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Cc: PAIR_eOfficeAction@uspto.gov
Subject: Private PAIR Correspondence Notification for Customer Number 26161

Oct 13, 2016 05:38:20 AM

Dear PAIR Customer:

FISH & RICHARDSON P.C. (BO)
P.O. BOX 1022
MINNEAPOLIS, MN 55440-1022
UNITED STATES

The following USPTO patent application(s) associated with your Customer Number, 26161 , have new outgoing correspondence. This correspondence is now available for viewing in Private PAIR.

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Application	Document	Mailroom Date	Attorney Docket No.
14300138	ISSUE.NTF	10/12/2016	15540-0370002

To view your correspondence online or update your email addresses, please visit us anytime at <https://portal.uspto.gov/secure/myportal/privatepair>.

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Thank you for prompt attention to this notice,

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UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	ISSUE DATE	PATENT NO.	ATTORNEY DOCKET NO.	CONFIRMATION NO.
14/300,138	11/01/2016	9482821	15540-0370002	4091

26161 7590 10/12/2016
FISH & RICHARDSON P.C. (BO)
P.O. BOX 1022
MINNEAPOLIS, MN 55440-1022

ISSUE NOTIFICATION

The projected patent number and issue date are specified above.

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b) (application filed on or after May 29, 2000)

The Patent Term Adjustment is 106 day(s). Any patent to issue from the above-identified application will include an indication of the adjustment on the front page.

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) WEB site (<http://pair.uspto.gov>).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Application Assistance Unit (AAU) of the Office of Data Management (ODM) at (571)-272-4200.

APPLICANT(s) (Please see PAIR WEB site <http://pair.uspto.gov> for additional applicants):

Rudolf HUBER, Aldingen-Aixheim, GERMANY;
TRUMPF LASER- UND SYSTEMTECHNIK GMBH, Ditzingen, GERMANY;
Wolfgang ANDREASCH, Weinstadt, GERMANY;

The United States represents the largest, most dynamic marketplace in the world and is an unparalleled location for business investment, innovation, and commercialization of new technologies. The USA offers tremendous resources and advantages for those who invest and manufacture goods here. Through SelectUSA, our nation works to encourage and facilitate business investment. To learn more about why the USA is the best country in the world to develop technology, manufacture products, and grow your business, visit SelectUSA.gov.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

First Named Inventor :	Rudolph Huber	Art Unit :	2874
Serial No. :	14/300,138	Examiner :	Akm E. Ullah
Filed :	June 9, 2014	Confirmation No. :	4091
		Notice of Allowance Date:	July 1, 2016
Title :	METHOD AND ARRANGEMENT FOR GENERATING A LASER BEAM HAVING A DIFFERING BEAM PROFILE CHARACTERISTIC BY A MULTI-CLAD FIBER		

MAIL STOP ISSUE FEE

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

REPLY TO NOTICE OF ALLOWANCE

In response to the Notice of Allowance dated July 1, 2016, enclosed is a completed Part B - Fee(s) Transmittal.

The issue fee is being paid with this reply on the Electronic Filing System. Apply those fees and any other necessary charges or credits to Deposit Account 06 1050, referencing the above attorney docket number.

COMMENTS ON EXAMINER'S REASONS FOR ALLOWANCE

It is recognized that in accordance with M.P.E.P. § 1302.14, the Examiner's reasons for allowance need not set forth all of the details as to why the claims are allowed. In the above-referenced application, it is not conceded that the Examiner's stated reasons for allowance are the only reasons for which the claims are allowable. The Examiner's reasons for allowance indicate that particular claim elements are not disclosed or suggested by the prior art of record, yet the claims may be patentable for other reasons as well, including the inventive combination of all of the recited claim elements. It is not conceded that the specific limitations identified by the Examiner are necessary to distinguish the art of record or to satisfy the requirements of 35 U.S.C. § 112. Moreover, the Examiner does not assert, and it would not be conceded, that the Examiner's reasons have any bearing on the patentability of claims in any other applications directed to the disclosed subject matter.

First Named Inventor : Rudolph Huber
Serial No. : 14/300,138
Filed : June 9, 2014
Page : 2 of 2

Attorney's Docket No.: 15540-0370002 /
SP10120US(PCT) CON; 18.01127; DS10502

In addition, each dependent claim stands on its own and may be allowable on its own merits. In particular, each dependent claim may be allowable on the basis of a combination of some of the features recited in the dependent claim and its base claim(s), which combination of features may not include all of the limitations identified in the Examiner's reasons for allowance.

Respectfully submitted,

Date: 09/29/2016

/Yunbo Guo/
Yunbo Guo
Reg. No. 70,538

Customer Number 26161
Fish & Richardson P.C.
Telephone: (512) 226-8108
Facsimile: (877) 769-7945

23570535.doc

PART B - FEE(S) TRANSMITTAL

**Complete and send this form, together with applicable fee(s), to: Mail Mail Stop ISSUE FEE
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450
or Fax (571)-273-2885**

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

26161 7590 07/01/2016

FISH & RICHARDSON P.C.
P.O. BOX 1022
MINNEAPOLIS, MN 55440-1022

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being facsimile transmitted to the USPTO (571) 273-2885, on the date indicated below.

(Depositor's name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
14/300,138	06/09/2014	Rudolph Huber	15540-0370002	4091

TITLE OF INVENTION: METHOD AND ARRANGEMENT FOR GENERATING A LASER BEAM HAVING A DIFFERING BEAM PROFILE CHARACTERISTIC BY A MULTI-CLAD FIBER

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	LARGE	\$960	\$0		\$960	10/01/2016

EXAMINER	ART UNIT	CLASS-SUBCLASS
ULLAH, AKM E.	2874	

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

☐ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.

☐ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list

(1) the names of up to 3 registered patent attorneys or agents OR, alternatively,

1 Fish & Richardson P.C.

(2) the name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

2 _____
3 _____

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document has been filed for recordation as set forth in 37 CFR 3.11. Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE

TRUMPF Laser- und Systemtechnik GmbH

(B) RESIDENCE: (CITY and STATE OR COUNTRY)

Ditzingen, Germany

Please check the appropriate assignee category or categories (will not be printed on the patent): ☐ Individual ☒ Corporation or other private group entity ☐ Government

4a. The following fee(s) are submitted:

☒ Issue Fee

☐ Publication Fee (No small entity discount permitted)

☐ Advance Order - # of Copies _____

4b. Payment of Fee(s): (Please first reapply any previously paid issue fee shown above)

☐ A check in the amount of the fee(s) is enclosed.

☐ Payment by credit card. Form PTO-2038 is attached.

☒ The Director is hereby authorized to charge the required fee(s), or credit any overpayment, to Deposit Account Number 06-1050

5. Change in Entity Status (from status indicated above)

☐ Applicant certifying micro entity status. See 37 CFR 1.29

☐ Applicant asserting small entity status. See 37 CFR 1.27.

☐ Applicant changing to regular undiscounted fee status.

NOTE: Absent a valid certification of Micro Entity Status (see form PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.

NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.

NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

The Director of the USPTO is requested to apply the Issue Fee and Publication Fee (if any) or to re-apply any previously paid issue fee to the application identified above. NOTE: The Issue Fee and Publication Fee (if required) will not be accepted from anyone other than the applicant; a registered attorney or agent; or the assignee or other party in interest as shown by the records of the United States Patent and Trademark Office.

Authorized Signature /Yunbo Guo/

Date 09/29/2016

Typed or printed name Yunbo Guo

Registration No. 70,538

Electronic Patent Application Fee Transmittal				
Application Number:		14300138		
Filing Date:		09-Jun-2014		
Title of Invention:		METHOD AND ARRANGEMENT FOR GENERATING A LASER BEAM HAVING A DIFFERING BEAM PROFILE CHARACTERISTIC BY A MULTI-CLAD FIBER		
First Named Inventor/Applicant Name:		Rudolf HUBER		
Filer:		Yunbo Guo/Matthew Doherty		
Attorney Docket Number:		15540-0370002		
Filed as Large Entity				
Filing Fees for Utility under 35 USC 111(a)				
Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
UTILITY APPL ISSUE FEE	1501	1	960	960

Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Extension-of-Time:				
Miscellaneous:				
Total in USD (\$)				960

Electronic Acknowledgement Receipt	
EFS ID:	27068627
Application Number:	14300138
International Application Number:	
Confirmation Number:	4091
Title of Invention:	METHOD AND ARRANGEMENT FOR GENERATING A LASER BEAM HAVING A DIFFERING BEAM PROFILE CHARACTERISTIC BY A MULTI-CLAD FIBER
First Named Inventor/Applicant Name:	Rudolf HUBER
Customer Number:	26161
Filer:	Yunbo Guo/Trisha Hawley
Filer Authorized By:	Yunbo Guo
Attorney Docket Number:	15540-0370002
Receipt Date:	29-SEP-2016
Filing Date:	09-JUN-2014
Time Stamp:	11:36:55
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	DA
Payment was successfully received in RAM	\$960
RAM confirmation Number	092916INTEFSW00012653061050
Deposit Account	
Authorized User	
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:	

File Listing:					
Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Issue Fee Payment (PTO-85B)	Response0370002.pdf	157487	no	3
			a3f338ff6f68e30a840c50d46f2b139047bed38c		
Warnings:					
Information:					
2	Fee Worksheet (SB06)	fee-info.pdf	30855	no	2
			aa0a59d98b8ea4bcb8b7a1adfdf8b0f805a49da14		
Warnings:					
Information:					
Total Files Size (in bytes):			188342		
This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503. <u>New Applications Under 35 U.S.C. 111</u> If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application. <u>National Stage of an International Application under 35 U.S.C. 371</u> If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course. <u>New International Application Filed with the USPTO as a Receiving Office</u> If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.					

To: PATDOCTC@fr.com,,
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Cc: PAIR_eOfficeAction@uspto.gov
Subject: Private PAIR Correspondence Notification for Customer Number 26161

Jul 13, 2016 05:26:59 AM

Dear PAIR Customer:

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P.O. BOX 1022
MINNEAPOLIS, MN 55440-1022
UNITED STATES

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Application	Document	Mailroom Date	Attorney Docket No.
14300138	APP.FILE.REC	07/13/2016	15540-0370002

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UNITED STATES DEPARTMENT OF COMMERCE
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APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY. DOCKET NO	TOT CLAIMS	IND CLAIMS
14/300,138	06/09/2014	2874	1840	15540-0370002	16	3

CONFIRMATION NO. 4091
CORRECTED FILING RECEIPT

26161
FISH & RICHARDSON P.C. (BO)
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MINNEAPOLIS, MN 55440-1022



000000084322732

Date Mailed: 07/13/2016

Receipt is acknowledged of this non-provisional patent application. The application will be taken up for examination in due course. Applicant will be notified as to the results of the examination. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF APPLICANT, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection. Please verify the accuracy of the data presented on this receipt. **If an error is noted on this Filing Receipt, please submit a written request for a Filing Receipt Correction. Please provide a copy of this Filing Receipt with the changes noted thereon. If you received a "Notice to File Missing Parts" for this application, please submit any corrections to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections**

Inventor(s)

Rudolf HUBER, Aldingen-Aixheim, GERMANY;
Wolfgang ANDREASCH, Weinstadt, GERMANY;

Applicant(s)

TRUMPF LASER- UND SYSTEMTECHNIK GMBH, Ditzingen, GERMANY;

Assignment For Published Patent Application

TRUMPF LASER- UND SYSTEMTECHNIK GMBH, Ditzingen, GERMANY

Power of Attorney: The patent practitioners associated with Customer Number 26161

Domestic Priority data as claimed by applicant

This application is a CON of 13/639,401 12/20/2012 PAT 8781269
which is a 371 of PCT/EP2011/055484 04/08/2011

Foreign Applications (You may be eligible to benefit from the **Patent Prosecution Highway** program at the USPTO. Please see <http://www.uspto.gov> for more information.)
GERMANY 10 2010 003 750.8 04/08/2010

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Permission to Access Search Results: No

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If Required, Foreign Filing License Granted: 07/08/2016

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 14/300,138**

Projected Publication Date: Not Applicable

Non-Publication Request: No

Early Publication Request: No
Title

METHOD AND ARRANGEMENT FOR GENERATING A LASER BEAM HAVING A DIFFERING
BEAM PROFILE CHARACTERISTIC BY A MULTI-CLAD FIBER

Preliminary Class

385

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications: No

PROTECTING YOUR INVENTION OUTSIDE THE UNITED STATES

Since the rights granted by a U.S. patent extend only throughout the territory of the United States and have no effect in a foreign country, an inventor who wishes patent protection in another country must apply for a patent in a specific country or in regional patent offices. Applicants may wish to consider the filing of an international application under the Patent Cooperation Treaty (PCT). An international (PCT) application generally has the same effect as a regular national patent application in each PCT-member country. The PCT process **simplifies** the filing of patent applications on the same invention in member countries, but **does not result** in a grant of "an international patent" and does not eliminate the need of applicants to file additional documents and fees in countries where patent protection is desired.

Almost every country has its own patent law, and a person desiring a patent in a particular country must make an application for patent in that country in accordance with its particular laws. Since the laws of many countries differ in various respects from the patent law of the United States, applicants are advised to seek guidance from specific foreign countries to ensure that patent rights are not lost prematurely.

Applicants also are advised that in the case of inventions made in the United States, the Director of the USPTO must issue a license before applicants can apply for a patent in a foreign country. The filing of a U.S. patent application serves as a request for a foreign filing license. The application's filing receipt contains further information and guidance as to the status of applicant's license for foreign filing.

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For information on preventing theft of your intellectual property (patents, trademarks and copyrights), you may wish to consult the U.S. Government website, <http://www.stopfakes.gov>. Part of a Department of Commerce initiative, this website includes self-help "toolkits" giving innovators guidance on how to protect intellectual property in specific countries such as China, Korea and Mexico. For questions regarding patent enforcement issues, applicants may call the U.S. Government hotline at 1-866-999-HALT (1-866-999-4258).

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Title 35, United States Code, Section 184
Title 37, Code of Federal Regulations, 5.11 & 5.15

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The grant of a license does not in any way lessen the responsibility of a licensee for the security of the subject matter as imposed by any Government contract or the provisions of existing laws relating to espionage and the national security or the export of technical data. Licensees should apprise themselves of current regulations especially with respect to certain countries, of other agencies, particularly the Office of Defense Trade Controls, Department of State (with respect to Arms, Munitions and Implements of War (22 CFR 121-128)); the Bureau of Industry and Security, Department of Commerce (15 CFR parts 730-774); the Office of Foreign Assets Control, Department of Treasury (31 CFR Parts 500+) and the Department of Energy.

NOT GRANTED

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To: PATDOCTC@fr.com,,
From: PAIR_eOfficeAction@uspto.gov
Cc: PAIR_eOfficeAction@uspto.gov
Subject: Private PAIR Correspondence Notification for Customer Number 26161

Jul 11, 2016 05:28:33 AM

Dear PAIR Customer:

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P.O. BOX 1022
MINNEAPOLIS, MN 55440-1022
UNITED STATES

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PATENT APPLICATION INFORMATION RETRIEVAL SYSTEM



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APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY. DOCKET NO	TOT CLAIMS	IND CLAIMS
14/300,138	06/09/2014	2874	1840	15540-0370002	16	3

CONFIRMATION NO. 4091
CORRECTED FILING RECEIPT

26161
FISH & RICHARDSON P.C. (BO)
P.O. BOX 1022
MINNEAPOLIS, MN 55440-1022



000000084244535

Date Mailed: 07/11/2016

Receipt is acknowledged of this non-provisional patent application. The application will be taken up for examination in due course. Applicant will be notified as to the results of the examination. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF APPLICANT, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection. Please verify the accuracy of the data presented on this receipt. **If an error is noted on this Filing Receipt, please submit a written request for a Filing Receipt Correction. Please provide a copy of this Filing Receipt with the changes noted thereon. If you received a "Notice to File Missing Parts" for this application, please submit any corrections to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections**

Inventor(s)

Rudolf HUBER, Aldingen-Aixheim, GERMANY;
Wolfgang ANDREASCH, Weinstadt, GERMANY;

Applicant(s)

TRUMPF LASER- UND SYSTEMTECHNIK GMBH, Ditzingen, GERMANY;

Assignment For Published Patent Application

TRUMPF LASER- UND SYSTEMTECHNIK GMBH, Ditzingen, GERMANY

Power of Attorney: The patent practitioners associated with Customer Number 26161

Domestic Priority data as claimed by applicant

This application is a CON of 13/639,401 12/20/2012 PAT 8781269
which is a 371 of PCT/EP2011/055484 04/08/2011

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GERMANY 10 2010 003 750.8 04/08/2010

Permission to Access Application via Priority Document Exchange: Yes

Permission to Access Search Results: No

Applicant may provide or rescind an authorization for access using Form PTO/SB/39 or Form PTO/SB/69 as appropriate.

If Required, Foreign Filing License Granted: 07/08/2016

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 14/300,138**

Projected Publication Date: Not Applicable

Non-Publication Request: No

Early Publication Request: No
Title

METHOD AND ARRANGEMENT FOR THE GENERATING A LASER BEAM HAVING A DIFFERING BEAM PROFILE CHARACTERISTIC BY A MULTI-CLAD FIBER

Preliminary Class

385

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications: No

PROTECTING YOUR INVENTION OUTSIDE THE UNITED STATES

Since the rights granted by a U.S. patent extend only throughout the territory of the United States and have no effect in a foreign country, an inventor who wishes patent protection in another country must apply for a patent in a specific country or in regional patent offices. Applicants may wish to consider the filing of an international application under the Patent Cooperation Treaty (PCT). An international (PCT) application generally has the same effect as a regular national patent application in each PCT-member country. The PCT process **simplifies** the filing of patent applications on the same invention in member countries, but **does not result** in a grant of "an international patent" and does not eliminate the need of applicants to file additional documents and fees in countries where patent protection is desired.

Almost every country has its own patent law, and a person desiring a patent in a particular country must make an application for patent in that country in accordance with its particular laws. Since the laws of many countries differ in various respects from the patent law of the United States, applicants are advised to seek guidance from specific foreign countries to ensure that patent rights are not lost prematurely.

Applicants also are advised that in the case of inventions made in the United States, the Director of the USPTO must issue a license before applicants can apply for a patent in a foreign country. The filing of a U.S. patent application serves as a request for a foreign filing license. The application's filing receipt contains further information and guidance as to the status of applicant's license for foreign filing.

Applicants may wish to consult the USPTO booklet, "General Information Concerning Patents" (specifically, the section entitled "Treaties and Foreign Patents") for more information on timeframes and deadlines for filing foreign patent applications. The guide is available either by contacting the USPTO Contact Center at 800-786-9199, or it can be viewed on the USPTO website at <http://www.uspto.gov/web/offices/pac/doc/general/index.html>.

For information on preventing theft of your intellectual property (patents, trademarks and copyrights), you may wish to consult the U.S. Government website, <http://www.stopfakes.gov>. Part of a Department of Commerce initiative, this website includes self-help "toolkits" giving innovators guidance on how to protect intellectual property in specific countries such as China, Korea and Mexico. For questions regarding patent enforcement issues, applicants may call the U.S. Government hotline at 1-866-999-HALT (1-866-999-4258).

LICENSE FOR FOREIGN FILING UNDER
Title 35, United States Code, Section 184
Title 37, Code of Federal Regulations, 5.11 & 5.15

GRANTED

The applicant has been granted a license under 35 U.S.C. 184, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" followed by a date appears on this form. Such licenses are issued in all applications where the conditions for issuance of a license have been met, regardless of whether or not a license may be required as set forth in 37 CFR 5.15. The scope and limitations of this license are set forth in 37 CFR 5.15(a) unless an earlier license has been issued under 37 CFR 5.15(b). The license is subject to revocation upon written notification. The date indicated is the effective date of the license, unless an earlier license of similar scope has been granted under 37 CFR 5.13 or 5.14.

This license is to be retained by the licensee and may be used at any time on or after the effective date thereof unless it is revoked. This license is automatically transferred to any related applications(s) filed under 37 CFR 1.53(d). This license is not retroactive.

The grant of a license does not in any way lessen the responsibility of a licensee for the security of the subject matter as imposed by any Government contract or the provisions of existing laws relating to espionage and the national security or the export of technical data. Licensees should apprise themselves of current regulations especially with respect to certain countries, of other agencies, particularly the Office of Defense Trade Controls, Department of State (with respect to Arms, Munitions and Implements of War (22 CFR 121-128)); the Bureau of Industry and Security, Department of Commerce (15 CFR parts 730-774); the Office of Foreign Assets Control, Department of Treasury (31 CFR Parts 500+) and the Department of Energy.

NOT GRANTED

No license under 35 U.S.C. 184 has been granted at this time, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" DOES NOT appear on this form. Applicant may still petition for a license under 37 CFR 5.12, if a license is desired before the expiration of 6 months from the filing date of the application. If 6 months has lapsed from the filing date of this application and the licensee has not received any indication of a secrecy order under 35 U.S.C. 181, the licensee may foreign file the application pursuant to 37 CFR 5.15(b).

SelectUSA

The United States represents the largest, most dynamic marketplace in the world and is an unparalleled location for business investment, innovation, and commercialization of new technologies. The U.S. offers tremendous resources and advantages for those who invest and manufacture goods here. Through SelectUSA, our nation works to promote and facilitate business investment. SelectUSA provides information assistance to the international investor community; serves as an ombudsman for existing and potential investors; advocates on behalf of U.S. cities, states, and regions competing for global investment; and counsels U.S. economic development organizations on investment attraction best practices. To learn more about why the United States is the best country in the world to develop technology, manufacture products, deliver services, and grow your business, visit <http://www.SelectUSA.gov> or call +1-202-482-6800.

To: PATDOCTC@fr.com,,
From: PAIR_eOfficeAction@uspto.gov
Cc: PAIR_eOfficeAction@uspto.gov
Subject: Private PAIR Correspondence Notification for Customer Number 26161

Jul 01, 2016 05:37:07 AM

Dear PAIR Customer:

FISH & RICHARDSON P.C. (BO)
P.O. BOX 1022
MINNEAPOLIS, MN 55440-1022
UNITED STATES

The following USPTO patent application(s) associated with your Customer Number, 26161 , have new outgoing correspondence. This correspondence is now available for viewing in Private PAIR.

The official date of notification of the outgoing correspondence will be indicated on the form PTOL-90 accompanying the correspondence.

Disclaimer:

The list of documents shown below is provided as a courtesy and is not part of the official file wrapper. The content of the images shown in PAIR is the official record.

Application	Document	Mailroom Date	Attorney Docket No.
14300138	NOA	07/01/2016	15540-0370002
	892	07/01/2016	15540-0370002
	1449	07/01/2016	15540-0370002

To view your correspondence online or update your email addresses, please visit us anytime at <https://sportal.uspto.gov/secure/myportal/privatepair>.

If you have any questions, please email the Electronic Business Center (EBC) at EBC@uspto.gov with 'e-Office Action' on the subject line or call 1-866-217-9197 during the following hours:

Monday - Friday 6:00 a.m. to 12:00 a.m.

Thank you for prompt attention to this notice,

UNITED STATES PATENT AND TRADEMARK OFFICE
PATENT APPLICATION INFORMATION RETRIEVAL SYSTEM



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

NOTICE OF ALLOWANCE AND FEE(S) DUE

26161 7590 07/01/2016
FISH & RICHARDSON P.C. (BO)
P.O. BOX 1022
MINNEAPOLIS, MN 55440-1022

EXAMINER

ULLAH, AKM E

ART UNIT

PAPER NUMBER

2874

DATE MAILED: 07/01/2016

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
14/300,138	06/09/2014	Rudolf HUBER	15540-0370002	4091

TITLE OF INVENTION: METHOD AND ARRANGEMENT FOR THE GENERATION OF A LASER BEAM WITH DIFFERENT BEAM PROFILE
CHARACTERISTICS BY MEANS OF A MULTI-CLAD FIBRE

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	\$960	\$0	\$0	\$960	10/03/2016

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.

THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE DOES NOT REFLECT A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE IN THIS APPLICATION. IF AN ISSUE FEE HAS PREVIOUSLY BEEN PAID IN THIS APPLICATION (AS SHOWN ABOVE), THE RETURN OF PART B OF THIS FORM WILL BE CONSIDERED A REQUEST TO REAPPLY THE PREVIOUSLY PAID ISSUE FEE TOWARD THE ISSUE FEE NOW DUE.

HOW TO REPLY TO THIS NOTICE:

I. Review the ENTITY STATUS shown above. If the ENTITY STATUS is shown as SMALL or MICRO, verify whether entitlement to that entity status still applies.

If the ENTITY STATUS is the same as shown above, pay the TOTAL FEE(S) DUE shown above.

If the ENTITY STATUS is changed from that shown above, on PART B - FEE(S) TRANSMITTAL, complete section number 5 titled "Change in Entity Status (from status indicated above)".

For purposes of this notice, small entity fees are 1/2 the amount of undiscounted fees, and micro entity fees are 1/2 the amount of small entity fees.

II. PART B - FEE(S) TRANSMITTAL, or its equivalent, must be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed and an extra copy of the form should be submitted. If an equivalent of Part B is filed, a request to reapply a previously paid issue fee must be clearly made, and delays in processing may occur due to the difficulty in recognizing the paper as an equivalent of Part B.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Utility patents issuing on applications filed on or after Dec. 12, 1980 may require payment of maintenance fees. It is patentee's responsibility to ensure timely payment of maintenance fees when due.

PART B - FEE(S) TRANSMITTAL

**Complete and send this form, together with applicable fee(s), to: Mail Mail Stop ISSUE FEE
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450
or Fax (571)-273-2885**

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

26161 7590 07/01/2016
FISH & RICHARDSON P.C. (BO)
P.O. BOX 1022
MINNEAPOLIS, MN 55440-1022

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being facsimile transmitted to the USPTO (571) 273-2885, on the date indicated below.

(Depositor's name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
14/300,138	06/09/2014	Rudolf HUBER	15540-0370002	4091

TITLE OF INVENTION: METHOD AND ARRANGEMENT FOR THE GENERATION OF A LASER BEAM WITH DIFFERENT BEAM PROFILE CHARACTERISTICS BY MEANS OF A MULTI-CLAD FIBRE

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	\$960	\$0	\$0	\$960	10/03/2016

EXAMINER	ART UNIT	CLASS-SUBCLASS
ULLAH, AKME	2874	385-018000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

- ☐ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.
- ☐ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list

- (1) The names of up to 3 registered patent attorneys or agents OR, alternatively, 1 _____
- (2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed. 2 _____
- 3 _____

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document has been filed for recordation as set forth in 37 CFR 3.11. Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE

(B) RESIDENCE: (CITY and STATE OR COUNTRY)

Please check the appropriate assignee category or categories (will not be printed on the patent): ☐ Individual ☐ Corporation or other private group entity ☐ Government

4a. The following fee(s) are submitted:

- ☐ Issue Fee
- ☐ Publication Fee (No small entity discount permitted)
- ☐ Advance Order - # of Copies _____

4b. Payment of Fee(s): (Please first reapply any previously paid issue fee shown above)

- ☐ A check is enclosed.
- ☐ Payment by credit card. Form PTO-2038 is attached.
- ☐ The director is hereby authorized to charge the required fee(s), any deficiency, or credits any overpayment, to Deposit Account Number _____ (enclose an extra copy of this form).

5. Change in Entity Status (from status indicated above)

- ☐ Applicant certifying micro entity status. See 37 CFR 1.29
- ☐ Applicant asserting small entity status. See 37 CFR 1.27
- ☐ Applicant changing to regular undiscounted fee status.

NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.

NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.

NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature _____ Date _____

Typed or printed name _____ Registration No. _____



UNITED STATES PATENT AND TRADEMARK OFFICE

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
14/300,138	06/09/2014	Rudolf HUBER	15540-0370002	4091

26161	7590	07/01/2016
FISH & RICHARDSON P.C. (BO)		
P.O. BOX 1022		
MINNEAPOLIS, MN 55440-1022		

EXAMINER	
ULLAH, AKM E	

ART UNIT	PAPER NUMBER
2874	

DATE MAILED: 07/01/2016

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b) (Applications filed on or after May 29, 2000)

The Office has discontinued providing a Patent Term Adjustment (PTA) calculation with the Notice of Allowance.

Section 1(h)(2) of the AIA Technical Corrections Act amended 35 U.S.C. 154(b)(3)(B)(i) to eliminate the requirement that the Office provide a patent term adjustment determination with the notice of allowance. See Revisions to Patent Term Adjustment, 78 Fed. Reg. 19416, 19417 (Apr. 1, 2013). Therefore, the Office is no longer providing an initial patent term adjustment determination with the notice of allowance. The Office will continue to provide a patent term adjustment determination with the Issue Notification Letter that is mailed to applicant approximately three weeks prior to the issue date of the patent, and will include the patent term adjustment on the patent. Any request for reconsideration of the patent term adjustment determination (or reinstatement of patent term adjustment) should follow the process outlined in 37 CFR 1.705.

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.

OMB Clearance and PRA Burden Statement for PTOL-85 Part B

The Paperwork Reduction Act (PRA) of 1995 requires Federal agencies to obtain Office of Management and Budget approval before requesting most types of information from the public. When OMB approves an agency request to collect information from the public, OMB (i) provides a valid OMB Control Number and expiration date for the agency to display on the instrument that will be used to collect the information and (ii) requires the agency to inform the public about the OMB Control Number's legal significance in accordance with 5 CFR 1320.5(b).

The information collected by PTOL-85 Part B is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450. Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Notice of Allowability	Application No. 14/300,138	Applicant(s) HUBER ET AL.	
	Examiner Akm Enayet Ullah	Art Unit 2874	AIA (First Inventor to File) Status No

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to 5/16/2016.
☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.
2. ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.
3. ☒ The allowed claim(s) is/are 17-27. As a result of the allowed claim(s), you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to PPHfeedback@uspto.gov.
4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

Certified copies:

- a) ☐ All b) ☐ Some *c) ☐ None of the:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

* Certified copies not received: _____.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.

THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____.
Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).
6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

- | | |
|---|--|
| 1. ☒ Notice of References Cited (PTO-892) | 5. ☒ Examiner's Amendment/Comment |
| 2. ☒ Information Disclosure Statements (PTO/SB/08),
Paper No./Mail Date <u>5/16/2016</u> | 6. ☒ Examiner's Statement of Reasons for Allowance |
| 3. ☐ Examiner's Comment Regarding Requirement for Deposit
of Biological Material | 7. ☐ Other _____. |
| 4. ☐ Interview Summary (PTO-413),
Paper No./Mail Date _____. | |

/Akm Enayet Ullah/
Primary Examiner, Art Unit 2874

The present application is being examined under the pre-AIA first to invent provisions.

EXAMINER'S AMENDMENT

An examiner's amendment to the record appears below. Should the changes and/or additions be unacceptable to applicant, an amendment may be filed as provided by 37 CFR 1.312. To ensure consideration of such an amendment, it MUST be submitted no later than the payment of the issue fee.

The application has been amended as follows:

A two way restriction was made in this application dated 11/23/2015.

Applicant's attorney elected without traverse claims 17- 27 for the examination purpose. Thus,

Cancel claims 28-39.

Note that claims 1-16 have been canceled by applicant dated June 09, 2014.

The following is an examiner's statement of reasons for allowance:

None of the reference disclose alone or in combination a method of coupling an input laser beam into a fiber end of an optical fiber that has at least an inner fiber core and an outer ring core, wherein coupling an input laser beam comprises electively coupling the input laser beam into either the inner fiber core alone or both the inner fiber core and the outer ring core; and

generating an output laser beam by interaction of the input laser beam with the optical fiber, wherein a beam profile characteristic of the output laser beam differs depending upon the elective coupling.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Contact Information

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Akm Enayet Ullah whose telephone number is (571)272-2361. The examiner can normally be reached on Mon.-Thursday 6:30-5:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Uyen-Chau Le can be reached on 571-272-2397. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Akm Enayet Ullah/
Primary Examiner
Art Unit 2874

AU

Notice of References Cited	Application/Control No. 14/300,138	Applicant(s)/Patent Under Reexamination HUBER ET AL.	
	Examiner Akm Enayet Ullah	Art Unit 2874	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	CPC Classification	US Classification
*	A	US-2013/0064706 A1	03-2013	Schwarze; Dieter	B22F3/1055	419/1
	B	US-				
	C	US-				
	D	US-				
	E	US-				
	F	US-				
	G	US-				
	H	US-				
	I	US-				
	J	US-				
	K	US-				
	L	US-				
	M	US-				

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	CPC Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
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*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

Receipt date: 05/16/2016

/A.U./ 06/01/2016

14300138 - GAU: 2874

First Named Inventor : Rudolph Huber
Serial No. : 14/300,138
Filed : June 9, 2014
Page : 2 of 3

Attorney's Docket No.: 15540-0370002 /
SP10120US(PCT) CON; 18.01127; DS10502

OK TO ENTER: /A.U./

Amendments to the Specification:

Please replace the title as follows:

METHOD AND ARRANGEMENT FOR GENERATING A LASER BEAM HAVING
A DIFFERING BEAM PROFILE CHARACTERISTIC BY A MULTI-CLAD FIBER

Issue Classification 	Application/Control No. 14300138	Applicant(s)/Patent Under Reexamination HUBER ET AL.	
	Examiner Akm Enayet Ullah	Art Unit 2874	

CPC					
Symbol				Type	Version
G02B	6	35		F	2013-01-01
B23K	26	073		I	2013-01-01
B23K	2203	06		A	2013-01-01
G02B	6	03644		A	2013-01-01
G02B	6	262		I	2013-01-01
G02B	6	4206		I	2013-01-01
G02B	6	4296		I	2013-01-01
G02B	6	02042		I	2013-01-01
G02B	6	3508		I	2013-01-01
B23K	26	064		I	2015-10-01

CPC Combination Sets					
Symbol	Type	Set	Ranking	Version	

NONE		Total Claims Allowed:	
(Assistant Examiner)	(Date)	11	
/Akm Enayet Ullah/ Primary Examiner.Art Unit 2874	06-16-2016	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	3

Issue Classification 	Application/Control No. 14300138	Applicant(s)/Patent Under Reexamination HUBER ET AL.
	Examiner Akm Enayet Ullah	Art Unit 2874

US ORIGINAL CLASSIFICATION						INTERNATIONAL CLASSIFICATION													
CLASS		SUBCLASS				CLAIMED					NON-CLAIMED								
385		14				G	0	2	B	6 / 36 (2006.01.01)									
CROSS REFERENCE(S)						G	0	2	B	6 / 35 (2006.01.01)									
CLASS	SUBCLASS (ONE SUBCLASS PER BLOCK)																		

NONE		Total Claims Allowed:	
		11	
(Assistant Examiner)	(Date)		
/Akm Enayet Ullah/ Primary Examiner.Art Unit 2874	06-16-2016	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	3

Issue Classification 	Application/Control No. 14300138	Applicant(s)/Patent Under Reexamination HUBER ET AL.
	Examiner Akm Enayet Ullah	Art Unit 2874

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47															
Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original
-	1	1	17	-	33										
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-	16	-	32												

NONE (Assistant Examiner) _____ (Date) _____		Total Claims Allowed: 11	
/Akm Enayet Ullah/ Primary Examiner.Art Unit 2874 (Primary Examiner) _____ (Date) _____		06-16-2016 O.G. Print Claim(s) 1	O.G. Print Figure 3

Search Notes 	Application/Control No. 14300138	Applicant(s)/Patent Under Reexamination HUBER ET AL.
	Examiner AKM ULLAH	Art Unit 2874

CPC- SEARCHED		
Symbol	Date	Examiner
B23K 26/064 20151001; G02B 6/4296 20130101; G02B 6/02042 20130101; G02B 6/35 20130101; G02B 6/3508 20130101; G02B 6/4206 20130101 International Class: G02B 6/35 20060101 G02B006/35; G02B 6/42	2/18/2016	AU

CPC COMBINATION SETS - SEARCHED		
Symbol	Date	Examiner

US CLASSIFICATION SEARCHED			
Class	Subclass	Date	Examiner
385	14-42	11/17/2015	AU
Updated above		6/16/2016	AU

SEARCH NOTES		
Search Notes	Date	Examiner
EAST, ASSIGNEE and INVENTOR	11/17/2015	AU
Updated above	6/16/2016	AU

INTERFERENCE SEARCH			
US Class/ CPC Symbol	US Subclass / CPC Group	Date	Examiner
All the classes and subclasses mentioned above		6/16/2016	AU

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CONFIRMATION NO. 4091

SERIAL NUMBER	FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.		
14/300,138	06/09/2014	385	2874	15540-0370002		
RULE						
APPLICANTS TRUMPF LASER- UND SYSTEMTECHNIK GMBH, Ditzingen, GERMANY;						
INVENTORS Rudolf HUBER, Aldingen-Aixheim, GERMANY; Wolfgang ANDREASCH, Weinstadt, GERMANY;						
** CONTINUING DATA ***** This application is a CON of 13/639,401 12/20/2012 PAT 8781269 which is a 371 of PCT/EP2011/055484 04/08/2011						
** FOREIGN APPLICATIONS ***** GERMANY 10 2010 003 750.8 04/08/2010						
** IF REQUIRED, FOREIGN FILING LICENSE GRANTED **						
Foreign Priority claimed ☒ Yes ☐ No 35 USC 119(a-d) conditions met ☒ Yes ☐ No Verified and Acknowledged /AKM E ULLAH/ Examiner's Signature		☐ Met after Allowance AU Initials	STATE OR COUNTRY GERMANY	SHEETS DRAWINGS 5	TOTAL CLAIMS 16	INDEPENDENT CLAIMS 3
ADDRESS FISH & RICHARDSON P.C. (BO) P.O. BOX 1022 MINNEAPOLIS, MN 55440-1022 UNITED STATES						
TITLE Method and Arrangement for the Generation of a Laser Beam With Different Beam Profile Characteristics by Means of a Multi-Clad Fibre						
FILING FEE RECEIVED 1840	FEES: Authority has been given in Paper No. _____ to charge/credit DEPOSIT ACCOUNT No. _____ for following:			☐ All Fees ☐ 1.16 Fees (Filing) ☐ 1.17 Fees (Processing Ext. of time) ☐ 1.18 Fees (Issue) ☐ Other _____ ☐ Credit		

Doc code: IDS

PTO/SB/08a (01-10)

Doc description: Information Disclosure Statement (IDS) Filed

Approved for use through 07/31/2012. OMB 0651-0031

U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number	14300138
	Filing Date	2014-06-09
	First Named Inventor	Rudolph Huber
	Art Unit	2874
	Examiner Name	Akm E. Ullah
	Attorney Docket Number	15540-0370002

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /A.U./

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Examiner Initial*	Cite No	Patent Number	Kind Code ¹	Issue Date	Name of Patentee or Applicant of cited Document	Pages, Columns, Lines where Relevant Passages or Relevant Figures Appear		
	1	8326099	B2	2012-12-04	Singer et al	English equivalent to WO 2010/009101		
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Examiner Initial*	Cite No	Foreign Document Number ³	Country Code ²ⁱ	Kind Code ⁴	Publication Date	Name of Patentee or Applicant of cited Document	Pages, Columns, Lines where Relevant Passages or Relevant Figures Appear	T ⁵
	1	100750511	KR	B1	2007-08-13		English Abstract	×
	2	WO2010009101	WO	A2	2010-01-21			☐
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**INFORMATION DISCLOSURE
STATEMENT BY APPLICANT**
(Not for submission under 37 CFR 1.99)

Application Number	14300138
Filing Date	2014-06-09
First Named Inventor	Rudolph Huber
Art Unit	2874
Examiner Name	Akm E. Ullah
Attorney Docket Number	15540-0370002

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T ⁵
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EXAMINER SIGNATURE

Examiner Signature	/Akm Enayet Ullah/	Date Considered	06/01/2016
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*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

¹ See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. ² Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). ³ For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. ⁴ Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. ⁵ Applicant is to place a check mark here if English language translation is attached.

EAST Search History**EAST Search History (Interference)**

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L13	0	((coupl\$4 adj2 laser adj2 beam) near10 (fiber or fibre)) same ((inner adj2 core) same (outer adj2 reing adj3 core)).clm.	USPAT	OR	OFF	2016/06/20 12:42
L14	0	((coupl\$4 adj2 laser adj2 beam) near10 (fiber or fibre)) and ((inner adj2 core) same (outer adj2 reing adj3 core)).clm.	USPAT	OR	OFF	2016/06/20 12:43
L15	0	(generating adj3 output adj3 laser adj3 beam) same (interaction) same (differs adj3 depending).clm.	USPAT	OR	OFF	2016/06/20 12:43
L16	1	(generating adj3 output adj3 laser adj3 beam) same (interaction) same (differs adj3 depending).clm.	US-PGPUB; USPAT	OR	OFF	2016/06/20 12:43
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L18	134	((coupl\$4 adj2 laser adj2 beam) near10 (fiber or fibre)).clm.	US-PGPUB; USPAT	OR	OFF	2016/06/20 12:43
L19	3	(beam adj3 profile) same (laser adj5 beam near10 differs) same (coupl\$4).clm.	US-PGPUB; USPAT	OR	OFF	2016/06/20 12:44
L20	1	18 and 19	US-PGPUB; USPAT	OR	OFF	2016/06/20 12:44

6/ 20/ 2016 12:45:17 PM

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EAST Search History**EAST Search History (Interference)**

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L19	3	(beam adj3 profile) same (laser adj5 beam near10 differs) same (coupl\$4).clm.	US-PGPUB; USPAT	OR	OFF	2016/06/20 12:44
L20	1	18 and 19	US-PGPUB; USPAT	OR	OFF	2016/06/20 12:44

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EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
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L2	538	(HUBER near3 Rudolf).in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2016/06/20 12:19
L3	75	(ANDREASCH near3 Wolfgang).in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2016/06/20 12:20
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L6	0	((coupl\$4 adj2 laser adj2 beam near10 (fiber or fibre)) same ((inner adj2 core)same (outer adj2 reing adj3 core))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2016/06/20 12:24
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L9	0	((inner adj2 core)same(outer adj2 reing adj3 core))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2016/06/20 12:28
L10	0	((inner adj2 core)and(outer adj2 reing adj3 core))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2016/06/20 12:28

EAST Search History

L11	3	(beam adj3 profile)same(laser adj5 beam near10 differs)same(coupl\$4)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2016/06/20 12:30
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6/ 20/ 2016 12:42:25 PM

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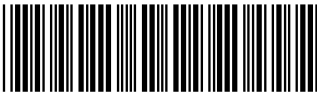
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L5	321839	G02B6/\$.cpc.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2016/06/20 12:21
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L7	0	((coupl\$4 adj2 laser adj2 beam)near10(fiber or fibre))and((inner adj2 core)same(outer adj2 reing adj3 core))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2016/06/20 12:27
L8	955	((coupl\$4 adj2 laser adj2 beam)near10(fiber or fibre))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2016/06/20 12:27
L9	0	((inner adj2 core)same(outer adj2 reing adj3 core))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2016/06/20 12:28
L10	0	((inner adj2 core)and(outer adj2 reing adj3 core))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2016/06/20 12:28

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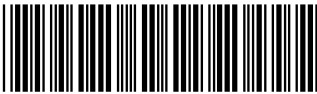
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6/ 20/ 2016 12:41:59 PM**C:\ Users\ aullah\ Documents\ EAST\ Workspaces\ 14014301A.wsp**

<i>Index of Claims</i> 	Application/Control No. 14300138	Applicant(s)/Patent Under Reexamination HUBER ET AL.
	Examiner AKM ULLAH	Art Unit 2874

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

☐ Claims renumbered in the same order as presented by applicant					☐ CPA					☐ T.D.					☐ R.1.47				
CLAIM		DATE																	
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-	35	÷	N	-															
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<i>Index of Claims</i> 	Application/Control No. 14300138	Applicant(s)/Patent Under Reexamination HUBER ET AL.
	Examiner AKM ULLAH	Art Unit 2874

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47									
CLAIM		DATE							
Final	Original	11/17/2015	02/18/2016	06/16/2016					
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-	38	÷	N	-					
-	39	÷	N	-					

Doc Code: DIST.E.FILE Document Description: Electronic Terminal Disclaimer - Filed		PTO/SB/26 U.S. Patent and Trademark Office Department of Commerce	
Electronic Petition Request	TERMINAL DISCLAIMER TO OBVIATE A DOUBLE PATENTING REJECTION OVER A "PRIOR" PATENT		
Application Number	14300138		
Filing Date	09-Jun-2014		
First Named Inventor	Rudolf HUBER		
Attorney Docket Number	15540-0370002		
Title of Invention	Method and Arrangement for the Generation of a Laser Beam With Different Beam Profile Characteristics by Means of a Multi-Clad Fibre		
☒ Filing of terminal disclaimer does not obviate requirement for response under 37 CFR 1.111 to outstanding Office Action ☒ This electronic Terminal Disclaimer is not being used for a Joint Research Agreement.			
Owner		Percent Interest	
TRUMPF Laser- und Systemtechnik GmbH		100%	
The owner(s) with percent interest listed above in the instant application hereby disclaims, except as provided below, the terminal part of the statutory term of any patent granted on the instant application which would extend beyond the expiration date of the full statutory term of prior patent number(s) 8781269 as the term of said prior patent is presently shortened by any terminal disclaimer. The owner hereby agrees that any patent so granted on the instant application shall be enforceable only for and during such period that it and the prior patent are commonly owned. This agreement runs with any patent granted on the instant application and is binding upon the grantee, its successors or assigns. In making the above disclaimer, the owner does not disclaim the terminal part of the term of any patent granted on the instant application that would extend to the expiration date of the full statutory term of the prior patent, "as the term of said prior patent is presently shortened by any terminal disclaimer," in the event that said prior patent later: - expires for failure to pay a maintenance fee; - is held unenforceable; - is found invalid by a court of competent jurisdiction; - is statutorily disclaimed in whole or terminally disclaimed under 37 CFR 1.321; - has all claims canceled by a reexamination certificate; - is reissued; or - is in any manner terminated prior to the expiration of its full statutory term as presently shortened by any terminal disclaimer. ☒ Terminal disclaimer fee under 37 CFR 1.20(d) is included with Electronic Terminal Disclaimer request.			

☐ I certify, in accordance with 37 CFR 1.4(d)(4), that the terminal disclaimer fee under 37 CFR 1.20(d) required for this terminal disclaimer has already been paid in the above-identified application.	
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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.	
THIS PORTION MUST BE COMPLETED BY THE SIGNATORY OR SIGNATORIES	
I certify, in accordance with 37 CFR 1.4(d)(4) that I am:	
☒ An attorney or agent registered to practice before the Patent and Trademark Office who is of record in this application Registration Number <u>70538</u>	
☐ A sole inventor	
☐ A joint inventor; I certify that I am authorized to sign this submission on behalf of all of the inventors as evidenced by the power of attorney in the application	
☐ A joint inventor; all of whom are signing this request	
Signature	/Yunbo Guo/
Name	Yunbo Guo

*Statement under 37 CFR 3.73(b) is required if terminal disclaimer is signed by the assignee (owner).
 Form PTO/SB/96 may be used for making this certification. See MPEP § 324.

Electronic Patent Application Fee Transmittal				
Application Number:		14300138		
Filing Date:		09-Jun-2014		
Title of Invention:		Method and Arrangement for the Generation of a Laser Beam With Different Beam Profile Characteristics by Means of a Multi-Clad Fibre		
First Named Inventor/Applicant Name:		Rudolf HUBER		
Filer:		Yunbo Guo/Matthew Doherty		
Attorney Docket Number:		15540-0370002		
Filed as Large Entity				
Filing Fees for Utility under 35 USC 111(a)				
Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Basic Filing:				
Statutory or Terminal Disclaimer	1814	1	160	160
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Extension-of-Time:				
Miscellaneous:				
Total in USD (\$)				160

Doc Code: DISQ.E.FILE

Document Description: Electronic Terminal Disclaimer – Approved

Application No.: 14300138

Filing Date: 09-Jun-2014

Applicant/Patent under Reexamination: HUBER et al.

Electronic Terminal Disclaimer filed on May 16, 2016

☒ APPROVED

This patent is subject to a terminal disclaimer

☐ DISAPPROVED

Approved/Disapproved by: Electronic Terminal Disclaimer automatically approved by EFS-Web

U.S. Patent and Trademark Office

Electronic Acknowledgement Receipt	
EFS ID:	25782892
Application Number:	14300138
International Application Number:	
Confirmation Number:	4091
Title of Invention:	Method and Arrangement for the Generation of a Laser Beam With Different Beam Profile Characteristics by Means of a Multi-Clad Fibre
First Named Inventor/Applicant Name:	Rudolf HUBER
Customer Number:	26161
Filer:	Yunbo Guo/Matthew Doherty
Filer Authorized By:	Yunbo Guo
Attorney Docket Number:	15540-0370002
Receipt Date:	16-MAY-2016
Filing Date:	09-JUN-2014
Time Stamp:	12:49:33
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	Deposit Account
Payment was successfully received in RAM	\$160
RAM confirmation Number	10231
Deposit Account	061050
Authorized User	FISH & RICHARDSON P C
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:	

File Listing:					
Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Electronic Terminal Disclaimer-Filed	eTerminal-Disclaimer.pdf	33529 3f219ce6acb6757a2932f0b47b33cf1a00c9312e	no	2
Warnings:					
Information:					
2	Fee Worksheet (SB06)	fee-info.pdf	30787 a9b9fb10b43e4263f67dccc189e10a8110ef3113f	no	2
Warnings:					
Information:					
Total Files Size (in bytes):			64316		
This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503. <u>New Applications Under 35 U.S.C. 111</u> If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application. <u>National Stage of an International Application under 35 U.S.C. 371</u> If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course. <u>New International Application Filed with the USPTO as a Receiving Office</u> If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.					

