

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
25 November 2004 (25.11.2004)

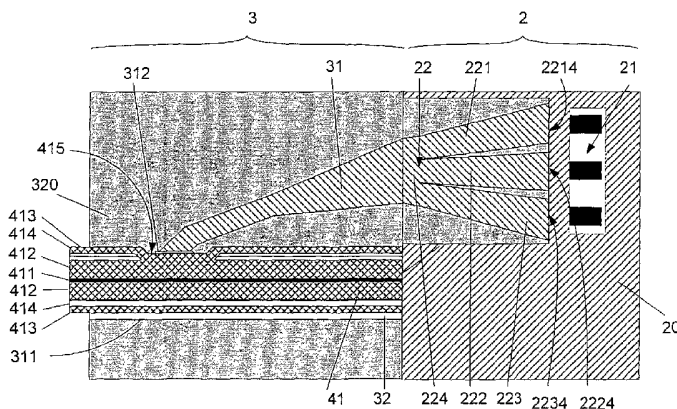
PCT

(10) International Publication Number
WO 2004/102236 A3

- (51) International Patent Classification⁷: G02B 6/30, 6/42
- (21) International Application Number: PCT/DK2004/000358
- (22) International Filing Date: 19 May 2004 (19.05.2004)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data:
 - PA 2003 00753 19 May 2003 (19.05.2003) DK
 - 60/471,355 19 May 2003 (19.05.2003) US
- (71) Applicant (for all designated States except US): NKT RESEARCH & INNOVATION A/S [DK/DK]; Blokken 84, DK-3460 Birkerød (DK).
- (72) Inventors; and
- (75) Inventors/Applicants (for US only): PEDERSEN, Claus, Friis [DK/DK]; Kabellejevej 31, 2.tv., DK-2700 Brønshøj (DK). PEDERSEN, MORTEN, Østergaard [DK/DK]; Syvbjergvej 69, DK-2625 Vallensbæk (DK). NIELSEN, Lars, Pleth [DK/DK]; Søvangen 36, DK-3450 Allerød (DK). ANDERSEN, Lars-Ulrik, Aaen [DK/DK]; Vangebovej 43, Søllerød, DK-2840 Holte (DK).
- (74) Agent: NIELSEN, Hans, Jørgen, Vind; NKT Research & Innovation A/S, Group IP, Blokken 84, DK-3460 Birkerød (DK).
- (81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.
- (84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

[Continued on next page]

(54) Title: A SIDE COUPLED OPTICAL WAVEGUIDE DEVICE



(57) Abstract: The invention relates to a coupling part (3) comprising at least one essentially planar coupling waveguide (31) formed on a coupling-substrate (30), the coupling-substrate having opposite waveguide- and substrate faces, the coupling waveguide or waveguides each having an output face, the coupling waveguides being adapted to be optically coupled to source waveguide or waveguides for supplying light power to the coupling part. An object of the present invention is to provide a cost-efficient scheme for integrating one or several light sources with optical waveguides with minimum loss of brightness and power. A further object of the invention is to facilitate the coupling of the light from a light source into passive or active application waveguides. A further object of the invention is to facilitate the coupling of the light from a light source module into passive or active application waveguides. The problem is solved in that the coupling part (3) comprises a) at least one elongate groove (32) in the form of a recess in the waveguide face, the groove being adapted to receive an elongated optical application waveguide (41), and b) at least one coupling waveguide (31) and at least one groove (32) are formed on the coupling-substrate (30) relative to each other so that the output face of the coupling waveguide is suitable for being side-coupled to an application waveguide (41) located in said groove. The invention further relates to a light source part and a light source module and to optical devices based on these parts. The invention may e.g. be used in high power fibre lasers or fibre amplifiers.

WO 2004/102236 A3



Published:

- *with international search report*
- *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

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

4 August 2005

INTERNATIONAL SEARCH REPORT

tional Application No PC1/DK2004/000358

A. CLASSIFICATION OF SUBJECT MATTER
 IPC 7 G02B6/30 G02B6/42

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 7 G02B H01S

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, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X A A A	EP 0 619 506 A (WHITAKER CORP) 12 October 1994 (1994-10-12) abstract; figures 9,10 ----- GB 1 305 872 A (GEORGE H. BROOKE THOMSON) 7 February 1973 (1973-02-07) abstract; figures 1,4 ----- PATENT ABSTRACTS OF JAPAN vol. 014, no. 452 (P-1112), 27 September 1990 (1990-09-27) & JP 02 181709 A (SUMITOMO ELECTRIC IND LTD), 16 July 1990 (1990-07-16) abstract ----- -/---	1,66 2-19, 67-87 1 1

Further documents are listed in the continuation of box C. Patent family members are listed in annex.

