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(54) Title: BULK OPTICAL (DE)MULTIPLEXER APPARATUS AND METHOD OF PACKAGING

(57) Abstract: A bulk optic (de)multiplexer (10) consists of a fiber pigtail array (20), a focusing optic (18) and a wavelength dispersive element or grating (16) in optical alignment along an optical axis (22). The focusing optic is rigidly affixed to the frame and the fiber pigtail array (20) and wavelength dispersive element (16) are attached by adjustable connectors (112, 56, 340) to facilitate alignment. The frame (12) has thermally expansive elements to compensate for shifts in light beams processed by the (de)multiplexer as a function of temperature. Vibration dampers (150, 152, 154, 160, 200) isolate the frame and optical elements from vibrations applied to the (de)multiplexer.



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INTERNATIONAL SEARCH REPORT

 International Application No
 PC 01/45276

A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 G02B6/34 G01J3/18 H04J14/02 G02B7/00 G02B7/18

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 G01J H04J

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)

WPI Data, PAJ, EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 123 237 A (LICENTIA GMBH) 31 October 1984 (1984-10-31) page 3, line 10 -page 4, line 7; figure 1	1,2,19
Y	---	10-18
Y	EP 0 654 917 A (AT & T CORP) 24 May 1995 (1995-05-24) column 15, line 4 - line 44; figure 6 column 17, line 19 -column 18, line 28	1-10,19, 20,37,38
Y	US 6 134 359 A (KEYWORTH BARRIE ET AL) 17 October 2000 (2000-10-17) column 4, line 22 - line 58; figures 1,2	1,37,38
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☒ 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

23 April 2002

Date of mailing of the international search report

11/07/2002

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INTERNATIONAL SEARCH REPORT

International Application No

PC

01/45276

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	DE 197 23 265 A (PIEZOSYSTEM JENA PRAEZISIONSJU) 10 December 1998 (1998-12-10) column 4, line 26 -column 5, line 55; figures 1,2 ---	2-10,19, 20
Y	US 4 972 079 A (BLANDING DOUGLASS L) 20 November 1990 (1990-11-20) column 3, line 4 -column 4, line 21; figures 2-4 ---	2,3,7-9, 19,20
Y	DE 33 01 658 A (PERKIN ELMER CORP) 4 August 1983 (1983-08-04) page 5, line 33 -page 7, line 19; figures 1,3 ---	2,3,6-9, 19,20
Y	US 4 719 614 A (LETERME DOMINIQUE ET AL) 12 January 1988 (1988-01-12) column 5, line 25 - line 36; figure 11 ---	4,5, 10-18
Y	US 5 195 707 A (IGNATUK WAYNE R ET AL) 23 March 1993 (1993-03-23) column 2, line 64 -column 3, line 62; figures 3-5 -----	4,5, 10-18

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 01/45276

Box I Observations where certain claims were found unsearchable (Continuation of item 1 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 II Observations where unity of invention is lacking (Continuation of item 2 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.:

1-20, 37, 38

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: 1-20,37,38

subject 1 relates to a (de)multiplexer and a method of its alignment. The (de)multiplexer is distinguished by the mechanisms for mounting and fixing of two different optical elements to a frame and their readjustable alignment.

2. Claims: 21,22,23,24,25,26,27,28

subject 2 relates to a (de)multiplexer distinguished by the mechanism for the readjustable alignment and fixing of a waveguide array to a frame in the case where a grating is fixed to the frame.

3. Claims: 29,30,31,32,33,34,35,36,39,40,41,42,43,44,45,46,47

subject 3 relates to a thermally stabilized (de)multiplexer and a method of thermally stabilizing the (de)multiplexer.

4. Claims: 48,49,50,51,52,53,54,55,56,57,58,59,60,61,62,63,64

subject 4 relates to a vibrationally isolated (de)multiplexer, a vibration damping support for a frame carrying optical elements, and a method of isolating the (de)multiplexer from external vibrations.

INTERNATIONAL SEARCH REPORT
on patent family members

International Application No

PC1 01/45276

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
EP 0123237	A	31-10-1984	DE 3314820 A1 DE 3460424 D1 EP 0123237 A1	25-10-1984 11-09-1986 31-10-1984
EP 0654917	A	24-05-1995	US 5526155 A CA 2132559 A1 EP 0654917 A2 JP 2679953 B2 JP 7212346 A	11-06-1996 13-05-1995 24-05-1995 19-11-1997 11-08-1995
US 6134359	A	17-10-2000	CA 2246570 A1 EP 0902309 A1	05-03-1999 17-03-1999
DE 19723265	A	10-12-1998	DE 19723265 A1	10-12-1998
US 4972079	A	20-11-1990	DE 69017624 D1 DE 69017624 T2 EP 0434816 A1 JP 4500871 T WO 9101507 A2	13-04-1995 21-09-1995 03-07-1991 13-02-1992 07-02-1991
DE 3301658	A	04-08-1983	DE 3301658 A1 JP 58127904 A	04-08-1983 30-07-1983
US 4719614	A	12-01-1988	FR 2546310 A1 CA 1255138 A1 DE 3464807 D1 EP 0127516 A1 JP 59227042 A	23-11-1984 06-06-1989 20-08-1987 05-12-1984 20-12-1984
US 5195707	A	23-03-1993	NONE	