

Exhibit D

Exhibit D

Ground 1: Hirata '999 [US20110187999A1], Alpay [US20090308852A1], Akiyama '098 [US20120008098A1] – claim charts for claims 1, 3, 4 and 7 as invalidated by Hirata '999 and Alpay and claim 3 by Hirata '999 and Alpay and Akiyama '098.

Publication Number	Country of Origin	Filing Date	Date of Publication
US20110187999A1 (“Hirata '999”)	United States of America	10/25/2010	08/04/2011
US20090308852A1 (“Alpay”)	United States of America	09/12/2008	12/17/2009
US20120008098A1 (“Akiyama '098”)	United States of America	06/28/2011	01/12/2012

	Claims of U.S. Patent No. 9,322,530	Citations and Analysis
	Claim 1	
1p	A light source device, comprising:	Hirata '999 discloses a light source device. Hirata '999 [0090]: In FIG. 1A, an excitation light source device 300 includes the blue excitation light source 101 for phosphor excitation light and a collimator lens 201 to collimate light rays emitted from the blue excitation light source 101. The blue excitation light rays emitted substantially in parallel from the excitation light source device 300 pass through a dichroic mirror 14, which transmits blue light and which reflects yellow light (for green and red), and are focused through a focusing lens 24 onto a light incidence side of a transparent substrate 27. On a light incidence side of the transparent substrate 27, a dichroic coat 272 which transmits blue light and which reflects yellow light (for green and red) is evaporated. The dichroic coat 272 is applied with a yellow phosphor 271. The yellow phosphor 271 is an Yttrium Aluminum Garnet (YAG) phosphor in general, but any other appropriate material may be employed.

		FIG. 1A
1a	a plurality of excitation light sources which emit excitation light;	Hirata '999 discloses a plurality of excitation light sources which emit excitation light. Hirata '999 [0094]: In FIG. 1B, <u>two blue excitation light sources 101</u> each including a light emitting plane 102 are arranged adjacent to each other in the x-axis direction. <u>The blue excitation light rays emitted from the blue excitation light source 101</u> are substantially collimated through the collimator lens 201 to be focused by the

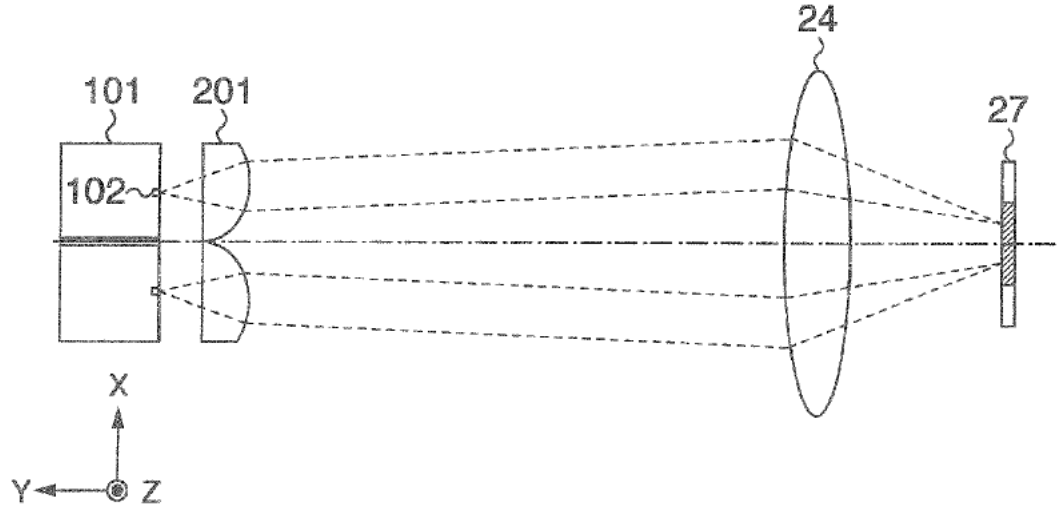
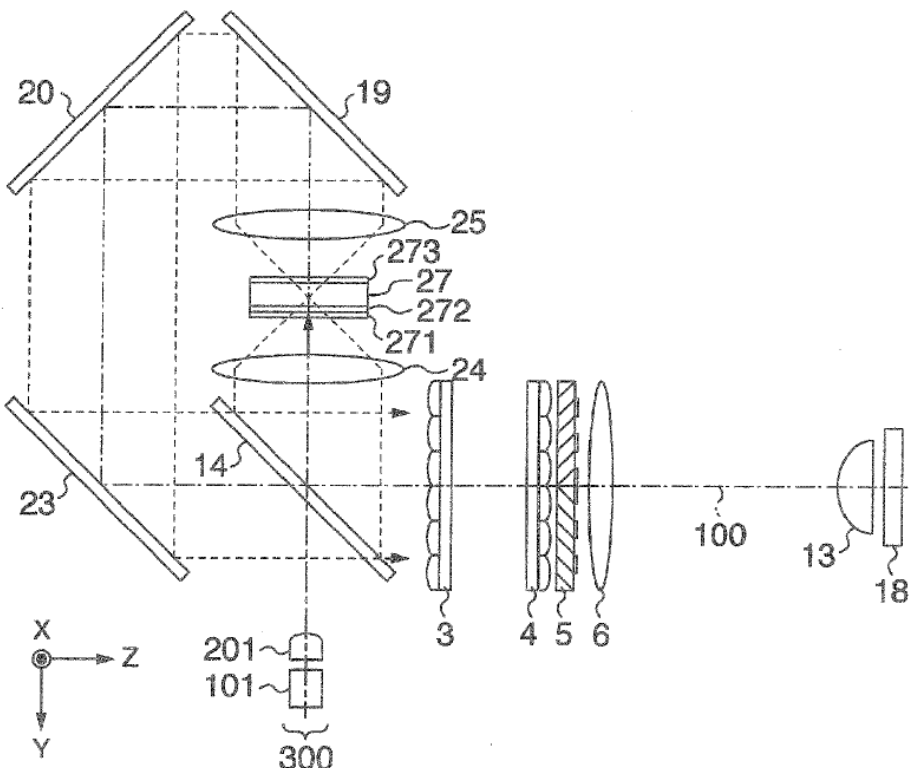
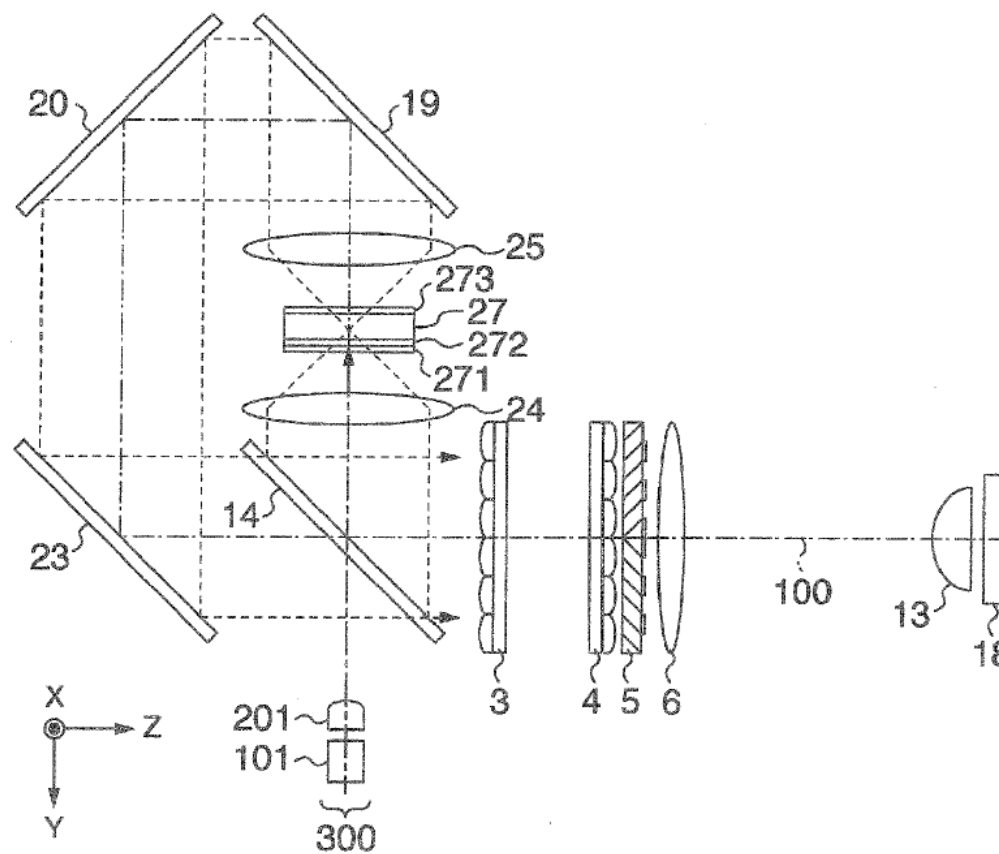
		focusing lens 24 onto the transparent substrate 27 including a yellow phosphor and a blue light diffusion layer. FIG. 1B 
1b	a phosphor which changes the excitation light to fluorescent light;	Hirata '999 discloses a phosphor which changes the excitation light to fluorescent light. Hirata '999 [0088]: ...The embodiment includes a light source in which <u>a yellow phosphor is excited by blue excitation light to emit yellow light.</u> Hirata '999 [0091]: Since part of the blue excitation light reacts with the <u>yellow phosphor 271</u>, yellow light is emitted in all directions.

		FIG. 1A 
1c	a dichroic mirror which transmits the excitation light and reflects the fluorescent light; and	Hirata '999 discloses a dichroic mirror which transmits the excitation light and reflects the fluorescent light. Hirata '999 [0090]: In FIG. 1A, an excitation light source device 300 includes the blue excitation light source 101 for phosphor excitation light and a collimator lens 201 to collimate light rays emitted from the blue excitation light source 101. The blue excitation light rays emitted substantially in parallel from <u>the excitation light source device 300 pass through a dichroic mirror 14, which transmits blue light and which</u>

reflects yellow light (for green and red), and are focused through a focusing lens 24 onto a light incidence side of a transparent substrate 27.

FIG. 1A

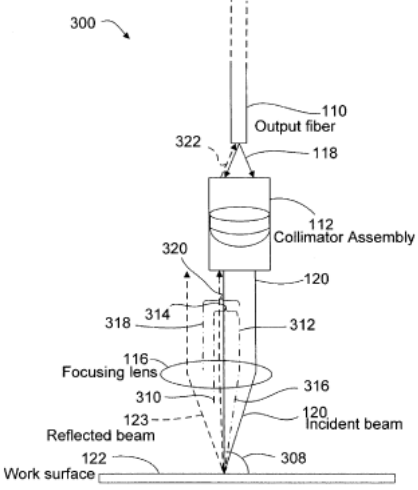


1d a condensing lens which condenses the excitation light transmitted through the dichroic mirror in an

Hirata '999 discloses a condensing lens, *e.g.* focusing lens, which condenses the excitation light transmitted through the dichroic mirror in an excitation light irradiation region on the phosphor.

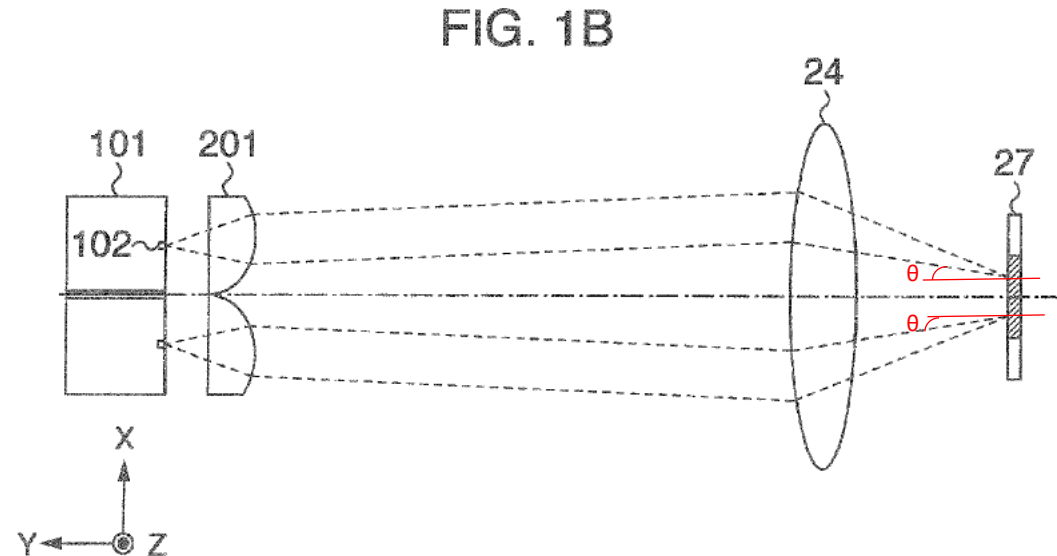
	excitation light irradiation region on the phosphor,	Hirata '999 [0090]: In FIG. 1A, an excitation light source device 300 includes the blue excitation light source 101 for phosphor excitation light and a collimator lens 201 to collimate light rays emitted from the blue excitation light source 101. <u>The blue excitation light rays emitted substantially in parallel from the excitation light source device 300 pass through a dichroic mirror 14,</u> which transmits blue light and which reflects yellow light (for green and red), and <u>are focused through a focusing lens 24 onto a light incidence side of a transparent substrate 27.</u> On a light incidence side of the transparent substrate 27, a dichroic coat 272 which transmits blue light and which reflects yellow light (for green and red) is evaporated. The dichroic coat 272 is applied with a yellow phosphor 271. Hirata '999 [0094]: In FIG. 1B, two blue excitation light sources 101 each including a light emitting plane 102 are arranged adjacent to each other in the x-axis direction. <u>The blue excitation light rays emitted from the blue excitation light source 101</u> are substantially collimated through the collimator lens 201 to be <u>focused by the focusing lens 24 onto the transparent substrate 27 including a yellow phosphor</u> and a blue light diffusion layer.
1e	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	Hirata '999 combines with Alpay to disclose that 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. Alpay discloses that the asymmetrical arrangement of light source is to prevent the laser from reflecting back to damage the laser light source. Alpay [0003]: Generally, certain lasers may be sensitive to optical feedback such as a laser beam reflected back to the laser from a work surface. For example, fiber lasers are typically very sensitive to back-reflections from a work surface. <u>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.</u> Further, a seed laser may be damaged in a high-power master oscillator fiber amplifier device by reflected light that is amplified on its way back to the seed laser. In many laser processing systems, such as laser micromachining systems, it is

	therefore desirable to prevent such back-reflections from finding a path back into the output fiber. Alpay [0007]: <u>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.</u> For example, FIG. 2 is a block diagram of another typical fiber laser processing system 200 having a tilted beam delivery subsystem (e.g., the output fiber 110, the collimator assembly 112, and the focusing lens 116) <u>such that the path of the incident laser beam 120 is non-perpendicular to the work surface 122.</u> Alpay [0027]: The incident laser beam 120 propagates along a first axis of propagation 312 from the collimator assembly 112 to the focusing lens 116. The first axis of propagation 312 is substantially parallel to the primary axis 310 of the focusing lens 116. There is, however, an 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). <u>Rather, the incident laser beam 120 hits the focusing lens 116 at an offset 314 from the center of the lens 116.</u> In one embodiment, the amount of offset 314 is greater than or equal to approximately one-half the diameter of the collimated incident laser beam 120. As discussed below, such an amount of offset 314 reduces or prevents overlap between the reflected laser beam 123 and the incident laser beam 120. Alpay [0028]: The focusing lens 116 converges the incident laser beam 120 to a focused spot diameter on the work surface 122. <u>As a result of 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 310 of the focusing lens 116.</u> Thus, the 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.
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		Alpay [0029]: As a consequence of using the offset 314 to tilt the incident laser beam 120, the path of the reflected laser beam 123 is angularly separated from the path of the incident laser beam 120. Thus, after returning through the focusing lens 116, the reflected laser beam 123 travels along a third axis of propagation 318 that is spatially separated from the first axis of propagation 312 of the incident laser beam 120. In certain embodiments, <u>an offset 320 between the first axis of propagation 312 corresponding to the incident laser beam 120 and the third axis of propagation 318 corresponding to the reflected laser beam 123 is configured 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.</u>  FIG. 3
1f	wherein when the excitation light irradiation region is a center and an incident angle to the excitation light irradiation region of any excitation	Hirata '999 or Alpay discloses 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.

light of each of the excitation light is an elevation angle θ , $\theta \neq 0$ ¹ is satisfied.

For example, Fig. 1B of Hirata '999 discloses that the excitation light enters obliquely to the excitation light irradiation region. Therefore, the annotated Fig. 1B of Hirata '999 below illustrates "an incident angle to the excitation light irradiation region of any excitation light of each of the excitation light is an elevation angle θ , $\theta \neq 0$."



In the alternative, Alpay also discloses that an incident angle to the excitation light irradiation region of any excitation light of each of the excitation light is an elevation angle θ , $\theta \neq 0$. For example, the incident laser beam 120 is non-perpendicular to the work surface 122.

Alpay [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.** For example, FIG. 2 is a block diagram of another typical fiber laser processing system 200

¹ The recitation " $\theta \neq 0$ " was amended to read " $\theta \neq 0$ " by Certificate of Correction.

	having a tilted beam delivery subsystem (e.g., the output fiber 110, the collimator assembly 112, and the focusing lens 116) <u>such that the path of the incident laser beam 120 is non-perpendicular to the work surface 122.</u> Alpay [0027]: The incident laser beam 120 propagates along a first axis of propagation 312 from the collimator assembly 112 to the focusing lens 116. The first axis of propagation 312 is substantially parallel to the primary axis 310 of the focusing lens 116. <u>There is, however, an 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.</u> In one embodiment, the amount of offset 314 is greater than or equal to approximately one-half the diameter of the collimated incident laser beam 120. As discussed below, such an amount of offset 314 reduces or prevents overlap between the reflected laser beam 123 and the incident laser beam 120. Alpay [0028]: The focusing lens 116 converges the incident laser beam 120 to a focused spot diameter on the work surface 122. <u>As a result of 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 310 of the focusing lens 116. Thus, the 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.</u>
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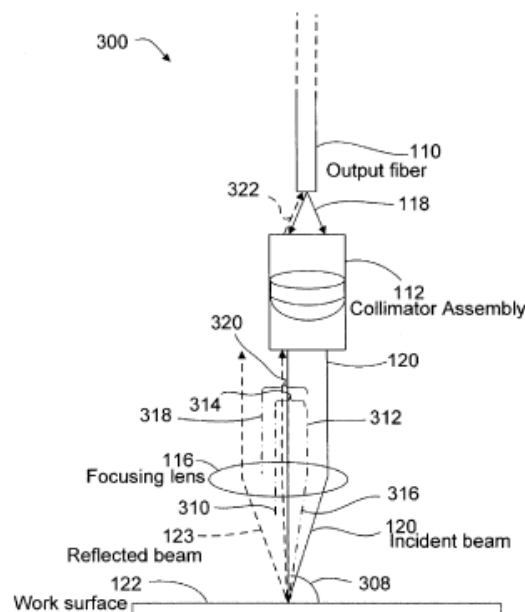


FIG. 3

Claim 3

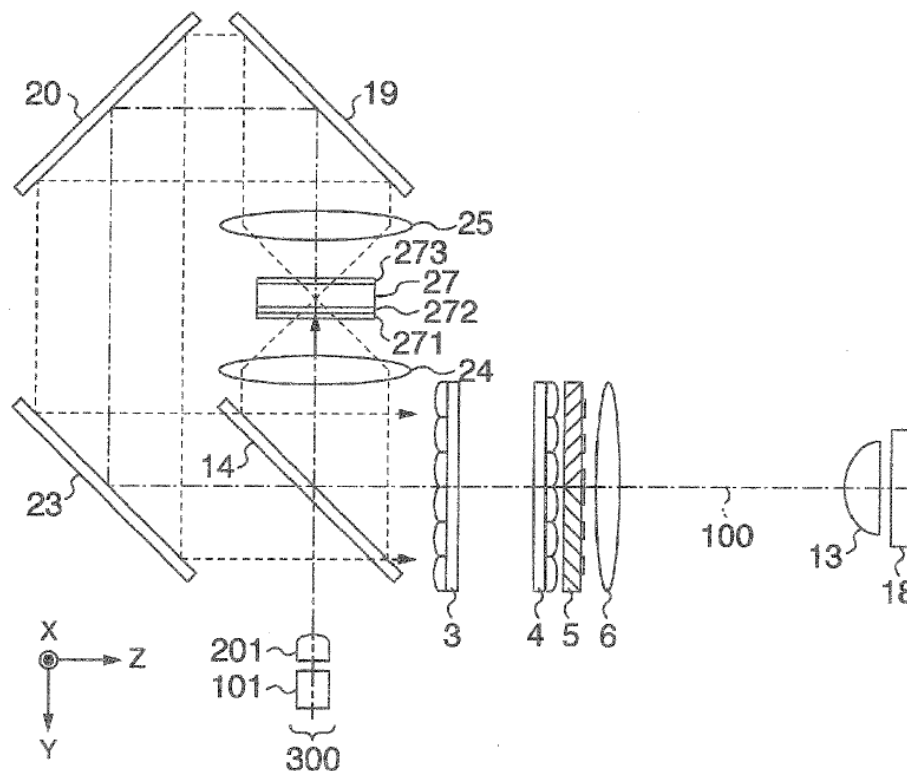
3p The light source device according to claim 1,

Hirata '999 discloses a light source device.

Hirata '999 [0090]: In FIG. 1A, **an excitation light source device 300** includes the blue excitation light source 101 for phosphor excitation light and a collimator lens 201 to collimate light rays emitted from the blue excitation light source 101. The blue excitation light rays emitted substantially in parallel from the excitation light source device 300 pass through **a dichroic mirror 14**, which transmits blue light and which reflects yellow light (for green and red), and are focused through **a focusing lens 24** onto

a light incidence side of a transparent substrate 27. On a light incidence side of the transparent substrate 27, a dichroic coat 272 which transmits blue light and which reflects yellow light (for green and red) is evaporated. The dichroic coat 272 is applied with **a yellow phosphor 271**. The yellow phosphor 271 is an Yttrium Aluminum Garnet (YAG) phosphor in general, but any other appropriate material may be employed.

FIG. 1A



3a The light source device according to claim 1, wherein when the excitation light irradiation region is a

Hirata '999 combines with Alpay or Akiyama '098 to disclose 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 θ_m and an

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 θ_m and an azimuth angle is ϕ_m, 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 θ_n and an azimuth angle is ϕ_n, there is no pair of the excitation lights in which $\theta_m - 2^\circ \leq \theta_n \leq \theta_m + 2^\circ$, and $\phi_m + 178^\circ \leq \phi_n \leq \phi_m + 182^\circ$ are established.	azimuth angle is ϕ_m, 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 θ_n and an azimuth angle is ϕ_n, there is no pair of the excitation lights in which $\theta_m - 2^\circ \leq \theta_n \leq \theta_m + 2^\circ$, and $\phi_m + 178^\circ \leq \phi_n \leq \phi_m + 182^\circ$ are established. In claim 3a, $\theta_m - 2^\circ \leq \theta_n \leq \theta_m + 2^\circ$ means $-2^\circ \leq \theta_m - \theta_n \leq 2^\circ$, and $\phi_m + 178^\circ \leq \phi_n \leq \phi_m + 182^\circ$ means $178^\circ \leq \phi_n - \phi_m \leq 182^\circ$. Based on column 6/lines 48-59 (“a mathematical formula 3 or a mathematical formula 4 is established as the condition for preventing incidence of the unconverted excitation light group 51 to the excitation light source group 5”), the meaning of “there is no pair of the excitation lights in which $\theta_m - 2^\circ \leq \theta_n \leq \theta_m + 2^\circ$, and $\phi_m + 178^\circ \leq \phi_n \leq \phi_m + 182^\circ$ are established” should be $\theta_n \neq \theta_m$ ($\theta_m \neq 0$, $\theta_n \neq 0$) (Equation 3), or $\phi_n \neq \phi_m + 180^\circ$ ($\theta_m \neq 0$, $\theta_n \neq 0$) (Equation 4). Alpay discloses the abovementioned limitation. Alpay [0007]: <u>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.</u> For example, FIG. 2 is a block diagram of another typical fiber laser processing system 200 having a tilted beam delivery subsystem (e.g., the output fiber 110, the collimator assembly 112, and the focusing lens 116) <u>such that the path of the incident laser beam 120 is non-perpendicular to the work surface 122.</u> Alpay [0027]: The incident laser beam 120 propagates along a first axis of propagation 312 from the collimator assembly 112 to the focusing lens 116. The first axis of propagation 312 is substantially parallel to the primary axis 310 of the focusing lens 116. <u>There is, however, an 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</u>
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² The recitation “ $\phi_m + 178^\circ \leq \phi_m \leq \phi_m + 182^\circ$ ” was amended to read “ $\phi_m + 178^\circ \leq \phi_n \leq \phi_m + 182^\circ$ ” by Certificate of Correction.

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. In one embodiment, the amount of offset 314 is greater than or equal to approximately one-half the diameter of the collimated incident laser beam 120. As discussed below, such an amount of offset 314 reduces or prevents overlap between the reflected laser beam 123 and the incident laser beam 120.

Alpay [0028]: The focusing lens 116 converges the incident laser beam 120 to a focused spot diameter on the work surface 122. As a result of 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 310 of the focusing lens 116. Thus, **the 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.**

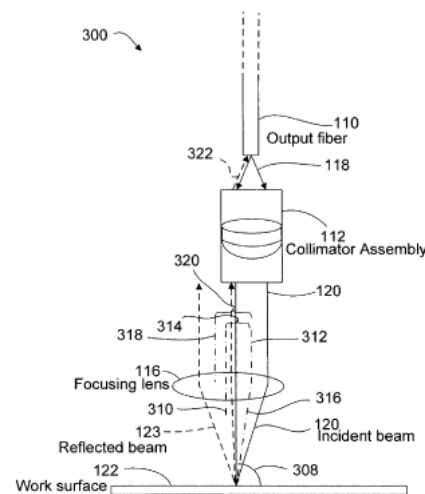


FIG. 3

In the alternative, Akiyama '098 discloses the limitation as well. For example, Fig. 2A of Akiyama '098 shows that all the excitation lights from the first excitation light generation section 20 are asymmetrically incident to the fluorescence generation section 70. Therefore, there is a condition that an incident angle to the excitation light irradiation region of the first excitation light (elevation angle) of each of the excitation lights, θ_m , and an incident angle to the excitation light irradiation region of the second excitation light (elevation angle) of each of the excitation lights, θ_n , $\theta_m \neq \theta_n$ ($\theta_m - \theta_n \neq 0$), and/or. an azimuth angle of the first excitation light of each of the excitation lights, ϕ_m , and an azimuth angle of the second excitation light of each of the excitation lights, ϕ_n , $\phi_m + 178^\circ \leq \phi_n \leq \phi_m + 182^\circ$.

Akiyama '098 [0072]: The excitation light combining section 50 transmits the blue light (first excitation light) from the first excitation light generation section 20 and reflects the blue light (second excitation light) from the second excitation light generation section 30 to thereby combine the blue light from the first excitation light generation section 20 and the blue light from the second excitation light generation section 30.

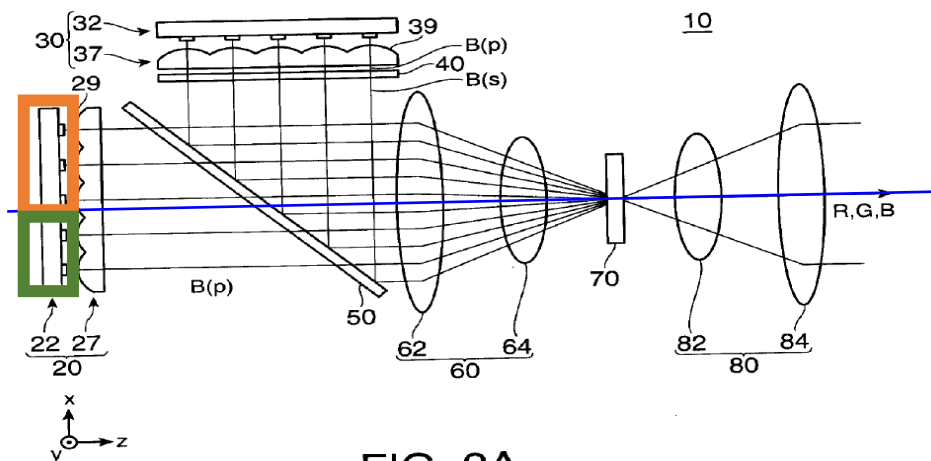


FIG. 2A

	Claim 4	
4p	The light source device according to claim 1,	Hirata '999 discloses a light source device. Hirata '999 [0090]: In FIG. 1A, <u>an excitation light source device 300</u> includes the blue excitation light source 101 for phosphor excitation light and a collimator lens 201 to collimate light rays emitted from the blue excitation light source 101. The blue excitation light rays emitted substantially in parallel from the excitation light source device 300 pass through <u>a dichroic mirror 14</u>, which transmits blue light and which reflects yellow light (for green and red), and are focused through <u>a focusing lens 24</u> onto a light incidence side of a transparent substrate 27. On a light incidence side of the transparent substrate 27, a dichroic coat 272 which transmits blue light and which reflects yellow light (for green and red) is evaporated. The dichroic coat 272 is applied with <u>a yellow phosphor 271</u>. The yellow phosphor 271 is an Yttrium Aluminum Garnet (YAG) phosphor in general, but any other appropriate material may be employed.

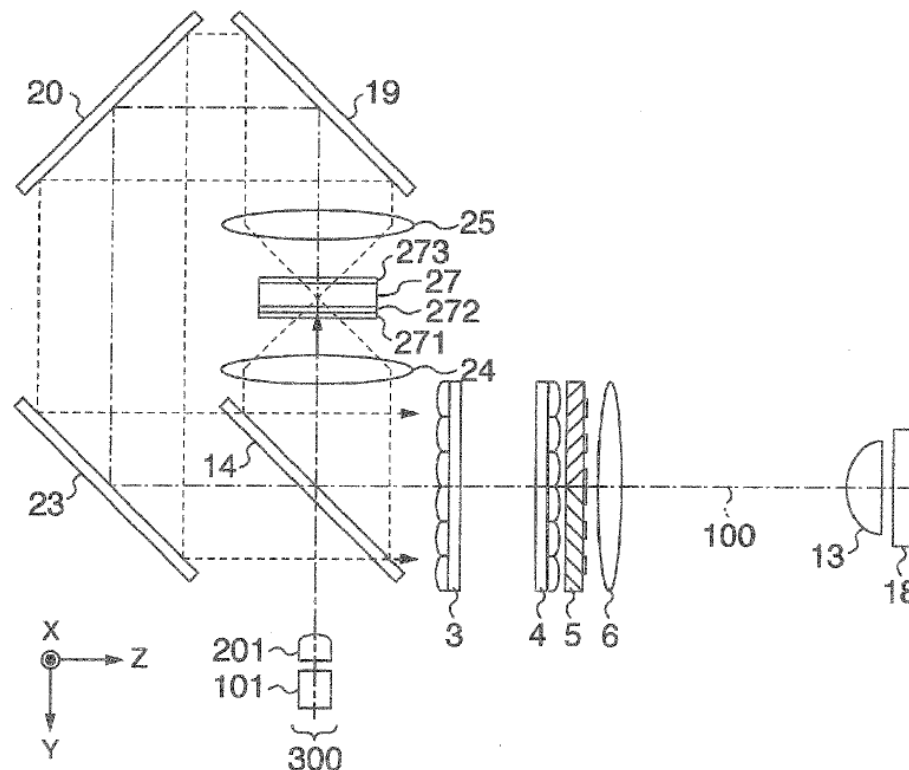
		FIG. 1A
4a	wherein the excitation light source is a solid light-emitting element.	Hirata '999 discloses that the excitation light source is a solid light-emitting element. Hirata '999 [0044]: Also, <u>the light source includes solid light emitting elements</u> such as light emitting diodes, lasers, and organic electroluminescence elements. Alternatively, the light source includes solid light emitting elements such as light emitting diodes, lasers, and organic electroluminescence elements, emitting excitation light to excite a phosphor. Alternatively, the light source includes solid light emitting elements such as light emitting diodes, lasers, and organic electroluminescence elements, the solid light emitting elements emitting light which is diffused in a diffusion layer.

		Hirata '999 [0088]: ... The embodiment includes a light source in which a yellow phosphor is excited by blue excitation light to emit yellow light. <u>A light source of the blue excitation light is a solid light emitting element</u> , e.g., a light emitting diode or a laser.
	Claim 7	
7p	A projection type video display device, comprising:	Hirata '999 discloses a projection type video display device. Hirata '999 [Abstract]: <u>A projection type display apparatus</u> including a light source, a display element, an illumination optical system and a projection lens to project a magnified image of the optical image. The illumination optical system includes a first array lens and a second array lens, each includes a plurality of lens elements arranged in a matrix, each of the lens elements having a rectangular opening... Hirata '999 [0064]: FIGS. 4A to 4C are schematic diagrams representing an outline of an optical system of <u>a projection type display apparatus</u> employing a light source device according to an embodiment.

		FIG. 4A
7a	the light source device according to claim 1;	Hirata '999 discloses a light source device. Hirata '999 [0090]: In FIG. 1A, an excitation light source device 300 includes the blue excitation light source 101 for phosphor excitation light and a collimator lens 201 to collimate light rays emitted from the blue excitation light source 101. The blue excitation light rays emitted substantially in parallel from the excitation light source device 300 pass through a dichroic mirror 14, which transmits blue light and which reflects yellow light (for green and red), and are focused through a focusing lens 24 onto a light incidence side of a transparent substrate 27. On a light incidence side of the transparent substrate 27, a dichroic coat 272 which transmits blue light and which reflects yellow light (for green and red) is evaporated. The dichroic coat 272 is applied

with **a yellow phosphor 271**. The yellow phosphor 271 is an Yttrium Aluminum Garnet (YAG) phosphor in general, but any other appropriate material may be employed.

FIG. 1A



7b a video display element;

Hirata '999 discloses a video display element.

Hirata '999 [Abstract]: A projection type display apparatus including a light source, **a display element**, an illumination optical system and a projection lens to project a magnified image of the optical image.

Hirata '999 [0064]: FIGS. 4A to 4C are schematic diagrams representing an outline of **an optical system of a projection type display apparatus** employing a light source device according to an embodiment.

Hirata '999 [0067]: Similarly to the first array lens 3, the second array lens 4 includes a plurality of lens cells arranged in a matrix each of which having a rectangular shape when viewed from the direction of the illumination optical axis, and each lens cells projects or maps the contour of the lens cell of the first array lens 3 corresponding thereto **onto a liquid-crystal display element 18**.

FIG. 4A

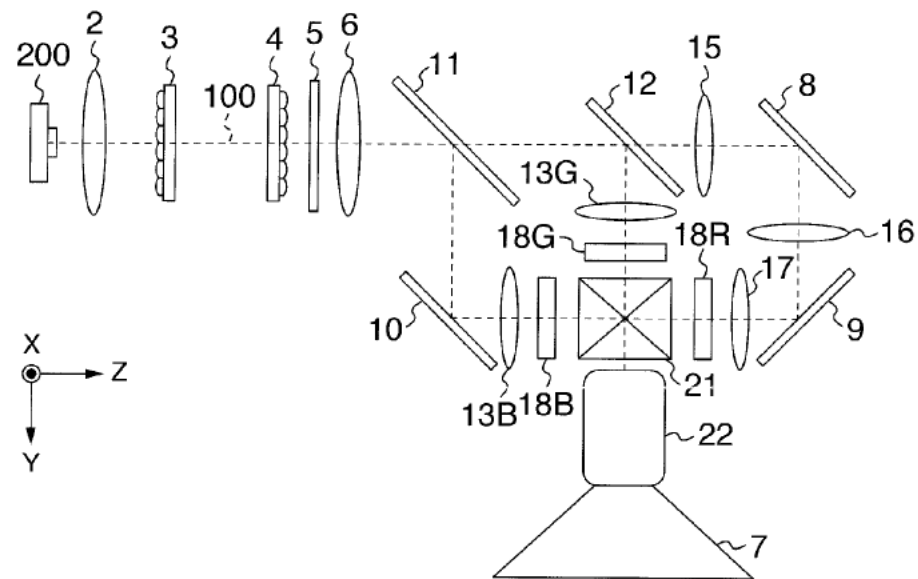


		FIG. 1A
7c	an illumination optical system which has a plurality of optical elements applying light from the light source device to the video display element; and	Hirata '999 discloses an illumination optical system which has a plurality of optical elements applying light from the light source device to the video display element. Hirata '999 [Abstract]: A projection type display apparatus including a light source, <u>a display element, an illumination optical system</u> and a projection lens to project a magnified image of the optical image.

Hirata '999 [0064]: FIGS. 4A to 4C are schematic diagrams representing an outline of **an optical system** of a projection type display apparatus employing a light source device according to an embodiment.

Hirata '999 [0067]: Similarly to the **first array lens 3, the second array lens 4** includes a plurality of lens cells arranged in a matrix each of which having a rectangular shape when viewed from the direction of the illumination optical axis, and each lens cells projects or maps the contour of the lens cell of the first array lens 3 corresponding thereto **onto a liquid-crystal display element 18**.

FIG. 4A

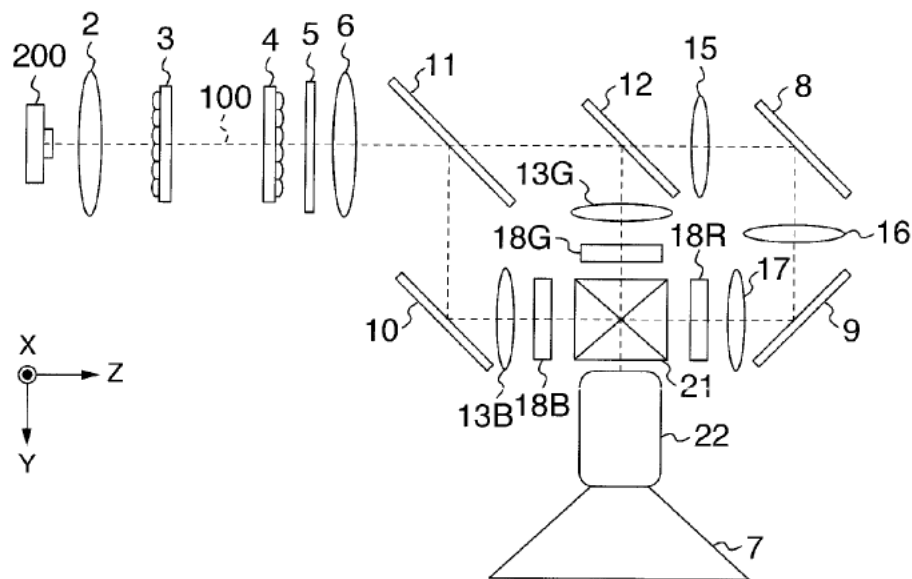


		FIG. 1A
7d	a projection lens which enlarges and projects an optical image formed by the video display element.	Hirata '999 discloses a projection lens which enlarges and projects an optical image formed by the video display element. Hirata '999 [0064]: FIGS. 4A to 4C are schematic diagrams representing an outline of an optical system of a projection type display apparatus employing a light source device according to an embodiment.

Hirata '999 [Abstract]: A projection type display apparatus including a light source, **a display element**, an illumination optical system and **a projection lens to project a magnified image of the optical image**.

Hirata '999 [0075]: ... **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, to thereby implement a display function of the display apparatus.**

FIG. 4A

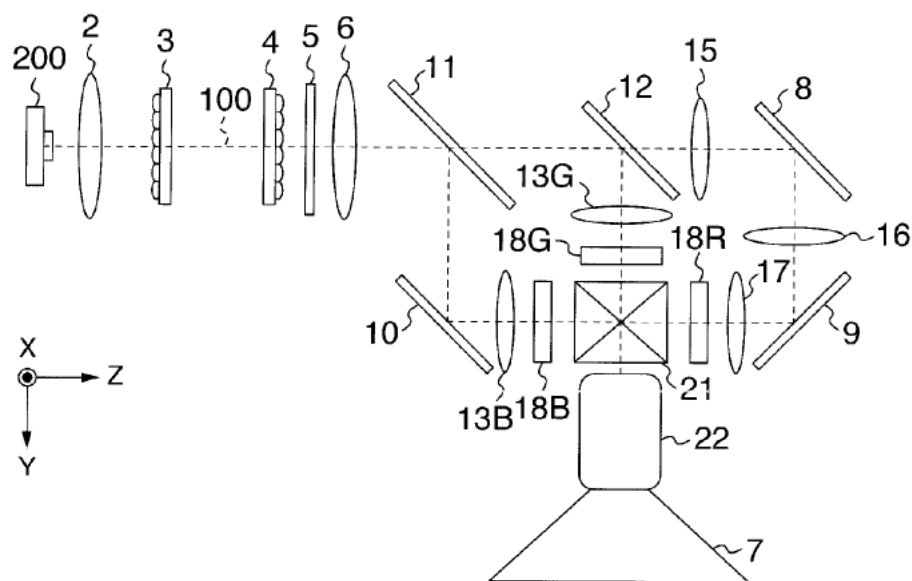
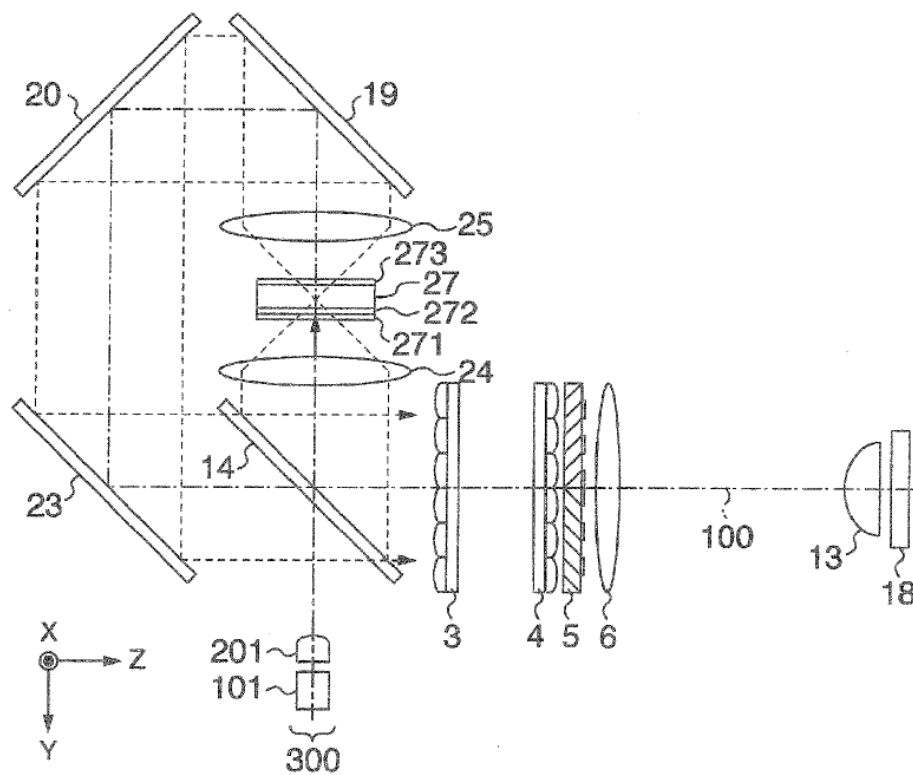


FIG. 1A



Ground 2(a): Hirata '999 [US20110187999A1], Alpay [US20090308852A1] – claim charts for claims 9 as invalidated by Hirata '999 and Alpay.

