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(12) **United States Patent**  
**Smith**

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- (54) **LASER-DRIVEN LIGHT SOURCE**
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- (\* ) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 820 days.

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(51) **Int. Cl.**  
**H05B 31/26** (2006.01)  
**G01J 3/10** (2006.01)  
**G21G 4/00** (2006.01)  
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(52) **U.S. Cl.** ..... **250/493.1**; 250/504 R;  
315/111.21; 315/111.71; 315/111.91; 313/231.31;  
313/231.41; 313/231.71

(58) **Field of Classification Search** ..... 250/423 R,  
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250/504 H; 315/111.21, 111.71, 111.91;  
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313/632, 633

See application file for complete search history.

(56) **References Cited**  
U.S. PATENT DOCUMENTS

- 4,088,966 A \* 5/1978 Samis ..... 313/231.51
- 4,498,029 A \* 2/1985 Yoshizawa et al. .... 315/39
- 4,646,215 A 2/1987 Levin et al. .... 362/296
- RE32,626 E \* 3/1988 Yoshizawa et al. .... 315/39

6,288,780 B1	9/2001	Fairley et al.	356/237.1
6,417,625 B1 *	7/2002	Brooks et al.	315/111.31
6,788,404 B2	9/2004	Lange	356/237.2
6,956,329 B2 *	10/2005	Brooks et al.	315/111.31
7,652,430 B1 *	1/2010	Delgado	313/633
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
2004/0264512 A1 *	12/2004	Hartlove et al.	372/5
2005/0167618 A1 *	8/2005	Hoshino et al.	250/504 R
2007/0285921 A1 *	12/2007	Zulim et al.	362/240

(Continued)

**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. Transfer*, vol. 46, 1991, pp. 299-308.

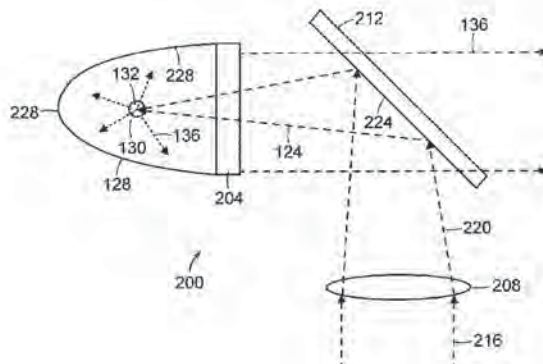
(Continued)

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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 continuous amount of energy to the ionized gas to generate a substantially continuous high brightness light.

**43 Claims, 8 Drawing Sheets**



## U.S. PATENT DOCUMENTS

2009/0032740 A1\* 2/2009 Smith et al. .... 250/503.1

## OTHER PUBLICATIONS

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

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- $\mu$ 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- $\mu$ m 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.

