, Fig. 3 *with id.*, [0087].

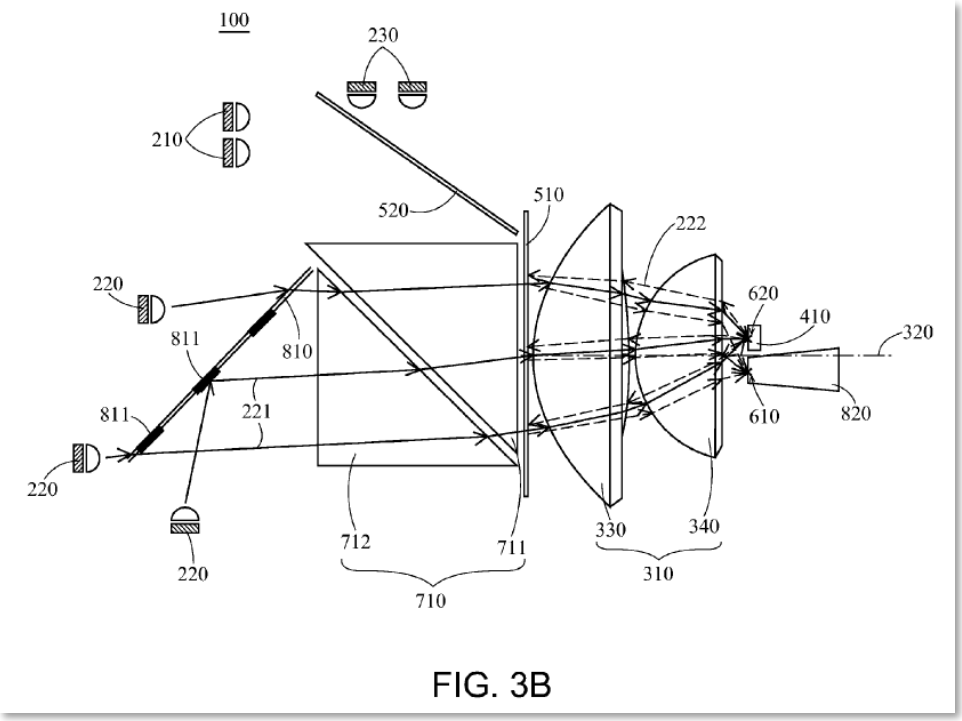


FIG. 3B

EX1009, Fig. 3B.

75. Figure 3B depicts an illumination system with light sources 210, 220. EX1009, 2:38-42. Light sources 220 emit light ultimately received by a wavelength transformer 410, which Huang explains could be a phosphor. EX1009, 2:61-64, 4:36-38. Figure 3B also depicts a dichroic mirror 510 that is adapted to allow light 221 from light sources 220 to travel through and to reflect light converted by the wavelength transformer. EX1009, 2:38-45, 2:61-3:10. Figure 3B also depicts an optical device 310 comprising a first lens 330 and second lens 340 that focuses light 221 passing through the dichroic mirror onto the wavelength transformer 410 that is disposed at a focal point. EX1009, 3:5, 4:38-40.

X. Analysis And Identification Of How The Claims Are Unpatentable

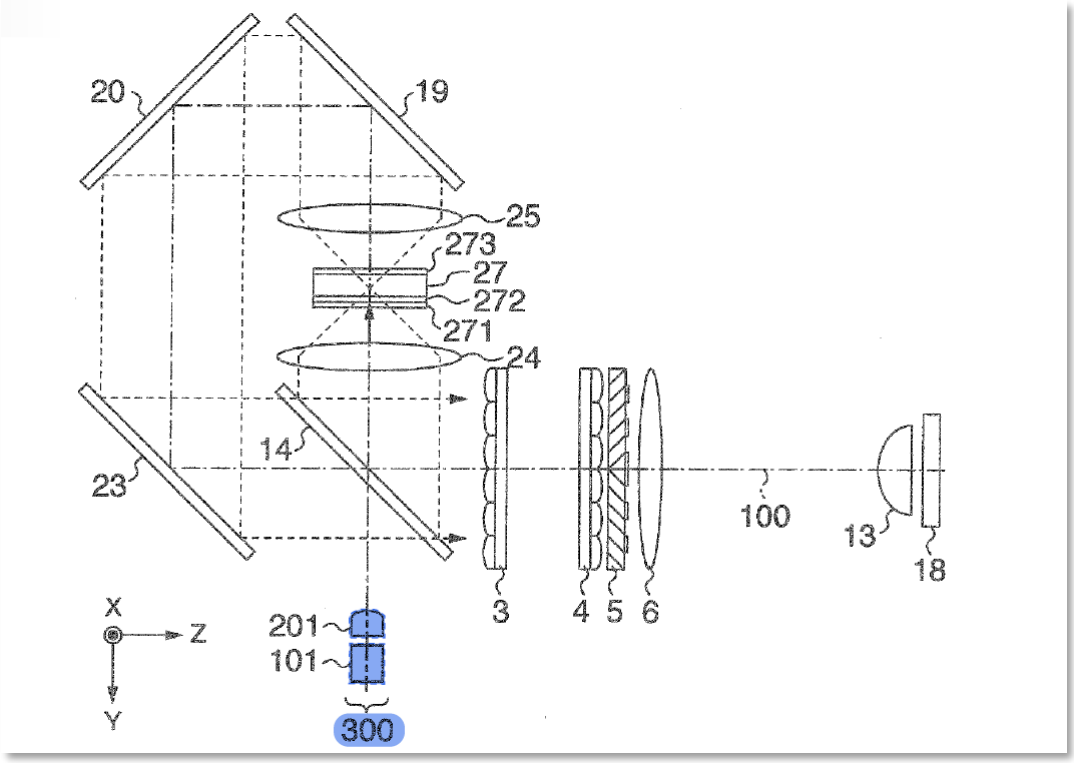
A. Ground 1: Hirata Anticipates and/or Renders Obvious Claims 1, 4, and 7

76. In my opinion and for the reasons explained below, Hirata anticipates and/or renders obvious the subject matter recited by claims 1, 4, and 7 of the '530 Patent.

1. Independent Claim 1

[1.0] A light source device, comprising:

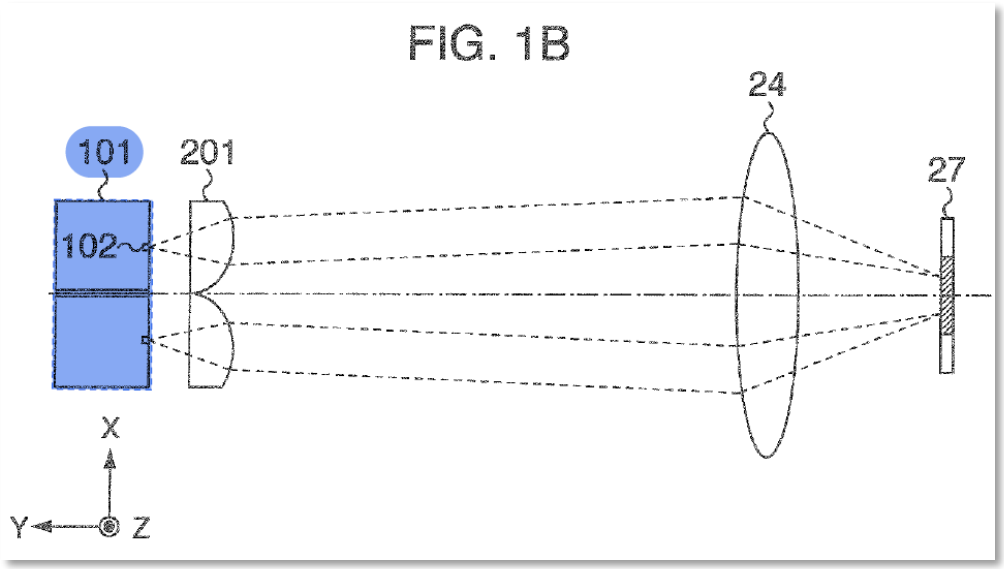
77. Hirata discloses a light source device. Figure 1A depicts "an excitation ***light source device*** 300 [that] includes the blue excitation light source 101[.]" EX1004, [0090] (emphasis added).



EX1004, Fig. 1A (annotated).

[1.1] a plurality of excitation light sources which emit excitation light;

78. Figure 1B depicts "two blue excitation light sources 101[.]" EX1004, [0094]. "The blue excitation light rays [are] emitted from the blue excitation light source 101[.]" EX1004, [0094].



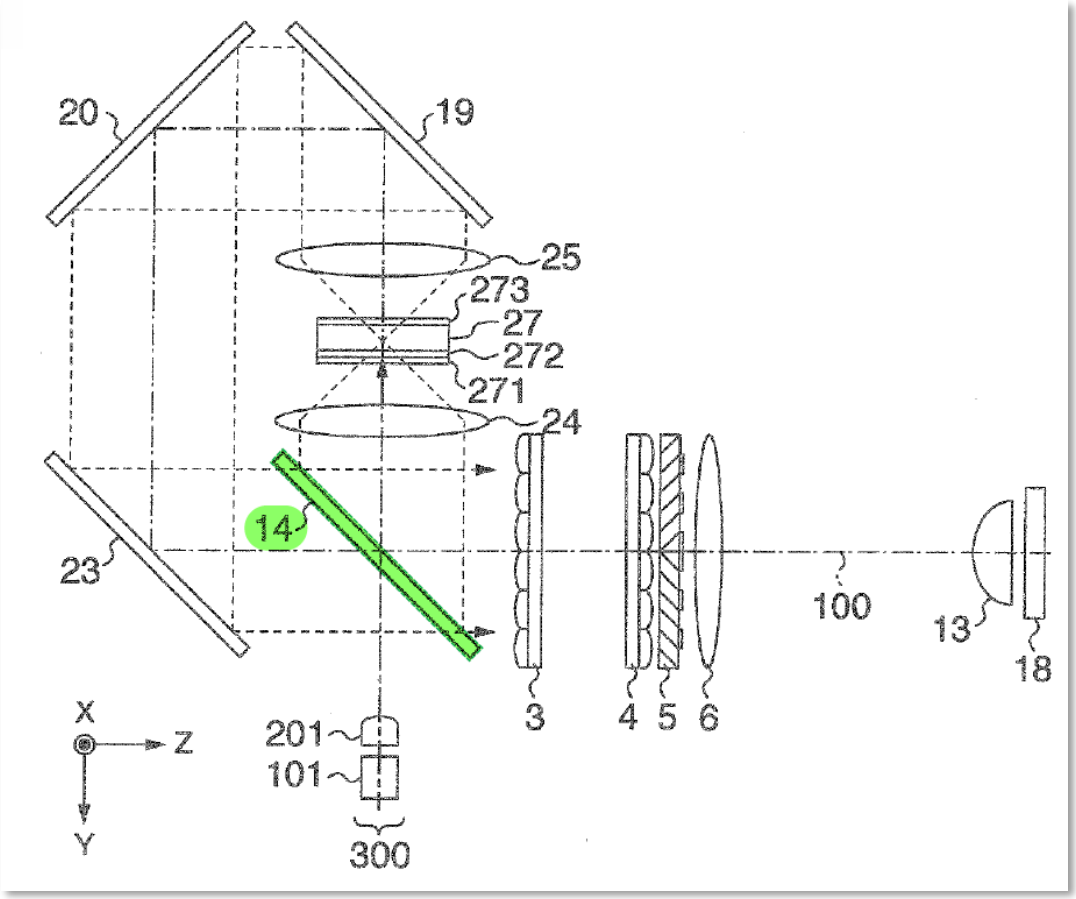
EX1004, Fig. 1B (annotated).

[1.2] a phosphor which changes the excitation light to fluorescent light;

79. Hirata discloses "a light source in which a yellow phosphor is excited by blue excitation light to emit yellow light." EX1004, [0088]; *see also id.*, [0091]. The yellow light emitted by the yellow phosphor in response to the blue excitation light is fluorescent light.

[1.3] a dichroic mirror which transmits the excitation light and reflects the fluorescent light; and;

80. Hirata discloses that "[t]he blue excitation light rays . . . from the excitation light source device 300 pass through a dichroic mirror 14, which transmits blue light and which reflects yellow light[.]" EX1004, [0090].

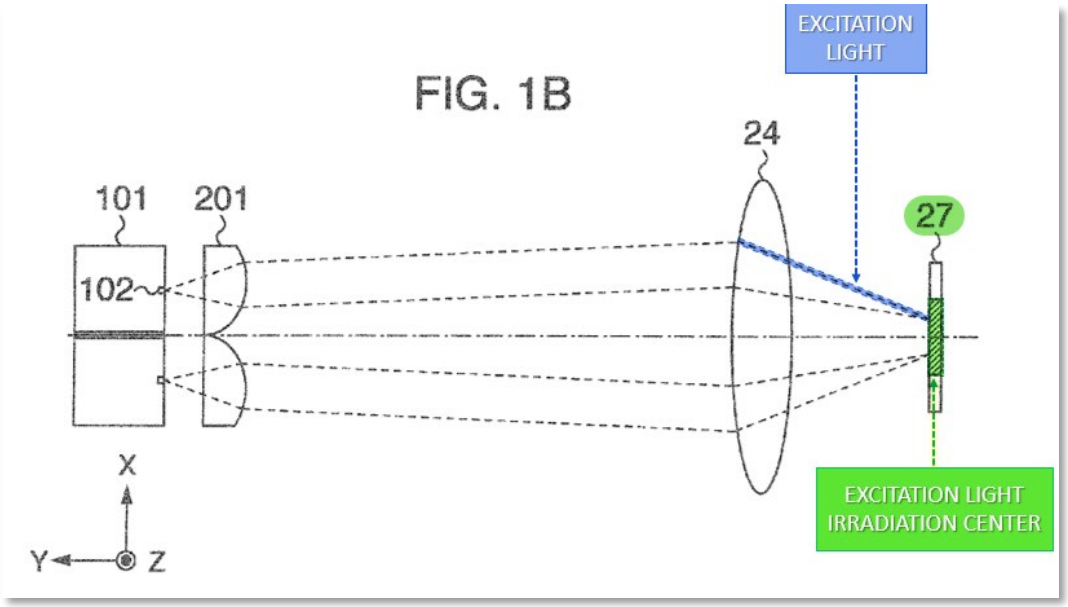


EX1004, Fig. 1A (annotated).

[1.4] a condensing lens which condenses the excitation light transmitted through the dichroic mirror in an excitation light irradiation region on the phosphor,

81. Hirata discloses that the blue excitation light rays from the excitation light source that pass through the dichroic mirror "are focused [*i.e.*, "condensed"] through a

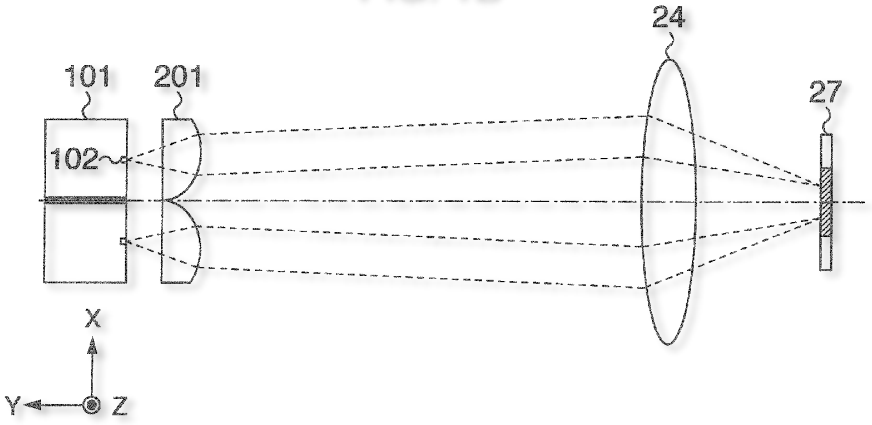
focusing lens 24 [*i.e.*, a "condensing lens"] onto a light incidence side of a transparent substrate 27 [*i.e.*, a "excitation light irradiation region"]." EX1004, [0090] (emphasis added). "[T]he transparent substrate 27 ***includ[es] a yellow phosphor***[.]" EX1004, [0094] (emphasis added).



[1.5] wherein the plurality of light sources are arranged so that each excitation light emitted from each of the plurality of light sources enters asymmetrically to a center of the condensing lens; and

82. As depicted in Figure 1B, there are "***two blue excitation light sources*** 101 each including a light emitting plane 102". The blue excitation light rays emitted by each excitation light source 101 enters offset and tilted from the optical axis of the focusing lens 24. Therefore, each excitation light emitted from each excitation light source 101 enters asymmetrically to the center of Hirata's condensing lens (*i.e.*, focusing lens 24):

FIG. 1B



EX1004, Fig. 1B; *see also id.*, [0094].

