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UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
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www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
18/057,342	11/21/2022	Jason Higley	USCO-089-US1-02	4719

152017 7590 08/22/2023

US Conec Ltd.
1138 25th Street Southeast
Hickory, NC 28602

EXAMINER	
JORDAN, ANDREW	

ART UNIT	PAPER NUMBER
2874	

NOTIFICATION DATE	DELIVERY MODE
08/22/2023	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):

docket@usconec.com
eofficeaction@appcoll.com
michael@leetzow.com

UNITED STATES PATENT AND TRADEMARK OFFICE

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APPLICATION NO.	ISSUE DATE	PATENT NO.
18/057,342	22-Aug-2023	11733466

US Conec Ltd.
1138 25th Street Southeast
Hickory, NC 28602

EGRANT NOTIFICATION

Your electronic patent grant (eGrant) is now available, which can be accessed via Patent Center at https://patentcenter.uspto.gov

The electronic patent grant is the official patent grant under 35 U.S.C. 153. For more information, please visit https://www.uspto.gov/electronicgrants

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APPLICATION NO.	ISSUE DATE	PATENT NO.	ATTORNEY DOCKET NO.	CONFIRMATION NO.
18/057,342	08/22/2023	11733466	USCO-089-US1-02	4719

152017 7590 08/02/2023

US Conec Ltd.
1138 25th Street Southeast
Hickory, NC 28602

ISSUE NOTIFICATION

The projected patent number and issue date are specified above. The patent will issue electronically. The electronically issued patent is the official patent grant pursuant to 35 U.S.C. § 153. The patent may be accessed on or after the issue date through Patent Center at https://patentcenter.uspto.gov/. The patent will be available in both the public and the private sides of Patent Center. Further assistance in electronically accessing the patent, or about Patent Center, is available by calling the Patent Electronic Business Center at 1-888-217-9197.

The USPTO is implementing electronic patent issuance with a transition period, during which period the USPTO will mail a ceremonial paper copy of the electronic patent grant to the correspondence address of record. Additional copies of the patent (i.e., certified and presentation copies) may be ordered for a fee from the USPTO's Certified Copy Center at https://certifiedcopycenter.uspto.gov/index.html. The Certified Copy Center may be reached at (800)972-6382.

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 0 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 Patents Stakeholder Experience (OPSE), Stakeholder Support Division (SSD) at (571)-272-4200.

INVENTOR(s) (Please see PAIR WEB site http://pair.uspto.gov for additional inventors):

Jason Higley, Hickory, NC;
Jillcha F. Wakjira, Hickory, NC;
Mitchell Cloud, Hickory, NC;
Darrell R. Childers, Hickory, NC;
Michael E. Hughes, Hickory, NC;

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

US Conec Ltd, Hickory, NC

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.

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ELECTRONIC ACKNOWLEDGEMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
18/057,342	**06/29/2023 10:34:24 AM ET**	**USCO-089-US1-02**

Title of Invention

MINI DUPLEX CONNECTOR WITH PUSH-PULL POLARITY MECHANISM AND CARRIER

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	4719	FILED BY	Michael Leetzow
PATENT CENTER #	62360024	FILING DATE	11/21/2022
CUSTOMER #	152017	FIRST NAMED INVENTOR	Jason Higley
CORRESPONDENCE ADDRESS	-	AUTHORIZED BY	-

Documents

TOTAL DOCUMENTS: 1

DOCUMENT	PAGES	DESCRIPTION	SIZE (KB)
web85b.pdf	3	Issue Fee Payment (PTO-85B)	61 KB

Digest

DOCUMENT	MESSAGE DIGEST(SHA-512)
web85b.pdf	760897AE5D0539C1665DFF7D12E979AE1A7D64FC6258D94AB78982FDD38E4714E71184AC863064F83F00423DBB260E7A98AA035E35DEA99702029A485FA38D0D

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 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.

UNITED STATES
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ELECTRONIC PAYMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
18/057,342	**06/29/2023 10:34:24 AM ET**	**USCO-089-US1-02**

Title of Invention

MINI DUPLEX CONNECTOR WITH PUSH-PULL POLARITY MECHANISM AND CARRIER

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	4719	FILED BY	Michael Leetzow
PATENT CENTER #	62360024	AUTHORIZED BY	-
CUSTOMER #	152017	FILING DATE	11/21/2022
CORRESPONDENCE ADDRESS	-	FIRST NAMED INVENTOR	Jason Higley

Payment Information

PAYMENT METHOD	PAYMENT TRANSACTION ID	PAYMENT AUTHORIZED BY
CARD / 1000	**E20236SA34419914**	**Michael Leetzow**

FEE CODE	DESCRIPTION	ITEM PRICE($)	QUANTITY	ITEM TOTAL($)
1501	UTILITY ISSUE FEE	1200.00	1	1200.00
			TOTAL AMOUNT:	**$1,200.00**

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.

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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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ISSUE FEE TRANSMITTAL FORM

APPLICATION #	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET #
18057342	11/21/2022	Jason Higley	USCO-089-US1-02

Title of Invention

MINI DUPLEX CONNECTOR WITH PUSH-PULL POLARITY MECHANISM AND CARRIER

Application Information

APPLICATION TYPE	Nonprovisional Application under 35 USC 111(a)	DATE DUE	09/28/2023
CONFIRMATION #	4719	ISSUE FEE DUE	$ 1200
EXAMINER	ANDREW JORDAN	PUBLICATION DUE	$ 0
GROUP ART UNIT	2874	TOTAL FEES DUE	$1200
CLASS - SUBCLASS	385/078000	PREV. PAID FEE	$ 0
ENTITY STATUS	Regular Undiscounted		

1. CHANGE OF CORRESPONDENCE ADDRESS AND/OR INDICATION OF FEE ADDRESS (37 CFR 1.33 & 1.363)

Correspondence Address

CURRENT ADDRESS

Maintenance Fee Address

CURRENT ADDRESS

☐ Change of correspondence address requested,system generated AIA/122-PC form attached

☐ Fee address indication requested, system generatedSB/47-PC form attached

2. ENTITY STATUS

Change in Entity Status

NEW STATUS

3. THE FOLLOWING FEES ARE SUBMITTED

☑ Issue Fee

☑ Publication Fee

4. FEE AUTHORIZATION

☐ I authorize USPTO to apply my previously paid issue fee to the current fees due

☐ The Director is herby authorized to apply my previously paid issue fee to the current fee due and to charge deficient fees to Deposit Account Number:

☐ If in addition to the payment of the issue fee amount submitted with this form, there are any discrepencies in any amount(s) due, the Director is authorized to charge any deficiency, or credit any overpayment, to Deposit Account Number:

5. FIRM AND/OR ATTORNEY NAMES TO BE PRINTED

NOTE: If no name is listed, no name will be printed
For printing on the patent front page, list to be displayed as entered

Michael L Leetzow PLLC
Shubhrangshu Sengupta

6. ASSIGNEE NAME(S) AND RESIDENCE DATA TO BE PRINTED

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 susbstitute for filing an assignment.

US Conec Ltd.	Hickory, NC UNITED STATES	Corporation

Signature

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 has filed and has been granted power of attorney in this application. I also

certify that this Fee(s) Transmittal form is being transmitted to the USPTO via Patent Center on the date indicated below.

Signature	Name	Registration #	Date
/Michael L. Leetzow/	Michael Leetzow	35932	06/29/2023

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
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NOTICE OF ALLOWANCE AND FEE(S) DUE

152017 7590 06/28/2023

US Conec Ltd.
1138 25th Street Southeast
Hickory, NC 28602

EXAMINER
JORDAN, ANDREW

ART UNIT	PAPER NUMBER
2874	

DATE MAILED: 06/28/2023

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
18/057,342	11/21/2022	Jason Higley	USCO-089-US1-02	4719

TITLE OF INVENTION: MINI DUPLEX CONNECTOR WITH PUSH-PULL POLARITY MECHANISM AND CARRIER

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$1200	$0.00	$0.00	$1200	09/28/2023

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 40% the amount of undiscounted fees, and micro entity fees are 20% the amount of undiscounted 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. 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: Maintenance fees are due in utility patents issuing on applications filed on or after Dec. 12, 1980. It is patentee's responsibility to ensure timely payment of maintenance fees when due. More information is available at www.uspto.gov/PatentMaintenanceFees.

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), by mail or fax, or via EFS-Web.

By mail, send to: Mail Stop ISSUE FEE
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

By fax, send to: (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 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. **Because electronic patent issuance may occur shortly after issue fee payment, any desired continuing application should preferably be filed prior to payment of this issue fee in order not to jeopardize copendency.**

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

152017 7590 06/28/2023
US Conec Ltd.
1138 25th Street Southeast
Hickory, NC 28602

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 transmitted to the USPTO via EFS-Web or by facsimile to (571) 273-2885, on the date below.

(Typed or printed name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
18/057,342	11/21/2022	Jason Higley	USCO-089-US1-02	4719

TITLE OF INVENTION: MINI DUPLEX CONNECTOR WITH PUSH-PULL POLARITY MECHANISM AND CARRIER

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$1200	$0.00	$0.00	$1200	09/28/2023

EXAMINER	ART UNIT	CLASS-SUBCLASS
JORDAN, ANDREW	2874	385-078000

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/AIA/122 or PTO/SB/122) attached.

❑ "Fee Address" indication (or "Fee Address" Indication form PTO/AIA/47 or 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,
(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.

1_____
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 must have been previously recorded, or filed for recordation, as set forth in 37 CFR 3.11 and 37 CFR 3.81(a). 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. Fees submitted: ❑Issue Fee ❑Publication Fee (if required)

4b. Method of Payment: *(Please first reapply any previously paid fee shown above)*

❑ Electronic Payment via Patent Center or EFS-Web ❑ Enclosed check ❑ Non-electronic payment by credit card (Attach form PTO-2038)

❑ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment to Deposit Account No. _____

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

❑ Applicant certifying micro entity status. See 37 CFR 1.29
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.

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

❑ Applicant changing to regular undiscounted fee 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. _____

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UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
18/057,342	11/21/2022	Jason Higley	USCO-089-US1-02	4719

152017 7590 06/28/2023

US Conec Ltd.
1138 25th Street Southeast
Hickory, NC 28602

EXAMINER	
JORDAN, ANDREW	
ART UNIT	PAPER NUMBER
2874	

DATE MAILED: 06/28/2023

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 30 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.** 18/057,342	**Applicant(s)** Higley et al.	
	Examiner ANDREW JORDAN	**Art Unit** 2874	**AIA (FITF) Status** Yes

-- 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 June 7, 2023.
   ☐ 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 1-17 . 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)
2. ☑ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date _____.
3. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material _____.
4. ☐ Interview Summary (PTO-413), Paper No./Mail Date. _____.
5. ☐ Examiner's Amendment/Comment
6. ☑ Examiner's Statement of Reasons for Allowance
7. ☐ Other _____.

/ANDREW JORDAN/
Primary Examiner, Art Unit 2874

Notice of Pre-AIA or AIA Status

The present application, filed on or after March 16, 2013, is being examined under the first inventor to file provisions of the 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.

DETAILED ACTION

This is an AIA application filed November 21, 2022.

The earliest effective filing date of this AIA application is seen as December 19, 2017, the date of the earliest priority application (United States provisional patent application serial number 62/607,555 December 19, 2017) for any claims which are fully supported under 35 U.S.C. 112(a) by the provisional application.

The same is similarly true for the following United States provisional patent application:

United States provisional patent application serial number 62/634,271 February 23, 2018.

The effective filing date of this AIA application is seen as November 21, 2022, the actual filing date, for any claims that are not fully supported by the foregoing provisional applications or the applications listed below.

The present application also claims priority to and is also related to:

United States patent application serial number 17/328,574 May 24, 2021 now U.S. Patent No. 11,506,848;

United States patent application serial number 16/462,897 May 21, 2019 now U.S. Patent No. 11,016,250; and

PCT international application number PCT/US2018/066518 filed December 19, 2018.

The claims originally filed **November 21, 2022** are entered, currently outstanding, and subject to examination.

This action is in response to the request for continued examination/RCE filing of June 7, 2023.

The current status and history of the claims is summarized below:

No changes were made to the claims.

Claims 1-17 are currently pending and outstanding.

No claims have been amended, cancelled, withdrawn, or added.

Claims 1-17 are currently outstanding and subject to examination.

This is a notice of allowability and is the second action on the merits.

Allowable subject matter is indicated below.

Often, in the substance of the action below, formal matters are addressed first, claim rejections second, and any response to arguments third.

Information Disclosure Statement

The information disclosure statement/IDS filed June 7, 2023 had certain cites not seen in Applicant's filing. There may be errors in the cites or the documents may be

missing.

Special Definitions for Claim Language - MPEP § 2111.01(IV)

No special definitions are seen as present in the specification regarding the language used in the claims. Consequently, the words and phrases of the claims are given their plain meaning. MPEP §§ 2173.01, 2173.05(a), and 2111.01.

If special definitions are present, Applicant should bring those to the attention of the examiner and the prosecution history with its next response in a manner both specific and particular. In doing so, there will be no mistake, confusion, and/or ambiguity as to what constitutes the special definition(s).

To date, Applicant has provided no indication of special definitions.

Claims Allowed

Claims 1-17 are allowed.

Allowable Subject Matter

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

The prior art does not teach or suggest

a fiber optic connector with two ferrules and springs having the crimp body, alignment feature, and strain relief boot

as set forth in the claimed combination of independent claim(s) 1.

The cited references are seen as providing the closest related art.

The newly-cited references share elements with the claims, but do not appear to

provide sufficient disclosure by which a person of ordinary skill in the art before the effective filing date of the claimed invention would find such claims obvious.

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."

Conclusion

Applicant's publication US 20230080980 A1 of 2023-03-16 was previously cited.

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. The cited references have elements related to Applicant's disclosure and/or claims or are otherwise associated with the other cited references, particularly with respect to optical connectors and related systems.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to ANDREW JORDAN whose telephone number is (571) 270-1571. The examiner can normally be reached most days 1000-1800 PACIFIC TIME ZONE (messages are returned).

Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an interview, applicant is encouraged to use the USPTO Automated Interview Request (AIR) at http://www.uspto.gov/interviewpractice.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Thomas (Tom) HOLLWEG can be reached on (571) 270-1739. The fax

phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of published or unpublished applications may be obtained from Patent Center. Unpublished application information in Patent Center is available to registered users. To file and manage patent submissions in Patent Center, visit: https://patentcenter.uspto.gov. Visit https://www.uspto.gov/patents/apply/patent-center for more information about Patent Center and https://www.uspto.gov/patents/docx for information about filing in DOCX format. For additional questions, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Andrew Jordan/
Primary Examiner, Art Unit 2883
V: (571) 270-1571 (Pacific time)
F: (571) 270-2571
June 14, 2023

Notice of References Cited	Application/Control No. 18/057,342	Applicant(s)/Patent Under Reexamination Higley et al.	
	Examiner ANDREW JORDAN	Art Unit 2874	Page 1 of 3

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	CPC Classification	US Classification
*	A	US-5619604-A	04-1997	Shiflett; Elbert O.	G02B6/3869	385/55
*	B	US-5737463-A	04-1998	Weiss; Roger E.	G02B6/3831	385/59
*	C	US-6019521-A	02-2000	Manning; Randy Marshall	G02B6/3888	385/76
*	D	US-6352373-B1	03-2002	Yamaguchi; Toru	G02B6/3869	385/60
*	E	US-6513989-B1	02-2003	Bleck; Oliver	G02B6/3897	385/60
*	F	US-7281859-B2	10-2007	Mudd; Ronald L.	G02B6/3869	385/83
*	G	US-20100008635-A1	01-2010	Zimmel; Steven C.	G02B6/3825	385/136
*	H	US-20100220961-A1	09-2010	de Jong; Michael	G02B6/38875	385/77
*	I	US-20140133820-A1	05-2014	Zimmel; Steven C.	G02B6/4472	385/135
*	J	US-20140169727-A1	06-2014	Veatch; Anthony	G02B6/3831	385/11
*	K	US-20150030289-A1	01-2015	JIANG; Bolin	G02B6/44	385/76
*	L	US-20150177463-A1	06-2015	LEE; JHIH-PING	G02B6/3879	385/76
*	M	US-20150191024-A1	07-2015	HEATH; Peter	B41J2/2117	347/15

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.

Notice of References Cited	Application/Control No. 18/057,342	Applicant(s)/Patent Under Reexamination Higley et al.	
	Examiner ANDREW JORDAN	Art Unit 2874	Page 2 of 3

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	CPC Classification	US Classification
*	A	US-20160238796-A1	08-2016	Nguyen; Hiep V.	G02B6/3893	1/1
*	B	US-20160306125-A1	10-2016	WU; Jun	G02B6/3879	1/1
*	C	US-20160327757-A1	11-2016	LEE; JHIH-PING	G02B6/3869	1/1
*	D	US-20170139430-A1	05-2017	Gledhill, III; Robert E.	G01F1/24	1/1
*	E	US-9804337-B2	10-2017	Anderson; John	G02B6/3825	1/1
*	F	US-20170299818-A1	10-2017	CHANG; Ming-Hua	G02B6/3871	1/1
*	G	US-20170343740-A1	11-2017	Nguyen; Long Van	G02B6/4284	1/1
*	H	US-20180252872-A1	09-2018	Chen; Szu Ming	G02B6/3893	1/1
*	I	US-10191230-B2	01-2019	Wong; Kimman	G02B6/3893	1/1
*	J	US-10281668-B2	05-2019	Takano; Kazuyoshi	G02B6/3893	1/1
*	K	US-20190278028-A1	09-2019	Higley; Jason	G02B6/3825	1/1
*	L	US-10585247-B2	03-2020	Takano; Kazuyoshi	G02B6/4292	1/1
*	M	US-20200150357-A1	05-2020	Higley; Jason	G02B6/38875	1/1

FOREIGN PATENT DOCUMENTS

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

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*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
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Notice of References Cited	Application/Control No. 18/057,342	Applicant(s)/Patent Under Reexamination Higley et al.	
	Examiner ANDREW JORDAN	Art Unit 2874	Page 3 of 3

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	CPC Classification	US Classification
*	A	US-20200301077-A1	09-2020	LEIGH; KEVIN B.	G02B6/3831	1/1
*	B	US-20200371299-A1	11-2020	GNIADEK; Jeffrey	G02B6/387	1/1
	C					
	D					
	E					
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FOREIGN PATENT DOCUMENTS

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Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/057,342	Higley et al.
	Examiner	**Art Unit**
	ANDREW JORDAN	2874

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

CLAIMS

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	05/06/2023	06/14/2023							
	1	=	=							
	2	=	=							
	3	=	=							
	4	=	=							
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	14	=	=							
	15	=	=							
	16	=	=							
	17	=	=							

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/057,342	Higley et al.
	Examiner	**Art Unit**
	ANDREW JORDAN	2874

CPC							
Symbol						**Type**	**Version**
G02B	/	6	/	3898		F	2013-01-01
G02B	/	6	/	3825		I	2013-01-01
G02B	/	6	/	3893		I	2013-01-01
G02B	/	6	/	3812		I	2013-01-01
G02B	/	6	/	3857		I	2013-01-01

CPC Combination Sets							
Symbol					**Type**	**Set**	**Ranking**	**Version**
	/		/					

NONE		Total Claims Allowed:	
(Assistant Examiner)	(Date)	17	
/ANDREW JORDAN/ Primary Examiner, Art Unit 2874	14 June 2023	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	2

U.S. Patent and Trademark Office — Part of Paper No.: 20230614

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/057,342	Higley et al.
	Examiner	**Art Unit**
	ANDREW JORDAN	2874

INTERNATIONAL CLASSIFICATION				
CLAIMED				
G02B6/38	/	6	/	38

NON-CLAIMED				
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US ORIGINAL CLASSIFICATION	
CLASS	**SUBCLASS**

CROSS REFERENCES(S)						
CLASS	**SUBCLASS (ONE SUBCLASS PER BLOCK)**					

NONE		**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	17	
/ANDREW JORDAN/ Primary Examiner, Art Unit 2874	14 June 2023	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	2

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/057,342	Higley et al.
	Examiner	**Art Unit**
	ANDREW JORDAN	2874

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIMS

Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original
1	1	4	10												
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3	3	9	12												
6	4	14	13												
7	5	15	14												
8	6	16	15												
10	7	5	16												
11	8	17	17												
12	9														

NONE		**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	17	
/ANDREW JORDAN/ Primary Examiner, Art Unit 2874	14 June 2023	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	2

U.S. Patent and Trademark Office — Part of Paper No.: 20230614

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/057,342	Higley et al.
	Examiner	Art Unit
	ANDREW JORDAN	2874

CPC - Searched*		
Symbol	**Date**	**Examiner**
G02B6/3812, /3825, /3857, /3893, /3898, /3831, /3879, /3878, and /3873; as well as across G02B6 generally	05/06/2023	aj

CPC Combination Sets - Searched*		
Symbol	**Date**	**Examiner**

US Classification - Searched*			
Class	**Subclass**	**Date**	**Examiner**

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

Search Notes		
Search Notes	**Date**	**Examiner**
G02B6/3812, /3825, /3857, /3893, /3898, /3831, /3879, /3878, and /3873; as well as across G02B6 generally (See search history printout)	05/06/2023	aj
Inventor name search	05/06/2023	aj
Assignee and/or Applicant name search	05/06/2023	aj
PE2E SEARCH search history attached (updated 6/14/23)	05/06/2023	aj
Text searching in the CPC search listing areas	05/06/2023	aj
Global Dossier check/confirm	05/06/2023	aj

/ANDREW JORDAN/ Primary Examiner, Art Unit 2874	

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/057,342	Higley et al.
	Examiner	Art Unit
	ANDREW JORDAN	2874

Interference Search			
US Class/CPC Symbol	US Subclass/CPC Group	Date	Examiner
	see attached PE2E SEARCH history (updated 6/14 /23)	05/06/2023	aj

/ANDREW JORDAN/ Primary Examiner, Art Unit 2874	

Doc code: IDS
Doc description: Information Disclosure Statement (IDS) Filed

PTO/SB/08a (01-22)
Approved for use through 05/31/2024. 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	18057342
Filing Date	2022-11-21
First Named Inventor	Jason Higley
Art Unit	2874
Examiner Name	Andrew JORDAN
Attorney Docket Number	USCO-089-US1-02

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
/AJ/	1	11525965	B2	2022-12-13	Childers et al.	

If you wish to add additional U.S. Patent citation information please click the Add button. Add

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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
	1	20170205588	A1	2017-07-20	LEE	
	2	20190391343	A1	2019-12-26	Aoshima et al.	

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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	0242818	WO	A1	2002-05-30	Theis et al.		
/AJ/	2	2015191024	WO	A1	2015-12-17	Takano et al.		

EFS Web 2.1.18

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /AJ/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	18057342
	Filing Date	2022-11-21
	First Named Inventor	Jason Higley
	Art Unit	2874
	Examiner Name	Andrew JORDAN
	Attorney Docket Number	USCO-089-US1-02

/AJ/	3	2017139430	WO	A1	2017-08-17	Lin		
/AJ/	4	2019195652	WO	A1	2019-10-10	HIGLEY et al.		
/AJ/	5	2020160254	WO	A1	2020-08-06	HIGLEY et al.		

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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]
/AJ/	1	18890292.8 Extended European Search Report; dated July 29, 2021; 8 pages	
/AJ/	2	FOCIS 10 Fiber Optic Connector Intermateability Standard –Type LC, March 6, 2002	
/AJ/	3	International Search Report and Written Opinion PCT/US2018/066523 Dated March 5, 2019; 8 pages	
	4	International Search Result/Written Opinion in PCT/US2020/160254, mailing date May 20, 2020	
/AJ/	5	Office Action in Chinese patent App. No. 202800118295 (Atty. Dkt. USCO-107-CN) dated October 8, 2022	
	6	Supplementary European Search report in corresponding European Patent App. No. 20749424.8 dated September 7, 2022, (Atty. Dkt. USCO-107-EU)	

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	18057342
	Filing Date	2022-11-21
	First Named Inventor	Jason Higley
	Art Unit	2874
	Examiner Name	Andrew JORDAN
	Attorney Docket Number	USCO-089-US1-02

EXAMINER SIGNATURE			
Examiner Signature	/ANDREW JORDAN/ (06/13/2023)	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.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /AJ/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	18057342
	Filing Date	2022-11-21
	First Named Inventor	Jason Higley
	Art Unit	2874
	Examiner Name	Andrew JORDAN
	Attorney Docket Number	USCO-089-US1-02

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	/Michael L Leetzow/	Date (YYYY-MM-DD)	2023-06-07
Name/Print	Michael L. Leetzow	Registration Number	35932

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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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.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /AJ/

PE2E SEARCH - Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	British Equivalents	Time Stamp
L164	3	("11525965" OR "20170205588" OR "20190391343").pn.	(US-PGPUB; USPAT)	OR	ON	ON	2023/06/13 09:59 PM
L165	278	("11525965"|"20170205588"|"20190391343"|"10042127"|"10054747"|"10146010"|"10168487"|"10185099"|"10185100"|"10228516"|"10281669"|"10288817"|"10520682"|"10520687"|"10598865"|"10641968"|"10678000"|"10705300"|"10768377"|"11092750"|"11092755"|"11112567"|"20050111796"|"20120213484"|"20130156379"|"20130183001"|"20130216186"|"20140133808"|"20150253519"|"20150260925"|"20170153396"|"20170276881"|"20170285268"|"20170285275"|"20170299820"|"20170336571"|"20180081124"|"20180120513"|"20180136414"|"20180217338"|"20180217340"|"20190018209"|"20190033533"|"20190137696"|"20190137701"|"20190179084"|"20190179086"|"20190179089"|"20190187387"|"20190235184"|"20190250344"|"20190302383"|"20190346633"|"20200209489"|"20200241215"|"20200264384"|"20200284998"|"20200285001"|"20200319410"|"20210149124"|"20210286138"|"20210373252"|"11555968"|"11592627"|"11614589"|"20210382236"|"20210405302"|"20230080980"|"4690494"|"4762389"|"4798440"|"5016968"|"5879173"|"5896479"|"6059461"|"6234682"|"7090509"|"7296935"|"8152385"|"8559781"|"8684611"|"897939	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/06/14 01:00 PM

		5"|"8985864"|"8985867"|"9052474"|"9207410"|"9507103"|"9523824"|"9568689"|"9606303"|"9625657"|"9638868"|"9684130"|"9739955"|"9761998"|"9829644").PN.					

PE2E SEARCH - Search History (Interference)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	British Equivalents	Time Stamp
N16	3	(((fiber$4 OR fibre$4) near2 optic$4 near2 connect$4) AND ((crimp$4 OR heat$1shrink$4) near2 bod$3) AND (align$4 near2 featur$4) AND (strain$4 near2 relief$4 near2 boot$4)).clm.	(US-PGPUB; USPAT)	OR	ON	ON	2023/06/14 01:22 PM
N17	14	N9 and N10	(US-PGPUB; USPAT)	OR	ON	ON	2023/06/14 01:22 PM

PE2E SEARCH - Search History (Similarity Search)

No Similarity Results available

Bibliographic Data

Application No: 18/057,342

Foreign Priority claimed: ○ Yes ◉ No

35 USC 119 (a-d) conditions met: ☐ Yes ☑ No ☐ Met After Allowance

Verified and Acknowledged: /ANDREW JORDAN/ (Examiner's Signature) ____ (Initials)

Title: MINI DUPLEX CONNECTOR WITH PUSH-PULL POLARITY MECHANISM AND CARRIER

FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
11/21/2022	385	2874	
RULE			

APPLICANTS

US Conec Ltd, Hickory, NC, UNITED STATES

INVENTORS

Jason Higley, Hickory, NC, UNITED STATES

Jillcha F. Wakjira, Hickory, NC, UNITED STATES

Mitchell Cloud, Hickory, NC, UNITED STATES

Darrell R. Childers, Hickory, NC, UNITED STATES

Michael E. Hughes, Hickory, NC, UNITED STATES

CONTINUING DATA

This application is a CON of 17328574 05/24/2021 PAT 11506848

17328574 is a CON of 16462897 05/21/2019 PAT 11016250

16462897 is a 371 of PCT/US2018/066518 12/19/2018

PCT/US2018/066518 has PRO of 62634271 02/23/2018

PCT/US2018/066518 has PRO of 62607555 12/19/2017

FOREIGN APPLICATIONS

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12/07/2022

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
18/057,342	11/21/2022	Jason Higley	USCO-089-US1-02	4719

152017 7590 06/14/2023

US Conec Ltd.
1138 25th Street Southeast
Hickory, NC 28602

EXAMINER
JORDAN, ANDREW

ART UNIT	PAPER NUMBER
2874	

NOTIFICATION DATE	DELIVERY MODE
06/14/2023	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):

docket@usconec.com
eofficeaction@appcoll.com
michael@leetzow.com

Applicant-Initiated Interview Summary	**Application No.** 18/057,342	**Applicant(s)** Higley et al.		
	Examiner ANDREW JORDAN	**Art Unit** 2874	**AIA (First Inventor to File) Status** Yes	**Page** 1 of 1

All Participants (applicant, applicants representative, PTO personnel)	**Title**	**Type**
ANDREW JORDAN	Primary Examiner	Telephonic
MICHAEL LEETZOW	Attorney of Record	

Date of Interview: 08 June 2023

Issues Discussed:

Other

Applicant made a courtesy call to examiner indicating the filing of an RCE re ids. Examiner returned the voice mail with information regarding the Office's QPIDS program. More information is below.
A late-filed IDS/information disclosure statement after allowance may be submitted under the QPIDS program.
Home (www.uspto.gov) --> Patents --> Initiatives --> Quick Path Information Disclosure Statement
https://www.uspto.gov/patents/initiatives/quick-path-information-disclosure-statement-qpids

/ANDREW JORDAN/ Primary Examiner, Art Unit 2874	

Applicant is reminded that a complete written statement as to the substance of the interview must be made of record in the application file. It is the applicants responsibility to provide the written statement, unless the interview was initiated by the Examiner and the Examiner has indicated that a written summary will be provided. See MPEP 713.04
Please further see:
MPEP 713.04
Title 37 Code of Federal Regulations (CFR) § 1.133 Interviews, paragraph (b)
37 CFR § 1.2 Business to be transacted in writing

Applicant recordation instructions: The formal written reply to the last Office action must include the substance of the interview. (See MPEP section 713.04). If a reply to the last Office action has already been filed, applicant is given a non-extendable period of the longer of one month or thirty days from this interview date, or the mailing date of this interview summary form, whichever is later, to file a statement of the substance of the interview.

Examiner recordation instructions: Examiners must summarize the substance of any interview of record. A complete and proper recordation of the substance of an interview should include the items listed in MPEP 713.04 for complete and proper recordation including the identification of the general thrust of each argument or issue discussed, a general indication of any other pertinent matters discussed regarding patentability and the general results or outcome of the interview, to include an indication as to whether or not agreement was reached on the issues raised.

PTO/SB/08a (01-22)
Approved for use through 05/31/2024. OMB 0651-0031
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.

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

Application Number	18057342
Filing Date	2022-11-21
First Named Inventor	Jason Higley
Art Unit	2874
Examiner Name	Andrew JORDAN
Attorney Docket Number	USCO-089-US1-02

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	11525965	B2	2022-12-13	Childers et al.	

If you wish to add additional U.S. Patent citation information please click the Add button. Add

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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
	1	20170205588	A1	2017-07-20	LEE	
	2	20190391343	A1	2019-12-26	Aoshima et al.	

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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	0242818	WO	A1	2002-05-30	Theis et al.		
	2	2015191024	WO	A1	2015-12-17	Takano et al.		

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	Attorney Docket Number	USCO-089-US1-02

	3	2017139430	WO	A1	2017-08-17	Lin		
	4	2019195652	WO	A1	2019-10-10	HIGLEY et al.		
	5	2020160254	WO	A1	2020-08-06	HIGLEY et al.		

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NON-PATENT LITERATURE DOCUMENTS Remove

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 29, 2021; 8 pages	
	2	FOCIS 10 Fiber Optic Connector Intermateability Standard –Type LC, March 6, 2002	
	3	International Search Report and Written Opinion PCT/US2018/066523 Dated March 5, 2019; 8 pages	
	4	International Search Result/Written Opinion in PCT/US2020/160254, mailing date May 20, 2020	
	5	Office Action in Chinese patent App. No. 202800118295 (Atty. Dkt. USCO-107-CN) dated October 8, 2022	
	6	Supplementary European Search report in corresponding European Patent App. No. 20749424.6 dated September 7, 2022, (Atty. Dkt. USCO-107-EU)	

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	Art Unit	2874
	Examiner Name	Andrew JORDAN
	Attorney Docket Number	USCO-089-US1-02

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	18057342
	Filing Date	2022-11-21
	First Named Inventor	Jason Higley
	Art Unit	2874
	Examiner Name	Andrew JORDAN
	Attorney Docket Number	USCO-089-US1-02

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	/Michael L Leetzow/	Date (YYYY-MM-DD)	2023-06-07
Name/Print	Michael L. Leetzow	Registration Number	35932

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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.

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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.

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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.

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
06 August 2020 (06.08.2020)

WIPO | PCT

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30 January 2020 (30.01.2020)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
62/798,699 30 January 2019 (30.01.2019) US

(71) Applicant: **US CONEC, LTD** [US/US]; 1138 25th St. SE, Hickory, North Carolina 28603-2306 (US).

(72) Inventors: **HIGLEY, Jason**; 3709 6th Street NE, Hickory, North Carolina 28601 (US). **CHILDERS, Darrell R.**; 364 6th St. NW, Hickory, North Carolina 28601 (US).

(74) Agent: **LEETZOW, Michael**; 2393 Crest Ridge Ct, Sanford, Florida 32771 (US).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, WS, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

(54) **Title:** SMALL FORM FACTOR CONNECTOR AND ADAPTER

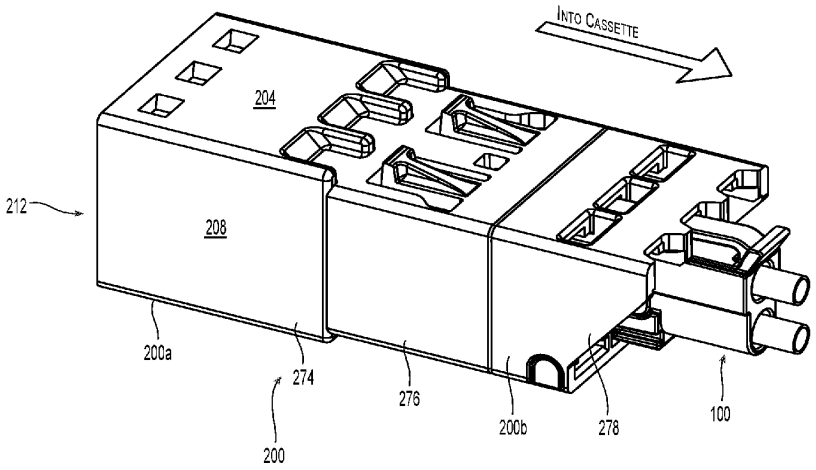


Fig. 3

(57) **Abstract:** A two-piece fiber optic connector and a corresponding two-piece adapter allow for the tripling of the optical fibers that can be used with a standard fiber-optic cassette. The two-piece fiber optic connector has a fold-over latch to engage the adapter. The two-piece adapter has at least one latch to engage the standard fiber-optic cassette to retain the two-piece adapter and the fiber optic connectors in the adapter within the cassette. This allows for the retrofitting and/or continued use of the standard fiber-optic cassette.

[Continued on next page]

WO 2020/160254 A1

Declarations under Rule 4.17:

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

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))*

SMALL FORM FACTOR CONNECTOR AND ADAPTER

Reference to Related Case

[0001] This application claims priority under 35 U.S.C. § 119 (e) to provisional application no. 62/798,699 filed on January 30, 2019, the contents of which are hereby incorporated by reference in their entirety.

BACKGROUND OF THE INVENTION

[0002] Adapters are used in a variety of applications to align and mate fiber optic connectors that are inserted on opposite sides of the adapters. One of the design parameters for adapters is the footprint of the adapters used with the panel or backplane. With the requirements of a higher connection density per panel, smaller and smaller adapters are being introduced.

[0003] One example where smaller form factor adapters are used is with fiber optic cassettes. Fiber optic cassettes have input ports where duplex LC connectors are inserted. These are then multiplexed into multi-fiber connectors (e.g., MPO connectors) for further optical transport. Cassettes have limited internal space to route optical fibers that receive the optical input from external duplex or other connectors. Currently, a single adapter used with the fiber optic cassettes can only accommodate only two LC connectors meaning that only two optical fibers can be routed through that space. Given that there are 6 spaces, this limits a fiber optic cassette to routing only 12 fibers.

[0004] In order to allow for a higher density, a new adapter has been designed that allows for a tripling of the number of optical fibers (and fiber optic connectors) that can be accommodated in a fiber optic cassette. The design allows for the installation of new fiber optic cassettes but also allows for the retrofitting of the already-installed cassettes. A corresponding fiber optic connector has also been designed that is compatible with the new adapter and provides other advantages, such as reducing the areas of snagging of optical fibers that are inherent in the LC connector design.

SUMMARY OF THE INVENTION

[0005] The present invention is directed to a two-piece fiber optic connector that includes a first portion having at least two passageways to receive a fiber optic ferrule in each of the at

least two passageways, a latch extending from a surface adjacent a rear portion of the first portion to removably engage an adapter, two side latches, each of the two latches disposed on a surface adjacent to the surface from which the latch extends and on opposite sides of the first portion, a second portion to receive a front portion of the first portion, and at least two side latch windows on the second portion to receive at least a portion of the two side latches to retain the first and second portions together.

[0006] In some embodiments, there are alignment shoulders on the first and second portions and they are configured to engage alignment projections projecting from walls in the adapter.

[0007] In some embodiments, the backplane adapter also includes at least one step alignment passageway to receive at least one alignment step on the fiber optic connector housing.

[0008] In other embodiments, the latch has a distal end and the distal end of the latch is disposed behind a blocking member.

[0009] In yet another aspect, the invention is directed to a two-piece adapter for mating fiber optic connectors on a fiber optic cassette body that includes a first portion to removably receive a plurality of fiber optic connectors in a first central opening, the first central opening having a plurality of alignment projections projecting from opposing walls, a central partition disposed within the first portion, the central partition having a first plurality of fiber optic ferrule openings, at least one latch to engage the fiber optic cassette body, a second portion attachable to the first portion, the second portion to removably receive a second plurality of fiber optic connectors in a second central opening, the central opening having a plurality of alignment projections projecting from opposing walls, and a second plurality of fiber optic ferrule openings to align with the first plurality of fiber optic ferrule openings.

[0010] In some embodiments, at least one of the second plurality of fiber optic connectors in the second central opening is a two-piece fiber optic connector attached to the second portion via a folded latch on a top or a bottom surface of one of the two pieces of the two-piece fiber optic connector.

[0011] In other embodiments, wherein the second portion includes a latch pocket to receive a portion of the at least one latch.

[0012] In yet another aspect, the present invention is directed to a combination of a two-piece adapter for receiving a two-piece fiber optic connector that includes a two-piece adapter that further includes a first piece configured to receive a plurality of fiber

optic connectors in a first central opening and a second piece removably attachable to the first piece and configured to removably receive at least two fiber optic connectors to mate with a respective one of the plurality of fiber optic connectors in the first piece, the first piece including a latch to attach the two-piece adapter to a fiber optic cassette body and further includes a two-piece fiber optic connector that further includes a first portion having at least two passageways to receive a fiber optic ferrule in each of the at least two passageways, and a second piece attachable to the first piece via a side latch, the second piece having a folded latch on a top or a bottom surface thereof to engage a portion of the two-piece adapter, the folded latch extending from a rear end of the second piece toward the first piece and a distal end of the folded latch disposed behind a blocking surface.

[0013] It is to be understood that both the foregoing general description and the following detailed description of the present embodiments of the invention are intended to provide an overview or framework for understanding the nature and character of the invention as it is claimed. The accompanying drawings are included to provide a further understanding of the invention, and are incorporated into and constitute a part of this specification. The drawings illustrate various embodiments of the invention and, together with the description, serve to explain the principles and operations of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] Fig. 1 is a front right side perspective view of a prior art cassette adapter with the input port side facing out;

[0015] Fig. 2 is a rear perspective view of the prior art cassette adapter with the internal connector ports facing out;

[0016] Fig. 3 is a right side perspective view of one embodiment of a two-piece fiber optic connector inserted into one embodiment of a two-piece adapter according to the present invention;

[0017] Fig. 4 is a front end perspective view of the two-piece adapter in Fig. 3;

[0018] Fig. 5 is a rear end perspective view of the two-piece adapter in Fig. 3;

[0019] Fig. 6 is a front elevation view of a central partition in the first portion of the two-piece adapter in Fig. 3;

[0020] Fig. 7 is a rear perspective view of the first portion of the two-piece adapter in Fig. 3;

[0021] Fig. 8 is a right perspective view of a second portion of the two piece adapter in Fig. 3;

[0022] Fig. 9 is a right perspective view of a partial cross section of the two-piece adapter in Fig. 3;

[0023] Fig. 10 is a left perspective view of a partial cross section of the two-piece adapter in Fig. 3;

[0024] Fig. 11A is a perspective view from the bottom side into the second portion of the two-piece adapter in Fig. 3;

[0025] Fig. 11B is a right perspective view of a partial cross section of the two-piece adapter with the two-piece fiber optic connector inserted therein;

[0026] Fig. 11C is a rear perspective view of a partial cross section of the two-piece adapter with the two-piece fiber optic connector inserted therein;

[0027] Fig. 12 is a top left perspective view of the two-piece fiber optic connector in Fig. 3;

[0028] Fig. 13 is a left perspective view of the two-piece fiber optic connector in Fig. 3;

[0029] Fig 14 is a left perspective exploded view of the two-piece fiber optic connector in Fig. 3;

[0030] Fig. 15 is a cross section of the two-piece fiber optic connector in Fig. 3;

[0031] Fig. 16 is a cross section of the two-piece fiber optic connector and the two-piece adapter in Fig. 3;

[0032] Fig. 17 is a front perspective view of a second portion of the two-piece fiber optic connector in Fig. 12;

[0033] Fig. 18 is a rear perspective view of a second portion of the two-piece fiber optic connector in Fig. 12;

[0034] Fig. 19 is a partial cross section view of the second portion of the two-piece fiber optic connector from the bottom side;

[0035] Fig. 20 is a right side perspective view of an exploded second embodiment of a two-piece fiber optic connector according to the present invention; and

[0036] Fig. 21 is a right side perspective view of an exploded second embodiment of a two-piece adapter according to the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0037] Reference will now be made in detail to the present preferred embodiment(s) of the invention, examples of which are illustrated in the accompanying drawings. Whenever possible, the same reference numerals will be used throughout the drawings to refer to the same or like parts.

[0038] Figures 1 and 2 illustrate a prior art adapter **10** that is used with fiber optic cassettes (not shown). The prior art adapters **10** are inserted into the fiber optic cassettes and are retained therein with the latches **12**. There are two openings **14** in the front of the adapter **10** to receive a pair of connectors, usually having the LC configuration. See Fig. 1. Similarly, there are connectors that are inserted into the openings **16** in the back side of the adapter **10**, to mate with the connectors inserted in the front. See Fig. 2. Optical fibers exit the back of the connectors in the back side of the adapter **10** and cross over the fiber optic cassette to be terminated in a different style connector, e.g., an MPO connector. However, the adapters **10** occupy a lot of space on the front of the fiber optic cassette for accommodating just two optical fibers. Thus, a new adapter and fiber optic connector are presented to triple the number of optical fibers that can be accommodated.

[0039] A first embodiment of a two-piece fiber optic connector **100** inserted into one embodiment of a two-piece adapter **200** according to the present invention is illustrated in Fig. 3. As will be recognized, the two-piece adapter **200** is inserted into the fiber optic cassette as illustrated by the arrow in Fig. 3. Thus, the two-piece fiber optic connector **100** would be inside the fiber optic cassette. As recognized from Figs. 3-11C, the two-piece adapter **200** can receive three duplex fiber optic connectors (on both sides). Since the two-piece adapter **200** is the same size as that of adapter **10**, this means the two-piece adapter **200** allows for a three-fold increase in the number of fiber optic connectors and optical fibers in the fiber optic cassette. The two-piece adapter **200** and the two-piece fiber optic connector 100 could also be used with a backplane, or a front panel of a server rack.

[0040] The two-piece adapter **200** has a first portion **200a** and a second portion **200b**. See, e.g., Figs. 7 and 8. The first portion **200a** has central opening **202** to removably receive a plurality of fiber optic connectors. The central opening **202** is formed by a top wall **204**, a bottom wall **206,** and two side walls **208** that extend from the top wall **204** to the bottom wall **206**, as shown for example in Fig. 4. Extending into the central opening

202 from the top wall **204** to the bottom wall **206** are a number of alignment projections **210**. The alignment projections **210** divide the central opening **202** into thirds and cooperate with alignment shoulders on the connectors inserted into the first portion **200a** from outside of the fiber optic cassette. Such a fiber optic connector may be the MDC-type connector that is sold by Applicant, and disclosed for example in WIPO Publication No. WO/2019/195652, the contents of which are incorporated herein by reference in their entirety.

[0041] The alignment projections (on both sides as detailed below) may be the same as or similar to those discussed in Applicant's U.S. Patent Nos. 9,857,538 and 10,156,684, for example, as well as in Applicant's pending patent application no. PCT/US18/66518 entitled "Mini Duplex Connector with Push-Pull Polarity and Carrier." The contents of these applications are incorporate herein by reference in their entirety.

[0042] Turning to Figs. 6 and 7 where the first portion **200a** from the front **212** (Fig. 6) and from the rear **214** (Fig. 7) are shown. The first portion **200a** has a central partition **216** that divides the first portion **200a** into two parts. At the front **212** is the central opening **202**, and at the rear **214** is where the second portion **200b** is connected to the first portion **200a**. See Figs. 8-10. Extending from the central partition **216** toward the front **212** are a number of fiber optic ferrule openings **218**. See also Figs. 9 and 10. The fiber optic ferrule openings **218**are to receive fiber optic ferrules from the connectors inserted into the central opening **202** and align them with the two-piece fiber optic connectors **100** as explained below. The fiber optic ferrule openings **218**may also be large enough to receive split sleeves (as is known in the art), which in turn then receive the fiber optic ferrules from the fiber optic connectors. These fiber optic ferrule openings **218** will align with similar fiber optic ferrule openings **220** in the second portion **200b**, which would also receive the split sleeves if they were used. See, e.g. Fig 10 showing one split sleeve **218a**. Thus, the fiber optic ferrule openings **218**,**220** ensure alignment of the optical fibers from the opposing fiber optic connectors within the two-piece adapter **200**.

[0043] The central partition **216** also includes two alignment openings **222**, which each receive an alignment post **224** (see e.g., Fig. 8)that is associated with the second portion **200b**. Indeed, in Fig. 9, the alignment posts **224** are visible within the alignment openings **222**. These two components further ensure that the fiber optic ferrule openings **218** will align with the ferrule openings **220**. As can be seen in Figs. 6 and 7, the

alignment openings **222** and the alignment posts **224** are disposed off-center vertically, thereby acting also as a polarity key to ensure that the two portions **200a**,**200b** are connected to one another in the correct orientation. There may be other external polarity features present in addition to or as an alternative to the alignment posts **224** and the alignment openings **222**. The central partition **216** also include depressions or openings **230** that provide space within the first portion **200a** for latches that are depressed to allow the two-piece adapter **200** to be moved in and out of the fiber optic cassette. This is discussed in more detail below.

[0044] Turing now to Fig. 8, the second portion **200b** is illustrated. Second portion **200b** has a front end **240** and a rear end **242**, with the rear end **242** being inserted into the rear **214** of the first portion **200a**. As noted above, the rear end **242** has a wall **244** from which the alignment posts **224** extend to engage the two alignment openings **222** in the central partition **216**. Extending from the wall **244** in a direction toward the front end **240** are a plurality of fiber optic ferrule openings **220** that match up to the fiber optic ferrule openings **218** discussed above.

[0045] The second portion **200b** also has at the front end **240** a central opening **250** to removably receive a plurality of two-piece fiber optic connectors **100**. The central opening **250** is formed by a top wall **252**, a bottom wall **254,** and two side walls **256** that extend from the top wall **252** to the bottom wall **254.** Extending into the central opening **250** from the top wall **252** to the bottom wall **254** are a number of alignment projections **260**. The alignment projections **260** divide the central opening **250** into thirds and cooperate with alignment shoulders on the plurality of two-piece fiber optic connectors **100** to guide the two-piece fiber optic connectors **100** to the fiber optic ferrule openings **220**.

[0046] The connection of the first portion **200a** to the second portion **200b** is achieved by simply pushing the second portion **200b** into the first portion **200a**. There are a number of detents **264** on second portion **200b** towards the rear end **242**. The first portion **200a** has a corresponding number of windows **266** to receive those detents **264**. See Figs. 5, 9, 10, and 11A. As illustrated, the detents **264** can be on both sides of the second portion **220b** and also have corresponding windows **266**, or they may only be on one side. The first portion 200a and the second portion **200b** are pushed together or relative to one another so that the detents **264** engage the windows **266**. The first and

second portions **200a**,**200b** each have a wall surface **268a**,**268b**, respectively as shown in Figs. 7 and 8, that contacts one another when the first and second portions **200a**,**200b** have been properly connected. The wall surface is a portion of the top surface, the bottom surface, and the side walls of the respective first and second portions **200a**,**200b.**

[0047] The two-piece adapter **200** also has a number of latches **270** to engage the fiber optic cassette. The latches **270** are illustrated as being four, two on each of the top and bottom of the first portion **200a**. The latches **270** are cantilevered and have an opening **272** (see, e.g., Fig. 5) surrounding the latch **270** that extends from outside into the first portion **200b**. As noted above, there are depressions or openings **230** (see, e.g., Fig. 7) that provide space for the latches **270** to be pushed into those depressions or openings **230** when the two-piece adapter **200** is inserted into a fiber optic cassette. A portion of the openings **272** near the side walls **208** of the first portion **200a** also function as the windows **266** to receive some of the detents **264**. It may also be possible to move the latches **270** from the first portion **200a** to the second portion **200b**.

[0048] It is to be noted that there are different portions of the first portion **200a** and the second portion **200b**. The first portion **200a** is divided into a front portion **274** and a rear portion **276** (see, e.g., Fig. 9), while the second portion **200b** is divided into front portion **278** and rear portion **280** (see, e.g., Fig. 11A). The front portion **274** has a larger circumference than the rear portion **276**. Similarly, the front portion **278** is larger than the rear portion **280**. The rear portion **280** is sized to fit into the rear portion **276**. Additionally, the front portion **278** has the same circumference as the rear portion **276** of the first portion **200b**. As illustrated in Fig. 9, these different sizes mean that the different portions of the first and second portions **200a**,**200b** lie in different planes. The front portion **274** of the first portion **200a** lies in a plane **A**, while the rear portion **274** of first portion **200a** and the front portion **276** of second portion **200b** lie in the same plane **B**. The rear portion **278** of the second portion **200a** lies in plane **C**. The larger circumference of the front portion **274** assists in keeping the two-piece adapter **200** from being pulled into the fiber optic cassette.

[0049] Illustrated in Figs. 12-15 is the two-piece fiber optic connector **100**, which includes a first portion **100a** and a second portion **100b**. The two-piece fiber optic connector **100** is a duplex connector, meaning that is has two fiber optic ferrules **102**, each of which have a single optical fiber (not illustrated) secured within the fiber optic

ferrule **102**. The first portion **100a** and the second portion **100b** could be modified to accept a multi-fiber ferrule as well. The first portion **100a** has two passageways **104** that accept the fiber optic ferrule **102** and other components that may be necessary for the protection of the fiber optic ferrule **102** and the optical fiber. For example, there is a ferrule holder **106** that accepts the fiber optic ferrules **102** from a front end **108** of the ferrule holder **106**. There may also be a heat shrink tube **110** at the back end of the ferrule holder **106**.

[0050] The first portion **100a** generally has a top surface **112**, a bottom surface **114**, and two side surfaces **116** (see, e.g., Fig. 13). As can be seen in the figures, the surfaces do not need to be flat, but they could be. At each of the junctions of the top surface **112** with the side surfaces **116** and at least a portion of where the bottom surface **114** meets the side surfaces **116**, there are alignment shoulders **118** (see, e.g., Fig. 12). These alignment shoulders **118** correspond to the alignment projections **260** in the second portion **200b** of the two-piece adapter **200**. When the alignment shoulders **118** correspond with the alignment projections **260**, the fiber optic ferrules **102** align with the alignment projections **260** in the second portion **200b**. See, e.g., Figs. 11A-11C.

[0051] The front of the ferrule holder **106** has a hexagonal nut shape with a chamfered surface of the ferrule holder **106**. See Fig. 14. The passageways **104** each have a forward facing surface **120** that engages a rearward facing surface **122** of the ferrule holders **106**. See, e.g., Fig. 15. There is no spring needed with the two-piece fiber optic connector **100**.

[0052] The first portion **100a** also has an integral latch **130** that engages the second portion **200b** of the two-piece adapter **200**. The integral latch **130** is formed at the same time and from the same material as the rest of the first portion **100a**. The latch **130** preferably starts at the rear end **132** of the second portion **200b** of the two-piece adapter **200** and extends toward a distal end or the front end **134**. There is a space **136** between the top surface **112** and the underside of the latch **130**. The space **136** allows a user to remove the two-piece fiber optic connector **100** from the two-piece adapter **200**. The latch **130** can also function as a key to prevent the two-piece fiber optic connector **100** from being inserted into the two-piece adapter **200** incorrectly. The latch **130** also has two latch extensions **138** that engage surfaces in the second portion **200b** of the two-piece adapter **200**. The front end **140** of the latch **130** is preferably positioned behind a

blocking surface **142**. As illustrated in Fig. 13, for example, the blocking surface **142** is a part of the top surface **112** on the first portion **100a**. The latch **130** is joined to the blocking surface **142** and forms a folded latch at the front end **134** of the two-piece connector **100**. Such a joining of the folded integral latch **130** eliminates any chances of snagging of fibers due to an exposed tip of a free hanging latch, as used in conventional LC connectors, for example. In a later embodiment, there is another blocking surface that is on the second portion of the fiber optic connector. Alternatively, the latch **130** may be secured to the top surface **112** of the first portion **100a**.

[0053] Returning to Figs. 11A-11C, the function of the latch **130**, the keying function of the latch **130** and the positioning of the two latch extensions **138** will be discussed. The second portion **200b** of the two-piece adapter **200** has in the top of the central opening **250** a groove **290** between the alignment projections **260** to receive the latch **130**. There is no corresponding groove in the bottom of the central opening **250**, thereby preventing a user from inserting the two-piece fiber optic connector **100** into the two-piece adapter **200** incorrectly. The top wall **204** also has three windows **292** that are aligned with the groove **290** to receive the two latch extensions **138** when the two-piece fiber optic connector **100** is inserted correctly. There is a break **294** in the alignment projections **260** in the second portion **200b**, thereby making a surface **296** against which the two latch extensions **138** will engage to prevent the two-piece fiber optic connector **100** from being removed accidentally. The user may press on the latch **130** to release the two latch extensions **138**, press on the latch **130** through the windows **292**, or press on the top surface of the latch **130** or a tab thereon to depress the latch **130**, shortening the space **136**.

[0054] The folded latch design of the latch **130** provides the advantage of controlling only a single dimension from where the latch **130** joins the blocking surface **142** to the rearward facing surface **122** of the ferrule holders **106** with respect to the rear piece of the connector to properly seat the ferrule, as shown in FIG. 11B. As a result, since there is only one dimension that needs to be controlled with respect to the ferrule positioning, and stacking of tolerances is not an issue with the design of this small form-factor two-piece connector **100**.

[0055] As best viewed in Fig. 11C, there is a continuation of the groove, a portion **298** that receives the front end **140** of the latch **130**.

[0056] The first portion **100a** also has two side latches **150** that correspond to side latch windows on the second portion **100b**. As best seen in Fig. 14, the two side surfaces **116** are not smooth, but have a contour **152** that protects the two side latches **150**. While the first portion **100a** and the second portion **100b** attach to each other via the side latches **150**, one of ordinary skill in view of this disclosure will appreciate that the first portion **100a** and the second portion **100b** may be attached to each other by other means, for example, by latches **150** being moved to the top surface **112** and the bottom surface **114**, with corresponding windows on the second portion **100b**. Yet alternatively, only a single side latch **150** is possible.

[0057] The second portion **100b** has a top surface **154**, a bottom surface **156**, and two side surfaces **158** with tabs **160** that extend along the side surfaces **116** of the first portion **100b**. The second portion **100b** also has the alignment shoulders **118a** that are a continuation of the alignment shoulders **118** of the first portion **100a**. The tabs **160** have side latch windows **162** that receive one of the two side latches **150** to secure the first portion **100a** to the second portion **100b**.

[0058] The second portion **100b** has two passageways **164** (e.g., in Fig. 15) to receive the fiber optic ferrules **102** and a front end **108** of the ferrule holder **106**. The passageways **164** include a portion **166** that have the configuration of the hexagonal nut portion of the ferrule holder **106**. See, e.g., Figs. 17-19. Thus, the ferrule holder **106** engages the portion **166** (in particular the chamfered portion) to prevent the ferrule holder **106** from extending beyond the portion **166**.

[0059] A second embodiment of a two-piece fiber optic connector **100'** is illustrated in Fig. 20. The majority of the two-piece fiber optic connector **100'** is similar to that described in detail above and will not be addressed again here. However, the two-piece fiber optic connector **100'** has a different latch 130' and a different front end **140'**. The front end **140'** of the latch **130'** is separated from the remainder of the first portion **100a'**. The second portion **100b'** has a latch pocket **142'** that functions as the blocking surface in this embodiment. The latch pocket **142'** prevents the latch **130'** from snagging other connectors, adapters, and optical fibers once the first portion **100a'** and the second portion **100b'** have been attached.

[0060] A second embodiment of a two-piece adapter **200'** is illustrated in Fig. 21. This adapter **200'** can be used with the two-piece fiber optic connector **100'** in Fig. 20. One of

the main differences in this embodiment, is that the alignment posts **224'** and the alignment openings **222'** are in the center of the central partitions **216'** and therefore do not provide a keying feature. However the second portion **200b** has two polarity keys **286'** and the first portion **200a** has two polarity slots **288'** to ensure the correct assembly of the two-piece adapter **200'**.

[0061] It will be apparent to those skilled in the art that various modifications and variations can be made to the present invention without departing from the spirit and scope of the invention. Thus it is intended that the present invention cover the modifications and variations of this invention provided they come within the scope of the appended claims and their equivalents.

We claim:

1. A two-piece fiber optic connector comprising:

a first portion having at least two passageways to receive a fiber optic ferrule in each of the at least two passageways;

a latch extending from a surface adjacent a rear portion of the first portion to removably engage an adapter;

two side latches, each of the two latches disposed on a surface adjacent to the surface from which the latch extends and on opposite sides of the first portion;

a second portion to receive a front portion of the first portion; and

at least two side latch windows on the second portion to receive at least a portion of the two side latches to retain the first and second portions together.

2. The two-piece fiber optic connector according to claim 1, further comprising alignment shoulders on the first and second portions.

3. The two-piece fiber optic connector according to claim 1, wherein the alignment shoulders are configured to engage alignment projections projecting from walls in the adapter.

4. The two-piece fiber optic connector according to claim 1, wherein the fiber optic ferrules are inserted into a holder having a hexagonal nut configuration and the second portion has internal configuration configured to receive the hexagonal nut configuration.

5. The two-piece fiber optic connector according to claim 1, wherein the latch has two rearward facing surfaces to engage a portion on the adapter to removably retain the two-piece fiber optic connector therein.

6. The two-piece fiber optic connector according to claim 1, wherein the latch has a distal end and the distal end of the latch is disposed behind a blocking member.

7. The two-piece fiber optic connector according to claim 6, wherein the blocking member is disposed on the second portion.

8. The two-piece fiber optic connector according to claim 6, wherein the blocking member is disposed on the first portion.

9. The two-piece fiber optic connector according to claim 6, wherein the blocking portion includes a latch pocket to receive a portion of latch.

10. A two-piece adapter for mating fiber optic connectors comprising:

a first portion to removably receive a plurality of fiber optic connectors in a first central opening, the first central opening having a plurality of alignment projections projecting from opposing walls;

a central partition disposed within the first portion, the central partition having a first plurality of fiber optic ferrule openings;

at least one latch to engage the fiber optic cassette body;

a second portion attachable to the first portion, the second portion to removably receive a second plurality of fiber optic connectors in a second central opening, the central opening having a plurality of alignment projections projecting from opposing walls; and

a second plurality of fiber optic ferrule openings to align with the first plurality of fiber optic ferrule openings.

11. The two-piece adapter for mating fiber optic connectors according to claim 10, further comprising at least one polarity key in the second portion to fit in at least one polarity slot in the first portion.

12. The two-piece adapter for mating fiber optic connectors according to claim 10, wherein the at least one latch is disposed on the first portion.

13. The two-piece adapter for mating fiber optic connectors according to claim 10, further comprising a first plurality of sleeve holes in the first portion and a second plurality of sleeve holes in the second portion, each of the sleeve holes in the first portion corresponding to one of the second plurality of sleeve holes.

14. The two-piece adapter for mating fiber optic connectors according to claim 13, further comprising a split sleeve disposed in each of first plurality of sleeve holes.

15. The two-piece adapter for mating fiber optic connectors according to claim 10, wherein each of the plurality of alignment projections in the first portion and the second portion engage a portion of a fiber optic connector to align the fiber optic connector with one of the plurality of sleeve holes.

16. The two-piece adapter for mating fiber optic connectors according to claim 10, wherein one of the first portion and the second portion have a detent and the other of the first and second portions have a corresponding receptacle to receive the detent to removably attach the first portion to the second portion.

17. The two-piece adapter for mating fiber optic connectors according to claim 10, wherein the first portion has a first outer surface and a second outer surface, the first outer surface having a circumference that is greater than the second outer surface and wherein the second portion has an outer surface, the outer surface of the second portion has a circumference that is the same as the circumference of the second outer surface of the first portion.

18. The two-piece adapter for mating fiber optic connectors according to claim 10, wherein at least one of the second plurality of fiber optic connectors in the second central opening is a two-piece fiber optic connector attached to the second portion via a folded latch on a top or a bottom surface of one of the two pieces of the two-piece fiber optic connector.

19. The two-piece fiber optic connector according to claim 10, wherein the second portion includes a latch pocket to receive a portion of the at least one latch.

20. A combination of a two-piece adapter for receiving a two-piece fiber optic connector comprising:

a two-piece adapter comprising:

a first piece configured to receive a plurality of fiber optic connectors in a first central opening; and

a second piece removably attachable to the first piece and configured to removably receive at least two fiber optic connectors to mate with a respective one of the

plurality of fiber optic connectors in the first piece, the first piece including a latch to attach the two-piece adapter to a fiber optic cassette body; and

a two-piece fiber optic connector comprising:

a first portion having at least two passageways to receive a fiber optic ferrule in each of the at least two passageways; and

a second piece attachable to the first piece via a side latch, the second piece having a folded latch on a top or a bottom surface thereof to engage a portion of the two-piece adapter, the folded latch extending from a rear end of the second piece toward the first piece and a distal end of the folded latch disposed behind a blocking surface.

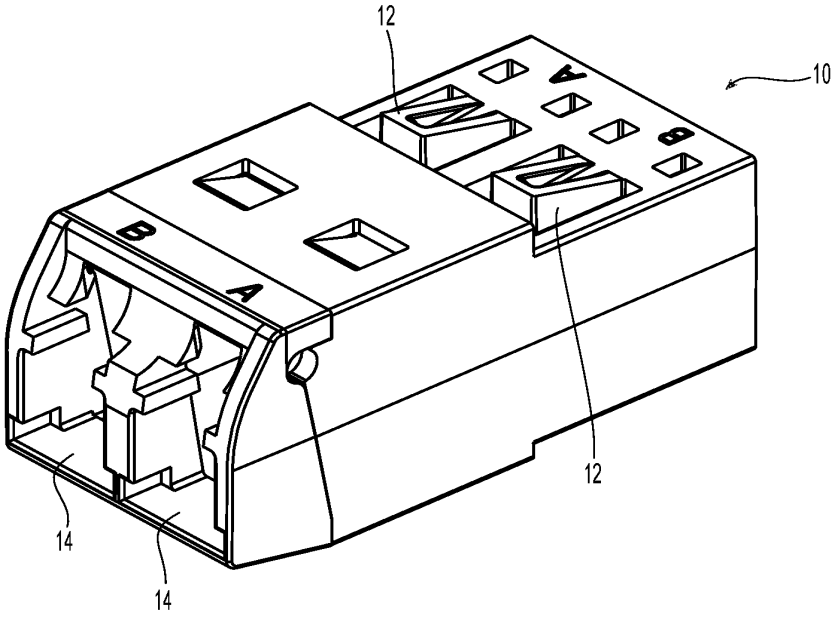


Fig. 1

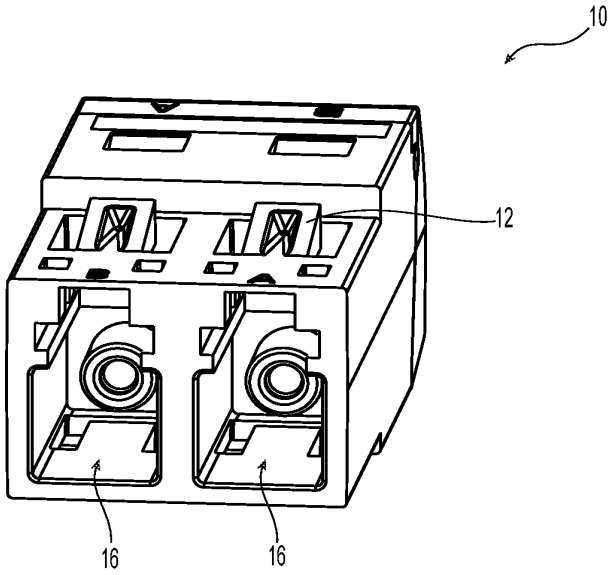


Fig. 2

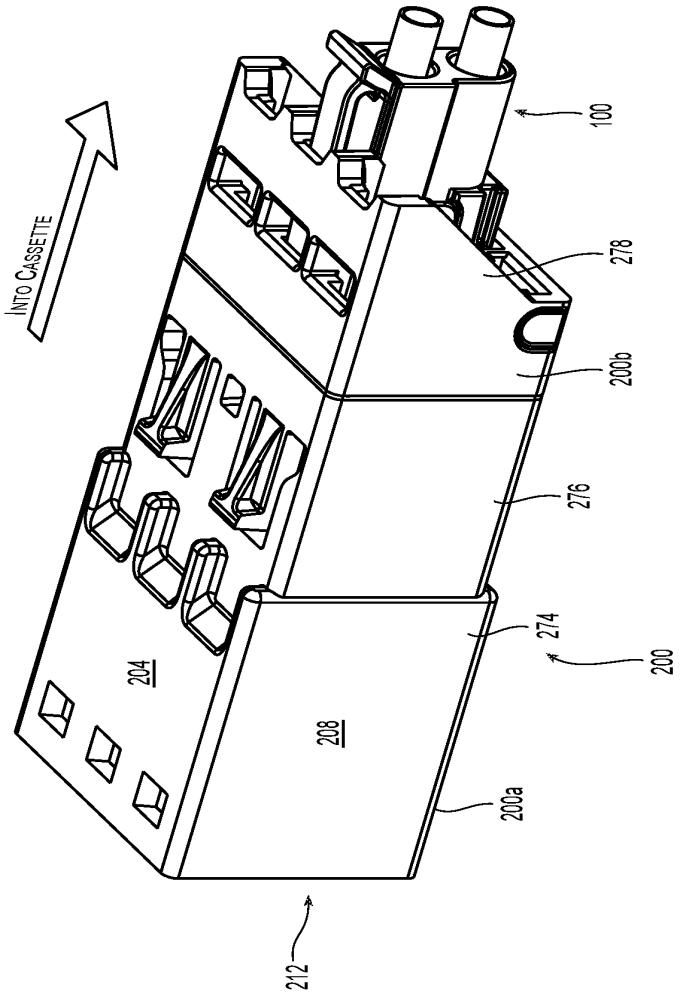


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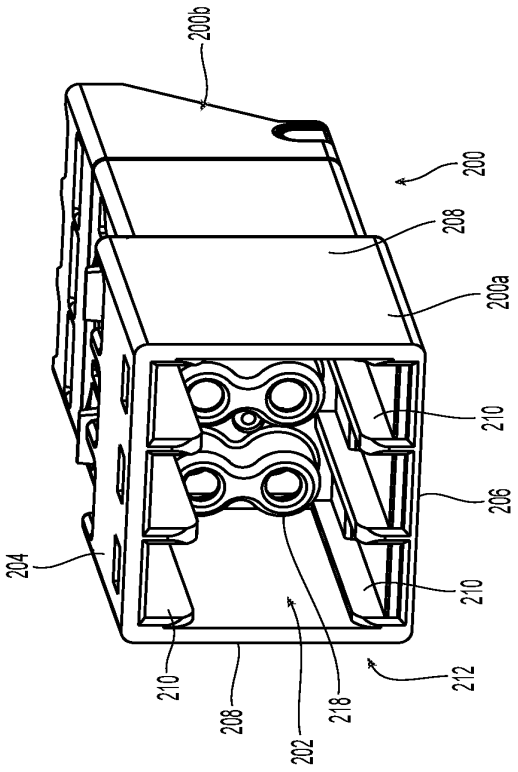


Fig. 4

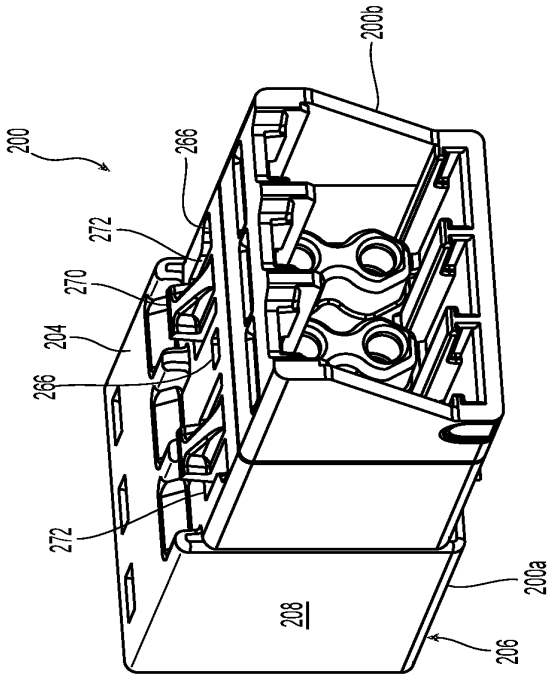


Fig. 5

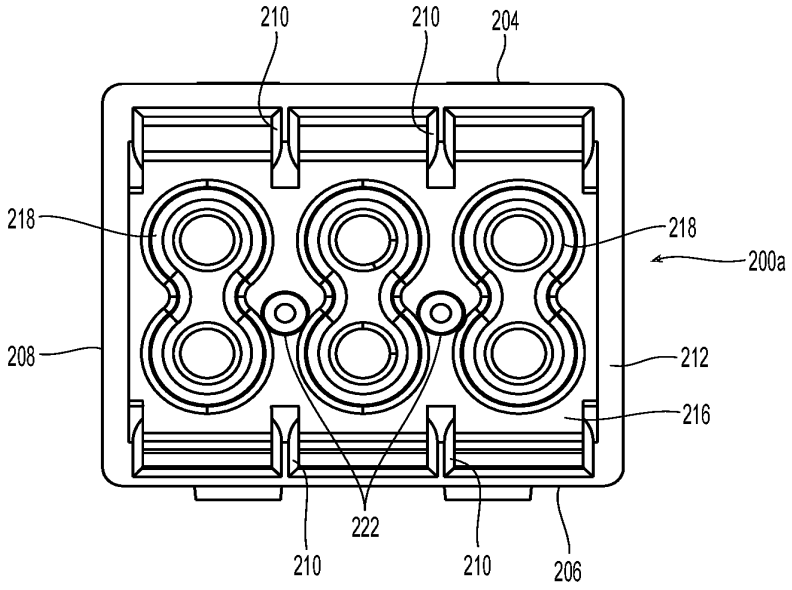

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Fig. 6

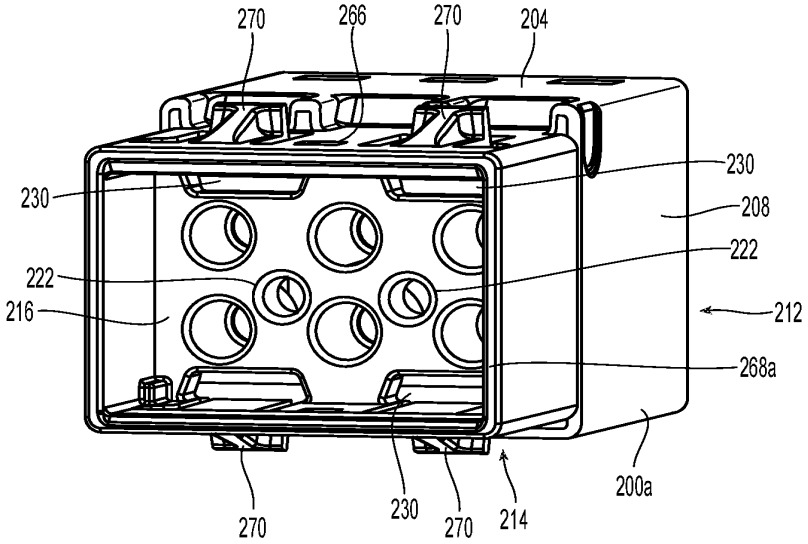

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Fig. 7

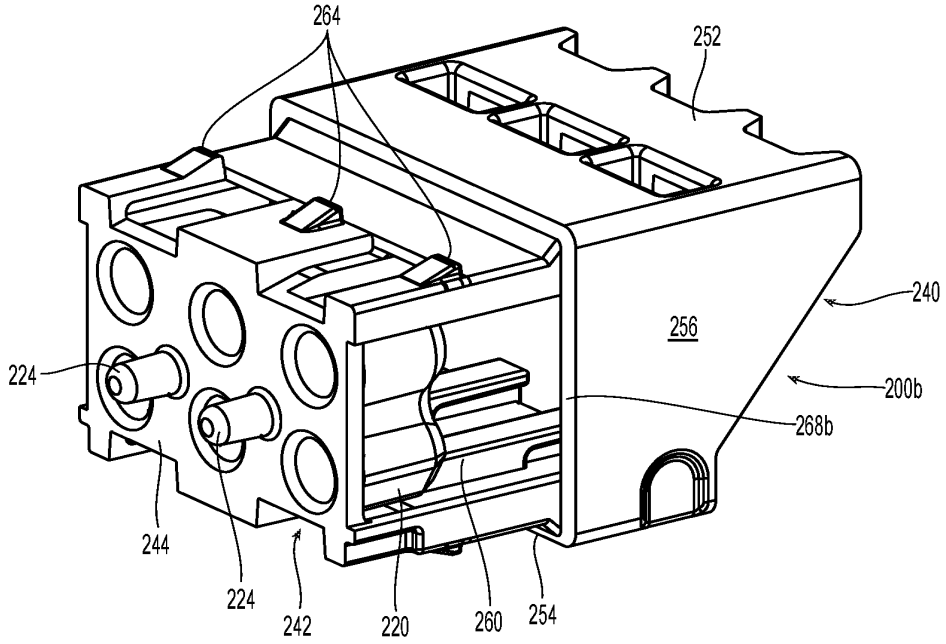


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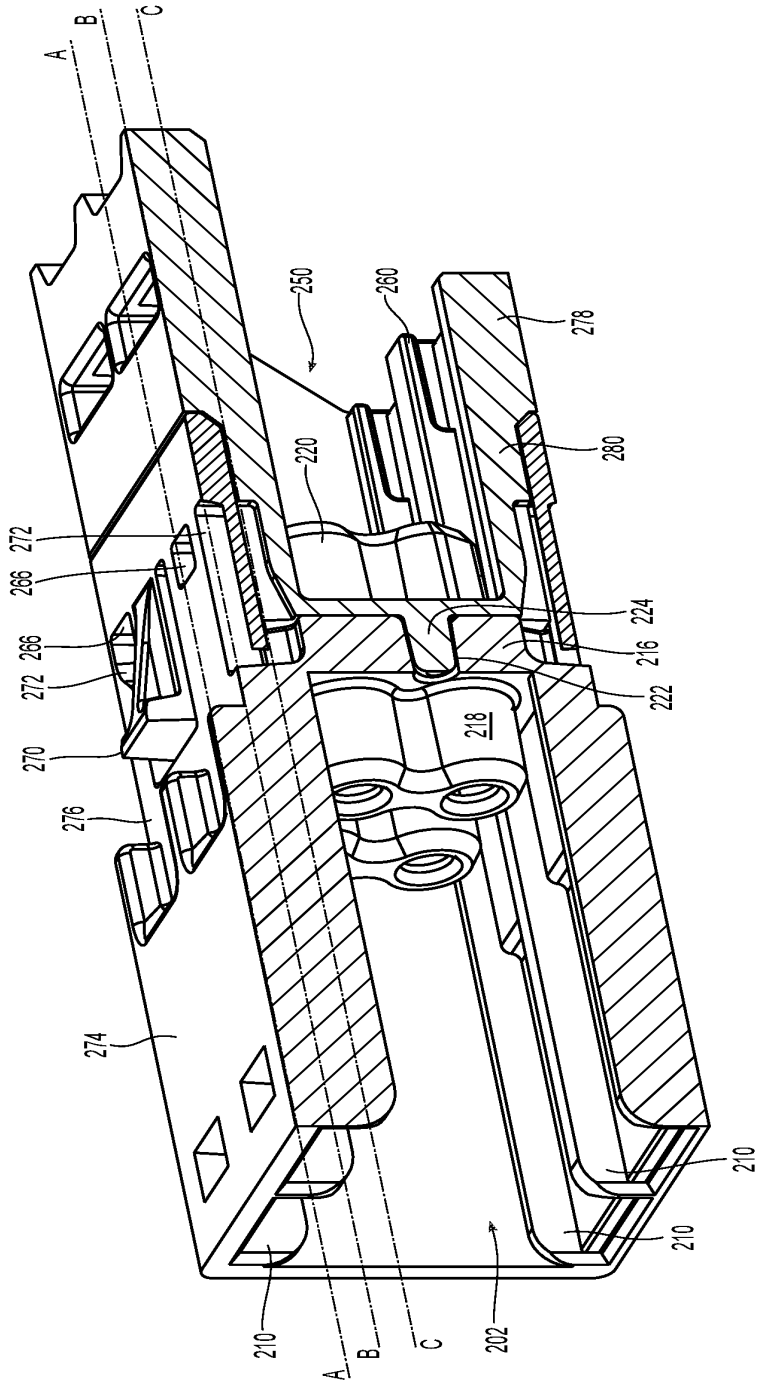

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Fig. 9

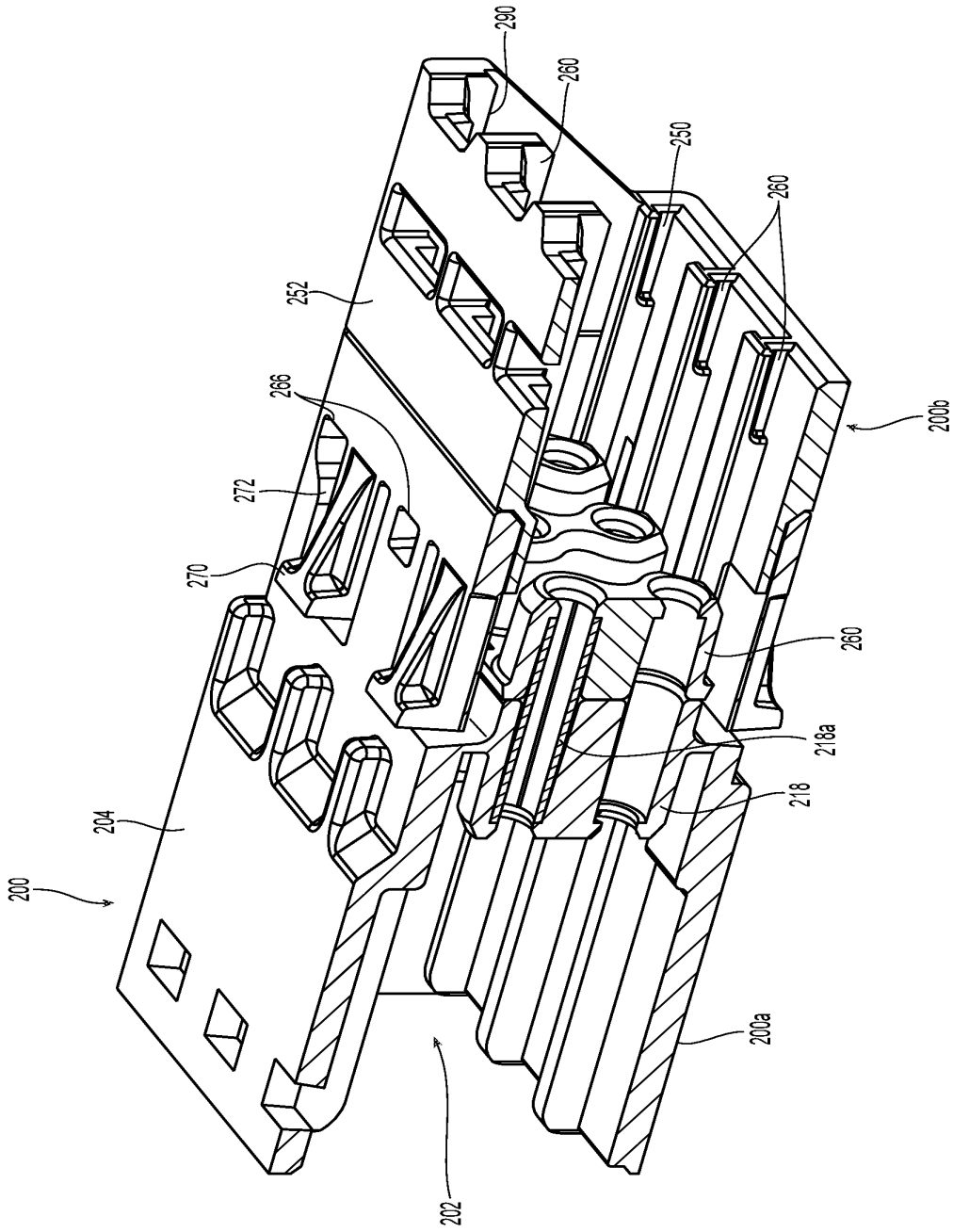

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Fig. 10

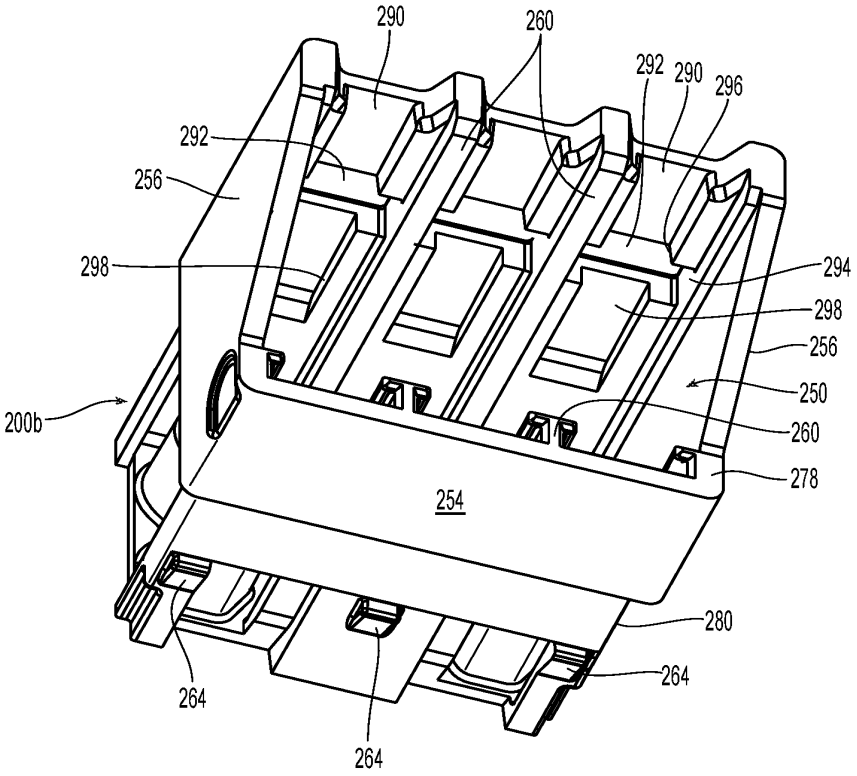

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Fig. 11A

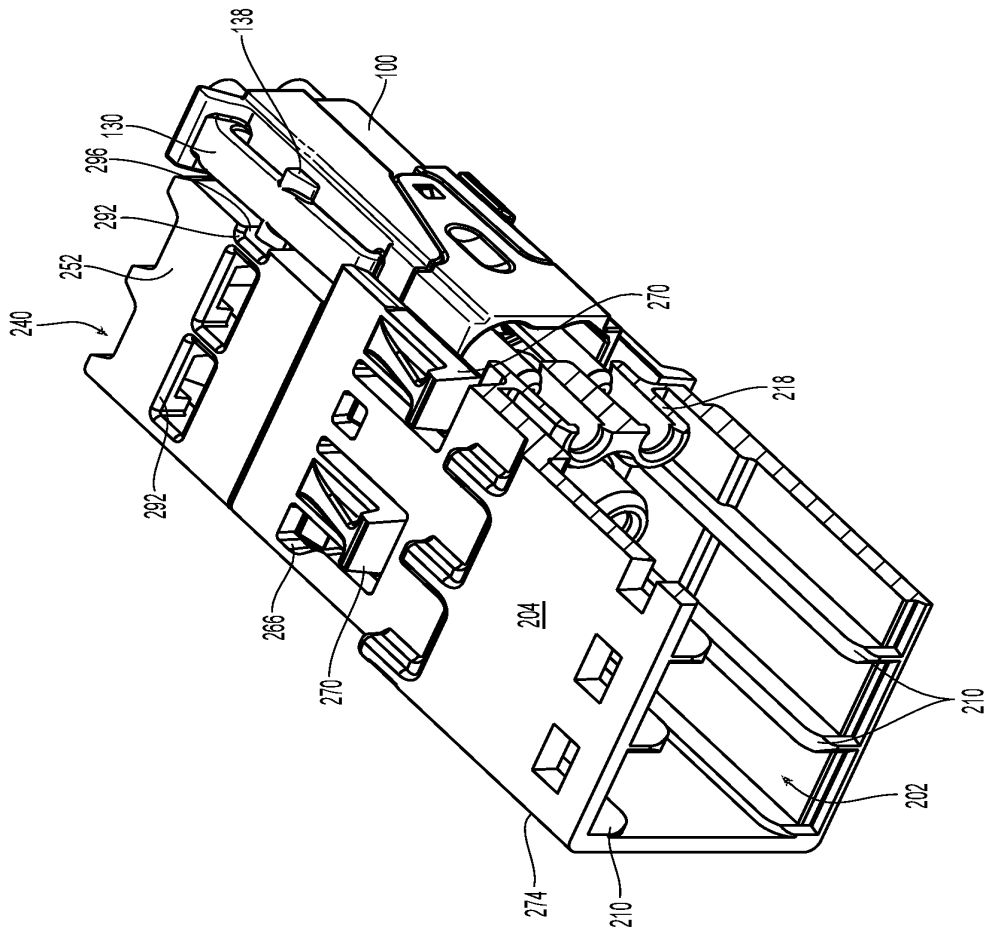

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Fig. 11B

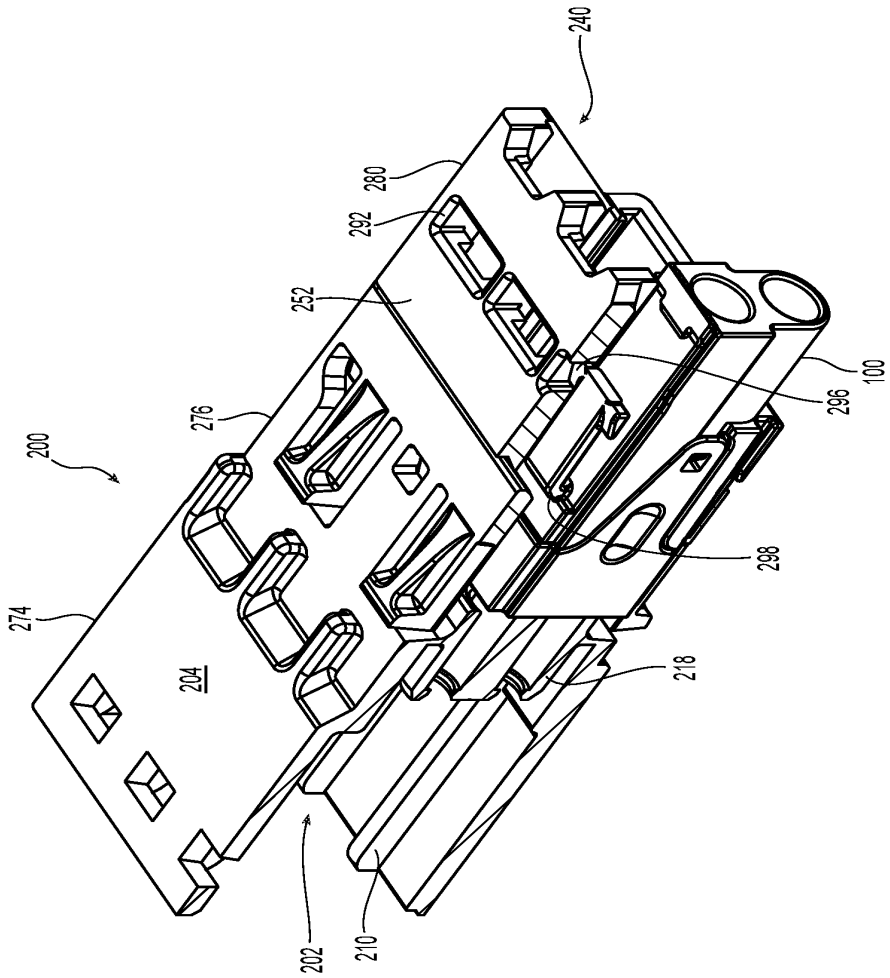


Fig. 11C

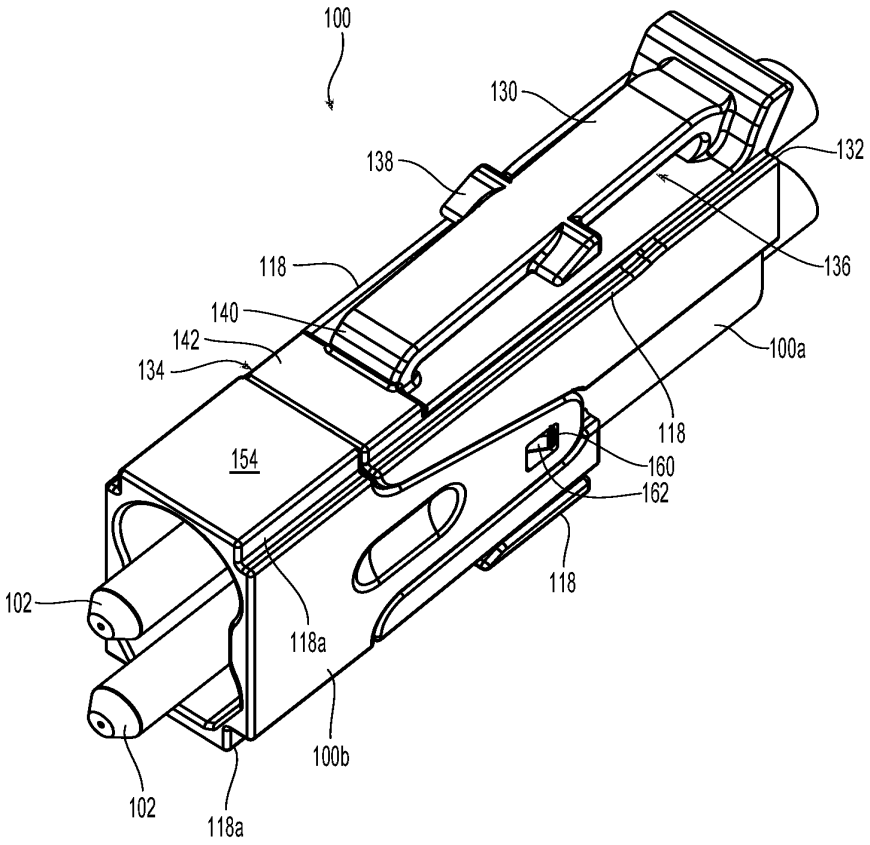

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Fig. 12

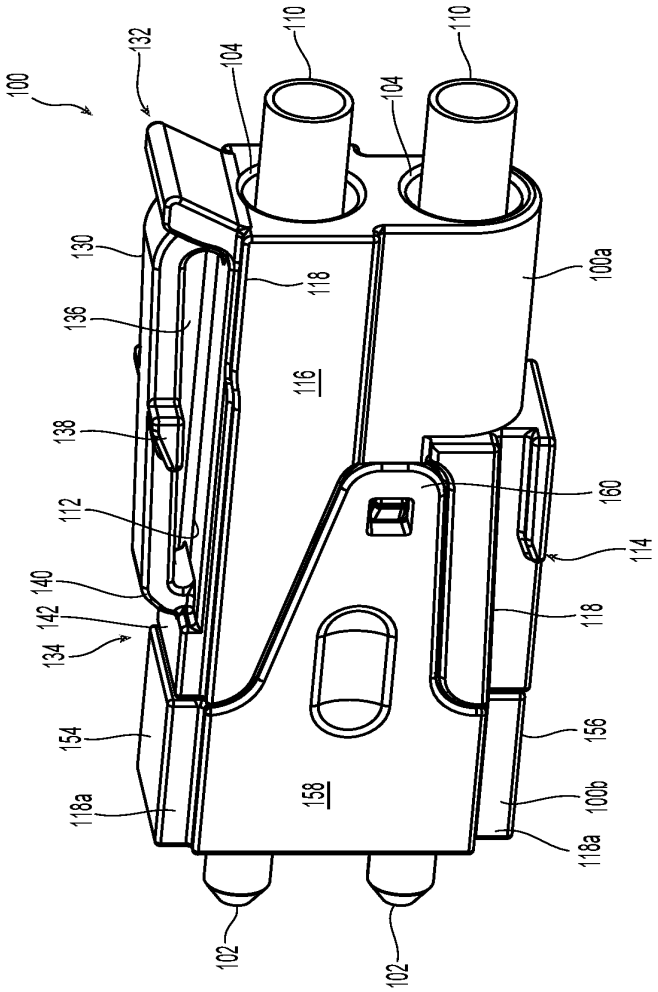

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Fig. 13

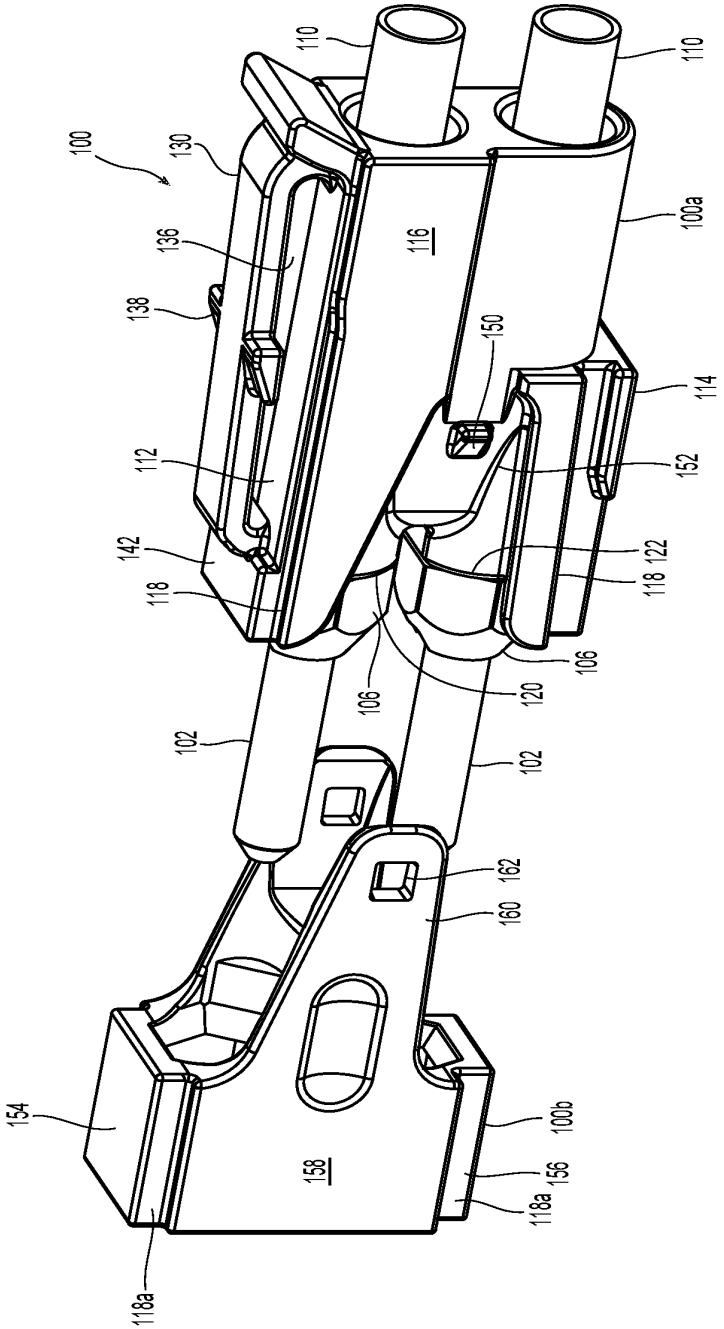

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Fig. 14

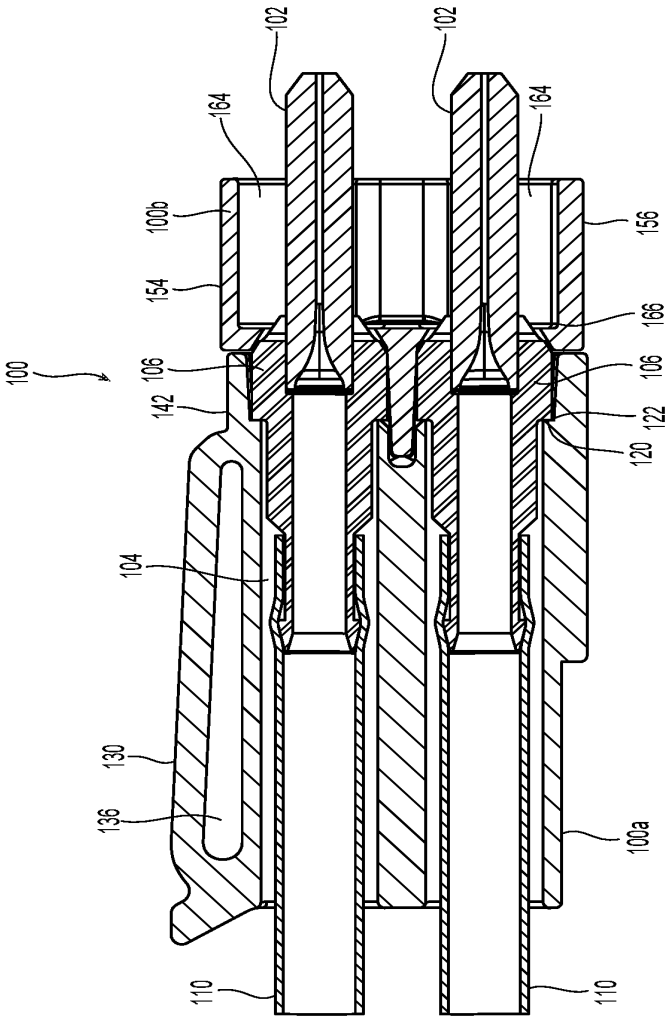

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Fig. 15

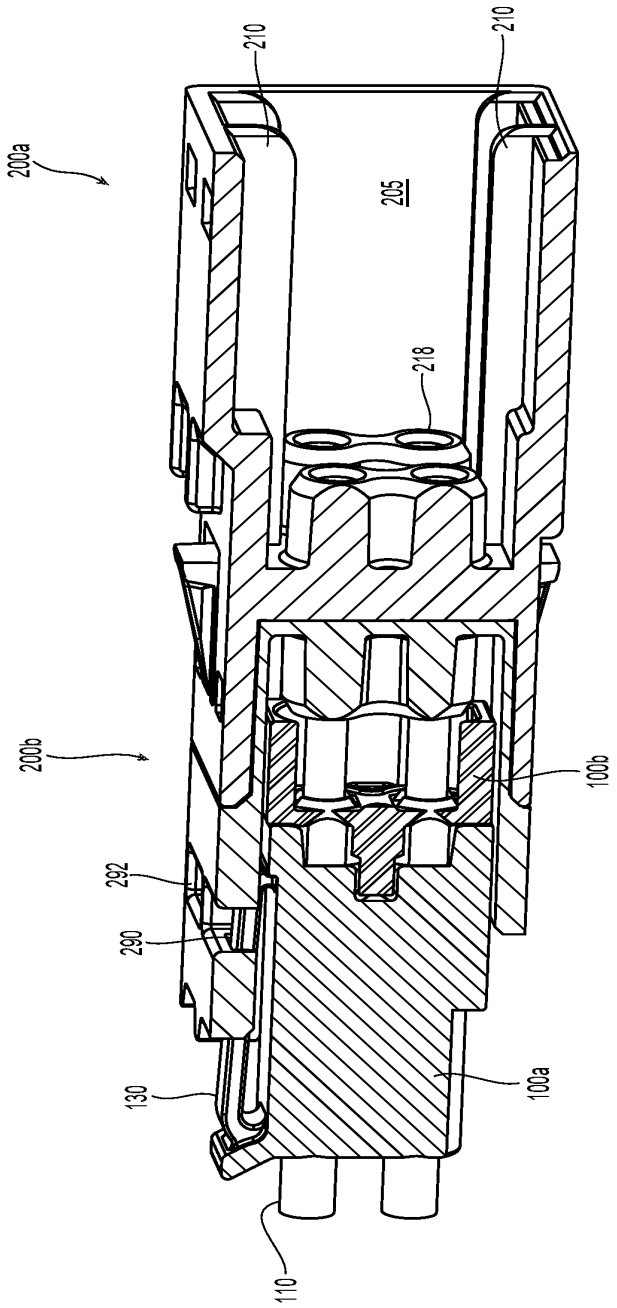


Fig. 16

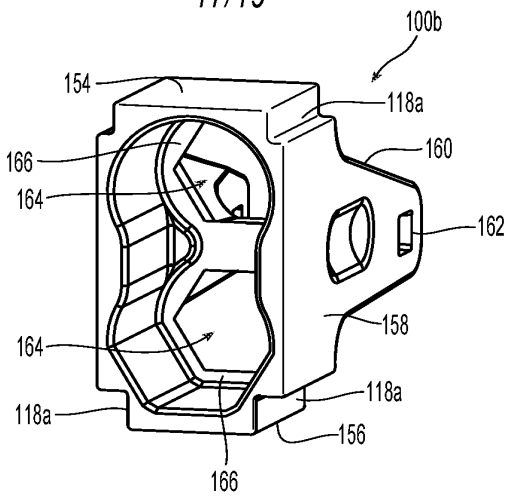


Fig. 17

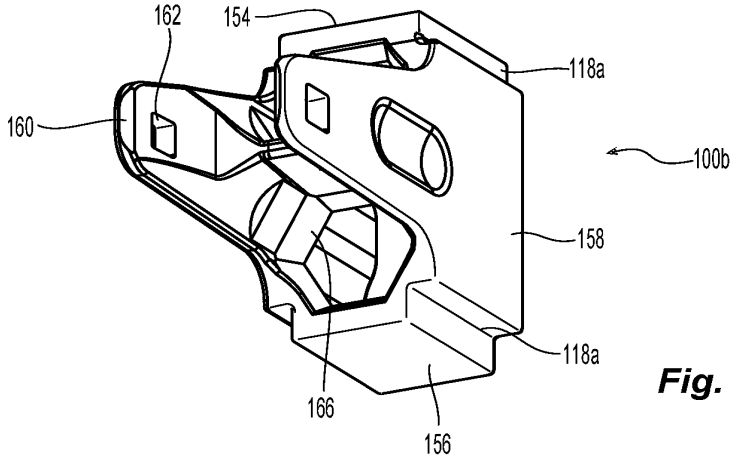


Fig. 18

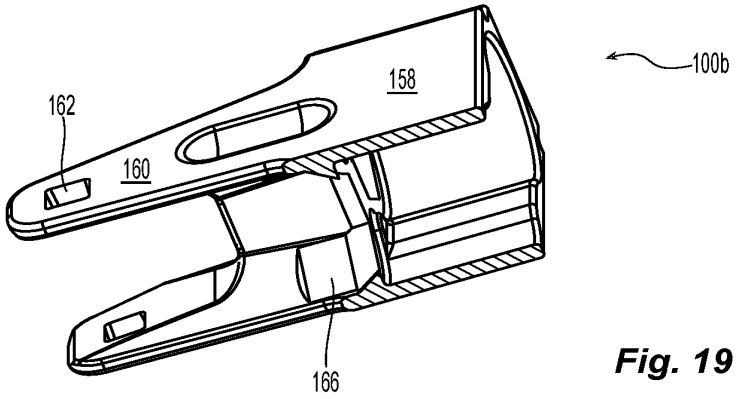


Fig. 19

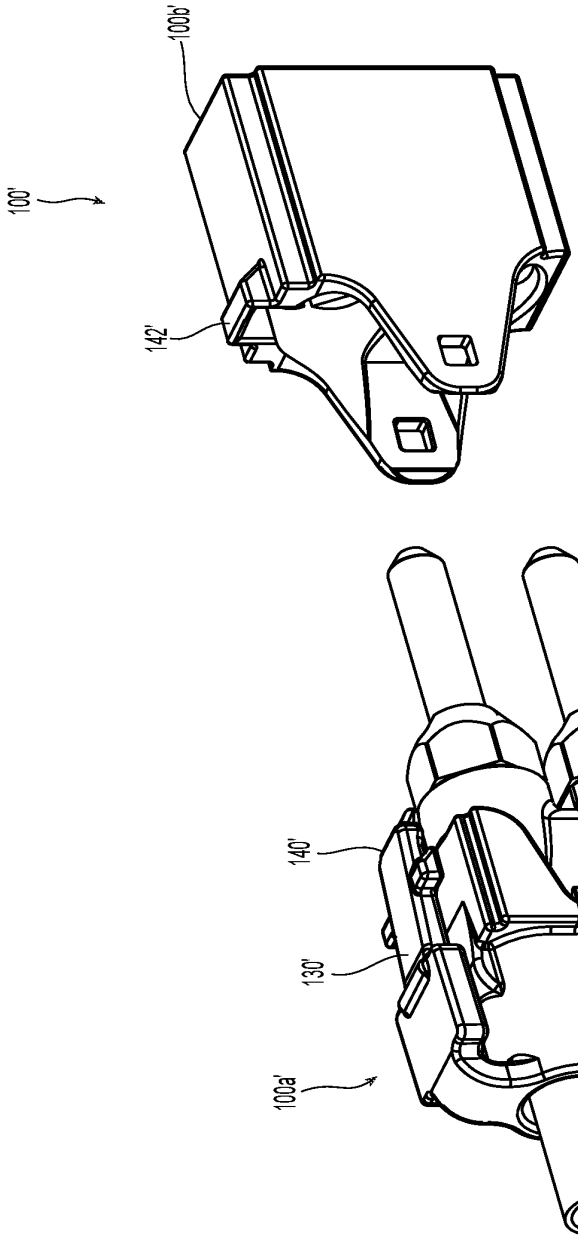


Fig. 20

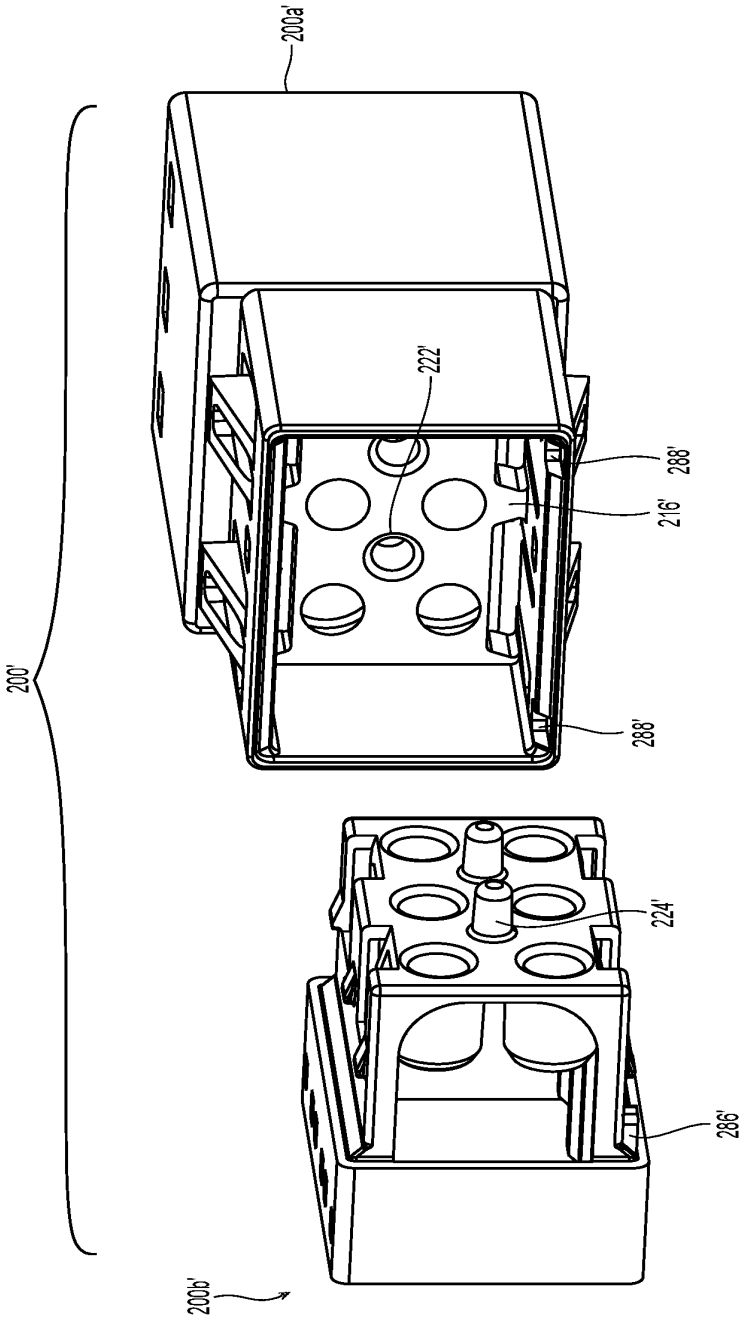


Fig. 21

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2020/015858

A. CLASSIFICATION OF SUBJECT MATTER

G02B 6/38(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)
G02B 6/38; G02B 6/36; G02B 6/42; G02B 638

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
Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
eKOMPASS(KIPO internal) & Keywords: optic, cable, adapter, connector, two-piece

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2019-0018201 A1 (SENKO ADVANCED COMPONENTS, INC.) 17 January 2019 paragraphs [0091]-[0099], [0126]-[0130] and figures 3-8, 24-36A	1-20
A	US 6513989 B1 (OLIVER BLECK et al.) 04 February 2003 claim 1 and figure 1	1-20
A	WO 2015-191024 A1 (SENKO ADVANCED COMPONENTS, INC.) 17 December 2015 claim 1 and figure 1	1-20
A	WO 2017-139430 A1 (ALLIANCE FIBER OPTIC PRODUCTS, INC.) 17 August 2017 claim 1 and figure 1	1-20
A	US 9804337 B2 (JOHN ANDERSON et al.) 31 October 2017 claim 1 and figure 4	1-20
A	US 2017-0343740 A1 (FINISAR CORPORATION) 30 November 2017 claim 1 and figure 4A	1-20

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:
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"D" document cited by the applicant in the international application
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"O" document referring to an oral disclosure, use, exhibition or other means
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"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	Date of mailing of the international search report
28 May 2020 (28.05.2020)	**28 May 2020 (28.05.2020)**

Name and mailing address of the ISA/KR
International Application Division
Korean Intellectual Property Office
189 Cheongsa-ro, Seo-gu, Daejeon, 35208, Republic of Korea
Facsimile No. +82-42-481-8578

Authorized officer
JUNG, Jong Han
Telephone No. +82-42-481-5642

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2020/015858

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Information on patent family members

International application No.

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2020/015858

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Form PCT/ISA/210 (patent family annex) (July 2019)

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(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
10 October 2019 (10.10.2019)

WIPO | PCT

(10) International Publication Number
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(51) International Patent Classification:
G02B 6/36 (2006.01) *G02B 6/38* (2006.01)

(21) International Application Number:
PCT/US2019/025944

(22) International Filing Date:
05 April 2019 (05.04.2019)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
62/653,706 06 April 2018 (06.04.2018) US
62/793,198 16 January 2019 (16.01.2019) US

(71) Applicant: **US CONEC, LTD** [US/US]; 1138 25th St. SE, Hickory, North Carolina 28603-2306 (US).

(72) Inventors: **HIGLEY, Jason**; 1241 20th Ave NW, Hickory, North Carolina 28601 (US). **CLOUD, Mitchell**; 7138 Forest Ridge Rd., Matthews, North Carolina 28104 (US).

(74) Agent: **LEETZOW, Michael**; 2393 Crest Ridge Ct, Sanford, Florida 32771 (US).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM,

(54) Title: FLEXIBLE PUSH-PULL BOOT AND CRIMP BODY FOR FIBER OPTIC CONNECTOR

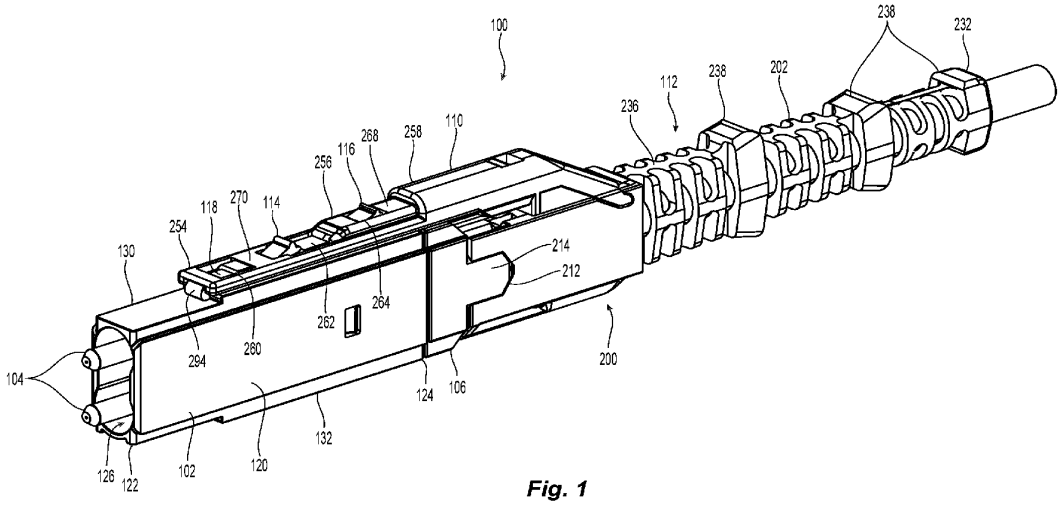


Fig. 1

(57) Abstract: A new boot for a fiber optic connector has a ribbed back portion, a center portion, and a forward extending portion that can be used to insert and remove the fiber optic connector to receptacle. The ribbed back portion has grasping elements and is connected to the center portion. The center portion is removably connected to a crimp body that is in turn connected to the connector housing. The front extension is connected to the fiber optic connector and also provides a keying feature depending on the side of the fiber optic connector on which it is installed.

[Continued on next page]

WO 2019/195652 A1

TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

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

Published:

— *with international search report (Art. 21(3))*

FLEXIBLE PUSH-PULL BOOT AND CRIMP BODY FOR FIBER OPTIC CONNECTOR

BACKGROUND OF THE INVENTION

[0001] This application claims priority of U.S. Provisional Patent Application serial numbers 62/653,706, filed on April 6, 2018, and 62/793,198, filed on January 16, 2019, the contents of both of which are incorporated by reference.

FIELD OF THE INVENTION

[0002] Fiber optic connectors, and the locations where they are installed, are becoming smaller, requiring a higher density application. The fiber optic connectors have been reduced in size such that a person can not easily grasp individual fiber optic connectors mounted in a receptacle in the high density areas. Thus, it can be very difficult to install a fiber optic connector in, and uninstall from, its respective receptacle. Adjacent fiber optic connectors are generally located too close to allow manual insertion and removal of a single fiber optic connector using the connector's outer housing as intended, particularly, when used in higher density applications. Some solutions to the smaller areas include push-pull tabs or projections connected to the fiber optic connector, either as an additional component or as an integral part of the fiber optic connector, usually the outer housing.

[0003] While these push-pull tabs provide a solution to the insertion and removal of some fiber optic connectors, there is still an issue with the optical fibers and optical cables getting tangled around the tabs. This could lead to the push-pull tabs being removed or broken, providing the user with no real options for removing the fiber optic connectors. Additionally, in a high density environment, there may be some confusion as to which fiber optic connector a particular push-pull tab belongs.

[0004] While a boot may be used for pushing a fiber optic connector into a receptacle, they are generally not intended to be used to remove a fiber optic connector. The boot is generally used for strain relief of the optical fibers secured within the fiber optic connectors. In many connectors, the boot simply cannot be used for fiber optic connector removal as the boot is not attached to the appropriate structures, such as the outer housing.

[0005] Additionally, the typical boot on a fiber optic connector can not convey the polarity of the fiber optic connector to which it is attached.

[0006] The present invention is therefore directed to a boot that can be used with a fiber optic connector to insert into and remove from a receptacle. The boot can also be detached from a portion of the fiber optic connector and reinstalled in a different configuration to identify a polarity of the fiber optic connector.

SUMMARY OF THE INVENTION

[0007] The present invention is directed to a boot for a fiber optic connector, the fiber optic connector having a housing, at least two fiber optic ferrules, and a crimp body, the boot that includes a center portion having a front end and a back end, a first longitudinal opening extending between the front end and the back end to receive a portion of the crimp body and a fiber optic cable, a back portion attached to the center portion and extending away from the front end of the center portion, the back portion defining a second longitudinal opening that is in communication with the first longitudinal opening, the back portion having grasping portions to allow a user to push and pull on the boot, and a front extension portion connected to the center portion and engageable with the fiber optic connector, the front extension portion extending forward and beyond the front end of the center portion and having at least one latch to engage a receptacle.

[0008] In some embodiments, the the boot is connectable to one of a first side and a second side of the fiber optic connector to determine a polarity of the fiber optic connector.

[0009] In some embodiments, the boot further includes a first engagement member to cooperate with a corresponding second engagement member on the crimp body to removably attach the boot to the crimp body.

[0010] In some embodiments, pulling on the boot causes the first engagement member to slide relative to the second engagement member thereby pulling the front extension rearwardly releasing the fiber optic connector from the receptacle.

[0011] In another aspect, the invention is directed to a combination of a boot and a crimp body for a fiber optic connector, the fiber optic connector having a housing, at least two fiber optic ferrules, and a spring push, the combination that includes a boot that further includes a center portion having a front end and a back end, a first longitudinal opening extending between the front end and the back end to receive a portion of the crimp body and a fiber optic cable, a back portion attached to the center portion and extending away from the front end of the center portion, the back portion defining a second longitudinal opening that is in

communication with the first longitudinal opening, the back portion having grasping portions to allow a user to push and pull on the boot, a front extension portion connected to the center portion and engageable with the fiber optic connector, the front extension portion extending forward and beyond the front end of the center portion and having at least one latch to engage a receptacle, and a crimp body that additionally includes a front portion configured to be disposed at least partially in the housing, a rear portion that extends rearwardly away from the front portion and provides an outer surface to receive a crimp band therearound, and a central portion disposed between the front and rear portions, wherein the boot has a first engagement member to cooperate with a corresponding second engagement member on the crimp body to removably attach the boot to the crimp body, the second engagement member being disposed on the central portion of the crimp body.

[0012] Additional features and advantages of the invention will be set forth in the detailed description which follows, and in part will be readily apparent to those skilled in the art from that description or recognized by practicing the invention as described herein, including the detailed description which follows, the claims, as well as the appended drawings.

[0013] It is to be understood that both the foregoing general description and the following detailed description of the present embodiments of the invention, and are intended to provide an overview or framework for understanding the nature and character of the invention as it is claimed. The accompanying drawings are included to provide a further understanding of the invention, and are incorporated into and constitute a part of this specification. The drawings illustrate various embodiments of the invention, and together with the description serve to explain the principles and operations of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] FIG. 1 is a top perspective view of one embodiment of a fiber optic connector with a crimp body, a boot, and a front extension according to the present invention;

[0015] FIG. 2 is a bottom perspective view of the fiber optic connector in FIG. 1;

[0016] FIG. 3 is a top plan view of the fiber optic connector in FIG. 1;

[0017] FIG. 4 is a side elevation view of the fiber optic connector in FIG. 1;

[0018] FIG. 5 is a bottom plan view of the fiber optic connector in FIG. 1;

[0019] FIG. 6 is a front perspective view of the fiber optic connector in FIG. 1 with the boot and front extension detached from the crimp body and the connector housing;

[0020] FIG. 7 is a cross sectional view of the front extension, latch body, and connector housing;

[0021] FIG. 8 is bottom perspective view of the front extension, crimp body, and boot from the fiber optic connector in FIG. 1;

[0022] FIG. 9 is a partial cross section of the crimp body and boot at the connection of these two components;

[0023] FIG. 10 is perspective view of the crimp body of the fiber optic connector in FIG. 1;

[0024] FIG. 11 is a bottom perspective view from the front of the boot and the front extension of the fiber optic connector in FIG. 1 down the opening therein;

[0025] FIG. 12 is a rear and bottom perspective view of the boot and the front extension of the fiber optic connector in FIG. 1 down the opening therein;

[0026] FIG. 13 is an enlarged view of a portion of the bottom portion of the boot;

[0027] FIG. 14 is a side perspective view of the boot and front extension being attached to the crimp body;

[0028] FIG. 15 is a side view of the boot and the front extension being pulled rearwardly to disengage the fiber optic connector from a receptacle;

[0029] FIG. 16 is a second embodiment of a fiber optic connector with a crimp body, a boot, and a front extension according to the present invention;

[0030] FIG. 17 is a third embodiment of fiber optic connector with a crimp body, a boot, and a front extension according to the present invention; and

[0031] FIG. 18 is an enlarged view of the connection between the boot and the crimp body in the fiber optic connecter of FIG. 16.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0032] Reference will now be made in detail to the present preferred embodiment(s) of the invention, examples of which are illustrated in the accompanying drawings. Whenever possible, the same reference numerals will be used throughout the drawings to refer to the same or like parts.

[0033] Applicant notes that the term “front” or “forward” means that direction where the fiber optic connector would meet with another fiber optic connector or device, while the term “rear” or “rearward” is used to mean the direction from which the optical fibers enter into the

fiber-optic ferrule or fiber optic connector. Thus, "front" is that part of the fiber optic connector on the left side of FIG. 1 and "forward" is out and to the left. "Rear" or "back" is that part of the fiber optic connector that is on the right side of the page and "rearward" and "backward" is toward the right.

[0034] One embodiment of a fiber optic connector **100** according to the present invention is illustrated in FIGS 1-15. The fiber optic connector **100**, as illustrated in FIGS. 1 - 6, may include a housing **102**, fiber optic ferrules **104** (which may be included in a ferrule assembly as disclosed in PCT/2018/066523), a crimp body **106**, a crimp ring and heat shrink tube **108**, a front extension **110** that is a part of strain relief boot **112**. As discussed in more detail below, the crimp body **106**, the front extension **110**, and a strain relief boot **112** are the focus of this application. The front extension **110** also functions as a push-pull mechanism or latch component, whereby the front extension **110** has at least one latch and more preferably two latches **114**, **116** on a latch body **118** that engage a receptacle (such as an adapter and/or a carrier) if used with the present invention. The front extension **110** also functions as a polarity key for the fiber optic connector **100**. As described in more detail below, the fiber optic connector **100** can only be inserted into a receptacle in one orientation with the front extension **110** installed on the fiber optic connector **100**. The housing **102** is symmetric about a longitudinal axis A through the fiber optic connector **100**. Thus, without the front extension **110**, the fiber optic connector **100** could be inserted into a receptacle in at least two ways. The front extension **110** prevents the fiber optic connector **100** from being inserted in all but one way - thereby giving it a polarity function.

[0035] Turning to the housing **102**, the housing **102** has a main body **120** extending between a front end **122** and a rear end **124**, and has an opening **126** extending therebetween. See also FIGS. 6 and 7. The fiber optic ferrules **104** are disposed within the opening **126** and have their front faces (for mating with other fiber optic ferrules) adjacent the front end **122**. The crimp body **106** is also at least partially disposed within the opening **126** at the rear end **124** of the housing **102**.

[0036] The outside of the housing **102** has many features that are integral to its use. First are the top surface **130** and the bottom surface **132**. The top and bottom surfaces **130**,**132** are preferably the same. Extending from the rear end **124** towards the front end **122** of the housing **102** on both the top surface **130** and the bottom surface **132** is a rail receiving portion **134**. The rail receiving portion **134** as illustrated does not extend the entire length of

the housing **102**, but it could extend farther along the length of the housing **102** than shown in the figures if so desired. The rail receiving portion **134** has a stop surface **136** at the end of the rail receiving portion **134**. The front extension **110** will make use of the stop surface **136** when the fiber optic connector **100** is inserted into or removed from various structures as discussed in more detail below.

[0037] The rail receiving portion **134** has a central portion **138** and two lobe sections **140**, one lobe on each side of the central portion **138**. As a result, the rail receiving portion **134** looks like part of a profile of a dog bone. This configuration matches that of the bottom surface of the front extension **110** (latch component or push-pull mechanism) to form a sliding dove-tail configuration. See FIG. 7. Other configurations are possible, such as, for example, a cap with undercuts (essentially an umbrella or a T-shape configuration).

[0038] The fiber optic connector **100** also includes a crimp body **106**. The crimp body **106** has a front portion **150** that is designed to interact and connect with the housing **102** and a spring push (not shown) that is used in conjunction with the fiber optic ferrules **104** in the opening **126** thereof. The crimp body **106** has a central portion **152** that fits against the rear end **124** of the housing **102**. The central portion **152** has a first portion **154** that includes a rail receiving portion **158** on both a top side **154** and a bottom side **156**. The rail receiving portion **158** has a central portion **160** and two lobe sections **162**, one lobe on each side of the central portion **160** that matches the same structure **134** on the housing **102** to engage the front extension **110**.

[0039] The central portion **152** has a second, more rearward portion **170** that include two notches **172** on both the top side **154** and the bottom side **156**. At a rearward end **174** of each of the four notches **172** (two on the top side **154** and two on the bottom side **156**) are forward facing surfaces **176** to engage latches on the boot **112**. The notches **172** and the forward facing surfaces **176** are involved in the connection of the boot **112** (and the front extension **110**) to the crimp body **106** and the housing **102** as explained below.

[0040] The crimp body **106** has a rear portion **180** that extends behind the central portion **152** and the housing **102** and provides an outer surface **182** to receive a crimp band (e.g., crimp ring and heat shrink tube) therearound. Extending through the crimp body **106** is an opening **184** through which optical fibers/optical fiber cable can pass between the fiber optic ferrules **104** and the boot **112**. Although the design will allow for the use of a crimp band to attach the aramid yarn from a fiber optic cable, the crimp band is optional and the fiber optic

connector will work without a crimp band when the aramid yarn is not present. Further, when the crimp band is not used, the crimp body would require the outer surface **182**.

[0041] Turning now to the boot **112**, the boot **112** includes the front extension **110**, a center portion **200** that is disposed between the front extension **110** and a ribbed back portion **202**. It should be noted that the front extension **110** is preferably an integral part of the center portion **200**, but it could be removably attached to the center portion **200** and still fall within the scope of the present invention.

[0042] The center portion **200** has a front end **204** and a back end **206** with a first longitudinal opening **208** extending throughout the center portion **200**. The first longitudinal opening **208** receives at least a portion of the crimp body **106**, including at least the rear portion **180** that extends behind the central portion **152** and the outer surface **182** with the crimp band. The first longitudinal opening **208** also receives the rearward portion **170** of the central portion **152** of the crimp body **106** as well as the notches **172** and the forward facing surfaces **176**. See FIG. 9.

[0043] The center portion **200** also has sides **210** that help to define the first longitudinal opening **208**. The sides **210** may also have cut-outs **212** that receive a portion **214** of the crimp body **106**. The cooperation between the cut-outs **212** and the portion **214** of the crimp body **106** assist in alignment and the integrity of the combination of the crimp body **106** and the center portion **200**. However, it should be noted that the sides **210** could be solid and cover the overlapping portion of the crimp body **106**. See, e.g., FIG. 16.

[0044] Within the first longitudinal opening **208** and extending from the sides **210** are two projections or latches **220** that extend into the first longitudinal opening **208**. When the boot **112** is attached to the crimp body **106**, the projections or latches **220** are disposed within the two notches **172** on one of the top side **154** or bottom side **156**, depending on the orientation of the boot **112**. In the fully engaged position, the projections or latches **220** are farthest from the forward facing surfaces **176** that at least partially define the two notches **172**. See FIG. 9. At this position, the front end **204** of the center portion **200** should be touching the first portion **154** of the central portion **152** of the crimp body **106**. See FIGS. 1, 8, and 9. The center portion **200** also has a bridge portion **222** that connects the sides **210** with the projections or latches **220**. This bridge portion **222** performs two functions. First, as seen in FIGS. 2 and 8, the bridge portion **222** blocks the rail receiving portion **158** when the front extension **110** is oriented on the other side of the fiber optic connector 100. See FIG. 8. This

bridge portion **222** assists in preventing the rail receiving portion **158** from snagging optical fibers and optical fiber cables when the fiber optic connector **100** is installed. Second, when a user pushes on the bridge portion **222** toward the first longitudinal opening **208**, the projections or latches **220** (and the sides **210**) are pushed outward and clear of the notches **172** and the forward facing surfaces **176**. This allows the boot **112** (and center portion **200**) to be removed from the crimp body **106** and from the fiber optic connector **100** if so desired.

[0045] It should be noted that while there are two projections or latches **220** and two notches **172** on each side, there may be more or fewer. For example, there may just be one latch and one corresponding notch. Alternatively, the latching of the boot **112** to the crimp body **106** may not be on an outside surface of the crimp body **106**. Instead, such latching may occur on an inside surface of the crimp body **106**, and may not be visible from the outside. For example, the notches **172** and the forward facing surfaces **176** may be inside the rearward portion **170** such that from outside, the rearward portion **170** will have a smooth continuous surface merging with the portion **214** of the crimp body. In another example, latches **220** may be extending from the bridge portion **222** into an internal groove inside or underneath the top surface of the rearward portion **170** (i.e., the portion between the forward facing surfaces **176**). In this scenario, the latches **220** would be facing upward or downward rather than sideways as shown in FIG. 11, for example.

[0046] The ribbed back portion **202** extends between a front end **230** and a back end **232** and is made of a plurality of rib members **234**. The ribbed back portion **202** is attached to the back end **206** of the center portion **200** and extends away from the front end **204**. Thus, the ribbed back portion **202** makes the boot **112** longer. The ribbed back portion **202** also has a spine **236** that joins the plurality of rib members **234** together. Along the spine **236** are a number of grasping portions **238** that provide surfaces for the user to grasp. The user can then use the ribbed back portion **202** to either push the fiber optic connector **100** into a receptacle or to pull on the ribbed back portion **202**, and the grasping portions **238** in particular, to pull the fiber optic connector **100** from a receptacle. The grasping portions **238** are illustrated as three annular members that are disposed along a length of the spine **236** and together with the plurality of rib members **234** form a second longitudinal opening **240** through the ribbed back portion **202**. The first longitudinal opening **208** and the second longitudinal opening **240** are in communication with one another and form a pathway for the optical fibers/fiber optic cable to be inserted from back end **232** to the opening **126** in the

housing so they can be fixed within the fiber optic ferrules **102** in the fiber optic connector **100**.

[0047] The construction of the ribbed back portion **202** with the plurality of rib members **234** and the spine **236** provides sufficient strength to allow it to be used to install and remove the fiber optic connector while at the same time being flexible to provide strain relief to the optical fibers. The ribbed back portion **202** is illustrated as being asymmetrical about the second longitudinal opening **240**, but could be of any appropriate shape and still fall within the scope of the present invention. Additionally, there could different rib structures and grasping portions such as those illustrated in FIGS. 16 and 17 that also fall within the scope of the present invention.

[0048] The front extension **110** has a main body **250** and a latch body **118** that attaches to the main body **250**. See FIGS. 6, 7, and 14. The main body **250** has a front portion **254**, a middle portion **256**, and a rear portion **258.** Generally, the front portion **254** is where the latch body **252** attaches to the main body **250** and provides for the latching of the fiber optic connector **100** to a first receptacle such as an adapter. The middle portion **256** provides an area for the latching of the fiber optic connector **100** to a second receptacle such as a ganged carrier. The rear portion **258** has an area for a return element associated with the latch body **252** and also connects the front extension **110** to the center portion **200** of the boot **112**.

[0049] The front portion **254** has two windows **260** and **262** and the middle portion **256** has a window **264**. The window **262** of the front portion **254** and window **264** are to receive a latch **114**, **116** from the latch body **118** therethrough. The first window **260** is to receive a latch pad **266** on the latch body **118**. There are two latch **266** pads on the latch body **118** that cooperate with a groove **266a** in the main body **250** to secure the latch body to the main body **250**. The latch pads slide within the grooves to allow for the latching and unlatching the fiber optic connector **100**. A more detailed discussion of this feature is disclosed in PCT/ 2018/066523, which is incorporated by reference herein.

[0050] The middle portion **256** has an upper surface **268** that is higher than an upper surface **270** of the front portion **254**. This allows for the latching of a carrier and an adapter with the same device. On the bottom side **272** of the middle portion **256** are two extensions **274,276** that are a complementary configuration of a rail receiving portion **134** of the housing **102**. See FIG. 13. The latch body **118** also has the same rail portion configuration of two extensions **280,282** on the bottom thereof. This allows the main body **250** and the

latch body **118** to be slidingly attached to the rail receiving portion **134** of the housing **102** and the rail receiving portion **158** of the crimp body **106**. When the latch body **118** is inserted into the front portion **254**, a front surface **284** of the two extensions **274,276** provides a pushing surface by which the main body **250** can push the latch body **118** in the rail receiving portion **134**. See also FIGS. 11 and 14. The front surface **286** of the two extensions **280,282** also provides a pushing surface to be used against the stop surface **136** of the housing **102**. See FIGS. 11 and 14. This allows for the user to exert a force on the boot **112** which is transferred through the main body **250** to the latch body **118** and to the housing **102** to insert the fiber optic connector **100** into a carrier and/or adapter.

[0051] Turning to FIGS. 1, 7, and 14, the latch body **118** has two latches for receptacles such as an adapter latch **114** and a carrier latch **116**. The latch body **118** may only have one of the latches, depending upon its uses and the needs of the user and the receptacles into which the fiber optic connector **100** is going to be inserted. The adapter latch **290** extends from a forward portion of the latch body **118** and protrudes through window **262** of the main body **250**. The carrier latch **116** also extends from the latch body **118**, from a rear portion thereof, and protrudes through the window **264** of the main body **250**. As is recognized from FIG. 4, the adapter latch **114** does not rise as high as the carrier latch **116**. The latch body **118** has a connector latch **294** as well. The connector latch **294** extends forward beyond the front surface **286** of the two extensions **280,282** to engage the stop surface **136**. The connector latch **294** has a downward curling portion **296** that provides a surface to engage the stop surface **136** to prevent the latch body **118** from moving rearwardly relative to the housing **102** as the boot **112** is pulled to disengage the fiber optic connector **100** from a receptacle as will now be explained.

[0052] Referring in particular to FIGS. 1, 6, 9, 14, and 15, the attachment, use, and the removal of the boot **112** on the fiber optic connector **100** will be explained. As is generally known in the art, a fiber optic connector would need to have the optical fibers terminated in the fiber optic ferrules before a strain-relief boot can be attached to the fiber optic connector. In this case, the boot **112** with the center portion **200** and the front extension **110** are put onto the optical fibers/fiber optic cable as illustrated in Fig 6. The optical fibers/fiber optic cable pass through the first longitudinal opening **208** and the second longitudinal opening **240** of the boot **112** and are secured in the fiber optic ferrules **104**. The jacket or covering on the optical fibers/fiber optic cable is then secured to the crimp body **106** with a crimp ring and

heat shrink tube **108** or in any other manner that is appropriate. As seen in FIG. 6, the boot **112** is disposed on the optical fibers/fiber optic cable and the fiber optic connector has been assembled. As the boot **112** is moved to the fiber optic connector (to the left in FIG. 6), it is apparent that the front extension **110** will engage the rail receiving portion **158** of the crimp body **106** first and then the rail receiving portion **134** of the housing **102**. As the boot **112** is further pushed to the left in the figure, the rear portion **180** of the crimp body **106** enters the first longitudinal opening **208** followed by the rearward portion **170** of the central portion **152** of the crimp body **106**. As the connector latch **294** starts to engage the stop surface **136** of the housing **102**, the notches **172** and the forward facing surfaces **176** of the central portion **152** of the crimp body **106** also enter the first longitudinal opening **208**. See FIG. 1. FIG. 14 also illustrates (with the connector housing **102** removed for clarity) how the crimp body **106** engages the boot **112** and the latches **220** moving past the forward facing surfaces **176**. With the front end **204** of the center portion **200** disposed against the crimp body **106**, the cut-outs **212** receive the portion **214** of the crimp body **106**. As seen in FIG. 9, the projections or latches **220** are disposed within the two notches **172** and are at the front end of the notches **172**. At this point, the fiber optic connector **100** is as illustrated in FIGS. 1-5 and ready to be inserted into a receptacle. The user could push on the ribbed back portion **202**, the grasping portions **238, the** front extension **110**, or the center portion **200** to insert the fiber optic connector **100** into the receptacle.

[0053] To remove the fiber optic connector **100** from the receptacle, the user could pull on the ribbed back portion **202**, the grasping portions **238**, the front extension **110**, or the center portion **200**. Referring to FIG. 15, when the user pulls on one of those structures, the front extension **110,** the center portion **200**, and ribbed back portion **202** move relative to the crimp body **106** and the housing **102**, the projections or latches **220** sliding rearwardly within the two notches **172**. It is important to note that the frictional force between the boot and the connector housing and crimp body should be low. It is desirable to have clearance between the boot and the crimp band, crimp body, housing, and the cable. It is also desirable to have a boot material that has a low coefficient of friction, such as polypropylene. Furthermore, a elastomeric boot material is not preferred because the user could deform the internal surface of the boot and cause added friction due to squeezing or pinching the boot while pulling. A material with a Young's Modulus greater than 500 MPa or possibly greater than 1 GPa has been shown not deform easily. See the arrows in FIG. 15. It is important to note that the

latch body **118** (and the adapter latch **114** and carrier latch **116**) also does not move because the connector latch **294** has engaged the stop surface **136** of the housing **102**. As the front extension **110** moves rearwardly, the main body **250** slides relative to the latch body **118** (and housing **102**), pushing the adapter latch **114** and carrier latch **116** downward out of the windows and disengaging them from their respective receptacle.

[0054] At this point the fiber optic connector **100** could be simply removed from the receptacle by pulling on the ribbed back portion **202**, the grasping portions **238**, the front extension **110**, or the center portion **200**. The engagement of the projections or latches **220** with the forward facing surfaces **176** prevents the boot **112** from being disengaged from the crimp body **106** and the housing **102**. However, as noted above, the user could push on the bridge portion **222**, which allows the boot **112** to be disengaged from the crimp body **106** and the housing **102**. At this point the boot **112** could be rotated about the optical fibers/fiber optic cable and reattached on the opposite side, thereby changing the polarity of the fiber optic connector **100**.

[0055] FIGS. 16-18 illustrates another embodiment of a boot **500** for use with a fiber optic connector. The boot **500** has a front extension **502**, a center portion **504**, and a ribbed back portion **506**. The front extension **502** of this embodiment is the same as that described above and will not be addressed any further. The ribbed back portion **506** functions in the same way as ribbed back portion **202** in that it can be used to push and pull on the fiber optic connector. It does have a different configuration with regard to the plurality of rib members **508** and the spine **510**, but still provides sufficient strength to allow it to be used to install and remove the fiber optic connector while at the same time being flexible to provide strain relief to the optical fibers. The ribbed back portion **506** has only a single grasping portion **512** at the back end **514**, although more grasping portions could be added. As can be seen in the figures, the spine **510** connects the plurality of rib members **508** from the center portion **504** to the grasping portion **512**.

[0056] The center portion **504** of the boot **500** is similar to the embodiment above, but with a few differences. First, the sides **516** that help to define the longitudinal opening therein do not have cut-outs. The sides of a crimp body **520** to be used with the boot **500** would not have to extend as far into the center portion with the engagement member noted below.

[0057] Second, the way of engagement between the center portion **500** and the crimp body **520** has changed. See FIG. 18. In this figure, the top and bottom of the center portion **500** have a single engagement member, a single element **522** that replaces the two projections or latches **220** in the prior embodiment. The single element **522** has a shape that is rounded at the front **524** and then has two rearward facing surfaces **526** to engage two inward facing latches **528**, **530** in the crimp body **520**. The interaction between the center portion **504** and the crimp body **520** is the same as discussed above. The boot **500** is advanced toward the crimp body **520** and the rounded front portion **524** causes the two inward facing latches **528**, **530** in the crimp body **520** to spread apart, allowing the engagement member **522** to be disposed between them. As the user pulls on the boot **500** to remove the fiber optic connector from a receptacle, the engagement member **522** moves relative to the two inward facing latches **528**, **530**. As discussed above, this movement causes the front extension **502** to release the latches and the engagement member **522** contacts the two inward facing latches **528**, **530** to pull the fiber optic connector from the receptacle. Once the fiber optic ferrule is removed from the receptacle, the user can pull of the center portion **504** while holding the crimp body or housing and disengage the boot **500** from the crimp body with a little more force than was necessary to disengage the fiber optic connector from the receptacle.

[0058] One other alternative in this embodiment that can be used on the other embodiment is the rail receiving portion **540** on both sides. The rail receiving portion **540** has a central portion **542** and two lobe sections **544** to engage the front extension **502**. However, the lobe sections **542** not as closed as the two lobe sections **162**. This allows the rail receiving portion **540** to act more as an alignment feature allowing the front extension **502** to be aligned with and then inserted in to the rail receiving portion **540** from above it, rather than being inserted from the rear side as in the prior embodiment.

[0059] It will be apparent to those skilled in the art that various modifications and variations can be made to the present invention without departing from the spirit and scope of the invention. Thus it is intended that the present invention cover the modifications and variations of this invention provided they come within the scope of the appended claims and their equivalents.

What is claimed:

1. A boot for a fiber optic connector, the fiber optic connector having a housing, at least two fiber optic ferrules, and a crimp body, the boot comprising:

a center portion having a front end and a back end, a first longitudinal opening extending between the front end and the back end to receive a portion of the crimp body and a fiber optic cable;

a back portion attached to the center portion and extending away from the front end of the center portion, the back portion defining a second longitudinal opening that is in communication with the first longitudinal opening, the back portion having grasping portions to allow a user to push and pull on the boot; and

a front extension portion connected to the center portion and engageable with the fiber optic connector, the front extension portion extending forward and beyond the front end of the center portion and having at least one latch to engage a receptacle.

2. The boot according to claim 1, wherein the boot is connectable to one of a first side and a second side of the fiber optic connector to determine a polarity of the fiber optic connector.

3. The boot according to claim 1, further comprising a first engagement member to cooperate with a corresponding second engagement member on the crimp body to removably attach the boot to the crimp body.

4. The boot according to claim 3, wherein the first engagement member comprises one of at least one projection and at least one notch and the second engagement member comprises the other of at least one projection and at least one notch, the at least one notch has a length to allow for movement of the at least one projection within the at least one notch without becoming unattached.

5. The boot according to claim 4, wherein pulling on the boot causes the first engagement member to slide relative to the second engagement member thereby pulling the front extension rearwardly releasing the fiber optic connector from the receptacle.

6. The boot according to claim 4, wherein the at least one projection includes two projections and the at least one notch comprises two notches.

7. The boot according to claim 4, wherein the at least one notch includes a forward facing surface and the at least one projection includes a rearward facing surface such that pulling on the boot causes the rearward facing surface to engage the forward facing surface.

8. The boot according to claim 3, wherein the first engagement member is disengaged from the second engagement member when the front portion of the boot in pressed inward toward the first longitudinal opening.

9. A combination of a boot and a crimp body for a fiber optic connector, the fiber optic connector having a housing, at least two fiber optic ferrules, and a spring push, the combination comprising:

a boot comprising:

a center portion having a front end and a back end, a first longitudinal opening extending between the front end and the back end to receive a portion of the crimp body and a fiber optic cable;

a back portion attached to the center portion and extending away from the front end of the center portion, the back portion defining a second longitudinal opening that is in communication with the first longitudinal opening, the back portion having grasping portions to allow a user to push and pull on the boot;

a front extension portion connected to the center portion and engageable with the fiber optic connector, the front extension portion extending forward and beyond the front end of the center portion and having at least one latch to engage a receptacle; and

a crimp body comprising

a front portion configured to be disposed at least partially in the housing;

a rear portion that extends rearwardly away from the front portion and provides an outer surface to receive a crimp band therearound; and

a central portion disposed between the front and rear portions,

wherein the boot has a first engagement member to cooperate with a corresponding second engagement member on the crimp body to removably attach the boot to the crimp

body, the second engagement member being disposed on the central portion of the crimp body.

10. The combination of a boot and a crimp body according to claim 9, wherein the first engagement member comprises one of at least one projection and at least one notch and the second engagement member comprises the other of at least one projection and at least one notch, the at least one notch has a length to allow for movement of the at least one projection within the at least one notch without becoming unattached.

11. The combination of a boot and a crimp body according to claim 10, wherein the at least one projection includes two projections and the at least one notch comprises two notches.

12. The combination of a boot and a crimp body according to claim 10, wherein the at least one notch includes a forward facing surface and the at least one projection includes a rearward facing surface such that pulling on the boot causes the rearward facing surface to engage the forward facing surface.

13. The combination of a boot and a crimp body according to claim 9, wherein the first engagement member is disengaged from the second engagement member when the front portion of the boot is pressed inward toward the first longitudinal opening.

14. The combination of a boot and a crimp body according to claim 9, wherein pulling on the boot causes the first engagement member to slide relative to the second engagement member thereby pulling the front extension rearwardly releasing the fiber optic connector from the receptacle.

15. The combination of a boot and a crimp body according to claim 9, wherein the central portion of the crimp body has top and bottom surfaces with a rail receiving portion, the rail receiving portion has a central portion and two lobe sections, one lobe on each side of the central portion.

16. A fiber optic connector having a boot, a crimp body, and a housing having at least two ferrules to hold optical fibers therein, the fiber optic connector comprising:

a front end opening in the housing for the at least two ferrules;

the crimp body attached to the housing rearward of the front end, the crimp body having a front portion, a central portion and a rear portion; and

the boot attached to the crimp body and having a front extension, the front extension extending towards the front end of the housing and is attached to one of the crimp body at the central portion or the housing and also has at least one latch to engage a receptacle, and the boot having a back portion having at least one grasping portion to allow a user to push and pull on the boot,

wherein the crimp body and the boot each have a longitudinal opening to accommodate at least two optical fibers.

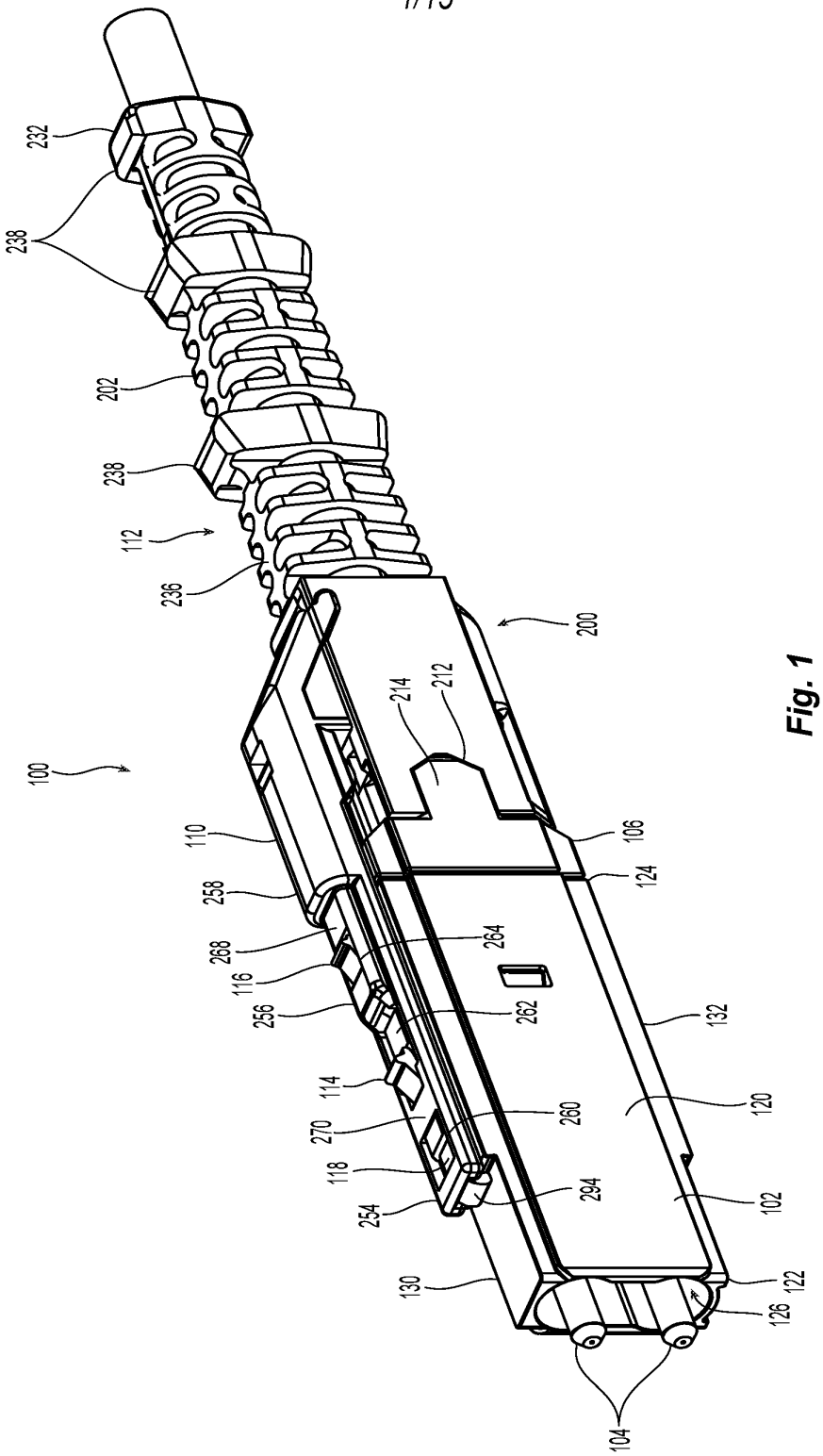

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Fig. 1

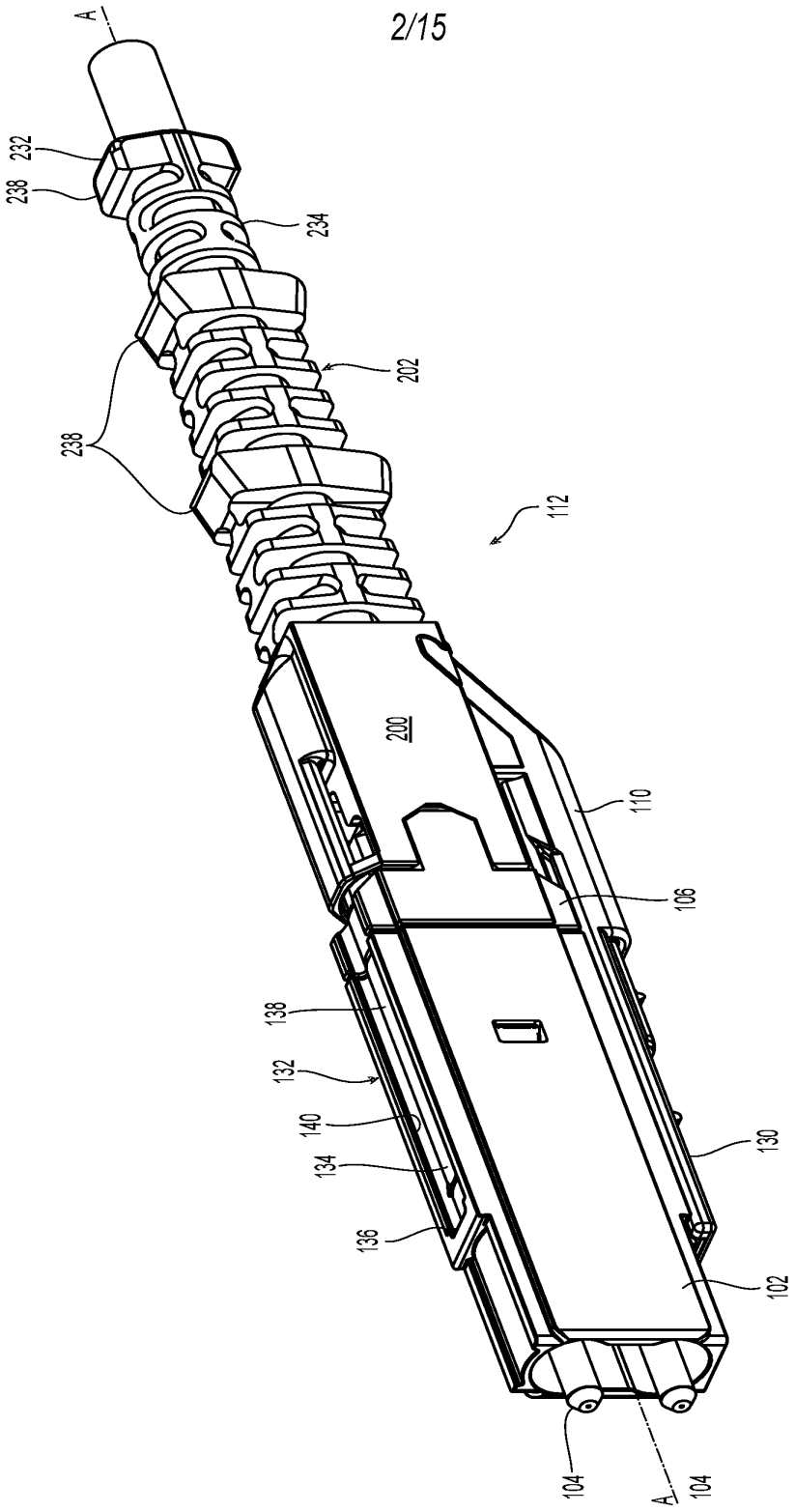

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Fig. 2

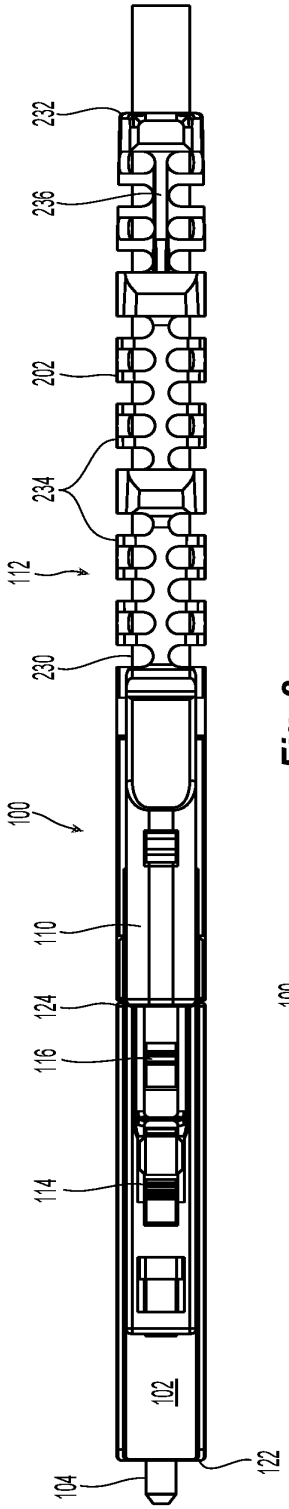


Fig. 3

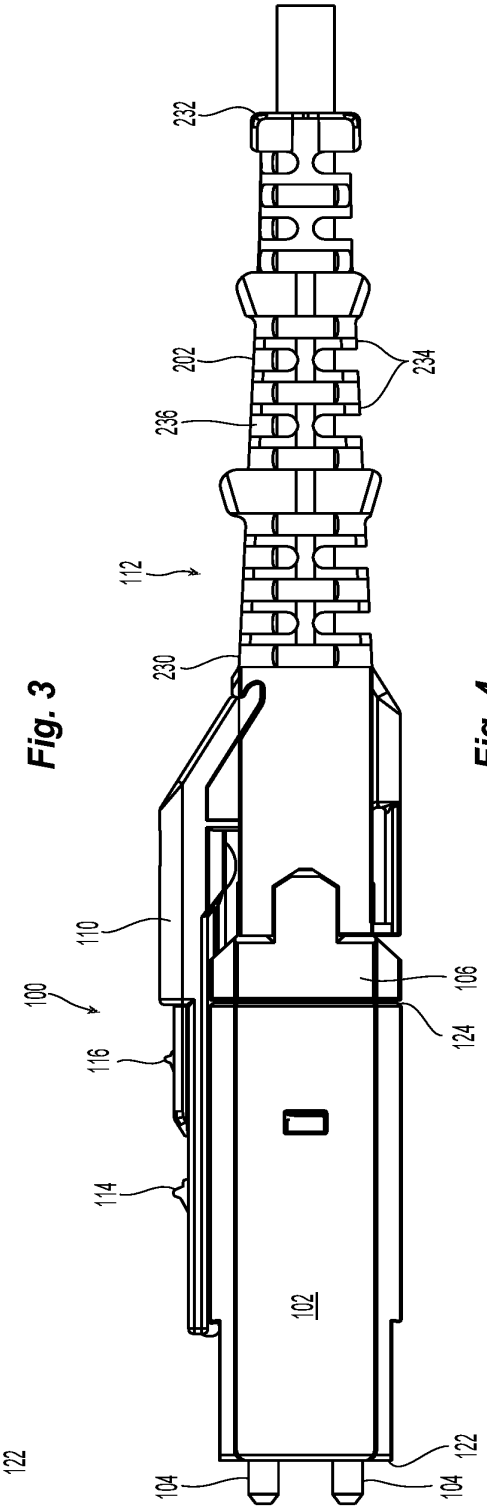


Fig. 4

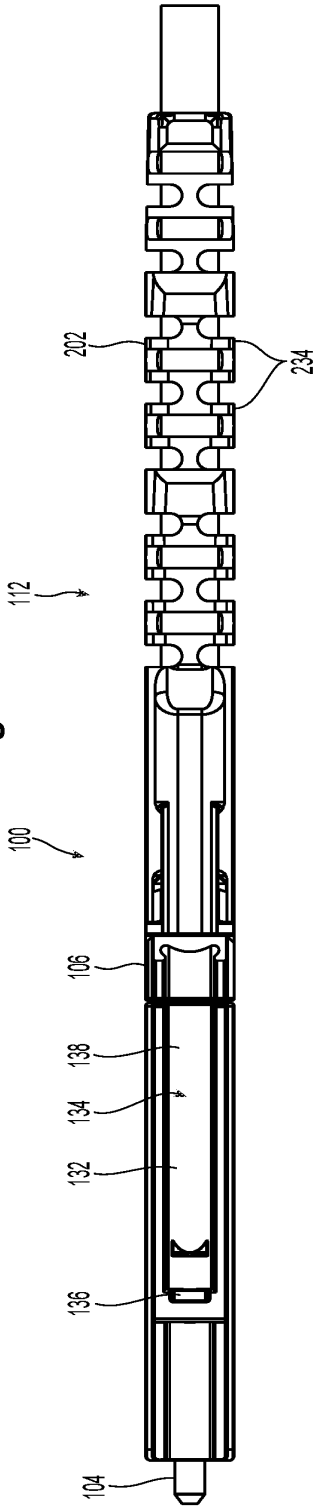


Fig. 5

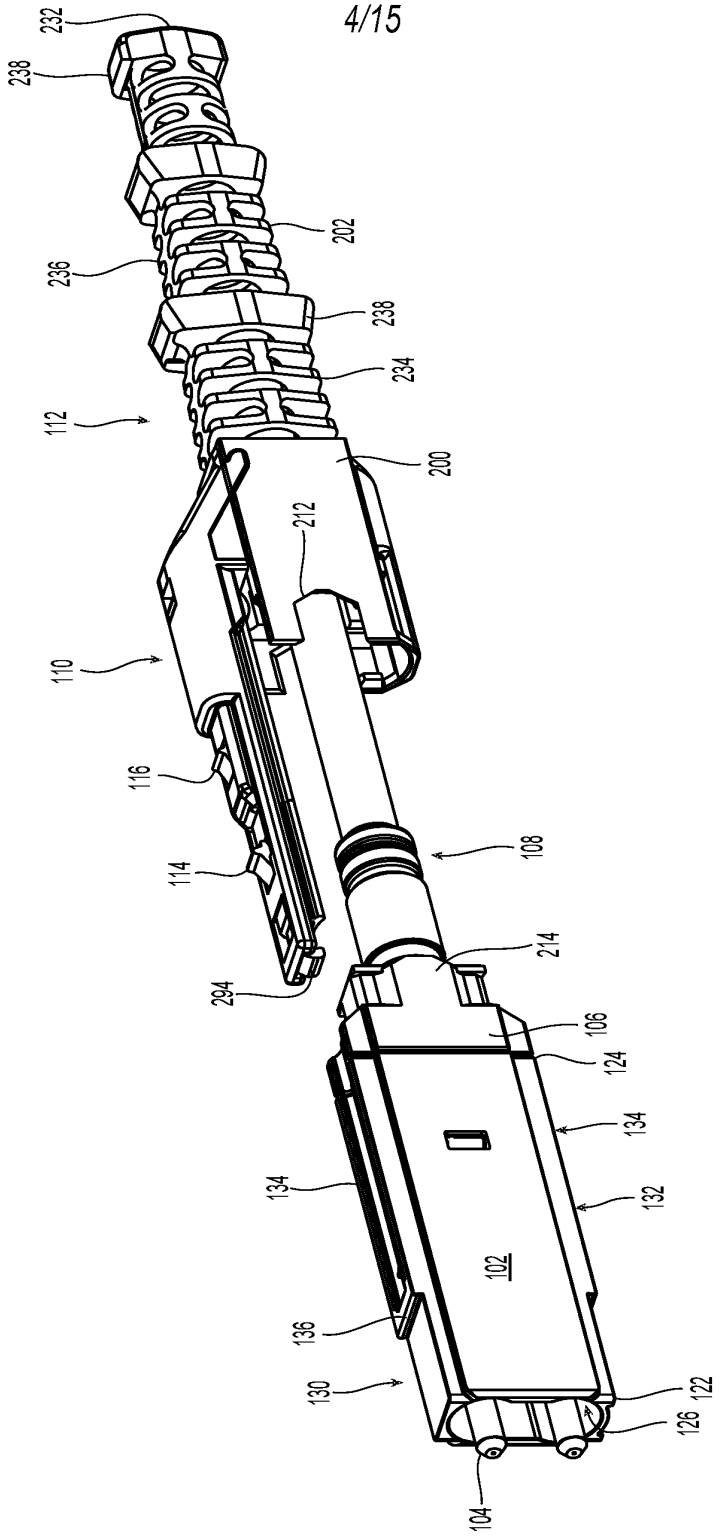

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Fig. 6

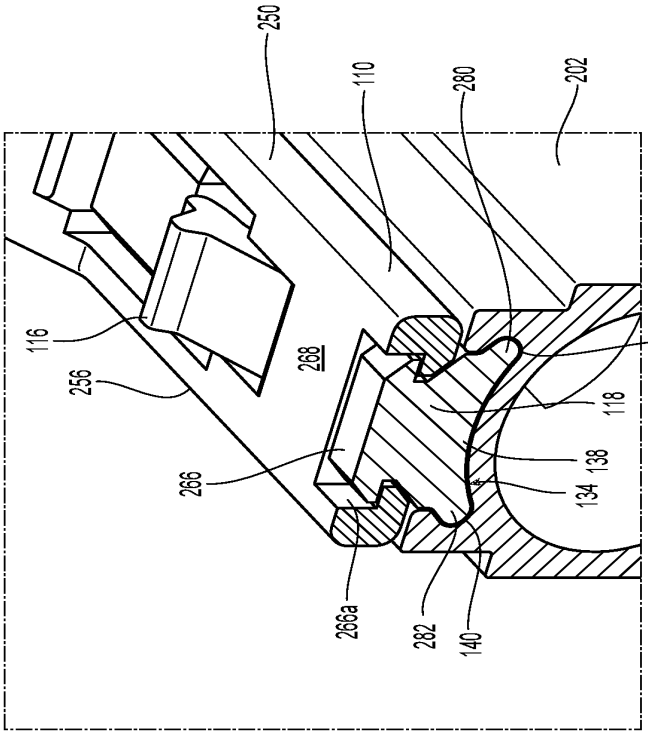


Fig. 7

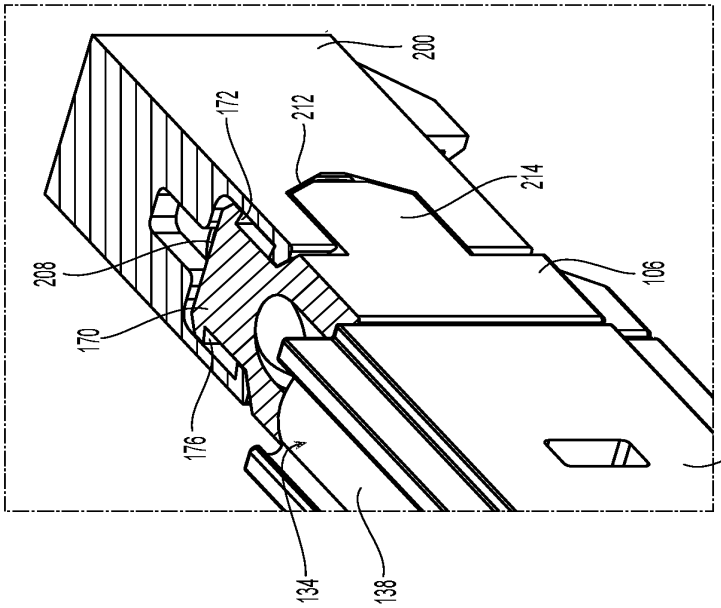

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Fig. 9

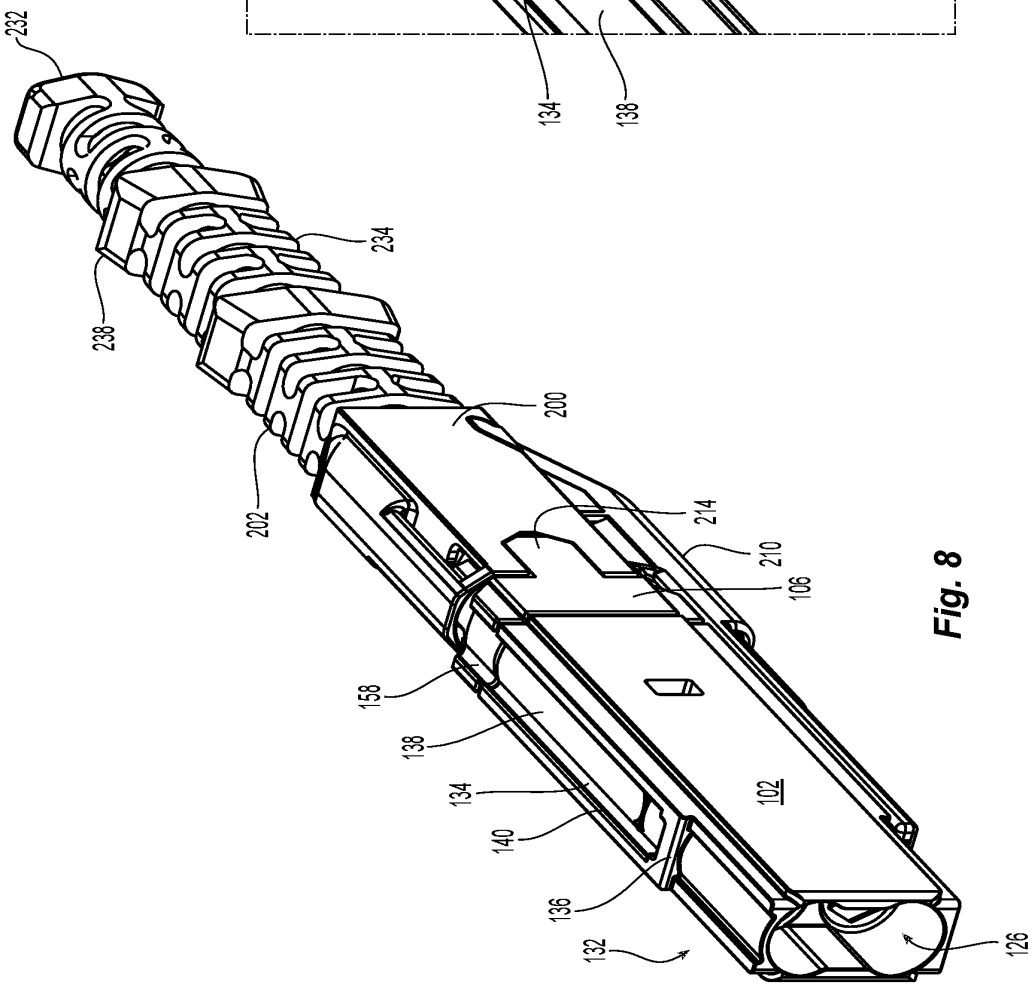

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Fig. 8

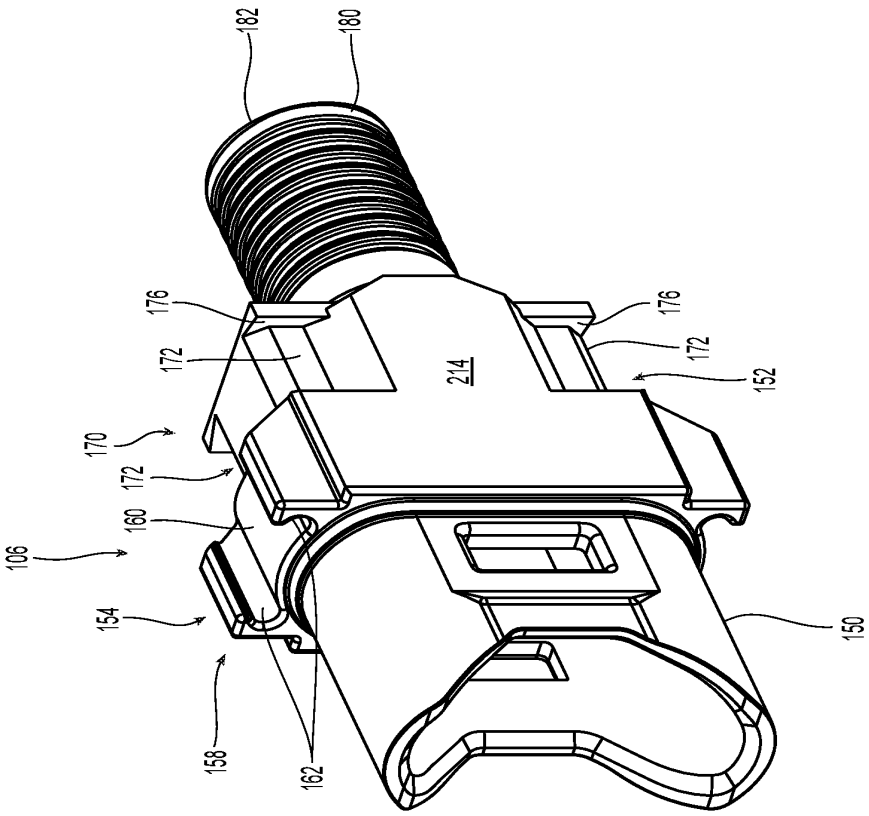


Fig. 10

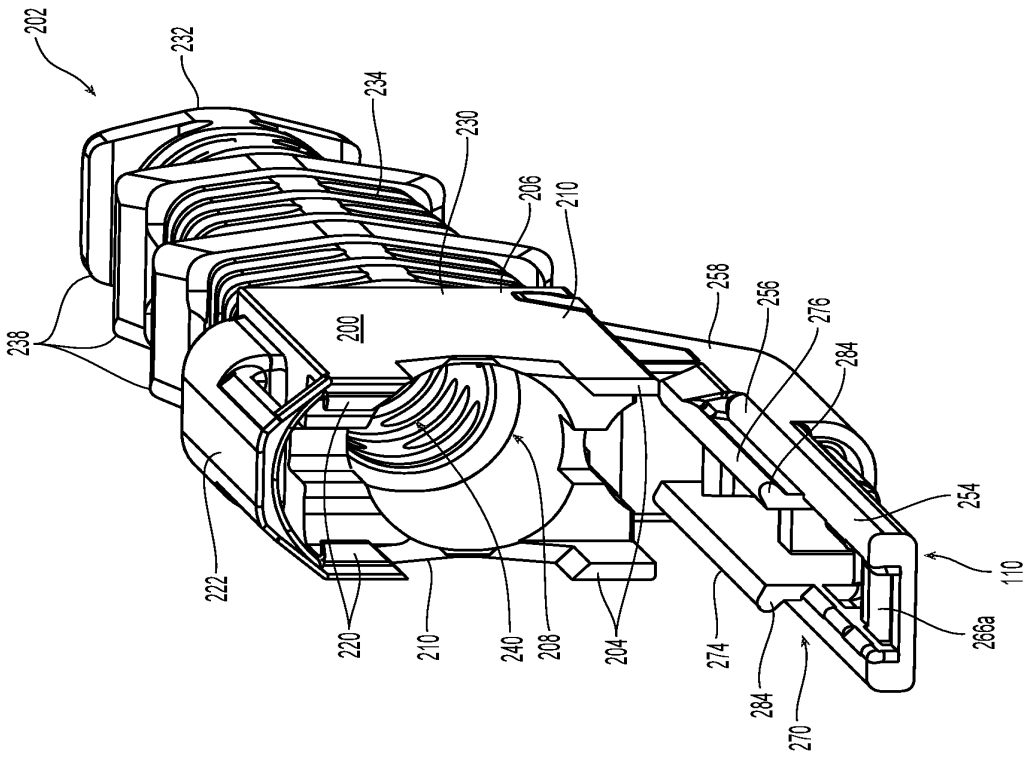

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Fig. 11

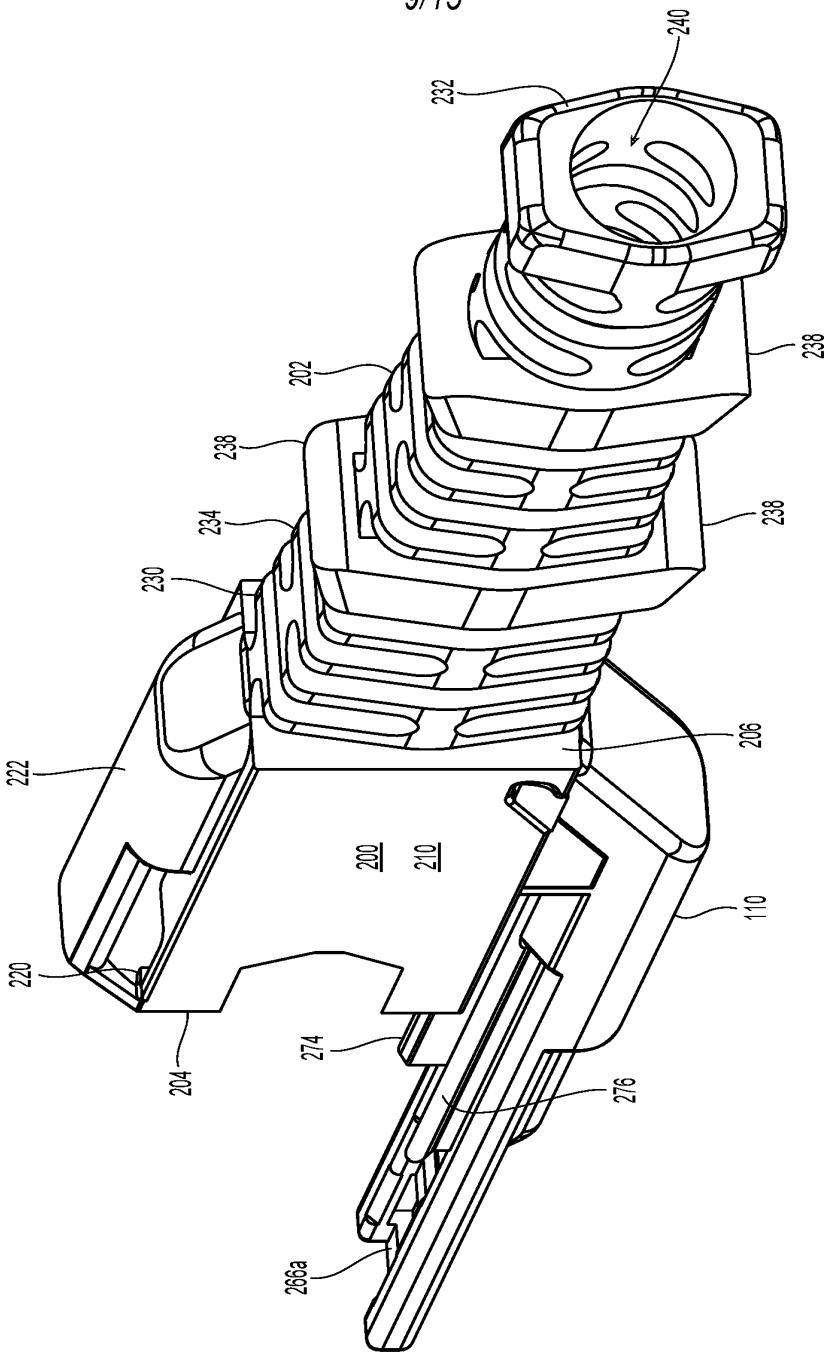

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Fig. 12

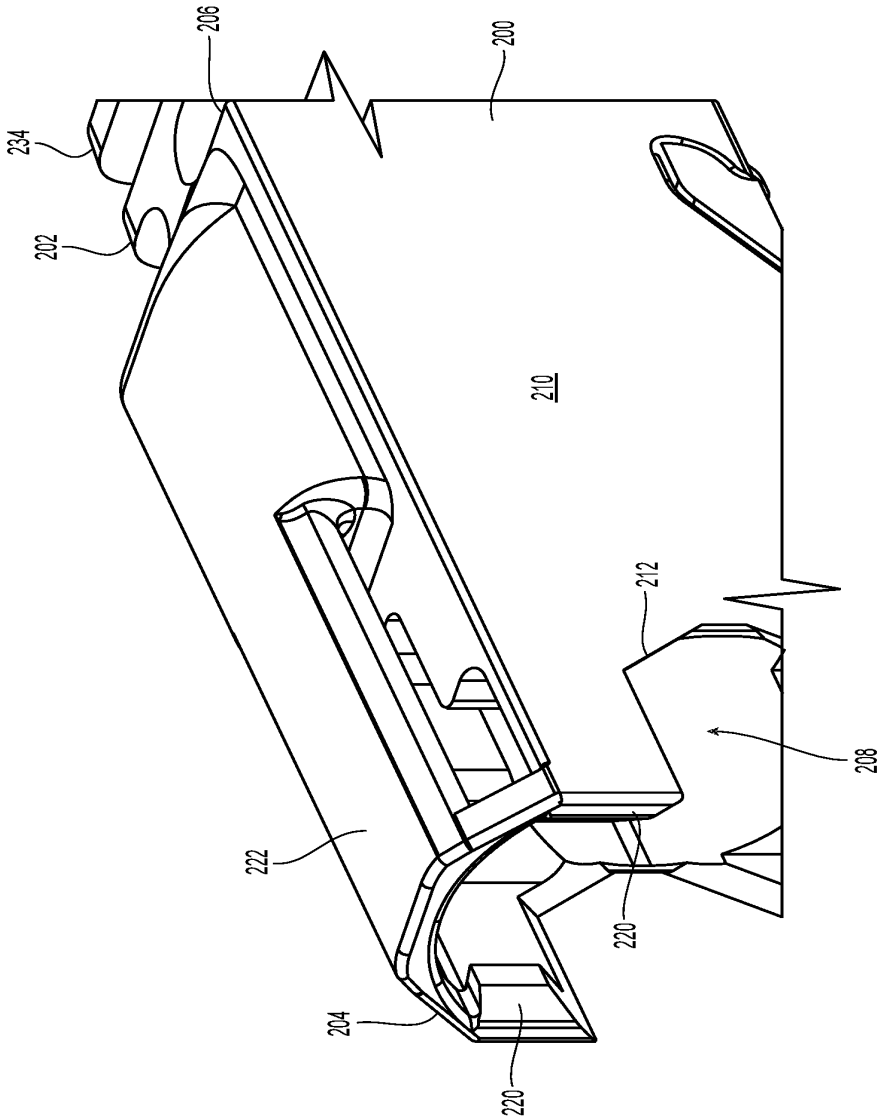


Fig. 13

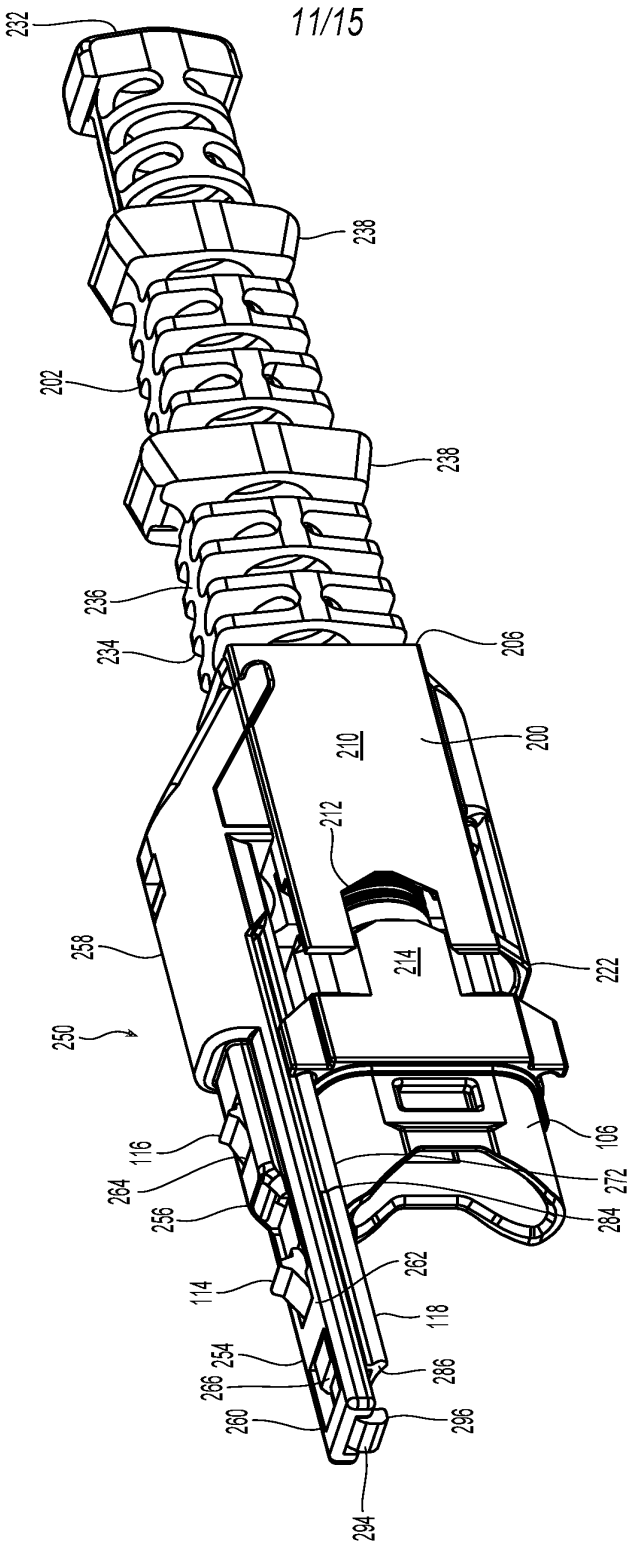

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Fig. 14

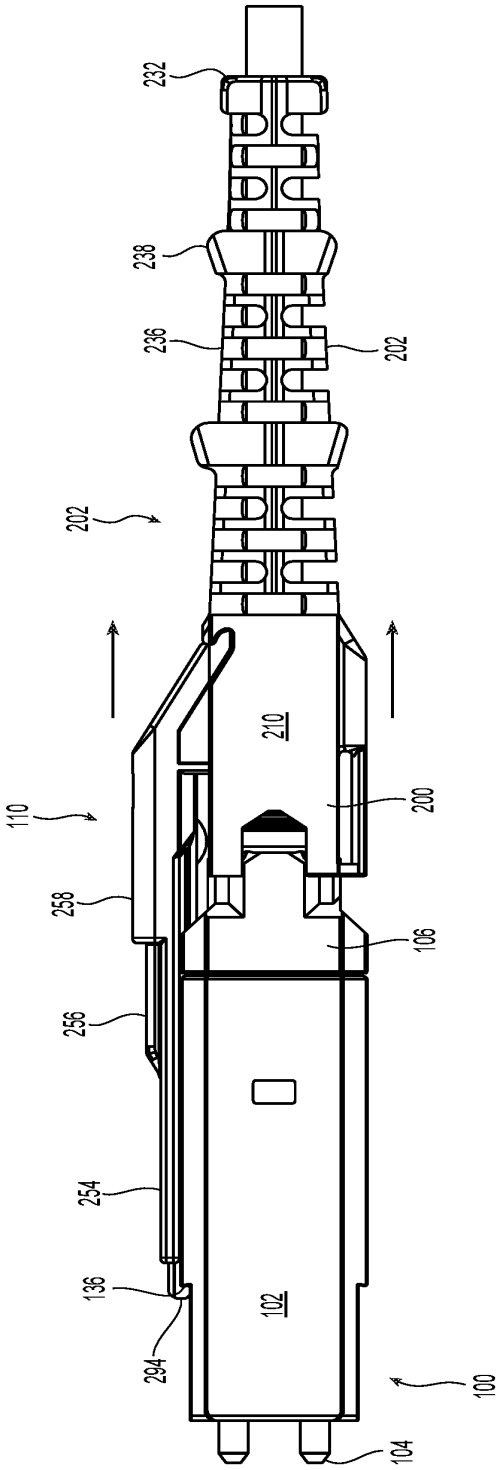

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Fig. 15

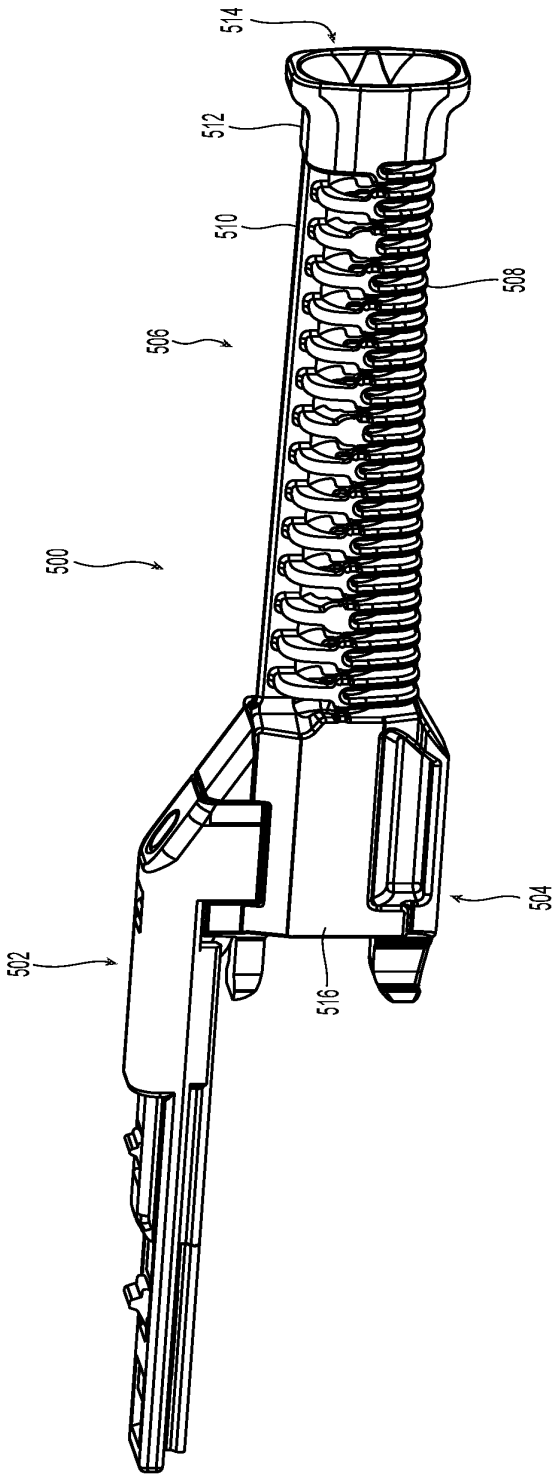


Fig. 16

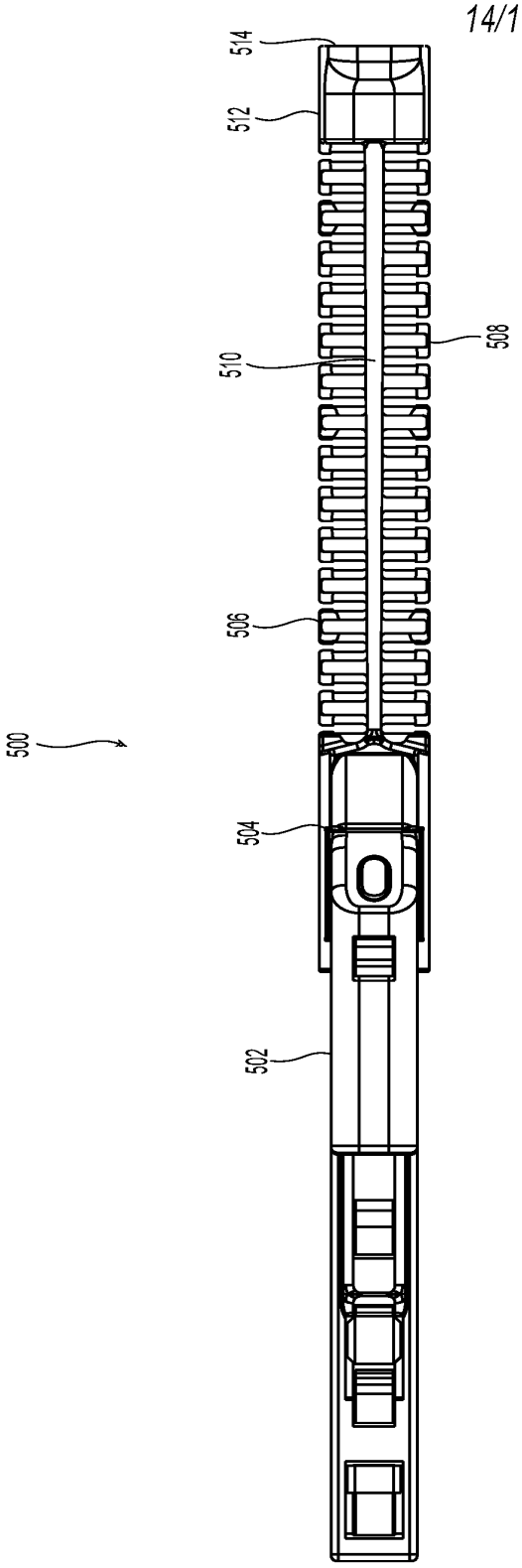


Fig. 17

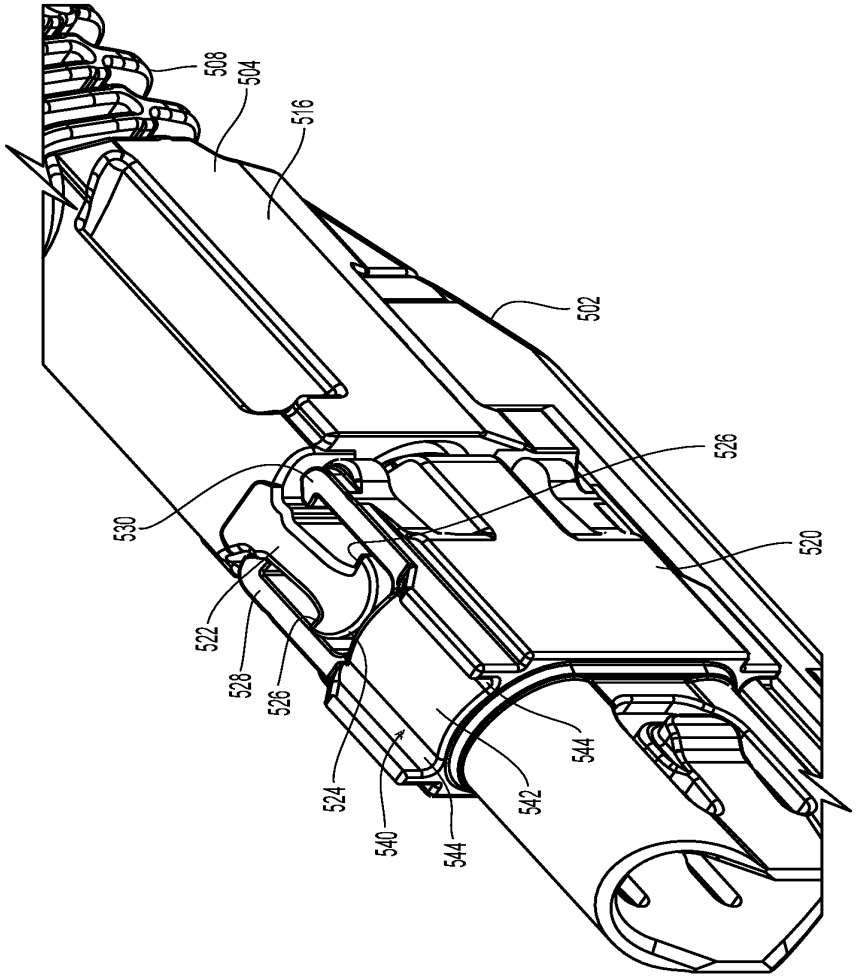


Fig. 18

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 19/25944

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - G02B 6/36, G02B 6/38 (2019.01)
CPC - G02B 6/3807, G02B 6/3893

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)
See Search History Document

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
See Search History Document

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
See Search History Document

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y --- A	US 2016/0209602 A1 (CORNING OPTICAL COMMUNICATIONS LLC) 21 July 2016 (21.07.2016), entire document especially Figs 5-6; paras [0021], [0023], [0024], [0029]	1, 2, 16 --- 3-15
Y --- A	US 2017/0205588 A1 (ALLIANCE FIBER OPTIC PRODUCTS, INC.) 20 July 2017 (20.07.2017), entire document especially para [0006]	1, 2, 16 --- 3-15
Y --- A	US 2017/0192180 A1 (CORNING OPTICAL COMMUNICATIONS LLC) 06 July 2017 (06.07.2017), entire document especially para [0023]	1, 2, 16 --- 3-15
Y	US 2014/0169727 A1 (VEATCH et al.) 19 June 2014 (19.06.2014), entire document especially Figs 7-10; paras [0028]-[0030]	2
A	US 2017/0160496 A1 (CORNING OPTICAL COMMUNICATIONS LLC) 08 June 2017 (08.06.2017), entire document	1-16

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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"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
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Date of the actual completion of the international search	Date of mailing of the international search report
10 June 2019	03 JUL 2019
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-8300	Authorized officer: Lee W. Young PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

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(71) Applicant: **ALLIANCE FIBER OPTIC PRODUCTS, INC.** [US/US]; 275 Gibraltar Drive, Sunnyvale, California 94089 (US).

(72) Inventor: **LIN, Yen Hsu**; 3F, No. 21, Lane 126, Section 3, Zhoungyang Road, Tucheng, New Taipei City, 236 (TW).

(74) Agent: **WEEKS, Adam R.**; CORNING OPTICAL COMMUNICATIONS LLC, Intellectual Property Department SP-TI-03-1, Corning, New York 14831 (US).

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Published:

— *with international search report (Art. 21(3))*

(54) Title: FIBER OPTIC CONNECTOR WITH DUAL MULTI-FIBER FERRULES, AND CABLE ASSEMBLIES AND SYSTEMS INCLUDING THE SAME

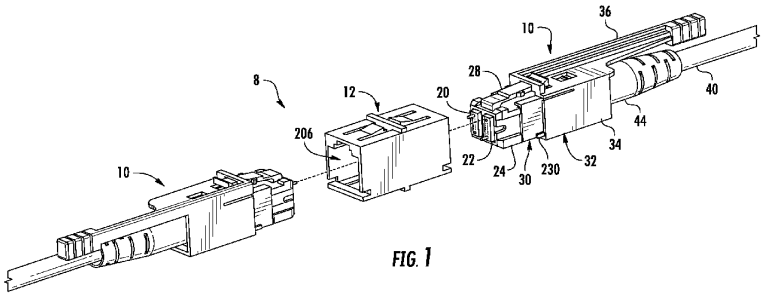


FIG. 1

(57) Abstract: A fiber optic connector (10) includes first (20) and second (22) ferrules arranged next to each other. The first and second ferrules each have a plurality of bores configured to support respective optical fibers. The fiber optic connector (10) also includes an inner connector body (24) having a front end from which the first and second ferrules extend, a latch arm (28) extending outwardly from the inner connector body, and an outer body (32) having a housing portion (34) in which the inner connector body is at least partially received and a handle (36) extending rearwardly from the housing portion. The outer body (32) can move relative to the inner connector body (24) to cause the latch arm (28) to flex toward the inner connector body.

WO 2017/139430 A1

FIBER OPTIC CONNECTOR WITH DUAL MULTI-FIBER FERRULES, AND CABLE ASSEMBLIES AND SYSTEMS INCLUDING THE SAME

Related Applications

[0001] This application claims the benefit of priority of U.S. Provisional Application No. 62/389,436, filed on February 9, 2016, the content of which is relied upon and incorporated herein by reference in its entirety.

Background

[0002] This disclosure relates generally to fiber optic connectors, and more particularly to fiber optic connectors that include multiple, multi-fiber ferrules, such as MT ferrules. This disclosure also relates to cable assemblies, systems, and methods including such fiber optic connectors.

[0003] Optical fibers and copper wires are useful in a wide variety of applications, including the telecommunications industry for data transmission. In a telecommunications system that uses either of these data transmission elements, there are typically many locations where cables that carry the elements connect to equipment or other cables. Connectors are typically provided on the ends of the cables to conveniently provide these connections. The connectors are designed to be received in ports that align the optical fiber(s) carried by connectors with the optical fiber(s) of other connectors or with equipment (e.g., transceivers) so that data can be transmitted between the components.

[0004] The demand for high bandwidth tends to drive a need for high-density interconnects, i.e. a large number of optical connections in a given space. By increasing the number of optical connections, more data can be transmitted in the given space. It can be a challenge, however, to design fiber optic connectors cable of providing high-density interconnects. The fiber optic connectors often become more difficult to handle and less robust as components are made smaller.

Summary

[0005] According to one embodiment of this disclosure, a fiber optic connector comprises first and second ferrules arranged next to each other. The first and second ferrules each have a plurality of bores configured to support respective optical fibers. The fiber optic connector also includes an inner connector body having a front end from which the first and second ferrules extend, a latch arm extending outwardly from the inner connector body, and an outer body having a housing portion in which the inner connector body is at least partially received and a handle extending rearwardly from

the housing portion. The outer body can move relative to the inner connector body to cause the latch arm to flex toward the inner connector body. For example, the outer body may be movable between a forward position in which the housing portion does not flex the latch arm and a rearward position in which the housing portion flexes the latch arm toward the inner connector body.

[0006] Fiber optic connectors in this disclosure, like the one summarized above, may be provided as part of a cable assembly. As an example, a cable assembly may include a fiber optic cable having a plurality of optical fibers. The cable assembly may also include the fiber optic connector mounted on the fiber optic cable. At least a first group of the plurality of optical fibers are supported by the plurality of bores in the first ferrule of the fiber optic connector, and at least a second group of the plurality of optical fibers are supported by the plurality bores in the second ferrule.

[0007] Fiber optic connectors in this disclosure, like the one summarized above, may also be provided together with an adapter as part of a fiber optic connector system. The adapter may include an adapter body having a passage into which the fiber optic connector can be inserted. The latch arm of the fiber optic connector is configured to engage the adapter body to retain the fiber optic connector in the passage of the adapter body. In some embodiments, the adapter body may include opposed first and second ends, and the passage extends through the adapter body between the opposed first and second ends. The fiber optic connector can then be inserted into the passage of the adapter body from either of the opposed first and second ends.

[0008] Additional features and advantages will be set forth in the detailed description which follows, and in part will be readily apparent to those skilled in the technical field of optical communications. It is to be understood that the foregoing general description, the following detailed description, and the accompanying drawings are merely exemplary and intended to provide an overview or framework to understand the nature and character of the claims.

Brief Description of the Drawings

[0009] The accompanying drawings are included to provide a further understanding, and are incorporated in and constitute a part of this specification. The drawings illustrate one or more embodiment(s), and together with the description serve to explain principles and operation of the various embodiments. Features and attributes associated with any of the embodiments shown or described may be applied to other embodiments shown, described, or appreciated based on this disclosure.

[0010] Fig. 1 is a perspective view of one embodiment of a fiber optic connector system that includes at least one fiber optic connector and an adapter, wherein two of the fiber optic connectors are shown removed from the adapter.

[0011] Fig. 2 is a perspective view of the fiber optic connector system of Fig. 1, wherein the fiber optic connectors are shown inserted into the adapter.

[0012] Fig. 3 is a perspective view of one of the fiber optic connectors used in the system of Figs. 1 and 2.

[0013] Fig. 4 is close-up perspective view a front portion of the fiber optic connector of Fig. 3, wherein the fiber optic connector includes first and second ferrules having respective first and second end faces.

[0014] Fig. 5 is similar to Fig. 4, but illustrates an alternative embodiment where the fiber optic connector includes first and second ferrules having respective first and second end faces with a different arrangement than what is shown in Fig. 4.

[0015] Fig. 6 is a perspective view of an exemplary ferrule for use in fiber optic connectors according to some embodiments of this disclosure.

[0016] Fig. 7 is an exploded perspective view of the fiber optic connector of Fig. 3.

[0017] Fig. 8 is a front perspective view of an inner connector body of the fiber optic connector of Fig. 3.

[0018] Fig. 9 is a rear perspective view of the inner connector body of the fiber optic connector of Fig. 3.

[0019] Fig. 10 is a perspective view of a spring push and a rear connector body of the fiber optic connector of Fig. 3, wherein the spring push is shown removed from the rear connector body.

[0020] Fig. 11 is similar to Fig. 10, but illustrates the spring push received within the rear connector body.

[0021] Fig. 12 is a perspective view of an outer body of the fiber optic connector of Fig. 3.

[0022] Figs. 13 and 14 are different perspective views of the adapter used in the system of Figs. 1 and 2.

[0023] Fig. 15 is a cross-sectional side view illustrating how the fiber optic connector of Fig. 3 cooperates with the adapter of Figs. 13 and 14 so that the fiber optic connector is retained in the adapter.

[0024] Figs. 16-18 are similar to Fig. 15, but sequentially illustrate how the outer body of the fiber optic connector may be moved in a rearward direction to depress a latch arm of the fiber optic connector and ultimately remove the fiber optic connector from the adapter.

DETAILED DESCRIPTION

[0025] Various embodiments will be further clarified by examples in the description below. To this end, Fig. 1 illustrates one example of a fiber optic connector system 8 ("system") including at least one fiber optic connector 10 (also referred to as "optical connector 10", or simply "connector 10") and an adapter 12. The adapter 12 may be used to mate two of the connectors 10, as shown in Fig. 2. The connector 10 and adapter 12 will each be discussed in further detail below.

[0026] Referring to Fig. 3, the connector 10 includes first and second ferrules 20, 22 arranged next to each other, an inner connector body 24 having a front end 26 from which the first and second ferrules 20, 22 extend, a latch arm 28 extending outwardly from the inner connector body 24, a rear connector body 30 received over a back portion of the inner connector body 24, and an outer body 32 that cooperates with the inner connector body 24, latch arm 28, and rear connector body 30. More specifically, the outer body 32 includes a housing portion 34 in which the inner connector body 30 is at least partially received and a handle 36 extending rearwardly from the housing portion 34. As will be described in greater detail below, the outer body 32 can move relative to the inner connector body 24 and rear connector body 30 so that the housing portion 34 can cause the latch arm 28 to flex toward the inner connector body 24. Eventually engagement between the rear connector body 30 and outer body 32 prevents further relative movement of the outer body 32 in a rearward direction. Pulling the handle 36 of the outer body 32 at this point results in the rear connector body 30 (and the inner connector body 24 that is coupled to the rear connector body 30) moving with the outer body 32 so that the connector 10 can be removed from the adapter 12.

[0027] Fig. 3 illustrates the connector 10 as being mounted on a cable 40, thereby forming a cable assembly 40. To this end, the connector 10 also includes a boot 44 coupled to the rear connector body 30 and extending over a portion of the cable 40 to help limit bending where the connector 10 is mounted on the cable 40. The first and second ferrules 20, 22 each include a plurality of bores 48 (also referred to as "micro-holes") that support respective optical fibers (not shown in Fig. 3) extending from within the cable 40 (i.e., the optical fibers extend from the cable 40, through the rear connector body 30 and inner connector body 24, and into the bores 48 of the first and second ferrules 20, 22).

[0028] Fig. 4 is a close-up perspective view of a front portion of the connector 10. In the embodiment shown, the first and second ferrules 20, 22 each include two rows of the bores 48. Although 8 bores are illustrated in each row, in alternative embodiments each row may include a greater number of bores (e.g., 12 or 16 bores) or less bores (e.g., 4 bores). Similarly, there may be a single row of bores or more than two rows of bores in alternative embodiments. Any combination of M rows x N bores is possible (e.g., 1 x N, 2 x N, 3 x N, ...M x N), although it may advantageous to use arrangements which are already available and used with different connector designs. For example, the first and second ferrules 20, 22 may each be a mechanical transfer (MT) ferrule like those used in known multi-fiber push-on (MPO) connectors.

[0029] The bores 48 in each row extend parallel to each other through at least a portion of the associated first or second ferrule 20, 22. As such, each row defines a respective fiber plane F_P, one of which is schematically illustrated in Fig. 4. The first and second ferrules 20, 22 include respective first and second end faces 50, 52 that are inclined (i.e., non-perpendicular) relative to the fiber planes defined by their respective bores 48. For example, the first and second end faces 50, 52 may be angle polished to result in the geometry shown. The polishing may be the same such that first end face 50 has the same geometry (e.g., slope/angle) as the second end face 52. In the embodiment shown in Fig. 4, a "high" end of the first and second end faces 50, 52 is on the left side of the first and second ferrules 20, 22, and a "low" end of the first and second end faces 50, 52 is on a right side of the first and second ferrules 20, 22. An alternative embodiment with an opposite arrangement is shown in Fig. 5, where the high end of the first and second end faces 50, 52 is on the right side of the first and second ferrules 20, 22, and the low end is on the left side. Either arrangement results in the first and second end faces 50, 52 having geometries that match those of a mating connector. That is, when a mating connector having the same design as the connector 10 is turned 180 degrees to face the connector 10, the first and second end faces 50, 52 of the two connectors will have complementary geometry to allow close physical contact and, therefore, facilitate optical coupling between optical fibers carried by the first and second ferrules 20, 22.

[0030] In some embodiments, the first and second ferrules 20, 22 may alternatively have a flat polish. For example, Fig. 6 illustrates one example of a ferrule 56 that may be used as the first and second ferrules. The ferrule 56 includes an end face 58 that is perpendicular or substantially perpendicular (e.g., within +/- 1 degree of perpendicular) to the fiber planes defined by the rows of bores 48. Other features of the ferrule 56 seen in Fig. 6 may apply to the first and second ferrules 20, 22 of Figs. 3 and 4. In particular, the end face 58 is defined on a front portion 60 ("shank") of the ferrule 56 that extends from a rear portion 62 ("shoulder") of the ferrule 56. The rear portion 62 has

a greater cross-sectional profile in a plane transverse to the fiber planes so that the ferrule 56 can be retained within the inner connector body 24 (see discussion below). The bores 48 extend from the end face 58 to a cavity 64 that begins in the front portion 60 and extends through the rear portion 62 to a rear opening (not shown) on a rear surface 66 of the ferrule 56. A window 68 may be provided on an outer surface of the front portion 60 to assist with placing adhesive in the cavity 64 when securing the ferrule 56 to optical fibers.

[0031] Still referring to Fig. 6, the ferrule 56 further includes first and second pin holes 70, 72 extending through the ferrule 56 on opposite sides of the rows of bores 48. Thus, the bores 48 are positioned between the first and second pin holes 70, 72. The first and second pin holes 70, 72 are each designed to accommodate a guide pin (not shown in Fig. 6). For example, referring back to Figs. 3 and 4, the connector 10 may include a first guide pin 74 extending through the first pin hole 70 in the first ferrule 20 and a second guide pin 76 extending through the second pin hole 72 in the second ferrule 22. The first and second pin holes 70, 72 may be considered as respective "upper" and "lower" pin holes when the connector 10 is assembled. Alternative embodiments are possible where the first guide pin 74 extends through the second (i.e., lower) pin hole 72 in the first ferrule 20, and the second guide pin 76 extends through the first (i.e., upper) pin hole 70 in the second ferrule 22. Either arrangement results in the first and second ferrules 20, 22 each having a single guide pin extending therethrough.

[0032] As shown in Fig. 7, the first and second guide pins 70, 72 may be part of respective first and second guide pin assemblies 80, 82 that each include a pin keeper 84 ("pin retainer") from which the associated guide pin (i.e., the first guide pin 70 or second guide pin 72) extends. Features on the pin keeper 84 cooperate with features on the associated guide pin to retain a portion of the guide pin within the pin keeper 84. When the connector 10 is assembled, the pin keepers 84 are positioned against the rear surfaces 66 of the first and second ferrules 20, 22, and the first and second guide pins 74, 76 extend through the associated pin holes 70, 72 so as to project beyond the first and second end faces 50, 52.

[0033] Still referring to Fig. 7, the connector further includes first and second springs 90, 92 for biasing the respective first and second ferrules 20, 22 toward the front end 26 of the inner connector body 24. The first and second springs 90, 92 each extend between one of the pin keepers 84 and a spring push 96 that is received in the rear connector body 30 when the connector 10 is assembled. Additional details related to the spring push 96 and assembly of the connector 10 in general will be described in greater detail below. However, it can be appreciated from Figs. 3 and 7 that the rear connector body 30 being coupled to the inner connector body 24 results in the first and second

springs 90, 92 extending within the inner connector body 24 and rear connector body 30, biasing the first and second ferrules 20, 22 in a forward direction.

[0034] The rear connector body 30 may be coupled to the inner connector body 24 in any suitable manner. In the embodiment shown, the rear connector body 30 is designed to be snapped onto a back portion 98 of the inner connector body 24. Latching features in the form of bumps 100 (e.g., ramped shoulders) are provided on the back portion 98 of the inner connector body 24. The rear connector body 30 is designed to receive the back portion 98 and includes openings/holes 102 (e.g., holes) that cooperate with the bumps 100 to couple the inner connector body 24 to the rear connector body 30. In other words, the rear connector body 30 can be inserted over the back portion 98, flexing as needed to accommodate the bumps 100, until the bumps 100 are received in or otherwise engage the openings 102. At this point the rear connector body 30 flexes (e.g., snaps) back towards an un-flexed shape. The bumps 10 are designed so that the rear connector body 30 cannot easily be pulled back over the bumps 100 and off the back portion 98 of the inner connector body 24.

[0035] Fig. 7 also illustrates the rear connector body 30 including a knurled portion 106. The knurled portion 106 may be integrally formed with the remainder of the rear connector body 30 as a monolithic structure. Alternatively, the knurled portion 106 may be formed separately and coupled to the rear connector body 30 by any suitable method (e.g., the knurled portion 106 may be a metal sleeve coupled to the rear connector body 30 by inserting molding techniques). Strength members 194 (e.g., aramid yarn) from the cable 40 may be placed over the knurled portion 106 and secured in place using a crimp band or tube 108. The boot 44 extends over the crimp tube 108 to abut the rear connector body 30 when the connector 10 is assembled.

[0036] Various components of the connector that have been introduced will now be described in further detail, beginning with the inner connector body 24. As shown in Fig. 8, the inner connector body 24 may be a generally rectangular body defined by side walls 112a-112d (i.e., the side walls define sides of the rectangular body in the embodiment shown). The fiber planes F_P (see Fig. 4) are positioned between the side walls 112a, 112c and intersect the side walls 112b, 112d when the connector 10 is assembled. Indeed, the side walls 112a, 112c may be generally parallel to the fiber planes F_P when the connector 10 is assembled, and the side walls 112b, 112d) may be generally perpendicular to the fiber planes F_P. The latch arm 28 extends from the side wall 112b. In some embodiments, the latch arm 28 itself may even intersect one or more of the fiber planes F_P when the connector 10 is assembled.

[0037] The latch arm 28 may be integrally formed with the inner connector body 24 (e.g., as a monolithic structure), as shown. Because the latch arm 28 extends outwardly and rearwardly, a space is defined between the latch arm 28 and the inner connector body 24. The space accommodates flexing of the latch arm 28 toward the inner connector body 24. To this end, the latch arm 28 is coupled to the inner connector body 24 in a manner that allows the latch arm 28 to flex toward the inner connector body 24 when a downward force is applied to the latch arm 28 (e.g., when the latch arm 28 is depressed).

[0038] Still referring to Fig. 8, the latch arm 28 has a generally uniform width until connector latches 116 ("latching features") project laterally on opposite sides of the latch arm 28. The connector latches 116 in the embodiment shown are shoulders that define rearward-facing surfaces. The latch arm 28 also includes a ramp 118 spaced rearward from the connector latches 116. In other words, the connector latches 116 are located on an intermediate portion of the latch arm 28 (i.e., between where the latch arm 28 extends from the side wall 112b of the inner connector body 24 and the ramp 118, which defines a terminal end of the latch arm 28 in the embodiment shown).

[0039] Only a single latch arm 28 is provided in the embodiment shown, although embodiments with multiple latch arms are also possible. To facilitate discussion for the embodiment shown, the side wall 112b of the inner connector body 24 from which the latch arm 28 extends may be referred to as a "top side wall" (or "top side") of the inner connector body 24. The opposite side wall 112d may then be referred to as a "bottom side wall", and the side walls 112a, 112c as "lateral side walls". The lateral side walls 112c each include a guide slot extending rearwardly from the front end 26 of the inner connector body 24. Guide chamfers 122 are provided on the connector body 24 at corners defined the side walls 112a-112d. The guide chamfers 122 include sloped surfaces and extend rearwardly from the front end 26. As will be apparent based on the description below, the guide chamfers 122 help guide the inner connector body 24 into an adapter, and the guide slots 120 cooperate with corresponding features on the adapter during such insertion to further guide the connector 10.

[0040] Still referring to Fig. 8, the inner connector body 24 includes an internal wall 128 that separates first and second passages 130, 132. The first and second passages 130, 132 receive the first and second ferrules 20, 22 (see, e.g., Fig. 4), respectively, when the connector 10 is assembled. Fig. 9 illustrates how the first and second ferrules 20, 22 may be inserted into the respective first and second passages 130, 132 from a back end 134 of the inner connector body 24. Each of the first and second passages 130, 132 includes a portion sized to accommodate the front portion 60 (Fig. 5) of the first and second ferrules 20, 22, but not the rear portion 62. Thus, internal geometry of the inner

connector body 24 prevents the first and second ferrules 20, 22 from being inserted completely through the first and second passages 130, 132.

[0041] As shown in Figs. 8 and 9, the internal wall 128 extends from the front end 26 of the inner connector body 24 to a location spaced from the back end 134. Thus, there is a cavity within the inner connector body 24 between the back end 134 and the internal wall 128, communicating with both the first and second passages 130, 132. The top side wall 112b and bottom side wall 112d of the inner connector body 24 each include a slot 136 extending the length of the common cavity (i.e., the slots 136 extend from the back end 134 to the internal wall 128).

[0042] Figs. 10 and 11 illustrate the rear connector body 30 and spring push 96 in further detail. The spring push 96 includes upper and lower extensions 140, 142 on opposite sides of a central member 144. The upper and lower extensions 140, 142 on each side define a channel (e.g., slot) for accommodating optical fibers. Thus, the spring push 96 includes first and second channels 146, 148 for accommodating respective first and second groups of optical fibers. The spring push 96 also includes guiding members 150 (also referred to as "guiding ways" or "tabs") above the upper extension 140 and below the lower extension 142 for reasons that will be discussed below.

[0043] Like the inner connector body 24, the rear connector body 30 in the embodiment shown is generally rectangular and includes a top side wall 154, a bottom side wall 156, and lateral side walls 158, 160. An internal cavity 162 of the rear connector body 30 accommodates both the spring push 96 and the back portion 98 (Fig. 7) of the inner connector body 24. In particular, the spring push 96 may be inserted into the internal cavity 162 until a rearward-facing surface on the spring push 96 contacts a forward-facing surface 164 in the internal cavity 162. A passage 166 that defines a smaller opening than the internal cavity 162 extends from the forward-facing surface 164 and through a remainder of the rear connector body 30 (including the knurled portion 106). The first and second channels 146, 148 of the spring push 96 have portions that overlap the passage 166 when the connector 10 is assembled so that optical fibers can extend from the cable 40 (see Fig. 7), through the rear connector body 30, through first and second springs 90, 92, and to the first and second ferrules 20, 22 in the inner connector body 24. A forward-facing surface of the spring push 96 defines a spring seat for the first and second springs 90, 92. In other words, the first and second springs 90, 92 can abut or otherwise rest against the forward-facing surface of the spring push 96 so that the first and second springs 90, 92 can bias the first and second ferrules 20, 22 forward in the inner connector body 24.

[0044] In Fig. 11, it can be seen how the guiding members 150 on the spring push 96 may contact inner surfaces the top side wall 154 and bottom side wall 156 of the rear connector body 30 in the

assembled position. Such an arrangement helps stabilize the spring push 96 before the rear connector body 30 is received over the inner connector body 24. The spring push 96, however, does not interfere with the internal cavity 162 accommodating the back portion 98 (Fig. 7) of the inner connector body 24. This is because the side walls 112a-112d on the inner connector body 24 can extend into portions of the internal cavity 162 between the remainder of the spring push 96 and the side walls 154, 156, 158, 160 of the rear connector body 30, with the guiding members 150 being received in the slots 136 on the top side wall 112b and bottom side wall 112b of the inner connector body 24.

[0045] Now referring to Fig. 12, the housing portion 34 of the outer body 32 has a tubular configuration, and specifically a rectangular tubular configuration defined by a top side wall 170, bottom side wall 172, and lateral side walls 174, 176. The top side wall 170 includes a window 178 (i.e., an opening through the top side wall 170) for receiving a latch 180 (Figs. 10 and 11) of the rear connector body 30. The top side wall 170 also includes a latch opening 180 for receiving the latch arm 28 (see, e.g., Fig. 4) when the connector 10 is assembled. A crossbar member 184 extends across the latch opening 182 at a front end 186 of the outer body 32 and includes downwardly-facing, sloped (i.e., angled) surfaces 188 for cooperating with the ramp 118 (Fig. 8) on the latch arm 28. The handle 36 extends rearwardly from the housing portion 34, as mentioned above. If desired, the handle 36 may include a cube 190 or other gripping member for a user to grasp at a terminal end of the handle 36.

[0046] Now that the components of the connector 10 have been described in further detail, a brief summary of how the connector 10 may be assembled on a cable will be provided before proceeding to the discuss features of the adapter 12. Referring back to Fig. 7, an exemplary assembly process may involve placing the boot 44, outer body 32, crimp tube 108, and rear connector body 30 onto the cable 40. The end of the cable 40 may then be prepared to form the cable assembly 42 (Fig. 3). This may include separating the optical fibers 192 into first and second groups, and even separating the optical fibers 192 within each of the first and second groups into sub-groups, or rows, to prepare the optical fibers 192 for insertion into the bores 48 in the respective first and second ferrules 20, 22. The manner in which the optical fibers 192 are separated and prepared will depend on the design of the cable 40. The cable 40 may, for example, include optical fiber ribbons (i.e., groups of the optical fibers 192 in a ribbonized form) or loose optical fibers. Appropriate techniques for separating and preparing the optical fibers 192 for insertion into the first and second ferrules 20, 22 will be appreciated by persons skilled in optical cable assembly processes.

[0047] At this point, the first and second springs 90, 92 may be placed over the first and second groups of optical fibers, which may then be inserted into and secured to the respective first and second ferrules 20, 22 using known processes. After forming these cable sub-assemblies, the first and second ferrules 20, 22 may be polished or otherwise processed. Because the inner connector body 24 has not yet been installed, the first and second ferrules 20, 22 can be accessed and handled with greater ease compared to when the connector 10 is fully assembled.

[0048] Before or after securing the optical fibers to the first and second ferrules 20, 22, the spring push 96 may be positioned onto the optical fibers at a location behind the first and second springs 90, 92. The first and second channels 146, 148 of the spring push 96 accommodate the first and second groups of the optical fibers, as noted above. The rear connector body 30 may then be moved forward over the spring push 96. Also, the inner connector body 24 may be installed onto the cable 40 by inserting the first and second ferrules 20, 22 into the respective first and second passages 130, 132 of the inner connector body 24. Ultimately the inner connector body 24 is inserted into and coupled to the rear connector body 30 in the manner described above.

[0049] Next, the cable 40 may be secured to the rear connector body 30. For example, strength members 194 (e.g., aramid yarn) from the cable 40 may be crimped or otherwise secured to the knurled portion 106 of the rear connector body 30 using the crimp tube 108. The boot 44 may then be moved forward over crimp tube 108 to abut the rear connector body 30, as mentioned above.

[0050] Before or after securing cable 40 to the rear connector body 30, the outer body 32 may be moved forward so that the rear connector body 30 and back portion 98 of the inner connector body 24 are received in the housing portion 32 of the outer body 30. The latch opening 182 on the housing portion 34 is wide enough to accommodate the latch arm 28, although it may be necessary to flex the latch arm 28 toward the inner connector body 24 so that the crossbar member 184 moves over the latch arm 28. Eventually the latch 180 on the top side wall 154 of the rear connector body 30 extends through the window 178 in the housing portion 34 of the outer body 32. Slots 194 may be provided on the lateral side walls 174, 176 of the housing portion 34 to facilitate the outer body 32 flexing when moving over the latch 180 on the rear connector body 30.

[0051] As mentioned above in connection with Figs. 1 and 2, the connector 10 may be part of a system 14 that also includes the adapter 12. Figs. 13 and 14 are different perspective views of an example embodiment of the adapter 12, which includes an adapter body 200 having opposed first and second ends 202, 204. A passage 206 extends through the adapter body 200 between the first and second ends 202, 204, resulting in a first opening 208 and second opening (not seen in Figs. 13 and 14) into the passage 206 at the first and second ends 202, 204. The adapter 12 also includes

respective keyways 216 extending into the adapter body 200 from the respective first and second ends 202, 204. Each keyway 216 is open to the passage 206 and configured to accommodate the latch arm 28 of the connector 10 when the connector 10 is inserted into the passage 206 via the first opening 208 or second opening. As can be appreciated, the connector 10 can be inserted into the passage 206 from either of the first and second ends 202, 204.

[0052] Adapter latches 220 are provided in upper corners of each keyway 216 at the first and second ends 202, 204 of the adapter body 200. The adapter latches 220 are essentially portions of the adapter body 200 that extend into a front, upper region of the associated keyway 216 to provide interference with the connector latches 116 (Fig. 8) on the latch arm 28. A lower region of each keyway 216 remains wide enough to accommodate the width of the latch arm 28 defined by the connector latches 116. Thus, when the connector 10 is inserted into the passage 206 via the first opening 208 or second opening, the latch arm 28 can flex toward the inner connector body 24 so that the connector latches 116 can pass under the adapter latches 220 in the lower region of the associated keyway 216. Once the connector latches 116 clear the adapter latches 220, the latch arm 28 can flex back away from the inner connector body 24 so that the connector latches 116 are moved into the upper region of the associated keyway 216, behind the associated adapter latches 220. Such an arrangement prevents the connector 10 from being pulled back out of the passage 206 unless the latch arm 28 is once again flexed toward the inner connector body 24.

[0053] Still referring to Fig. 13, the adapter body 200 includes at least one inner surface 224 having a guiding member 226 ("guiding way") projecting into the passage 206. Each guiding member 226 is received in one of the guide slots 120 (Fig. 8) on the lateral side walls 112a, 112b of the inner connector body 24 when the connector 10 is inserted into the adapter 12. As can be appreciated, the guiding member(s) 226 cooperate with the guide slots 120 to help position the connector 10 within the passage 206, thereby facilitating alignment between pairs of connectors that are mated using the adapter 12. Indeed, the adapter 12 need not include any additional alignment sleeve or the like within the passage 206.

[0054] Engagement between the guiding members 226 and the guide slots 120 may limit the extent to which the connector 10 can be inserted into the passage 206 from either the first end 202 or second end 204 of the adapter body 200. Alternatively or additionally, bumps 230 (Figs. 10 and 11) on the lateral side walls 158, 160 of the rear connector body 30 may engage a portion of the adapter body 200 to limit such insertion. For example, opposed first and second side walls 232, 234 of the adapter body 200 may each include slots 236 at the first and second ends 202, 204 of the adapter body 200. Inserting the connector 10 into the passage 206 results in each bump 230 on the

rear connector body 30 being received in one of the slots 236. The bumps 230 may "bottom out" in the slots 236, thereby preventing further insertion of the connector 10.

[0055] The adapter in the embodiment shown is generally symmetrical, with a first portion including the first end 202 of the adapter body 200 and a second portion including the second end 204 of the adapter body 200. An adapter flange 240 is positioned between the first and second portions in a central section of the adapter body 200. Each of the first and second portions also includes a mount structure 242 for securing the adapter 200 to a panel, faceplate, wall, or other bulkhead having an opening for the adapter body 200. In alternative embodiments, the adapter 12 may not be symmetrical (e.g., only the first portion or second portion may include a mount structure).

[0056] The insertion of the connector 10 into the adapter 12 has already been briefly discussed. Referring back to Figs. 1 and 2 with this discussion in mind, it can be seen how the handle 36 of the outer body 32 may be used achieve this insertion. In particular, a user may grasp the handle 36 and move the outer body 32 forward over the rear connector body 30 and inner connector body 24 until the housing portion 34 of the outer body 32 contacts the bumps 230 on the rear connector body 30. After such contact, the outer body 30 can be used to push the connector 10 into the adapter 12. The contact between the outer body 32 and bumps 230 on the rear connector body 30 may even be present initially such that the pushing begins without there first being relative movement between the outer body 32 and rear connector body 30.

[0057] To remove the connector 10 from the adapter 12, the handle 36 may be pulled rearwardly so that the outer body 32 depresses the latch arm 28 and ultimately pulls the connector 10 from the adapter 12. Figs. 15-18 are cross-sectional views sequentially illustrating this process and the cooperation between various features already discussed. In Fig. 15, the connector 10 is fully inserted into the passage 206 of the adapter 12. Fig. 15 shows one of the adapter latches 220 blocking rearward movement of one of the connector latches 116 to retain the connector 10 within the adapter 12. It can also be seen how the ramp 118 on the latch arm 28 is positioned behind the crossbar member 184 of the outer body 32 at this stage.

[0058] In Fig. 16, the outer body 30 has been moved relative to the remainder of the connector 10. More specifically, the outer body 30 has been moved in a rearward direction (e.g., by pulling the handle 36) so that the sloped surfaces 188 of the crossbar member 184 contact the ramp 118 of the latch arm 28. Further movement of the outer body 30 in the rearward direction results in the crossbar member 184 moving along the ramp 118 and causing the latch arm 28 to flex toward the inner connector body 24. Thus, the outer body 32 may be used to depress the latch arm 28.

[0059] Eventually the latch 180 on the top side wall 154 of the rear connector body 30 engages the housing portion 34 of the outer body 32, as shown in Fig. 17. The engagement prevents further movement of the outer body 32 relative to the rear connector body 30 in the rearward direction. By this point, the outer body 32 has caused the latch arm 28 to flex sufficiently toward the inner connector body 24 so that the connector latches 116 are positioned in the lower region of the associated keyway 216 of the adapter 12, beneath the adapter latches 220.

[0060] As shown in Fig. 18, the outer body 30 may then be used to pull the connector 10 out of the passage 206 of the adapter 12. In other words, continuing to pull the handle 36 of the outer body 30 in a reward direction results in the connector 10 moving as a unit in that direction. The connector latches 116 pass under the adapter latches 220 due to the depressed state of the latch arm 28.

[0061] Those skilled in optical connectivity will appreciate that other modifications and variations can be made without departing from the spirit or scope of the invention defined by the claims below. This includes modifications, combinations, sub-combinations, and variations of the disclosed embodiments. For example, although the connector 10 is has a “dual-ferrule” arrangement where only the first and second ferrules 20, 22 are arranged next to each other, embodiments will be appreciated where there are more than two ferrules arranged side-by-side. Additionally, although the ferrules described above include the bores 48 extending to the respective end faces of the ferrules, in alternative embodiments the connector 10 may include lens-based ferrules where optical fibers do not extend all the way to the ferrule end faces.

What is claimed is:

1. A fiber optic connector, comprising:

first and second ferrules that each have a plurality of bores configured to support respective optical fibers;

an inner connector body having a front end from which the first and second ferrules extend;

a latch arm extending outwardly from the inner connector body; and

an outer body having a housing portion in which the inner connector body is at least partially received and a handle extending rearwardly from the housing portion, wherein the outer body can move relative to the inner connector body to cause the latch arm to flex toward the inner connector body.

2. The fiber optic connector of claim 1, further comprising:

a rear connector body coupled to the inner connector body such that the outer body can also move relative to the rear connector body; and

first and second inner springs extending within the inner connector body and rear connector body, wherein the first and second inner springs bias the respective first and second ferrules toward the front end of the inner connector body.

3. The fiber optic connector of claim 2, wherein the rear connector body includes a rear passage for allowing optical fibers to extend through the rear connector body and to the first and second ferrules in the inner connector body, the fiber optic connector further comprising:

a spring push received within the rear connector body and including first and second channels communicating with the rear passage, wherein the first and second inner springs contact the spring push.

4. The fiber optic connector of claim 3, wherein the spring push includes a forward-facing surface defining respective first and second spring seats for the respective first and second inner springs.

5. The fiber optic connector of either claim 3 or 4, wherein:

the inner connector body further includes a back end opposite the front end and a plurality of side walls;

the spring push is shaped so that the side walls of the inner connector body extend between portions of the spring push and inner surfaces of the rear connector body;

at least one of the side walls of the inner connector body includes at least one slot extending from the back end of the inner connector body toward the front end of the inner connector body; and

the spring push includes at least one guiding tab received in the at least one slot of the at least one side wall of the inner connector body.

6. The fiber optic connector of any of claims 2-5, wherein the rear connector body includes at least one latch configured to limit rearward movement of the outer body relative to the rear connector body.

7. The fiber optic connector of claim 6, wherein:

the housing portion of the outer body includes side surfaces and a window through one of the side surfaces; and

the at least one latch of the rear connector body comprises a projection on the rear connector body that extends through the window in the outer body.

8. The fiber optic connector of any of claims 2-7, wherein the rear connector body includes at least one side wall having a bump configured to limit forward movement of the outer body relative to the rear connector body.

9. The fiber optic connector of any of claims 1-8, wherein the housing portion of the outer body includes a latch opening, and wherein the latch arm extends from the inner connector body and through the latch opening of the outer body.

10. The fiber optic connector of any of claims 1-9, wherein:

the latch arm includes at least one connector latch and a ramp spaced from the at least one connector latch; and

the ramp facilitates the outer body being able to cause the latch arm to flex toward the inner connector body upon rearward movement of the outer body relative to the inner connector body.

11. The fiber optic connector of any of claims 1-10, wherein:

the inner connector body includes first and second passages separated by an internal wall; and

the first and second ferrules are received in the respective first and second passages.

12. The fiber optic connector of any of claims 1-11, wherein the plurality of bores in each of the first and second ferrules comprises at least one row of bores in each of the first and second ferrules.

13. The fiber optic connector of claim 12, wherein the bores in each row extend parallel to each other such that each row defines a respective fiber plane.

14. The fiber optic connector of claim 13, wherein the latch arm extends outwardly from a side of the inner connector body that intersects the fiber planes defined by the at least one row of bores in each of the first and second ferrules.

15. The fiber optic connector of either claim 13 or 14, wherein the first and second ferrules include respective first and second end faces that are inclined relative the fiber planes defined by the at least one row of bores in the respective first and second ferrules.

16. The fiber optic connector of either claim 13 or 14, wherein the first and second ferrules include respective first and second end faces that are substantially perpendicular to the fiber planes defined by the at least one row of bores in the respective first and second ferrules.

17. The fiber optic connector of any of claims 1-16, wherein the first and second ferrules each include upper and lower pin holes extending therethrough and between which the respective plurality of bores are positioned, the fiber optic connector further comprising:

a first guide pin extending through the lower pin hole in the first ferrule; and

a second guide pin extending through the upper pin hole in the second ferrule.

18. The fiber optic connector of any of claims 1-17, wherein the housing portion of the outer body comprises a tubular body.

19. The fiber optic connector of any of claims 1-18, wherein the latch arm is the only latch arm extending from the inner connector body.

20. A cable assembly, comprising:

a fiber optic cable including a plurality of optical fibers; and

a fiber optic connector according to any of claims 1-19 mounted on the fiber optic cable, wherein at least a first group of the plurality of optical fibers are supported by the plurality of bores in the first ferrule, and wherein at least a second group of the plurality of optical fibers are supported by the plurality bores in the second ferrule.

21. A fiber optic connector system, comprising:

a fiber optic connector according to any of claims 1-19; and

an adapter including an adapter body having a passage into which the fiber optic connector can be inserted;

wherein the latch arm of the fiber optic connector is configured to engage the adapter body to retain the fiber optic connector in the passage of the adapter body.

22. The fiber optic connector system of claim 21, wherein:

the adapter body includes opposed first and second ends;

the passage extends through the adapter body between the opposed first and second ends; and

the fiber optic connector can be inserted into the passage of the adapter body from either of the opposed first and second ends.

23. The fiber optic connector system of claim 22, wherein the adapter further includes:

first and second openings into the passage at the respective first and second ends of the adapter body; and

first and second keyways extending into the adapter body from the respective first and second ends, wherein the first and second keyways are open to the passage in the adapter body and configured to accommodate the latch arm of the fiber optic connector when the fiber optic connector is inserted into the passage via the respective first or second opening.

24. The fiber optic connector system of any of claims 21-23, wherein:

the adapter body includes at least one inner surface having a guiding member projecting into the passage of the adapter body; and

the inner connector body includes at least one side wall with at least one guide slot extending from the front end of the inner connector body; and

the at least one guiding member of the adapter body is received in the at least one guide slot of the inner connector body when the fiber optic connector is inserted into the passage of the adapter body.

25. The fiber optic connector of any of claims 21-24, wherein:

the adapter body includes opposed first and second side walls each having a slot;

the fiber optic connector further includes a rear connector body coupled to the inner connector body such that the outer body can also move relative to the rear connector body;

the rear connector body includes at least one outer surface with a bump configured to limit forward movement of the outer body relative to the rear connector body;

each bump on the rear connector body is received in one of the slots in the first and second side walls of the adapter body when the fiber optic connector is retained in the passage of the adapter body.

26. The fiber optic connector system of any of claims 21-25, wherein there is no adapter sleeve within the passage of the adapter body.

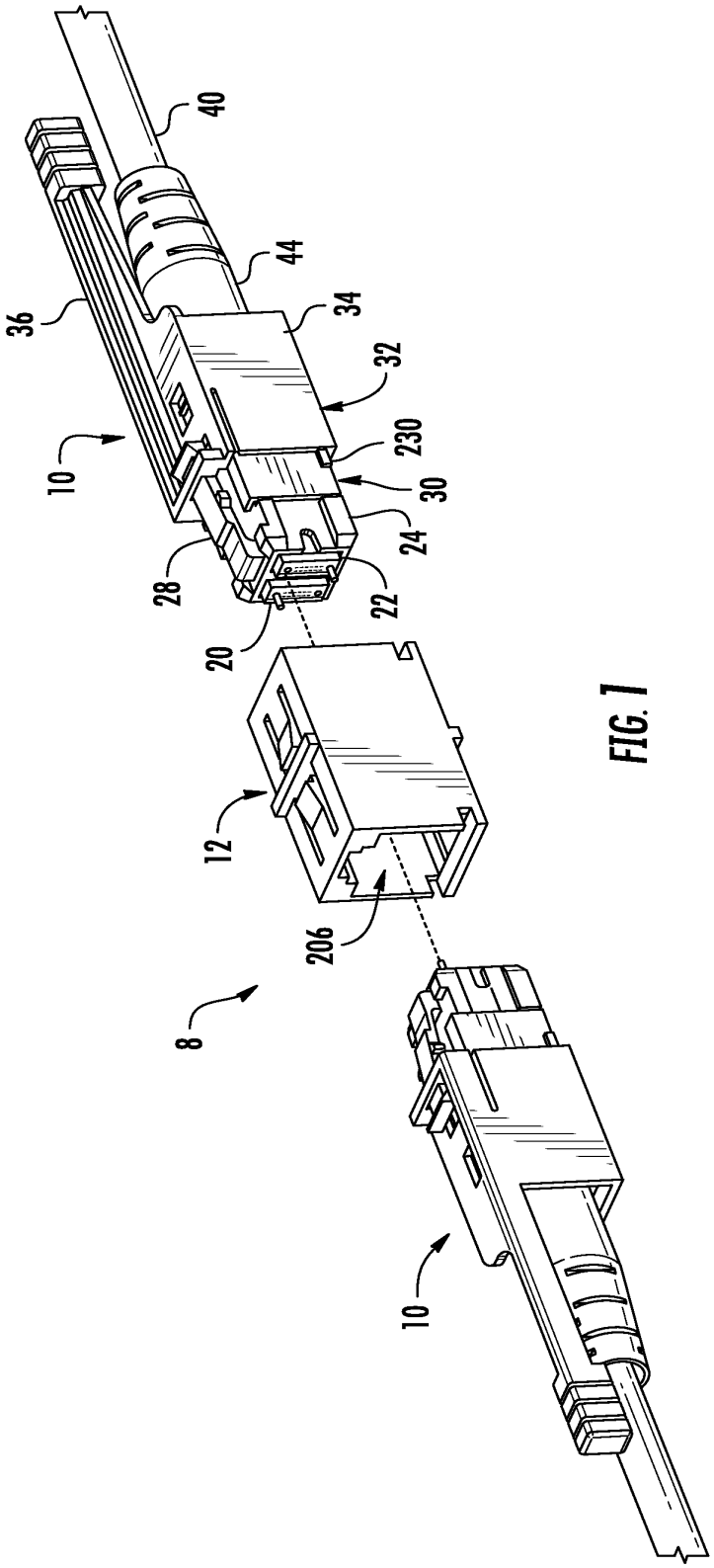


FIG. 1

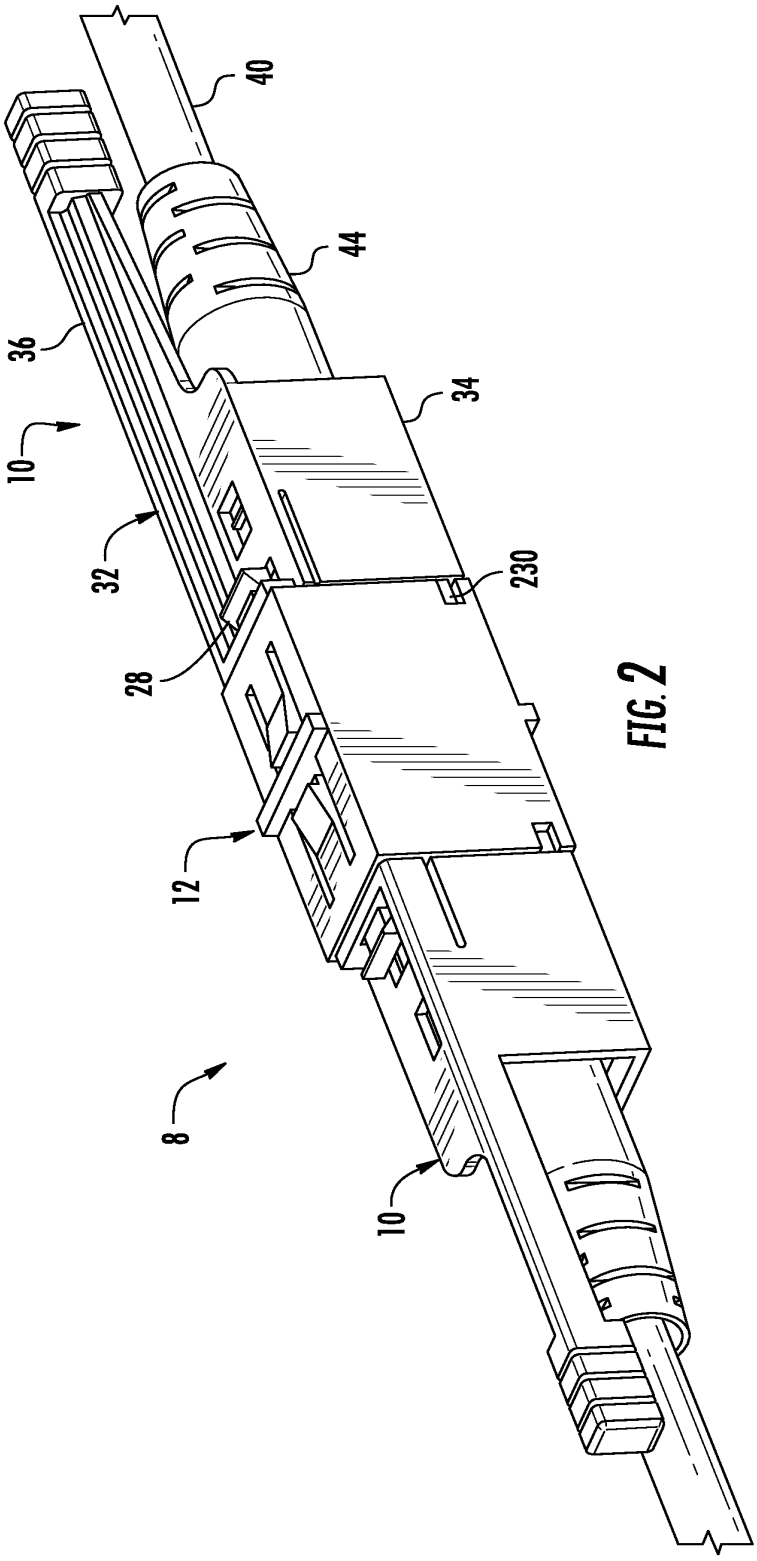


FIG. 2

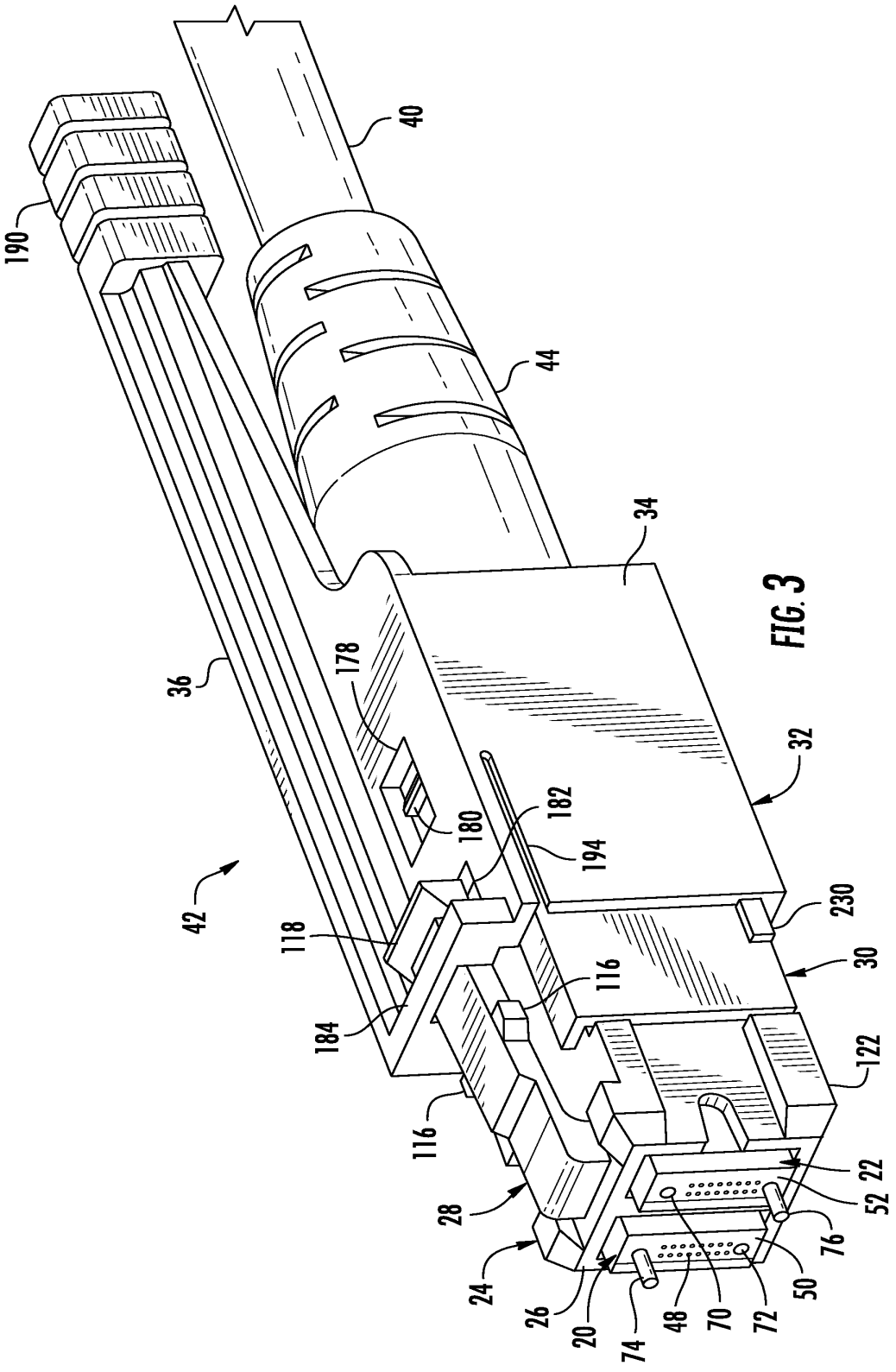

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FIG. 3

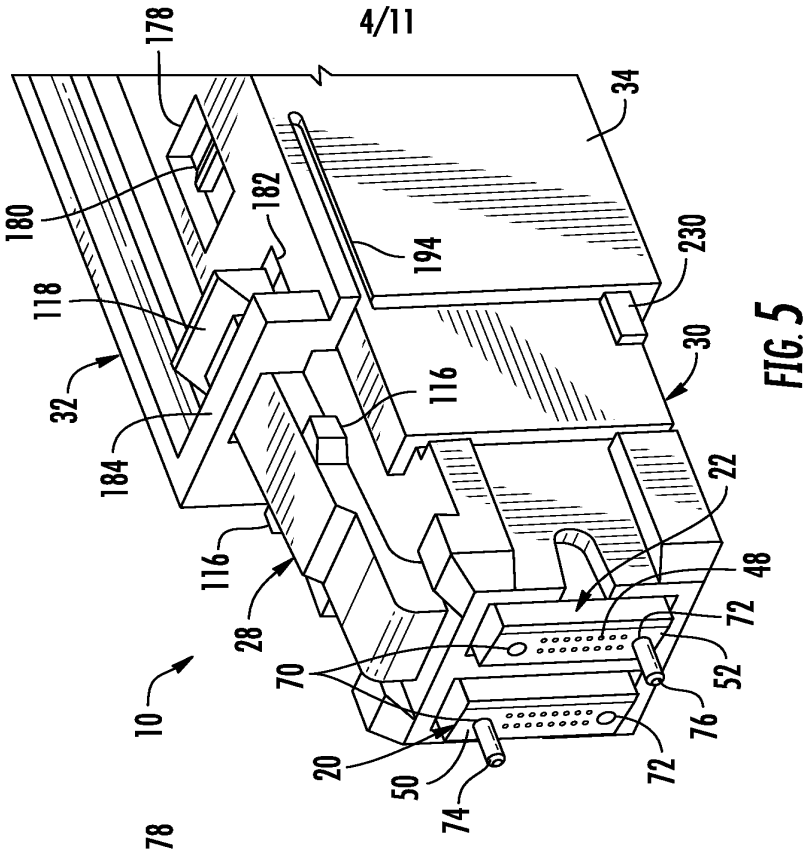

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FIG. 5

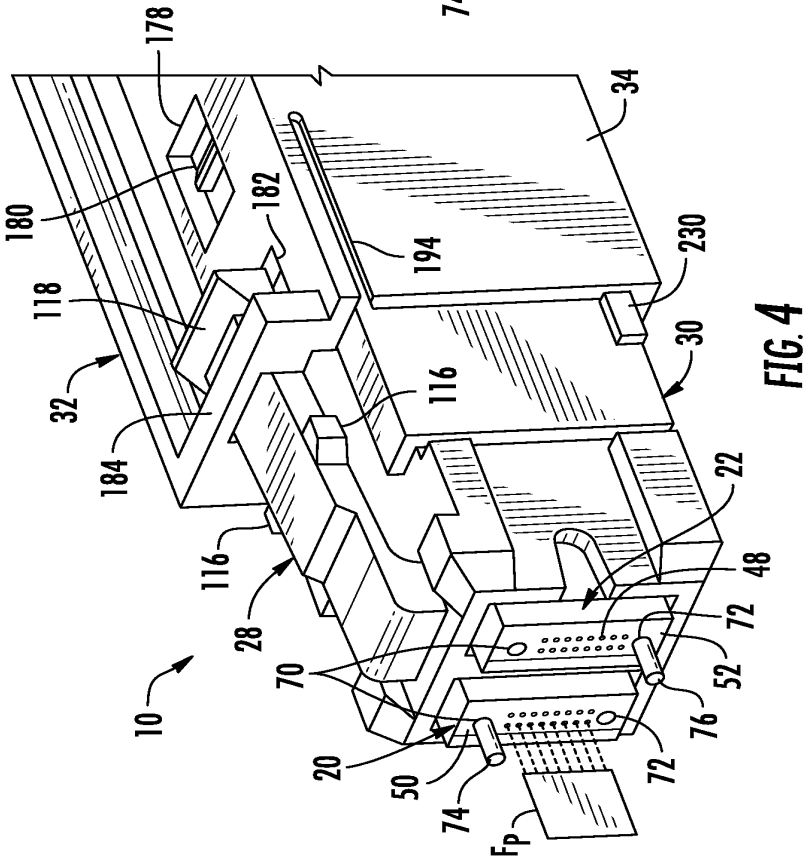

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FIG. 4

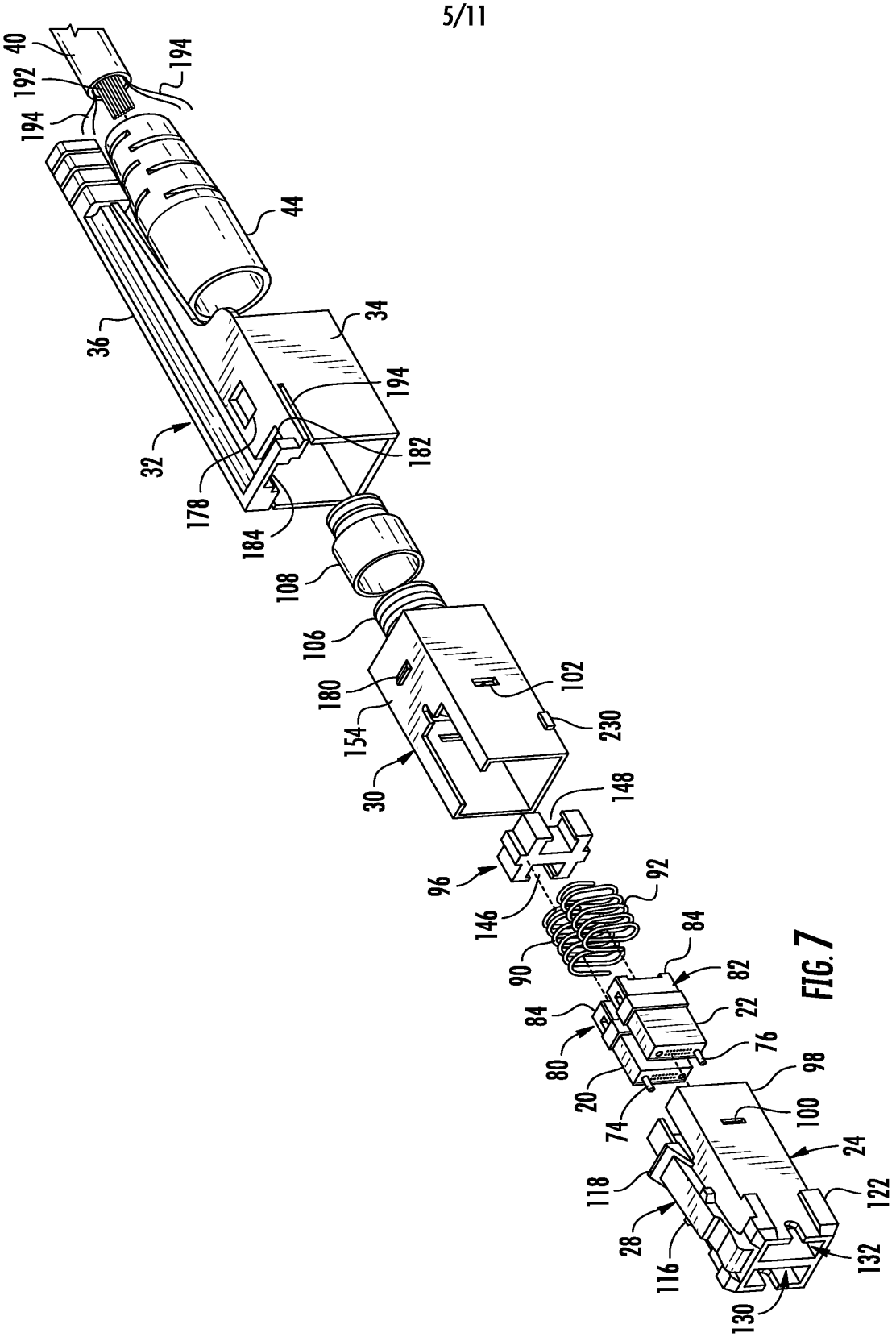

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FIG. 7

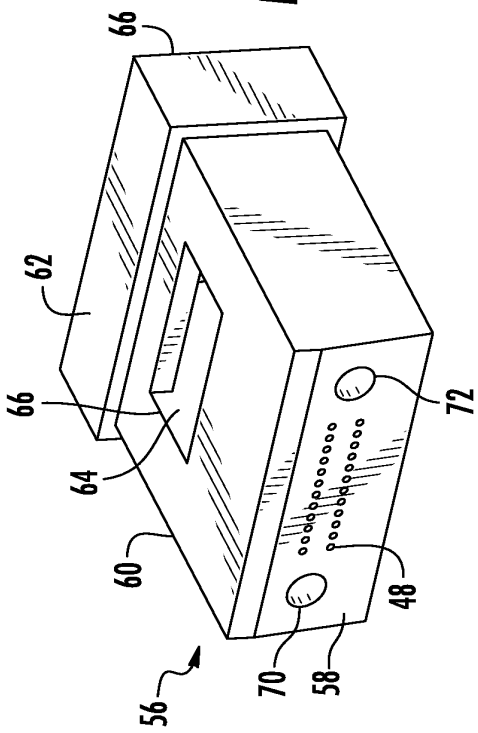


FIG. 6

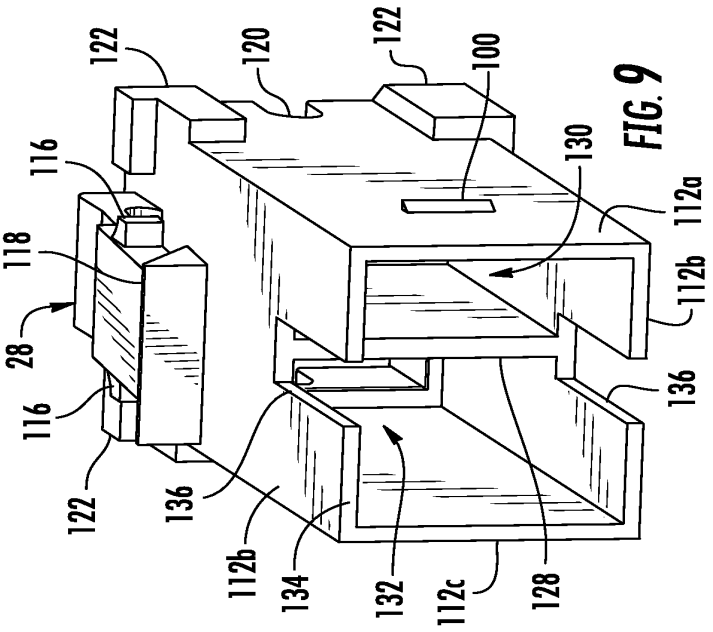


FIG. 9

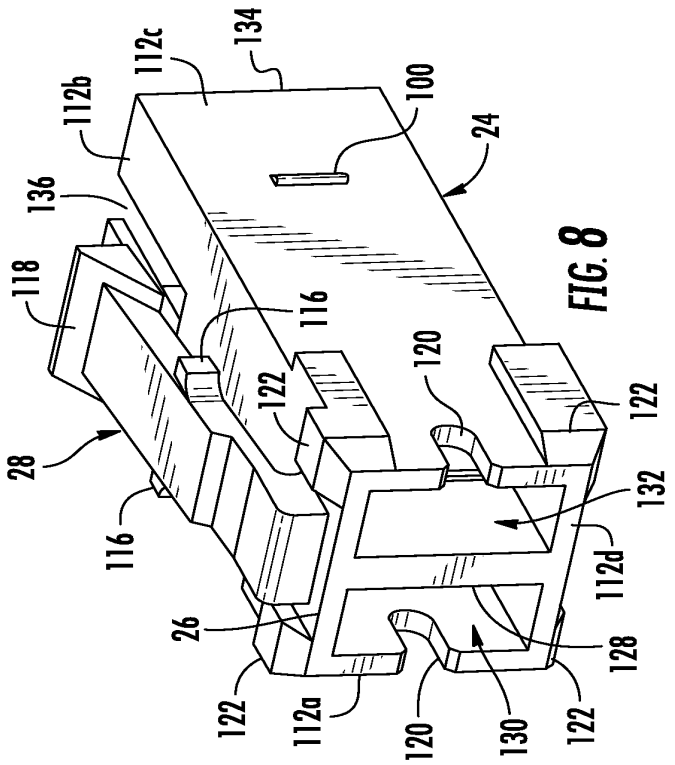


FIG. 8

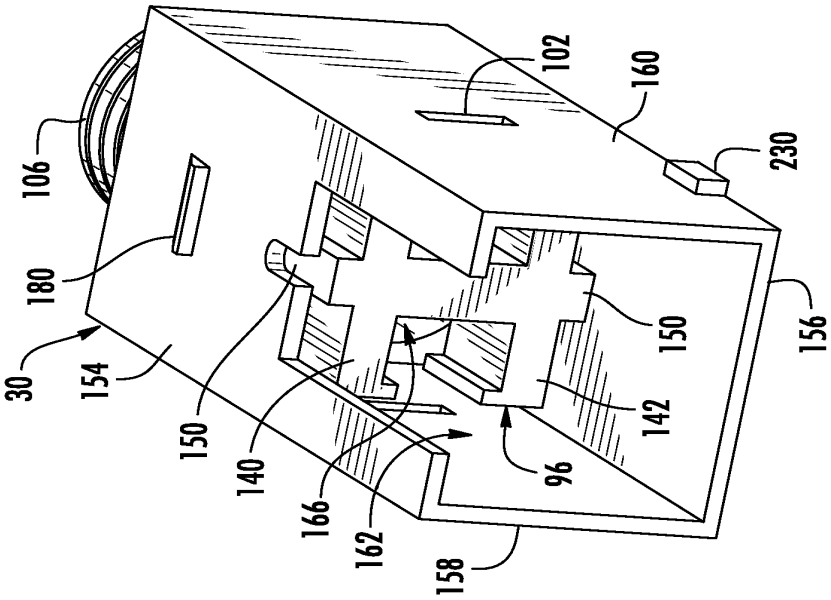

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FIG. 11

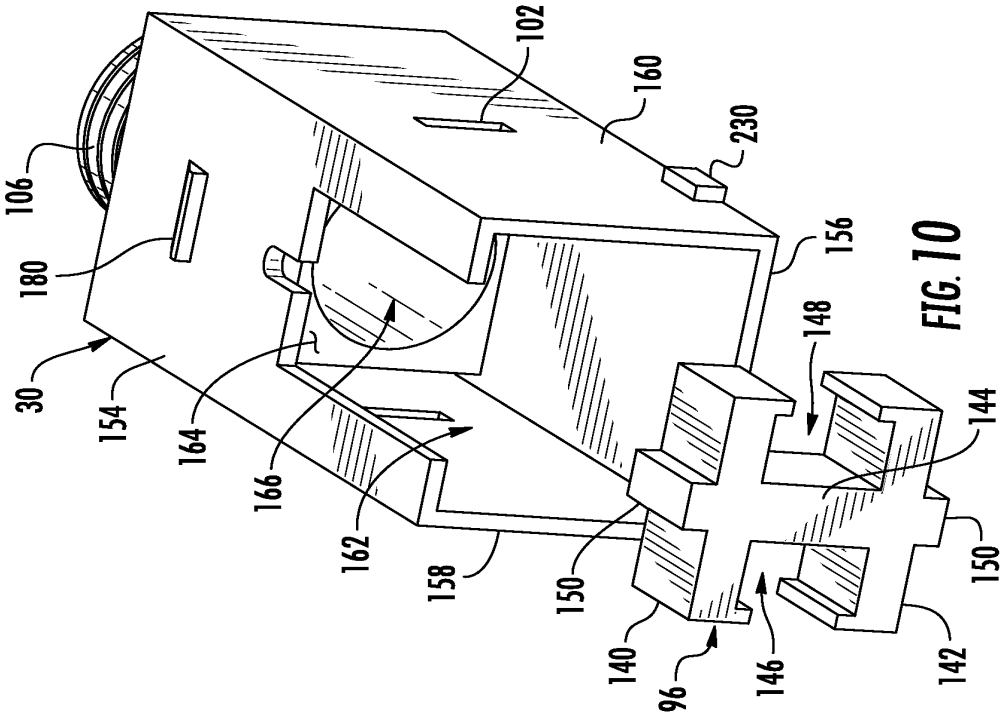

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FIG. 10

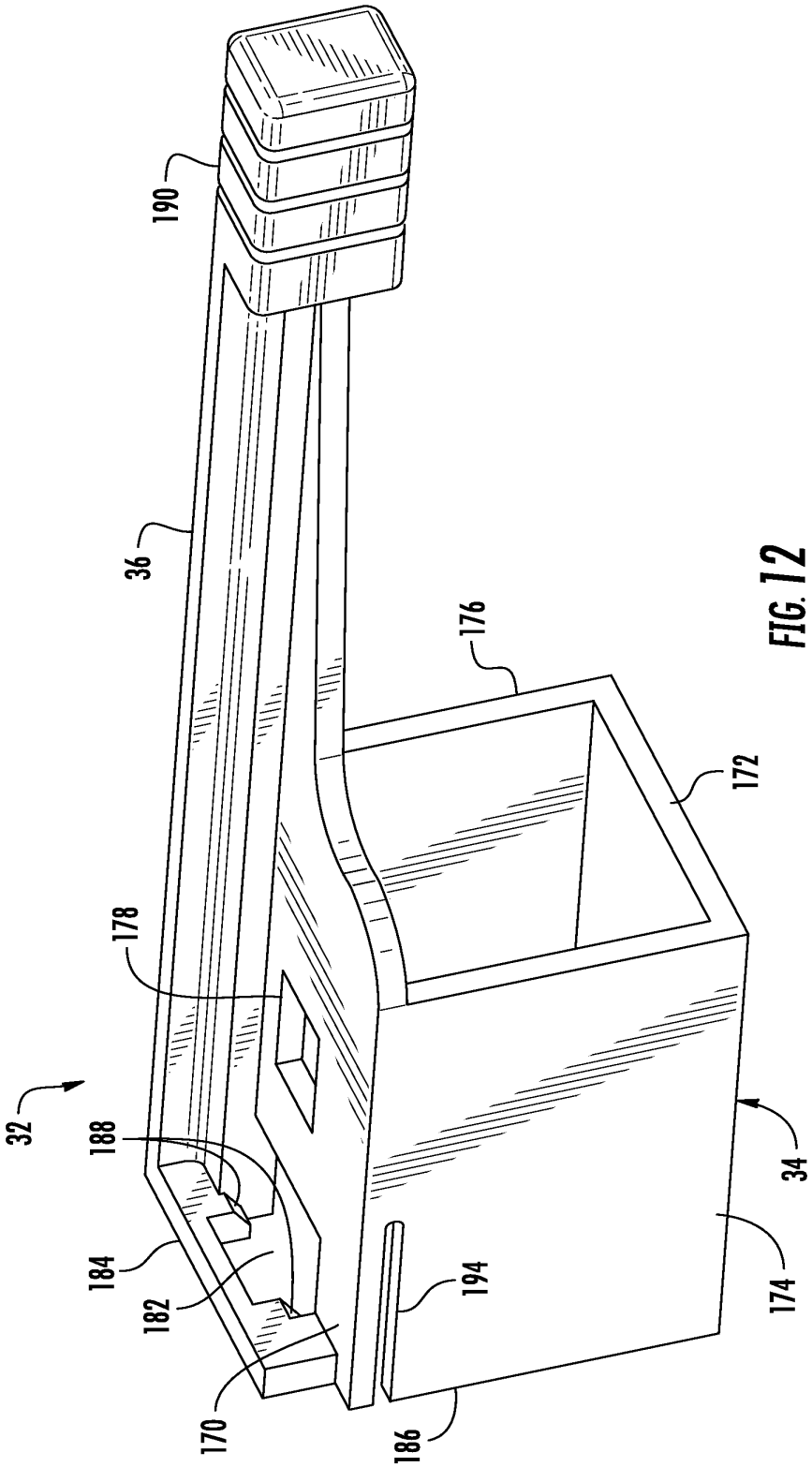


FIG. 12

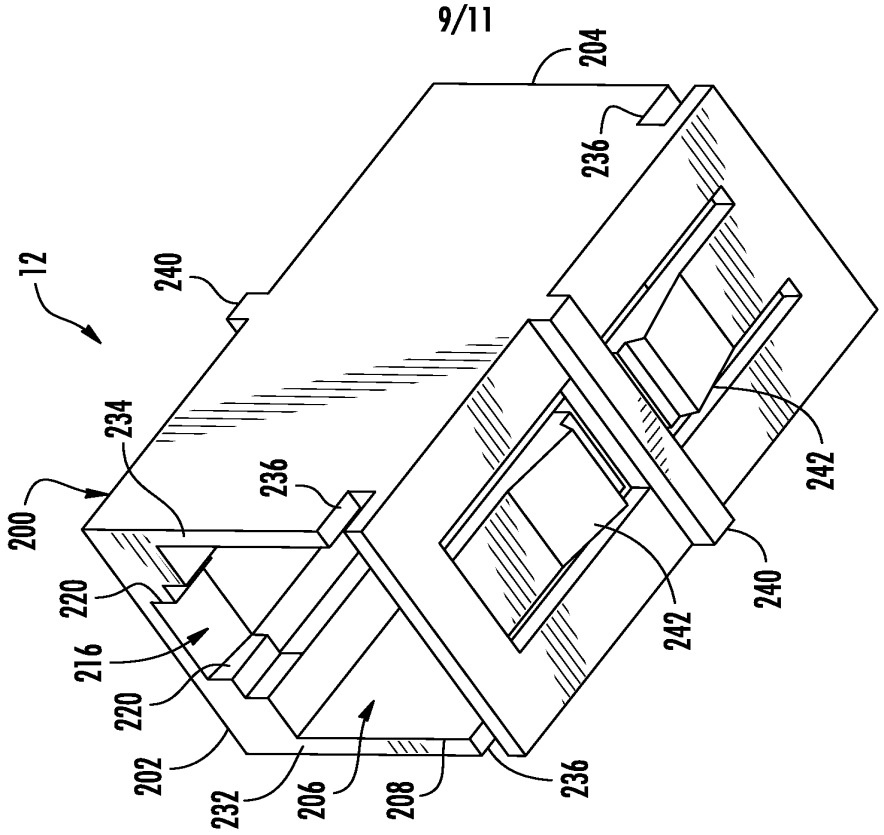

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FIG. 14

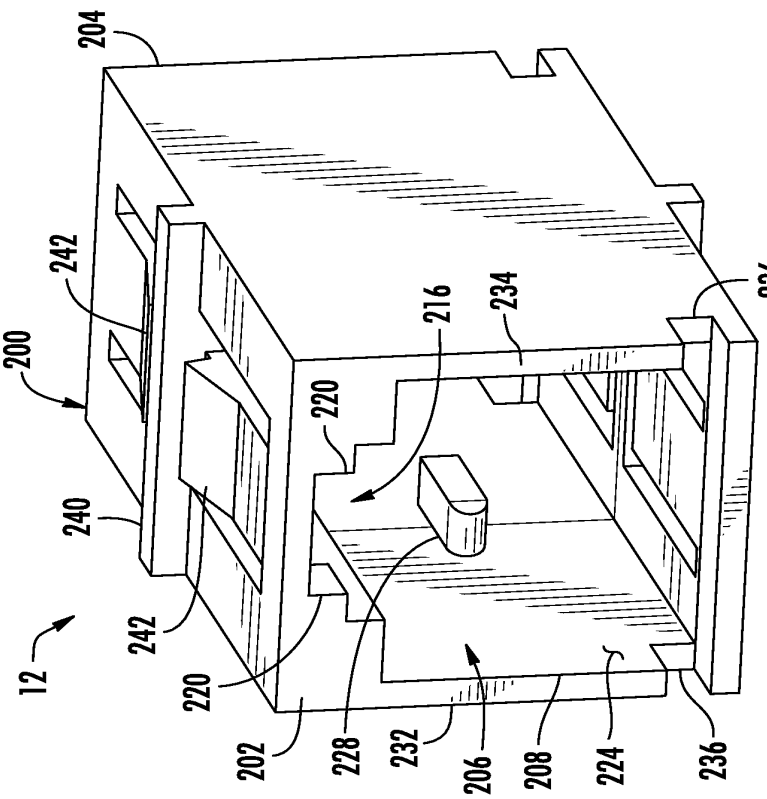

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FIG. 13

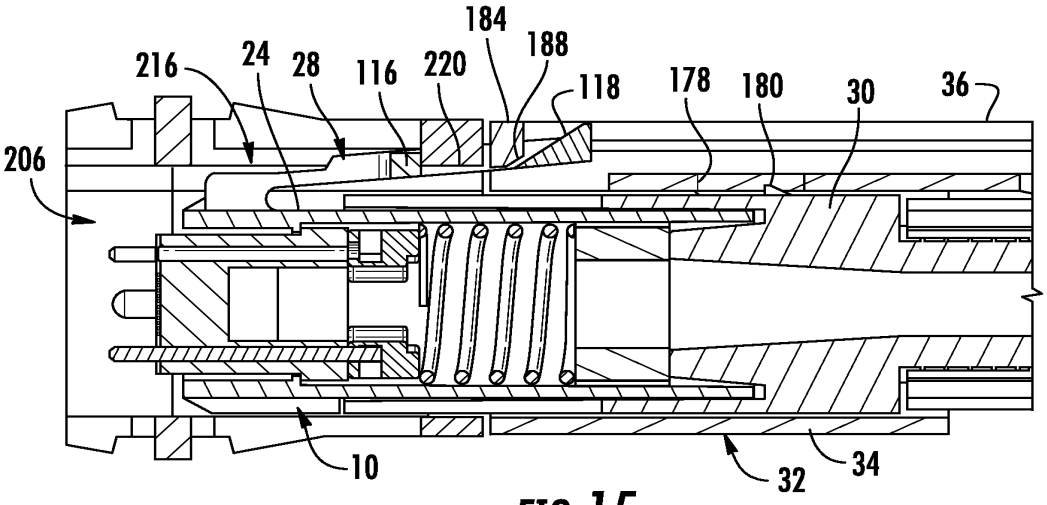

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FIG. 15

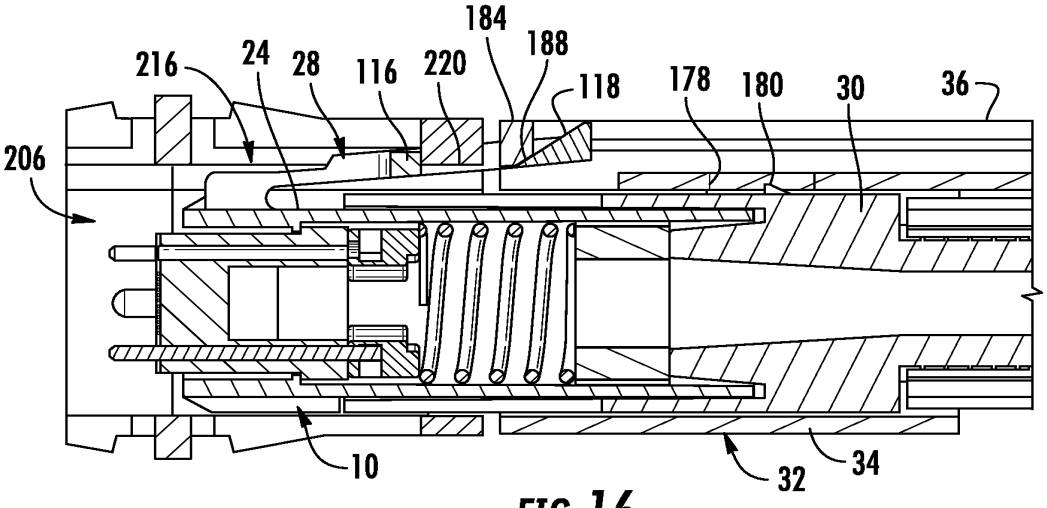

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FIG. 16

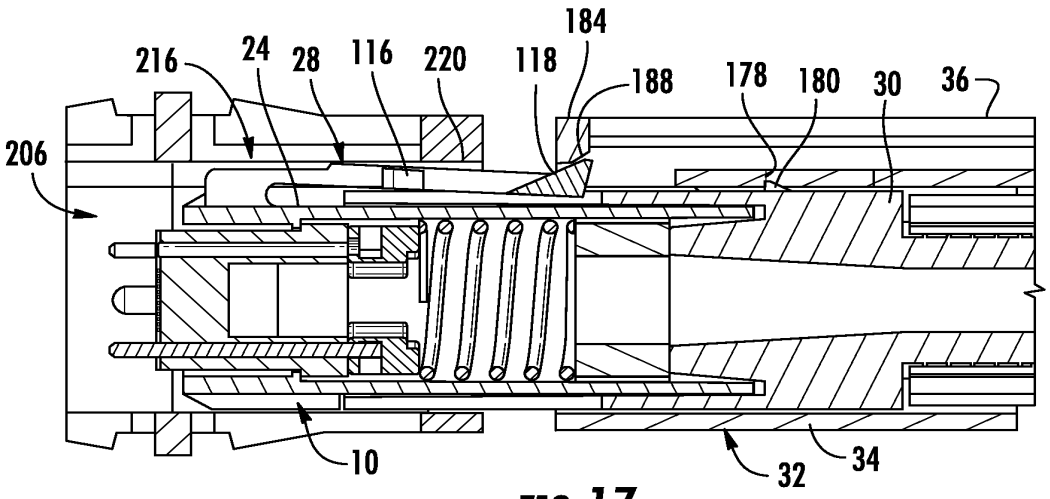

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FIG. 17

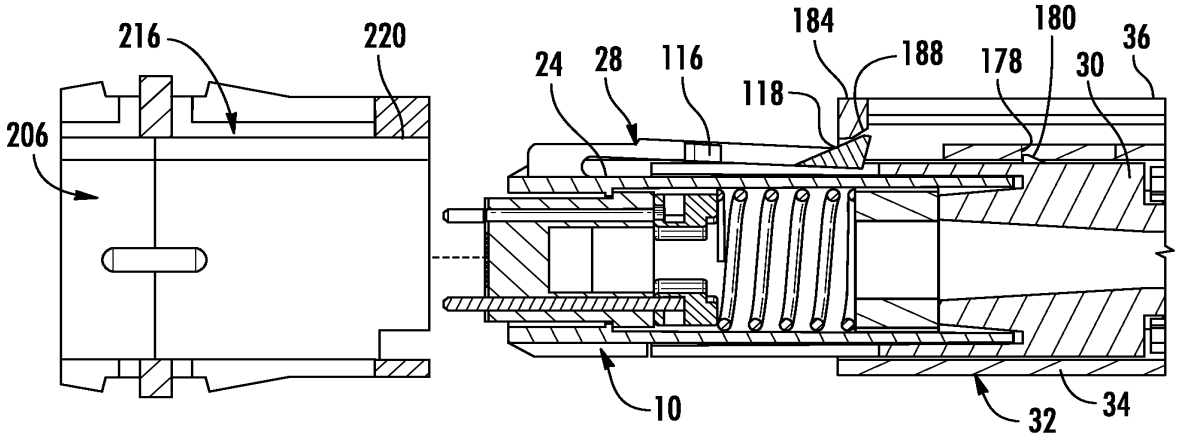

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FIG. 18

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2017/017098

A. CLASSIFICATION OF SUBJECT MATTER
INV. G02B6/38
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
G02B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 01/37010 A2 (WHITAKER CORP [US]) 25 May 2001 (2001-05-25) the whole document	1-26
A	US 2004/117981 A1 (ROTH RICHARD F [US] ET AL) 24 June 2004 (2004-06-24) paragraph [0014] - paragraph [0026]; figures 3,5e	1-16
A	US 2014/348468 A1 (LAGZIEL RAFI [IL] ET AL) 27 November 2014 (2014-11-27) paragraph [0023] - paragraph [0024]; figure 1	1-26
A	EP 1 039 322 A1 (LUCENT TECHNOLOGIES INC [US]) 27 September 2000 (2000-09-27) paragraph [0037] - paragraph [0045]; figures 4A-B	1-26

☐ 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

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"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
20 March 2017	28/03/2017

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Andreassen, Jon

1

Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/US2017/017098

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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		US 6357928 B1	19-03-2002
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US 2004117981 A1	24-06-2004	AU 2003299743 A1	22-07-2004
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		JP 2000292655 A	20-10-2000
		US 6259856 B1	10-07-2001

Form PCT/ISA/210 (patent family annex) (April 2005)

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G02B 6/36 (2006.01) *G02B 6/40* (2006.01)
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PCT/US2014/041500

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9 June 2014 (09.06.2014)

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(71) Applicant: **SENKO ADVANCED COMPONENTS, INC.** [US/US]; Unit D, 450 Donald Lynch Blvd, Marlborough, Massachusetts 01752 (US).

(72) Inventors: **TAKANO, Kazuyoshi**; 9021 Ambassador Drive, Westborough, Massachusetts 01581 (US). **IIZUMI, Kenji**; Unit D, 450 Donald Lynch Blvd, Marlborough, Massachusetts 01752 (US).

(74) Agents: **MCCARTHY, Alison L.** et al.; Suite 5000, 500 Grant Street, Pittsburgh, Pennsylvania 15219-2507 (US).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, 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, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report (Art. 21(3))*

WO 2015/191024 A1

(54) Title: REDUCED-PROFILE CONNECTORS, ADAPTERS, AND CONNECTION ASSEMBLIES THEREOF

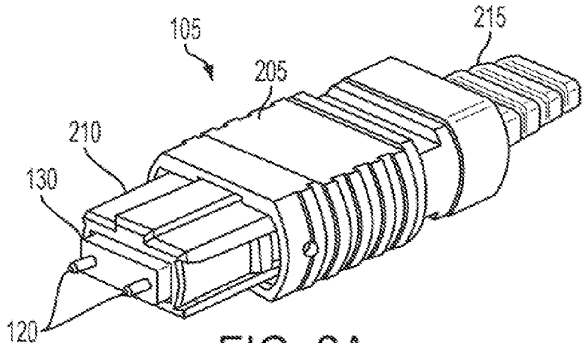


FIG. 2A

(57) Abstract: Reduced-profile connection components are described. The reduced-profile connection components are configured to connect various data transmission elements, including cables, network devices, and computing devices. A non-limiting example of a connection component includes a fiber optic connection component, including connectors, adapters, and assemblies formed therefrom. In some embodiments, the connection components may include mechanical transfer (MT) and multi-fiber push-on/pull-off (MPO) connection components, such as MT ferrules and MPO adapters. The reduced-profile connection components configured according to some embodiments have a smaller profile and/or require less parts to achieve a connection compared to conventional connection components. In some embodiments, the reduced-profile connection components may be used with conventional connection components. For example a reduced-profile connector may use a conventional MT ferrule to establish a connection within a conventional MPO adapter.

REDUCED-PROFILE CONNECTORS, ADAPTERS, AND CONNECTION ASSEMBLIES THEREOF

FIELD OF THE INVENTION

[0001] The described technology generally relates to components for connecting data transmission elements and, more specifically, to connectors, adapters, and connection assemblies formed therefrom that are configured to have a reduced profile and/or a reduced quantity of parts in comparison to conventional connection components while providing a secure connection between data transmission elements, such as cable segments, equipment, and/or devices.

BACKGROUND

[0002] Demand for bandwidth by enterprises and individual consumers continues to experience exponential growth. To meet this demand efficiently and economically, data centers have to achieve ultra-high density cabling with low loss budgets. Fiber optics have become the standard cabling medium used by data centers to meet the growing needs for data volume and transmission speeds.

[0003] Individual optical fibers are extremely small. For example, even with protective coatings, optical fibers may be only about 250 microns in diameter (only about 4 times the diameter of a human hair). As such, hundreds of fibers can be installed in cables that will take up relatively little space. However, terminating these fibers with connectors greatly increases the space required to connect cable segments and communication devices. Although multiple fibers may be arranged within a single connector, the resulting connection component may still increase the space used by the optical fibers by 20 to 50 fold. For example, multi-fiber connectors such as those using multi-fiber push-on/pull-off (MPO) technology may connect 12 or 24 fibers. However, a typical MPO connector may have a

length of about 30 millimeters to 50 millimeters and a width of about 10 millimeters to 15 millimeters. Multiplying these dimensions by the hundreds of connections in a typical data center results in a significant amount of space devoted to these cable connections. In order to cost-effectively increase data transmission capacity and speed, data centers must increase the number of fiber optic cables and, therefore, cable connections within existing space. Accordingly, data centers and other communication service providers would benefit from a multi-fiber connector having a reduced profile capable of securely connecting multiple fibers while requiring less space than conventional multi-fiber connectors.

SUMMARY

[0004] This disclosure is not limited to the particular systems, devices and methods described, as these may vary. The terminology used in the description is for the purpose of describing the particular versions or embodiments only, and is not intended to limit the scope.

[0005] As used in this document, the singular forms "a," "an," and "the" include plural references unless the context clearly dictates otherwise. Unless defined otherwise, all technical and scientific terms used herein have the same meanings as commonly understood by one of ordinary skill in the art. Nothing in this disclosure is to be construed as an admission that the embodiments described in this disclosure are not entitled to antedate such disclosure by virtue of prior invention. As used in this document, the term "comprising" means "including, but not limited to."

[0006] In one aspect, a reduced-profile connection assembly may include an adapter, a ferrule having a connection side, and a reduced-profile clip fixedly arranged within the adapter, the reduced-profile clip having hooks configured to engage a portion of the ferrule opposite the connection side to prevent movement of the ferrule within the adapter.

[0007] In one aspect, a reduced-profile connection assembly may include a ferrule having a connection end, a connector including an inner housing having the ferrule fixedly arranged therein at a first end and flanges extending from a second end opposite the first end and an ejector housing disposed around the inner housing and configured to slide along the inner housing between a locked position and an unlocked position, and an adapter having a clip fixedly arranged therein, the clip having hooks configured to engage protrusions extending from an outer surface of the inner housing to prevent movement of the inner housing within the adapter, wherein the ejector housing interfaces with the clip in the locked position to prevent disengagement of the hooks from the protrusions.

[0008] In one aspect, a reduced-profile connection assembly may include a ferrule, a connector having the ferrule fixedly arranged therein and comprising at least one adapter latch having at least one adapter latch projection, and an adapter having at least on recess, the at least one recess configured to engage the adapter latch projection when the connector is locked in the adapter to prevent movement of the connector within the adapter.

[0009] In one aspect, a reduced-profile connection assembly may include a ferrule, a connector having the ferrule fixedly arranged therein and comprising at least one adapter latch having at least one adapter latch projection, and an adapter having a clip fixedly arranged therein, the clip having a recess configured to engage the adapter latch projection when the connector is locked in the adapter to prevent movement of the connector within the adapter.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] The above and other objects of the present invention will become more readily apparent from the following detailed description taken in connection with the accompanying drawings.

[0011] FIG. 1 depicts an illustrative conventional multiple-fiber push-on/pull-off (MPO) type multi-fiber connection assembly.

[0012] FIGS. 2A-2C depict an illustrative connector of a conventional MPO connection assembly.

[0013] FIG. 3 depicts a cross-sectional view of a connector arranged within an assembly.

[0014] FIGS. 4A-4E depict illustrative reduced-profile connection components according to a ferrule clip embodiment.

[0015] FIGS. 5A-5F depict reduced-profile connection components according to a dual-housing embodiment.

[0016] FIGS. 6A-6D depict illustrative reduced-profile connection components according to a first resilient latch embodiment.

[0017] FIGS. 7A-7J depict illustrative reduced-profile connection components according to a second resilient latch embodiment.

[0018] FIGS. 8A-8E depict illustrative reduced-profile connection components according to a third resilient latch embodiment.

DETAILED DESCRIPTION

[0019] The described technology generally relates to components configured to connect data transmission elements, such as cable segments, communication equipment, networking devices, and computing devices. In some embodiments, the data transmission elements may be connected using reduced-profile connection components, including, without

limitation, connectors, ferrules, adapters, and connection assemblies formed therefrom. The reduced-profile connection components may be configured to require fewer elements and/or less space than conventional connection components. In general, a reduced profile connection component may be smaller in at least one dimension in comparison to a corresponding conventional connection component. In some embodiments, the reduced-profile connection components and/or portions thereof may be used with existing conventional connection components. For example, some embodiments may include a reduced-profile connector configured to provide a secure connection using a conventional adapter. The reduced-profile connection assemblies and portions thereof may be made from various resilient materials, such as plastics, polymers, rubber, silicon-based materials, and any combination thereof.

[0020] The described technology provides multiple technological advantages. A non-limiting example of a technological advantage is that reduced-profile connection components and connections formed using the reduced-profile connection components require less space, for example, on a connection interface of a device in a data room. In this manner, an increased number of connections may be formed in a smaller area. Another non-limiting example of a technological advantage is that reduced-profile connection components may generally require fewer elements and/or materials than corresponding conventional connection components. This technological advantage may operate, among other things, to reduce the effort and/or cost associated with assembling the connection component. A further non-limiting example of a technological advantage is that the reduced-profile connection components are easier to manipulate, such as establishing and/or removing a connection (for instance, “plugging in”/ “unplugging” a component) than corresponding conventional connection components.

[0021] In some embodiments, the data transmission elements may include fiber optic data transmission elements. In some embodiments, the reduced-profile connection components may include components configured to provide a secure connection for fiber optic data transmission elements. In some embodiments, the reduced-profile connection components may be configured to implement various types of fiber optic connection components, including multiple-fiber (or multi-fiber) connection components . Non-limiting examples of multi-fiber connection components include mechanical transfer (MT), multiple-fiber push-on/pull-off (MPO), and multi-fiber MTP® connectors ("MTP"). Although fiber optic connection components, and MPO-compatible components in particular, are used as examples herein, embodiments are not so limited as any type of data transmission medium and associated components capable of operating according to some embodiments are contemplated herein.

[0022] FIG. 1 depicts an illustrative conventional MPO type multi-fiber connection assembly (an "MPO connection assembly"). As shown in FIG. 1, an MPO connection assembly **100** may include connectors **105**, **110** and a corresponding optical fiber adapter ("adapter") **115**. The connectors **105**, **110** may be designated as a male connector **105**, which has guide pins or "pins" **120**, and a female connector **110**, which has pin receptacles, guide pin holes, or "holes" **140**. The guide pins **120** may be arranged within a male ferrule **130** on a connection side thereof and the guide pin holes **140** may be arranged within a female ferrule **150** on a connection side thereof. The ferrules **130**, **150** may be formed from plastic or other polymer materials. The ferrules **130**, **150** may be configured as MT type ferrules.

[0023] The connectors **105**, **110** may be coupled with each other through the adapter **115** such that the guide pins **120** can be inserted into the guide pin holes **140** and the face of the male ferrule **130** will be in contact with the face of the female ferrule **150**, connecting the ends of the optical fibers (or "ribbon") **135** arranged within each respective ferrule. The

optical fibers **135** may be arranged between the guide pins **120** on the male ferrule **130** and between the guide pin holes **140** on the female ferrule **150** such that the ends of the optical fibers will line up and form a continuous our substantially continuous fiber optic connection. The ferrules **130**, **150** may include various numbers of optical fibers **135**, such as 1, 2, 4, 8, 12, 24, or 72 optical fibers. When the connectors **105**, **110** are coupled through the adapter **115**, hooks (for example, flanges or resilient flanges) **160** disposed on a clip (an "adapter clip") arranged within the adapter **115** can hook on recesses **125** of the connector **105** and recesses **145** of the connector **110** to support and maintain the connection of optical fibers **135** between the ferrules **130**, **150**. The guide pins **120** and the guide pin holes **140** operate to line up the ends of the optical fibers **135** on the faces of the ferrules **130**, **150** and the adapter **115** operates to provide a compression force on the ferrules configured to maintain sufficient contact therebetween to support a connection between the opposing optical fibers.

[0024] FIGS. 2A-2C depict an illustrative connector of a conventional MPO connection assembly. As shown in FIG. 2A, a connector **105** may include an ejector housing **205** slidably disposed about a front housing **210** connected to a boot **215**. A ferrule **130** having a pin holder **235** (collectively, may be referred to as a "ferrule" herein) may be arranged within the front housing **210**. Although a male connector **105** including a male ferrule **130** is depicted in FIGS. 2A-2C, the illustrative connector depicted therein may be configured the same or substantially similar using a female connector **110** including a female ferrule **150**. FIG. 2B depicts an expanded (or "exploded") view of the connector **105**. As shown in FIG. 2B, the connector may include a spring **225** configured to provide a force against the ferrule **130** in a direction toward the front housing **210** and away from the boot **215**. The spring **225** may be arranged within a spring push (or "back post") **220** configured to interface with the boot **215**. FIG. 2C depicts an expanded view of the ejector housing **205** and the front housing **210** showing the springs **230** arranged therebetween. The springs **230**

may operate to provide a force against the ejector housing **205** to push the ejector housing toward the front of the front housing **210** where the ferrule projects from the front housing and away from the boot **215**.

[0025] The connector **105** may be inserted (or plugged) into an adapter **115** by pushing the connector, for example, using the boot, into the adapter until the hooks **160** in the adapter hook (or "snap") on the recesses **125** of the connector. The springs **230** may operate to maintain the ejector housing **205** in the forward (or "locked") position to retain the hooks **160** in the recesses **125** to preserve a secure connection. The connector may be removed (or unplugged) from the adapter by pulling on the ejector housing **205** in a direction away from the adapter. As the ejector housing **205** is pulled in a direction away from the adapter **115**, the ejector housing can slide over the front housing **210** in a direction away from the adapter to remove the hooks **160** from the recesses **125**, thereby disconnecting the connector **105**.

[0026] As shown in FIGS. 2A-2C, conventional MPO connectors **105** require multiple parts. For example, not including the ferrule **130** or components thereof, the connector **105** may require about 7 parts, including the ejector housing **205**, the front housing **210**, the boot **215**, the spring push **220**, the spring **225**, and the springs **230**. All of the components of the connector **105** require time, material, and other resources and/or costs to manufacture and assemble. In addition, the multiple components required for the connector **105** require the connector and connection assembly **100** to have certain minimum dimensions and, therefore, an overall profile. For example, a conventional connector **105** may be about 30 millimeters to about 50 millimeters long and about 12 millimeters to about 20 millimeters wide. Furthermore, plugging in the connector **105** to the adapter **115** requires a sufficient pushing force, generally from the boot **215**, while unplugging the connector requires a relatively large pulling force on the ejector housing **205**. Accordingly, manipulating the components of the connection assembly **105**, such as plugging in/unplugging the connector

105, is inefficient and challenging within the limited space around racks and modules within a typical data room. Moreover, assembling the connector **105** components, such as the housings **205, 210** and the springs **230** and the spring push **220** and the spring **225**, is time consuming, inefficient, and consumes valuable resources that may otherwise be dedicated to data room maintenance.

[0027] FIG. 3 depicts a cross-sectional view of a connector arranged within an assembly. As shown in FIG. 3, as the connector **105** is pushed into the adapter **115**, the hooks **160** arranged on the clip **310** may spread apart and be pushed over projections **170** on the outer surface of the front housing **210** to become seated in the recess **125**. In the locked position, the springs **230** push the ejector housing **205** over and/or against the hooks **160** to prevent the hooks from spreading apart and moving over the projections **170**, thereby maintaining the hooks within the recesses **125** and preventing removal of the connector **105** from the adapter. In order to remove the connector **105** from the adapter **115**, the ejector housing **205** must be pulled in a direction away from the adapter and toward the boot **215**. The ejector housing **205** must be pulled with sufficient force to overcome the tension provided by the springs **230** in order to allow the ejector housing to slide over the front housing **210** and out of the adapter **115**, uncovering the hooks **160**. A continued force on the ejector housing **205** away from the adapter **115** causes the connector **105** to move in a direction away from the adapter, spreading apart the hooks **160**, which slide over the projections **170** and free the connector **105** from the adapter.

[0028] FIGS. 4A-4E depict illustrative reduced-profile connection components according to a ferrule clip embodiment. As shown in FIGS. 4A-4D, a reduced-profile connection assembly may include a clip **405** (a "ferrule clip" or "reduced profile clip") arranged within an adapter **425** and configured to hold a ferrule **130** therein. The clip **405** may include hooks **410** configured to maintain the ferrule **130** within the adapter **425**, for

example, by engaging with the ferrule **130** and/or a pin holder **420** on a side opposite a connection side or surface of the ferrule. In some embodiments, the ferrule **130** may not include a pin holder **420**. In such embodiments, a spacer (not shown) may be arranged within the clip **405** to engage the hooks **410** in a manner similar to the pin holder **420**. In some embodiments, the hooks **410** may be configured to support and maintain a connection between the ferrule **130** and a corresponding ferrule (not shown) within the adapter similar to the functionality provided by the spring **225** and the spring push **220** in a conventional connection assembly.

[0029] In some embodiments, the clip **405** may be arranged within conventional components, such as a conventional adapter **425**. For example, the reduced profile connection assembly may include an MT ferrule **130** and an MPO adapter **425**. In some embodiments, the adapter **425** may include a reduced-profile component portion **435** and a conventional component portion **440**. The reduced-profile component portion **435** may be configured to engage reduced-profile connection components, such as a ferrule **130** that is not arranged within or in association with conventional connection components, such as an ejector housing **205**, a front housing **210**, springs **230**, spring **225**, or the like. The conventional component portion **440** may be configured to engage conventional connection components, such as MT, MPO, and/or MTP. As such, reduced-profile connection components may be configured to operate with existing data transmission equipment, devices, connection assemblies, and/or the like.

[0030] As shown in FIG. 4D, the adapter **425** may include a clip **430** for a second ferrule (not shown), such as a female ferrule corresponding with the male ferrule **130**. Inserting the ferrule **130** within the clip **405** may connect the ferrule with the corresponding ferrule disposed within the clip **430**. The hooks **410** may be configured to hold the ferrule

130 within the adapter **425** and to maintain the connection with the corresponding ferrule located in the clip **430**.

[0031] In some embodiments, the adapter **425** may include an external portion **435** that may be located external to a communication device or structure (for instance, a wall) and an internal portion **440** that may be located internal to the communication device or structure. Non-limiting examples of communication devices include computing devices, servers, racks, switches, hubs, cabling, outlets, network testing equipment, or the like. In some embodiments, a first type of ferrule (for example, a female ferrule (not shown)) may be arranged within the internal portion **440** and a second type of ferrule (for example, a male ferrule **130**) may be installed (or plugged) into the external portion **435** to form a connection with the first type of ferrule.

[0032] FIG. 4E depicts an illustrative ferrule installation device according to some embodiments. As shown in FIG. 4E, a ferrule installation device **445** may be used to install the ferrule **130** into the clip **410** of the adapter. The ferrule installation device **445** may include a lever **460** that may be pressed (for instance, pushed toward the body of the ferrule installation device) to raise a hook portion **455** thereof. The ferrule installation device **445** may grasp the ferrule **430** by raising the hook portion **455**, inserting the ferrule into a frame portion **470** and releasing the lever **460** to position the hook portion **460** against or within a portion of the ferrule, such as within a recess **565** disposed within the ferrule. As the ferrule installation device **445** is inserted into the adapter, the frame portion **470** may engage the hooks **410** to spread them apart and allow the ferrule to be positioned within the clip **405**. In some embodiments, the frame portion **470** may engage one or more protrusions **475** arranged on an outer surface of the hooks **410**. Once the ferrule **430** has been positioned within the clip **405**, the lever **460** may be pressed, thereby disengaging the hook portion **455** from the ferrule **130**. As the ferrule installation device **445** is removed from the adapter **425**, the hooks

410 close in and engage the ferrule **130**. The ferrule installation device **445** may have various dimensions, including a length of about 20 millimeters to about 40 millimeters. In some embodiments, the ferrule installation device **445** may have a length of about 36.5 millimeters.

[0033] As compared with conventional connection components, such as connector **105**, the ferrule clip embodiment depicted in FIGS. 4A-4C does not require a housing, such as ejector housing **205** and front housing **210**. The ferrule clip embodiment may be configured to use a clip **405** adapted to hold and support a ferrule **130** without a housing and associated components, such as the spring **225** and the back pusher **220**. In some embodiments, the hooks **410** of the clip **425** may only extend about 0 millimeters (for example, the clip is entirely or substantially entirely located within the adapter **425**), about 1 millimeter, about 2 millimeters, about 3 millimeters, and any value or range between any two of these values (including endpoints) outside of the adapter **425**. Accordingly, the ferrule clip embodiment may be used to establish a connection using about 30 millimeters to about 50 millimeters less space than conventional connection components.

[0034] Although the ferrule **130** depicted in illustrative embodiments herein, such as the ferrule clip embodiment depicted in FIGS. 4A-4C, is a male MT ferrule, embodiments are not so limited. Indeed, the ferrule **130** may be configured as any type and/or gender of ferrule capable of operating according to some embodiments. In particular, some embodiments are "gender neutral," in that either male or female connection components may be used therewith.

[0035] FIGS. 5A-5F depict reduced-profile connection components according to a dual-housing embodiment. As shown in FIGS. 5A and 5B, a reduced-profile connector **500** may include an inner housing **510** configured to hold a ferrule **130** in a front portion thereof. An outer housing **505** may be slidably disposed around the inner housing **505**. The inner housing **510** may include flanges **515** having projections **535** and recesses **545** formed

thereon. FIGS. 5C and 5D depict the connector **505** arranged within an adapter **545** in an unlocked position and a locked position, respectively. In some embodiments, the adapter **545** may include a conventional adapter and/or adapter components, such as clips ("adapter clips," "MPO adapter clips", or "conventional clips") **520**. For example, the adapter **545** may include a conventional MPO adapter and conventional clips **520** configured to receive conventional ferrules, such as MT ferrules **130**. In this manner, the reduced-profile connector **500** may be used with conventional connection adapters **545**.

[0036] As the connector **500** is pushed into the adapter **545**, projections **550** on the inner housing **510** may engage hooks **555** on the clip **520**, thereby spreading the hooks apart **555** until the hooks clear the projections and seat within a recess **560**. In the unlocked position, a distal portion **530** of the outer housing **505** may be seated in recesses **540** of the flanges **515**. To lock the connector **505** in the adapter **545**, the outer housing **505** may be pushed along the inner housing **510** in a direction toward the adapter. As the outer housing **505** moves toward the adapter **545**, the distal portion **530** may push against the projections **535** of the flanges **515** and may push the flanges **515** inward (for instance, away from the outer housing). As the flanges **515** move inward, the distal portion **530** may slide over the projections **535** and the outer housing **505** may move toward the adapter **545**. The flanges **515** may return to the straight position after the distal portion **530** clears the projections **535** and, therefore, the distal portion is no longer pushing on the projections. The projections **535** may prevent the outer housing **505** from sliding away from the adapter **545**. When the distal portion **530** has cleared the projections **535**, a proximal portion **525** of the outer housing **505** may engage the hooks **555**, preventing the hooks from spreading apart and sliding over the projections **550**.

[0037] As shown in FIG. 5E, the inner housing **510** may include ferrule latches (or "bend-in latches") **570** arranged on one or more surfaces thereof. The ferrule latches **570**

may be configured to be pushed inward toward the hollow center of the inner housing **510**. In FIG. 5F, a cross-sectional view of the connector illustrates that the outer housing **505** may push the latches **570** inward to engage the ferrule **130** and/or a pin holder **565** connected to the ferrule. The internal surfaces of the inner housing **510** may also include projections **580** or other structures configured to engage the ferrule **530** to prevent the ferrule from moving in a direction opposite the ferrule latches **570**. Accordingly, the ferrule latches **570** may be configured to push or otherwise engage the ferrule **130** and/or the pin holder **565** to push the ferrule in a first direction (for example, away from the flanges **515**) and/or prevent movement of the ferrule in a second direction (for example, toward the flanges **515**), while the projections **580** may be configured to prevent movement of the ferrule in the first direction. In this manner, the ferrule **130** may be supported and maintained within the inner housing **510** when the outer housing **505** is in a position that pushes down on the ferrule latches **570**, for example, when the outer housing is in the locked position.

[0038] In some embodiments, the connector **500** may use only 2 parts, for instance, the outer housing **505** and the inner housing **510**, to connect the ferrule **130** to a corresponding ferrule (not shown) within the adapter **545**. In comparison, conventional connectors may require 7 components to achieve the same functionality. In some embodiments, the connector **505** may have a length of about 20 millimeters to about 30 millimeters. In some embodiments, the connector may have a length of about 26 millimeters. In some embodiments, the connector **505** may have a length of about 20 millimeters, about 22 millimeters, about 24 millimeters, about 26 millimeters, about 28 millimeters, about 30 millimeters, and any value or range between any two of these values (including endpoints). In some embodiments, the connector may have a length of about 26 millimeters. In some embodiments, when in the locked position, the connector **505** may extend out of the adapter **545** by about 15 millimeters, about 20 millimeters, about 25 millimeters, about 30

millimeters, and any value or range between any two of these values (including endpoints). In some embodiments, the connector **505** may extend out of the adapter **545** by about 24 millimeters.

[0039] FIGS. 6A-6D depict illustrative reduced-profile connection components according to a first resilient latch embodiment. As shown in FIGS. 6A and 6B, a connector **610** may be configured to hold a ferrule **130**. The connector **610** may include resilient latches, such as adapter latches **615** and ferrule latches **620**. The ferrule latches **620** may be configured to maintain the ferrule **130** within the connector **610**. For example, assembly of the connector **610** may include inserting the ferrule **130** into a rear opening **630** of the connector **610** and pushing the ferrule toward the front of the connector (for instance, the end opposite the rear opening). As the ferrule **130** passes through the connector **610** the ferrule may engage the ferrule latches **620** and push the ferrule latches outward (for instance, away from the ferrule). When the ferrule **130** and/or pin holder **625** passes the ferrule latches **620**, the latches may no longer being pushed outward. As such, the ferrule latches **620** may retract to their normal position. The ferrule latches **620** may include projections or other structures (not shown) extending inward. These projections may engage the ferrule **130** and/or pin holder **625** to prevent the movement of the ferrule toward the rear opening **630**. The connector **610** may also include one or more internal projections or other internal structures configured to project inward toward the hollow cavity of the connector to engage a front portion of the ferrule **130** and/or pin holder **625**. These internal projections may prevent movement of the ferrule **130** in a direction toward the front of the connector **610**, away from the rear opening **630**. In this manner, the ferrule **130** may be held within the connector **610**.

[0040] FIGS. 6C and 6D depict a connector **610** arranged within an adapter **605**. To insert the connector **610** into the adapter **605**, the adapter latches **615** may be pressed inward, toward the body of the connector sufficient to allow the first projections **640** to clear inner

wall portions **650** of the adapter. When the first projections **640** have cleared the inner wall portions **650**, the first projections may seat in recesses (or openings) **645** in the inner wall of the adapter **605** and the inner wall portions **650** may seat in recesses **655** of the adapter latches **615**. When the connector **610** is in the adapter, for example, when the first projections have seated in the recesses **645** and/or the ferrule **130** has established a connection with a corresponding ferrule (not shown), the inner pressing force on the adapter latches **615** may be released and second projections **635** may interface with the inner wall portions **650**. The second projections **635** may prevent movement of the connector **610** further into the adapter **605** by engaging the inner wall portions. Accordingly, removal and/or insertion (plugging in) of the connector **610** into the adapter **605** may only require pressing on the adapter latches **615** while pushing the connector into the adapter.

[0041] In some embodiments, the adapter **605** may include a reduced-profile component portion **660** and a conventional component portion **665**. The reduced-profile component portion **660** may be configured to engage reduced-profile connection components, such as the connector **610** and/or a ferrule **130** that is not arranged within or in association with conventional connection components, such as an ejector housing **205**, a front housing **210**, springs **230**, spring **225**, or the like. The conventional component portion **665**, may be configured to engage conventional connection components, such as MT, MPO, and/or MTP. As such, reduced-profile connection components may be configured to operate with existing data transmission equipment, devices, connection assemblies, and/or the like.

[0042] In some embodiments, the connector **610** may use only 1 part (the actual connector **610**), not including the ferrule **130**. In comparison, conventional connectors may require 7 components to achieve the same functionality. In some embodiments, the connector **610** may have a length of about 10 millimeters to about 20 millimeters. In some embodiments, the connector may have a length of about 13 millimeters. In some

embodiments, the connector **610** may have a length of about 10 millimeters, about 12 millimeters, about 14 millimeters, about 16 millimeters, about 18 millimeters, about 20 millimeters, and any value or range between any two of these values (including endpoints).

[0043] FIGS. 7A-7J depict illustrative reduced-profile connection components according to a second resilient latch embodiment. As shown in FIGS. 7A and 7B, a connector **710** may be configured to hold a ferrule **130**, for example, connected to a pin holder **775**. The ferrule **130** may include a recess **780** or other similar structure for engaging portions of the inside surface of the main body **760**. The connector **710** may include a resilient adapter latch **715** arranged on a top portion thereof. The adapter latch **715** may include a catch projection **725**, a catch surface **730**, and a recess **735**. The connector **710** may include a main body **760** and a rear cover assembly (or "rear cover") **755** configured to attach to (or "snap") into the main body. The rear cover **755** may include springs **770** and flanges **765**. In some embodiments, the springs **770** may be configured to press against the flanges **765** to provide a force pushing the flanges outward (for example, away from the springs). In some embodiments, the flanges **765** may provide a barrier to the springs **770** such that the force of the springs may be directed toward the ferrule **130** and/or pin holder **775** instead of, without the flanges, in a direction orthogonal to the ferrule. In some embodiments, the springs **770** may be formed as one piece with curled ends configured to provide a resilient force.

[0044] FIGS. 7D and 7E depict the connector **710** and an adapter **705** configured to receive the connector **710**. The adapter **705** may include a clip **720** having, as depicted in FIG. 7F, hooks **745**, a latch catch **750** formed, and an opening immediately adjacent the latch catch. The connector **710** may be inserted into the adapter **705** by pressing down (for instance, toward the main body **760**) the adapter latch **715** while pushing the connector into the opening **740** of the adapter. As shown in more detail in FIGS. 7G and 7H, the connector

710 may engage the clip **720** within the adapter to maintain (or "lock") the connector within the adapter.

[0045] FIGS. 7G and 7H depict a cross-section of top-down view and a side view, respectively, of a connector **710** installed in an adapter **705**. As shown in FIG. 7G, the rear cover **755** may be installed within the main body **760** of the connector **205**. As the rear cover **755** is being pushed into the main body **760**, the flanges **765** may be pressed inward (toward the springs **770**) until the flanges clear a back portion **785** of the main body and become seated on an internal side of the back portion. The springs **770** may engage the ferrule **130** and/or pin holder **775** and push the ferrule in a direction away from the rear cover **755**.

[0046] In some embodiments, the adapter **705** may be used for conventional connection components (not shown), such as MPO connectors, and for reduced-profile connectors **710**. In some embodiments, the hooks **745** of the clip **720** may not engage or may not substantially engage the connector. For instance, the hooks **745** may not touch and/or engage the connector **710** in a manner that retains the connector within the adapter **705**. In some embodiments, the hooks **745** may be used to engage and retain a conventional connector, such as an MPO connector.

[0047] The connector **710** may be inserted in the adapter **705** by pushing down on the adapter latch **715** to allow the catch projection **725** of the adapter latch to clear (to slide under) the latch catch **750** of the clip **720** while pushing the connector through the opening **740**. When the catch projection **725** has cleared the latch catch **750**, the adapter latch **715** may be released. The resilient nature of the adapter latch **715** may cause the adapter latch to push upward (away from the main body **760**). The upper force of the adapter latch **715** may cause the catch projection **725** to engage an inner surface of the latch catch **750**, the latch catch to be seated in the recess **735**, and/or the catch surface **730** to engage an outer surface of the latch catch. The engagement between the catch projection **725** and the latch catch **750**

may prevent the connector **710** from being removed from the adapter **705**. Accordingly, removal and/or insertion (plugging in) of the connector **710** into the adapter **705** only requires pressing on the adapter latches **715** while pushing the connector into the adapter.

[0048] FIG. 7I depicts an internal view of the connector **710** installed within the adapter **705**. FIG. 7J depicts a connector **710** in which the pin holder engages a spring element **785** instead of the spring **770**.

[0049] In some embodiments, the connector **710** may use only 3 or less parts, not including the ferrule **130**. For example, the connector **710** may include the main body **760**, the rear cover **755**, and/or the spring **770**. In comparison, conventional connectors may require 7 components to achieve the same functionality. In some embodiments, the connector **710** may have a length of about 10 millimeters to about 20 millimeters. In some embodiments, the connector may have a length of about 13 millimeters. In some embodiments, the connector **710** have a length of about 10 millimeters, about 12 millimeters, about 14 millimeters, about 16 millimeters, about 18 millimeters, about 20 millimeters, and any value or range between any two of these values (including endpoints).

[0050] FIGS. 8A-8E depict illustrative reduced-profile connection components according to a third resilient latch embodiment. As shown in FIGS. 8A-8C, a connector **810** may be configured to hold a ferrule **130**. The connector **810** may include a resilient adapter latch **815** on a top portion thereof. The adapter latch **815** may include a catch projection **825**.

[0051] FIGS. 8D and 8F depict a cross-section of top-down view and a side view, respectively, of a connector **810** installed in an adapter **805**. The adapter **805** may include a clip **720**, as depicted in FIG. 7F, having hooks **745** and a latch catch **750** formed thereon. In some embodiments, the adapter **705** may be used for conventional connection components (not shown), such as MPO connectors, and for reduced-profile connectors **710**. In some embodiments, the hooks **745** of the clip **720** may not engage or may not substantially engage

the connector. For instance, the hooks **745** may not touch and/or engage the connector **710** in a manner that retains the connector within the adapter **705**. In some embodiments, the hooks **745** may be used to engage and retain a conventional connector, such as an MPO connector. The connector **810** may include various structures **850**, such as projections, ridges, spacers, or the like that are configured to engage the pin holder **745** and/or the rear portion of the ferrule **130** to prevent the ferrule from moving toward the rear portion of the connector **810**.

[0052] The connector **810** may be inserted into the adapter **805** by pressing down (for instance, toward the ferrule **130**) the adapter latch **815** while pushing the connector into the opening **840** of the adapter. The connector **810** may engage with the clip **720** within the adapter to maintain (or "lock") the connector within the adapter. The connector **810** may be inserted in the adapter **805** by pushing down on the adapter latch **815** to allow the catch projection **825** of the adapter latch to clear (to slide under) the latch catch **750** of the clip **720** while pushing the connector through the opening **840**. When the catch projection **825** has cleared the latch catch **750**, the adapter latch **815** may be released. The resilient nature of the adapter latch **815** may cause the adapter latch to push upward (for instance, away from the ferrule **130**). The upper force of the adapter latch **815** may cause the catch projection **825** to engage an inner surface of the latch catch **750**. The engagement between the catch projection **825** and the latch catch **750** may prevent the connector **810** from being removed from the adapter **805**. Accordingly, removal and/or insertion (plugging in) of the connector **810** into the adapter **805** only requires pressing on the adapter latches **815**.

[0053] In some embodiments, the connector **810** may use only 2 or less parts, not including the ferrule **130**. For example, the connector **810** may include a main body and a rear cover. In comparison, conventional connectors may require 7 components to achieve the same functionality. In some embodiments, the connector **810** may have a length of about 10 millimeters to about 20 millimeters. In some embodiments, the connector may have a length

of about 13 millimeters. In some embodiments, the connector **810** have a length of about 10 millimeters, about 12 millimeters, about 14 millimeters, about 16 millimeters, about 18 millimeters, about 20 millimeters, and any value or range between any two of these values (including endpoints).

[0054] Although a fiber optic connector has been used as an illustrative embodiment, this detailed description is not so limited, as any type of electrical and/or communication connector may be used according to some embodiments. The connectors, adapters, and connection assemblies formed therefrom may be used in combination with other connection elements and/or materials, such as crimpers, bands, straps, ferrules, locking materials, fluids, gels, or the like.

[0055] In the above detailed description, reference is made to the accompanying drawings, which form a part hereof. In the drawings, similar symbols typically identify similar components, unless context dictates otherwise. The illustrative embodiments described in the detailed description, drawings, and claims are not meant to be limiting. Other embodiments may be used, and other changes may be made, without departing from the spirit or scope of the subject matter presented herein. It will be readily understood that the aspects of the present disclosure, as generally described herein, and illustrated in the Figures, can be arranged, substituted, combined, separated, and designed in a wide variety of different configurations, all of which are explicitly contemplated herein.

[0056] The present disclosure is not to be limited in terms of the particular embodiments described in this application, which are intended as illustrations of various aspects. Many modifications and variations can be made without departing from its spirit and scope, as will be apparent to those skilled in the art. Functionally equivalent methods and apparatuses within the scope of the disclosure, in addition to those enumerated herein, will be apparent to those skilled in the art from the foregoing descriptions. Such modifications and

variations are intended to fall within the scope of the appended claims. The present disclosure is to be limited only by the terms of the appended claims, along with the full scope of equivalents to which such claims are entitled. It is to be understood that this disclosure is not limited to particular methods, reagents, compounds, compositions or biological systems, which can, of course, vary. It is also to be understood that the terminology used herein is for the purpose of describing particular embodiments only, and is not intended to be limiting.

[0057] With respect to the use of substantially any plural and/or singular terms herein, those having skill in the art can translate from the plural to the singular and/or from the singular to the plural as is appropriate to the context and/or application. The various singular/plural permutations may be expressly set forth herein for sake of clarity.

[0058] It will be understood by those within the art that, in general, terms used herein, and especially in the appended claims (for example, bodies of the appended claims) are generally intended as "open" terms (for example, the term "including" should be interpreted as "including but not limited to," the term "having" should be interpreted as "having at least," the term "includes" should be interpreted as "includes but is not limited to"). While various compositions, methods, and devices are described in terms of "comprising" various components or steps (interpreted as meaning "including, but not limited to"), the compositions, methods, and devices can also "consist essentially of" or "consist of" the various components and steps, and such terminology should be interpreted as defining essentially closed-member groups. It will be further understood by those within the art that if a specific number of an introduced claim recitation is intended, such an intent will be explicitly recited in the claim, and in the absence of such recitation no such intent is present. For example, as an aid to understanding, the following appended claims may contain usage of the introductory phrases "at least one" and "one or more" to introduce claim recitations. However, the use of such phrases should not be construed to imply that the introduction of a

claim recitation by the indefinite articles "a" or "an" limits any particular claim containing such introduced claim recitation to embodiments containing only one such recitation, even when the same claim includes the introductory phrases "one or more" or "at least one" and indefinite articles such as "a" or "an" (for example, “a” and/or “an” should be interpreted to mean “at least one” or “one or more”); the same holds true for the use of definite articles used to introduce claim recitations. In addition, even if a specific number of an introduced claim recitation is explicitly recited, those skilled in the art will recognize that such recitation should be interpreted to mean at least the recited number (for example), the bare recitation of "two recitations," without other modifiers, means at least two recitations, or two or more recitations). Furthermore, in those instances where a convention analogous to “at least one of A, B, and C, et cetera” is used, in general such a construction is intended in the sense one having skill in the art would understand the convention (for example, “ a system having at least one of A, B, and C” would include but not be limited to systems that have A alone, B alone, C alone, A and B together, A and C together, B and C together, and/or A, B, and C together, et cetera). In those instances where a convention analogous to “at least one of A, B, or C, et cetera” is used, in general such a construction is intended in the sense one having skill in the art would understand the convention (for example, “ a system having at least one of A, B, or C” would include but not be limited to systems that have A alone, B alone, C alone, A and B together, A and C together, B and C together, and/or A, B, and C together, et cetera). It will be further understood by those within the art that virtually any disjunctive word and/or phrase presenting two or more alternative terms, whether in the description, claims, or drawings, should be understood to contemplate the possibilities of including one of the terms, either of the terms, or both terms. For example, the phrase “A or B” will be understood to include the possibilities of “A” or “B” or “A and B.”

[0059] In addition, where features or aspects of the disclosure are described in terms of Markush groups, those skilled in the art will recognize that the disclosure is also thereby described in terms of any individual member or subgroup of members of the Markush group.

[0060] As will be understood by one skilled in the art, for any and all purposes, such as in terms of providing a written description, all ranges disclosed herein also encompass any and all possible subranges and combinations of subranges thereof. Any listed range can be easily recognized as sufficiently describing and enabling the same range being broken down into at least equal halves, thirds, quarters, fifths, tenths, or the like. As a non-limiting example, each range discussed herein can be readily broken down into a lower third, a middle third, and an upper third. As will also be understood by one skilled in the art all language such as "up to," "at least," and the like include the number recited and refer to ranges which can be subsequently broken down into subranges as discussed above. Finally, as will be understood by one skilled in the art, a range includes each individual member. Thus, for example, a group having 1-3 cells refers to groups having 1, 2, or 3 cells. Similarly, a group having 1-5 cells refers to groups having 1, 2, 3, 4, or 5 cells, and so forth.

[0061] Various of the above-disclosed and other features and functions, or alternatives thereof, may be combined into many other different systems or applications. Various presently unforeseen or unanticipated alternatives, modifications, variations or improvements therein may be subsequently made by those skilled in the art, each of which is also intended to be encompassed by the disclosed embodiments.

CLAIMS

What Is Claimed Is:

1. A reduced-profile connection assembly, comprising:

an adapter;

a ferrule having a connection side; and

a reduced-profile clip fixedly arranged within the adapter, the reduced-profile clip having hooks configured to engage a portion of the ferrule opposite the connection side to prevent movement of the ferrule within the adapter.

2. The reduced-profile connection assembly of claim 1, wherein the ferrule is a fiber optic ferrule.

3. The reduced-profile connection assembly of claim 1, wherein the ferrule is a mechanical transfer ferrule.

4. The reduced-profile connection assembly of claim 1, wherein at least a portion of the adapter is configured as a multi-fiber push-on/pull-off adapter.

5. The reduced-profile connection assembly of claim 1, further comprising a ferrule installation device configured to install the ferrule within the reduced-profile clip.

6. The reduced-profile connection assembly of claim 1, wherein the hooks extend about 2 millimeters outside of the adapter.

7. A reduced-profile connection assembly, comprising:

a ferrule having a connection end;

a connector comprising:

an inner housing having the ferrule fixedly arranged therein at a first end and flanges extending from a second end opposite the first end, and

an ejector housing disposed around the inner housing and configured to slide along the inner housing between a locked position and an unlocked position; and

an adapter having a clip fixedly arranged therein, the clip having hooks configured to engage protrusions extending from an outer surface of the inner housing to prevent movement of the inner housing within the adapter, wherein the ejector housing interfaces with the clip in the locked position to prevent disengagement of the hooks from the protrusions.

8. The reduced-profile connection assembly of claim 7, wherein the ferrule is a fiber optic ferrule.

9. The reduced-profile connection assembly of claim 7, wherein the ferrule is a mechanical transfer ferrule.

10. The reduced-profile connection assembly of claim 7, wherein at least a portion of the adapter is configured as a multi-fiber push-on/pull-off adapter.

11. The reduced-profile connection assembly of claim 7, wherein the inner housing comprises at least one ferrule latch configured to engage the ferrule at an end opposite the connection end, thereby preventing movement of the ferrule within the inner housing in a direction toward the flanges.

12. The reduced-profile connection assembly of claim 11, wherein the ejector housing is configured to push the at least one ferrule latch into engagement with the ferrule.

13. The reduced-profile connection assembly of claim 7, wherein each of the flanges comprise a recess and a projection,

wherein a distal portion of the ejector housing is configured to be seated in the recess when in the locked position.

14. The reduced-profile connection assembly of claim 13, wherein a distal portion of the ejector housing is configured to be seated in the recess when in the unlocked position, thereby preventing movement of the ejector housing in a proximal direction along the inner housing.

15. The reduced-profile connection assembly of claim 13, wherein a proximal portion of the ejector housing is configured to engage the projection when in the locked position, thereby preventing movement of the ejector housing in a distal direction along the inner housing.

16. The reduced-profile connection assembly of claim 7, wherein the connector comprises 2 parts.

17. The reduced-profile connection assembly of claim 7, wherein the connector has a length of about 20 millimeters to about 30 millimeters.

18. The reduced-profile connection assembly of claim 7, wherein the connector has a length of about 26 millimeters.

19. The reduced-profile connection assembly of claim 7, wherein the connector extends outside of the adapter when in the locked position about 15 millimeters to about 30 millimeters.

20. The reduced-profile connection assembly of claim 7, wherein the connector extends outside of the adapter when in the locked position about 24 millimeters.

21. A reduced-profile connection assembly, comprising:

a ferrule;

a connector having the ferrule fixedly arranged therein and comprising at least one adapter latch having at least one adapter latch projection; and

an adapter having at least on recess, the at least one recess configured to engage the adapter latch projection when the connector is locked in the adapter to prevent movement of the connector within the adapter.

22. The reduced-profile connection assembly of claim 21, wherein the ferrule is a fiber optic ferrule.

23. The reduced-profile connection assembly of claim 21, wherein the ferrule is a mechanical transfer ferrule.

24. The reduced-profile connection assembly of claim 21, wherein at least a portion of the adapter is configured as a multi-fiber push-on/pull-off adapter.

25. The reduced-profile connection assembly of claim 21, wherein the at least one adapter latch comprises two adapter latches arranged on opposite side portions of the connector.

26. The reduced-profile connection assembly of claim 25, wherein the at least one recess comprises two recesses arranged on opposite side walls of the adapter corresponding with the at least one adapter latch projection of the two adapter latches.

27. The reduced-profile connection assembly of claim 21, wherein the connector comprises 1 part.

28. The reduced-profile connection assembly of claim 21, wherein the connector has a length of about 10 millimeters to about 20 millimeters.

29. The reduced-profile connection assembly of claim 21, wherein the connector has a length of about 13 millimeters.

30. A reduced-profile connection assembly, comprising:

a ferrule;

a connector having the ferrule fixedly arranged therein and comprising at least one adapter latch having at least one adapter latch projection; and

an adapter having a clip fixedly arranged therein, the clip having a recess configured to engage the adapter latch projection when the connector is locked in the adapter to prevent movement of the connector within the adapter.

31. The reduced-profile connection assembly of claim 30, wherein the ferrule is a fiber optic ferrule.

32. The reduced-profile connection assembly of claim 30, wherein the ferrule is a mechanical transfer ferrule.

33. The reduced-profile connection assembly of claim 30, wherein at least a portion of the adapter is configured as a multi-fiber push-on/pull-off adapter.

34. The reduced-profile connection assembly of claim 30, further comprising at least one spring arranged within the connector, the at least one spring configured to engage an end of the ferrule opposite the connection end to prevent movement of the ferrule within the connector in a direction away from the connection end.

35. The reduced-profile connection assembly of claim 30, further comprising at least one spacer arranged within the connector, the at least one spring configured to engage an end of the ferrule opposite the connection end to prevent movement of the ferrule within the connector in a direction away from the connection end.

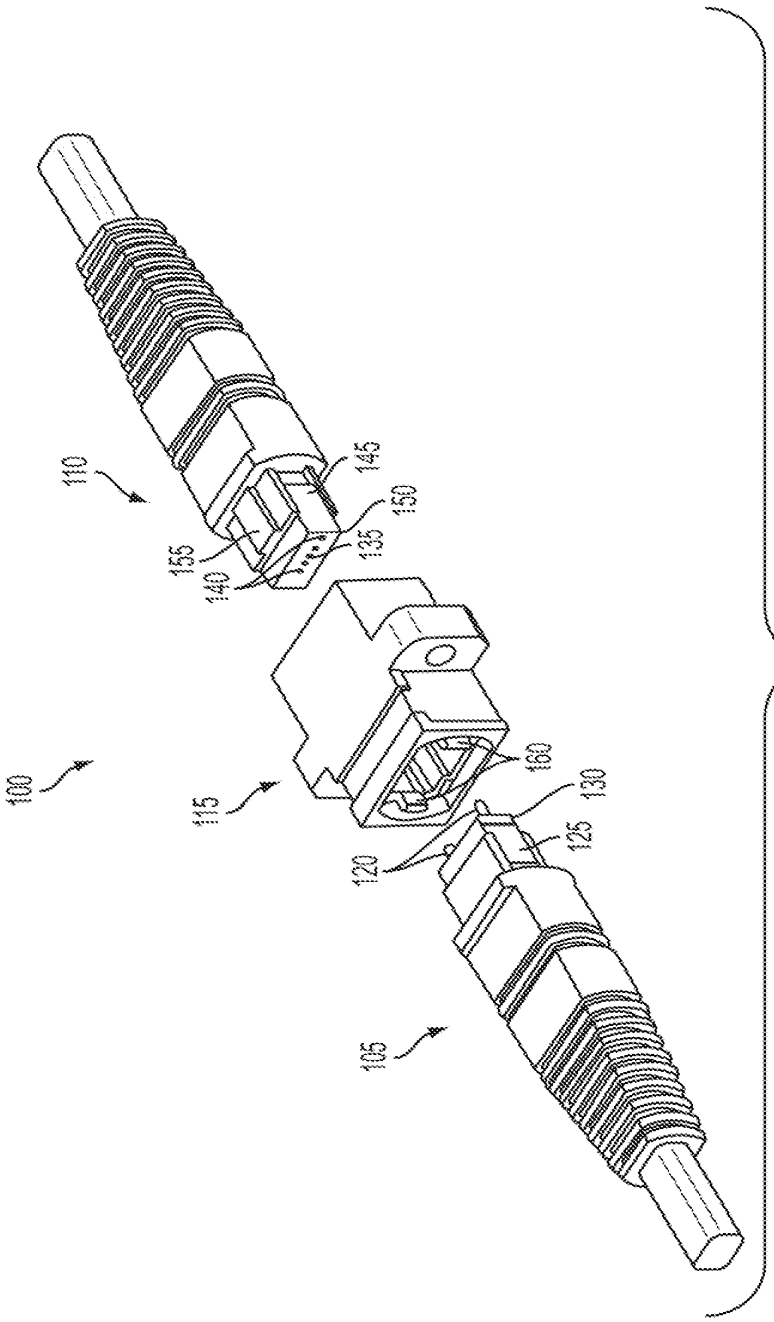


FIG. 1

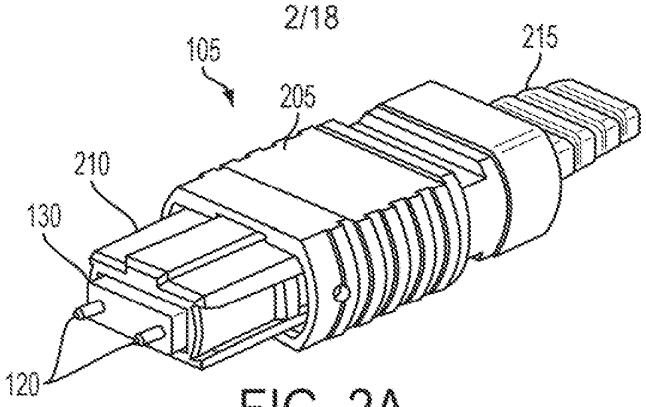


FIG. 2A

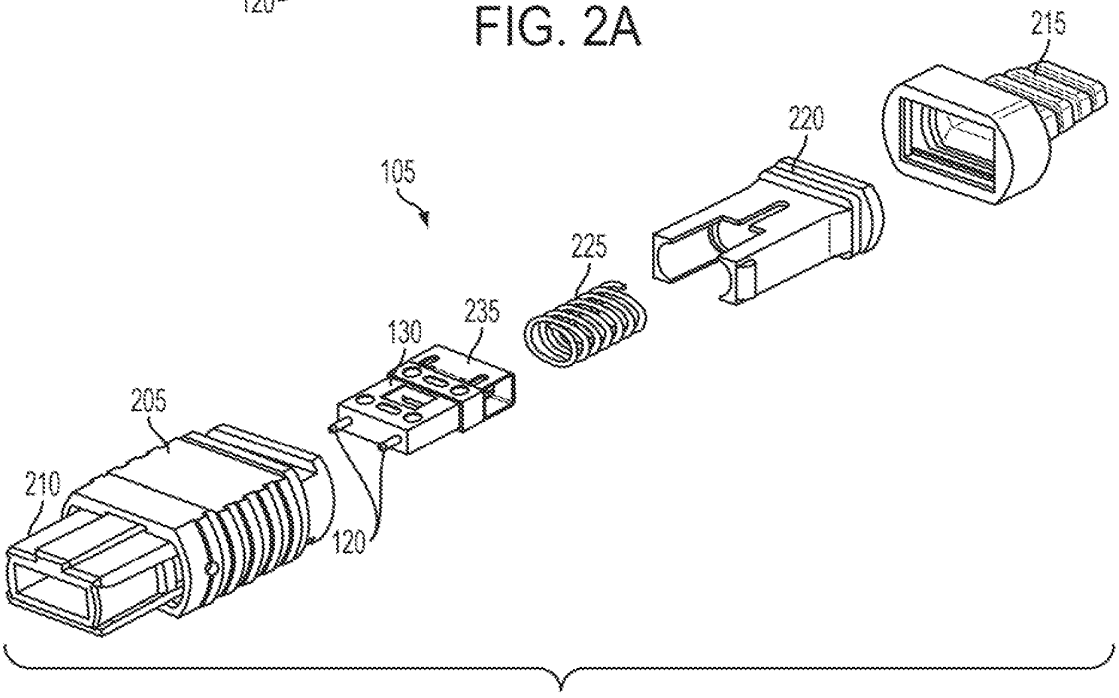


FIG. 2B

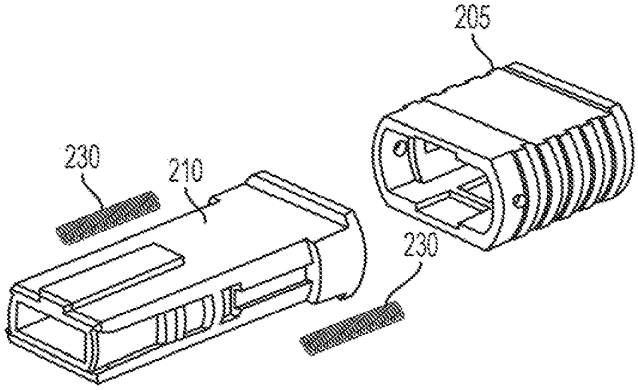


FIG. 2C

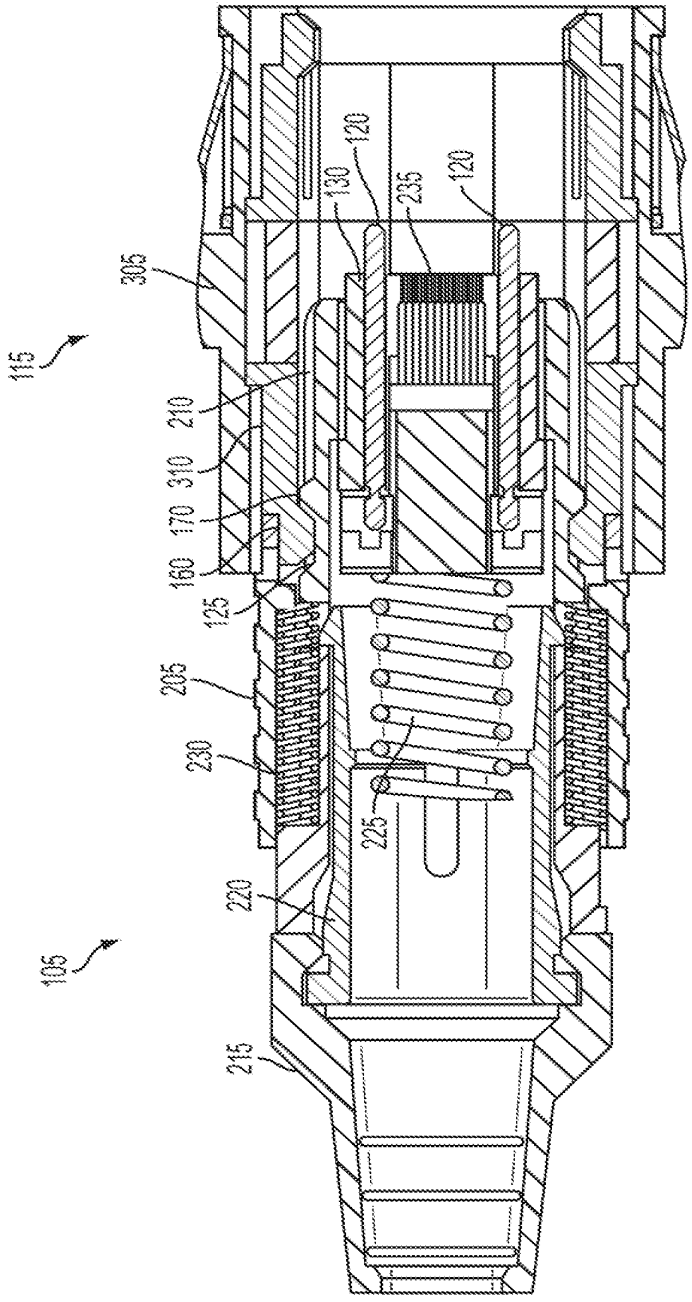

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FIG. 3

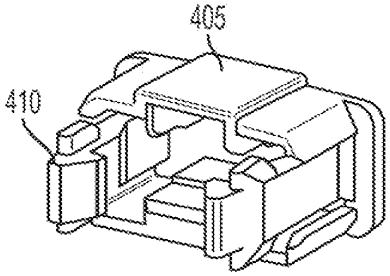


FIG. 4A

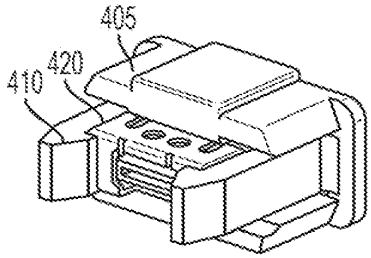


FIG. 4B

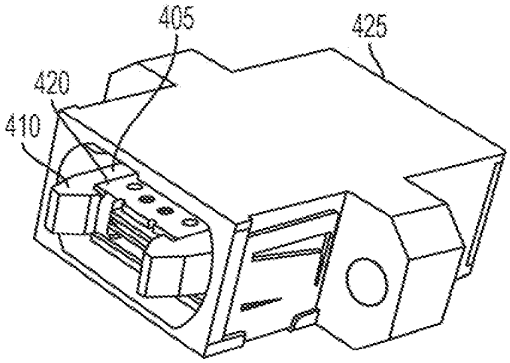


FIG. 4C

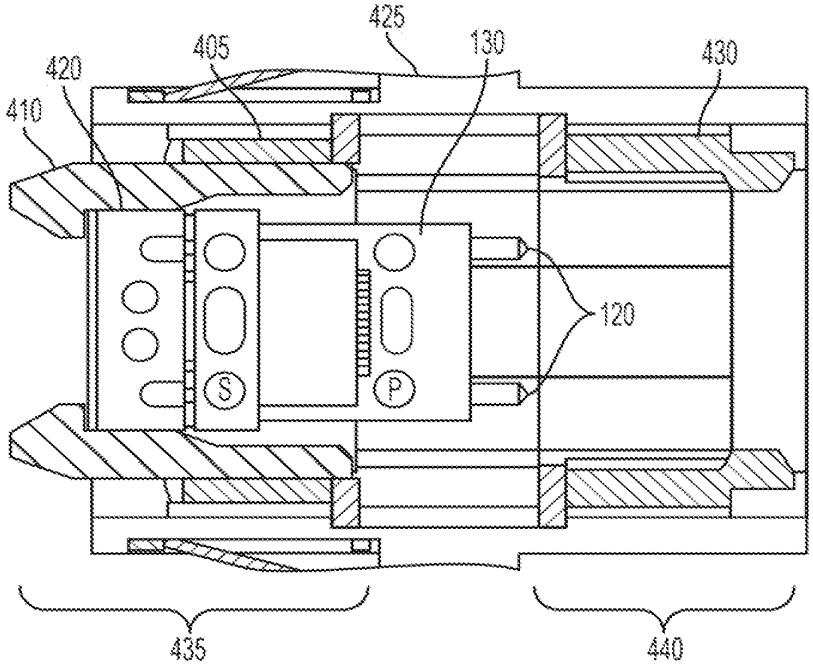


FIG. 4D

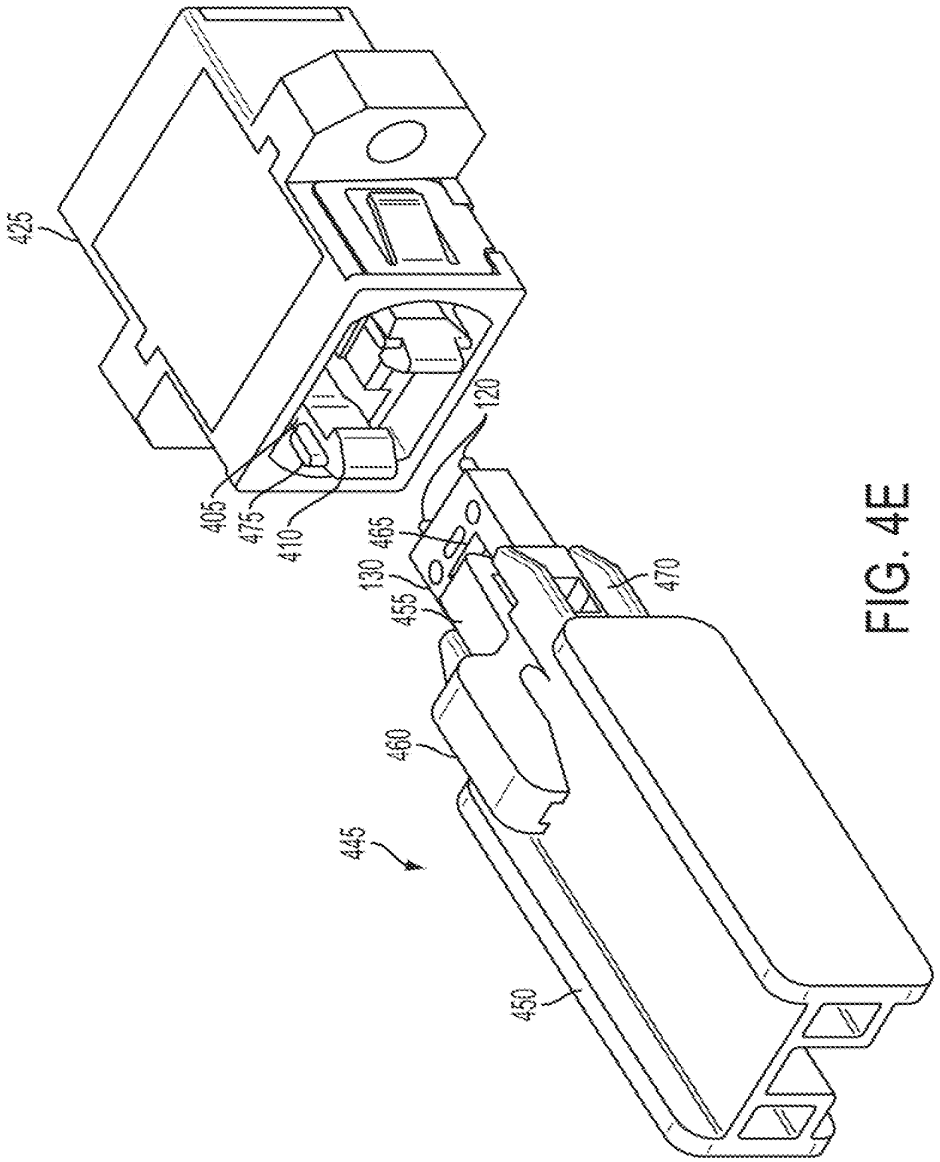


FIG. 4E

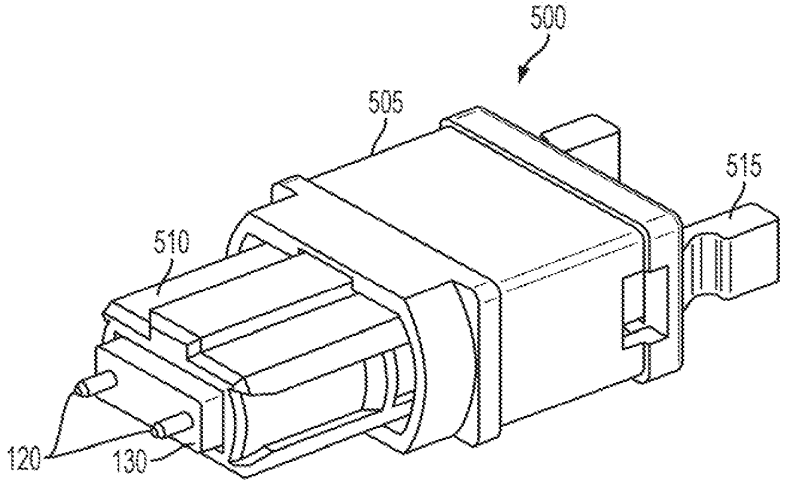


FIG. 5A

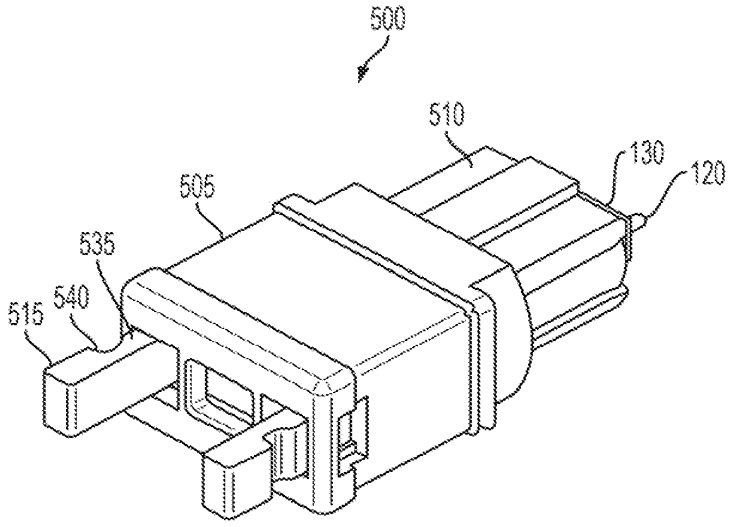


FIG. 5B

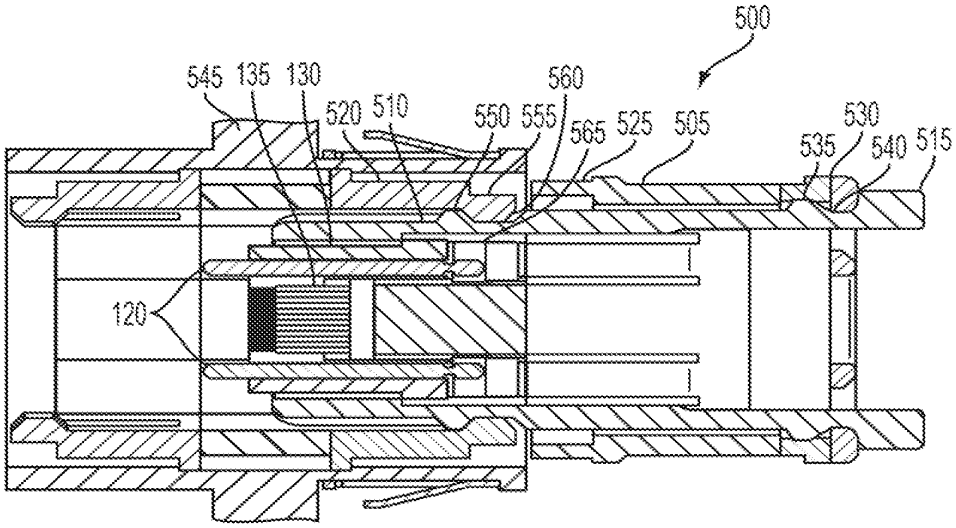

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FIG. 5C

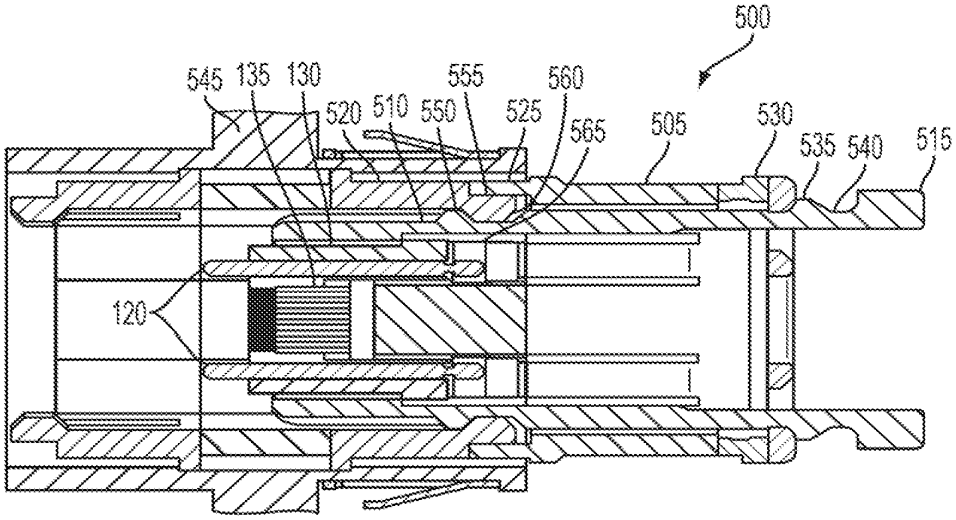

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FIG. 5D

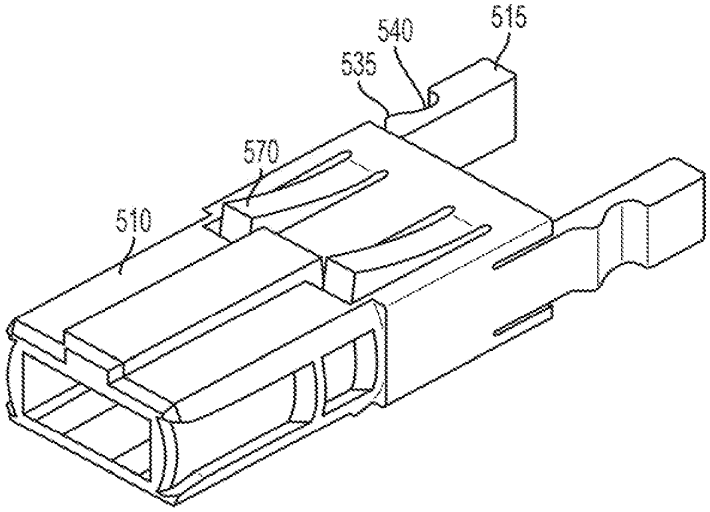


FIG. 5E

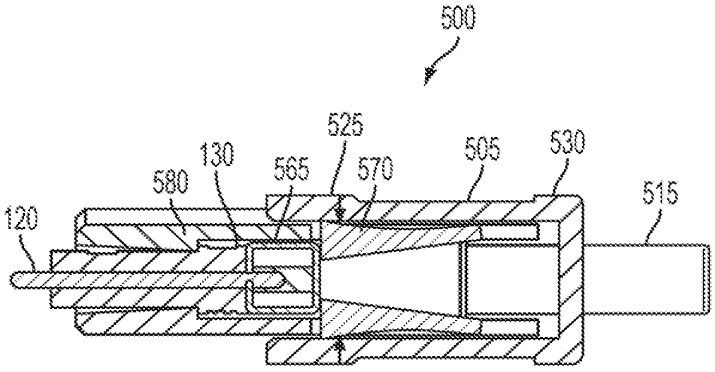


FIG. 5F

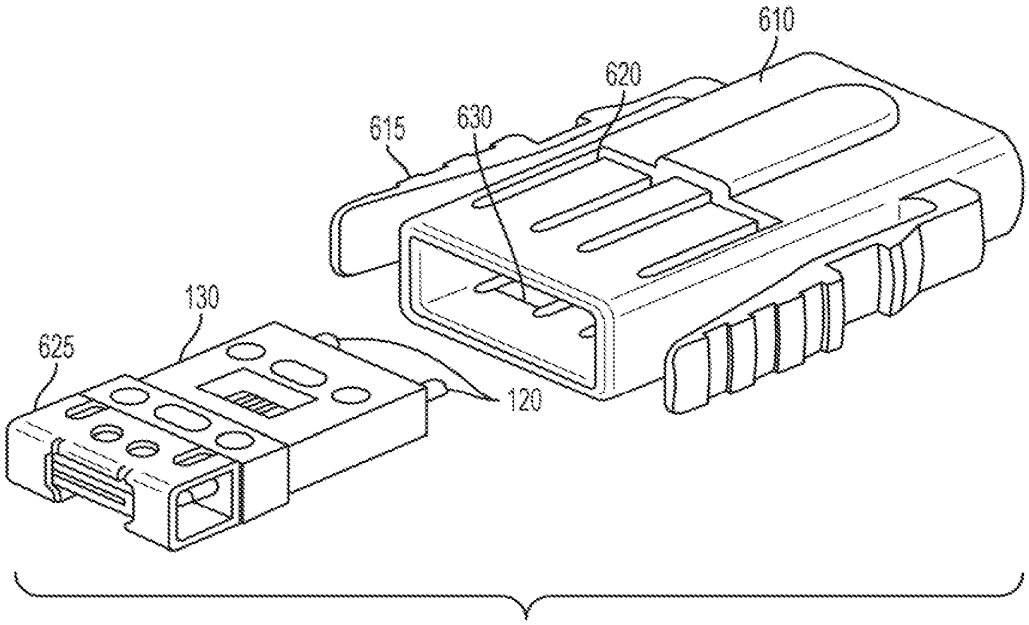


FIG. 6A

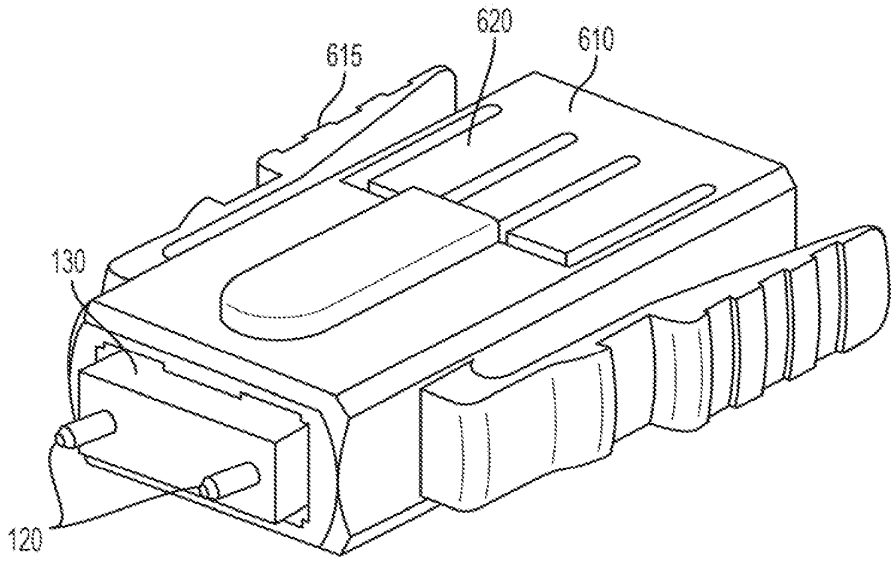


FIG. 6B

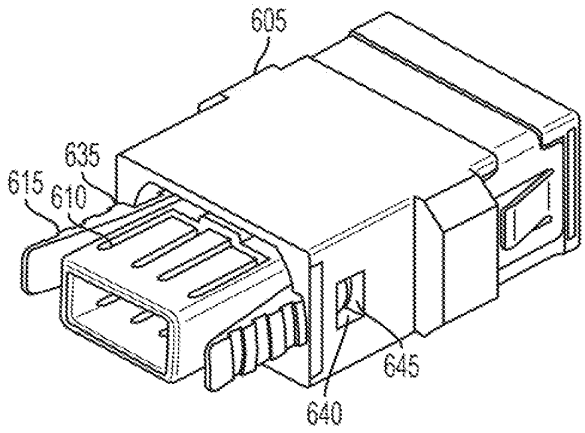

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FIG. 6C

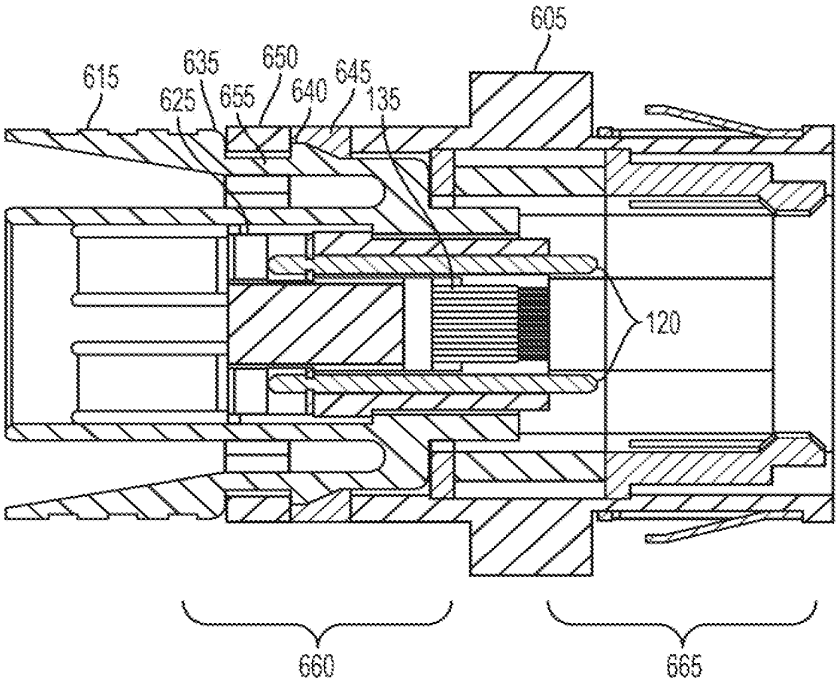

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FIG. 6D

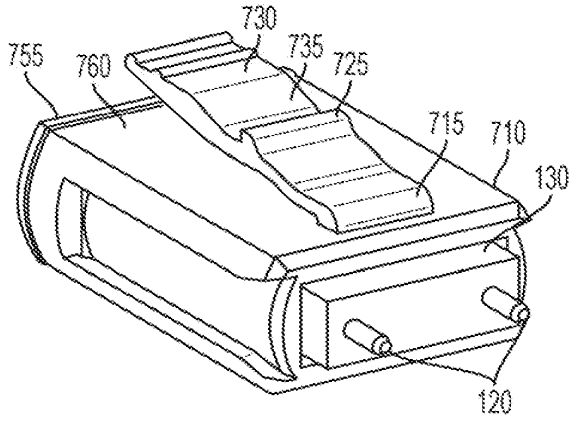


FIG. 7A

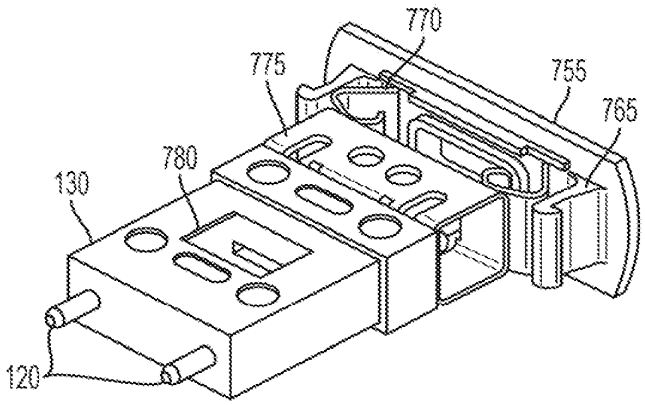


FIG. 7B

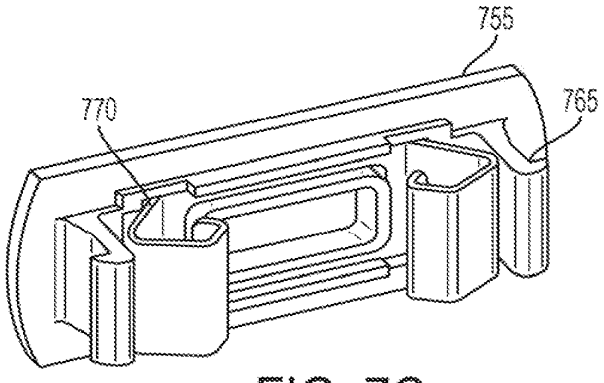


FIG. 7C

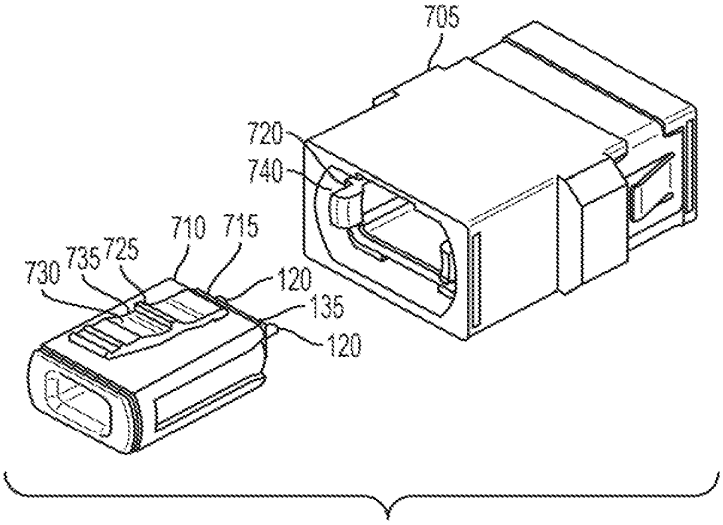


FIG. 7D

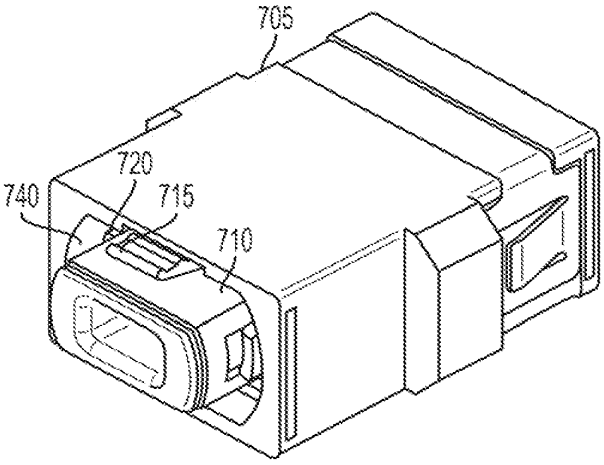


FIG. 7E

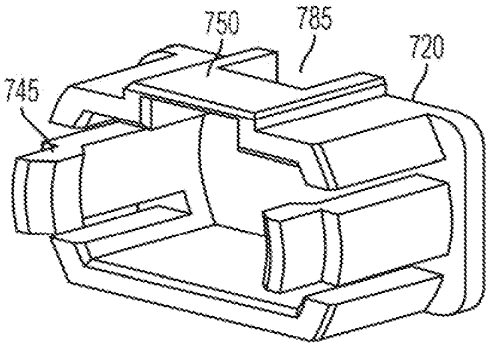


FIG. 7F

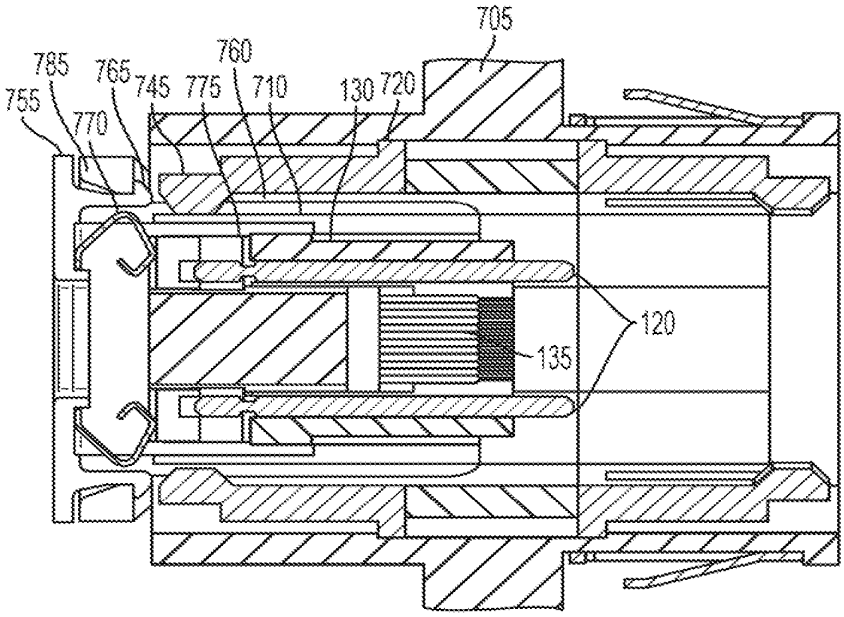

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FIG. 7G

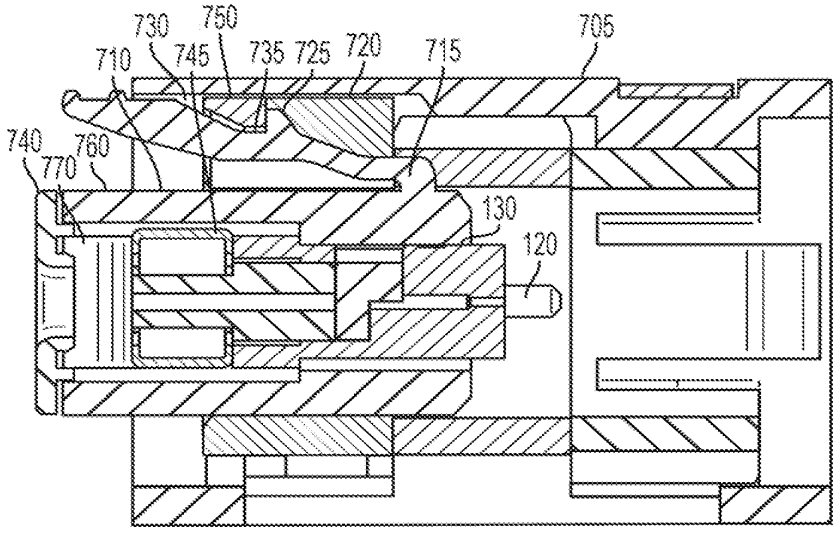

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FIG. 7H

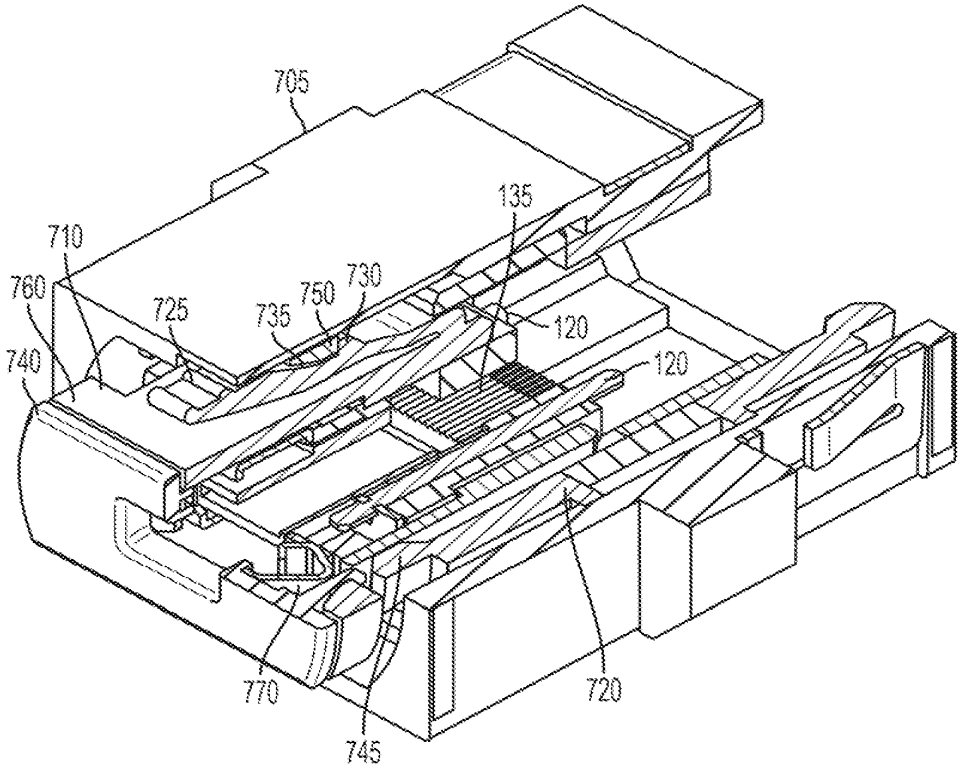


FIG. 7I

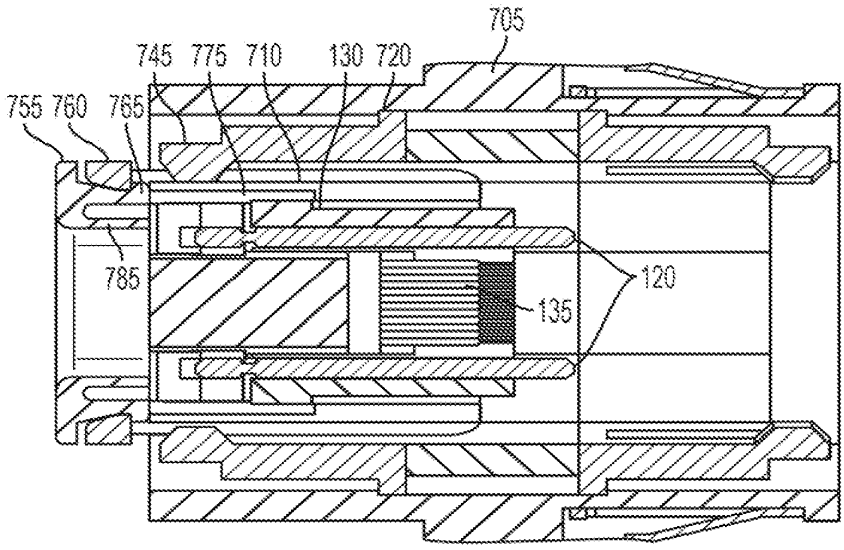


FIG. 7J

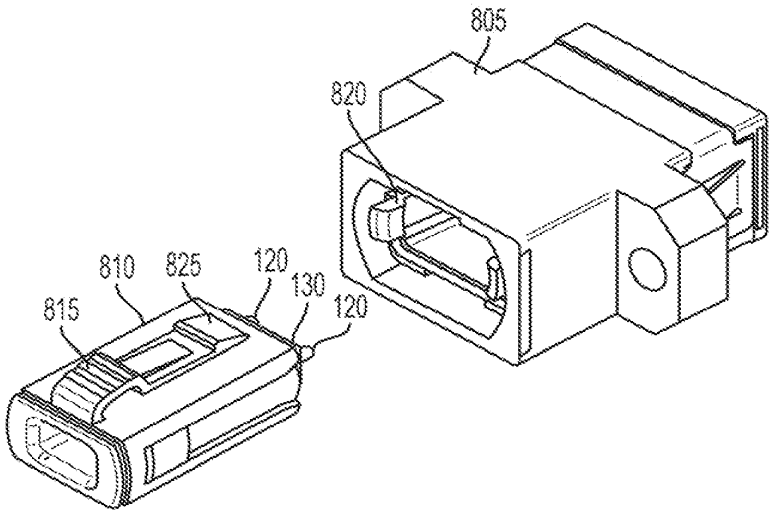


FIG. 8A

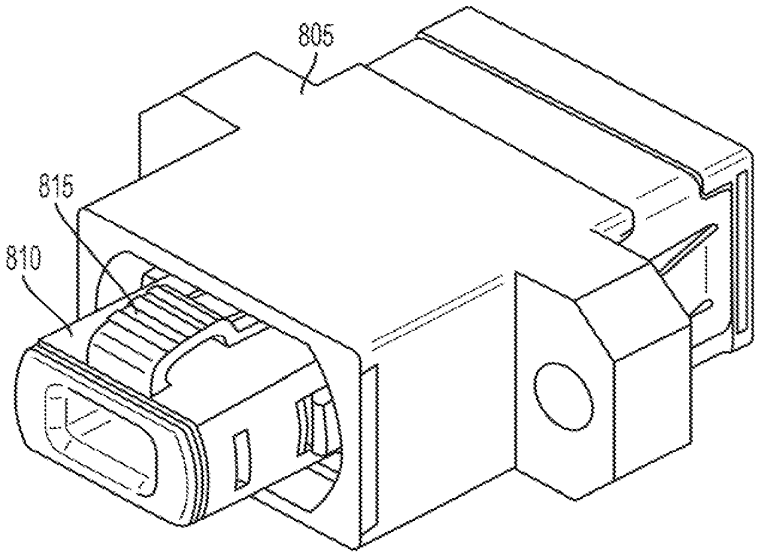


FIG. 8B

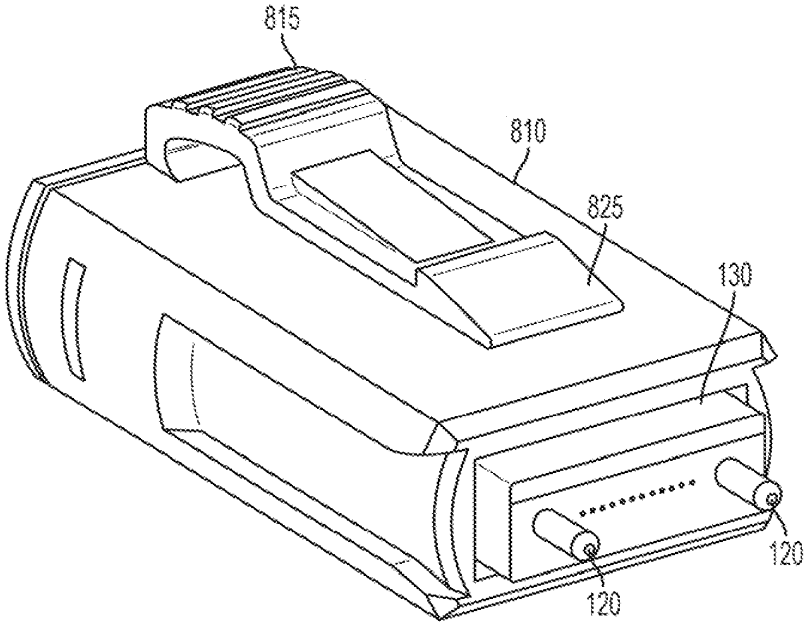


FIG. 8C

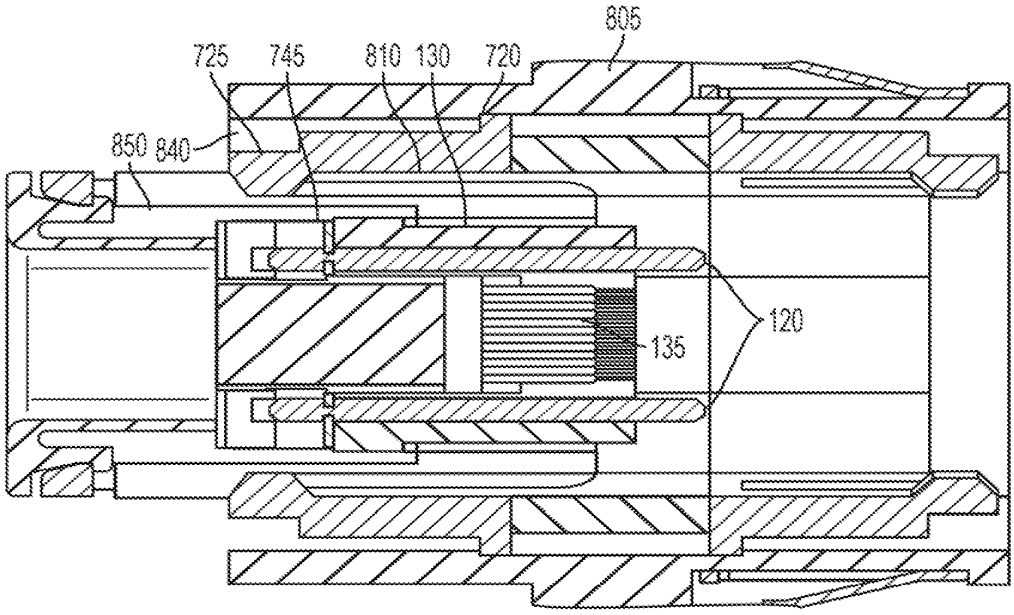

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FIG. 8D

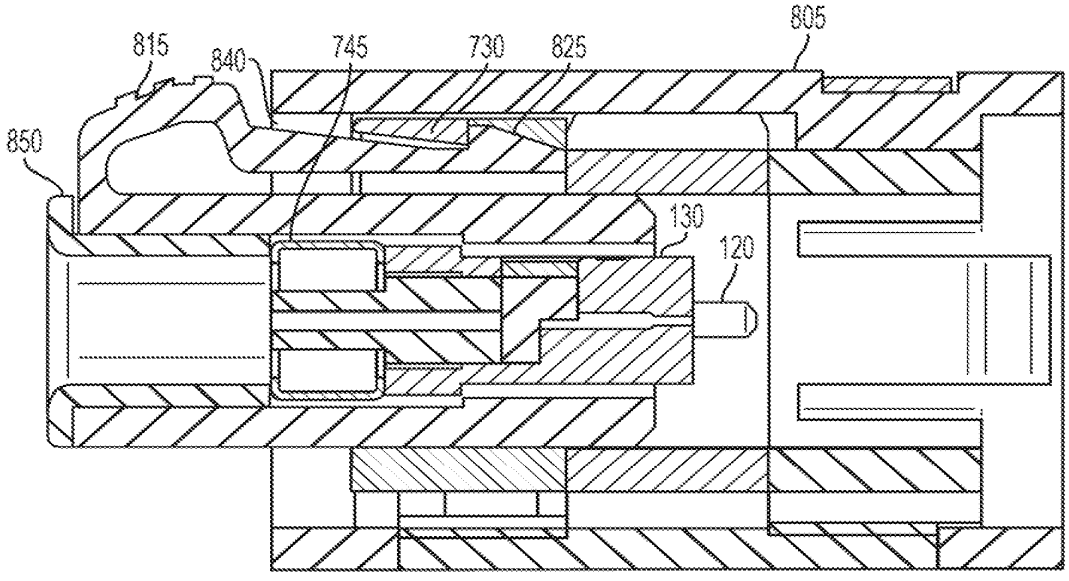

805
815
840
745
730
825
850
130
120

FIG. 8E

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US14/41500

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - G02B 6/36, 6/38, 6/40 (2014.01)
CPC - G02B 6/1228, 6/381, 6/3833
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(8) Classification(s): G02B 6/36, 6/38, 6/40 (2014.01)
CPC Classification(s): G02B 6/1228, 6/381, 6/3833, 6/3825, 6/3885; USPC Classification(s): 385/72, 81, 55

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
MicroPatent (US-G, US-A, EP-A, EP-B, WO, JP-bib, DE-C,B, DE-A, DE-T, DE-U, GB-A, FR-A); IP.Com, Google, Google Scholar, Proquest; search terms used: Ferrule fiber optic adapter clip hooks multi-fiber push-on/pull-off adapter mpo mt mechanical transfer

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X --- Y	US 6,682,228 B2 (RATHNAM, L. et al.) January 27, 2004; figures 1A-6C; column 1, lines 13-18 and 48-59; column 3, line 14- column 5, line 63; column 6, lines 33-39.	1-5, 7-16, 21-35 ---- 6, 17-20
Y	US 8,651,749 B2 (DAINESE JÚNIOR, P. Jr. et al.) February 18, 2014; figures 19-20; column 13, lines 17-29.	6
Y	US 2013/0121653 A1 (SHITAMA, S. et al.) May 16, 2013; figures 3-4; paragraphs [0025, 0027-0028].	17-18
Y	US 2009/0022457 A1 (DE JONG, M. et al.) January 22, 2009; figures 1, 5 and 7; paragraphs [0032 and 0040-0041].	19-20
A	US 2007/0098329 A1 (SHIMOJI, N. et al.) May 3, 2007; entire document.	1-20
A	US 2014/0133808 A1 (HILL, J. et al.) May 15, 2014; entire document.	1-20

☐ Further documents are listed in the continuation of Box C. ☐

* Special categories of cited documents:
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"E" earlier application or patent but published on or after the international filing date
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"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	Date of mailing of the international search report
29 August 2014 (29.08.2014)	09 OCT 2014
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-3201	Authorized officer: Shane Thomas PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

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201 16 042.0	30. September 2001 (30.09.2001)	DE

(71) Anmelder *(für alle Bestimmungsstaaten mit Ausnahme von US)*: **EUROMICRON WERKZEUGE GMBH** [DE/DE]; Im Seifen 12, 35756 Mittenaar (DE).

(72) Erfinder; und

(75) Erfinder/Anmelder *(nur für US)*: **THEIS, Hans** [DE/DE]; Im Seifen 12, 35756 Mittenaar (DE). **THEIS, Michael** [DE/DE]; Im Seifein 12, 35756 Mittenaar (DE). **HERR, Günter** [DE/DE]; Kirchweg 9, 35630 Ehringshausen-Dreisbach (DE).

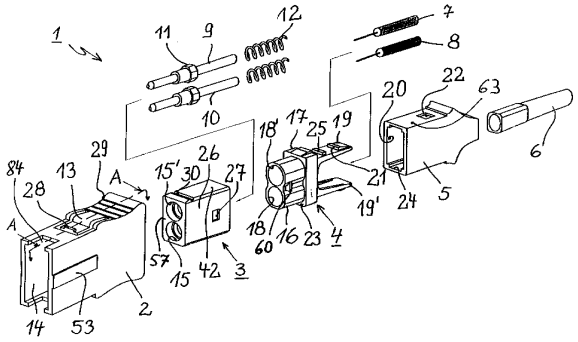
(74) Anwalt: **MIERSWA, Klaus**; Friedrichstrasse 171, 68199 Mannheim (DE).

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[Fortsetzung auf der nächsten Seite]

(54) Title: CONNECTOR FOR OPTICAL WAVEGUIDES COMPRISING A CONNECTOR HOUSING

(54) Bezeichnung: STECKER FÜR LICHTWELLENLEITER MIT EINEM STECKERGEHÄUSE



(57) Abstract: The invention relates to a connector (1, 56, 101, 156) for optical waveguides (6, 6a, 7, 8, 106d), which comprises a connector housing (2, 43, 102, 143). A bundle of light guides (6, 6a, 7, 8, 106d) with optical fibers (7, 8) is introduced at the rear end of said housing, and ferrules (9, 10), into which the optical fibers (7, 8) are respectively introduced, exit at the front end of the housing. The ferrules (9, 10) are held inside a ferrule housing (3, 4, 103, 104) in a spring-loaded manner, and the ferrule housing is placed inside the connector housing (2, 43, 103, 143), which is shaped accordingly for accommodating the ferrule housing (3, 4, 103, 104). The connector (1, 56, 101, 156) is intended for plugging together with a coupling housing (31, 31', 131, 32, 32', 132) that accommodates the connector (1, 56, 101, 156). The ferrule housing is comprised of a core housing (3, 103) and of a core inner housing (4, 104), which are designed for accommodating two individual ferrules (9, 10). The ferrules (9, 10) are held inside the core housing (3, 103), and the front ends of the ferrules (9, 10) project forward and through the core housing (3, 103). The rear ends of the ferrules (9, 10) project into the core inner housing (4, 104). The core housing (3, 103) and the core inner housing (4, 104) are at least partially plugged into one another and form a double unit (3-4, 103-104).

(57) Zusammenfassung: Die Erfindung betrifft einen Stecker (1, 56, 101, 156) für Lichtwellenleiter (6, 6a, 7, 8, 106d), mit einem Stechkergehäuse (2, 43, 102, 143), an dessen hinteren Ende ein Lichtleiterbündel (6, 6a, 7, 8, 106d) mit Lichtwellenleiterfasern (7, 8) eingeführt ist und an dessen vorderen Ende Ferrule (9, 10) austreten, in die je eind der Lichtwellenleiterfasern (7, 8) eingeführt ist, wobei die Ferrule (9, 10) federbelastet in einem Ferrulegehäuse (3, 4, 103, 104) entsprechend geformte Steckergehäuse (2, 43, 103,

[Fortsetzung auf der nächsten Seite]

WO 02/42818 A1

DE (Gebrauchsmuster), DM, DZ, EE, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, RO, RU, SD, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZW.

(84) Bestimmungsstaaten *(regional)*: ARIPO-Patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), eurasisches Patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), europäisches Patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI-Patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Veröffentlicht:
— *mit internationalem Recherchenbericht*
— *vor Ablauf der für Änderungen der Ansprüche geltenden Frist; Veröffentlichung wird wiederholt, falls Änderungen eintreffen*

Zur Erklärung der Zweibuchstaben-Codes und der anderen Abkürzungen wird auf die Erklärungen ("Guidance Notes on Codes and Abbreviations") am Anfang jeder regulären Ausgabe der PCT-Gazette verwiesen.

143) eingelegt ist, wobei der Stecker (1, 56, 101, 156) zum Zusammenstecken mit einem den Stecker (1, 56, 101, 156) aufnehmenden Kupplungsgehäuse (31, 31', 131, 32, 32', 132) bestimmt ist. Das Ferrulegehäuse besteht aus einem Kerngehäuse (3, 103) und einem Kerninnengehäuse (4, 104), welche zur Aufnahme von zwei einzelnen Ferrulen (9, 10) ausgestaltet sind, wobei die Ferrule (9, 10) im Kerngehäuse (3, 103) gehaltert sind und die vorderen Enden der Ferrule (9, 10) das Kerngehäuse (3, 103) nach vorn durchragen und die hinteren Enden der Ferrule (9, 10) in das Kerninnengehäuse (4, 104) ragen, wobei Kerngehäuse (3, 103) und Kerninnengehäuse (4, 104) wenigstens teilweise ineinander gestechkt sind und eine Doppeleinheit (3-4, 103-104) bilden.

Stecker für Lichtwellenleiter mit einem Steckergehäuse

Technisches Gebiet:

Die Erfindung betrifft einen Stecker für Lichtwellenleiter mit einem Steckergehäuse, an dessen hinterem Ende ein Lichtleiterbündel mit mindestens zwei Lichtwellenleiterfasern eingeführt ist und an dessen gegenüberliegendem vorderen Ende Ferrule austreten, in die je eine der Lichtwellenleiterfasern eingeführt ist, wobei die Ferrule in einem Ferrulegehäuse gehaltert sind, welches in ein zur Aufnahme des Ferrulegehäuses entsprechend geformtes Steckergehäuse eingelegt ist und die Ferrule federbelastet in ihrer Axialrichtung beweglich sind, wobei der Stecker zum Zusammenstecken mit einem den Stecker aufnehmenden Kupplungsgehäuse bestimmt ist, gemäß dem Oberbegriff des Anspruchs 1.

Stand der Technik:

Gattungsgemäße Stecker des Standes der Technik sind prinzipiell gemäß dem Dokument US-PS 5,315,679 aufgebaut. Durch dieses Dokument ist ein Stecker für Lichtleiterkabel bekannt geworden, welcher aus einem Steckergehäuse aus zwei flächigen Halbschalen besteht, in dessen Inneren zwei Ferrule angeordnet sind. Die Ferrule sind einzeln in je einem geschlossenen Ferrulegehäuse beweglich gehaltert, wobei ein sogenanntes Zip-Cord-Kabel, welches zwei getrennte Lichtleitfasern beinhaltet, in zwei Einzelkabeln geführt ist. Jedes Kabel ist einzeln innerhalb des Steckergehäuses zum jeweiligen Ferrulegehäuse an die einzelnen Ferrule geführt, weshalb jedes Kabel einzeln und getrennt abgefangen und zugentlastet werden muß. Diese Art der Ferruleführung ist unter der Bezeichnung Simplex-Führung oder Simplexferrul bekannt und dadurch ausgezeichnet, dass je Ferrul ein separates Ferrulgehäuse vorhanden ist. Auch Doppelstecker oder Stecker mit mehr als zwei Ferrulen, 2n-Ferrulen, sind aus einzelnen Simplexferrulen zusammengesetzt.

Des Weiteren ist es bekannt, einen Doppelstecker aus zwei Ferrulen aufzubauen, deren Enden mit den Lichtleitfasern in einer gemeinsamen Stirnfläche oder Platte aus Kunststoff enden und darin eingegossen sind. Obwohl diese Anordnung eine größere Packungsdichte der einzelnen Stecker bzw. Ferrule

erlaubt, besitzt ein derartiger Stecker den Nachteil, dass die einzelnen Ferrule aus Herstellungsgründen keine konvexe Kontaktform mehr aufweisen. Denn die Oberfläche eines Simplex-Ferruls besitzt bevorzugt eine konvexe Kontaktform unter einem Winkel zwischen 8 Grad bis 9 Grad (sog. angel-polishing-connector = apc-Kontaktierung). In diesem Fall trifft der an der Spitze konvex geformte Ferrul auf die Spitze des gleichermaßen konvex geformten Ferruls des gegenüberliegenden Steckers in der Kupplung, wobei dieser Ferrul um 180 Grad gegenüber dem erstgenannten Ferrul gedreht ist. Auf diese Weise wird sichergestellt, dass reflektiertes Störlicht weitestgehend unschädlich ist und nur zu einem Bruchteil in die Lichtleitfasern gelangen kann. Diese apc-Kontaktierung ist jedoch nur bei Einzelferrulen möglich.

Des Weiteren müssen Stecker gegen ungewolltes Abziehen des Steckers durch unsachgemäße Behandlung gesichert sein. Es hat sich gezeigt, daß der Lösemechanismus auch dadurch gelöst werden kann, daß am Lichtleitkabel selbst stark gezogen wird, was die Verbindung zwischen Stecker und Kupplung nicht lösen soll.

Technische Aufgabe:

Der Erfindung liegt die Aufgabe zugrunde, einen Stecker der gattungsbildenden Art zu schaffen, der den Aufbau eines Doppelsteckers oder eines Mehrfach-Doppelsteckers ermöglicht, bei welchen die Vorteile des Einzelferruls erhalten bleiben, insbesondere die Möglichkeit der apc-Kontaktierung zweier gegenüberliegender Ferrule gegeben ist; des Weiteren soll der Stecker eine hohe Packungsdichte ermöglichen. Ferner soll der Stecker eine zuverlässige Abzugssicherung aufweisen, so dass er nicht versehentlich durch Zug am Kabel abgezogen werden kann.

Offenbarung der Erfindung und deren Vorteile:

Diese Aufgabe wird erfindungsgemäß gelöst durch einen Stecker für Lichtwellenleiter, mit einem Steckergehäuse, an dessen hinteren Ende ein Lichtleiterbündel mit mindestens zwei Lichtwellenleiterfasern eingeführt ist und an dessen gegenüberliegendem vorderen Ende Ferrule austreten, in die je eine der Lichtwellenleiterfasern eingeführt ist, wobei die Ferrule in einem

Ferrulegehäuse gehaltert sind, welches in das zur Aufnahme des Ferrulegehäuses entsprechend geformte Steckergehäuse eingelegt ist und die Ferrule federbelastet in ihrer Axialrichtung beweglich sind, wobei der Stecker zum Zusammenstecken mit einem den Stecker aufnehmenden Kupplungsgehäuse bestimmt ist, wobei das Ferrulegehäuse aus einem Kerngehäuse und einem Kerninnengehäuse besteht, welche zur Aufnahme von zwei einzelnen Ferrulen ausgestaltet sind, wobei die Ferrule im Kerngehäuse gehaltert sind und die vorderen Enden der Ferrule das Kerngehäuse nach vorn durchragen und die hinteren Enden der Ferrule in das Kerninnengehäuse ragen, und Kerngehäuse und Kerninnengehäuse wenigstens teilweise ineinander gesteckt sind und eine Doppeleinheit bilden.

In einer weiteren Ausgestaltung des Steckers ist das Kerninnengehäuse wenigstens teilweise in das Kerngehäuse eingesteckt, wobei auf der hintere Teil des Kerninnengehäuses in einem Aufnahmegehäuse aufgenommen ist, in welches das Lichtleiterbündel eingeführt ist, wobei das Kerngehäuse, das Kerninnengehäuse und das Aufnahmegehäuse in das Steckergehäuse gesteckt und dort schwimmend gehaltert sind.

In einer weiteren vorteilhaften Ausgestaltung des Steckers weist das Kerngehäuse die Form eines Gehäusequaders mit Seitenwandungen und einer vorderen Stirnfläche auf, in der sich mittig zwei Durchgangslöcher für den Durchgang der Ferrule befinden, wobei der Gehäusequader zur Aufnahme der Ferrule nach hinten offen ist.

In einer weiteren vorteilhaften Ausgestaltung des Steckers umfaßt das Kerninnengehäuse eine mit Durchgangslöchern versehene Quaderplatte, auf deren Vorderseite ein in axialer Richtung des Steckers sich erstreckender Doppelzylinder mit zwei Durchgangslöchern aufgesetzt ist und an deren Rückseite zwei Führungszungen in axialer Richtung sich erstrecken zum Einführen in das hintere Aufnahmegehäuse, wobei die Führungszungen und das Aufnahmegehäuse gegenseitige Verrastungsmittel aufweisen.

Gemäß einer bevorzugten Ausführungsform sind die Verrastungsmittel Rastnasen und Rastfenster, wobei die Rastnasen an den Führungszungen angeordnet sind und das Aufnahmegehäuse die Form eines Gehäusequaders mit je ein Rastfenster aufweisenden Seitenwandungen besitzt, in welche die Rastnasen nach Einführen der Führungszungen in das Aufnahmegehäuse einzurasten imstande sind.

Insbesondere ermöglichen die erfindungsgemäßen Doppeleinheiten zur Halterung von immer gleichzeitig zwei Ferrulen den Aufbau von Mehrfach-Doppelsteckern, nämlich 2•n-Doppelsteckern, welche kompakt und erheblich kleiner aufgebaut sind als vergleichbare Stecker des Standes der Technik. Zum Aufbau eines Mehrfach-Doppelsteckers ist hierzu die Doppeleinheit aus vorderem Kerngehäuse und hinterem Kerninnengehäuse in identischer Weise mehrfach vorhanden, wobei die Doppeleinheiten in einem Aufnahmegehäuse nebeneinander angeordnet sind.

In diesem Fall besteht das Aufnahmegehäuse aus zwei übereinander angeordneten Gehäuseschalen, zwischen denen die Doppeleinheiten nebeneinander aufgereiht sind, wobei die Kerninnengehäuse in den Gehäuseschalen mittels Verrastung miteinander verrastet sind und Doppeleinheiten sowie Aufnahmegehäuse in ein Mehrfachsteckergehäuse gesteckt und darin schwimmend gehaltert sind, welches eine Mehrzahl von aneinandergereihten und miteinander verbundenen Doppelsteckergehäusen umfaßt. In einer weiteren Ausführungsform des Mehrfach-Doppelsteckers weisen die beiden äußeren Doppelsteckergehäuse des Mehrfachsteckergehäuses Laschen zum Lösen der Verriegelung durch Eindrücken der Laschen mit dem Aufnahmegehäuse auf.

In einer anderen bevorzugten Ausführungsform umfaßt das Kerninnengehäuse eine mit Durchgangslöchern versehene vordere Quaderplatte und eine von dieser in Richtung des Lichtwellenleiters parallel beabstandete, mit der vorderen Quaderplatte durch einen Verbindungssteg verbundene hintere Quaderplatte, wobei die seitliche bzw. vertikale Ausdehnung des Verbindungssteges geringer ist als seitliche bzw. vertikale Ausdehnung der hinteren Quaderplatte. Auf der Vorderseite der vorderen Quaderplatte ist ein in axialer Richtung des Steckers

sich erstreckender Doppelzylinder mit den Durchgangslöchern aufgesetzt, welche zur Durchführung der Ferrule durch das Kerninnengehäuse dienen. Das Aufnahmegehäuse besteht aus zwei miteinander verrastbaren Halbschalen, wobei die Hauptflächen der beiden Halbschalen an ihren Innenseiten im Bereich des vorderen Endes des Aufnahmegehäuses jeweils eine Vertiefung aufweisen, welche bei miteinander verrasteten Halbschalen zur formschlüssigen Aufnahme der hinteren Quaderplatte imstande sind.

Das Aufnahmegehäuse besteht gemäß einer Ausführungsform eines erfindungsgemäßen Mehrfachsteckers aus zwei übereinander angeordneten Gehäuseschalen, zwischen denen die Doppeleinheiten nebeneinander aufgereiht sind, wobei die Doppeleinheiten sowie die Aufnahmegehäuse in ein Mehrfachsteckergehäuse gesteckt und darin schwimmend gehaltert sind, welches eine Mehrzahl von aneinandergereihten und miteinander verbundenen Doppelsteckergehäusen umfaßt.

Der erfindungsgemäße Stecker ist Teil eines Stecker-Kupplung-Systems, wobei beim Einstecken des Steckers in die Kupplung das Kerngehäuse mit seinem vorderen Ende aufgrund einer gegenseitiger Verrastung in der Kupplung verrastet.

Die gegenseitige Verrastung von Kerngehäuse und Kupplung bezüglich des Kerngehäuses kann eine Quernut umfassen, welche in der Schmalseite des Kerngehäuses verläuft, wobei die Kupplung ein Außenkupplungsgehäuse und ein Innenkupplungsgehäuse umfaßt, welches eine im wesentlichen quaderförmigen Platte aufweist, auf der sich zwei Arme senkrecht erheben, an deren Enden Rastnasen angeordnet sind, welche beim Einschieben des Kerngehäuses zwischen die beiden Arme des Innenkupplungsgehäuses in den Quernuten verrasten.

Das Innenkupplungsgehäuse kann ferner zwei innere Führungszylinder aufweisen, welche an den Stirnflächen offen sind und zur Aufnahme und Führung der in die Kupplung ragenden Endbereich der Ferrule dienen.

Erfindungsgemäß kann der Stecker mit einer Abzugssicherung gegen ungewolltes Abziehen des Steckers von der Kupplung versehen sein, wobei die Abzugssicherung aktivierbar und deaktivierbar ist. Hierzu umfaßt der Stecker mindestens eine durch je ein Kerngehäuse und ein Kerninnengehäuse gebildete Doppeleinheit und ist bei gegenseitiger Verrastung von Kerngehäuse und Kupplung das Steckergehäuse in Längsrichtung des Steckers gegenüber dem Kerngehäuse und der Kupplung zum Zweck der Aktivierung der Abzugssicherung in eine erste Stellung und zum Zweck der Deaktivierung der Abzugssicherung in eine zweite Stellung verschiebbar, wobei in der ersten Stellung, aktivierte Abzugssicherung, ein Teil der Wandung des Steckergehäuses im Bereich der Rastnasen so angeordnet ist, daß keine Auslenkbarkeit der Rastnasen der Arme aus den Quernuten heraus besteht, so daß die mechanische Verbindung zwischen Stecker und Kupplung durch Zug am Lichtleiter oder am Aufnahmegehäuse nicht lösbar ist. Ein Abziehen des Doppel- bzw. Mehrfachsteckers von der Kupplung ist somit erfindungsgemäß nicht möglich.

In der zweiten Stellung hingegen, deaktivierte Abzugssicherung, ist kein Teil der Wandung des Steckergehäuses im Bereich der Rastnasen angeordnet, so daß eine Auslenkbarkeit der Rastnasen der Arme aus den Quernuten heraus gegeben ist und die mechanische Verbindung zwischen Stecker und Kupplung durch Zug am Lichtleiter oder am Aufnahmegehäuse lösbar ist. Ein Abziehen des Doppel- bzw. Mehrfachsteckers von der Kupplung ist somit möglich.

Gemäß einer bevorzugten Ausführungsform ist in der zweiten Stellung des Steckergehäuses die Auslenkbarkeit der Rastnasen aus den Quernuten dadurch gegeben, daß die Arme mit ihren von der Kupplung abgewandten Endbereichen in Aussparungen der Wandung des Steckergehäuses einzugreifen imstande sind.

Nur der erfindungsgemäße Aufbau ermöglicht eine Miniaturierung des Steckers zum Zwecke der Übertragung optischer Information.

Mit der Erfindung wird in vorteilhafter Weise der Aufbau eines Doppelsteckers oder eines Mehrfach-Doppelsteckers ermöglicht, bei welchen die entscheidenden Vorteile des Einzelferruls erhalten bleiben und insbesondere die Möglichkeit der

apc-Kontaktierung zweier sich in einer Kupplung gegenüberliegende Ferrule gegeben ist. Ein weiterer Vorteil der Erfindung besteht darin, dass der Stecker eine hohe Packungsdichte ermöglicht, was aufgrund der erfindungsgemäßen Doppeleinheiten möglich ist. Ebenso weist der Stecker eine zuverlässige Abzugssicherung auf, so dass er nicht versehentlich durch Zug am Lichtleitkabel abgezogen werden kann.

Kurzbezeichnung der Zeichnung, in der zeigen:

Figur 1a,b, c schematische Schnittansichten des erfindungsgemäßen Steckers zur Darstellung der unterschiedlichen relativen Positionen der einzelnen Teile beim Einschieben des Steckers in eine Kupplung zur Darstellung der Funktionsweise einer erfindungsgemäßen abzugssicheren Verrastung,

Figur 2 eine perspektivische Explosionsdarstellung eines Doppelsteckers zur Darstellung sämtlicher Einzelteile,

Figur 3 einen Querschnitt durch zwei aneinandergefügte Kupplungen zur Aufnahme zweier gegenseitig eingesteckter Stecker,

Figur 4 eine Draufsicht auf Figur 3 von oben,

Figur 5 eine perspektivische Ansicht der Figur 3,

Figur 6 eine perspektivische Ansicht einer Einzelkupplung gemäß der Figur 5,

Figur 7 eine perspektivische Ansicht eines Innenkupplungsgehäuses innerhalb des Außenkupplungsgehäuses gemäß Figur 6,

Figur 8 einen Längsschnitt durch einen Stecker mitsamt zwei Kupplungen,

Figur 9 einen Längsschnitt durch zwei Stecker, welche in zwei Kupplungen gegenseitig gesteckt sind,

Figur 10 eine perspektivische Explosionsdarstellung eines Mehrfachsteckergehäuses, nämlich achtfach, zur Darstellung der Einzelteile,

Figur 11 eine Draufsicht auf eine Gehäuseschale des hinteren Aufnahmegehäuses,

Figur 12 eine Ansicht der Stirnseite der Figur 11,

Figur 13 eine Draufsicht auf ein Mehrfachsteckergehäuse,

Figur 14	eine seitliche Draufsicht auf Figur 14,
Figur 15	einen Schnitt längs der Linie C-C von Figur 13,
Figur 16	einen Schnitt längs der Linie A-A von Figur 14,
Figur 17	einen Schnitt längs der Linie B-B von Figur 14,
Figur 18	eine Seitenansicht des Mehrfachsteckergehäuses der Figur 19,
Figur 19	eine perspektivische Ansicht von Figur 13,
Figur 20	eine Draufsicht auf eine zugehörige Mehrfachkupplung,
Figur 21	einen Schnitt längs der Linie A-A von Figur 20,
Figur 22	einen Schnitt längs der Linie A-A des Teils 2 von Figur 2,
Figur 23	eine perspektivische Explosionsdarstellung einer weiteren Ausführungdsform eines Doppelsteckers zur Darstellung sämtlicher Einzelteile,
Figur 24	eine perspektivische Darstellung einer Halbschale gemäß einer weiteren Ausführungsform eines Aufnahmegehäuses,
Figur 25a,b,c,d	verschiedene Darstellungen einer Halbschale gemäß einer weiteren Ausführungsform eines Aufnahmegehäuses,
Figur 25e	eine perspektivische Darstellung der zu der Halbschale von Fig. 25a-d gehörenden anderen Halbschale,
Figur 26	eine perspektivische Darstellung einer weiteren Ausführungsform eines Außenkupplungsgehäuses,
Figur 27a,b,c	schematische Schnittansichten des von Fig. 23 Steckers zur Darstellung der unterschiedlichen relativen Positionen der einzelnen Teile beim Einschieben des Steckers in die Kupplung von Fig. 26 zur Darstellung der Funktionsweise einer erfindungsgemäßen abzugssicheren Verrastung
Figur 28	eine perspektivische Explosionsdarstellung einer weiteren Ausführungsform eines Mehrfach-Steckers,
Figur 29	eine Draufsicht auf eine Halbschale des Steckers von Fig. 28,
Figur 30	eine perspektivische Darstellung zu dem Stecker von Fig. 28 passenden Mehrfach-Kupplung,
Figur 31	eine perspektivische Darstellung des Steckers von Fig. 28, welcher mit der Kupplung von Fig. 30 verbunden ist, und

Figur 32 eine Querschnittsdarstellung des Steckers von Fig. 28 und der Kupllung von Fig. 30 zur Darstellung der Funktionsweise einer erfindungsgemäßen abzugssicheren Verrastung.

Wege zur Ausführung der Erfindung:

Die Fig. 1a, b, c zeigen schematisch den Vorgang des Einführens eines erfindungsgemäßen Doppelsteckers 1 in ein Außenkupplungsgehäuse 31. Der Doppelstecker 1 umfaßt das Aufnahmegehäuse 5, ein Kerninnengehäuse 4, ein Kerngehäuse 3 und ein im Querschnitt dargestelltes Steckergehäuse 2. Das Aufnahmegehäuse 5, das Kerninnengehäuse 4 und das Kerngehäuse 3 sind in Fig. 1 zusammengefügt wie unter Bezug auf Fig. 2-9 noch erläutert wird, so daß lediglich die Quaderplatte 17 des Kerninnengehäuses 4 sichtbar ist, da der Rest desselben im Aufnahmegehäuse 5 bzw. im Kerngehäuse 3 aufgenommen ist. Das Steckergehäuse 2 ist über die Doppeleinheit 3-4 geschoben. In Fig. 1a ist der Doppelstecker 1 erst teilweise in das Außenkupplungsgehäuse 31 eingeschoben. Eine Verrastung des Doppelsteckers mit der Kupplung ist noch nicht gegeben. In Fig. 1b ist die aus der Doppeleinheit 3-4 und dem Aufnahmegehäuse 5 bestehende Baugruppe vollständig in die Kupplung eingeführt. Das Kerngehäuse 3 ist mittels der Quernuten 30 und der Rastnasen 38 mit dem Innenkupplungsgehäuse 32 verrastet. Diese Verrastung kann jedoch durch Zug am hinteren Aufnahmegehäuse oder am Lichtleiterbündel 6 (in Fig. 1 nicht gezeigt) mit geringer Kraft wieder gelöst werden, da die Rastnasen 38 unter Biegung der Arme 37 sehr leicht seitlich nach außen in die Aussparungen 84 und damit aus den Quernuten 30 heraus ausgelenkt werden können.

Nun wird das Steckergehäuse 2 in Richtung der Kupplung geschoben, bis es seinerseits mittels Rastnasen 28 und Rastfenstern 35 mit dem Außenkupplungsgehäuse 31 verrastet (Fig. 1c). Die Aussparungen 84 sind gegenüber Fig. 1b in Richtung der Kupplung verschoben und befinden sich nicht mehr im Bereich der Rastnasen 38. Die Verrastung zwischen Kerngehäuse 3 und Innenkupplungsgehäuse 32 kann nun nicht mehr durch Zug am Aufnahmegehäuse 5 oder am Lichtleiterbündel 6 (in Fig. 1 nicht gezeigt) gelöst werden, da die Rastnasen 38 nicht mehr seitlich aus den Quernuten 30 heraus ausgelenkt werden können. Die Verrastung zwischen Kerngehäuse 3 und

Innenkupplungsgehäuse 32 ist in der in Fig. 1c gezeigten Stellung des Steckergehäuses 2 nicht lösbar und fungiert somit als Abzugssicherung. Stecker und Kupplung sind fest miteinander verriegelt. Eine Deaktivierung der Abzugssicherung und damit eine Entriegelung sind nur möglich, indem das Steckergehäuse 2 in Richtung des Lichtleiterbündels 6 zurückverschoben wird, also in die in Fig. 1b gezeigte Stellung. Hierzu wird zunächst Druck auf die Laschen 13 ausgeübt, wodurch die Rastnasen 28 aus den Rastfenstern 35 ausgelenkt werden, und anschließend das Steckergehäuse 2 in Richtung des Lichtleiterbündels 6 bewegt. Nun kann der Stecker 1 unter seitlicher Auslenkung der Rastnasen 38 wieder mit geringem Kraftaufwand von der Kupplung gelöst werden.

Gemäß den Figuren 2 bis 9 ist dort ein Doppelstecker dargestellt, welcher als wesentliche Teile aus einem Steckergehäuse 2, einem Kerngehäuse 3, einem Kerninnengehäuse 4 sowie einem Aufnahmegehäuse 5 besteht, in welches ein Lichtleiterbündel 6 eingeführt ist und welches auf das Kerninnengehäuse 4 folgt. Das Kerngehäuse 3 ist als Gehäusequader ausgeführt mit zwei sich gegenüberliegenden Breitseiten 26 und dazwischen angeordneten Schmalseiten 42 sowie einer nach vorn weisenden Stirnfläche 57, in der zwei übereinander angeordnete Durchgangslöcher 15, 15' angeordnet sind. Das Kerninnengehäuse 4 umfaßt eine Quaderplatte 17, welche auf ihrer vorderen Breitseite 23 einen Doppelzylinder 16 in Richtung der Längsachse des Steckers 1 trägt, wobei der Doppelzylinder 16 zwei Durchgangslöcher 18, 18' besitzt. Auf der gegenüberliegenden abgewandten Breitseite der Quaderplatte 17 ragen senkrecht zur derselben zwei beabstandete Führungszungen 19, 19' auf, welche auf ihren Außenseiten je einen quer verlaufenden Steg 25 sowie Rastnasen 21 aufweisen. Kerngehäuse 3 und Kerninnengehäuse 4 bilden eine sogenannte Doppeleinheit zur Aufnahme von zwei Ferrulen 9, 10, welche innerhalb dieser Doppeleinheit mittels Druckfedern 12 federbelastet gehaltert sind, wie es im Einzelnen in den Figuren 8 und 9 gezeigt ist.

Das Kerngehäuse 3 wie auch das Kerninnengehäuse 4 sind zur Aufnahme der beiden Ferrule 9, 10 ausgestaltet, wobei die Ferrule im Kerngehäuse 3 gehaltert sind, was insbesondere aus den Figuren 8 und 9 hervorgeht und die vorderen

Enden der Ferrule 9, 10 die Stirnfläche 57 des Kerngehäuses nach vorn durchragen. Die hinteren Enden der Ferrule 9, 10 ragen in das Kerninnengehäuse 4, was ebenfalls aus Figur 8 zu entnehmen ist. Kerngehäuse 3 und Kerninnengehäuse 4 sind relativ wenigstens teilweise ineinandergesteckt und bilden dadurch die Doppeleinheit 3-4, wobei im gezeigten Beispiel das Kerninnengehäuse 4 mit seinem vorderen Teil in den Aufnahmeraum des Kerngehäuses 3 gesteckt ist. Mit dem Zusammenfügen von Kerngehäuse 3 und Kerninnengehäuse 4 steht das Kerngehäuse 3 auf der Breitseite 23 der vorderen Quaderplatte 17 des Kerninnengehäuses 4 auf, wie es aus Figur 8 hervorgeht. Der Doppelzylinder 16 auf der Quaderplatte 17 weist eine Rastnase 60 auf, welche beim Aufschieben des Kerngehäuses 3 oder Gehäusequaders auf den Doppelzylinder 16 in ein Rastfenster 27 innerhalb der Breitseite 26 des Kerngehäuses 3 bzw. des Gehäusequaders 3 einrastet.

Zur exakten Halterung der Ferrule 9, 10 besitzen diese in bekannter Weise eine fest angeordnete Drehsicherung 11, welche eine Mehrzahl von Schlüsselflächen trägt, aufgrund derselben die Ferrule in einer entsprechenden Winkelteilung entsprechend der Anzahl der Schlüsselflächen innerhalb des Kerngehäuses zu diesem positioniert werden kann. Die Ferrule 9, 10 sind dabei von hinten in das Kerngehäuse 3 eingesetzt und in entsprechend geformten Sitzen innerhalb des Kerngehäuses nebeneinander angeordnet und in axialer Richtung beweglich gehaltert, wobei je eine Druckfeder 12 von hinten auf die Ferrule 9, 10 aufgeschoben ist und mit ihrem vorderen Ende an der Drehsicherung 11 angreift.

Das hintere Ende der Druckfeder 12 stützt sich gegen einen inneren Absatz des Kerninnengehäuses 4 ab, wobei dieser innen umlaufende Absatz im Bereich der Quaderplatte 17 liegt, wie es aus Figur 8 zu entnehmen ist. Auf diese Weise können sich die Ferrule 9, 10 entgegen der Federkraft der Federn 12 etwas in axialer Richtung bewegen. Die hinteren Enden der Ferrule 9, 10 sind durch entsprechende Durchgangslöcher innerhalb der Quaderplatte 17 geführt und erstrecken sich längs zwischen den Führungszungen 19, 19', wie es ebenfalls aus der Figur 8 am besten hervorgeht.

Die Doppeleinheit 3-4 aus Kerngehäuse 3 und Kerninnengehäuse 4 ist in ein Aufnahmevolumen 20 eines hinteren Aufnahmegehäuses 5 gesteckt, welches ebenfalls im Wesentlichen als Gehäusequader gestaltet ist; in dieses Aufnahmegehäuse 5 ist von hinten ein Lichtleiterbündel 6 eingeführt. Das Lichtleiterbündel 6 weist mindestens zwei Lichtleiterfasern 7, 8 auf, wobei die Lichtleiterfasern 7, 8 durch die Ferrule 9, 10 an die Spitze derselben geführt sind.

Zum Zusammenbau von Kerngehäuse 3, Kerninnengehäuse 4 und Aufnahmegehäuse 5 wird nach der Montage der Lichtleiterfasern 7, 8 innerhalb der Ferrule 9, 10 die Doppeleinheit 3-4 mit den darin angeordneten Ferrulen 9, 10 in das Aufnahmevolumen 20 des Aufnahmegehäuses 5 gesteckt. Das Aufnahmegehäuse 5 weist innen in den Schmalseiten 63 Führungsnuten 24 auf, in denen beim Einschieben der Führungszungen 19, 19' die Rastnasen 21 sowie die quer verlaufenden Stege 25 entlanggleiten, wobei in der Endstellung die Rastnasen 21 innerhalb von in den Schmalseiten 63 des Aufnahmegehäuses 5 befindliche Rastfenster 22 einrasten. Dann sitzt der äußere, stirnseitige Rand des Aufnahmegehäuses bzw. Gehäusequaders auf der hinteren Breitseite der Quaderplatte 17 auf, wie es der Figur 8 zu entnehmen ist.

Die Doppeleinheit 3-4 zusammen mit dem Aufnahmegehäuse 5 werden in ein Steckergehäuse 2 eingeführt, welches ebenfalls im Wesentlichen als Gehäusequader ausgeführt ist mit zwei sich gegenüberliegenden großen Gehäuseflächen und zwei dazwischen angeordneten Schmalseiten; das Steckergehäuse 2 ist an seinen beiden Stirnseiten offen. Das Kerngehäuse 3, das Kerninnengehäuse 4 und das Aufnahmegehäuse 5 sind im Steckergehäuse 2 schwimmend gehaltert.

Beim Einstecken des Steckers 1 in eine Kupplung verrastet das Kerngehäuse 3 mit seinem vorderen Ende aufgrund einer gegenseitigen Verrastung innerhalb der Kupplung, was insbesondere in den Figuren 3 bis 9 dargestellt ist. Eine einzelne Kupplung besteht aus einem Außenkupplungsgehäuse 31, 31', in welches ein Innenkupplungsgehäuse 32, 32' eingesetzt ist. Beide Teile, nämlich Außenkupplungsgehäuse 31, 31' wie Innenkupplungsgehäuse 32, 32', sind vorzugsweise doppelt vorhanden, wie es den Figuren 3, 5 und 9 zu entnehmen ist, wenn mittels zweier identischer Stecker 1 eine Fortführung einer Licht-

wellenleiterverbindung geschaffen werden soll. In das Aufnahmevolumen 33 des Außenkupplungsgehäuses 31, 31' kann das Steckergehäuse 2 eingeschoben werden, wozu die Innenkontur des Aufnahmevolumens 33 des Außenkupplungsgehäuses 31, 31' und die Außenkontur des Steckergehäuses 2 entsprechend geformt sind.

Innerhalb eines jeden Außenkupplungsgehäuses 31, 31' ist ein Innenkupplungsgehäuse 32, 32' angeordnet, welches gemäß der Figur 7 aus einer Platte 36 besteht, auf der mittig ein länglich-ovales Aufnahmeteil 39 mit zwei Durchgangslöchern 40 angeordnet ist, wobei die Platte 36 mit den Durchgangslöchern 40 fluchtende Löcher aufweist. Des Weiteren erheben sich auf der Platte 36 zwei sich im Abstand gegenüberstehende Arme 37, 37', zwischen denen sich das Aufnahmeteil 39 befindet, wobei die Arme 37, 37' an ihren freien Enden Rastnasen 38 aufweisen. Wie es aus der Figur 8 zu entnehmen ist, greifen diese Rastnasen 38 beim Vorschieben des Steckers 1 in das Außenkupplungsgehäuse 31, 31' in die innerhalb der Schmalseiten 42 des Kerngehäuses 3 quer verlaufende Quernuten 30 ein und verrasten darin. Auf diese Weise wird die Doppeleinheit 3-4 sicher innerhalb des Innenkupplungsgehäuses 32, 32' gehaltert.

Eine weitere bevorzugte Ausführungsform eines Steckers 56 ist in den Figuren 10 bis 21 dargestellt, welche einen Mehrfach-Doppelstecker 56 mit einem achtfachen Mehrfachsteckergehäuse zeigen. Im Wesentlichen setzt sich ein Mehrfach-Doppelstecker aus einer Mehrzahl von Doppelsteckern zusammen, wobei jeweils die Doppeleinheit 3-4 aus Kerngehäuse 3 und Kerninnengehäuse 4 vorhanden und gleich ausgeführt sind. Damit sind zum Aufbau eines Mehrfach-Doppelsteckers 56 die Doppeleinheit 3-4 aus Kerngehäuse 3 und Kerninnengehäuse 4 in identischer Weise mehrfach vorhanden, wobei die Doppeleinheiten 3-4 in einem Aufnahmegehäuse, umfassend eine untere Gehäuseschale 44 und eine (nicht gezeigte) obere Gehäuseschale, nebeneinander angeordnet sind. Das Aufnahmegehäuse, in welches von hinten das Lichtleiterbündel 6 eingeführt ist, kann vorzugsweise gegenüber dem Aufnahmegehäuse 5 des Doppelsteckers 1 modifiziert ausgeführt sein.

Vorzugsweise sind zum Aufbau eines Mehrfach-Doppelsteckers die Doppelstecker n-mal vorhanden. Allerdings sind ebenso Ausführungen möglich und für Sonderanwendungen sinnvoll, in denen beispielsweise drei Einzelferrule in einem Dreier-Kerngehäuse sowie einem Dreier-Kerninnengehäuse angeordnet sind, wobei die Ferrule nebeneinander oder übereinander angeordnet sein können.

Bei dem beispielhaft gezeigten Mehrfach-Doppelstecker 56 besteht das Aufnahmegehäuse aus zwei übereinander angeordneten Gehäuseschalen, von denen nur die untere dargestellt ist und zwischen denen die Doppeleinheiten 3-4, wie sie für die Ausführung des Doppelsteckers 1 beschrieben sind, nebeneinander aufgereiht sind. Die Kerninnengehäuse 4 in den beiden Gehäuseschalen 44 können mittels einer Verrastung 21, 48, 49 (Fig. 11) miteinander verrasten. Die Doppeleinheiten 3-4 sowie die Aufnahmegehäuse 5 sind in ein Mehrfachsteckergehäuse 43 gesteckt und darin schwimmend gehaltert, wobei das Mehrfachsteckergehäuse 43 eine Mehrzahl von aneinandergereihten und miteinander verbundenen Doppelsteckergehäusen 58, 59 umfasst. Die innen liegenden Doppelsteckergehäuse 59 sind identisch ausgeführt, die jeweiligen randseitigen Doppelsteckergehäuse 58 sind zueinander sysmmterisch ausgeführt.

Die Figuren 11 und 12 zeigen eine Draufsicht auf die untere Gehäuseschale 44 des Aufnahmegehäuses sowie eine Ansicht der Stirnseite der unteren Gehäuseschale 44 eines Mehrfach-Doppelsteckers 56. In der inneren Hauptseite 50 einer jeden Gehäuseschale 44 sind voneinander beabstandete Aufnahmenuten 47 ausgebildet, welche auf ihren Bodenflächen Rastfenster 48 und 49 aufweisen. Die Aufnahmenuten 47 dienen zur Aufnahme je einer Doppeleinheit 3-4, wobei der Steg 25 (Figur 2) im Rastfenster 49 und die Rastnase 21 im Rastfenster 48 einrasten. Die untere Gehäuseschale 44 weist an ihrem hinteren, sich verjüngenden Ende, in welches das Lichtleiterbündel 6 eingeführt ist, Verrastungsmittel für die (nicht gezeigte) obere Gehäuseschale auf, welche beispielsweise aus je einer Führungszunge 45 mit einer daran angeordneten Rastnase 46 bestehen.

Die Figuren 13 bis 19 zeigen in verschiedenen Darstellungen und Schnitten das Mehrfachsteckergehäuse 43 eines Mehrfach-Doppelsteckers 56. Die einzelnen Doppelsteckergehäuse 58 und 59 sind an ihren vorderen, der Kupplung zugewandten Ende voneinander beabstandet und an ihren hinteren, der Kupplung abgewandten Ende zusammengefaßt, was aus den Figuren 10 und 19 ersichtlich ist.

In der Figur 20 ist eine Draufsicht, in der Figur 21 ein Schnitt längs der Linie A-A von Figur 20 einer Mehrfachkupplung gezeigt, welche einem Mehrfach-Doppelsteckers 56 zugeordnet ist. Eine derartige Mehrfachkupplung besteht wiederum aus einem Außenkupplungsgehäuse 51, welches eine Mehrzahl von Aufnahmeteilen 52 entsprechend einem Außenkupplungsgehäuse für einen Doppelstecker umfaßt. Diese Mehrzahl von Aufnahmeteilen 52 ist zu einem Block zusammengefaßt, der ein integriertes Außenkupplungsgehäuse 51 ausbildet. In jedem einzelnen Aufnahmeteil 52 des Außenkupplungsgehäuses 51 ist ein Innenkupplungsgehäuse 32, 32' entsprechend der Figur 7 angeordnet. Man erkennt aus Figur 20, ebenso wie aus den Figuren 3 und 6, dass die Innenwandung des Außenkupplungsgehäuses 31 bzw. des einzelnen Aufnahmeteils 52 in der Breitseite eine Führungsnut 55, 64 aufweist. In diese jeweilige Führungsnut 55, 64 gleitet beim Einführen des Steckergehäuses 2 bzw. des Mehrfachsteckergehäuses 43 in das zugehörige Außenkupplungsgehäuse 31, 31' bzw. 51 ein erhöhter Längssteg 53 bzw. 62 zur Führung innerhalb der Kupplung hinein, wobei der Längssteg 53 bzw. 62 auf wenigstens einer der äußeren Breitseiten des Steckergehäuses 2 bzw. des Mehrfachsteckergehäuses 43 ausgebildet ist.

In Figur 23 ist in Form einer Explosionszeichnung ein andere Ausführungsform 101 eines erfindungsgemäßen Doppelsteckers dargestellt, welcher als wesentliche Teile aus einem Steckergehäuse 102, einem Kerngehäuse 103, einem Kerninnengehäuse 104 sowie einem zweiteiligen Aufnahmegehäuse 105a, 105b besteht, in welches mit Hilfe eines Crimpanchlusses 106a, einer Crimphülse 106b und eines Knickschutzes 106c ein Lichtleiterbündel 106d eingeführt ist und welches auf das Kerninnengehäuse 104 folgt. Das Kerngehäuse 103 ist als Gehäusequader ausgeführt mit zwei sich gegen-

überliegenden Breitseiten 126 und dazwischen angeordneten Schmalseiten 142 mit Federschlitzen 142a sowie einer nach vorn weisenden Stirnfläche 157, in der zwei übereinander angeordnete Durchgangslöcher 115, 115' angeordnet sind.

Das Kerninnengehäuse 104 umfaßt eine vordere Quaderplatte 117a, welche auf ihrer vorderen Breitseite 123 einen Doppelzylinder 116 in Richtung der Längsachse des Steckers 101 trägt, wobei der Doppelzylinder 116 zwei Durchgangslöcher 118, 118' besitzt. Das Kerninnengehäuse 104 umfaßt ferner eine hintere Quaderplatte 117b. Diese ist parallel zur vorderen Quaderplatte 117a angeordnet und befindet sich in einem Abstand zu der hinteren Breitseite der vorderen Quaderplatte 117a und mit derselben durch einen ebenfalls quaderförmigen Verbindungssteg 117c verbunden, dessen Längsausdehnung dem Abstand zwischen der hinteren Breitseite der vorderen Quaderplatte 117a und der Vorderseite der hinteren Quaderplatte 117b entspricht und dessen seitliche bzw. vertikale Ausdehnung jeweils geringer ist als seitliche bzw. vertikale Ausdehnung der vorderen und der hinteren Quaderplatte 117a, 117b.

Kerngehäuse 103 und Kerninnengehäuse 104 bilden eine sogenannte Doppeleinheit 103-104 zur Aufnahme von zwei Ferrulen 9, 10, welche innerhalb dieser Doppeleinheit mittels Druckfedern 12 federbelastet gehaltert sind.

Das Kerngehäuse 103 wie auch das Kerninnengehäuse 104 sind zur Aufnahme der beiden Ferrule 9, 10 ausgestaltet, wobei die Ferrule im Kerngehäuse 103 gehaltert sind und die vorderen Enden der Ferrule 9, 10 die Stirnfläche 157 des Kerngehäuses 103 nach vorn durchragen. Die hinteren Enden der Ferrule 9, 10 ragen in das Kerninnengehäuse 104. Kerngehäuse 103 und Kerninnengehäuse 104 sind relativ wenigstens teilweise ineinandergesteckt und bilden dadurch die Doppeleinheit 103-104. Mit dem Zusammenfügen von Kerngehäuse 103 und Kerninnengehäuse 104 steht das Kerngehäuse 103 auf der vorderen Breitseite 123 der vorderen Quaderplatte 117a des Kerninnengehäuses 104 auf. Seitlich an dem Doppelzylinder 116 sind einander gegenüberliegend Rastnasen 160 angeordnet, welche welche beim Aufschieben des Kerngehäuses 103 auf den Doppelzylinder 116 in entsprechende Rastfenster 127 des Kerngehäuses 103 einzurasten imstande sind.

Die Ferrule 9, 10 weisen Drehsicherungen 11 auf und sind von hinten in das Kerngehäuse 103 eingesetzt und in entsprechend geformten Sitzen innerhalb des Kerngehäuses 103 nebeneinander angeordnet und in axialer Richtung beweglich gehaltert, wobei je eine Druckfeder 12 von hinten auf die Ferrule 9, 10 aufgeschoben ist und mit ihrem vorderen Ende an der Drehsicherung 11 angreift. Das hintere Ende der Druckfeder 12 stützt sich gegen einen inneren Absatz des Kerninnengehäuses 104 ab. Auf diese Weise können sich die Ferrule 9, 10 entgegen der Federkraft der Federn 12 etwas in axialer Richtung bewegen. Die hinteren Enden der Ferrule 9, 10 sind durch entsprechende Durchgangslöcher innerhalb der vorderen Quaderplatte 117a geführt. Das Lichtleiterbündel 6a weist mindestens zwei Lichtleiterfasern 7, 8 auf, wobei die Lichtleiterfasern 7, 8 durch die Ferrule 9, 10 an die Spitze derselben geführt sind.

Das Aufnahmegehäuse 105a, 105b umfaßt zwei Teile, nämlich eine linke Halbschale 105a und eine rechte Halbschale 105b, welche mittels Rastnasen 166, 167 und Rastfenstern 168 in einander gegenüberliegender miteinander verrastbar sind, wobei zwischen den Halbschalen 105a, 105b ein Hohlraum vorhanden ist.

Form und Position der Rastnasen 166, 167 und der Rastlöcher 168 sind vorteilhafterweise so gewählt, daß beide Halbschalen 105a, 105b keine Unterschiede aufzuweisen brauchen, sondern identisch ausgeführt sein können und dennoch miteinander verrastbar sind. Beide Halbschalen 105a, 105b sind so geformt, daß der hintere Bereich des Hohlraumes des Aufnahmegehäuses 105a, 105b bei miteinander verrasteten Halbschalen 105a, 105b einen zur Einführung eines Lichtleiterbündels 6a dienenden Crimpanschluß 106a mit Crimphülse 106b und Knickschutz 106c aufzunehmen und formschlüssig zu verankern imstande ist.

An seiner Vorderseite weist das Aufnahmegehäuse 105a, 105b bei miteinander verrasteten Halbschalen 105a, 105b ein offenes Frontfenster 169 auf. Die Hauptflächen der beiden Halbschalen 105a, 105b sowie deren obere und untere Begrenzungsflächen weisen an ihren Innenseiten im Bereich des Frontfensters jeweils eine Vertiefung 165 auf (Fig. 24), wobei diese Vertiefungen 165 bei

miteinander verrasteten Halbschalen 105a, 105b in der Innenwandung des Aufnahmegehäuses 105a, 105b eine senkrecht zur Längsrichtung des Doppelsteckers 101 vollständig umlaufende Rinne bilden. Die Rinne ist so geformt, daß sie zur formschlüssigen Aufnahme der hinteren Quaderplatte 117b imstande ist. Das Kerninnengehäuse 104 ist somit in dem Aufnahmegehäuse 105a, 105b formschlüssig verankerbar, indem bei voneinander getrennten Halbschalen 105a, 105b die hintere Quaderplatte 117b zunächst ein die Vertiefungen 165 einer der Halbschalen 105a, 105b eingelegt und anschließen letztere mit der anderen Halbschale verrastet wird.

Die Doppeleinheit 103-104 zusammen mit dem Aufnahmegehäuse 105a, 105b werden in ein Steckergehäuse 102 eingeführt, welches im Wesentlichen als Gehäusequader ausgeführt ist mit zwei sich gegenüberliegenden großen Gehäuseflächen und zwei dazwischen angeordneten Schmalseiten; das Steckergehäuse 102 ist an seinen beiden Stirnseiten offen. Seine beiden Schmalseite weisen im Bereich der vorderen Enden Aussparungen 184 auf. Das Kerngehäuse 103, das Kerninnengehäuse 104 und das Aufnahmegehäuse 105a, 105b sind im Steckergehäuse 102 schwimmend gehaltert.

Fig. 25 zeigt eine andere Ausführungsfom eines zweiteiligen Aufnahmegehäuses 105c, 105d, welches bereits von vornherein ein Kerninnengehäuse 104a umfaßt und anstelle des Aufnahmegehäuses 105a, 105b und des Kerninnengehäuses 104 von Fig. 23 verwendbar ist. Das Aufnahmegehäuse 105c, 105d umfaßt zwei Halbschalen 105c, 105d, wobei die eine Halbschale 105c fest mit dem Kerninnengehäuse 104a verbunden ist; die Halbschale 105c und das Kerninnengehäuse 104a sind dabei bevorzugterweise ein einziges monolithisches Formteil und können daher vorteilhafterweise in einem einzigen Produktionsvorgang, z.B. Spritzen oder Pressen, hergestellt werden. Fig. 25a zeigt eine Frontansicht der Halbschale 105c mit dem Kerninnengehäuse 104a aus Richtung der Kupplung, Fig. 25b die entsprechende Ansicht aus der entgegengeszten Richtung. Fig. 25c eine Draufsicht auf die Außenseite der Halbschale 105c und Fig. 25d eine Seitenansicht derselben, wobei jeweils von links das nicht gezeigte Lichtleiterbündel 6a einzuführen ist und das Kerninnengehäuse 104a die

Halbschale 105c nach rechts in Richtung der Kupplung überragt. Fig. 25e zeigt die zugehörige andere Halbschale 105d in perspektivischer Darstellung.

Beim Einstecken des Steckers 1 in eine Kupplung verrastet das Kerngehäuse 103 mit seinem vorderen Ende aufgrund einer gegenseitigen Verrastung innerhalb der Kupplung. Eine einzelne Kupplung besteht aus einem Außenkupplungsgehäuse 131 (Fig. 26), in welches ein Innenkupplungsgehäuse 132 eingesetzt ist. Beide Teile, nämlich Außenkupplungsgehäuse 131 wie Innenkupplungsgehäuse 132 sind vorzugsweise doppelt vorhanden, wenn mittels zweier identischer Stecker 101 eine Fortführung einer Lichtwellenleiterverbindung geschaffen werden soll. In das Aufnahmevolumen 133 des Außenkupplungsgehäuses 131 kann das Steckergehäuse 102 eingeschoben werden, wozu die Innenkontur des Aufnahmevolumens 133 des Außenkupplungsgehäuses 131 und die Außenkontur des Steckergehäuses 102 entsprechend geformt sind. Das Außenkupplungsgehäuse 131 weist ferner eine Führungsnut 154 zur Aufnahme des Längssteges 153 und damit zur Führung des Steckergehäuses 102 (Fig. 23) auf.

Die Fig. 27a,b,c zeigen schematisch den Vorgang des Ankuppelns eines erfindungsgemäßen Doppelsteckers 101 in ein Außenkupplungsgehäuse 131. Der Doppelstecker 101 umfaßt das Aufnahmegehäuse 105a, 105b, wobei in Fig. 27 nur die Halbschale 105a sichtbar, die andere Halbschale 105b hingegen verdeckt ist, sowie ein Kerninnengehäuse 104, ein Kerngehäuse 103 und ein im Querschnitt dargestelltes Steckergehäuse 102. Das Aufnahmegehäuse 105a, 105b, das Kerninnengehäuse 104 und das Kerngehäuse 103 sind in Fig. 27 zusammengefügt wie unter Bezug auf Fig. 24 erläutert wurde, so daß lediglich die vordere Quaderplatte 117a des Kerninnengehäuses sichtbar ist, da der Rest desselben im Aufnahmegehäuse 105a, 105b bzw. im Kerngehäuse 103 aufgenommen ist. Das Steckergehäuse 102 ist über die Doppeleinheit 103-104 geschoben. In Fig. 26a ist der Doppelstecker 101 erst teilweise in das Außenkupplungsgehäuse 131 eingeschoben. Eine Verrastung des Doppelsteckers mit der Kupplung ist noch nicht gegeben.

In Fig. 27b ist die aus der Doppeleinheit 103-104 und dem Aufnahmegehäuse bestehende Baugruppe vollständig in die Kupplung eingeführt. Das Kerngehäuse 103 ist mittels der Quernuten 130 und der an Armen 137 angeordneten Rastnasen 138 mit dem Innenkupplungsgehäuse 132 verrastet. Diese Verrastung kann jedoch durch Zug am hinteren Aufnahmegehäuse oder am Lichtleiterbündel 6a (in Fig. 27 nicht gezeigt) mit geringer Kraft wieder gelöst werden, da die Rastnasen 138 unter Biegung der Arme 137 sehr leicht seitlich nach außen in die Aussparungen 184 und damit aus den Quernuten 130 heraus ausgelenkt werden können.

Nun wird das Steckergehäuse 102 in Richtung der Kupplung geschoben, bis es seinerseits mittels Rastnasen 128 und Rastfenstern 135 mit dem Außenkupplungsgehäuse 131 verrastet (Fig. 27c). Die Aussparungen 184 sind gegenüber Fig. 27b in Richtung der Kupplung verschoben und befinden sich nicht mehr im Bereich der Rastnasen 138. Die Verrastung zwischen Kerngehäuse 103 und Innenkupplungsgehäuse 132 kann nun nicht mehr durch Zug am Aufnahmegehäuse 105a, 105b oder am Lichtleiterbündel 6a (in Fig. 27 nicht gezeigt) gelöst werden, da die Rastnasen 138 nicht mehr seitlich aus den Quernuten 130 heraus ausgelenkt werden können. Die Verrastung zwischen Kerngehäuse 103 und Innenkupplungsgehäuse 132 ist in der in Fig. 27c gezeigten Stellung des Steckergehäuses 102 nicht lösbar und fungiert somit als Abzugssicherung. Stecker und Kupplung sind fest miteinander verriegelt.

Eine Deaktivierung der Abzugssicherung und damit eine Entriegelung sind nur möglich, indem das Steckergehäuse 102 in Richtung des Lichtleiterbündels 6a zurückverschoben wird, also in die in Fig. 27b gezeigte Stellung. Hierzu wird zunächst Druck auf die Laschen 113 ausgeübt, wodurch die Rastnasen 128 aus den Rastfenstern 135 ausgelenkt werden, und anschließend das Steckergehäuse 102 in Richtung des Lichtleiterbündels 6a bewegt. Nun kann der Stecker 101 unter seitlicher Auslenkung der Rastnasen 138 wieder mit geringem Kraftaufwand von der Kupplung gelöst werden.

In Figur 28 ist in Form einer Explosionszeichnung ein andere Ausführungsform 101 eines erfindungsgemäßen Mehrfach-Doppelsteckers 156 dargestellt. Im

Wesentlichen setzt sich der Mehrfach-Doppelstecker 156 aus einem Steckergehäuse 143, aus einer oberen und einer unteren Gehäuseschale und einer Mehrzahl von untereinander gleich ausgeführten Doppeleinheiten 103-104 zusammen, wobei die Doppeleinheiten 103-104 in einem Aufnahmegehäuse, umfassend die untere Gehäuseschale 144 und die (nicht gezeigte) obere Gehäuseschale, nebeneinander angeordnet sind. In das Aufnahmevolumen ist mit Hilfe eines Crimpanchlusses 106a, einer Crimphülse 106b und eines Knickschutzes 106c ein Lichtleiterbündel 106d eingeführt.

Vorzugsweise sind zum Aufbau des Mehrfach-Doppelsteckers von Fig. 28 die Doppelstecker von Fig. 24 n-mal vorhanden. Allerdings sind ebenso Ausführungen möglich und für Sonderanwendungen sinnvoll, in denen beispielsweise drei Einzelferrule in einem Dreier-Kerngehäuse sowie einem Dreier-Kerninnengehäuse angeordnet sind, wobei die Ferrule nebeneinander oder übereinander angeordnet sein können.

Bei dem in Fig. 28 beispielhaft gezeigten Mehrfach-Doppelstecker 156 besteht das Aufnahmegehäuse aus zwei übereinander angeordneten Gehäuseschalen, von denen nur die untere dargestellt ist und zwischen denen die Doppeleinheiten 103-104, wie sie für die Ausführung des Doppelsteckers 101 beschrieben sind, nebeneinander aufgereiht sind. Die Kerninnengehäuse 104 können mittels einer Verrastung miteinander verrasten. Die Kerngehäuse 103 weisen Quernuten 130 auf, deren Funktion bereits unter Bezug auf Fig. 27 erläutert wurde. Die Doppeleinheiten 103-104 sind in ein Mehrfachsteckergehäuse 143 gesteckt und darin schwimmend gehaltert, wobei das Mehrfachsteckergehäuse 143 eine Mehrzahl von aneinandergereihten und miteinander verbundenen Doppelsteckergehäusen 158, 159 umfassen kann. Die innen liegenden Doppelsteckergehäuse 159 sind untereinander identisch ausgeführt, die jeweiligen randseitigen Doppelsteckergehäuse 158 sind zueinander symmterisch ausgeführt. Die inneren Doppelsteckergehäuse 159 weisen Laschen 113 und Rastnasen 128 auf, deren Funktion derjenigen der Laschen 113 und der Rastnasen 128 entspricht, welche bereits unter Bezug auf Fig. 27 erläutert wurde.

Fig. 29 zeigt die untere Halbschale 144 von Fig. 28 in senkrechter Draufsicht. Die im Beispiel von Fig. 28 und Fig. 29 für insgesamt acht Ferrulen ausgelegte untere Halbschale 144 eines erfindungsgemäßen Mehrfach-Doppelsteckers weist eine halbzylindrische Aufnahme für den Knickschutz 106c und ein je Bett 192 für die Aufnahme des Crimpanschlusses 106a und eines Faseraufteilers 198 auf, welche im Regelfall im Endbereich des Lichtleiterbündels 106d zur drehsicheren Verankerung desselben angeordnet ist.

Rastnasen 193 welche sich von der Hauptfläche der Halbschale 144 nach oben erstrecken, dienen zur Verrastung der unteren Halbschale 144 mit der nicht gezeigten oberen Halbschale, wobei Form und Position der Rastnasen 193 vorteilhafterweise so gewählt sind, daß die untere und die obere Halbschale keine Unterschiede aufzuweisen brauchen, sondern identisch ausgeführt sein können und dennoch miteinander verrastbar sind. Der vordere Endbereich der Halbschalen ist jeweils so geformt, daß das zwischen den Halbschalen befindliche Aufnahmevolumen ein Mehrfachsteckergehäuse 158 aufzunehmen imstande ist, wobei durch Führungsstege 194 vier voneinander getrennte Aufnahmenuten 195 zur Aufnahme je einer Doppeleinheit 103-104 dienen.

Die Fig. 31 und 32 zeigen den Mehrfachstecker 156 von Fig. 28, welcher mit der Mehrfach-Kupplung 151 von Fig. 30 verbunden ist. Fig. 31 ist eine perspektivische Darstellung des Systems Mehrfachstecker-Mehrfachkupplung, während Fig. 32 eine gegenüber Fig. 31 vergrößerte Querschnittsdarstellung ist, wobei die Blickrichtung der Richtung des Pfeils von Fig. 31 entspricht und in Fig. 32 nur der vordere Teil des Mehrfachsteckers 156 dargestellt ist.

Die Mehrfach-Kupplung 151 umfaßt ein Mehrfachkupplungs- Außengehäuse 231 und ein Mehrfachkupplungs-Innengehäuse 232. Der Mehrfachstecker 156 umfaßt zwei Halbschalen 144a, 144b, welche mit der Halbschale 144 von Fig. 28 jeweils identisch sind, sowie vier Doppeleinheiten 103-104 und ein Mehrfach-Steckergehäuse 143. In Fig. 31 sind die Doppeleinheiten vom den Halbschalen 144a, 144b und dem Mehrfach-Steckergehäuse 143 verdeckt und daher nicht sichtbar. In Fig. 32 liegen die Doppeleinheiten 103-104 in einer Richtung senkrecht zur Papierebene hintereinander.

Die Halbschalen 144a, 144b, das Kerninnengehäuse 104 und das Kerngehäuse 103 sind in Fig. 31 und Fig. 32 zusammengefügt wie unter Bezug auf Fig. 28 erläutert wurde. Die hintere Quaderplatte 117b jedes Kerninnengehäuses 104 ist entlang ihrer vier Schmalseiten in entsprechenden Vertiefungen 265 der Halbschalen 144a, 144b aufgenommen, so daß die Kerninnengehäuse 104 formschlüssig durch die Schalschalen 144a, 144b gehaltert sind. Das Mehrfach-Steckergehäuse 143 ist teilweise in das Mehrfachkupplungs-Außengehäuse 231 eingeschoben, wobei sich der der Kupplung zugewandte Endbereich des Mehrfach-Steckergehäuses 143 zwischen dem Mehrfachkupplungs-Außengehäuse 231 und dem dem Stecker 156 zugewandten Endbereich des Mehrfachkupplungs-Innengehäuse 232 befindet.

Die Bewegung des Mehrfach-Steckergehäuses ist gegenüber den Halbschalen 144a, 144b durch Anschläge 285a, 285b und gegenüber dem Mehrfachkupplungs-Außengehäuse 231 durch Rastfenster 213 und Rastnasen 128a von keilförmigem Querschnitt begrenzt.

Das Mehrfachkupplungs-Innengehäuse 232 weist Rastnasen 238 auf, wobei jeweils eine Rastnase 238 in eine Quernut 130 der Kerngehäuse 103 eingreift. Das Kerngehäuse 103 ist daher mittels der Quernuten 130 und der Rastnasen 238 mit der Kupplung verrastet. Die Verrastung zwischen Kerngehäuse 103 und Mehrfachkupplungs-Innengehäuse 232 kann nicht durch Zug am Stecker 156 oder am Lichtleiterbündel (in Fig. 32 nicht gezeigt) gelöst werden, da die Rastnasen 238 durch den kupplungsseitigen Endbereich der Wandung des Mehrfach-Steckergehäuses 143 daran gehindert werden, seitlich aus den Quernuten 130 heraus ausgelenkt werden zu können. Die Verrastung zwischen Kerngehäuse 103 und Mehrfachkupplungs-Innengehäuse 232 ist in der in Fig. 32 gezeigten Stellung des Mehrfach-Steckergehäuses 143 nicht lösbar und fungiert somit als Abzugssicherung. Stecker und Kupplung sind fest miteinander verriegelt. Ein z.B. ungewolltes Abziehen des Steckers von der Kupplung ist nicht möglich.

Eine Deaktivierung der Abzugssicherung und damit eine Entriegelung sind nur möglich, indem das Mehrfach-Steckergehäuse 143 in Richtung des

Lichtleiterbündels 6a so weit zurückverschoben wird, daß sich die Aussparungen 284 im Bereich der Rastnasen 238 befinden. Hierzu wird das Mehrfach-Steckergehäuse 143 gegenüber der Kupplung und gegenüber den Halbschalen 144a, 144b in Richtung des Lichtleiterbündels 6a bewegt, so daß die Rastnasen 113 aus den Rastfenstern 213 gleiten und die Aussparungen 284 in den Bereich der Rastnasen 238 wandern. Nun kann der Mehrfach-Stecker 156 unter seitlicher Auslenkung der Rastnasen 238 mit geringem Kraftaufwand von der Kupplung gelöst werden.

Selbstverständlich sind auch Abwandlungen möglich, welche eine andere Zahl von Doppeleinheiten 103-104 als vier aufzunehmen imstande sind.

Nur der erfindungsgemäße Aufbau ermöglicht eine Miniaturierung des Steckers zum Zwecke der Übertragung optischer Information. Gemäß einer bevorzugten Ausführungsform weist das Außenkupplungsgehäuse in Richtung quer zur Längsachse des Steckers eine Höhe von ca. 12 mm und eine Breite von ca. 6 mm und in Richtung der Längsachse des Steckers (1,56,101,156) eine Ausdehnung von 11 mm und das Kerngehäuse in Richtung quer zur Längsachse des Steckers eine Höhe von ca. 6 mm und eine Breite von ca. 3,5 mm auf.

Mit dem Gegenstand der Erfindung können nunmehr in vorteilhafter Weise insbesondere Bündeladern von Lichtleitern, also individuelle Fasern, wie auch Bändchen verarbeitet werden. Insbesondere weist der Gegenstand der Erfindung eine vierfache, oder sogar mehr, Dichte von Steckern gegenüber vergleichbaren Steckern des Standes der Technik auf. Der erfindungsgemäße Stecker kann sowohl für Verbindungskabel, Jumperkabel oder Trunkkabel, wie auch zur Zuführung in Boxen von Verteilerschränken eingesetzt werden. Zum Beispiel können nunmehr in einer Box statt 8 Fasern 32 kontaktiert werden. Auch kann zur besseren Verriegelung und gegen ein ungewolltes Abziehen des erfindungsgemäßen Steckers eine zusätzliche Verriegelungshülse (lock hood) vorgesehen sein.

Gewerbliche Anwendbarkeit:

Die Erfindung ist insbesondere zum Aufbau von Steckern in der Lichtleitfaser-Technik gewerblich anwendbar, wobei der erfindungsgemäße Stecker Teil eines Stecker-Kupplung-Systems ist und beim Einstecken des Steckers in die Kupplung das Kerngehäuse mit seinem vorderen Ende aufgrund einer gegenseitiger Verrastung in der Kupplung verrastet. Die besondere Nützlichkeit der Erfindung liegt darin, dass durch dieselbe in vorteilhafter Weise der Aufbau eines Doppelsteckers oder eines Mehrfach-Doppelsteckers ermöglicht wird, bei welchen die entscheidenden Vorteile des Einzelferruls erhalten bleiben und insbesondere die Möglichkeit der apc-Kontaktierung zweier sich in einer Kupplung gegenüberliegende Ferrule gegeben ist. Eine weitere Nützlichkeit der Erfindung besteht darin, dass der Stecker eine hohe Packungsdichte ermöglicht, was aufgrund der erfindungsgemäßen Doppeleinheiten möglich ist. Ebenso weist der Stecker eine zuverlässige Abzugssicherung auf, so dass er nicht versehentlich durch Zug am Lichtleitkabel abgezogen werden kann.

Liste der Bezugszeichen:

1, 101	Doppelstecker
2, 102	Steckergehäuse
3, 103	Kerngehäuse
4, 104	Kerninnengehäuse
5, 105a, b	hinteres Aufnahmegehäuse
6, 6a	Lichtleiterbündel
7, 8	Lichtleiterfasern
9, 10	Keramikferrule
11	Drehsicherung
12	Druckfeder
13, 113	Lasche
14	Aufnahmevolumen von 2
15, 15', 115, 115'	Durchgangslöcher
18, 18', 118, 118'	Durchgangslöcher
16, 116	Doppelzylinder
17, 117a, 117b	Quaderplatte, vordere, hintere Quaderplatte
19, 19', 45	Führungszungen
20	Aufnahmevolumen von 5
21, 28, 38, 46	Rastnasen
22, 27, 35, 35'	Rastfenster
23, 123	vordere Breitseite von 17, 117a
34, 42, 63, 142	Schmalseiten
24	Führungsnut
25	Steg
26, 126	Breitseite
29	Griffmulde
30, 130	Quernut
31, 31', 131	Außenkupplungsgehäuse
32, 32', 132	Innenkupplungsgehäuse

33, 131	Aufnahmevolumen von 31, 131
36	Platte
37, 37',137	Arme
39	Aufnahmeteil
40	Durchgangsloch
41	Führungshülse
43	Mehrfachsteckergehäuse
44, 144	Gehäuseschale
47	Aufnahmenuten
48, 49	Rastfenster
50	Hauptseite
51	Außenkupplungsgehäuse
52	Aufnahmeteile
53, 62, 153	Längssteg
54, 55, 64, 154	Führungsnut
56, 156	Mehrfach-Doppelstecker
57, 157	Stirnfläche von 3, 103
58, 59	Doppelsteckergehäuse
60	Rastnase
106a	Crimpanschluß
106b	Crimphülse
106c	Knickschutz
106d	Lichtleiterbündel
113	Lasche
117c	Verbindungssteg
128a	Rastnase
130	Quernut
135	Rastfenster
138	Rastnase
143	Steckergehäuse
144, 144a, 144b	Halbschalen
151	Mehrfach-Kupplung
156	Mehrfach-Stecker
158, 159	Doppelsteckergehäuse

165	Vertiefungen
168	Rastfenster
169	Frontfenster
184, 190	Aussparung
191	Aufnahme
192	Bett
194	Führungsstege
195	Aufnahmenuten
198	Faseraufteiler
213	Rastfenster
231	Mehrfachkupplungs-Außengehäuse
232	Mehrfachkupplungs-Innengehäuse
265	Vertiefungen
284	Aussparungen
285a, b	Anschläge

Patentansprüche:

1. Stecker (1,56,101,156) für Lichtwellenleiter (6,6a,7,8,106d), mit einem Steckergehäuse (2,43,102,143), an dessen hinteren Ende ein Lichtleiterbündel (6,6a,7,8,106d) mit mindestens zwei Lichtwellenleiterfasern (7,8) eingeführt ist und an dessen gegenüberliegendem vorderen Ende Ferrule (9,10) austreten, in die je eine der Lichtwellenleiterfasern (7,8) eingeführt ist, wobei die Ferrule (9,10) in einem Ferrulegehäuse (3,4, 103,104) gehaltert sind, welches in das zur Aufnahme des Ferrulegehäuses (3,4, 103,104) entsprechend geformte Steckergehäuse (2,43,102,143) eingelegt ist und die Ferrule (9,10) federbelastet in ihrer Axialrichtung beweglich sind, wobei der Stecker (1,56,101,156) zum Zusammenstecken mit einem den Stecker (1,56,101,156) aufnehmenden Kupplungsgehäuse (31,31',131, 32,32',132) bestimmt ist,
dadurch gekennzeichnet,
dass das Ferrulegehäuse aus einem Kerngehäuse (3,103) und einem Kerninnengehäuse (4,104) besteht, welche zur Aufnahme von zwei einzelnen Ferrulen (9,10) ausgestaltet sind, wobei die Ferrule (9,10) im Kerngehäuse (3,103) gehaltert sind und die vorderen Enden der Ferrule (9,10) das Kerngehäuse (3,103) nach vorn durchragen und die hinteren Enden der Ferrule (9,10) in das Kerninnengehäuse (4,104) ragen, wobei Kerngehäuse (3,103) und Kerninnengehäuse (4,104) wenigstens teilweise ineinander gesteckt sind und eine Doppeleinheit (3-4,103-104) bilden.

2. Stecker nach Anspruch 1, dadurch gekennzeichnet,
dass das Kerninnengehäuse (4,104) wenigstens teilweise in das Kerngehäuse (3,103) eingesteckt ist, wobei der hintere Teil des Kerninnengehäuses (4,104) in einem Aufnahmegehäuse (5, 105a,105b, 144a,144b) aufgenommen ist, in welches das Lichtleiterbündel (6,6a,106d) eingeführt ist, und dass das Kerngehäuse (3,103), das Kerninnengehäuse (4,104) und das Aufnahmegehäuse (5, 105a,105b, 144a,144b) in das Steckergehäuse (2,43,102,143) gesteckt und dort schwimmend gehaltert sind.

3. Stecker nach Anspruch 1, dadurch gekennzeichnet,
dass das Kerngehäuse (3,103) die Form eines Gehäusequaders aufweist mit Seitenwandungen (26,42,126,142) und einer vorderen Stirnfläche (57,157), in

der sich mittig zwei Durchgangslöcher (15,15',115,115') für den Durchgang der Ferrule (9,10) befinden, wobei der Gehäusequader (3,103) zur Aufnahme der Ferrule (9,10) nach hinten offen ist.

4. Stecker nach Anspruch 2, dadurch gekennzeichnet,
dass das Kerninnengehäuse (4) eine mit Durchgangslöchern (18,18') versehene Quaderplatte (17) umfaßt, auf deren Vorderseite (23) ein in axialer Richtung des Steckers (1,56) sich erstreckender Doppelzylinder (16) mit den Durchgangslöchern (18,18') aufgesetzt ist und an deren Rückseite zwei Führungszungen (19,19') in axialer Richtung sich erstrecken zum Einführen in das hintere Aufnahmegehäuse (5), wobei Führungszungen (19,19') und Aufnahmegehäuse (5) gegenseitige Verrastungsmittel (21,22) aufweisen.

5. Stecker nach Anspruch 4, dadurch gekennzeichnet,
dass die Verrastungsmittel (21,22) Rastnasen (21) und Rastfenster (22) sind, wobei die Rastnasen (21) an den Führungszungen (19,19') angeordnet sind und das Aufnahmegehäuse (5) die Form eines Gehäusequaders (5) mit je ein Rastfenster (22) aufweisenden Seitenwandungen (23) besitzt, in welche die Rastnasen nach Einführen der Führungszungen (19,19') in das Aufnahmegehäuse (5) einzurasten imstande sind.

6. Stecker nach Anspruch 1, dadurch gekennzeichnet,
dass zum Aufbau eines Mehrfach-Doppelsteckers (56,156) die Doppeleinheit (3-4,103-104) aus Kerngehäuse (3,103) und Kerninnengehäuse (4,104) in identischer Weise mehrfach vorhanden ist, wobei die Doppeleinheiten (3-4,103-104) in einem Aufnahmegehäuse (44, 144, 144a,144b) nebeneinander angeordnet sind.

7. Stecker nach Anspruch 6, dadurch gekennzeichnet,
dass das Aufnahmegehäuse (5) aus zwei übereinander angeordneten Gehäuseschalen (44) besteht, zwischen denen die Doppeleinheiten (3-4) nebeneinander aufgereiht sind, wobei die Kerninnengehäuse (4) in den Gehäuseschalen (44) mittels einer Verrastung (21,48,49) miteinander verrastet sind und die Doppeleinheiten (3-4) sowie die Aufnahmegehäuse (5) in ein Mehrfach-

steckergehäuse (43) gesteckt und darin schwimmend gehaltert sind, welches eine Mehrzahl von aneinandergereihten und miteinander verbundenen Doppelsteckergehäusen (58,59) umfaßt.

8. Stecker nach Anspruch 7, dadurch gekennzeichnet,
dass die mindestens ein Teil der Doppelsteckergehäuse (58,59) des Mehrfachsteckergehäuses (43) Laschen (13) zum Lösen der Verriegelung mit dem Aufnahmegehäuse (44) aufweist.

9. Stecker nach Anspruch 2 oder nach Anspruch 2 und 7, dadurch gekennzeichnet, dass

- das Kerninnengehäuse (104) eine mit Durchgangslöchern (118,118') versehene vordere Quaderplatte (117a) und eine von dieser in Richtung des Lichtwellenleiters (106a) parallel beabstandete, mit der vorderen Quaderplatte (117a) durch einen Verbindungssteg (117c) verbundene hintere Quaderplatte (117b) umfaßt, wobei die seitliche bzw. vertikale Ausdehnung des Verbindungssteges (117c) geringer ist als seitliche bzw. vertikale Ausdehnung der hinteren Quaderplatte (117b),
- auf der Vorderseite (123) der vorderen Quaderplatte (117a) ein in axialer Richtung des Steckers (101) sich erstreckender Doppelzylinder (116) mit den Durchgangslöchern (118,118') aufgesetzt ist,
- und das Aufnahmegehäuse (105a,105b,144,144a,144b) aus zwei miteinander verrastbaren Halbschalen (105a,105b,144,144a,144b) besteht, wobei die Hauptflächen der beiden Halbschalen (105a,105b,144,144a,144b) an ihren Innenseiten im Bereich des vorderen Endes des Aufnahmegehäuses (105a,105b,144,144a,144b) jeweils eine Vertiefung (165,265) aufweisen, welche bei miteinander verrasteten Halbschalen (105a,105b,144,144a,144b) zur formschlüssigen Aufnahme der hinteren Quaderplatte (117b) imstande sind.

10. Stecker nach Anspruch 7, dadurch gekennzeichnet,
dass das Aufnahmegehäuse (144,144a,144b) aus zwei übereinander angeordneten Gehäuseschalen (144,144a,144b) besteht, zwischen denen die Doppeleinheiten (103-104) nebeneinander aufgereiht sind, wobei die

Doppeleinheiten (103-104) sowie die Aufnahmegehäuse (144,144a,144b) in ein Mehrfachsteckergehäuse (143) gesteckt und darin schwimmend gehaltert sind, welches eine Mehrzahl von aneinandergereihten und miteinander verbundenen Doppelsteckergehäusen (158,159) umfaßt.

11. Stecker nach einem der Ansprüch 1 bis 10. dadurch gekennzeichnet, daß das Kerngehäuse (3,103) in Richtung quer zur Längsachse des Steckers (1,56,101,156) eine Höhe von ca. 6 mm und eine Breite von ca. 3,5 mm aufweist.

12. Stecker-Kupplung-System mit einem Stecker nach einem der Ansprüche 1 bis 11, dadurch gekennzeichnet,
dass beim Einstecken des Steckers (1,56,101,156) in eine Kupplung (31,31', 32,32', 51, 131, 132, 151) das Kerngehäuse (3,103) mit seinem vorderen Ende aufgrund einer gegenseitiger Verrastung (30,38, 130,138) in der Kupplung (31,31', 32,32', 51, 131, 132, 151) verrastet.

13. Stecker-Kupplung-System nach Anspruch 12, dadurch gekennzeichnet,
dass die gegenseitige Verrastung von Kerngehäuse (3,103) und Kupplung (31,31', 32,32', 51, 131, 132, 151) bezüglich des Kerngehäuses (3,103) eine Quernut (30,130) umfassen, welche in der Schmalseite (42,142) des Kerngehäuses (3,103) verläuft, wobei die Kupplung ein Außenkupplungsgehäuse (31,31',131) und ein Innenkupplungsgehäuse (32,32',132) umfaßt, welches eine im wesentlichen quaderförmigen Platte (36) aufweist, auf der sich zwei Arme (37,37',137) senkrecht erheben, an deren Enden Rastnasen (38,138) angeordnet sind, welche beim Einschieben des Kerngehäuses (3,103) zwischen die beiden Arme (37,37',137) des Innenkupplungsgehäuses (32,32',132) in den Quernuten (30,130) verrasten.

14. Stecker-Kupplung-System nach Anspruch 13, dadurch gekennzeichnet,
dass das Innenkupplungsgehäuse (32,32',132) ferner zwei innere Führungszylinder aufweist, welche an den Stirnflächen offen sind und zur Aufnahme und Führung der in die Kupplung ragenden Endbereich der Ferrule (9,10) dienen.

15. Stecker-Kupplung-System nach Anspruch 13, dadurch gekennzeichnet, dass der Stecker (1,56,101,156) mindestens eine durch je ein Kerngehäuse (3,103) und ein Kerninnengehäuse (4,104) gebildete Doppeleinheit (3-4,103-104) umfaßt und bei gegenseitiger Verrastung von Kerngehäuse (3,103) und Kupplung (31,31', 32,32', 51, 131, 132, 151) das Steckergehäuse (2, 43,102,143) in Längsrichtung des Steckers (1,56,101,156) gegenüber dem Kerngehäuse (3,103) und der Kupplung (31,31', 32,32', 51, 131, 132, 151) zum Zweck der Aktivierung einer Abzugssicherung in eine erste Stellung und zum Zweck der Deaktivierung der Abzugssicherung in eine zweite Stellung verschiebbar ist, wobei
in der ersten Stellung ein Teil der Wandung des Steckergehäuses (2, 43,102,143) im Bereich der Rastnasen (38,38‘,138) so angeordnet ist, daß keine Auslenkbarkeit der Rastnasen (38,38‘,138) der Arme (37,37‘,137) aus den Quernuten (30,130) heraus besteht, so daß die mechanische Verbindung zwischen Stecker (1,56,101,156) und Kupplung (31,31', 32,32', 51, 131, 132, 151) durch Zug am Lichtleiter (6,6a,106d) oder am Aufnahmegehäuse (5, 44, 105, 144, 144a,144b) nicht lösbar ist,
jedoch in der zweiten Stellung kein Teil der Wandung des Steckergehäuses (2,43,102,143) im Bereich der Rastnasen (38,38‘,138) angeordnet ist, so daß eine Auslenkbarkeit der Rastnasen (38,38‘,138) der Arme (37,37‘,137) aus den Quernuten (30,130) heraus gegeben ist und die mechanische Verbindung zwischen Stecker (1,56,101,156) und Kupplung (31,31', 32,32', 51, 131, 132, 151) durch Zug am Lichtleiter (6,6a,106d) oder am Aufnahmegehäuse (5, 44, 105a, 105b, 144, 144a,144b) lösbar ist.

16. Stecker-Kupplung-System nach Anspruch 15, dadurch gekennzeichnet, daß in der zweiten Stellung des Steckergehäuses (2,43,102,143) die Auslenkbarkeit der Rastnasen (38,38‘,138) aus den Quernuten (30,130) dadurch gegeben ist, daß die Arme (37,37‘,137) mit ihren von der Kupplung (31,31', 32,32', 51, 131, 132, 151) abgewandten Endbereichen in Aussparungen (84,184,284) der Wandung des Steckergehäuses (2,43,102,143) einzugreifen imstande sind.

17. Stecker-Kupplung-System nach Anspruch 15, dadurch gekennzeichnet, daß das Außenkupplungsgehäuse (31,31',131) in Richtung quer zur Längsachse des Steckers (1,56,101,156) eine Höhe von ca. 12 mm und eine Breite von ca. 6 mm und in Richtung der Längsachse des Steckers (1,56,101,156) eine Ausdehnung von 11 mm aufweist.

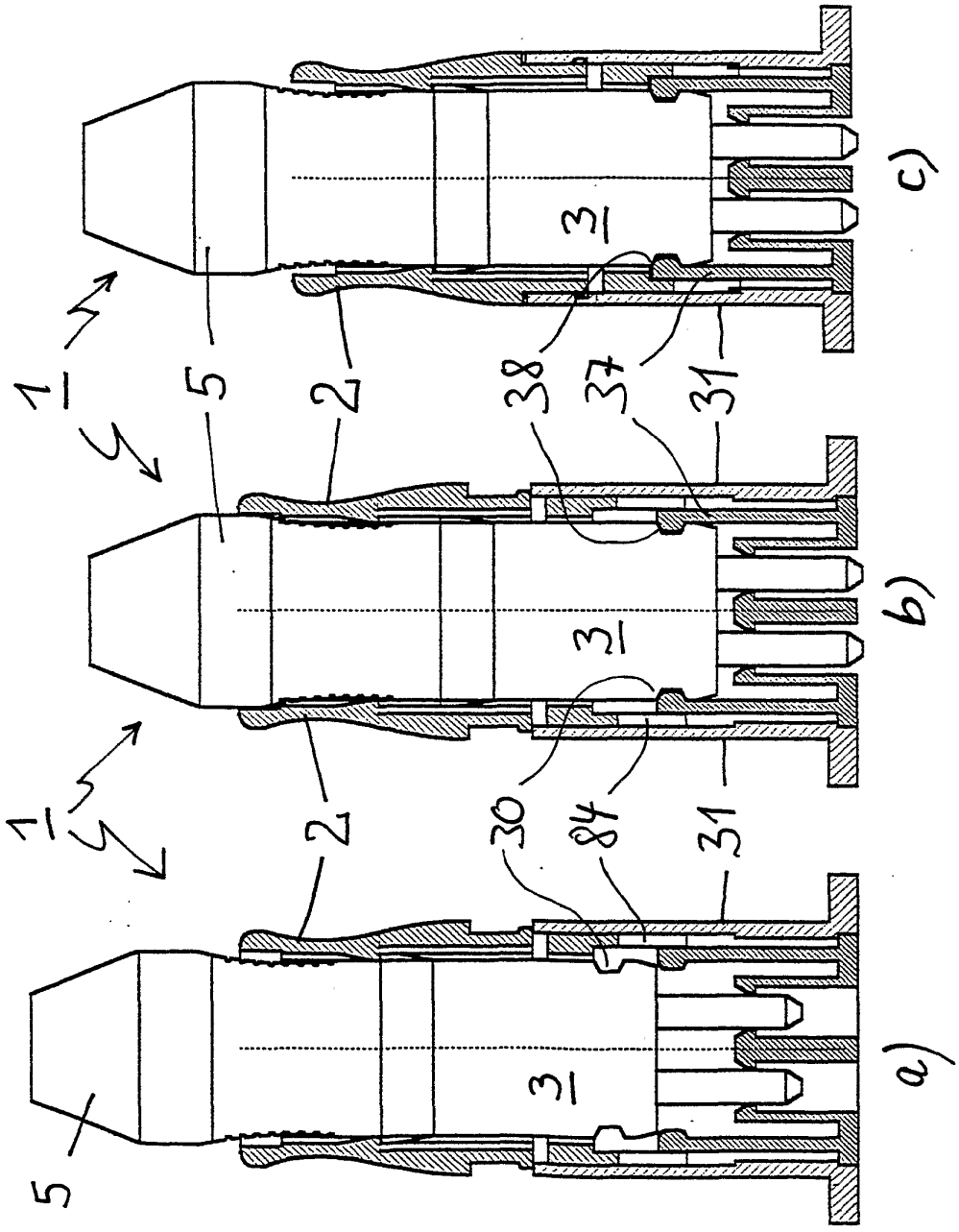


Fig. 1

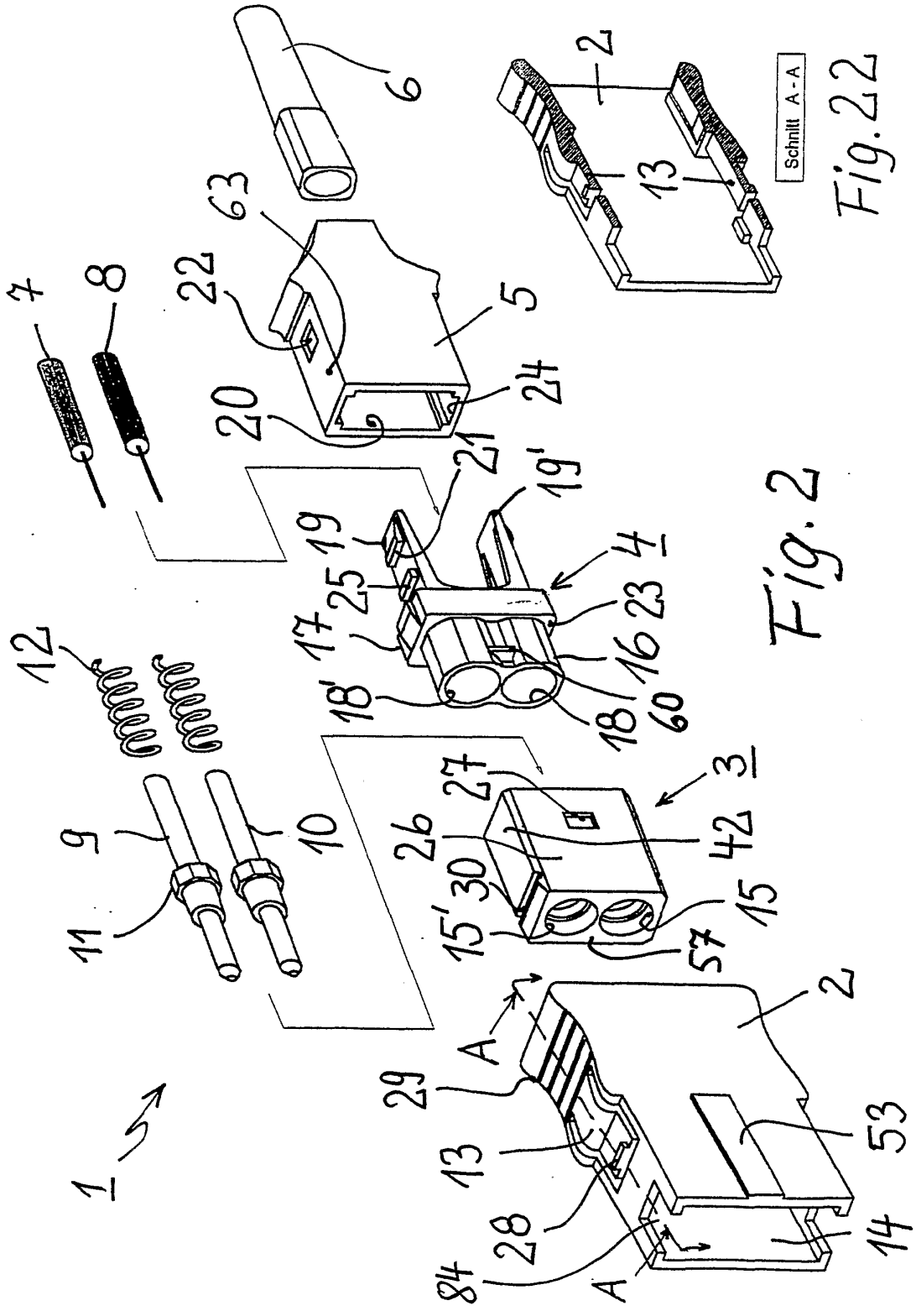

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A
Schnitt A-A

Fig. 2

Fig. 22

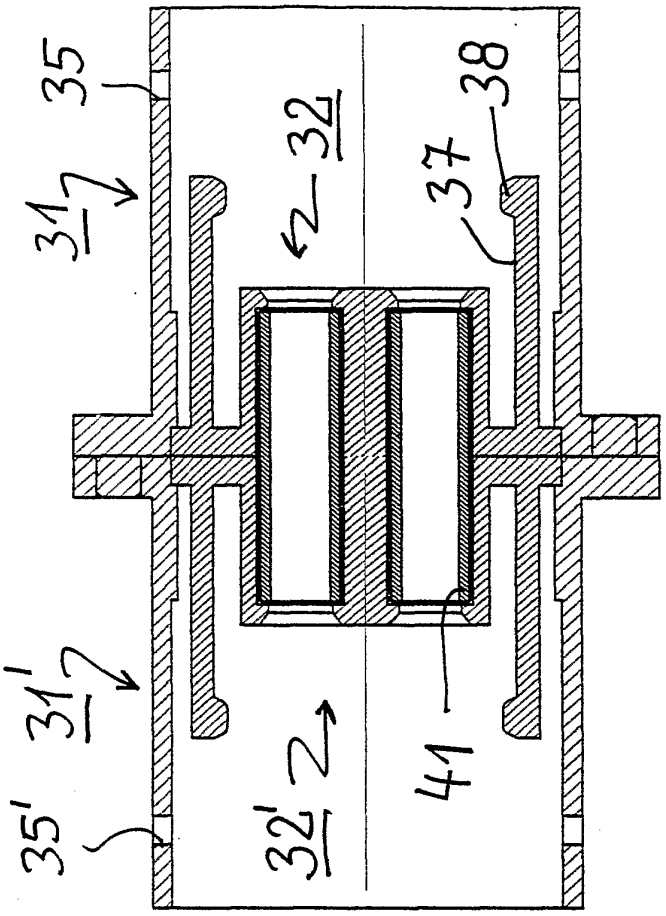


Fig. 3

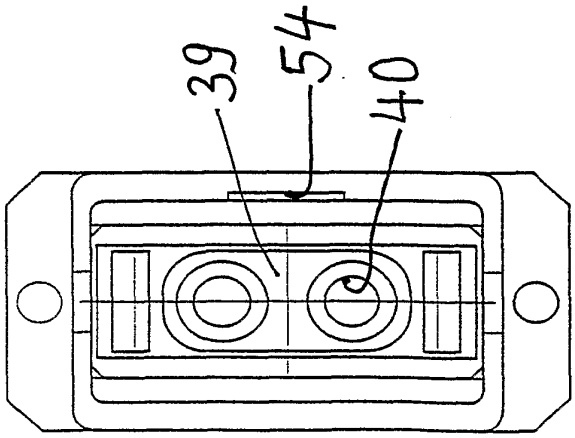


Fig. 4

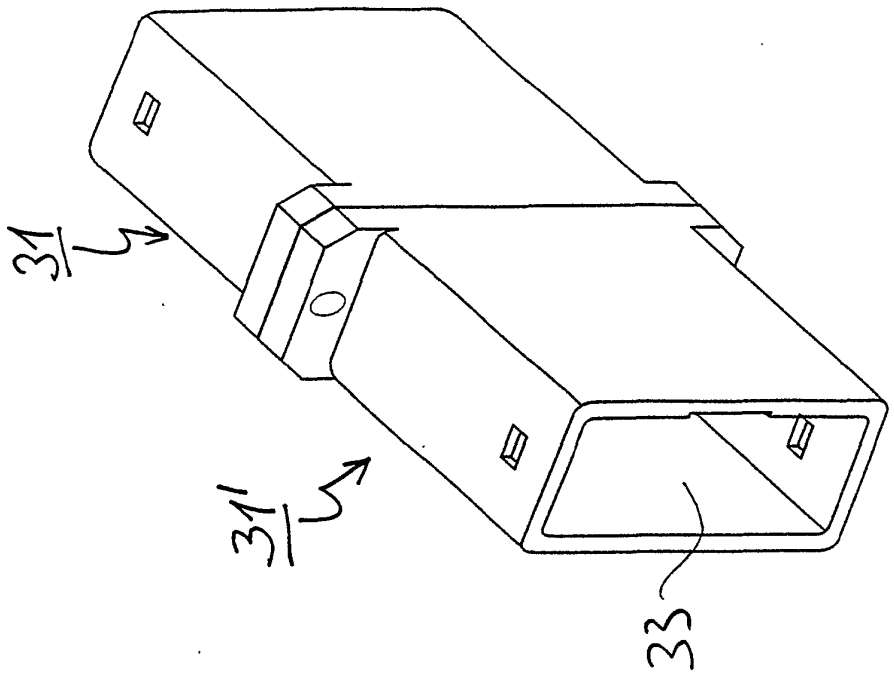


Fig.5

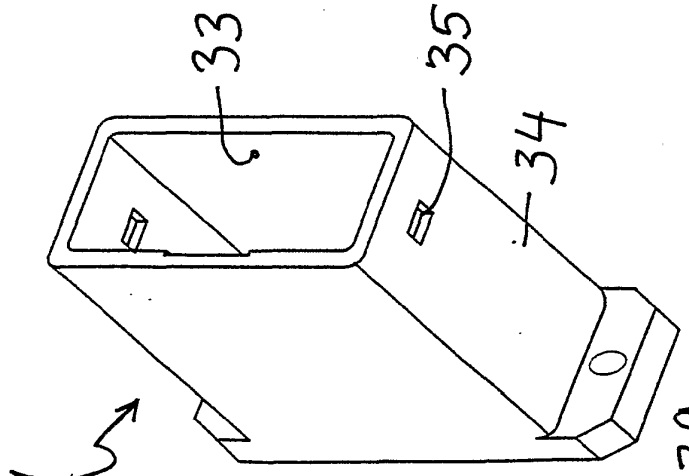


Fig.6

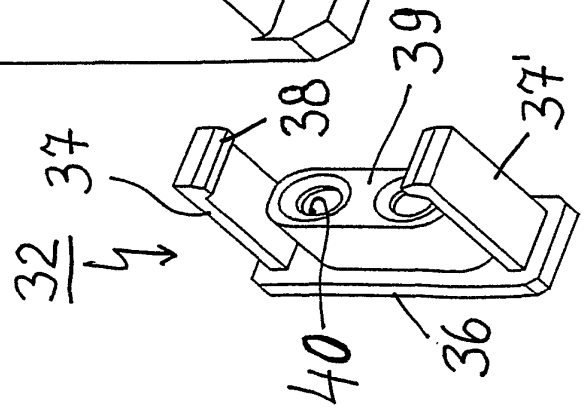


Fig.7

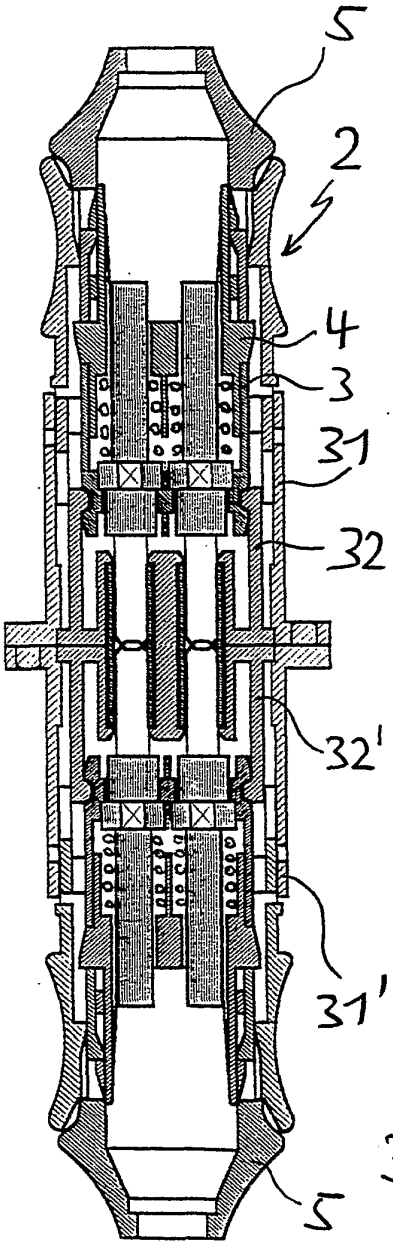

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Fig. 9

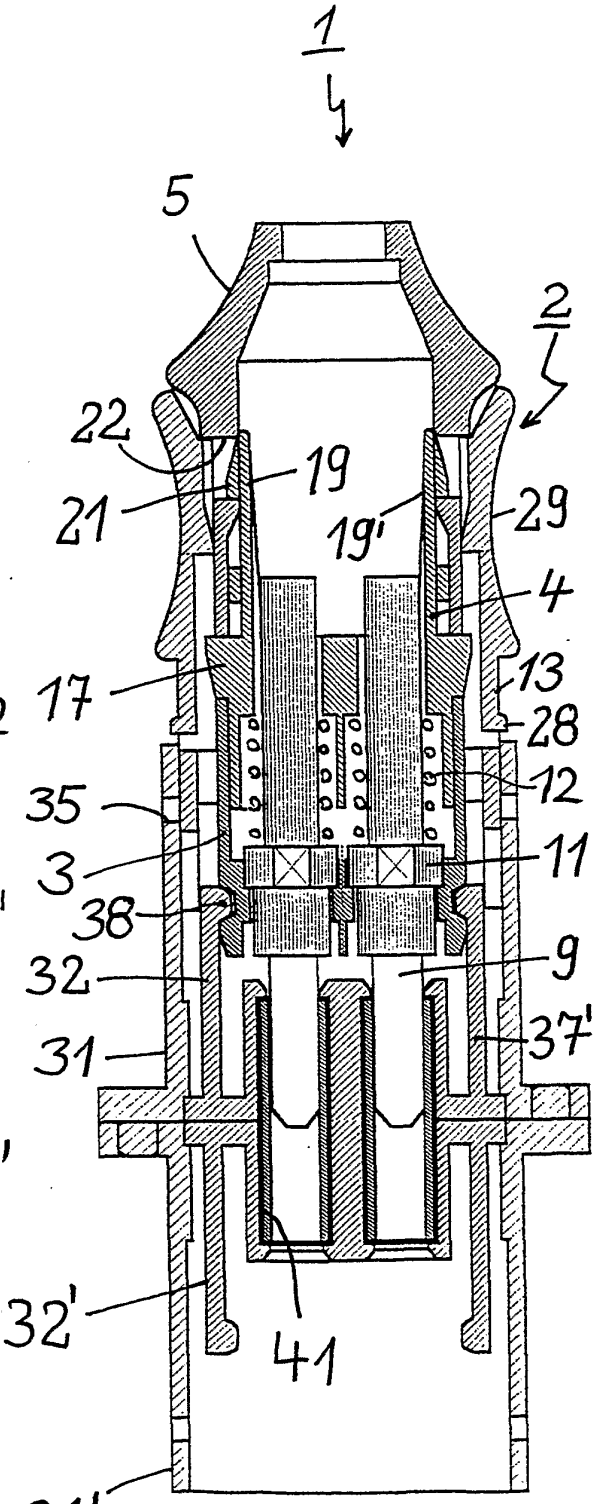

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Fig. 8

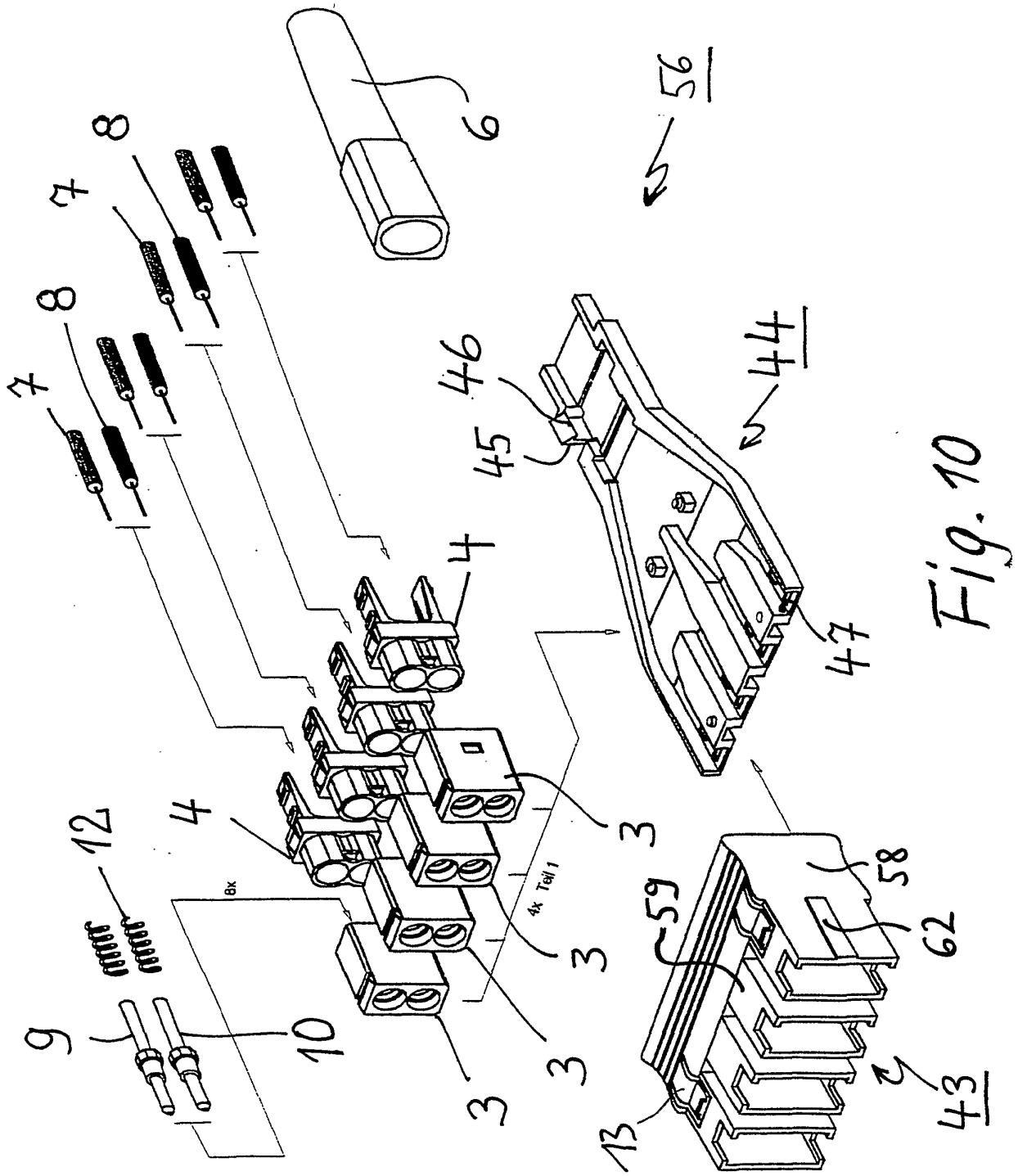


Fig. 10

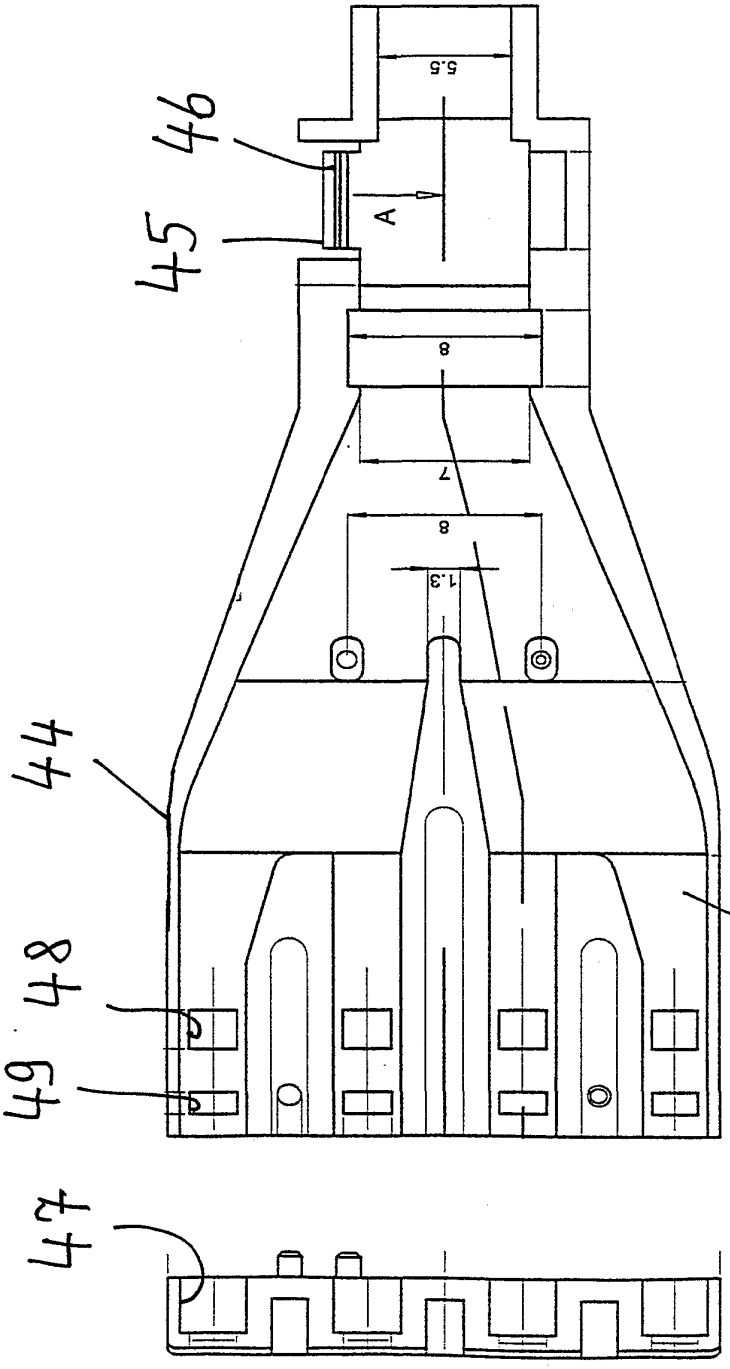
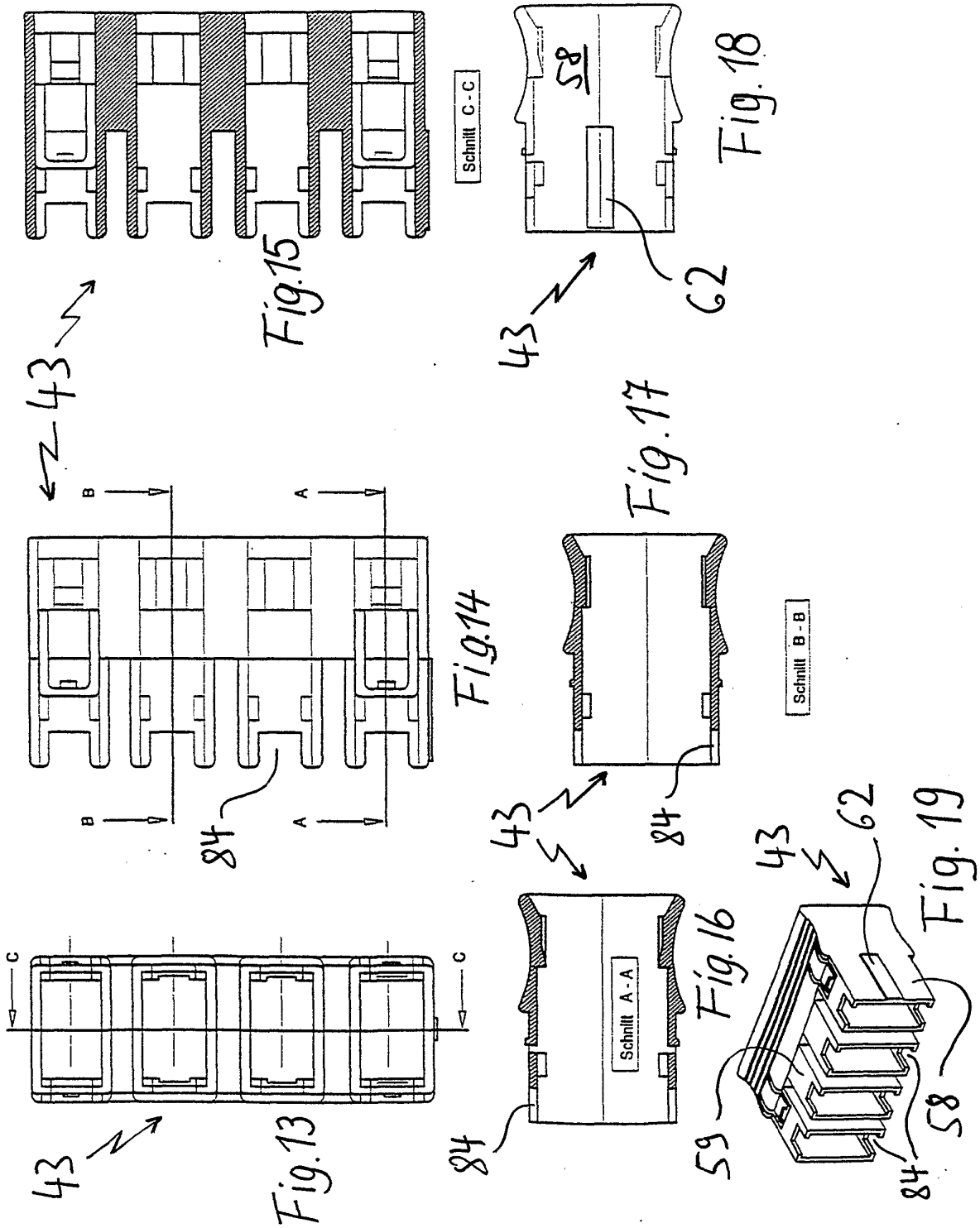


Fig. 11

Fig. 12


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Fig.15
Schnitt C-C
58
62
Fig.18
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B
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Fig.14
Fig.17
Schnitt B-B
C
Fig.13
Schnitt A-A
Fig.16
59
Fig.19

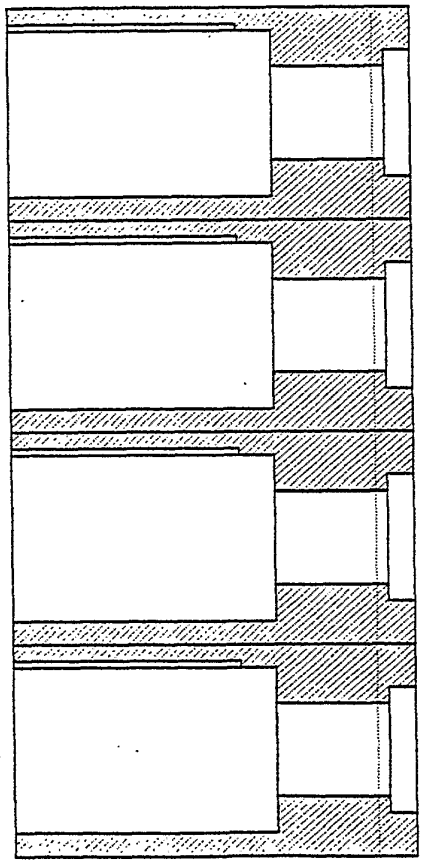


Fig. 21

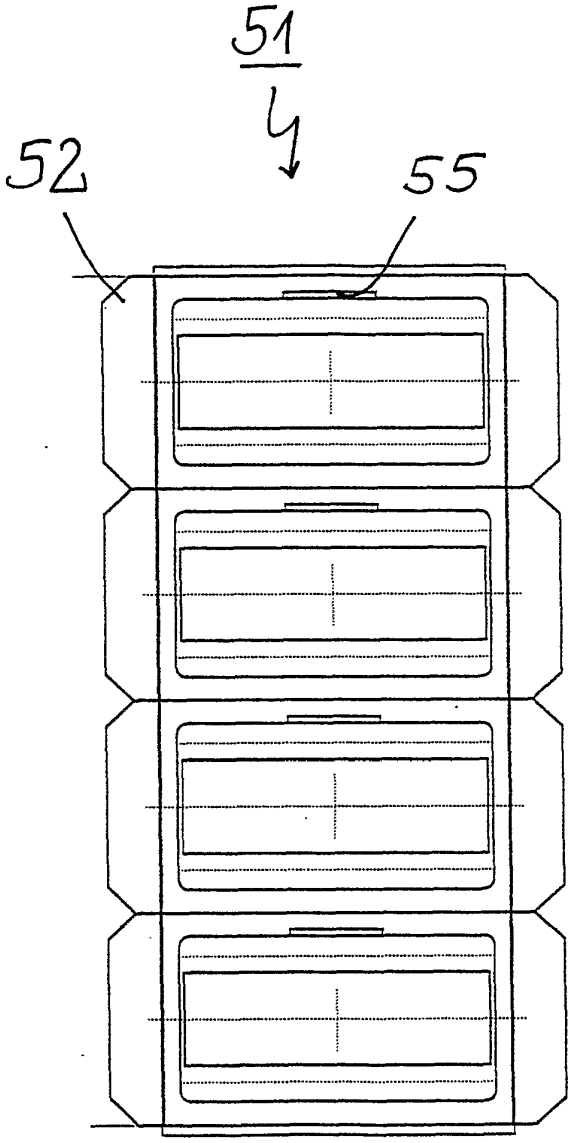


Fig. 20

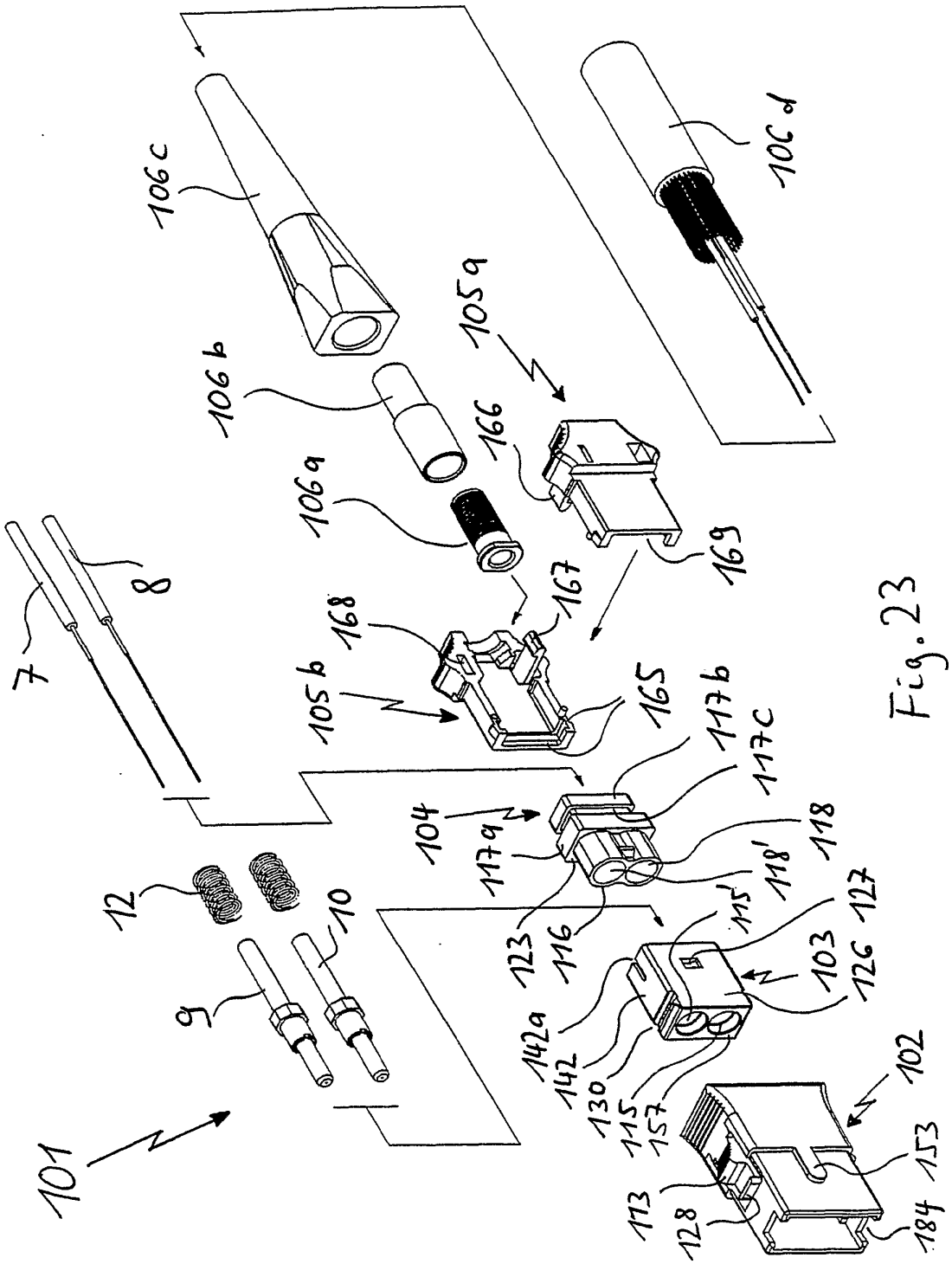

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Fig. 23

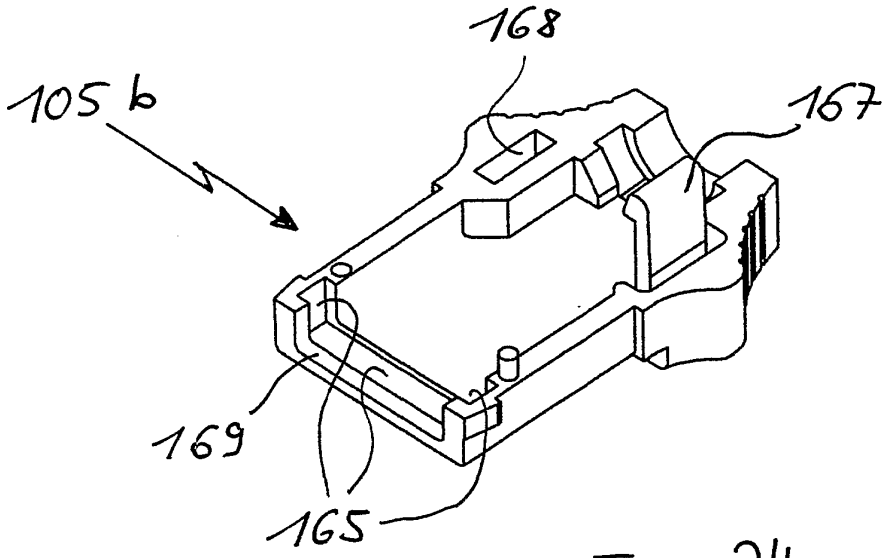


Fig. 24

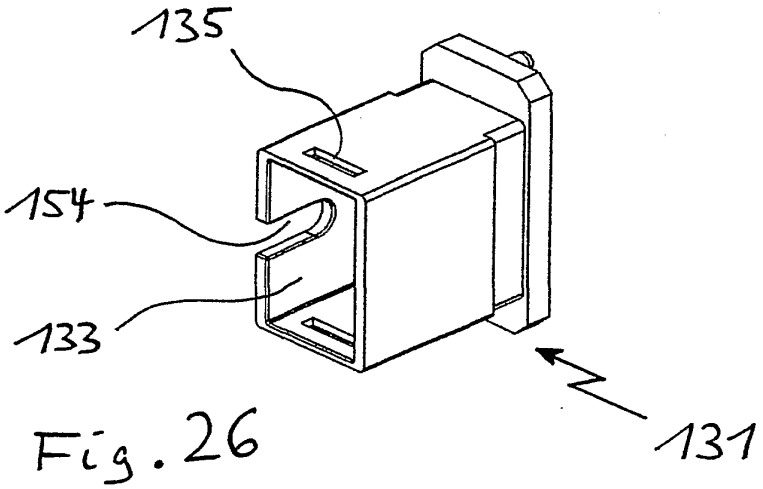


Fig. 26

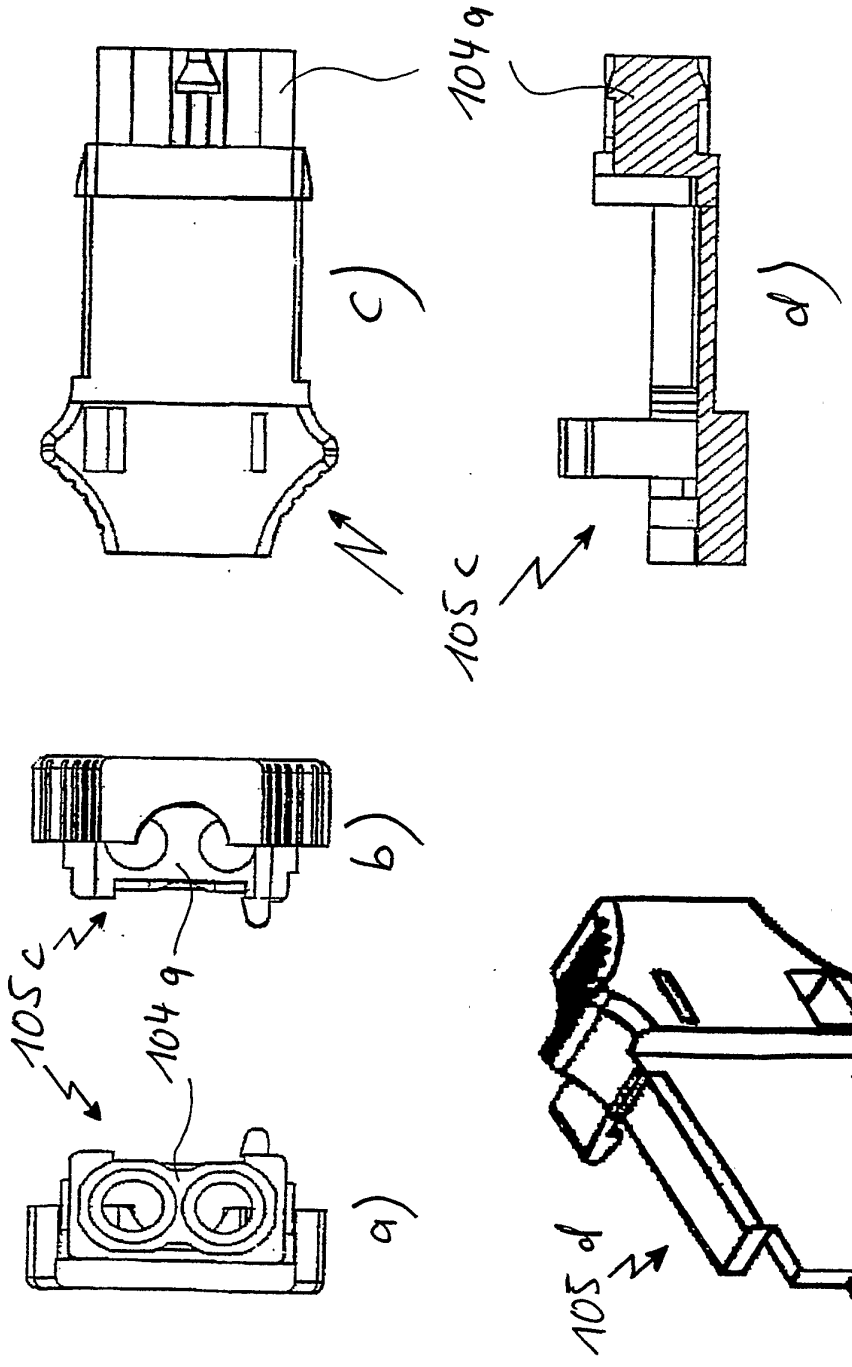


Fig. 25

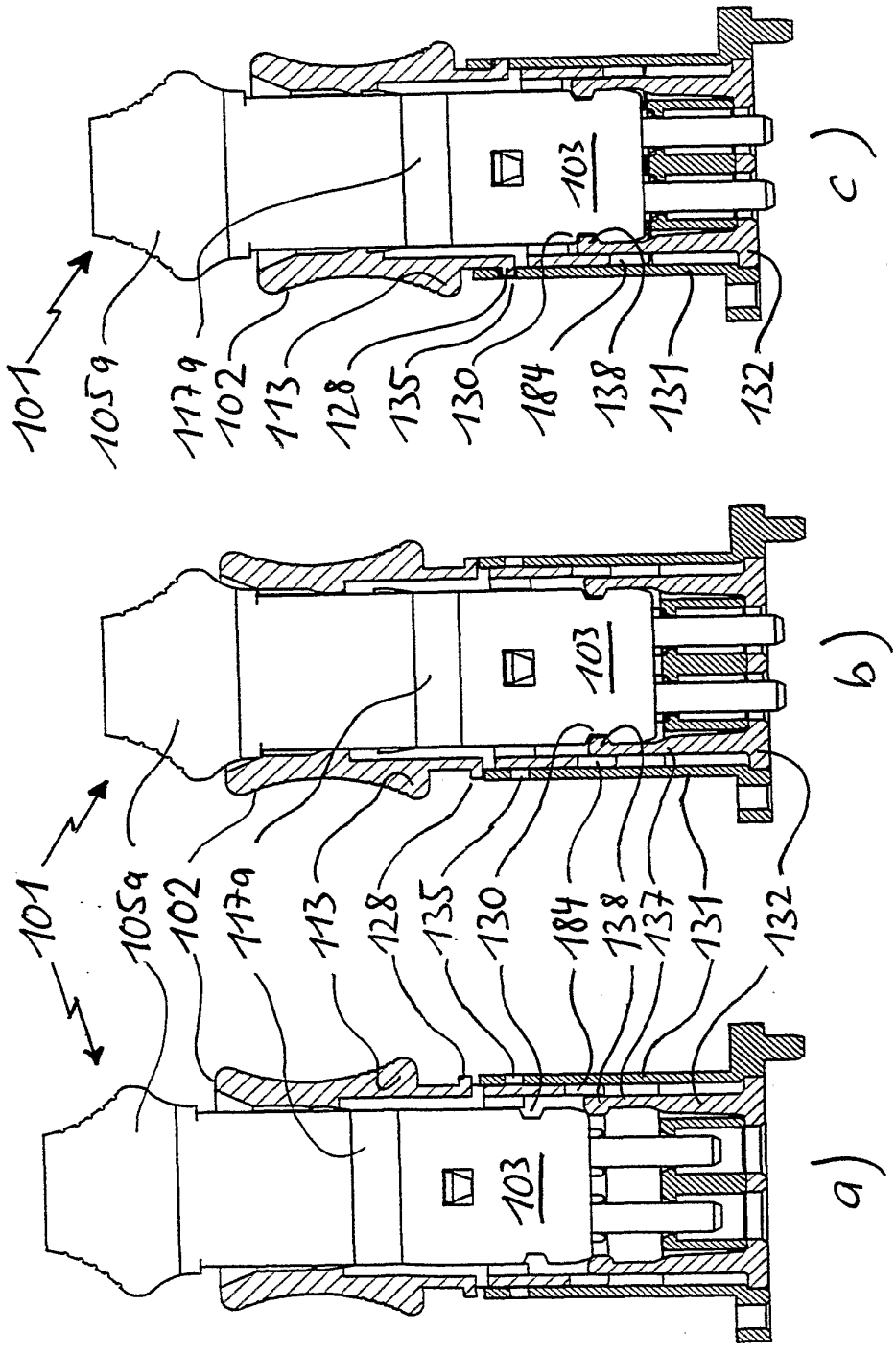


Fig. 27

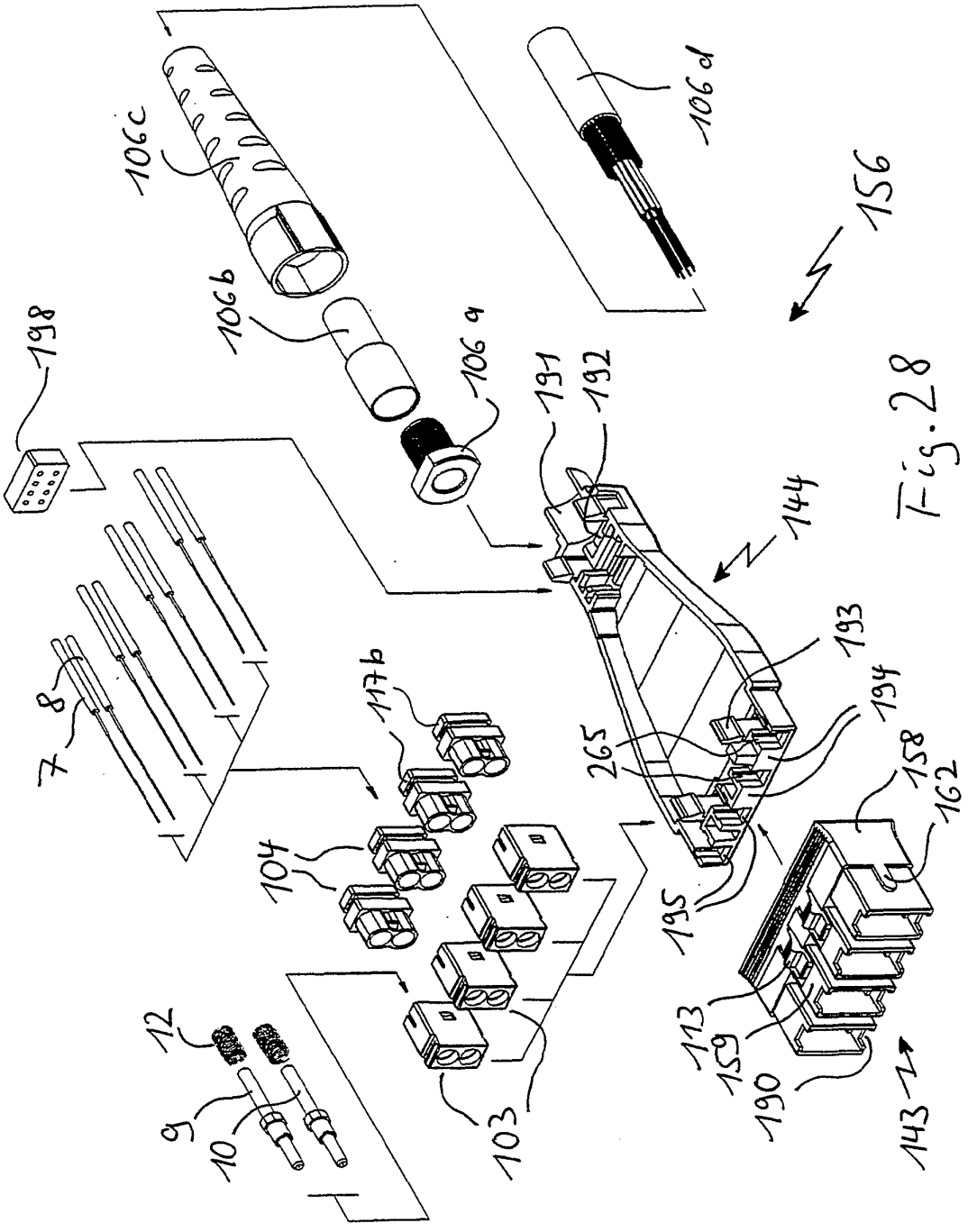

106c
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106b
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Fig. 28

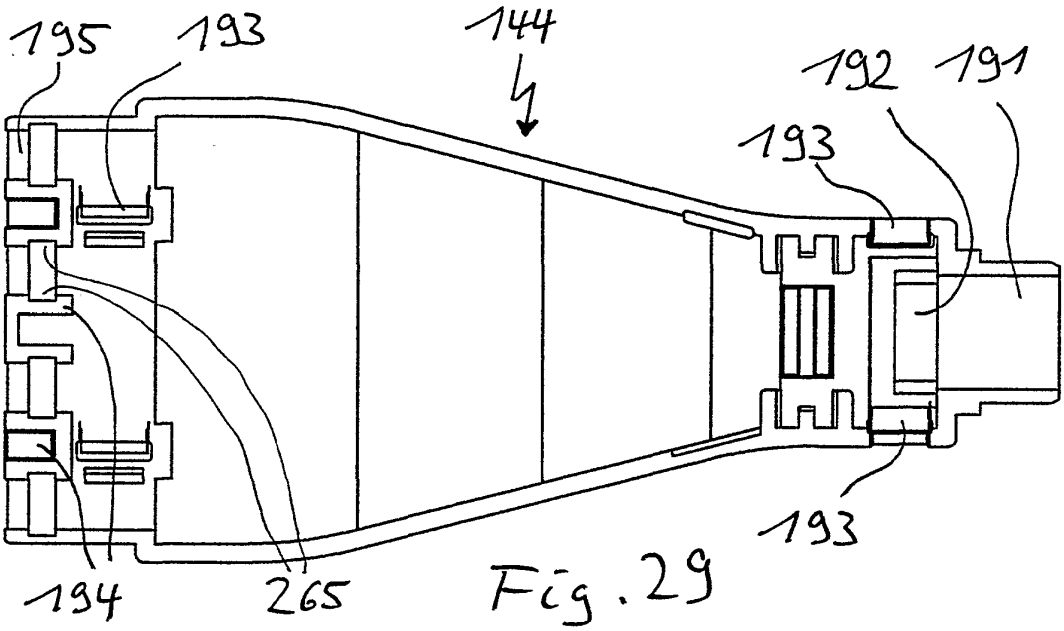


Fig. 29

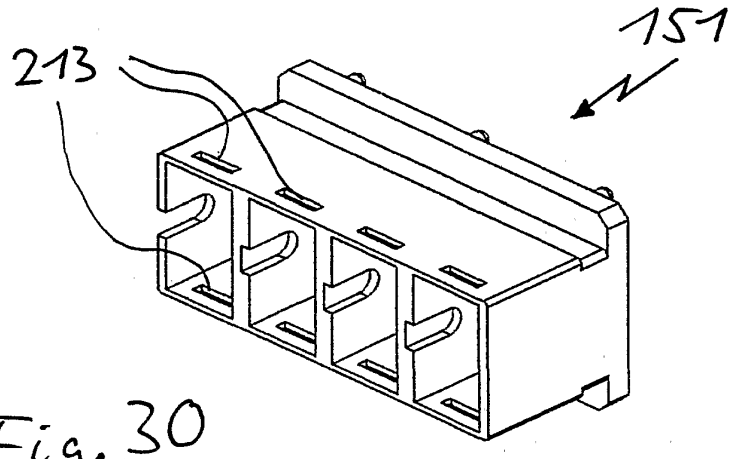


Fig. 30

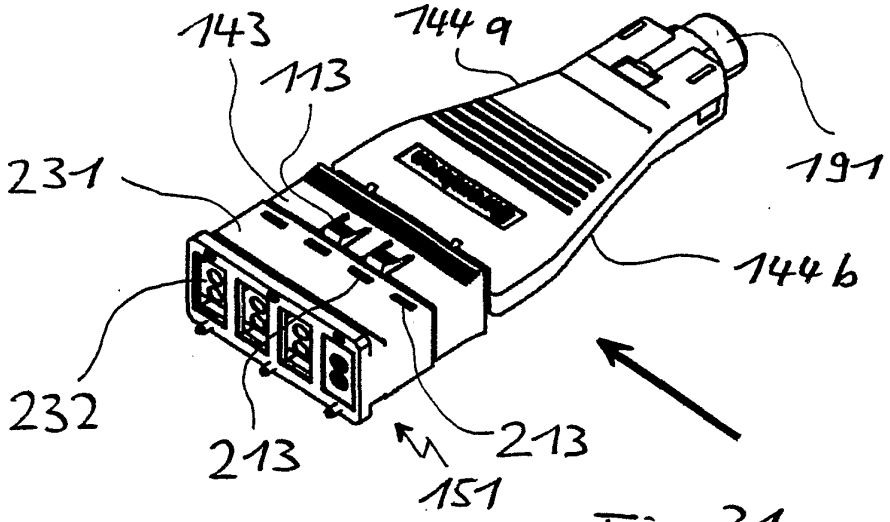

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Fig. 31

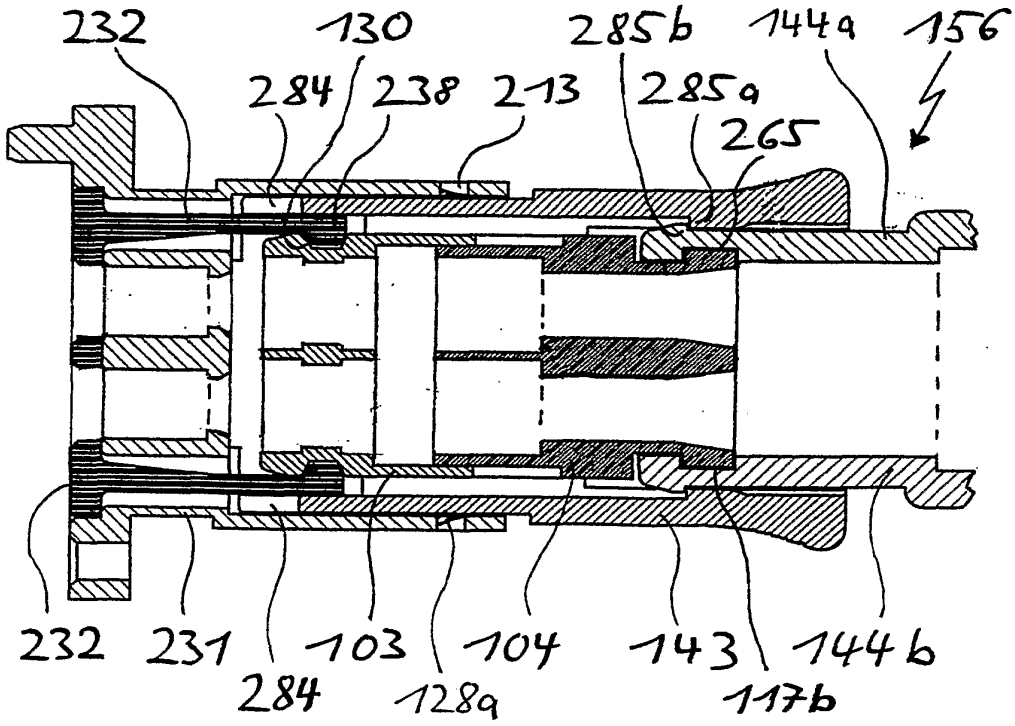

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144a
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213
285a
265
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144b
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128a
117b

Fig. 32

INTERNATIONAL SEARCH REPORT

Inte al Application No
PCT/EP 01/13501

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 G02B6/38

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 G02B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, PAJ, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4 759 599 A (YAMAGUCHI YASUHIRO ET AL) 26 July 1988 (1988-07-26) abstract; figures 1,2,7B,7C,8	1,3,12
Y	column 3, line 21-66	1,6
X	PATENT ABSTRACTS OF JAPAN vol. 012, no. 477 (P-800), 14 December 1988 (1988-12-14) & JP 63 193109 A (NIPPON TELEGR & TELEPH CORP), 10 August 1988 (1988-08-10)	1,2, 12-14
Y	abstract; figures 1-4	1,6
Y	US 5 123 071 A (SCHAFFER RONALD R ET AL) 16 June 1992 (1992-06-16) abstract; figure 2 column 8, line 57 -column 9, line 2	1,6

-/--

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

[X] Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
25 March 2002	03/04/2002

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

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Category °	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
X	PATENT ABSTRACTS OF JAPAN vol. 012, no. 415 (P-781), 4 November 1988 (1988-11-04) & JP 63 151910 A (TOSHIBA CORP;OTHERS: 01), 24 June 1988 (1988-06-24) abstract; figures 1-3	1,3
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A	US 5 134 679 A (ROBIN MAX S ET AL) 28 July 1992 (1992-07-28) abstract; figure 2 column 3, line 1-8	1,4,6

INTERNATIONAL SEARCH REPORT

Information on patent family members

Inte al Application No
PCT/EP 01/13501

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INTERNATIONALER RECHERCHENBERICHT

Inte nales Aktenzeichen
PCT/EP 01/13501

A. KLASSIFIZIERUNG DES ANMELDUNGSGEGENSTANDES
IPK 7 G02B6/38

Nach der Internationalen Patentklassifikation (IPK) oder nach der nationalen Klassifikation und der IPK

B. RECHERCHIERTE GEBIETE

Recherchierter Mindestprüfstoff (Klassifikationssystem und Klassifikationssymbole)
IPK 7 G02B

Recherchierte aber nicht zum Mindestprüfstoff gehörende Veröffentlichungen, soweit diese unter die recherchierten Gebiete fallen

Während der internationalen Recherche konsultierte elektronische Datenbank (Name der Datenbank und evtl. verwendete Suchbegriffe)
EPO-Internal, PAJ, WPI Data

C. ALS WESENTLICH ANGESEHENE UNTERLAGEN

Kategorie°	Bezeichnung der Veröffentlichung, soweit erforderlich unter Angabe der in Betracht kommenden Teile	Betr. Anspruch Nr.
X	US 4 759 599 A (YAMAGUCHI YASUHIRO ET AL) 26. Juli 1988 (1988-07-26) Zusammenfassung; Abbildungen 1,2,7B,7C,8	1,3,12
Y	Spalte 3, Zeile 21-66	1,6
X	PATENT ABSTRACTS OF JAPAN vol. 012, no. 477 (P-800), 14. Dezember 1988 (1988-12-14) & JP 63 193109 A (NIPPON TELEGR & TELEPH CORP), 10. August 1988 (1988-08-10)	1,2, 12-14
Y	Zusammenfassung; Abbildungen 1-4	1,6
Y	US 5 123 071 A (SCHAFFER RONALD R ET AL) 16. Juni 1992 (1992-06-16) Zusammenfassung; Abbildung 2 Spalte 8, Zeile 57 -Spalte 9, Zeile 2	1,6
	-/--	

[X] Weitere Veröffentlichungen sind der Fortsetzung von Feld C zu entnehmen

[X] Siehe Anhang Patentfamilie

° Besondere Kategorien von angegebenen Veröffentlichungen :
"A" Veröffentlichung, die den allgemeinen Stand der Technik definiert, aber nicht als besonders bedeutsam anzusehen ist
"E" älteres Dokument, das jedoch erst am oder nach dem internationalen Anmeldedatum veröffentlicht worden ist
"L" Veröffentlichung, die geeignet ist, einen Prioritätsanspruch zweifelhaft erscheinen zu lassen, oder durch die das Veröffentlichungsdatum einer anderen im Recherchenbericht genannten Veröffentlichung belegt werden soll oder die aus einem anderen besonderen Grund angegeben ist (wie ausgeführt)
"O" Veröffentlichung, die sich auf eine mündliche Offenbarung, eine Benutzung, eine Ausstellung oder andere Maßnahmen bezieht
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"X" Veröffentlichung von besonderer Bedeutung; die beanspruchte Erfindung kann allein aufgrund dieser Veröffentlichung nicht als neu oder auf erfinderischer Tätigkeit beruhend betrachtet werden
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"&" Veröffentlichung, die Mitglied derselben Patentfamilie ist

Datum des Abschlusses der internationalen Recherche	Absendedatum des internationalen Recherchenberichts
25. März 2002	03/04/2002

Name und Postanschrift der Internationalen Recherchenbehörde	Bevollmächtigter Bediensteter
Europäisches Patentamt, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Tx. 31 651 epo nl, Fax: (+31–70) 340–3016	Beaven, G

Formblatt PCT/ISA/210 (Blatt 2) (Juli 1992)

C.(Fortsetzung) ALS WESENTLICH ANGESEHENE UNTERLAGEN

Kategorie°	Bezeichnung der Veröffentlichung, soweit erforderlich unter Angabe der in Betracht kommenden Teile	Betr. Anspruch Nr.
X	PATENT ABSTRACTS OF JAPAN vol. 012, no. 415 (P-781), 4. November 1988 (1988-11-04) & JP 63 151910 A (TOSHIBA CORP;OTHERS: 01), 24. Juni 1988 (1988-06-24) Zusammenfassung; Abbildungen 1-3	1,3
A	PATENT ABSTRACTS OF JAPAN vol. 011, no. 328 (P-629), 27. Oktober 1987 (1987-10-27) & JP 62 111215 A (FURUKAWA ELECTRIC CO LTD:THE;OTHERS: 01), 22. Mai 1987 (1987-05-22) Zusammenfassung; Abbildungen 1-3	1,3,6
A	US 5 134 679 A (ROBIN MAX S ET AL) 28. Juli 1992 (1992-07-28) Zusammenfassung; Abbildung 2 Spalte 3, Zeile 1-8	1,4,6

INTERNATIONALER RECHERCHENBERICHT

Angaben zu Veröffentlichungen, die zur selben Patentfamilie gehören

Int. ales Aktenzeichen
PCT/EP 01/13501

Im Recherchenbericht angeführtes Patentdokument	Datum der Veröffentlichung	Mitglied(er) der Patentfamilie	Datum der Veröffentlichung
US 4759599 A	26-07-1988	JP 1981808 C	25-10-1995
		JP 7007139 B	30-01-1995
		JP 62148907 A	02-07-1987
		DE 3689113 D1	04-11-1993
		DE 3689113 T2	31-03-1994
		EP 0228063 A2	08-07-1987
		KR 9005739 B1	09-08-1990
JP 63193109 A	10-08-1988	JP 2601813 B2	16-04-1997
US 5123071 A	16-06-1992	DE 9102805 U1	29-05-1991
		FR 2659455 A1	13-09-1991
		GB 2241794 A	11-09-1991
		US 5082344 A	21-01-1992
JP 63151910 A	24-06-1988	JP 2098662 C	02-10-1996
		JP 8007306 B	29-01-1996
JP 62111215 A	22-05-1987	JP 1767169 C	11-06-1993
		JP 4058607 B	18-09-1992
US 5134679 A	28-07-1992	KEINE	

Doc code: RCEX
Doc description: Request for Continued Examination (RCE)

PTO/SB/30EFS (01-22)
Approved for use through 05/31/2024. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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REQUEST FOR CONTINUED EXAMINATION(RCE)TRANSMITTAL
(Submitted Only via EFS-Web)

Application Number	18/057,342	Filing Date	2022-11-21	Docket Number (if applicable)	USCO-089-US1-02	Art Unit	2874
First Named Inventor	Jason Higley			Examiner Name	Andrew JORDAN		

This is a Request for Continued Examination (RCE) under 37 CFR 1.114 of the above-identified application.
Request for Continued Examination (RCE) practice under 37 CFR 1.114 does not apply to any utility or plant application filed prior to June 8, 1995, or to any design application. The Instruction Sheet for this form is located at WWW.USPTO.GOV

SUBMISSION REQUIRED UNDER 37 CFR 1.114

Note: If the RCE is proper, any previously filed unentered amendments and amendments enclosed with the RCE will be entered in the order in which they were filed unless applicant instructs otherwise. If applicant does not wish to have any previously filed unentered amendment(s) entered, applicant must request non-entry of such amendment(s).