Publication Number	Country of Origin	Filing Date	Date of Publication
US20110187999A1 (“Hirata '999”)	United States of America	10/25/2010	08/04/2011
US20090308852A1 (“Alpay”)	United States of America	09/12/2008	12/17/2009

	Claims of U.S. Patent No. 9,322,530	Citations and Analysis
	Claim 9	
9p	A light source device, comprising:	Hirata '999 discloses a light source device. Hirata '999 [0090]: In FIG. 1A, an excitation light source device 300 includes the blue excitation light source 101 for phosphor excitation light and a collimator lens 201 to collimate light rays emitted from the blue excitation light source 101. The blue excitation light rays emitted substantially in parallel from the excitation light source device 300 pass through a dichroic mirror 14, which transmits blue light and which reflects yellow light (for green and red), and are focused through a focusing lens 24 onto a light incidence side of a transparent substrate 27. On a light incidence side of the transparent substrate 27, a dichroic coat 272 which transmits blue light and which reflects yellow light (for green and red) is evaporated. The dichroic coat 272 is applied with a yellow phosphor 271. The yellow phosphor 271 is an Yttrium Aluminum Garnet (YAG) phosphor in general, but any other appropriate material may be employed.

		FIG. 1A
9a	an excitation light source which emit excitation light;	Hirata '999 discloses an excitation light source which emit excitation light. Hirata '999 [0094]: In FIG. 1B, two blue excitation light sources 101 each including a light emitting plane 102 are arranged adjacent to each other in the x-axis direction. <u>The blue excitation light rays emitted from the blue excitation light source 101</u> are substantially collimated through the collimator lens 201 to be focused by the

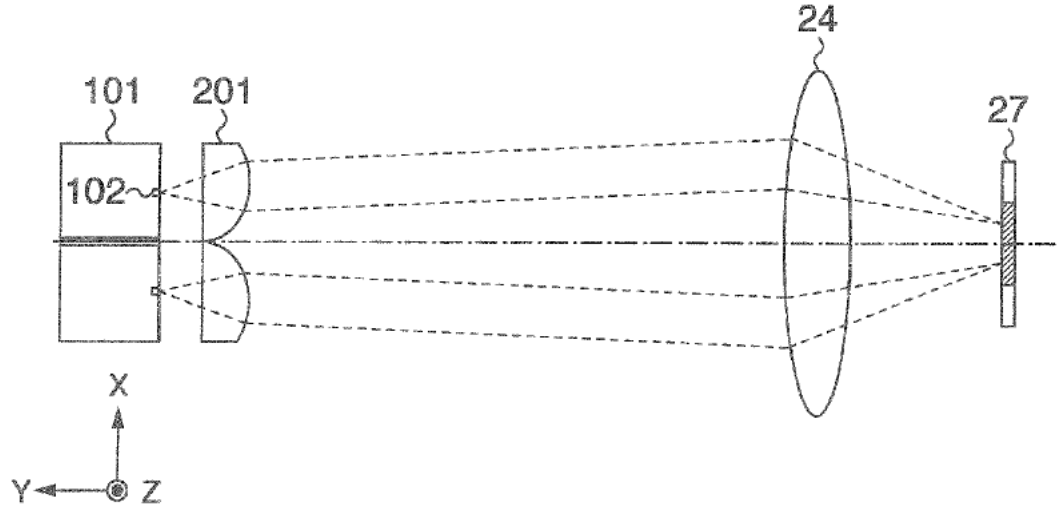
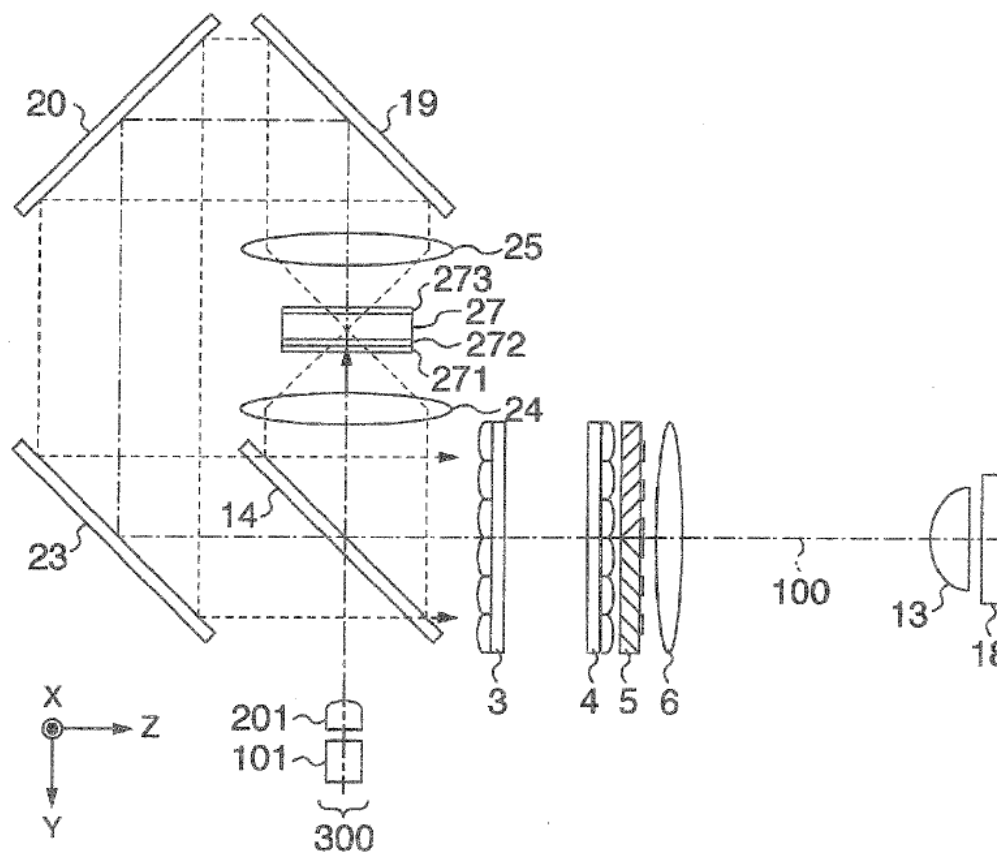
		focusing lens 24 onto the transparent substrate 27 including a yellow phosphor and a blue light diffusion layer. FIG. 1B 
9b	a phosphor which changes the excitation light to fluorescent light;	Hirata '999 discloses a phosphor which changes the excitation light to fluorescent light. Hirata '999 [0088]: ...The embodiment includes a light source in which <u>a yellow phosphor is excited by blue excitation light to emit yellow light.</u> Hirata '999 [0091]: Since part of the blue excitation light reacts with the <u>yellow phosphor 271</u>, yellow light is emitted in all directions.

		FIG. 1A
9c	a dichroic mirror which transmits the excitation light and reflects the fluorescent light; and	Hirata '999 discloses a dichroic mirror which transmits the excitation light and reflects the fluorescent light. Hirata '999 [0090]: In FIG. 1A, an excitation light source device 300 includes the blue excitation light source 101 for phosphor excitation light and a collimator lens 201 to collimate light rays emitted from the blue excitation light source 101. The blue excitation light rays emitted substantially in parallel from <u>the excitation light source device 300 pass through a dichroic mirror 14, which transmits blue light and which</u>

reflects yellow light (for green and red), and are focused through a focusing lens 24 onto a light incidence side of a transparent substrate 27.

FIG. 1A



9d a condensing lens which condenses the excitation light transmitted through the dichroic mirror in an

Hirata '999 discloses a condensing lens, *e.g.* focusing lens, which condenses the excitation light transmitted through the dichroic mirror in an excitation light irradiation region on the phosphor.

	excitation light irradiation region on the phosphor,	Hirata '999 [0090]: In FIG. 1A, an excitation light source device 300 includes the blue excitation light source 101 for phosphor excitation light and a collimator lens 201 to collimate light rays emitted from the blue excitation light source 101. <u>The blue excitation light rays emitted substantially in parallel from the excitation light source device 300 pass through a dichroic mirror 14,</u> which transmits blue light and which reflects yellow light (for green and red), and <u>are focused through a focusing lens 24 onto a light incidence side of a transparent substrate 27.</u> On a light incidence side of the transparent substrate 27, a dichroic coat 272 which transmits blue light and which reflects yellow light (for green and red) is evaporated. The dichroic coat 272 is applied with a yellow phosphor 271. Hirata '999 [0094]: In FIG. 1B, two blue excitation light sources 101 each including a light emitting plane 102 are arranged adjacent to each other in the x-axis direction. <u>The blue excitation light rays emitted from the blue excitation light source 101</u> are substantially collimated through the collimator lens 201 to be <u>focused by the focusing lens 24 onto the transparent substrate 27 including a yellow phosphor</u> and a blue light diffusion layer.
9e	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	Hirata '999 combines with Alpay to disclose that 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. In Alpay, due to the asymmetrical arrangement of the excitation light sources, the unconverted excitation light is prevented from entering the excitation light source. Alpay [0003]: Generally, certain lasers may be sensitive to optical feedback such as a laser beam reflected back to the laser from a work surface. For example, fiber lasers are typically very sensitive to back-reflections from a work surface. <u>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.</u> Further, a seed laser may be damaged in a high-power master

	oscillator fiber amplifier device by reflected light that is amplified on its way back to the seed laser. In many laser processing systems, such as laser micromachining systems, it is therefore desirable to prevent such back-reflections from finding a path back into the output fiber. Alpay [0007]: <u>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.</u> For example, FIG. 2 is a block diagram of another typical fiber laser processing system 200 having a tilted beam delivery subsystem (e.g., the output fiber 110, the collimator assembly 112, and the focusing lens 116) <u>such that the path of the incident laser beam 120 is non-perpendicular to the work surface 122.</u> Alpay [0027]: The incident laser beam 120 propagates along a first axis of propagation 312 from the collimator assembly 112 to the focusing lens 116. The first axis of propagation 312 is substantially parallel to the primary axis 310 of the focusing lens 116. There is, however, an 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). <u>Rather, the incident laser beam 120 hits the focusing lens 116 at an offset 314 from the center of the lens 116.</u> In one embodiment, the amount of offset 314 is greater than or equal to approximately one-half the diameter of the collimated incident laser beam 120. As discussed below, such an amount of offset 314 reduces or prevents overlap between the reflected laser beam 123 and the incident laser beam 120. Alpay [0028]: The focusing lens 116 converges the incident laser beam 120 to a focused spot diameter on the work surface 122. <u>As a result of 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 310 of the focusing lens 116.</u> Thus, the focusing lens 116 changes the incident laser beam's path from the
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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.

Alpay [0029]: As a consequence of using the offset 314 to tilt the incident laser beam 120, the path of the reflected laser beam 123 is angularly separated from the path of the incident laser beam 120. Thus, after returning through the focusing lens 116, the reflected laser beam 123 travels along a third axis of propagation 318 that is spatially separated from the first axis of propagation 312 of the incident laser beam 120. In certain embodiments, **an offset 320 between the first axis of propagation 312 corresponding to the incident laser beam 120 and the third axis of propagation 318 corresponding to the reflected laser beam 123 is configured 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.**

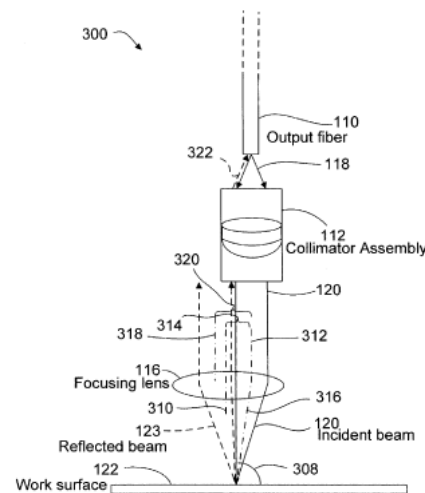
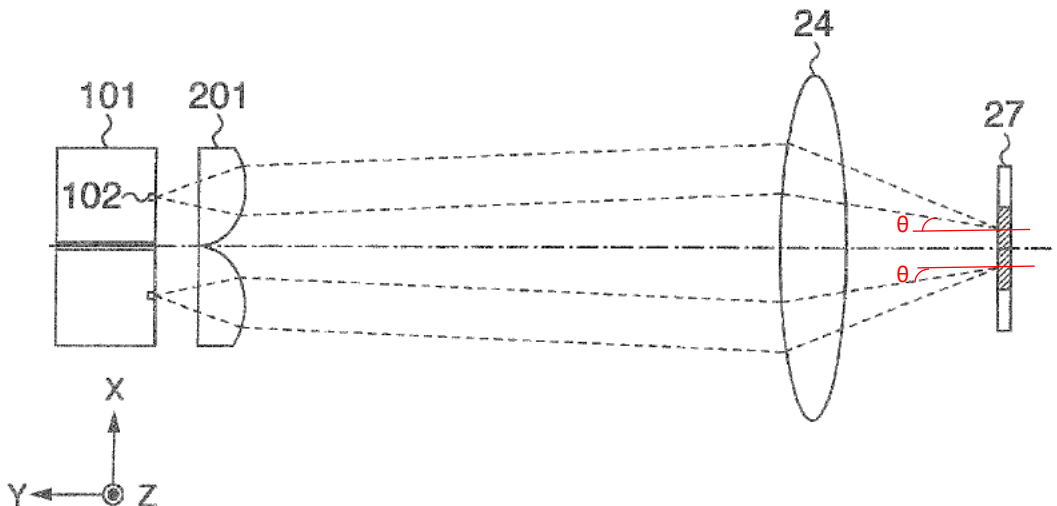


FIG. 3

9f	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, $\theta \neq 0$³ is satisfied.	Hirata '999 or Alpay discloses that 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. For example, Fig. 1B of Hirata '999 discloses that the excitation light enters obliquely to the excitation light irradiation region. Therefore, the annotated Fig. 1B of Hirata '999 below illustrates “an incident angle to the excitation light irradiation region of any excitation light of each of the excitation light is an elevation angle θ, $\theta \neq 0$.” FIG. 1B  In the alternative, Alpay also discloses that an incident angle to the excitation light irradiation region of any excitation light of each of the excitation light is an elevation angle θ, $\theta \neq 0$. For example, the incident laser beam 120 is non-perpendicular to the work surface 122.
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³ The recitation “ $\theta \neq 0$ ” was amended to read “ $\theta \neq 0$ ” by Certificate of Correction.

	Alpay [0007]: <u>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.</u> For example, FIG. 2 is a block diagram of another typical fiber laser processing system 200 having a tilted beam delivery subsystem (e.g., the output fiber 110, the collimator assembly 112, and the focusing lens 116) <u>such that the path of the incident laser beam 120 is non-perpendicular to the work surface 122.</u> Alpay [0027]: The incident laser beam 120 propagates along a first axis of propagation 312 from the collimator assembly 112 to the focusing lens 116. The first axis of propagation 312 is substantially parallel to the primary axis 310 of the focusing lens 116. <u>There is, however, an 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.</u> In one embodiment, the amount of offset 314 is greater than or equal to approximately one-half the diameter of the collimated incident laser beam 120. As discussed below, such an amount of offset 314 reduces or prevents overlap between the reflected laser beam 123 and the incident laser beam 120. Alpay [0028]: The focusing lens 116 converges the incident laser beam 120 to a focused spot diameter on the work surface 122. As a result of 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 310 of the focusing lens 116. Thus, <u>the 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.</u>
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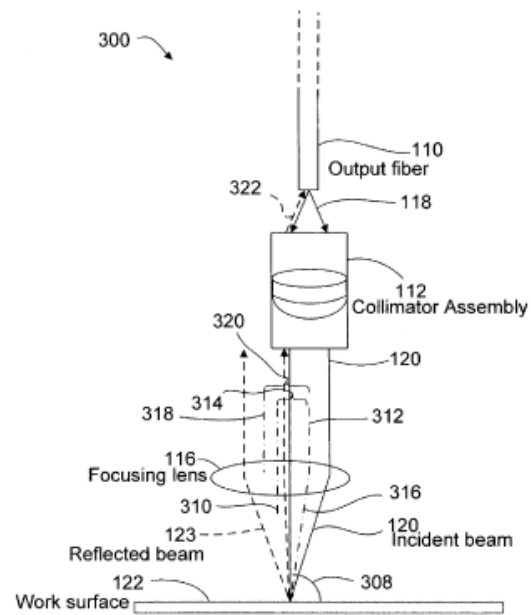


FIG. 3

Ground 2(b): Hirata '999 [US20110187999A1], Abu-Ageel [US20110044046A1] – claim chart claim 9 as invalidated by Hirata '999 and Abu-Ageel.

Publication Number	Country of Origin	Filing Date	Date of Publication
US20110187999A1 (“Hirata '999”)	United States of America	10/25/2010	08/04/2011
US20110044046A1 (“Abu-Ageel”)	United States of America	04/21/2010	02/24/2011

	Claims of U.S. Patent No. 9,322,530	Citations and Analysis
	Claim 9	
9p	A light source device, comprising:	Hirata '999 discloses a light source device. Hirata '999 [0090]: In FIG. 1A, an excitation light source device 300 includes the blue excitation light source 101 for phosphor excitation light and a collimator lens 201 to collimate light rays emitted from the blue excitation light source 101. The blue excitation light rays emitted substantially in parallel from the excitation light source device 300 pass through a dichroic mirror 14, which transmits blue light and which reflects yellow light (for green and red), and are focused through a focusing lens 24 onto a light incidence side of a transparent substrate 27. On a light incidence side of the transparent substrate 27, a dichroic coat 272 which transmits blue light and which reflects yellow light (for green and red) is evaporated. The dichroic coat 272 is applied with a yellow phosphor 271. The yellow phosphor 271 is an Yttrium Aluminum Garnet (YAG) phosphor in general, but any other appropriate material may be employed.

		FIG. 1A The diagram illustrates an optical system for an excitation light source. A light source 101, part of a device 300, emits light through a collimator lens 201. The light path is guided by mirrors 19, 20, and 23, and passes through a series of optical components including lenses 24, 25, 27, 271, 272, 273 and filters 3, 4, 5, 6. The light is then directed towards a detector or sensor 13. A coordinate system (X, Y, Z) is provided for reference.
9a	an excitation light source which emits excitation light;	Hirata '999 discloses an excitation light source which emits excitation light. Hirata '999 [0090]: In FIG. 1A, an excitation light source device 300 includes the blue excitation light source 101 for phosphor excitation light and a collimator lens 201 to collimate light rays emitted from the blue excitation light source 101. Hirata [0094]: In FIG. 1B, two blue excitation light sources 101 each including a light emitting plane 102 are arranged adjacent to each other in the x-axis direction. The blue

excitation light rays emitted from the blue excitation light source 101 are substantially collimated through the collimator lens 201 to be focused by the focusing lens 24 onto the transparent substrate 27 including a yellow phosphor and a blue light diffusion layer.

FIG. 1A

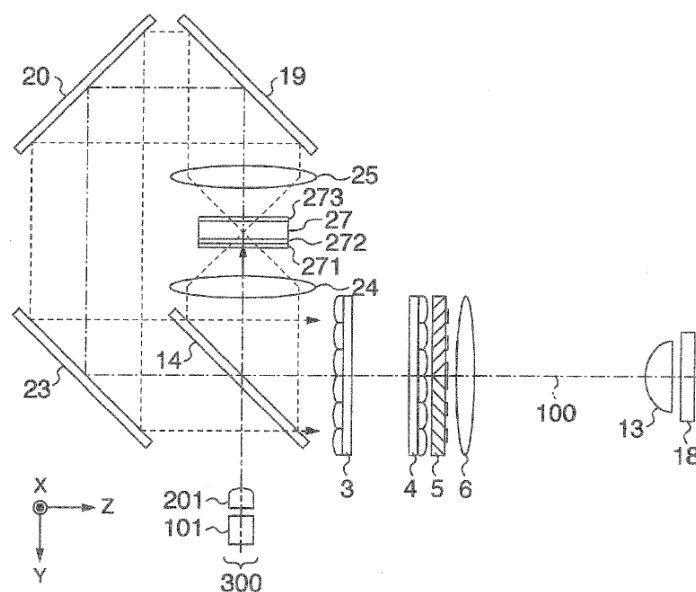


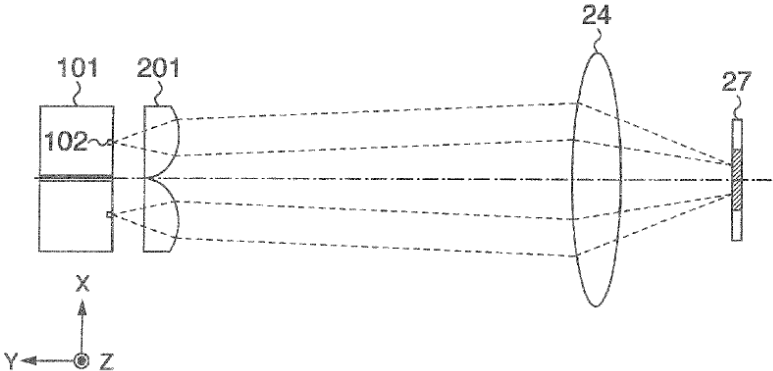
		FIG. 1B 
9b	a phosphor which changes the excitation light to fluorescent light;	Hirata '999 discloses a phosphor which changes the excitation light to fluorescent light. Hirata '999 [0088]: ...The embodiment includes a light source in which <u>a yellow phosphor is excited by blue excitation light to emit yellow light.</u> Hirata '999 [0091]: Since part of the blue excitation light reacts with <u>the yellow phosphor 271</u>, yellow light is emitted in all directions.

		FIG. 1A
9c	a dichroic mirror which transmits the excitation light and reflects the fluorescent light; and	Hirata '999 discloses a dichroic mirror which transmits the excitation light and reflects the fluorescent light. Hirata '999 [0090]: In FIG. 1A, an excitation light source device 300 includes the blue excitation light source 101 for phosphor excitation light and a collimator lens 201 to collimate light rays emitted from the blue excitation light source 101. The blue excitation light rays emitted substantially in parallel from <u>the excitation light source device 300 pass through a dichroic mirror 14, which transmits blue light and which</u>

		reflects yellow light (for green and red), and are focused through a focusing lens 24 onto a light incidence side of a transparent substrate 27. FIG. 1A
9d	a condensing lens which condenses the excitation light transmitted through the dichroic mirror in an excitation light irradiation region on the phosphor,	Hirata '999 discloses a condensing lens, <i>e.g.</i> focusing lens, which condenses the excitation light transmitted through the dichroic mirror in an excitation light irradiation region on the phosphor. Hirata '999 [0090] In FIG. 1A, an excitation light source device 300 includes the blue excitation light source 101 for phosphor excitation light and a collimator lens 201 to

collimate light rays emitted from the blue excitation light source 101. **The blue excitation light rays emitted substantially in parallel from the excitation light source device 300 pass through a dichroic mirror 14, which transmits blue light and which reflects yellow light (for green and red), and are focused through a focusing lens 24 onto a light incidence side of a transparent substrate 27.** On a light incidence side of the transparent substrate 27, a dichroic coat 272 which transmits blue light and which reflects yellow light (for green and red) is evaporated. **The dichroic coat 272 is applied with a yellow phosphor 271.**

Hirata '999 [0094]: In FIG. 1B, two blue excitation light sources 101 each including a light emitting plane 102 are arranged adjacent to each other in the x-axis direction. **The blue excitation light rays emitted from the blue excitation light source 101 are** substantially collimated through the collimator lens 201 to **be focused by the focusing lens 24 onto the transparent substrate 27 including a yellow phosphor** and a blue light diffusion layer.

FIG. 1A

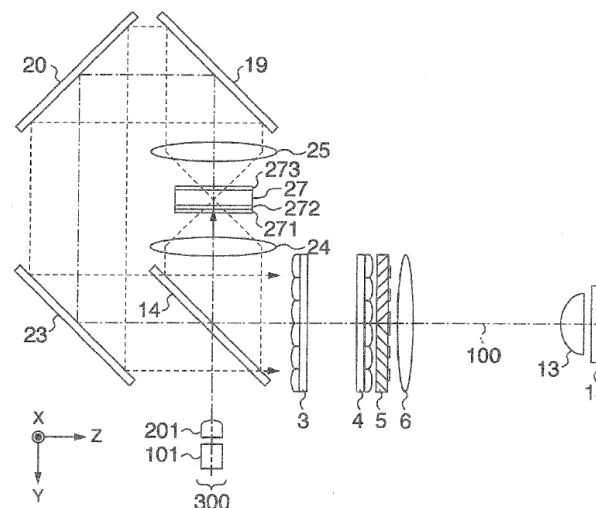
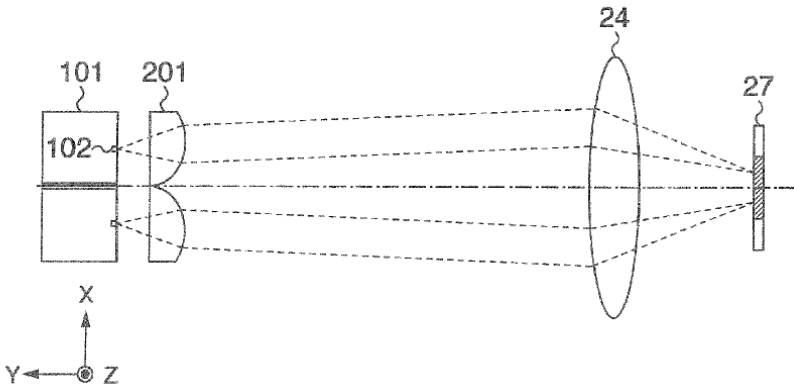


		FIG. 1B 
9e	wherein the excitation light sources are arranged so that when excitation light emitted from the excitation light source enters the excitation light irradiation region and is reflected without being converted into fluorescent light, the unconverted excitation light is prevented from entering the excitation light source, and	Hirata '999 combines with Abu-Ageel to disclose that 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. Abu-Ageel [0002]: The disclosure relates <u>generally to light sources, illumination systems, projection systems</u> and backlights. More particularly, it relates to high brightness light sources, <u>illumination systems, projection systems</u> and backlights that utilize violet lasers and wavelength conversion materials such as phosphor. Abu-Ageel [0082]: ... Part of the light impinging on the wavelength conversion layer 413 gets absorbed and converted into light with a new wavelength band (i.e., converted light) and <u>the remainder gets diffused by the wavelength conversion layer 413 but does not get converted</u>. Both the source light and converted light get collimated by the light envelope 420 and <u>impinge on the entrance aperture of optical element 417.... Optical element 417 reflects a substantial amount of the source light that impinges on it toward the wavelength conversion layer 413, thus, providing</u>

another chance for source light to be converted by the wavelength conversion layer 413.

Abu-Ageel [0087]: FIG. 3C shows a cross-sectional view of another exemplary illumination assembly 6700. Illumination assembly 6700 consists of a violet laser 410, hollow light envelope (or guide) 620 with an aperture 620 *a*, **a wavelength conversion layer 613**, an optional low-refractive index layer 623 located between the wavelength conversion layer 613 and **the reflective coating 614, ... Optical element 625 is preferably a coating that reflects non-converted light (i.e., light received from source 411 that was not absorbed or converted within light envelope 620) back to light envelope 620 and allows the converted light to pass out of the envelope 620.** Alternatively, optical element 625 can be a reflective polarizer, dichroic mirror...

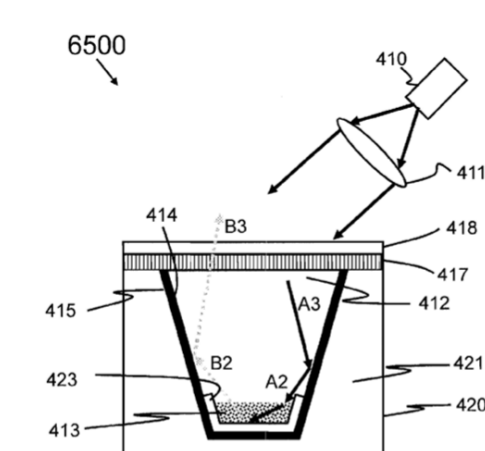


FIG.3A

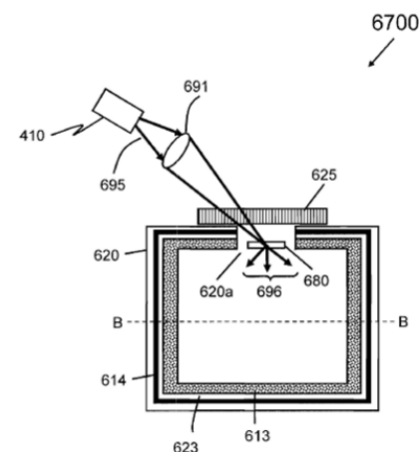
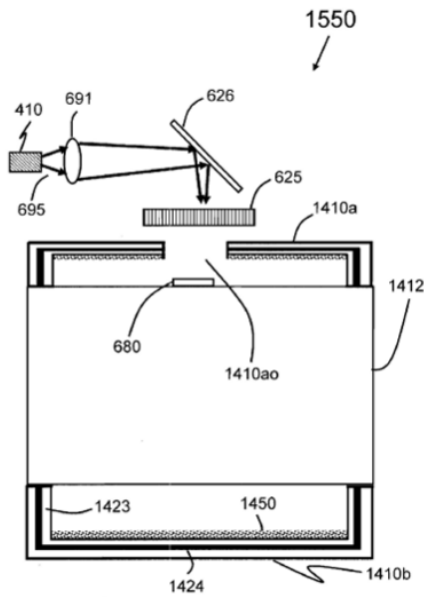
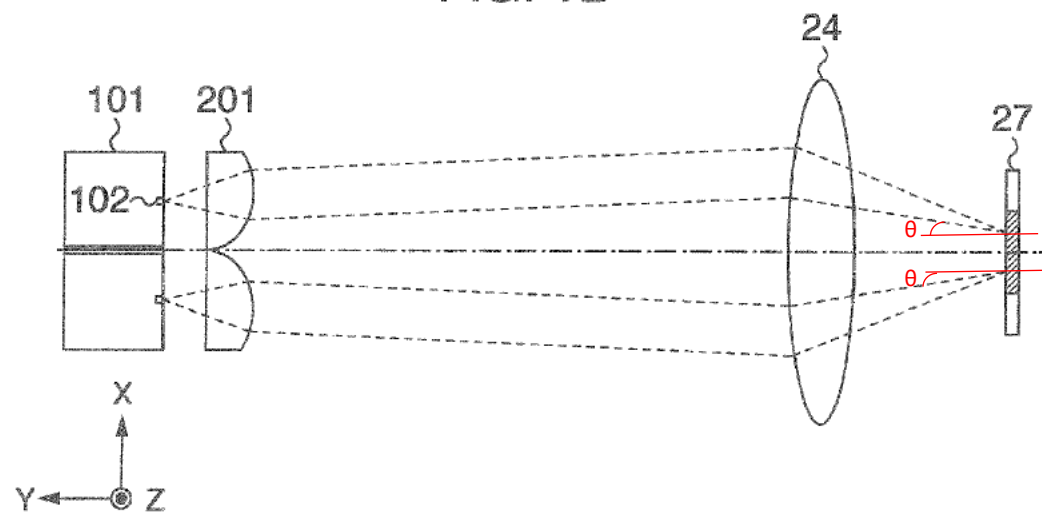


FIG.3C

		 FIG. 4B
9f	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, $\theta \neq 0$⁴ is satisfied.	Hirata '999 discloses 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. Fig. 1B of Hirata '999 discloses that the excitation light enters obliquely to the excitation light irradiation region. Therefore, the annotated Fig. 1B of Hirata '999 below illustrates “an incident angle to the excitation light irradiation region of any excitation light of each of the excitation light is an elevation angle θ, $\theta \neq 0$.”

⁴ The recitation “ $\theta \neq 0$ ” was amended to read “ $\theta \neq 0$ ” by Certificate of Correction.

FIG. 1B



Ground 2(c): Hirata '999 [US20110187999A1], Kitano '349 [US20110292349A1] – claim chart for claim 9 as invalidated by Hirata '999 and Kitano '349.

Publication Number	Country of Origin	Filing Date	Date of Publication
US20110187999A1 (“Hirata '999”)	United States of America	10/25/2010	08/04/2011
US20110292349A1 (“Kitano '349”)	United States of America	05/27/2011	12/01/2011

	Claims of U.S. Patent No. 9,322,530	Citations and Analysis
	Claim 9	
9p	A light source device, comprising:	Hirata '999 discloses a light source device. Hirata '999 [0090]: In FIG. 1A, an excitation light source device 300 includes the blue excitation light source 101 for phosphor excitation light and a collimator lens 201 to collimate light rays emitted from the blue excitation light source 101. The blue excitation light rays emitted substantially in parallel from the excitation light source device 300 pass through a dichroic mirror 14, which transmits blue light and which reflects yellow light (for green and red), and are focused through a focusing lens 24 onto a light incidence side of a transparent substrate 27. On a light incidence side of the transparent substrate 27, a dichroic coat 272 which transmits blue light and which reflects yellow light (for green and red) is evaporated. The dichroic coat 272 is applied with a yellow phosphor 271. The yellow phosphor 271 is an Yttrium Aluminum Garnet (YAG) phosphor in general, but any other appropriate material may be employed.

Hirata '999 discloses an excitation light source which emits excitation light.

Hirata '999 [0094]: In FIG. 1B, **two blue excitation light sources 101** each including a light emitting plane 102 are arranged adjacent to each other in the x-axis direction. **The**

blue excitation light rays emitted from the blue excitation light source 101 are substantially collimated through the collimator lens 201 to be focused by the focusing lens 24 onto the transparent substrate 27 including a yellow phosphor and a blue light diffusion layer.

FIG. 1A

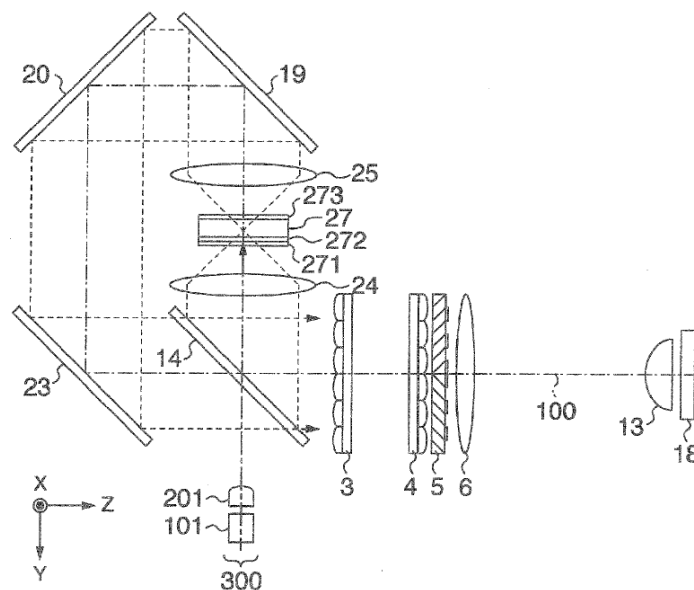
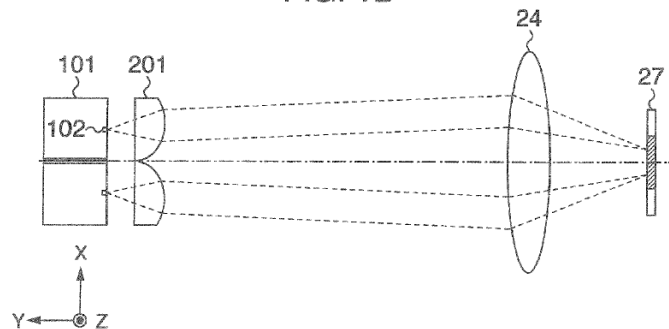


FIG. 1B



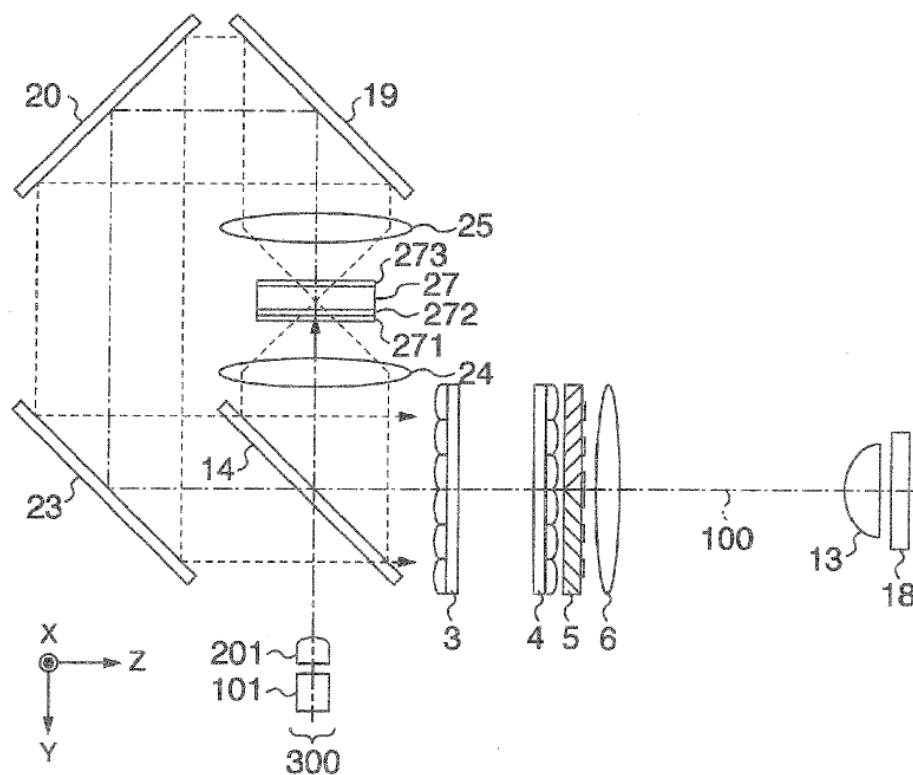
9b a phosphor which changes the excitation light to fluorescent light;

Hirata '999 discloses a phosphor which changes the excitation light to fluorescent light.

Hirata '999 [0088]: ...The embodiment includes a light source in which **a yellow phosphor is excited by blue excitation light to emit yellow light.**

Hirata '999 [0091]: Since part of the blue excitation light reacts with **the yellow phosphor 271**, yellow light is emitted in all directions.

FIG. 1A



9c	a dichroic mirror which transmits the excitation light and reflects the fluorescent light; and	Hirata '999 discloses a dichroic mirror which transmits the excitation light and reflects the fluorescent light. Hirata '999 [0090]: In FIG. 1A, an excitation light source device 300 includes the blue excitation light source 101 for phosphor excitation light and a collimator lens 201 to collimate light rays emitted from the blue excitation light source 101. The blue excitation light rays emitted substantially in parallel from <u>the excitation light source device 300 pass through a dichroic mirror 14, which transmits blue light and which reflects yellow light (for green and red)</u>, and are focused through a focusing lens 24 onto a light incidence side of a transparent substrate 27.
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		FIG. 1A The diagram illustrates an optical system for phosphor excitation. At the bottom left, an excitation light source device 300 contains a blue excitation light source 101 and a collimator lens 201. Light from the source 101 passes through the lens 201 and is reflected by a dichroic mirror 14 at a 45-degree angle. The light then passes through a condensing lens 25 and is focused onto a phosphor 18. A lens assembly 100, consisting of lenses 3, 4, 5, and 6, is positioned between the dichroic mirror 14 and the phosphor 18. A coordinate system is shown with the Z-axis pointing right, the Y-axis pointing down, and the X-axis pointing out of the page. Other components include mirrors 19 and 20, and a lens 24.
9d	a condensing lens which condenses the excitation light transmitted through the dichroic mirror in an excitation light irradiation region on the phosphor,	Hirata '999 discloses a condensing lens, <i>e.g.</i> focusing lens, which condenses the excitation light transmitted through the dichroic mirror in an excitation light irradiation region on the phosphor. Hirata '999 [0090] In FIG. 1A, an excitation light source device 300 includes the blue excitation light source 101 for phosphor excitation light and a collimator lens 201 to collimate light rays emitted from the blue excitation light source 101. The blue

excitation light rays emitted substantially in parallel from the excitation light source device 300 pass through a dichroic mirror 14, which transmits blue light and which reflects yellow light (for green and red), and are focused through a focusing lens 24 onto a light incidence side of a transparent substrate 27. On a light incidence side of the transparent substrate 27, a dichroic coat 272 which transmits blue light and which reflects yellow light (for green and red) is evaporated. **The dichroic coat 272 is applied with a yellow phosphor 271.**

Hirata '999 [0094]: In FIG. 1B, two blue excitation light sources 101 each including a light emitting plane 102 are arranged adjacent to each other in the x-axis direction. The blue excitation light rays emitted from the blue excitation light source 101 are substantially collimated through the collimator lens 201 to **be focused by the focusing lens 24 onto the transparent substrate 27 including a yellow phosphor** and a blue light diffusion layer.

FIG. 1A

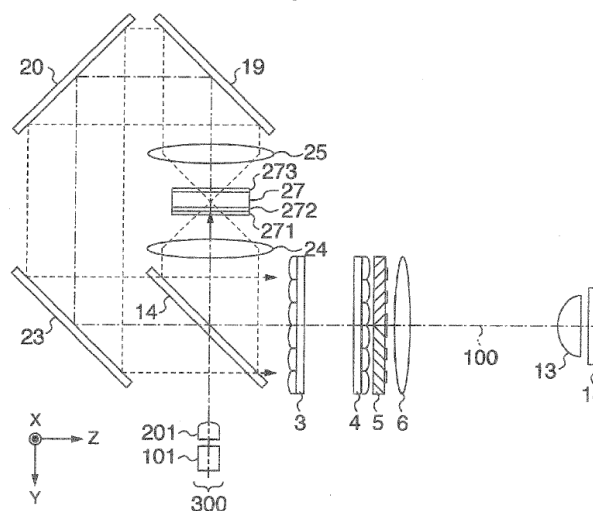
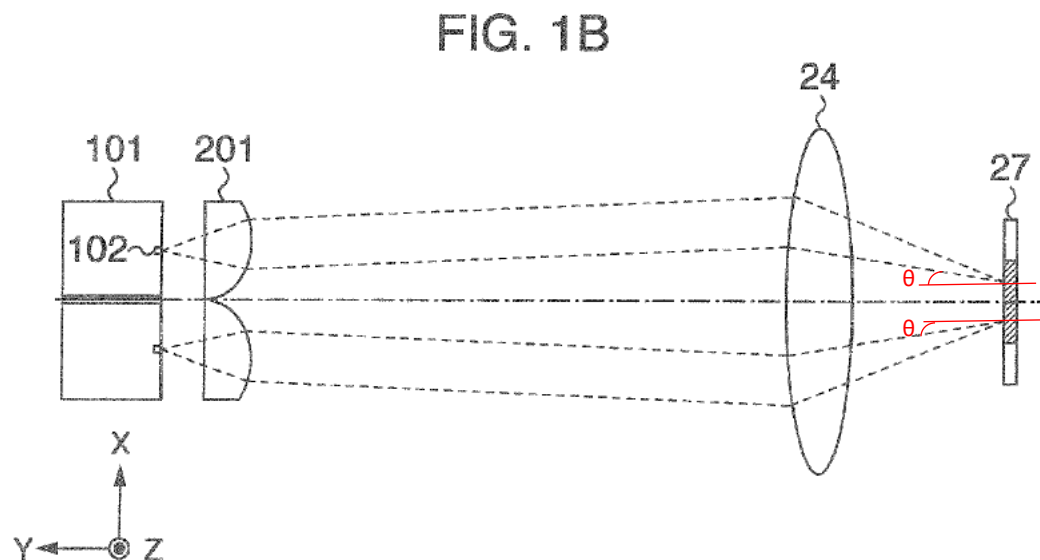


		FIG. 1B
9e	wherein the excitation light sources are arranged so that when excitation light emitted from the excitation light source enters the excitation light irradiation region and is reflected without being converted into fluorescent light, the unconverted excitation light is prevented from entering the excitation light source, and	Hirata '999 combines with Kitano '349 to disclose that 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. Kitano '349 [0048]: <u>Not all of the excitation light is wavelength-converted into green fluorescence at the fluorescent material 201, but there exists unconverted blue light.</u> Of the blue excitation light incident on the fluorescent material 201, the unconverted blue light passes through the condenser lenses 207 and 208 again to be substantially collimated. The unconverted blue light is scattered light scattered by the fluorescent material 201, and there exists light having polarization direction different from that at the time when the light was incident on the fluorescent material. Therefore, among components of <u>the unconverted blue light that are incident on the dichroic mirror 213 again, S polarization components are reflected by the dichroic mirror 213, which components will be first blue light.</u>
9f	wherein when the excitation light irradiation region is a center and an incident angle to the excitation light	Hirata '999 discloses 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.

irradiation region of any excitation light of each of the excitation light is an elevation angle θ , $\theta \neq 0^5$ is satisfied.