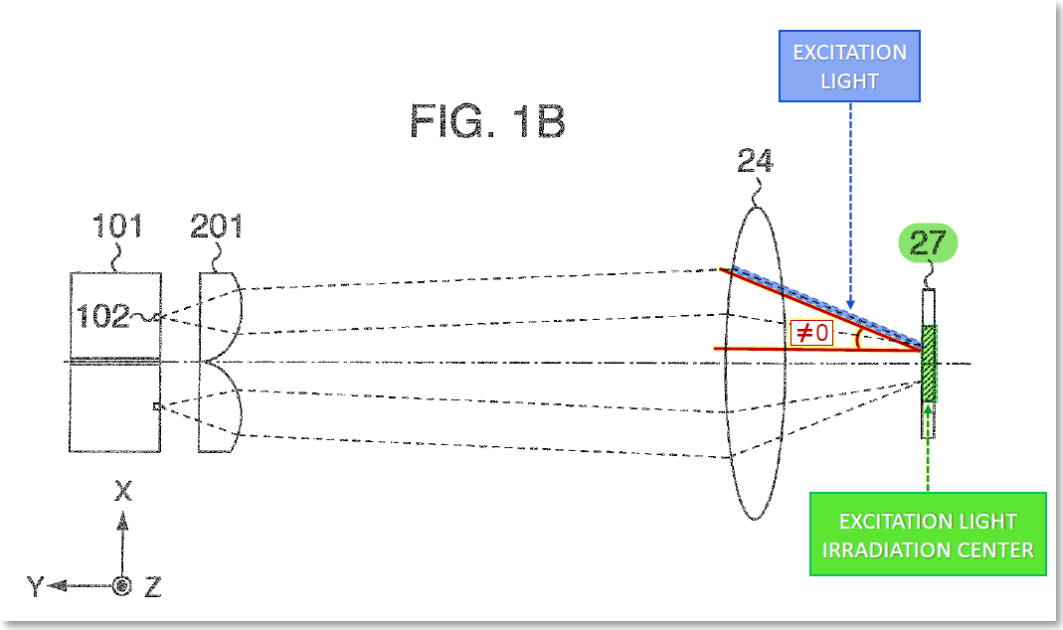
83. A POSITA would have found that because the light beams are off-set and tilted they are asymmetrically entering the condensing lens. To the extent that this is disputed, it would also have been obvious to offset the light source 101 and collimator lens 20 in a perpendicular direction to the plane of the figure (Z-axis) or along the X-axis of the Fig. 1B to avoid back reflections from reflected or scattered excitation light.

[1.6] wherein when the excitation light irradiation region is a center and an incident angle to the excitation light irradiation region of any excitation light of each of the excitation light is an elevation angle θ, θ≠0 is satisfied[2].

84. Figure 1B depicts an arrangement where the excitation light enters obliquely to the excitation light irradiation region (transparent substrate 27, which includes yellow phosphor 271). EX1004, [0090], [0094]. As a result, the incident angle

[2] The recitation "θ≠θ" was amended to read "θ≠0" by Certificate of Correction.

to the excitation light irradiation region of any excitation light of each of the excitation light sources is not equal to zero.



EX1004, Fig. 1B (annotated).

2. Dependent Claim 4

[4.0/4.1] The light source device according to claim 1, wherein the excitation light source is a solid light-emitting element.

85. Claim 4 is anticipated or rendered obvious by Hirata. Hirata discloses that the excitation light sources disclosed therein can be "***solid light emitting elements*** such as light emitting diodes, lasers, and organic electroluminescence elements." EX1004, [0044]; *see also id.*, [0088].

3. Dependent Claim 7

[7.0] A projection type video display device, comprising:

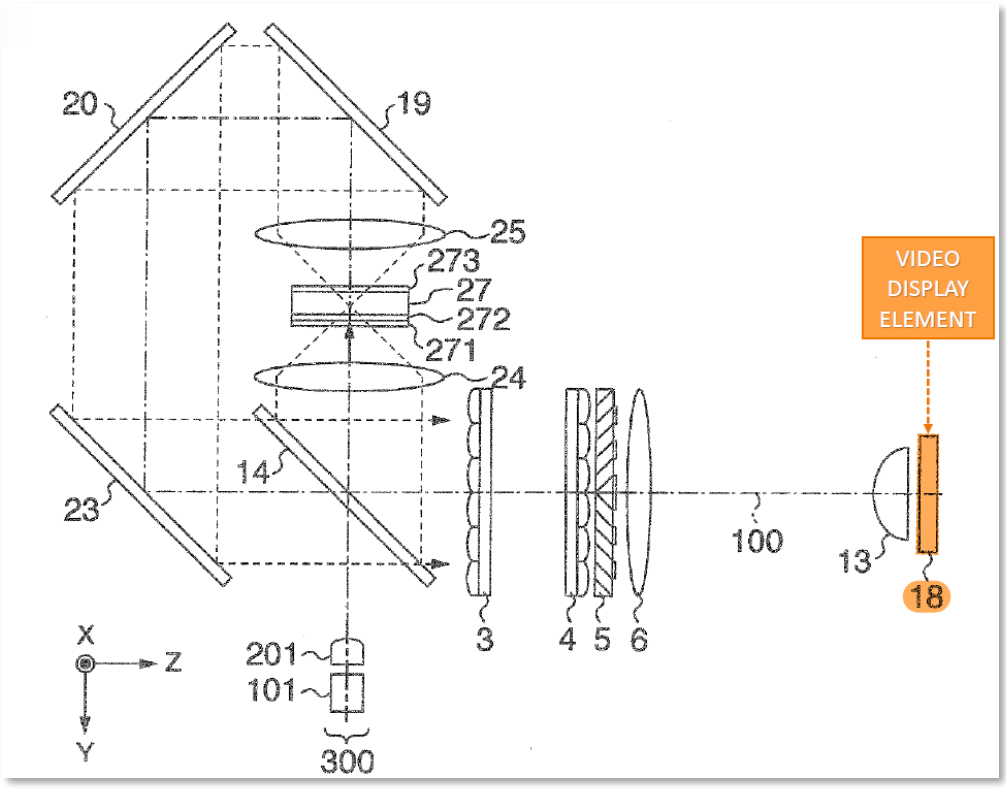
86. Hirata discloses a projection type video display device. Specifically, Hirata discloses "[a] projection type display apparatus[.]" EX1004, Abstract, [0064].

[7.1] the light source device according to claim 1;

87. Hirata discloses a light source device according to Claim 1. *See supra* Ground 1, Claim 1.

[7.2] a video display element;

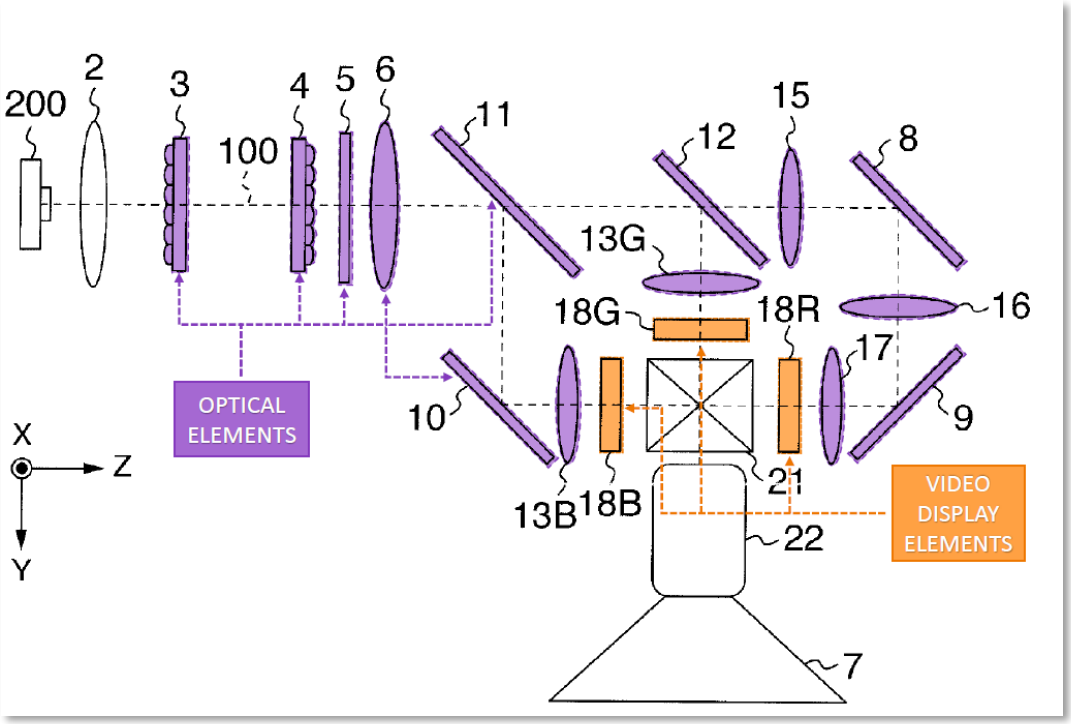
88. Hirata discloses a "liquid crystal display element 18" as depicted in Figure 1A. A POSITA would understand this element to be a video display element.



EX1004, Fig. 1A (annotated); *see also id.*, [0064].

[7.3] an illumination optical system which has a plurality of optical elements applying light from the light source device to the video display element; and;

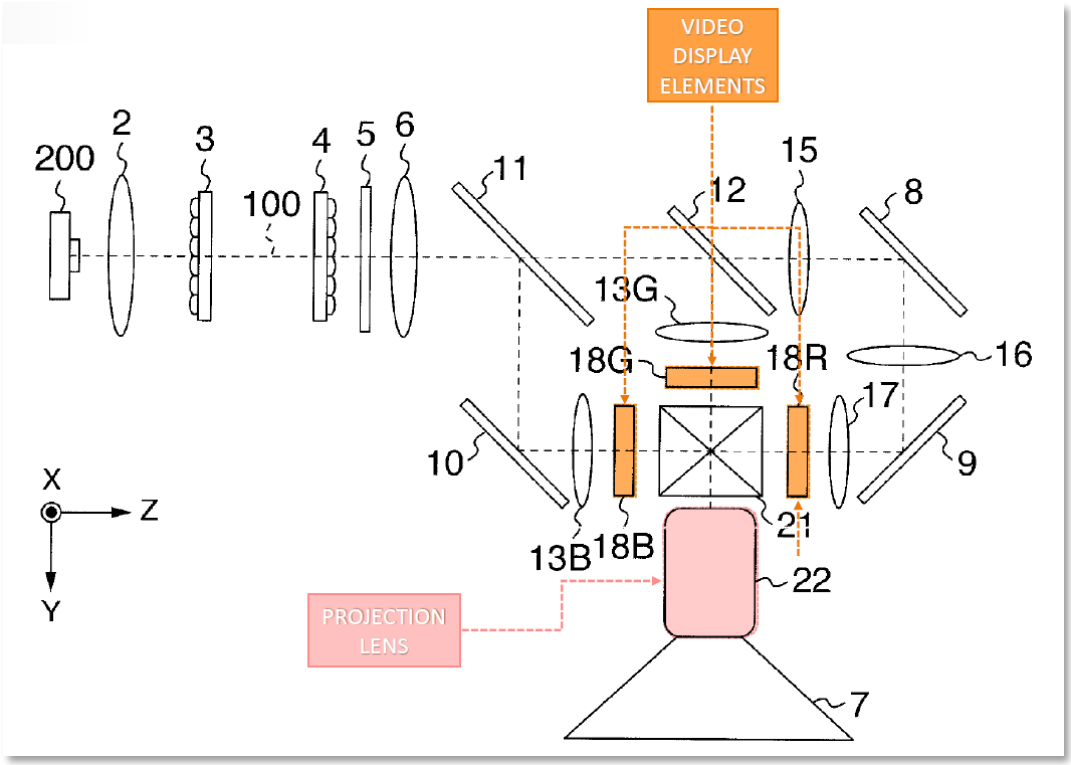
89. Hirata discloses an "optical system of a projection type display apparatus" that includes a plurality of optical elements that apply light from the light source device to the video display element. EX1004, [0064]. These optical elements include array lenses with "a plurality of lens cells arranged in a matrix[,] . . . and each lens cell[] projects or maps the contour of the lens cell of the first array lens 3 corresponding thereto onto a liquid-crystal display element 18."



EX1004, Fig. 4A (annotated); *see also id.*, [0068]-[0074].

[7.4] a projection lens which enlarges and projects an optical image formed by the video display element.

90. Hirata discloses a projection lens that enlarges and projects an optical image formed by the video display element: "An optical image formed on each liquid-crystal display element through an optical intensity modulation is ***projected*** by the ***projection lens 22*** as a ***magnified*** image onto the screen 7[.]"



EX1004, Fig. 4A (annotated).

91. Thus, Hirata discloses or renders obvious each limitation of claims 1, 4, and 7.

B. Ground 2: Kurosaki in View of Alpay Renders Claims 1, 3, 4, 7, and 9 Obvious

92. In my opinion and for the reasons explained below, Kurosaki in view of Alpay renders obvious the subject matter recited by claims 1, 3, 4, 7, and 9 of the '530 Patent.

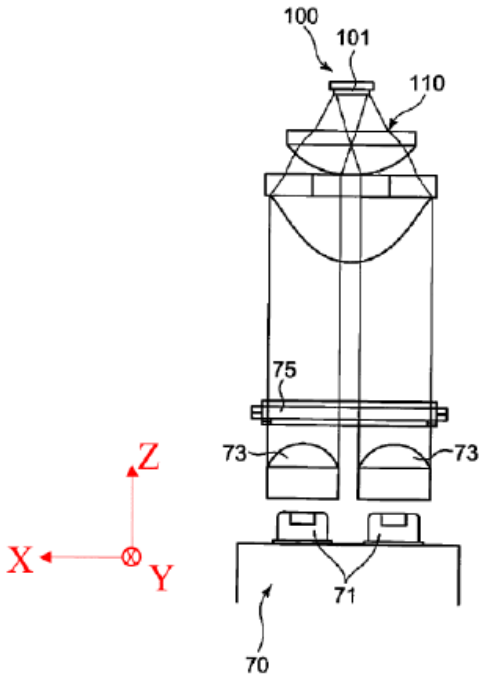
93. As a threshold matter, a POSITA would have been motivated to combine Kurosaki with Alpay, and would have had a reasonable expectation of success in making the combination. Kurosaki and Alpay both employ lasers, and a POSITA would have looked at Alpay while considering the reliability of the Kurosaki projector. Kurosaki describes a projection type display apparatus including a light source device with a plurality of light sources, such as lasers. Prior to the '530 Patent, it was well known that back reflections affected, degraded, or impaired the performance of laser diodes. EX1005, [0003] ("[C]ertain lasers may be sensitive to optical feedback such as a laser beam reflected back to the laser from a work surface. . . . [I]t is therefore desirable to prevent such back-reflections from finding a path back into the output fiber."); *see also* EX1013, 1:11-17 ("For many applications back-reflection of the light emitted by a laser diode into the laser active region has a significant, negative, impact on the performance of the laser."); EX1014, 1:19-22 ("In high power fiber-optic systems, optical isolators are used to protect low-power components from damage that may be caused by back-reflected light from amplifiers or other components."). By the time of the priority date of the '530 Patent, not only was this problem known, but tools

had been developed to combat this problem, such as optical isolators. EX1005, [0004]-[0005]; EX1013; EX1014. Optical isolators, however, "are usually quite bulky (especially when configured for use with high-power beams) and expensive." EX1005, [0006]. A POSITA would have known this and would have at least considered protecting the laser diodes of Kurosaki by the means taught by Alpay, which discloses a different method to prevent unwanted, destabilizing feedback, or by the use of optical isolators that were well known and used in front of laser diodes in applications such as telecommunications and high power lasers. In other words, by the time of the priority date of the '530 patent it was well known that back reflections can affect adversely the performance of a laser. Therefore, a POSITA looking at Kurosaki would have considered the teaching of Alpay.

94. A POSITA would have understood as of the '530 Patent's priority date that some portion of excitation light emitted by Kurosaki's excitation light sources 71 would not be converted by Kurosaki's luminescent plate 101 and would be reflected back in the direction of excitation light sources 71. *See, e.g.*, EX1008, [0048]; EX1001 1:28-31. With this understanding, such a POSITA would have recognized the advantage of implementing the asymmetric arrangement of Alpay into the light source device of Kurosaki by further offsetting Kurosaki's excitation light sources 71 from the optical axis of Kurosaki's collective lens 110 to prevent unconverted excitation light from either excitation light source 71 from entering either the same light source 71 it

originated from or its partner light source 71. Implementing Alpay's offset into the device disclosed by Kurosaki will provide further protection against reflected excitation light from reaching Kurosaki's excitation light sources 71, which will in turn prevent potential damage to Kurosaki's light sources 71. EX1005, [0003]; *see also* EX1013, 1:11-17; EX1014, 1:19-22. This would have been nothing but following known methods with predictable results and desirable to improve projector reliability.