° 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 document 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 13 April 2005	Date of mailing of the international search report 16. 06. 2005
---	---

Name and mailing address of the ISA European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Authorized officer Faderl, I
--	-------------------------------------

INTERNATIONAL SEARCH REPORT

International Application No
PCT/DK2004/000358

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5 625 728 A (JURCZYSZYN MICHEL ET AL) 29 April 1997 (1997-04-29) abstract; figures 2,3 -----	1
A	HAKIMI F ET AL: "A new side coupling method for double-clad fiber amplifiers" CONFERENCE ON LASERS AND ELECTRO-OPTICS. (CLEO 2001). TECHNICAL DIGEST. POSTCONFERENCE EDITION. BALTIMORE, MD, MAY 6-11, 2001, TRENDS IN OPTICS AND PHOTONICS. (TOPS), US, WASHINGTON, WA: OSA, US, vol. 56, 6 May 2001 (2001-05-06), pages 116-116, XP010559624 ISBN: 1-55752-662-1 the whole document -----	1
A	US 6 301 421 B1 (BROSNAN STEPHEN J ET AL) 9 October 2001 (2001-10-09) abstract; figure 1 -----	1
P,A	WO 03/079077 A (FOLKENBERG JACOB RIIS ;SKOVGAARD PETER M W (DK); BROENG JES (DK);) 25 September 2003 (2003-09-25) cited in the application the whole document -----	1
A	WO 02/50585 A (CQUINT COMM CORP) 27 June 2002 (2002-06-27) abstract; figure 56 -----	1
A	US 5 239 601 A (DENIS HERVE ET AL) 24 August 1993 (1993-08-24) abstract; figures -----	1
X	EP 0 801 316 A (OHMEDA INC) 15 October 1997 (1997-10-15) abstract; figure 1a column 9, lines 1-58 -----	20,21 22-65
X	PATENT ABSTRACTS OF JAPAN vol. 006, no. 164 (E-127), 27 August 1982 (1982-08-27) & JP 57 084189 A (NEC CORP), 26 May 1982 (1982-05-26) abstract -----	20
A	US 4 818 062 A (SCIFRES ET AL) 4 April 1989 (1989-04-04) abstract; figures 1,2 column 2, lines 47-65 -----	20
A	WO 91/12641 A (SCIENTIFIC GENERICS LIMITED) 22 August 1991 (1991-08-22) abstract; figure 3 -----	20
	----- -/--	

INTERNATIONAL SEARCH REPORT

International Application No PCT/DK2004/000358

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 02/11253 A (HARRIS CORPORATION) 7 February 2002 (2002-02-07) abstract; figures 9,10 -----	1-87
A	US 5 887 097 A (HENRY ET AL) 23 March 1999 (1999-03-23) abstract; figure 3 -----	20

INTERNATIONAL SEARCH REPORT

International application No.
PCT/DK2004/000358

Box 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 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 additional 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 an additional fee, this Authority did not invite payment of any additional fee.
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.
- No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-19, 66-87

A coupling part for coupling light to an application part, the coupling part comprising at least one essentially planar coupling waveguide formed on a coupling substrate, the coupling-substrate having opposite waveguide- and substrate faces, at least one of the coupling waveguides having an input face and an output face, the input face of the coupling waveguide or waveguides being adapted to be optically coupled to source waveguides for supplying light power to the coupling part wherein the coupling part comprises at least one elongate groove in the form of a recess in the waveguide face, the groove being adapted to receive an elongate optical application waveguide, and said at least one coupling waveguide and said at least one groove are formed on the coupling-substrate relative to each other so that said output face of said coupling waveguide is suitable for being side-coupled to said application waveguide located in said groove.

