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Smith et al.

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(54) **LASER-DRIVEN LIGHT SOURCE**

(56) **References Cited**

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patent is extended or adjusted under 35
U.S.C. 154(b) by 551 days.

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Related U.S. Application Data

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a continuation-in-part of application No. 11/395,523,
filed on Mar. 31, 2006, now Pat. No. 7,435,982.

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G01J 3/10 (2006.01)
G01J 1/34 (2006.01)
H01J 63/08 (2006.01)
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(52) **U.S. Cl.** **250/503.1**; 250/504 R; 250/365;
313/231.31; 315/111.21; 700/121; 700/166

(58) **Field of Classification Search** 250/503.1,
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700/121, 166

See application file for complete search history.

U.S. PATENT DOCUMENTS

4,646,215	A	2/1987	Levin et al.	362/296
6,288,780	B1	9/2001	Fairley et al.	356/237.1
6,788,404	B2	9/2004	Lange	356/237.2
7,050,149	B2*	5/2006	Owa et al.	355/30
7,427,167	B2*	9/2008	Holder et al.	385/92
7,429,818	B2*	9/2008	Chang et al.	313/231.31
2002/0021508	A1	2/2002	Ishihara	359/853
2003/0168982	A1	9/2003	Kim	313/634
2003/0231496	A1	12/2003	Sato et al.	362/268
2004/0026512	A1	2/2004	Otsubo	235/462.37
2004/0264512	A1	12/2004	Hartlove et al.	372/5
2005/0167618	A1	8/2005	Hoshino et al.	250/504

FOREIGN PATENT DOCUMENTS

JP 61-193358 8/1986

OTHER PUBLICATIONS

Wilbers et al., "The VUV Emissivity of a High-Pressure Cascade
Argon Arc from 125 to 200 nm," *J. Quant. Spectrosc. Radiat. Trans-*
fer, vol. 46, 1991, pp. 299-308.

Wilbers et al., "The Continuum Emission of an Arc Plasma," *J.*
Quant. Spectrosc. Radiat. Transfer, vol. 45, No. 1, 1991, pp. 1-10.

(Continued)

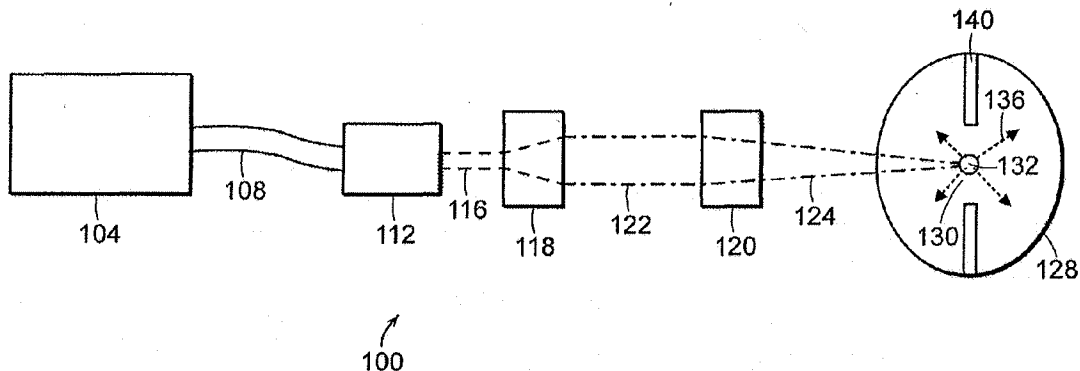
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(57) **ABSTRACT**

An apparatus for producing light includes a chamber and an
ignition source that ionizes a gas within the chamber. The
apparatus also includes at least one laser that provides energy
to the ionized gas within the chamber to produce a high
brightness light. The laser can provide a substantially con-
tinuous amount of energy to the ionized gas to generate a
substantially continuous high brightness light.

