



US007989786B2

(12) **United States Patent**
Smith et al.

(10) **Patent No.:** **US 7,989,786 B2**
(45) **Date of Patent:** **Aug. 2, 2011**

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

(56) **References Cited**

(75) Inventors: **Donald K. Smith**, Boston, 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 551 days.

(21) Appl. No.: **12/166,918**

(22) Filed: **Jul. 2, 2008**

(65) **Prior Publication Data**

US 2009/0032740 A1 Feb. 5, 2009

Related U.S. Application Data

(63) 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.**
G01J 3/10 (2006.01)
G01J 1/34 (2006.01)
H01J 63/08 (2006.01)
H05H 1/24 (2006.01)

(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;**
250/504 R, 365; 313/231.31; 315/111.21;
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.

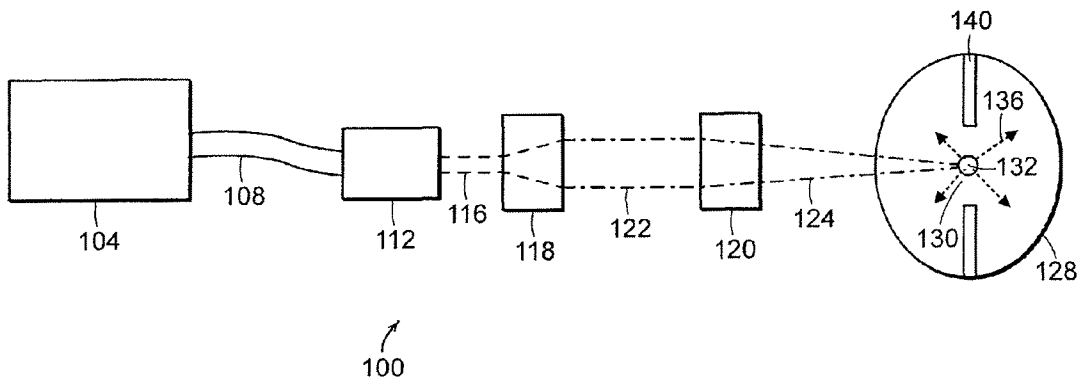
(Continued)

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

39 Claims, 17 Drawing Sheets



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.
- 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.
- "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

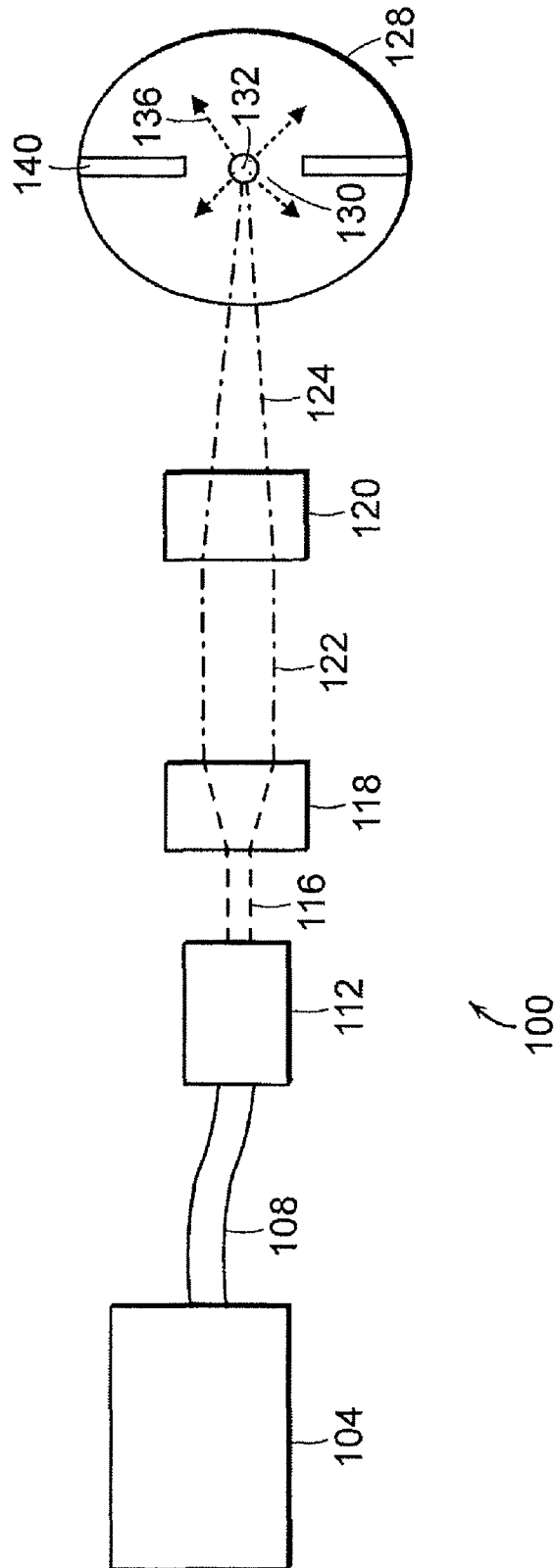


FIG. 1

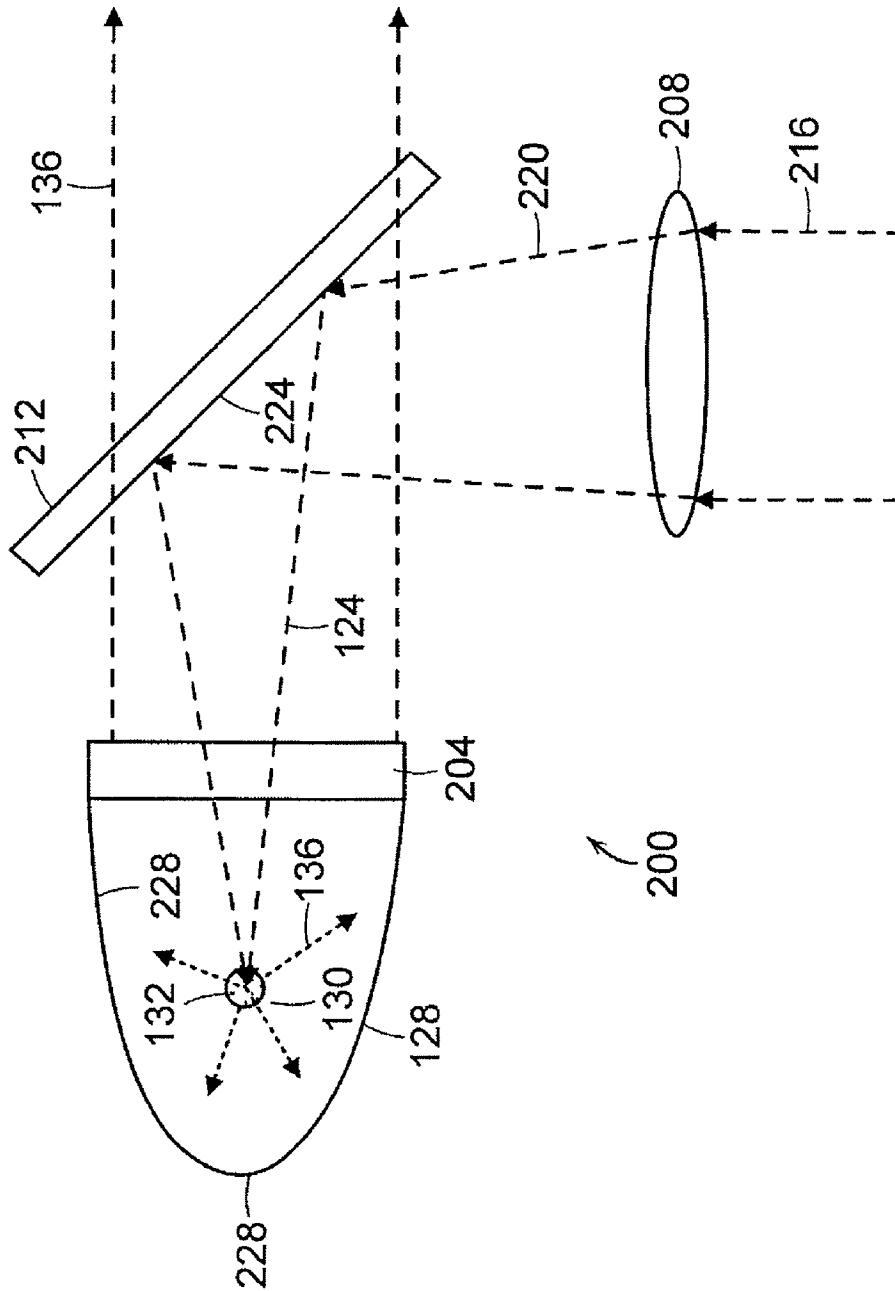


FIG. 2

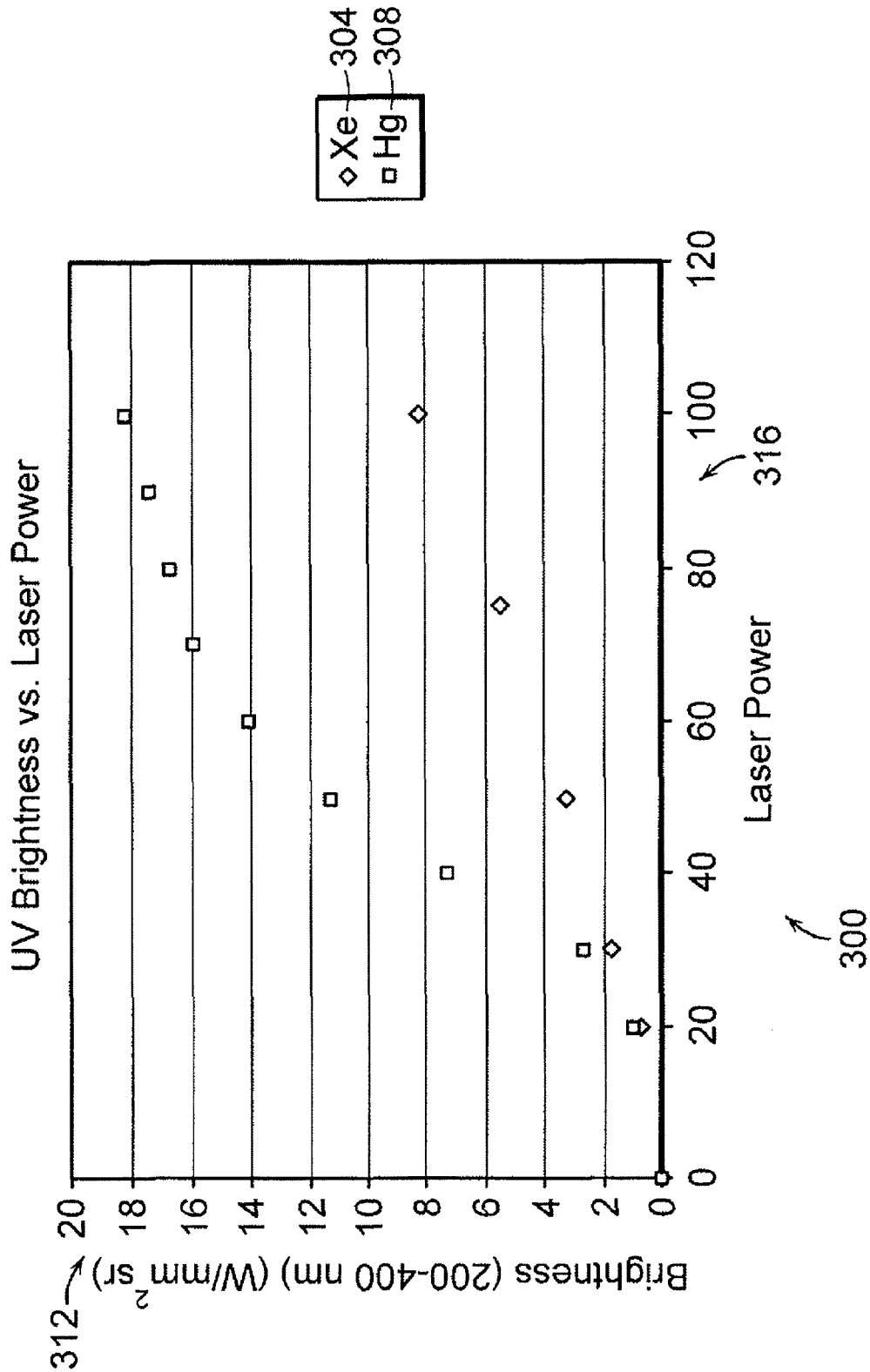


FIG. 3

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.