2. claims: 20-65

A light source part comprising

- a) a multitude of N laser diodes LD_i with predetermined numerical apertures $NALD_i$, $i=1, 2, \dots, N$, each individual laser diode having an emitting face with a laser stripe for emitting light power,
- b) a multitude of M essentially planar optical input source waveguides WG_j with predetermined numerical apertures $NAWG_j$, $j=1, 2, \dots, M$, the waveguides each having an input face with a capture area for capturing light and the waveguides being formed on a source-substrate,
- c) each waveguide being adapted to receive light from one or more corresponding laser diodes, and
- d) an output interface for making light from the laser diodes available wherein said input source waveguides and their corresponding laser diode or diodes have matching numerical apertures and physical dimensions of their capture area and laser stripe, and the laser diodes are mounted or formed on the source-substrate with the emitting faces relative to the input faces of the waveguides to minimize the loss of brightness between the emitting face of the individual laser diodes and the input face of the individual waveguides.

INTERNATIONAL SEARCH REPORT
 information on patent family members

International Application No
 PCT/DK2004/000358

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
EP 0619506	A	12-10-1994	EP 0619506 A2 JP 6308350 A	12-10-1994 04-11-1994
GB 1305872	A	07-02-1973	DE 2233296 A1 ES 399482 A1 FR 2124481 A5 JP 51039839 B	03-05-1973 01-07-1975 22-09-1972 29-10-1976
JP 02181709	A	16-07-1990	NONE	
US 5625728	A	29-04-1997	FR 2727769 A1 EP 0715192 A1	07-06-1996 05-06-1996
US 6301421	B1	09-10-2001	NONE	
WO 03079077	A	25-09-2003	AU 2003226891 A1 WO 03079077 A1 EP 1485737 A1	29-09-2003 25-09-2003 15-12-2004
WO 0250585	A	27-06-2002	AU 3273802 A AU 4167502 A WO 0250575 A2 WO 0250585 A1 US 2002081055 A1 US 2002122615 A1 WO 03038498 A2 US 2003081903 A1	01-07-2002 01-07-2002 27-06-2002 27-06-2002 27-06-2002 05-09-2002 08-05-2003 01-05-2003
US 5239601	A	24-08-1993	FR 2659148 A1 CA 2053893 A1 DE 69122813 D1 DE 69122813 T2 EP 0471066 A1 WO 9113378 A1 JP 4507153 T	06-09-1991 02-09-1991 28-11-1996 07-05-1997 19-02-1992 05-09-1991 10-12-1992
EP 0801316	A	15-10-1997	US 5790729 A CA 2199895 A1 EP 0801316 A2 JP 10039164 A	04-08-1998 10-10-1997 15-10-1997 13-02-1998
JP 57084189	A	26-05-1982	NONE	
US 4818062	A	04-04-1989	US 4763975 A US 4820010 A US RE33722 E	16-08-1988 11-04-1989 22-10-1991
WO 9112641	A	22-08-1991	AT 115783 T AU 646660 B2 AU 7230591 A BR 9106032 A CA 2074834 A1 DE 69105952 D1 DE 69105952 T2 DK 515410 T3 EP 0515410 A1 FI 923588 A WO 9112641 A1	15-12-1994 03-03-1994 03-09-1991 05-01-1993 13-08-1991 26-01-1995 20-04-1995 20-02-1995 02-12-1992 11-08-1992 22-08-1991

INTERNATIONAL SEARCH REPORT
 Information on patent family members

International Application No
 PCT/DK2004/000358

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
WO 9112641	A		GB 2256503 A , B	09-12-1992
			JP 5504896 T	29-07-1993
			JP 3378904 B2	17-02-2003
			NO 923131 A	09-10-1992
			US 5258989 A	02-11-1993

WO 0211253	A	07-02-2002	US 6594420 B1	15-07-2003
			AU 7897301 A	13-02-2002
			EP 1342296 A2	10-09-2003
			WO 0211253 A2	07-02-2002
			US 2002075559 A1	20-06-2002
			US 2002021486 A1	21-02-2002

US 5887097	A	23-03-1999	DE 69815219 D1	10-07-2003
			DE 69815219 T2	29-04-2004
			EP 0893719 A1	27-01-1999
			JP 3478972 B2	15-12-2003
			JP 11074588 A	16-03-1999