95. Kurosaki's Figure 5 depicts an arrangement where excitation light sources 71 are offset from the optical axis of collective lens 110 and offset in the X-axis direction of Figure 5.



EX1012, Fig. 5 (annotated).

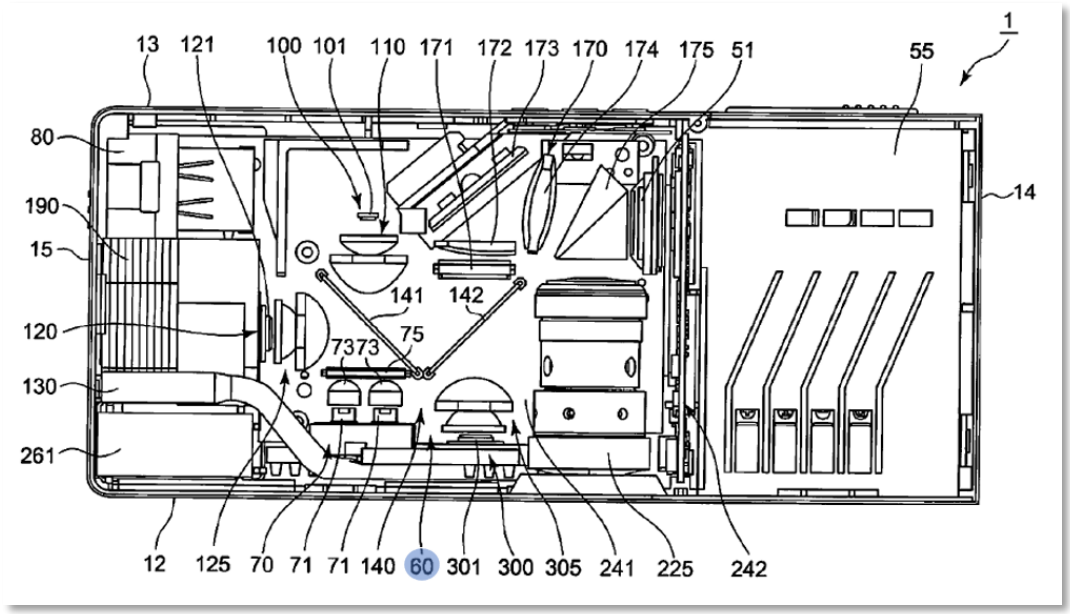
96. Though this arrangement would prevent unconverted light from the lefthand excitation light source 71 from feeding back to the same lefthand excitation light source 71, it would not prevent unconverted light from the lefthand excitation light source 71 from feeding back to the righthand excitation light source. A POSITA, upon review of Alpay, would be motivated to also offset both excitation light sources 71 (with collimator lenses 73 and microlens array 75) from the optical axis of collective lens 110 in Figure 5's Y-axis, out of the plane of Figure 5, or by shifting the righthand excitation light source 71 (with collimator lenses 73 and microlens array 75) in X-axis direction to make the incident angles of the excitation lights of the two excitation light sources 71 to the luminescent material layer of luminescent plate 101 differently from each other. This arrangement in view of Alpay would prevent unwanted feedback of unconverted excitation light from either excitation light source.

97. A POSITA would thus have naturally looked to the teachings of Alpay and its asymmetrical arrangement as a means of achieving these benefits by modifying the arrangement of the light source in Kurosaki to avoid the light source from being disposed at the light path of the reflected excitation light so as to reduce or prevent overlap between the reflected laser beam and the incident laser beam. EX1005, [0010] ("The lens includes a primary axis that is substantially parallel to, and offset from, the first axis of propagation.").

1. Independent Claim 1

[1.0] A light source device, comprising:

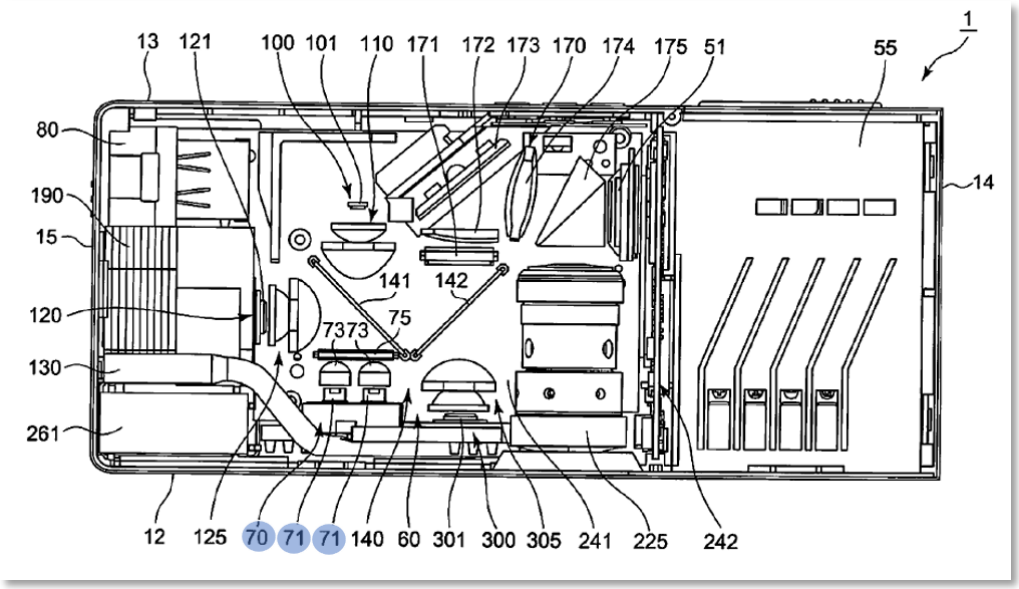
98. Kurosaki discloses a light source device, identified as a "light source unit 60[.]" EX1012, [0023].



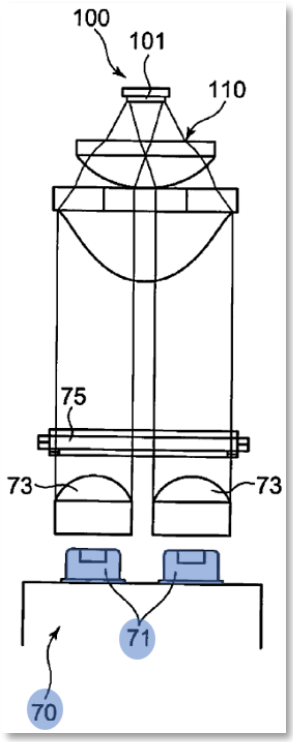
EX1012, Fig. 3 (annotated).

[1.1] a plurality of excitation light sources which emit excitation light;

99. Kurosaki discloses that its light source device (light source unit 60) comprises an "excitation light shining unit 70" that includes two (*i.e.*, a plurality of) "excitation light sources 71[.]" EX1012, [0041].



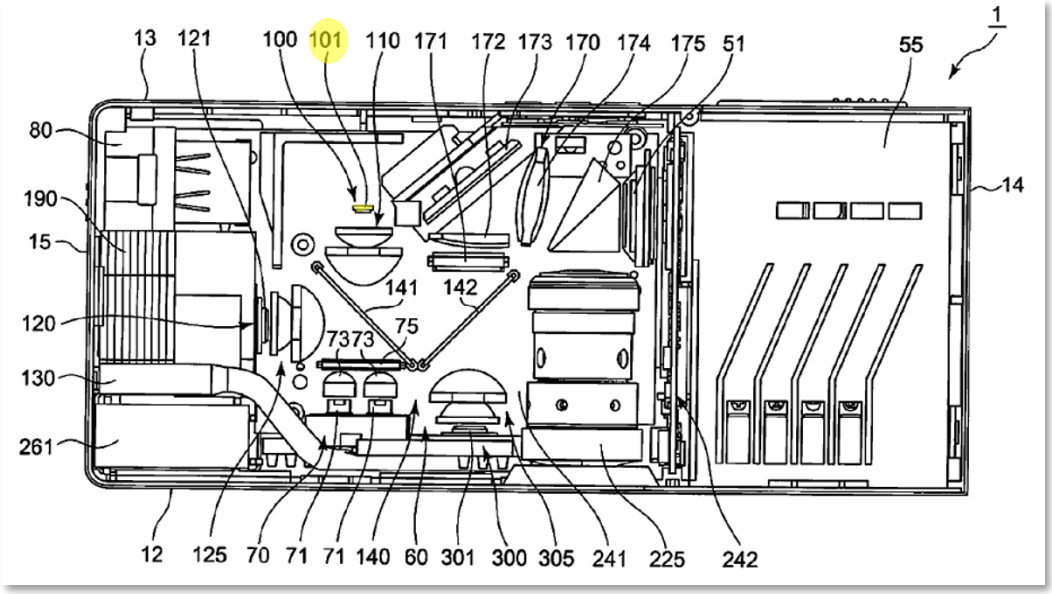
EX1012, Fig. 3 (annotated).



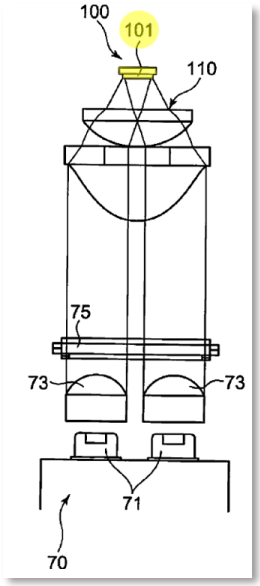
Id., Fig. 5 (annotated). Each excitation light source is a blue laser that emits a laser beam as excitation light. EX1012, [0041]-[0042].

[1.2] a phosphor which changes the excitation light to fluorescent light;

100. Kurosaki discloses a luminescent plate 101 has a rectangular green luminescent material layer that "generates green luminescent light by use of a laser beam emitted from excitation light source 71 as excitation light and emits this green luminescent light[.]" EX1012, [0041]-[0042]. A POSITA would understand that the luminescent material layer of luminescent plate 101 is typically a phosphor and luminescent light is the fluorescent light.



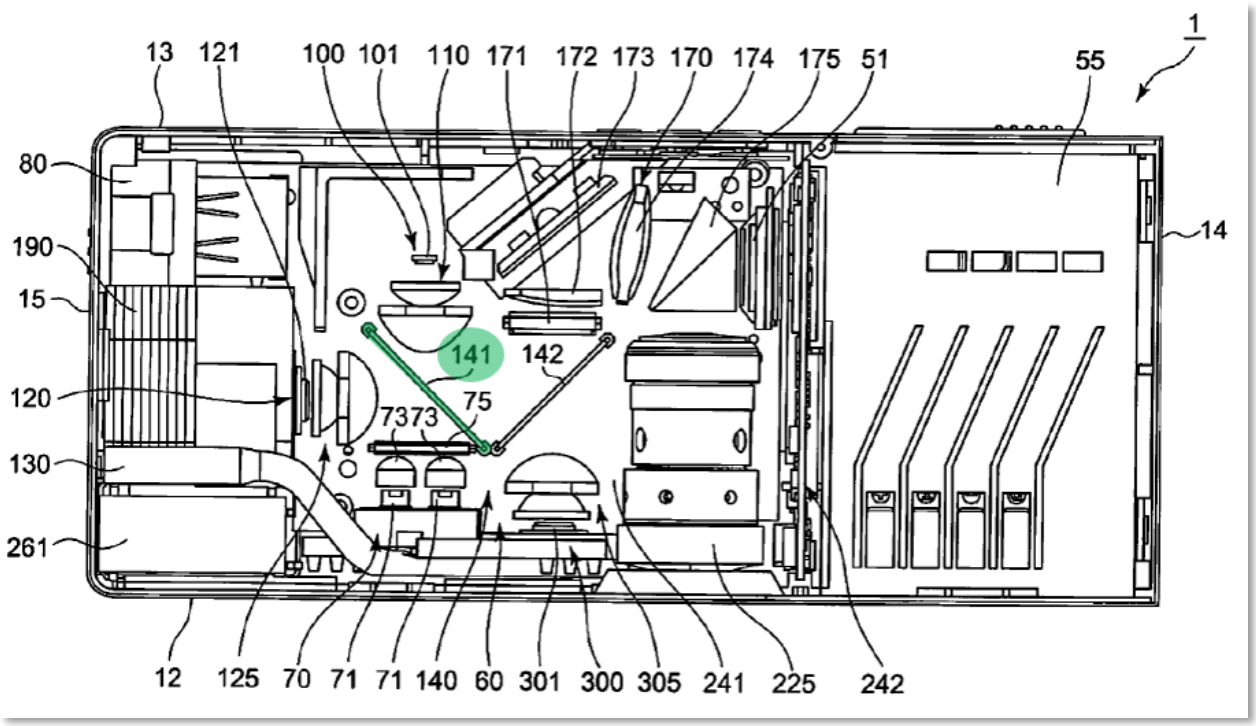
EX1012, Fig. 3 (annotated).



Id., Fig. 5 (annotated).

[1.3] a dichroic mirror which transmits the excitation light and reflects the fluorescent light; and

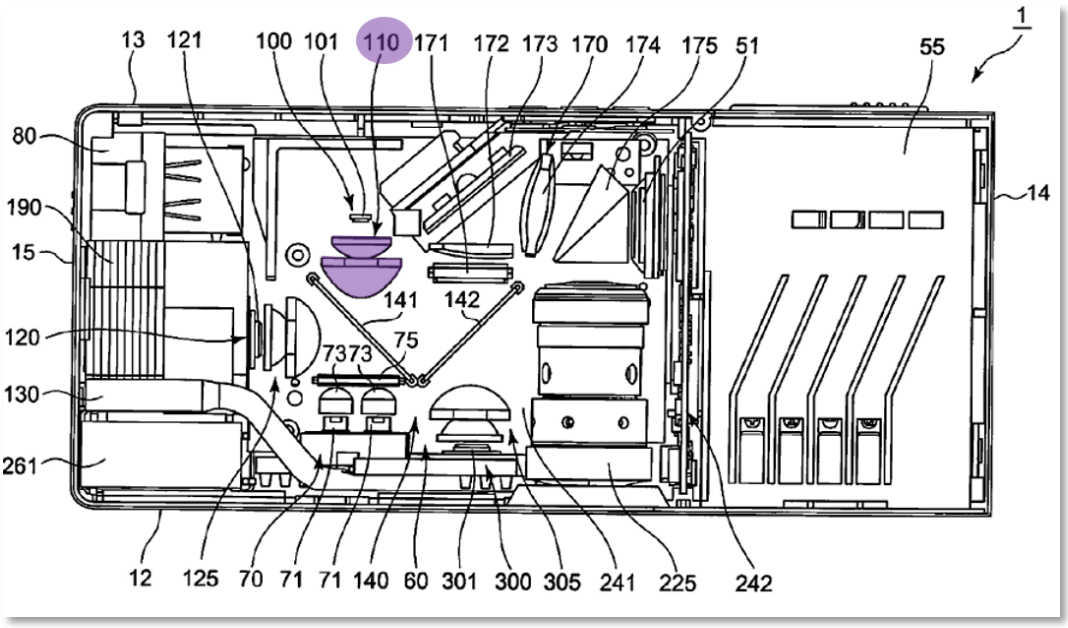
101. Kurosaki discloses a "dichroic mirror 141 which transmits excitation light from the excitation light shining unit 70 . . . and reflects luminescent light emitted from the luminescent plate 101[.]" EX1012, [0044]



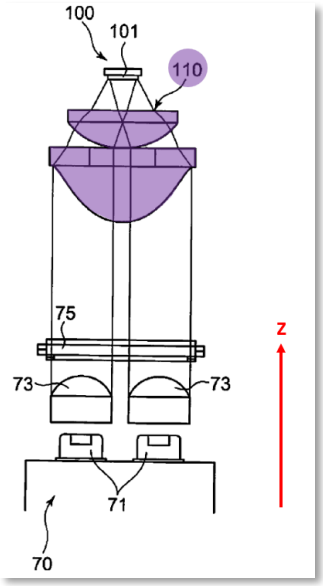
EX1012, Fig. 3 (annotated).

[1.4] a condensing lens which condenses the excitation light transmitted through the dichroic mirror in an excitation light irradiation region on the phosphor,

102. Kurosaki discloses a condensing lens (collective lens 110) that condenses excitation light transmitted through the dichroic mirror "on to the luminescent material layer [of luminescent plate 101] . . . so that the center positions thereof [*i.e.*, an excitation light irradiation region] are superposed one on another on the luminescent material layer." EX1012, [0025]



EX1012, Fig. 3 (annotated).



Id., Fig. 5 (annotated).

[1.5] wherein the plurality of light sources are arranged so that each excitation light emitted from each of the plurality of light sources enters asymmetrically to a center of the condensing lens; and

103. Kurosaki discloses that, there are "two excitation light sources 71", "[t]his excitation light source 71 is a blue laser emitter and emits a laser beam[.]" EX1012, [0041]. As shown in Figure 5, the laser beam emitted by each excitation light source 71 enters offset from the optical axis of the condensing lens (collective lens 110). EX1012, Fig. 5. Therefore, each excitation light emitted from each excitation light source 71 enters asymmetrically to the center of Kurosaki's condensing lens (i.e., collective lens 110).

