

US008309943B2

(12) United States Patent

Smith et al.

(10) Patent No.:

US 8,309,943 B2

(45) Date of Patent:

Nov. 13, 2012

(54) LASER-DRIVEN LIGHT SOURCE

(75) Inventors: **Donald K. Smith**, Boston, MA (US); William M. Holber, Winchester, MA (US); Jeffrey A. Casey, Winchester, MA

(US)

(73) Assignee: Energetiq Technology, Inc., Woburn,

MA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35

U.S.C. 154(b) by 41 days.

(21) Appl. No.: 13/099,823

(22) Filed: May 3, 2011

(65) Prior Publication Data

US 2011/0204265 A1 Aug. 25, 2011

Related U.S. Application Data

(63) Continuation of application No. 12/166,918, filed on Jul. 2, 2008, now Pat. No. 7,989,786, which is a continuation-in-part of application No. 11/695,348, filed on Apr. 2, 2007, now Pat. No. 7,786,455, which is a continuation-in-part of application No. 11/395,523, filed on Mar. 31, 2006, now Pat. No. 7,435,982.

(51) Int. Cl. H01J 63/08 (2006.01) H05H 1/24 (2006.01) H05B 31/00 (2006.01)

See application file for complete search history.

(56) References Cited

U.S. PATENT DOCUMENTS

4,646,215	A	2/1987	Levin et al.	
6,184,517	B1 *	2/2001	Sawada et al	250/222.2
6,288,780	BI	9/2001	Fairley et al.	
6,788,404	B2	9/2004	Lange	
7,050,149	B2	5/2006	Owa et al.	
7,427,167	B2	9/2008	Holder et al.	
7,429,818	B2	9/2008	Chang et al.	
7,435,982	B2 *	10/2008	Smith	250/504 R
7,989,786	B2 *	8/2011	Smith et al	250/503.1
2002/0021508	A1	2/2002	Ishihara	
2003/0168982	A1	9/2003	Kim	
2003/0231496	A1	12/2003	Sato et al.	
		10-	*:	

(Continued)

FOREIGN PATENT DOCUMENTS

JP 61-193358 8/1986

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.

(Continued)

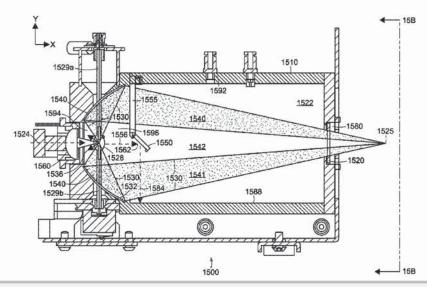
Primary Examiner — Nikita Wells

(74) Attorney, Agent, or Firm — Proskauer Rose LLP

(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.

21 Claims, 17 Drawing Sheets





U.S. PATENT DOCUMENTS

2004/0026512	Al	2/2004	Otsubo	
2004/0264512	A1	12/2004	Hartlove et al.	
2005/0167618	A1	8/2005	Hoshino et al.	
2011/0181191	A1*	7/2011	Smith et al	315/149

OTHER PUBLICATIONS

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.

Fiedorowicz et al., "X-Ray Emission form Laser-Irradiated Gas Puff Targets," Appl. Phys. Lett. 62 (22), May 31, 1993, pp. 2778-2780.

Franzen, "CW Gas Breakdown in Argon Using 10.6- µm Laser Radiation," *Appl. Phys. Lett.*, vol. 21, No. 2, Jul. 15, 1972, pp. 62-64. Generalov et al., "Continuous Optical Discharge," *ZhETF Pis. Red.* 11, No. 9, May 5, 1970, pp. 302-304.

Generalov et al., "Experimental Investigation of a Continuous Optical Discharge," *Soviet Physics JETP*, vol. 34, No. 4, Apr. 1972, pp. 763-769.

Hecht, "Refraction", Optics (Third Edition), 1998, Chapter 4, pp. 100-101.

Jeng et al., "Theoretical Investigation of Laser-Sustained Argon Plasmas," J. Appl. Phys. 60 (7), Oct. 1, 1986, pp. 2272-2279.

Keefer, "Laser-Sustained Plasmas," Laser-Induced Plasmas and Applications, published by Marcel Dekker, edited by Radziemski et al., 1989, pp. 169-206.

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.

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.

Kozlov et al., "Sustained Optical Discharges in Molecular Gases," Soy. Phys. Tech. Phys. 49(11), Nov. 1979, pp. 1283-1287.

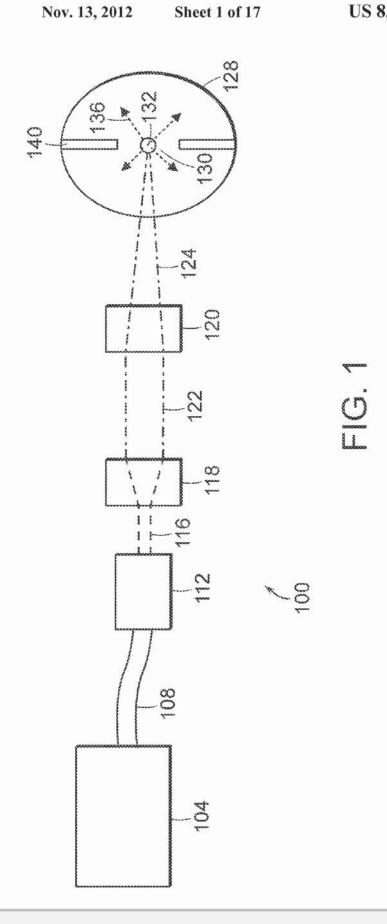
Moody, "Maintenance of a Gas Breakdown in Argon Using 10.6-µcw Radiation," *Journal of Applied Physics*, vol. 46, No. 6, Jun. 1975, pp. 2475-2482.

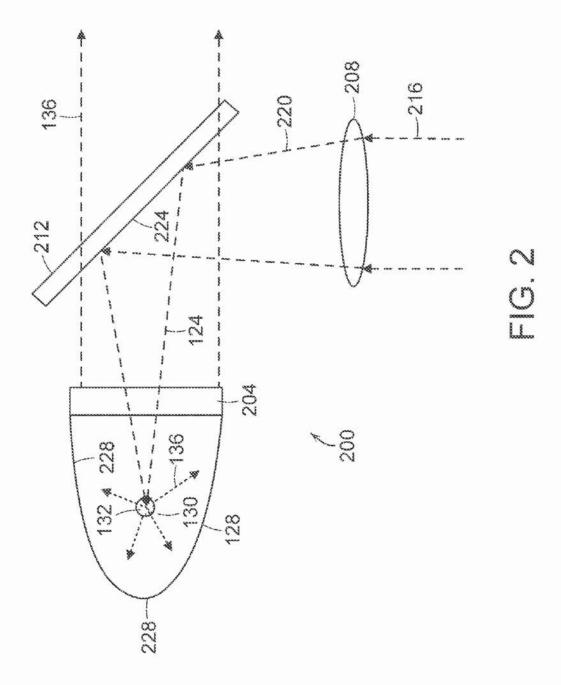
Raizer, "Optical Discharges," Sov. Phys. Usp. 23(11), Nov. 1980, pp. 789-806.

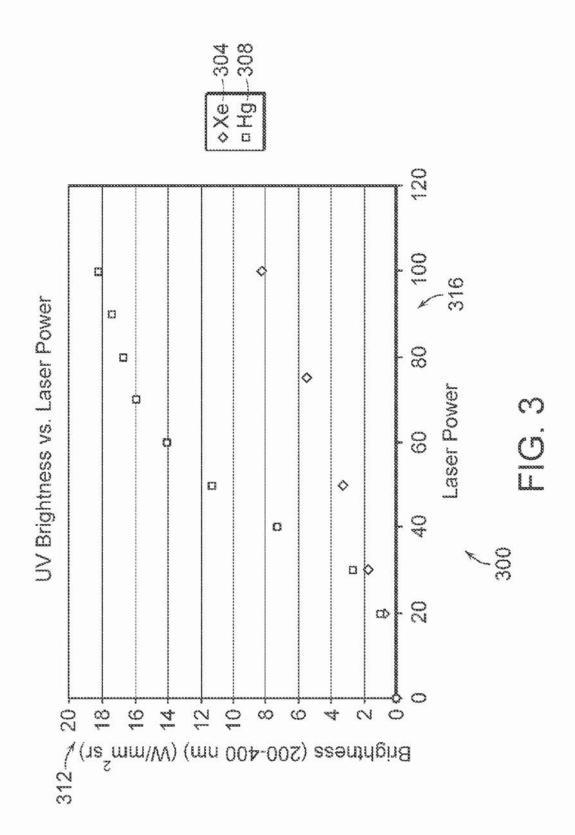
"Super-Quiet Xenon Lamp Super-Quiet Mercury-Xenon 1-16. Lamp," *Hamamatsu Product Information*, Nov. 2005, pp. 1-16. Wilbers et al., "The Continuum Emission of an Arc Plasma," *J. Quant. Spectrosc. Radiat. Transfer*, vol. 45, No. 1, 1991, pp. 1-10. Wilbers et al., "The VUV Emissivity of a High-Pressure Cascade Argon Arc from 125 to 200 nm," *J. Quant. Spectrosc. Radiat. Transfer*, vol. 46, 1991, pp. 299-308.

* cited by examiner











DOCKET

Explore Litigation Insights



Docket Alarm provides insights to develop a more informed litigation strategy and the peace of mind of knowing you're on top of things.

Real-Time Litigation Alerts



Keep your litigation team up-to-date with **real-time** alerts and advanced team management tools built for the enterprise, all while greatly reducing PACER spend.

Our comprehensive service means we can handle Federal, State, and Administrative courts across the country.

Advanced Docket Research



With over 230 million records, Docket Alarm's cloud-native docket research platform finds what other services can't. Coverage includes Federal, State, plus PTAB, TTAB, ITC and NLRB decisions, all in one place.

Identify arguments that have been successful in the past with full text, pinpoint searching. Link to case law cited within any court document via Fastcase.

Analytics At Your Fingertips



Learn what happened the last time a particular judge, opposing counsel or company faced cases similar to yours.

Advanced out-of-the-box PTAB and TTAB analytics are always at your fingertips.

API

Docket Alarm offers a powerful API (application programming interface) to developers that want to integrate case filings into their apps.

LAW FIRMS

Build custom dashboards for your attorneys and clients with live data direct from the court.

Automate many repetitive legal tasks like conflict checks, document management, and marketing.

FINANCIAL INSTITUTIONS

Litigation and bankruptcy checks for companies and debtors.

E-DISCOVERY AND LEGAL VENDORS

Sync your system to PACER to automate legal marketing.