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

First Named Inventor : Rudolph Huber Art Unit : 2874
Serial No. : 14/300,138 Examiner : Akm E. Ullah
Filed : June 9, 2014
Title : METHOD AND ARRANGEMENT FOR GENERATING A LASER
BEAM HAVING A DIFFERING BEAM PROFILE
CHARACTERISTIC BY A MULTI-CLAD FIBER (AS AMENDED)

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

REPLY TO ACTION OF MARCH 7, 2016

Please consider the following reply.

First Named Inventor : Rudolph Huber
Serial No. : 14/300,138
Filed : June 9, 2014
Page : 2 of 3

Attorney's Docket No.: 15540-0370002 /
SP10120US(PCT) CON; 18.01127; DS10502

Amendments to the Specification:

Please replace the title as follows:

METHOD AND ARRANGEMENT FOR GENERATING A LASER BEAM HAVING
A DIFFERING BEAM PROFILE CHARACTERISTIC BY A MULTI-CLAD FIBER

First Named Inventor : Rudolph Huber
Serial No. : 14/300,138
Filed : June 9, 2014
Page : 3 of 3

Attorney's Docket No.: 15540-0370002 /
SP10120US(PCT) CON; 18.01127; DS10502

REMARKS

Without conceding the propriety of the obviousness-type double patenting rejections, Applicants concurrently submit a Terminal Disclaimer over U.S. Patent No.8,781,269, to obviate the rejection, so the rejection should be withdrawn.

Please apply any necessary charges or credits to Deposit Account 06-1050, referencing the above attorney docket number.

Respectfully submitted,

Date: 05/16/2016

/Yunbo Guo/

Yunbo Guo
Reg. No. 70,538

Customer Number 26161
Fish & Richardson P.C.
Telephone: (512) 226-8108
Facsimile: (877) 769-7945

23524328.doc

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number	14300138
	Filing Date	2014-06-09
	First Named Inventor	Rudolph Huber
	Art Unit	2874
	Examiner Name	Akm E. Ullah
	Attorney Docket Number	15540-0370002

U.S. PATENTS							Remove	
Examiner Initial*	Cite No	Patent Number	Kind Code ¹	Issue Date	Name of Patentee or Applicant of cited Document	Pages, Columns, Lines where Relevant Passages or Relevant Figures Appear		
	1	8326099	B2	2012-12-04	Singer et al	English equivalent to WO 2010/009101		
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Examiner Initial*	Cite No	Publication Number	Kind Code ¹	Publication Date	Name of Patentee or Applicant of cited Document	Pages, Columns, Lines where Relevant Passages or Relevant Figures Appear		
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Examiner Initial*	Cite No	Foreign Document Number ³	Country Code ² i	Kind Code ⁴	Publication Date	Name of Patentee or Applicant of cited Document	Pages, Columns, Lines where Relevant Passages or Relevant Figures Appear	T ⁵
	1	100750511	KR	B1	2007-08-13		English Abstract	×
	2	WO2010009101	WO	A2	2010-01-21			☐
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number		14300138
	Filing Date		2014-06-09
	First Named Inventor	Rudolph Huber	
	Art Unit	2874	
	Examiner Name	Akm E. Ullah	
	Attorney Docket Number	15540-0370002	

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T ⁵
	1		

If you wish to add additional non-patent literature document citation information please click the Add button

EXAMINER SIGNATURE

Examiner Signature		Date Considered	
--------------------	--	-----------------	--

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

¹ See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. ² Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). ³ For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. ⁴ Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. ⁵ Applicant is to place a check mark here if English language translation is attached.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number	14300138
	Filing Date	2014-06-09
	First Named Inventor	Rudolph Huber
	Art Unit	2874
	Examiner Name	Akm E. Ullah
	Attorney Docket Number	15540-0370002

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

See attached certification statement.

☒ The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Yunbo Guo/	Date (YYYY-MM-DD)	2016-05-16
Name/Print	Yunbo Guo	Registration Number	70538

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these records.
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5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.



KOREAN PATENT ABSTRACTS

(11) Publication number: 100750511 B1
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 (22) Date of filing: 29.05.2006
 (51) Int. Cl: A61M 1/14 (2006.01);
 A61M 1/22 (2006.01);
 A61M 1/00 (2006.01);

(71) Applicant: NEWHEART BIO CO., LTD.
 (72) Inventor: LEE, KWANG HO
 KIM, DUCK JOONG
 LEE, SANG HOON
 MIN, BYOUNG GOO
 CHOI, HYUK

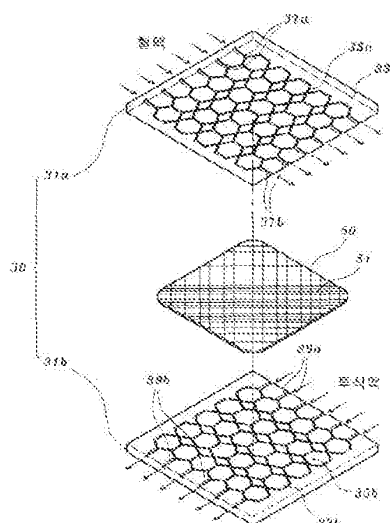
(54) ARTIFICIAL RENAL MICROCHIP USING ELECTROSPUN NANO-WEB AND PDMS LAYER WHICH PURIFIES BLOOD INSIDE PATIENT'S BODY AND ASSISTS ROLE OF ARTIFICIAL HEART MACHINE

(57) Abstract:

PURPOSE: An artificial renal microchip using an electrospun nano-web and a PDMS layer is provided to induce the function of a glomerulus function of the nano-web and to control the size of the nano-pore to improve utility thereof.

CONSTITUTION: An artificial renal microchip includes a housing, a PDMS layer(30) and a nano-web(50). The housing includes a blood inflow pipe, a blood outflow pipe, a dialytic liquid inflow pipe and a dialytic outflow pipe. The blood flowing through a blood inflow pipe passes between an upper layer(31a) and the nano-web(50) and flows out through a blood outflow pipe. The dialytic liquid flowing through the dialytic liquid inflow pipe passes between the lower layer(31b) and the nano-web(50), and flows out through a dialytic liquid outflow pipe.

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(19)대한민국특허청(KR)
(12) 등록특허공보(B1)

(51) 。 Int. Cl.

A61M 1/14 (2006.01)

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(65) 공개번호

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(74) 대리인

권혁성

김삼수

안미정

(56) 선행기술조사문헌

KR1019870001057 B1

WO0247785 A1

KR1020060057176 A

심사관 : 김병환

전체 청구항 수 : 총 6 항

(54) 나노 웹과 PDMS 레이어를 이용한 인공 신장 칩

(57) 요약

본 발명은 나노 웹과 PDMS 레이어를 이용한 인공 신장 칩에 관한 것으로, 환자의 체내 혈액 정화에 나노 웹(Nano Web)과 PDMS 레이어(PolyDiMethySiloxane layer)를 이용함으로써 혈액 및 투석액의 물질 교환 및 통과가 가능하여 보다 효과적인 혈액 투석이 가능할 뿐만 아니라, 부피 대피 표면적 비율을 실현할 수 있으며, 혈액 및 투석액이 통과하는 나노 웹의 사구체 기능을 유도할 수 있고, 나노 기공의 크기를 제어할 수 있어 유용성을 향상시킬 수 있으며, 환자의 상태에 따라 산소의 투입을 통한 인공 심폐기의 역할을 보조할 수 있을 뿐만 아니라, 혈전 방지를 위한 헤파린 등의 약물을 주입할 수 있으며, 기계적 성질이 우수한 나노 웹과 PDMS 레이어를 이용한 인공 신장 칩을 제공하기 위한 것으로서, 그 기술적 구성은 혈액이 유입 및 유출되기 위한 혈액 유입 파이프 및 혈액 유출 파이프와 투석액이 유입 및 유출되기 위한 투석액 유입 파이프 및 투석액 유출 파이프가 구비되는 하우징; 상기 하우징의 내부에 구비되어 상기 혈액 유입 파이프와 투석액 유입 파이프를 통하여 유입되는 혈액 및 투석액을 혈액 유출 파이프와 투석액 유출 파이프로 유출하되, 분리가능하게 연결되는 상, 하층 레이어로 구비되는 PDMS 레이어; 및 상기 PDMS 레이어의 상, 하층 레이어 사이에 개재되는 나노 웹; 을 포함하는 구성으로 이루어지는 것을 특징으로 한다.

대표도

도 2

특허청구의 범위

청구항 1.

혈액이 유입 및 유출되기 위한 혈액 유입 파이프(11a) 및 혈액 유출 파이프(11b)와 투석액이 유입 및 유출되기 위한 투석액 유입 파이프(13a) 및 투석액 유출 파이프(13b)가 구비되는 하우징(10);

분리가능하게 연결되는 상, 하층 레이어(31a, 31b)를 포함하도록 구성되어 상기 하우징(10)의 내부에 구비되는 PDMS 레이어(30); 및

상기 PDMS 레이어(30)의 상, 하층 레이어(31a, 31b) 사이에 개재되는 나노 웹(50);

을 포함하여,

상기 혈액 유입 파이프(11a)를 통해 유입된 혈액은 상기 상층 레이어(31a)와 상기 나노 웹(50) 사이를 통과하여 상기 혈액 유출 파이프(11b)를 통해 유출되고, 상기 투석액 유입 파이프(13a)를 통해 유입된 투석액은 상기 하층 레이어(31b)와 상기 나노 웹(50) 사이를 통과하여 상기 투석액 유출 파이프(13b)를 통해 유출되도록 구성되는 것을 특징으로 하는 나노 웹과 PDMS 레이어를 이용한 인공 신장 칩.

청구항 2.

제1항에 있어서,

상기 상, 하층 레이어(31a, 31b)의 하부면과 상부면에 육각형상으로 다수 연결되며, 혈액 및 투석액이 유동하기 위한 유동홈(35a, 35b)을 갖는 채널(33a, 33b)이 각각 형성되는 것을 특징으로 하는 나노 웹과 PDMS 레이어를 이용한 인공 신장 칩.

청구항 3.

제2항에 있어서,

상기 상층 레이어(31a)의 채널(33a) 일측과 타측에 혈액이 유입되기 위한 혈액 유입구(37a)와 혈액이 유출되기 위한 혈액 유출구(37b)가 각각 형성되고, 상기 하층 레이어(31b)의 채널(33b) 일측과 타측에 투석액이 유입되기 위한 투석액 유입구(39a)와 투석액이 유출되기 위한 투석액 유출구(39b)가 각각 형성되는 것을 특징으로 하는 나노 웹과 PDMS 레이어를 이용한 인공 신장 칩.

청구항 4.

제3항에 있어서,

상기 각 채널(33a, 33b)에 형성되는 혈액 유입구(37a) 및 혈액 유출구(37b)와 투석액 유입구(39a) 및 투석액 유출구(39b)가 상호 대칭되게 형성되고, 각 채널(33a, 33b)에서 유동하는 혈액 및 투석액이 격자방향으로 유입 및 유출되도록 이루어지는 것을 특징으로 하는 나노 웹과 PDMS 레이어를 이용한 인공 신장 칩.

청구항 5.

삭제

청구항 6.

제1항에 있어서,

상기 나노 웹(50)은 다수개의 나노 파이버(51)가 상호 연결되며, 연결된 형상이 격자형상을 이루는 것을 특징으로 하는 나노 웹과 PDMS 레이어를 이용한 인공 신장 칩.

청구항 7.

삭제

청구항 8.

제6항에 있어서,

상기 나노 파이버(51)의 직경이 0.5 μm 로 이루어지는 것을 특징으로 하는 나노 웹과 PDMS 레이어를 이용한 인공 신장 칩.

청구항 9.

삭제

명세서

발명의 상세한 설명

발명의 목적

발명이 속하는 기술 및 그 분야의 종래기술

본 발명은 인공 신장 칩에 관한 것으로, 보다 상세하게는 환자의 체내 혈액 정화에 나노 웹(Nano Web)과 PDMS 레이어(PolyDiMethySiloxane layer)를 이용함으로써 혈액 및 투석액의 물질 교환 및 통과가 가능하여 보다 효과적인 혈액 투석이 가능할 뿐만 아니라, 부피 대피 표면적 비율을 실현할 수 있으며, 혈액 및 투석액이 통과하는 나노 웹의 사구체 기능을

유도할 수 있고, 나노 기공의 크기를 제어할 수 있어 유용성을 향상시킬 수 있으며, 환자의 상태에 따라 산소의 투입을 통한 인공 심폐기의 역할을 보조할 수 있을 뿐만 아니라, 혈전 방지를 위한 헤파린 등의 약물을 주입할 수 있으며, 기계적 성질이 우수한 나노 웹과 PDMS 레이어를 이용한 인공 신장 칩에 관한 것이다.

일반적으로, 신부전(Renal Failure)이란 신장의 사구체 여과 기능의 손실로 인하여 신장 기능의 회복이 불가능하게 된 상태를 의미하며, 이러한 신부전 환자에게는 인공 신장기(Artificial Renal)를 통해 신장의 기능을 유지해주는 혈액 투석법이 적용되고 있다.

여기서, 혈액 투석법을 이용한 인공 신장기의 원리는 체내 혈액이 반투과성의 중공사막(Hollow Fiber)을 통해 체액의 투석액(Dialysate)과 물질 교환이 이루어지도록 하여 혈액을 여과하는 것이다.

현재, 중공사막을 이용한 혈액 투석기(Hemodialyzer)에서는 이상적인 혈액과 투석액 흐름의 조건을 유도해야 하며, 일정 시간 균일한 혈액 투석의 효율을 확보해야 하는 필요성이 요구된다.

그러나, 중공사막을 이용한 혈액 투석기는 그 표면적에 대한 혈액량의 비율이 높은 장점에도 불구하고, 혈액 및 투석액의 흐름을 각각 분리하여 효율적으로 제어하기가 불가능하며, 투석이 이루어지는 동안 중공사막간 농도의 분극화, 단백질의 흡착, 막 표면에 발생하는 겔(Gel)층의 형성과 그로 인한 중공사막의 막힘 현상들로 인해 혈액 투석 시에 혈액과 투석액간의 저항을 유발하며, 이로 인해 혈액 투석 시간에 따른 유속의 감소를 발생시켜 일정 효율 이상의 투석 효율을 기대하기 어렵다는 문제점이 있었다.

또한, 사용된 혈액 투석기는 재사용이 용이하지 않는 등 신부전 환자에게 경제적인 부담을 발생시키는 문제점이 있었다.

발명이 이루고자 하는 기술적 과제

본 발명은 상기한 문제점을 해결하기 위하여 안출된 것으로, 환자의 체내 혈액 정화에 나노 웹(Nano Web)과 PDMS 레이어(PolyDiMethylsiloxane layer)를 이용함으로써 혈액 및 투석액의 물질 교환 및 통과가 가능하여 보다 효과적인 혈액 투석이 가능할 뿐만 아니라, 부피 대피 표면적 비율을 실현할 수 있으며, 혈액 및 투석액이 통과하는 나노 웹의 사구체 기능을 유도할 수 있고, 나노 기공의 크기를 제어할 수 있어 유용성을 향상시킬 수 있으며, 환자의 상태에 따라 산소의 투입을 통한 인공 심폐기의 역할을 보조할 수 있을 뿐만 아니라, 혈전 방지를 위한 헤파린 등의 약물을 주입할 수 있으며, 기계적 성질이 우수한 나노 웹과 PDMS 레이어를 이용한 인공 신장 칩을 제공하는 것을 목적으로 한다.

발명의 구성

상기한 바와 같은 목적을 달성하기 위하여 본 발명은, 혈액이 유입 및 유출되기 위한 혈액 유입 파이프 및 혈액 유출 파이프와 투석액이 유입 및 유출되기 위한 투석액 유입 파이프 및 투석액 유출 파이프가 구비되는 하우징; 상기 하우징의 내부에 구비되어 상기 혈액 유입 파이프와 투석액 유입 파이프를 통하여 유입되는 혈액 및 투석액을 혈액 유출 파이프와 투석액 유출 파이프로 유출되도록, 분리가능하게 연결되는 상, 하층 레이어로 구비되는 PDMS 레이어; 및 상기 PDMS 레이어의 상, 하층 레이어 사이에 개재되는 나노 웹; 을 포함하는 구성으로 이루어지는 것을 특징으로 한다.

바람직하게는, 상기 상, 하층 레이어의 하부면과 상부면에 육각형상으로 다수 연결되되, 혈액 및 투석액이 유동하기 위한 유동홈을 갖는 채널이 각각 형성된다.

여기서, 상기 상층 레이어의 채널 일측과 타측에 혈액이 유입되기 위한 혈액 유입구와 혈액이 유출되기 위한 혈액 유출구가 각각 형성되고, 상기 하층 레이어의 채널 일측과 타측에 투석액이 유입되기 위한 투석액 유입구와 투석액이 유출되기 위한 투석액 유출구가 각각 형성된다.

한편, 상기 각 채널에 형성되는 혈액 유입구 및 혈액 유출구와 투석액 유입구 및 투석액 유출구가 상호 대칭되게 형성되고, 각 채널에서 유동하는 혈액 및 투석액이 격자방향으로 유입 및 유출되도록 이루어진다.

대안적으로는, 상기 채널의 형상이 가변가능하게 이루어진다.

여기서, 상기 나노 웹은 다수개의 나노 파이버가 상호 연결되되, 연결된 형상이 격자형상을 이룬다.

대안적으로는, 상기 나노 파이버의 연결된 형상이 가변가능하게 이루어진다.

한편, 상기 나노 파이버의 직경이 0.5 μm 로 이루어진다.

더불어, 상기 나노 파이버의 직경이 가변가능하게 이루어진다.

이하, 본 발명의 바람직한 실시예를 첨부된 도면을 참조하여 보다 상세하게 설명한다. 단, 하기 실시예는 본 발명을 예시하는 것일 뿐 본 발명의 내용이 하기 실시예에 한정되는 것은 아니다.

도 1은 본 발명에 의한 나노 웹과 PDMS 레이어를 이용한 인공 신장 칩을 개략적으로 나타내는 도면이고, 도 2는 본 발명에 의한 나노 웹과 PDMS 레이어를 이용한 인공 신장 칩을 개략적으로 나타내는 분해도이고, 도 3은 본 발명에 의한 나노 웹과 PDMS 레이어를 이용한 인공 신장 칩의 나노 웹을 확대하여 나타내는 도면이다.

도면에서 도시하고 있는 바와 같이, 본 발명에 의한 나노 웹과 PDMS 레이어(30)를 이용한 인공 신장 칩(1)은 혈액이 유입 및 유출되기 위한 혈액 유입 파이프(11a) 및 혈액 유출 파이프(11b)와 투석액이 유입 및 유출되기 위한 투석액 유입 파이프(13a) 및 투석액 유출 파이프(13b)가 구비되는 하우징(10)과 상기 하우징(10)의 내부에 구비되어 상기 혈액 유입 파이프(11a)와 투석액 유입 파이프(13a)를 통하여 유입되는 혈액 및 투석액을 혈액 유출 파이프(11b)와 투석액 유출 파이프(13b)로 유출하되, 분리가능하게 연결되는 상, 하층 레이어(31a, 31b)로 구비되는 PDMS 레이어(30) 및 상기 PDMS 레이어(30)의 상, 하층 레이어(31a, 31b)에 개재되는 나노 웹(50)을 포함하여 구성된다.

여기서, 상기 하우징(10)에 연결되며, 외부에서 공급되는 혈액이 유입 및 유출되기 위한 혈액 유입 파이프(11a) 및 혈액 유출 파이프(11b)와 외부에서 공급되는 투석액이 유입 및 유출되기 위한 투석액 유입 파이프(13a) 및 투석액 유출 파이프(13b)는 상호 대칭되게 설치된다.

한편, 상기 PDMS 레이어(30)의 상기 상, 하층 레이어(31a, 31b) 하부면 및 상부면에는 육각형상으로 다수 연결되며, 혈액 및 투석액이 유동하기 위한 유동홈(35a, 35b)을 갖는 채널(33a, 33b)이 각각 형성된다.

여기서, 상기 채널(33a, 33b)의 유동홈(35a, 35b)의 크기 및 직경은 환자의 상태에 따라 가변가능하게 이루어지는 것이 바람직하다.

그리고, 상기 상층 레이어(31a)의 채널(33a) 일측과 타측에 혈액이 유입되기 위한 혈액 유입구(37a)와 혈액이 유출되기 위한 혈액 유출구(37b)가 각각 형성되고, 상기 하층 레이어(31b)의 채널(33b) 일측과 타측에 투석액이 유입되기 위한 투석액 유입구(39a)와 투석액이 유출되기 위한 투석액 유출구(39b)가 각각 형성된다.

여기서, 상기 각 채널(33a, 33b)에 형성되는 혈액 유입구(37a) 및 혈액 유출구(37b)와 투석액 유입구(39a) 및 투석액 유출구(39b)가 상호 대칭되게 형성되고, 각 채널(33a, 33b)에서 유동하는 혈액 및 투석액이 격자방향으로 유입 및 유출되도록 이루어진다.

본 발명의 일 실시예에서는 상기 상, 하층 레이어(31a, 31b)의 하부면 및 상부면에 형성되는 각 채널(33a, 33b)이 육각형상을 다수개 갖되, 각각이 상호 연결되는 구조로 이루어져 있으나, 혈액 및 투석액의 유동이 용이하다면 상기 채널(33a, 33b)의 삼각, 사각, 오각, 팔각 등으로 형성되는 것도 가능하다.

또한, 혈액 및 투석액의 유동이 용이하다면 상기 채널(33a, 33b)이 원형 등 기타 다양한 형상으로 가변가능하게 이루어지는 것도 가능하다.

한편, 상기 나노 웹(Nano Web, 50)은 미세한 분상체 형상으로 형성되는 다수개의 나노 파이버(Nano Fiber, 51)가 상호 연결되며, 다수개의 나노 파이버(51)가 연결된 형상이 격자 형상으로 형성된다.

여기서, 상기 나노 웹(50)은 혈액 적합성과 투과물성이 검증된 Polyethersulfone로 이루어지고, 형성되는 기공(Pore)의 크기는 전기방사(Electrospinning)를 이용하는 것이 바람직하며, 이로 인해 나노 웹(50)의 기반이 되는 나노 파이버(51)의 특성이 기존 재료에 비해 매우 큰 부피 대비 표면적 비율을 실현할 수 있다.

본 발명의 일 실시예에서는 상기 나노 웹(50)을 이루는 나노 파이버(51)의 연결된 형상이 격자 형상으로 이루어져 있으나, 상기 상, 하층 레이어(31a, 31b)의 사이에 개재되어 상, 하층 레이어(31a, 31b)의 각 채널(33a, 33b)을 통하여 유동하는 혈액 및 투석액의 물질 교환 및 통과가 가능하다면 상기 나노 파이버(51)의 연결된 형상이 기타 다양한 형상으로 가변가능하게 이루어지는 것도 가능하다.

여기서, 상기 나노 웹(50)을 이루는 나노 파이버(51)의 직경은 0.5 μm 로 이루어지는 것이 바람직하나, 혈액 및 투석액의 물질 교환 및 통과가 가능하다면 상기 나노 파이버(51)가 그 이상 또는 이하의 직경을 갖도록 이루어지는 등 상기 나노 파이버(51)의 직경이 가변가능하게 이루어지는 것도 가능하다.

본 발명의 일 실시예에서는 상기 상층 레이어(31a)와 하층 레이어(31b) 사이에 하나의 나노 웹(50)이 개재되어 있으나, 상층 레이어(31a) 및 하층 레이어(31b)를 유동하는 혈액 및 투석액의 물질 교환 및 통과가 용이하다면 상기 상층 레이어(31a)와 하층 레이어(31b) 사이에 적어도 하나 이상의 나노 웹(50)이 개재되는 것도 가능하다.

이하, 본 발명에 의한 나노 웹과 PDMS 레이어를 이용한 인공 신장 칩(1)의 작동과정을 설명한다.

먼저, 상기 하우징(10)에 연결되는 혈액 유입 파이프(11a) 및 투석액 유입 파이프(13a)를 통하여 혈액 및 투석액이 유입된다.

그리고, 상기 하우징(10) 내로 유입되는 혈액은 상기 상층 레이어(31a)에 형성된 채널(33a)로 유입되어 상층 레이어(31a)와 나노 웹(50) 사이를 지나게 되고, 상기 하우징(10) 내로 유입되는 투석액은 상기 하층 레이어(31b)에 형성된 채널(33b)을 통해 하층 레이어(31b)와 나노 웹(50) 사이를 지나게 된다. 즉, 상기 혈액 유입 파이프(11a) 및 투석액 유입 파이프(13a)를 통하여 유입되는 혈액 및 투석액이 하우징(10) 내부에 구비되는 PDMS 레이어(30)로 유입되며, 상기 PDMS 레이어(30)의 상층 레이어(31a) 및 하층 레이어(31b)에 상호 대칭되게 형성되는 각 채널(33a, 33b)로 유입된다.

이때, 상기 혈액 유입 파이프(11a) 및 투석액 유입 파이프(13a)를 통하여 유입되는 혈액 및 투석액은 상기 상층 레이어(31a)에 형성되는 채널(33a)의 혈액 유입구(37a)와 하층 레이어(31b)에 형성되는 채널(33b)의 투석액 유입구(39a)를 통하여 각각 유입된다.

상기한 바와 같이, 상기 상층 레이어(31a) 및 하층 레이어(31b)의 각 채널(33a, 33b)에 형성되는 혈액 유입구(37a)와 투석액 유입구(39a)로 유입되는 혈액 및 투석액은 각 채널(33a, 33b)의 유동홈(35a, 35b)을 따라 유동한 후 각 채널(33a, 33b)에 형성되는 혈액 유출구(37b)와 투석액 유출구(39b)를 통하여 하우징(10)에 연결되는 혈액 유출 파이프(11b) 및 투석액 유출 파이프(13b)로 유출된다.

여기서, 상기 상층 레이어(31a) 및 하층 레이어(31b)의 각 채널(33a, 33b)에 형성되는 유동홈(35a, 35b)을 따라 유동하는 혈액 및 투석액은 상층 레이어(31a)와 하층 레이어(31b) 사이에 개재되는 나노 웹(50)을 통하여 물질의 교환 및 통과하면서 혈액이 투석된다. 즉, 상층 레이어(31a)의 채널(33a)과 하층 레이어(31b)의 채널(33b) 사이에 개재되는 나노 웹(50)을 유동하는 혈액 및 투석액이 교환 및 통과하면서 혈액 내에 존재하는 독소를 제거함으로써 혈액을 정화한다.

본 발명의 일 실시예에서는 상기 상층 레이어(31a)에 형성되는 채널(33a)에 혈액이 유동하고, 하층 레이어(31b)에 형성되는 채널(33b)에 투석액이 유동하는 구조로 이루어져 있으나, 상기 상층 레이어(31a)에 형성되는 채널(33a)에 투석액이 유동하고, 하층 레이어(31b)에 형성되는 채널(33b)에 혈액이 유동하는 구조로 이루어지는 것도 가능하다.

또한, 상기 상층 레이어(31a) 또는 하층 레이어(31b)에 형성되는 채널(33a, 33b)에 환자의 상태에 따른 산소를 투입하여 인공 심폐기의 역할을 수행하도록 이루어지는 것도 가능하고, 혈전 방지를 위한 헤파린 등을 주입하거나, 기타 다양한 약물을 주입하도록 이루어지는 것도 가능하다.

상기한 바와 같이, 상기 나노 웹(50)을 사이에 두고, 혈액과 투석액의 물질 교환 및 통과가 가능한 2중 구조의 PDMS 레이어(30)를 갖으며, 중공사막의 기능을 대체하도록 반투과막(Semi-permeable membrane)의 나노 웹(50)이 적용됨으로써 혈액의 여과 및 정화의 기능을 수행할 뿐만 아니라, 사구체의 기능을 유도할 수 있다.

본 발명은 특정의 실시예와 관련하여 도시 및 설명하였지만, 첨부 특허청구범위에 의해 나타난 발명의 사상 및 영역으로부터 벗어나지 않는 한도 내에서 다양한 개조 및 변화가 가능하다는 것을 당업계에서 통상의 지식을 가진 자라면 누구나 쉽게 알 수 있을 것이다.

발명의 효과

이상에서 설명한 바와 같이 상기와 같은 구성을 갖는 본 발명은 환자의 체내 혈액 정화에 나노 웹(Nano Web)과 PDMS 레이어(PolyDimethylsiloxane layer)를 이용함으로써 혈액 및 투석액의 물질 교환 및 통과가 가능하여 보다 효과적인 혈액 투석이 가능할 뿐만 아니라, 부피 대피 표면적 비율을 실현할 수 있으며, 혈액 및 투석액이 통과하는 나노 웹의 사구체 기능을 유도할 수 있고, 나노 기공의 크기를 제어할 수 있어 유용성을 향상시킬 수 있으며, 환자의 상태에 따라 산소의 투입을 통한 인공 심폐기의 역할을 보조할 수 있을 뿐만 아니라, 혈전 방지를 위한 헤파린 등의 약물을 주입할 수 있으며, 기계적 성질이 우수하다는 등의 효과를 거둘 수 있다.

도면의 간단한 설명

도 1은 본 발명에 의한 나노 웹과 PDMS 레이어를 이용한 인공 신장 칩을 개략적으로 나타내는 도면,

도 2는 본 발명에 의한 나노 웹과 PDMS 레이어를 이용한 인공 신장 칩을 개략적으로 나타내는 분해도,

도 3은 본 발명에 의한 나노 웹과 PDMS 레이어를 이용한 인공 신장 칩의 나노 웹을 확대하여 나타내는 도면.

<도면의 주요 부분에 대한 부호의 설명>

1 : 인공 신장 칩, 10 : 하우징,

11a : 혈액 유입 파이프, 11b : 혈액 유출 파이프,

13a : 투석액 유입 파이프, 13b : 투석액 유출 파이프,

30 : PDMS 레이어, 31a : 상층 레이어,

31b : 하층 레이어, 33a, 33b : 채널,

35a, 35b : 유동홈, 37a : 혈액 유입구,

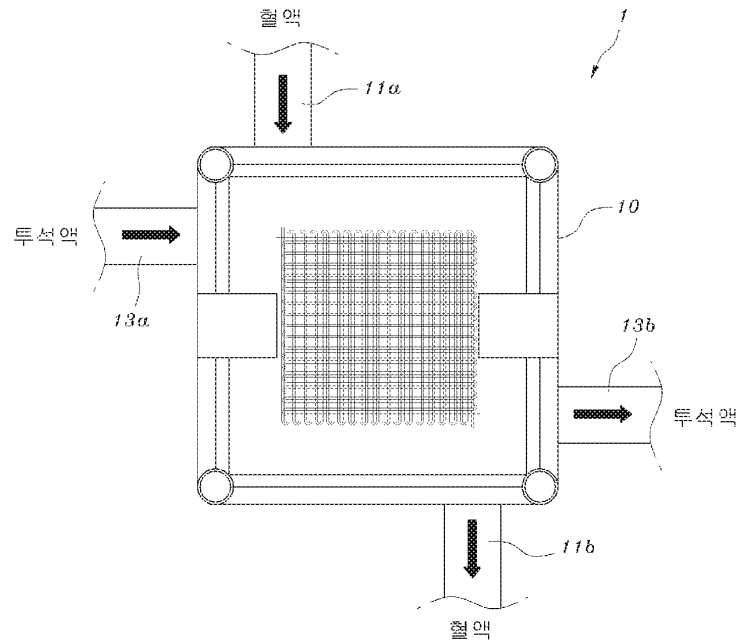
37b : 혈액 유출구, 39a : 투석액 유입구,

39b : 투석액 유출구, 50 : 나노 웹,

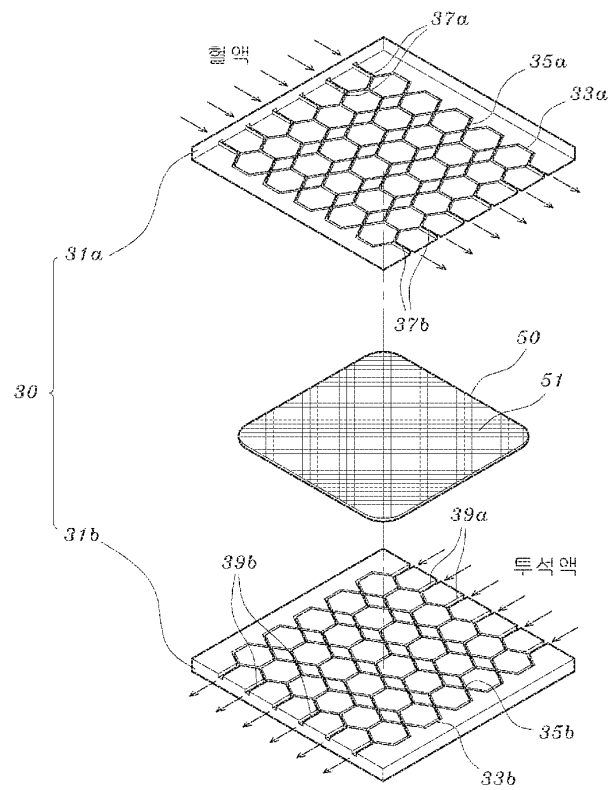
51 : 나노 파이버.

도면

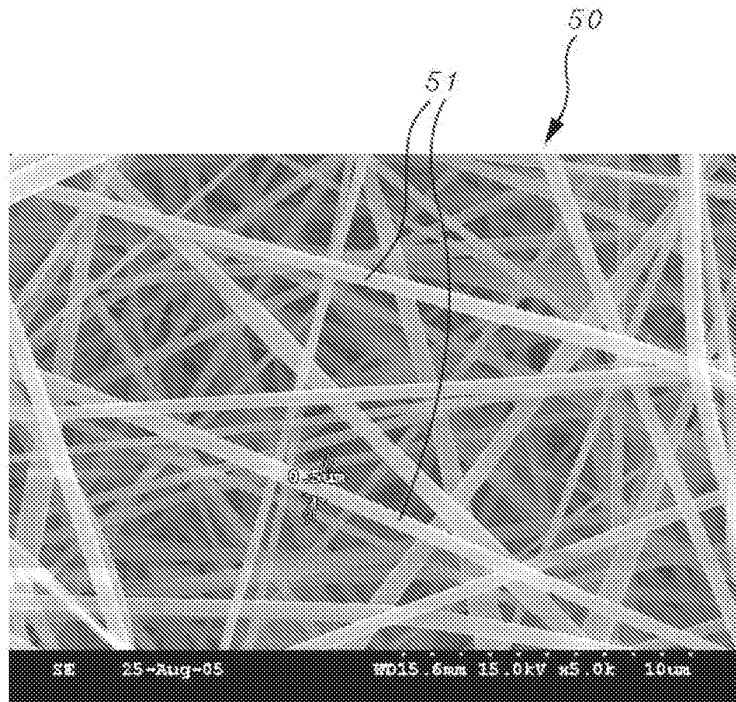
도면1



도면2



도면3



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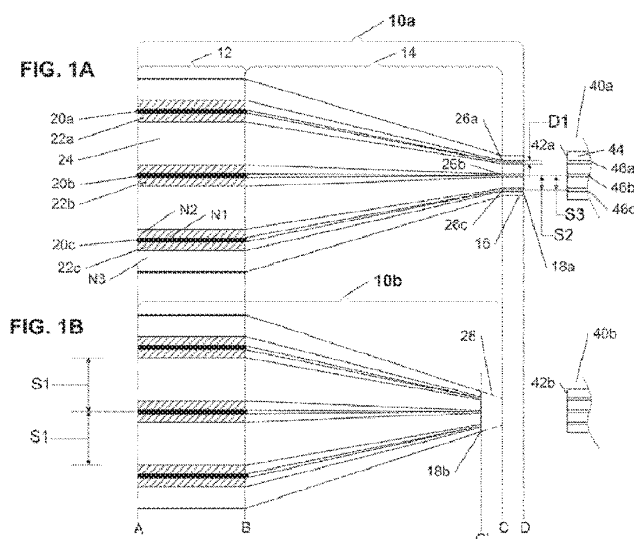
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(54) Title: OPTICAL FIBER COUPLER ARRAY



(57) Abstract: An optical fiber coupler array capable of providing multiple low loss, high coupling coefficient interfaces between a predetermined number of low numerical aperture optical fibers and an optical waveguide device with at least a corresponding number of waveguide interfaces. The novel coupler array includes a plurality of coupler inner cores and a plurality of corresponding coupler outer cores, within a medium surrounding each plural outer core, and also includes a first end for interfacing with plural optical fibers and a second end for interfacing with a plurality of waveguide interfaces of an optical waveguide device. The sizes of the inner and outer cores are gradually reduced from the first end to the second end in accordance with at least one predetermined reduction profile. Various parameters, such as refractive indices and sizes of the inner and outer cores and the medium (as well as the reduction profile) are selected to produce a plurality of low numerical aperture waveguides at the first end, and a plurality of high numerical aperture waveguides at the second end, while advantageously minimizing insertion loss and maximizing the coupling co-

efficient at each end. Advantageously, the novel coupler array may be fabricated as an array of individually drawn couplers from multiple parallel fused preforms (arranged in a row, or in another geometric cross section). Alternately, the novel coupler array may be fabricated from a single preform (glass or polymer) embedded with a plurality of parallel inner and outer core sets.

OPTICAL FIBER COUPLER ARRAY

FIELD OF THE INVENTION

The present invention relates generally to couplers, and more particularly to an optical fiber device comprising an array of multiple optical
5 fiber couplers capable of providing multiple low loss, high coupling coefficient interfaces between a predetermined number of low numerical aperture optical fibers and an optical waveguide device with at least a corresponding number of waveguide interfaces.

BACKGROUND OF THE INVENTION

10 Optical waveguide devices are indispensable in various high technology industrial applications, and especially in telecommunications. In recent years, these devices, including planar waveguides, and two or three dimensional photonic crystals are being used increasingly in conjunction with conventional optical fibers. In particular, optical waveguide devices based on
15 chiral optical fibers are advantageous and desirable in applications in which conventional optical fibers are also utilized. However, there are significant challenges in interfacing optical waveguide devices, including chiral optical fiber devices, with conventional low index contrast optical fibers. Typically, at least two major obstacles must be dealt with: (1) the difference between the
20 diameters of the optical waveguide device and the conventional fiber (especially with respect to the differences in core sizes), and (2) the difference between the numerical apertures of the optical waveguide device and the conventional fiber. Failure to properly address these obstacles results in

increased insertion losses and a decreased coupling coefficient at each interface.

A commonly assigned U.S. Patent No. 7,308,173, entitled "OPTICAL FIBER COUPLER WITH LOW LOSS AND HIGH COUPLING COEFFICIENT
5 AND METHOD OF FABRICATION THEREOF", which is hereby incorporated herein in its entirety, advantageously addressed all of the above issues by providing various embodiments of a novel optical fiber coupler capable of providing a low loss, high coupling coefficient interface between conventional optical fibers and optical waveguide devices.

10 Nevertheless, a number of challenges still remain. With the proliferation of optical devices with multiple waveguide interfaces (e.g., waveguide arrays), establishing low loss high-accuracy connections to arrays of high numerical aperture waveguides often provide problematic, especially because the spacing between the waveguides was very small making coupling thereto all
15 the more difficult.

It would thus be desirable to provide an optical fiber coupler array that provides a high coupling coefficient interface with high accuracy and easy alignment between an optical waveguide device having a plurality of high numerical aperture waveguide interfaces, and a plurality of optical fibers each
20 having low numerical apertures.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings, wherein like reference characters denote corresponding or similar elements throughout the various figures:

FIG. 1A is a schematic diagram of a side view of a first
5 exemplary embodiment of the optical fiber coupler array of the present invention;

FIG. 1B is a schematic diagram of a side view of a an alternate embodiment of the inventive optical fiber coupler array of FIG. 1A;

FIG. 2 shows a schematic diagram of a side view of a second
10 exemplary embodiment of the optical fiber coupler array of the present invention;

FIG. 3 shows schematic diagrams of a side view, and of alternate cross-sectional views, of a first embodiment of an optical fiber coupler array perform that may be utilized to fabricate the inventive optical
15 fiber coupler array of FIGs. 1A and 1B; and

FIGs. 4A and 4B, show schematic diagrams of side views, and of an exemplary cross-sectional view, of a second embodiment of an optical fiber coupler array perform, and of a stage of initial preparation thereof, that may be utilized to fabricate the inventive optical fiber coupler array of FIG. 2.

20

SUMMARY OF THE INVENTION

The present invention is directed to an optical fiber coupler array capable of providing multiple low loss, high coupling coefficient interfaces between a predetermined number of low numerical aperture optical fibers, and an optical waveguide device with at least a corresponding number of waveguide interfaces. The novel coupler array includes a plurality of coupler inner cores and a plurality of corresponding coupler outer cores, within a medium surrounding each plural outer core, and also includes a first end for interfacing with plural optical fibers and a second end for interfacing with a plurality of waveguide interfaces of an optical waveguide device. The sizes of the inner and outer cores are gradually reduced from the first end to the second end in accordance with at least one predetermined reduction profile. Various parameters, such as refractive indices and sizes of the inner and outer cores and the medium (as well as the reduction profile), are preferably selected, in accordance with the present invention, to produce a plurality of low numerical aperture waveguides at the first end, and to produce a plurality of high numerical aperture waveguides at the second end, while advantageously minimizing insertion loss and maximizing the coupling coefficient at each end. Advantageously, the inventive coupler array may be fabricated as an array of individually drawn couplers from multiple parallel fused preforms (arranged in a row, or in another geometric cross section).

Alternately, in another embodiment of the present invention, the novel coupler array may be fabricated from a single preform (glass or polymer), embedded with a plurality of parallel inner and outer core sets.

Other objects and features of the present invention will become apparent from the following detailed description considered in conjunction with the accompanying drawings. It is to be understood, however, that the drawings are designed solely for purposes of illustration and not as a
5 definition of the limits of the invention, for which reference should be made to the appended claims.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The present invention is directed to an optical fiber coupler array capable of providing multiple low loss, high coupling coefficient interfaces between a predetermined number of low numerical aperture optical fibers and
5 an optical waveguide device with at least a corresponding number of high numerical aperture waveguide interfaces.

Referring now to FIG. 1A, a first exemplary embodiment of an optical fiber coupler array of the present invention is shown as a coupler array 10a. The novel coupler array 10a includes a plurality of coupler inner cores (20a-
10 20c) of a first refractive index N1, and a plurality of corresponding coupler outer cores (22a-22c) of a second refractive index N2, within a medium 24 surrounding each plural outer core 22a-22c, of a third refractive index N3. Preferably, the refractive indexes are selected in accordance with the following relationship:

15
$$N1 > N2 > N3$$

At the outset it should be noted, that while various drawing figures show three or more inner / outer core sets in the array, the coupler array of the present invention may include any number of two or more inner and outer core sets, selected as a matter of design choice without departing from the
20 spirit of the invention.

The novel coupler array 10a also includes a first end /section 12 (between A and B, which can be much smaller than is shown in FIG. 1A) for interfacing with plural optical fibers and a second end / section 16 (between C

and D) for interfacing with a plurality of waveguide interfaces 46a-46c of an optical waveguide device 40a. The sizes of the inner and outer cores 20a-20c, and 22a-22c, respectively, are gradually reduced from the position B at the first end 12 to position C at the second end 16, in accordance with at least one predetermined reduction profile.

Preferably, various parameters, such as refractive indices $N1 - N3$, and sizes of the inner and outer cores 20a-20c, and 22a-22c, respectively, and the medium (as well as the at least one predetermined reduction profile) are selected to produce a plurality of low numerical aperture waveguides at the first end 12 (at position B), and a plurality of high numerical aperture waveguides 26a to 26c) at the second end 16, while advantageously minimizing insertion loss and maximizing the coupling coefficient at each end.

Advantageously, the spacings $S2$ between the plural high numerical aperture waveguides at an interface surface 18a at position D of the array 10a, is smaller than the spacings $S1$ between the inner/outer core sets at position A of the first end 12, thus providing a dense interconnect interface for plural high numerical aperture waveguides interfaces 46a to 46c with spacings $S3$ therebetween that preferably substantially matches the magnitude of $S2$.

In an alternate embodiment of the coupler array 10a of FIG. 1A, a coupler array 10b is shown in FIG. 1B. In certain applications, requiring very high precision, it is possible that the small interface portion at second end 16 of array 10a may have spacings $S2$ and/or waveguide 26a-26c diameters $D1$ that do not sufficiently match the corresponding parameters at an interface 42b of a waveguide 40b. In this case, it may be advantageous to fabricate the

array 10a in a manner such that the interface parameters S2 and D1 are smaller than corresponding parameters at interface 42b, and then remove small portions of the second end 16 and if necessary continue beyond, toward position B (e.g., by polishing) until an interface 18b with desired parameters is produced at position C'.
5

FIG. 2 shows a schematic diagram of a side view of a second exemplary embodiment of the optical fiber coupler array 50 of the present invention, in which the novel coupler array has been fabricated as an array 54 of individually drawn couplers 54a to 54c from multiple parallel fused performs (arranged in a row, or in another geometric cross section). Each coupler portion includes an inner and outer core set 56a-56c, and 58a-58c respectively, with each set being surrounded by a corresponding medium section 60a to 60c. The coupler array 50 may be useful for connection to waveguide devices, such as device 80, with a reasonably large interface 82 and spacings S2 between waveguide interface elements 86a – 86c that are of sufficient size to match the spacings of corresponding waveguide 50 high numerical aperture interfaces of couplers 54a to 54c at position C. As previously noted, the diameters D1 of the interfaces of couplers 54a to 54c at position C, are preferably selected to match diameters D2 of the waveguide interface elements 86a – 86c.
10
15
20

Referring now to FIG. 3, a first embodiment of an optical fiber coupler array perform that may be utilized to fabricate the inventive optical fiber coupler array 10a, 10b of FIGs. 1A and 1B is shown, with plural inner cores 106a and outer cores 104a embedded in parallel within a single perform medium 102 (made from glass or polymer for example). By way of example, if
25

the resulting optical coupler array is intended to be polarization maintaining, then, as is shown in cross section view CS-1, the outer cores 104a may have 180 degree cross-sectional symmetry (e.g. a rectangle cross-section). Otherwise as shown in view CS-2, the outer cores 104a may be conventional.

5 Referring now to FIGs. 4A and 4B, a second embodiment of an exemplary optical fiber coupler array perform 100 that may be utilized to fabricate the inventive optical fiber coupler array 50 of FIG. 2 is shown. FIG. 4A shows a stage of initial preparation thereof, wherein a set of performs 150a – 150d, each comprising an inner core 154a, and an outer core 156a
10 surrounded by a medium 152a, are connected to one another in parallel to each (for example by being fused together). FIG. 4B, then shows a ready for use perform 200 comprising the four performs 150a-150d in a square cross-section configuration, which by way of further example is shown, in view CS-3, as having a square cross-section with polarization maintaining outer cores
15 156a. As noted above, this exemplary perform 200 may be used to fabricate an embodiment of the inventive coupler array which comprises a plurality of individually drawn high numerical aperture waveguide couplers (such as coupler array 50 of FIG. 2).

Thus, while there have been shown and described and pointed out
20 fundamental novel features of the invention as applied to preferred embodiments thereof, it will be understood that various omissions and substitutions and changes in the form and details of the devices and methods illustrated, and in their operation, may be made by those skilled in the art without departing from the spirit of the invention. For example, it is expressly
25 intended that all combinations of those elements and/or method steps which

perform substantially the same function in substantially the same way to achieve the same results are within the scope of the invention. It is the intention, therefore, to be limited only as indicated by the scope of the claims appended hereto.

5

CLAIMS

We Claim:

1. An optical coupler array for use with an optical waveguide device having a plurality of waveguides each having a capacity for at least
5 one optical mode of a predetermined mode field profile, comprising:

an elongated optical fiber element having a first end and a second end,
and comprising:

a plurality of coupler inner cores, each having a first refractive index, a first inner core size at said first end, and a
10 second inner core size at said second end,

a plurality of coupler outer cores, each longitudinally surrounding a corresponding said plural coupler inner core, and each having a second refractive index, a first outer core size at said first end and a second outer core size at said second end,
15 said second inner core and second outer core sizes being substantially smaller than said first inner core and first outer core sizes, and

a medium having a third refractive index surrounding each said plural coupler outer core, wherein said first refractive index is greater than said second refractive index, wherein said
20 second refractive index is greater than said third refractive index, wherein said each said first inner core size and each said first outer core size are gradually reduced, in accordance with a predetermined reduction profile, between said first end and said

second end along said optical fiber element, until said second inner core size and said second outer core size are reached for each respective said plural coupler inner core and said plural outer core, wherein each said second inner core size is selected to be insufficient to guide light, each said second outer core size is selected to match the said predetermined mode field profile of the at least one optical mode of the plural waveguides, such that light traveling from said first end to said second end escapes from each said plural coupler inner core into each said corresponding plural coupler outer core proximal to said second end, and light traveling from said second end to said first end moves from each said plural coupler outer core into each said corresponding plural coupler inner core proximal to said first end, so that said first end forms a plurality of low numerical aperture waveguides and said second end forms a plurality of high numerical aperture waveguides.

2. The optical coupler array of claim 1, wherein said predetermined reduction profile comprises a plurality of predetermined reduction profiles that vary from one another.

3. The optical coupler array of claim 2, wherein plural predetermined reduction profiles that vary from one another in accordance with a relative position of each set of said plural inner and outer cores from a center of said optical fiber element.

5

4. The optical coupler array of claim 1, wherein said medium is composed of one of: a glass or a polymer.

5. The optical coupler array of claim 1, wherein said medium
10 comprises a plurality of elongated medium sections, each being longitudinally connected to at least one other plural medium section, and each comprising therein a respective set of said corresponding plural inner and outer cores, and wherein said coupler array comprises a plurality of individually drawn coupler interfaces from each of said plural medium portions and said
15 respective inner and outer core sets.

6. The optical coupler array of claim 1, wherein said elongated optical fiber element is fabricated from a single preform embedded with a plurality of sets of corresponding inner and outer cores, each plural set being
20 positioned in parallel to one another.