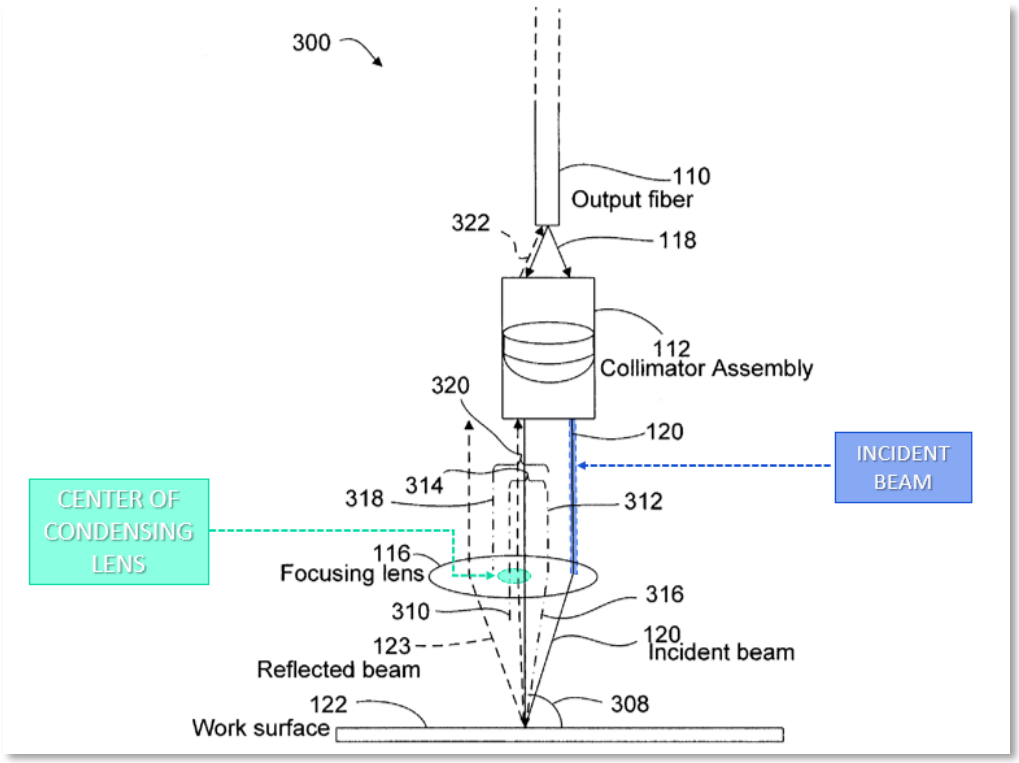
104. Moreover, Alpay teaches a light source arranged so that excitation light emitted from the light source enters asymmetrically to a center of the condensing lens. Specifically, Alpay teaches that light must be prevented from reflecting back to damage the light source:

> Generally, certain lasers may be sensitive to optical feedback such as a laser beam reflected back to the laser from a work surface. ***If such reflections are not properly blocked, e.g., if there is a return path for such reflections to couple back into an output fiber, it is possible that both the output fiber and gain fibers may be damaged.***

EX1005, [0003] (emphasis added); *see also id.,* [007].

105. Alpay teaches that one method to prevent such damage is to "reduce or avoid back-reflections" by "'tilt[ing]' the entire beam delivery system with respect to the work surface 122 so that ***the angle of incidence of the beam hitting the work surface is not 90 degrees***." EX1005, [0007] (emphasis added). "[A]n offset 314

between the first axis of propagation 312 of the incident laser beam 120 and the primary axis 310 of the focusing lens 116. In other words, the (collimated) incident laser beam 120 does not hit the focusing lens 116 at the center of the lens 116 (as in the standard layouts shown in FIGS. 1 and 2). Rather, the incident laser beam 120 hits the focusing lens 116 at an offset 314 from the center of the lens 116." EX1005, [0027]; *see also id.*, [0028]-[0029]. Alpay further teaches that an asymmetric arrangement is preferred because the "asymmetric arrangement provided by the offset 314 between the first axis of propagation 312 of the incident laser beam 120 and the primary axis 310 of the focusing lens 116, the focusing lens 116 'tilts' the incident laser beam 120 toward the primary axis of the focusing lens 116." EX1005, [0028]. "***[T]he path of the reflected laser beam 123 is angularly separated from the path of the incident laser beam 120*** . . . such that the reflected laser beam 123 does not overlap with the incident laser beam 120. Thus, all or at least a substantial portion of the reflected laser beam 123 does not return through the collimator assembly 118 to the output fiber 110." EX1005, [0029] (emphasis added). This arrangement is depicted in Figure 3.



EX1005, Fig. 3 (annotated).

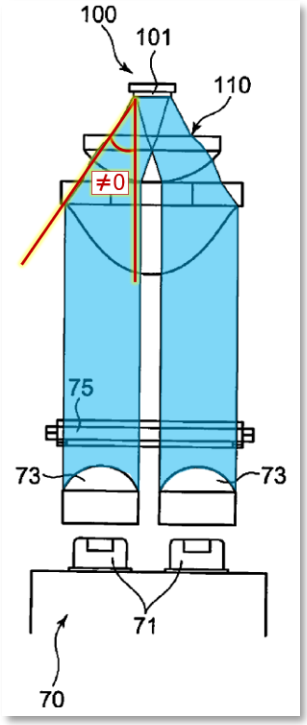
106. As explained above, a POSITA, in view of Alpay, would be motivated to also offset one or both light sources 71 (together with collimator lenses 73 and microlens array 75) from the optical axis of collective lens 110 in Figure 5's Y-axis; this is out of the plane of Figure 5. Such a source arrangement would prevent unwanted feedback of unconverted excitation light from either excitation light source.

107. Further, in view of Alpay a POSITA would have displaced laterally the light sources 71 (together with collimator lenses 73 and microlens array 75) of Kurosaki, in either x, or y, or both directions to avoid back reflections; this would resulted in an asymmetric arrangement of the light beams.

108. A POSITA would have recognized the advantage of implementing the asymmetric arrangement of Alpay into the light source device of Kurosaki to reduce or avoid the back reflections to the light sources so as to protect the light sources and improve the reliability of the light source device described by Kurosaki as explained above.

[1.6] wherein when the excitation light irradiation region is a center and an incident angle to the excitation light irradiation region of any excitation light of each of the excitation light is an elevation angle θ, θ≠0 is satisfied.

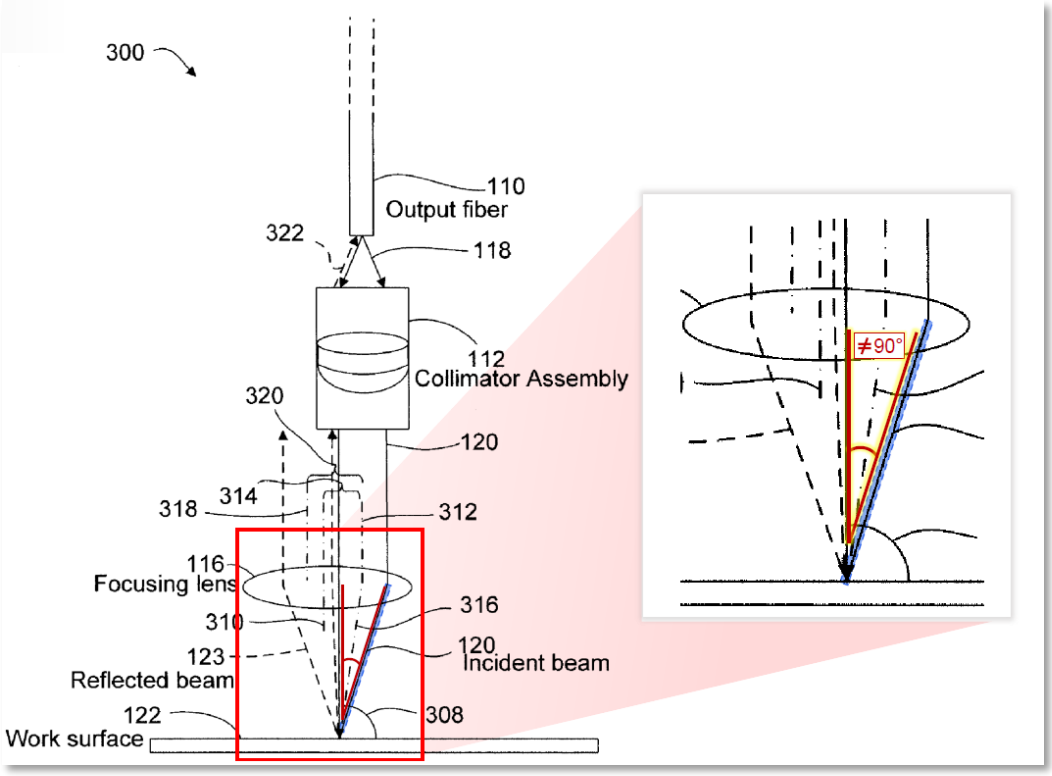
109. Kurosaki's Figure 5 discloses an arrangement where excitation light enters obliquely to the luminescent plate 101 from the left- and right-hand sides of the central axis of luminescent plate 101:



EX1012, Fig. 5 (annotated).

110. Figure 5 thus discloses "an incident angle to the excitation light irradiation region of any excitation light of each of the excitation light is an elevation angle θ, θ≠0 is satisfied."

111. Moreover, Alpay discloses an arrangement where an excitation light delivery subsystem is "tilt[ed]" with respect to an excitation light irradiation system (work surface 122 in Alpay) "so that the angle of incidence of the beam hitting the work surface is not 90 degrees" as shown in Figure 3, which means that the incident angle (elevation angle) θ is not equal to 0.



EX1005, Fig. 3 (annotated)

112. As discussed above, a POSITA would have been motivated to combine the teachings of Alpay with those of Kurosaki to protect Kurosaki's light sources and improve output of the light sources of Kurosaki.

2. Dependent Claim 3

[3.0/3.1] The light source device according to claim 1, wherein when the excitation light irradiation region is a center, in an incident angle to the excitation light irradiation region of first excitation light of each of the excitation lights, an elevation angle is θm and an azimuth angle is φm, and in an incident angle to the excitation light irradiation region of second excitation light different from the first excitation light, an elevation angle is θn and an azimuth angle is φn, there is no pair of the excitation lights in which θm−2°≦θn≦θm+2°, and φm+178°≦ φn ≦φm+182° are established.

113. As the '530 Patent makes clear, the purpose of this limitation is to avoid light of an excitation light source from overlapping with unconverted light when entering or exiting the light irradiation region, thus preventing unconverted light from entering any light source and potentially damaging or degrading that light source. EX1001, 6:37-7:5.

114. The disclosure of Alpay, when combined with the light source device of Kurosaki, makes the limitations of Claim 3 obvious. Alpay discloses the use of an arrangement in which a light source is off-axis from the optical path of a condensing lens to avoid back reflections. *See* EX1005, [0007] ("Another approach to reduce or avoid back-reflections is to 'tilt' the entire beam delivery subsystem with respect to the work surface 122 so that the angle of incidence of the beam hitting the work surface is not 90 degrees."), [0027] ("[T]he (collimated) incident laser beam 120 does not hit the

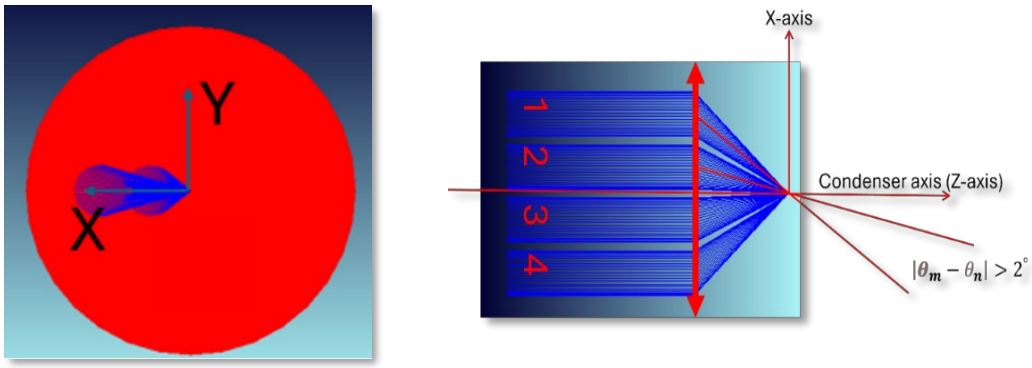
focusing lens 116 at the center of the lens 116 . . . . Rather, the incident laser beam 120 hits the focusing lens 116 at an offset 314 from the center of the lens 116."), [0028] ("[T]he focusing lens 116 changes the incident laser beam's path from the first axis of propagation 312 to a second axis of propagation 316 that intersects the work surface 122 at a non-perpendicular angle of attack 308."), [0029] (***"[T]he path of the reflected laser beam 123 is angularly separated from the path of the incident laser beam 120 . . . such that the reflected laser beam 123 does not overlap with the incident laser beam 120."***) (emphasis added)).

115. Though the specific mathematical conditions recited in Claim 3 are not explicitly disclosed by Alpay, these conditions would have been obvious to a POSITA in view of Alpay and/or through routine experimentation. A POSITA intending to avoid potentially damaging feedback by unconverted excitation light, would be motivated to stay well clear of arrangements where the reflected beams would return to any laser source. The combination of Kurosaki and Alpay, as explained below, would have resulted in the specific mathematical conditions recited in Claim 3 not being established; this would have been nothing more than applying known methods to produced expected results.

116. The claim requires that both mathematical conditions $\theta m-2° \leqq \theta n \leqq \theta m+2°$ and $\varphi m+178° \leqq \varphi n \leqq \varphi m+182°$ must not be met. The figures below illustrate that the

application of Alpay's teachings to Kurosaki would have resulted in the specific mathematical conditions of -2°≦θn-θm≦2° and 178°≦φn-φm≦182° not being met.

117. A POSITA having reviewed Alpay could have moved one or both of the excitation light sources (together with collimator lenses 73 and microlens array 75) of Kurosaki along the X-axis such that both excitation light sources, and thus the excitation light beams coming from each excitation light source, sat on one side of the Z-axis (*i.e.*, the optical path of the condensing lens of Kurosaki).

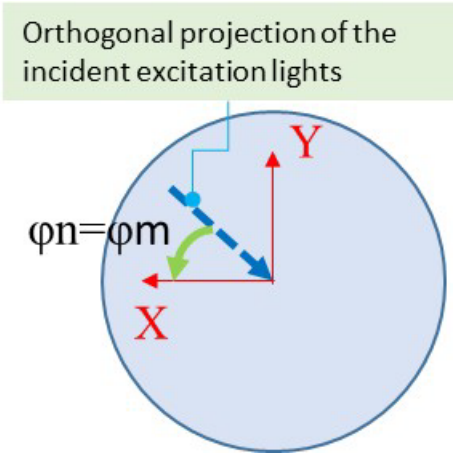


118. The lefthand figure above, viewed along the Z-axis (the optical axis of the condenser lens), shows the two light sources (together with collimator lenses 73 and microlens array 75) of Kurosaki being shifted leftward along the X-axis offset from the optical axis of the condenser lens based on the teachings from Alpay.

119. The righthand figure shows this same arrangement but viewed along the Y-axis. As shown in the righthand figure, the incident excitation light beams (labeled

1 and 2) would have elevation angles θ that are different by more than 2°, thus failing to meet the mathematical condition θm−2°≦θn≦θm+2° as Claim 3 requires.

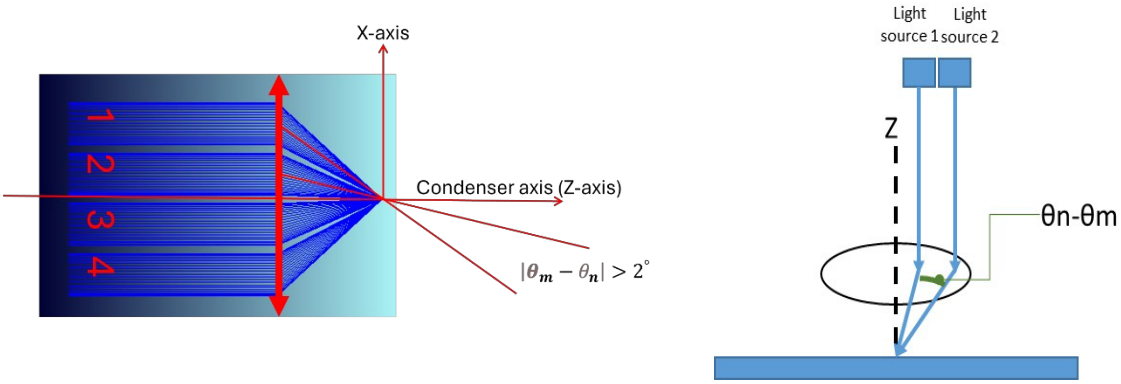
120. The righthand figure also shows the beams of reflected, unconverted excitation light (labeled 3 and 4), are not on the same path as the incident excitation light path.