39 Claims, 17 Drawing Sheets



ASML 1315

OTHER PUBLICATIONS

- Beck, "Simple Pulse Generator for Pulsing Xenon Arcs with High Repetition Rate," *Rev. Sci. Instrum.*, vol. 45, No. 2, Feb. 1974, pp. 318-319.
- Raizer, "Optical Discharges," *Sov. Phys. Usp.* 23(11), Nov. 1980, pp. 789-806.
- Fiedorowicz et al., "X-Ray Emission from Laser-Irradiated Gas Puff Targets," *Appl. Phys. Lett.* 62 (22), May 31, 1993, pp. 2778-2780.
- Keefer et al., "Experimental Study of a Stationary Laser-Sustained Air Plasma," *Journal of Applied Physics*, vol. 46, No. 3, Mar. 1975, pp. 1080-1083.
- Jeng et al., "Theoretical Investigation of Laser-Sustained Argon Plasmas," *J. Appl. Phys.* 60 (7), Oct. 1, 1986, pp. 2272-2279.
- Franzen, "CW Gas Breakdown in Argon Using 10.6- μ m Laser Radiation," *Appl. Phys. Lett.*, vol. 21, No. 2, Jul. 15, 1972, pp. 62-64.
- Moody, "Maintenance of a Gas Breakdown in Argon Using 10.6- μ cw Radiation," *Journal of Applied Physics*, vol. 46, No. 6, Jun. 1975, pp. 2475-2482.
- Generalov et al., "Experimental Investigation of a Continuous Optical Discharge," *Soviet Physics JETP*, vol. 34, No. 4, Apr. 1972, pp. 763-769.
- Generalov et al., "Continuous Optical Discharge," *ZhETF Pis. Red.* 11, No. 9, May 5, 1970, pp. 302-304.
- Kozlov et al., "Radiative Losses by Argon Plasma and the Emissive Model of a Continuous Optical Discharge," *Sov. Phys. JETP*, vol. 39, No. 3, Sep. 1974, pp. 463-468.
- Carlhoff et al., "Continuous Optical Discharges at Very High Pressure," *Physica* 103C, 1981, pp. 439-447.
- Creemers et al., "Evaluation of the Continuous Optical Discharge for Spectrochemical Analysis," *Spectrochimica Acta*, vol. 40B, No. 4, 1985, pp. 665-679.
- Kozlov et al., "Sustained Optical Discharges in Molecular Gases," *Sov. Phys. Tech. Phys.* 49(11), Nov. 1979, pp. 1283-1287.
- Keefer, "Laser-Sustained Plasmas," *Laser-Induced Plasmas and Applications*, published by Marcel Dekker, edited by Radziemski et al., 1989, pp. 169-206.
- "Super-Quiet Xenon Lamp Super-Quiet Mercury-Xenon Lamp," *Hamamatsu Product Information*, Nov. 2005, pp. 1-16.
- Hecht, "Refraction," *Optics (Third Edition)*, 1998, Chapter 4, pp. 100-101.