Fig. 1B of Hirata '999 discloses that the excitation light enters obliquely to the excitation light irradiation region. Therefore, the annotated Fig. 1B of Hirata '999 below illustrates "an incident angle to the excitation light irradiation region of any excitation light of each of the excitation light is an elevation angle θ , $\theta \neq 0$."



⁵ The recitation " $\theta \neq 0$ " was amended to read " $\theta \neq 0$ " by Certificate of Correction.

Ground 3: Huang [US8783886B2], Alpay [US20090308852A1], Akiyama '098 [US20120008098A1], – claim charts for claims 1, 3 and 4 as invalidated by Huang and Alpay, and claims 3 and 7 by Huang, Alpay and Akiyama '098.

Publication Number	Country of Origin	Filing Date	Date of Publication
US8783886B2 (“Huang”)	United States of America	06/27/2011	07/22/2014
US20090308852A1 (“Alpay”)	United States of America	09/12/2008	12/17/2009
US20120008098A1 (“Akiyama '098”)	United States of America	06/28/2011	01/12/2012

	Claims of U.S. Patent No. 9,322,530	Citations and Analysis
	Claim 1	
1p	A light source device, comprising:	Huang discloses a light source device. Huang [Column 2/Lines 38-45]: As shown in FIG. 2, an illumination system 100 according to an embodiment of the present invention is disposed in a projection device (not shown), and comprises a first light source 210, <u>a second light source 220, an optical device 310, a wavelength transformer 410 and a first dichroic mirror 510.</u> In reference to both FIGS. 3A and 3B, the first light source 210 emits a first light beam 211, while the second light source 220 emits a second light beam 221.

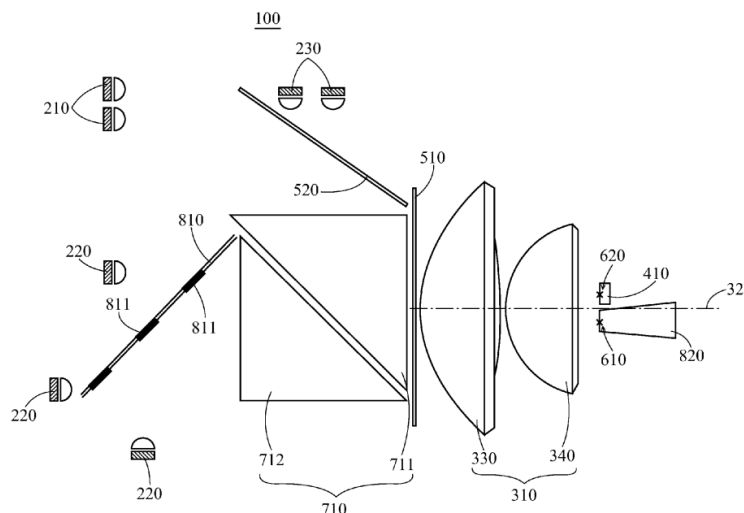


FIG. 2

1a	a plurality of excitation light sources which emit excitation light;	Huang discloses a plurality of excitation light sources which emit excitation light. Huang [Column 2/Lines 38-45]: As shown in FIG. 2, an illumination system 100 according to an embodiment of the present invention is disposed in a projection device (not shown), and comprises a first light source 210, <u>a second light source 220</u>, an optical device 310, a wavelength transformer 410 and a first dichroic mirror 510. In reference to both FIGS. 3A and 3B, the first light source 210 emits a first light beam 211, <u>while the second light source 220 emits a second light beam 221.</u> Huang [Column 4/Lines 16-19]: ...the second light source 220 comprises a plurality of secondary light sources for emitting a plurality of secondary light beams (not shown) respectively.
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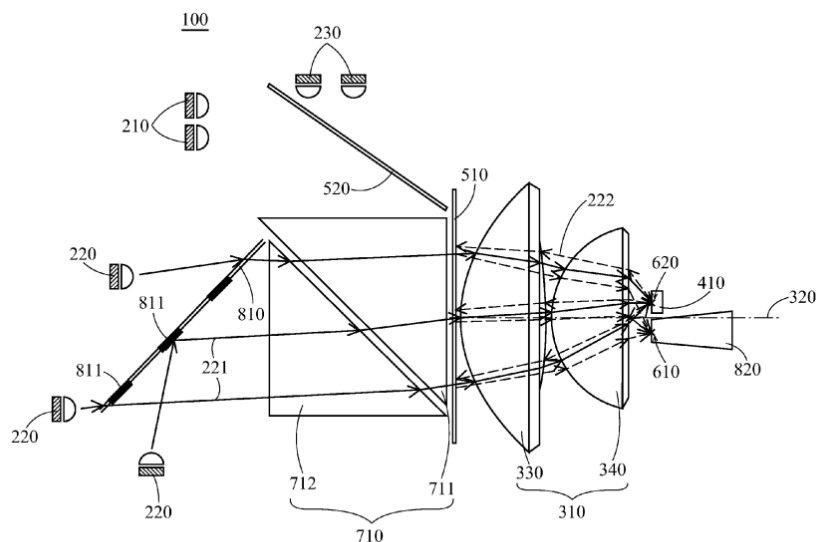


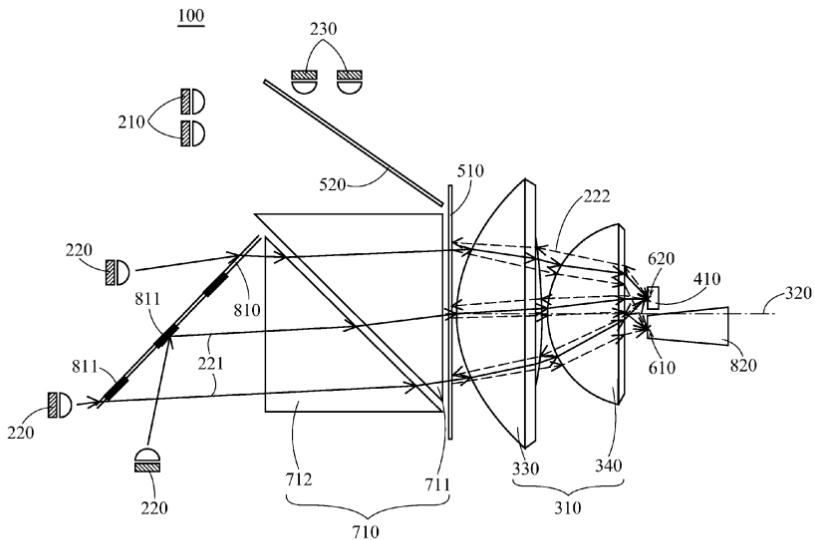
FIG. 3B

1b a phosphor which changes the excitation light to fluorescent light;

Huang discloses a phosphor, *e.g.* wavelength transformer, which changes the excitation light to fluorescent light.

Huang [Column 2/Lines 38-45]: As shown in FIG. 2, an illumination system 100 according to an embodiment of the present invention is disposed in a projection device (not shown), and comprises a first light source 210, a second light source 220, an optical device 310, **a wavelength transformer 410** and a first dichroic mirror 510. In reference to both FIGS. 3A and 3B, the first light source 210 emits a first light beam 211, while the second light source 220 emits a second light beam 221.

Huang [Column 2/Lines 61-64]: The wavelength transformer 410 is disposed at the second focal point 620, and receives and transforms the second light beam 221 emitted by the second light source 220 into a third light beam 222.

		Huang [Column 4/Lines 36-38]: <u>The wavelength transformer 410 may be a yellow or green phosphor, and correspondingly, the third light beam 222 is a yellow or green light beam.</u>  FIG. 3B
1c	a dichroic mirror which transmits the excitation light and reflects the fluorescent light; and	Huang discloses a dichroic mirror which transmits the excitation light and reflects the fluorescent light. Huang [Column 2/Lines 38-45]: As shown in FIG. 2, an illumination system 100 according to an embodiment of the present invention is disposed in a projection device (not shown), and comprises a first light source 210, a second light source 220, an optical device 310, a wavelength transformer 410 and <u>a first dichroic mirror 510</u>. In reference to both FIGS. 3A and 3B, the first light source 210 emits a first light beam 211, while the second light source 220 emits a second light beam 221.

Huang [Column 2/Lines 61-67 and Column 3/Lines 1-10]: The wavelength transformer 410 is disposed at the second focal point 620, and receives and transforms the second light beam 221 emitted by the second light source 220 into a third light beam 222. **The first dichroic mirror 510, which is disposed between the first and the second light sources 210, 220 and the optical device 310, is adapted to allow the first light beam 211 and the second light beam 221 to travel therethrough and reflect the third light beam 222.** In other words, as shown in FIG. 3B, when the second light beam 221, emitted by the second light source 220, is focused by the optical device 310 onto the wavelength transformer 410 that is disposed at the second focal point 620, the second light beam 221 is transformed into the third light beam 222. Then, **the third light beam 222 is emitted from the second focal point 620 to pass through the optical device 310, and is then reflected by the first dichroic mirror 510 to the optical device 310 to be focused onto the first focal point 610.**

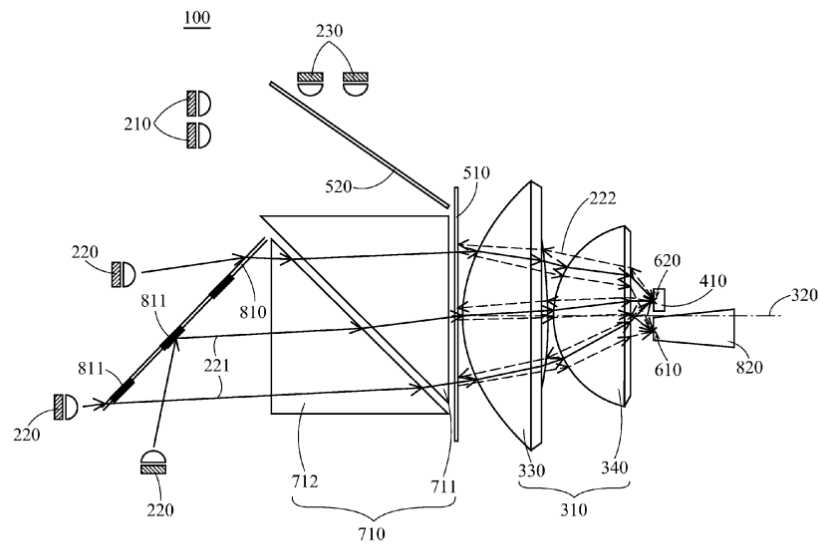


FIG. 3B

1d	a condensing lens which condenses the excitation light transmitted through the dichroic mirror in an excitation light irradiation region on the phosphor,	Huang discloses a condensing lens, <i>e.g.</i>, an optical device, which condenses the excitation light transmitted through the dichroic mirror in an excitation light irradiation region on the phosphor. In Huang, the optical device 310 including a condensing lens 330 or 340 condenses the second light beam 221 at the second focal point 620 that is an excitation light irradiation region on the wavelength transformer, <i>e.g.</i> phosphor. Huang [Column 2/Lines 61-67 and Column 3/Lines 1-10]: The wavelength transformer 410 is disposed at the second focal point 620, and receives and transforms the second light beam 221 emitted by the second light source 220 into a third light beam 222. The first dichroic mirror 510, which is disposed between the first and the second light sources 210, 220 and the optical device 310, is adapted to allow the first light beam 211 and the second light beam 221 to travel therethrough and reflect the third light beam 222. In other words, as shown in FIG. 3B, when <u>the second light beam 221, emitted by the second light source 220, is focused by the optical device 310 onto the wavelength transformer 410 that is disposed at the second focal point 620, the second light beam 221 is transformed into the third light beam 222.</u> Then, the third light beam 222 is emitted from the second focal point 620 to pass through the optical device 310, and is then reflected by the first dichroic mirror 510 to the optical device 310 to be focused onto the first focal point 610.
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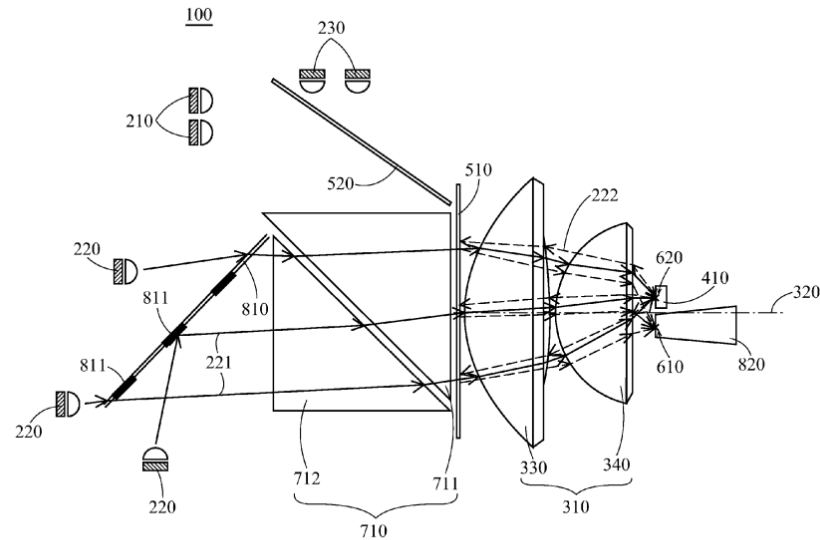


FIG. 3B

1e 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

Huang or Alpay discloses that 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.

In Huang, each of the bottom two light sources 220 enters asymmetrically with respect to one another and the center of the condensing lens, as shown in the figure below.

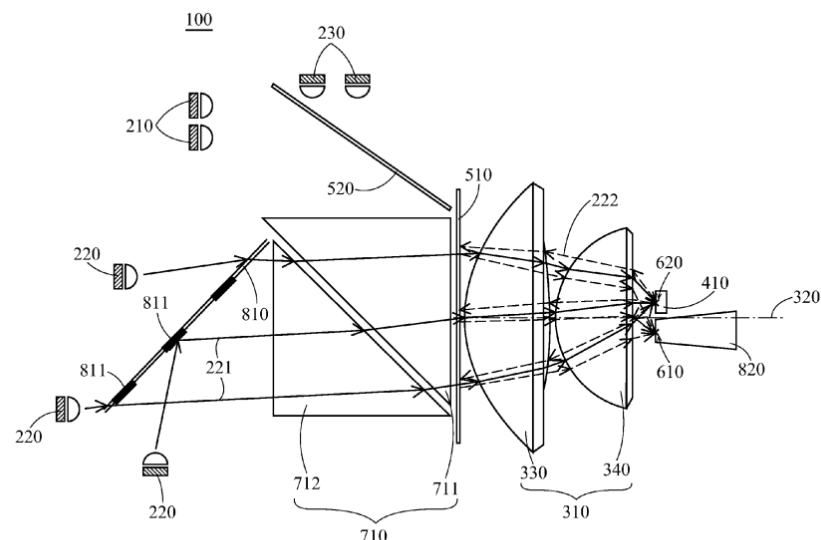
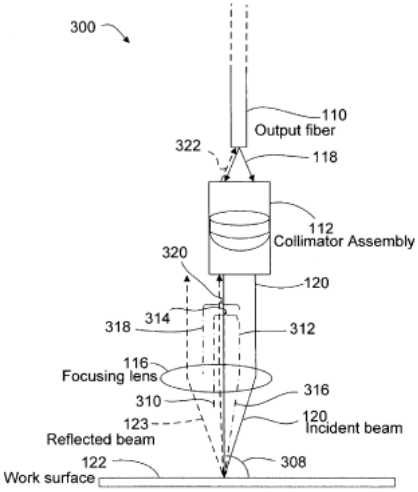


FIG. 3B

In the alternative, Alpay discloses that the asymmetrical arrangement of light source is to prevent the laser from reflecting back to damage the laser light source.

Alpay [0003]: Generally, certain lasers may be sensitive to optical feedback such as a laser beam reflected back to the laser from a work surface. For example, fiber lasers are typically very sensitive to back-reflections 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.** Further, a seed laser may be damaged in a high-power master oscillator fiber amplifier device by reflected light that is amplified on its way back to the seed laser. In many laser processing systems, such as laser micromachining systems, it is therefore desirable to prevent such back-reflections from finding a path back into the output fiber.

	Alpay [0007]: <u>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.</u> For example, FIG. 2 is a block diagram of another typical fiber laser processing system 200 having a tilted beam delivery subsystem (e.g., the output fiber 110, the collimator assembly 112, and the focusing lens 116) <u>such that the path of the incident laser beam 120 is non-perpendicular to the work surface 122.</u> Alpay [0027]: The incident laser beam 120 propagates along a first axis of propagation 312 from the collimator assembly 112 to the focusing lens 116. The first axis of propagation 312 is substantially parallel to the primary axis 310 of the focusing lens 116. There is, however, an 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). <u>Rather, the incident laser beam 120 hits the focusing lens 116 at an offset 314 from the center of the lens 116.</u> In one embodiment, the amount of offset 314 is greater than or equal to approximately one-half the diameter of the collimated incident laser beam 120. As discussed below, such an amount of offset 314 reduces or prevents overlap between the reflected laser beam 123 and the incident laser beam 120. Alpay [0028]: The focusing lens 116 converges the incident laser beam 120 to a focused spot diameter on the work surface 122. <u>As a result of 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 310 of the focusing lens 116.</u> Thus, the 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. Alpay [0029]: As a consequence of using the offset 314 to tilt the incident laser beam 120, the path of the reflected laser beam 123 is angularly separated from the path of the incident laser beam 120. Thus, after returning through the focusing lens 116, the
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		reflected laser beam 123 travels along a third axis of propagation 318 that is spatially separated from the first axis of propagation 312 of the incident laser beam 120. In certain embodiments, <u>an offset 320 between the first axis of propagation 312 corresponding to the incident laser beam 120 and the third axis of propagation 318 corresponding to the reflected laser beam 123 is configured 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.</u>  FIG. 3
1f	wherein when the excitation light irradiation region is a center and an incident angle to the excitation light irradiation region of any excitation	Huang combines with Alpay to disclose 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. For example, the incident laser beam 120 is non-perpendicular to the work surface 122. Alpay [0007]: <u>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</u>

light of each of the excitation light is an elevation angle θ, $\theta \neq 0^6$ is satisfied.	<u>angle of incidence of the beam hitting the work surface is not 90 degrees.</u> For example, FIG. 2 is a block diagram of another typical fiber laser processing system 200 having a tilted beam delivery subsystem (e.g., the output fiber 110, the collimator assembly 112, and the focusing lens 116) <u>such that the path of the incident laser beam 120 is non-perpendicular to the work surface 122.</u> Alpay [0027]: The incident laser beam 120 propagates along a first axis of propagation 312 from the collimator assembly 112 to the focusing lens 116. The first axis of propagation 312 is substantially parallel to the primary axis 310 of the focusing lens 116. <u>There is, however, an 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.</u> In one embodiment, the amount of offset 314 is greater than or equal to approximately one-half the diameter of the collimated incident laser beam 120. As discussed below, such an amount of offset 314 reduces or prevents overlap between the reflected laser beam 123 and the incident laser beam 120. Alpay [0028]: The focusing lens 116 converges the incident laser beam 120 to a focused spot diameter on the work surface 122. <u>As a result of 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 310 of the focusing lens 116. Thus, the 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.</u>
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⁶ The recitation “ $\theta \neq 0$ ” was amended to read “ $\theta \neq 0$ ” by Certificate of Correction.

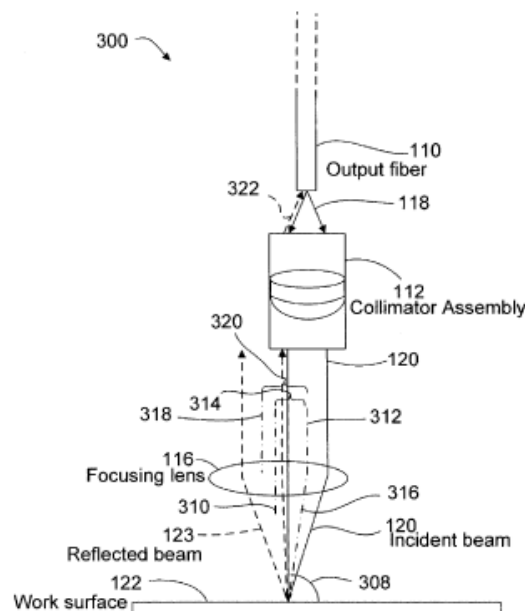


FIG. 3

Claim 3

3p The light source device according to claim 1,

Huang discloses a light source device.

Huang [Column 2/Line 38-45]: As shown in FIG. 2, an illumination system 100 according to an embodiment of the present invention is disposed in a projection device (not shown), and comprises a first light source 210, **a second light source 220, an optical device 310, a wavelength transformer 410 and a first dichroic mirror 510**. In reference to both FIGS. 3A and 3B, the first light source 210 emits a first light beam 211, while the second light source 220 emits a second light beam 221.

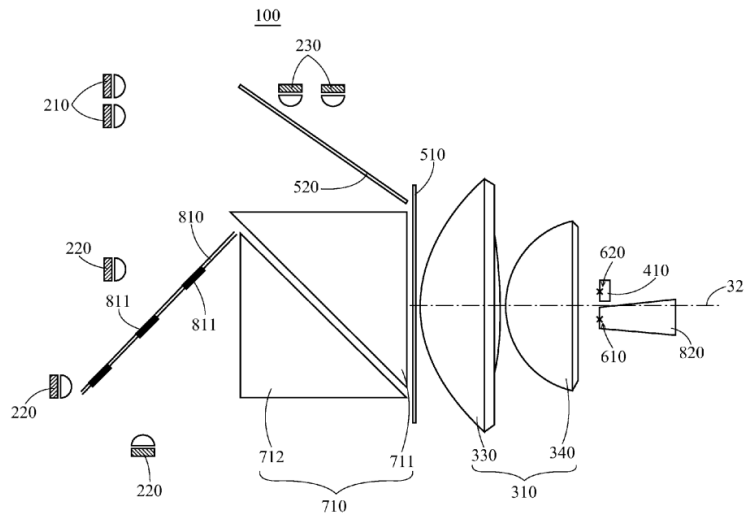


FIG. 2

3a 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 θ_m and an azimuth angle is ϕ_m , 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 θ_n and an azimuth angle is ϕ_n , there is

Huang combines with Alpay or Akiyama '098 to disclose 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 θ_m and an azimuth angle is ϕ_m , 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 θ_n and an azimuth angle is ϕ_n , there is **no pair** of the excitation lights in which $\theta_m - 2^\circ \leq \theta_n \leq \theta_m + 2^\circ$, and $\phi_m + 178^\circ \leq \phi_n \leq \phi_m + 182^\circ$ are established.

In claim 3a, $\theta_m - 2^\circ \leq \theta_n \leq \theta_m + 2^\circ$ means $-2^\circ \leq \theta_m - \theta_n \leq 2^\circ$, and $\phi_m + 178^\circ \leq \phi_n \leq \phi_m + 182^\circ$ means $178^\circ \leq \phi_n - \phi_m \leq 182^\circ$.

Based on column 6/lines 48-59 ("a mathematical formula 3 **or** a mathematical formula 4 is established as the condition for preventing incidence of the unconverted excitation

no pair of the excitation lights in which $\theta_m - 2^\circ \leq \theta_n \leq \theta_m + 2^\circ$, and $\varphi_m + 178^\circ \leq \varphi_n \leq \varphi_m + 182^\circ$⁷ are established.	light group 51 to the excitation light source group 5”), the meaning of “there is no pair of the excitation lights in which $\theta_m - 2^\circ \leq \theta_n \leq \theta_m + 2^\circ$, and $\varphi_m + 178^\circ \leq \varphi_n \leq \varphi_m + 182^\circ$ are established” should be $\theta_n \neq \theta_m$ ($\theta_m \neq 0$, $\theta_n \neq 0$) (Equation 3), or $\varphi_n \neq \varphi_m + 180^\circ$ ($\theta_m \neq 0$, $\theta_n \neq 0$) (Equation 4). Alpay discloses the abovementioned limitation. Alpay [0007]: <u>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.</u> For example, FIG. 2 is a block diagram of another typical fiber laser processing system 200 having a tilted beam delivery subsystem (e.g., the output fiber 110, the collimator assembly 112, and the focusing lens 116) <u>such that the path of the incident laser beam 120 is non-perpendicular to the work surface 122.</u> Alpay [0027]: The incident laser beam 120 propagates along a first axis of propagation 312 from the collimator assembly 112 to the focusing lens 116. The first axis of propagation 312 is substantially parallel to the primary axis 310 of the focusing lens 116. <u>There is, however, an 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.</u> In one embodiment, the amount of offset 314 is greater than or equal to approximately one-half the diameter of the collimated incident laser beam 120. As discussed below, such an amount of offset 314 reduces or prevents overlap between the reflected laser beam 123 and the incident laser beam 120. Alpay [0028]: The focusing lens 116 converges the incident laser beam 120 to a focused spot diameter on the work surface 122. As a result of the asymmetric arrangement provided by the offset 314 between the first axis of propagation 312 of the incident laser
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⁷ The recitation “ $\varphi_m + 178^\circ \leq \varphi_m \leq \varphi_m + 182^\circ$ ” was amended to read “ $\varphi_m + 178^\circ \leq \varphi_n \leq \varphi_m + 182^\circ$ ” by Certificate of Correction.

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 310 of the focusing lens 116. Thus, **the 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.**

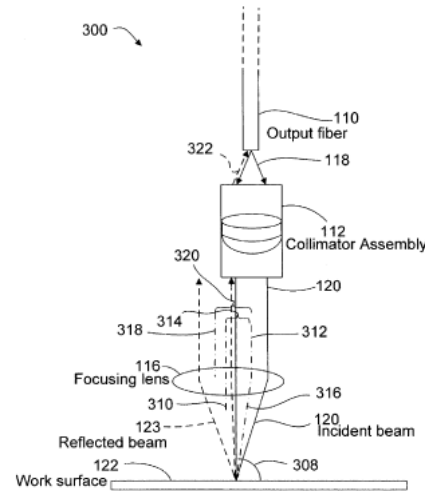


FIG. 3

In the alternative, Akiyama '098 discloses the limitation as well. For example, Fig. 2A of Akiyama '098 shows that all the excitation lights from the first excitation light generation section 20 are asymmetrically incident to the fluorescence generation section 70. Therefore, there is a condition that an incident angle to the excitation light irradiation region of the first excitation light (elevation angle) of each of the excitation lights, θ_m , and an incident angle to the excitation light irradiation region of the second excitation light (elevation angle) of each of the excitation lights, θ_n , $\theta_m \neq \theta_n$ ($\theta_m - \theta_n \neq 0$), and/or. an azimuth angle of the first excitation light of each of the excitation lights, ϕ_m , and an azimuth angle of the second excitation light of each of the excitation lights, ϕ_n , $\phi_m + 178^\circ \leq \phi_n \leq \phi_m + 182^\circ$.

Akiyama '098 [0072]: The excitation light combining section 50 transmits the blue light (first excitation light) from the first excitation light generation section 20 and reflects the blue light (second excitation light) from the second excitation light generation section 30 to thereby combine the blue light from the first excitation light generation section 20 and the blue light from the second excitation light generation section 30.

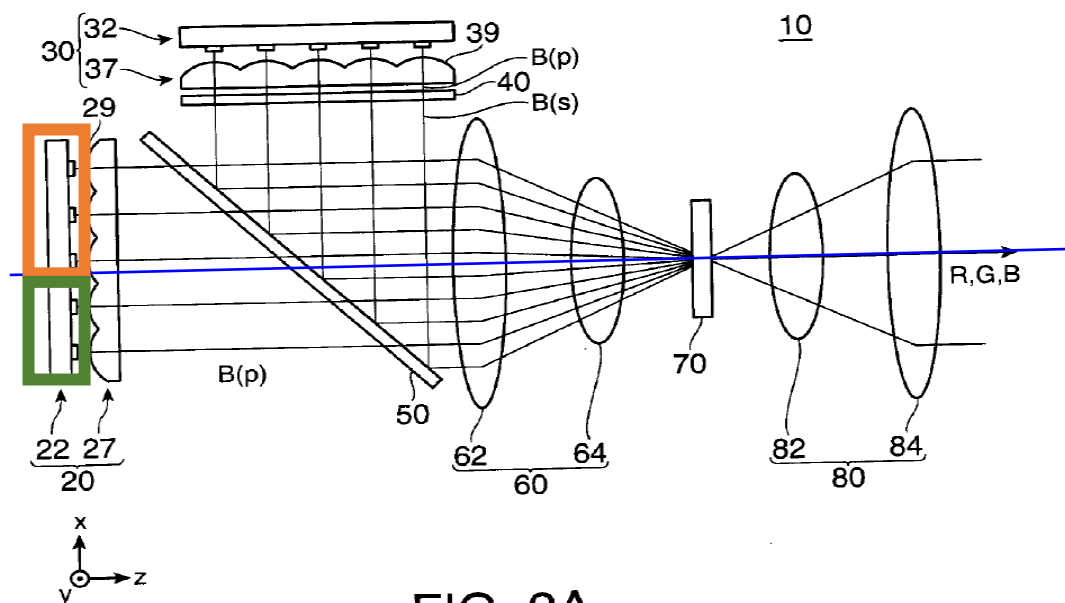


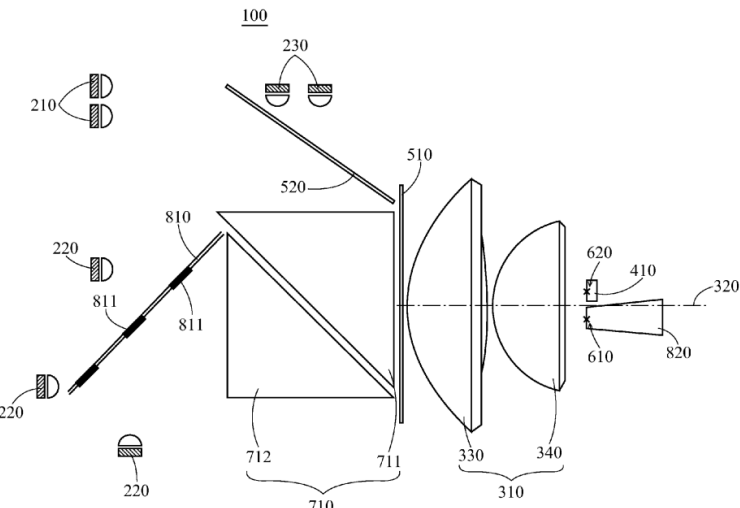
FIG. 2A

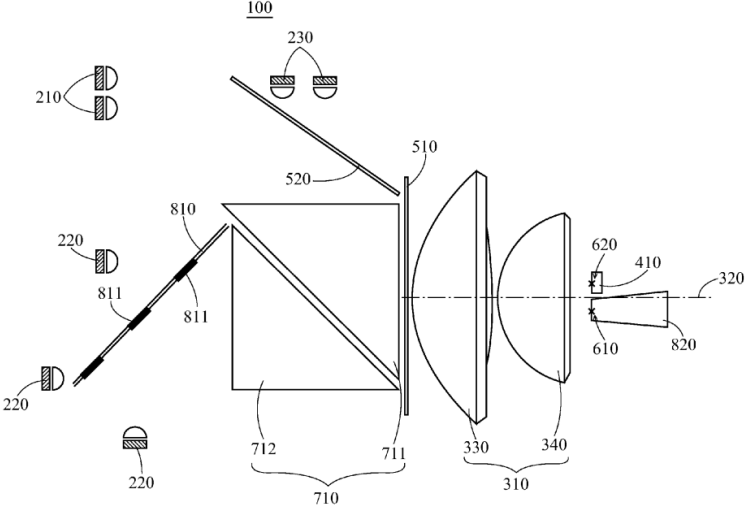
Claim 4

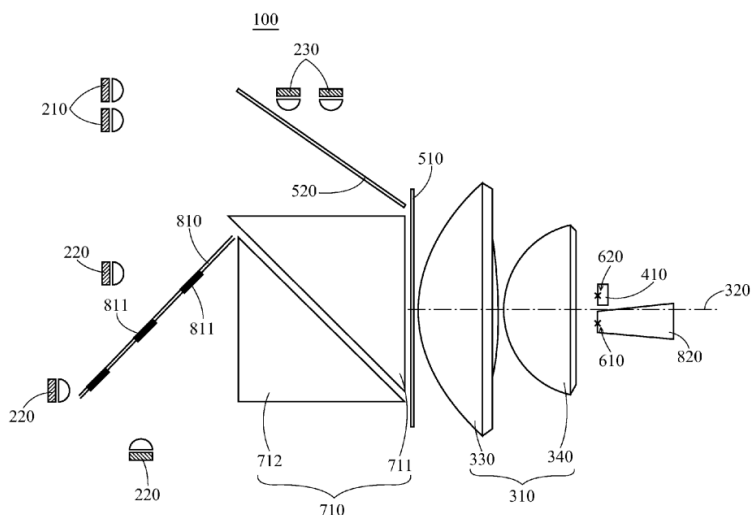
4p The light source device according to claim 1,

Huang discloses a light source device.

Huang [Column 2/Line 38-45]: As shown in FIG. 2, an illumination system 100 according to an embodiment of the present invention is disposed in a projection device (not shown), and comprises a first light source 210, **a second light source 220, an optical device 310, a wavelength transformer 410 and a first dichroic mirror 510.** In

		reference to both FIGS. 3A and 3B, the first light source 210 emits a first light beam 211, while the second light source 220 emits a second light beam 221.  FIG. 2
4a	wherein the excitation light source is a solid light-emitting element.	Huang discloses the excitation light source is a solid light-emitting element. Huang [Column 4/Lines 47-50]: According to the above descriptions, the illumination system 100 according to an embodiment of the present invention utilizes solid light sources with both a high luminance and a long service life and operates in the following way:
	Claim 7	
7p	A projection type video display device, comprising:	Huang discloses a projection type video display device. Huang [Column 2/Lines 38-42]: As shown in FIG. 2, an illumination system 100 according to an embodiment of the present invention is disposed in a projection device

		(not shown), and comprises a first light source 210, a second light source 220, an optical device 310, a wavelength transformer 410 and a first dichroic mirror 510. Huang [Column 2/Lines 56-60]: A light homogenizing device 820 has an inlet disposed at the first focal point 610 to receive the first light source 211, and has an outlet connected to the projection device (not shown) to actually project an image onto a micro-display (not shown) of the projection device.  FIG. 2
7a	the light source device according to claim 1;	Huang discloses a light source device. Huang [Column 2/Line 38-45]: As shown in FIG. 2, an illumination system 100 according to an embodiment of the present invention is disposed in a projection device (not shown), and comprises a first light source 210, a second light source 220, an optical device 310, a wavelength transformer 410 and a first dichroic mirror 510. In reference to both FIGS. 3A and 3B, the first light source 210 emits a first light beam 211, while the second light source 220 emits a second light beam 221.

		 FIG. 2
7b	a video display element;	Huang discloses a video display element. Huang [Column 2/Lines 56-60]: A light homogenizing device 820 has an inlet disposed at the first focal point 610 to receive the first light source 211, and has an outlet connected to the projection device (not shown) to actually project an image onto <u>a micro-display (not shown) of the projection device.</u>
7c	an illumination optical system which has a plurality of optical elements applying light from the light source device to the video display element; and	Huang combines with Akiyama '098 to disclose an illumination optical system which has a plurality of optical elements applying light from the light source device to the video display element. Huang [Column 2/Line 38-45]: As shown in FIG. 2, <u>an illumination system 100</u> according to an embodiment of the present invention is disposed in a projection device

(not shown), and comprises a first light source 210, **a second light source 220, an optical device 310, a wavelength transformer 410 and a first dichroic mirror 510**. In reference to both FIGS. 3A and 3B, the first light source 210 emits a first light beam 211, while the second light source 220 emits a second light beam 221.

Huang [Column 2/Lines 56-60]: A light **homogenizing device 820** has an inlet disposed at the first focal point 610 to receive the first light source 211, and has an outlet connected to the projection device (not shown) **to actually project an image onto a micro-display (not shown) of the projection device.**

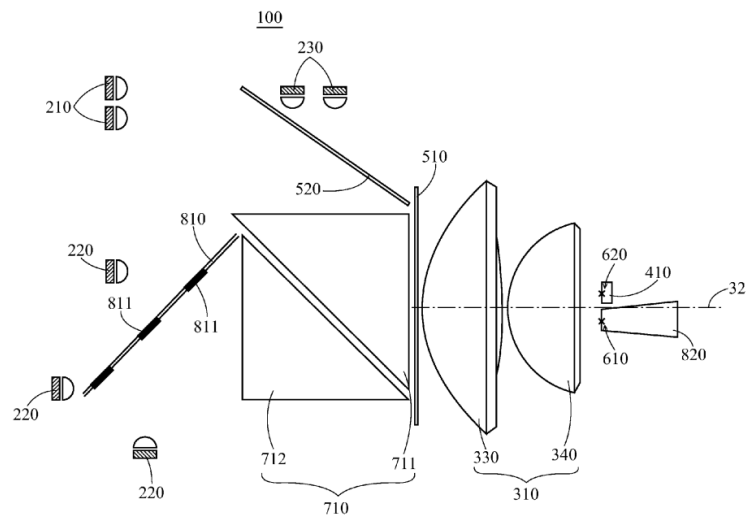
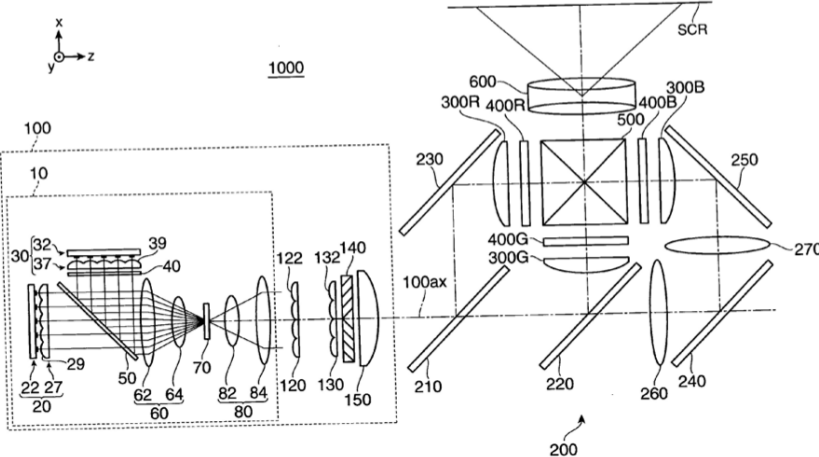


FIG. 2

Akiyama '098 [0058] The illumination device 100 is provided with the light source device 10, **a first lens array 120, a second lens array 130, a polarization conversion element 140, and an overlapping lens 150.**

		Akiyama '098 [0082] The collimating optical system 80 roughly collimates the light from the fluorescence generation section 70. As shown in FIGS. 1 and 2A, the collimating optical system 80 is provided with a first lens 82 and a second lens 84. Further, the number of lenses constituting the collimating optical system can be one, or more than two. Akiyama '098 [0089] The color separation light guide optical system 200 is provided with <u>dichroic mirrors 210, 220, reflecting mirrors 230, 240, and 250, and relay lens 260, 270.</u> The color separation light guide optical system 200 has a function of separating the light from the illumination device 100 into the red light, the green light, and the blue light, and respectively guiding the colored lights of the red light, the green light, and the blue light <u>to the liquid crystal light modulation devices 400R, 400G, and 400B to be the objects of illumination.</u>  FIG. 1
7d	a projection lens which enlarges and projects an optical image formed by the video display element.	Huang or Akiyama '098 discloses a projection lens which enlarges and projects an optical image formed by the video display element. In Huang, the uniform light beam homogenized by the homogenizing device can be enlarged by the projection system to produce lager and high-quality images.

	Huang [Column 2/Lines 56-60]: A light homogenizing device 820 has an inlet disposed at the first focal point 610 to receive the first light source 211, and has an outlet connected to <u>the projection device (not shown) to actually project an image onto a micro-display (not shown) of the projection device.</u> Huang [Column 4/Lines 40-46]: Opposite to the wavelength transformer 410 at the second focal point 620, a light homogenizing device 820 is disposed at the first focal point 610 to receive the <u>first light beam 211, the third light beam 222 and the fourth light beam 231, which are projected outwards after being combined.</u> The light homogenizing device 820 is preferably an integration rod or a light tunnel. Huang [Column 5/Lines 4-9]: (3) the fourth light beam 231 (a red light beam) emitted by the third light source 230 (a red laser light source) sequentially travels through the second dichroic mirror 520, the light coupling device 710, the first dichroic mirror 510 and the optical device 310, and <u>is focused onto the light homogenizing device 820 disposed at the first focal point 610.</u> Huang [Column 5/Lines 10-20]: Therefore, by means of the optical components (e.g., the optical device 310, the light coupling device 710 and the like) disposed within the illumination system 100, the first light beam 211 (the blue light beam), the third light beam 222 (the yellow light beam or the greenlight beam) and the fourth light beam 231 (the red light beam) are all focused to the first focal point 610 and <u>then combined into a homogenized white light beam by the uniform device 820 for projection outwards.</u> This reduces the number of the optical components to be used and the volume of the illumination system and improves the light combining efficiency of the illumination system 100.
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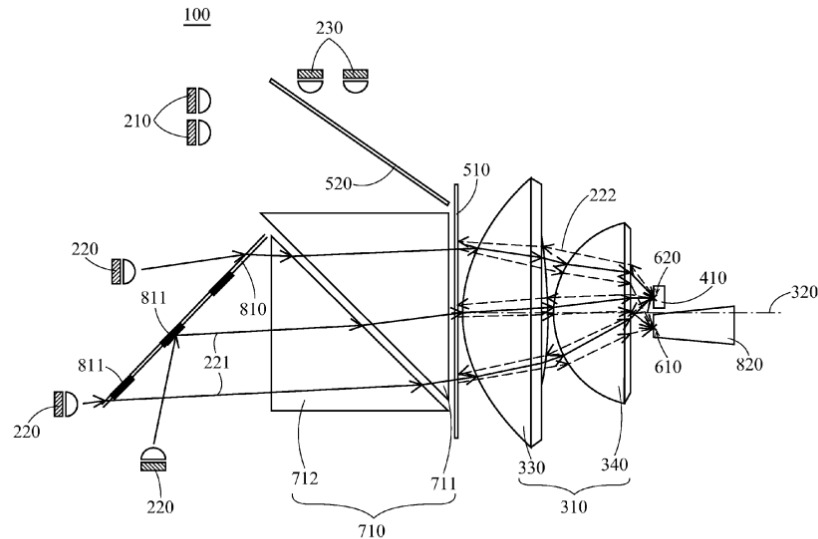


FIG. 3B

Akiyama '098 [0057] As shown in FIG. 1, the projector 1000 according to the first embodiment is provided with the illumination device 100, a color separation light guide optical system 200, three liquid crystal light modulation devices 400R, 400G, and 400B as a light modulation device, a cross dichroic prism 500, and **a projection optical system 600.**

Akiyama '098 [0103] The color image emitted from the cross dichroic prism 500 is **projected in an enlarged manner by the projection optical system 600** to form an image on the screen SCR.