121. Moreover, based on the same arrangement described above, the resulting azimuth angles φn and φm of the excitation light beams, which are the angle between the x-axis and the orthogonal projection of the incident excitation lights on the x-y plane respectively, would be the same (φn=φm). As such, it would fail to meet the mathematical condition φm+178°≦ φn ≦φm+182° as Claim 3 requires.

122. A POSITA, with an understanding of the disclosure of Alpay, would have understood that the arrangement of the light sources of Kurosaki disposed on one side of the optical axis of the condenser lens would have or obviously have the differences

in elevation angles larger than 1, 2, 3, 4 , or 5 degrees as shown below. This is also because the converging and focusing light from each excitation light has an angular expansion of more than a few degrees, i.e. 2, 3, 4, 5, 6 or more degrees.



123. Furthermore, this is not the only possible arrangement. Working from the arrangement of Kurosaki in view of Alpay, a POSITA would have understood that any arrangement in which the difference in the elevation angle of each excitation light source was sufficiently large (*i.e.*, for example 5°, 10°, or more degrees) would prevent undesirable back reflections as taught by Alpay.

124. A POSITA, with an understanding of the disclosure of Alpay, would also have understood that differences in elevation angles that were too small (*i.e.*, for example 1° or 2°) might not prevent unwanted back reflections when the light sources are not on the same side of the optical axis of the condenser lens, and would have considered arrangements that resulted in a difference of elevation angles larger than, for example 5, 10, or 15 degrees. Thus, in the course of avoiding back reflections a POSITA would not have met the mathematical conditions of Claim 3.

125. Thus, this Claim element is obvious upon Kurosaki and Alpay.

3. Dependent Claim 4

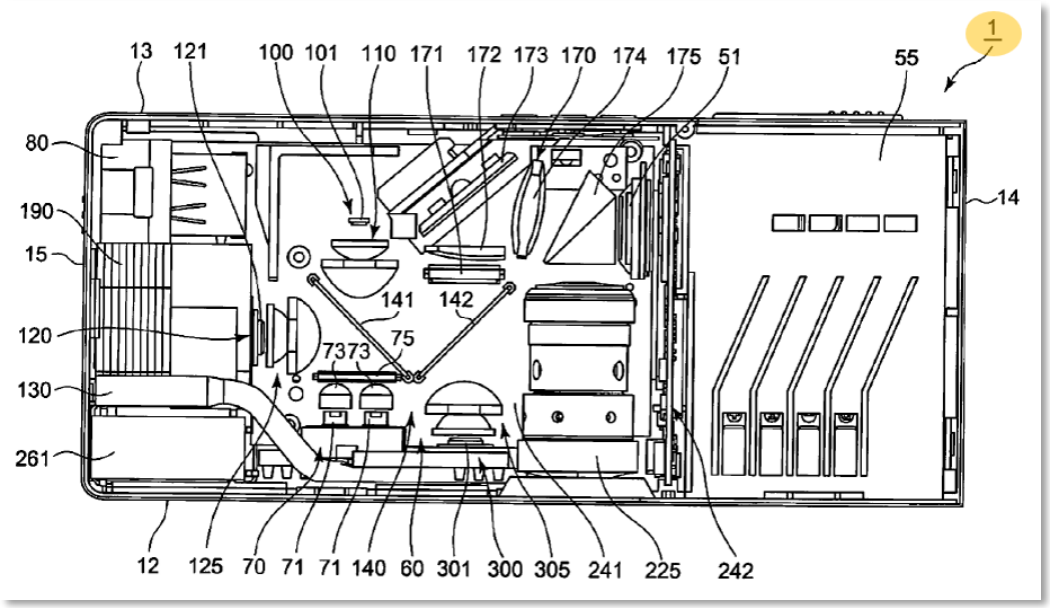
[4.0/4.1] The light source device according to claim 1, wherein the excitation light source is a solid light-emitting element.

126. Claim 4 is obvious over Kurosaki in view of Alpay. Kurosaki discloses that its excitation light source is a blue laser emitter that emits a laser beam. EX1012, [0041]. A POSITA would understand that a laser emitter could be a solid light-emitting element. In addition, a POSITA would have understood that the laser in Kurosaki would have been a solid light-emitting element such as a laser diode as shown in Figures 3 and 5 of Kurosaki.

4. Dependent Claim 7

[7.0] A projection type video display device, comprising:

127. Kurosaki discloses a projection type video display device in the form of projector 1 as depicted in Figure 3:



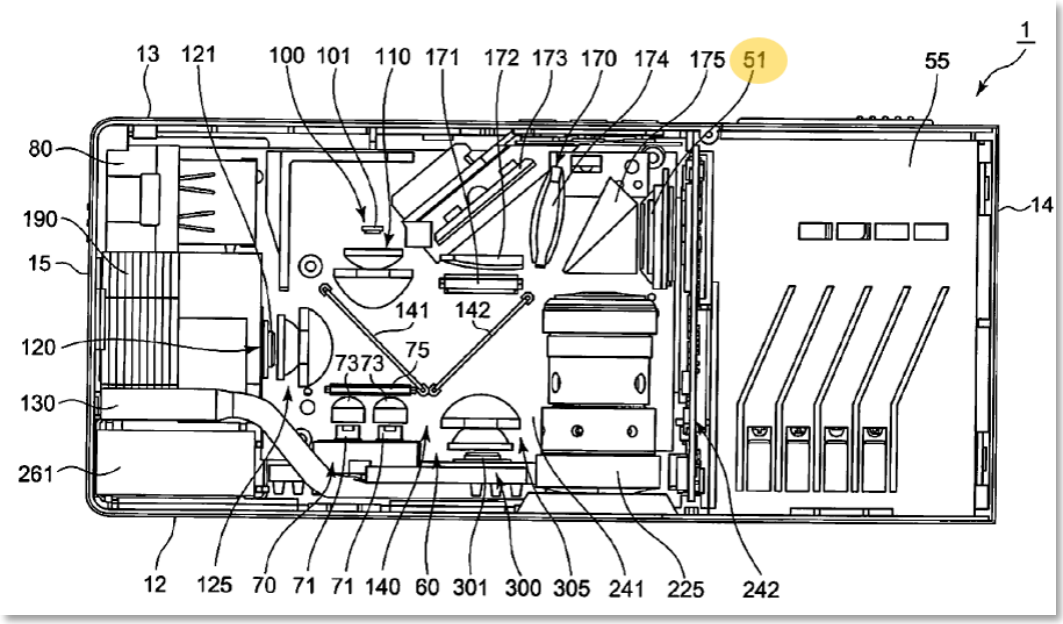
EX1012, Fig. 3 (annotated); *see also id.*, [0022].

[7.1] the light source device according to claim 1;

128. The combination of Kurosaki and Alpay teaches a light source device according to Claim 1. *See supra* Ground 2, Claim 1

[7.2] a video display element;

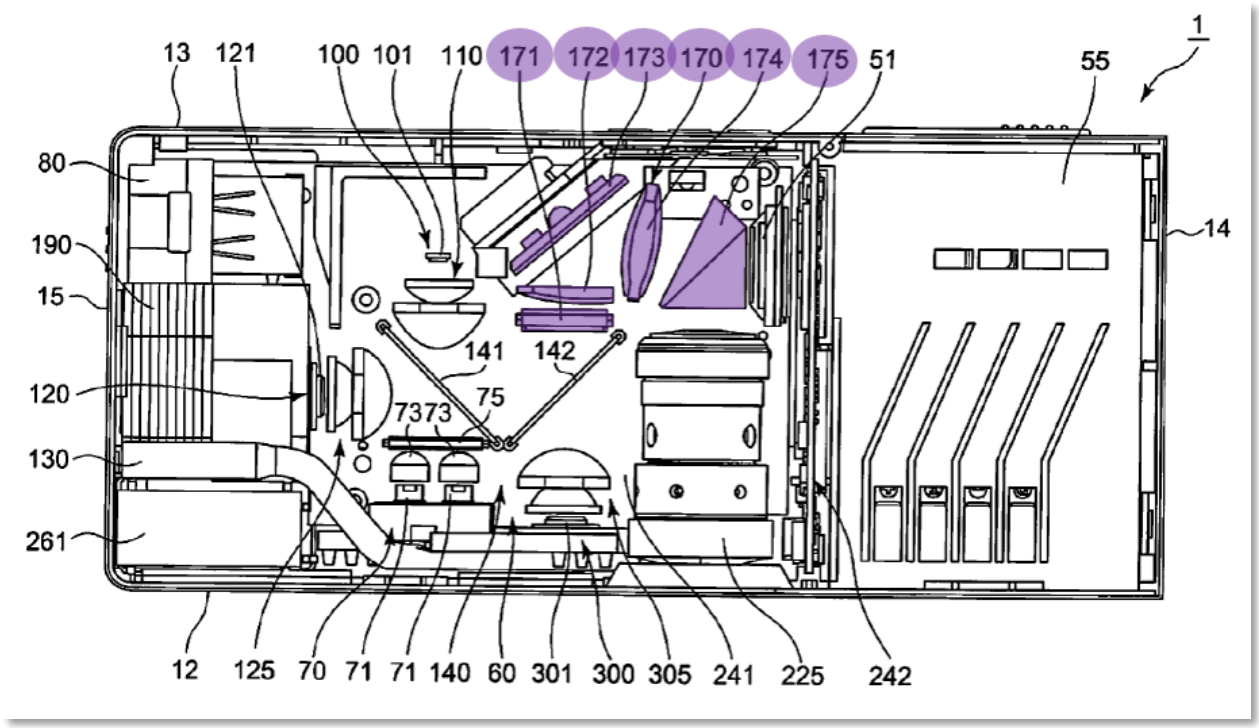
129. Kurosaki discloses a video display element in the form of "display device 51[,]" which can be a DMD. EX1012, [0038].



EX1012, Fig. 3 (annotated). As the '530 Patent makes clear, a DMD is a video display element. EX1001, 19:48-49 ("The video display element in this example may be a DMD (Digital Mirror Device) element[.]")

[7.3] an illumination optical system which has a plurality of optical elements applying light from the light source device to the video display element; and;

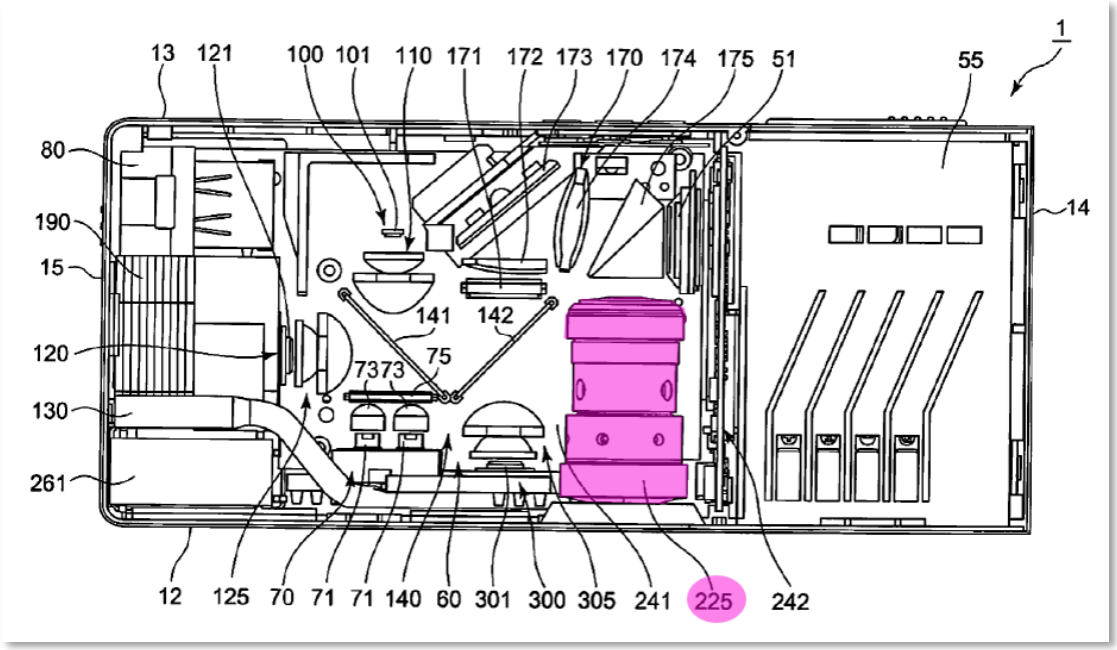
130. Kurosaki discloses an illumination optical system (light guiding system 170) that applies light from Kurosaki's light source device (light source unit 60) to Kurosaki's video display element (display device 51). EX1012, [0022]. Kurosaki's light guiding system 170 includes "a microlens array 171, an optical axis alteration mirror 173 . . . , a collective lens 172 . . . , a collective lens 174 . . . , and a prism 175." EX1012, [0050]. A POSITA would recognize these components as "optical elements" as required by this Claim Element.



EX1012, Fig. 3 annotated.

[7.4] a projection lens which enlarges and projects an optical image formed by the video display element.

131. Kurosaki discloses a "projection-side optical system" that is incorporated in a lens barrel 225. EX1012, [0033], [0052]. The projection-side optical system includes "a fixed lens group and a movable lens group[.]" *Id.*, [0052].



EX1012, Fig. 3 (annotated); A POSITA would understand that any of the lenses included in the fixed lens group or the movable lens group would meet the limitations of this Claim Element.

5. Independent Claim 9

[9.0] A light source device, comprising:

132. Kurosaki discloses a light source device. Claim Element [9.0] is identical to Claim Element [1.0]. *Compare* EX1001, 20:17 *with id.*, 21:55. For the same reasons that Kurosaki discloses the limitations of Claim Element [1.0], Kurosaki discloses the limitations of Claim Element [9.0]. *See supra* Ground 2, Claim 1, Claim Element [1.0].

[9.1] an excitation light source which emits excitation light;

133. Claim Element [9.1] is substantially similar to Claim Element [1.1], with the only difference being that Claim Element [9.1] requires "an" excitation light source

while Claim Element [1.1] requires a plurality of excitation light sources. *Compare* EX1001, 20:18-19 *with id.*, 21:56. For the same reasons that Kurosaki teaches a plurality of excitation light sources which emit excitation light, it discloses "an" excitation light source which emits excitation light. *See supra* Ground 2, Claim 1, Claim Element [1.1].

[9.2] a phosphor which changes the excitation light to fluorescent light;

134. Claim Element [9.2] is identical to Claim Element [1.2]. *Compare* EX1001, 20:20-21 *with id*, 21:57-58. For the same reasons Kurosaki teaches every limitation of Claim Element [1.2], it discloses every limitation of Claim Element [9.2]. *See supra* Ground 2, Claim 1, Claim Element [1.2].

[9.3] a dichroic mirror which transmits the excitation light and reflects the fluorescent light; and

135. Claim Element [9.3] is identical to Claim Element [1.3]. *Compare* EX1001, 20:22-23 *with id.*, 21:59-60. For the same reasons Kurosaki discloses every limitation of Claim Element [1.3], it discloses every limitation of Claim Element [9.3]. *See supra* Ground 2, Claim 1, Claim Element [1.3].

[9.4] a condensing lens which condenses the excitation light transmitted through the dichroic mirror in an excitation light irradiation region on the phosphor,

136. Claim Element [9.4] is identical to Claim Element [1.4]. *Compare* EX1001, 20:24-26 *with id.*, 21:61-63. For the same reasons Kurosaki discloses every

limitation of Claim Element [1.4], it discloses every limitation of Claim Element [9.4]. *See supra* Ground 2, Claim 1, Claim Element [1.4].

> **[9.5] wherein the excitation light sources are arranged so that when excitation light emitted from the excitation light source enters the excitation light irradiation region and is reflected without being converted into fluorescent light, the unconverted excitation light is prevented from entering the excitation light source; and**

137. As explained above, Alpay teaches an arrangement where excitation light enters asymmetrically to a center of the condensing lens. *See supra* Ground 2, Claim 1, Claim Element [1.5]. Alpay further teaches that an asymmetric arrangement is preferred because the "asymmetric arrangement provided by the offset 314 between the first axis of propagation 312 of the incident laser beam 120 and the primary axis 310 of the focusing lens 116, the focusing lens 116 'tilts' the incident laser beam 120 toward the primary axis of the focusing lens 116." EX1005, [0028]; *see also supra* Ground 2, Claim 1, Claim Element [1.5].

138. A POSITA would have recognized the advantage of implementing the asymmetric arrangement of Alpay into the light source device of Kurosaki to avoid degradation or damage of the light source device described by Kurosaki and improved its reliability as explained above.

