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— *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))*

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(54) Title: EXTERNAL-CAVITY ONE-DIMENSIONAL MULTI-WAVELENGTH BEAM COMBINING OF TWO-DIMENSIONAL LASER ELEMENTS

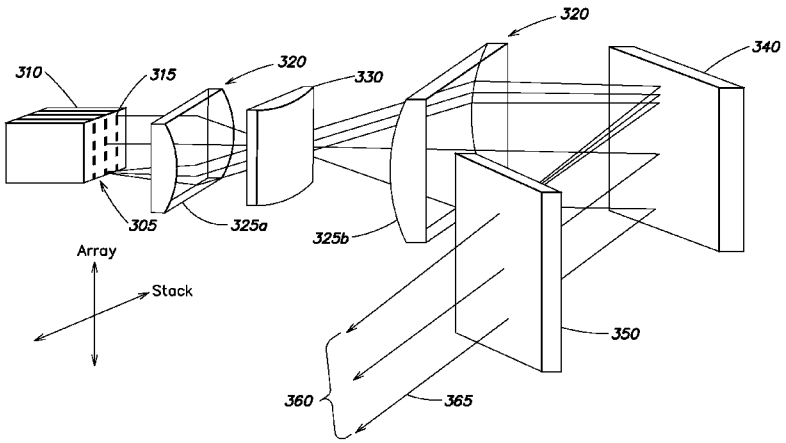

FIG. 3

(57) Abstract: An external-cavity one-dimensional multi-wavelength beam combiner that performs wavelength beam combining along a stacking dimension of a laser stack formed of a plurality of laser arrays, each laser array configured to generate optical radiation having a unique wavelength, and each of the plurality of laser arrays including a plurality of laser emitters arranged along an array dimension of the laser stack. The multi-wavelength beam combiner includes a cylindrical telescope configured to image each of the laser emitters along a slow axis of the laser emitters, a transform lens arranged to intercept the optical radiation from each of the plurality of laser arrays and combine the optical radiation along a stacking dimension of the laser stack to form a multi-wavelength optical beam, and a diffraction element positioned at a region of overlap of the optical radiation to receive and transmit the multi-wavelength optical beam.

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INTERNATIONAL SEARCH REPORT

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ADD. G02B27/10

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)
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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 practical, search terms used)
EPO-Internal, INSPEC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2004/095983 A1 (WHITLEY RICHARD M [US]) 20 May 2004 (2004-05-20)	23-26
A	paragraphs [0024], [0035]; figures 1a,1b	1-22
Y	WO 2006/097531 A1 (THALES SA [FR]; LARAT CHRISTIAN [FR]; LALLIER ERIC [FR]) 21 September 2006 (2006-09-21)	1-22
A	page 2, lines 15-18 page 6, lines 5-15,30-35 page 7, lines 2-10,17-23,31-33 page 8, line 15 - page 9, line 4; figures 8,9	23-26

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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	CHANN B ET AL: "Frequency narrowed external cavity diode laser array bar" OPTICS LETTERS, vol. 25, no. 18, 15 September 2000 (2000-09-15), pages 1352-1354, XP002605185	1-22
A	page 1352, left-hand column; figure 1	23
A	ZHU H ET AL: "Spectrally narrowed external-cavity high-power stack of laser diode arrays" OPTICS LETTERS OPT. SOC. AMERICA USA, vol. 30, no. 11, 1 June 2005 (2005-06-01), pages 1342-1344, XP002605186 ISSN: 0146-9592 DOI: DOI:10.1364/OL.30.001342 figure 1	1-26
A	GOPINATH J T ET AL: "1450nm high brightness wavelength beam combined diode laser array" OPTICS EXPRESS, vol. 16, no. 13, 23 June 2008 (2008-06-23) , pages 9405-9409, XP002605187 figure 1	1-26
A	JP 2007 165624 A (SONY CORP) 28 June 2007 (2007-06-28) the whole document	1,15,23
A	US 6 356 576 B1 (SMITH SCOTT T [US]) 12 March 2002 (2002-03-12) the whole document	1,8
A	US 2007/047608 A1 (VOLODIN BORIS L [US] ET AL) 1 March 2007 (2007-03-01) paragraph [0097]; figures 4-7	1,2,13, 26

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2004095983 A1	20-05-2004	NONE	
WO 2006097531 A1	21-09-2006	FR 2883384 A1	22-09-2006
JP 2007165624 A	28-06-2007	NONE	
US 6356576 B1	12-03-2002	AU 1489601 A	04-06-2001
		DE 60037754 T2	15-01-2009
		EP 1252689 A1	30-10-2002
		JP 3499824 B2	23-02-2004
		JP 2001264688 A	26-09-2001
		WO 0139337 A1	31-05-2001
US 2007047608 A1	01-03-2007	NONE	