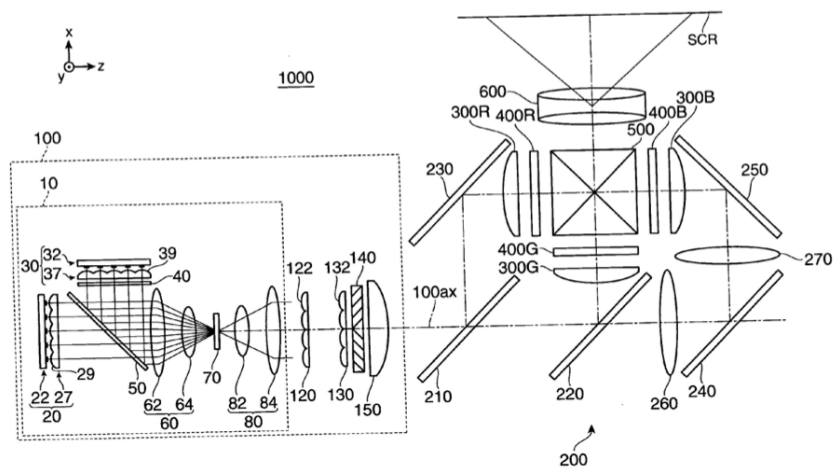
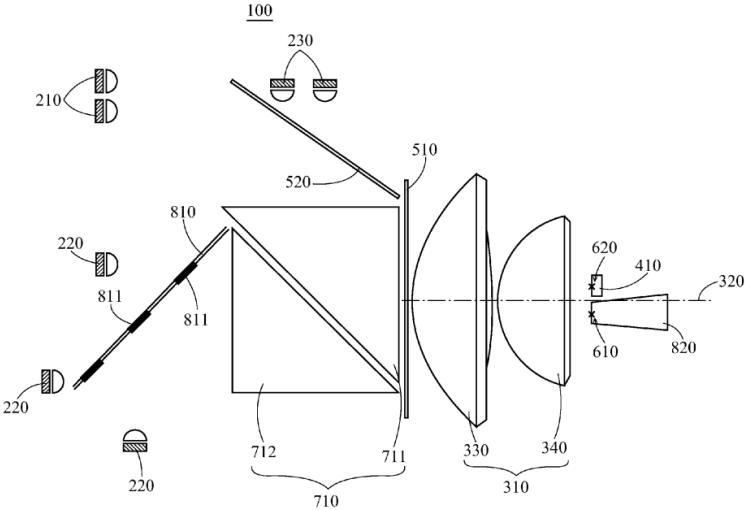


FIG. 1

Ground 4(a): Huang [US8783886B2], Alpay [US20090308852A1] – claim charts for claim 9 as invalidated by Huang and Alpay.

Publication Number	Country of Origin	Filing Date	Date of Publication
US8783886B2 (“Huang”)	United States of America	06/27/2011	07/22/2014
US20090308852A1 (“Alpay”)	United States of America	09/12/2008	12/17/2009

	Claims of U.S. Patent No. 9,322,530	Citations and Analysis
	Claim 9	
9p	A light source device, comprising:	Huang discloses a light source device. Huang [Column 2/Lines 38-45]: As shown in FIG. 2, an illumination system 100 according to an embodiment of the present invention is disposed in a projection device (not shown), and comprises a first light source 210, <u>a second light source 220, an optical device 310, a wavelength transformer 410 and a first dichroic mirror 510.</u> In reference to both FIGS. 3A and 3B, the first light source 210 emits a first light beam 211, while the second light source 220 emits a second light beam 221.

		 FIG. 2
9a	an excitation light source which emit excitation light;	Huang discloses an excitation light source which emit excitation light. Huang [Column 2/Lines 38-45]: As shown in FIG. 2, an illumination system 100 according to an embodiment of the present invention is disposed in a projection device (not shown), and comprises a first light source 210, <u>a second light source 220</u>, an optical device 310, a wavelength transformer 410 and a first dichroic mirror 510. In reference to both FIGS. 3A and 3B, the first light source 210 emits a first light beam 211, <u>while the second light source 220 emits a second light beam 221.</u> Huang [Column 4/Lines 16-19]: ...the second light source 220 comprises a plurality of secondary light sources for emitting a plurality of secondary light beams (not shown) respectively.

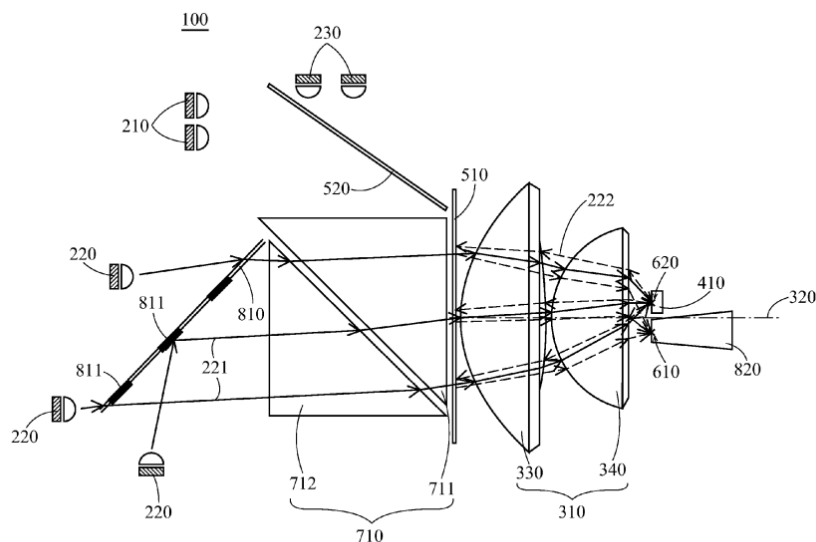


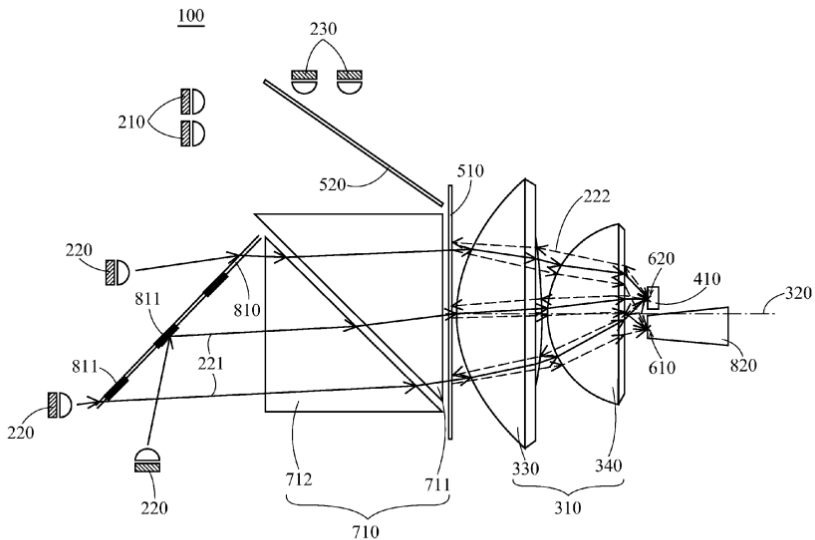
FIG. 3B

9b a phosphor which changes the excitation light to fluorescent light;

Huang discloses a phosphor, *e.g.* wavelength transformer, which changes the excitation light to fluorescent light.

Huang [Column 2/Lines 38-45]: As shown in FIG. 2, an illumination system 100 according to an embodiment of the present invention is disposed in a projection device (not shown), and comprises a first light source 210, a second light source 220, an optical device 310, **a wavelength transformer 410** and a first dichroic mirror 510. In reference to both FIGS. 3A and 3B, the first light source 210 emits a first light beam 211, while the second light source 220 emits a second light beam 221.

Huang [Column 2/Lines 61-64]: The wavelength transformer 410 is disposed at the second focal point 620, and receives and transforms the second light beam 221 emitted by the second light source 220 into a third light beam 222.

		Huang [Column 4/Lines 36-38]: <u>The wavelength transformer 410 may be a yellow or green phosphor, and correspondingly, the third light beam 222 is a yellow or green light beam.</u>  FIG. 3B
9c	a dichroic mirror which transmits the excitation light and reflects the fluorescent light; and	Huang discloses a dichroic mirror which transmits the excitation light and reflects the fluorescent light. Huang [Column 2/Lines 38-45]: As shown in FIG. 2, an illumination system 100 according to an embodiment of the present invention is disposed in a projection device (not shown), and comprises a first light source 210, a second light source 220, an optical device 310, a wavelength transformer 410 and <u>a first dichroic mirror 510</u>. In reference to both FIGS. 3A and 3B, the first light source 210 emits a first light beam 211, while the second light source 220 emits a second light beam 221.

Huang [Column 2/Lines 61-67 and Column 3/Lines 1-10]: The wavelength transformer 410 is disposed at the second focal point 620, and receives and transforms the second light beam 221 emitted by the second light source 220 into a third light beam 222. **The first dichroic mirror 510, which is disposed between the first and the second light sources 210, 220 and the optical device 310, is adapted to allow the first light beam 211 and the second light beam 221 to travel therethrough and reflect the third light beam 222.** In other words, as shown in FIG. 3B, when the second light beam 221, emitted by the second light source 220, is focused by the optical device 310 onto the wavelength transformer 410 that is disposed at the second focal point 620, the second light beam 221 is transformed into the third light beam 222. Then, **the third light beam 222 is emitted from the second focal point 620 to pass through the optical device 310, and is then reflected by the first dichroic mirror 510 to the optical device 310 to be focused onto the first focal point 610.**

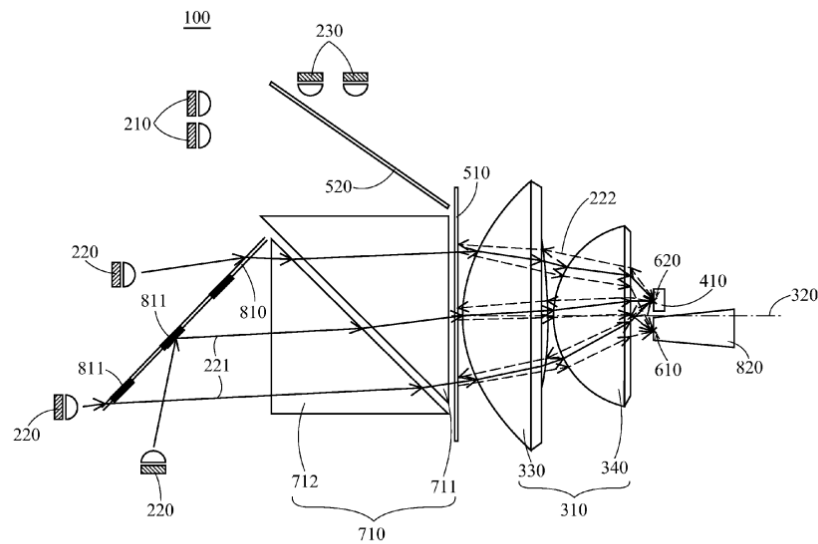
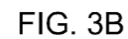


FIG. 3B

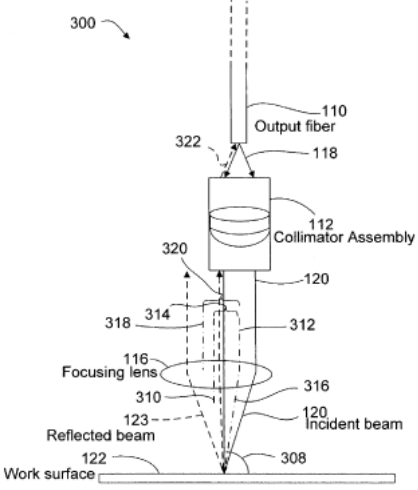
9d	a condensing lens which condenses the excitation light transmitted through the dichroic mirror in an excitation light irradiation region on the phosphor,	Huang discloses a condensing lens, <i>e.g.</i>, an optical device, which condenses the excitation light transmitted through the dichroic mirror in an excitation light irradiation region on the phosphor. In Huang, the optical device 310 including a condensing lens 330 or 340 condenses the second light beam 221 at the second focal point 620 that is an excitation light irradiation region on the wavelength transformer, <i>e.g.</i> phosphor. Huang [Column 2/Lines 61-67 and Column 3/Lines 1-10]: The wavelength transformer 410 is disposed at the second focal point 620, and receives and transforms the second light beam 221 emitted by the second light source 220 into a third light beam 222. The first dichroic mirror 510, which is disposed between the first and the second light sources 210, 220 and the optical device 310, is adapted to allow the first light beam 211 and the second light beam 221 to travel therethrough and reflect the third light beam 222. In other words, as shown in FIG. 3B, when <u>the second light beam 221, emitted by the second light source 220, is focused by the optical device 310 onto the wavelength transformer 410 that is disposed at the second focal point 620, the second light beam 221 is transformed into the third light beam 222.</u> Then, the third light beam 222 is emitted from the second focal point 620 to pass through the optical device 310, and is then reflected by the first dichroic mirror 510 to the optical device 310 to be focused onto the first focal point 610.
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Huang or Alpay discloses that 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.

In Huang, each of the bottom two light sources 220 enters asymmetrically with respect to one another and the center of the condensing lens, as shown in the figure below. Due to the asymmetrical arrangement of the excitation light sources, the unconverted excitation light is prevented from entering the excitation light source.

	therefore desirable to prevent such back-reflections from finding a path back into the output fiber. Alpay [0007]: <u>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.</u> For example, FIG. 2 is a block diagram of another typical fiber laser processing system 200 having a tilted beam delivery subsystem (e.g., the output fiber 110, the collimator assembly 112, and the focusing lens 116) <u>such that the path of the incident laser beam 120 is non-perpendicular to the work surface 122.</u> Alpay [0027]: The incident laser beam 120 propagates along a first axis of propagation 312 from the collimator assembly 112 to the focusing lens 116. The first axis of propagation 312 is substantially parallel to the primary axis 310 of the focusing lens 116. There is, however, an 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). <u>Rather, the incident laser beam 120 hits the focusing lens 116 at an offset 314 from the center of the lens 116.</u> In one embodiment, the amount of offset 314 is greater than or equal to approximately one-half the diameter of the collimated incident laser beam 120. As discussed below, such an amount of offset 314 reduces or prevents overlap between the reflected laser beam 123 and the incident laser beam 120. Alpay [0028]: The focusing lens 116 converges the incident laser beam 120 to a focused spot diameter on the work surface 122. <u>As a result of 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 310 of the focusing lens 116.</u> Thus, the 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.
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		Alpay [0029]: As a consequence of using the offset 314 to tilt the incident laser beam 120, the path of the reflected laser beam 123 is angularly separated from the path of the incident laser beam 120. Thus, after returning through the focusing lens 116, the reflected laser beam 123 travels along a third axis of propagation 318 that is spatially separated from the first axis of propagation 312 of the incident laser beam 120. In certain embodiments, <u>an offset 320 between the first axis of propagation 312 corresponding to the incident laser beam 120 and the third axis of propagation 318 corresponding to the reflected laser beam 123 is configured 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.</u>  FIG. 3
9f	wherein when the excitation light irradiation region is a center and an incident angle to the excitation light irradiation region of any excitation	Huang combines with Alpay to disclose 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. For example, the incident laser beam 120 is non-perpendicular to the work surface 122.

	light of each of the excitation light is an elevation angle θ, $\theta \neq 0^8$ is satisfied.	Alpay [0007]: <u>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.</u> For example, FIG. 2 is a block diagram of another typical fiber laser processing system 200 having a tilted beam delivery subsystem (e.g., the output fiber 110, the collimator assembly 112, and the focusing lens 116) <u>such that the path of the incident laser beam 120 is non-perpendicular to the work surface 122.</u> Alpay [0027]: The incident laser beam 120 propagates along a first axis of propagation 312 from the collimator assembly 112 to the focusing lens 116. The first axis of propagation 312 is substantially parallel to the primary axis 310 of the focusing lens 116. <u>There is, however, an 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.</u> In one embodiment, the amount of offset 314 is greater than or equal to approximately one-half the diameter of the collimated incident laser beam 120. As discussed below, such an amount of offset 314 reduces or prevents overlap between the reflected laser beam 123 and the incident laser beam 120. Alpay [0028]: The focusing lens 116 converges the incident laser beam 120 to a focused spot diameter on the work surface 122. As a result of 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 310 of the focusing lens 116. Thus, <u>the 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.</u>
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⁸ The recitation “ $\theta \neq 0$ ” was amended to read “ $\theta \neq 0$ ” by Certificate of Correction.

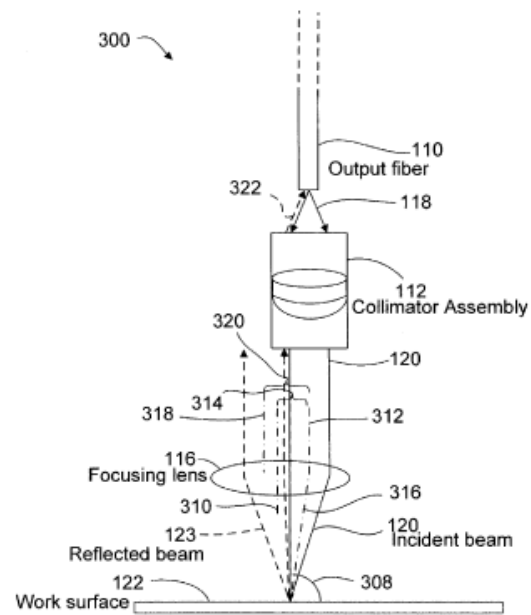


FIG. 3

Ground 4(b): Huang [US8783886B2], Abu-Ageel [US20110044046A1], Alpay [US20090308852A1] – claim chart for claim 9 as invalidated by Huang, Abu-Ageel and Alpay.

Publication Number	Country of Origin	Filing Date	Date of Publication
US8783886B2 (“Huang”)	United States of America	06/27/2011	07/22/2014
US20110044046A1 (“Abu-Ageel”)	United States of America	04/21/2010	02/24/2011
US20090308852A1 (“Alpay”)	United States of America	09/12/2008	12/17/2009

	Claims of U.S. Patent No. 9,322,530	Citations and Analysis
	Claim 9	
9p	A light source device, comprising:	Huang discloses a light source device. Huang [Column 2/Lines 38-45]: As shown in FIG. 2, an illumination system 100 according to an embodiment of the present invention is disposed in a projection device (not shown), and comprises a first light source 210, <u>a second light source 220, an optical device 310, a wavelength transformer 410 and a first dichroic mirror 510.</u> In reference to both FIGS. 3A and 3B, the first light source 210 emits a first light beam 211, while the second light source 220 emits a second light beam 221.

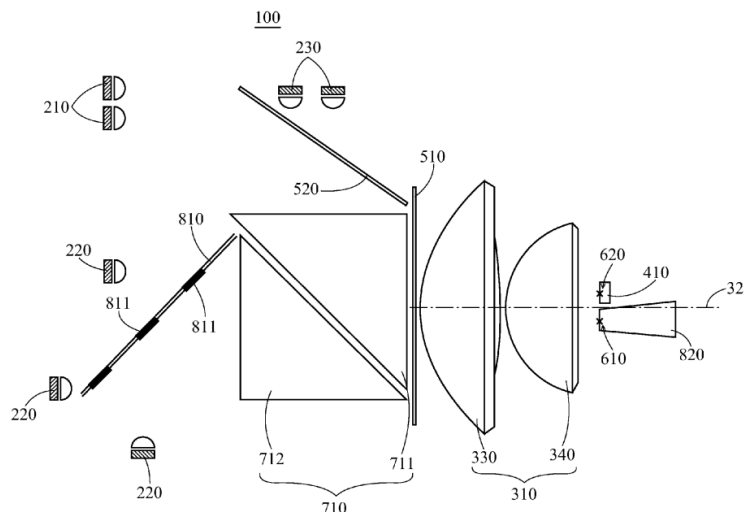


FIG. 2

9a an excitation light source which emits excitation light;

Huang discloses an excitation light source which emits excitation light.

Huang [Column 2/Lines 38-45]: As shown in FIG. 2, an illumination system 100 according to an embodiment of the present invention is disposed in a projection device (not shown), and comprises a first light source 210, a second light source 220, an optical device 310, a wavelength transformer 410 and a first dichroic mirror 510. In reference to both FIGS. 3A and 3B, the first light source 210 emits a first light beam 211, while **the second light source 220 emits a second light beam 221.**

Huang [Column 4/Lines 16-19]: ...the second light source 220 comprises a plurality of secondary light sources for emitting a plurality of secondary light beams (not shown) respectively.

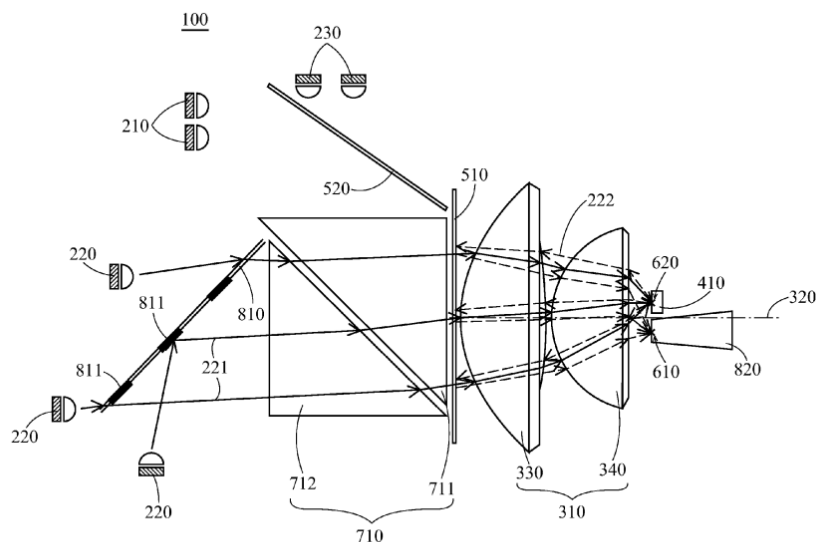


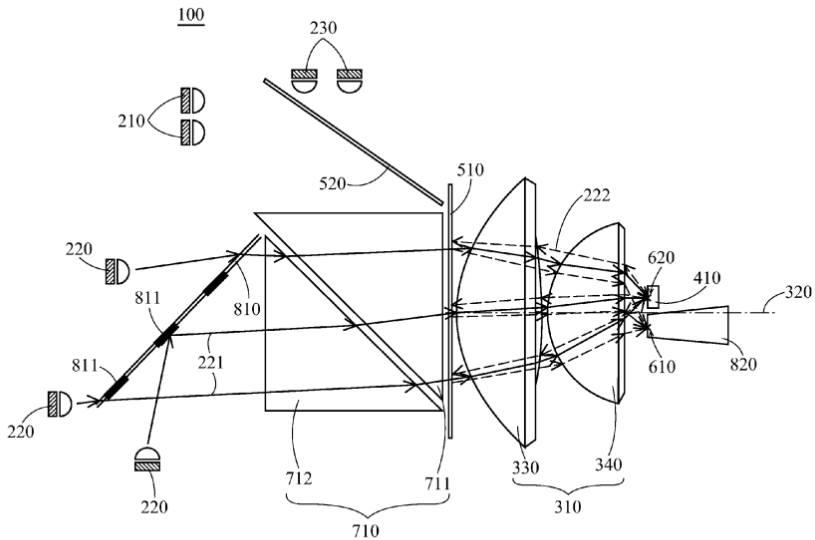
FIG. 3B

9b a phosphor which changes the excitation light to fluorescent light;

Huang discloses a phosphor, *e.g.* wavelength transformer, which changes the excitation light to fluorescent light.

Huang [Column 2/Lines 38-45]: As shown in FIG. 2, an illumination system 100 according to an embodiment of the present invention is disposed in a projection device (not shown), and comprises a first light source 210, a second light source 220, an optical device 310, **a wavelength transformer 410** and a first dichroic mirror 510. In reference to both FIGS. 3A and 3B, the first light source 210 emits a first light beam 211, while the second light source 220 emits a second light beam 221.

Huang [Column 2/Lines 61-64]: The wavelength transformer 410 is disposed at the second focal point 620, and receives and transforms the second light beam 221 emitted by the second light source 220 into a third light beam 222.

		Huang [Column 4/Lines 36-38]: <u>The wavelength transformer 410 may be a yellow or green phosphor, and correspondingly, the third light beam 222 is a yellow or green light beam.</u>  FIG. 3B
9c	a dichroic mirror which transmits the excitation light and reflects the fluorescent light; and	Huang discloses a dichroic mirror which transmits the excitation light and reflects the fluorescent light. Huang [Column 2/Lines 38-45]: As shown in FIG. 2, an illumination system 100 according to an embodiment of the present invention is disposed in a projection device (not shown), and comprises a first light source 210, a second light source 220, an optical device 310, a wavelength transformer 410 and <u>a first dichroic mirror 510</u>. In reference to both FIGS. 3A and 3B, the first light source 210 emits a first light beam 211, while the second light source 220 emits a second light beam 221.

Huang [Column 2/Lines 61-67 and Column 3/Lines 1-10]: The wavelength transformer 410 is disposed at the second focal point 620, and receives and transforms the second light beam 221 emitted by the second light source 220 into a third light beam 222. **The first dichroic mirror 510, which is disposed between the first and the second light sources 210, 220 and the optical device 310, is adapted to allow the first light beam 211 and the second light beam 221 to travel therethrough and reflect the third light beam 222.** In other words, as shown in FIG. 3B, when the second light beam 221, emitted by the second light source 220, is focused by the optical device 310 onto the wavelength transformer 410 that is disposed at the second focal point 620, the second light beam 221 is transformed into the third light beam 222. Then, **the third light beam 222 is emitted from the second focal point 620 to pass through the optical device 310, and is then reflected by the first dichroic mirror 510 to the optical device 310 to be focused onto the first focal point 610.**

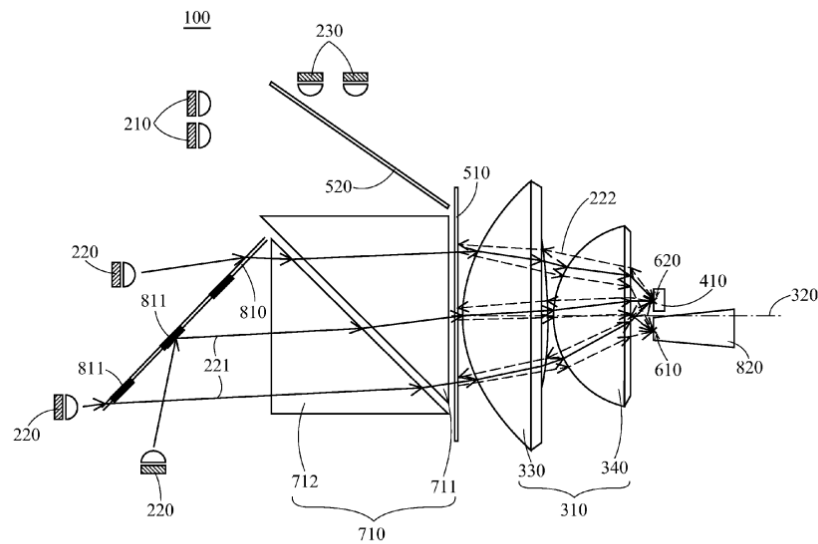


FIG. 3B

9d	a condensing lens which condenses the excitation light transmitted through the dichroic mirror in an excitation light irradiation region on the phosphor,	Huang discloses a condensing lens, <i>e.g.</i>, an optical device, which condenses the excitation light transmitted through the dichroic mirror in an excitation light irradiation region on the phosphor. In Huang, the optical device 310 including a condensing lens 330 or 340 condenses the second light beam 221 at the second focal point 620 that is an excitation light irradiation region on the wavelength transformer, <i>e.g.</i> phosphor. Huang [Column 2/Lines 61-67 and Column 3/Lines 1-10]: The wavelength transformer 410 is disposed at the second focal point 620, and receives and transforms the second light beam 221 emitted by the second light source 220 into a third light beam 222. The first dichroic mirror 510, which is disposed between the first and the second light sources 210, 220 and the optical device 310, is adapted to allow the first light beam 211 and the second light beam 221 to travel therethrough and reflect the third light beam 222. In other words, as shown in FIG. 3B, when <u>the second light beam 221, emitted by the second light source 220, is focused by the optical device 310 onto the wavelength transformer 410 that is disposed at the second focal point 620, the second light beam 221 is transformed into the third light beam 222.</u> Then, the third light beam 222 is emitted from the second focal point 620 to pass through the optical device 310, and is then reflected by the first dichroic mirror 510 to the optical device 310 to be focused onto the first focal point 610.
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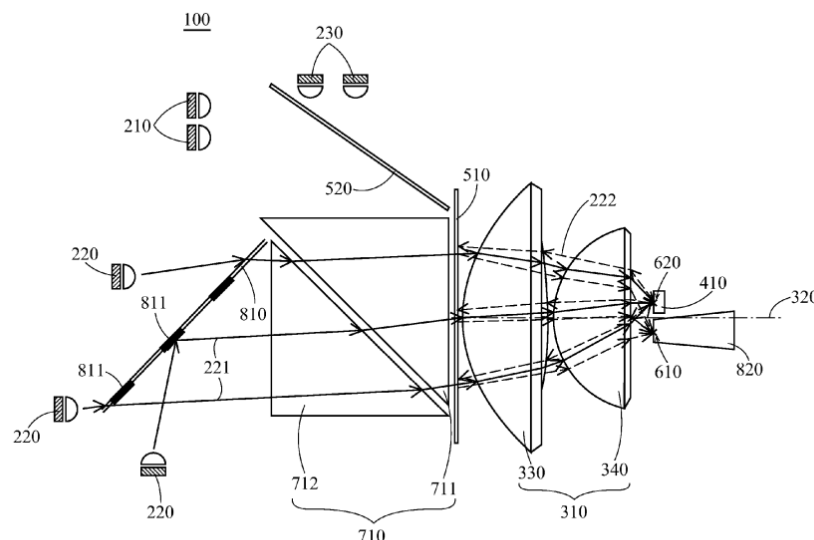
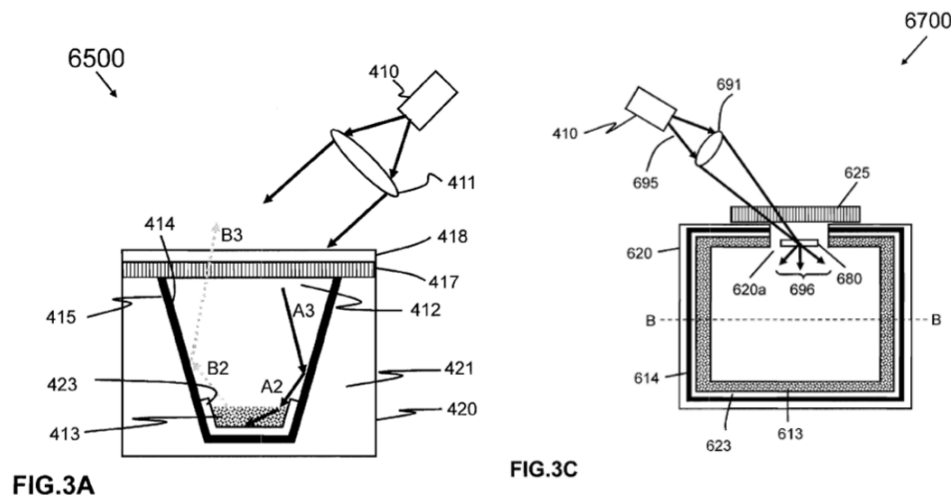


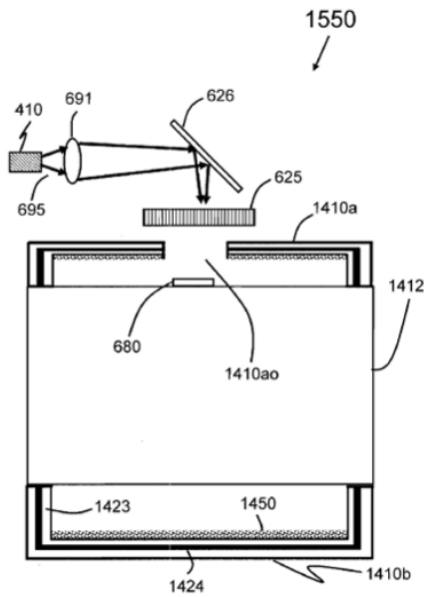
FIG. 3B

9e	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	Huang combines with Abu-Ageel to disclose that 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. Abu-Ageel [0002]: The disclosure relates <u>generally to light sources, illumination systems, projection systems</u> and backlights. More particularly, it relates to high brightness light sources, <u>illumination systems, projection systems</u> and backlights that utilize violet lasers and wavelength conversion materials such as phosphor. Abu-Ageel [0082]: ... Part of the light impinging on the wavelength conversion layer 413 gets absorbed and converted into light with a new wavelength band (i.e.,
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converted light) and the remainder gets diffused by the wavelength conversion layer 413 but does not get converted. Both the source light and converted light get collimated by the light envelope 420 and impinge on the entrance aperture of optical element 417.... Optical element 417 reflects a substantial amount of the source light that impinges on it toward the wavelength conversion layer 413, thus, providing another chance for source light to be converted by the wavelength conversion layer 413.

Abu-Ageel [0087]: FIG. 3C shows a cross-sectional view of another exemplary illumination assembly 6700. Illumination assembly 6700 consists of a violet laser 410, hollow light envelope (or guide) 620 with an aperture 620 a, a wavelength conversion layer 613, an optional low-refractive index layer 623 located between the wavelength conversion layer 613 and the reflective coating 614, ... Optical element 625 is preferably a coating that reflects non-converted light (i.e., light received from source 411 that was not absorbed or converted within light envelope 620) back to light envelope 620 and allows the converted light to pass out of the envelope 620. Alternatively, optical element 625 can be a reflective polarizer, dichroic mirror...



		 FIG. 4B
9f	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, $\theta \neq 0^9$ is satisfied.	Huang combines with Alpay to disclose 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. For example, the incident laser beam 120 is non-perpendicular to the work surface 122. Alpay [0007]: <u>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.</u> For example, FIG. 2 is a block diagram of another typical fiber laser processing system 200 having a tilted beam delivery subsystem (e.g., the output fiber 110, the collimator

⁹ The recitation “ $\theta \neq 0$ ” was amended to read “ $\theta \neq 0^9$ ” by Certificate of Correction.

	assembly 112, and the focusing lens 116) <u>such that the path of the incident laser beam 120 is non-perpendicular to the work surface 122.</u> Alpay [0027]: The incident laser beam 120 propagates along a first axis of propagation 312 from the collimator assembly 112 to the focusing lens 116. The first axis of propagation 312 is substantially parallel to the primary axis 310 of the focusing lens 116. <u>There is, however, an 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.</u> In one embodiment, the amount of offset 314 is greater than or equal to approximately one-half the diameter of the collimated incident laser beam 120. As discussed below, such an amount of offset 314 reduces or prevents overlap between the reflected laser beam 123 and the incident laser beam 120. Alpay [0028]: The focusing lens 116 converges the incident laser beam 120 to a focused spot diameter on the work surface 122. <u>As a result of 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 310 of the focusing lens 116. Thus, the 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.</u>
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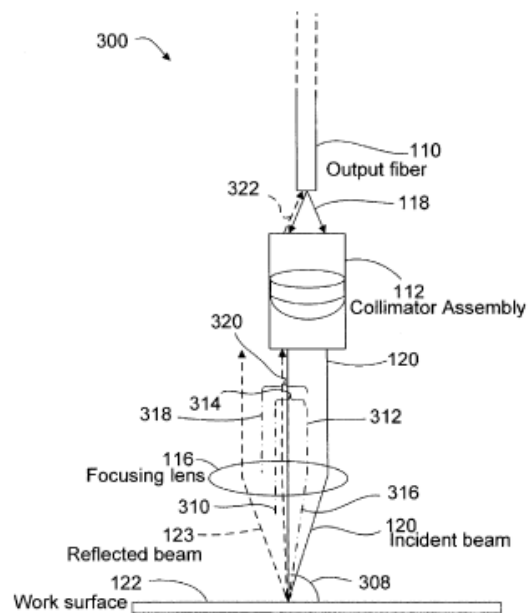
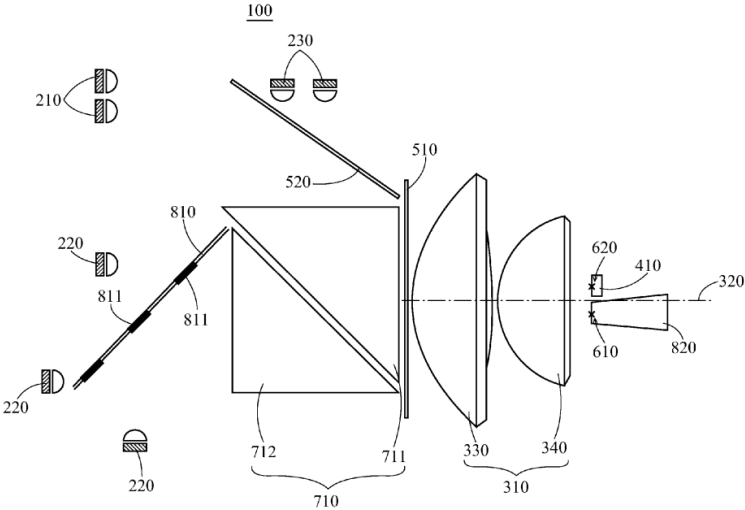


FIG. 3

Ground 4(c): Huang [US8783886B2], Kitano '349 [US20110292349A1], Alpay [US20090308852A1] – claim chart for claim 9 as invalidated by Huang, Kitano '349 and Alpay.

Publication Number	Country of Origin	Filing Date	Date of Publication
US8783886B2 (“Huang”)	United States of America	06/27/2011	07/22/2014
US20110292349A1 (“Kitano '349”)	United States of America	05/27/2011	12/01/2011
US20090308852A1 (“Alpay”)	United States of America	09/12/2008	12/17/2009

	Claims of U.S. Patent No. 9,322,530	Citations and Analysis
	Claim 9	
9p	A light source device, comprising:	Huang discloses a light source device. Huang [Column 2/Lines 38-45]: As shown in FIG. 2, an illumination system 100 according to an embodiment of the present invention is disposed in a projection device (not shown), and comprises a first light source 210, <u>a second light source 220, an optical device 310, a wavelength transformer 410 and a first dichroic mirror 510.</u> In reference to both FIGS. 3A and 3B, the first light source 210 emits a first light beam 211, while the second light source 220 emits a second light beam 221.

		 FIG. 2
9a	an excitation light source which emits excitation light;	Huang discloses an excitation light source which emits excitation light. Huang [Column 2/Lines 38-45]: As shown in FIG. 2, an illumination system 100 according to an embodiment of the present invention is disposed in a projection device (not shown), and comprises a first light source 210, a second light source 220, an optical device 310, a wavelength transformer 410 and a first dichroic mirror 510. In reference to both FIGS. 3A and 3B, the first light source 210 emits a first light beam 211, while <u>the second light source 220 emits a second light beam 221.</u> Huang [Column 4/Lines 16-19]: ...the second light source 220 comprises a plurality of secondary light sources for emitting a plurality of secondary light beams (not shown) respectively.

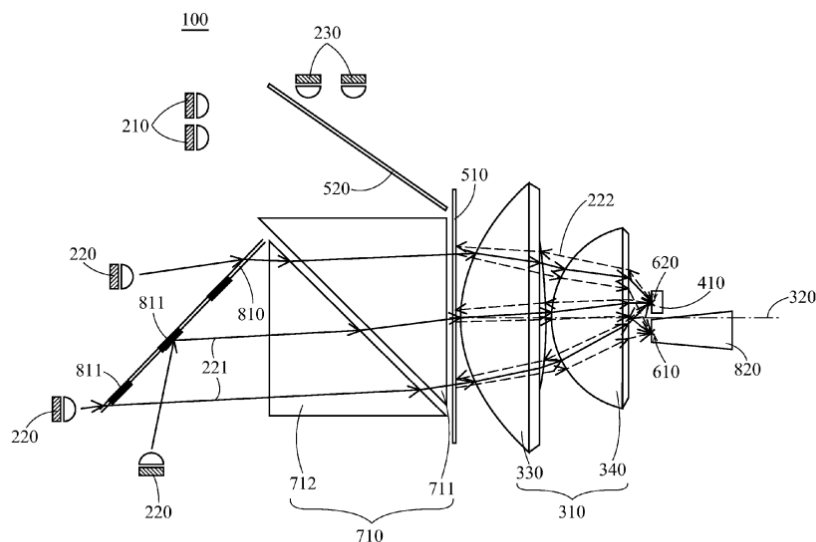
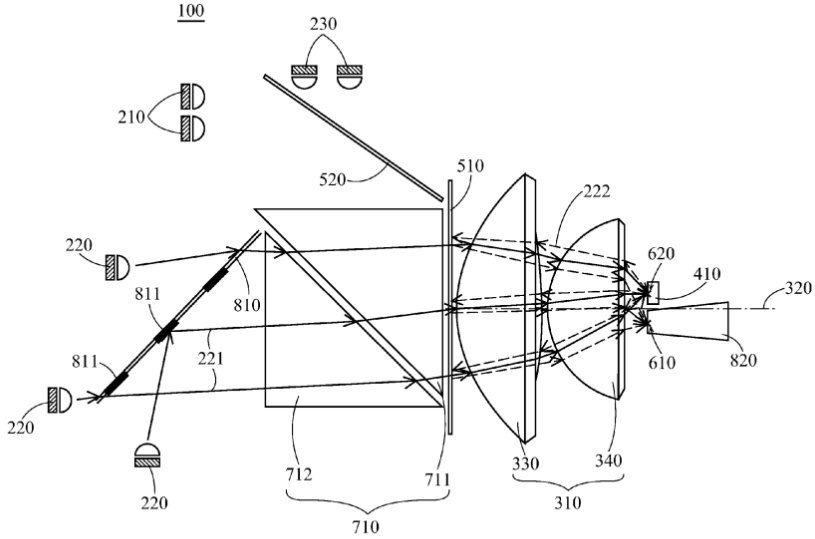


FIG. 3B

9b a phosphor which changes the excitation light to fluorescent light;

Huang discloses a phosphor, *e.g.* wavelength transformer, which changes the excitation light to fluorescent light.

Huang [Column 2/Lines 38-45]: As shown in FIG. 2, an illumination system 100 according to an embodiment of the present invention is disposed in a projection device (not shown), and comprises a first light source 210, a second light source 220, an optical device 310, **a wavelength transformer 410** and a first dichroic mirror 510. In reference to both FIGS. 3A and 3B, the first light source 210 emits a first light beam 211, while the second light source 220 emits a second light beam 221.

		Huang [Column 2/Lines 61-64]: The wavelength transformer 410 is disposed at the second focal point 620, and receives and transforms the second light beam 221 emitted by the second light source 220 into a third light beam 222.  FIG. 3B
9c	a dichroic mirror which transmits the excitation light and reflects the fluorescent light; and	Huang discloses a dichroic mirror which transmits the excitation light and reflects the fluorescent light. Huang [Column 2/Lines 38-45]: As shown in FIG. 2, an illumination system 100 according to an embodiment of the present invention is disposed in a projection device (not shown), and comprises a first light source 210, a second light source 220, an optical device 310, a wavelength transformer 410 and a first dichroic mirror 510. In reference to both FIGS. 3A and 3B, the first light source 210 emits a first light beam 211, while the second light source 220 emits a second light beam 221.

Huang [Column 2/Lines 61-67 and Column 3/Lines 1-10]: The wavelength transformer 410 is disposed at the second focal point 620, and receives and transforms the second light beam 221 emitted by the second light source 220 into a third light beam 222. **The first dichroic mirror 510, which is disposed between the first and the second light sources 210, 220 and the optical device 310, is adapted to allow the first light beam 211 and the second light beam 221 to travel therethrough and reflect the third light beam 222.** In other words, as shown in FIG. 3B, when the second light beam 221, emitted by the second light source 220, is focused by the optical device 310 onto the wavelength transformer 410 that is disposed at the second focal point 620, the second light beam 221 is transformed into the third light beam 222. Then, **the third light beam 222 is emitted from the second focal point 620 to pass through the optical device 310, and is then reflected by the first dichroic mirror 510 to the optical device 310 to be focused onto the first focal point 610.**

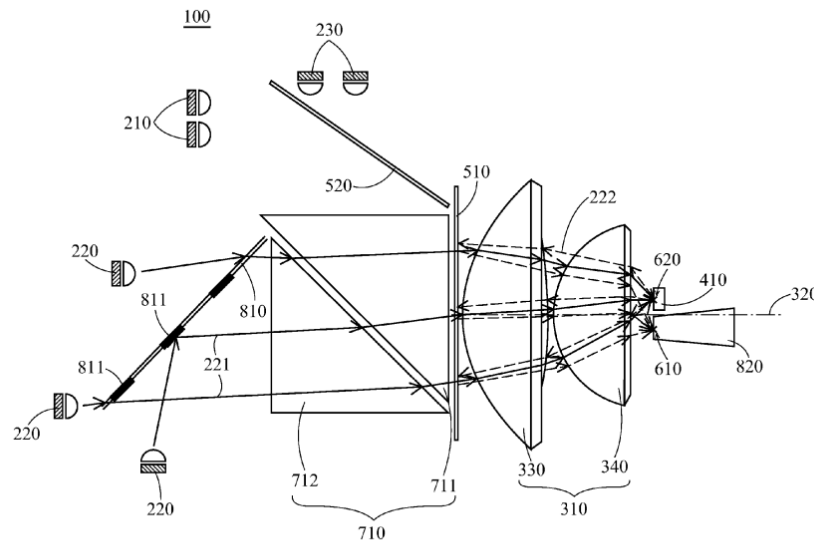


FIG. 3B

9d	a condensing lens which condenses the excitation light transmitted through the dichroic mirror in an excitation light irradiation region on the phosphor,	Huang discloses a condensing lens, <i>e.g.</i>, an optical device, which condenses the excitation light transmitted through the dichroic mirror in an excitation light irradiation region on the phosphor. In Huang, the optical device 310 including a condensing lens 330 or 340 condenses the second light beam 221 at the second focal point 620 that is an excitation light irradiation region on the wavelength transformer, <i>e.g.</i> phosphor. Huang [Column 2/Lines 61-67 and Column 3/Lines 1-10]: The wavelength transformer 410 is disposed at the second focal point 620, and receives and transforms the second light beam 221 emitted by the second light source 220 into a third light beam 222. The first dichroic mirror 510, which is disposed between the first and the second light sources 210, 220 and the optical device 310, is adapted to allow the first light beam 211 and the second light beam 221 to travel therethrough and reflect the third light beam 222. In other words, as shown in FIG. 3B, when <u>the second light beam 221, emitted by the second light source 220, is focused by the optical device 310 onto the wavelength transformer 410 that is disposed at the second focal point 620, the second light beam 221 is transformed into the third light beam 222.</u> Then, the third light beam 222 is emitted from the second focal point 620 to pass through the optical device 310, and is then reflected by the first dichroic mirror 510 to the optical device 310 to be focused onto the first focal point 610.
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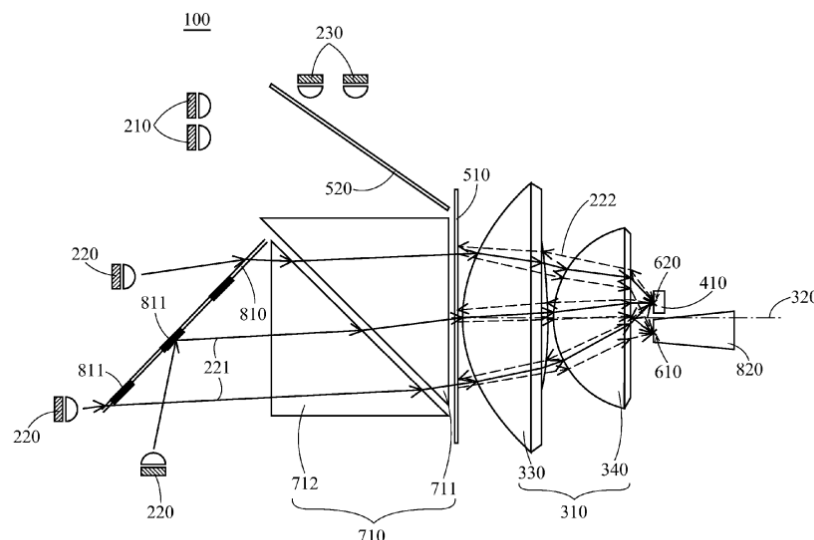


FIG. 3B

9e 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

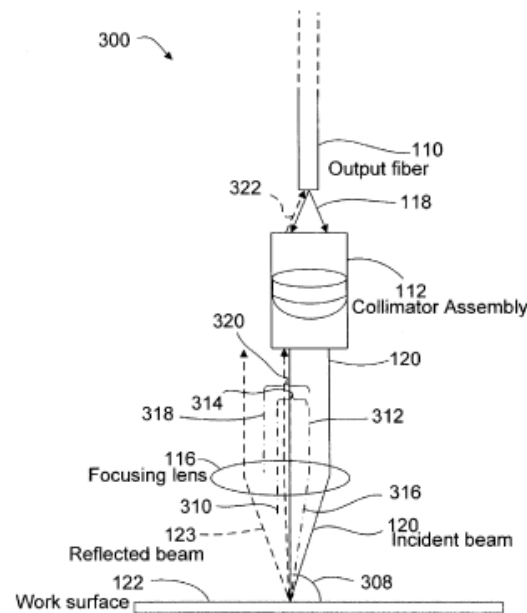
Huang combines with Kitano '349 to disclose that the excitation light sources are arranged so that when excitation light emitted from the excitation light source enters the excitation light irradiation region and is reflected without being converted into fluorescent light, the unconverted excitation light is prevented from entering the excitation light source.

Kitano '349 [0048]: **Not all of the excitation light is wavelength-converted into green fluorescence at the fluorescent material 201, but there exists unconverted blue light.** Of the blue excitation light incident on the fluorescent material 201, the unconverted blue light passes through the condenser lenses 207 and 208 again to be substantially collimated. The unconverted blue light is scattered light scattered by the fluorescent material 201, and there exists light having polarization direction different from that at the time when the light was incident on the fluorescent material. Therefore,

		among components of <u>the unconverted blue light that are incident on the dichroic mirror 213 again, S polarization components are reflected by the dichroic mirror 213, which components will be first blue light.</u>
9f	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 , $\theta \neq 0$ ¹⁰ is satisfied.	Huang combines with Alpay to disclose 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. For example, the incident laser beam 120 is non-perpendicular to the work surface 122. Alpay [0007]: <u>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.</u> For example, FIG. 2 is a block diagram of another typical fiber laser processing system 200 having a tilted beam delivery subsystem (e.g., the output fiber 110, the collimator assembly 112, and the focusing lens 116) <u>such that the path of the incident laser beam 120 is non-perpendicular to the work surface 122.</u> Alpay [0027]: The incident laser beam 120 propagates along a first axis of propagation 312 from the collimator assembly 112 to the focusing lens 116. The first axis of propagation 312 is substantially parallel to the primary axis 310 of the focusing lens 116. <u>There is, however, an 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.</u> In one embodiment, the amount of offset 314 is greater than or equal to approximately one-half the diameter of the collimated incident laser beam 120. As discussed below, such an amount of offset 314 reduces or prevents overlap between the reflected laser beam 123 and the incident laser beam 120.

¹⁰ The recitation “ $\theta \neq 0$ ” was amended to read “ $\theta \neq 0$ ” by Certificate of Correction.

Alpay [0028]: The focusing lens 116 converges the incident laser beam 120 to a focused spot diameter on the work surface 122. As a result of 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 310 of the focusing lens 116. Thus, **the 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.**



Ground 5: Kurosaki '998 [US20110234998A1], Alpay [US20090308852A1] – claim charts for claims 1, 3, 4 and 7 as invalidated by Kurosaki '998 and Alpay, and claim 3 by Kurosaki '998, Alpay and Akiyama '098

Publication Number	Country of Origin	Filing Date	Date of Publication
US20110234998A1 (“Kurosaki '998”)	United States of America	03/24/2011	09/29/2011
US20090308852A1 (“Alpay”)	United States of America	09/12/2008	12/17/2009
US20120008098A1 (“Akiyama '098”)	United States of America	06/28/2011	01/12/2012

	Claims of U.S. Patent No. 9,322,530	Citations and Analysis
	Claim 1	
1p	A light source device, comprising:	Kurosaki '998 discloses a light source device. Kurosaki '998 [0023]: <u>The light source unit 60 includes an excitation light shining device 70 which includes in turn an excitation light source 71 and a microlens array 75, a luminescent plate 101 which includes a green luminescent material layer which receives light emitted from the excitation light source 71 to emit light in a green wavelength band, ...</u> Kurosaki '998 [0044]: <u>The light source-side optical system 140 includes a collective lens 110 which collects light emitted from the excitation shining unit 70 and luminescent light emitted from the luminescent plate 101, a collective lens 125 which collects light emitted from the red light source 121, a collective lens 305 which collects light emitted from the <u>blue light source 301, a first dichroic mirror 141 which transmits excitation light from the excitation light shining unit 70 and light from the red light source unit 120 and reflects luminescent light emitted from the luminescent plate 101.</u></u>

		FIG. 3
1a	a plurality of excitation light sources which emit excitation light;	Kurosaki '998 discloses a plurality of excitation light sources which emit excitation light. Kurosaki '998 [0041]: The excitation light shining unit 70 <u>includes two excitation light sources 71</u>.... This excitation light source 71 is a blue laser emitter and <u>emits a laser beam</u> in a blue wavelength band towards the luminescent plate 101. Kurosaki '998 [0042]: Then, the luminescent plate 101 generates green luminescent light by use of <u>a laser beam emitted from the excitation light source 71 as excitation light</u>

and emits this green luminescent light from the same plane as the incident plane of the excitation light.

FIG. 3

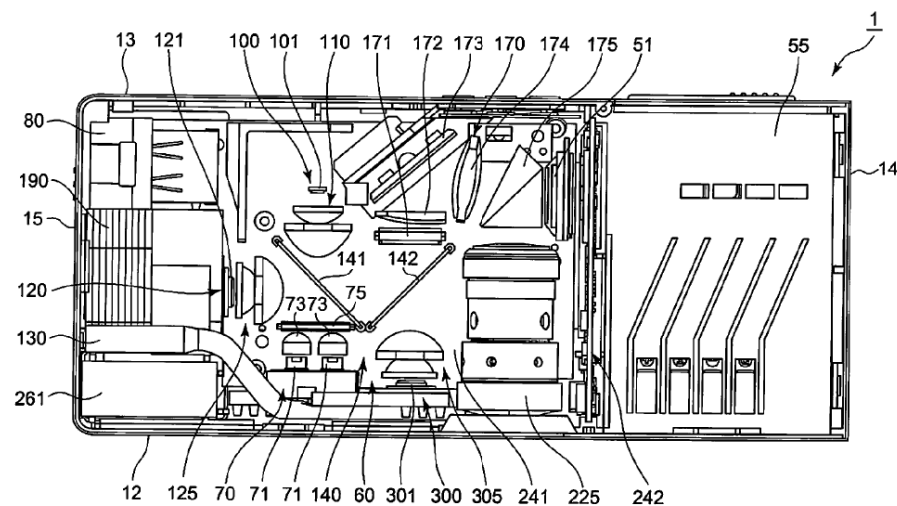
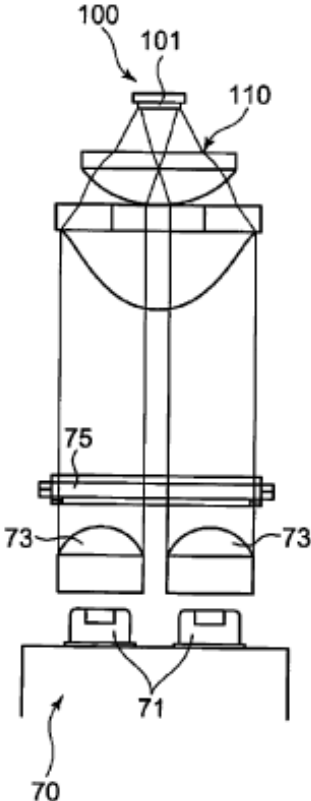


		FIG. 5 
1b	a phosphor which changes the excitation light to fluorescent light;	Kurosaki '998 discloses a phosphor, <i>e.g.</i> , luminescent plate, which changes the excitation light to fluorescent light.

Kurosaki '998 [0041]: The excitation light shining unit 70 includes two excitation light sources 71.... This excitation light source 71 is a blue laser emitter and emits a laser beam in a blue wavelength band towards the **luminescent plate 101**.
Kurosaki '998 [0042]: Then, **the luminescent plate 101 generates green luminescent light** by use of a laser beam emitted from the excitation light source 71 as excitation light and emits this green luminescent light from the same plane as the incident plane of the excitation light.

FIG. 3

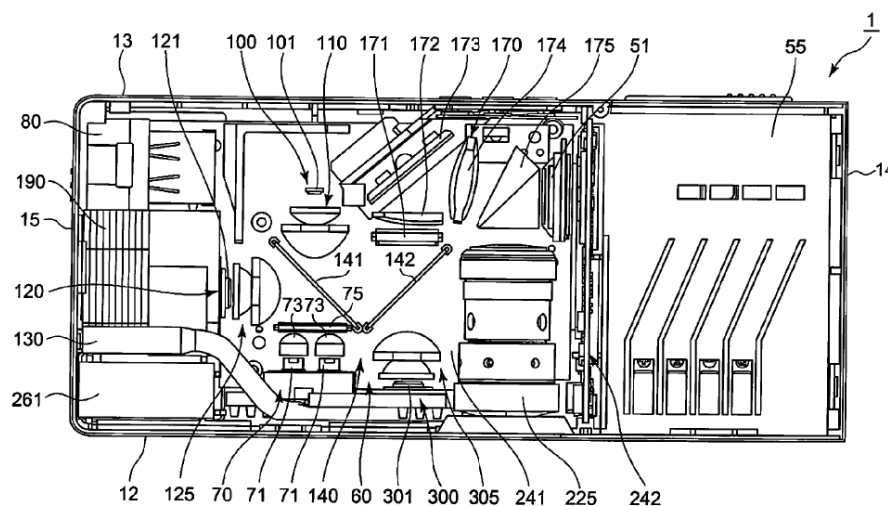
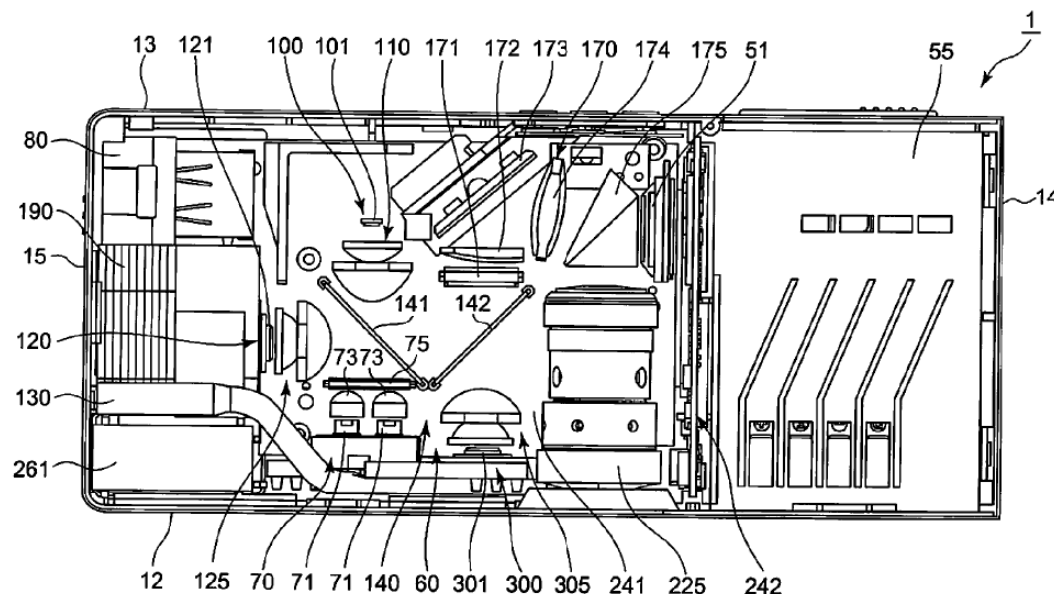


		FIG. 5
1c	a dichroic mirror which transmits the excitation light and reflects the fluorescent light; and	Kurosaki '998 discloses a dichroic mirror which transmits the excitation light and reflects the fluorescent light.

Kurosaki '998 [0044]: ..., a first **dichroic mirror 141 which transmits excitation light from the excitation light shining unit 70** and light from the red light source unit 120 **and reflects luminescent light emitted from the luminescent plate 101**, ...

FIG. 3



1d a condensing lens which condenses the excitation light transmitted through the dichroic mirror in an excitation light irradiation region on the phosphor,

Kurosaki '998 discloses a condensing lens, *e.g.*, collective lens, which condenses the excitation light transmitted through the dichroic mirror in an excitation light irradiation region on the phosphor, *e.g.*, luminescent plate.

Kurosaki '998 [0025]: In the light source unit 60, a collective lens 110 is disposed in proximity to the luminescent plate 101, and pencils of **light** that have passed through the micro convex lenses 75 **are shone onto the luminescent material layer by the collective lens 110** so that center positions thereof are superposed one on another on the luminescent material layer.

FIG. 3

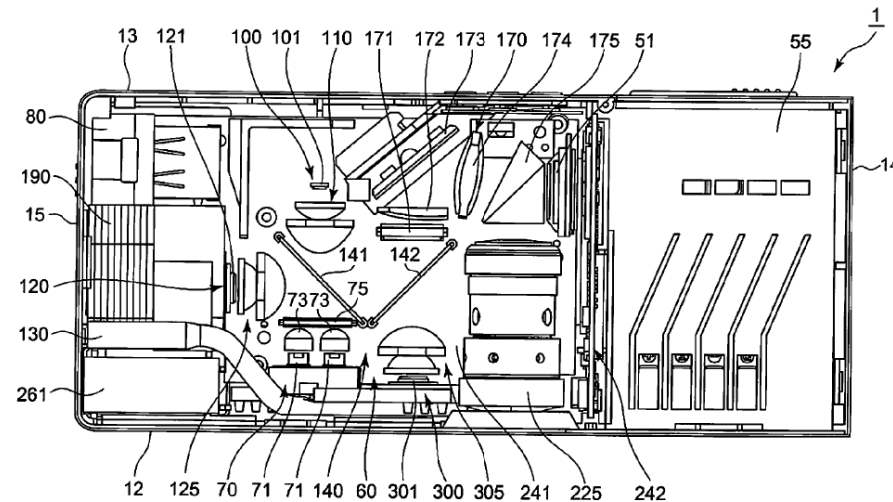
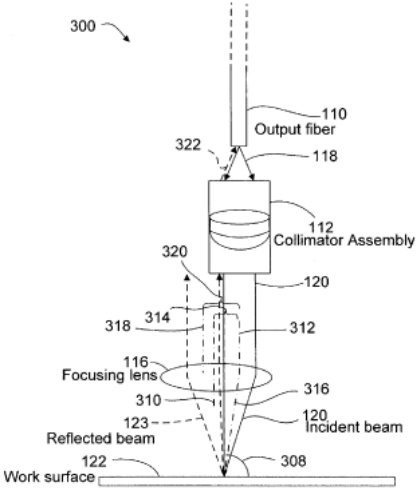


		FIG. 5
1e	wherein the plurality of light sources are arranged so that each excitation light emitted from each of the plurality of light sources enters asymmetrically to a center of the condensing lens; and	Kurosaki '998 combines with Alpay to disclose wherein the plurality of light sources are arranged so that each excitation light emitted from each of the plurality of light sources enters asymmetrically to a center of the condensing lens.

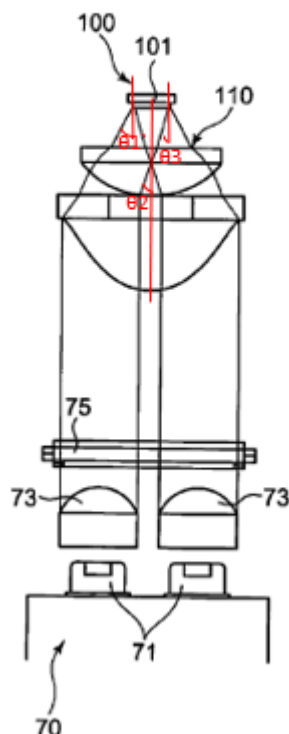
	Alpay discloses that the asymmetrical arrangement of light source is to prevent the laser from reflecting back to damage the laser light source. Alpay [0003]: Generally, certain lasers may be sensitive to optical feedback such as a laser beam reflected back to the laser from a work surface. For example, fiber lasers are typically very sensitive to back-reflections from a work surface. <u>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.</u> Further, a seed laser may be damaged in a high-power master oscillator fiber amplifier device by reflected light that is amplified on its way back to the seed laser. In many laser processing systems, such as laser micromachining systems, it is therefore desirable to prevent such back-reflections from finding a path back into the output fiber. Alpay [0007]: <u>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.</u> For example, FIG. 2 is a block diagram of another typical fiber laser processing system 200 having a tilted beam delivery subsystem (e.g., the output fiber 110, the collimator assembly 112, and the focusing lens 116) <u>such that the path of the incident laser beam 120 is non-perpendicular to the work surface 122.</u> Alpay [0027]: The incident laser beam 120 propagates along a first axis of propagation 312 from the collimator assembly 112 to the focusing lens 116. The first axis of propagation 312 is substantially parallel to the primary axis 310 of the focusing lens 116. There is, however, an 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). <u>Rather, the incident laser beam 120 hits the focusing lens 116 at an offset 314 from the center of the lens 116.</u> In one embodiment, the amount of offset 314 is greater than or equal to approximately one-half the diameter of the collimated incident laser beam 120. As discussed below, such an amount of offset 314 reduces or prevents overlap between the reflected laser beam 123 and the incident laser beam 120.
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	Alpay [0028]: The focusing lens 116 converges the incident laser beam 120 to a focused spot diameter on the work surface 122. <u>As a result of 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 310 of the focusing lens 116.</u> Thus, the 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. Alpay [0029]: As a consequence of using the offset 314 to tilt the incident laser beam 120, the path of the reflected laser beam 123 is angularly separated from the path of the incident laser beam 120. Thus, after returning through the focusing lens 116, the reflected laser beam 123 travels along a third axis of propagation 318 that is spatially separated from the first axis of propagation 312 of the incident laser beam 120. In certain embodiments, <u>an offset 320 between the first axis of propagation 312 corresponding to the incident laser beam 120 and the third axis of propagation 318 corresponding to the reflected laser beam 123 is configured 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.</u>
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		 FIG. 3
1f	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, $\theta \neq 0$¹¹ is satisfied.	Kurosaki '998 or Alpay discloses that 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. In Kurosaki '998, Fig. 5 discloses that excitation light enters obliquely to the luminescent plate 101 from the left side and right-hand side of the central axis of luminescent plate 101, respectively. Therefore, Fig. 5 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, $\theta \neq 0$.”

¹¹ The recitation “ $\theta \neq 0$ ” was amended to read “ $\theta \neq 0$ ” by Certificate of Correction.

FIG. 5



In the alternative, Alpay also discloses that an incident angle to the excitation light irradiation region of any excitation light of each of the excitation light is an elevation angle θ , $\theta \neq 0$. For example, the incident laser beam 120 is non-perpendicular to the work surface 122.

Alpay [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

	<u>angle of incidence of the beam hitting the work surface is not 90 degrees.</u> For example, FIG. 2 is a block diagram of another typical fiber laser processing system 200 having a tilted beam delivery subsystem (e.g., the output fiber 110, the collimator assembly 112, and the focusing lens 116) <u>such that the path of the incident laser beam 120 is non-perpendicular to the work surface 122.</u> Alpay [0027]: The incident laser beam 120 propagates along a first axis of propagation 312 from the collimator assembly 112 to the focusing lens 116. The first axis of propagation 312 is substantially parallel to the primary axis 310 of the focusing lens 116. <u>There is, however, an 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.</u> In one embodiment, the amount of offset 314 is greater than or equal to approximately one-half the diameter of the collimated incident laser beam 120. As discussed below, such an amount of offset 314 reduces or prevents overlap between the reflected laser beam 123 and the incident laser beam 120. Alpay [0028]: The focusing lens 116 converges the incident laser beam 120 to a focused spot diameter on the work surface 122. <u>As a result of 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 310 of the focusing lens 116. Thus, the 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.</u>
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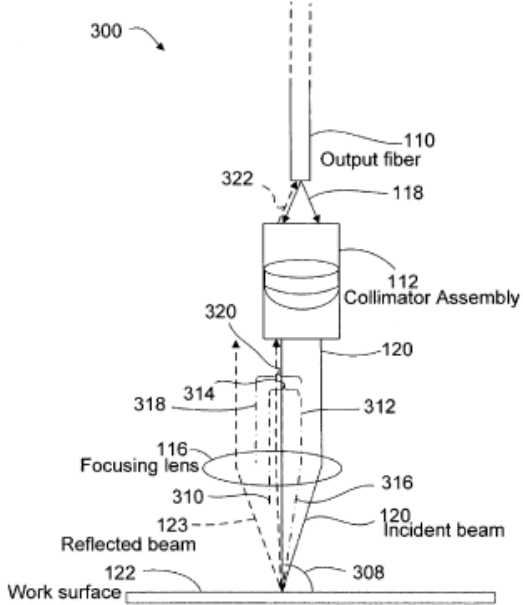
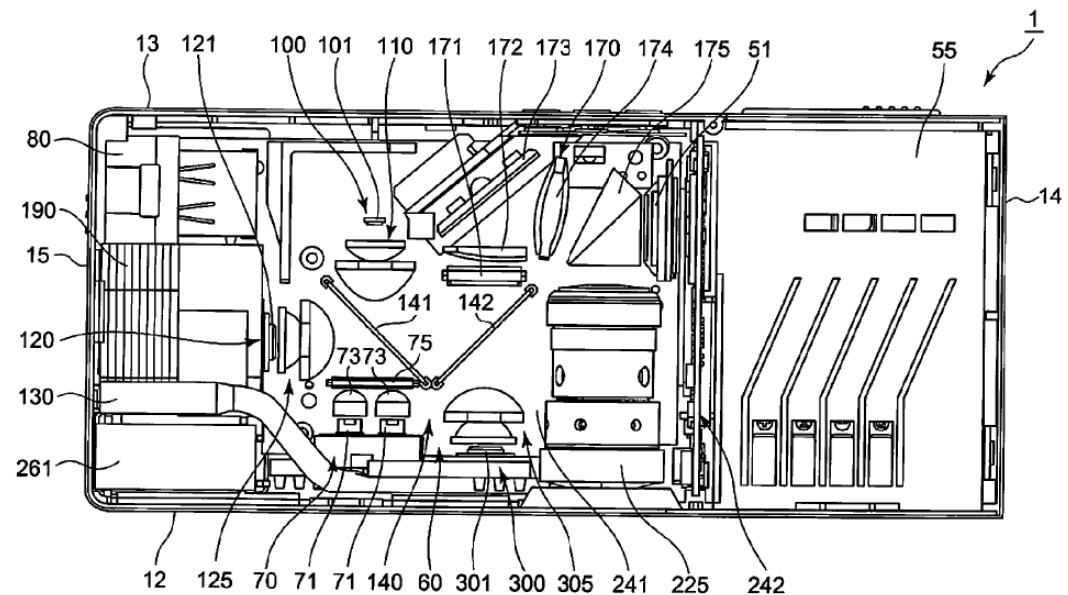
		 FIG. 3
	Claim 3	
3p	A light source device according to claim 1, comprising:	Kurosaki '998 discloses a light source device. Kurosaki '998 [0023]: <u>The light source unit 60 includes an excitation light shining device 70 which includes in turn an excitation light source 71 and a microlens array 75, a luminescent plate 101 which includes a green luminescent material layer which receives light emitted from the excitation light source 71 to emit light in a green wavelength band, ...</u>

FIG. 3



3a	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 θ_m and an azimuth angle is ϕ_m, 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 θ_n and an azimuth angle is ϕ_n, there is no pair of the excitation lights in which $\theta_m - 2^\circ \leq \theta_n \leq \theta_m + 2^\circ$, and $\phi_m + 178^\circ \leq \phi_n \leq \phi_m + 182^\circ$¹² are established.	Kurosaki '998 combines with Alpay or Akiyama '098 to disclose 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 θ_m and an azimuth angle is ϕ_m, 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 θ_n and an azimuth angle is ϕ_n, there is no pair of the excitation lights in which $\theta_m - 2^\circ \leq \theta_n \leq \theta_m + 2^\circ$, and $\phi_m + 178^\circ \leq \phi_n \leq \phi_m + 182^\circ$ are established. In claim 3a, $\theta_m - 2^\circ \leq \theta_n \leq \theta_m + 2^\circ$ means $-2^\circ \leq \theta_m - \theta_n \leq 2^\circ$, and $\phi_m + 178^\circ \leq \phi_n \leq \phi_m + 182^\circ$ means $178^\circ \leq \phi_n - \phi_m \leq 182^\circ$. Based on column 6/lines 48-59 (“a mathematical formula 3 or a mathematical formula 4 is established as the condition for preventing incidence of the unconverted excitation light group 51 to the excitation light source group 5”), the meaning of “there is no pair of the excitation lights in which $\theta_m - 2^\circ \leq \theta_n \leq \theta_m + 2^\circ$, and $\phi_m + 178^\circ \leq \phi_n \leq \phi_m + 182^\circ$ are established” should be $\theta_n \neq \theta_m$ ($\theta_m \neq 0$, $\theta_n \neq 0$) (Equation 3), or $\phi_n \neq \phi_m + 180^\circ$ ($\theta_m \neq 0$, $\theta_n \neq 0$) (Equation 4). Alpay discloses the abovementioned limitation. Alpay [0007]: <u>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.</u> For example, FIG. 2 is a block diagram of another typical fiber laser processing system 200 having a tilted beam delivery subsystem (e.g., the output fiber 110, the collimator assembly 112, and the focusing lens 116) <u>such that the path of the incident laser beam 120 is non-perpendicular to the work surface 122.</u> Alpay [0027]: The incident laser beam 120 propagates along a first axis of propagation 312 from the collimator assembly 112 to the focusing lens 116. The first axis of propagation 312 is substantially parallel to the primary axis 310 of the focusing lens 116.
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¹² The recitation “ $\phi_m + 178^\circ \leq \phi_n \leq \phi_m + 182^\circ$ ” was amended to read “ $\phi_m + 178^\circ \leq \phi_n \leq \phi_m + 182^\circ$ ” by Certificate of Correction.

There is, however, an 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. In one embodiment, the amount of offset 314 is greater than or equal to approximately one-half the diameter of the collimated incident laser beam 120. As discussed below, such an amount of offset 314 reduces or prevents overlap between the reflected laser beam 123 and the incident laser beam 120.

Alpay [0028]: The focusing lens 116 converges the incident laser beam 120 to a focused spot diameter on the work surface 122. As a result of 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 310 of the focusing lens 116. Thus, **the 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.**

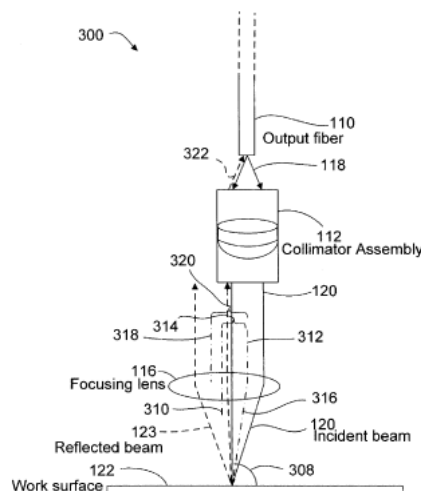
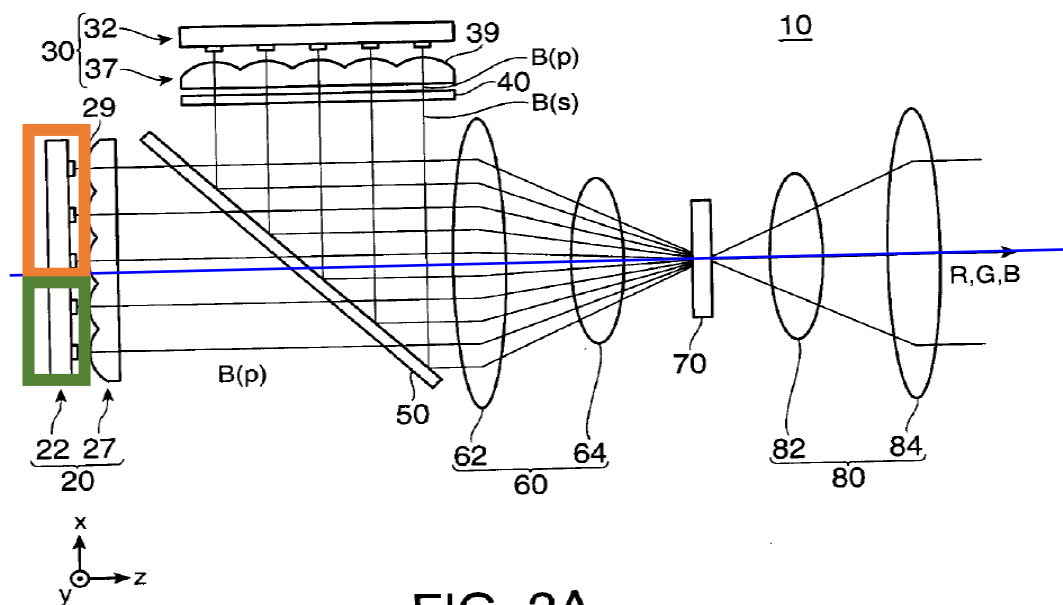


FIG. 3

In the alternative, Akiyama '098 discloses the limitation as well. For example, Fig. 2A of Akiyama '098 shows that all the excitation lights from the first excitation light generation section 20 are asymmetrically incident to the fluorescence generation section 70. Therefore, there is a condition that an incident angle to the excitation light irradiation region of the first excitation light (elevation angle) of each of the excitation lights, θ_m , and an incident angle to the excitation light irradiation region of the second excitation light (elevation angle) of each of the excitation lights, θ_n , $\theta_m \neq \theta_n$ ($\theta_m - \theta_n \neq 0$), and/or. an azimuth angle of the first excitation light of each of the excitation lights, ϕ_m , and an azimuth angle of the second excitation light of each of the excitation lights, ϕ_n , $\phi_m + 178^\circ \leq \phi_n \leq \phi_m + 182^\circ$.

Akiyama '098 [0072]: The excitation light combining section 50 transmits the blue light (first excitation light) from the first excitation light generation section 20 and reflects the blue light (second excitation light) from the second excitation light generation

section 30 to thereby combine the blue light from the first excitation light generation section 20 and the blue light from the second excitation light generation section 30.



	Claim 4	
4p	The light source device according to claim 1,	Kurosaki '998 discloses a light source device. Kurosaki '998 [0023]: <u>The light source unit 60 includes an excitation light shining device 70 which includes in turn an excitation light source 71</u> and a microlens array 75, <u>a luminescent plate 101 which includes a green luminescent material layer which receives light emitted from the excitation light source 71 to emit light in a green wavelength band, ...</u> Kurosaki '998 [0044]: <u>The light source-side optical system 140</u> includes a collective lens 110 which collects light emitted from the excitation shining unit 70 and luminescent light emitted from the luminescent plate 101, a collective lens 125 which collects light emitted from the red light source 121, a collective lens 305 which collects light emitted from the <u>blue light source 301, a first dichroic mirror 141 which transmits excitation light from the excitation light shining unit 70 and light from the red light source unit 120 and reflects luminescent light emitted from the luminescent plate 101</u>

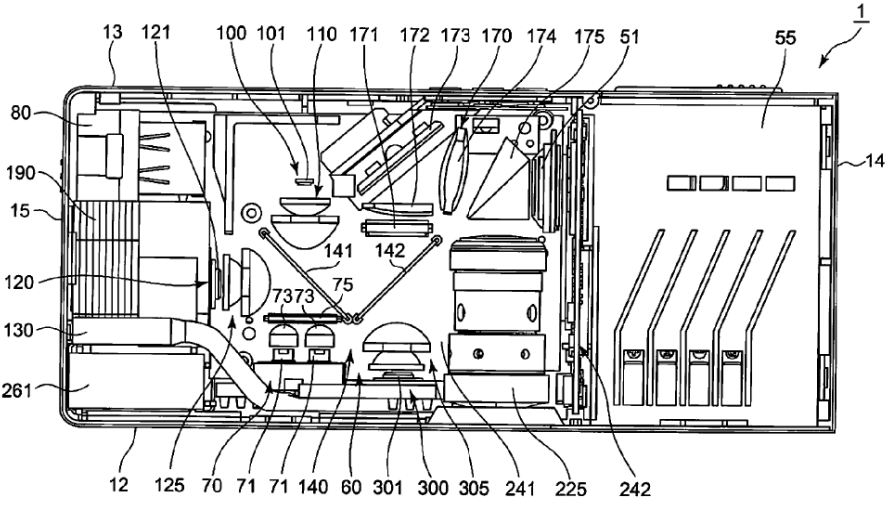
		FIG. 3
4a	wherein the excitation light source is a solid light-emitting element.	Kurosaki '998 discloses that the excitation light source is a solid light-emitting element. Kurosaki '998 [0041]: The excitation light shining unit 70 includes two excitation light sources 71.... <u>This excitation light source 71 is a blue laser emitter and emits a laser beam</u> in a blue wavelength band towards the luminescent plate 101.

		FIG. 3
	Claim 7	
7p	A projection type video display device,	Kurosaki '998 discloses a projection type video display device. Kurosaki '998 [0022]: A projector 1 according to the invention includes a light source unit 60, a display device 51, a projection-side optical system, a light guiding optical system 170 for guiding light from the light source unit 60 to the display device 51 and for aligning a optical axis of a projection light which is generated in the display device 51 with a optical axis of the projection-side optical system, and a projector control unit for controlling the light source unit 60 and the display device 51.

		FIG. 3
7a	the light source device according to claim 1,	Kurosaki '998 discloses a light source device. Kurosaki '998 [0023]: <u>The light source unit 60 includes an excitation light shining device 70 which includes in turn an excitation light source 71 and a micro lens array 75, a luminescent plate 101 which includes a green luminescent material layer which receives light emitted from the excitation light source 71 to emit light in a green wavelength band, ...</u> Kurosaki '998 [0044]: <u>The light source-side optical system 140 includes a collective lens 110 which collects light emitted from the excitation shining unit 70 and luminescent light emitted from the luminescent plate 101, a collective lens 125 which collects light emitted from the red light source 121, a collective lens 305 which collects light emitted from the blue light source 301, a first dichroic mirror 141 which transmits excitation light from the excitation light shining unit 70 and light from the red light source unit 120 and reflects luminescent light emitted from the luminescent plate 101</u>

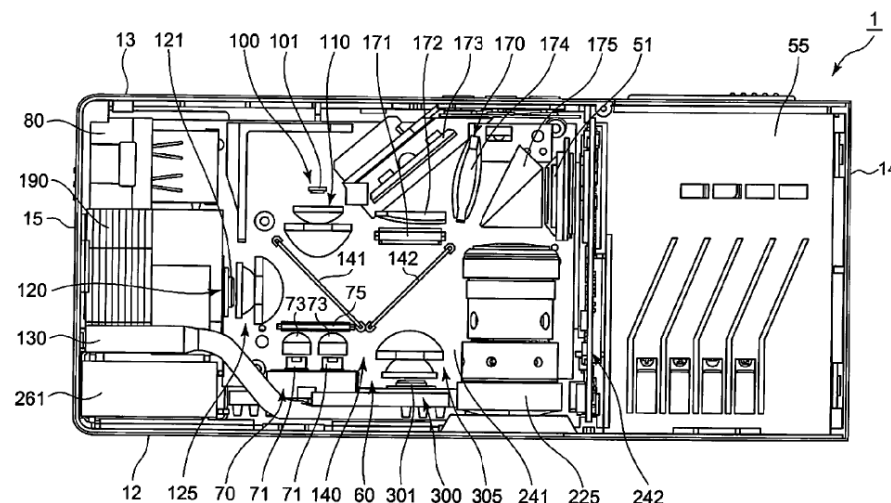
		FIG. 3
7b	a video display element;	Kurosaki '998 discloses a video display element, <i>e.g.</i>, DMD. Kurosaki '998 [0022]: A projector 1 according to the invention includes a light source unit 60, a display device 51, a projection-side optical system, a light guiding optical system 170 for guiding light from the light source unit 60 to the display device 51 and for aligning a optical axis of a projection light which is generated in the display device 51 with a optical axis of the projection-side optical system, and a projector control unit for controlling the light source unit 60 and the display device 51.

	Kurosaki '998 [0038]: ...In addition, <u>the projector 1 includes the display device 51 such as a DMD...</u> FIG. 3
7c	an illumination optical system which has a plurality of optical elements applying light from the light source device to the video display element; and Kurosaki '998 discloses an illumination optical system which has a plurality of optical elements applying light from the light source device to the video display element. Kurosaki '998 [0022]: A projector 1 according to the invention includes a light source unit 60, a display device 51, <u>a projection-side optical system, a light guiding optical system 170 for guiding light from the light source unit 60 to the display device 51</u> and for aligning a optical axis of a projection light which is generated in the display device 51 with a optical axis of the projection-side optical system, and a projector control unit for controlling the light source unit 60 and the display device 51. Kurosaki '998 [0050]: The light guiding optical system 170 includes <u>a microlens array 171, an optical axis alteration mirror 173</u> for altering an axis of light emitted from the light source unit 60 towards the display device 51, <u>a collective lens 172</u> which

		is interposed between the optical axis alteration mirror 173 and the microlens array 171, a collective lens 174 which is positioned on the optical axis which is altered by the <u>optical axis alteration mirror 173 and a prism 175.</u> FIG. 3 
7d	a projection lens which enlarges and projects an optical image formed by the video display element.	Kurosaki '998 discloses a projection lens which enlarges and projects an optical image formed by the video display element. Kurosaki '998 [0033]: In this projector 1, pencils of light which are emitted from a light source unit 60, that is, pencils of light which are collected to a predetermined plane by a light source-side optical system 140 of the light source unit 60 are shone onto the display device 51 via a light guiding optical system 170 to thereby <u>form an optical image by reflected light reflected at the display device 51</u> which is controlled to be driven by the display drive unit 26. <u>The image so formed is projected on to a screen, not shown, for display via a projection-side optical system,</u> which will be described later. A movable lens group 235 of the projection-side optical system is driven by a lens motor 45 for zooming or focusing.