[9.6] wherein when the excitation light irradiation region is a center and an incident angle to the excitation light irradiation region of any excitation light of each of the excitation light is an elevation angle θ, θ≠0 is satisfied.

139. Claim Element [9.6] is identical to Claim Element [1.6]. *Compare* EX1001, 20:31-37 *with id.*, 22:3-9. For the same reasons both Kurosaki and Alpay teach every limitation of Claim Element [1.6], they disclose every limitation of Claim Element [9.6]. *See supra* Ground 2, Claim 1, Claim Element [1.6].

C. Ground 3: Kurosaki in View of Abu-Ageel Renders Claim 9 Obvious

140. In my opinion and for the reasons explained below, Kurosaki in view of Abu-Ageel renders obvious the subject matter recited by claim 9 of the '530 Patent.

141. As a threshold matter, a POSITA would have been motivated to combine Kurosaki with Abu-Ageel, and would have had a reasonable expectation of success in making the combination. Kurosaki and Abu-Ageel are analogous and/or complimentary art because they disclose laser light sources. Kurosaki describes a projection type display apparatus including a light source device using lasers. Abu-Ageel describes a high-brightness light source using lasers.

142. Prior to the '530 Patent, it was well known that back reflections affected, degraded, or impaired the performance of laser diodes. EX1005, [0003] ("[C]ertain lasers may be sensitive to optical feedback such as a laser beam reflected back to the laser from a work surface. . . . [I]t is therefore desirable to prevent such back-reflections from finding a path back into the output fiber."); *see also* EX1013, 1:11-17 ("For many

applications back-reflection of the light emitted by a laser diode into the laser active region has a significant, negative, impact on the performance of the laser."); EX1014, 1:19-22 ("In high power fiber-optic systems, optical isolators are used to protect low-power components from damage that may be caused by back-reflected light from amplifiers or other components."). By the time of the priority date of the '530 Patent, not only was this problem known, but tools had been developed to combat this problem, such as optical isolators. EX1005, [0004]-[0005]; EX1013; EX1014. Optical isolators, however, "are usually quite bulky (especially when configured for use with high-power beams) and expensive." EX1005, [0006]. A POSITA would have known this and would have at least considered protecting the laser diodes of Kurosaki by the means taught by Abu-Ageel, which discloses a different method to prevent unwanted, destabilizing feedback, or by the use of optical isolators that were well known and used in front of laser diodes in applications such as telecommunications and high power lasers. In other words, by the time of the priority date of the '530 patent it was well known that back reflections can affect adversely the performance of a laser. Therefore, a POSITA looking at Kurosaki would have considered the teaching of Abu-Ageel.

143. A POSITA designing a light source device like that of Kurosaki would have been aware of this problem and would have understood that arrangements like that of Abu-Ageel addressed the issue. Interested in preventing potential damage to excitation light sources within such a device, a POSITA would have looked to Abu-

Ageel and similar art to accomplish this goal. This would have been nothing but following known methods with predictable results to improve the reliability of the Kurosaki projector.

1. Independent Claim 9

[9.0] A light source device, comprising:

144. Kurosaki discloses a light source device. *See supra* Ground 2, Claim 9, Claim Element [9.0].

[9.1] an excitation light source which emits excitation light;

145. As explained above, Kurosaki teaches Claim Element [9.1]. *See supra* Ground 2, Claim 9, Claim Element [9.1].

[9.2] a phosphor which changes the excitation light to fluorescent light;

146. As explained above, Kurosaki teaches Claim Element [9.2]. *See supra* Ground 2, Claim 9, Claim Element [9.2].

[9.3] a dichroic mirror which transmits the excitation light and reflects the fluorescent light; and

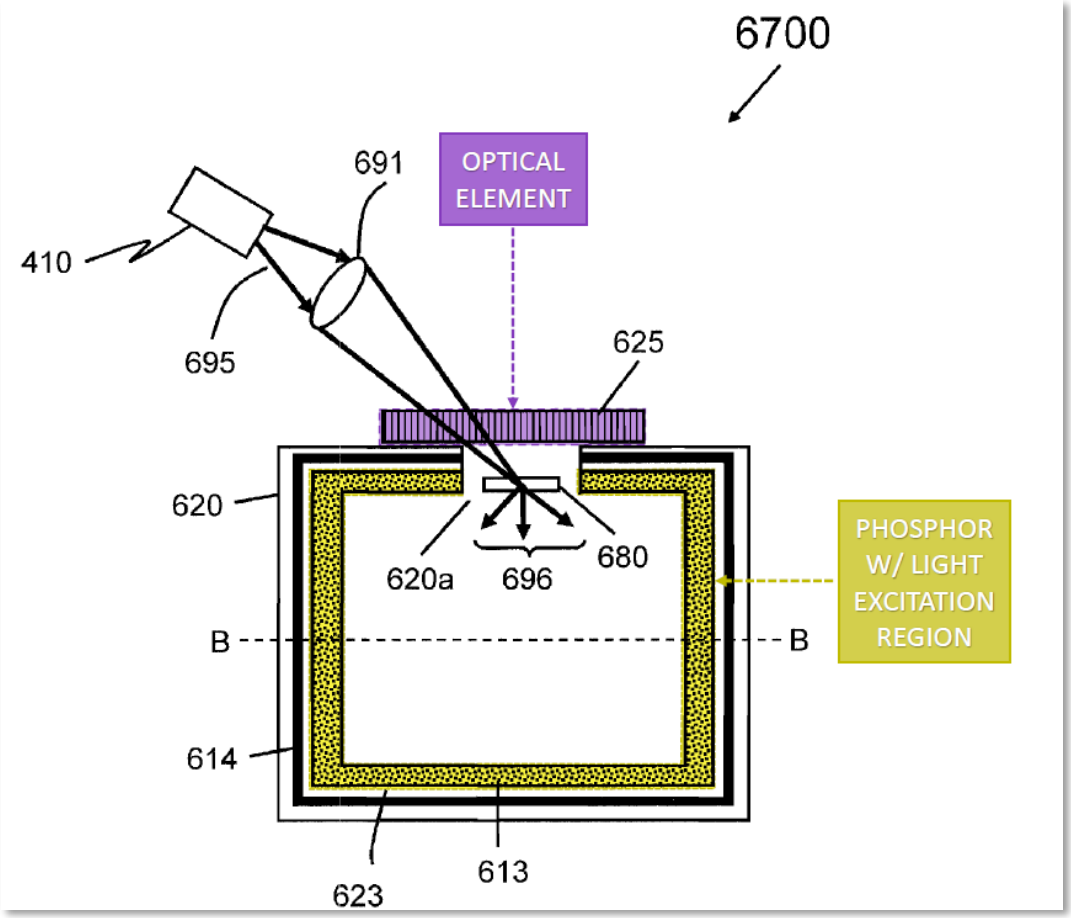
147. As explained above, Kurosaki discloses Claim Element [9.3]. *See supra* Ground 2, Claim 9, Claim Element [9.3].

[9.4] a condensing lens which condenses the excitation light transmitted through the dichroic mirror in an excitation light irradiation region on the phosphor,

148. As explained above, Kurosaki discloses Claim Element [9.4]. *See supra* Ground 2, Claim 9, Claim Element [9.4].

[9.5] wherein the excitation light sources are arranged so that when excitation light emitted from the excitation light source enters the excitation light irradiation region and is reflected without being converted into fluorescent light, the unconverted excitation light is prevented from entering the excitation light source; and

149. Abu-Ageel teaches an arrangement where excitation light sources are arranged so that when excitation light emitted from the excitation light source enters the excitation light irradiation region and is reflected without being converted into fluorescent light, the unconverted excitation light is prevented from entering the excitation light source.



EX1007, Fig. 3C (annotated).

150. Figure 3C depicts a light envelope 620 into which excitation light 695 is directed (or focused) through aperture 620a. EX1007, [0087]. Upon entry, such light is converted by an excitation light region of a phosphor (wavelength conversion layer 613). EX1007, [0087]; *see also id.* at [0005] (identifying a "wavelength conversion layer" as a phosphor). An optical element 625 is preferably a coating that reflects non-converted light back into the light envelope, thus preventing it from reaching the light source 411 (incorrectly designated 410 in Figure 3C). EX1007, Fig. 3C, [0087]. A POSITA would have considered the teachings of Abu-Ageel and would have included an optical element like 625 in the excitation light to block or prevent back reflections of excitation light. In addition, it would have been obvious to also insert an optical isolator in view of Abu-Ageel.

151. Thus, unconverted excitation light is prevented from entering the excitation light source.

[9.6] wherein when the excitation light irradiation region is a center and an incident angle to the excitation light irradiation region of any excitation light of each of the excitation light is an elevation angle θ, θ≠0 is satisfied.

152. As explained above, Kurosaki teaches Claim Element [9.6]. *See supra* Ground 2, Claim 9, Claim Element [9.6].

D. Ground 4: Huang in View of Alpay Renders Claims 1, 3, 4, and 9 Obvious

153. In my opinion and for the reasons explained below, Huang in view of Alpay renders obvious the subject matter recited by claims 1, 3, 4, and 9 of the '530 Patent.

154. As a threshold matter, a POSITA would have been motivated to combine Huang with Alpay, and would have had a reasonable expectation of success in making the combination. Huang and Alpay both employ lasers, and a POSITA would have looked at Alpay while considering the reliability of the lasers of Huang. Huang describes a light source device with a plurality of light sources, such as lasers. Prior to the '530 Patent, it was well known that back reflections affected, degraded, or impaired the performance of laser diodes. EX1005, [0003] ("[C]ertain lasers may be sensitive to optical feedback such as a laser beam reflected back to the laser from a work surface. . . . [I]t is therefore desirable to prevent such back-reflections from finding a path back into the output fiber."); *see also* EX1013, 1:11-17 ("For many applications back-reflection of the light emitted by a laser diode into the laser active region has a significant, negative, impact on the performance of the laser."); EX1014, 1:19-22 ("In high power fiber-optic systems, optical isolators are used to protect low-power components from damage that may be caused by back-reflected light from amplifiers or other components."). By the time of the priority date of the '530 Patent, not only was this problem known, but tools had been developed to combat this problem, such as optical isolators. EX1005, [0004]-[0005]; EX1013; EX1014. Optical isolators, however, "are usually quite bulky (especially when configured for use with high-power beams) and expensive." EX1005, [0006]. A POSITA would have known this and would have at least considered protecting the laser diodes of Huang by the means taught by

Alpay, which discloses a different method to prevent unwanted, destabilizing feedback, or by the use of optical isolators that were well known and used in the front of laser diodes in applications such as telecommunications and high power lasers. In other words, by the time of the priority date of the ’530 patent it was well known that back reflections can affect adversely the performance of a laser. Therefore, a POSITA looking at Huang would have considered or implemented the teachings of Alpay.

155. A POSITA would have understood as of the ’530 Patent’s priority date that some portion of excitation light emitted by Huang’s light sources 220 would not be converted by Huang’s wavelength transformer 410 and would be reflected back in the direction of light sources 220. *See, e.g.*, EX1008, [0048]; EX1001, 1:28-31. Though, as discussed below, Huang depicts an asymmetrical arrangement of light sources, Huang does not identify protecting the light sources described therein as the rationale for this asymmetrical arrangement. EX1003, ¶¶##. Moreover, it is uncertain that Huang’s arrangement prevents the issue of damaging back reflections. With the disclosure of Alpay and his or her own prior knowledge as a skilled artisan, such a POSITA would have recognized the advantage of implementing the asymmetric arrangement of Alpay into the light source device of Huang by further offsetting Huang’s light sources 220 from the optical axis of Huang’s optical device 310 to ensure that unconverted excitation light from any light source 220 does not enter either the same light source 220 it originated from or any other light source 220. Implementing

Alpay's teachings into the device disclosed by Huang would have provided further protection against reflected excitation light from reaching Huang's light sources. EX1005, [0003]; *see also* EX1013, 1:11-17; EX1014, 1:19-22. This would have been nothing but following known methods with predictable results and desirable to improve the projector reliability.

156. Huang's Figure 3B depicts an arrangement where light sources 220 are offset from the optical axis of optical device 310 in the X- and Y-axes of Figure 3B.

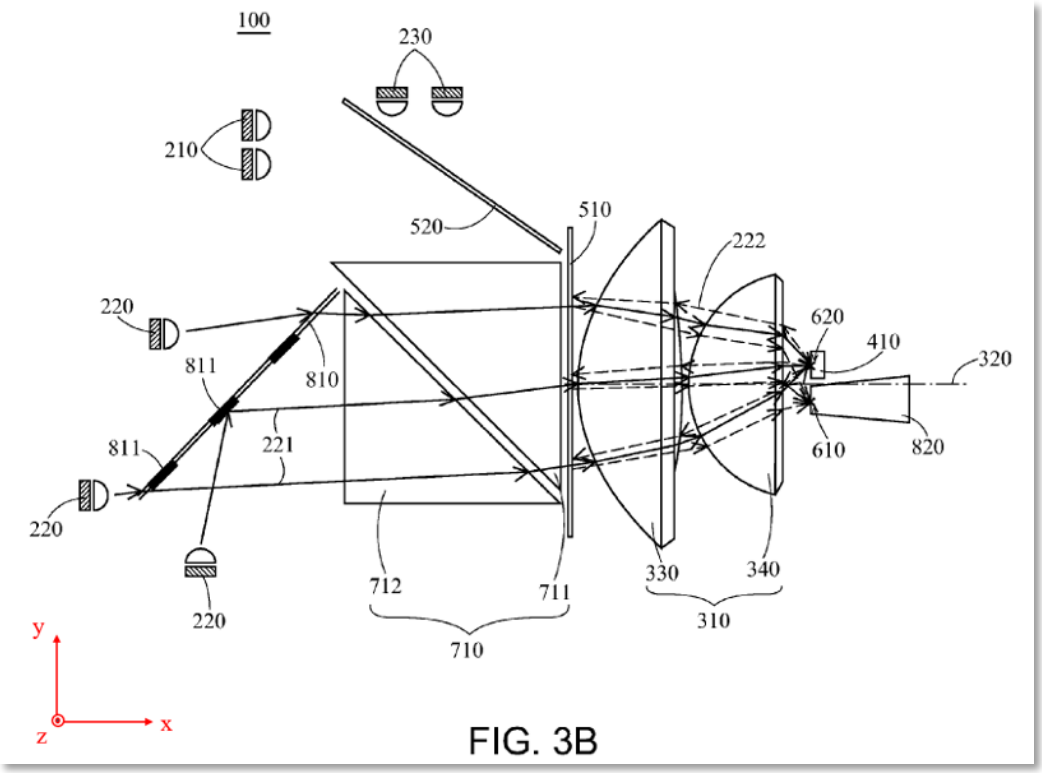


FIG. 3B

EX1009, Fig. 3B (annotated).

157. Though this arrangement would prevent unconverted light from the any light source 220 from feeding back to the ***same*** light source 220, it may not prevent

unconverted light from feeding back to other light sources 220. A POSITA, in view of Alpay, would be motivated to also offset all light sources 220 from the optical axis of collective lens 110 in Figure 3B's Z-axis, or by shifting certain excitation light source 220 in Y-axis or –Y-axis direction to make incident angles of the excitation lights 221 to the wavelength transformer differently from each other. As illustrated above this arrangement in view of Alpay would prevent unwanted feedback of unconverted excitation light from either excitation light source.

158. A POSITA would thus have naturally looked to the teachings of Alpay and its asymmetrical arrangement as a means of achieving these benefits by modifying the arrangement of the light source in Huang to avoid the light source from being disposed at the light path of the reflected excitation light so as to reduce or prevent overlap between the reflected laser beam and the incident laser beam. EX1005, [0010] ("The lens includes a primary axis that is substantially parallel to, and offset from, the first axis of propagation.").

1. Independent Claim 1

[1.0] A light source device, comprising:

159. Huang teaches a light source device. Huang discloses projecting devices comprising "a first light source 210 [and] a second light source 220." EX1009, 2:38-42.