* cited by examiner

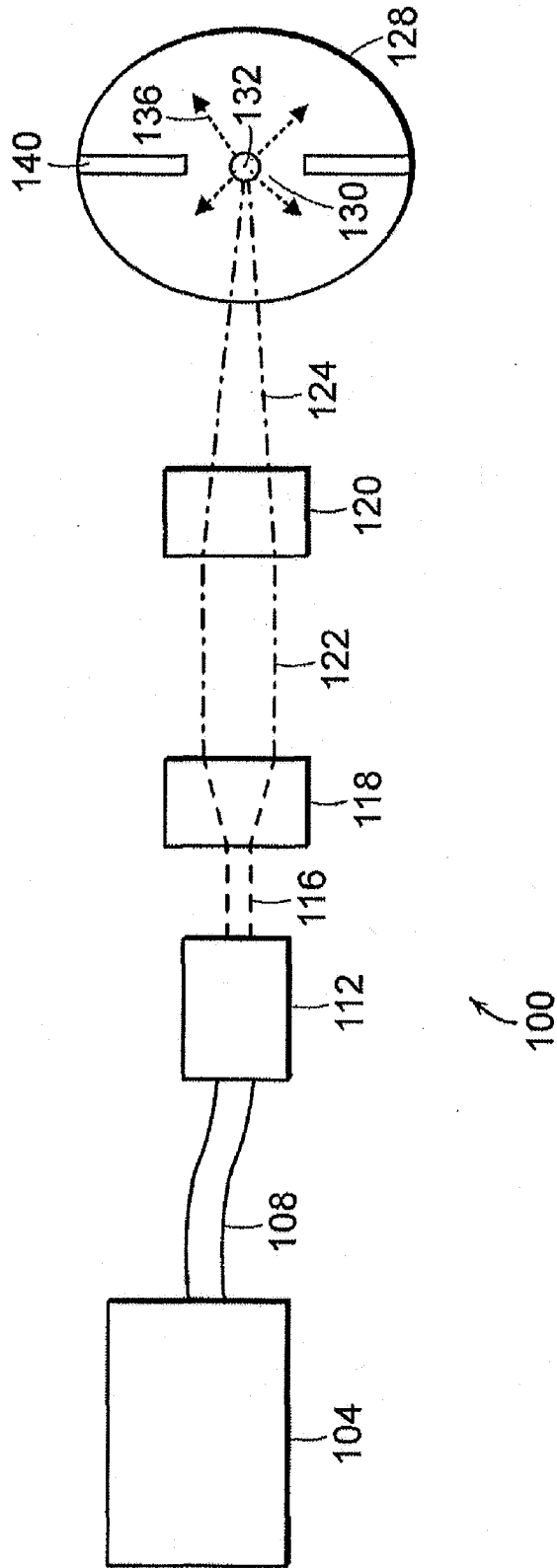


FIG. 1

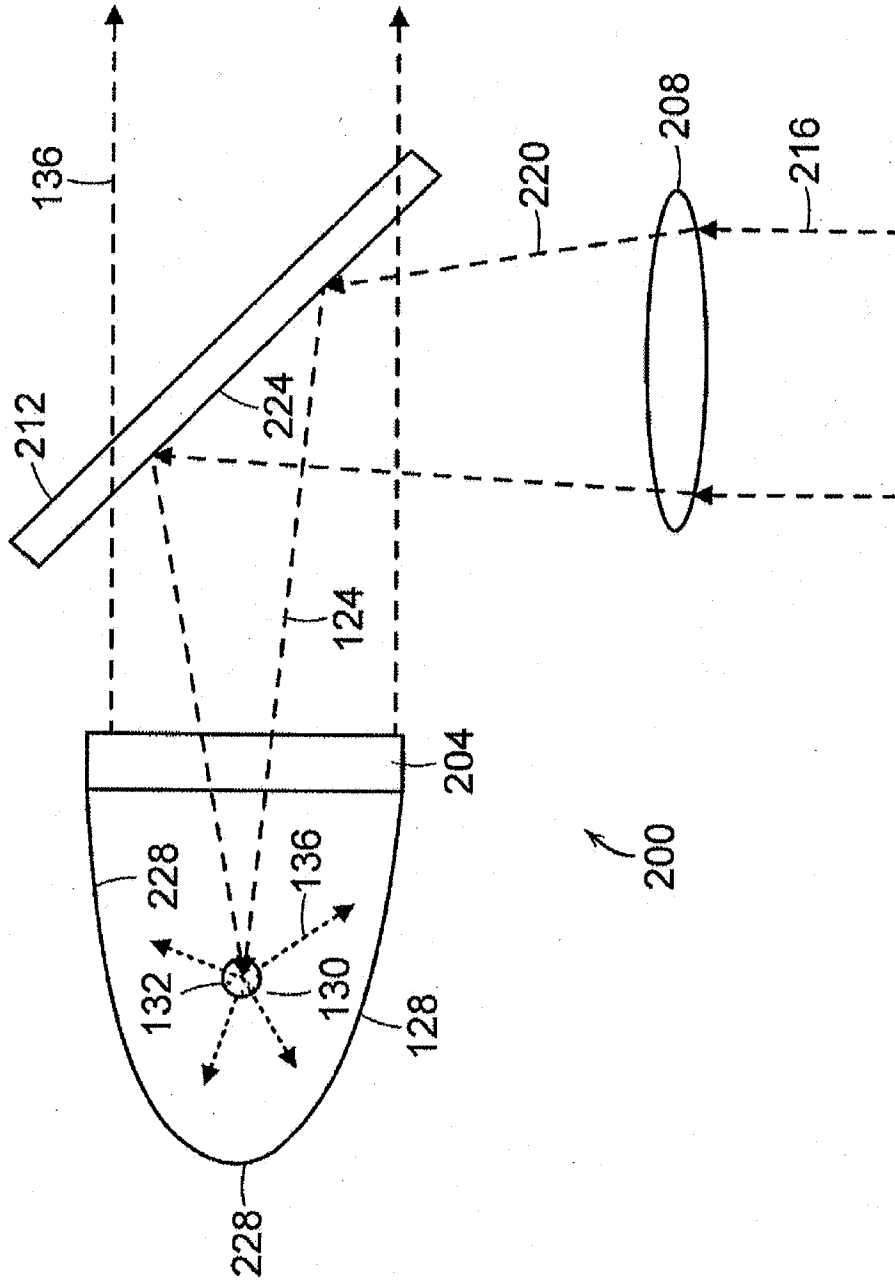