Kurosaki '998 [0052]: **The projection-side optical system incorporated in the lens barrel 225** includes a fixed lens group and a movable lens group and realizes a zooming function and a focusing function by causing lenses of the movable lens group to operate in an optical direction by controlling the lens motor 45.

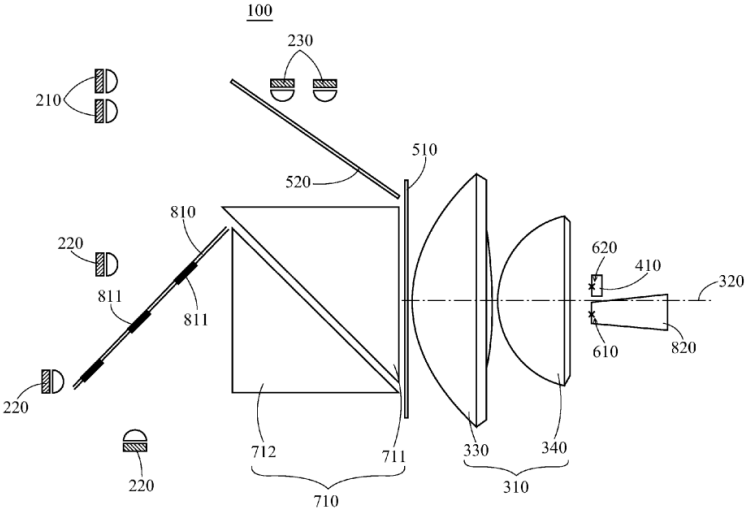
FIG. 3



Ground 6: Huang [US8783886B2], Hirata '999 [US20110187999A1] – claim charts for claims 1, 4, 7 and 9 as invalidated by Huang and Hirata '999.

Publication Number	Country of Origin	Filing Date	Date of Publication
US8783886B2 (“Huang”)	United States of America	06/27/2011	07/22/2014
US20110187999A1 (“Hirata '999”)	United States of America	10/25/2010	08/04/2011

	Claims of U.S. Patent No. 9,322,530	Citations and Analysis
	Claim 1	
1p	A light source device, comprising:	Huang discloses a light source device. Huang [Column 2/Lines 38-45]: As shown in FIG. 2, an illumination system 100 according to an embodiment of the present invention is disposed in a projection device (not shown), and comprises a first light source 210, <u>a second light source 220, an optical device 310, a wavelength transformer 410 and a first dichroic mirror 510.</u> In reference to both FIGS. 3A and 3B, the first light source 210 emits a first light beam 211, while the second light source 220 emits a second light beam 221.

		 FIG. 2
1a	a plurality of excitation light sources which emit excitation light;	Huang discloses a plurality of excitation light sources which emit excitation light. Huang [Column 2/Lines 38-45]: As shown in FIG. 2, an illumination system 100 according to an embodiment of the present invention is disposed in a projection device (not shown), and comprises a first light source 210, a second light source 220, an optical device 310, a wavelength transformer 410 and a first dichroic mirror 510. In reference to both FIGS. 3A and 3B, the first light source 210 emits a first light beam 211, <u>while the second light source 220 emits a second light beam 221.</u> Huang [Column 4/Lines 16-19]: ...the second light source 220 comprises a plurality of secondary light sources for emitting a plurality of secondary light beams (not shown) respectively.

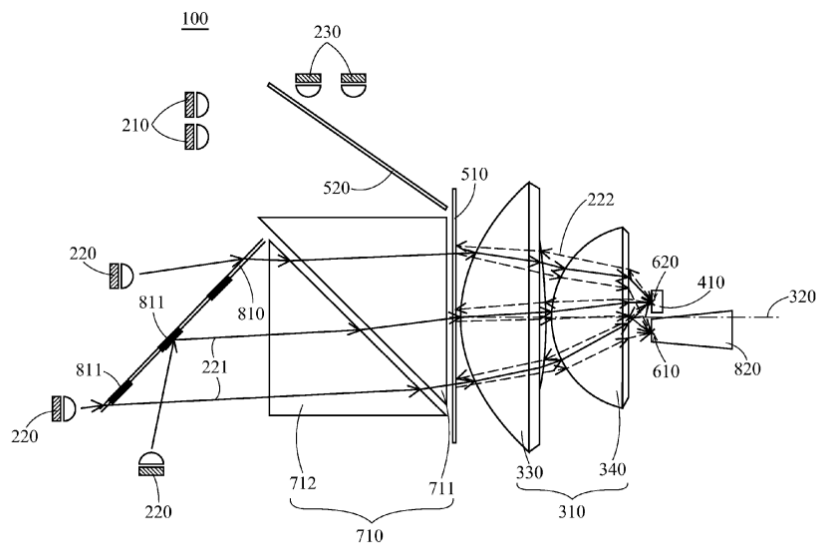
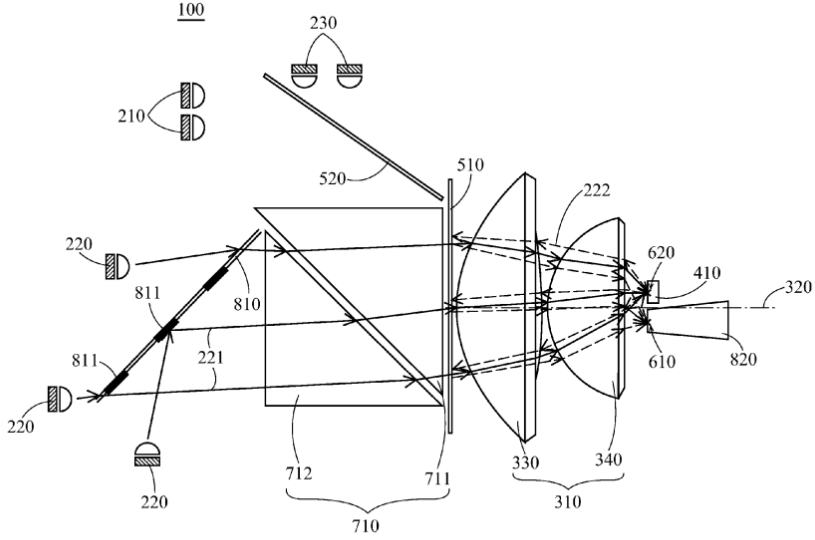


FIG. 3B

1b	a phosphor which changes the excitation light to fluorescent light;	Huang discloses a phosphor, <i>e.g.</i> wavelength transformer, which changes the excitation light to fluorescent light. Huang [Column 2/Lines 38-45]: As shown in FIG. 2, an illumination system 100 according to an embodiment of the present invention is disposed in a projection device (not shown), and comprises a first light source 210, a second light source 220, an optical device 310, a wavelength transformer 410 and a first dichroic mirror 510. In reference to both FIGS. 3A and 3B, the first light source 210 emits a first light beam 211, while the second light source 220 emits a second light beam 221.
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		Huang [Column 2/Lines 61-64]: The wavelength transformer 410 is disposed at the second focal point 620, and receives and transforms the second light beam 221 emitted by the second light source 220 into a third light beam 222. Huang [Column 4/Lines 36-38]: <u>The wavelength transformer 410 may be a yellow or green phosphor, and correspondingly, the third light beam 222 is a yellow or green light beam.</u>  FIG. 3B
1c	a dichroic mirror which transmits the excitation light and reflects the fluorescent light; and	Huang discloses a dichroic mirror which transmits the excitation light and reflects the fluorescent light. Huang [Column 2/Lines 38-45]: As shown in FIG. 2, an illumination system 100 according to an embodiment of the present invention is disposed in a projection device (not shown), and comprises a first light source 210, a second light source 220, an optical device 310, a wavelength transformer 410 and a first dichroic mirror 510. In reference

	to both FIGS. 3A and 3B, the first light source 210 emits a first light beam 211, while the second light source 220 emits a second light beam 221. Huang [Column 2/Lines 61-67 and Column 3/Lines 1-10]: The wavelength transformer 410 is disposed at the second focal point 620, and receives and transforms the second light beam 221 emitted by the second light source 220 into a third light beam 222. <u>The first dichroic mirror 510</u>, which is disposed between the first and the second light sources 210, 220 and the optical device 310, <u>is adapted to allow the first light beam 211 and the second light beam 221 to travel therethrough and reflect the third light beam 222.</u> In other words, as shown in FIG. 3B, when the second light beam 221, emitted by the second light source 220, is focused by the optical device 310 onto the wavelength transformer 410 that is disposed at the second focal point 620, the second light beam 221 is transformed into the third light beam 222. Then, <u>the third light beam 222 is emitted from the second focal point 620 to pass through the optical device 310, and is then reflected by the first dichroic mirror 510 to the optical device 310 to be focused onto the first focal point 610.</u>
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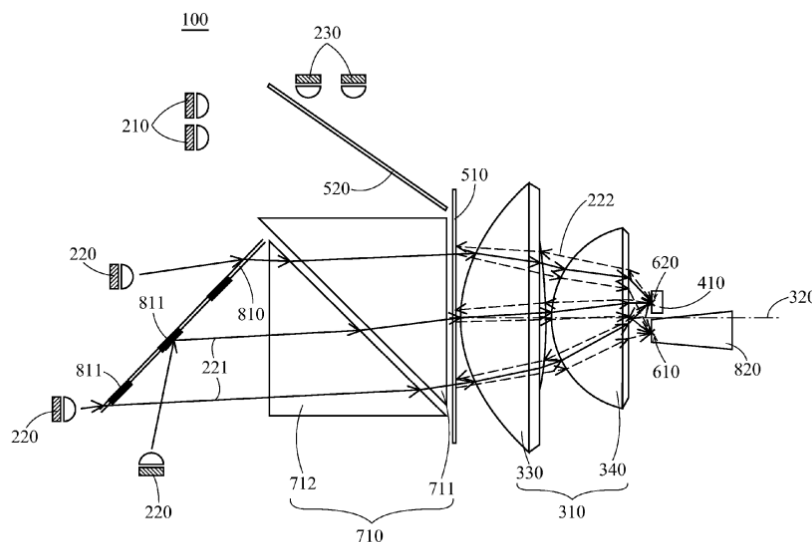
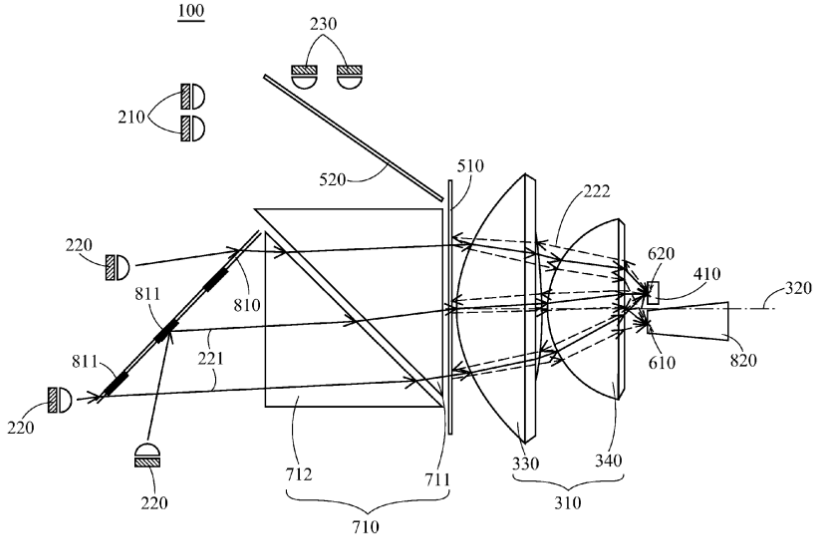
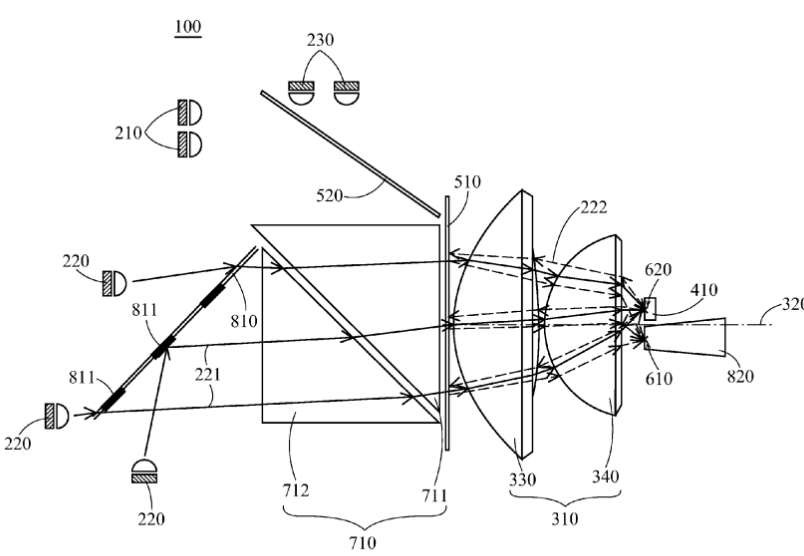


FIG. 3B

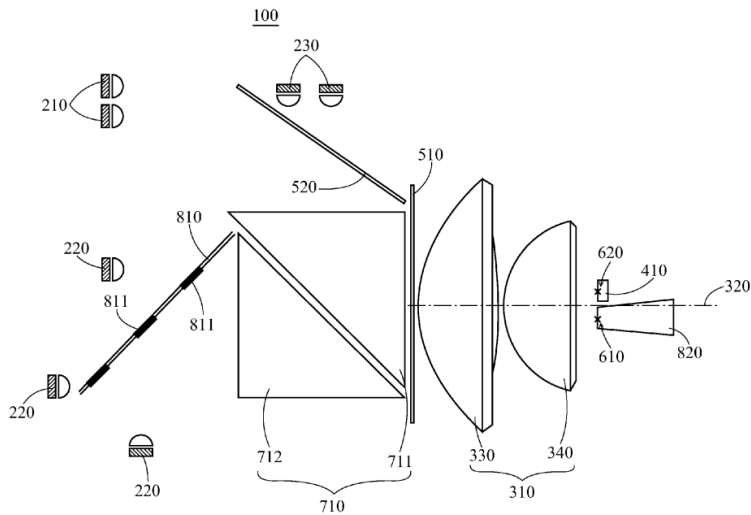
1d	a condensing lens which condenses the excitation light transmitted through the dichroic mirror in an excitation light irradiation region on the phosphor,	Huang discloses a condensing lens, <i>e.g.</i>, an optical device, which condenses the excitation light transmitted through the dichroic mirror in an excitation light irradiation region on the phosphor. In Huang, the optical device 310 including a condensing lens 330 or 340 condenses the second light beam 221 at the second focal point 620 that is an excitation light irradiation region on the wavelength transformer, <i>e.g.</i> phosphor. Huang [Column 2/Lines 61-67 and Column 3/Lines 1-10]: The wavelength transformer 410 is disposed at the second focal point 620, and receives and transforms the second light beam 221 emitted by the second light source 220 into a third light beam 222. The first dichroic mirror 510, which is disposed between the first and the second light sources 210, 220 and the optical device 310, is adapted to allow the first light beam 211 and the
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		second light beam 221 to travel therethrough and reflect the third light beam 222. In other words, as shown in FIG. 3B, when <u>the second light beam 221, emitted by the second light source 220, is focused by the optical device 310 onto the wavelength transformer 410 that is disposed at the second focal point 620, the second light beam 221 is transformed into the third light beam 222.</u> Then, the third light beam 222 is emitted from the second focal point 620 to pass through the optical device 310, and is then reflected by the first dichroic mirror 510 to the optical device 310 to be focused onto the first focal point 610.  FIG. 3B
1e	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	Huang discloses that 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.

		In Huang, each of the bottom two light sources 220 enters asymmetrically with respect to one another and the center of the condensing lens, as shown in the figure below.  FIG. 3B
1f	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, $\theta \neq 0$¹³ is satisfied.	Huang combines with Hirata '999 to disclose that 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. For example, Fig. 1B of Hirata '999 discloses that the excitation light enters obliquely to the excitation light irradiation region. Therefore, the annotated Fig. 1B of Hirata '999 below illustrates “an incident angle to the excitation light irradiation region of any excitation light of each of the excitation light is an elevation angle θ, $\theta \neq 0$.”

¹³ The recitation “ $\theta \neq 0$ ” was amended to read “ $\theta \neq 0$ ” by Certificate of Correction.

		FIG. 1B
	Claim 4	
4p	The light source device according to claim 1,	Huang discloses a light source device. Huang [Column 2/Line 38-45]: As shown in FIG. 2, an illumination system 100 according to an embodiment of the present invention is disposed in a projection device (not shown), and comprises a first light source 210, a second light source 220, an optical device 310, a wavelength transformer 410 and a first dichroic mirror 510. In reference to both FIGS. 3A and 3B, the first light source 210 emits a first light beam 211, while the second light source 220 emits a second light beam 221.

		 FIG. 2
4a	wherein the excitation light source is a solid light-emitting element.	Huang discloses the excitation light source is a solid light-emitting element. Huang [Column 4/Lines 47-50]: According to the above descriptions, the illumination system 100 according to an embodiment of the present invention utilizes <u>solid light sources</u> with both a high luminance and a long service life and operates in the following way:
Claim 7		
7p	A projection type video display device, comprising:	Huang discloses a projection type video display device. Huang [Column 2/Lines 38-42]: As shown in FIG. 2, an illumination system 100 according to an embodiment of the present invention is disposed in <u>a projection device</u> (not shown), and comprises a first light source 210, a second light source 220, an optical device 310, a wavelength transformer 410 and a first dichroic mirror 510.

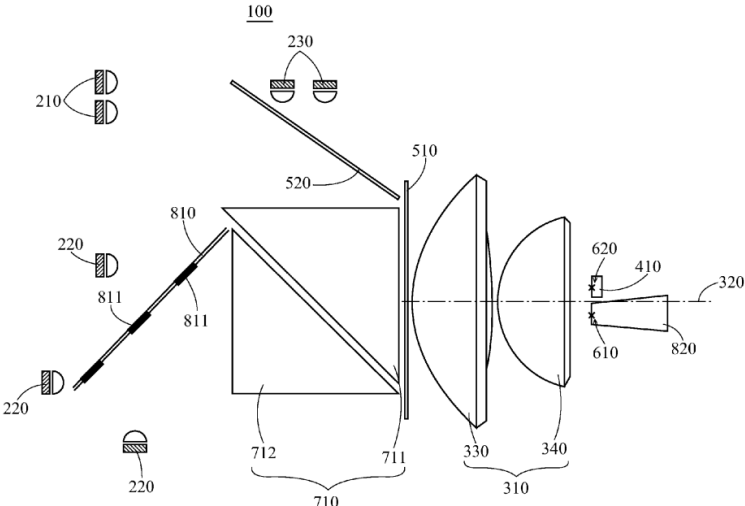
		Huang [Column 2/Lines 56-60]: A light homogenizing device 820 has an inlet disposed at the first focal point 610 to receive the first light source 211, and has an outlet connected to the projection device (not shown) to actually project an image onto a micro-display (not shown) of the projection device.  FIG. 2
7a	the light source device according to claim 1;	Huang discloses a light source device. Huang [Column 2/Line 38-45]: As shown in FIG. 2, an illumination system 100 according to an embodiment of the present invention is disposed in a projection device (not shown), and comprises a first light source 210, a second light source 220, an optical device 310, a wavelength transformer 410 and a first dichroic mirror 510. In reference to both FIGS. 3A and 3B, the first light source 210 emits a first light beam 211, while the second light source 220 emits a second light beam 221.

		FIG. 2
7b	a video display element;	Huang discloses a video display element. Huang [Column 2/Lines 56-60]: A light homogenizing device 820 has an inlet disposed at the first focal point 610 to receive the first light source 211, and has an outlet connected to the projection device (not shown) to actually project an image onto <u>a micro-display (not shown) of the projection device.</u>
7c	an illumination optical system which has a plurality of optical elements applying light from the light source device to the video display element; and	Huang combines with Hirata '999 to disclose an illumination optical system which has a plurality of optical elements applying light from the light source device to the video display element. Huang [Column 2/Line 38-45]: As shown in FIG. 2, <u>an illumination system 100</u> according to an embodiment of the present invention is disposed in a projection device

(not shown), and comprises a first light source 210, **a second light source 220, an optical device 310, a wavelength transformer 410 and a first dichroic mirror 510**. In reference to both FIGS. 3A and 3B, the first light source 210 emits a first light beam 211, while the second light source 220 emits a second light beam 221.

Huang [Column 2/Lines 56-60]: A light **homogenizing device 820** has an inlet disposed at the first focal point 610 to receive the first light source 211, and has an outlet connected to the projection device (not shown) **to actually project an image onto a micro-display (not shown) of the projection device.**

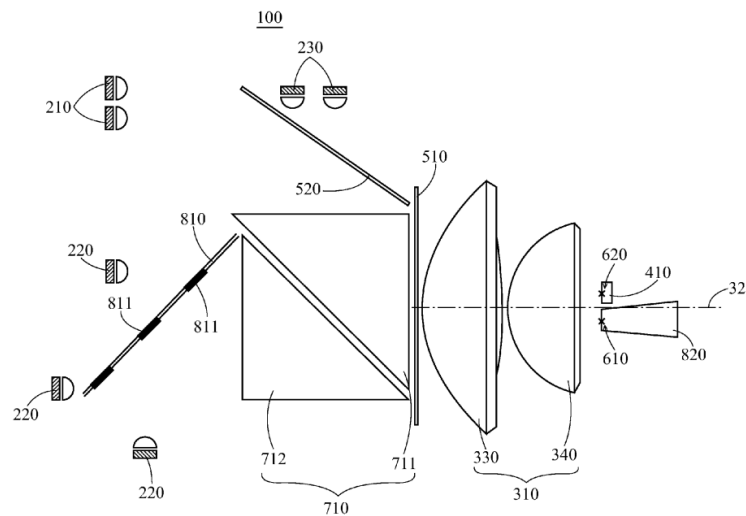


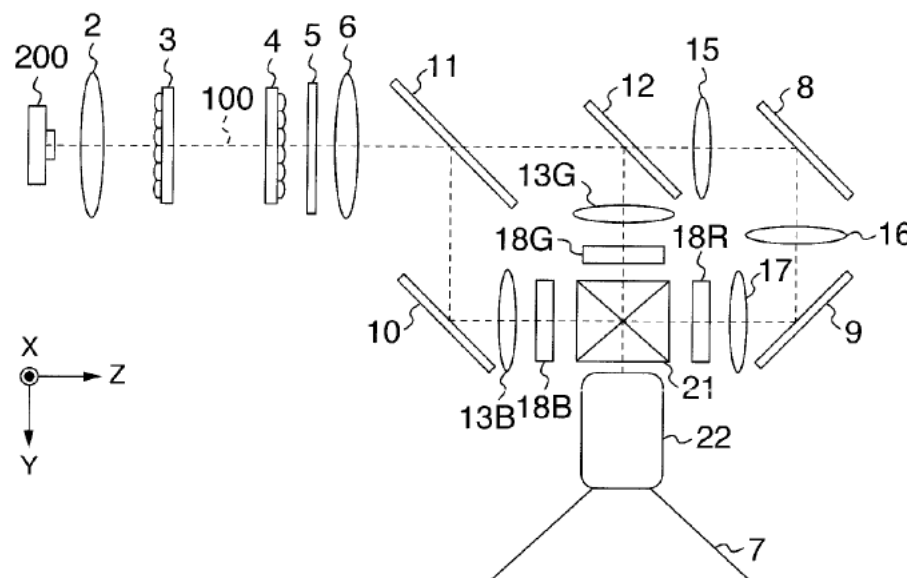
FIG. 2

Hirata '999 [Abstract]: A projection type display apparatus including a light source, **a display element, an illumination optical system** and a projection lens to project a magnified image of the optical image.

Hirata '999 [0064]: FIGS. 4A to 4C are schematic diagrams representing an outline of **an optical system** of a projection type display apparatus employing a light source device according to an embodiment.

Hirata '999 [0067]: Similarly to the **first array lens 3, the second array lens 4** includes a plurality of lens cells arranged in a matrix each of which having a rectangular shape when viewed from the direction of the illumination optical axis, and each lens cells projects or maps the contour of the lens cell of the first array lens 3 corresponding thereto **onto a liquid-crystal display element 18**.

FIG. 4A



7d a projection lens which enlarges and projects an optical image formed by the video display element.

Huang or Hirata '999 discloses a projection lens which enlarges and projects an optical image formed by the video display element.

	In Huang, the uniform light beam homogenized by the homogenizing device can be enlarged by the projection system to produce lager and high-quality images. Huang [Column 2/Lines 56-60]: A light homogenizing device 820 has an inlet disposed at the first focal point 610 to receive the first light source 211, and has an outlet connected to <u>the projection device (not shown) to actually project an image onto a micro-display (not shown) of the projection device.</u> Huang [Column 4/Lines 40-46]: Opposite to the wavelength transformer 410 at the second focal point 620, a light homogenizing device 820 is disposed at the first focal point 610 to receive the <u>first light beam 211, the third light beam 222 and the fourth light beam 231, which are projected outwards after being combined.</u> The light homogenizing device 820 is preferably an integration rod or a light tunnel. Huang [Column 5/Lines 4-9]: (3) the fourth light beam 231 (a red light beam) emitted by the third light source 230 (a red laser light source) sequentially travels through the second dichroic mirror 520, the light coupling device 710, the first dichroic mirror 510 and the optical device 310, and <u>is focused onto the light homogenizing device 820 disposed at the first focal point 610.</u> Huang [Column 5/Lines 10-20]: Therefore, by means of the optical components (e.g., the optical device 310, the light coupling device 710 and the like) disposed within the illumination system 100, the first light beam 211 (the blue light beam), the third light beam 222 (the yellow light beam or the greenlight beam) and the fourth light beam 231 (the red light beam) are all focused to the first focal point 610 and <u>then combined into a homogenized white light beam by the uniform device 820 for projection outwards.</u> This reduces the number of the optical components to be used and the volume of the illumination system and improves the light combining efficiency of the illumination system 100.
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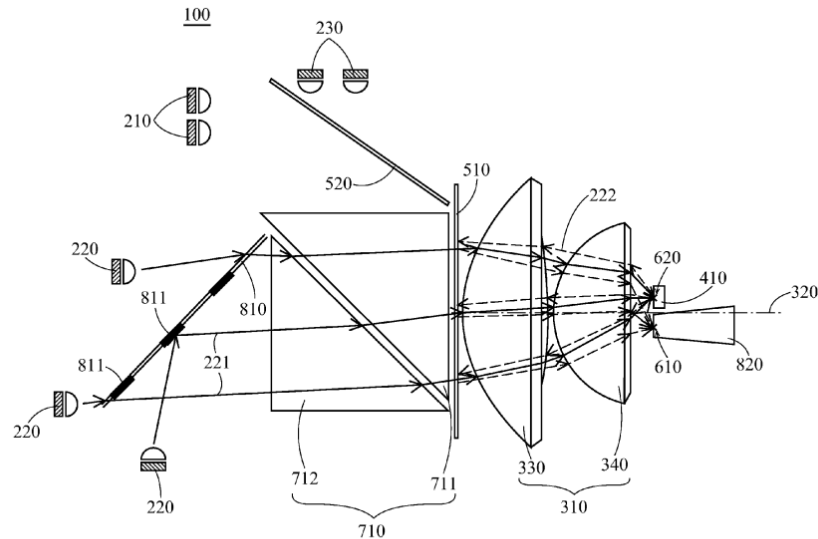


FIG. 3B

Hirata '999 [0064]: FIGS. 4A to 4C are schematic diagrams representing an outline of an optical system of **a projection type display apparatus** employing a light source device according to an embodiment.

Hirata '999 [Abstract]: A projection type display apparatus including a light source, **a display element**, an illumination optical system and **a projection lens to project a magnified image of the optical image**.

Hirata '999 [0075]: ... **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, to thereby implement a display function of the display apparatus.

		FIG. 4A
	Claim 9	
9p	A light source device, comprising:	Huang discloses a light source device. Huang [Column 2/Lines 38-45]: As shown in FIG. 2, an illumination system 100 according to an embodiment of the present invention is disposed in a projection device (not shown), and comprises a first light source 210, a second light source 220, an optical device 310, a wavelength transformer 410 and a first dichroic mirror 510. In reference to both FIGS. 3A and 3B, the first light source 210 emits a first light beam 211, while the second light source 220 emits a second light beam 221.

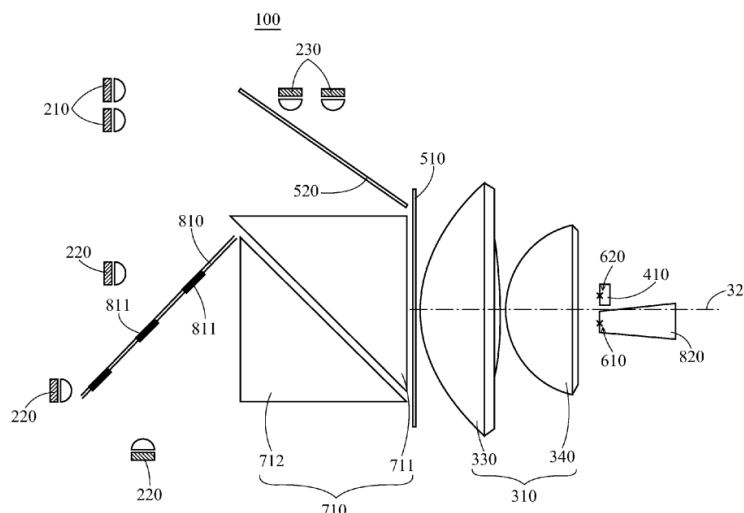


FIG. 2

9a	an excitation light source which emit excitation light;	Huang discloses an excitation light source which emit excitation light. Huang [Column 2/Lines 38-45]: As shown in FIG. 2, an illumination system 100 according to an embodiment of the present invention is disposed in a projection device (not shown), and comprises a first light source 210, a second light source 220, an optical device 310, a wavelength transformer 410 and a first dichroic mirror 510. In reference to both FIGS. 3A and 3B, the first light source 210 emits a first light beam 211, <u>while the second light source 220 emits a second light beam 221.</u> Huang [Column 4/Lines 16-19]: ...the second light source 220 comprises a plurality of secondary light sources for emitting a plurality of secondary light beams (not shown) respectively.
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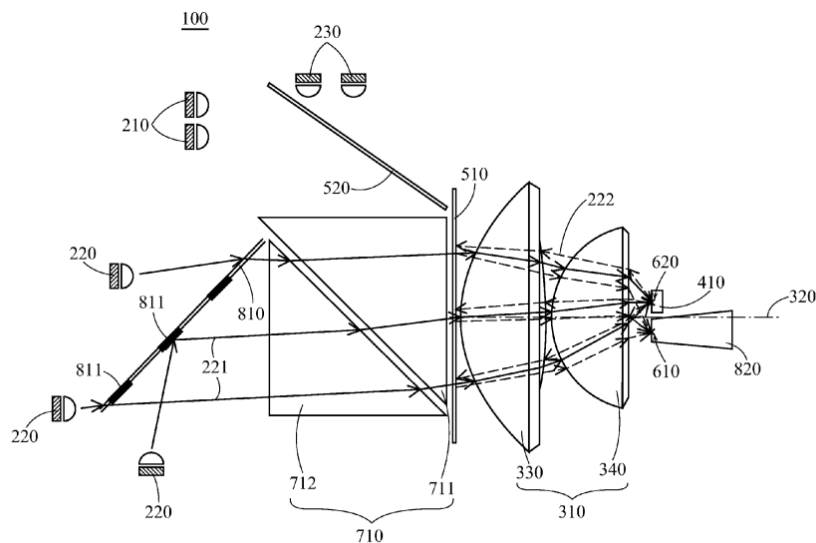
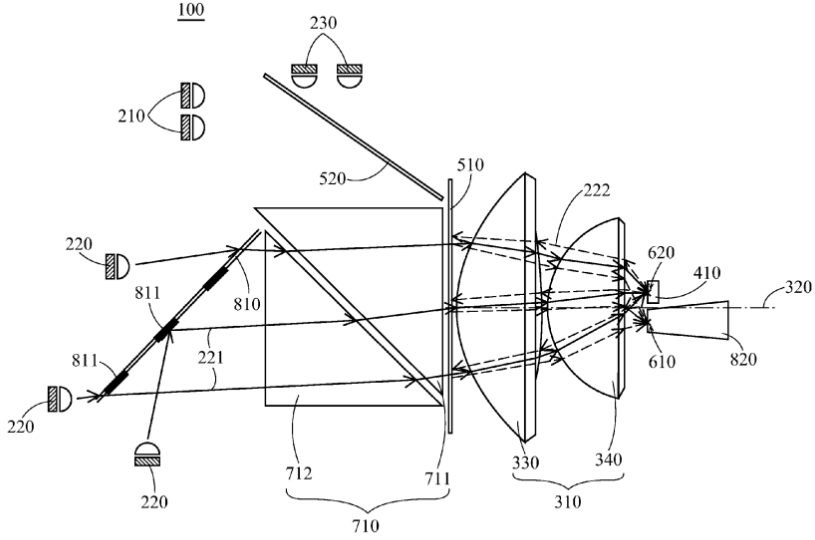


FIG. 3B

9b a phosphor which changes the excitation light to fluorescent light;

Huang discloses a phosphor, *e.g.* wavelength transformer, which changes the excitation light to fluorescent light.

Huang [Column 2/Lines 38-45]: As shown in FIG. 2, an illumination system 100 according to an embodiment of the present invention is disposed in a projection device (not shown), and comprises a first light source 210, a second light source 220, an optical device 310, **a wavelength transformer 410** and a first dichroic mirror 510. In reference to both FIGS. 3A and 3B, the first light source 210 emits a first light beam 211, while the second light source 220 emits a second light beam 221.

		Huang [Column 2/Lines 61-64]: The wavelength transformer 410 is disposed at the second focal point 620, and receives and transforms the second light beam 221 emitted by the second light source 220 into a third light beam 222. Huang [Column 4/Lines 36-38]: <u>The wavelength transformer 410 may be a yellow or green phosphor, and correspondingly, the third light beam 222 is a yellow or green light beam.</u>  FIG. 3B
9c	a dichroic mirror which transmits the excitation light and reflects the fluorescent light; and	Huang discloses a dichroic mirror which transmits the excitation light and reflects the fluorescent light. Huang [Column 2/Lines 38-45]: As shown in FIG. 2, an illumination system 100 according to an embodiment of the present invention is disposed in a projection device (not shown), and comprises a first light source 210, a second light source 220, an optical device 310, a wavelength transformer 410 and a first dichroic mirror 510. In reference

	to both FIGS. 3A and 3B, the first light source 210 emits a first light beam 211, while the second light source 220 emits a second light beam 221. Huang [Column 2/Lines 61-67 and Column 3/Lines 1-10]: The wavelength transformer 410 is disposed at the second focal point 620, and receives and transforms the second light beam 221 emitted by the second light source 220 into a third light beam 222. <u>The first dichroic mirror 510</u>, which is disposed between the first and the second light sources 210, 220 and the optical device 310, <u>is adapted to allow the first light beam 211 and the second light beam 221 to travel therethrough and reflect the third light beam 222.</u> In other words, as shown in FIG. 3B, when the second light beam 221, emitted by the second light source 220, is focused by the optical device 310 onto the wavelength transformer 410 that is disposed at the second focal point 620, the second light beam 221 is transformed into the third light beam 222. Then, <u>the third light beam 222 is emitted from the second focal point 620 to pass through the optical device 310, and is then reflected by the first dichroic mirror 510 to the optical device 310 to be focused onto the first focal point 610.</u>
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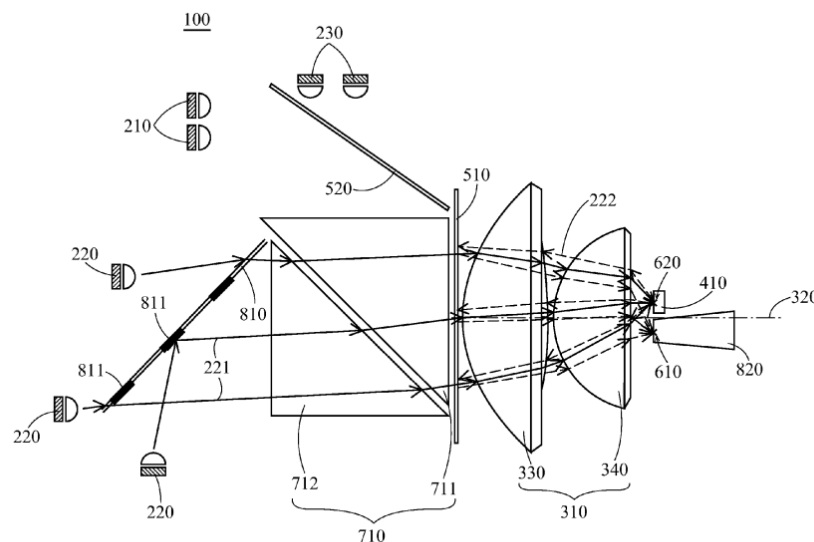


FIG. 3B

9d a condensing lens which condenses the excitation light transmitted through the dichroic mirror in an excitation light irradiation region on the phosphor,

Huang discloses a condensing lens, *e.g.*, an optical device, which condenses the excitation light transmitted through the dichroic mirror in an excitation light irradiation region on the phosphor.

In Huang, the optical device 310 including a condensing lens 330 or 340 condenses the second light beam 221 at the second focal point 620 that is an excitation light irradiation region on the wavelength transformer, *e.g.* phosphor.

Huang [Column 2/Lines 61-67 and Column 3/Lines 1-10]: The wavelength transformer 410 is disposed at the second focal point 620, and receives and transforms the second light beam 221 emitted by the second light source 220 into a third light beam 222. The first dichroic mirror 510, which is disposed between the first and the second light sources 210, 220 and the optical device 310, is adapted to allow the first light beam 211 and the

second light beam 221 to travel therethrough and reflect the third light beam 222. In other words, as shown in FIG. 3B, when **the second light beam 221, emitted by the second light source 220, is focused by the optical device 310 onto the wavelength transformer 410 that is disposed at the second focal point 620, the second light beam 221 is transformed into the third light beam 222.** Then, the third light beam 222 is emitted from the second focal point 620 to pass through the optical device 310, and is then reflected by the first dichroic mirror 510 to the optical device 310 to be focused onto the first focal point 610.

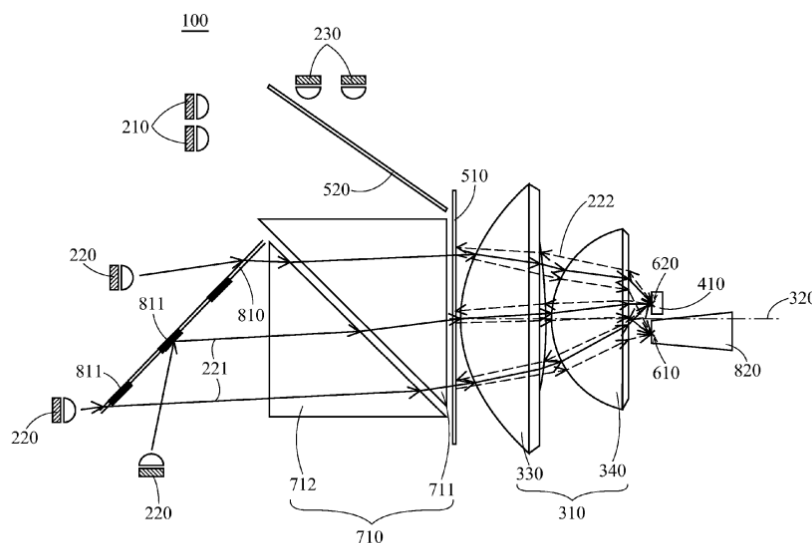
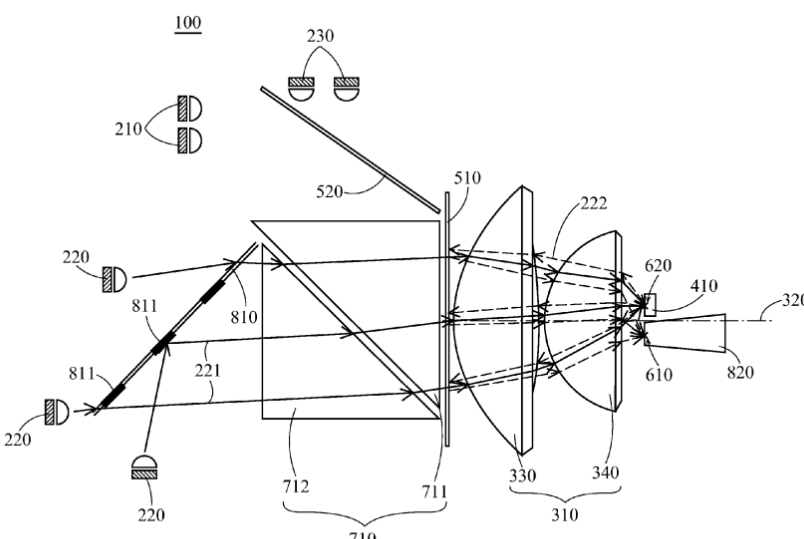


FIG. 3B

9e

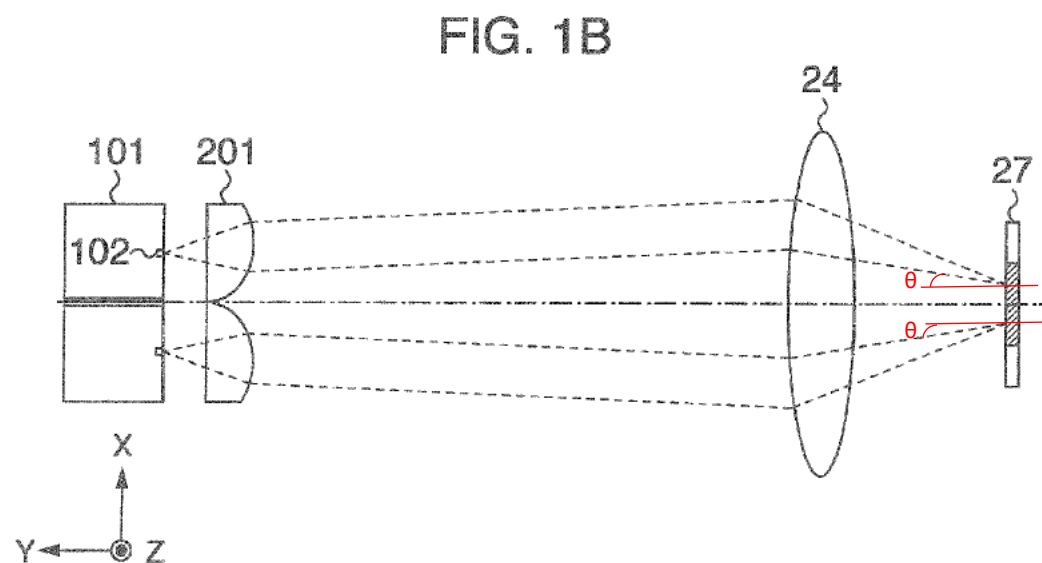
wherein the excitation light sources are arranged so that when excitation light emitted from the excitation light source enters the excitation light irradiation region and is reflected

Huang discloses that 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.

	without being converted into fluorescent light, the unconverted excitation light is prevented from entering the excitation light source, and	In Huang, each of the bottom two light sources 220 enters asymmetrically with respect to one another and the center of the condensing lens, as shown in the figure below. Due to the asymmetrical arrangement of the excitation light sources, the unconverted excitation light is prevented from entering the excitation light source.  FIG. 3B
9f	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, $\theta \neq 0$¹⁴ is satisfied.	Huang combines with Hirata '999 to disclose 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. For example, Fig. 1B of Hirata '999 discloses that the excitation light enters obliquely to the excitation light irradiation region. Therefore, the annotated Fig. 1B of Hirata '999

¹⁴ The recitation " $\theta \neq 0$ " was amended to read " $\theta \neq 0$ " by Certificate of Correction.

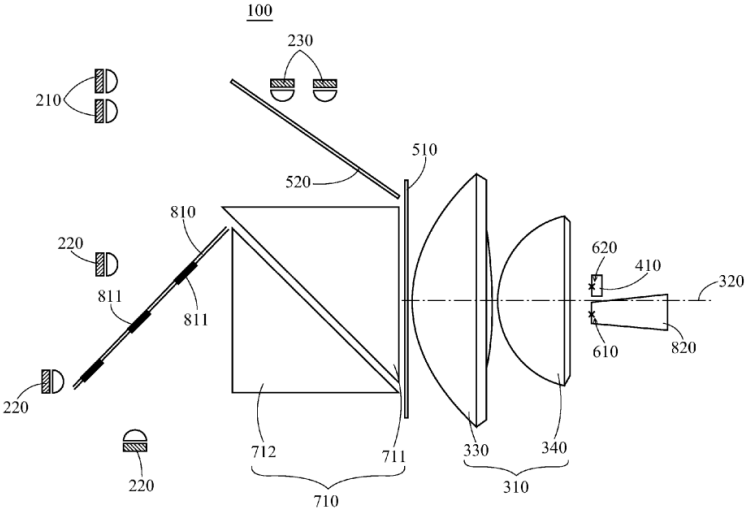
below illustrates “an incident angle to the excitation light irradiation region of any excitation light of each of the excitation light is an elevation angle θ , $\theta \neq 0$.”



Ground 7: Huang [US8783886B2], Kurosaki '998 [US20110234998A1] – claim charts for claims 1, 4, 7 and 9 as invalidated by Huang and Kurosaki '998

Publication Number	Country of Origin	Filing Date	Date of Publication
US8783886B2 (“Huang”)	United States of America	06/27/2011	07/22/2014
US20110234998A1 (“Kurosaki '998”)	United States of America	03/24/2011	09/29/2011

	Claims of U.S. Patent No. 9,322,530	Citations and Analysis
	Claim 1	
1p	A light source device, comprising:	Huang discloses a light source device. Huang [Column 2/Lines 38-45]: As shown in FIG. 2, an illumination system 100 according to an embodiment of the present invention is disposed in a projection device (not shown), and comprises a first light source 210, a second light source 220, an optical device 310, a wavelength transformer 410 and a first dichroic mirror 510. In reference to both FIGS. 3A and 3B, the first light source 210 emits a first light beam 211, while the second light source 220 emits a second light beam 221.

		 FIG. 2
1a	a plurality of excitation light sources which emit excitation light;	Huang discloses a plurality of excitation light sources which emit excitation light. Huang [Column 2/Lines 38-45]: As shown in FIG. 2, an illumination system 100 according to an embodiment of the present invention is disposed in a projection device (not shown), and comprises <u>a first light source 210, a second light source 220</u>, an optical device 310, a wavelength transformer 410 and a first dichroic mirror 510. In reference to both FIGS. 3A and 3B, the first light source 210 emits a first light beam 211, <u>while the second light source 220 emits a second light beam 221.</u> Huang [Column 4/Lines 16-19]: ...the second light source 220 comprises a plurality of secondary light sources for emitting a plurality of secondary light beams (not shown) respectively.

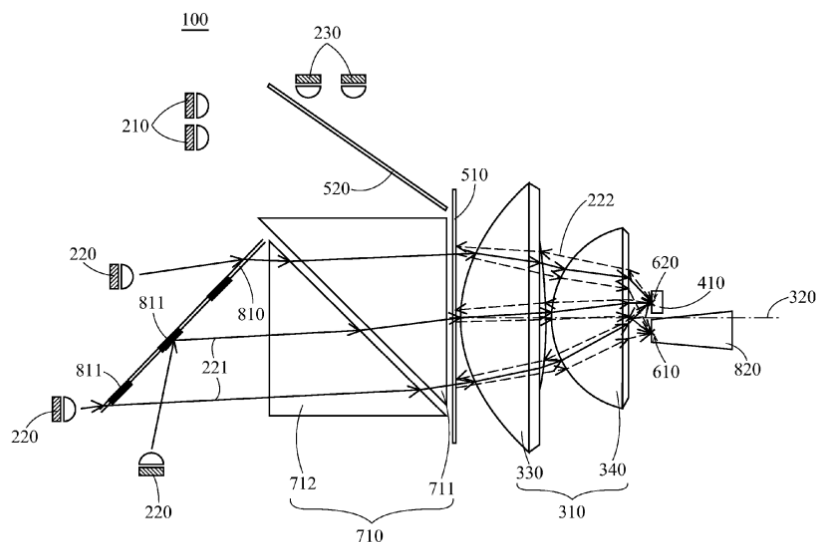


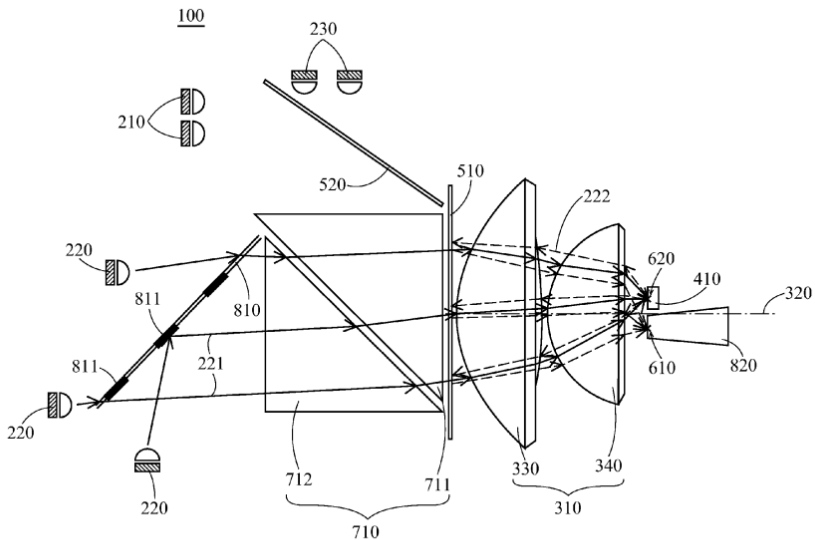
FIG. 3B

1b a phosphor which changes the excitation light to fluorescent light;

Huang discloses a phosphor, *e.g.* wavelength transformer, which changes the excitation light to fluorescent light.

Huang [Column 2/Lines 38-45]: As shown in FIG. 2, an illumination system 100 according to an embodiment of the present invention is disposed in a projection device (not shown), and comprises a first light source 210, a second light source 220, an optical device 310, **a wavelength transformer 410** and a first dichroic mirror 510. In reference to both FIGS. 3A and 3B, the first light source 210 emits a first light beam 211, while the second light source 220 emits a second light beam 221.

Huang [Column 2/Lines 61-64]: The wavelength transformer 410 is disposed at the second focal point 620, and receives and transforms the second light beam 221 emitted by the second light source 220 into a third light beam 222.

		Huang [Column 4/Lines 36-38]: <u>The wavelength transformer 410 may be a yellow or green phosphor, and correspondingly, the third light beam 222 is a yellow or green light beam.</u>  FIG. 3B
1c	a dichroic mirror which transmits the excitation light and reflects the fluorescent light; and	Huang discloses a dichroic mirror which transmits the excitation light and reflects the fluorescent light. Huang [Column 2/Lines 38-45]: As shown in FIG. 2, an illumination system 100 according to an embodiment of the present invention is disposed in a projection device (not shown), and comprises a first light source 210, a second light source 220, an optical device 310, a wavelength transformer 410 and <u>a first dichroic mirror 510</u>. In reference to both FIGS. 3A and 3B, the first light source 210 emits a first light beam 211, while the second light source 220 emits a second light beam 221.

Huang [Column 2/Lines 61-67 and Column 3/Lines 1-10]: The wavelength transformer 410 is disposed at the second focal point 620, and receives and transforms the second light beam 221 emitted by the second light source 220 into a third light beam 222. **The first dichroic mirror 510, which is disposed between the first and the second light sources 210, 220 and the optical device 310, is adapted to allow the first light beam 211 and the second light beam 221 to travel therethrough and reflect the third light beam 222.** In other words, as shown in FIG. 3B, when the second light beam 221, emitted by the second light source 220, is focused by the optical device 310 onto the wavelength transformer 410 that is disposed at the second focal point 620, the second light beam 221 is transformed into the third light beam 222. Then, **the third light beam 222 is emitted from the second focal point 620 to pass through the optical device 310, and is then reflected by the first dichroic mirror 510 to the optical device 310 to be focused onto the first focal point 610.**

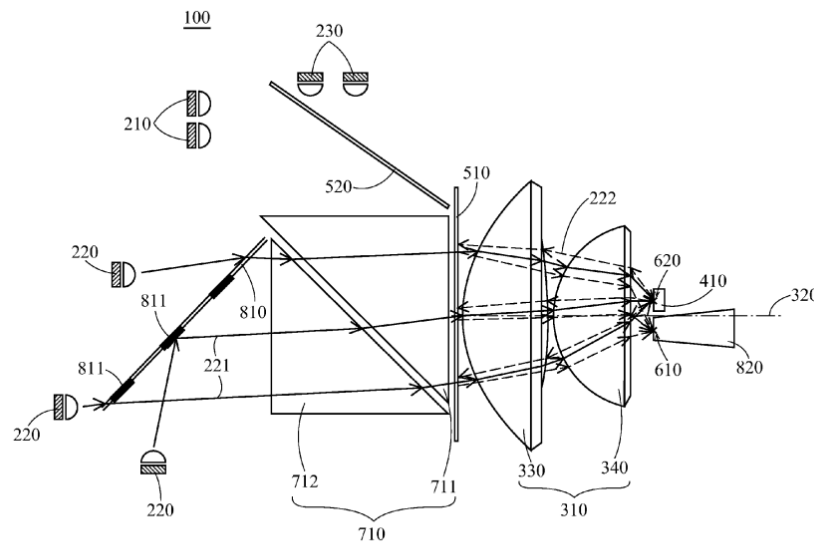


FIG. 3B

1d	a condensing lens which condenses the excitation light transmitted through the dichroic mirror in an excitation light irradiation region on the phosphor,	Huang discloses a condensing lens, <i>e.g.</i>, an optical device, which condenses the excitation light transmitted through the dichroic mirror in an excitation light irradiation region on the phosphor. In Huang, the optical device 310 including a condensing lens 330 or 340 condenses the second light beam 221 at the second focal point 620 that is an excitation light irradiation region on the wavelength transformer, <i>e.g.</i> phosphor. Huang [Column 2/Lines 61-67 and Column 3/Lines 1-10]: The wavelength transformer 410 is disposed at the second focal point 620, and receives and transforms the second light beam 221 emitted by the second light source 220 into a third light beam 222. The first dichroic mirror 510, which is disposed between the first and the second light sources 210, 220 and the optical device 310, is adapted to allow the first light beam 211 and the second light beam 221 to travel therethrough and reflect the third light beam 222. In other words, as shown in FIG. 3B, when <u>the second light beam 221, emitted by the second light source 220, is focused by the optical device 310 onto the wavelength transformer 410 that is disposed at the second focal point 620, the second light beam 221 is transformed into the third light beam 222.</u> Then, the third light beam 222 is emitted from the second focal point 620 to pass through the optical device 310, and is then reflected by the first dichroic mirror 510 to the optical device 310 to be focused onto the first focal point 610.
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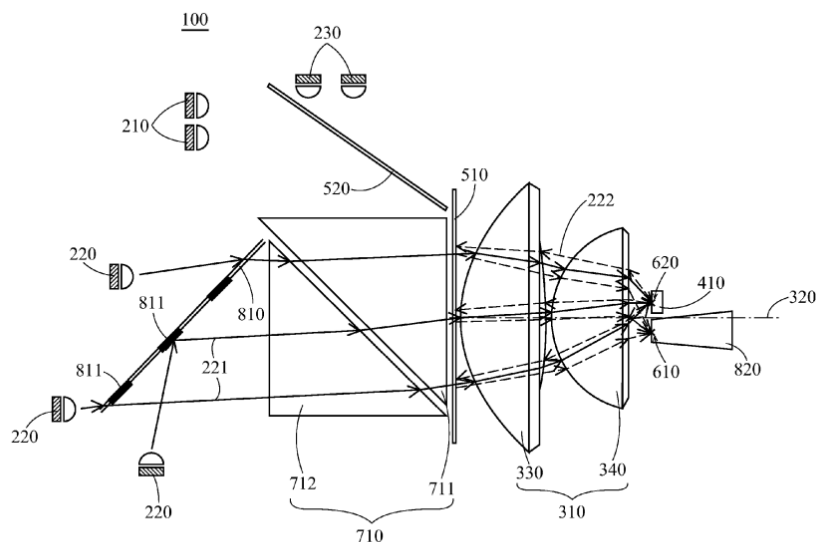


FIG. 3B

1e 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

Huang discloses 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.

In Huang, each of the bottom two light sources 220 enters asymmetrically with respect to one another and the center of the condensing lens, as shown in the figure below.

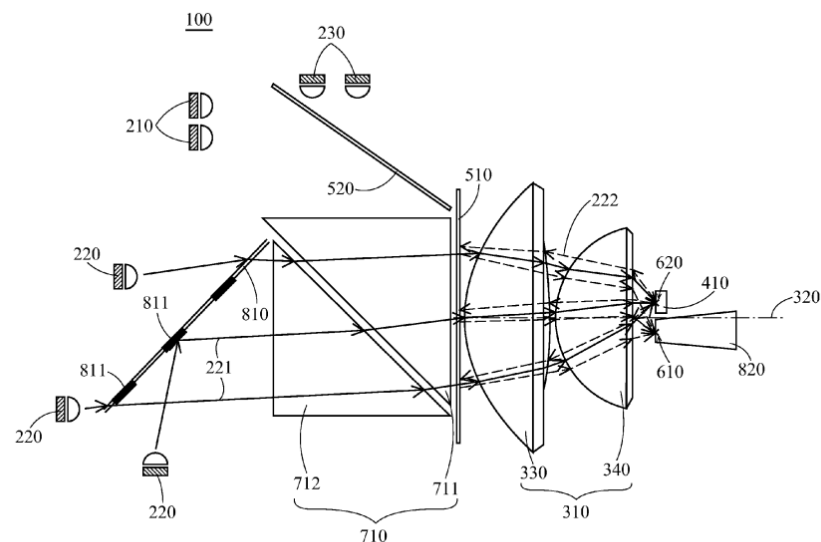
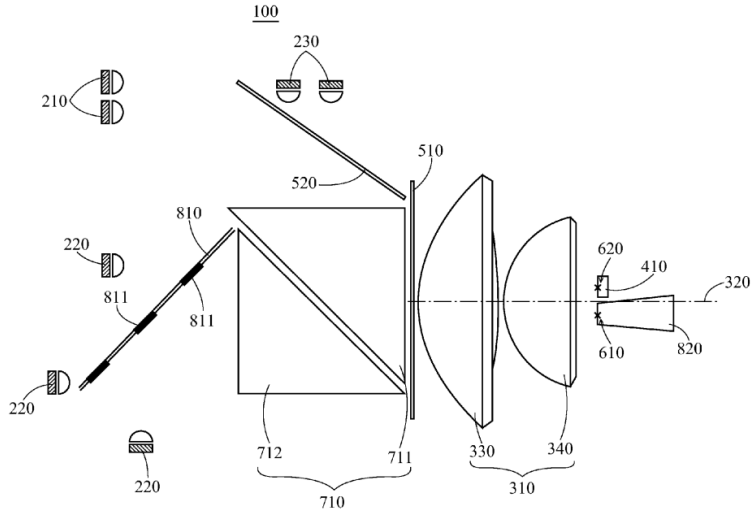


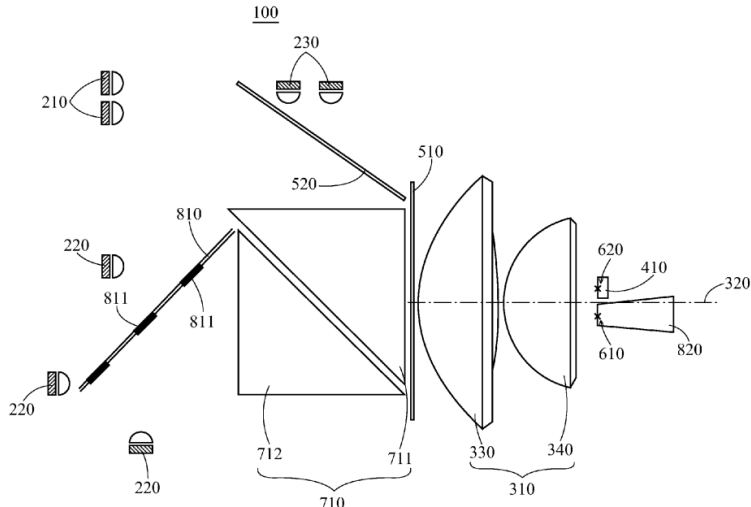
FIG. 3B

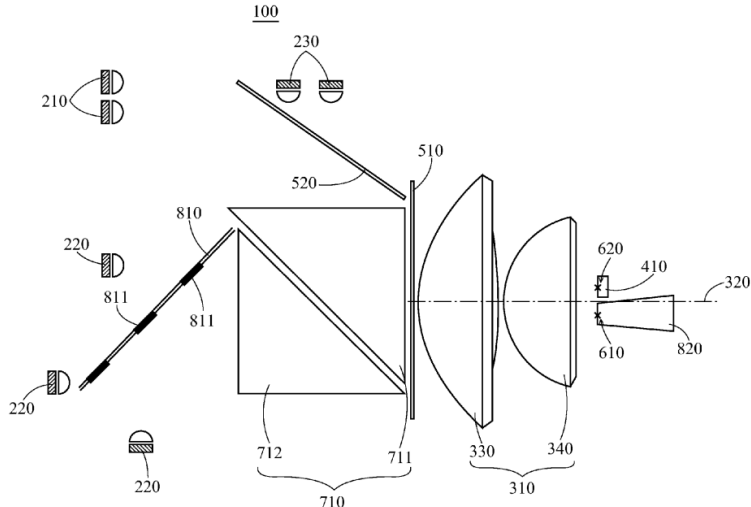
1f	wherein when the excitation light irradiation region is a center and an incident angle to the excitation light irradiation region of any excitation light of each of the excitation light is an elevation angle θ, $\theta \neq 0$¹⁵ is satisfied.	Huang combines with Kurosaki '998 to disclose that when 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. In Kurosaki '998, Fig. 5 discloses that excitation light enters obliquely to the luminescent plate 101 from the left side and right-hand side of the central axis of luminescent plate 101, respectively. Therefore, Fig. 5 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, $\theta \neq 0$.”
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¹⁵ The recitation “ $\theta \neq 0$ ” was amended to read “ $\theta \neq 0$ ” by Certificate of Correction.

		FIG. 5
	Claim 4	
4p	The light source device according to claim 1,	Huang discloses a light source device. Huang [Column 2/Line 38-45]: As shown in FIG. 2, an illumination system 100 according to an embodiment of the present invention is disposed in a projection device (not shown), and comprises a first light source 210, a second light source 220, an

		optical device 310, a wavelength transformer 410 and a first dichroic mirror 510. In reference to both FIGS. 3A and 3B, the first light source 210 emits a first light beam 211, while the second light source 220 emits a second light beam 221.  FIG. 2
4a	wherein the excitation light source is a solid light-emitting element.	Huang discloses the excitation light source is a solid light-emitting element. Huang [Column 4/Lines 47-50]: According to the above descriptions, the illumination system 100 according to an embodiment of the present invention utilizes solid light sources with both a high luminance and a long service life and operates in the following way:
	Claim 7	
7p	A projection type video display device, comprising:	Huang discloses a projection type video display device.

		Huang [Column 2/Lines 38-42]: As shown in FIG. 2, an illumination system 100 according to an embodiment of the present invention is disposed in a projection device (not shown), and comprises a first light source 210, a second light source 220, an optical device 310, a wavelength transformer 410 and a first dichroic mirror 510. Huang [Column 2/Lines 56-60]: A light homogenizing device 820 has an inlet disposed at the first focal point 610 to receive the first light source 211, and has an outlet connected to the projection device (not shown) to actually project an image onto a micro-display (not shown) of the projection device.  FIG. 2
7a	the light source device according to claim 1;	Huang discloses a light source device. Huang [Column 2/Line 38-45]: As shown in FIG. 2, an illumination system 100 according to an embodiment of the present invention is disposed in a projection device (not shown), and comprises a first light source 210, a second light source 220, an

		optical device 310, a wavelength transformer 410 and a first dichroic mirror 510. In reference to both FIGS. 3A and 3B, the first light source 210 emits a first light beam 211, while the second light source 220 emits a second light beam 221.  FIG. 2
7b	a video display element;	Huang discloses a video display element. Huang [Column 2/Lines 56-60]: A light homogenizing device 820 has an inlet disposed at the first focal point 610 to receive the first light source 211, and has an outlet connected to the projection device (not shown) to actually project an image onto <u>a micro-display (not shown) of the projection device.</u>
7c	an illumination optical system which has a plurality of optical elements applying light from the light source	Huang combines with Kurosaki '998 to disclose an illumination optical system which has a plurality of optical elements applying light from the light source device to the video display element.

device to the video display element;
and

Huang [Column 2/Line 38-45]: As shown in FIG. 2, **an illumination system 100** according to an embodiment of the present invention is disposed in a projection device (not shown), and comprises a first light source 210, **a second light source 220, an optical device 310, a wavelength transformer 410 and a first dichroic mirror 510**. In reference to both FIGS. 3A and 3B, the first light source 210 emits a first light beam 211, while the second light source 220 emits a second light beam 221.

Huang [Column 2/Lines 56-60]: A light **homogenizing device 820** has an inlet disposed at the first focal point 610 to receive the first light source 211, and has an outlet connected to the projection device (not shown) **to actually project an image onto a micro-display (not shown) of the projection device.**

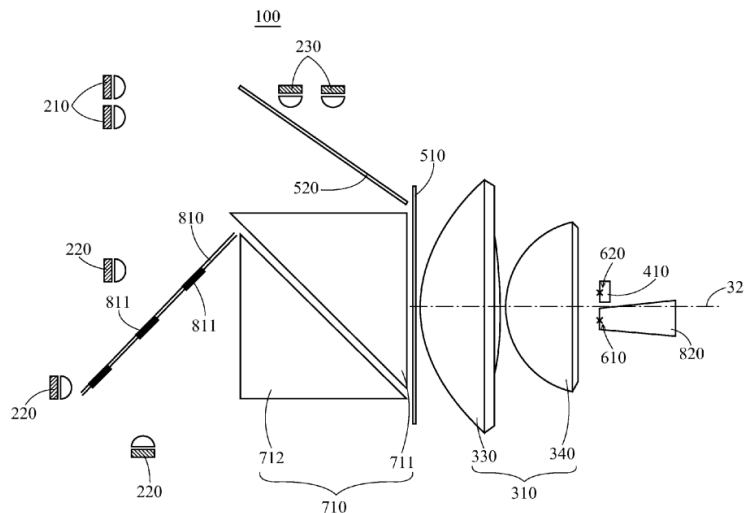


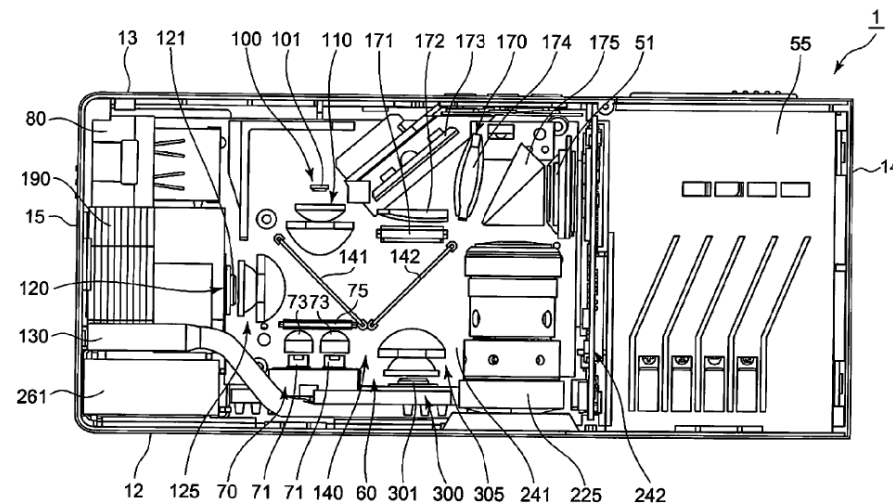
FIG. 2

Kurosaki '998 [0022]: A projector 1 according to the invention includes a light source unit 60, a display device 51, **a projection-side optical system, a light guiding optical system 170 for guiding light from the light source unit 60 to the display**

device 51 and for aligning a optical axis of a projection light which is generated in the display device 51 with a optical axis of the projection-side optical system, and a projector control unit for controlling the light source unit 60 and the display device 51. Kurosaki '998 [0038]: ...In addition, **the projector 1 includes the display device 51 such as a DMD...**

Kurosaki '998 [0050]: The light guiding optical system 170 includes **a microlens array 171, an optical axis alteration mirror 173** for altering an axis of light emitted from the light source unit 60 towards the display device 51, **a collective lens 172** which is interposed between the optical axis alteration mirror 173 and the microlens array 171, a collective lens 174 which is positioned on the optical axis which is altered by the **optical axis alteration mirror 173 and a prism 175.**

FIG. 3



7d	a projection lens which enlarges and projects an optical image formed by the video display element.	Huang or Kurosaki '998 discloses a projection lens which enlarges and projects an optical image formed by the video display element. In Huang, the uniform light beam homogenized by the homogenizing device can be enlarged by the projection system to produce larger and high-quality images. Huang [Column 2/Lines 56-60]: A light homogenizing device 820 has an inlet disposed at the first focal point 610 to receive the first light source 211, and has an outlet connected to <u>the projection device (not shown) to actually project an image onto a micro-display (not shown) of the projection device.</u> Huang [Column 4/Lines 40-46]: Opposite to the wavelength transformer 410 at the second focal point 620, a light homogenizing device 820 is disposed at the first focal point 610 to receive the <u>first light beam 211, the third light beam 222 and the fourth light beam 231, which are projected outwards after being combined.</u> The light homogenizing device 820 is preferably an integration rod or a light tunnel. Huang [Column 5/Lines 4-9]: (3) the fourth light beam 231 (a red light beam) emitted by the third light source 230 (a red laser light source) sequentially travels through the second dichroic mirror 520, the light coupling device 710, the first dichroic mirror 510 and the optical device 310, and <u>is focused onto the light homogenizing device 820 disposed at the first focal point 610.</u> Huang [Column 5/Lines 10-20]: Therefore, by means of the optical components (e.g., the optical device 310, the light coupling device 710 and the like) disposed within the illumination system 100, the first light beam 211 (the blue light beam), the third light beam 222 (the yellow light beam or the greenlight beam) and the fourth light beam 231 (the red light beam) are all focused to the first focal point 610 and <u>then combined into a homogenized white light beam by the uniform device 820 for projection outwards.</u> This reduces the number of the optical components to be used and the volume of the illumination system and improves the light combining efficiency of the illumination system 100.
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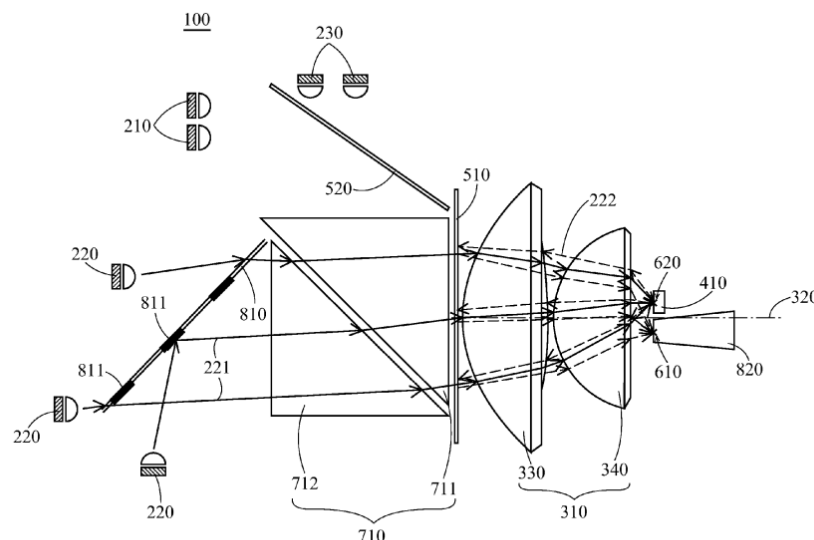


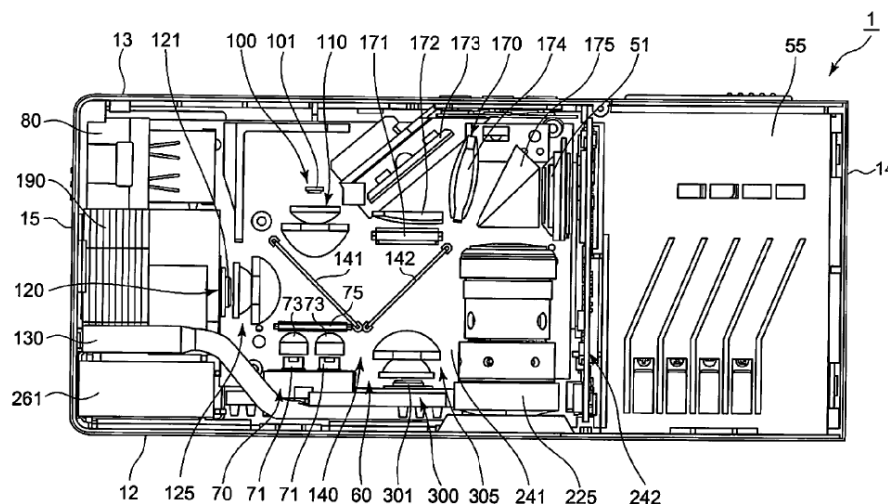
FIG. 3B

Kurosaki '998 [0033]: In this projector 1, pencils of light which are emitted from a light source unit 60, that is, pencils of light which are collected to a predetermined plane by a light source-side optical system 140 of the light source unit 60 are shone onto the display device 51 via a light guiding optical system 170 to thereby **form an optical image by reflected light reflected at the display device 51** which is controlled to be driven by the display drive unit 26. **The image so formed is projected on to a screen, not shown, for display via a projection-side optical system,** which will be described later. A movable lens group 235 of the projection-side optical system is driven by a lens motor 45 for zooming or focusing.

Kurosaki '998 [0052]: **The projection-side optical system incorporated in the lens barrel 225** includes a fixed lens group and a movable lens group and realizes a zooming

function and a focusing function by causing lenses of the movable lens group to operate in an optical direction by controlling the lens motor 45.

FIG. 3



Claim 9

9p A light source device, comprising:

Huang discloses a light source device.

Huang [Column 2/Lines 38-45]: As shown in FIG. 2, an illumination system 100 according to an embodiment of the present invention is disposed in a projection device (not shown), and comprises a first light source 210, **a second light source 220, an optical device 310, a wavelength transformer 410 and a first dichroic mirror 510**. In reference to both FIGS. 3A and 3B, the first light source 210 emits a first light beam 211, while the second light source 220 emits a second light beam 221.

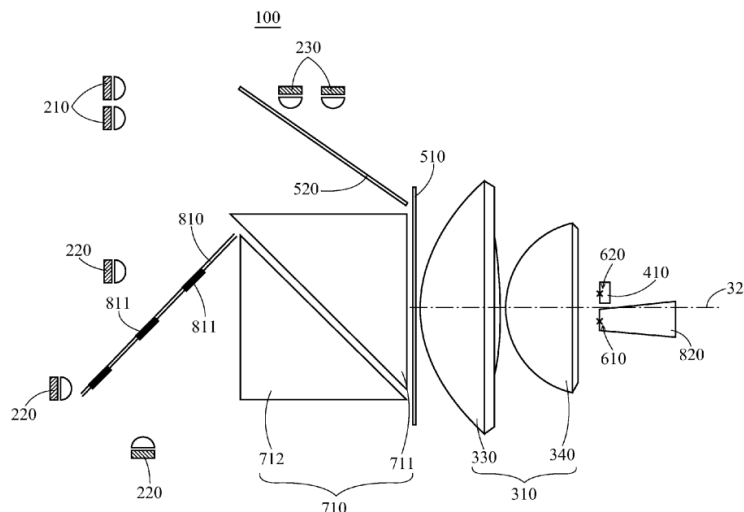


FIG. 2

9a an excitation light source which emit excitation light;

Huang discloses an excitation light source which emit excitation light.

Huang [Column 2/Lines 38-45]: As shown in FIG. 2, an illumination system 100 according to an embodiment of the present invention is disposed in a projection device (not shown), and comprises a first light source 210, **a second light source 220**, an optical device 310, a wavelength transformer 410 and a first dichroic mirror 510. In reference to both FIGS. 3A and 3B, the first light source 210 emits a first light beam 211, **while the second light source 220 emits a second light beam 221.**

Huang [Column 4/Lines 16-19]: ...the second light source 220 comprises a plurality of secondary light sources for emitting a plurality of secondary light beams (not shown) respectively.

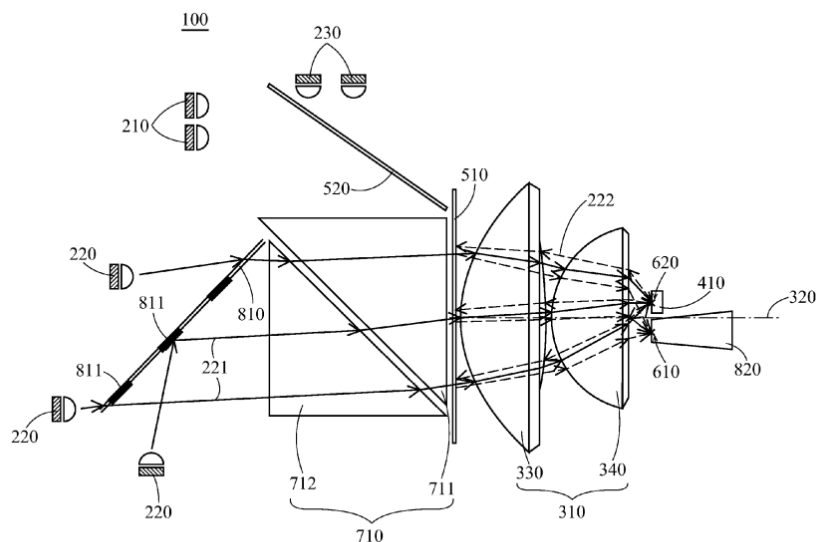


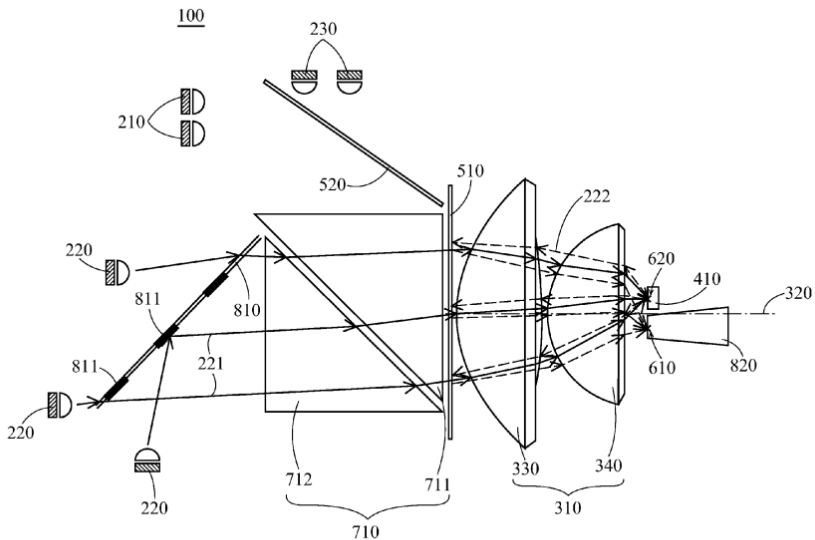
FIG. 3B

9b a phosphor which changes the excitation light to fluorescent light;

Huang discloses a phosphor, *e.g.* wavelength transformer, which changes the excitation light to fluorescent light.

Huang [Column 2/Lines 38-45]: As shown in FIG. 2, an illumination system 100 according to an embodiment of the present invention is disposed in a projection device (not shown), and comprises a first light source 210, a second light source 220, an optical device 310, **a wavelength transformer 410** and a first dichroic mirror 510. In reference to both FIGS. 3A and 3B, the first light source 210 emits a first light beam 211, while the second light source 220 emits a second light beam 221.

Huang [Column 2/Lines 61-64]: The wavelength transformer 410 is disposed at the second focal point 620, and receives and transforms the second light beam 221 emitted by the second light source 220 into a third light beam 222.

		Huang [Column 4/Lines 36-38]: <u>The wavelength transformer 410 may be a yellow or green phosphor, and correspondingly, the third light beam 222 is a yellow or green light beam.</u>  FIG. 3B
9c	a dichroic mirror which transmits the excitation light and reflects the fluorescent light; and	Huang discloses a dichroic mirror which transmits the excitation light and reflects the fluorescent light. Huang [Column 2/Lines 38-45]: As shown in FIG. 2, an illumination system 100 according to an embodiment of the present invention is disposed in a projection device (not shown), and comprises a first light source 210, a second light source 220, an optical device 310, a wavelength transformer 410 and <u>a first dichroic mirror 510</u>. In reference to both FIGS. 3A and 3B, the first light source 210 emits a first light beam 211, while the second light source 220 emits a second light beam 221.

Huang [Column 2/Lines 61-67 and Column 3/Lines 1-10]: The wavelength transformer 410 is disposed at the second focal point 620, and receives and transforms the second light beam 221 emitted by the second light source 220 into a third light beam 222. **The first dichroic mirror 510, which is disposed between the first and the second light sources 210, 220 and the optical device 310, is adapted to allow the first light beam 211 and the second light beam 221 to travel therethrough and reflect the third light beam 222.** In other words, as shown in FIG. 3B, when the second light beam 221, emitted by the second light source 220, is focused by the optical device 310 onto the wavelength transformer 410 that is disposed at the second focal point 620, the second light beam 221 is transformed into the third light beam 222. Then, **the third light beam 222 is emitted from the second focal point 620 to pass through the optical device 310, and is then reflected by the first dichroic mirror 510 to the optical device 310 to be focused onto the first focal point 610.**

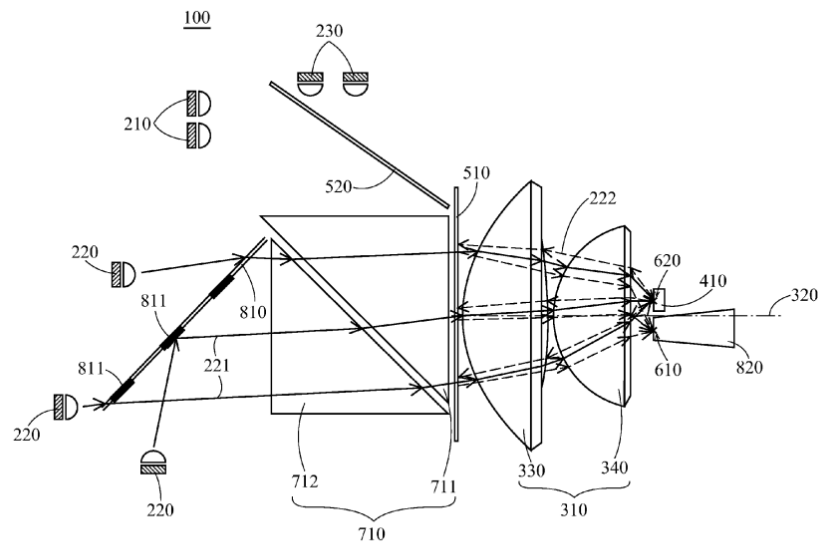


FIG. 3B

9d	a condensing lens which condenses the excitation light transmitted through the dichroic mirror in an excitation light irradiation region on the phosphor,	Huang discloses a condensing lens, <i>e.g.</i>, an optical device, which condenses the excitation light transmitted through the dichroic mirror in an excitation light irradiation region on the phosphor. In Huang, the optical device 310 including a condensing lens 330 or 340 condenses the second light beam 221 at the second focal point 620 that is an excitation light irradiation region on the wavelength transformer, <i>e.g.</i> phosphor. Huang [Column 2/Lines 61-67 and Column 3/Lines 1-10]: The wavelength transformer 410 is disposed at the second focal point 620, and receives and transforms the second light beam 221 emitted by the second light source 220 into a third light beam 222. The first dichroic mirror 510, which is disposed between the first and the second light sources 210, 220 and the optical device 310, is adapted to allow the first light beam 211 and the second light beam 221 to travel therethrough and reflect the third light beam 222. In other words, as shown in FIG. 3B, when <u>the second light beam 221, emitted by the second light source 220, is focused by the optical device 310 onto the wavelength transformer 410 that is disposed at the second focal point 620, the second light beam 221 is transformed into the third light beam 222.</u> Then, the third light beam 222 is emitted from the second focal point 620 to pass through the optical device 310, and is then reflected by the first dichroic mirror 510 to the optical device 310 to be focused onto the first focal point 610.
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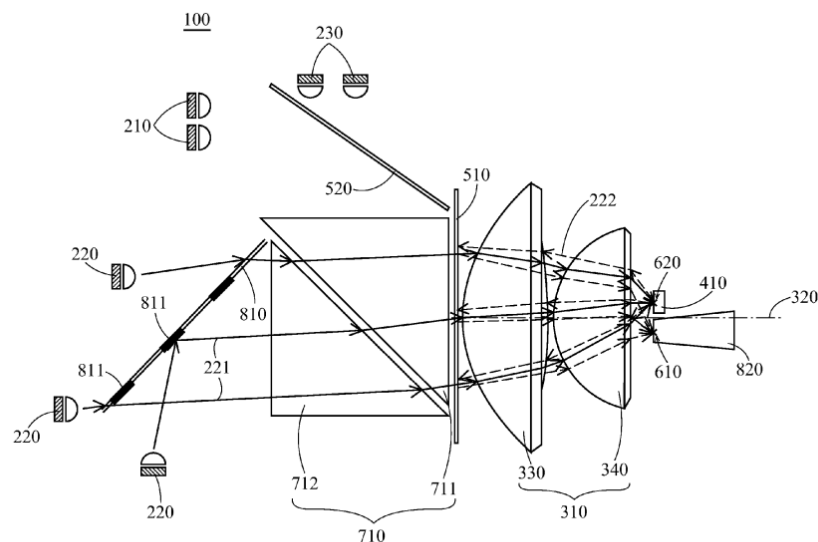


FIG. 3B

9e 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

Huang discloses that 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.