7. The optical coupler array of claim 6, wherein a first distance between said plural high numerical aperture waveguides at said second end is smaller than a second distance between said plural low numerical aperture

waveguides at said first end, thus providing a dense interconnect interface for plural high numerical aperture waveguides.

8. The optical coupler array of claim 6, wherein said plural sets of
5 corresponding inner and outer cores are positioned and arranged in at least one row.

10

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FIG. 1A

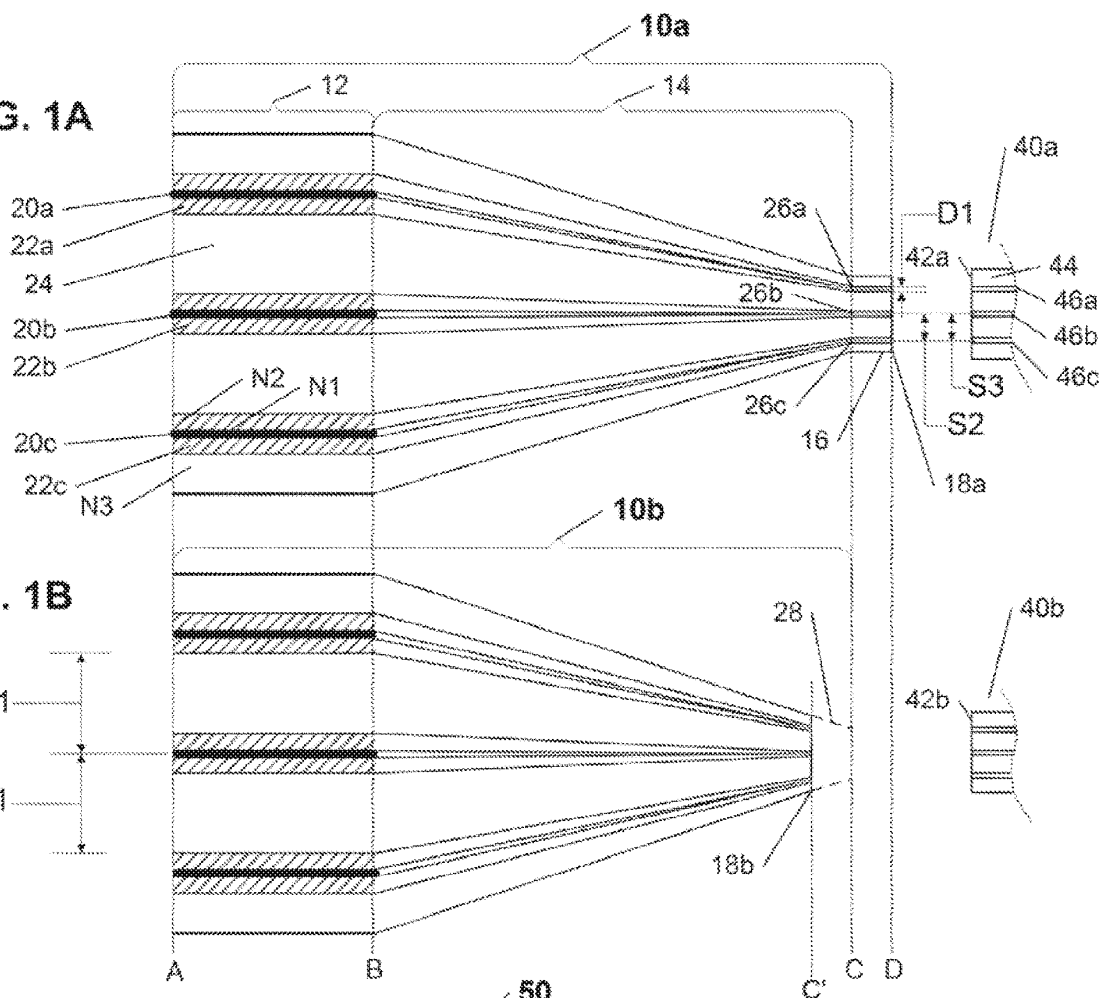


FIG. 1B

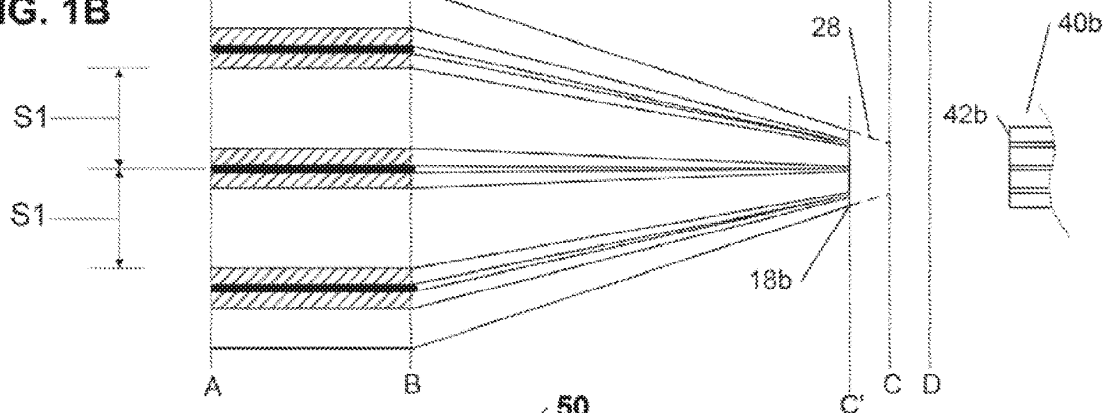
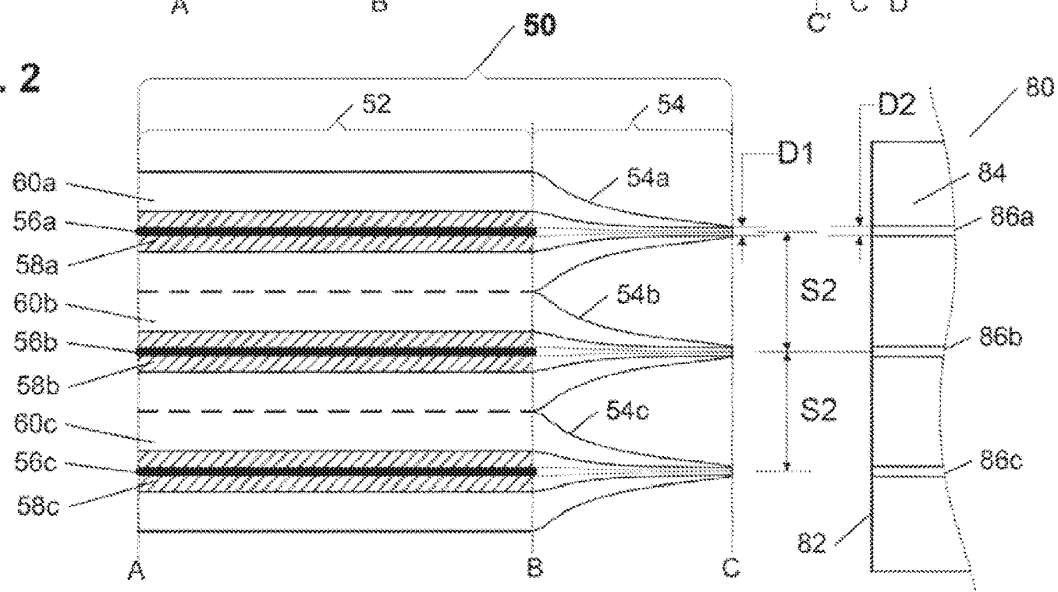
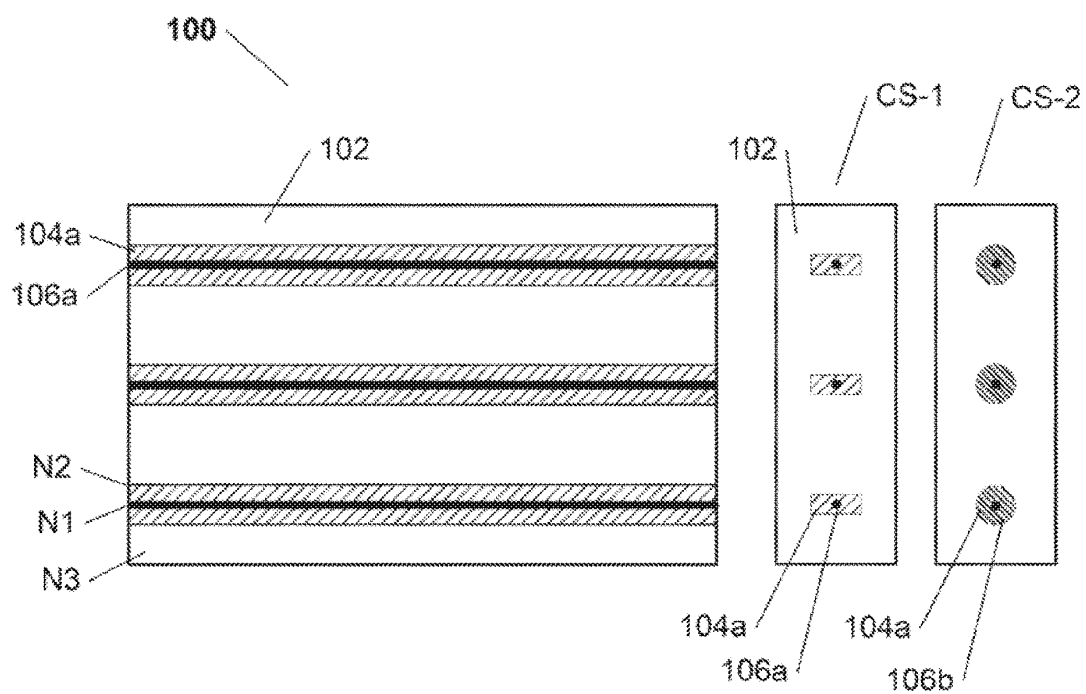


FIG. 2



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FIG. 3



3/3

FIG. 4A

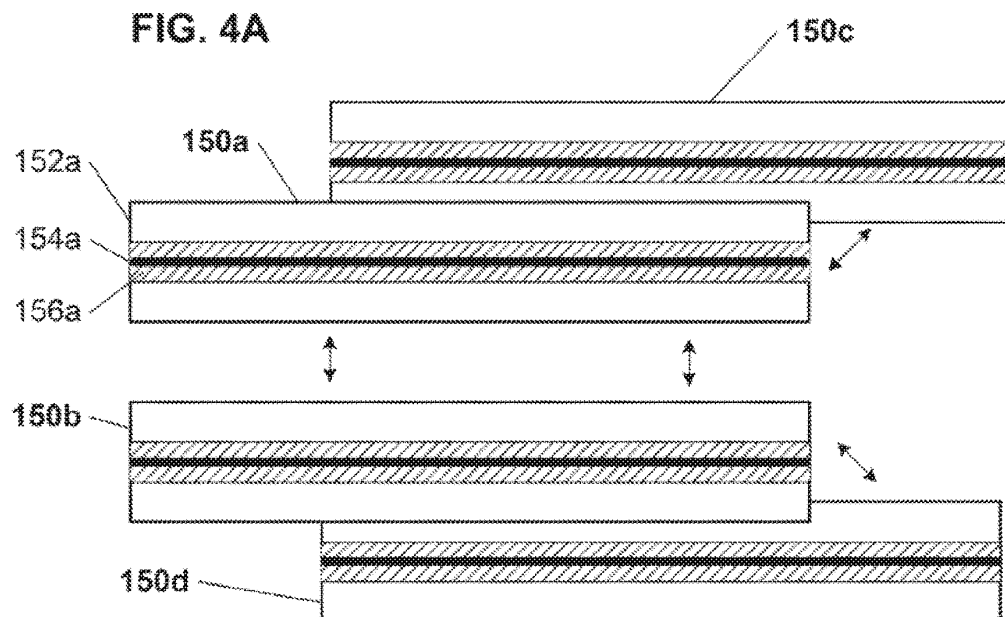
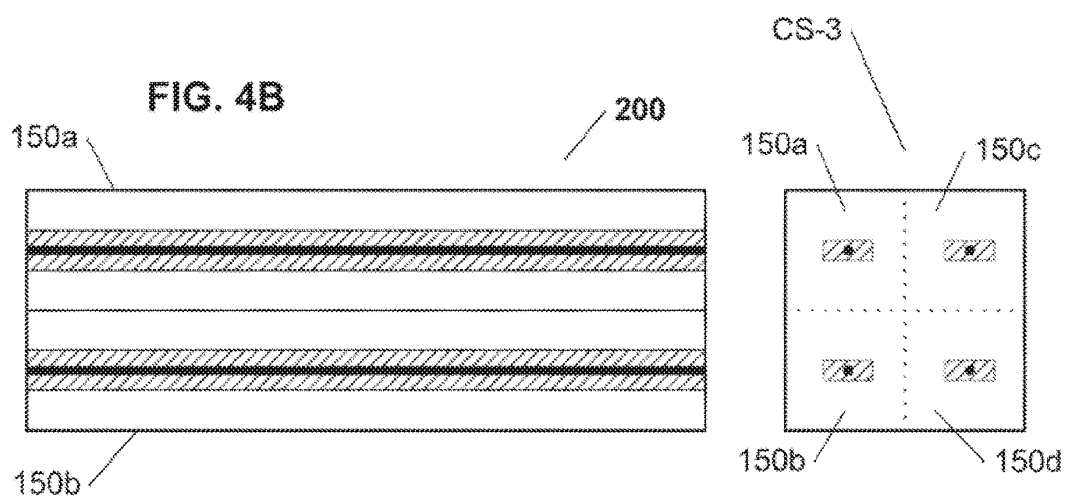


FIG. 4B



(43) International Publication Date
21 January 2010 (21.01.2010)(10) International Publication Number
WO 2010/009101 A3(51) International Patent Classification:
G02B 6/30 (2006.01) G02B 6/43 (2006.01)
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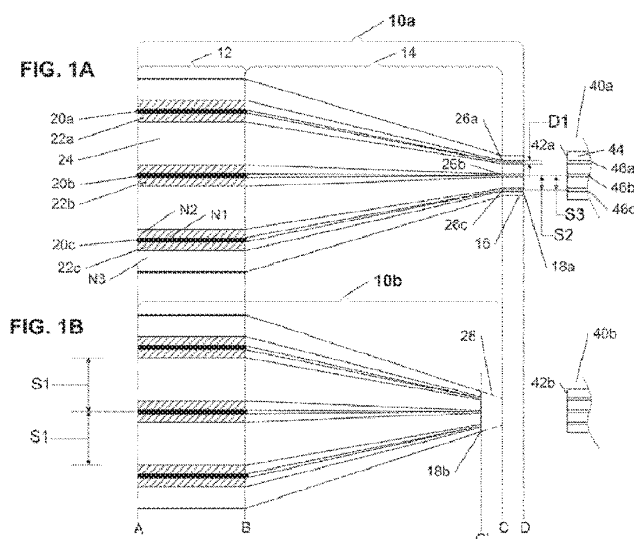
(30) Priority Data:
61/080,684 14 July 2008 (14.07.2008) US(71) Applicant (for all designated States except US): CHI-
RAL PHOTONICS, INC. [US/US]; 26 Chapin Road,
Unit 1104, Pine Brook, NJ 07058 (US).(72) Inventors: SINGER, Jonathan; 7142 Center Bridge
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GROSCHL, Daniel; 6 Powder Horn Drive, Suffern, NY
10901 (US).(74) Agent: ETKIN, Edward; Law Office Of Edward Etkin,
Esq., PC, 228 West End Ave., Suite A, Brooklyn, NY
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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,
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ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV,
MC, MK, MT, NL, NO, PL, PT, RO, 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))

— before the expiration of the time limit for amending the
claims and to be republished in the event of receipt of
amendments (Rule 48.2(h))

[Continued on next page]

(54) Title: OPTICAL FIBER COUPLER ARRAY

(57) Abstract: An optical fiber coupler array
capable of providing multiple low loss, high
coupling coefficient interfaces between a pre-
determined number of low numerical aperture
optical fibers and an optical waveguide device
with at least a corresponding number of
waveguide interfaces. The novel coupler array
includes a plurality of coupler inner cores and
a plurality of corresponding coupler outer
cores, within a medium surrounding each plu-
ral outer core, and also includes a first end for
interfacing with plural optical fibers and a sec-
ond end for interfacing with a plurality of
waveguide interfaces of an optical waveguide
device. The sizes of the inner and outer cores
are gradually reduced from the first end to the
second end in accordance with at least one
predetermined reduction profile. Various pa-
rameters, such as refractive indices and sizes
of the inner and outer cores and the medium
(as well as the reduction profile) are selected
to produce a plurality of low numerical aper-
ture waveguides at the first end, and a plu-
rality of high numerical aperture waveguides at
the second end, while advantageously minimizing
insertion loss and maximizing the coupling co-efficient at each end. Advantageously, the novel coupler array may be fabricated as an array of individually drawn couplers from
multiple parallel fused preforms (arranged in a row, or in another geometric cross section). Alternately, the novel coupler array
may be fabricated from a single preform (glass or polymer) embedded with a plurality of parallel inner and outer core sets.



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

11 March 2010

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2009/050506

A. CLASSIFICATION OF SUBJECT MATTER		
G02B 6/30(2006.01)i, G02B 6/38(2006.01)i, G02B 6/43(2006.01)i		
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: G02B 6/30; G02B 6/38; G02B 6/43;		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Korean utility models and applications for utility models since 1975. Japanese utility models and applications for utility models since 1975		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) eKOMPASS(KIPO internal) & Keywords: optical fiber, optical coupler, dual core, numerical aperture		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2005-0135740 A1 (KOPP, V. et al.) 23 June 2005 See the abstract, paragraphs [41]-[42]; figures 1 and 3.	1-8
A	US 4795228 A (SCHNEIDER, HARTMUT) 03 January 1989 See the abstract, column 2, line 60 - column 3, line 28; figures 1-2.	1-8
A	US 6330382 B1 (HARSHBARGER, D. E. et al.) 11 December 2001 See the abstract, column 3, line 14 - line 59; figure 1.	1-8
A	US 6324326 B1 (DEJNEKA, M. J. et al.) 27 November 2001 See the abstract, column 11, line 4 - column 12, line 18; figure 13	1-8
PX	JP 2008-203496 A (FUJIKURA LTD.) 04 September 2008 See the abstract, paragraphs [20]-[24]; figures 1-7.	1,2,4
☐ Further documents are listed in the continuation of Box C. ☒ See patent family 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 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 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 06 JANUARY 2010 (06.01.2010)		Date of mailing of the international search report 07 JANUARY 2010 (07.01.2010)
Name and mailing address of the ISA/KR  Korean Intellectual Property Office Government Complex-Daejeon, 139 Seonsa-ro, Seo-gu, Daejeon 302-701, Republic of Korea Facsimile No. 82-42-472-7140		Authorized officer SONG, Hyun Chae Telephone No. 82-42-481-5786 

Form PCT/ISA/210 (second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2009/050506

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2005-0135740 A1	23.06.2005	US 7308173 B2	11.12.2007
US 4795228 A	03.01.1989	None	
US 6330382 B1	11.12.2001	None	
US 6324326 B1	27.11.2001	None	
JP 2008-203496 A	04.09.2008	None	

Electronic Patent Application Fee Transmittal				
Application Number:		14300138		
Filing Date:		09-Jun-2014		
Title of Invention:		Method and Arrangement for the Generation of a Laser Beam With Different Beam Profile Characteristics by Means of a Multi-Clad Fibre		
First Named Inventor/Applicant Name:		Rudolf HUBER		
Filer:		Yunbo Guo/Matthew Doherty		
Attorney Docket Number:		15540-0370002		
Filed as Large Entity				
Filing Fees for Utility under 35 USC 111(a)				
Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Miscellaneous:				
Submission- Information Disclosure Stmt	1806	1	180	180
Total in USD (\$)				180

Electronic Acknowledgement Receipt	
EFS ID:	25784492
Application Number:	14300138
International Application Number:	
Confirmation Number:	4091
Title of Invention:	Method and Arrangement for the Generation of a Laser Beam With Different Beam Profile Characteristics by Means of a Multi-Clad Fibre
First Named Inventor/Applicant Name:	Rudolf HUBER
Customer Number:	26161
Filer:	Yunbo Guo/Matthew Doherty
Filer Authorized By:	Yunbo Guo
Attorney Docket Number:	15540-0370002
Receipt Date:	16-MAY-2016
Filing Date:	09-JUN-2014
Time Stamp:	12:53:25
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	Deposit Account
Payment was successfully received in RAM	\$180
RAM confirmation Number	10280
Deposit Account	061050
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Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		Response0370002.pdf	55090	yes	3
			c3ee43ab0ba06a34eb3af62ecffefefd25503b4		
	Multipart Description/PDF files in .zip description				
	Document Description		Start	End	
	Amendment/Req. Reconsideration-After Non-Final Reject		1	1	
	Specification		2	2	
	Applicant Arguments/Remarks Made in an Amendment		3	3	
Warnings:					
Information:					
2	Information Disclosure Statement (IDS) Form (SB08)	IDS0370002.pdf	612023	no	4
			f377771e2eb78b6ba0d7c91e62ab6924d977cd0b		
Warnings:					
Information:					
3	Foreign Reference	KR.pdf	833694	no	10
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Warnings:					
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4	Foreign Reference	WO.pdf	2415329	no	22
			4ff5ea193b4bb7211782455b84716a326987a4d0		
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5	Fee Worksheet (SB06)	fee-info.pdf	30804	no	2
			e5578b8ac00554fe75190610a5be77d72844b219		
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Total Files Size (in bytes):			3946940		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.



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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
14/300,138	06/09/2014	Rudolf HUBER	15540-0370002	4091
26161 7590 03/07/2016 FISH & RICHARDSON P.C. (BO) P.O. BOX 1022 MINNEAPOLIS, MN 55440-1022			EXAMINER ULLAH, AKM E	
			ART UNIT 2874	PAPER NUMBER
			NOTIFICATION DATE 03/07/2016	DELIVERY MODE ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

PATDOCTC@fr.com

Office Action Summary	Application No. 14/300,138	Applicant(s) HUBER ET AL.	
	Examiner Akm Enayet Ullah	Art Unit 2874	AIA (First Inventor to File) Status No

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTHS FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 12/29/2015.
☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on ____.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on ____; the restriction requirement and election have been incorporated into this action.
- 4) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims*

- 5) ☒ Claim(s) 17-39 is/are pending in the application.
5a) Of the above claim(s) 28-39 is/are withdrawn from consideration.
- 6) ☐ Claim(s) ____ is/are allowed.
- 7) ☒ Claim(s) 17-27 is/are rejected.
- 8) ☐ Claim(s) ____ is/are objected to.
- 9) ☐ Claim(s) ____ are subject to restriction and/or election requirement.

* If any claims have been determined allowable, you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to PPHfeedback@uspto.gov.

Application Papers

- 10) ☐ The specification is objected to by the Examiner.
- 11) ☒ The drawing(s) filed on 6/9/2014 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

Certified copies:

- a) ☒ All b) ☐ Some** c) ☐ None of the:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. ____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

** See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☒ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b)
Paper No(s)/Mail Date 4/10/15, 8/11/15, 8/14/15, 8/28/15 & 9/18/15
- 3) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. ____.
- 4) ☐ Other: ____.

The present application is being examined under the pre-AIA first to invent provisions.

Detailed Action

Applicant cooperation is requested in correcting any errors of which applicant may become aware in the specification

Status of the Application

Parent Data

This instant US application serial number 14/ 300138, filed 06/09/2014 is a continuation of 13639401, filed 12/20/2012 ,now U.S. Patent #8781269 13639401 is a national stage entry of PCT/EP2011/055484 , International Filing Date: 04/08/2011 also claims foreign priority to 102010003750.8 , filed 04/08/2010.

Claims 17- 39 are pending in this application.

Claims 1-16 have been cancelled.

A (2) ways restriction was made in this application. Applicant's attorney elected Group I, claims 17-27. This election was made without traverse.

Thus, claims 18-39 have been withdrawn from further consideration.

If applicant is aware of any prior art or any other co- pending application not already of record, he/she is reminded of his/her duty under 37 CFR 1.56 to disclose the same.

If applicant provides prior art, he/she is requested to cite it on form PTO- 1449 in accordance with the guideline set forth in MPEP 609.

The Title Of The Invention is Not Descriptive

The title of the invention is not descriptive. A new title is required that is clearly indicative of the invention to which the claims are directed.

Foreign Priority

Receipt is acknowledged of papers submitted under 35 U.S.C. 119(a)-(d), which papers have been placed of record in the file.

Notice re Prior art available under both Pre-AIA and AIA

In the event the determination of the status of the application as subject to AIA 35 U.S.C. 102 and 103 (or as subject to pre-AIA 35 U.S.C. 102 and 103) is incorrect, any correction of the statutory basis for the rejection will not be considered a new ground of rejection if the prior art relied upon, and the rationale supporting the rejection, would be the same under either status.

Double Patenting

The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent and to prevent possible harassment by multiple assignees. A nonstatutory double patenting rejection is appropriate here the claims at issue are not identical, but at least one examined application claim is not patentably distinct from the reference claim(s) because the examined application claim is either anticipated by, or would have been obvious over, the reference claim(s). See, e.g., *In re Berg*, 140 F.3d 1428, 46 USPQ2d 1226 (Fed. Cir. 1998); *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van*

Art Unit: 2874

Ornum, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 SPQ 619 (CCPA 1970); and *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

1. A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) or 1.321(d) may be used to overcome an actual or provisional rejection based on a nonstatutory double patenting ground provided the reference application or patent either is shown to be commonly owned with this application, or claims an invention made as a result of activities undertaken within the scope of a joint research agreement. A terminal disclaimer must be signed in compliance with 37 CFR 1.321(b).

The USPTO internet Web site contains terminal disclaimer forms which may be used. Please visit <http://www.uspto.gov/forms/>. The filing date of the application will determine what form should be used. A web-based eTerminal Disclaimer may be filled out completely online using web-screens. An eTerminal Disclaimer that meets all requirements is auto-processed and approved immediately upon submission. For more information about eTerminal Disclaimers, refer to <http://www.uspto.gov/patents/process/file/efs/guidance/eTD-info-I.jsp>.

Claims 17 - 27 are rejected on the ground of nonstatutory double patenting as being unpatentable over claims 1-5 of U.S. Patent No. 8,781,269 [hereinafter referred as '269]. Although the claims at issue are not identical, they are not patentably distinct from each other because the language is virtually identical with the exception that the instant claims specifically state a "laser beam is coupled into the fiber end of multi-clad fiber and emitted from each other fiber end of the multi-clad fiber and having different beam profile characteristics" connector whereas '269 is drawn to a "method for generating a laser beam with different beam profile characteristics.

However, it is well known to apply the general principles of such method for generating a laser beam with different beam profile.

Thus, it would have been obvious to one of ordinary skill in the art at the time the invention was made to explicitly state "a laser beam coupling with the end of a f double clad fiber" when referring to the different beam profile characteristics of the output laser beam as many well-known general classes of coupling between laser beam to a multi-clad fiber as possible. Furthermore, it is noted, as a non-limiting example, that it is commonplace to apply mutually useful inventive concepts from the optical fiber coupling area to such laser beam coupling [and vice versa] and to make any necessary adaptations in order to apply a general inventive concept to either coupling type [See also: MPEP §2144.07 Art Recognized Suitability for an Intended Purpose].

Thus each of claims 17 -27 are rejected.

Contact Information

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Akm Enayet Ullah whose telephone number is 571-272-2361. The examiner can normally be reached on Monday through Thursday from 6:30 am to 5 pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Uyen-Chau Le, can be reached on 571-272-2397. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

/Akm Enayet Ullah/
Primary Examiner
Art Unit 2874

Notice of References Cited	Application/Control No. 14/300,138	Applicant(s)/Patent Under Reexamination HUBER ET AL.	
	Examiner Akm Enayet Ullah	Art Unit 2874	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	CPC Classification	US Classification
*	A	US-8,781,269 B2	07-2014	Huber; Rudolf	B23K26/073	385/147
	B	US-				
	C	US-				
	D	US-				
	E	US-				
	F	US-				
	G	US-				
	H	US-				
	I	US-				
	J	US-				
	K	US-				
	L	US-				
	M	US-				

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	CPC Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
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	V	
	W	
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Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

Search Notes 	Application/Control No. 14300138	Applicant(s)/Patent Under Reexamination HUBER ET AL.
	Examiner AKM ULLAH	Art Unit 2874

CPC- SEARCHED		
Symbol	Date	Examiner
B23K 26/064 20151001; G02B 6/4296 20130101; G02B 6/02042 20130101; G02B 6/35 20130101; G02B 6/3508 20130101; G02B 6/4206 20130101 International Class: G02B 6/35 20060101 G02B006/35; G02B 6/42	2/18/2016	AU

CPC COMBINATION SETS - SEARCHED		
Symbol	Date	Examiner

US CLASSIFICATION SEARCHED			
Class	Subclass	Date	Examiner
385	14-42	11/17/2015	AU

SEARCH NOTES		
Search Notes	Date	Examiner
EAST, ASSIGNEE and INVENTOR	11/17/2015	AU

INTERFERENCE SEARCH			
US Class/ CPC Symbol	US Subclass / CPC Group	Date	Examiner

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Receipt date: 09/18/2015

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /A.U.

Doc code: IDS

Doc description: Information Disclosure Statement (IDS) Filed

PTO/SB/08a (01-10)

Approved for use through 07/31/2012. OMB 0651-0031

U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number		14300138 14300138 - GAU: 2874	
	Filing Date		2014-06-09	
	First Named Inventor	Rudolph Huber		
	Art Unit	2883 Receipt date: 09/18/2015		
	Examiner Name			
	Attorney Docket Number	15540-0370002		

U.S. PATENTS							Remove	
Examiner Initial*	Cite No	Patent Number	Kind Code ¹	Issue Date	Name of Patentee or Applicant of cited Document	Pages, Columns, Lines where Relevant Passages or Relevant Figures Appear		
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Examiner Initial*	Cite No	Foreign Document Number ³	Country Code ² j	Kind Code ⁴	Publication Date	Name of Patentee or Applicant of cited Document	Pages, Columns, Lines where Relevant Passages or Relevant Figures Appear	T ⁵
/A.U./	1	0362466	EP	A2	1990-09-26	Hessel	English Abstract	☒
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Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.						T ⁵

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Receipt date: 09/18/2015

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Examiner Signature	/Akm Enayet Ullah/	Date Considered	02/18/2016
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*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

¹ See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. ² Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). ³ For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. ⁴ Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. ⁵ Applicant is to place a check mark here if English language translation is attached.

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	Art Unit	2883 14300138 - GAU: 2874
	Examiner Name	
	Attorney Docket Number	15540-0370002

Receipt date: 09/18/2015

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

☐ That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

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☐ See attached certification statement.

☒ The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☐ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Yunbo Guo/	Date (YYYY-MM-DD)	2015-09-18
Name/Print	Yunbo Guo	Registration Number	70538

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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14300138 - GAU: 2874

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

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2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

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Sheet 1 of 1

Substitute Disclosure Form	U.S. Department of Commerce Patent and Trademark Office	Attorney Docket No. 15540-0370002	Application No. 14/300,138
Information Disclosure Statement by Applicant (Use several sheets if necessary) (37 CFR §1.98(b))		Applicant TRUMPF Laser- und Systemtechnik GmbH	
		Filing Date June 9, 2014	Group Art Unit 2883

U.S. Patent Documents

Examiner Initial	Desig. ID	Document Number	Publication Date	Patentee	Class	Subclass	Filing Date If Appropriate
	1	5,461,682	1995-10-24	Nagel			
/A.U./	2	5,461,692	1995-10-24	Nagel			
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Foreign Patent Documents or Published Foreign Patent Applications

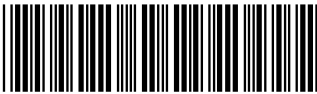
Examiner Initial	Desig. ID	Document Number	Publication Date	Country or Patent Office	Class	Subclass	Translation	
							Yes	No
	12							
	13							
	14							
	15							
	16							

Other Documents (include Author, Title, Date, and Place of Publication)

Examiner Initial	Desig. ID	Document
	17	
	18	
	19	
	20	

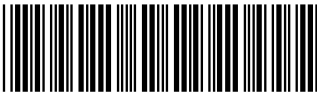
Examiner Signature /Akm Enayet Ullah/	Date Considered 02/18/2016
EXAMINER: Initials citation considered. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.	

Substitute Disclosure Form

<i>Index of Claims</i> 	Application/Control No. 14300138	Applicant(s)/Patent Under Reexamination HUBER ET AL.
	Examiner AKM ULLAH	Art Unit 2874

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

☐ Claims renumbered in the same order as presented by applicant				☐ CPA				☐ T.D.				☐ R.1.47			
CLAIM		DATE													
Final	Original	11/17/2015	02/18/2016												
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<i>Index of Claims</i> 	Application/Control No. 14300138	Applicant(s)/Patent Under Reexamination HUBER ET AL.
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CLAIM		DATE													
Final	Original	11/17/2015	02/18/2016												
	37	÷	N												
	38	÷	N												
	39	÷	N												

Receipt date: 08/28/2015

Doc code: IDS

Doc description: Information Disclosure Statement (IDS) Filed

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	Filing Date		2014-06-09	
	First Named Inventor	Rudolph Huber		
	Art Unit	2883 14300138 - GAU: 2874		
	Examiner Name			
	Attorney Docket Number	15540-0370002		

U.S. PATENTS						Remove
Examiner Initial*	Cite No	Patent Number	Kind Code ¹	Issue Date	Name of Patentee or Applicant of cited Document	Pages, Columns, Lines where Relevant Passages or Relevant Figures Appear
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/A.U./	1	20050031261	A1	2005-02-10	Tanaka	English equivalent of CN 1580865

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/A.U./	1	1580865	CN	A	2005-02-16			☐

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	Filing Date		2014-06-09
	First Named Inventor	Rudolph Huber	
	Art Unit	2883	
	Examiner Name		
	Attorney Docket Number	15540-0370002	

14300138 - GAU: 2874

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Examiner Signature	/Akm Enayet Ullah/	Date Considered	02/18/2016
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	Art Unit	2883	
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14300138 - GAU: 2874

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Name/Print	Yunbo Guo	Registration Number	70538

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Examiner Initial*	Cite No	Patent Number	Kind Code ¹	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	5461682	A	1995-10-24	Nagel	
	2	7592568	B2	2009-09-22	Varnham et al	
	3	8008600	B2	2011-08-30	Nakamae et al	

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	1							☐

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Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T ⁵	
	1		☐	
If you wish to add additional non-patent literature document citation information please click the Add button				
EXAMINER SIGNATURE				
Examiner Signature	/Akm Enayet Ullah/		Date Considered	02/18/2016
*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.				
¹ See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. ² Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). ³ For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. ⁴ Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. ⁵ Applicant is to place a check mark here if English language translation is attached.				

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number	14300138
	Filing Date	2014-06-09
	First Named Inventor	Rudolph Huber
	Art Unit	2883
	Examiner Name	
	Attorney Docket Number	15540-0370002

14300138 - GAU: 2874

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

- ☐ That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

- ☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

- ☐ See attached certification statement.
- ☐ The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.
- ☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Yunbo Guo/	Date (YYYY-MM-DD)	2015-08-11
Name/Print	Yunbo Guo	Registration Number	70538

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these records.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Receipt date: 04/10/2015

14300138 - GAU: 2874

Doc code: IDS

PTO/SB/08a (01-10)

Doc description: Information Disclosure Statement (IDS) Filed

Approved for use through 07/31/2012. OMB 0651-0031

U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number		14300138
	Filing Date		2014-06-09
	First Named Inventor	Rudolph Huber	
	Art Unit	2883	14300138 - GAU: 2874
	Examiner Name	/Akm Enayet Ullah/	
	Attorney Docket Number	15540-0370002	

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /A.U./

U.S. PATENTS						Remove
Examiner Initial*	Cite No	Patent Number	Kind Code ¹	Issue Date	Name of Patentee or Applicant of cited Document	Pages, Columns, Lines where Relevant Passages or Relevant Figures Appear
	1	3941670	A	1976-03-02	Pratt et al	
	2	4475788	A	1984-10-09	Tomassini et al	
	3	4575181	A	1986-03-11	Ishikawa	
	4	5684642	A	1997-11-04	Zumoto et al	
	5	7372877	B2	2008-05-13	Shirakawa et al	
	6	7379237	B1	2008-05-27	Di Teodoro et al	
	7	7379648	B1	2008-05-27	Brooks et al	
	8	7720340	B2	2010-05-18	Lewis et al	

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	Art Unit	2883		
	Examiner Name			
	Attorney Docket Number	15540-0370002		

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14300138 - GAU: 2874

	9	7738166	B2	2010-06-15	Murison et al	
	10	7809225	B2	2010-10-05	Bouma et al	
	11	7839902	B2	2010-11-23	Li et al	
	12	7933479	B2	2011-04-26	Gonthier et al	
	13	8076632	B2	2011-12-13	Kreysing et al	
	14	8094370	B2	2012-01-10	Lewis	
	15	8456523	B2	2013-06-04	Stork Gennant Wersborg	

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	1	20020071647	A1	2002-06-13	Manzur	
	2	20020168139	A1	2002-11-14	Clarkson et al	

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	Attorney Docket Number	15540-0370002		

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3	20020172485	A1	2002-11-21	Keaton et al	
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4	20060251367	A1	2006-11-09	Seifert et al	
5	20060263024	A1	2006-11-23	Dong et al	

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	1	3833992	DE	A1		1990-04-12		☐
	2	3833993	DE	A1		1990-04-12		☐
	3	4200587	DE	C1		1993-04-01		☐
	4	2284892	FR	A1		1976-04-09		☐
	5	2449689	GB	A		2008-12-03		☐

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number		14300138
	Filing Date		2014-06-09
	First Named Inventor	Rudolph Huber	
	Art Unit	2883	
	Examiner Name		
	Attorney Docket Number	15540-0370002	

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14300138 - GAU: 2874

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T ⁵
	1	Extended European Search Report dated July 1, 2013.	☐
	2	International Search Report dated May 6, 2011.	☐
	3	German Office Action dated November 22, 2010.	☐

If you wish to add additional non-patent literature document citation information please click the Add button **Add****EXAMINER SIGNATURE**

Examiner Signature	/Akm Enayet Ullah/	Date Considered	02/18/2016
--------------------	--------------------	-----------------	------------

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¹ See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. ² Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). ³ For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. ⁴ Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. ⁵ Applicant is to place a check mark here if English language translation is attached.

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OR

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☐ See attached certification statement.

☐ The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Yunbo Guo/	Date (YYYY-MM-DD)	2015-04-10
Name/Print	Yunbo Guo	Registration Number	70538

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2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
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9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

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Application	Document	Mailroom Date	Attorney Docket No.
14300138	CTNF	03/07/2016	15540-0370002
	892	03/07/2016	15540-0370002
	1449	03/07/2016	15540-0370002
	1449	03/07/2016	15540-0370002
	1449	03/07/2016	15540-0370002
	1449	03/07/2016	15540-0370002
	1449	03/07/2016	15540-0370002

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

First Named Inventor : Rudolph Huber Art Unit : 2883
Serial No. : 14/300,138 Examiner : Akm E. Ullah
Filed : June 9, 2014
Title : METHOD AND ARRANGEMENT FOR GENERATING A LASER
BEAM HAVING A DIFFERING BEAM PROFILE
CHARACTERISTIC BY MEANS OF A MULTI-CLAD FIBER

Mail Stop Amendment

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

REPLY TO RESTRICTION REQUIREMENT

In response to the restriction requirement made in the action dated November 23, 2015, identified Group I (claims 17-27) is elected for examination. The election is made without traverse.

Please apply any necessary charges or credits to Deposit Account No. 06-1050, referencing the above attorney docket number.

Respectfully submitted,

Date: 12/23/2015

/Yunbo Guo/
Yunbo Guo
Reg. No. 70,538

Customer Number 26161
Fish & Richardson P.C.
Telephone: (512) 226-8108
Facsimile: (877) 769-7945

23472424.doc

Electronic Acknowledgement Receipt	
EFS ID:	24473666
Application Number:	14300138
International Application Number:	
Confirmation Number:	4091
Title of Invention:	Method and Arrangement for the Generation of a Laser Beam With Different Beam Profile Characteristics by Means of a Multi-Clad Fibre
First Named Inventor/Applicant Name:	Rudolf HUBER
Customer Number:	26161
Filer:	Yunbo Guo/Matthew Doherty
Filer Authorized By:	Yunbo Guo
Attorney Docket Number:	15540-0370002
Receipt Date:	29-DEC-2015
Filing Date:	09-JUN-2014
Time Stamp:	08:47:02
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no
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File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Response to Election / Restriction Filed	Response0370002.pdf	52658 51958d4612067e48b9707c12b2f91484023f7efa	no	1

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Information:

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New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.



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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
14/300,138	06/09/2014	Rudolf HUBER	15540-0370002	4091
26161 7590 11/23/2015 FISH & RICHARDSON P.C. (BO) P.O. BOX 1022 MINNEAPOLIS, MN 55440-1022			EXAMINER ULLAH, AKM E	
			ART UNIT 2874	PAPER NUMBER
			NOTIFICATION DATE 11/23/2015	DELIVERY MODE ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

PATDOCTC@fr.com

Office Action Summary	Application No. 14/300,138	Applicant(s) HUBER ET AL.	
	Examiner Akm Enayet Ullah	Art Unit 2874	AIA (First Inventor to File) Status No

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 2 MONTHS FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 4/10/2015.
☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on ____.
- 2a) ☐ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on ____; the restriction requirement and election have been incorporated into this action.
- 4) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims*

- 5) ☒ Claim(s) 17-39 is/are pending in the application.
5a) Of the above claim(s) ____ is/are withdrawn from consideration.
- 6) ☐ Claim(s) ____ is/are allowed.
- 7) ☐ Claim(s) ____ is/are rejected.
- 8) ☐ Claim(s) ____ is/are objected to.
- 9) ☒ Claim(s) 17-39 are subject to restriction and/or election requirement.

* If any claims have been determined allowable, you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to PPHfeedback@uspto.gov.

Application Papers

- 10) ☐ The specification is objected to by the Examiner.
- 11) ☐ The drawing(s) filed on ____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

Certified copies:

- a) ☐ All b) ☐ Some** c) ☐ None of the:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. ____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

** See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) ☒ Notice of References Cited (PTO-892) | 3) ☐ Interview Summary (PTO-413) |
| 2) ☐ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b) | Paper No(s)/Mail Date. ____. |
| Paper No(s)/Mail Date ____. | 4) ☐ Other: ____. |

The present application is being examined under the pre-AIA first to invent provisions.

Detailed Action

Parent Data

This instant US application serial number 14/300138, filed 06/09/2014 is a continuation of 13639401, filed 12/20/2012 ,now U.S. Patent #8781269 13639401 is a national stage entry of PCT/EP2011/055484 , International Filing Date: 04/08/2011 which claims foreign priority to 102010003750.8 , filed 04/08/2010.

DETAILED ACTION

Election/Restrictions

REQUIREMENT FOR UNITY OF INVENTION

As provided in 37 CFR 1.475(a), a national stage application shall relate to one invention only or to a group of inventions so linked as to form a single general inventive concept ("requirement of unity of invention"). Where a group of inventions is claimed in a national stage application, the requirement of unity of invention shall be fulfilled only when there is a technical relationship among those inventions involving one or more of the same or corresponding special technical features. The expression "special technical

features” shall mean those technical features that define a contribution which each of the claimed inventions, considered as a whole, makes over the prior art.

The determination whether a group of inventions is so linked as to form a single general inventive concept shall be made without regard to whether the inventions are claimed in separate claims or as alternatives within a single claim. See 37 CFR 1.475(e).

WHEN CLAIMS ARE DIRECTED TO MULTIPLE CATEGORIES OF INVENTIONS

As provided in 37 CFR 1.475(b), a national stage application containing claims to different categories of invention will be considered to have unity of invention if the claims are drawn only to one of the following combinations of categories:

- (1) A product and a process specially adapted for the manufacture of said product; or
- (2) A product and process of use of said product; or
- (3) A product, a process specially adapted for the manufacture of the said product, and a use of the said product; or
- (4) A process and an apparatus or means specifically designed for carrying out the said process; or
- (5) A product, a process specially adapted for the manufacture of the said product, and an apparatus or means specifically designed for carrying out the said process.

Otherwise, unity of invention might not be present. See 37 CFR 1.475(c).

Restriction is required under 35 U.S.C. 121 and 372.

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 accordance with 37 CFR 1.499, applicant is required, in reply to this action, to elect a single invention to which the claims must be restricted.

Group I, claim(s) 17-27, drawn to a method comprising coupling an input laser into a fiber.

Group II, claim(s) 28-39, drawn to a device for generating a laser beam with different beam profile.

The groups of inventions listed above 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:

Coupling an input laser beam into a fiber and/or an optical fiber core and at least one outer ring core and a switchable coupling adjustment device lack unity of invention because even though the inventions of these groups require the technical feature of coupling adjustment, this technical feature is not a special technical feature as it does not make a contribution over the prior art in view of such as for an example Winzer reference (USPNO. 3,975,082 states that A laser beam coupling arrangement for wide-band optical data switching systems, consisting of an electronically controllable, optical mask, a hologram, a waveguide matrix and a coherent light source

employs dynamic hologram recording in which a sandwich structure is provided for hologram

recording and comprises a transparent electrode, a photo-resistor layer, a dielectric reflector, electro-optical or electro-plastic material and a transparent counter-electrode between the controllable, optical mask and the inputs and outputs of the waveguides which are to be coupled.

Applicant is advised that the reply to this requirement to be complete must include (i) an election of a species or invention to be examined even though the requirement may be traversed (37 CFR 1.143) and (ii) identification of the claims encompassing the elected invention.

The election of an invention or species may be made with or without traverse. To preserve a right to petition, the election must be made with traverse. If the reply does not distinctly and specifically point out supposed errors in the restriction requirement, the election shall be treated as an election without traverse. Traversal must be presented at the time of election in order to be considered timely. Failure to timely traverse the requirement will result in the loss of right to petition under 37 CFR 1.144. If claims are added after the election, applicant must indicate which of these claims are readable on the elected invention or species.

Should applicant traverse on the ground that the inventions have unity of invention (37 CFR 1.475(a)), applicant must provide reasons in support thereof.

Applicant may submit evidence or identify such evidence now of record showing the inventions to be obvious variants or clearly admit on the record that this is the case.

Where such evidence or admission is provided by applicant, if the examiner finds one of the inventions unpatentable over the prior art, the evidence or admission may be used in a rejection under 35 U.S.C. 103(a) of the other invention.

Applicant is reminded that upon the cancellation of claims to a non-elected invention, the inventorship must be corrected in compliance with 37 CFR 1.48(a) if one or more of the currently named inventors is no longer an inventor of at least one claim remaining in the application. A request to correct inventorship under 37 CFR 1.48(a) must be accompanied by an application data sheet in accordance with 37 CFR 1.76 that identifies each inventor by his or her legal name and by the processing fee required under 37 CFR 1.17(i).

The examiner has required restriction between product or apparatus claims and process claims. Where applicant elects claims directed to the product/apparatus, and all product/apparatus claims are subsequently found allowable, withdrawn process claims that include all the limitations of the allowable product/apparatus claims should be considered for rejoinder. All claims directed to a nonelected process invention must include all the limitations of an allowable product/apparatus claim for that process invention to be rejoined.

In the event of rejoinder, the requirement for restriction between the product/apparatus claims and the rejoined process claims will be withdrawn, and the rejoined process claims will be fully examined for patentability in accordance with 37

CFR 1.104. Thus, to be allowable, the rejoined claims must meet all criteria for patentability including the requirements of 35 U.S.C. 101, 102, 103 and 112. Until all claims to the elected product/apparatus are found allowable, an otherwise proper restriction requirement between product/apparatus claims and process claims may be maintained. Withdrawn process claims that are not commensurate in scope with an allowable product/apparatus claim will not be rejoined. See MPEP § 821.04.

Additionally, in order for rejoinder to occur, applicant is advised that the process claims should be amended during prosecution to require the limitations of the product/apparatus claims. **Failure to do so may result in no rejoinder.** Further, note that the prohibition against double patenting rejections of 35 U.S.C. 121 does not apply where the restriction requirement is withdrawn by the examiner before the patent issues. See MPEP § 804.01.