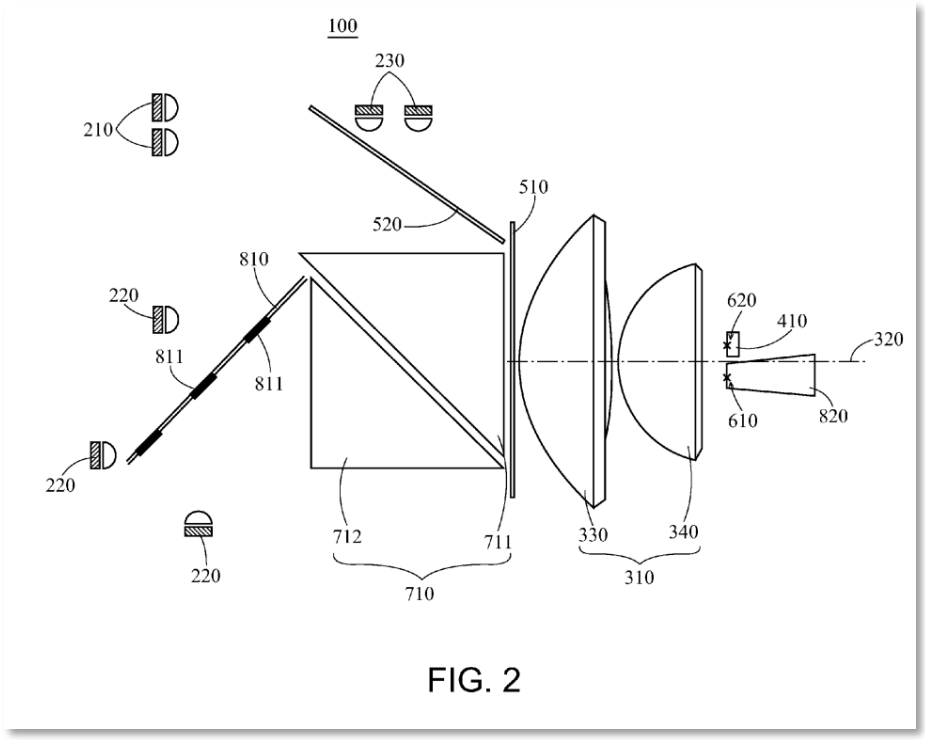
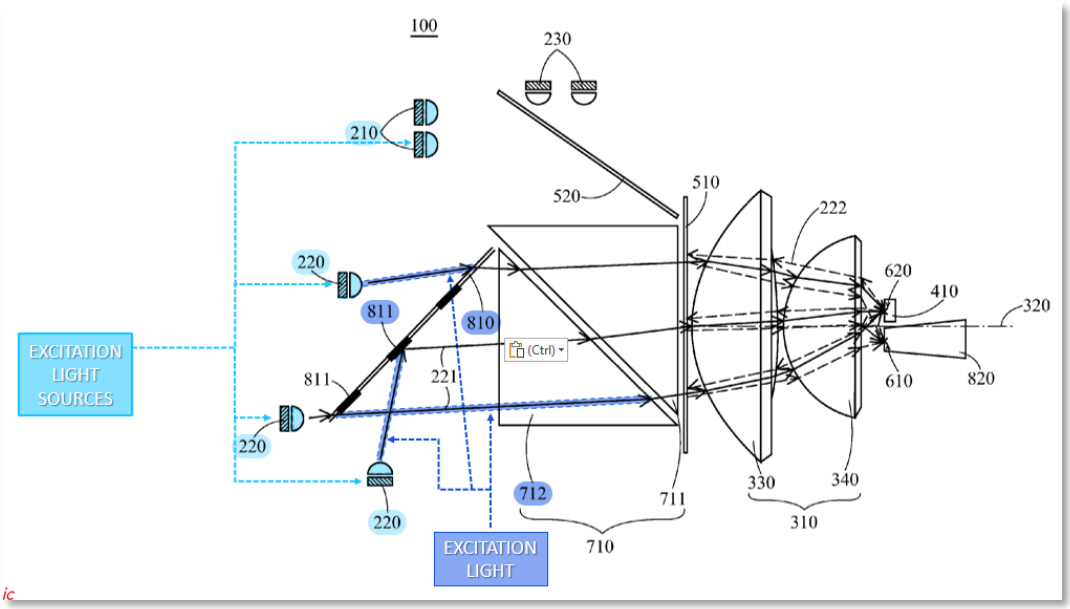


FIG. 2

EX1009, Fig. 2

[1.1] a plurality of excitation light sources which emit excitation light;

160. Huang teaches a plurality of excitation light sources which emit excitation light.

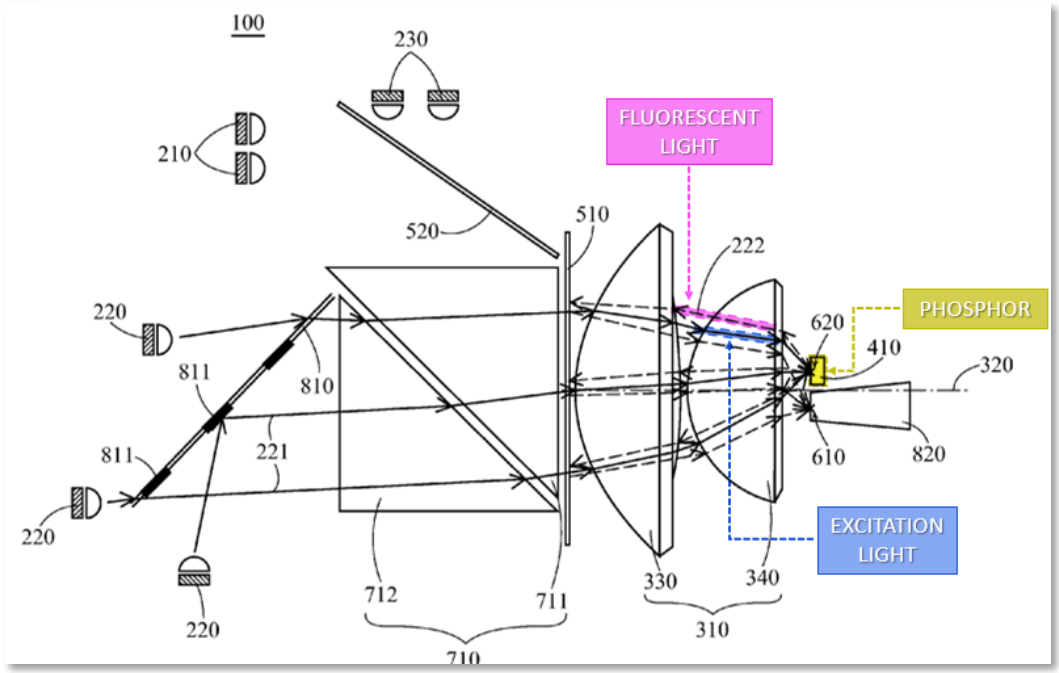


EX1009, Fig. 3B (annotated).

161. As shown in Figure 3B, Huang comprises a plurality of light sources 220. EX1009, 2:38-42, 4:16-19; 4:29-34. These light sources 220 emit light 221 that is ultimately received by a wavelength transformer 410, which could be a phosphor. EX1009, 2:61-64, 4:36-38. A POSITA would understand that the wavelength transformer, as a phosphor, would transform the excitation light to fluorescent light and that the light emitted by light source 220 comprised of a plurality of blue laser light sources is thus excitation light.

[1.2] a phosphor which changes the excitation light to fluorescent light;

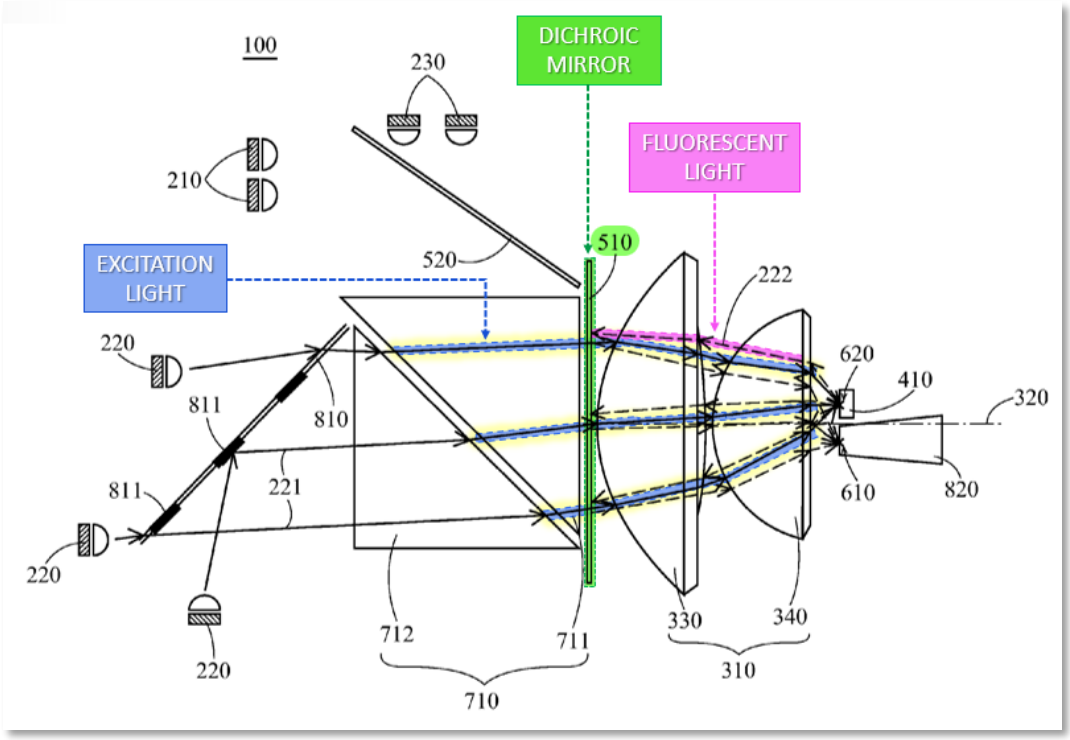
162. Huang teaches a phosphor (wavelength transformer 410) that transforms excitation light from excitation light sources (second light source 220) to fluorescent light. *See supra* Ground 4, Claim 1, Claim Element [1.1].



EX1009, Fig. 3B (annotated).

[1.3] a dichroic mirror which transmits the excitation light and reflects the fluorescent light; and

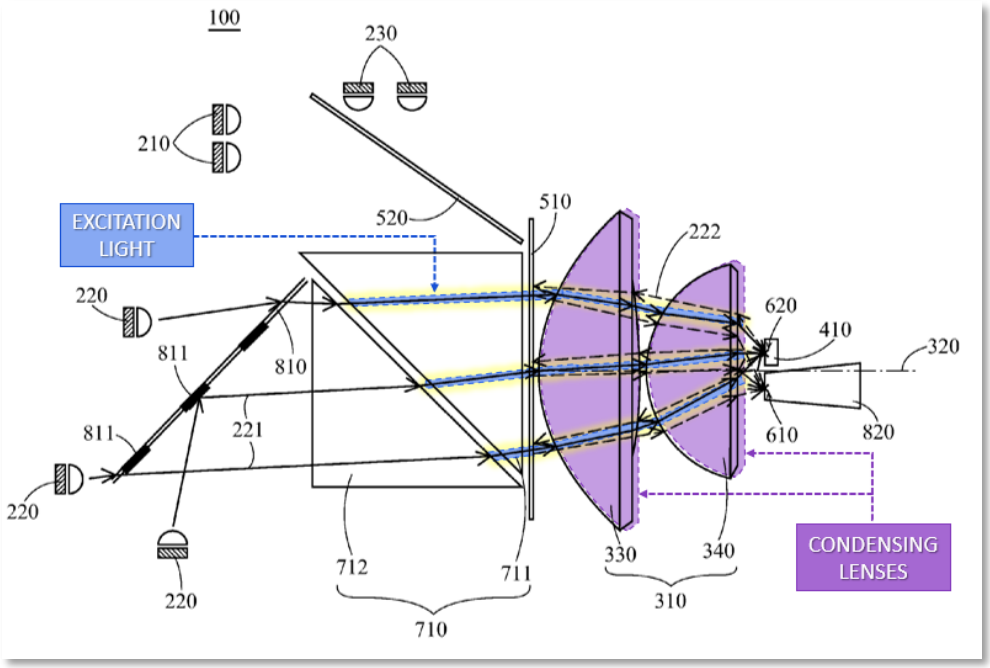
163. Huang discloses a dichroic mirror 510, which "is adapted to allow the first light beam 211 and the second light beam 221" (*i.e.*, the excitation light) "to travel therethrough and reflect the third light beam 222" (*i.e.*, the fluorescent light). EX1009, 2:38-45, 2:61-3:10.



EX1009, Fig. 3B (annotated).

[1.4] a condensing lens which condenses the excitation light transmitted through the dichroic mirror in an excitation light irradiation region on the phosphor,

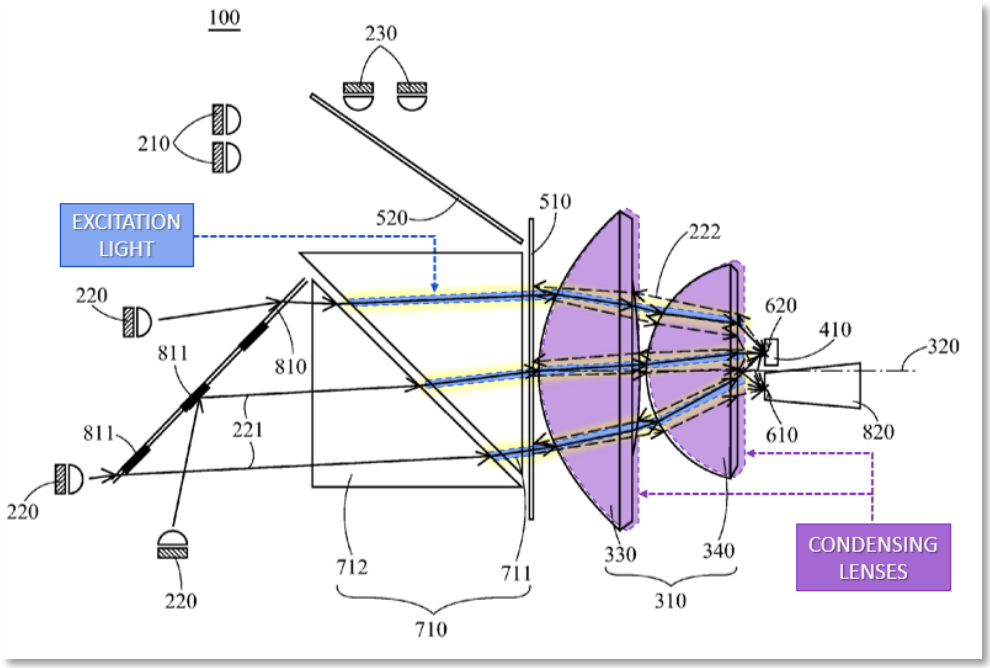
164. Huang teaches that excitation light transmitted through the dichroic mirror is "focused by the optical device 310 onto the wavelength transformer 410 [(*i.e.*, a phosphor)] that is disposed at the second focal point 620[(*i.e.*, "an excitation light irradiation region").]" EX1009, 3:3-5. Huang teaches that the optical device 310 "may comprise a ***first lens*** 330 and a ***second lens*** 340[,]" either one of which satisfies the "condensing lens" limitation of Claim Element 1e. EX1009, 4:38-40. This arrangement is shown in Figure 3B:



EX1009, Fig. 3B (annotated). Figure 3B demonstrate that the excitation light enters the condensing lens(es) asymmetrically.

[1.5] wherein the plurality of light sources are arranged so that each excitation light emitted from each of the plurality of light sources enters asymmetrically to a center of the condensing lens; and

165. Huang teaches a plurality of light sources arranged so that each excitation light (*e.g.*, light beams 221) emitted from the plurality of light sources 220 enters asymmetrically to a center of the condensing lens (*e.g.*, lens 330, lens 340). This is shown in Figure 3B.



EX1009, Fig. 3B (annotated). Figure 3B demonstrate that the excitation light enters the condensing lens(es) asymmetrically. The excitation beams are tilted with respect to the condenser lens optical axis (320), yielding and off-axis spot (620) where the phosphor is located. Further, offsetting the excitation beams out of the plane of the drawing or shifting certain light source 220 in the Y-axis direction in view of Alpay would further make the excitation light asymmetrically entering to a center of the condensing lens.

166. As explained above in the context of Ground 2, Alpay makes obvious the limitations of Claim Element [1.5]. *See supra* Ground 2, Claim 1, Claim Element [1.5].

[1.6] wherein when the excitation light irradiation region is a center and an incident angle to the excitation light irradiation region of any excitation light of each of the excitation light is an elevation angle θ, θ≠0 is satisfied.

167. As explained above in the context of Ground 2, Alpay teaches the limitations of Claim Element [1.6]. *See supra* Ground 2, Claim 1, Claim Element [1.6].

As discussed above in the context of Claim Element [1.5], a POSITA would have been motivated to combine the teachings of Alpay with those of Huang to avoid retroreflections. *See supra* Ground 2, Claim 1, Claim Element [1.6]. Further, the excitation light from sources 220 arrives to the condenser lens at an angle and focuses at the phosphor (620) that is located off of the lens axis (320); each of the light beams is shown in Figure 3B incident on the phosphor at an elevation angle different from zero.