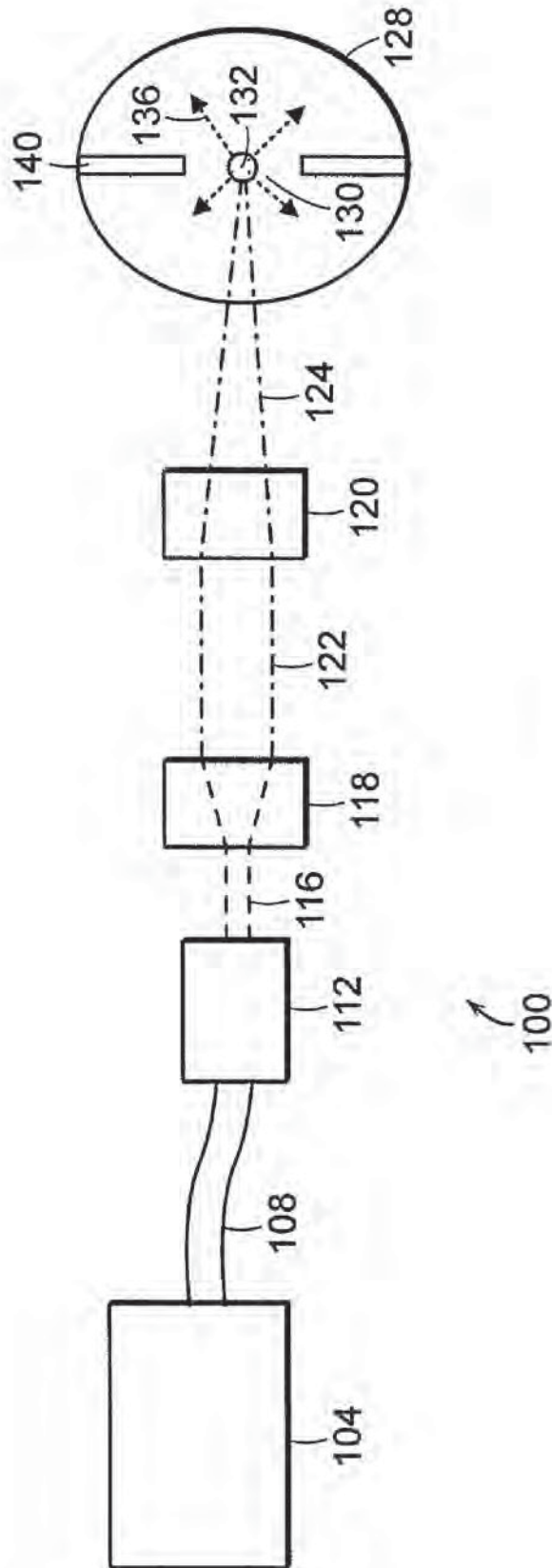
Cremers et al., "Evaluation of the Continuous Optical Discharge for Spectrochemical Analysis," *Spectrochimica Acta*, vol. 40B, No. 4, 1985, pp. 665-679.

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.

Hamamatsu Product Information, "Super-Quiet Xenon Lamp Super-Quiet Mercury-Xenon Lamp," Nov. 2005.

\* cited by examiner



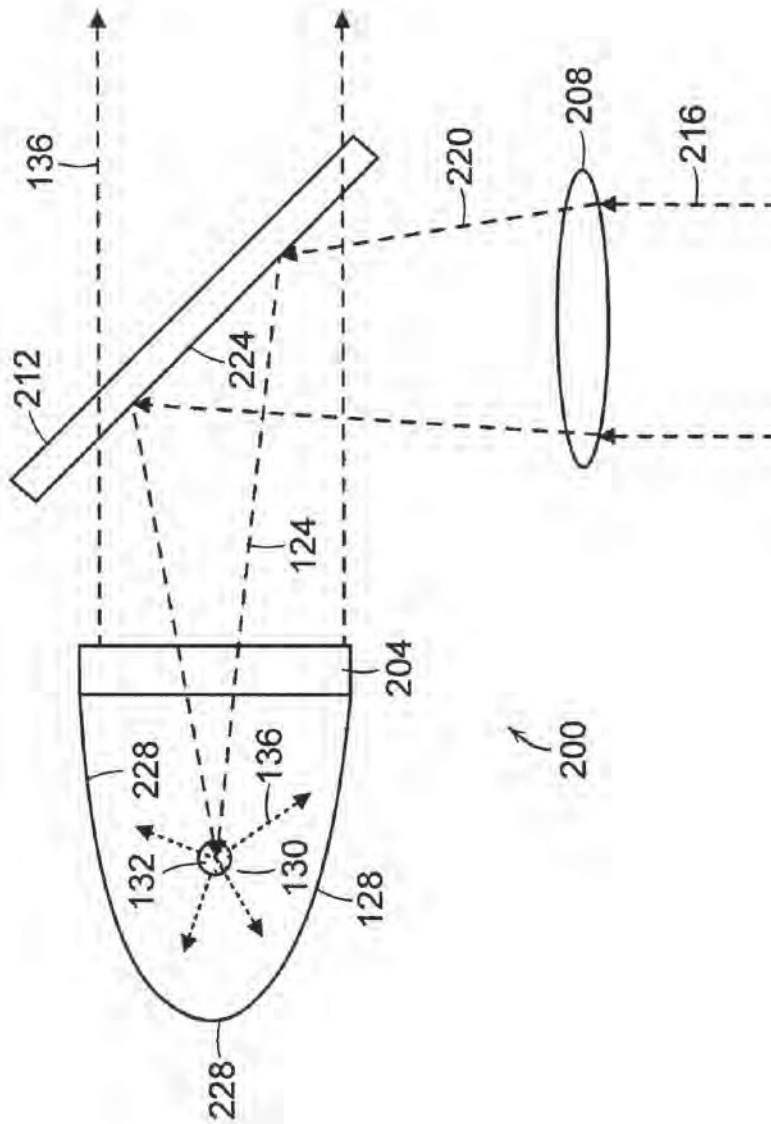


FIG. 2

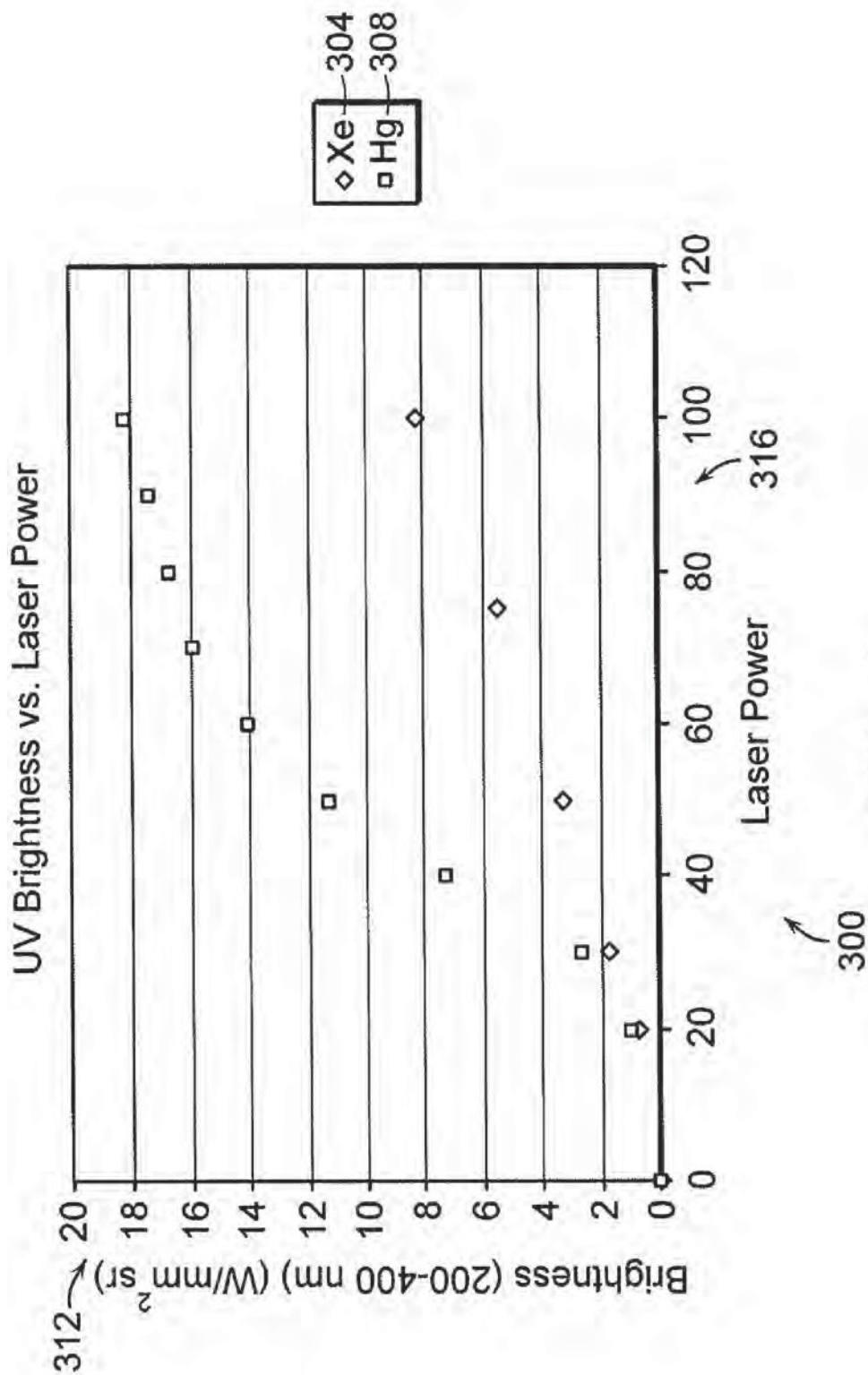


FIG. 3

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