FIG. 2

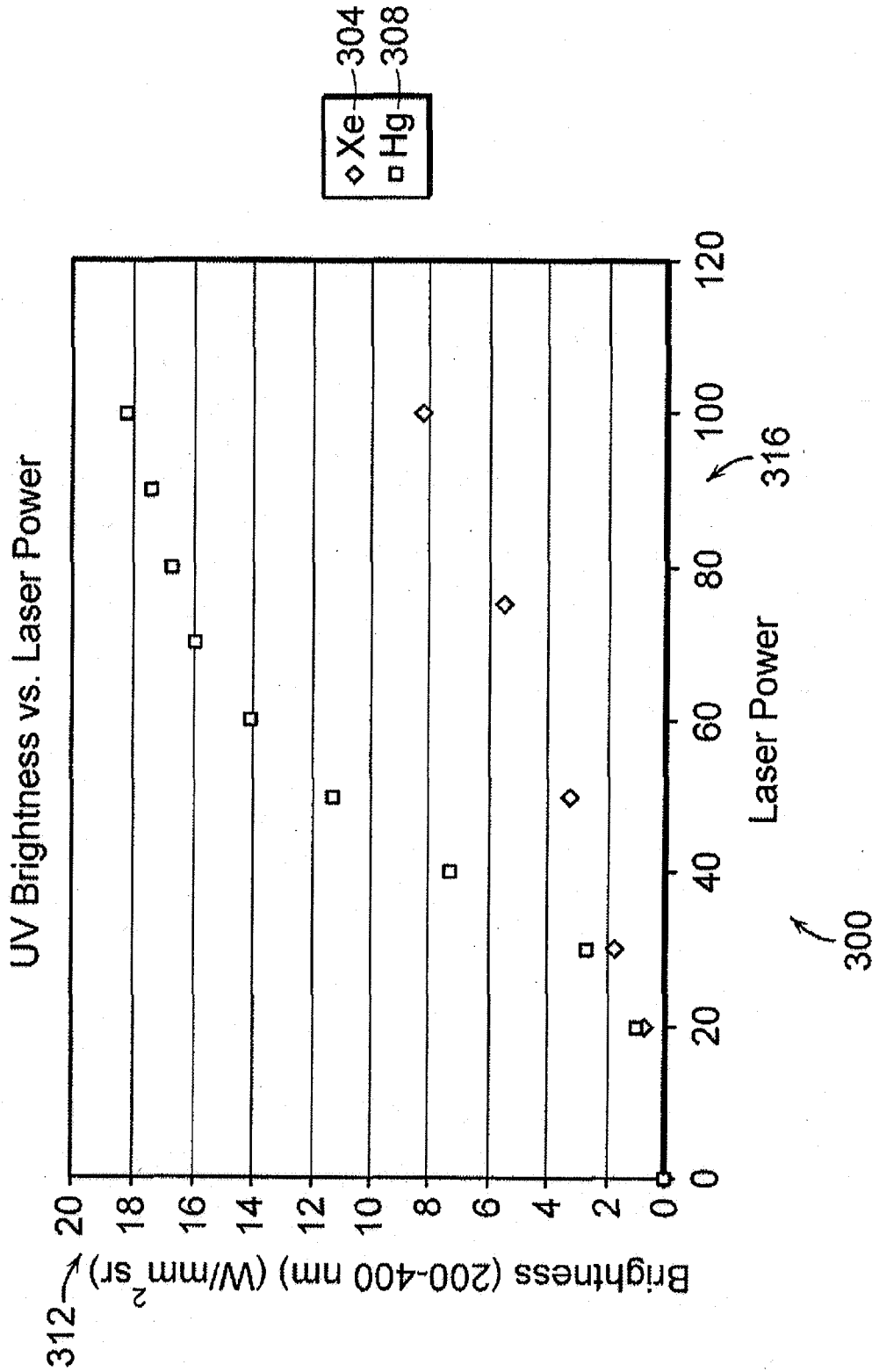


FIG. 3

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