2. Dependent Claim 3

[3.0/3.1] The light source device according to claim 1, wherein when the excitation light irradiation region is a center, in an incident angle to the excitation light irradiation region of first excitation light of each of the excitation lights, an elevation angle is θm and an azimuth angle is φm, and in an incident angle to the excitation light irradiation region of second excitation light different from the first excitation light, an elevation angle is θn and an azimuth angle is φn, there is no pair of the excitation lights in which θm−2°≦θn≦θm+2°, and φm+178°≦ φn ≦φm+182° are established.

168. Claim 3 is obvious over Huang in view of Alpay. As explained above, Alpay teaches the limitations of Claim 3. *See supra* Ground 2, Claim 3. As discussed above, a POSITA would have been motivated to combine the teachings of Alpay with those of Huang to protect the light source and improve the reliability of Huang's source, which would result in the limitations of Claim 3 being obvious.

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3. Dependent Claim 4

[4.0/4.1] The light source device according to claim 1, wherein the excitation light source is a solid light-emitting element.

169. Claim 4 is obvious over Huang in view of Alpay. Specifically, Huang discloses that the excitation light sources disclosed therein can be "***solid light sources*** with both a high luminance and a long service life[.]" EX1009, Col. 4:47-50.

4. Independent Claim 9

[9.0] A light source device, comprising:

170. Huang teaches a light source device. Claim Element [9.0] is identical to Claim Element [1.0]. *Compare* EX1001, Col. 20:17 *with id.* Col. 21:55. Thus, for the same reasons that Huang teaches any limitations of Claim Element [1.0], it also teaches any limitations of Claim Element [9.0]. *See supra* Ground 4, Claim 1, Claim Element [1.0].

[9.1] an excitation light source which emits excitation light;

171. Claim Element [9.1] is substantially similar to Claim Element [1.1], with the only difference being that Claim Element [9.1] requires "an" excitation light source while Claim Element [1.1] requires a plurality of excitation light sources. *Compare* EX1001, Col. 20:18-19 *with id.* at Col. 21:56. Thus, for the same reasons that Huang teaches a plurality of excitation light sources which emit excitation light, it also teaches "an" excitation light source which emits excitation light. *See supra* Ground 4, Claim 1, Claim Element [1.1].

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[9.2] a phosphor which changes the excitation light to fluorescent light;

172. Claim Element [9.2] is identical to Claim Element [1.2]. *Compare* EX1001, Col. 20:20-21 *with id* at Col. 21:57-58. Thus, for the same reasons Huang teaches every limitation of Claim Element [1.2], it also teaches every limitation of Claim Element [9.2]. *See supra* Ground 4, Claim 1, Claim Element [1.2].

[9.3] a dichroic mirror which transmits the excitation light and reflects the fluorescent light; and

173. Claim Element [9.3] is identical to Claim Element [1.3]. *Compare* EX1001, Col. 20:22-23 *with id.* at Col. 21:59-60. Thus, for the same reasons Huang teaches every limitation of Claim Element [1.3], it also teaches every limitation of Claim Element [9.3]. *See supra* Ground 4, Claim 1, Claim Element [1.3].

[9.4] a condensing lens which condenses the excitation light transmitted through the dichroic mirror in an excitation light irradiation region on the phosphor,

174. Claim Element [9.4] is identical to Claim Element [1.4]. *Compare* EX1001, Col. 20:24-26 *with id.* at Col. 21:61-63. Thus, for the same reasons Huang teaches every limitation of Claim Element [1.4], it also teaches every limitation of Claim Element [9.4]. *See supra* Ground 4, Claim 1, Claim Element [1.4].

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[9.5] wherein the excitation light sources are arranged so that when excitation light emitted from the excitation light source enters the excitation light irradiation region and is reflected without being converted into fluorescent light, the unconverted excitation light is prevented from entering the excitation light source; and

175. As explained above, Huang teaches a plurality of light sources arranged so that each excitation light (*e.g.*, light beams 221) emitted from the plurality of light sources 220 enters asymmetrically to a center of the condensing lens (*e.g.*, lens 330, lens 340). As explained above in the context of Ground 2, Alpay teaches that an asymmetrical arrangement prevents back reflections from reaching excitation light sources and potentially damaging them. *See supra* Ground 2. A POSITA would thus have understood that an asymmetrical arrangement of the light sources in Huang would prevent unconverted excitation light from entering any excitation light source, and would have used the teaching of Alpay to ensure that an asymmetrical arrangement was maintained to prevent back reflections.

[9.6] wherein when the excitation light irradiation region is a center and an incident angle to the excitation light irradiation region of any excitation light of each of the excitation light is an elevation angle θ, θ≠0 is satisfied.

176. Claim Element [9.6] is identical to Claim Element [1.6]. *Compare* EX1001, Col. 20:31-37 *with id.* at Cols. 22:3-9. Thus, for the same reasons Alpay teaches every limitation of Claim Element [1.6], it also teaches every limitation of Claim Element [9.6]. *See supra* Ground 4, Claim 1, Claim Element [1.6].

E. Ground 4a: Huang in View of Alpay and Akiyama Renders Claims 3 and 7 Obvious

177. In my opinion and for the reasons explained below, Huang in view of Alpay and Akiyama renders obvious the subject matter recited by Claim 7 of the '530 Patent.

178. As a threshold matter, a POSITA would have been motivated to combine Akiyama with the combination of Huang and Alpay, and would have had a reasonable expectation of success in making the combination. The combination of Huang and Alpay teach a light source device for use in a projection device (Huang) with Alpay's asymmetrical arrangement of light sources to prevent back reflections. Akiyama teaches a complete projection device. EX1006, [0003] ("The present invention relates to a light source device and a projector.") A POSITA, looking to employ the light source device of Huang, as improved by Alpay, for a projector device would naturally look to Akiyama and similar references in which to employ that light source device.

1. Dependent Claim 7

[7.0] A projection type video display device, comprising:

179. Akiyama discloses "a projector" that contains the light source described therein. EX1006, [0003]. Huang also teaches "a projection device" employing the illumination system of Huang. EX1009, 2:38-42.

[7.1] the light source device according to claim 1;

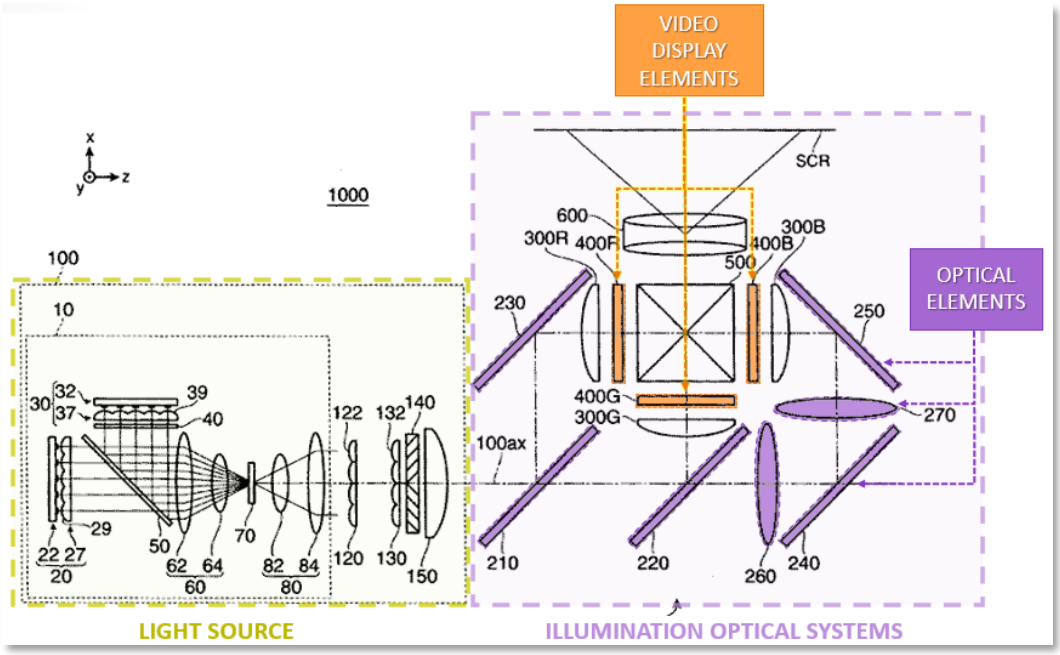
180. The combination of Huang and Alpay teaches a light source device according to Claim 1. *See supra* Ground 4, Claim 1.

[7.2] a video display element;

181. Akiyama teaches video display elements in the form of liquid crystal modulation devices. EX1006, [0089]. Huang teaches a "micro-display" of the projection device disclosed by Huang, which a POSITA would understand to be a "video display element." EX1009, 2:56-60.

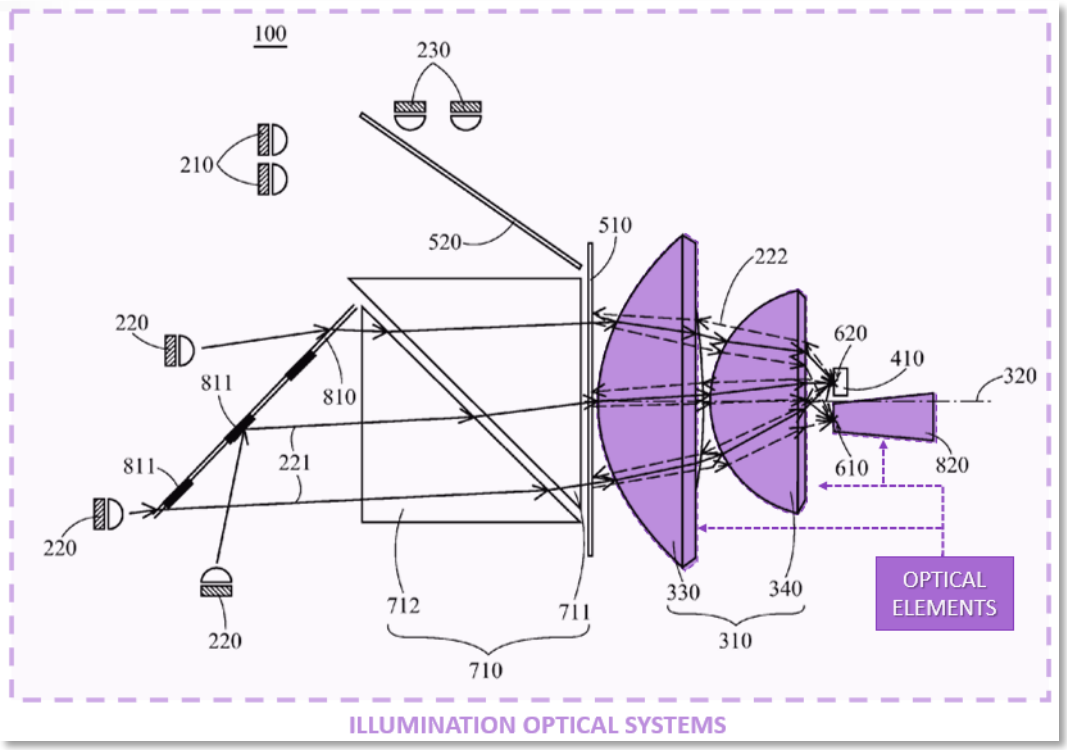
[7.3] an illumination optical system which has a plurality of optical elements applying light from the light source device to the video display element; and

182. Akiyama discloses an optical illumination system that discloses the limitations of Claim Element [7.3]. Akiyama discloses an illumination optical system (optical system 200), which comprises a plurality of optical elements, including dichroic mirrors 210, 220, reflecting mirrors 230, 240, 250, and relay lenses 260, 270. EX1006, [0089]. These optical elements apply light for a light source (illumination device 100) to video display elements (liquid crystal modulation devices 400R, 400G, 440B). EX1006, [0089].



EX1006, Fig. 1 (annotated).

183. Huang also discloses an illumination optical system (illumination system 100) for a projection device that comprises, *inter alia*, an optical device 310, which further comprises a plurality of optical elements in the form of condensing lenses, and a light homogenizing device 820, which applies light to the micro-display described above in connection with Claim Element [7.2]. EX1009, 3:3-5, 4:38-40.



EX1009, Fig. 3B (annotated).

[7.4] a projection lens which enlarges and projects an optical image formed by the video display element.

184. Akiyama teaches that the images formed by the video display elements of Claim Element [7.4] (liquid crystal modulation devices 400R, 400G, 440B) are enlarged by a projection optical system 600, which a POSITA would understand comprises one or more lenses. EX1006, [0057], [0103]. The limitations of Claim Element [7.4] are thus met.

F. Ground 5: Huang in View of Abu-Ageel and Alpay Renders Claim 9 Obvious

185. In my opinion and for the reasons explained below, Huang in view of Abu-Ageel and Alpay renders obvious the subject matter recited by claim 9 of the '530 Patent.

186. As a threshold matter, a POSITA would have been motivated to combine Huang with Abu-Ageel and Alpay, and would have had a reasonable expectation of success in making the combination. Huang, Alpay, and Abu-Ageel are analogous and/or complimentary art because they disclose light sources as explained above.

187. Prior to the '530 Patent, it was well known that back reflections affected, degraded, or impaired the performance of laser diodes. ("[C]ertain lasers may be sensitive to optical feedback such as a laser beam reflected back to the laser from a work surface. . . . [I]t is therefore desirable to prevent such back-reflections from finding a path back into the output fiber."); *see also* EX1013, 1:11-17 ("For many applications back-reflection of the light emitted by a laser diode into the laser active region has a significant, negative, impact on the performance of the laser."); EX1014, 1:19-22 ("In high power fiber-optic systems, optical isolators are used to protect low-power components from damage that may be caused by back-reflected light from amplifiers or other components."); By the time of the priority date of the '530 Patent, not only was this problem known, but tools had been developed to combat this problem, such as optical isolators. EX1005, [0004]-[0005]; EX1013; EX1014. Optical isolators,

however, "are usually quite bulky (especially when configured for use with high-power beams) and expensive." EX1005, [0006]. A POSITA would have known this and would have at least considered protecting the laser diodes of Huang and Alpay by the means taught by Abu-Ageel, which discloses a different method to prevent unwanted, destabilizing feedback, or by the use of optical isolators that were well known and used in front of laser diodes in applications such as telecommunications and high power lasers. In other words, by the time of the priority date of the '530 patent it was well known that back reflections can affect adversely the performance of a laser. Therefore, a POSITA looking at Huang and Alpay would have also considered the teaching of Abu-Ageel.

188. A POSITA designing a light source device like that of Huang would have been aware of the back reflection problem and would have understood that arrangements like that of Abu-Ageel could also be used to further avoid back reflections. Interested in protecting the excitation light sources, a POSITA would have looked to Abu-Ageel and similar art to accomplish to suppress back reflections to the excitation light sources. This would have been nothing but following known methods with predictable results and desirable to improve reliability.

1. Independent Claim 9

[9.0] A light source device, comprising:

189. Huang teaches a light source device. *See supra* Ground 4, Claim 9, Claim Element [9.0].

[9.1] an excitation light source which emits excitation light;

190. As explained above, Huang teaches Claim Element [9.1]. *See supra* Ground 4, Claim 9, Claim Element [9.1].

[9.2] a phosphor which changes the excitation light to fluorescent light;

191. As explained above, Huang teaches Claim Element [9.2]. *See supra* Ground 4, Claim 9, Claim Element [9.2].

[9.3] a dichroic mirror which transmits the excitation light and reflects the fluorescent light; and

192. As explained above, Huang teaches Claim Element [9.3]. *See supra* Ground 4, Claim 9, Claim Element [9.3].

[9.4] a condensing lens which condenses the excitation light transmitted through the dichroic mirror in an excitation light irradiation region on the phosphor,

193. As explained above, Huang teaches Claim Element [9.4]. *See supra* Ground 4, Claim 9, Claim Element [9.4].

[9.5] wherein the excitation light sources are arranged so that when excitation light emitted from the excitation light source enters the excitation light irradiation region and is reflected without being converted into fluorescent light, the unconverted excitation light is prevented from entering the excitation light source; and

194. As explained above, Abu-Ageel makes obvious Claim Element [9.5]. *See supra* Ground 3, Claim 9, Claim Element [9.5].

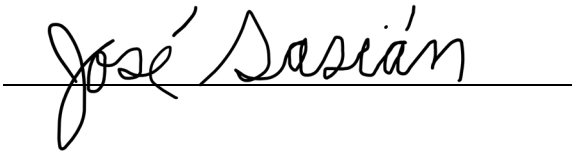
[9.6] wherein when the excitation light irradiation region is a center and an incident angle to the excitation light irradiation region of any excitation light of each of the excitation light is an elevation angle θ, θ≠0 is satisfied.

195. As explained above, Alpay teaches Claim Element [9.6]. *See supra* Ground 4, Claim 9, Claim Element [9.6].

XI. Secondary Considerations

196. I am not aware of any secondary considerations that would make claims 1, 3, 4, 7, or 9 of the ’530 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, 3, 4, 7, or 9 of the ’530 Patent would have been obvious to a POSITA as of September 26, 2011.

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 February 7, 2025.

By: