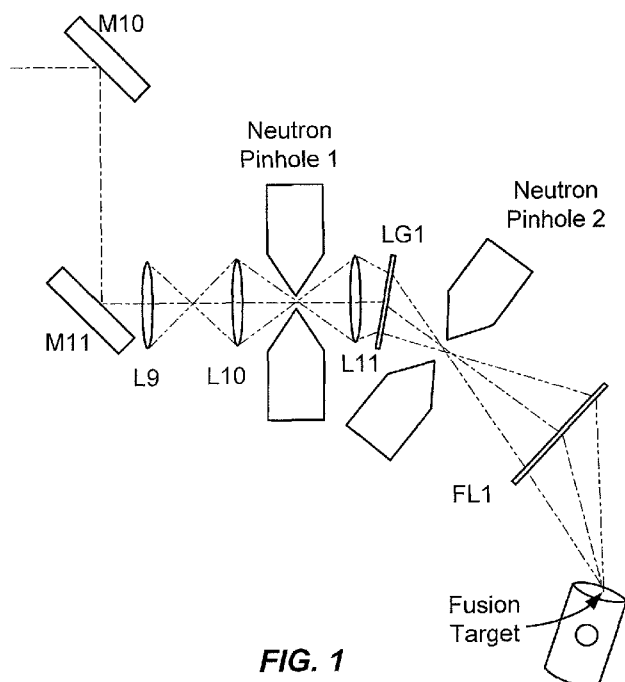




- (51) International Patent Classification:
G21B 1/25 (2006.01)
- (21) International Application Number:
PCT/US2012/022443
- (22) International Filing Date:
24 January 2012 (24.01.2012)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data:
61/437,177 28 January 2011 (28.01.2011) US
- (71) Applicant (for all designated States except US):
LAWRENCE LIVERMORE NATIONAL SECURITY, LLC [US/US]; 2300 First Street, Suite 204, Livermore, California 94550 (US).
- (72) Inventors; and
(75) Inventors/Applicants (for US only): **BAYRAMIAN, Andy** [US/US]; 2300 First Street, Suite 204, Livermore, California 94550 (US). **LATKOWSKI, Jeffery** [US/US]; 2300 First Street, Suite 204, Livermore, California 94550 (US). **SAWICKI, Rick** [US/US]; 2300 First Street, Suite 204, Livermore, California 94550 (US). **DERI, Robert** [US/US]; 2300 First Street, Suite 204, Livermore, California 94550 (US).
- (74) Agents: **LARGENT, Craig C.** et al.; Kilpatrick Townsend & Stockton LLP, Two Embarcadero Center, 8th Floor, San Francisco, California 94111 (US).
- (81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

[Continued on next page]

(54) Title: FINAL BEAM TRANSPORT SYSTEM



(57) Abstract: A system includes a laser system operable to provide a laser beam along an optical path and a fusion chamber coupled to the optical path. The system also includes a neutron pinhole disposed along the optical path between the laser system and the fusion chamber and a neutron attenuation region disposed along the optical path between the laser system and the fusion chamber.



(84) Designated States (*unless otherwise indicated, for every kind of regional protection available*): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report (Art. 21(3))*

(88) Date of publication of the international search report:

26 October 2012

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2012/022443

A. CLASSIFICATION OF SUBJECT MATTER IPC(8) - G21B1/25 (2012.01) USPC - 376/146 According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) IPC(8) - G21B1/03, 1/17, 1/23, 1/25 (2012.01) USPC - 376/102, 103, 104, 146 Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) PatBase, Orbit.com, Google Patents, Engineering Village		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2005/0205811 A1 (PARTLO et al.) 22 September 2005 (22.09.2005) entire document	16, 18-22
---		---
Y		11-15, 17
Y	US 4,518,843 A (ANTOL et al.) 21 May 1985 (21.05.1985) entire document	1-15
Y	US 2007/0273893 A1 (BOCK et al.) 29 November 2007 (29.11.2007) entire document	1-10
Y	US 2009/0159074 A1 (RABINOWITZ) 25 June 2009 (25.06.2009) entire document	4, 7, 11-15
Y	US 2009/0310731 A1 (BURKE et al.) 17 December 2009 (17.12.2009) entire document	17
A	US 4,735,762 A (LASCHE) 05 April 1988 (05.04.1988) column 13, line 33 through column 14, line 34, column 15, lines 10-39; figures 24-25B	1-22
A	US 6,428,470 B1 (THOMPSON) 06 August 2002 (06.08.2002) column 14, lines 30-64; figures 7-9	1-22
☐ Further documents are listed in the continuation of Box C. ☐		
* Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family		
Date of the actual completion of the international search 19 July 2012		Date of mailing of the international search report 07 AUG 2012
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-3201		Authorized officer: Blaine R. Copenheaver PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2012/022443

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

See extra sheet.

1. ☒ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☒ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US2012/022443

This application contains the following inventions or groups of inventions which are not so linked as to form a single general inventive concept under PCT Rule 13.1. In order for all inventions to be examined, the appropriate additional examination fees must be paid.

Group I, claims 1-10, drawn to a method of replacing an optical element positioned in a high radiation environment comprising: halting operation of a beamline, pulling a cable to transfer the optical element through a radiation wall, exchanging the optical element, pulling the cable to transfer the replacement optical element through the radiation wall, positioning the replacement optical element, seating the replacement optical element on the first face of the telescope, seating the replacement optical element on kinematic elements, and verifying an optical alignment of the replacement optical element, and resuming operation of the beamline.

Group II, claims 11-15, drawn to an optical system comprising: a vacuum chamber, an optic mount mounted on the first end of the vacuum chamber, a Fresnel optic mounted to the mounting surface of the optic mount, and a second optical element mounted to the second end of the vacuum chamber.

Group III, claims 16-22, drawn to a system comprising: a fusion chamber coupled to the optical path, a neutron pinhole disposed along the optical path between the laser system and the fusion chamber, and a neutron attenuation region disposed along the optical path between the laser system and the fusion chamber.

The inventions listed as Groups I, II and III do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons: the special technical feature of the Group I invention halting operation of a beamline, pulling a cable to transfer the optical element through a radiation wall, exchanging the optical element, pulling the cable to transfer the replacement optical element through the radiation wall, positioning the replacement optical element, seating the replacement optical element on the first face of the telescope, seating the replacement optical element on kinematic elements, and verifying an optical alignment of the replacement optical element, and resuming operation of the beamline as claimed therein is not present in the invention of Groups II and III. The special technical feature of the Group II invention: a vacuum chamber, an optic mount mounted on the first end of the vacuum chamber, a Fresnel optic mounted to the mounting surface of the optic mount and a second optical element mounted to the second end of the vacuum chamber as claimed therein is not present in the invention of Groups I or III. The special technical feature of the Group III invention: a fusion chamber coupled to the optical path, a neutron pinhole disposed along the optical path between the laser system and the fusion chamber, and a neutron attenuation region disposed along the optical path between the laser system and the fusion chamber as claimed therein is not present in the invention of Groups I and II.

Groups I, II and III lack unity of invention because even though the inventions of these groups require the technical feature of a chamber coupled to an optical path, an optic mount (optical element) and a cable attached to the optic mount (optical element), this technical feature is not a special technical feature as it does not make a contribution over the prior art in view of US 6,428,470 B1 (THOMPSON) 06 August 2002 (06.08.2002) column 14, lines 30-64; figures 7-9.

Since none of the special technical features of the Group I, II or III inventions are found in more than one of the inventions, unity of invention is lacking.