Contact Information

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Akm Enayet Ullah whose telephone number is (571)272-2361. The examiner can normally be reached on Mon.-Thursday 6:30-5:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Uyen-Chau Le can be reached on 571-272-2397. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Akm Enayet Ullah/
Primary Examiner
Art Unit 2874

AUllah

Notice of References Cited	Application/Control No. 14/300,138	Applicant(s)/Patent Under Reexamination HUBER ET AL.	
	Examiner Akm Enayet Ullah	Art Unit 2874	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	CPC Classification	US Classification
*	A	US-3,975,082 A	08-1976	Winzer; Gerhard	G02B5/32	359/34
	B	US-				
	C	US-				
	D	US-				
	E	US-				
	F	US-				
	G	US-				
	H	US-				
	I	US-				
	J	US-				
	K	US-				
	L	US-				
	M	US-				

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	CPC Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

EAST Search History**EAST Search History (Prior Art)**

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	4506	(coupl\$4)same(laser adj2 beam with fiber)	US-PGPUB; USPAT	OR	OFF	2015/11/17 07:56
L2	39	1 and (switch\$4)same (coupl\$4 with adjust\$4)	US-PGPUB; USPAT	OR	OFF	2015/11/17 07:57
L3	1	"3975082".pn.	US-PGPUB; USPAT	OR	OFF	2015/11/17 07:58

11/ 17/ 2015 8:00:03 AM**C:\ Users\ aullah\ Documents\ EAST\ Workspaces\ east search.wsp**



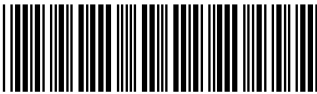
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UNITED STATES DEPARTMENT OF COMMERCE
 United States Patent and Trademark Office
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 P.O. Box 1450
 Alexandria, Virginia 22313-1450
 www.uspto.gov

BIB DATA SHEET

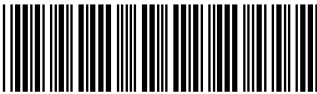
CONFIRMATION NO. 4091

SERIAL NUMBER	FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.		
14/300,138	06/09/2014 RULE	385	2874	15540-0370002		
APPLICANTS TRUMPF LASER- UND SYSTEMTECHNIK GMBH, Ditzingen, GERMANY; INVENTORS Rudolf HUBER, Aldingen-Aixheim, GERMANY; Wolfgang ANDREASCH, Weinstadt, GERMANY; ** CONTINUING DATA ***** This application is a CON of 13/639,401 12/20/2012 PAT 8781269 which is a 371 of PCT/EP2011/055484 04/08/2011 ** FOREIGN APPLICATIONS ***** GERMANY 10 2010 003 750.8 04/08/2010 ** IF REQUIRED, FOREIGN FILING LICENSE GRANTED **						
Foreign Priority claimed ☒ Yes ☐ No 35 USC 119(a-d) conditions met ☒ Yes ☐ No Verified and Acknowledged /AKM E ULLAH/ Examiner's Signature		☐ Met after Allowance AU Initials	STATE OR COUNTRY GERMANY	SHEETS DRAWINGS 5	TOTAL CLAIMS 16	INDEPENDENT CLAIMS 3
ADDRESS FISH & RICHARDSON P.C. (BO) P.O. BOX 1022 MINNEAPOLIS, MN 55440-1022 UNITED STATES						
TITLE Method and Arrangement for the Generation of a Laser Beam With Different Beam Profile Characteristics by Means of a Multi-Clad Fibre						
FILING FEE RECEIVED 1840	FEES: Authority has been given in Paper No. _____ to charge/credit DEPOSIT ACCOUNT No. _____ for following:			☐ All Fees ☐ 1.16 Fees (Filing) ☐ 1.17 Fees (Processing Ext. of time) ☐ 1.18 Fees (Issue) ☐ Other _____ ☐ Credit		

Index of Claims 	Application/Control No. 14300138	Applicant(s)/Patent Under Reexamination HUBER ET AL.
	Examiner AKM ULLAH	Art Unit 2874

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

☐ Claims renumbered in the same order as presented by applicant			☐ CPA			☐ T.D.			☐ R.1.47		
CLAIM		DATE									
Final	Original	11/17/2015									
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	3	-									
	4	-									
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<i>Index of Claims</i> 	Application/Control No. 14300138	Applicant(s)/Patent Under Reexamination HUBER ET AL.
	Examiner AKM ULLAH	Art Unit 2874

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47										
CLAIM		DATE								
Final	Original	11/17/2015								
	37	÷								
	38	÷								
	39	÷								

<i>Search Notes</i> 	Application/Control No. 14300138	Applicant(s)/Patent Under Reexamination HUBER ET AL.
	Examiner AKM ULLAH	Art Unit 2874

CPC- SEARCHED		
Symbol	Date	Examiner
	11/17/2015	AU

CPC COMBINATION SETS - SEARCHED		
Symbol	Date	Examiner

US CLASSIFICATION SEARCHED			
Class	Subclass	Date	Examiner
385	14-42	11/17/2015	AU

SEARCH NOTES		
Search Notes	Date	Examiner
EAST, ASSIGNEE and INVENTOR	11/17/2015	AU

INTERFERENCE SEARCH			
US Class/ CPC Symbol	US Subclass / CPC Group	Date	Examiner

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Application	Document	Mailroom Date	Attorney Docket No.
14300138	CTRS	11/23/2015	15540-0370002
	892	11/23/2015	15540-0370002

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Application	Document	Mailroom Date	Attorney Docket No.
14300138	NTC.PUB	10/15/2015	15540-0370002

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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
14/300,138	06/09/2014	Rudolf HUBER	15540-0370002

CONFIRMATION NO. 4091

26161
FISH & RICHARDSON P.C. (BO)
P.O. BOX 1022
MINNEAPOLIS, MN 55440-1022

PUBLICATION NOTICE



OC000000078060731

Title:Method and Arrangement for the Generation of a Laser Beam With Different Beam Profile Characteristics by Means of a Multi-Clad Fibre

Publication No.US-2015-0293306-A1

Publication Date:10/15/2015

NOTICE OF PUBLICATION OF APPLICATION

The above-identified application will be electronically published as a patent application publication pursuant to 37 CFR 1.211, et seq. The patent application publication number and publication date are set forth above.

The publication may be accessed through the USPTO's publically available Searchable Databases via the Internet at www.uspto.gov. The direct link to access the publication is currently <http://www.uspto.gov/patft/>.

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Office of Data Management, Application Assistance Unit (571) 272-4000, or (571) 272-4200, or 1-888-786-0101

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number		14300138	
	Filing Date		2014-06-09	
	First Named Inventor	Rudolph Huber		
	Art Unit	2883		
	Examiner Name			
	Attorney Docket Number	15540-0370002		

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number		14300138
	Filing Date		2014-06-09
	First Named Inventor	Rudolph Huber	
	Art Unit	2883	
	Examiner Name		
	Attorney Docket Number	15540-0370002	

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Examiner Signature		Date Considered	
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*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

¹ See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. ² Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). ³ For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. ⁴ Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. ⁵ Applicant is to place a check mark here if English language translation is attached.

**INFORMATION DISCLOSURE
STATEMENT BY APPLICANT**
(Not for submission under 37 CFR 1.99)

Application Number	14300138
Filing Date	2014-06-09
First Named Inventor	Rudolph Huber
Art Unit	2883
Examiner Name	
Attorney Docket Number	15540-0370002

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

- ☐ That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

- ☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

- ☐ See attached certification statement.
- ☒ The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.
- ☐ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Yunbo Guo/	Date (YYYY-MM-DD)	2015-09-18
Name/Print	Yunbo Guo	Registration Number	70538

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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Espacenet

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Light-guide and irradiation device.

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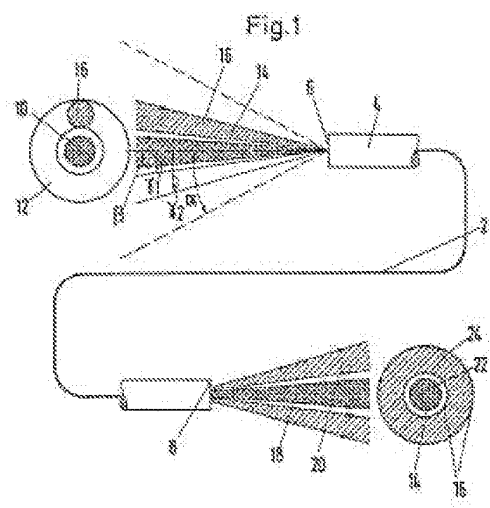
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Abstract of EP0362466 (A2)

For the laser light irradiation of, in particular, biological materials by means of a light guide (2) for transmitting laser light from the light source to the application location, a plurality of mutually independent ray bundles (14, 16) are transmitted by a single common light guide in such a way that a plurality of different coupling-in angular areas (10, 12) are assigned to the light guide on the input side (6) between the light source and the proximal guide end, and a plurality of different coupling-out angular areas (18, 20), in each case corresponding to one of the coupling-in angular areas, are assigned to the light guide on the output side (8) between the distal guide end and the application location, and each coupling-in angular area and assigned coupling-out angular area (10, 18 and 12, 20); in each case has running through it one of the mutually independent ray bundles (14 and 16).



12

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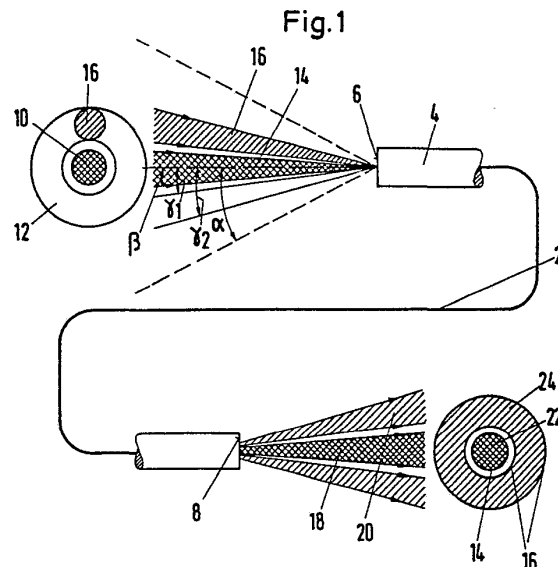
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54 Lichtleiter- und Bestrahlungseinrichtung.

57 Zur Laserlichtbestrahlung von insbesondere biologischen Materialien mittels eines Lichtleiters (2) zur Laserlichtübertragung von der Lichtquelle zur Applikationsstelle werden mehrere voneinander unabhängige Strahlenbündel (14, 16) durch einen einzigen gemeinsamen Lichtleiter in der Weise übertragen, daß dem Lichtleiter auf der Eintrittsseite (6) zwischen Lichtquelle und proximalem Leiterende mehrere unterschiedliche Einkoppelwinkelbereiche (10, 12) und auf der Austrittsseite (8) zwischen distalem Leiterende und Applikationsstelle mehrere unterschiedliche, jeweils einem der Einkoppelwinkelbereiche entsprechende Auskoppelwinkelbereiche (18, 20) zugeordnet sind und jeder Ein- und zugeordnete Auskoppelwinkelbereich (10, 18 bzw. 12, 20) von jeweils einem der voneinander unabhängigen Strahlenbündel (14 bzw. 16) durchsetzt ist.



EP 0 362 466 A2

LICHTLEITER- und BESTRAHLUNGSEINRICHTUNG

Die Erfindung bezieht sich auf eine Lichtleiter-einrichtung, und insbesondere ein medizinisches Applikationsteil, nach dem Oberbegriff des Patentanspruchs 1, sowie eine Bestrahlungseinrichtung für insbesondere biologische Materialien mittels optischer Strahlung, nach dem Oberbegriff des Patentanspruchs 2.

Es ist bekannt, daß Laserstrahlen bei medizinischer, aber auch anderer, technischer Anwendung je nach Wellenlänge, Betriebsart (cw-, Puls- oder Q-switch-Betrieb) und Bestrahlungsparametern, wie Bestrahlungsenergie und -intensität, oder Abstrahlcharakteristik, an der Applikationsstelle unterschiedliche Wirkungen auslösen. So hat etwa die 1,06 μm -Strahlung eines Neodym-YAG-Lasers auf biologische Gewebe einen mehr koagulierenden Effekt, während eine langwelligere Laserstrahlung eine mehr schneidende Wirkung besitzt. Sollen die verschiedenartigen Bestrahlungswirkungen nacheinander oder gleichzeitig jeweils dosiert in unterschiedlichen Teilzonen der Applikationsstelle erreicht werden, so ergibt sich die Schwierigkeit, daß bei den bekannten Einrichtungen der beanspruchten Art wegen der beengten Platzverhältnisse, z. B. in Lumen von organischen Hohlgefäßen, lediglich ein einziger Lichtleiter ohne Umschalt- oder Steuerungsmöglichkeit am distalen Ende zur Verfügung steht und daher eine solche multifunktionale Anwendung nur in sehr begrenztem Umfang und auch dann nur durch einen nicht immer zulässigen und jedenfalls bedienungsaufwendigen Austausch des Applikationssystems einschließlich des Lichtleiters möglich ist.

Aufgabe der Erfindung ist es, eine Einrichtung der beanspruchten Art so auszubilden, daß mit einem einzigen Lichtleiter auf baulich einfache Weise und ohne Steueraufwand am distalen Ende mehrere verschiedenartige, jeweils individuell dosierbare Bestrahlungswirkungen in räumlich voneinander getrennten Teilzonen der Applikationsstelle zu erzielen sind.

Diese Aufgabe wird erfindungsgemäß durch die im Anspruch 1 gekennzeichnete Lichtleitereinrichtung bzw. die im Anspruch 2 gekennzeichnete Bestrahlungseinrichtung gelöst.

Erfindungsgemäß werden mehrere, voneinander unabhängige Strahlenbündel von einer einzigen Lichtleitfaser in der Weise übertragen, daß sie unter jeweils unterschiedlichen Einkoppelwinkeln in das proximale Lichtleiterende eingestrahlt werden und aufgrund dadurch ausgenutzter, spezifischer Eigenschaften des Lichtleiters in räumlich voneinander abgegrenzten Auskoppelwinkelbereichen am distalen Leiterende austreten, ohne daß es hier irgendwelcher Trenn- oder gar Steuerorgane für die

emittierten Strahlenbündel bedarf. Mit den erfindungsgemäßen Einrichtungen gelingt es allein durch proximalseitige Steuereingriffe, für die - anders als am distalen Leiterende - in baulicher Hinsicht ausreichend Raum vorhanden ist, mehrere unterschiedliche Applikationswirkungen jeweils einzeln dosierbar wahlweise simultan oder wechselweise in verschiedenen, sich gewünschtenfalls aber auch überdeckenden Teilzonen der Applikationsstelle zu erzielen. Die Erfindung eignet sich daher in hervorragender Weise für medizinische Anwendungsfälle in beengten Behandlungsfeldern, wo der therapeutische Gesamterfolg von der Synergiewirkung mehrerer verschiedenartiger und jeweils einzeln dosierbarer optischer Bestrahlungs- und insbesondere Laserlichteffekte abhängt.

In weiterer vorteilhafter Ausgestaltung der Erfindung sind die Ein- und Auskoppelwinkelbereiche gemäß Anspruch 3 vorzugsweise bezüglich der Lichtleiter-Mittelachse radialsymmetrisch gestaffelt, so daß sich auch bei Lichtleitern mit begrenzter maximaler Apertur noch problemlos eine deutliche Trennung der einzelnen Strahlenbündel erzielen läßt. Aus dem gleichen Grund werden diese gemäß Anspruch 4 zweckmäßigerweise jeweils in Form konvergenter, auf die Lichtleiter-Eintrittsfläche fokussierter Lichtkegel eingekoppelt. Für die getrennte Lichtbündel-Übertragung ist bei Laserlicht-Wellenlängen in der Größenordnung von 3 μm bis 2 μm als Lichtleiter, wie gemäß Anspruch 5 bevorzugt, eine übliche Multimode-Lichtleiter-Glasfaser vollständig ausreichend.

Die unterschiedlichen Einzeleffekte der Strahlenbündel werden gemäß Anspruch 6 vorzugsweise dadurch erzielt, daß sich die Strahlenbündel hinsichtlich Strahlungsleistung, Betriebsart und/oder Wellenlänge voneinander unterscheiden bzw. unabhängig voneinander steuerbar sind. In baulich besonders einfacher Weise werden die Strahlenbündel gemäß Anspruch 7 zweckmäßigerweise nach Art einer Zweipunkt-Steuerung selektiv in das proximale Lichtleiterende eingekoppelt.

Für die verschiedenartigen Lichtbündel ist gemäß Anspruch 8 eine mehrteilige Lichtquelle mit mehreren, voneinander getrennten Lichterzeugern vorgesehen. Gemäß einer zweiten, baulich wesentlich einfacheren Variante wird jedoch gemäß Anspruch 9 eine einteilige Lichtquelle mit einem nachgeschalteten Strahlungsteiler zur Aufspaltung der Lichtstrahlung in die einzelnen Strahlenbündel verwendet, wobei in diesem Fall für Strahlenbündel unterschiedlicher Wellenlänge gemäß Anspruch 10 bevorzugt eine multichromatische Lichtstrahlung emittierender Laser und als Strahlteiler ein die Laserstrahlung wellenlängenabhängig aufspalten-

des Prisma vorgesehen ist. In baulich besonders einfacher Weise wird die selektive Ansteuerung der einzelnen Einkoppelwinkelbereiche mit den zugeordneten Strahlenbündeln gemäß Anspruch 11 zweckmäßigerweise durch einen umschaltbaren Spiegel- oder ein ähnliches lichtablenkendes oder -sperrendes Schaltelement mit mindestens einer aktiven, jeweils einem der Einkoppelwinkelbereiche zugeordneten Schaltposition bewirkt.

Anhand der in den Figuren schematisch dargestellten Ausführungsbeispiele wird die Erfindung nachfolgend näher beschrieben. Es zeigen:

Fig. 1 einen Lichtleiter zur Übertragung zweier voneinander unabhängiger Strahlenbündel einschließlich der jeweils zugeordneten, unterschiedlichen Ein- und Auskoppelwinkelbereiche;

Fig. 2 eine Bestrahlungseinrichtung mit einem am proximalseitigen Lichtleiterende angeordneten, selektiv verstellbaren Lichtdeflektor in Form eines Prismas zum wechselweisen Umschalten der von einer Lichtquelle emittierten Strahlung auf unterschiedliche Auskoppelwinkelbereiche;

Fig. 3 eine Bestrahlungseinrichtung mit einem zwischen Lichtquelle und Lichtleiter angeordneten Strahlteiler zur Aufspaltung der Lichtstrahlung in zwei parallele, jeweils unter unterschiedlichen Winkeln ein- und ausgekoppelte Lichtbündel;

Fig. 4 eine Bestrahlungseinrichtung mit einer einzigen Laserlicht-Quelle für gleichzeitig zwei Wellenlängen einschließlich des ein- und auskoppelseitigen Strahlenverlaufs; und

Fig. 5 eine Bestrahlungseinrichtung mit zweiteiliger Lichtquelle zur getrennten Lichtbündelerzeugung einschließlich der jeweiligen Ein- und Abstrahlcharakteristika.

Fig. 1 zeigt einen Lichtleiter 2 in Form einer Multimode-Einzelfaser mit senkrecht zur Lichtleiterachse 4 verlaufenden Ein- und Austrittsflächen 6, 8 und einem durch den Öffnungswinkel α definierten Akzeptanzkegel. Dem Lichtleiter 2 sind am proximalen Leiterende innerhalb des Akzeptanzkegels zwei unterschiedliche Einkoppelwinkelbereiche zugeordnet, nämlich ein innerer Einkoppelwinkelbereich 10, der durch einen auf die Eintrittsfläche 6 gerichteten, zur Leiterachse 4 coaxialen Zentralkegel mit dem halben Scheitelwinkel β gebildet wird, sowie ein den inneren Kegelbereich 10 ringförmig umschließender, äußerer Einkoppelwinkelbereich 12, welcher von ebenfalls auf die Eintrittsfläche 6 gerichteten und zur Lichtleiterachse 4 coaxialen Kegelmantelflächen mit jeweils gegenüber dem Winkel β stufenweise erhöhten, halben Scheitelwinkeln γ_1 bzw. γ_2 begrenzt wird.

Innerhalb jedes Einkoppelwinkelbereichs 10, 12 wird jeweils ein konvergentes Strahlenbündel, nämlich das kreuzschraffierte, achsensymmetrische Strahlenbündel 14 einerseits und das schräg eingestrahlte Strahlenbündel 16 andererseits auf die

Eintrittsfläche 6 des Lichtleiters 4 fokussiert, und aufgrund der spezifischen Transmissionseigenschaften einer Lichtleitfaser 2 wird das zentrale Strahlenbündel 14 am distalen Leiterende in einem dem Einkoppelwinkelbereich 10 entsprechenden, achsensymmetrischen Auskoppelwinkelbereich 18 abgestrahlt, während das schräge Strahlenbündel 16 den Lichtleiter 2 innerhalb eines dem Einkoppelwinkelbereich 16 entsprechenden Auskoppelwinkelbereiches 20 als vom zentralen Strahlenbündel getrenntes, ringförmiges Lichtbündel verläßt. Die Größe der Einkoppelwinkelbereiche 10, 12 ist unter Berücksichtigung der numerischen Apertur des Lichtleiters 2 dabei so zu wählen, daß bei möglichst geringen Transmissionsverlusten sich die Strahlenbündel 14, 16 an der Auskoppelseite nicht überlappen. Auf diese Weise lassen sich allein durch Steuereingriffe von der Einkoppelseite des Lichtleiters 2 her gleichzeitig oder zeitlich hintereinander mehrere, voneinander unabhängige Strahlenbündel 14, 16 am distalen Leiterende unter verschiedenen Abstrahlcharakteristika und gewünschtenfalls verschiedenen Wellenlängen in voneinander getrennten Teilzonen 22, 24 der Applikationsstelle zur Einwirkung bringen, ohne den Lichtleiter 2 auswechseln zu müssen.

Die Bestrahlungseinrichtung gemäß Fig. 2a, b enthält neben dem in Fig. 1 gezeigten Lichtleiter 2 eine Laserlichtquelle 26 und eine zwischen dieser und dem proximalen Leiterende wirksamen Optik mit einer Fokussierlinse 28 und einem unmittelbar vor der einkoppelseitigen Endfläche 6 des Lichtleiters 2 angeordneten, selektiv in den Strahlengang der Fokussierlinse 28 einschwenkbaren Lichtdeflektor 30 in Form eines Prismas, durch das das konvergente Laserlichtbündel wechselweise zwischen dem achsensymmetrischen, zentralen Einkoppelwinkelbereich 10 (Fig. 2a) und dem hierzu schräg versetzten Einkoppelwinkelbereich 12 umschaltbar ist, wodurch die Abstrahlcharakteristik am distalen Leiterende 8 derart verändert wird, daß die Laserlichtstrahlung dort einmal in einem dem Einkoppelwinkelbereich 10 entsprechenden, zentralen Auskoppelwinkelbereich 18 und dann in der aktiven Schaltposition des Prismas 30 in den ringkegelförmigen Auskoppelwinkelbereich 20 abgestrahlt wird.

Bei der Bestrahlungseinrichtung gemäß Fig. 3 wird durch einen parallelen Versatz eines von einer Laserlichtquelle 26 erzeugten Laserstrahls vor der einkoppelseitigen Fokussierlinse 28 eine selektiv steuerbare Abstrahlcharakteristik am distalseitigen Ende 8 des Lichtleiters 2 bewirkt, wobei gemäß Fig. 3 ein Strahlteiler 32 vor der Fokussierlinse 28 angeordnet ist, der den Laserstrahl in zwei parallele Bündel 14, 16 aufteilt, so daß sich am distalseitigen Leiterende 8 gleichzeitig beide Abstrahlcharakteristika 18 und 20 ergeben. Wird anstelle des Strahlteilers 32 ein selektiv einschwenkbarer Spiegel ver-

wendet, so läßt sich - ähnlich wie bei der Einrichtung gemäß Fig. 2 - eine wechselweise Umschaltung des Laserstrahls zwischen dem zentralen und dem ringkegelförmigen Auskoppelbereich 18 und 20 erreichen.

Fig. 4 zeigt eine Bestrahlungseinrichtung mit einer Laserlichtquelle 26, die gleichzeitig zwei unterschiedliche Wellenlängen, z. B. eine 1,06 μm - und eine 1,32 μm -Strahlung erzeugt. Die Laserstrahlung wird zunächst durch ein Prisma 34 hinsichtlich der Wellenlänge getrennt, und anschließend wird die 1,32 μm -Strahlung 14 axial, also innerhalb des zentralen Einkoppelwinkelbereichs 10 gemäß Fig. 1, und die 1,06 μm -Strahlung 16 mit Hilfe eines Reflektors 36 schräg, also innerhalb des Einkoppelwinkelbereichs 12, auf das proximale Leiterende 6 fokussiert, so daß die langwelligere Strahlung am distalen Leiterende 8 innerhalb des Auskoppelwinkelbereichs 18 austritt und auf die zentrale Teilzone 22 der Applikationsstelle auftrifft, während die kurzwelligere 1,06 μm -Strahlung vom distalen Leiterende 8 mit der ringkegelförmigen Abstrahlcharakteristik 20 emittiert wird und an der Applikationsstelle in der Ringzone 24 zur Einwirkung gebracht werden kann.

Die Bestrahlungseinrichtung gemäß Fig. 5 enthält eine zweiteilige Lichtquelle mit zwei unabhängig voneinander steuerbaren Lasern zur Erzeugung der z. B. hinsichtlich Wellenlänge, Betriebsart und /oder Leistung verschiedenartigen Laserlichtbündel 14, 16, von denen das eine - wiederum entsprechend dem Einkoppelwinkelbereich 10 gemäß Fig. 1 - axial und das andere mit Hilfe eines Spiegelsystems 38 innerhalb des Einkoppelwinkelbereichs 12 gemäß Fig. 1 schräg in das proximale Leiterende 6 eingekoppelt wird. Je nachdem, ob beide Strahlenbündel 14, 16 gleichzeitig oder zeitversetzt eingestrahlt werden, lassen sich am distalen Leiterende 8 entweder beide Abstrahlcharakteristika 18, 20 simultan erreichen oder es kann abwechselnd von der einen auf die andere Abstrahlcharakteristik umgeschaltet werden.

Die beschriebenen Lichtleiter- und Bestrahlungsanordnungen eignen sich insbesondere zur medizinischen Laserapplikation mit dünnen Endoskopen oder Kathetern. So erzeugen z. B. in der Gastroenterologie und Pneumologie thermisch wirkende Neodym-YAG-Laser mit einem herkömmlichen Lichtleiter bei senkrechtem Auftreffen der Laserstrahlung auf das Gewebe eine kreisförmige bestrahlte Fläche mit einem ausgeprägten Temperaturmaximum im Flächenmittelpunkt. Mit den erfindungsgemäßen Einrichtungen hingegen läßt sich durch gezielte Dosierung der beiden Strahlenbündel 14, 16, also etwa durch eine einfache Umschaltung der Einkoppelung entsprechend den Fig. 2, 3 oder 5, eine unabhängig von der zentralen Teilzone 22 bestrahlte Ringfläche 24 erzeugen und dadurch

eine wesentlich gleichmäßigere Temperaturverteilung mit einem vorzugsweise koagulierenden Effekt auf das biologische Gewebe erzielen. Wird dagegen eine blutarme abtragende oder schneidende Wirkung des Laserstrahls gewünscht, so lassen sich beide Abstrahlcharakteristika simultan verwenden. So wird etwa mit den Einrichtungen gemäß den Fig. 4 und 5 das Gewebe durch die langwelligere Laserstrahlung im Zentrum der Applikationsstelle vaporisiert, während die umliegende Ringzone 24 durch die kurzwelligere Laserstrahlung koaguliert wird.

15 Ansprüche

1. Lichtleiteranordnung, insbesondere medizinisches Applikationsteil, zur Lichtwellen-, insbesondere Laserlichtübertragung von einer Lichtquelle zu einer Applikationsstelle, dadurch **gekennzeichnet**, daß zur Übertragung mehrerer voneinander unabhängiger optischer Strahlenbündel (14, 16) ein einziger gemeinsamer Lichtleiter (2) vorgesehen und diesem auf der Eintrittsseite zwischen Lichtquelle und proximalem Leiterende (6) mehrere unterschiedliche Einkoppelwinkelbereiche (10, 12) und auf der Austrittsseite zwischen distalem Leiterende (8) und Applikationsstelle (22, 24) mehrere unterschiedliche, jeweils einem der Einkoppelwinkelbereiche entsprechende Auskoppelwinkelbereiche (18, 20) zugeordnet sind und jeder Ein- und zugeordnete Auskoppelwinkelbereich (10, 18 bzw. 12, 20) von jeweils einem der voneinander unabhängigen Strahlenbündel (14 bzw. 16) durchsetzt ist.

2. Bestrahlungseinrichtung für insbesondere biologische Materialien mittels optischer Strahlung, mit einem Lichtleiter zur Lichtwellen-, insbesondere Laserlichtübertragung von einer Lichtquelle zu einer Applikationsstelle, sowie mit einer zwischen Lichtquelle und proximalem Leiterende angeordneten Optik zur Einkoppelung der von der Lichtquelle erzeugten Strahlung in den Lichtleiter, dadurch **gekennzeichnet**, daß mehrere, voneinander unabhängige Strahlenbündel (14, 16) durch die Optik (28 bis 38) in jeweils unterschiedlichen Einkoppelwinkelbereichen (10, 12) in die Eintrittsfläche (6) eines einzelnen Lichtleiters (2) eingestrahlt werden derart, daß sie am distalen Leiterende (8) getrennt voneinander in jeweils unterschiedlichen Auskoppelwinkelbereichen (18, 20) austreten.

3. Einrichtung nach Anspruch 1 oder 2, dadurch **gekennzeichnet**, daß der eine Ein- und der zugeordnete Auskoppelwinkelbereich (10, 18) durch einen zur Lichtleiterachse (4) zentrischen Innenkegel gebildet ist, der ringförmig von mehreren, zum Innenkegel coaxialen, jeweils

einen weiteren Ein- bzw. zugeordneten Auskoppelwinkelbereich (12, 20) begrenzenden Kegelmantelflächen mit jeweils stufenweise bis zum Akzeptanzwinkel (α) des Lichtleiters (2) erhöhtem Öffnungswinkel (γ_1, γ_2) umschlossen ist. 1 5

4. Einrichtung nach Anspruch 3, dadurch **gekennzeichnet**, daß die Strahlenbündel (14, 16) in den Einkoppelwinkelbereichen (10, 12) jeweils als konvergente, auf die Lichtleiter-Eintrittsfläche (6) fokussierte Lichtkegel ausgebildet sind. 10

5. Einrichtung nach einem der vorhergehenden Ansprüche, dadurch **gekennzeichnet**, daß der Lichtleiter (2) eine Multimode-Lichtleitfaser ist. 15

6. Einrichtung nach einem der vorhergehenden Ansprüche, dadurch **gekennzeichnet**, daß die Strahlenbündel (14, 16) hinsichtlich Strahlungsleistung, Betriebsart und/oder Wellenlänge verschiedenartig bzw. unabhängig voneinander steuerbar sind. 20

7. Einrichtung nach einem der vorhergehenden Ansprüche, dadurch **gekennzeichnet**, daß die Strahlenbündel (14, 16) selektiv in das proximale Leiterende einkoppelbar sind. 25

8. Einrichtung nach einem der vorhergehenden Ansprüche, dadurch **gekennzeichnet**, daß eine mehrteilige Lichtquelle (26.1, 26.2) zur getrennten Erzeugung mindestens zweier, unter unterschiedlichen Einkoppelwinkeln auf den Lichtleiter (2) gerichteter Strahlenbündel (14, 16) vorgesehen ist. 30 35

9. Einrichtung nach einem der Ansprüche 1 - 7, dadurch **gekennzeichnet**, daß eine einzige Lichtquelle (26) vorgesehen ist und die Optik einen Strahlteiler (32, 34) zur Aufteilung der Lichtstrahlung auf die einzelnen Einkoppelwinkelbereiche (10, 12) enthält. 40

10. Einrichtung nach Anspruch 9, dadurch **gekennzeichnet**, daß die Lichtquelle (26) als Laser mit gleichzeitig mehreren Wellenlängen ausgebildet und als Strahlteiler ein Prisma (34) zur Aufteilung des Laserlichtes in jeweils monochromatische Lichtbündel (14, 16) vorgesehen ist. 45

11. Einrichtung nach einem der vorhergehenden Ansprüche, dadurch **gekennzeichnet**, daß die Optik mindestens einen umschaltbaren Lichtdeflektor (30, 32, 36, 38) mit einer oder mehreren aktiven, jeweils einem der Einkoppelwinkelbereiche (12) zugeordneten Schaltpositionen enthält. 50 55

Fig.1

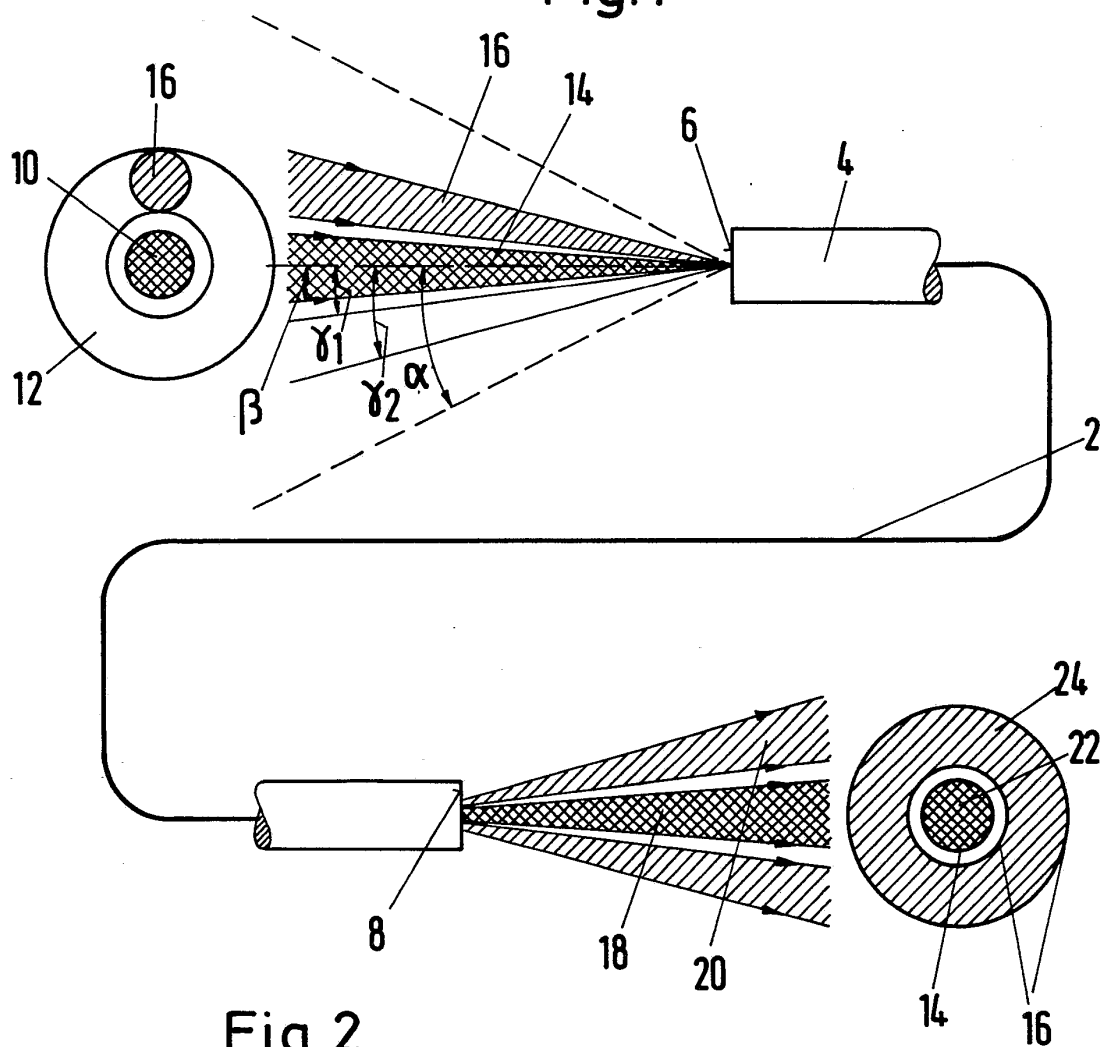


Fig.2

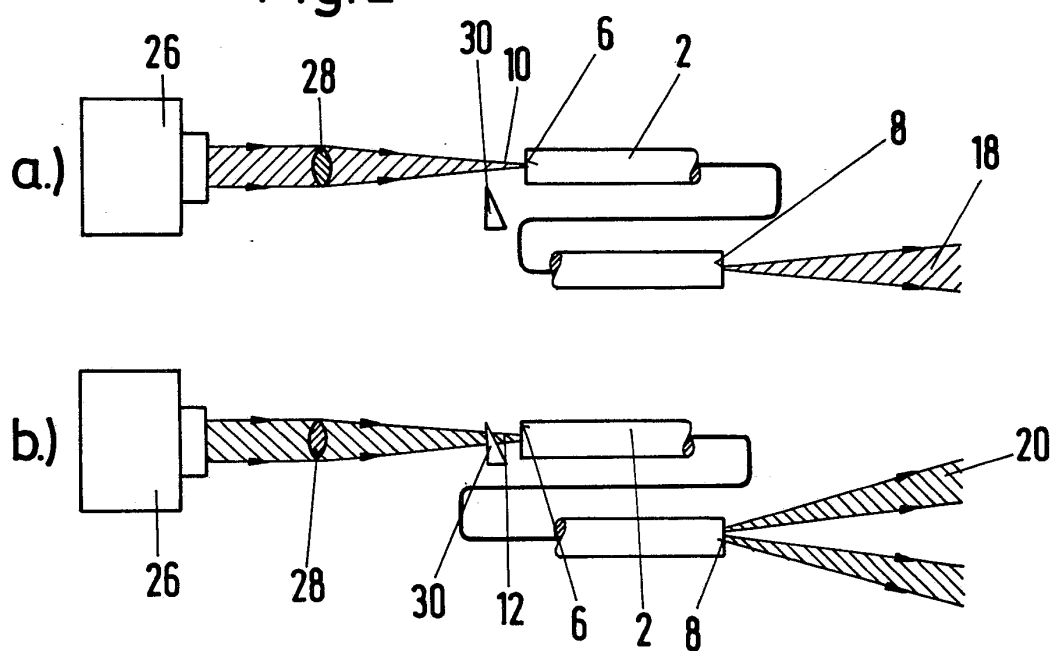


Fig.3

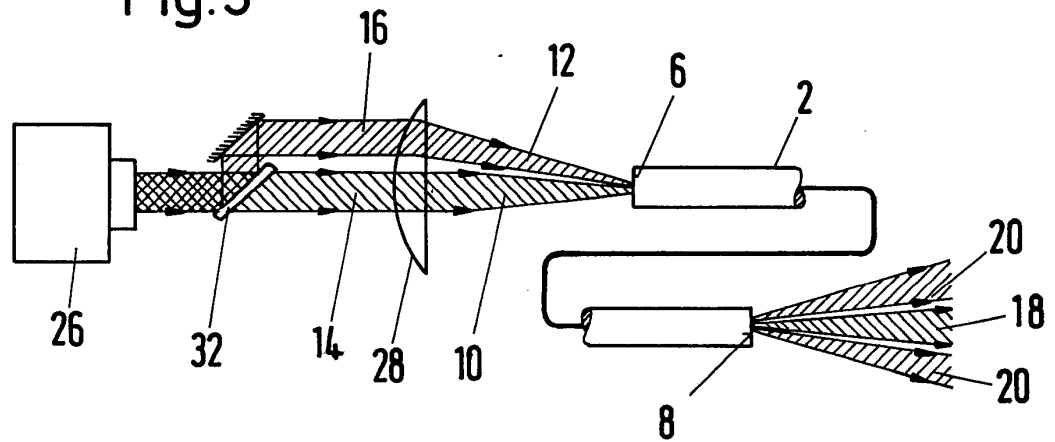


Fig. 4

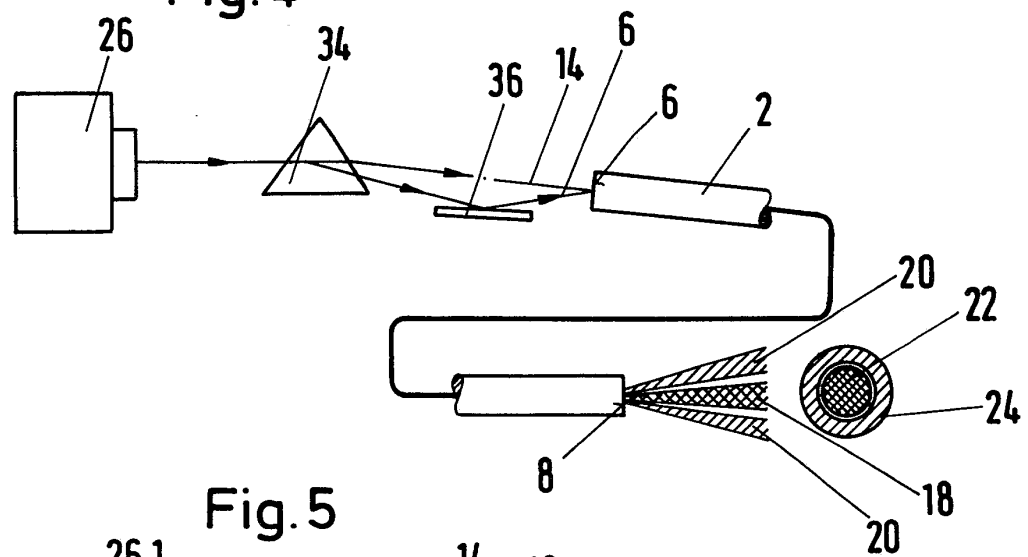
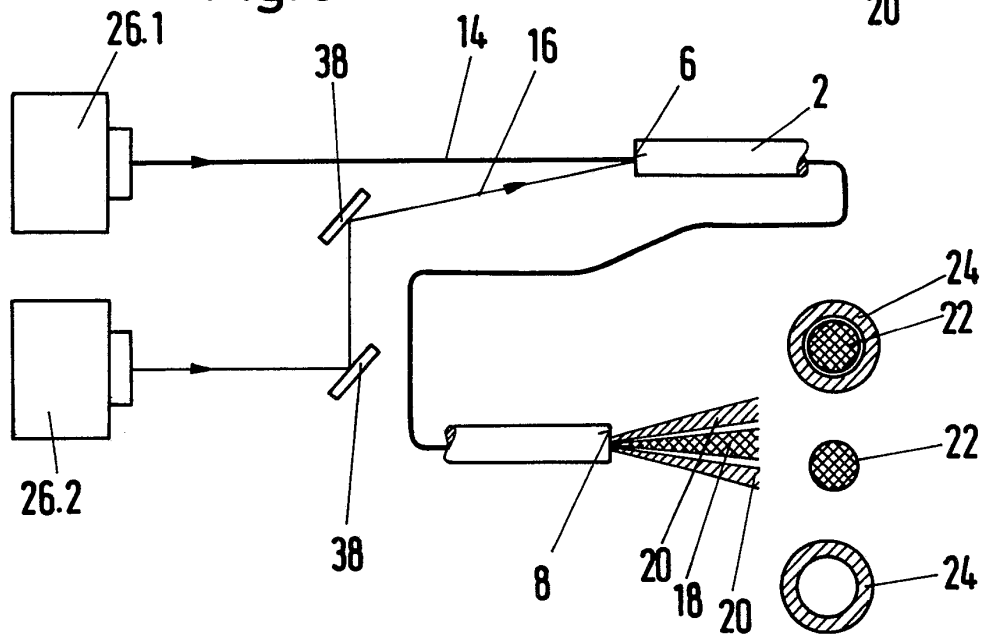


Fig. 5



12 **EUROPÄISCHE PATENTANMELDUNG**

21 Anmeldenummer: **89106487.5**

51 Int. Cl.⁵: **A61B 17/36, A61B 17/00,
G02B 6/26, B23K 26/00**

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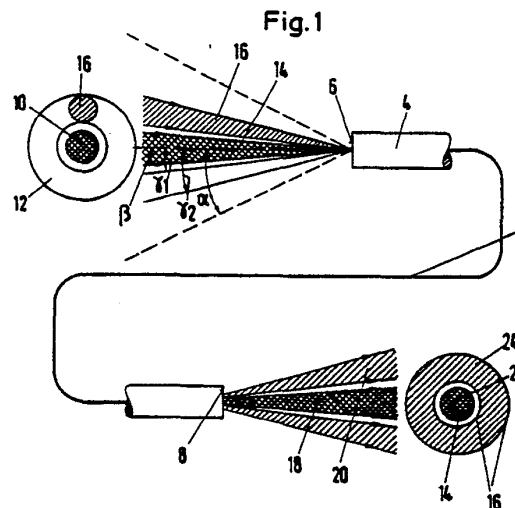
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54 **Lichtleiter- und Bestrahlungseinrichtung.**

57 Zur Laserlichtbestrahlung von insbesondere bio-
 logischen Materialien mittels eines Lichtleiters (2) zur
 Laserlichtübertragung von der Lichtquelle zur Appli-
 kationsstelle werden mehrere voneinander unabhän-
 gige Strahlenbündel (14, 16) durch einen einzigen
 gemeinsamen Lichtleiter in der Weise übertragen,
 daß dem Lichtleiter auf der Eintrittsseite (6) zwischen
 Lichtquelle und proximalem Leiterende mehrere un-
 terschiedliche Einkoppelwinkelbereiche (10, 12) und
 auf der Austrittsseite (8) zwischen distalem Leiteren-
 de und Applikationsstelle mehrere unterschiedliche,
 jeweils einem der Einkoppelwinkelbereiche entspre-
 chende Auskoppelwinkelbereiche (18, 20) zugeord-
 net sind und jeder Ein- und zugeordnete Auskoppel-
 winkelbereich (10, 18 bzw. 12, 20) von jeweils einem
 der voneinander unabhängigen Strahlenbündel (14
 bzw. 16) durchsetzt ist.





Europäisches
Patentamt

EUROPÄISCHER RECHERCHENBERICHT

Nummer der Anmeldung

EP 89 10 6487

EINSCHLÄGIGE DOKUMENTE			
Kategorie	Kennzeichnung des Dokuments mit Angabe, soweit erforderlich, der maßgeblichen Teile	Betrifft Anspruch	KLASSIFIKATION DER ANMELDUNG (Int. Cl.5)
X	WO-A-8 202 956 (N.V. PHILIPS' GLOEILAMPENFABRIEKEN) * Zusammenfassung; Abbildung 1; Seite 1, Zeile 17 - Seite 2, Zeile 7; Seite 2, Zeilen 16-27; Seite 5, Zeile 35 - Seite 6, Zeile 29; Seite 6, Zeile 35 - Seite 8, Zeile 7; Abbildung 2 *	1-5	A 61 B 17/36 A 61 B 17/00 G 02 B 6/26 B 23 K 26/00
A	---	6-8	
A	G. SCHROEDER "TECHNISCHE OPTIK" 4. Auflage 1984, Seiten 97-99, Vogel Buchverlag, Wuerzburg, DE; * Kapitel 5.1.2.; Bild 5.4 b)c) *	1,2	
A	---		
A	EP-A-0 198 959 (R.M. DWYER et al.) * Zusammenfassung; Seite 4, Zeilen 7-21; Seite 4, Zeile 31 - Seite 5, Zeile 33; Seite 6, Zeilen 19-29; Abbildungen 1,3 *	1,2,6-8,10	
A	---		
A	APPLIED PHYSICS LETTERS Band 51, Nr. 23, 7. Dezember 1987, Seiten 1887-1888, New York, US; T. ARAI et al.: "Simultaneous delivery of neodymium:yttrium aluminum garnet and CO laser beams by a single As-S glass fiber" * Seite 1887, linke Spalte, Zeile 9 - rechte Spalte, Absatz 2; Figur 1 *	1,2,5-8	RECHERCHIERTE SACHGEBIETE (Int. Cl.5) A 61 B B 23 K G 02 B
A	---		
A	DE-A-3 717 142 (J. TULIP) * Zusammenfassung; Abbildung 1 *	9-11	
A	-----		
Der vorliegende Recherchenbericht wurde für alle Patentansprüche erstellt			
Recherchenort BERLIN		Abschlußdatum der Recherche 04-07-1990	Prüfer HYLLA W R
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Electronic Acknowledgement Receipt	
EFS ID:	23534756
Application Number:	14300138
International Application Number:	
Confirmation Number:	4091
Title of Invention:	Method and Arrangement for the Generation of a Laser Beam With Different Beam Profile Characteristics by Means of a Multi-Clad Fibre
First Named Inventor/Applicant Name:	Rudolf HUBER
Customer Number:	26161
Filer:	Yunbo Guo/Matthew Doherty
Filer Authorized By:	Yunbo Guo
Attorney Docket Number:	15540-0370002
Receipt Date:	18-SEP-2015
Filing Date:	09-JUN-2014
Time Stamp:	12:45:49
Application Type:	Utility under 35 USC 111(a)

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Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Information Disclosure Statement (IDS) Form (SB08)	IDS0370002gg.pdf	611880 33c42642c4b07b643a1ffa85eb2f4670dd93831b	no	4

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number		14300138	
	Filing Date		2014-06-09	
	First Named Inventor	Rudolph Huber		
	Art Unit	2883		
	Examiner Name			
	Attorney Docket Number	15540-0370002		

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	Filing Date		2014-06-09
	First Named Inventor	Rudolph Huber	
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number	14300138
	Filing Date	2014-06-09
	First Named Inventor	Rudolph Huber
	Art Unit	2883
	Examiner Name	
	Attorney Docket Number	15540-0370002

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A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Yunbo Guo/	Date (YYYY-MM-DD)	2015-08-28
Name/Print	Yunbo Guo	Registration Number	70538

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7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
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[19] 中华人民共和国国家知识产权局

[51] Int. Cl⁷

G02B 27/09

G02B 6/00 H01S 3/00

H01L 21/00



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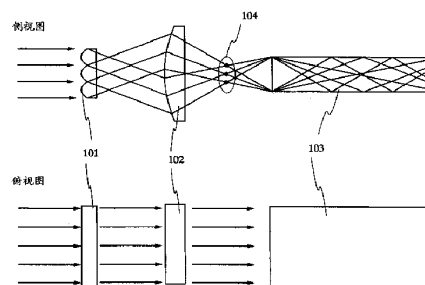
代理人 张雪梅 张志醒

权利要求书 2 页 说明书 19 页 附图 12 页

[54] 发明名称 束均化器, 激光辐照设备, 以及制造半导体器件的方法

[57] 摘要

柱形透镜阵列无法被制造成各个柱形透镜具有相同的曲率半径和相同的表面精度。因此, 当用柱形透镜阵列来执行激光退火时, 被柱形透镜阵列分裂的各个束斑无法在相同的表面内被完全地叠加。结果, 就形成了矩形束边沿部分能量被衰减了的区域, 激光束的强度分布从而变得不均匀。在本发明中, 柱形透镜阵列结合光波导被使用。在激光束沿预定方向被柱形透镜阵列分裂之后, 各个分裂的束被组合, 然后激光束被入射到沿与预定方向相同的方向作用的光波导中。这能够修正由柱形透镜阵列加工不精确所造成的激光束强度的变化。



ISSN 1008-4274

1. 一种束均化器, 它包含:
用来沿预定方向分裂和组合激光束的光学系统, 以及
用来沿该预定方向均化激光束的强度分布的光波导。
- 5 2. 根据权利要求1的束均化器, 还包含:
用来沿垂直于该预定方向的方向分裂和组合激光束的光学系统。
3. 根据权利要求1的束均化器,
其中, 光波导具有面对地提供的一对反射平面。
4. 根据权利要求1的束均化器,
10 其中, 光波导具有面对地提供的二对反射平面。
5. 一种激光辐照设备, 它包含:
激光振荡器, 以及
束均化器,
其中, 束均化器包括:
15 用来沿预定方向分裂和组合激光束的光学系统, 以及
用来沿该预定方向均化激光束的强度分布的光波导; 且
其中, 激光束在透射通过光学系统之后, 被入射到光波导中。
6. 根据权利要求5的激光辐照设备, 还包含:
用来沿垂直于该预定方向的方向分裂和组合激光束的光学系统。
- 20 7. 根据权利要求5的激光辐照设备,
其中, 光波导具有面对地提供的一对反射平面。
8. 根据权利要求5的激光辐照设备,
其中, 光波导具有面对地提供的二对反射平面。
9. 根据权利要求5的激光辐照设备,
25 其中, 激光振荡器是准分子激光器、YAG激光器、或玻璃激光器。
10. 根据权利要求5的激光辐照设备,
其中, 激光振荡器是YVO₄激光器、YLF激光器、或Ar激光器。
11. 根据权利要求5的激光辐照设备, 还包含:
用来相对于激光束移动被辐照表面的移动台。
- 30 12. 根据权利要求11的激光辐照设备, 还包含:
用来将被辐照表面传送到移动台的传送装置。
13. 一种制造半导体器件的方法, 它包含下列步骤:

- 在衬底上形成非单晶半导体膜, 以及
对作为被辐照表面的非单晶半导体膜执行激光退火工艺,
其中, 激光退火工艺包括下列步骤:
用光学系统沿预定方向分裂和组合激光束,
5 用光波导沿预定方向均化激光束的强度分布, 以及
在相对于非单晶半导体膜移动激光束的同时, 对非单晶半导体膜
进行辐照。
14. 根据权利要求13的制造半导体器件的方法,
其中, 采用了用来沿垂直于预定方向的方向分裂和组合激光束的
10 光学系统。
15. 根据权利要求13的制造半导体器件的方法,
其中, 光波导具有面对地提供的一对反射平面。
16. 根据权利要求13的制造半导体器件的方法,
其中, 光波导具有面对地提供的二对反射平面。
- 15 17. 根据权利要求13的制造半导体器件的方法,
其中, 激光振荡器是准分子激光器、YAG激光器、或玻璃激光器。
18. 根据权利要求13的制造半导体器件的方法,
其中, 激光振荡器是YVO₄激光器、YLF激光器、或Ar激光器。
19. 根据权利要求13的制造半导体器件的方法,
20 其中, 采用了用来相对于激光束移动被辐照表面的移动台。
20. 根据权利要求19的制造半导体器件的方法,
其中, 采用了用来将被辐照表面传送到移动台的传递装置。

束均化器，激光辐照设备，以及制造半导体器件的方法

技术领域

- 5 本发明涉及到用来使被辐照表面特定区域内的激光束强度分布均匀的束均化器。此外，本发明涉及到用来将激光束辐照到被辐照表面的激光辐照设备。本发明还涉及到具有用激光辐照设备形成的结晶半导体膜的半导体器件的制造方法。

背景技术

- 10 近年来，借助于将激光束辐照到形成在玻璃衬底上的非晶半导体膜而制造结晶半导体膜的方法，已经被广泛地使用（以下将此方法称为激光退火）。要指出的是，此处所用的术语“结晶半导体膜”意味着具有被晶化的区域的半导体膜，且包括在其整个表面上具有晶化区域的半导体膜。

- 15 玻璃衬底比人造石英衬底更便宜，因而具有能够容易地制造大衬底的优点。另一方面，玻璃衬底的缺点是其熔点低于人造石英的熔点。但当对形成在玻璃衬底上的半导体膜进行激光退火时，有可能仅仅对半导体膜提供高温而对玻璃衬底不造成任何热损伤。此外，与采用电炉的加热方法相比，激光退火提供了高得多的产率。

- 20 由于用激光退火方法制造的结晶半导体膜具有高的迁移率，故此结晶半导体膜被广泛地用作例如构成有源矩阵液晶显示器件的驱动电路的 TFT 的有源层。

- 25 从准分子激光器发射的激光束常常被用作此激光束。准分子激光器的优点是具有高的输出，能够以高的重复速率振荡激光束，以及通常被用作半导体膜的硅膜对从准分子激光束发射的激光束的吸收系数高。而且，以激光束通过光学系统被成形为在被辐照表面上具有矩形形状，以及矩形激光束的辐照位置相对于被辐照表面移动的方式，来执行激光辐照。由于这种方法提供了高的生产率，故在工业上是优异的。要指出的是，在本说明书中，在被辐照表面上具有矩形形状的激光束被称为矩形束。
- 30

 由于从激光振荡器发射的激光束通常具有高斯强度分布，故为了进行均匀的激光退火，必须对被辐照表面上激光束的强度分布进行均

化。近年来,为了均化强度分布,常常采用这样一种方法,其中,柱形透镜阵列被用来沿预定方向分裂激光束,然后将各个被分裂的激光束叠加在同一个表面上。根据此方法,矩形束能够被形成为沿长轴具有 300mm 或以上的长度而沿短轴具有 1mm 或以下的长度,因而有可能有效地对形成在大衬底上的半导体膜进行激光退火。

但当采用柱形透镜阵列时,各个柱形透镜的加工精度是一个问题。柱形透镜阵列由排列的多个柱形透镜组成,不可能将各个柱形透镜制造成具有相同的曲率半径和相同的表面精度。结果,由于被柱形透镜阵列分裂的各个束斑无法完全被叠加在相同的辐照表面中,故在矩形束中形成有强度分布被衰减的区域。当对半导体膜进行激光退火时就出现问题。当用具有这种不均匀强度分布的矩形束的激光退火形成的半导体膜被用来制造 TFT 时,尤其是当这种 TFT 被用来制造液晶或有机 EL 显示器时,就可能在显示器上出现条纹或颜色变化。

发明内容

考虑到上述问题而提出了本发明,本发明的目的是改善激光束的强度分布均匀性,并提供一种能够修正特别是由于柱形透镜阵列加工不精确性造成的激光束的强度变化的技术。

本发明结合用来形成矩形束的柱形透镜阵列而采用一种光波导,以便得到强度分布更均匀的矩形束。亦即,以激光束沿预定方向被柱形透镜阵列分裂之后,各个分裂的束被组合,激光束然后被引入到沿与预定方向相同的方向作用的光波导中的方式,来修正由于柱形透镜阵列加工不精确性造成的激光束强度分布的变化。

当在光波导中面对地提供一对反射平面时,预定方向就与要形成的矩形束的短轴方向一致。使光波导沿矩形束短轴方向作用的原因如下。通常用来对半导体膜进行激光退火的矩形束具有非常短的短轴,一般为 1mm 或以下。为了沿这种非常窄的矩形束的短轴方向均化激光束的强度分布,分裂的束斑必须以非常高的精度被叠加。正是光波导容易地使得这种叠加成为可能,分裂的束斑从而能够完全被叠加在同一个位置。

而且,当光波导沿长轴方面具有另一对面对地提供的反射平面时,矩形束能够沿其长轴和短轴方向具有均匀的强度分布。

为了解决上述问题,本发明提供了一种束均化器,它包括用来沿

预定方向分裂激光束并组合分裂的激光束的光学系统以及用来沿预定方向均化激光束的强度分布的光波导，其中，激光束在透射通过光学系统之后，被入射到光波导中。

本发明公开的束均化器还包括用来沿垂直于预定方向的方向分裂激光束以及用来组合分裂的束的光学系统。

在本发明公开的束均化器中，光波导具有面对地提供的一对反射平面。

在本发明公开的束均化器中，光波导具有面对地提供的二对反射平面。

10 本发明公开了一种激光辐照设备，它包括激光振荡器和束均化器，其中，束均化器具有用来沿预定方向分裂激光束并组合分裂的激光束的光学系统以及用来沿预定方向均化激光束的强度分布的光波导，且其中，激光束在透射通过光学系统之后，被入射到光波导中。

15 本发明公开的激光辐照设备还包括用来沿垂直于预定方向的方向分裂激光束以及用来组合分裂的激光束的光学系统。

在本发明公开的激光辐照设备中，光波导具有面对地提供的一对反射平面。

在本发明公开的激光辐照设备中，光波导具有面对地提供的二对反射平面。

20 在本发明公开的激光辐照设备中，激光振荡器是准分子激光器、YAG 激光器、或玻璃激光器。

在本发明公开的激光辐照设备中，激光振荡器是 YVO₄ 激光器、YLF 激光器、或 Ar 激光器。

25 本发明公开的激光辐照设备还包括用来相对于激光束移动被辐照表面的移动台。

本发明公开的激光辐照设备还包括用来将辐照表面传送到移动台的传送装置。

30 本发明公开了一种用来制造半导体器件的方法，它包括在衬底上形成非单晶半导体膜的步骤以及对作为辐照表面的非单晶半导体膜进行激光退火的步骤，其中，激光退火包括用光学系统沿预定方向分裂激光束并组合各个分裂的束的步骤、用光波导沿预定方向均化激光束的强度分布的步骤、以及在将激光束相对于非单晶半导体膜移动的情

况下辐照非单晶半导体膜的步骤。

在本发明公开的制造半导体器件的方法中，采用了用来沿垂直于预定方向的方向分裂激光束以及用来组合各个分裂的束的光学系统。

用于本发明公开的制造半导体器件的方法中的光波导具有面对地
5 提供的一对反射平面。

用于本发明公开的制造半导体器件的方法中的光波导具有面对地提供的二对反射平面。

用于本发明公开的制造半导体器件的方法中的激光振荡器，是准分子激光器、YAG 激光器、或玻璃激光器。

10 用于本发明公开的制造半导体器件的方法中的激光振荡器，是YVO₄激光器、YLF 激光器、或 Ar 激光器。

在本发明公开的制造半导体器件的方法中，采用了用来相对于激光束移动辐照表面的移动台。

在本发明公开的制造半导体器件的方法中，采用了用来将辐照表面传送到移动台的传递装置。
15

[本发明的有利效应]

根据本发明，利用用来分裂和组合激光束的光学系统，分裂的束被分别聚焦在不同的点，强度分布因而在各个焦点处被分散，而不形成强度非常高的点。而且，由于借助于调整光学系统的位置，能够将
20 焦点设定成离开光波导一定距离，故激光束不被聚焦在光波导内部。因此，光波导不太可能被损伤。由于如上所述强度分布在焦点处被分散，故即使当激光束由于例如激光束发散角的改变而被聚焦在光波导内部时，光波导也不太可能被损伤。以在强度分布被分散的同时激光束透过那里入射到光波导中并且各个分裂的激光束被叠加在同一个表
25 面上的方式，激光束的强度分布被均化。在各个分裂的激光束被叠加于此的光波导出口处，激光束的强度分布被均化。由于激光束的强度分布被分散，故能够使用透射型光波导，并能够降低光导损失。

此外，由于激光束能够具有均匀的强度分布，故有可能具有激光束功率的宽的裕度。图 7A 和 7B 解释了这一点。图 7A 示出了强度分布
30 不均匀的激光束的形状。通常，激光束的功率不总是稳定的而有一定程度的变化。在用强度分布不均匀的激光束进行激光退火的情况下，当功率意外增大时，束分布的顶部超过适合于晶化的能量范围。因此，

当对作为被辐照目标的半导体膜进行激光退火时，半导体膜可能被烧蚀。相反，当功率降低时，原先能量低的束分布底部下降到低于适合于晶化的能量范围。因此，可能由于能量不足而不进行晶化。另一方面，如图 7B 所示，当采用强度分布均匀的激光束时，即使功率有一定程度的变化，激光束也不超过或低于适合于晶化的能量范围。于是能够稳定地进行均匀的晶化。因此，利用本发明形成的强度分布均匀的激光束，能够在激光束功率的宽裕度内进行激光退火。

当利用本发明公开的包括束均化器的激光辐照设备来执行激光退火时，能够在辐照表面处均化激光束的强度分布。因此，能够提高衬底上结晶性的均匀性。当本发明被应用于 TFT 的大规模生产时，由于均匀的结晶性能够减小电学特性的变化和提高可靠性，故有可能有效地制造具有高的工作特性的 TFT。

借助于满足这些优点，能够提高以有源矩阵液晶显示器件为典型的半导体器件的工作特性和可靠性。而且，半导体器件的制造工艺能够具有宽的裕度来提高成品率。因此，能够以更低的成本制造半导体器件。

附图说明

图 1A 和 1B 示出了本发明的实施方案模式；
图 2A 和 2B 示出了本发明的实施方案模式；
图 3A 和 3B 示出了本发明的实施方案模式；
图 4A 和 4B 示出了本发明的实施方案 1；
图 5A 和 5B 示出了本发明的实施方案 2；
图 6A 和 6B 示出了本发明的实施方案 3；
图 7A 和 7B 示出了本发明的有利效应；
图 8A 和 8B 示出了本发明的实施方案 2；
图 9A-9D 示出了本发明的实施方案 4；
图 10A-10D 示出了本发明的实施方案 4；
图 11A 和 11B 示出了本发明的实施方案 4；
图 12A-12H 示出了本发明的实施方案 5。

具体实施方式

首先，参照图 1A-2B 来解释用本发明公开的束均化器均化激光束强度分布的方法。在图 1A 的侧视图中，激光束沿箭头所示方向传播。

柱形透镜阵列 101 和柱形凸透镜 102 被用作光学系统来分裂激光束和组合各个分裂的激光束。光波导 103 具有面对地提供的一对反射平面，具有由折射率为 n ($n>1$) 的媒质占据其间的区域。因此，根据与光纤相同的原理，入射到光波导 103 中的激光束由于以临界角或以上的角度入射到其中而被全反射。例如，借助于在空气中提供由石英（折射率约为 1.5）组成的光波导，能够得到在光波导与空气之间的界面处具有全反射平面的光波导。利用这种光波导，与激光束不被全反射的光波导相比，激光束的透射率变得高得多。于是，从激光振荡器发射的激光束能够更有效地传播到被辐照表面。此外，光波导可以具有二对面对地提供的反射平面。而且，还可以使用空气占据该对反射平面之间区域的光波导。

在图 1A 的侧视图中，激光束被柱形透镜阵列 101 分裂，且各个分裂的激光束被柱形凸透镜 102 聚焦，然后，激光束被入射到光波导 103 中。此时，由于各个分裂的激光束不聚焦在一个点，而是分别聚焦在不同的点 104，故强度分布被分散在各个焦点处。此外，借助于调整柱形透镜阵列 101 和柱形凸透镜 102 的位置，能够将焦点 104 设定成离开光波导一定距离。因此，由于激光束不被聚焦在光波导内部，故光波导能够保持安全。而且，即使当焦点 104 由于激光束发散角的稍许改变而移动到光波导 103 内部时，由于激光束不聚焦在一个点而是聚焦在激光束强度分布被分散的多个点，故也不太可能损伤光波导。于是，有可能安全地使用光波导，并在其出口处形成强度分布被均化了的激光束。

另一方面，图 2A 和 2B 示出了仅仅使用柱形凸透镜来汇聚激光束以便激光束入射到光波导中的例子。在图 2A 和 2B 中，激光束沿箭头所示方向传播。柱形凸透镜 201 汇聚激光束，使激光束入射到光波导 202 中。与图 1A 和 1B 所示光波导 103 一样，光波导 202 由折射率为 n ($n>1$) 的媒质组成。由于光波导的折射率大于空气的折射率，故在以临界角或以上的角度在光波导 202 与空气之间的界面 202a 和 202b 处被全反射的情况下，激光束透射通过光波导 202。激光束在光波导 202 中被反复反射，且各个激光束在光波导 202 的出口处被叠加。由于柱形凸透镜 201 汇聚的激光束被聚焦在一个点（焦点 203），故激光束的强度在焦点 203 处被聚集。如图 2A 和 2B 所示，当激光束的发散角稍

许改变，从而将焦点 203 移动到光波导 202 内部时，在使用高输出激光束的情况下，在激光束具有高强度的点处就产生强电场或等离子体，导致光波导损伤。

因此，在本实施方案膜式中，借助于用柱形透镜阵列和柱形凸透镜分裂焦点，激光束的强度分布被分散。于是，有可能使激光束入射到光波导中而不对光波导造成任何损伤。要指出的是，在图 1A 和 1B 中，激光束仅仅能够沿一个方向被均化。为了实际上将激光束成形为矩形，如图 3A 和 3B 所示，可以增加具有旋转 90 度的柱形透镜阵列和柱形凸透镜的光学系统。

接着，参照图 3A 和 3B 来解释采用上述束均化器来形成矩形束的光学系统。

首先解释图 3A 的侧视图。在图 3A 中，垂直于纸面的方向是矩形束长轴的方向。从激光振荡器 301 发射的激光束沿箭头所示方向传播。在激光束沿矩形束短轴方向被柱形透镜阵列 302 分裂之后，各个分裂的束被柱形透镜 304 汇聚，然后激光束被入射到光波导 306 中。光波导 306 具有一对面对地提供的反射平面，根据上述原因被设定为沿矩形束短轴方向作用。

于是，在光波导 306 的出口处形成了沿短轴方向具有均匀强度分布的激光束。而且，矩形束沿短轴方向的长度由柱形凸透镜 307 决定，然后矩形激光束被辐照到辐照表面 308。

接着来解释图 3B 的俯视图。在图 3B 中，从激光振荡器 301 发射的激光束沿矩形束短轴方向被柱形透镜阵列 303 分裂。而且，各个分裂的束被柱形凸透镜 305 汇聚，以便决定矩形束沿长轴方向的长度，然后，矩形束被辐照到辐照表面 308。于是，能够在辐照表面 308 上形成沿长轴和短轴方向强度分布被均化了的矩形束。

以这种方式，能够安全地使用光波导，并能够形成沿长轴和短轴方向强度分布被均化了的激光束。利用这种激光束，能够对辐照目标均匀地进行激光退火。例如，当半导体膜被用作辐照目标并对其进行激光退火时，有可能均匀地晶化半导体膜，有可能得到具有均匀结晶性的结晶半导体膜，并有可能激活杂质。

此外，当柱形透镜阵列中的阵列数目增加时，被分裂的束的数目增加。因此，借助于分散激光束的强度分布而得到的有利效果也提高。

[实施方案 1]

本实施方案参照图 4A 和 4B 来解释使用与实施方案模式所述不同的光波导的例子。

在图 4A 和 4B 中，激光束沿箭头所示方向传播。用于本实施方案的光波导 406 具有面对地提供的一对反射平面。与图 3A 和 3B 中解释的由折射率为 n ($n > 1$) 的媒质组成的占据成对反射平面之间区域的光波导 306 相反，图 4A 和 4B 中的光波导 406 在该对反射平面之间具有空气填充的空的空间。光波导 306 与 406 的不同就在于此。此外，根据上述理由，光波导 406 的成对反射平面被排列成沿矩形束短轴方向作用。在图 4A 的侧视图中，垂直于纸面的方向是形成在辐照表面 308 上的矩形束长轴的方向。

在图 4A 的侧视图中，从激光振荡器 401 发射的激光束沿矩形束短轴方向被柱形透镜阵列 402 分裂。各个分裂的激光束被柱形凸透镜 404 汇聚，使激光束入射到光波导 406 中。由于各个分裂的激光束此时被聚焦在不同的点，故激光束的强度被分散在各个焦点。这使得即使焦点意外地接触到光学元件，也能够防止光学元件被损伤。此激光束透射通过光波导 406，且激光束的强度分布在光波导 406 的出口处沿矩形束短轴方向被均化。矩形束沿短轴方向的长度由柱形凸透镜 407 确定，此矩形激光束被辐照到辐照表面 408。

接着，在图 4B 的俯视图中，从激光振荡器 401 发射的激光束沿矩形束长轴方向被柱形透镜阵列 403 分裂。各个分裂的激光束被柱形凸透镜 405 汇聚，以便确定其沿长轴方向的长度，然后被发射到辐照表面 408。

于是，在辐照表面 408 处形成了强度分布沿长轴和短轴方向被均化了的矩形束。

[实施方案 2]

本实施方案参照图 5A 和 5B 来解释与使用实施方案模式所述不同的光学系统和不同光波导的例子。在本实施方案中，蝇眼透镜被用作透镜阵列。蝇眼透镜与柱形透镜阵列不同之处在于多个球形透镜在相对于激光束行进方向的垂直平面内被排列成矩阵。光波导 504 具有二对面对地提供的反射平面，其间的区域被人造石英占据。由于人造石英的折射率不同于空气的折射率，故激光束在光波导 504 中被反复反

射。具体地说,在此情况下,由于人造石英具有比空气更高的折射率,故激光束在光波导 504 中以临界角或更大的角度被反复地全反射,并到达出口。

在图 5A 和 5B 中,激光束沿箭头所示方向传播。在图 5A 和 5B 中,从激光振荡器 501 发射的激光束被蝇眼透镜 502 水平地和垂直地分裂,然后,各个分裂的激光束被球形透镜 503 汇聚。与仅仅能够沿一个方向汇聚激光束的柱形透镜相反,球形凸透镜能够沿各个方向汇聚激光束,柱形透镜阵列与蝇眼透镜在这一点上是不同的。此时,由于激光束被蝇眼透镜 502 分裂,故各个分裂的激光束不被聚焦在一点,而是分别聚焦在不同的点。由于激光束的强度分布被分散在这些焦点处,故不存在强度非常高的点。然后,激光束被入射到光波导 504 中。由于光波导 504 具有二对面对地提供的反射平面,故在光波导 504 出口处形成了强度分布被均化了的正方形激光束。在根据预期目的用球形透镜 505 调整从光波导 504 发射的激光束的尺寸之后,激光束以均匀的强度被辐照到辐照表面 506。如图 8B 所示,在本实施方案中,以激光束被辐照在同一个点上受 10 次照射之后,辐照表面水平地或垂直地移动正方形束斑一个边长的方式,激光束被辐照到形成在玻璃衬底上的作为被辐照表面的非单晶半导体膜,然后以同样的方式进行激光退火。要指出的是,操作者可以根据要制造的器件而确定受照射的数目。

根据本发明,有可能形成具有尖锐边沿的强度分布的矩形束。在本实施方案中,有可能在辐照表面 506 上形成具有尖锐边沿的强度分布的正方形束。图 8A 示出了被不具有尖锐边沿的强度分布的激光束退火过的衬底的例子,而图 8B 示出了被具有尖锐边沿的强度分布的激光束退火过的衬底的例子。在图 8A 中,由于激光束不具有尖锐边沿的强度分布,故各个束斑中被均匀退火的区域小,意味着能够被使用的区域小。另一方面,在图 8B 所示的本实施方案中,各个正方形束斑中能够被使用的区域大。因此,在 TFT 被制造在对其执行激光退火之后的衬底上的情况下,能够制造更多的 TFT。而且,如放大图所示,能够以与束斑中相同的间距,跨越各个束斑之间的边界来制造 TFT。于是,例如当用这种衬底制造液晶屏时,有可能制造没有不均匀性的液晶屏。

虽然在本实施方案中形成了正方形束,但借助于改变光波导沿垂

直或水平方向的宽度，也能够形成矩形束。

[实施方案 3]

本实施方案参照图 6A 和 6B 来解释使用实施方案模式所述的不同光波导的例子。在图 6A 和 6B 中，柱形透镜阵列 602 被用作透镜阵列。
5 光波导 606 具有二对面对地提供的反射平面，其间的区域被人造石英占据。由于人造石英的折射率大于空气的折射率，故入射到光波导 606 中的激光束被反复地全反射并到达出口。

在图 6A 和 6B 中，从激光振荡器 601 发射的激光束沿箭头所示方向传播。首先来解释图 6A 的侧视图。在图 6A 的侧视图中，垂直于纸面的方向是矩形束长轴的方向。激光束被入射到柱形透镜阵列 602 中，
10 并沿矩形束的短轴被分裂。然后，激光束被柱形凸透镜 604 汇聚。此时，由于激光束被柱形透镜阵列 602 分裂，故各个分裂的束分别被聚焦在不同的点。因此，激光束的强度分布在各个焦点被分散，从而不存在强度非常高的点。然后，激光束被入射到光波导 606 中。激光束
15 在光波导 606 中被反复地反射，且矩形束的强度分布在光波导 606 的出口处沿矩形激光束的短轴方向被均化。然后，矩形束的长度由柱形凸透镜 607 确定，且矩形激光束被辐照到辐照表面 609。

接着来解释图 6B 的俯视图。从激光振荡器 601 发射的激光束被柱形透镜阵列 603 沿矩形束的长轴方向分裂，然后被柱形凸透镜 605 汇聚。
20 然后，被入射到光波导 606 中。此时，由于激光束被聚焦在多个点，故强度分布被分散而不形成任何强度非常高的点。于是能够安全地使用光波导。而且，由于光波导 606 具有二对面对地提供的反射平面，故强度分布不仅能够沿短轴方向被均化，而且还能够沿长轴方向被均化。于是，能够在光波导 606 的出口处形成强度分布沿长轴和短
25 轴方向被均化了的矩形束。而且，其沿长轴方向的长度由柱形凸透镜 608 确定，然后，矩形激光束被辐照到辐照表面 609。

于是，利用柱形透镜阵列和具有面对地提供的二对反射平面的光波导，能够形成强度分布沿长轴和短轴方向被均化了的矩形激光束。在本发明中，借助于用柱形透镜阵列分裂激光束，能够分散激光束的
30 强度分布。因此，光波导不太可能被损伤，从而更安全地执行激光退火。

[实施方案 4]

本实施方案参照图 9-11 来解释本发明的激光辐照设备被用来形成结晶半导体膜并进一步制造半导体器件的例子。

一开始,如图 9A 所示,基底绝缘膜 1101a 和 1101b 被形成在衬底 1100 上。诸如玻璃衬底、石英衬底、或结晶玻璃衬底之类的绝缘衬底、陶瓷衬底、不锈钢衬底、金属衬底(例如钽、钨、钼等)、半导体衬底、塑料衬底(例如聚酰亚胺、丙烯酸类、聚乙烯、对苯二酸酯、聚碳酸酯、聚芳基化合物、聚醚砜等),能够被用作衬底 1100。此衬底由至少能够抗工艺中产生的热的材料组成。在本实施方案中,采用了玻璃衬底。

基底绝缘膜 1101a 和 1101b 由氧化硅膜、氮化硅膜、氮氧化硅膜之类的单层结构或二个层或更多个层的叠层结构组成。用诸如溅射方法、减压 CVD 方法、或等离子体 CVD 方法之类的熟知方法来形成这些膜。虽然在本实施方案中形成了二层结构的基底绝缘膜,但也可以形成单层结构或 3 个层或更多个层的叠层结构的基底绝缘膜。在本实施方案中,形成了厚度为 50nm 的氧氮化硅膜作为第一基底绝缘膜 1101a,且形成了厚度为 100nm 的氮氧化硅膜作为第二基底绝缘膜 1101b。要指出的是,氧氮化硅膜和氮氧化硅膜在氮和氧之间的比例方面是不同的。氧氮化硅膜包含的氮多于氧,而氮氧化硅膜包含的氧多于氮。

接着,形成非晶半导体膜 1102。可以用诸如溅射方法、减压 CVD 方法、或等离子体 CVD 方法之类的熟知方法,用厚度为 25-80nm 的硅或硅基材料(例如 $\text{Si}_2\text{Ge}_{1-x}$)来形成非晶半导体膜。在本实施方案中,形成了厚度为 66nm 的非晶硅。

随后,非晶硅被晶化。在本实施方案中,激光退火方法被用于晶化。

本发明的激光辐照设备被用于激光退火工艺。准分子激光器、YAG 激光器、玻璃激光器、YVO₄ 激光器、YLF 激光器、Ar 激光器等,可以被用作激光辐照设备中的激光振荡器。

如图 9B 所示,用本发明的激光辐照设备来执行激光退火,以便晶化非晶硅。更具体地说,可以用实施方案 1-3 中任何一个所述的方法来执行激光退火。例如,在能量密度被设定为 200-1000mJ/cm²且受照射数目被设定为 10-50 的条件下执行激光退火。

接着, 结晶半导体膜被腐蚀, 以便形成图 9C 所示的所希望的岛状的结晶半导体膜 1102a-1102d。然后, 用低压 CVD 方法、等离子体 CVD 方法、溅射方法等, 用包括硅的绝缘膜, 形成厚度约为 115nm 的栅绝缘膜 1103。在本实施方案中形成了氧化硅膜。在此情况下, 用等离子体 CVD 方法, 在 TEOS (原硅酸四乙酯) 和 O_2 被混合, 反应压力被设定为 40Pa, 衬底温度被设定为 300-400℃, 以及高频 (13.56MHz) 下以 0.5-0.8W/cm² 的电密度放电的条件下, 形成了氧化硅膜。利用随后在 400-500℃ 的温度下的热处理, 这样制造的氧化硅膜获得了良好的栅绝缘膜特性。

10 当用本发明的激光辐照设备晶化半导体膜时, 有可能抑制束斑不均匀的强度分布所造成的结晶性的不均匀性, 从而有可能得到特性优异而均匀的结晶半导体膜。

接着, 在栅绝缘膜上形成厚度为 30nm 的氮化钽 (TaN) 膜作为第一导电层, 并在其上形成厚度为 370nm 的钨 (W) 膜作为第二导电层。15 可以用溅射方法用 Ta 作为靶, 在氮气气氛中形成此 TaN 膜。并可以用溅射方法用 W 作为靶形成 W 膜。为了将它们用作栅电极, 它们必须具有低的电阻, 且最后使 W 膜的电阻率为 20 $\mu\Omega$ cm 或以下。因此, 最好用溅射方法, 用高纯 W (纯度为 99.99%) 作为靶来形成 W 膜, 而且, 当形成 W 膜时, 必须非常小心不要使杂质混入到其中。这样就有可能使其电阻率为 9-20 $\mu\Omega$ cm。

20 虽然本实施方案用厚度为 30nm 的 TaN 形成第一导电层, 并用厚度为 370nm 的 W 形成第二导电层, 但这些导电层的材料不局限于此。第一和第二导电层二者都可以由选自 Ta、W、Ti、Mo、Al、Cu、Cr、Nd 的元素组成, 或由包括上述元素作为其主要成分的化合物材料或合金材料组成。此外, 也可以采用掺有诸如磷之类杂质的典型为结晶硅膜的半导体膜。而且, 还可以使用 AgPdCu 合金。还可以采用这些材料的组合。第一导电层的厚度最好为 20-100nm, 而第二导电层的厚度最好为 100-400nm。虽然本实施方案示出了二层结构, 但导电层可以被形成单层结构或 3 个层或更多个层的叠层结构。

30 接着, 根据光刻方法, 通过曝光工艺形成抗蚀剂掩模 1201。然后, 借助于用抗蚀剂掩模 1201 对导电层进行腐蚀, 来形成电极和布线。在第一和第二腐蚀条件下执行第一腐蚀工艺。用抗蚀剂掩模来执行腐

蚀, 以便形成栅电极和布线。腐蚀条件被适当地选择。

在本实施方案中, ICP (感应耦合等离子体) 腐蚀方法被用作第一腐蚀工艺。此腐蚀工艺在第一腐蚀条件下进行, 其中, 气体流速分别为 25/25/10sccm 的 CF_4 、 Cl_2 、 O_2 被用作腐蚀气体, 借助于在 1.0Pa 的压力下将 500W 的 RF (13.56MHz) 电功率施加到线圈状电极, 来产生等离子体。还将 150W 的 RF (13.56MHz) 电功率施加到衬底侧 (样品台), 并施加基本上负的自偏置电压。W 膜在第一腐蚀条件下被腐蚀, 并使第一导电层的边沿部分成锥形。在第一腐蚀条件下, W 膜在每分钟 200nm 的腐蚀速率下被腐蚀, 而 TaN 膜以每分钟 80nm 的腐蚀速率被腐蚀, 且 W 对 TaN 的选择比约为 2.5。根据第一腐蚀条件, W 膜的锥角约为 26 度。

接着, 在第二腐蚀条件下执行腐蚀工艺。在第二腐蚀条件下, 气体流速分别为 30/30sccm 的 CF_4 和 Cl_2 被用作腐蚀气体, 借助于在 1.0Pa 的压力下对线圈状电极施加 500W 的 RF (13.56MHz) 功率, 来产生等离子体。然后执行大约 15 秒钟腐蚀工艺。还将 20W 的 RF (13.56MHz) 功率施加到衬底侧 (样品台), 并从而施加基本上负的自偏置电压。在采用 CF_4 和 Cl_2 混合气体的第二腐蚀条件下, W 膜和 TaN 膜都被腐蚀到相同的程度。

在第二腐蚀条件下, W 膜在每分钟 59nm 的腐蚀速率下被腐蚀, 而 TaN 膜以每分钟 66nm 的腐蚀速率被腐蚀, 要指出的是, 为了执行腐蚀工艺而不在栅绝缘膜上留下残留物, 可以增加大约 10-20% 的腐蚀时间。在第一腐蚀工艺中, 未被电极覆盖的栅绝缘膜被腐蚀大约 20-50nm。

在第一腐蚀工艺中, 由于施加到衬底侧的偏置电压的作用而使第一和第二导电层的边沿部分成为锥状。

接着, 执行第二腐蚀工艺而不清除抗蚀剂掩模 1201。在气体流速分别为 24/12/24sccm 的 SF_6 、 Cl_2 、 O_2 被用作腐蚀气体, 且借助于在 1.3Pa 的压力下将 700W 的 RF (13.56MHz) 功率施加到线圈状电极来产生等离子体的条件下, 来执行第二腐蚀工艺。这样, 腐蚀被进行大约 25 秒钟。还将 10W 的 RF (13.56MHz) 功率施加到衬底侧, 从而施加基本上负的自偏置电压。在此腐蚀条件下, W 膜被选择性地腐蚀, 并形成第二导电层。另一方面, 第一导电层则很少被腐蚀。第一和第二

腐蚀工艺形成了图 10A 所示的包括第一导电层 1104a-1104d 和第二导电层 1105a-1105d 的栅电极。

然后, 如图 10B 所示, 执行第一掺杂工艺而不清除抗蚀剂掩模 1201。提供 n 型的杂质元素通过第一掺杂工艺以低的浓度被掺杂在结晶半导体层中。可以用离子掺杂方法或离子注入方法来执行第一掺杂工艺。在剂量为每平方厘米 1×10^{13} 离子至每平方厘米 5×10^{14} 离子, 且加速电压为 40-80kV 的条件下, 执行离子掺杂方法。在本实施方案中, 加速电压被设定为 50kV。周期表中第 15 元素, 典型为磷 (P) 或砷 (As), 可以被用作提供 n 型的杂质元素。在本实施方案中使用了磷 (P)。此时, 第一导电层被用作掩模来形成第一杂质区 (N^- 区) 1111a-1114a, 其中, 低浓度杂质以自对准方式被加入。

接着, 清除抗蚀剂掩模 1201, 然后重新形成抗蚀剂掩模 1202。如图 10C 所示, 在比第一掺杂工艺更高的加速电压下, 执行第二掺杂工艺。在第二掺杂工艺中也加入提供 n 型的杂质。在剂量被设定为每平方厘米 1×10^{13} 离子至每平方厘米 3×10^{15} 离子, 且加速电压被设定为 60-120kV 的条件下, 执行离子掺杂方法。在本实施方案中, 剂量被设定为每平方厘米 3.0×10^{15} 离子, 而加速电压被设定为 65kV。在第二掺杂工艺中, 第二导电层被用作杂质元素的掩模, 并执行掺杂工艺, 使杂质元素也被加入在位于第一导电层下方的半导体层中。

在第二掺杂工艺中, 第二杂质区 (N^- 区, LoV 区) 1111b 和 1114b 被形成在未与第二导电层重叠或未被掩模覆盖但与第一导电层重叠的结晶半导体层部分中。提供 n 型的杂质以每立方厘米 1×10^{18} 原子至每平方厘米 5×10^{19} 原子的浓度被加入在第二杂质区中。此外, 提供 n 型的杂质以每立方厘米 1×10^{19} 原子至每平方厘米 5×10^{21} 原子的高浓度被加入在暴露的未被第一导电层和掩模覆盖的结晶半导体膜部分 (此部分是第三杂质区 1111c、1113c、以及 1114c: N^+ 区)。而且, 此 N^+ 区存在于半导体层中, 并部分地被掩模 1202 覆盖。在此被掩模 1202 覆盖的部分中提供 n 型的杂质的浓度与执行第一掺杂工艺时的浓度相同, 因此, 此部分仍然被称为第一杂质区 (N^- 区)。

虽然在本实施方案中借助于执行二次掺杂工艺而形成各个杂质区, 但本发明不局限于此, 而是可以借助于在适当确定的条件下执行一次或多次掺杂工艺来形成具有所希望的杂质浓度的各个杂质区。

接着,在清除抗蚀剂掩模 1202 之后,如图 10D 所示,重新形成抗蚀剂 1203,以便执行第三掺杂工艺。第三掺杂工艺形成第四杂质区(P⁺区) 1112d 和 1114d 以及第五杂质区(P⁻区) 1112e 和 1114e,其中,提供与第一和第二导电类型相反的导电类型杂质元素被加入到半导体层,以便形成 p 沟道 TFT。

在第三掺杂工艺中,第四杂质区(P⁺区) 1113d 和 1114d 被形成在未被抗蚀剂掩模 1203 覆盖和未与第一导电层重叠的结晶半导体层部分中。且第五杂质区(P⁻区) 1113e 和 1114e 被形成在未被抗蚀剂掩模 1203 覆盖和未与第二导电层重叠但与第一导电层重叠的部分中。诸如硼(B)、铝(Al)、镓(Ga)之类的周期表第 13 元素已知是提供 p 型的杂质元素。

在本实施方案中,硼(B)被用作提供 p 型的杂质元素来形成第四杂质区 1113d 和 1114d 以及第五杂质区 1113e 和 1114e,并在剂量被设定为每平方厘米 1×10^{16} 离子,且加速电压被设定为 80kV 的条件下,用双硼烷(B₂H₆)来执行离子掺杂方法。

要指出的是,贯穿第三掺杂工艺,形成 n 沟道 TFT 的半导体层被抗蚀剂掩模 1202 覆盖。

此处,利用第一和第二掺杂工艺,磷以不同的浓度分别被加入在第四杂质区(P⁺区) 1113d 和 1114d 以及第五杂质区(P⁻区) 1113e 和 1114e 中。但第三掺杂工艺被执行,使第四杂质区(P⁺区) 1113d 和 1114d 以及第五杂质区(P⁻区) 1113e 和 1114e 中提供 p 型的杂质元素的浓度为每立方厘米 1×10^{19} 原子至每平方厘米 5×10^{21} 原子。因此,第四杂质区(P⁺区) 1113d 和 1114d 以及第五杂质区(P⁻区) 1113e 和 1114e 用作 p 沟道 TFT 的源区和漏区毫无问题。

虽然本发明借助于执行一次第三掺杂工艺而形成了第四杂质区(P⁺区) 1113d 和 1114d 以及第五杂质区(P⁻区) 1113e 和 1114e,但本发明不局限于此。也可以借助于根据掺杂工艺中的条件适当地执行多次掺杂工艺来形成第四杂质区(P⁺区)以及第五杂质区(P⁻区)。

这些掺杂工艺形成了第一杂质区(N⁻区) 1112a、第二杂质区(N⁻区, Lov 区) 1111b、第三杂质区(N⁺区) 1111c 和 1113c、第四杂质区(P⁺区) 1113d 和 1114d、以及第五杂质区(P⁻区) 1113e 和 1114e。

接着,如图 11A 所示,清除抗蚀剂掩模 1203,并形成第一钝化膜

1120. 包括硅的厚度为 100-200nm 的绝缘膜被形成作为第一钝化膜。等
离子体 CVD 方法或溅射方法可以被用作成膜方法。在本实施方案中，
用等离子体 CVD 方法形成了厚度为 100nm 的氮氧化硅膜。可以用等离
子体 CVD 方法，用 SiH_4 、 N_2O 以及 NH_3 ，或用 SiH_4 和 N_2O 来形成此氮氧
5 化硅膜。这些膜在反应压力被设定为 20-200Pa、衬底温度被设定为
300-400℃、以及高频(60MHz)功率密度被设定为每平方厘米 0.1-1.0W
的条件下被制造。此外，用 SiH_4 、 N_2O 以及 H_2 制造的氮化氮氧化硅膜可
以被用作第一钝化膜。当然，第一钝化膜 1120 不仅可以如本实施方案
所示用氮氧化硅膜被形成成为单层结构，而且可以用包括硅的其它绝缘
10 膜形成单层结构或叠层结构。

然后，用本发明的激光辐照设备执行激光退火，以便恢复半导体
层的结晶性并激活加入到半导体层中的杂质。例如，在能量密度被设
定为 100-1000 mJ/cm^2 和受照射数目被设定为 10-50 的条件下，执行
激光退火。不仅能够使用激光退火，而且也能够使用热处理或快速热
15 退火 (RTA)。

当在形成第一钝化膜 1120 之后执行热处理时，可以在激活的同时
执行半导体层的氢化。氢化是为了用包括在第一钝化膜中的氢来终止
半导体层的悬挂键。

作为变通，可以在形成钝化膜 1120 之前执行热处理。但当第一导
20 电层 1104a-1104d 和第二导电层 1105a-1105d 的材料不具有足够的抗
热性时，最好如本实施方案所示在形成第一钝化膜 1120 之后执行热处
理，以便保护布线。当在形成第一钝化膜 1120 之前执行热处理时，由
于在热处理中不存在钝化膜，故无法执行利用包括在钝化膜中的氢的
氢化。

25 在此情况下，利用等离子体激发的氢来执行氢化（等离子体氢
化），或借助于在 300-450℃ 的温度下在包括 3-100% 的氢的气氛中进
行 1-12 小时加热而执行氢化。

接着，在第一钝化膜 1120 上形成第一层间绝缘膜 1121。无机绝
缘膜或有机绝缘膜可以被用作第一层间绝缘膜。用 CVD 方法形成的氧
30 化硅膜或用 SOG (旋涂玻璃) 方法涂敷的氧化硅膜可以被用作无机绝缘
膜。聚酰亚胺、聚酰胺、BCB (苯并环丁烯)、丙烯酸类、正性光敏有
机树脂、负性光敏有机树脂等组成的膜，能够被用作有机绝缘膜。也

可以采用丙烯酸类膜和氮氧化硅膜的叠层膜。

此外，层间绝缘膜可以由框架结构由硅（Si）和氧（O）键组成且包括至少替位氢的材料组成。而且，层间绝缘膜可以由具有至少替位氟、烷基、芳基碳氢化合物之一的材料组成。硅氧烷聚合物可以作为
5 这种材料的典型例子。

根据结构，硅氧烷聚合物可以被分类成硅石玻璃、烷基硅氧烷聚合物、烷基倍半硅氧烷聚合物、倍半硅氧烷氢化物聚合物、烷基倍半硅氧烷氢化物聚合物等。

或者，可以用包括具有 Si-N 键的聚合物（聚硅氮烷 polysilazane）的材料来形成层间绝缘膜。
10

虽然膜被形成得如此薄，但利用上述材料，层间绝缘膜能够保持其足够平整性和高度绝缘特性。而且，由于上述材料具有高的抗热性，故能够得到在多层布线中能抗回流工艺的层间绝缘膜。而且，由于具有低的吸潮特性，故有可能形成具有较小脱水体积的层间绝缘膜。

在本实施方案中，非光敏丙烯酸膜被形成成为 1.6 微米厚。第一层间绝缘膜能够降低和整平形成在衬底上的 TPT 所造成的凹凸。由于为了整平的目的而特别形成第一层间绝缘膜，故最好采用由能够被容易地整平的材料组成的绝缘膜。
15

然后，在第一层间绝缘膜上，用氮氧化硅膜形成第二钝化膜。膜厚度最好约为 10-200nm，第二钝化膜防止潮气渗透到第一层间绝缘膜中。不仅能够采用氮氧化硅膜，而且还能够采用氮化硅膜、氮化铝膜、氮氧化铝膜、类金刚石碳（DLC）膜或氮化碳（CN）膜。
20

用 RF 溅射方法形成的膜是一种高度致密的膜，其势垒特性优异。在例如形成氮氧化硅膜的情况下，在 Si 被用作靶，N₂、Ar、N₂O 以 31:5:4 的气体流速比流动，压力被设定为 0.4Pa，以及功率被设定为 3000W 的条件下，执行 RF 溅射。在形成氮化硅膜的情况下，例如，Si 被用作靶，N₂ 和 Ar 以 1:1 的气体流速比在工作室中流动，压力被设定为 0.8Pa，功率被设定为 3000W，成膜温度被设定为 215℃。在本实施方案中，RF 溅射被用来形成厚度为 70nm 的氮氧化硅膜。
25

随后，对第二钝化膜、第一层间绝缘膜、以及第一钝化膜进行腐蚀，以便形成与第三和第四杂质区相接触的接触孔。
30

接着，如图 11B 所示，形成与各个杂质区电连接的布线 1122-

1128. 要指出的是, 借助于对厚度为 50nm 的 Ti 膜和厚度为 500nm 的合金膜 (Al 和 Ti) 的叠层膜进行图形化, 来形成这些布线。当然, 此布线不仅可以被形成为二层结构, 而且还可以被形成为单层结构或 3 个层或更多个层的叠层结构。此外, 布线材料不局限于 Al 和 Ti。例如,
- 5 可以借助于对其中 Al 膜或 Cu 膜被形成在 TaN 膜上, 然后在其上进一步形成 Ti 膜的叠层膜进行图形化, 来形成此布线。

[实施方案 5]

- 用实施方案 1-3 所示激光辐照设备制造的半导体器件 (特别是显示器件 (液晶显示器件和 EL 显示器件等)), 能够被用于各种电子装置, 有电视装置、摄象机、数码相机、风镜式显示器 (头戴式显示器)、
- 10 导航系统、放声装置 (汽车音响、音响元件系统等)、个人计算机、游戏机、个人数字助理 (移动计算机、移动电话、移动游戏机、电子记事本等)、配备有记录媒质的放像装置 (具体为配备有能够播放诸如数字万能碟盘 (DVD) 之类的记录媒质并能够显示图象的显示器的装置)
- 15 等。图 12A-12H 示出了这些电子装置的例子。

- 图 12A 示出了一种电视装置, 它包括机壳 13001、支座 13002、显示部分 13003、扬声器部分 13004、视频输入端子 13005 等。实施方案 1-3 所示激光辐照设备能够被用来制造显示部分 13003 等, 从而能够完成此电视装置。EL 显示器或液晶显示器能够被用作显示部分
- 20 13003。要指出的是, 此电视装置包括用于计算机、电视广播接收、广告等的所有电视装置。

- 图 12B 示出了一种数码相机, 它包括主体 13101、显示部分 13102、图象接收部分 13103、操作键 13104、外部连接端口 13105、快门 13106 等。实施方案 1-3 所示的激光辐照设备能够被用来制造显示部分 13102
- 25 等, 从而能够完成此数码相机。

图 12C 示出了一种计算机, 它包括主体 13201、机壳 13202、显示部分 13203、键盘 13204、外部连接端口 13205、鼠标 13206 等。实施方案 1-3 所示的激光辐照设备能够被用来制造显示部分 13203 等, 从而能够完成此计算机。

- 30 图 12D 示出了一种移动计算机, 它包括主体 13301、显示部分 13302、开关 13303、操作键 13304、红外线端口 13305 等。实施方案 1-3 所示的激光辐照设备能够被用来制造显示部分 13302 等, 从而能

够完成此移动计算机。

图 12E 示出了一种配备有记录媒质的放像装置(此装置具体为 DVD 播放机)，它包括主体 13401、机壳 13402、显示部分 A 13403、显示部分 B 23404、记录媒质(例如 DVD)读出器 13405、操作键 13406、
5 扬声器部分 13407 等。显示部分 A 13403 主要显示图象信息，而显示部分 B 13404 主要显示文本信息。实施方案 1-3 所示的激光辐照设备能够被用来制造显示部分 A 13403 和显示部分 B 23404 等，从而能够完成此放像装置。要指出的是，配备有记录媒质的放像装置包括游戏机等。

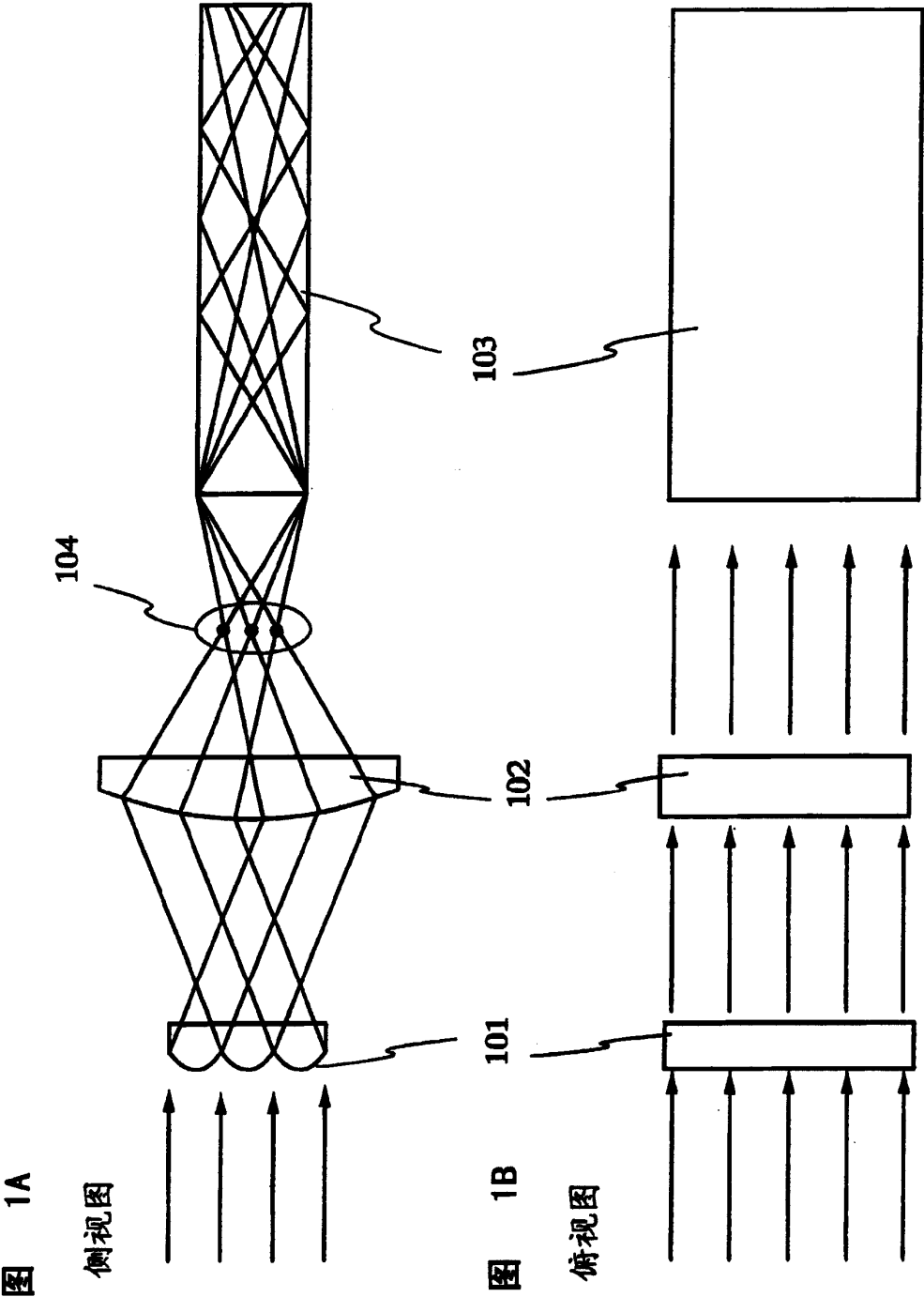
10 图 12F 示出了一种风镜式显示器(头戴式显示器)，它包括主体 13501、显示部分 13502、以及镜臂部分 13503。实施方案 1-3 所示的激光辐照设备能够被用来制造显示部分 13502 等，从而能够完成此风镜式显示器。

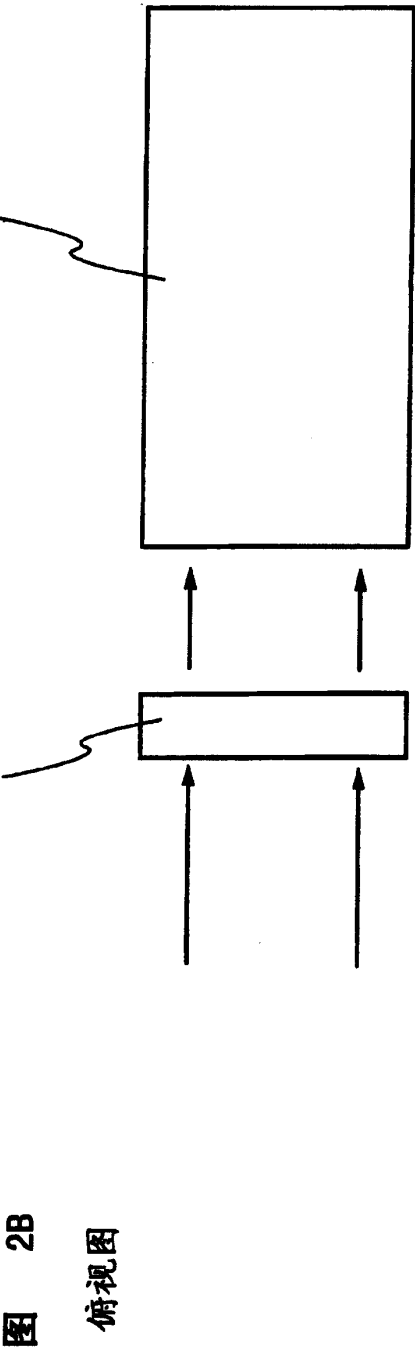
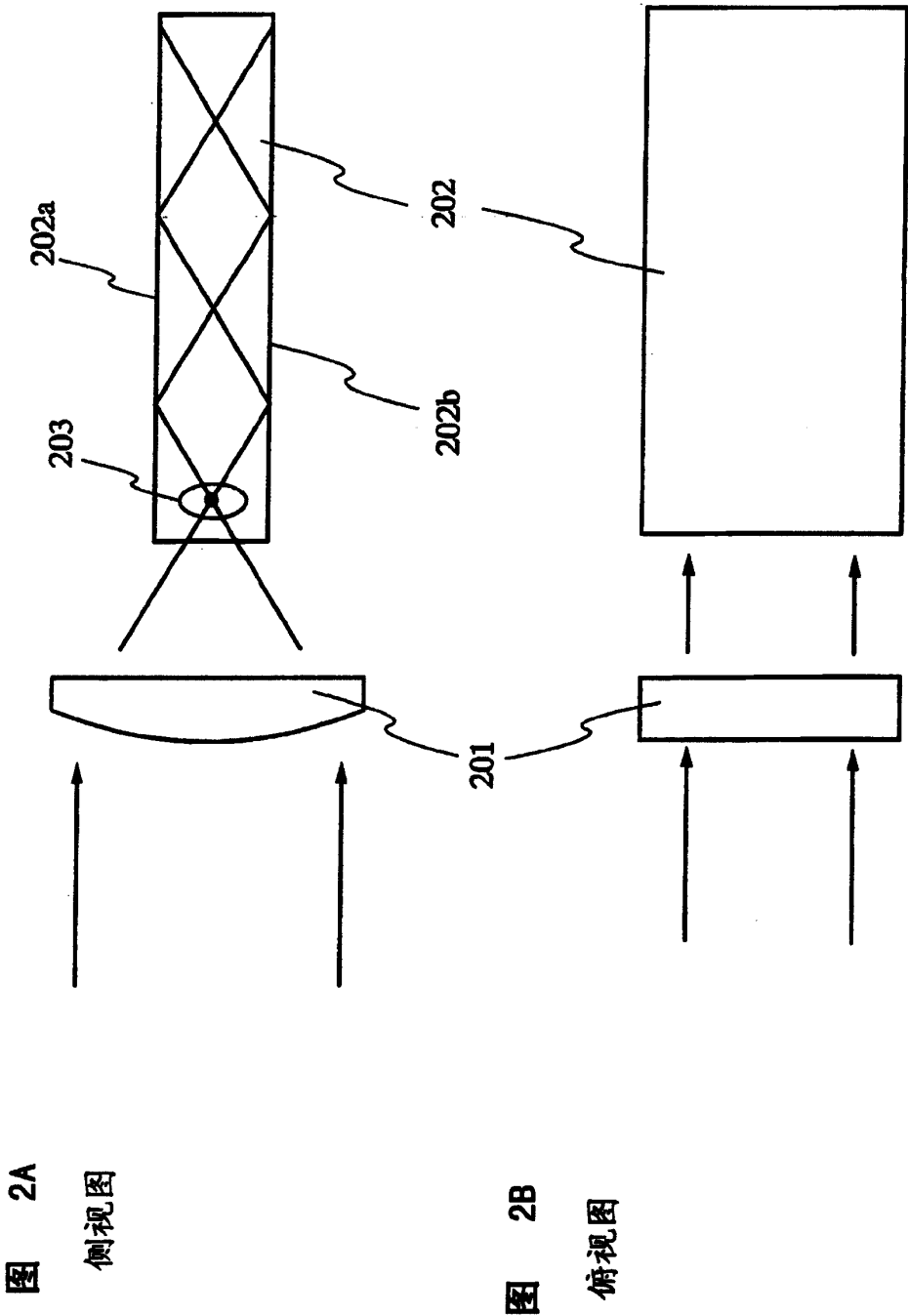
图 12G 示出了一种摄象机，它包括主体 13601、显示部分 13602、
15 机壳 13603、外部连接端口 13604、遥控接收机 13605、图象接收机 13606、电池 13607、声音输入部分 13608、操作键 13609、目镜部分 13610 等。实施方案 1-3 所示的激光辐照设备能够被用来制造显示部分 13602 等，从而能够完成此摄象机。

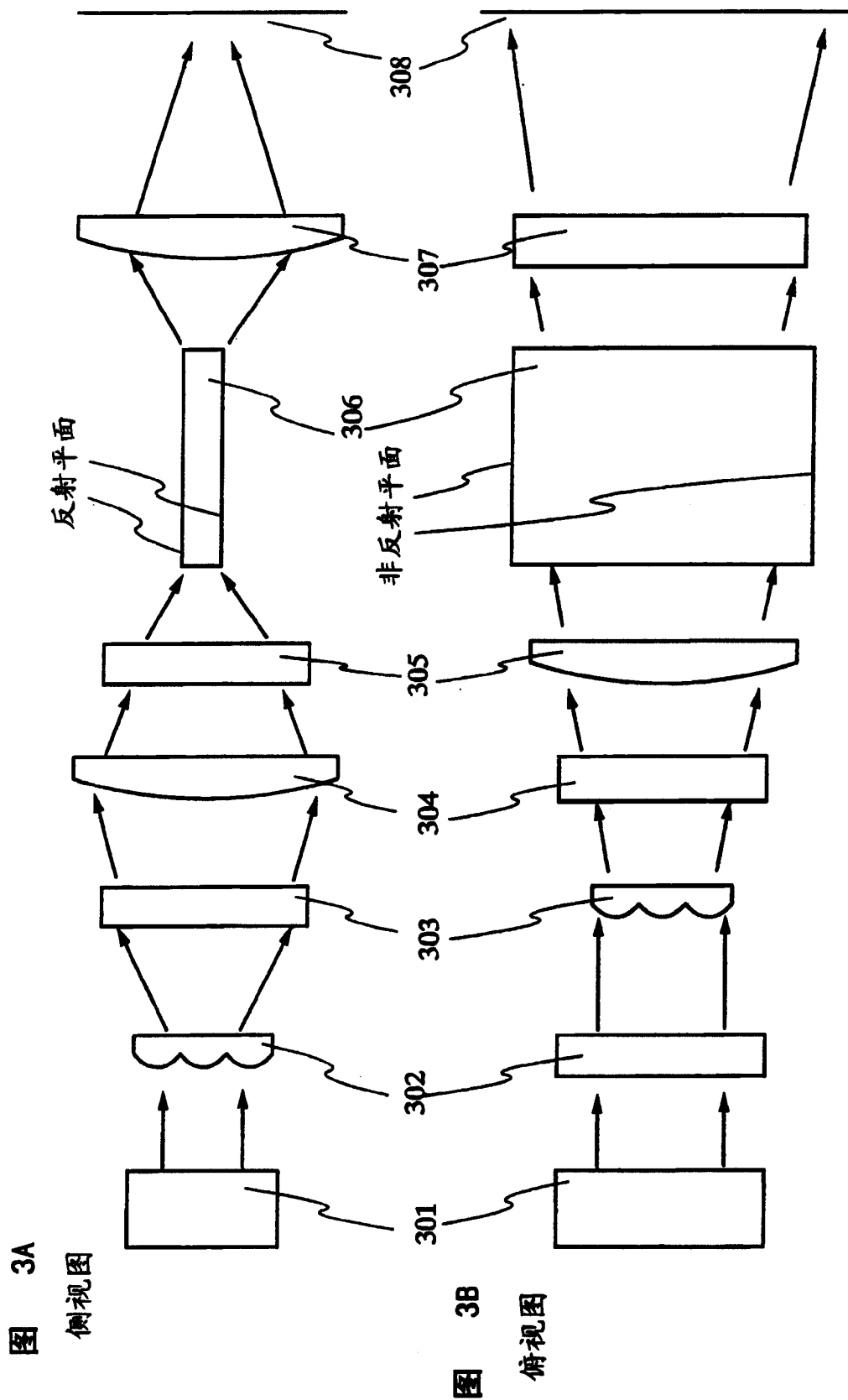
图 12H 示出了一种移动电话，它包括主体 13701、机壳 13702、显示部分 13703、声音输入部分 13704、声音输出部分 13705、操作键 13706、外部连接端口 13707、天线 13708 等。实施方案 1-3 所示的激光辐照设备能够被用来制造显示部分 13703 等，从而能够完成此移动电话。当显示部分 13703 在黑色背景上显示白色字母时，移动电话消耗的功率较少。

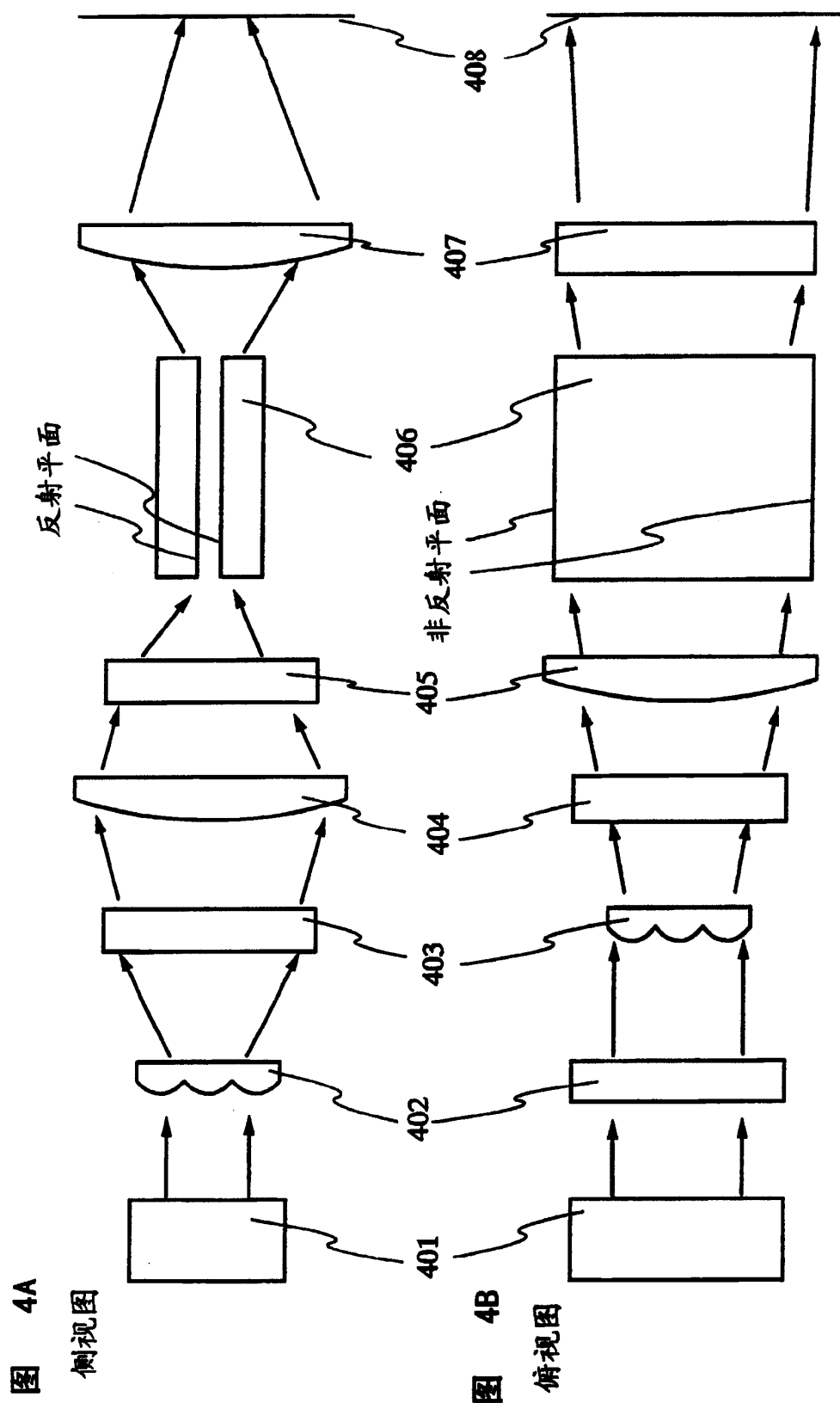
25 用于这些电子装置显示部分的显示器件，具有用来驱动象素的薄膜晶体管。实施方案 1-3 所示的激光辐照设备能够被用来晶化用于薄膜晶体管的半导体膜。在如 EL 显示器件那样用于电子装置显示部分的显示器件要求高的精度和高的结晶性的情况下，有可能制造具有其显示不均匀性借助于利用实施方案 1-3 所示的激光辐照设备对半导体膜
30 进行晶化而进一步降低了的显示部分的电子装置。

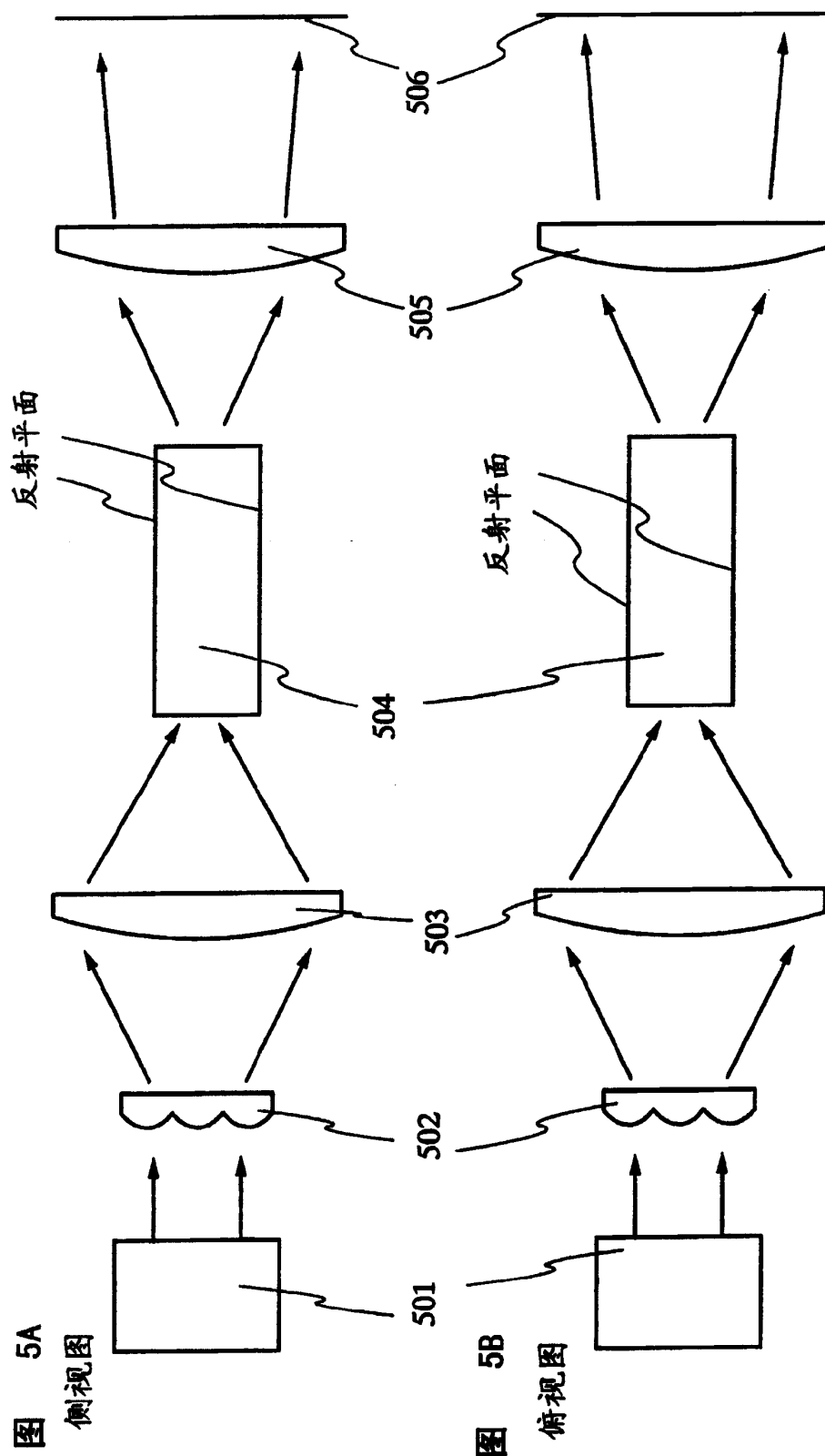
如上所述，用本发明的激光辐照设备制造的半导体器件的应用范围是极为广阔的，此半导体器件能够被应用于所有领域的电子装置。











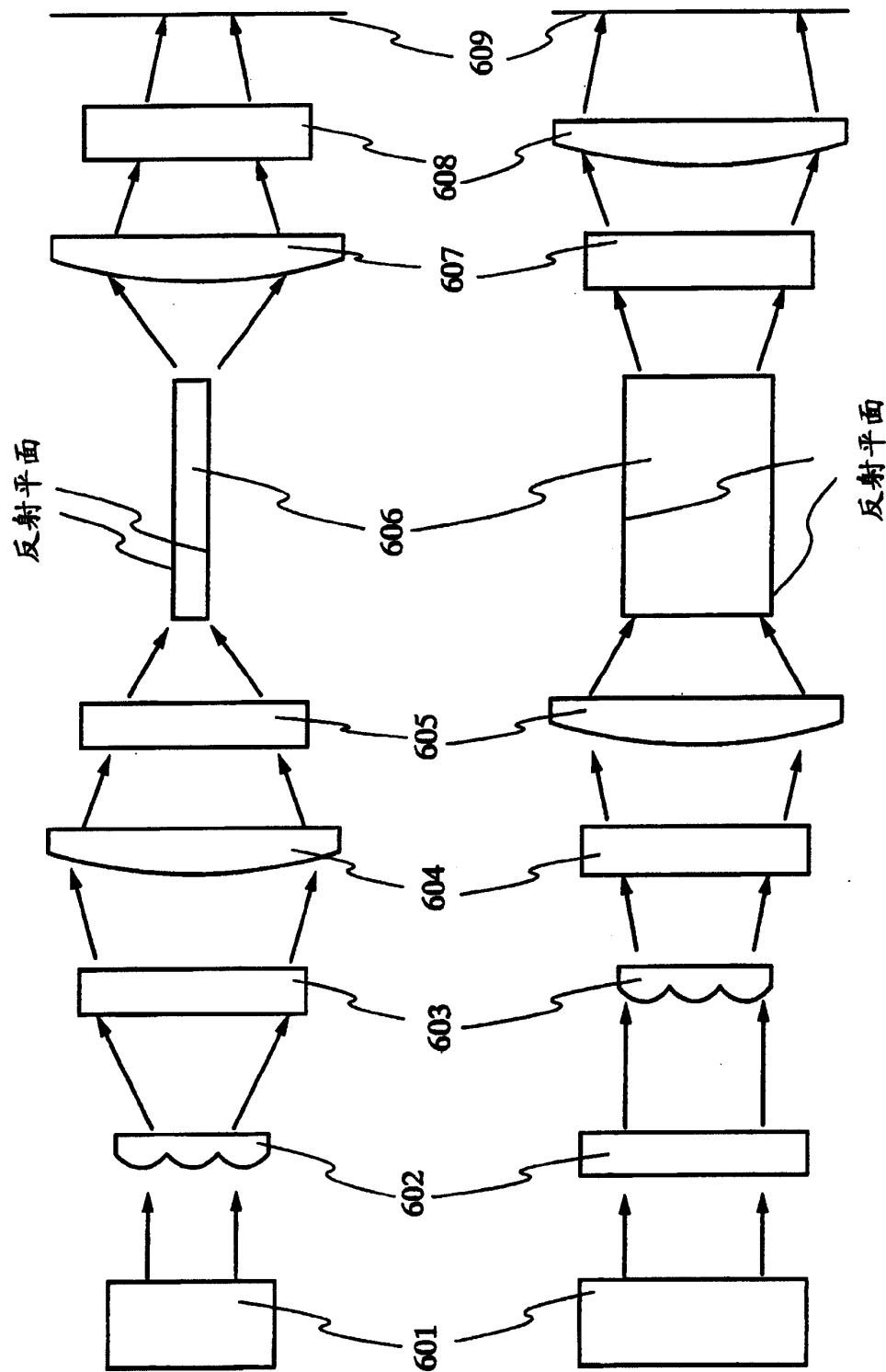


图 6A
侧视图

图 6B
俯视图

图 7A

强度分布不均匀的激光束

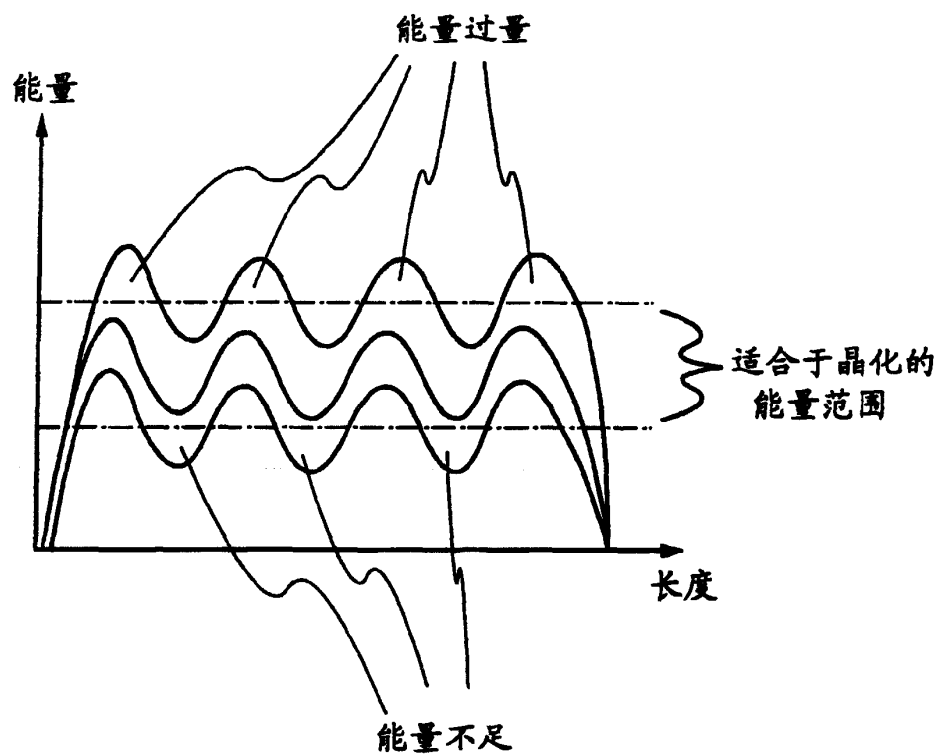
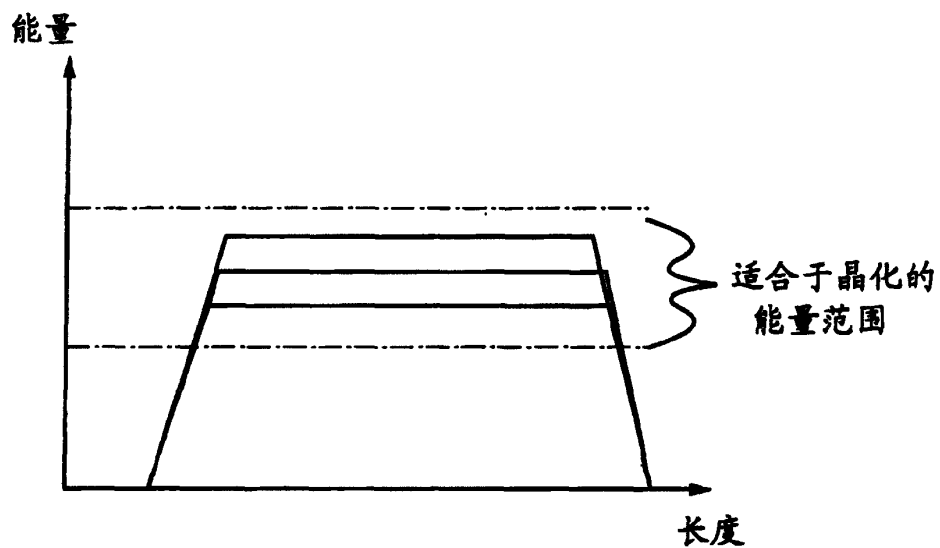


图 7B

强度分布均匀的激光束



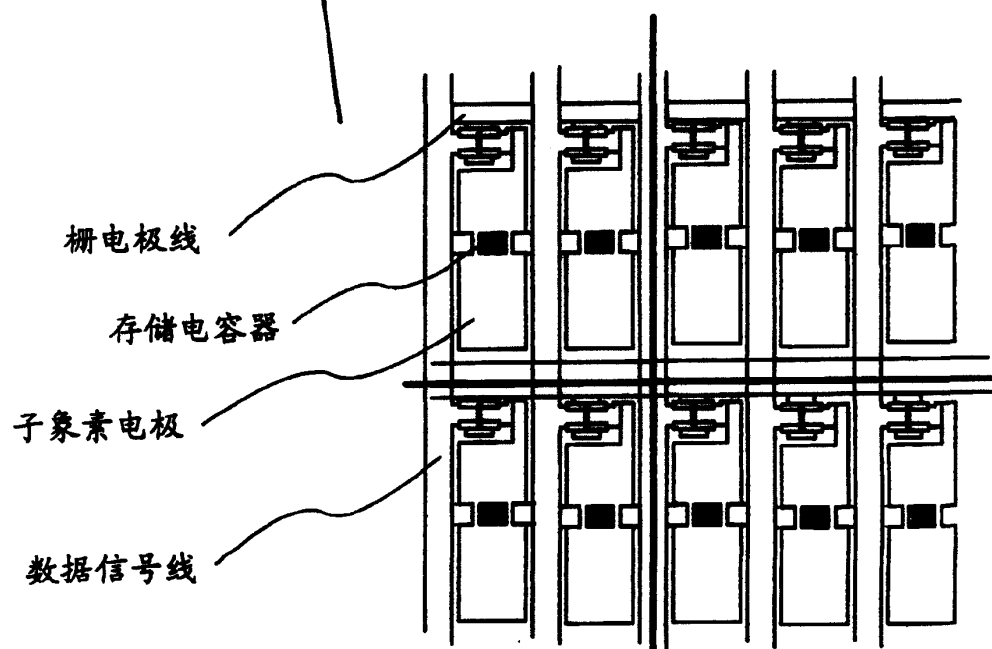
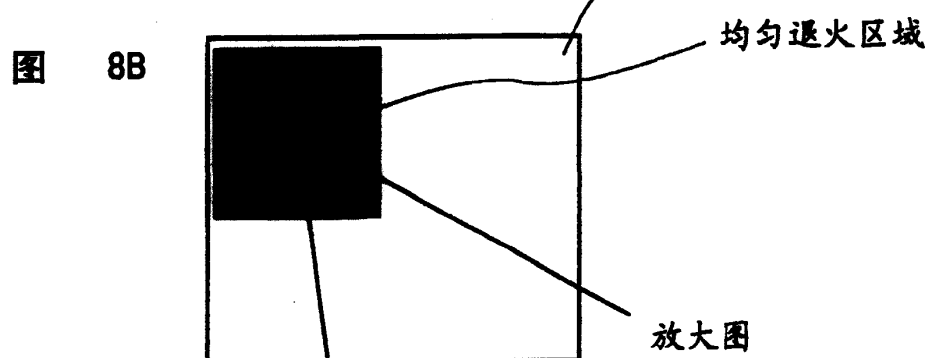
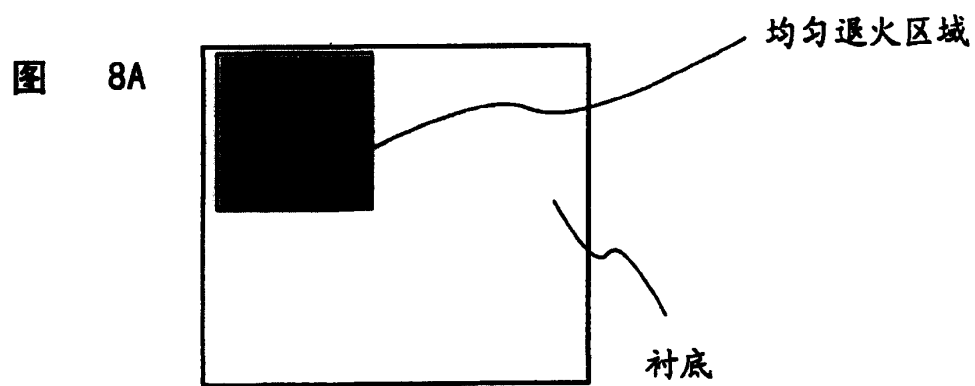


图 9A

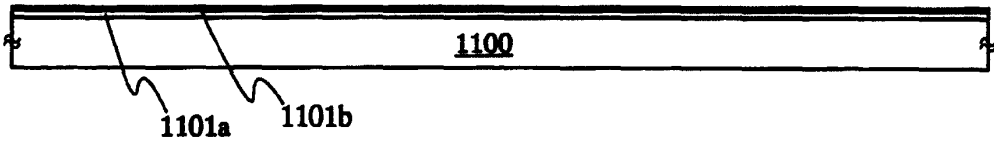


图 9B

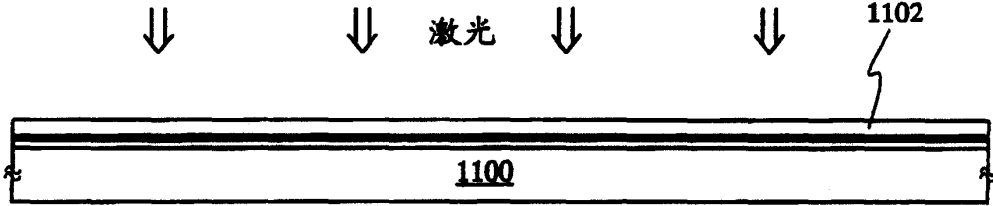


图 9C

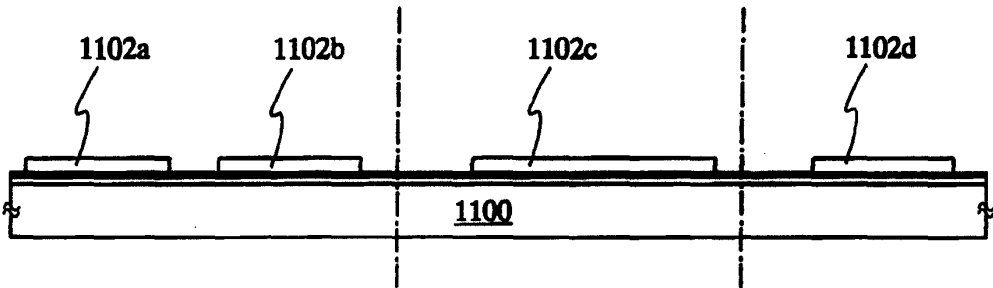


图 9D

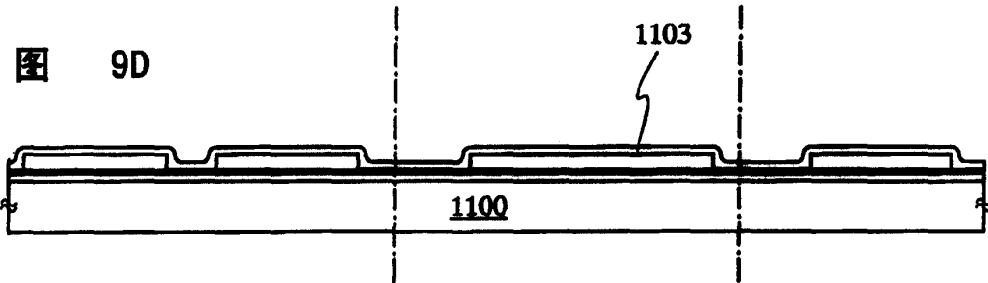


图 10A

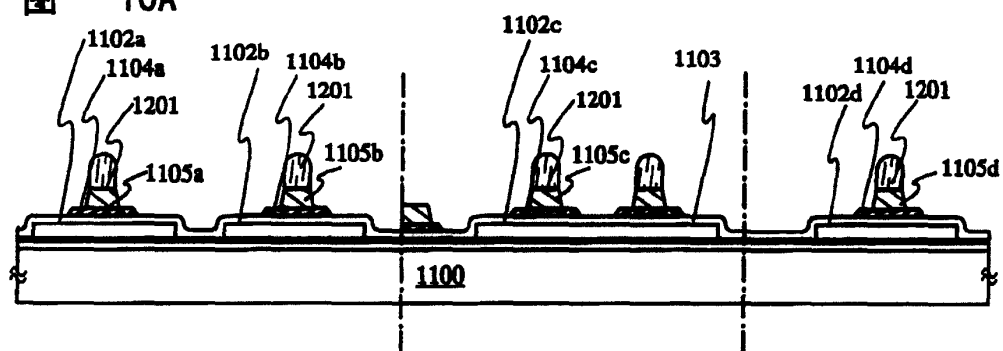


图 10B

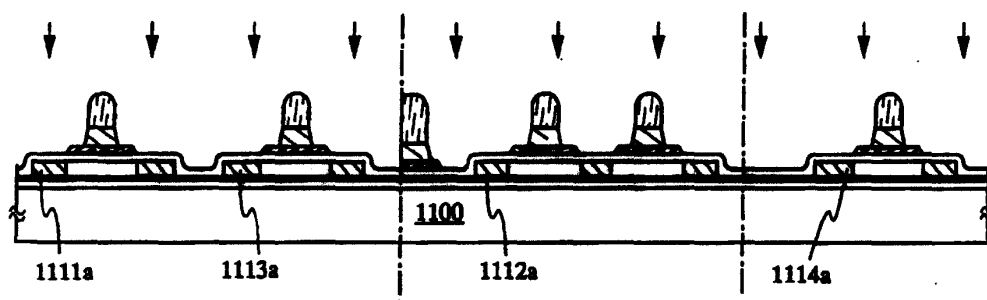


图 10C

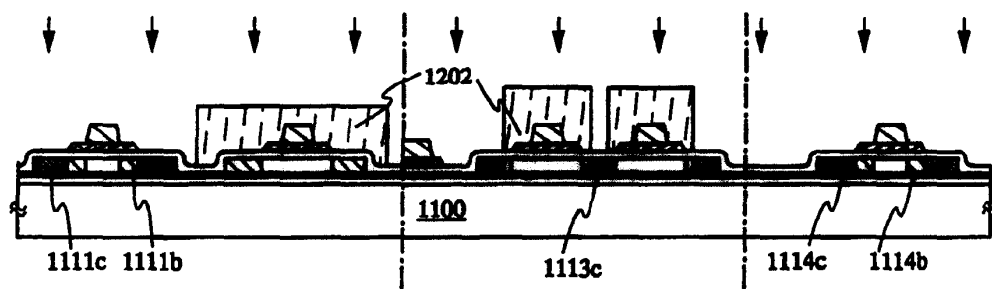
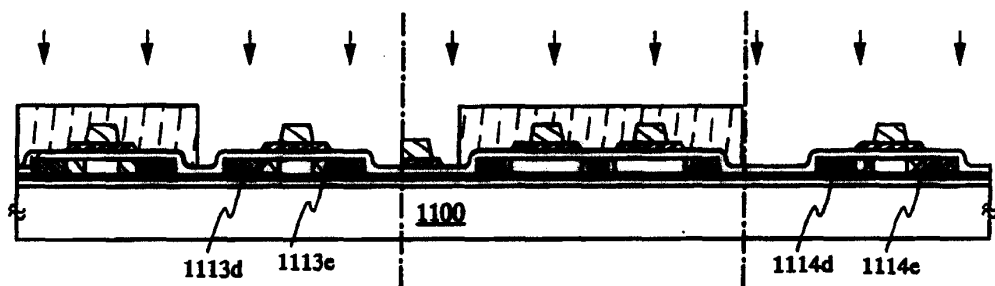


图 10D



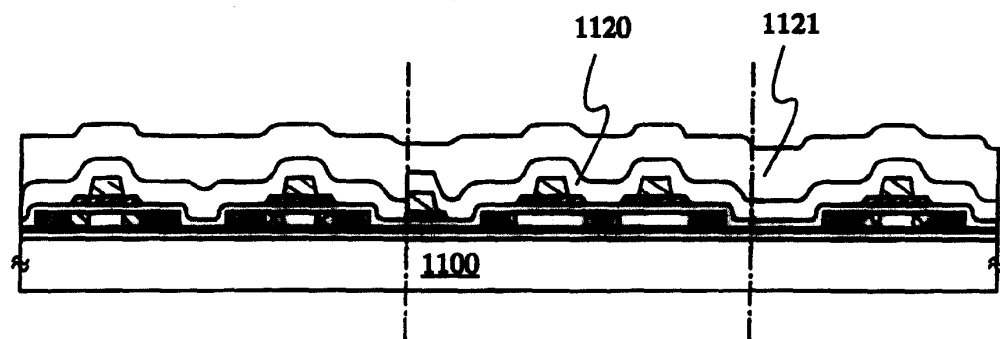


图 11A

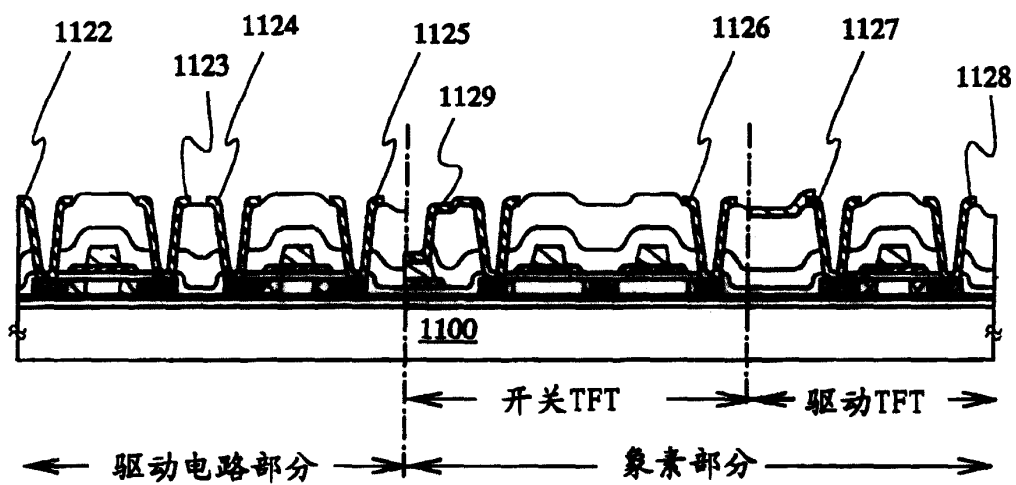


图 11B

图 12A

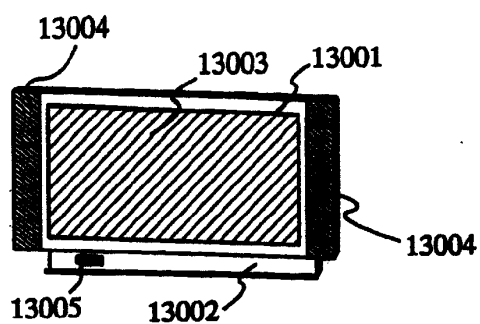


图 12B

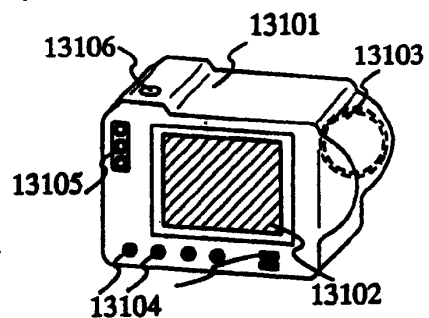


图 12C

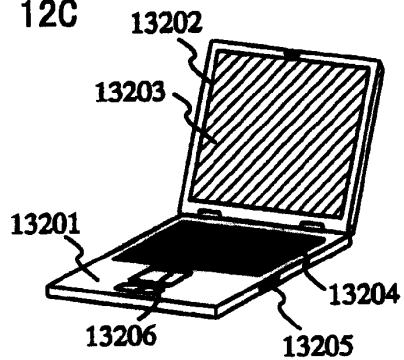


图 12D

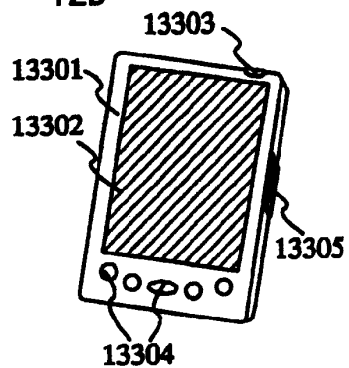


图 12E

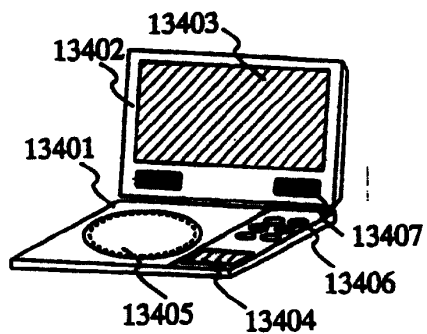


图 12F

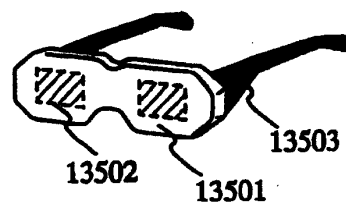


图 12G

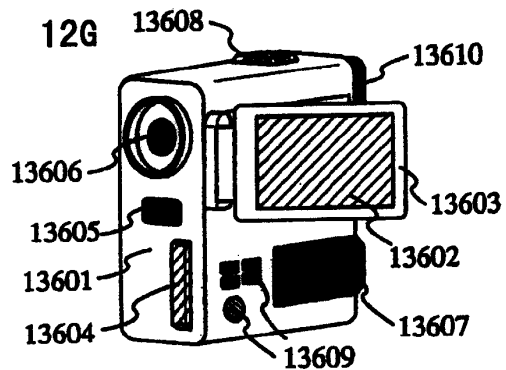
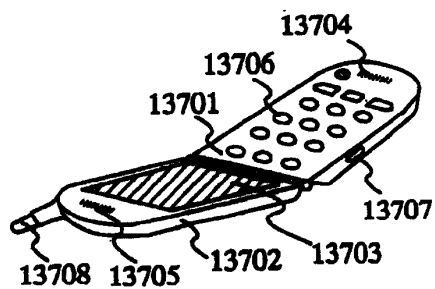


图 12H



Electronic Acknowledgement Receipt	
EFS ID:	23338654
Application Number:	14300138
International Application Number:	
Confirmation Number:	4091
Title of Invention:	Method and Arrangement for the Generation of a Laser Beam With Different Beam Profile Characteristics by Means of a Multi-Clad Fibre
First Named Inventor/Applicant Name:	Rudolf HUBER
Customer Number:	26161
Filer:	Yunbo Guo/Matthew Doherty
Filer Authorized By:	Yunbo Guo
Attorney Docket Number:	15540-0370002
Receipt Date:	28-AUG-2015
Filing Date:	09-JUN-2014
Time Stamp:	10:48:21
Application Type:	Utility under 35 USC 111(a)

Payment information:

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File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Information Disclosure Statement (IDS) Form (SB08)	IDS0370002rr.pdf	611952 0c0d5709b4360393e12514a082d09682cf9a5b49	no	4

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Information:

2	Foreign Reference	CN1580865.pdf	5093471 d8be21e6045ee8cc9310e4e7a98df5eaa085958d	no	34
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Substitute Disclosure Form U.S. Department of Commerce Patent and Trademark Office Information Disclosure Statement by Applicant (Use several sheets if necessary) (37 CFR §1.98(b))	Attorney Docket No. 15540-0370002	Application No. 14/300,138
	Applicant TRUMPF Laser- und Systemtechnik GmbH	
	Filing Date June 9, 2014	Group Art Unit 2883

U.S. Patent Documents							
Examiner Initial	Desig. ID	Document Number	Publication Date	Patentee	Class	Subclass	Filing Date If Appropriate
	1	5,461,682	1995-10-24	Nagel			
	2	5,461,692	1995-10-24	Nagel			
	3						
	4						
	5						
	6						
	7						
	8						
	9						
	10						
	11						

Foreign Patent Documents or Published Foreign Patent Applications								
Examiner Initial	Desig. ID	Document Number	Publication Date	Country or Patent Office	Class	Subclass	Translation	
							Yes	No
	12							
	13							
	14							
	15							
	16							

Other Documents (include Author, Title, Date, and Place of Publication)		
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	17	
	18	
	19	
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EFS ID:	23209647
Application Number:	14300138
International Application Number:	
Confirmation Number:	4091
Title of Invention:	Method and Arrangement for the Generation of a Laser Beam With Different Beam Profile Characteristics by Means of a Multi-Clad Fibre
First Named Inventor/Applicant Name:	Rudolf HUBER
Customer Number:	26161
Filer:	Yunbo Guo/Matthew Doherty
Filer Authorized By:	Yunbo Guo
Attorney Docket Number:	15540-0370002
Receipt Date:	14-AUG-2015
Filing Date:	09-JUN-2014
Time Stamp:	11:06:04
Application Type:	Utility under 35 USC 111(a)

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1	Transmittal Letter	Transmittal0370002.pdf	49567 4e3fb83ddb904f49c93350ce47fb82e20f04a0ac	no	1

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2	Information Disclosure Statement (IDS) Form (SB08)	1449_0370002.pdf	69295 60f496bb99443b3b53f5f388898d50ddbbf310bc	no	1
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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

First Named Inventor : Rudolph Huber Art Unit : 2883
Serial No. : 14/300,138 Examiner : Unknown
Filed : June 9, 2014
Title : METHOD AND ARRANGEMENT FOR GENERATING A LASER
BEAM HAVING A DIFFERING BEAM PROFILE
CHARACTERISTIC BY MEANS OF A MULTI-CLAD FIBER

MAIL STOP AMENDMENT

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

CORRECTIVE INFORMATION DISCLOSURE STATEMENT

Please consider the reference listed on the enclosed Disclosure Form. This is being filed to correctly list U.S. Patent No. 5,461,692, which was listed incorrectly on the information disclosure statement filed August 11, 2015.

This statement is being filed within three months of the filing date of the application or before the receipt of a first action on the merits.

Apply any necessary charges or credits to deposit account 06-1050, referencing the above attorney docket number.

Please contact the undersigned if there are any questions regarding this Statement.

Respectfully submitted,

Date: 8/13/2015

/Yunbo Guo/
Yunbo Guo
Reg. No. 70,538

Customer Number 26161
Fish & Richardson P.C.
Telephone: (512) 226-8108
Facsimile: (877) 769-7945

23425583.doc

Doc code: IDS

Doc description: Information Disclosure Statement (IDS) Filed

PTO/SB/08a (01-10)

Approved for use through 07/31/2012. OMB 0651-0031

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	Filing Date		2014-06-09	
	First Named Inventor	Rudolph Huber		
	Art Unit	2883		
	Examiner Name			
	Attorney Docket Number	15540-0370002		

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	2	7592568	B2	2009-09-22	Varnham et al			
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	Filing Date		2014-06-09
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number	14300138
	Filing Date	2014-06-09
	First Named Inventor	Rudolph Huber
	Art Unit	2883
	Examiner Name	
	Attorney Docket Number	15540-0370002

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

☐ That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

☐ See attached certification statement.

☐ The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Yunbo Guo/	Date (YYYY-MM-DD)	2015-08-11
Name/Print	Yunbo Guo	Registration Number	70538

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EFS ID:	23177882
Application Number:	14300138
International Application Number:	
Confirmation Number:	4091
Title of Invention:	Method and Arrangement for the Generation of a Laser Beam With Different Beam Profile Characteristics by Means of a Multi-Clad Fibre
First Named Inventor/Applicant Name:	Rudolf HUBER
Customer Number:	26161
Filer:	Yunbo Guo/Matthew Doherty
Filer Authorized By:	Yunbo Guo
Attorney Docket Number:	15540-0370002
Receipt Date:	11-AUG-2015
Filing Date:	09-JUN-2014
Time Stamp:	15:39:21
Application Type:	Utility under 35 USC 111(a)

Payment information:

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File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Information Disclosure Statement (IDS) Form (SB08)	IDS0370002bb.pdf	612207 23925dd2780ccfd5d500055ccc70fe17971c52b9	no	4

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National Stage of an International Application under 35 U.S.C. 371

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PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875				Application or Docket Number 14/300,138		Filing Date 06/09/2014		☐ To be Mailed		
ENTITY: ☒ LARGE ☐ SMALL ☐ MICRO										
APPLICATION AS FILED – PART I										
		(Column 1)		(Column 2)						
FOR		NUMBER FILED		NUMBER EXTRA		RATE (\$)		FEE (\$)		
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))		N/A		N/A		N/A				
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))		N/A		N/A		N/A				
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))		N/A		N/A		N/A				
TOTAL CLAIMS (37 CFR 1.16(i))		minus 20 =		*		X \$ =				
INDEPENDENT CLAIMS (37 CFR 1.16(h))		minus 3 =		*		X \$ =				
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))		If the specification and drawings exceed 100 sheets of paper, the application size fee due is \$310 (\$155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).								
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))										
* If the difference in column 1 is less than zero, enter "0" in column 2.						TOTAL				
APPLICATION AS AMENDED – PART II										
		(Column 1)		(Column 2)		(Column 3)				
AMENDMENT	07/24/2015		CLAIMS REMAINING AFTER AMENDMENT			HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE (\$)	ADDITIONAL FEE (\$)	
	Total (37 CFR 1.16(i))		* 33		Minus	** 33	= 0	X \$80 =	0	
	Independent (37 CFR 1.16(h))		* 3		Minus	***3	= 0	X \$420 =	0	
	☐ Application Size Fee (37 CFR 1.16(s))									
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))									
	TOTAL ADD'L FEE								0	
		(Column 1)		(Column 2)		(Column 3)				
AMENDMENT			CLAIMS REMAINING AFTER AMENDMENT			HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE (\$)	ADDITIONAL FEE (\$)	
	Total (37 CFR 1.16(i))		*		Minus	**	=	X \$ =		
	Independent (37 CFR 1.16(h))		*		Minus	***	=	X \$ =		
	☐ Application Size Fee (37 CFR 1.16(s))									
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))									
	TOTAL ADD'L FEE									
* If the entry in column 1 is less than the entry in column 2, write "0" in column 3. ** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20". *** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3". The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.										

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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
14/300,138	06/09/2014	Rudolf HUBER	15540-0370002

CONFIRMATION NO. 4091

NEW OR REVISED PPD NOTICE

26161
FISH & RICHARDSON P.C. (BO)
P.O. BOX 1022
MINNEAPOLIS, MN 55440-1022



NOTICE OF NEW OR REVISED PROJECTED PUBLICATION DATE

The above-identified application has a new or revised projected publication date. The current projected publication date for this application is 10/15/2015. If this is a new projected publication date (there was no previous projected publication date), the application has been cleared by Licensing & Review or a secrecy order has been rescinded and the application is now in the publication queue.

If this is a revised projected publication date (one that is different from a previously communicated projected publication date), the publication date has been revised due to processing delays in the USPTO or the abandonment and subsequent revival of an application. The application is anticipated to be published on a date that is more than six weeks different from the originally-projected publication date.

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Application	Document	Mailroom Date	Attorney Docket No.
14300138	NTC.PUB.DATE	07/10/2015	15540-0370002

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**DEPARTMENT OF DEFENSE
ACCESS ACKNOWLEDGEMENT / SECRECY ORDER RECOMMENDATION
FOR PATENT APPLICATION**

Application Serial No: DPI4300138

Date Referred: 06/10/2014

I hereby acknowledge that the Department of Defense reviewers have inspected this application in administration of 35 USC 181 on behalf of the Agencies/Commands specified below. DoD reviewers will not divulge any information from this application for any purpose other than administration of 35 USC 181.

Defense Agency	Recommendation	Reviewer Name	Date Reviewed
Army	Forwarded	Cynthia Britton	18 Jun 2014
ARL	Secrecy Not Recommended	Larry Burton	09 Jun 2015

Defense Agency	Reviewer Name	Date Viewed PDF
DTSA	Jennie Trinidad	18 Jun 2014 13:29

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DoD Completion of Review: Final
Forwarded to USPTO: 06/11/2015

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

First Named Inventor :	Rudolph Huber	Art Unit :	2883
Serial No. :	14/300,138	Examiner :	Unknown
Filed :	June 9, 2014		
Title :	METHOD AND ARRANGEMENT FOR GENERATING A LASER BEAM HAVING A DIFFERING BEAM PROFILE CHARACTERISTIC BY MEANS OF A MULTI-CLAD FIBER		

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

PRELIMINARY AMENDMENT

Prior to examination, please amend the application as indicated on the following pages.

Amendments to the Claims:

This listing of claims replaces all prior versions and listings of claims in the application:

Listing of Claims:

1-16. (Cancelled)

17. (New) A method comprising:

coupling an input laser beam into a fiber end of an optical fiber that has at least an inner fiber core and an outer ring core, wherein coupling an input laser beam comprises electively coupling the input laser beam into either the inner fiber core alone or both the inner fiber core and the outer ring core; and

generating an output laser beam by interaction of the input laser beam with the optical fiber, wherein a beam profile characteristic of the output laser beam differs depending upon the elective coupling.

18. (New) The method of claim 17, wherein electively coupling the input laser beam into the optical fiber comprises relative motion between the input laser beam and a coupling-side face of the optical fiber in a direction transverse to the input laser beam.

19. (New) The method of claim 17, wherein electively coupling the input laser beam into the optical fiber comprises altering a diameter of the input laser beam at a coupling-side face of the optical fiber.

20. (New) The method of claim 17, wherein electively coupling the input laser beam into both the inner fiber core and the outer ring core comprises dividing the input laser beam into

at least two sub-beams, each of which is coupled into one of the inner fiber core and the outer ring core of the optical fiber.

21. (New) The method of claim 17, wherein electively coupling the input laser beam into the optical fiber comprises adjusting the input laser beam by using an optical wedge plate configured to be adjusted continuously between two end positions.

22. (New) The method of claim 17, wherein the optical fiber is a multi-clad fiber comprising at least the inner fiber core, a first cladding surrounding the inner fiber core, the outer ring core, and a second cladding surrounding the outer ring core.

23. (New) A method comprising:
coupling an input laser beam into a fiber end of an optical fiber that has at least an inner fiber core and an outer ring core, wherein coupling an input laser beam comprises electively coupling the input laser beam into either the inner fiber core alone or the outer ring core alone;
and
generating an output laser beam by interaction of the input laser beam with the optical fiber, wherein a beam profile characteristic of the output laser beam differs depending upon the elective coupling.

24. (New) The method of claim 23, wherein electively coupling the input laser beam into the optical fiber comprises relative motion between the input laser beam and a coupling-side face of the optical fiber in a direction transverse to the input laser beam.

25. (New) The method of claim 23, wherein electively coupling the input laser beam into the optical fiber comprises altering a beam cross-section of the input laser beam at a coupling-side face of the optical fiber.

26. (New) The method of claim 23, wherein electively coupling the input laser beam into the optical fiber comprises adjusting the input laser beam by using an optical wedge plate configured to be adjusted continuously between two end positions.

27. (New) The method of claim 23, wherein the optical fiber is a multi-clad fiber comprising at least the inner fiber core, a first cladding surrounding the inner fiber core, the outer ring core, and a second cladding surrounding the outer ring core.

28. (New) A device for generating a laser beam with different beam profile characteristics, comprising:

- an optical fiber having an inner fiber core and at least one outer ring core; and
- a switchable coupling adjustment device configured to adjust a coupling of an input laser beam to a coupling-side face of the optical fiber between at least two switch positions, wherein in a first of the at least two switch positions the input laser beam is coupled into the inner fiber core alone and in a second of the at least two switch positions the input laser beam is coupled at least into the at least one outer ring core.

29. (New) The device of claim 28, wherein the switchable coupling adjustment device comprises at least one of:

- adjustable deflection optics that, in the at least two switch positions, deflect the input laser beam in a direction transverse to an axis of the coupling-side face to varying extents depending on the switch position, and

- a control device that, in the at least two switch positions, moves the coupling-side face of the optical fiber in a direction transverse to the input laser beam to varying extents depending on the switch position.

30. (New) The device of claim 29, wherein the adjustable deflection optics comprise an optical element configured to be positioned in the at least two different switch positions transverse to an optical axis of the input laser beam.

31. (New) The device of claim 30, wherein the optical element is configured to be arranged outside a beam path of the input laser beam in one of the at least two switch positions and is at least partially in the beam path of the input laser beam in another one of the at least two switch positions.

32. (New) The device of claim 31, wherein the optical element is formed by a beam divider configured to be moved into the input laser beam to divide the input laser beam into at least two sub-beams each of which is coupled into one of the cores of the optical fiber.

33. (New) The device of claim 32, wherein the beam divider is an optical wedge plate configured to be adjusted continuously between two end positions.

34. (New) The device of claim 28, wherein the switchable device comprises adjustable optics or an adjustable aperture that, in the at least two switch positions, project the input laser beam with different beam cross-sections or beam diameters, onto the coupling-side face of the optical fiber.

35. (New) The device of claim 34, wherein the adjustable optics is configured to be moved back and forth along an optical axis of the input laser beam between the at least two switch positions.

36. (New) The device of claim 28, wherein a maximum diameter of the inner fiber core of the optical fiber is approximately 200 μm or less.

37. (New) The device of claim 28, wherein a ring thickness of the at least one outer ring core of the optical fiber is no less than a diameter of the inner fiber core.

38. (New) The device of claim 28, wherein the optical fiber is a multi-clad fiber comprising at least the inner fiber core, a first cladding surrounding the inner fiber core, the outer ring core, and a second cladding surrounding the outer ring core.

First Named Inventor : Rudolph Huber
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Page : 6 of 7

Attorney's Docket No.: 15540-0370002 / 18.01127;
DS10502

39. (New) The device of claim 38, wherein, for the optical fiber, a numerical aperture of the first cladding is higher than a numerical aperture of the second cladding.

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Filed : June 9, 2014
Page : 7 of 7

Attorney's Docket No.: 15540-0370002 / 18.01127;
DS10502

REMARKS

Applicants ask that all claims be examined in view of the amendment to the claims. In addition, please apply any other necessary charges or credits to Deposit Account 06-1050, referencing the above attorney docket number.

Respectfully submitted,

Date: 04/10/2015

/Yunbo Guo/
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Doc code: IDS

Doc description: Information Disclosure Statement (IDS) Filed

PTO/SB/08a (01-10)

Approved for use through 07/31/2012. OMB 0651-0031

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	Filing Date		2014-06-09
	First Named Inventor	Rudolph Huber	
	Art Unit	2883	
	Examiner Name		
	Attorney Docket Number	15540-0370002	

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	3	4575181	A	1986-03-11	Ishikawa	
	4	5684642	A	1997-11-04	Zumoto et al	
	5	7372877	B2	2008-05-13	Shirakawa et al	
	6	7379237	B1	2008-05-27	Di Teodoro et al	
	7	7379648	B1	2008-05-27	Brooks et al	
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	Filing Date		2014-06-09	
	First Named Inventor	Rudolph Huber		
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	9	7738166	B2	2010-06-15	Murison et al	
	10	7809225	B2	2010-10-05	Bouma et al	
	11	7839902	B2	2010-11-23	Li et al	
	12	7933479	B2	2011-04-26	Gonthier et al	
	13	8076632	B2	2011-12-13	Kreysing et al	
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	First Named Inventor	Rudolph Huber		
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	Examiner Name			
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	3	20020172485	A1	2002-11-21	Keaton et al	
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	1	Extended European Search Report dated July 1, 2013.	☐
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	Filing Date	2014-06-09
	First Named Inventor	Rudolph Huber
	Art Unit	2883
	Examiner Name	
	Attorney Docket Number	15540-0370002

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Name/Print	Yunbo Guo	Registration Number	70538

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Electronic Patent Application Fee Transmittal				
Application Number:		14300138		
Filing Date:		09-Jun-2014		
Title of Invention:		Method and Arrangement for the Generation of a Laser Beam With Different Beam Profile Characteristics by Means of a Multi-Clad Fibre		
First Named Inventor/Applicant Name:		Rudolf HUBER		
Filer:		Yunbo Guo/Matthew Doherty		
Attorney Docket Number:		15540-0370002		
Filed as Large Entity				
Filing Fees for Utility under 35 USC 111(a)				
Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
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Claims in Excess of 20	1202	3	80	240
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Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Extension-of-Time:				
Miscellaneous:				
Total in USD (\$)				240

Electronic Acknowledgement Receipt	
EFS ID:	22026075
Application Number:	14300138
International Application Number:	
Confirmation Number:	4091
Title of Invention:	Method and Arrangement for the Generation of a Laser Beam With Different Beam Profile Characteristics by Means of a Multi-Clad Fibre
First Named Inventor/Applicant Name:	Rudolf HUBER
Customer Number:	26161
Filer:	Yunbo Guo/Matthew Doherty
Filer Authorized By:	Yunbo Guo
Attorney Docket Number:	15540-0370002
Receipt Date:	10-APR-2015
Filing Date:	09-JUN-2014
Time Stamp:	12:31:16
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	Deposit Account
Payment was successfully received in RAM	\$240
RAM confirmation Number	8704
Deposit Account	061050
Authorized User	
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:	

File Listing:					
Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		PrelimAmend0370002.pdf	66965	yes	7
			41a4e853aaaf2bb2ad334ba2ba4762fd4183bff6		
	Multipart Description/PDF files in .zip description				
	Document Description		Start	End	
	Preliminary Amendment		1	1	
	Claims		2	6	
	Applicant Arguments/Remarks Made in an Amendment		7	7	
Warnings:					
Information:					
2	Information Disclosure Statement (IDS) Form (SB08)	IDS0370002a.pdf	612976	no	6
			9f1345af556af213fcc5384acd12099f0fd24232		
Warnings:					
Information:					
3	Fee Worksheet (SB06)	fee-info.pdf	30655	no	2
			59aec0cea3bb31fa4eb39c51a7c5c7c2c0d32c54		
Warnings:					
Information:					
Total Files Size (in bytes):			710596		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875					Application or Docket Number 14/300,138		Filing Date 06/09/2014		☐ To be Mailed				
ENTITY: ☒ LARGE ☐ SMALL ☐ MICRO													
APPLICATION AS FILED – PART I													
(Column 1)			(Column 2)										
FOR		NUMBER FILED		NUMBER EXTRA		RATE (\$)		FEE (\$)					
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))		N/A		N/A		N/A							
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))		N/A		N/A		N/A							
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))		N/A		N/A		N/A							
TOTAL CLAIMS (37 CFR 1.16(j))		minus 20 =		*		X \$ =							
INDEPENDENT CLAIMS (37 CFR 1.16(h))		minus 3 =		*		X \$ =							
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))		If the specification and drawings exceed 100 sheets of paper, the application size fee due is \$310 (\$155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).											
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))													
* If the difference in column 1 is less than zero, enter "0" in column 2.						TOTAL							
APPLICATION AS AMENDED – PART II													
(Column 1)			(Column 2)			(Column 3)							
AMENDMENT	04/10/2015		CLAIMS REMAINING AFTER AMENDMENT			HIGHEST NUMBER PREVIOUSLY PAID FOR		PRESENT EXTRA		RATE (\$)		ADDITIONAL FEE (\$)	
	Total (37 CFR 1.16(i))		* 23		Minus	** 20		= 3		X \$80 =		240	
	Independent (37 CFR 1.16(h))		* 3		Minus	***3		= 0		X \$420 =		0	
	☐ Application Size Fee (37 CFR 1.16(s))												
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))												
	TOTAL ADD'L FEE											240	
(Column 1)			(Column 2)			(Column 3)							
AMENDMENT			CLAIMS REMAINING AFTER AMENDMENT			HIGHEST NUMBER PREVIOUSLY PAID FOR		PRESENT EXTRA		RATE (\$)		ADDITIONAL FEE (\$)	
	Total (37 CFR 1.16(i))		*		Minus	**		=		X \$ =			
	Independent (37 CFR 1.16(h))		*		Minus	***		=		X \$ =			
	☐ Application Size Fee (37 CFR 1.16(s))												
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))												
	TOTAL ADD'L FEE												
* If the entry in column 1 is less than the entry in column 2, write "0" in column 3. ** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20". *** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3". The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.											LIE /CHERYL CLARK/		

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
14/300,138	06/09/2014	Rudolf HUBER	15540-0370002

CONFIRMATION NO. 4091

POA ACCEPTANCE LETTER

26161
FISH & RICHARDSON P.C. (BO)
P.O. BOX 1022
MINNEAPOLIS, MN 55440-1022



Date Mailed: 12/11/2014

NOTICE OF ACCEPTANCE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 12/04/2014.

The Power of Attorney in this application is accepted. Correspondence in this application will be mailed to the above address as provided by 37 CFR 1.33.

/dtdinh/

Office of Data Management, Application Assistance Unit (571) 272-4000, or (571) 272-4200, or 1-888-786-0101

To: PATDOCTC@fr.com,,
From: PAIR_eOfficeAction@uspto.gov
Cc: PAIR_eOfficeAction@uspto.gov
Subject: Private PAIR Correspondence Notification for Customer Number 26161

Dec 11, 2014 05:21:05 AM

Dear PAIR Customer:

FISH & RICHARDSON P.C. (BO)
P.O. BOX 1022
MINNEAPOLIS, MN 55440-1022
UNITED STATES

The following USPTO patent application(s) associated with your Customer Number, 26161 , have new outgoing correspondence. This correspondence is now available for viewing in Private PAIR.

The official date of notification of the outgoing correspondence will be indicated on the form PTOL-90 accompanying the correspondence.

Disclaimer:

The list of documents shown below is provided as a courtesy and is not part of the official file wrapper. The content of the images shown in PAIR is the official record.

Application	Document	Mailroom Date	Attorney Docket No.
14300138	N570	12/11/2014	15540-0370002

To view your correspondence online or update your email addresses, please visit us anytime at <https://sportal.uspto.gov/secure/myportal/privatepair>.

If you have any questions, please email the Electronic Business Center (EBC) at EBC@uspto.gov with 'e-Office Action' on the subject line or call 1-866-217-9197 during the following hours:

Monday - Friday 6:00 a.m. to 12:00 a.m.

Thank you for prompt attention to this notice,

UNITED STATES PATENT AND TRADEMARK OFFICE
PATENT APPLICATION INFORMATION RETRIEVAL SYSTEM

TRANSMITTAL FOR POWER OF ATTORNEY TO ONE OR MORE REGISTERED PRACTITIONERS

Application Number	14/300,138		
Filing Date	June 9, 2014		
First Named Inventor	Rudolph Huber		
Title	METHOD AND ARRANGEMENT FOR GENERATING A LASER BEAM HAVING A DIFFERING BEAM PROFILE CHARACTERISTIC BY MEANS OF A MULTI-CLAD FIBER		
Art Unit	2883		
Examiner Name			
Attorney Docket Number	15540-0370002		
SIGNATURE of Applicant or Patent Practitioner			
Signature	/Yunbo Guo/	Date (Optional)	
Name	Yunbo Guo	Registration Number	70,538
Title (if Applicant is a juristic entity)			
Applicant Name (if Applicant is a juristic entity)			
NOTE: This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4(d) for signature requirements and certifications. If more than one applicant, use multiple forms.			
☒ *Total of <u> 1 </u> forms are submitted.			

23310864.doc

POWER OF ATTORNEY BY APPLICANT

I hereby revoke all previous powers of attorney given in the application identified in either the attached transmittal letter or the boxes below.

Application Number	Filing Date

(Note: The boxes above may be left blank if information is provided on form PTO/AIA/82A.)

- ☐ I hereby appoint the Patent Practitioner(s) associated with the following Customer Number as my/our attorney(s) or agent(s), and to transact all business in the United States Patent and Trademark Office connected therewith for the application referenced in the attached transmittal letter (form PTO/AIA/82A) or identified above:

26161

OR

- ☒ I hereby appoint Practitioner(s) named in the attached list (form PTO/AIA/82C) as my/our attorney(s) or agent(s), and to transact all business in the United States Patent and Trademark Office connected therewith for the patent application referenced in the attached transmittal letter (form PTO/AIA/82A) or identified above. (Note: Complete form PTO/AIA/82C.)

Please recognize or change the correspondence address for the application identified in the attached transmittal letter to:

- ☐ The address associated with the above-mentioned Customer Number

OR

- ☒ The address associated with Customer Number: **26161**

OR

Firm or Individual Name			
Address			
City	State	Zip	
Country			
Telephone	Email		

I am the Applicant (if the Applicant is a juristic entity, list the Applicant name in the box):

TRUMPF Laser- und Systemtechnik GmbH

- ☐ Inventor or Joint Inventor (title not required below)
- ☐ Legal Representative of a Deceased or Legally Incapacitated Inventor (title not required below)
- ☒ Assignee or Person to Whom the Inventor is Under an Obligation to Assign (provide signer's title if applicant is a juristic entity)
- ☐ Person Who Otherwise Shows Sufficient Proprietary Interest (e.g., a petition under 37 CFR 1.46(b)(2) was granted in the application or is concurrently being filed with this document) (provide signer's title if applicant is a juristic entity)

SIGNATURE of Applicant for Patent

The undersigned (whose title is supplied below) is authorized to act on behalf of the applicant (e.g., where the applicant is a juristic entity).

Signature		Date (Optional)	8.9.2014
Name	Dr. Klaus Parey		
Title	Manager Innovation Management + Technical Services TRUMPF Laser- und Systemtechnik GmbH		

NOTE: Signature - This form must be signed by the applicant in accordance with 37 CFR 1.33. See 37 CFR 1.4 for signature requirements and certifications. If more than one applicant, use multiple forms.

- ☒ *Total of 1 forms are submitted.

This collection of information is required by 37 CFR 1.131, 1.32, and 1.33. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 3 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

POWER OF ATTORNEY BY APPLICANT

No more than ten (10) patent practitioners total may be appointed as set forth below by name and registration number. This page need not be submitted if appointing the Patent Practitioner(s) associated with a Customer Number (see form PTO/AIA/82B):

Name	Registration Number
J. Peter Fasse	32,983
John F. Hayden	67,640
James W. Babineau	42,276
Michael R. Hamlin	54,149
Chris C. Bowley	55,016
Joseph Valentino	62,396
Matthew E. Browning	64,470
Yunbo Guo	70,538
Erin L. Baker	70,596

Electronic Acknowledgement Receipt	
EFS ID:	20865280
Application Number:	14300138
International Application Number:	
Confirmation Number:	4091
Title of Invention:	Method and Arrangement for the Generation of a Laser Beam With Different Beam Profile Characteristics by Means of a Multi-Clad Fibre
First Named Inventor/Applicant Name:	Rudolf HUBER
Customer Number:	67272
Filer:	Yunbo Guo/Matthew Doherty
Filer Authorized By:	Yunbo Guo
Attorney Docket Number:	4074-036-CON
Receipt Date:	04-DEC-2014
Filing Date:	09-JUN-2014
Time Stamp:	13:47:45
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no
------------------------	----

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Power of Attorney	POA0370002.pdf	254940	no	4
			535aa2713d6de43c305f34002ec83b6fd51e886f		

Warnings:

Information:

Total Files Size (in bytes):	254940
This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503. <u>New Applications Under 35 U.S.C. 111</u> If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application. <u>National Stage of an International Application under 35 U.S.C. 371</u> If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course. <u>New International Application Filed with the USPTO as a Receiving Office</u> If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.	



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY. DOCKET NO	TOT CLAIMS	IND CLAIMS
14/300,138	06/09/2014	2883	1600	4074-036-CON	16	3

CONFIRMATION NO. 4091

67272

Axinn Veltrop Harkrider LLP
114 West 47th Street
New York, NY 10036

FILING RECEIPT



OC000000069115945

Date Mailed: 06/20/2014

Receipt is acknowledged of this non-provisional patent application. The application will be taken up for examination in due course. Applicant will be notified as to the results of the examination. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF APPLICANT, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection. Please verify the accuracy of the data presented on this receipt. **If an error is noted on this Filing Receipt, please submit a written request for a Filing Receipt Correction. Please provide a copy of this Filing Receipt with the changes noted thereon. If you received a "Notice to File Missing Parts" for this application, please submit any corrections to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections**

Inventor(s)

Rudolf HUBER, Aldingen-Aixheim, GERMANY;
Wolfgang ANDREASCH, Weinstadt, GERMANY;

Applicant(s)

TRUMPF LASER- UND SYSTEMTECHNIK GMBH, Ditzingen, GERMANY

Assignment For Published Patent Application

TRUMPF LASER- UND SYSTEMTECHNIK GMBH, Ditzingen, GERMANY

Power of Attorney: None

Domestic Priority data as claimed by applicant

This application is a CON of 13/639,401 12/20/2012
which is a 371 of PCT/EP2011/055484 04/08/2011

Foreign Applications (You may be eligible to benefit from the **Patent Prosecution Highway** program at the USPTO. Please see <http://www.uspto.gov> for more information.)
GERMANY 10 2010 003 750.8 04/08/2010

Permission to Access - A proper **Authorization to Permit Access to Application by Participating Offices** (PTO/SB/39 or its equivalent) has been received by the USPTO.

Projected Publication Date: To Be Determined - pending completion of Security Review

Non-Publication Request: No

Early Publication Request: No

Title

Method and Arrangement for the Generation of a Laser Beam With Different Beam Profile Characteristics by Means of a Multi-Clad Fibre

Preliminary Class

385

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications: No

PROTECTING YOUR INVENTION OUTSIDE THE UNITED STATES

Since the rights granted by a U.S. patent extend only throughout the territory of the United States and have no effect in a foreign country, an inventor who wishes patent protection in another country must apply for a patent in a specific country or in regional patent offices. Applicants may wish to consider the filing of an international application under the Patent Cooperation Treaty (PCT). An international (PCT) application generally has the same effect as a regular national patent application in each PCT-member country. The PCT process **simplifies** the filing of patent applications on the same invention in member countries, but **does not result** in a grant of "an international patent" and does not eliminate the need of applicants to file additional documents and fees in countries where patent protection is desired.

Almost every country has its own patent law, and a person desiring a patent in a particular country must make an application for patent in that country in accordance with its particular laws. Since the laws of many countries differ in various respects from the patent law of the United States, applicants are advised to seek guidance from specific foreign countries to ensure that patent rights are not lost prematurely.

Applicants also are advised that in the case of inventions made in the United States, the Director of the USPTO must issue a license before applicants can apply for a patent in a foreign country. The filing of a U.S. patent application serves as a request for a foreign filing license. The application's filing receipt contains further information and guidance as to the status of applicant's license for foreign filing.

Applicants may wish to consult the USPTO booklet, "General Information Concerning Patents" (specifically, the section entitled "Treaties and Foreign Patents") for more information on timeframes and deadlines for filing foreign patent applications. The guide is available either by contacting the USPTO Contact Center at 800-786-9199, or it can be viewed on the USPTO website at <http://www.uspto.gov/web/offices/pac/doc/general/index.html>.

For information on preventing theft of your intellectual property (patents, trademarks and copyrights), you may wish to consult the U.S. Government website, <http://www.stopfakes.gov>. Part of a Department of Commerce initiative, this website includes self-help "toolkits" giving innovators guidance on how to protect intellectual property in specific countries such as China, Korea and Mexico. For questions regarding patent enforcement issues, applicants may call the U.S. Government hotline at 1-866-999-HALT (1-866-999-4258).

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Title 35, United States Code, Section 184
Title 37, Code of Federal Regulations, 5.11 & 5.15

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This license is to be retained by the licensee and may be used at any time on or after the effective date thereof unless it is revoked. This license is automatically transferred to any related applications(s) filed under 37 CFR 1.53(d). This license is not retroactive.

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NOT GRANTED

No license under 35 U.S.C. 184 has been granted at this time, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" DOES NOT appear on this form. Applicant may still petition for a license under 37 CFR 5.12, if a license is desired before the expiration of 6 months from the filing date of the application. If 6 months has lapsed from the filing date of this application and the licensee has not received any indication of a secrecy order under 35 U.S.C. 181, the licensee may foreign file the application pursuant to 37 CFR 5.15(b).

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PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875						Application or Docket Number 14/300,138				
APPLICATION AS FILED - PART I										
(Column 1)		(Column 2)		SMALL ENTITY		OTHER THAN SMALL ENTITY				
FOR	NUMBER FILED	NUMBER EXTRA	RATE(\$)	FEE(\$)		RATE(\$)	FEE(\$)			
BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A			N/A	280			
SEARCH FEE (37 CFR 1.16(k), (l), or (m))	N/A	N/A	N/A			N/A	600			
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A			N/A	720			
TOTAL CLAIMS (37 CFR 1.16(j))	16	minus 20 = *			OR	x 80 =	0.00			
INDEPENDENT CLAIMS (37 CFR 1.16(h))	3	minus 3 = *			OR	x 420 =	0.00			
APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is \$310 (\$155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).						0.00			
MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))							0.00			
* If the difference in column 1 is less than zero, enter "0" in column 2.				TOTAL		TOTAL	1600			
APPLICATION AS AMENDED - PART II										
(Column 1)		(Column 2)		(Column 3)		SMALL ENTITY		OTHER THAN SMALL ENTITY		
AMENDMENT A		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE(\$)	ADDITIONAL FEE(\$)		RATE(\$)	ADDITIONAL FEE(\$)
	Total (37 CFR 1.16(i))	*	Minus	**	=	x	=	OR	x	=
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x	=	OR	x	=
	Application Size Fee (37 CFR 1.16(s))							OR		
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
TOTAL ADD'L FEE								OR	TOTAL ADD'L FEE	
AMENDMENT B		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE(\$)	ADDITIONAL FEE(\$)		RATE(\$)	ADDITIONAL FEE(\$)
	Total (37 CFR 1.16(i))	*	Minus	**	=	x	=	OR	x	=
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x	=	OR	x	=
	Application Size Fee (37 CFR 1.16(s))							OR		
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
TOTAL ADD'L FEE								OR	TOTAL ADD'L FEE	
* If the entry in column 1 is less than the entry in column 2, write "0" in column 3. ** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20". *** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3". The "Highest Number Previously Paid For" (Total or Independent) is the highest found in the appropriate box in column 1.										

To: patents@AVHLAW.COM,,
From: PAIR_eOfficeAction@uspto.gov
Cc: PAIR_eOfficeAction@uspto.gov
Subject: Private PAIR Correspondence Notification for Customer Number 67272

Jun 20, 2014 05:19:17 AM

Dear PAIR Customer:

Axinn Veltrop Harkrider LLP
114 West 47th Street
New York, NY 10036
UNITED STATES

The following USPTO patent application(s) associated with your Customer Number, 67272 , have new outgoing correspondence. This correspondence is now available for viewing in Private PAIR.

The official date of notification of the outgoing correspondence will be indicated on the form PTOL-90 accompanying the correspondence.

Disclaimer:

The list of documents shown below is provided as a courtesy and is not part of the official file wrapper. The content of the images shown in PAIR is the official record.

Application	Document	Mailroom Date	Attorney Docket No.
14300138	APP.FILE.REC	06/20/2014	4074-036-CON

To view your correspondence online or update your email addresses, please visit us anytime at <https://sportal.uspto.gov/secure/myportal/privatepair>.

If you have any questions, please email the Electronic Business Center (EBC) at EBC@uspto.gov with 'e-Office Action' on the subject line or call 1-866-217-9197 during the following hours:

Monday - Friday 6:00 a.m. to 12:00 a.m.

Thank you for prompt attention to this notice,

UNITED STATES PATENT AND TRADEMARK OFFICE
PATENT APPLICATION INFORMATION RETRIEVAL SYSTEM

UTILITY PATENT APPLICATION TRANSMITTAL <i>(Only for new nonprovisional applications under 37 CFR 1.53(b))</i>	Attorney Docket No. 4074-036-CON	
	First Named Inventor Rudolf Huber	
	Title Method and Arrangement for the Generation of a Laser Beam With Different Beam Profiles	
	Express Mail Label No.	

APPLICATION ELEMENTS <i>See MPEP chapter 600 concerning utility patent application contents.</i>	Commissioner for Patents P.O. Box 1450 Alexandria, VA 22313-1450
1. ☐ Fee Transmittal Form (PTO/SB/17 or equivalent) 2. ☐ Applicant asserts small entity status. See 37 CFR 1.27 3. ☐ Applicant certifies micro entity status. See 37 CFR 1.29. Applicant must attach form PTO/SB/15A or B or equivalent. 4. ☒ Specification [Total Pages <u>18</u>] Both the claims and abstract must start on a new page. (See MPEP § 608.01(a) for information on the preferred arrangement) 5. ☒ Drawing(s) (35 U.S.C. 113) [Total Sheets <u>5</u>] 6. ☒ Inventor's Oath or Declaration [Total Pages <u>4</u>] (including substitute statements under 37 CFR 1.64 and assignments serving as an oath or declaration under 37 CFR 1.63(e)) a. ☐ Newly executed (original or copy) b. ☒ A copy from a prior application (37 CFR 1.63(d)) 7. ☒ Application Data Sheet * See note below. See 37 CFR 1.76 (PTO/AIA/14 or equivalent) 8. ☐ CD-ROM or CD-R in duplicate, large table, or Computer Program (Appendix) ☐ Landscape Table on CD 9. Nucleotide and/or Amino Acid Sequence Submission (if applicable, items a. – c. are required) a. ☐ Computer Readable Form (CRF) b. ☐ Specification Sequence Listing on: i. ☐ CD-ROM or CD-R (2 copies); or ii. ☐ Paper c. ☐ Statements verifying identity of above copies	ACCOMPANYING APPLICATION PAPERS 10. ☐ Assignment Papers (cover sheet & document(s)) Name of Assignee _____ 11. ☐ 37 CFR 3.73(c) Statement ☐ Power of Attorney (when there is an assignee) 12. ☐ English Translation Document (if applicable) 13. ☐ Information Disclosure Statement (PTO/SB/08 or PTO-1449) ☐ Copies of citations attached 14. ☐ Preliminary Amendment 15. ☐ Return Receipt Postcard (MPEP § 503) (Should be specifically itemized) 16. ☐ Certified Copy of Priority Document(s) (if foreign priority is claimed) 17. ☐ Nonpublication Request Under 35 U.S.C. 122(b)(2)(B)(i). Applicant must attach form PTO/SB/35 or equivalent. 18. ☐ Other: _____ _____ _____ _____

***Note:** (1) Benefit claims under 37 CFR 1.78 and foreign priority claims under 1.55 **must** be included in an Application Data Sheet (ADS).
(2) For applications filed under 35 U.S.C. 111, the application must contain an ADS specifying the applicant if the applicant is an assignee, person to whom the inventor is under an obligation to assign, or person who otherwise shows sufficient proprietary interest in the matter. See 37 CFR 1.46(b).

19. CORRESPONDENCE ADDRESS				
☒ The address associated with Customer Number: <u>67272</u> OR ☐ Correspondence address below				
Name				
Address				
City	State	Zip Code		
Country	Telephone	Email		
Signature	/Michael D. Bednarek/		Date	2014-06-09
Name (Print/Type)	Michael D. Bednarek		Registration No. (Attorney/Agent)	32,329

This collection of information is required by 37 CFR 1.53(b). The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Privacy Act Statement

The **Privacy Act of 1974 (P.L. 93-579)** requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (*i.e.*, GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Document Description: Oath or declaration filed

PTO/SB/01 (09-12)

Approved for use through 01/31/2014. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

DECLARATION FOR UTILITY OR DESIGN PATENT APPLICATION (37 CFR 1.63)		Attorney Docket Number	4074-036
		First Named Inventor	Rudolf HUBER
☐ Declaration Submitted With Initial Filing OR ☒ Declaration Submitted After Initial Filing (surcharge (37 CFR 1.16(f)) required)		<i>COMPLETE IF KNOWN</i>	
		Application Number	13/639,401
		Filing Date	10/04/2012
		Art Unit	TBD
		Examiner Name	TBD

I hereby declare that: (1) Each inventor's residence, mailing address, and citizenship are as stated below next to their name; and (2) I believe the inventor(s) named below to be the original and first inventor(s) of the subject matter which is claimed and for which a patent is sought on the invention titled:

Method And Arrangement For Generating A Laser Beam Having A Differing Beam Profile Characteristic By Means Of A Multi-Clad Fiber

(Title of the Invention)

the application of which was made or was authorized to be made by me and

☐ is attached hereto

OR

☒ was filed on (MM/DD/YYYY) 10/04/2012 as United States Application Number or PCT International Application Number 13/639,401 and was amended on (MM/DD/YYYY) _____ (if applicable).

I hereby state that I have reviewed and understand the contents of the above identified application, including the claims, as amended by any amendment specifically referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56, including for continuation-in-part applications, material information which became available between the filing date of the prior application and the national or PCT international filing date of the continuation-in-part application.

Authorization To Permit Access To Application by Participating Offices

☒ If checked, the undersigned hereby grants the USPTO authority to provide the European Patent Office (EPO), the Japan Patent Office (JPO), the Korean Intellectual Property Office (KIPO), the World Intellectual Property Office (WIPO), and any other intellectual property offices in which a foreign application claiming priority to the above-identified patent application is filed access to the above-identified patent application. See 37 CFR 1.14(c) and (h). This box should not be checked if the applicant does not wish the EPO, JPO, KIPO, WIPO, or other intellectual property office in which a foreign application claiming priority to the above-identified patent application is filed to have access to the above-identified patent application.

In accordance with 37 CFR 1.14(h)(3), access will be provided to a copy of the above-identified patent application with respect to: 1) the above-identified patent application-as-filed; 2) any foreign application to which the above-identified patent application claims priority under 35 U.S.C. 119(a)-(d) if a copy of the foreign application that satisfies the certified copy requirement of 37 CFR 1.55 has been filed in the above-identified patent application; and 3) any U.S. application-as-filed from which benefit is sought in the above-identified patent application.

In accordance with 37 CFR 1.14(c), access may be provided to information concerning the date of filing the Authorization to Permit Access to Application by Participating Offices.

[Page 1 of 3]

This collection of information is required by 35 U.S.C. 115 and 37 CFR 1.63. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 21 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

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DECLARATION — Utility or Design Patent Application

Claim of Foreign Priority Benefits

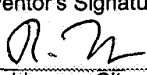
I hereby claim foreign priority benefits under 35 U.S.C. 119(a)-(d) or (f), or 365(b) of any foreign application(s) for patent, inventor's or plant breeder's rights certificate(s), or 365(a) of any PCT international application which designated at least one country other than the United States of America, listed below and have also identified below, by checking the box, any foreign application for patent, inventor's or plant breeder's rights certificate(s), or any PCT international application having a filing date before that of the application on which priority is claimed.

Prior Foreign Application Number(s)	Country	Foreign Filing Date (MM/DD/YYYY)	Priority Not Claimed	Certified Copy Attached?	
				YES	NO
10 2010 003 750.8	DE	04/08/2010	☐	☐	☒
PCT/EP2011/055484	WO	04/08/2011	☐	☐	☒
			☐	☐	☐
			☐	☐	☐

☐ Additional foreign application number(s) are listed on a supplemental priority data sheet PTO/SB/02B attached hereto.

[Page 2 of 3]

DECLARATION — Utility or Design Patent Application

Direct all correspondence to: ☒		The address associated with Customer Number: 67272		OR ☐ Correspondence address below	
Name					
Address					
City		State		Zip	
Country		Telephone		Email	
WARNING: Petitioner/applicant is cautioned to avoid submitting personal information in documents filed in a patent application that may contribute to identity theft. Personal information such as social security numbers, bank account numbers, or credit card numbers (other than a check or credit card authorization form PTO-2038 submitted for payment purposes) is never required by the USPTO to support a petition or an application. If this type of personal information is included in documents submitted to the USPTO, petitioners/applicants should consider redacting such personal information from the documents before submitting them to the USPTO. Petitioner/applicant is advised that the record of a patent application is available to the public after publication of the application (unless a non-publication request in compliance with 37 CFR 1.213(a) is made in the application) or issuance of a patent. Furthermore, the record from an abandoned application may also be available to the public if the application is referenced in a published application or an issued patent (see 37 CFR 1.14). Checks and credit card authorization forms PTO-2038 submitted for payment purposes are not retained in the application file and therefore are not publicly available.					
I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C. 1001 and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.					
I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both.					
NAME OF SOLE OR FIRST INVENTOR:		☐ A petition has been filed for this unsigned inventor			
Given Name (first and middle (if any))		Family Name or Surname			
Rudolf		HUBER			
Inventor's Signature			Date		
			04.12.2012		
Residence: City	State	Country		Citizenship	
Aldingen-Aixheim		DE		DE	
Mailing Address					
Albstrasse 31					
City	State	Zip		Country	
Aldingen-Aixheim		D-78554		DE	
☒ Additional inventors or a legal representative are being named on the <u>1</u> supplemental sheet(s) PTO/SB/02A or 02LR attached hereto					

DECLARATION	ADDITIONAL INVENTOR(S) Supplemental Sheet
Page 1 of 1	

Name of Additional Joint Inventor, if any:		☐ A petition has been filed for this unsigned inventor	
Given Name (first and middle (if any))		Family Name or Surname	
Wolfgang		ANDREASCH	
Inventor's Signature <i>Wolfgang Andreasch</i>		Date 06.12.2012	
Weinstadt Residence: City	State	DE Country	DE Citizenship
Weinbergstrasse 2/1			
Mailing Address			
Weinstadt City	State	D-71384 Zip	DE Country
Name of Additional Joint Inventor, if any:		☐ A petition has been filed for this unsigned inventor	
Given Name (first and middle (if any))		Family Name or Surname	
Martin		HUONKER	
Inventor's Signature <i>MH</i>		Date 12/14/12	
Dietingen Residence: City	State	DE Country	DE Citizenship
Einsteinweg 24			
Mailing Address			
Dietingen City	State	78661 Zip	DE Country
Name of Additional Joint Inventor, if any:		☐ A petition has been filed for this unsigned inventor	
Given Name (first and middle (if any))		Family Name or Surname	
Inventor's Signature		Date	
Residence: City	State	Country	Citizenship
Mailing Address			
City	State	Zip	Country

This collection of information is required by 35 U.S.C. 115 and 37 CFR 1.63. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 21 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

If you need assistance in completing the form, call 1-800-PTO-9199 (1-800-786-9199) and select option 2.

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	4074-036-CON
		Application Number	
Title of Invention	Method and Arrangement for the Generation of a Laser Beam With Different Beam Profile Characteristics by Means of a Multi-Clad Fibre		
The application data sheet is part of the provisional or nonprovisional application for which it is being submitted. The following form contains the bibliographic data arranged in a format specified by the United States Patent and Trademark Office as outlined in 37 CFR 1.76. This document may be completed electronically and submitted to the Office in electronic format using the Electronic Filing System (EFS) or the document may be printed and included in a paper filed application.			

Secrecy Order 37 CFR 5.2

☐ Portions or all of the application associated with this Application Data Sheet may fall under a Secrecy Order pursuant to 37 CFR 5.2 (Paper filers only. Applications that fall under Secrecy Order may not be filed electronically.)

Inventor Information:

Inventor 1					Remove
Legal Name					
Prefix	Given Name	Middle Name	Family Name	Suffix	
	Rudolf		HUBER		
Residence Information (Select One) ☐ US Residency ☒ Non US Residency ☐ Active US Military Service					
City	Aldingen-Aixheim	Country of Residence i	DE		
Mailing Address of Inventor:					
Address 1	Albstrasse 31				
Address 2					
City	Aldingen-Aixheim	State/Province			
Postal Code	D-78554	Country i	DE		
Inventor 2					Remove
Legal Name					
Prefix	Given Name	Middle Name	Family Name	Suffix	
	Wolfgang		ANDREASCH		
Residence Information (Select One) ☐ US Residency ☒ Non US Residency ☐ Active US Military Service					
City	Weinstadt	Country of Residence i	DE		
Mailing Address of Inventor:					
Address 1	Weinbergstrasse 2/1				
Address 2					
City	Weinstadt	State/Province			
Postal Code	D-71384	Country i	DE		
All Inventors Must Be Listed - Additional Inventor Information blocks may be generated within this form by selecting the Add button.					Add

Correspondence Information:

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	4074-036-CON	
		Application Number		
Title of Invention	Method and Arrangement for the Generation of a Laser Beam With Different Beam Profile Characteristics by Means of a Multi-Clad Fibre			
Enter either Customer Number or complete the Correspondence Information section below. For further information see 37 CFR 1.33(a).				
☐ An Address is being provided for the correspondence information of this application.				
Customer Number	67272			
Email Address	patents@avhlaw.com		Add Email	Remove Email

Application Information:

Title of the Invention	Method and Arrangement for the Generation of a Laser Beam With Different Beam Profile Characteristics by Means of a Multi-Clad Fibre		
Attorney Docket Number	4074-036-CON	Small Entity Status Claimed	☐
Application Type	Nonprovisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)	5	Suggested Figure for Publication (if any)	
Filing By Reference : Only complete this section when filing an application by reference under 35 U.S.C. 111(c) and 37 CFR 1.57(a). Do not complete this section if application papers including a specification and any drawings are being filed. Any domestic benefit or foreign priority information must be provided in the appropriate section(s) below (i.e., "Domestic Benefit/National Stage Information" and "Foreign Priority Information"). For the purposes of a filing date under 37 CFR 1.53(b), the description and any drawings of the present application are replaced by this reference to the previously filed application, subject to conditions and requirements of 37 CFR 1.57(a).			
Application number of the previously filed application	Filing date (YYYY-MM-DD)	Intellectual Property Authority or Country	

Publication Information:

☐ Request Early Publication (Fee required at time of Request 37 CFR 1.219)
☐ Request Not to Publish. I hereby request that the attached application not be published under 35 U.S.C. 122(b) and certify that the invention disclosed in the attached application has not and will not be the subject of an application filed in another country, or under a multilateral international agreement, that requires publication at eighteen months after filing.

Representative Information:

Representative information should be provided for all practitioners having a power of attorney in the application. Providing this information in the Application Data Sheet does not constitute a power of attorney in the application (see 37 CFR 1.32). Either enter Customer Number or complete the Representative Name section below. If both sections are completed the customer Number will be used for the Representative Information during processing.			
Please Select One: ☒ Customer Number ☐ US Patent Practitioner ☐ Limited Recognition (37 CFR 11.9)			
Customer Number	67272		

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	4074-036-CON
		Application Number	
Title of Invention	Method and Arrangement for the Generation of a Laser Beam With Different Beam Profile Characteristics by Means of a Multi-Clad Fibre		

Domestic Benefit/National Stage Information:

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121, or 365(c) or indicate National Stage entry from a PCT application. Providing this information in the application data sheet constitutes the specific reference required by 35 U.S.C. 119(e) or 120, and 37 CFR 1.78.

When referring to the current application, please leave the application number blank.

