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(54) **Title:** LASER PROCESSING APPARATUS AND METHOD AND AN OPTICAL COMPONENT THEREFOR

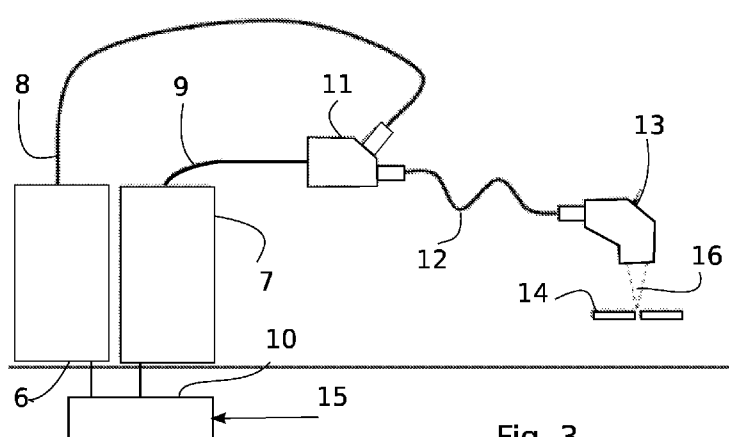


Fig. 3

(57) **Abstract:** The invention concerns an apparatus and its use for laser processing. The invention also concerns a method and an optical component. According to the invention, at a first laser device (6), providing a first optical feed fiber (8) and a second laser device (7) providing a second optical feed fiber (9) is provided. A beam combining means (11) connected to the first and second feed fibers and to a multi-core optical fiber (12) is adapted to form a composite laser beam by having the first optical feed fiber (8) aligned with a first core of the multi-core optical fiber and the second optical feed fiber aligned with at least one second core of the multi-core optical fiber (12). The first and second cores outputs a composite laser beam (16) to a workpiece (14) to be processed. A control unit (10) individually controls the power density of the output laser beams.



INTERNATIONAL SEARCH REPORT

International application No
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A. CLASSIFICATION OF SUBJECT MATTER
INV. G02B6/02 B23K26/06
ADD.

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)
G02B B23K

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)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2013/223792 A1 (HUBER RUDOLF [DE] ET AL) 29 August 2013 (2013-08-29)	1-4,9, 10,16,17
Y	paragraphs [0032] - [0049]; figures 1-4, 6 -----	5-8
Y	EP 1 909 366 A1 (FURUKAWA ELECTRIC CO LTD [JP]; UBE INDUSTRIES [JP]; REX IND CO [JP]) 9 April 2008 (2008-04-09)	5
	paragraphs [0037] - [0063]; figures 1-9, 13 -----	
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	paragraphs [0021] - [0035]; figures 1-6 -----	
A	US 2014/263208 A1 (KARLSEN SCOTT R [US] ET AL) 18 September 2014 (2014-09-18)	1-10
	the whole document ----- -/-	



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

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"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

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INTERNATIONAL SEARCH REPORT

International application No
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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.
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X	US 2014/010508 A1 (MATSUO SHOICHIRO [JP] ET AL) 9 January 2014 (2014-01-09) paragraphs [0035] - [0080]; figures 1-4 -----	11-13, 15-17 14
X	WO 2009/077637 A1 (CORELASE OY [FI]; SALOKATVE ARTO [FI]) 25 June 2009 (2009-06-25) the whole document -----	11-13, 15-17
X	KOSTERIN A ET AL: "Tapered fiber bundles for high power applications", 2005 OPTICAL FIBER COMMUNICATIONS CONFERENCE TECHNICAL DIGEST (IEEE CAT. NO. 05CH37672) IEEE PISCATAWAY, NJ, USA, IEEE, vol. 2, 6 March 2005 (2005-03-06), pages 146-148, XP010831431, ISBN: 978-1-55752-783-7 the whole document -----	11-13
Y	US 2005/094952 A1 (GONTHIER FRANCOIS [CA] ET AL) 5 May 2005 (2005-05-05) paragraphs [0036] - [0065]; figures 1-3, 8 -----	14

INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI2015/050402

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 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 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.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

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

1. claims: 1-10, 16, 17

Apparatus and method for laser processing of a workpiece

2. claims: 11-15

Optical component for combining and aligning laser beams

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/FI2015/050402

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