In Huang, each of the bottom two light sources 220 enters asymmetrically with respect to one another and the center of the condensing lens, as shown in the figure below. Due to the asymmetrical arrangement of the excitation light sources, the unconverted excitation light is prevented from entering the excitation light source.

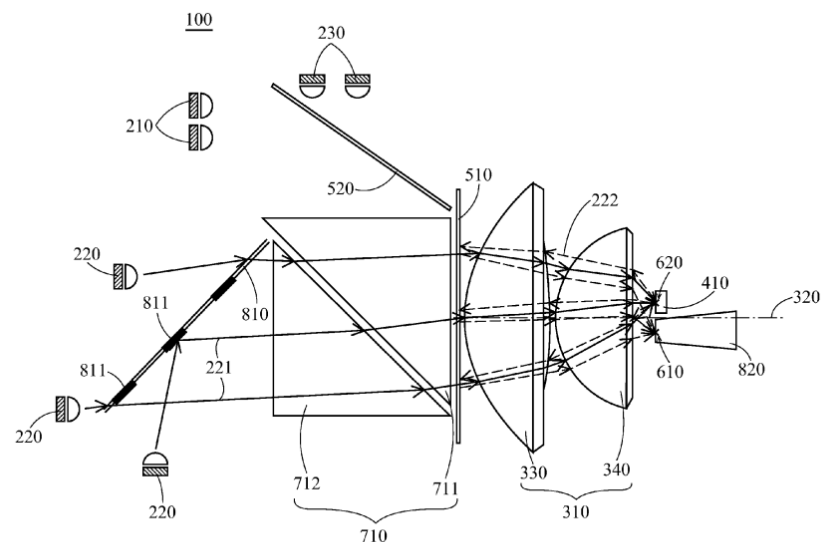
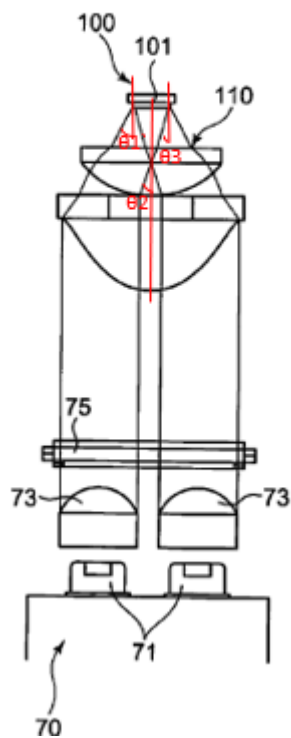


FIG. 3B

9f	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, $\theta \neq 0$¹⁶ is satisfied.	Huang combines with Kurosaki '998 to discloses 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. In Kurosaki '998, Fig. 5 discloses that excitation light enters obliquely to the luminescent plate 101 from the left side and right-hand side of the central axis of luminescent plate 101, respectively. Therefore, Fig. 5 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, $\theta \neq 0$.”
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¹⁶ The recitation “ $\theta \neq 0$ ” was amended to read “ $\theta \neq 0$ ” by Certificate of Correction.

FIG. 5



Ground 8: Kurosaki '998 [US20110234998A1], Abu-Ageel [US20090308852A1] – claim chart for claims 9 as invalidated by Kurosaki '998 and Abu-Ageel

Publication Number	Country of Origin	Filing Date	Date of Publication
US20110234998A1 (“Kurosaki '998”)	United States of America	03/24/2011	09/29/2011
US20110044046A1 (“Abu-Ageel”)	United States of America	04/21/2010	02/24/2011

	Claims of U.S. Patent No. 9,322,530	Citations and Analysis
	Claim 9	
9p	A light source device, comprising:	Kurosaki '998 discloses a light source device. Kurosaki '998 [0023]: <u>The light source unit 60 includes an excitation light shining device 70 which includes in turn an excitation light source 71</u> and a microlens array 75, <u>a luminescent plate 101 which includes a green luminescent material layer which receives light emitted from the excitation light source 71 to emit light in a green wavelength band,</u> ... Kurosaki '998 [0044]: <u>The light source-side optical system 140</u> includes a collective lens 110 which collects light emitted from the excitation shining unit 70 and luminescent light emitted from the luminescent plate 101, a collective lens 125 which collects light emitted from the red light source 121, a collective lens 305 which collects light emitted from the <u>blue light source 301, a first dichroic mirror 141 which transmits excitation light from the excitation light shining unit 70 and light from the red light source unit 120 and reflects luminescent light emitted from the luminescent plate 101.</u>

		FIG. 3
9a	an excitation light source which emits excitation light;	Kurosaki '998 discloses an excitation light source which emits excitation light. Kurosaki '998 [0041]: The excitation light shining unit 70 includes two excitation light sources 71.... <u>This excitation light source 71 is a blue laser emitter and emits a laser beam</u> in a blue wavelength band towards the luminescent plate 101. Kurosaki '998 [0042]: Then, the luminescent plate 101 generates green luminescent light by <u>use of a laser beam emitted from the excitation light source 71 as excitation light</u> and emits this green luminescent light from the same plane as the incident plane of the excitation light.

FIG. 3

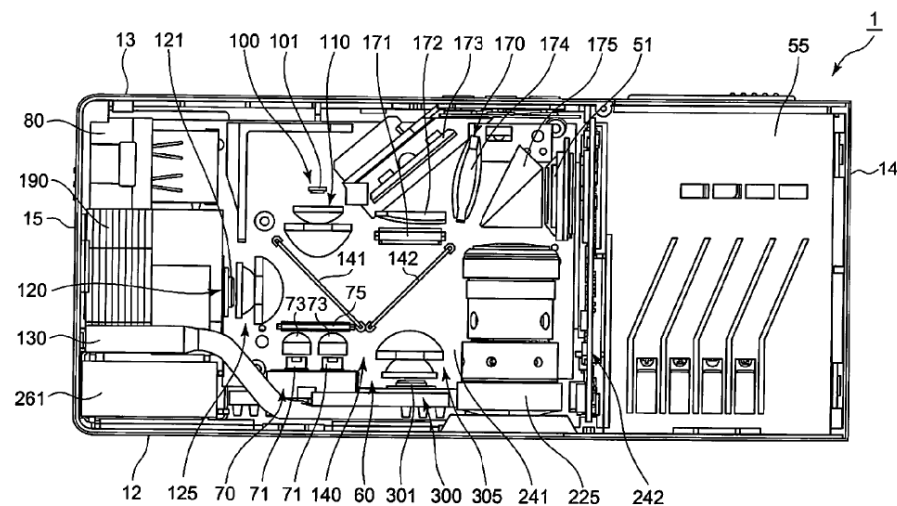
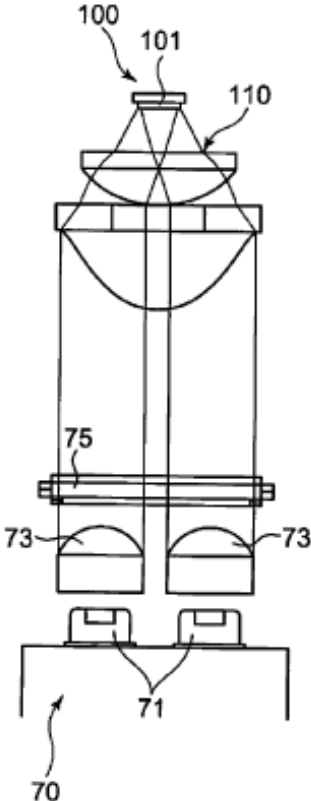


		FIG. 5 
9b	a phosphor which changes the excitation light to fluorescent light;	Kurosaki '998 discloses a phosphor, <i>e.g.</i> , luminescent plate, which changes the excitation light to fluorescent light.

Kurosaki '998 [0041]: The excitation light shining unit 70 includes two excitation light sources 71.... This excitation light source 71 is a blue laser emitter and emits a laser beam in a blue wavelength band towards the **luminescent plate 101**.
Kurosaki '998 [0042]: Then, **the luminescent plate 101 generates green luminescent light** by use of a laser beam emitted from the excitation light source 71 as excitation light and emits this green luminescent light from the same plane as the incident plane of the excitation light.

FIG. 3

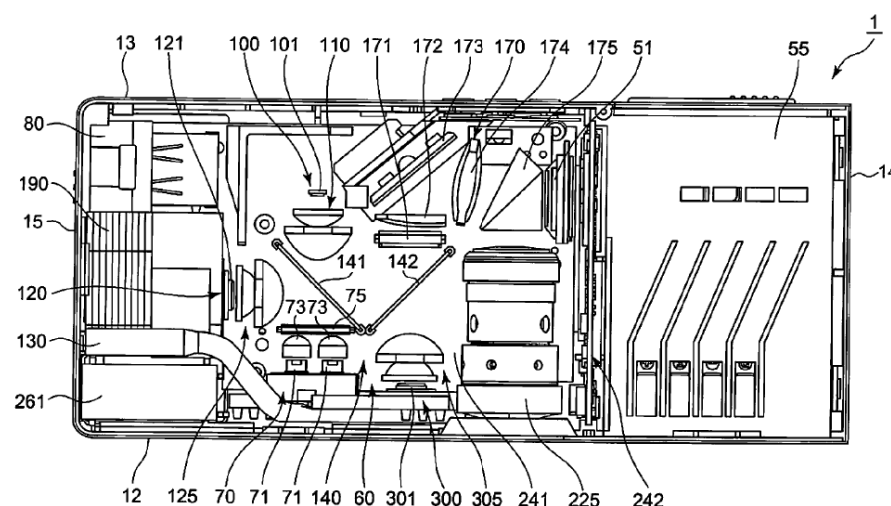


		FIG. 5
9c	a dichroic mirror which transmits the excitation light and reflects the fluorescent light; and	Kurosaki '998 discloses a dichroic mirror which transmits the excitation light and reflects the fluorescent light.

		Kurosaki '998 [0044]: ..., a first dichroic mirror 141 which transmits excitation light from the excitation light shining unit 70 and light from the red light source unit 120 and reflects luminescent light emitted from the luminescent plate 101, ... FIG. 3
9d	a condensing lens which condenses the excitation light transmitted through the dichroic mirror in an excitation light irradiation region on the phosphor,	Kurosaki '998 discloses a condensing lens, <i>e.g.</i>, collective lens, which condenses the excitation light transmitted through the dichroic mirror in an excitation light irradiation region on the phosphor, <i>e.g.</i>, luminescent plate. Kurosaki '998 [0025]: In the light source unit 60, a collective lens 110 is disposed in proximity to the luminescent plate 101, and pencils of light that have passed through the micro convex lenses 75 are shone onto the luminescent material layer by the collective lens 110 so that center positions thereof are superposed one on another on the luminescent material layer.

FIG. 3

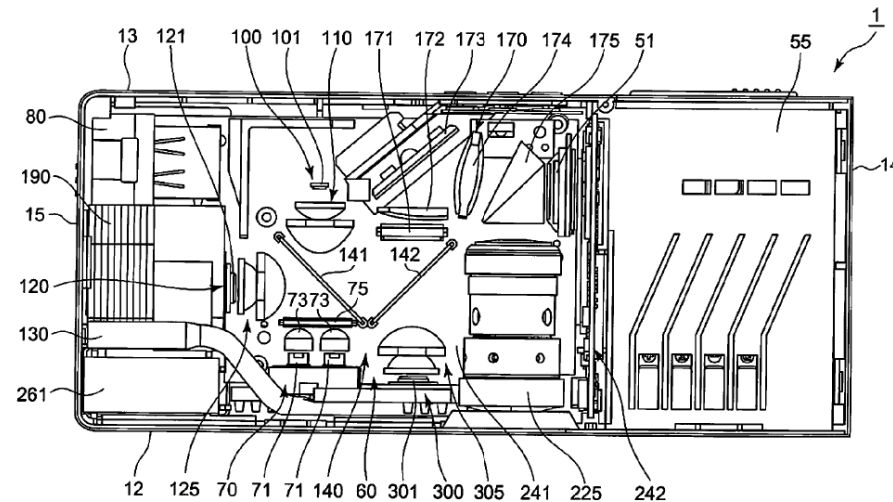
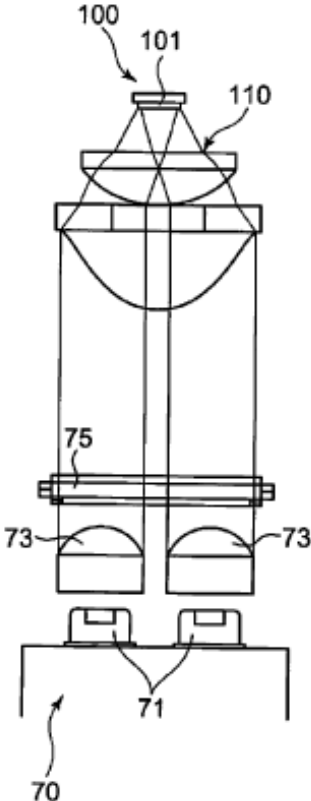


		FIG. 5 
9e	wherein the excitation light sources are arranged so that when excitation light emitted from the excitation light source enters the excitation light irradiation region and is reflected	Kurosaki '998 combines with Abu-Ageel to disclose that the excitation light sources are arranged so that 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.

without being converted into fluorescent light, the unconverted excitation light is prevented from entering the excitation light source,	Abu-Ageel [0002]: The disclosure relates <u>generally to light sources, illumination systems, projection systems</u> and backlights. More particularly, it relates to high brightness light sources, <u>illumination systems, projection systems</u> and backlights that utilize violet lasers and wavelength conversion materials such as phosphor. Abu-Ageel [0082]: ... Part of the light impinging on the wavelength conversion layer 413 gets absorbed and converted into light with a new wavelength band (i.e., converted light) and <u>the remainder gets diffused by the wavelength conversion layer 413 but does not get converted.</u> Both the source light and converted light get collimated by the light envelope 420 and <u>impinge on the entrance aperture of optical element 417.... Optical element 417 reflects a substantial amount of the source light that impinges on it toward the wavelength conversion layer 413, thus, providing another chance for source light to be converted by the wavelength conversion layer 413.</u> Abu-Ageel [0087]: FIG. 3C shows a cross-sectional view of another exemplary illumination assembly 6700. Illumination assembly 6700 consists of a violet laser 410, hollow light envelope (or guide) 620 with an aperture 620 <i>a</i>, <u>a wavelength conversion layer 613</u>, an optional low-refractive index layer 623 located between the wavelength conversion layer 613 and <u>the reflective coating 614, ... Optical element 625 is preferably a coating that reflects non-converted light (i.e., light received from source 411 that was not absorbed or converted within light envelope 620) back to light envelope 620 and allows the converted light to pass out of the envelope 620.</u> Alternatively, optical element 625 can be a reflective polarizer, dichroic mirror...
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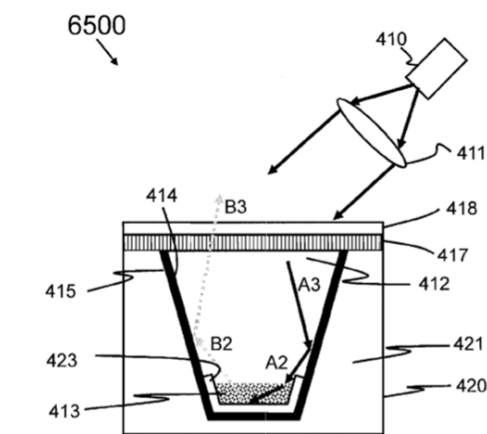


FIG. 3A

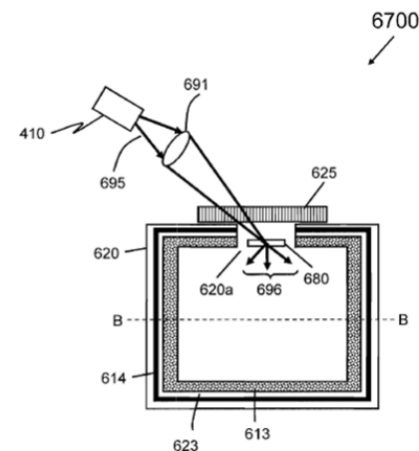


FIG. 3C

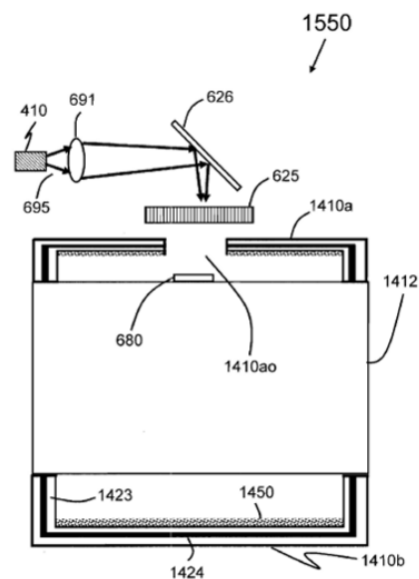
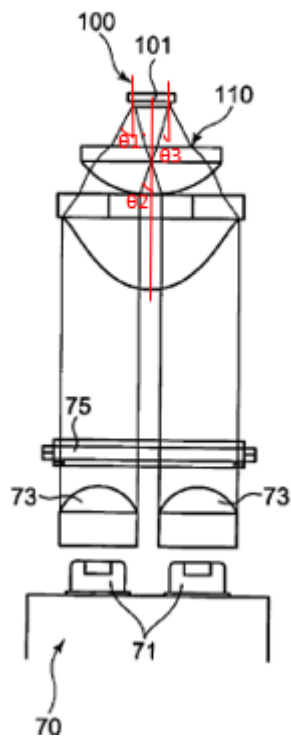


FIG. 4B

9f	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 , $\theta \neq 0$ ¹⁷ is satisfied.	Kurosaki '998 discloses that 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. In Kurosaki '998, Fig. 5 discloses that excitation light enters obliquely to the luminescent plate 101 from the left side and right-hand side of the central axis of luminescent plate 101, respectively. Therefore, Fig. 5 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, $\theta \neq 0$.”
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¹⁷ The recitation “ $\theta \neq 0$ ” was amended to read “ $\theta \neq 0$ ” in the Certificate of Correction.

FIG. 5



Ground 9: Kurosaki '998 [US20110234998A1], Kitano '349 [US20110292349A1] – claim chart for claims 9 as invalidated by Kurosaki '998 and Kitano '349

Publication Number	Country of Origin	Filing Date	Date of Publication
US20110234998A1 (“Kurosaki '998”)	United States of America	03/24/2011	09/29/2011
US20110292349A1 (“Kitano '349”)	United States of America	05/27/2011	12/01/2011

	Claims of U.S. Patent No. 9,322,530	Citations and Analysis
	Claim 9	
9p	A light source device, comprising:	Kurosaki '998 discloses a light source device. Kurosaki '998 [0023]: <u>The light source unit 60 includes an excitation light shining device 70 which includes in turn an excitation light source 71</u> and a microlens array 75, <u>a luminescent plate 101 which includes a green luminescent material layer which receives light emitted from the excitation light source 71 to emit light in a green wavelength band,</u> ... Kurosaki '998 [0044]: <u>The light source-side optical system 140</u> includes a collective lens 110 which collects light emitted from the excitation shining unit 70 and luminescent light emitted from the luminescent plate 101, a collective lens 125 which collects light emitted from the red light source 121, a collective lens 305 which collects light emitted from the <u>blue light source 301, a first dichroic mirror 141 which transmits excitation light from the excitation light shining unit 70 and light from the red light source unit 120 and reflects luminescent light emitted from the luminescent plate 101</u>

		FIG. 3
9a	an excitation light source which emits excitation light;	Kurosaki '998 discloses an excitation light source which emits excitation light. Kurosaki '998 [0041]: The excitation light shining unit 70 includes two excitation light sources 71.... <u>This excitation light source 71 is a blue laser emitter and emits a laser beam</u> in a blue wavelength band towards the luminescent plate 101. Kurosaki '998 [0042]: Then, the luminescent plate 101 generates green luminescent light by <u>use of a laser beam emitted from the excitation light source 71 as excitation light</u> and emits this green luminescent light from the same plane as the incident plane of the excitation light.

FIG. 3

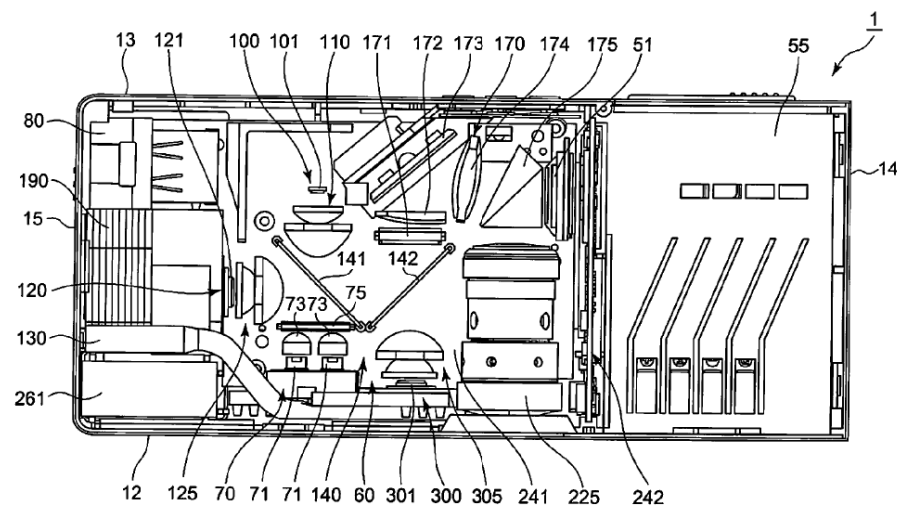


		FIG. 5 100 101 110 75 73 73 71 70
9b	a phosphor which changes the excitation light to fluorescent light;	Kurosaki '998 discloses a phosphor, <i>e.g.</i> , luminescent plate, which changes the excitation light to fluorescent light.

Kurosaki '998 [0041]: The excitation light shining unit 70 includes two excitation light sources 71.... This excitation light source 71 is a blue laser emitter and emits a laser beam in a blue wavelength band towards the **luminescent plate 101**.
Kurosaki '998 [0042]: Then, **the luminescent plate 101 generates green luminescent light** by use of a laser beam emitted from the excitation light source 71 as excitation light and emits this green luminescent light from the same plane as the incident plane of the excitation light.

FIG. 3

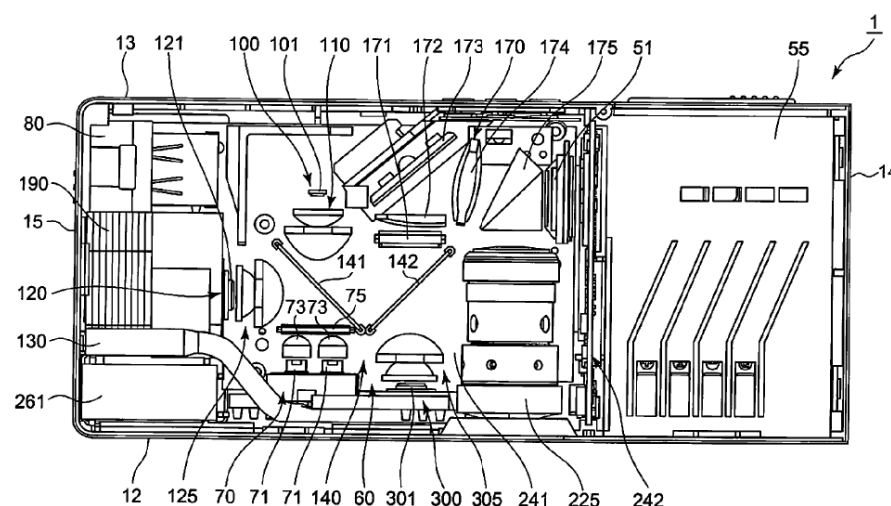


		FIG. 5
9c	a dichroic mirror which transmits the excitation light and reflects the fluorescent light; and	Kurosaki '998 discloses a dichroic mirror which transmits the excitation light and reflects the fluorescent light.

		Kurosaki '998 [0044]: ..., a first dichroic mirror 141 which transmits excitation light from the excitation light shining unit 70 and light from the red light source unit 120 and reflects luminescent light emitted from the luminescent plate 101, ... FIG. 3
9d	a condensing lens which condenses the excitation light transmitted through the dichroic mirror in an excitation light irradiation region on the phosphor,	Kurosaki '998 discloses a condensing lens, <i>e.g.</i>, collective lens, which condenses the excitation light transmitted through the dichroic mirror in an excitation light irradiation region on the phosphor, <i>e.g.</i>, luminescent plate. Kurosaki '998 [0025]: In the light source unit 60, a collective lens 110 is disposed in proximity to the luminescent plate 101, and pencils of light that have passed through the micro convex lenses 75 are shone onto the luminescent material layer by the collective lens 110 so that center positions thereof are superposed one on another on the luminescent material layer.

Kurosaki '998 [0045]: **The collective lenses 110, 125, 305** are each configured as a single collective lens by combining a plurality of lenses. In addition, the first dichroic mirror 141 is disposed in a position where the optical axis of the excitation light shining unit 70 and the optical axis of the red light source unit 120 intersect each other. Further, the second dichroic mirror 142 is disposed in a position where the optical axis of the red light source unit 120 and the optical axis of the blue light source unit 300 intersect each other.

FIG. 3

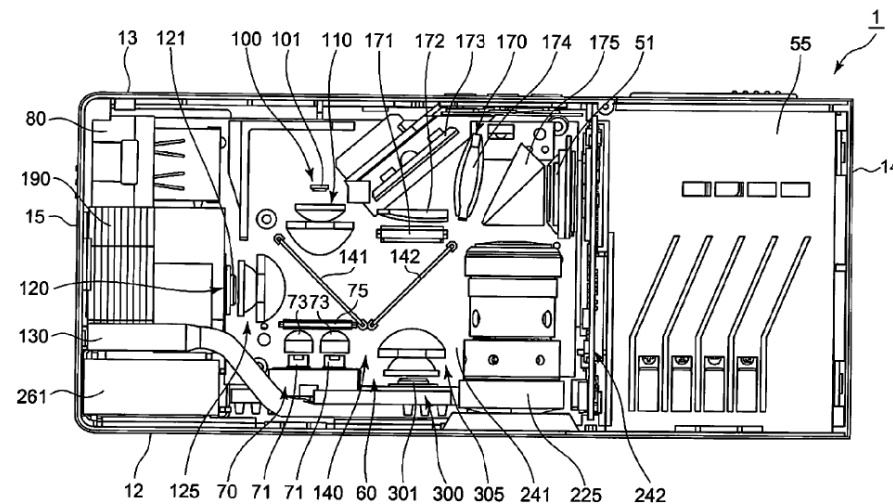
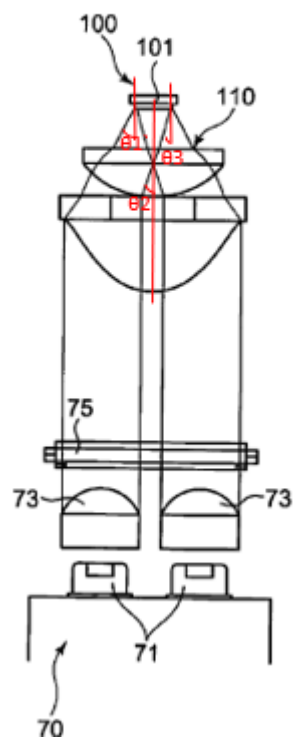


		FIG. 5
9e	wherein the excitation light sources are arranged so that when excitation light emitted from the excitation light source enters the excitation light irradiation region and is reflected	Kurosaki '998 combines with Kitano '349 to disclose that the excitation light sources are arranged so that 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.

	without being converted into fluorescent light, the unconverted excitation light is prevented from entering the excitation light source,	Kitano '349 [0048]: <u>Not all of the excitation light is wavelength-converted into green fluorescence at the fluorescent material 201, but there exists unconverted blue light.</u> Of the blue excitation light incident on the fluorescent material 201, the unconverted blue light passes through the condenser lenses 207 and 208 again to be substantially collimated. The unconverted blue light is scattered light scattered by the fluorescent material 201, and there exists light having polarization direction different from that at the time when the light was incident on the fluorescent material. Therefore, among components of <u>the unconverted blue light that are incident on the dichroic mirror 213 again, S polarization components are reflected by the dichroic mirror 213, which components will be first blue light.</u>
9f	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 , $\theta \neq 0$ ¹⁸ is satisfied.	Kurosaki '998 discloses that 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. In Kurosaki '998, Fig. 5 disclosed that excitation light enters obliquely to the luminescent plate 101 from the left side and right-hand side of the central axis of luminescent plate 101, respectively. Therefore, Fig. 5 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 , $\theta \neq 0$.”

¹⁸ The recitation “ $\theta \neq 0$ ” was amended to read “ $\theta \neq 0$ ” by Certificate of Correction.

FIG. 5



Ground 10: Kurosaki '998 [US20110234998A1], Alpay [US20090308852A1] – claim chart for claims 9 as invalidated by Kurosaki '998 and Alpay.

Publication Number	Country of Origin	Filing Date	Date of Publication
US20110234998A1 (“Kurosaki '998”)	United States of America	03/24/2011	09/29/2011
US20090308852A1 (“Alpay”)	United States of America	09/12/2008	12/17/2009

	Claims of U.S. Patent No. 9,322,530	Citations and Analysis
	Claim 9	
9p	A light source device, comprising:	Kurosaki '998 discloses a light source device. Kurosaki '998 [0023]: <u>The light source unit 60 includes an excitation light shining device 70 which includes in turn an excitation light source 71</u> and a microlens array 75, <u>a luminescent plate 101 which includes a green luminescent material layer which receives light emitted from the excitation light source 71 to emit light in a green wavelength band</u>, ... Kurosaki '998 [0044]: <u>The light source-side optical system 140</u> includes a collective lens 110 which collects light emitted from the excitation shining unit 70 and luminescent light emitted from the luminescent plate 101, a collective lens 125 which collects light emitted from the red light source 121, a collective lens 305 which collects light emitted from the <u>blue light source 301, a first dichroic mirror 141 which transmits excitation light from the excitation light shining unit 70 and light from the red light source unit 120 and reflects luminescent light emitted from the luminescent plate 101</u>

		FIG. 3
9a	an excitation light source which emits excitation light;	Kurosaki '998 discloses an excitation light source which emits excitation light. Kurosaki '998 [0041]: The excitation light shining unit 70 includes two excitation light sources 71.... <u>This excitation light source 71 is a blue laser emitter and emits a laser beam</u> in a blue wavelength band towards the luminescent plate 101. Kurosaki '998 [0042]: Then, the luminescent plate 101 generates green luminescent light by <u>use of a laser beam emitted from the excitation light source 71 as excitation light</u> and emits this green luminescent light from the same plane as the incident plane of the excitation light.

FIG. 3

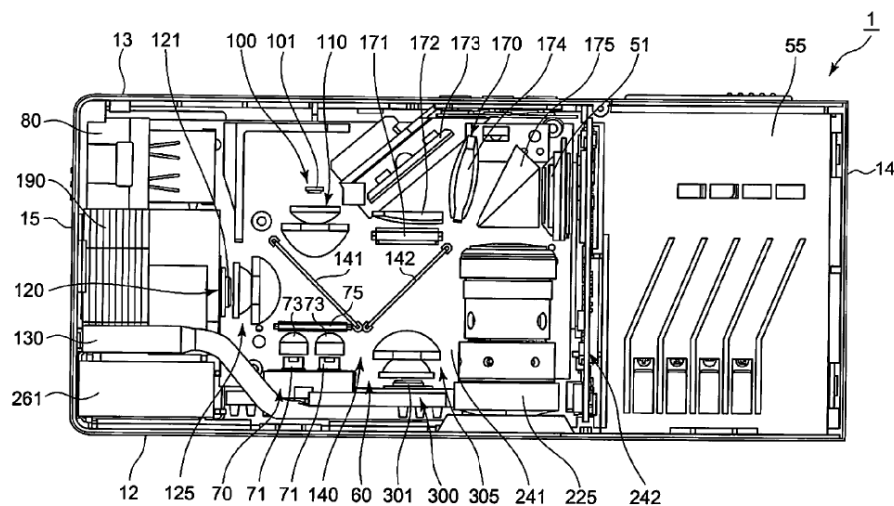


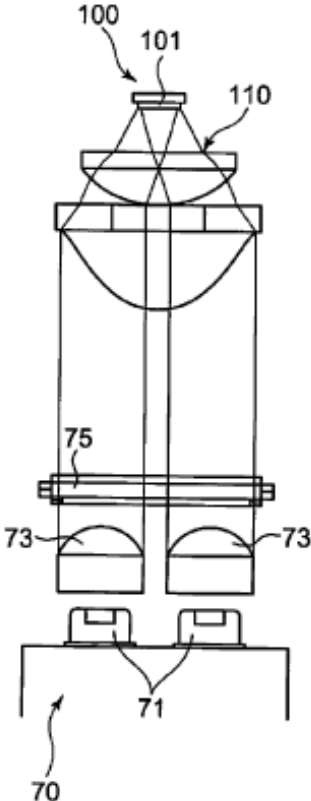
		FIG. 5 
9b	a phosphor which changes the excitation light to fluorescent light;	Kurosaki '998 discloses a phosphor, <i>e.g.</i> , luminescent plate, which changes the excitation light to fluorescent light.

FIG. 3

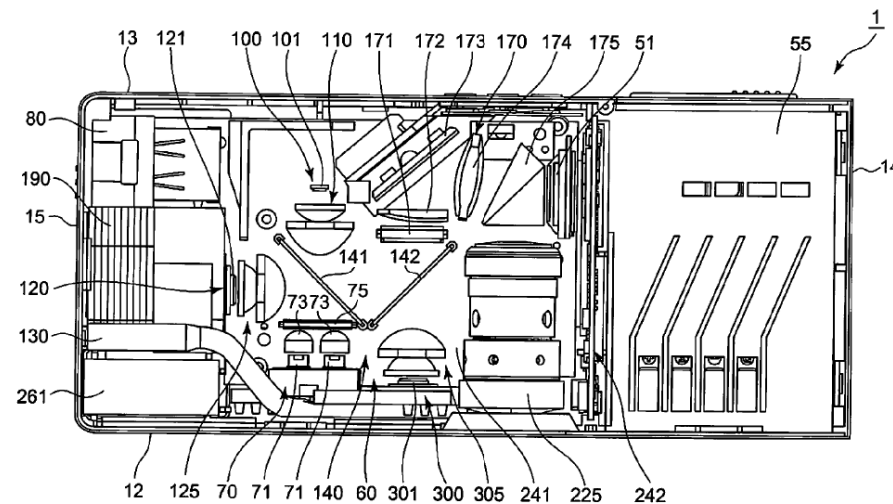
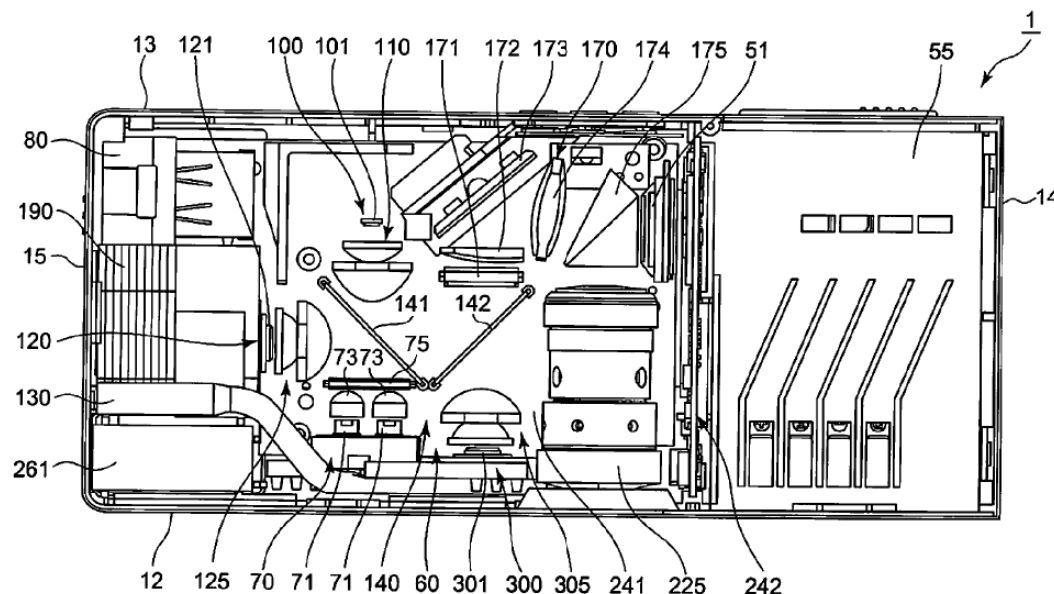


		FIG. 5
9c	a dichroic mirror which transmits the excitation light and reflects the fluorescent light; and	Kurosaki '998 discloses a dichroic mirror which transmits the excitation light and reflects the fluorescent light.

Kurosaki '998 [0044]: ..., a first **dichroic mirror 141 which transmits excitation light from the excitation light shining unit 70** and light from the red light source unit 120 **and reflects luminescent light emitted from the luminescent plate 101**, ...

FIG. 3



9d a condensing lens which condenses the excitation light transmitted through the dichroic mirror in an excitation light irradiation region on the phosphor,

Kurosaki '998 discloses a condensing lens, *e.g.*, collective lens, which condenses the excitation light transmitted through the dichroic mirror in an excitation light irradiation region on the phosphor, *e.g.*, luminescent plate.

Kurosaki '998 [0025]: In the light source unit 60, a collective lens 110 is disposed in proximity to the luminescent plate 101, and pencils of **light** that have passed through the micro convex lenses 75 **are shone onto the luminescent material layer by the collective lens 110** so that center positions thereof are superposed one on another on the luminescent material layer.

FIG. 3

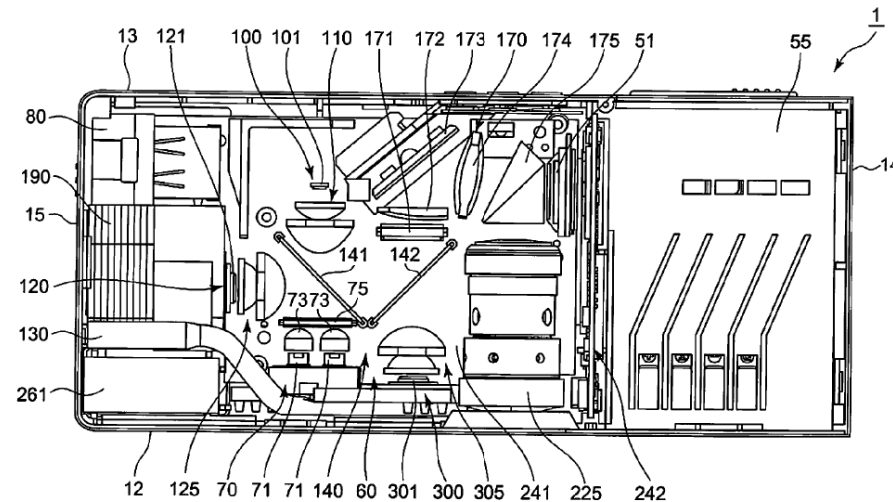
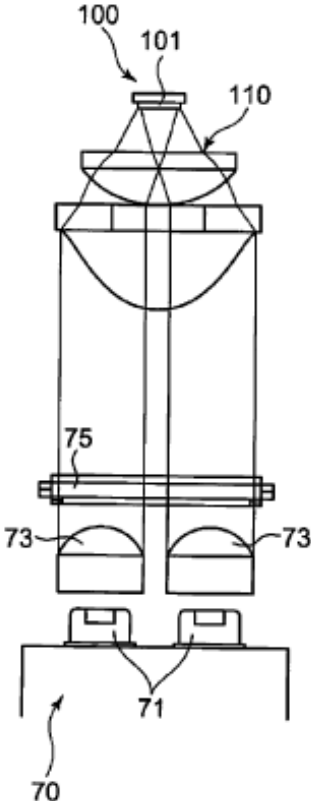
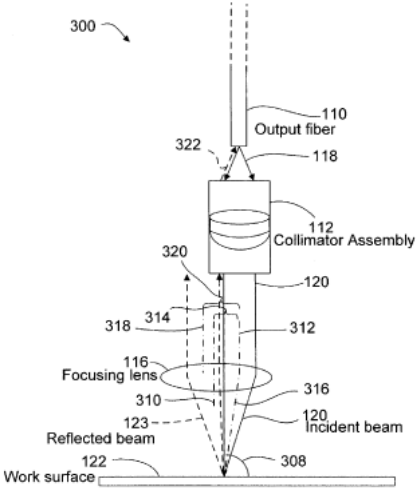


		FIG. 5 
9e	wherein the excitation light sources are arranged so that when excitation light emitted from the excitation light source enters the excitation light irradiation region and is reflected	Kurosaki '998 combines with Alpay to disclose that the excitation light sources are arranged so that when 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.

without being converted into fluorescent light, the unconverted excitation light is prevented from entering the excitation light source,	In Alpay, due to the asymmetrical arrangement of the excitation light sources, the unconverted excitation light is prevented from entering the excitation light source. Alpay [0003]: Generally, certain lasers may be sensitive to optical feedback such as a laser beam reflected back to the laser from a work surface. For example, fiber lasers are typically very sensitive to back-reflections from a work surface. <u>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.</u> Further, a seed laser may be damaged in a high-power master oscillator fiber amplifier device by reflected light that is amplified on its way back to the seed laser. In many laser processing systems, such as laser micromachining systems, it is therefore desirable to prevent such back-reflections from finding a path back into the output fiber. Alpay [0007]: <u>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.</u> For example, FIG. 2 is a block diagram of another typical fiber laser processing system 200 having a tilted beam delivery subsystem (e.g., the output fiber 110, the collimator assembly 112, and the focusing lens 116) <u>such that the path of the incident laser beam 120 is non-perpendicular to the work surface 122.</u> Alpay [0027]: The incident laser beam 120 propagates along a first axis of propagation 312 from the collimator assembly 112 to the focusing lens 116. The first axis of propagation 312 is substantially parallel to the primary axis 310 of the focusing lens 116. There is, however, an 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). <u>Rather, the incident laser beam 120 hits the focusing lens 116 at an offset 314 from the center of the lens 116.</u> In one embodiment, the amount of offset 314 is greater than or equal to approximately one-half the diameter of the collimated incident laser beam 120. As
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	discussed below, such an amount of offset 314 reduces or prevents overlap between the reflected laser beam 123 and the incident laser beam 120. Alpay [0028]: The focusing lens 116 converges the incident laser beam 120 to a focused spot diameter on the work surface 122. <u>As a result of 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 310 of the focusing lens 116.</u> Thus, the 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. Alpay [0029]: As a consequence of using the offset 314 to tilt the incident laser beam 120, the path of the reflected laser beam 123 is angularly separated from the path of the incident laser beam 120. Thus, after returning through the focusing lens 116, the reflected laser beam 123 travels along a third axis of propagation 318 that is spatially separated from the first axis of propagation 312 of the incident laser beam 120. In certain embodiments, <u>an offset 320 between the first axis of propagation 312 corresponding to the incident laser beam 120 and the third axis of propagation 318 corresponding to the reflected laser beam 123 is configured 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.</u>
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		 FIG. 3
9f	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, $\theta \neq 0$¹⁹ is satisfied.	Kurosaki '998 discloses that 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. In Kurosaki '998, Fig. 5 disclosed that excitation light enters obliquely to the luminescent plate 101 from the left side and right-hand side of the central axis of luminescent plate 101, respectively. Therefore, Fig. 5 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, $\theta \neq 0$.”

¹⁹ The recitation “ $\theta \neq 0$ ” was amended to read “ $\theta \neq 0$ ” by Certificate of Correction.

FIG. 5