Prior Application Status	Pending	Remove	
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)
	Continuation of	13/639401	2012-12-20
Prior Application Status	Pending	Remove	
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)
13/639401	a 371 of international	PCT/EP2011/055484	2011-04-08
Additional Domestic Benefit/National Stage Data may be generated within this form by selecting the Add button.			Add

Foreign Priority Information:

This section allows for the applicant to claim priority to a foreign application. Providing this information in the application data sheet constitutes the claim for priority as required by 35 U.S.C. 119(b) and 37 CFR 1.55(d). When priority is claimed to a foreign application that is eligible for retrieval under the priority document exchange program (PDX) the information will be used by the Office to automatically attempt retrieval pursuant to 37 CFR 1.55(h)(1) and (2). Under the PDX program, applicant bears the ultimate responsibility for ensuring that a copy of the foreign application is received by the Office from the participating foreign intellectual property office, or a certified copy of the foreign priority application is filed, within the time period specified in 37 CFR 1.55(g)(1).

Remove			
Application Number	Country ⁱ	Filing Date (YYYY-MM-DD)	Access Code ^j (if applicable)
10 2010 003 750.8	DE	2010-04-08	
Additional Foreign Priority Data may be generated within this form by selecting the Add button.			Add

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	4074-036-CON
		Application Number	
Title of Invention	Method and Arrangement for the Generation of a Laser Beam With Different Beam Profile Characteristics by Means of a Multi-Clad Fibre		

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications

This application (1) claims priority to or the benefit of an application filed before March 16, 2013 and (2) also contains, or contained at any time, a claim to a claimed invention that has an effective filing date on or after March 16, 2013. ☐ NOTE: By providing this statement under 37 CFR 1.55 or 1.78, this application, with a filing date on or after March 16, 2013, will be examined under the first inventor to file provisions of the AIA.
--

Authorization to Permit Access:

☒ Authorization to Permit Access to the Instant Application by the Participating Offices If checked, the undersigned hereby grants the USPTO authority to provide the European Patent Office (EPO), the Japan Patent Office (JPO), the Korean Intellectual Property Office (KIPO), the World Intellectual Property Office (WIPO), and any other intellectual property offices in which a foreign application claiming priority to the instant patent application is filed access to the instant patent application. See 37 CFR 1.14(c) and (h). This box should not be checked if the applicant does not wish the EPO, JPO, KIPO, WIPO, or other intellectual property office in which a foreign application claiming priority to the instant patent application is filed to have access to the instant patent application. In accordance with 37 CFR 1.14(h)(3), access will be provided to a copy of the instant patent application with respect to: 1) the instant patent application-as-filed; 2) any foreign application to which the instant patent application claims priority under 35 U.S.C. 119(a)-(d) if a copy of the foreign application that satisfies the certified copy requirement of 37 CFR 1.55 has been filed in the instant patent application; and 3) any U.S. application-as-filed from which benefit is sought in the instant patent application. In accordance with 37 CFR 1.14(c), access may be provided to information concerning the date of filing this Authorization.
--

Applicant Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.
--

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	4074-036-CON
		Application Number	
Title of Invention	Method and Arrangement for the Generation of a Laser Beam With Different Beam Profile Characteristics by Means of a Multi-Clad Fibre		

Applicant 1				Remove
If the applicant is the inventor (or the remaining joint inventor or inventors under 37 CFR 1.45), this section should not be completed. The information to be provided in this section is the name and address of the legal representative who is the applicant under 37 CFR 1.43; or the name and address of the assignee, person to whom the inventor is under an obligation to assign the invention, or person who otherwise shows sufficient proprietary interest in the matter who is the applicant under 37 CFR 1.46. If the applicant is an applicant under 37 CFR 1.46 (assignee, person to whom the inventor is obligated to assign, or person who otherwise shows sufficient proprietary interest) together with one or more joint inventors, then the joint inventor or inventors who are also the applicant should be identified in this section.				
Clear				
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Application Data Sheet 37 CFR 1.76		Attorney Docket Number	4074-036-CON
		Application Number	
Title of Invention	Method and Arrangement for the Generation of a Laser Beam With Different Beam Profile Characteristics by Means of a Multi-Clad Fibre		

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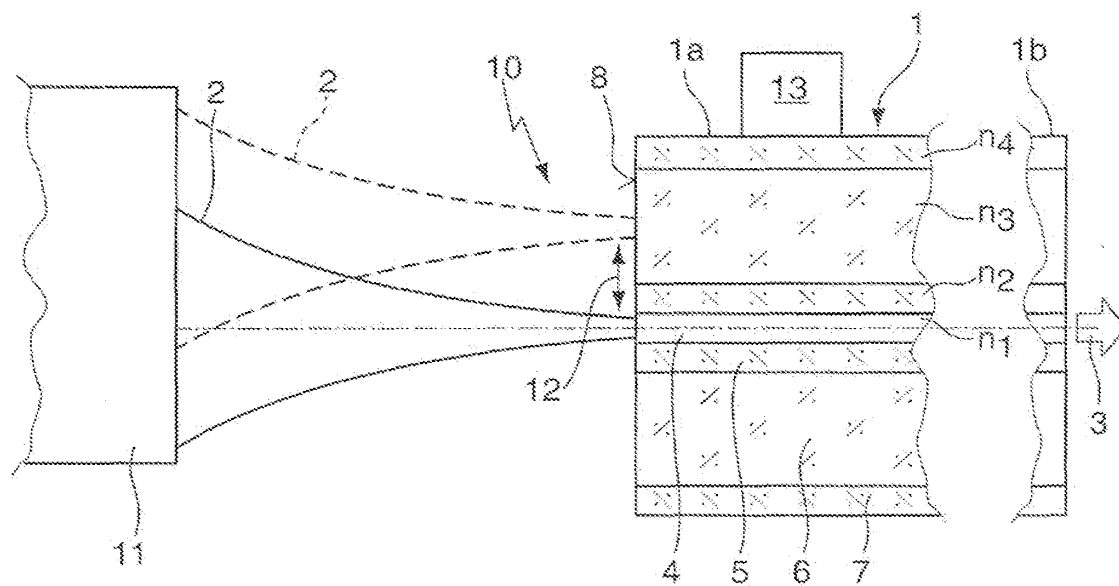


Fig. 1

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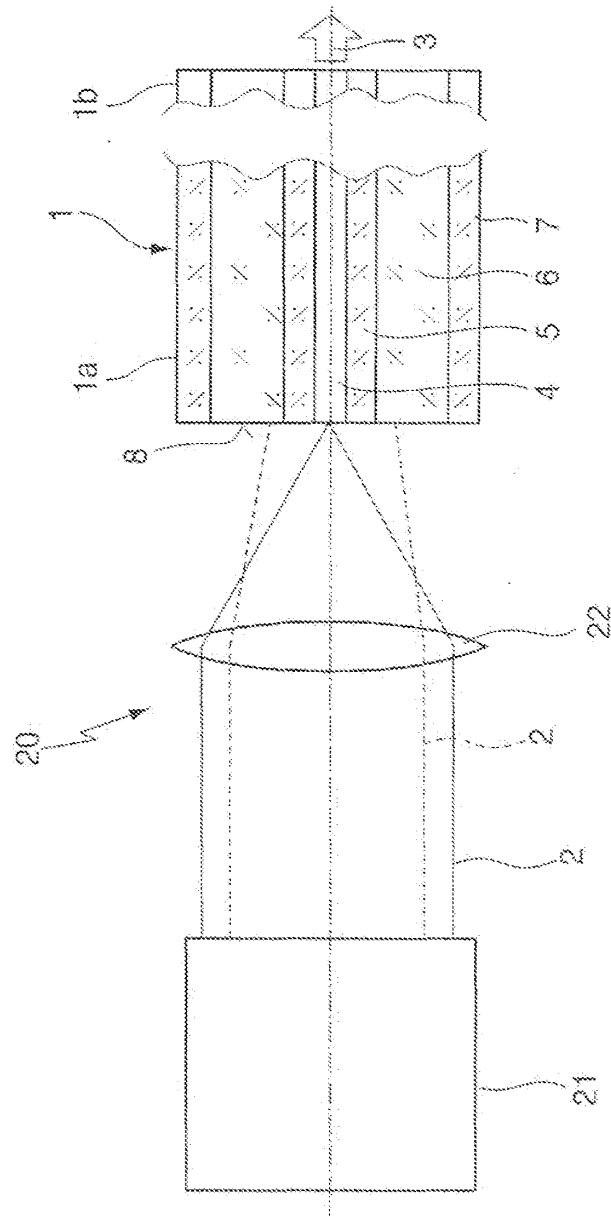


Fig. 2a

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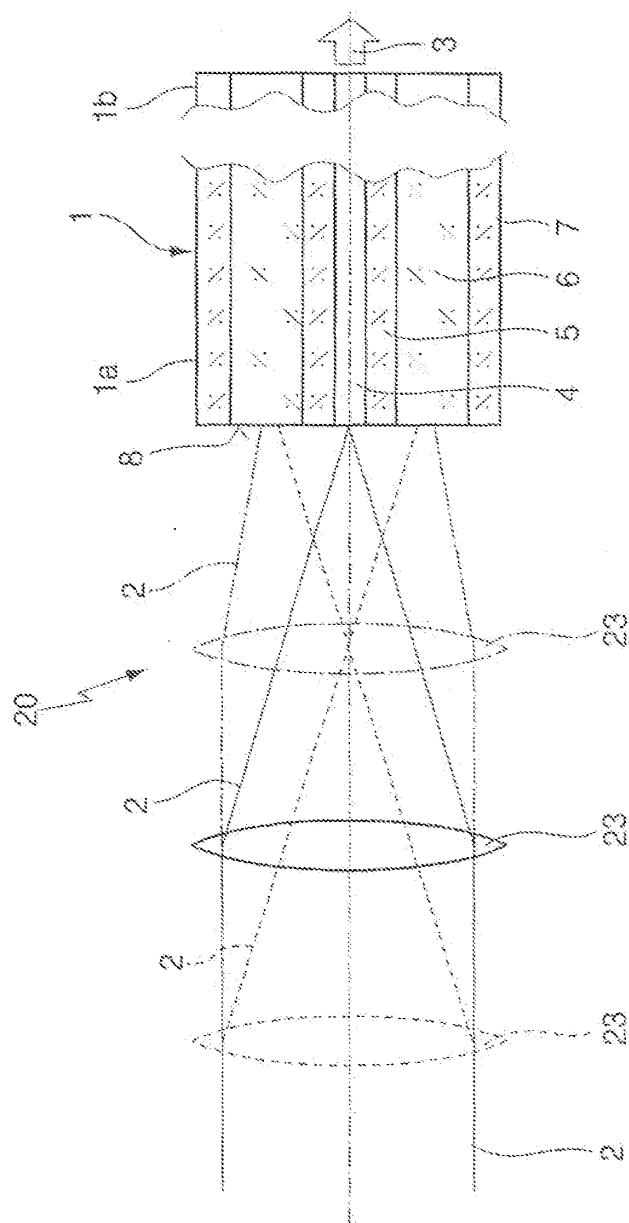


Fig. 2b

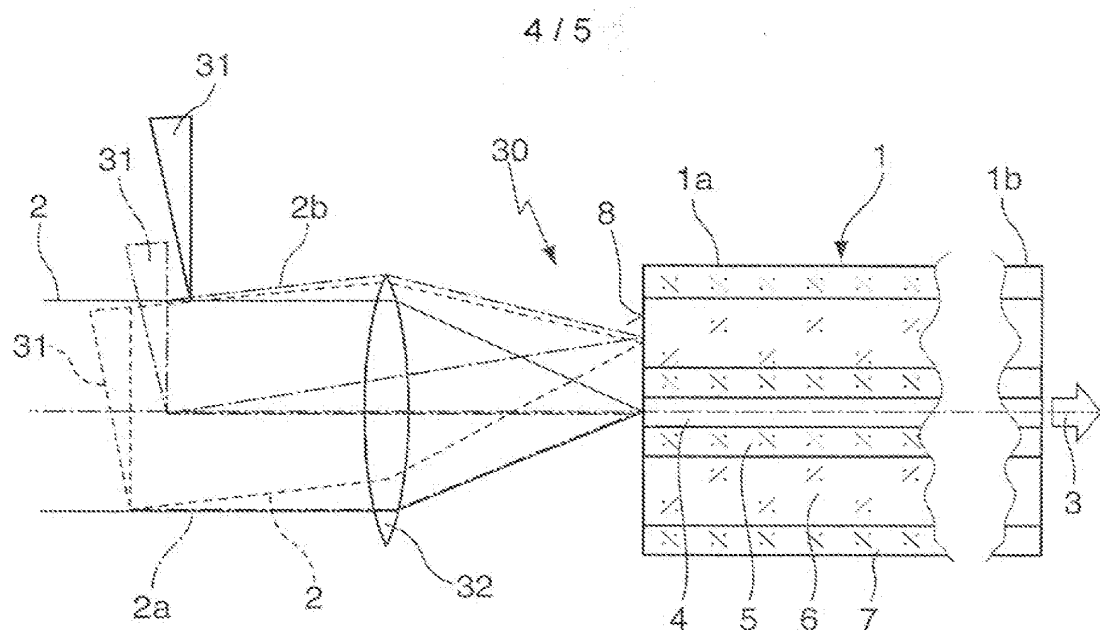


Fig. 3

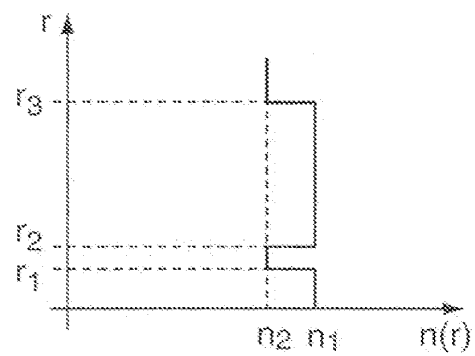


Fig. 4

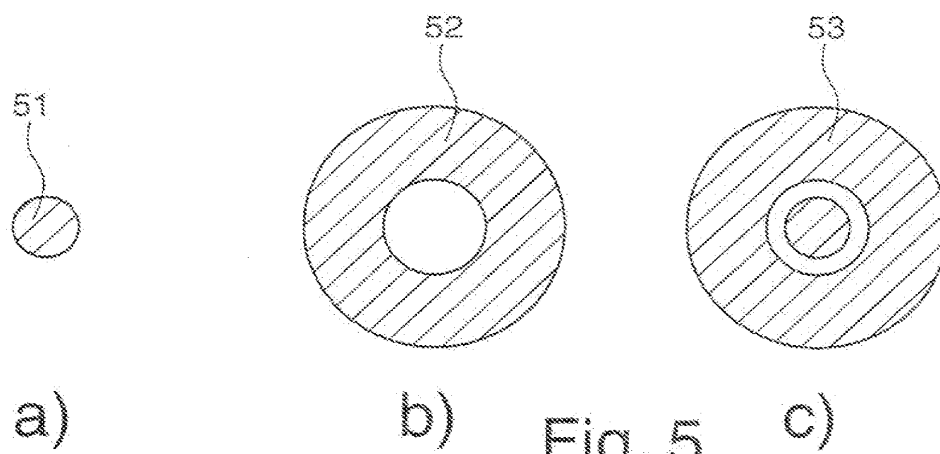
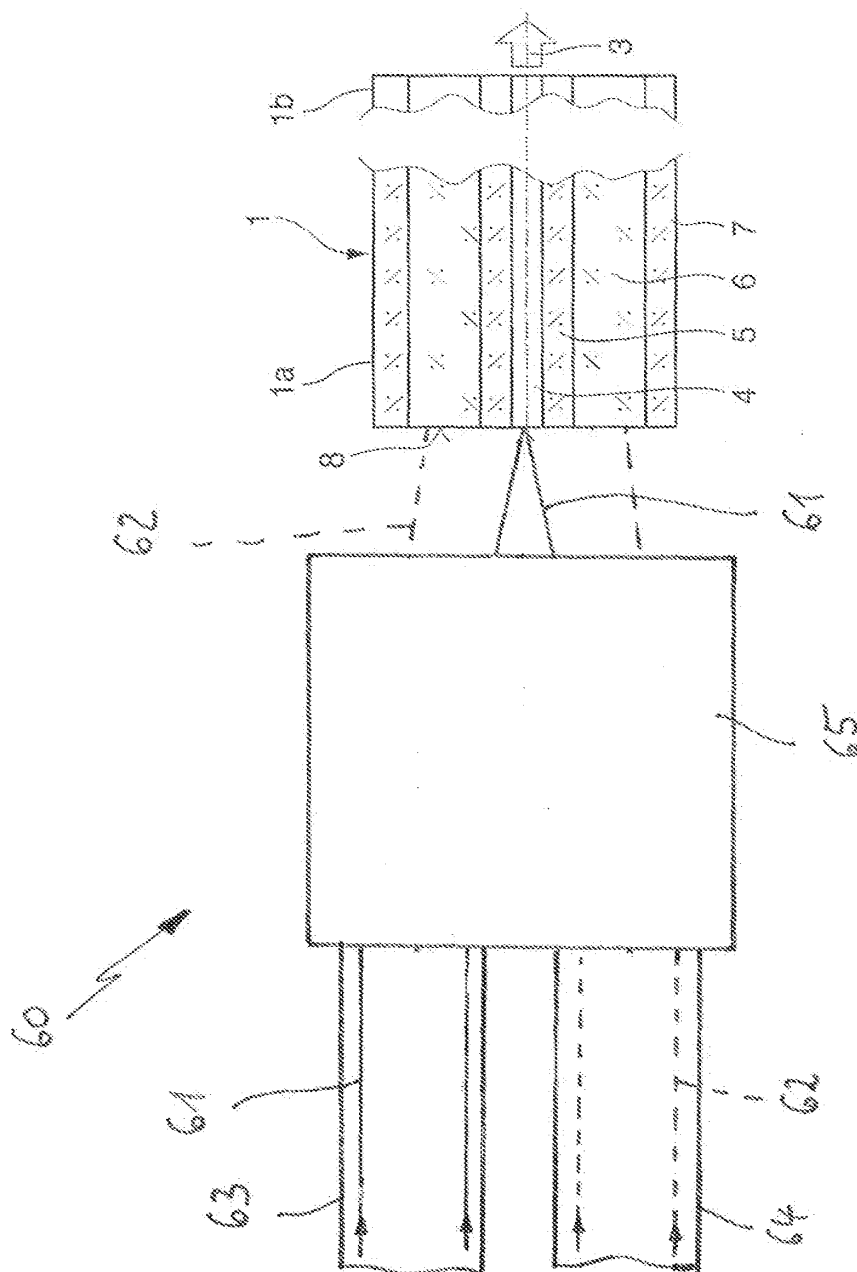


Fig. 5

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**METHOD AND ARRANGEMENT FOR THE GENERATION OF A LASER BEAM WITH
DIFFERENT BEAM PROFILE CHARACTERISTICS BY MEANS OF A MULTI-CLAD
FIBRE**

BACKGROUND OF THE INVENTION

CROSS-REFERENCE TO RELATED APPLICATION

This application is a continuation of U.S. patent application no. 13/639,401, filed December 20, 2012.

1. Field of the Invention

[001] The invention concerns a method and arrangement for the generation of a laser beam with different beam profile characteristics.

2. Description of Related Art

[002] In materials processing by means of laser beams, different processes and applications have different requirements for characteristic laser beam parameters such as focal diameter, intensity distribution or beam profile quality at the processing point. Therefore, changing a process or application in a laser machining system usually involves the necessary resetting work, which may range from relatively simple replacement of individual optical components to transfer to a different system.

[003] For example, DE 38 33 992 A1 describes a method for achieving specific laser beam properties in which the laser beams of two laser beam sources are coupled into a conventional optical fibre at different coupling angles. A beam is thus created, depending on the coupling angles of the two laser beams, with various wavelengths which are selected to suit the biological or medical processing task at hand. In addition to the use of two laser sources, this method may also employ just one laser source with a variable wavelength. The coupling conditions into the optical fibre depend greatly on the wavelength here. However, if, for example, the applications do not have different wavelengths or rather even require the use of a single wavelength, the method outlined proves not to be optimum on account of its disproportionate complexity for such cases and its limiting specialisation in applications of a different type. Moreover, the

method proposed is limited to the beam formation dependent on the wavelength which, in turn, leads to limitations for its potential applications.

SUMMARY OF THE INVENTION

[004] Therefore, the object of the present invention is to indicate a method for generating a laser beam with different laser beam profile characteristics which, using several laser beam sources or just one laser beam source, in particular with a single wavelength, allows an application-specific change to the laser beam characteristics with relatively little effort, and to provide an arrangement for this method. A further aim is to expand the range of adaptation potential of beam profile characteristics to miscellaneous applications as far as possible, while reducing the complexity of the arrangement and the method.

[005] In accordance with the invention, this object is solved by a method in which a laser beam is coupled into one fibre end of a multi-clad fibre, in particular a double-clad fibre, and coupled out of the other end of the multi-clad fibre and, to generate different beam profile characteristics of the output laser beam, the input laser beam is electively coupled either at least into the inner fibre core of the multi-clad fibre or at least into at least one outer ring core of the multi-clad fibre or, however, electively a first laser beam is coupled at least into the inner fibre core of the multi-clad fibre and a different, second laser beam is coupled at least into at least one outer ring core of the multi-clad fibre.

[006] In this invention, a multi-clad fibre means a fibre with one inner fibre core and at least one outer ring core, for example a double-clad fibre with a single outer ring core or also a triple-clad fibre with an additional outer ring core adjacent to the first outer ring core. To change the beam profile characteristics of the output laser beam, the input laser beam is coupled variously into one or more of the cores of the multi-clad fibre.

[007] For the sake of simplicity, the invention will be described in the following using a double-clad fibre. It will be clear to an expert that the principle of the invention can easily also be transferred to multi-clad fibres with additional outer ring cores adjacent to the first outer ring core.

[008] A double-clad fibre with two cores has an inner fibre core and cladding surrounding this fibre core that is as thin and low-refractive as possible. This is followed by a single outer ring core which is also surrounded by low-refractive second

cladding. This may be followed by an additional layer of glass which determines the external diameter of the fibre but has no influence on its function in terms of beam guidance. This is completed by a coating of a synthetic material such as silicone and/or nylon which serves to protect the fibre.

[009] By using a double-clad fibre, the present invention makes it possible to choose between different beam profile characteristics at the fibre output, depending on whether the beam is coupled into the inner fibre core, the outer ring core or into both the inner fibre core and the outer ring core. In material processing using laser beams, in particular using high power in the kW range, the ability to switch between these coupling variants makes it possible, for example to choose between a comparatively good beam quality with a sharp focus as is required, for example, for a laser cutting process, and, in contrast, a 'reduced' beam quality with a 'blurred' focus with almost uniform intensity distribution in the beam cross-section, which is particularly suitable for welding processes.

[0010] To achieve a high laser beam quality, the laser beam is coupled into the inner fibre core of the double-clad fibre, which, in this case, behaves like a conventional standard fibre, the fibre core of which is surrounded by low-refractive cladding. However, if a laser beam with a wider profile and, for example, with uniform intensity is required, the laser beam is coupled into the outer ring core or into both the inner fibre core and the outer ring core. Depending on the application, therefore, at the output of the double-clad fibre, a laser beam can be achieved with a filled circular profile in accordance with the inner fibre core, with a ring profile in accordance with the outer ring core, with a filled circular profile in accordance with the two core areas together (with a narrow missing ring through the first cladding) or with the corresponding intermediate stages of the stated profile characteristics.

[0011] In a preferred version of the method in accordance with the invention, for the elective coupling of the laser beam into the double-clad fibre, relative motion takes place between the input laser beam and the coupling-side face of the double-clad fibre in a direction transverse to the laser beam, in particular in the form of parallel displacement. If the coupling-side face of the double-clad fibre is moved transverse to the laser beam, no additional optical elements are required to switch between the various couplings. With sufficiently long free beam propagation of the laser beam before it strikes the double-clad fibre, angular deflection of the laser beam, which

is also understood as deflection transverse to the axis of the coupling-side face, is also possible in order to couple the laser beam into the inner fibre core and/or into the outer ring core of the double-clad fibre. In this case, this involves rotation of the laser beam axis about a point instead of displacement, whereby the change in the angle of incidence should remain negligible for the coupling.

[0012] In another preferred version of the method in accordance with the invention, for electively coupling of the laser beam into the double-clad fibre, the input laser beam is projected with different beam cross-sections, in particular with different beam diameters, onto the coupling-side face of the double-clad fibre. These different beam diameters can be set, for example with optics that can travel along the laser beam axis such as a lens or aperture which, depending on its travel position, couples the laser beam either only into the inner fibre core or into the outer ring core or into both the inner fibre core and the outer ring core. Alternatively, a different beam cross-section or diameter can also be set by optics such as a lens or aperture being electively moved into or out of the beam path of the laser beam. In another alternative, the beam cross-section or diameter can be adapted to desired coupling conditions into the double-clad fibre using a laser source with alternative guidance options via optical fibres with different beam guidance characteristics, which can, for example, be set via the diameter of the beam guidance optical fibre core. This principle of choosing the coupling conditions into the double-clad fibre can also be applied to the use of the laser beam sources assigned to the upstream optical fibres, in particular to laser beam sources of different beam qualities.

[0013] In another preferred version of the method in accordance with the invention, for the coupling of the laser beam both into the inner fibre core and into the at least one outer ring core, the input laser beam is divided into at least two sub-beams, each of which is coupled into one of the two cores of the double-clad fibre. This allows the division of the beam power between the inner fibre core and the outer ring core to be particularly well controlled if they are to be used simultaneously. With the two sub-beams, it is also possible, in a particularly easy fashion, to omit the area of the first cladding of the double-clad fibre in connection with coupling. Specifically for applications in the high-power area, it is important that no laser beam is coupled into the first or second cladding of the double-clad fibre. Any such beam coupled into the cladding is propagated with a large angle in relation to the fibre axis in the inner fibre core or outer

ring core and emerges at the fibre end also with a large angle, as a result of which connecting optics can become heated. In addition, a beam in the second cladding can destroy the coating of the fibre. To safely prevent the propagation of the laser beam in the cladding, mode strippers can be used, for example. Accordingly, it is preferred also not to couple any laser beam into the double-clad fibre during the switching process in order to prevent any propagation in the cladding. This can be done, for example, by switching the laser off or deflecting the beam into an absorber by using beam shutters.

[0014] In another aspect, the invention also concerns an arrangement suitable for implementing the method described above. The arrangement in accordance with the invention comprises a double-clad fibre with one inner fibre core and at least one outer ring core and a switchable device with at least two switch positions in which the input laser beam is electively coupled either at least into the inner fibre core of the double-clad fibre or at least into the at least one outer ring core of the double-clad fibre or, electively, a first laser beam is coupled at least into the inner fibre core of the multi-clad fibre and a different, second laser beam is coupled at least into one outer ring core of the multi-clad fibre.

[0015] In a preferred embodiment of the arrangement in accordance with the invention, the switchable device is formed by adjustable deflection optics which, in their at least two switch positions, deflect an input laser beam in a direction transverse to the axis of the coupling-side face of the double-clad fibre to varying extents or formed by a control device which, in its at least two switch positions, moves the coupling-side face in a direction transverse to the input laser beam to varying extents. Deflection optics in accordance with the invention mean any adjustable optics that couples a laser beam, depending on the adjustment position, into at least partially different fibre areas of the double-clad fibre.

[0016] In another preferred embodiment of the arrangement in accordance with the invention, the switchable device is formed by mobile optics or a mobile aperture which, in their at least two switch positions, project the input laser beam with different beam cross-sections, in particular with different beam diameters, onto the coupling-side face of the double-clad fibre. The mobile optics can, for example, be prisms, plane-parallel (glass) plates, convex and concave lenses, mirrors, diffractive optical elements, etc. individually or in combinations.

[0017] It is particularly preferred for the optics to be formed by a beam divider, in particular by an optical wedge plate that can be moved into the laser beam, to divide the input laser beam into at least two sub-beams, each of which is coupled into one of the cores of the double-clad fibre. Advantageously, the division of the intensity between the inner fibre core and the outer ring core depends on how far the beam divider intervenes in the beam path. This makes it possible to adapt the intensity division and thus the beam profile of the output laser beam optimally to each application.

[0018] However, the wedge plate can also be used as a beam switch to couple the laser beam in its entirety either into the inner fibre core or into the outer ring core. Moving/displacing the coupling optics transverse to the optical axis of the laser beam causes a comparable effect. In this version, the coupling optics are located in the beam path in the switchable states, producing different beam deflections, depending on the position of the coupling optics. As the beam is not divided here and the intensities cannot be divided via sub-beams, it is preferred to deflect either into the inner fibre core or into the outer ring core and to switch between at least two states representing these positions.

[0019] Preferably, the diameter of the inner fibre core of the double-clad fibre is maximum approximately 200 μm , in particular maximum approximately 150 μm , preferably maximum approximately 120 μm . For example, with a diameter of the inner fibre core of approximately 100 μm , a good quality of the output laser beam can be achieved for demanding laser applications, such as laser cutting processes, in connection with the beam being coupled into the inner fibre core.

[0020] The ring thickness of the at least one outer ring core of the double-clad fibre is preferably greater than or equal to the diameter of the inner fibre core. The outer ring diameter corresponds to the wider laser beam profile required for specific applications, such as laser welding, and is approximately 600 μm or 400 μm , for example, depending on the application.

[0021] In an advantageous embodiment of the arrangement in accordance with the invention, the numerical aperture of the first cladding surrounding the inner fibre core is higher than the numerical aperture of the second cladding surrounding the at least one outer ring core in a double-clad fibre. As a result, a beam coupled inadvertently into the first cladding can penetrate the second cladding and be emitted and displayed there by a mode stripper. This facilitates the adjustment of the inner fibre core and fault

monitoring. For example, the first cladding has a standard numerical aperture of 0.22 (tolerance ± 0.02), whereby the second cladding in this case preferably has a numerical aperture of 0.18 (tolerance ± 0.015) and should be thick enough to guide the laser beam well, for example 10 μm thick, preferably less, such as 3 to 5 μm , with a cladding core diameter ratio (CCDR) of 1.2. The first cladding forms a conventional transport fibre with the inner fibre core.

[0022] In another preferred embodiment, the switchable device has, on the input side, at least two optical fibres via which at least two different laser beams can be supplied, whereby the switchable device electively couples one laser beam at least into the inner fibre core of the multi-clad fibre and the other laser beam at least into at least one outer ring core of the multi-clad fibre.

[0023] The embodiments described with the use of one or more laser beam sources can also be used in combination, for example within a cascaded system.

[0024] Further advantages of the invention are provided in the following description and the drawing. The embodiments shown and described should not be considered to be an exhaustive list. They are instead examples for the purposes of describing the invention. Similarly, the above-mentioned characteristics and those described below can be used individually or in any combinations.

[0025] The invention is presented in a number of embodiments in the drawing and will be described in further detail in the following description. The presentation in the figures in the drawing should only be considered to be an outline. It contains no restrictions in respect of details or dimensions and is not to scale.

BRIEF DESCRIPTION OF THE DRAWINGS

[0026] Figs. 1 to 3 show three arrangements in accordance with the invention for generating a laser beam with different beam profile characteristics, in which a laser beam is coupled into the fibre end of a double-clad fibre and emitted from the other fibre end of the double-clad fibre;

[0027] Fig. 4 shows the radial course of the refractive index of the double-clad fibre shown in Figs. 1 to 3.

[0028] Figs. 5a to 5c show various possible beam profiles of the laser beam emitted from the double-clad fibre in Figs. 1 to 3; and

[0029] Fig. 6 shows another arrangement in accordance with the invention for generating a laser beam with different beam profile characteristics, whereby, electively, a first laser beam is coupled into the inner fibre core of a double-clad fibre and a different, second laser beam is coupled both into the inner fibre core and into the outer ring core of the double-clad fibre.

DETAILED DESCRIPTION

[0030] Figs. 1 to 3 show three different arrangements 10, 20, 30 for generating a laser beam with different beam profile characteristics, whereby the laser beam is coupled into one fibre end 1a of a multi-clad fibre 1, which is a double-clad fibre 1 in the present case, and is emitted from the other fibre end 1b of the double-clad fibre 1. The input laser beam is labelled 2 and the emitted laser beam is labelled 3.

[0031] As shown in Fig. 1, the double-clad fibre 1 has an inner fibre core 4 (for example of undoped quartz glass) with a refractive index n_1 and thin first cladding 5 (for example of doped quartz glass) surrounding the inner fibre core 4, the refractive index n_2 of which is lower than n_1 . This is followed by an outer ring core 6 (for example of undoped quartz glass) with refractive index n_3 which is also surrounded by low-refractive second cladding 7 (for example of doped quartz glass) with refractive index n_4 . The refractive indices n_1 and n_3 can be the same or different; the same applies to the refractive indices n_2 and n_4 . This may be followed by an additional layer of glass (not shown) which determines the external diameter of the fibre but has no influence on its function in terms of beam guidance. This is typically completed by a coating (not shown) of a synthetic material such as silicone and/or nylon which serves to protect the fibre.

[0032] Fig. 4 shows an outline of the radial dependence of the refractive index n within the double-clad fibre 1, where $n_1 = n_3$ and $n_2 = n_4$. The figure shows an area with radius r_1 and high refractive index n_1 corresponding to the inner fibre core 4, a ring area between radii r_1 and r_2 with lower refractive index n_2 corresponding to the first cladding 5, a ring area with external radius r_3 and high refractive index n_1 corresponding to the outer ring core 6 and, finally, the second cladding 7 with low refractive index n_2 . On account of the lower refractive index of the cladding 5, 7, light is guided in the inner fibre core 4 and in the outer ring core 6 by means of total reflection.

[0033] To change the beam profile characteristics of the emitted laser beam 3, it is possible, as described below in detail, for the input laser beam 2 striking the coupling-side face 8 of the double-clad fibre 1 to be coupled, by means of a switchable device, electively either into the inner fibre core 4 or into the outer ring core 6 or both into the inner fibre core 4 and into the outer ring core 6 of the double-clad fibre 1.

[0034] In the arrangement 10 shown in Fig. 1, the switchable device for electively coupling the laser beam 2 into the double-clad fibre 1 is formed by adjustable deflection optics 11 with two switch positions, which are represented by continuous and dotted lines. In these two switch positions, the laser beam 2 focused on the coupling-side face 8 is deflected in a direction 12 transverse to the axis of the coupling-side face 8 to varying extents, in particular displaced in parallel to varying extents. In one switch position, the laser beam 2 is coupled centrally or eccentrically to the fibre axis only into the inner fibre core 4 and in the other switch position it is coupled eccentrically to the fibre axis only into the outer ring core 6. In the first case, the emitted laser beam 3 has the beam profile shown in Fig. 5a, i.e. a narrow filled circular profile 51 corresponding to the inner fibre core 4, and a comparatively high beam quality with a sharp focus, as is required for material processing, for example for a laser cutting process. In the second case, the emitted laser beam 3 has the wider beam profile shown in Fig. 5b, i.e. a ring profile 52 corresponding to the outer ring core 6, and a comparatively lower beam quality, as is required for material processing, for example for a laser welding process. Under suitable coupling conditions into the outer ring core 6, the emitted laser beam 3 has a top hat ring beam profile, the quality of which is suitable for many applications.

[0035] The deflection optics 11, the components of which are not shown individually in Fig. 1, are based on beam deflection principles familiar to an expert. In particular, a deflection mirror can be used here. The location of the coupling into the

coupling-side face of the double-clad fibre 1 can be determined by the angular position of the deflection mirror or the deflection mirror can deflect the beam, depending on position, to various outputs which, in turn, define various coupling areas. A semireflecting deflection mirror or a deflection mirror that is only partially in the beam path can also perform the described function of a beam divider. Preferably, the deflection optics 11 contain additional means for coupling the laser beam 2 into the coupling-side face 8 of the double-clad fibre 1, such as, for example, a focusing lens, which can alternatively also be arranged before or after the deflection optics 11.

[0036] A sufficiently long double-clad fibre 1 also allows for angularly homogeneous intensity distribution in the output laser beam 3 with eccentric coupling of the laser beam 2 to the fibre axis into the inner fibre core 4 or the outer ring core 6.

[0037] If, however, the beam is coupled both into the inner fibre core 4 and into the outer ring core 6 of the double-clad fibre 1, the output laser beam 3 has the uniformly filled wide beam profile 53 shown in Fig. 5c with an omitted ring corresponding to the first cladding 5.

[0038] Alternatively (or in addition) to the deflection optics 11, the switchable device for electively coupling the laser beam 2 into the double-clad fibre 1 can also be formed, for example, by a motor-driven control device 13 which displaces the coupling-side face 8 of the double-clad fibre 1 in a direction 12 transverse to the input laser beam 2 to varying extents, whereby the laser beam 2 focused on the coupling-side face 8 can be coupled either into the inner fibre core 4 or into the outer ring core 6.

[0039] In the arrangement 20 shown in Fig. 2a, the switchable device for electively coupling the laser beam 2 into the double-clad fibre 1 is formed by adjustable telescopic/expansion optics 21 which are shown here only in outline. In their switch positions, not shown here, the telescopic/expansion optics 21 expand the input laser beam 2 to different beam diameters. Depending on the beam diameter, the laser beam 2 is then projected by coupling optics (for example a lens) 22 with different beam diameters, in this case different focal diameters, onto the coupling-side face 8 of the double-clad fibre 1. As shown with continuous and dotted lines, the laser beam 2 is, for example, coupled centrically only into the inner fibre core 4 in one switch position of the telescopic/expansion optics 21 and coupled centrically both into the inner fibre core 4 and into the outer ring core 6 in another switch position. In the first case, the output laser beam 3 has beam profile 51 and in the second case beam profile 53.

[0040] Via the diameter of the expanded laser beam 2, the proportion of the laser beam coupled into the outer ring core 6 can be set continuously and thus also the intensity distribution into the inner fibre core 4 and the outer ring core 6, allowing the beam profile of the output laser beam 3 to be adapted to each application optimally.

[0041] In the arrangement 20 shown in Fig. 2b, the switchable device for electively coupling the laser beam 2 into the double-clad fibre 1 is formed by focusing optics 23 shown here as a lens which can be displaced along the laser beam axis to various switch positions, which are represented by continuous, dotted, and dashed and dotted lines. In these switch positions, the input laser beam 2 is coupled by the focusing optics 23 with different beam diameters onto the coupling-side face 8 of the double-clad fibre 1. In one switch position, the focused laser beam 2 is coupled centrically only into the inner fibre core 4. In the two other switch positions, the defocused laser beam 2 is coupled centrically both into the inner fibre core 4 and into the outer ring core 6. In the first case, the output laser beam 3 has beam profile 51 and in the second case beam profile 53.

[0042] In the arrangement 30 shown in Fig. 3, the switchable device for electively coupling the laser beam 2 into the double-clad fibre 1 is formed by a beam switch implemented here only by way of example as an optical wedge plate 31 which can be adjusted continuously between two end positions that are shown with continuous and dotted lines. In one of its end positions, the optical wedge plate 31 is arranged outside the beam path of the input laser beam 2 so that the entire input laser beam 2 is coupled via coupling optics (for example a lens) 32 only into the inner fibre core 4, whereby the output laser beam 3 has beam profile 51. In its other end position, shown by the dotted line, the wedge plate 31 is arranged in the entire beam path of the laser beam 2 so that the entire laser beam 2 is deflected by the wedge plate 31 and is coupled via the coupling optics 32 only into the outer ring core 6, whereby the output laser beam 3 has beam profile 52.

[0043] Moving/displacing the coupling optics 32 transverse to the optical axis of the laser beam 2 causes a comparable effect. In this version, the coupling optics 32 are located in the beam path in the switchable states, producing different beam deflections, depending on the position of the coupling optics 32. As the beam is not divided here and the intensities cannot be divided via sub-beams, it is preferred to

deflect either into the inner fibre core 4 or into the outer ring core 6 and to switch between at least two states representing these positions.

[0044] As indicated with a dotted line, partially introducing the wedge plate 31 into the input laser beam 2 creates two sub-beams 2a, 2b, so that here, for example, the optical wedge plate 31 acts as a beam divider. The first sub-beam 2a is not influenced by the wedge plate 31 and thus continues to be coupled via the coupling optics 32 into the inner fibre core 4, while the second sub-beam 2b is deflected by the wedge plate 31 in relation to the first sub-beam 2a and coupled via the coupling optics 32 into the outer ring core 6. The output laser beam 3 has beam profile 53. Partially introducing the wedge plate 31 into the input laser beam 2 therefore creates two sub-beams 2a, 2b, with a division of intensity between the inner fibre core 4 and the outer ring core 6, depending on the degree of introduction, whereby the beam profile of the output laser beam 3 can be optimally adapted to each application.

[0045] Moreover, the two sub-beams 2a, 2b offer the significant advantage that they omit the area of the first cladding 5 in connection with coupling. Specifically for applications in the high-power area, it is important that no laser beam is coupled into the inner or outer cladding 5, 7. This beam is propagated with a large angle in the inner core or outer ring core and emerges at the fibre end also with a large angle, as a result of which connecting optics can become heated. In addition, the beam in the outer cladding 7 can destroy the coating of the fibre 1.

[0046] A diameter of the inner fibre core 4 of approximately 100 μm guarantees, for typical applications with high power in the kW range, the production of good beam profile quality in connection with coupling the laser beam 2 into the inner fibre core 4. The first cladding 5 is already sufficiently thick, at approximately 10 μm , preferably at approximately 5 μm , to guide the laser beam well. With a ring thickness of the outer ring core 6 of approximately 240 μm , the external diameter of the outer ring core 6 is approximately 600 μm . For certain applications, such as laser welding, this corresponds to the necessary widening of the laser beam profile.

[0047] Fig. 6 shows another arrangement 60 for generating a laser beam with different beam profile characteristics, whereby, electively, a first laser beam 61 is coupled into the inner fibre core 4 of the double-clad fibre 1 and a different, second laser beam 62 is coupled both into the inner fibre core 4 and into the outer ring core 6 of the double-clad fibre 1. The two laser beams 61, 62, which can, for example, have different

beam qualities, are guided in optical fibres 63, 64 to switching optics 65 (for example an optical switch system), shown here only in outline, which can be switched between two switch positions. In one switch position, the first laser beam 61 with the higher beam quality is coupled into the inner fibre core 4 of the double-clad fibre 1 and, in the second switch position, the second laser beam 62 is coupled both into the inner fibre core 4 and into the outer ring core 6 of the double-clad fibre 1. In the first case, the output laser beam 3 has beam profile 51 and in the second case beam profile 53. The double-clad fibre 1 leads to a laser processing machine (not shown) so that the arrangement 60 is used to switch laser beams 61, 62 with different beam qualities for the laser processing machine. However, the laser beam 62 can also only be directed at the outer ring core 6 of the double-clad fibre 1 via the switching optics 65.

[0048] Up to now, laser processing machines that are to be supplied with several laser beams of different beam qualities needed several sockets for the various optical fibres and a corresponding optical switch system to allow the various laser beams to be coupled into the following beam path. For a desired laser beam, the appropriate optical fibre cable has to be manually replugged, which is undesirable on account of an increased risk of soiling, or beam guidance optics are required on the laser processing machines themselves. This is disadvantageous as several optical fibre cables have to be laid within the laser processing machine, the entire switching optics have to be mounted and moved on the axis system of the laser processing machine and the size of the switching optics, in connection with the space available, limits the possibilities or the possible optical concepts.

[0049] In the arrangement 60, the switching optics 65 are supplied on the input side by two lasers with the two laser beams of different beam qualities, and the respective laser beams 61, 62 are coupled into the central double-clad fibre 1 via the switching optics 65. In this way, the switching between the two laser beams 61, 62 is separated from the axis system of the laser processing machine and takes place outside the laser processing machine itself. The laser beams are then supplied to the machine via the double-clad fibre 1. One or more additional light-guiding ring cores around the outer ring core 6 are also conceivable so that additional laser beams with different beam qualities can be guided via the switching optics 65.

WHAT IS CLAIMED IS:

1. A method for generating a laser beam (3) with different beam profile characteristics, characterised in that: a laser beam (2) is coupled into the fibre end (1a) of a multi-clad fibre (1), in particular a double-clad fibre, and emitted from the other fibre end (1b) of the multi-clad fibre (1), and
for the generation of different beam profile characteristics of the output laser beam (3), the input laser beam (2) is electively coupled either into the inner fibre core (4) of the multi-clad fibre (1) or into the inner fibre core (4) and at least one outer ring core (6) of the multi-clad fibre (1).
2. A method for generating a laser beam (3) with different beam profile characteristics, characterised in that: a laser beam (2) is coupled into the fibre end (1a) of a multi-clad fibre (1), in particular a double-clad fibre, and emitted from the other fibre end (1b) of the multi-clad fibre (1), and
for the generation of different beam profile characteristics of the output laser beam (3), the input laser beam (2) is electively coupled either into the inner fibre core (4) of the multi-clad fibre (1) or into one outer ring core (6) of the multi-clad fibre (1).
3. A method according to claim 1, characterised in that, for electively coupling of the laser beam (2) into the multi-clad fibre (1), relative motion takes place between the input laser beam (2) and the coupling-side face (8) of the multi-clad fibre (1) in a direction (12) transverse to the laser beam (2).
4. A method according to claim 2, characterised in that, for electively coupling of the laser beam (2) into the multi-clad fibre (1), relative motion takes place between the input laser beam (2) and the coupling-side face (8) of the multi-clad fibre (1) in a direction (12) transverse to the laser beam (2).
5. A method according to claim 1, characterised in that, for electively coupling of the laser beam (2) into the multi-clad fibre (1), the input laser beam (2) with respectively

different beam cross-sections, in particular with respectively different beam diameters, is projected onto the coupling-side face (8) of the multi-clad fibre (1).

6. A method according to claim 1, characterised in that, for the coupling of the laser beam (2) into both the inner fibre core (4) and at least one outer ring core (6), the input laser beam (2) is divided into at least two sub-beams (2a, 2b), each of which is coupled into one of the cores (4, 6) of the multi-clad fibre (1).

7. An arrangement (10; 20; 30; 60) for generating a laser beam (3) with different beam profile characteristics,

characterised by:

a multi-clad fibre (1), in particular a double-clad fibre with one inner fibre core (4) and at least one outer ring core (6), and

a switchable device (11, 13; 21, 22; 23; 31, 32; 65) with at least two switch positions in which an input laser beam (2; 61, 62) is electively coupled either into the inner fibre core (4) of the multi-clad fibre (1) or at least into at least one outer ring core (6) of the multi-clad fibre (1).

8. An arrangement according to claim 7, characterised in that the switchable device comprises adjustable deflection optics (11, 22, 31, 32) which, in their at least two switch positions, deflect an input laser beam (2) in a direction (12) transverse to the axis of the coupling-side face (8) to varying extents and/or a control device (13) which, in its at least two switch positions, moves the coupling-side face (8) of the multi-clad fibre (1) in a direction (12) transverse to the input laser beam (2) to varying extents.

9. An arrangement according to claim 8, characterised in that the deflection optics comprises an optical element (22, 31, 32) which can be positioned in at least two different switch positions transverse to the laser axis.

10. An arrangement according to claim 7, characterised in that the switchable device comprises adjustable optics (21; 23) or an adjustable aperture which, in their at least two switch positions, project the input laser beam (2) with different beam cross-sections, in

particular with different beam diameters, onto the coupling-side face (8) of the double-clad fibre (1).

11. An arrangement according to claim 10, characterised in that the adjustable optics (23) can be moved back and forth along the laser beam axis between their at least two switch positions.

12. An arrangement according to claim 9, characterised in that the optical element (31) or an aperture is arranged in one switch position outside the beam path of the laser beam (2) and in at least one other switch position at least partially in the beam path of the laser beam (2).

13. An arrangement according to claim 12, characterised in that the optical element is formed by a beam divider, in particular an optical wedge plate (31), which can be moved into the laser beam (2), to divide the input laser beam (2) into at least two sub-beams (2a, 2b) each of which is coupled into one of the cores (4, 6) of the multi-clad fibre (1).

14. An arrangement according to claim 7, characterised in that the diameter (2 r1) of the inner fibre core (4) of the multi-clad fibre (1) is maximum approximately 200 μm , in particular maximum approximately 150 μm and preferably maximum approximately 120 μm .

15. An arrangement according to one of claim 7, characterised in that the ring thickness (r3 -r2) of the at least one outer ring core (6) of the multi-clad fibre (1) is greater than or equal to the diameter (2 r1) of the inner fibre core (4).

16. An arrangement according to claim 7, characterised in that, for the multi-clad fibre (1), the numerical aperture of a first cladding (5) surrounding the inner fibre core (4) is higher than the numerical aperture of a second cladding (7) surrounding the at least one outer ring core (6).

PATENT

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ABSTRACT OF THE DISCLOSURE

The invention concerns a method for generating a laser beam (3) with different beam profile characteristics, whereby a laser beam (2) is coupled into one fibre end (1a) of a multi-clad fibre (1), in particular a double-clad fibre, and emitted from the other fibre end (1b) of the multi-clad fibre (1) and whereby, to generate different beam profile characteristics of the output laser beam (3), the input laser beam (2) is electively coupled either at least into the inner fibre core (4) of the multi-clad fibre (1) or at least into at least one outer ring core (6) of the multi-clad fibre (1), as well as a corresponding arrangement (10).

(Fig. 1)

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1	Transmittal of New Application	4074-036-CON_Transmittal.pdf	275958	no	2
			8aff60651dd7c51d3526896579b0ddb3ec67d602		
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2	Oath or Declaration filed	4074-036-CON_Declaration.pdf	428359	no	4
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3	Application Data Sheet	4074-036-CON_ADS.pdf	1571789	no	7
			187826f5044724a8c11595bc632cdafd77cbbb80		
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4	Drawings-only black and white line drawings	4074-036-CON_Drawings.pdf	371076	no	5
			5ff00049c339b24439b5490dbd8669dd89cf13a5		
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5		4074-036-CON_Spec.pdf	9631526	yes	18
			8959a874effad1057254c4aba5ac7f0de8bb23fa		
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	Claims		14	17	
	Abstract		18	18	
Warnings:					
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6	Fee Worksheet (SB06)	fee-info.pdf	33269	no	2
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