☐ Previously submitted. If a final Office action is outstanding, any amendments filed after the final Office action may be considered as a submission even if this box is not checked.

- ☐ Consider the arguments in the Appeal Brief or Reply Brief previously filed on _____
- ☐ Other _____

☒ Enclosed

- ☐ Amendment/Reply
- ☒ Information Disclosure Statement (IDS)
- ☐ Affidavit(s)/ Declaration(s)
- ☐ Other _____

MISCELLANEOUS

☐ Suspension of action on the above-identified application is requested under 37 CFR 1.103(c) for a period of months _____
(Period of suspension shall not exceed 3 months; Fee under 37 CFR 1.17(i) required)

☐ Other _____

FEES

☐ **The RCE fee under 37 CFR 1.17(e) is required by 37 CFR 1.114 when the RCE is filed.**
The Director is hereby authorized to charge any underpayment of fees, or credit any overpayments, to Deposit Account No _____

SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT REQUIRED

☒ Patent Practitioner Signature

Applicant Signature

PTO/SB/30EFS (01-22)
Approved for use through 05/31/2024. OMB 0651-0031
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.

Signature of Registered U.S. Patent Practitioner			
Signature	/Michael L. Leetzow/	Date (YYYY-MM-DD)	2023-06-07
Name	Michael L. Leetzow	Registration Number	35932

This collection of information is required by 37 CFR 1.114. 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.

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.

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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.

Electronic Patent Application Fee Transmittal	
Application Number:	18057342
Filing Date:	21-Nov-2022
Title of Invention:	MINI DUPLEX CONNECTOR WITH PUSH-PULL POLARITY MECHANISM AND CARRIER
First Named Inventor/Applicant Name:	Jason Higley
Filer:	MICHAEL LEETZOW
Attorney Docket Number:	USCO-089-US1-02

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($)
Miscellaneous:				
RCE- 1ST REQUEST	1801	1	1360	1360
		Total in USD ($)		**1360**

Electronic Acknowledgement Receipt	
EFS ID:	48119092
Application Number:	18057342
International Application Number:	
Confirmation Number:	4719
Title of Invention:	MINI DUPLEX CONNECTOR WITH PUSH-PULL POLARITY MECHANISM AND CARRIER
First Named Inventor/Applicant Name:	Jason Higley
Customer Number:	152017
Filer:	MICHAEL LEETZOW
Filer Authorized By:	
Attorney Docket Number:	USCO-089-US1-02
Receipt Date:	07-JUN-2023
Filing Date:	21-NOV-2022
Time Stamp:	21:14:14
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$1360
RAM confirmation Number	E202367L15039017
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	Information Disclosure Statement (IDS) Form (SB08)	20230608_USCO089US102.pdf	1282969 c3fcafc0a1d4e64e1ded7cd96bc056638707bfb5	no	5
Warnings:					
Information:					
2	Foreign Reference	WO2020160254A1.pdf	1389360 4300a9358706aa56a729b3d081380365f66a0ebb	no	41
Warnings:					
Information:					
3	Foreign Reference	WO2019195652A1.pdf	1339696 47aa5644af731921693eb44c34b97719b1ba7a80	no	35
Warnings:					
Information:					
4	Foreign Reference	WO2017139430A1.pdf	1188028 a0e0375c8ba6450878222de40d90e3a5df3e28cb	no	33
Warnings:					
Information:					
5	Foreign Reference	WO2015191024A1.pdf	2311705 5536004c54ba96b5f93181b0bd354eaaa846827e	no	49
Warnings:					
Information:					
6	Foreign Reference	WO0242818A1.pdf	2776696 50cd1ec20aa50797509623bfb3b3a30d4436793d	no	58
Warnings:					
Information:					

7	Non Patent Literature	WO_ISRMarch52019.pdf	361110 74a651a42686c9f976283fadeefc69aee4888411	no	8
Warnings:					
Information:					
8	Non Patent Literature	SupplementaryEUSearchReport.pdf	314626 6c1cab4e7cc9265d56d9fb02a9adb005380ba374	no	6
Warnings:					
Information:					
9	Non Patent Literature	SecondOfficeActon.pdf	254507 2f45da09013540095cba2b0c5e3d3db04d93f2b4	no	8
Warnings:					
Information:					
10	Non Patent Literature	ISR-WO_107-INT_PCTUS2020015858.pdf	206230 3ee8a729fe693986dc84637c6332804ce3ba0e70	no	5
Warnings:					
Information:					
11	Non Patent Literature	ForIDS_TIA-604-10A_FOCIS10_2002.pdf	428889 f9960053d03f925f86f933123991f7b4a46fc83e	no	38
Warnings:					
Information:					
12	Non Patent Literature	ExtendedSearchReportJuly29.pdf	381912 b8a853e97fa63ba9b353926e71369676aa8b7a3f	no	8
Warnings:					
Information:					
13	Non Patent Literature	Englishtranslationofficeactionext2.pdf	537205 34ffefd978000cdb11628a56177c34b7d837a031	no	7
Warnings:					
Information:					

14	Request for Continued Examination (RCE)	USCO-089-US1-02_USPTO_SB30_20230607_205455.pdf	1681481 f0902792c5a1a9f57a176282d69fcb82d78e2049	no	3
Warnings:					
Information:					
15	Fee Worksheet (SB06)	fee-info.pdf	37893 7f3e04fb464b2900fbfe1079487cf64608fe6a6c	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	14492307		

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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United States Patent and Trademark Office
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Alexandria, Virginia 22313-1450
www.uspto.gov

NOTICE OF ALLOWANCE AND FEE(S) DUE

152017 7590 05/19/2023

US Conec Ltd.
1138 25th Street Southeast
Hickory, NC 28602

EXAMINER
JORDAN, ANDREW

ART UNIT	PAPER NUMBER
2874	

DATE MAILED: 05/19/2023

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
18/057,342	11/21/2022	Jason Higley	USCO-089-US1-02	4719

TITLE OF INVENTION: MINI DUPLEX CONNECTOR WITH PUSH-PULL POLARITY MECHANISM AND CARRIER

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$1200	$0.00	$0.00	$1200	08/21/2023

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 40% the amount of undiscounted fees, and micro entity fees are 20% the amount of undiscounted 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. 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: Maintenance fees are due in utility patents issuing on applications filed on or after Dec. 12, 1980. It is patentee's responsibility to ensure timely payment of maintenance fees when due. More information is available at www.uspto.gov/PatentMaintenanceFees.

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), by mail or fax, or via EFS-Web.

By mail, send to: Mail Stop ISSUE FEE
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

By fax, send to: (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 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. **Because electronic patent issuance may occur shortly after issue fee payment, any desired continuing application should preferably be filed prior to payment of this issue fee in order not to jeopardize copendency.**

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

152017 7590 05/19/2023
US Conec Ltd.
1138 25th Street Southeast
Hickory, NC 28602

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 transmitted to the USPTO via EFS-Web or by facsimile to (571) 273-2885, on the date below.

(Typed or printed name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
18/057,342	11/21/2022	Jason Higley	USCO-089-US1-02	4719

TITLE OF INVENTION: MINI DUPLEX CONNECTOR WITH PUSH-PULL POLARITY MECHANISM AND CARRIER

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$1200	$0.00	$0.00	$1200	08/21/2023

EXAMINER	ART UNIT	CLASS-SUBCLASS
JORDAN, ANDREW	2874	385-078000

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/AIA/122 or PTO/SB/122) attached.

❑ "Fee Address" indication (or "Fee Address" Indication form PTO/AIA/47 or 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,
(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.

1_____
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 must have been previously recorded, or filed for recordation, as set forth in 37 CFR 3.11 and 37 CFR 3.81(a). 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. Fees submitted: ❑Issue Fee ❑Publication Fee (if required)

4b. Method of Payment: *(Please first reapply any previously paid fee shown above)*

❑ Electronic Payment via Patent Center or EFS-Web ❑ Enclosed check ❑ Non-electronic payment by credit card (Attach form PTO-2038)

❑ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment to Deposit Account No. _____

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

❑ Applicant certifying micro entity status. See 37 CFR 1.29
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.

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

❑ Applicant changing to regular undiscounted fee 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. _____

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
18/057,342	11/21/2022	Jason Higley	USCO-089-US1-02	4719

152017 7590 05/19/2023

US Conec Ltd.
1138 25th Street Southeast
Hickory, NC 28602

EXAMINER	
JORDAN, ANDREW	
ART UNIT	PAPER NUMBER
2874	

DATE MAILED: 05/19/2023

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 30 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. 18/057,342	Applicant(s) Higley et al.	
	Examiner ANDREW JORDAN	Art Unit 2874	AIA (FITF) Status Yes

-- 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 the filing of 11/21/2022.
   ☐ 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 1-17 . 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)
2. ☐ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date _____.
3. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material _____.
4. ☐ Interview Summary (PTO-413), Paper No./Mail Date. _____.
5. ☐ Examiner's Amendment/Comment
6. ☑ Examiner's Statement of Reasons for Allowance
7. ☐ Other _____.

/ANDREW JORDAN/
Primary Examiner, Art Unit 2874

Notice of Pre-AIA or AIA Status

The present application, filed on or after March 16, 2013, is being examined under the first inventor to file provisions of the 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.

DETAILED ACTION

Special Definitions for Claim Language - MPEP § 2111.01(IV)

No special definitions are seen as present in the specification regarding the language used in the claims. Consequently, the words and phrases of the claims are given their plain meaning. MPEP §§ 2173.01, 2173.05(a), and 2111.01.

If special definitions are present, Applicant should bring those to the attention of the examiner and the prosecution history with its next response.

Claims Allowed

Claims 1-17 are allowed.

Allowable Subject Matter

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

The prior art does not teach or suggest

a fiber optic connector with two ferrules having the crimp body, alignment feature, and strain relief boot

as set forth in the claimed combination of independent claim(s) 1.

The cited references are seen as providing the closest related art.

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."

Conclusion

Applicant's publication US 20230080980 A1 of 2023-03-16 is cited.

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. The cited references have elements related to Applicant's disclosure and/or claims or are otherwise associated with the other cited references, particularly with respect to optical connectors and related systems.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to ANDREW JORDAN whose telephone number is (571) 270-1571. The examiner can normally be reached most days 1000-1800 PACIFIC TIME ZONE (messages are returned).

Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an interview, applicant is encouraged to use the USPTO Automated Interview Request (AIR) at http://www.uspto.gov/interviewpractice.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Thomas (Tom) HOLLWEG can be reached on (571) 270-1739. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of published or unpublished applications may be obtained from Patent Center. Unpublished application information in Patent Center is available to registered users. To file and manage patent submissions in Patent Center, visit: https://patentcenter.uspto.gov. Visit https://www.uspto.gov/patents/apply/patent-center for more information about Patent Center and https://www.uspto.gov/patents/docx for information about filing in DOCX format. For additional questions, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Andrew Jordan/
Primary Examiner, Art Unit 2883
V: (571) 270-1571 (Pacific time)
F: (571) 270-2571
May 6, 2023

Notice of References Cited	Application/Control No. 18/057,342	Applicant(s)/Patent Under Reexamination Higley et al.	
	Examiner ANDREW JORDAN	Art Unit 2874	Page 1 of 8

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	CPC Classification	US Classification
*	A	US-4690494-A	09-1987	Hirose; Takao	G02B6/3898	385/60
*	B	US-4762389-A	08-1988	Kaihara; Shigeru	G02B6/3825	385/59
*	C	US-4798440-A	01-1989	Hoffer; John C.	G02B6/4246	385/88
*	D	US-5016968-A	05-1991	Hammond; Rodney W.	G02B6/3831	385/78
*	E	US-5879173-A	03-1999	Poplawski; Daniel S.	H01R13/6582	439/138
*	F	US-5896479-A	04-1999	Vladic; Daniel P.	G02B6/3885	385/59
*	G	US-6059461-A	05-2000	Aoki; Kazunori	G02B6/3825	385/59
*	H	US-6234682-B1	05-2001	Nagaoka; Yasutaka	G02B6/3878	385/59
*	I	US-20050111796-A1	05-2005	Matasek, Jeffrey A.	G02B6/4277	385/55
*	J	US-7090509-B1	08-2006	Gilliland; Patrick B.	G02B6/4277	439/76.1
*	K	US-7296935-B1	11-2007	Childers; Darrell R	G02B6/3885	385/59
*	L	US-8152385-B2	04-2012	de Jong; Michael	G02B6/38875	385/71
*	M	US-20120213484-A1	08-2012	Childers; Darrell R.	G02B6/3885	29/428

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NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
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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.

Notice of References Cited	Application/Control No. 18/057,342	Applicant(s)/Patent Under Reexamination Higley et al.	
	Examiner ANDREW JORDAN	Art Unit 2874	Page 2 of 8

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*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	CPC Classification	US Classification
*	A	US-20130156379-A1	06-2013	OTT; Michael James	G02B6/3863	385/76
*	B	US-20130183001-A1	07-2013	Ott; Michael James	G02B6/3809	385/72
*	C	US-20130216186-A1	08-2013	Ott; Michael J.	G02B6/3869	385/78
*	D	US-8559781-B2	10-2013	Childers; Darrell R.	G02B6/3893	385/134
*	E	US-8684611-B2	04-2014	Childers; Darrell R.	G02B6/3821	385/78
*	F	US-20140133808-A1	05-2014	HILL; John P.	G02B6/44	385/84
*	G	US-8985864-B2	03-2015	Ott; Michael James	G02B6/3869	385/72
*	H	US-8985867-B2	03-2015	Michael; James Ott	G02B6/3825	385/60
*	I	US-8979395-B2	03-2015	Michael; James Ott	G02B6/3809	385/95
*	J	US-9052474-B2	06-2015	Jiang; Bolin	A01N25/10	1/1
*	K	US-20150260925-A1	09-2015	Ott; Michael James	G02B6/3825	15/104.8
*	L	US-20150260922-A1	09-2015	Ott; Michael James	G02B6/3893	385/72
*	M	US-20150253519-A1	09-2015	Ott; Michael James	G02B6/3898	29/520

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Notice of References Cited	Application/Control No. 18/057,342	Applicant(s)/Patent Under Reexamination Higley et al.	
	Examiner ANDREW JORDAN	Art Unit 2874	Page 3 of 8

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*	A	US-9207410-B2	12-2015	Lee; Jhih-Ping	G02B6/3879	1/1
*	B	US-9507103-B2	11-2016	Wu; Jun	G02B6/3885	1/1
*	C	US-9523824-B2	12-2016	Ott; Michael James	G02B6/3863	1/1
*	D	US-9568689-B2	02-2017	Nguyen; Hiep V.	G02B6/3898	1/1
*	E	US-9606303-B2	03-2017	Wakjira; Jillcha F.	G02B6/3879	1/1
*	F	US-9625657-B2	04-2017	Ott; Michael James	G02B6/3825	1/1
*	G	US-9638868-B2	05-2017	Ott; Michael James	G02B6/3858	1/1
*	H	US-9684130-B2	06-2017	Veatch; Anthony	G02B6/2726	1/1
*	I	US-20170153396-A1	06-2017	Nguyen; Hiep V.	G02B6/3821	1/1
*	J	US-9739955-B2	08-2017	Lee; Jhih-Ping	G02B6/3821	1/1
*	K	US-9761998-B2	09-2017	De Dios Martin; Longinos	H01R13/6335	1/1
*	L	US-20170276881-A1	09-2017	Ott; Michael James	G02B6/3809	1/1
*	M	US-20170299820-A1	10-2017	Lee; Jhih-Ping	G02B6/3821	1/1

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Notice of References Cited	Application/Control No. 18/057,342	Applicant(s)/Patent Under Reexamination Higley et al.	
	Examiner ANDREW JORDAN	Art Unit 2874	Page 4 of 8

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*	B	US-20170285275-A1	10-2017	Hill; John P.	G02B6/3857	1/1
*	C	US-9829644-B2	11-2017	Nguyen; Hiep V.	G02B6/381	1/1
*	D	US-20170336571-A1	11-2017	Ott; Michael James	G02B6/3869	1/1
*	E	US-20180081124-A1	03-2018	Nguyen; Hiep V.	G02B6/3821	1/1
*	F	US-20180136414-A1	05-2018	Childers; Darrell R.	G02B6/3874	1/1
*	G	US-20180120513-A1	05-2018	Conrad; Craig M.	G02B6/3898	1/1
*	H	US-10054747-B2	08-2018	Lee; Jhih-Ping	G02B6/3821	1/1
*	I	US-20180217338-A1	08-2018	Takano; Kazuyoshi	G02B6/3879	1/1
*	J	US-20180217340-A1	08-2018	WONG; Kimman	G02B6/3893	1/1
*	K	US-10042127-B2	08-2018	Ott; Michael James	G02B6/3881	1/1
*	L	US-10146010-B2	12-2018	Ott; Michael James	G02B6/3809	1/1
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	Examiner ANDREW JORDAN	Art Unit 2874	Page 5 of 8

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*	B	US-10168487-B2	01-2019	Conrad; Craig M.	G02B6/3898	1/1
*	C	US-20190018209-A1	01-2019	TAKANO; Kazuyoshi	G02B6/3893	1/1
*	D	US-20190033533-A1	01-2019	Ott; Michael James	G02B6/3862	1/1
*	E	US-10228516-B2	03-2019	Veatch; Anthony	G02B6/3831	1/1
*	F	US-10288817-B2	05-2019	Nguyen; Hiep V.	G02B6/3893	1/1
*	G	US-10281669-B2	05-2019	Takano; Kazuyoshi	G02B6/3893	1/1
*	H	US-20190137701-A1	05-2019	LEE; JHIH-PING	G02B6/3821	1/1
*	I	US-20190137696-A1	05-2019	Conrad; Craig M.	G02B6/3841	1/1
*	J	US-20190187387-A1	06-2019	WONG; Kimman	G02B6/3821	1/1
*	K	US-20190179086-A1	06-2019	Takano; Kazuyoshi	G02B6/3893	1/1
*	L	US-20190179089-A1	06-2019	Takano; Kazuyoshi	G02B6/3825	1/1
*	M	US-20190179084-A1	06-2019	Ott; Michael James	G02B6/3869	1/1

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	Examiner ANDREW JORDAN	Art Unit 2874	Page 6 of 8

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*	B	US-20190235184-A1	08-2019	TAKANO; Kazuyoshi	G02B6/3821	1/1
*	C	US-20190302383-A1	10-2019	Takano; Kazuyoshi	G02B6/387	1/1
*	D	US-20190346633-A1	11-2019	Cloud; Mitchell	G02B6/3888	1/1
*	E	US-10520687-B2	12-2019	Lee; Jhih-Ping	G02B6/3821	1/1
*	F	US-10520682-B2	12-2019	Ott; Michael James	G02B6/3888	1/1
*	G	US-10598865-B2	03-2020	Ott; Michael James	G02B6/389	1/1
*	H	US-10641968-B2	05-2020	Takano; Kazuyoshi	G02B6/3893	1/1
*	I	US-10678000-B2	06-2020	Takano; Kazuyoshi	G02B6/3893	1/1
*	J	US-10705300-B2	07-2020	Takano; Kazuyoshi	G02B6/4292	1/1
*	K	US-20200209489-A1	07-2020	TAKANO; Kazuyoshi	G02B6/4292	1/1
*	L	US-20200241215-A1	07-2020	Ott; Michael James	G02B6/3881	1/1
*	M	US-20200264384-A1	08-2020	Higley; Jason	G02B6/3831	1/1

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	Examiner ANDREW JORDAN	Art Unit 2874	Page 7 of 8

U.S. PATENT DOCUMENTS

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*	A	US-20200284998-A1	09-2020	Higley; Jason	G02B6/3878	1/1
*	B	US-20200285001-A1	09-2020	Childers; Darrell R.	G02B6/3812	1/1
*	C	US-10768377-B2	09-2020	Conrad; Craig M.	G02B6/3898	1/1
*	D	US-20200319410-A1	10-2020	Ott; Michael James	G02B6/3809	1/1
*	E	US-20210149124-A1	05-2021	Higley; Jason	G02B6/3888	1/1
*	F	US-11092755-B2	08-2021	Ott; Michael James	G02B6/3888	1/1
*	G	US-11092750-B2	08-2021	Ott; Michael James	G02B6/3825	1/1
*	H	US-11112567-B2	09-2021	Higley; Jason	G02B6/3893	1/1
*	I	US-20210286138-A1	09-2021	Higley; Jason	G02B6/3898	1/1
*	J	US-20210405302-A1	12-2021	Higley; Jason	G02B6/38875	1/1
*	K	US-20210382236-A1	12-2021	Ott; Michael James	G02B6/3858	1/1
*	L	US-20210373252-A1	12-2021	Ott; Michael James	G02B6/3862	1/1
*	M	US-11555968-B2	01-2023	Ott; Michael James	G02B6/3825	1/1

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.

Notice of References Cited	Application/Control No. 18/057,342	Applicant(s)/Patent Under Reexamination Higley et al.	
	Examiner ANDREW JORDAN	Art Unit 2874	Page 8 of 8

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	CPC Classification	US Classification
*	A	US-11592627-B2	02-2023	Higley; Jason	G02B6/38875	1/1
*	B	US-11614589-B2	03-2023	Ott; Michael James	G02B6/3869	385/72
*	C	US-20230080980-A1	03-2023	Higley; Jason	G02B6/3898	385/78
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	E					
	F					
	G					
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	I					
	J					
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FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	CPC Classification
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NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
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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.

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/057,342	Higley et al.
	Examiner	Art Unit
	ANDREW JORDAN	2874

CPC - Searched*		
Symbol	**Date**	**Examiner**
G02B6/3812, /3825, /3857, /3893, /3898, /3831, /3879, /3878, and /3873; as well as across G02B6 generally	05/06/2023	aj

CPC Combination Sets - Searched*		
Symbol	**Date**	**Examiner**

US Classification - Searched*			
Class	**Subclass**	**Date**	**Examiner**

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

Search Notes		
Search Notes	**Date**	**Examiner**
G02B6/3812, /3825, /3857, /3893, /3898, /3831, /3879, /3878, and /3873; as well as across G02B6 generally (See search history printout)	05/06/2023	aj
Inventor name search	05/06/2023	aj
Assignee and/or Applicant name search	05/06/2023	aj
PE2E SEARCH search history attached	05/06/2023	aj
Text searching in the CPC search listing areas	05/06/2023	aj
Global Dossier check/confirm	05/06/2023	aj

/ANDREW JORDAN/ Primary Examiner, Art Unit 2874	

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/057,342	Higley et al.
	Examiner	Art Unit
	ANDREW JORDAN	2874

Interference Search			
US Class/CPC Symbol	US Subclass/CPC Group	Date	Examiner
	see attached PE2E SEARCH history	05/06/2023	aj

/ANDREW JORDAN/ Primary Examiner, Art Unit 2874	

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/057,342	Higley et al.
	Examiner	**Art Unit**
	ANDREW JORDAN	2874

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

CLAIMS										
☐ Claims renumbered in the same order as presented by applicant						☐ CPA		☐ T.D.		☐ R.1.47
CLAIM		**DATE**								
Final	Original	05/06/2023								
	1	=								
	2	=								
	3	=								
	4	=								
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	13	=								
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	15	=								
	16	=								
	17	=								

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/057,342	Higley et al.
	Examiner	**Art Unit**
	ANDREW JORDAN	2874

CPC							
Symbol						**Type**	**Version**
G02B	/	6	/	3898		F	2013-01-01
G02B	/	6	/	3825		I	2013-01-01
G02B	/	6	/	3893		I	2013-01-01
G02B	/	6	/	3812		I	2013-01-01
G02B	/	6	/	3857		I	2013-01-01

CPC Combination Sets							
Symbol					**Type**	**Set**	**Ranking**	**Version**
	/		/					

NONE		Total Claims Allowed:	
(Assistant Examiner)	(Date)	17	
/ANDREW JORDAN/ Primary Examiner, Art Unit 2874	06 May 2023	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	2

U.S. Patent and Trademark Office — Part of Paper No.: 20230506

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/057,342	Higley et al.
	Examiner	**Art Unit**
	ANDREW JORDAN	2874

INTERNATIONAL CLASSIFICATION				
CLAIMED				
G02B6/38	/	6	/	38

NON-CLAIMED				
	/		/	

US ORIGINAL CLASSIFICATION	
CLASS	**SUBCLASS**

CROSS REFERENCES(S)						
CLASS	**SUBCLASS (ONE SUBCLASS PER BLOCK)**					

NONE (Assistant Examiner)	(Date)	**Total Claims Allowed:** 17	
/ANDREW JORDAN/ Primary Examiner, Art Unit 2874 (Primary Examiner)	06 May 2023 (Date)	O.G. Print Claim(s) 1	O.G. Print Figure 2

U.S. Patent and Trademark Office

Part of Paper No.: 20230506

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/057,342	Higley et al.
	Examiner	**Art Unit**
	ANDREW JORDAN	2874

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIMS

Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original
1	1	4	10												
2	2	13	11												
3	3	9	12												
6	4	14	13												
7	5	15	14												
8	6	16	15												
10	7	5	16												
11	8	17	17												
12	9														

NONE (Assistant Examiner)	(Date)	**Total Claims Allowed:** 17	
/ANDREW JORDAN/ Primary Examiner, Art Unit 2874 (Primary Examiner)	06 May 2023 (Date)	O.G. Print Claim(s) 1	O.G. Print Figure 2

U.S. Patent and Trademark Office Part of Paper No.: 20230506

PE2E SEARCH - Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	British Equivalents	Time Stamp
L1	1	("20210286138").pn.	(US-PGPUB; USPAT)	OR	ON	ON	2022/06/21 07:10 PM
L2	2	("20210286138").pn.	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/06/21 07:10 PM
L3	16	"66992961".fmid.	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/06/21 07:10 PM
L4	16	("66992961").fmid.	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/06/21 07:11 PM
L5	16	4 OR 3	(US-PGPUB; USPAT; USOCR; FIT (AP, AT,	OR	ON	ON	2022/06/21 07:11 PM

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L6	2728	((Jason near2 Higley) OR (Jillcha near2 Wakjira) OR (Jillcha near2 F. near2 Wakjira) OR (Mitchell near2 Cloud) OR (Darrell near2 Childers) OR (Darrell near2 R. near2 Childers) OR (Michael near2 Hughes) OR (Michael near2 E. near2 Hughes)).inv.	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/06/21 07:23 PM
L7	16	((Jason near2 Higley) AND ((Jillcha near2 Wakjira) OR (Jillcha near2 F. near2 Wakjira)) AND (Mitchell near2 Cloud) AND ((Darrell near2 Childers) OR (Darrell near2 R. near2 Childers)) AND ((Michael near2 Hughes) OR (Michael near2 E. near2 Hughes))).inv.	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/06/21 07:23 PM
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			SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L9	489	(CONEC).as,aanm,asn.	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/06/21 07:24 PM
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L14	6	(G02B6/3898 AND G02B6/3812 AND G02B6/3825 AND G02B6/3857 AND G02B6/3893 AND G02B6/3831 AND G02B6/3879 AND G02B6/3878).cpc.	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/06/21 07:25 PM
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			WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
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L21	839945	G02B6/$.cpc.	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/06/22 05:44 PM

L22	41611	(G02B6/3898 OR G02B6/3812 OR G02B6/3825 OR G02B6/3857 OR G02B6/3893 OR G02B6/3831 OR G02B6/3879 OR G02B6/3878).cpc. 385/78.clas. 385/78.fs. G02B6/3898.cpc. G02B6/3812.cpc. G02B6/3825.cpc. G02B6/3857.cpc. G02B6/3893.cpc.	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/06/22 05:44 PM
L23	40636	(G02B6/3898 OR G02B6/3812 OR G02B6/3825 OR G02B6/3857 OR G02B6/3893 OR G02B6/3831 OR G02B6/3879 OR G02B6/3878).cpc.	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/06/22 05:45 PM
L24	36	("10156684" OR "10191230" OR "10281668" OR "10527802" OR "10585247" OR "10677996" OR "11016250" OR "11016251" OR "20100008635" OR "20100220961" OR "20140133820" OR "20140169727" OR "20150030289" OR "20150177463" OR "20150191024" OR "20160238796" OR "20160306125" OR "20160327757" OR "20170139430" OR "20170299818" OR "20170343740" OR "20180252872" OR "20190018201" OR "20190278028" OR "20200150357" OR	(US-PGPUB; USPAT)	OR	ON	ON	2022/07/02 06:01 AM

		"20200301077" OR "20200371299" OR "5619604" OR "5737463" OR "6019521" OR "6352373" OR "6513989" OR "6572276" OR "7281859" OR "9804337" OR "9857538").pn.					
L25	45722	((latch$4 OR push$1pull$4) WITH slid$4) AND (latch$4 WITH rail$4)	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/07/02 06:19 AM
L26	503	25 AND 19	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/07/02 06:20 AM
L27	41671	22 OR 23	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO;	OR	ON	ON	2022/07/02 06:21 AM

			JPO; DERWENT; IBM_TDB)				
L28	219	25 AND 27	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/07/02 06:21 AM
L29	14426	crimp$4 WITH rail$4	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/07/02 06:21 AM
L30	39	29 AND 27	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/07/02 06:22 AM
L31	403	(rail near2 receiving near2 portion) WITH hous$4	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS,	OR	ON	ON	2022/07/02 06:31 AM

			IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L32	13	31 AND 30	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/07/02 06:31 AM
L33	53445	((Fiber$4 OR fibre$4) near2 optic$4 connect$4) AND (Hous$4) AND (Rail$4 near2 receiv$4)	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/07/02 06:38 AM
L34	6065	((Fiber$4 OR fibre$4) near2 optic$4 connect$4) SAME (Hous$4) SAME (Rail$4 near2 receiv$4)	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/07/02 06:39 AM

L35	186	34 AND 27	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/07/02 06:40 AM
L36	3032	((Fiber$4 OR fibre$4) near2 optic$4 connect$4) SAME ((Hous$4) WITH (Rail$4 near2 receiv$4))	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/07/02 06:40 AM
L37	112	36 AND 27	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/07/02 06:40 AM
L38	195	((Fiber$4 OR fibre$4) near2 optic$4 connect$4) SAME ((Hous$4) WITH (Rail$4 near2 receiv$4) WITH (latch$4 OR detent$4 OR pawl$4))	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL,	OR	ON	ON	2022/07/02 06:43 AM

			NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L39	13	38 AND 27	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/07/02 06:43 AM
L40	38	(Artificial Intelligence) More like doc: US-20210286138-A1 Text: (WO-2017127208-A1 OR EP-3405824-A1 OR US-7331719-B2 OR US-20070127873-A1 OR CN-107193087-B OR CN-207008118-U OR CN-107193087-A OR EP-3405824-B1 OR CN-112612087-A OR EP-3414608-B1 OR WO-2019126333-A1 OR US-20200284998-A1 OR EP-3761091-A1 OR US-20210149124-A1 OR CN-114303083-A OR EP-3776033-A1 OR US-20210341681-A1 OR US-20210263228-A1 OR EP-3729154-A1 OR US-20210278609-A1).did.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/07/02 06:47 AM
L41	5	40 AND rail$4	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV,	OR	ON	ON	2022/07/02 06:47 AM

			MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L42	60	(((Fiber$4 OR fibre$4) near2 optic$4 connect$4) SAME ((Hous$4) WITH (Rail$4 near2 receiv$4) WITH (latch$4 OR detent$4 OR pawl$4))).clm.	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/07/02 06:53 AM
L43	457	("2899669" | "3264601" | "3332860" | "3474380" | "3497866" | "3670290" | "3673545" | "3737729" | "3792284" | "3805116" | "3809908" | "3976877" | "3990761" | "4149072" | "4156903" | "4161650" | "4176897" | "4217488" | "4226491" | "4234968" | "4249266" | "4252402" | "4257124" | "4273413" | "4276656" | "4330870" | "4347655" | "4357606" | "4360248" | "4366565" | "4369494" | "4380360" | "4388671" | "4393516" | "4399563" | "4408273" | "4422088" | "4427879" | "4430699" | "4432604" | "4437190" | "4446515" | "4449244" | "4453903" | "4459658" | "4461537" | "4470154" | "4486059" | "4493113" | "4501021" | "4506937" | "4510553" | "4511207" | "4514586" | "4516204" | "4519670" | "4519672" | "4519673" | "4522463" | "4526438" | "4526986" | "4527286" | "4529266" | "4530566" | "4531810" | "4533208"	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2022/07/02 07:05 AM

		| "4533209" | "4533813" | "4534616" | "4534617" | "4535233" | "4537468" | "4539476" | "4540237" | "4540246" | "4541685" | "4542076" | "4544231" | "4544233" | "4544234" | "4545074" | "4545077" | "4545642" | "4545643" | "4545644" | "4545645" | "4548465" | "4548466" | "4548467" | "4549782" | "4549783" | "4550975" | "4553811" | "4553814" | "4556279" | "4556281" | "4556282" | "4557551" | "4560234" | "4563057" | "4566753" | "4568145" | "4569569" | "4573760" | "4580295" | "4580872" | "4588256" | "4589728" | "4595839" | "4597631" | "4612670" | "4614836" | "4625333" | "4629270" | "4634239" | "4647148" | "4652976" | "4663240" | "4663603" | "4678264" | "4679883" | "RE32502" | "4695106" | "4697864" | "4708433" | "4720630" | "4722584" | "4727248" | "4762388" | "4772931" | "4798430" | "4807006" | "4807955" | "4811165" | "4812133" | "4840451" | "4844581" | "4847711" | "4849944" | "4857002" | "4881789" | "4884336" | "4897711" | "4906197" | "4913511" | "4927225" | "4944568" | "4945229" | "4953929" | "4977329" | "4979787" | "4986625" | "4990104" | "5004434" | "5005939" | "5006286" | "5011246" | "5011425" | "5013247" | "5035482" | "5039194" | "5043775" | "5045971" | "5046955" | "5060373" | "5069522" | "5082344" | "5084802" | "5093879" | "5094623" | "5099307" | "5101463" | "5104243" | "5107404" | "5108294" | "5109453" | "5116239" | "5117476" | "5118362" | "5120578" | "5122893"					

		| "5125849" | "5134677" | "5136152" | "5136603" | "5138537" | "5155786" | "5168537" | "5170146" | "5183405" | "5202943" | "5212752" | "5234353" | "5241614" | "5243678" | "5259054" | "5271079" | "5274729" | "5280191" | "5285466" | "5285511" | "5285512" | "5289345" | "5295214" | "5296813" | "5304069" | "5305182" | "5317663" | "5321819" | "5325455" | "5329428" | "5329604" | "5333225" | "5335301" | "5337391" | "5337396" | "5337398" | "5345524" | "5345530" | "5356300" | "5357402" | "5361244" | "5366664" | "5375040" | "5397242" | "5414787" | "5416668" | "5416870" | "5416871" | "5416872" | "5428704" | "5432630" | "5434747" | "5446814" | "5452387" | "5455703" | "5470259" | "5475734" | "5478253" | "5482658" | "5487678" | "5491712" | "5499311" | "5499312" | "5515468" | "5528408" | "5535296" | "5546281" | "5547385" | "5548677" | "5550941" | "5554037" | "5561727" | "5567167" | "5577064" | "5580269" | "5596663" | "5598319" | "5599595" | "5629919" | "5631998" | "5687267" | "5696669" | "5717533" | "5724729" | "5734558" | "5736782" | "5767999" | "5779504" | "5847932" | "5879173").pn. OR ("7090509").urpn. AND (PGPB | USPT | USOC).dbnm.				
L44	83	((Fiber$4 OR fibre$4) near2 optic$4 near2 connect$4) SAME (Hous$4) SAME (Rail$4 near2 receiv$4)	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL,	OR	ON	ON	2022/07/02 07:06 AM

			NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L45	58	44 AND 27	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/07/02 07:06 AM
L46	1	45 AND 43	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/07/02 07:07 AM
L47	1	("20230080980").pn.	(US-PGPUB; USPAT)	OR	ON	ON	2023/04/13 12:43 PM
L48	2	("20230080980").pn.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/04/13 12:43 PM

L49	26	"66992961".fmid.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/04/13 12:44 PM
L50	27	3 OR 2 OR 1	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/04/13 12:44 PM
L51	28	(Artificial Intelligence) More like doc: US-20230080980-A1 Text: (US-20200284998-A1 OR WO-2019126333-A1 OR EP-3729154-A1 OR US-11016250-B2 OR US-11506848-B2 OR US-20210286138-A1 OR CN-111492284-A OR US-20230096618-A1 OR CN-115201974-A OR CN-111492284-B OR US-20200285001-A1 OR US-11016251-B2 OR WO-2019126337-A1 OR EP-3729153-A1 OR US-11525965-B2 OR US-20210278609-A1 OR CN-111512202-B OR CN-111512202-A OR CN-115933066-A OR WO-2017127208-	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/04/13 12:47 PM

		A1).did.					
L52	26	("66992961").fmid.	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/04/13 01:33 PM
L53	45222	(G02B6/3898 or G02B6/3812 or G02B6/3825 or G02B6/3857 or G02B6/3893 or G02B6/3831 or G02B6/3879 or G02B6/3878 or G02B6/3873).cpc.	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/04/13 01:34 PM
L54	890513	G02B6/$.cpc. (G02B6/3898 OR G02B6/3812 OR G02B6/3825 OR G02B6/3857 OR G02B6/3893 OR G02B6/3831 OR G02B6/3879 OR G02B6/3878 OR G02B6/3873).cpc. 385/78.clas. 385/78.fs. G02B6/3898.cpc. G02B6/3812.cpc. G02B6/3825.cpc. G02B6/3857.cpc. G02B6/3893.cpc. (385/78).ccls. (385/78).ccls. (385/78).fs. (385/78).fs. (385/78).ccls,fs. (385/78).ccls,fs. (G02B6/3898 OR G02B6/3812 OR G02B6/3825 OR G02B6/3857 OR	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/04/13 01:35 PM

		G02B6/3893).cpc.					
L55	47811	(G02B6/3898 OR G02B6/3812 OR G02B6/3825 OR G02B6/3857 OR G02B6/3893 OR G02B6/3831 OR G02B6/3879 OR G02B6/3878 OR G02B6/3873).cpc. 385/78.clas. 385/78.fs. G02B6/3898.cpc. G02B6/3812.cpc. G02B6/3825.cpc. G02B6/3857.cpc. G02B6/3893.cpc. (385/78).ccls. (385/78).ccls. (385/78).fs. (385/78).fs. (385/78).ccls,fs. (385/78).ccls,fs. (G02B6/3898 OR G02B6/3812 OR G02B6/3825 OR G02B6/3857 OR G02B6/3893).cpc.	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/04/13 01:35 PM
L56	890263	G02B6/$.cpc.	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/04/13 01:35 PM
L57	28	(G02B6/3898 AND G02B6/3812 AND G02B6/3825 AND G02B6/3857 AND G02B6/3893 AND G02B6/3831 AND G02B6/3879 AND G02B6/3878 AND G02B6/3873).cpc. (G02B6/3898 AND G02B6/3812 AND G02B6/3825 AND G02B6/3857 AND G02B6/3893).cpc.	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/04/13 01:35 PM

L58	28	(G02B6/3898 AND G02B6/3812 AND G02B6/3825 AND G02B6/3857 AND G02B6/3893).cpc.	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/04/13 01:35 PM
L59	9	(G02B6/3898 AND G02B6/3812 AND G02B6/3825 AND G02B6/3857 AND G02B6/3893 AND G02B6/3831 AND G02B6/3879 AND G02B6/3878 AND G02B6/3873).cpc.	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/04/13 01:35 PM
L60	560	(US near2 CONEC).as,aanm,asn.	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/04/13 01:35 PM
L61	20	((Jason near2 Higley) AND ((Jillcha near2 Wakjira) OR (Jillcha near2 F. near2 Wakjira)) AND (Mitchell near2 Cloud) AND ((Darrell near2 Childers) OR (Darrell near2 R. near2 Childers)) AND	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL,	OR	ON	ON	2023/04/13 01:36 PM

		((Michael near2 Hughes) OR (Michael near2 E. near2 Hughes))).inv.	NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L62	2926	((Jason near2 Higley) OR (Jillcha near2 Wakjira) OR (Jillcha near2 F. near2 Wakjira) OR (Mitchell near2 Cloud) OR (Darrell near2 Childers) OR (Darrell near2 R. near2 Childers) OR (Michael near2 Hughes) OR (Michael near2 E. near2 Hughes)).inv.	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/04/13 01:36 PM
L63	20	15 AND 14	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/04/13 01:36 PM
L64	331	16 AND 14	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/04/13 01:36 PM
L65	21	16 AND 14 AND 11	(US-PGPUB; USPAT; USOCR; FIT (AP, AT,	OR	ON	ON	2023/04/13 01:36 PM

			AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L66	327	16 AND 14 AND 8	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/04/13 01:37 PM
L67	12	((fiber$4 OR fibre$4) near2 optic$4 near2 connect$4) AND (hous$4) AND (main$4 near2 body$4) AND (open$4) AND (two$3 near2 ferrule$4 near2 assemblies$4) AND ((fiber$4 OR fibre$4) near2 optic$4 near2 ferrule$4) AND (ferrule$4 near2 holder$4) AND (two$3 near2 springs$4) AND (bias$4) AND (retain$4) AND (crimp$4 near2 bod$3) AND (align$4 near2 featur$4) AND (strain$4 near2 relief$4 near2 boot$4)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/05/06 10:51 PM
L68	54	((fiber$4 OR fibre$4) near2 optic$4 near2 connect$4) AND ((crimp$4 OR heat$1shrink$4) near2 bod$3) AND (align$4 near2 featur$4) AND	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS,	OR	ON	ON	2023/05/06 10:57 PM

		(strain$4 near2 relief$4 near2 boot$4)	IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L69	42	22 NOT 21	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/05/06 10:58 PM
L70	42	23 AND 8	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/05/06 10:58 PM
L71	42	23 NOT 21	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/05/06 10:59 PM

L72	35	23 NOT 21 NOT 14	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/05/06 11:00 PM
L73	35	23 NOT 21 NOT 14	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/05/06 11:08 PM
L74	45	("1112567"|"20210149124"|"20210286138"|"20210405302"|"5879173"|"7090509").PN.	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/05/06 11:22 PM
L75	341	("0054747"|"0168487"|"0185099"|"0185100"|"0228516"|"0281668"|"0281669"|"0288817"|"0520687"|"0585247"|"0641968"|"0678000"|"0705300"|"0768377"|"20050111796"|"20140133808"|"20170153396"|"20170	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL,	OR	ON	ON	2023/05/06 11:24 PM

		285268"|"20170285275"|"20170299820"|"20180081124"|"20180120513"|"20180136414"|"20180217338"|"20180217340"|"20190018209"|"20190137696"|"20190137701"|"20190179086"|"20190179089"|"20190187387"|"20190235184"|"20190250344"|"20190278028"|"20190302383"|"20190346633"|"20200150357"|"20200209489"|"20200264384"|"20200284998"|"20200285001"|"4690494"|"4762389"|"4798440"|"5016968"|"5896479"|"6059461"|"6234682"|"7296935"|"8152385"|"8559781"|"9052474"|"9207410"|"9507103"|"9568689"|"9606303"|"9684130"|"9739955"|"9761998"|"9829644"|"0677996"|"20150191024"|"20170139430"|"20170343740"|"20180252872"|"20200301077"|"20200371299"|"6019521"|"6513989"|"7281859"|"9804337"|"20150177463"|"20100220961"|"20140169727"|"20150030289"|"20160238796"|"20160306125"|"20160327757"|"20170299818"|"5619604"|"5737463"|"6352373"|"20190278028"|"0585247"|"20100008635"|"20140133820"|"20200150357").PN.	NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L76	2	("20200284998").PN.	(US-PGPUB; USPAT; USOCR; DERWENT)	OR	ON	ON	2020/10/12 02:09 PM
L77	4	"66992961".fmid.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2020/10/12 02:10 PM
L78	5	L76 or L77	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2020/10/12 02:10 PM
L79	1880	((Jason near2 Higley) or (Jillcha near2 Wakjira) or (Jillcha near2 "F." near2 Wakjira) or (Mitchell	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2020/10/12 02:14 PM

		near2 Cloud) or (Darrell near2 Childers) or (Darrell near2 "R." near2 Childers) or (Michael near2 Hughes) or (Michael near2 "E." near2 Hughes)).inv.					
L80	4	((Jason near2 Higley) and ((Jillcha near2 Wakjira) or (Jillcha near2 "F." near2 Wakjira)) and (Mitchell near2 Cloud) and ((Darrell near2 Childers) or (Darrell near2 "R." near2 Childers)) and ((Michael near2 Hughes) or (Michael near2 "E." near2 Hughes))).inv.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2020/10/12 02:15 PM
L81	285	(US near2 CONEC).as,aanm,asn.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2020/10/12 02:15 PM
L82	150	L79 and L81	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2020/10/12 02:15 PM
L83	172486	(push$1pull$4 near2 mechanism) or push$1pull$4	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2020/10/23 11:28 PM
L84	4	("66992961").fmid.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2020/10/23 11:29 PM
L85	1883	((Jason near2 Higley) or (Jillcha near2 Wakjira) or (Jillcha near2 "F." near2 Wakjira) or (Mitchell near2 Cloud) or (Darrell near2 Childers) or (Darrell near2 "R." near2 Childers) or (Michael near2 Hughes) or (Michael near2 "E." near2 Hughes)).inv.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2020/10/23 11:44 PM
L86	4	((Jason near2 Higley) and ((Jillcha near2 Wakjira) or (Jillcha near2 "F." near2 Wakjira)) and (Mitchell near2 Cloud) and ((Darrell near2 Childers) or (Darrell near2 "R."	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2020/10/23 11:44 PM

		near2 Childers)) and ((Michael near2 Hughes) or (Michael near2 "E." near2 Hughes))).inv.					
L87	271	(US near2 CONEC).as,aanm,asn.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2020/10/23 11:44 PM
L88	22470	(G02B6/3898 or G02B6/3812 or G02B6/3857 or G02B6/3825 or G02B6/3893).cpc. 385/78.clas. 385/78.fs. G02B6/3898.cpc. G02B6/3812.cpc. G02B6/3825.cpc. G02B6/3857.cpc. G02B6/3893.cpc. (385/78).ccls. (385/78).ccls. (385/78).fs. (385/78).fs. (385/78).ccls,fs. (385/78).ccls,fs. (G02B6/3898 or G02B6/3812 or G02B6/3825 or G02B6/3857 or G02B6/3893).cpc.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2020/10/23 11:44 PM
L89	3	(G02B6/3898 and G02B6/3812 and G02B6/3857 and G02B6/3825 and G02B6/3893).cpc. (G02B6/3898 and G02B6/3812 and G02B6/3825 and G02B6/3857 and G02B6/3893).cpc.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2020/10/23 11:44 PM
L90	3	(G02B6/3898 and G02B6/3812 and G02B6/3857 and G02B6/3825 and G02B6/3893).cpc.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2020/10/23 11:45 PM
L91	3	(G02B6/3898 and G02B6/3812 and G02B6/3825 and G02B6/3857 and G02B6/3893).cpc.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2020/10/23 11:45 PM
L92	630	L83 and L88	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2020/10/23 11:46 PM
L93	26	L83 and L87	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT;	OR	ON	ON	2020/10/23 11:46 PM

			IBM_TDB)				
L94	17	L83 and L87 and L85	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2020/10/23 11:48 PM
L95	1615	L83 with latch$4	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2020/10/23 11:59 PM
L96	5	L94 and L95	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2020/10/23 11:59 PM
L97	14	("10191230"|"10527802"|"20190018201"|"20100220961"|"20140169727"|"20150030289"|"20150177463"|"20160238796"|"20160306125"|"20160327757"|"20170299818"|"5619604"|"5737463"|"6352373").PN.	(US-PGPUB; USPAT)	OR	ON	ON	2020/10/24 12:01 AM
L98	78	("16778144" "24309036" "24430653" "65000276" "57182707" "57221852" "53931403" "56622105" "53399806" "49993222" "47108191" "42125909" "62979226" "62979226").fmid.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2020/10/24 12:01 AM
L99	64	L98 not L97	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2020/10/24 12:02 AM
L100	11	("20100220961"|"20140169727"|"20150030289"|"20150177463"|"20160238796"|"20160306125"|"20160327757"|"20170299818"|"5619604"|"5737463"|"6352373").PN.	(US-PGPUB; USPAT)	OR	ON	ON	2020/10/24 01:25 AM
L101	8	"16778144".fmid.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2020/10/24 01:33 AM
L102	5	("4690494" | "4762389" | "4798440" | "6059461" | "6234682").PN. OR ("6352373").URPN.	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2020/10/24 01:33 AM
L103	1	("20190018201").PN.	(US-PGPUB; USPAT)	OR	ON	ON	2020/10/24 01:40 AM
L104	2	("10191230"|"10527802").PN.	(US-PGPUB; USPAT)	OR	ON	ON	2020/10/24 01:41 AM

L105	18366	latch$4 with hous$4 with slid$4	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2020/10/26 03:11 PM
L106	22477	(G02B6/3898 or G02B6/3812 or G02B6/3857 or G02B6/3825 or G02B6/3893).cpc. 385/78.clas. 385/78.fs. G02B6/3898.cpc. G02B6/3812.cpc. G02B6/3825.cpc. G02B6/3857.cpc. G02B6/3893.cpc. (385/78).ccls. (385/78).ccls. (385/78).fs. (385/78).fs. (385/78).ccls,fs. (385/78).ccls,fs. (G02B6/3898 or G02B6/3812 or G02B6/3825 or G02B6/3857 or G02B6/3893).cpc.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2020/10/26 03:11 PM
L107	427	L105 and L106	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2020/10/26 03:11 PM
L108	289	(US near2 CONEC).as,aanm,asn.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2020/10/26 03:16 PM
L109	31	L108 and latch$4 and hous$4 and slid$4	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2020/10/26 03:16 PM
L110	992	L106 and ((latch$4 or push$1pull$4) with slid$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2020/10/26 03:20 PM
L111	73	L106 and ((latch$4 or push$1pull$4) with slid$4) and (latch$4 with rail$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2020/10/26 03:22 PM
L112	11	"62978783".fmid.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2020/10/26 03:26 PM
L113	7	"62978783".fmid. and crimp$4	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2020/10/26 06:54 PM
L114	22477	(G02B6/3898 or G02B6/3812 or G02B6/3857 or	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT;	OR	ON	ON	2020/10/26 06:55 PM

		G02B6/3825 or G02B6/3893).cpc. 385/78.clas. 385/78.fs. G02B6/3898.cpc. G02B6/3812.cpc. G02B6/3825.cpc. G02B6/3857.cpc. G02B6/3893.cpc. (385/78).ccls. (385/78).ccls. (385/78).fs. (385/78).fs. (385/78).ccls,fs. (385/78).ccls,fs. (G02B6/3898 or G02B6/3812 or G02B6/3825 or G02B6/3857 or G02B6/3893).cpc.	IBM_TDB)				
L115	73	L114 and ((latch$4 or push$1pull$4) with slid$4) and (latch$4 with rail$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2020/10/26 06:55 PM
L116	7	"62978783".fmid. and crimp$4 and L115	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2020/10/26 06:55 PM
L117	22477	(G02B6/3898 or G02B6/3812 or G02B6/3857 or G02B6/3825 or G02B6/3893).cpc. 385/78.clas. 385/78.fs. G02B6/3898.cpc. G02B6/3812.cpc. G02B6/3825.cpc. G02B6/3857.cpc. G02B6/3893.cpc. (385/78).ccls. (385/78).ccls. (385/78).fs. (385/78).fs. (385/78).ccls,fs. (385/78).ccls,fs. (G02B6/3898 or G02B6/3812 or G02B6/3825 or G02B6/3857 or G02B6/3893).cpc.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2020/10/26 08:33 PM
L118	73	L117 and ((latch$4 or push$1pull$4) with slid$4) and (latch$4 with rail$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2020/10/26 08:33 PM
L119	26	crimp$4 and L118	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2020/10/26 09:09 PM
L120	140	("20020090177" | "20030017729" | "20030220008" |	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2020/10/26 09:23 PM

		"20030220080" | "20030220081" | "20030220082" | "20030220083" | "20030220084" | "20030220085" | "20030220086" | "20030220087" | "20030220088" | "20030220089" | "20030222008" | "20040247252" | "20050054230" | "20050058404" | "20050124201" | "20060049826" | "20060089039" | "20070049082" | "20070077806" | "20070140621" | "20070232118" | "20070298636" | "20080030220" | "20080226237" | "20090042424" | "20090047818" | "20090245732" | "20100216325" | "20100220961" | "20110058773" | "20110081113" | "20110091159" | "20110183541" | "20110217008" | "20110299814" | "20120057826" | "20120155810" | "20120208388" | "20120213478" | "20120308183" | "20130115794" | "20130163934" | "20130301994" | "20130323949" | "20140141641" | "20140169727" | "20160116685" | "20160356962" | "20170031109" | "5011424" | "5090916" | "5123071" | "5211572" | "5315679" | "5335301" | "5462457" | "5481634" | "5574812" | "5579425" | "5638474" | "5651690" | "5675682" | "6024498" | "6076974" | "6196733" | "6250817" | "6250942"					

		"6254418" | "6276839" | "6325547" | "6357934" | "6435732" | "6443627" | "6447170" | "6692289" | "6776645" | "6863556" | "6885560" | "6994580" | "7037129" | "7052186" | "7101212" | "7163414" | "7281938" | "7297013" | "7326075" | "7329137" | "7354292" | "7413473" | "7421181" | "7425159" | "7440670" | "7445484" | "7465180" | "7534125" | "7534128" | "7549888" | "7588373" | "7594766" | "7632125" | "7641398" | "7651361" | "7666023" | "7690939").PN. OR ("7736171" | "7753710" | "7771225" | "7892012" | "8152384" | "8152385" | "8187018" | "8221007" | "8235745" | "8267712" | "8317532" | "8382506" | "8465317" | "8556645" | "8690593" | "8747141" | "8764308" | "8864390" | "8870466" | "8876403" | "8979569" | "9557495" | "9570852").PN. OR ("9761998").URPN.					
L121	2	("2018/0217338").URPN.	(USPAT)	OR	ON	ON	2020/10/26 09:27 PM
L122	189	("20020172467" | "20030053787" | "20030157825" | "20040052473" | "20040136657" | "20040141693" | "20040161958" | "20040234209" | "20050111796" | "20050141817" | "20060089049" | "20060127025" | "20060160429" | "20060269194" | "20060274411" | "20070028409" | "20070079854" | "20070098329" | "20070149062" | "20070230874" | "20070232115" | "20070243749" | "20080008430" |	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2020/10/26 09:29 PM

		"20080044137" | "20080069501" | "20080101757" | "20080226237" | "20080267566" | "20090022457" | "20090028507" | "20090092360" | "20090196555" | "20090214162" | "20090220197" | "20090290938" | "20100034502" | "20100247041" | "20100322561" | "20110044588" | "20110131801" | "20110177710" | "20120099822" | "20120155810" | "20120189260" | "20120269485" | "20120301080" | "20130071067" | "20130089995" | "20130094816" | "20130121653" | "20130183012" | "20130259429" | "20130322825" | "20140016901" | "20140023322" | "20140050446" | "20140133808" | "20140219621" | "20140226946" | "20140241678" | "20140241688" | "20140334780" | "20140348477" | "20150301294" | "20150331201" | "20150355417" | "20150378113" | "20160131849" | "20160172852" | "20160195682" | "20160259135" | "20160266326" | "20160291262" | "20160320572" | "20170003458" | "4150790" | "4327964" | "4478473" | "4762388" | "4764129" | "4840451" | "4872736" | "4979792" | "5041025" | "5212752" | "5265181" | "5289554" |				

		"5317663" | "5335301" | "5348487" | "5444806" | "5481634" | "5506922" | "5521997" | "5570445" | "5588079" | "5684903" | "5687268" | "5781681" | "5937130").PN. OR ("5956444" | "5971626" | "6041155" | "6049040" | "6134370" | "6178283" | "6206577" | "6206581" | "6227717" | "6238104" | "6247849" | "6364537" | "6461054" | "6471412" | "6478472" | "6551117" | "6579014" | "6634801" | "6648520" | "6682228" | "6685362" | "6695486" | "6854894" | "6872039" | "6935789" | "7090406" | "7090407" | "7091421" | "7111990" | "7113679" | "7150567" | "7153041" | "7198409" | "7207724" | "7258493" | "7281859" | "7315682" | "7325976" | "7325980" | "7329137" | "7331718" | "7354291" | "7371082" | "7387447" | "7390203" | "7431604" | "7463803" | "7465180" | "7510335" | "7513695" | "7561775" | "7591595" | "7594766" | "7641398" | "7695199" | "7699533" | "7824113" | "7837395" | "8083450" | "8186890" | "8192091" | "8202009" | "8251733" | "8267595" | "8270796" | "8408815" | "8465317" | "8636424" | "8651749" | "8770863" | "9411110" | "9494744" | "9548557" | "9551842" | "9568686" | "9581768" | "9599778" | "9684313" | "9709753" | "9869825" | "D323143" | "D533504" | "D534124" | "D543146" | "D558675" | "D572661" | "D641708" | "RE37080").PN. OR ("10185100").URPN.				
L123	2500	crimp$4 with rail$4	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2020/10/28 07:20 PM

L124	22481	(G02B6/3898 or G02B6/3812 or G02B6/3857 or G02B6/3825 or G02B6/3893).cpc. 385/78.clas. 385/78.fs. G02B6/3898.cpc. G02B6/3812.cpc. G02B6/3825.cpc. G02B6/3857.cpc. G02B6/3893.cpc. (385/78).ccls. (385/78).ccls. (385/78).fs. (385/78).fs. (385/78).ccls,fs. (385/78).ccls,fs. (G02B6/3898 or G02B6/3812 or G02B6/3825 or G02B6/3857 or G02B6/3893).cpc.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2020/10/28 07:20 PM
L125	7	L123 and L124	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2020/10/28 07:20 PM
L126	2	"68101153".FMID.	(US-PGPUB; USPAT; FPRS; JPO)	OR	ON	ON	2020/10/28 07:21 PM
L127	97900	(polar$4 or polariz$4 or polarizat$4) with indic$4	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2020/10/28 08:29 PM
L128	22481	(G02B6/3898 or G02B6/3812 or G02B6/3857 or G02B6/3825 or G02B6/3893).cpc. 385/78.clas. 385/78.fs. G02B6/3898.cpc. G02B6/3812.cpc. G02B6/3825.cpc. G02B6/3857.cpc. G02B6/3893.cpc. (385/78).ccls. (385/78).ccls. (385/78).fs. (385/78).fs. (385/78).ccls,fs. (385/78).ccls,fs. (G02B6/3898 or G02B6/3812 or G02B6/3825 or G02B6/3857 or G02B6/3893).cpc.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2020/10/28 08:29 PM
L129	116	L127 and L128	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2020/10/28 08:29 PM
L130	172705	(push$1pull$4 near2 mechanism) or	(US-PGPUB; USPAT; USOCR; FPRS; EPO;	OR	ON	ON	2020/10/28 08:29 PM

		push$1pull$4	JPO; DERWENT; IBM_TDB)				
L131	24	L127 and L128 and L130	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2020/10/28 08:29 PM
L132	38	L130 with carrier with connector	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2020/10/28 08:42 PM
L133	11	L132 and L128	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2020/10/28 08:42 PM
L134	2	WO-2019126333-$.did.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2020/10/28 08:43 PM
L135	4	"66992961".fmid.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2020/10/28 08:43 PM
L136	659	(crimp$4 near2 bod$3) with receiv$4	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2020/10/28 09:10 PM
L137	61	L136 and L128	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2020/10/28 09:10 PM
L138	21	(crimp$4 near2 bod$3) with ((receiv$4 or accommodat$4) near2 (surfac$4 or sid$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2020/10/28 09:11 PM
L139	3	L138 and L128	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2020/10/28 09:12 PM
L140	38	(crimp$4 near2 bod$3) with rail$4	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2020/10/28 09:14 PM
L141	3	L140 and L128	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2020/10/28 09:14 PM
L142	491523	G02B6/$.cpc.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2020/10/28 09:15 PM
L143	8	L140 and L144	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2020/10/28 09:16 PM

L144	3600	L127 and L144	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2020/10/28 09:17 PM
L145	51	L127 and L144 and L130	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2020/10/28 09:17 PM
L146	12	"50681773".fmid.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2020/10/28 09:29 PM
L147	97938	(polar$4 or polariz$4 or polarizat$4) with indic$4	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2020/10/28 10:15 PM
L148	12	"50681773".fmid.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2020/10/28 10:15 PM
L149	6	L150 and L149	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2020/10/28 10:15 PM
L150	8	"16778144".fmid.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2020/10/28 11:53 PM
L151	4	(US-20180217338-$ or US-20140133808-$).did. or (US-9761998-$ or US-10705300-$).did.	(US-PGPUB; USPAT)	OR	ON	ON	2020/10/29 12:23 AM
L152	14571	ferrul$4 with spring$4	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2020/10/29 12:23 AM
L153	3	L153 and L154	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2020/10/29 12:24 AM
L154	16	("10585247"|"10677996"|"20100008635"|"20140133820"|"20150191024"|"20170139430"|"20170343740"|"20180252872"|"20190278028"|"20200150357"|"20200301077"|"20200371299"|"6019521"|"6513989"|"7281859"|"9804337").PN.	(US-PGPUB; USPAT)	OR	ON	ON	2021/03/12 08:11 PM
L155	4	wo-2019126333-$.did. or wo-2020160254-$.did.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT;	OR	ON	ON	2021/03/12 08:15 PM

			IBM_TDB)				
L156	16	L156 or L157	(US-PGPUB; USPAT)	OR	ON	ON	2021/03/12 08:17 PM
L157	20	L156 or L157	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/03/12 08:17 PM
L158	23079	(G02B6/3898 or G02B6/3812 or G02B6/3857 or G02B6/3825 or G02B6/3893).cpc. 385/78.clas. 385/78.fs. G02B6/3898.cpc. G02B6/3812.cpc. G02B6/3825.cpc. G02B6/3857.cpc. G02B6/3893.cpc. (385/78).ccls. (385/78).ccls. (385/78).fs. (385/78).fs. (385/78).ccls,fs. (385/78).ccls,fs. (G02B6/3898 or G02B6/3812 or G02B6/3825 or G02B6/3857 or G02B6/3893).cpc.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/03/12 08:18 PM
L159	81	L160 and ((latch$4 or push$1pull$4) with slid$4) and (latch$4 with rail$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/03/12 08:18 PM
L160	23079	(G02B6/3898 or G02B6/3812 or G02B6/3857 or G02B6/3825 or G02B6/3893).cpc. 385/78.clas. 385/78.fs. G02B6/3898.cpc. G02B6/3812.cpc. G02B6/3825.cpc. G02B6/3857.cpc. G02B6/3893.cpc. (385/78).ccls. (385/78).ccls. (385/78).fs. (385/78).fs. (385/78).ccls,fs. (385/78).ccls,fs. (G02B6/3898 or G02B6/3812 or G02B6/3825 or G02B6/3857 or G02B6/3893).cpc.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/03/12 08:18 PM
L161	81	L162 and ((latch$4 or push$1pull$4) with slid$4) and (latch$4 with rail$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/03/12 08:18 PM
L162	81	L163 or L161	(US-PGPUB; USPAT;	OR	ON	ON	2021/03/12

			USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)				08:19 PM
L163	2	L159 and L164	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/03/12 08:19 PM

PE2E SEARCH - Search History (Interference)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	British Equivalents	Time Stamp
N1	1682	(((latch$4 OR push$1pull$4) WITH slid$4) AND (latch$4 WITH rail$4)).clm.	(US-PGPUB; USPAT)	OR	ON	ON	2022/07/02 06:48 AM
N2	10673	((push$1pull$4 near2 mechanism) OR push$1pull$4).clm.	(US-PGPUB; USPAT)	OR	ON	ON	2022/07/02 06:48 AM
N3	7	((crimp$4 near2 bod$3) WITH ((receiv$4 OR accommodat$4) near2 (surfac$4 OR sid$3))).clm.	(US-PGPUB; USPAT)	OR	ON	ON	2022/07/02 06:48 AM
N4	4974	((polar$4 OR polariz$4 OR polarizat$4) WITH indic$4).clm.	(US-PGPUB; USPAT)	OR	ON	ON	2022/07/02 06:49 AM
N5	11	N1 AND N2	(US-PGPUB; USPAT)	OR	ON	ON	2022/07/02 06:50 AM
N6	22	(((Fiber$4 OR fibre$4) near2 optic$4 connect$4) SAME ((Hous$4) WITH (Rail$4 near2 receiv$4) WITH (latch$4 OR detent$4 OR pawl$4))).clm.	(US-PGPUB; USPAT)	OR	ON	ON	2022/07/02 06:53 AM
N7	141861	G02B6/$.cpc. (G02B6/3898 OR G02B6/3812 OR G02B6/3825 OR G02B6/3857 OR G02B6/3893 OR G02B6/3831 OR G02B6/3879 OR G02B6/3878).cpc. 385/78.clas. 385/78.fs. G02B6/3898.cpc. G02B6/3812.cpc. G02B6/3825.cpc. G02B6/3857.cpc. G02B6/3893.cpc. (385/78).ccls. (385/78).ccls. (385/78).fs. (385/78).fs. (385/78).ccls,fs. (385/78	(US-PGPUB; USPAT)	OR	ON	ON	2022/07/02 06:54 AM

		).ccls,fs. (G02B6/3898 OR G02B6/3812 OR G02B6/3825 OR G02B6/3857 OR G02B6/3893).cpc.					
N8	2	N6 AND N7	(US-PGPUB; USPAT)	OR	ON	ON	2022/07/02 06:55 AM
N9	1567	(((latch$4 or push$1pull$4) with slid$4) and (latch$4 with rail$4)).clm.	(US-PGPUB; USPAT)	OR	ON	ON	2021/03/12 08:21 PM
N10	10170	((push$1pull$4 near2 mechanism) or push$1pull$4).clm.	(US-PGPUB; USPAT)	OR	ON	ON	2021/03/12 08:22 PM
N11	9	((crimp$4 near2 bod$3) with ((receiv$4 or accommodat$4) near2 (surfac$4 or sid$3))).clm.	(US-PGPUB; USPAT)	OR	ON	ON	2021/03/12 08:22 PM
N12	4566	((polar$4 or polariz$4 or polarizat$4) with indic$4).clm.	(US-PGPUB; USPAT)	OR	ON	ON	2021/03/12 08:22 PM
N13	0	N9 and N10 and N11	(US-PGPUB; USPAT)	OR	ON	ON	2021/03/12 08:22 PM
N14	5	N9 and N10	(US-PGPUB; USPAT)	OR	ON	ON	2021/03/12 08:23 PM
N15	3	(((fiber$4 OR fibre$4) near2 optic$4 near2 connect$4) AND ((crimp$4 OR heat$1shrink$4) near2 bod$3) AND (align$4 near2 featur$4) AND (strain$4 near2 relief$4 near2 boot$4)).clm.	(US-PGPUB; USPAT)	OR	ON	ON	2023/05/06 11:30 PM

PE2E SEARCH - Search History (Similarity Search)

No Similarity Results available

Bibliographic Data

Application No: 18/057,342

Foreign Priority claimed: ○ Yes ◉ No

35 USC 119 (a-d) conditions met: ☐ Yes ☑ No ☐ Met After Allowance

Verified and Acknowledged: /ANDREW JORDAN/ (Examiner's Signature) | (Initials)

Title: MINI DUPLEX CONNECTOR WITH PUSH-PULL POLARITY MECHANISM AND CARRIER

FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
11/21/2022	385	2874	
RULE			

APPLICANTS

US Conec Ltd, Hickory, NC, UNITED STATES

INVENTORS

Jason Higley, Hickory, NC, UNITED STATES

Jillcha F. Wakjira, Hickory, NC, UNITED STATES

Mitchell Cloud, Hickory, NC, UNITED STATES

Darrell R. Childers, Hickory, NC, UNITED STATES

Michael E. Hughes, Hickory, NC, UNITED STATES

CONTINUING DATA

This application is a CON of 17328574 05/24/2021 PAT 11506848

17328574 is a CON of 16462897 05/21/2019 PAT 11016250

16462897 is a 371 of PCT/US2018/066518 12/19/2018

PCT/US2018/066518 has PRO of 62634271 02/23/2018

PCT/US2018/066518 has PRO of 62607555 12/19/2017

FOREIGN APPLICATIONS

IF REQUIRED, FOREIGN LICENSE GRANTED**

12/07/2022

STATE OR COUNTRY

UNITED STATES

ADDRESS

FILING FEE RECEIVED

$1,820

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
18/057,342	11/21/2022	Jason Higley	USCO-089-US1-02

CONFIRMATION NO. 4719

152017
US Conec Ltd.
1138 25th Street Southeast
Hickory, NC 28602

PUBLICATION NOTICE

OC000000137586814

Title:MINI DUPLEX CONNECTOR WITH PUSH-PULL POLARITY MECHANISM AND CARRIER

Publication No.US-2023-0080980-A1
Publication Date:03/16/2023

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/.

The publication process established by the Office does not provide for mailing a copy of the publication to applicant. A copy of the publication may be obtained from the Office upon payment of the appropriate fee set forth in 37 CFR 1.19(a)(1). Orders for copies of patent application publications are handled by the USPTO's Public Records Division. The Public Records Division can be reached by telephone at (571) 272-3150 or (800) 972-6382, by facsimile at (571) 273-3250, by mail addressed to the United States Patent and Trademark Office, Public Records Division, Alexandria, VA 22313-1450 or via the Internet.

In addition, information on the status of the application, including the mailing date of Office actions and the dates of receipt of correspondence filed in the Office, may also be accessed via the Internet through the Patent Electronic Business Center at www.uspto.gov using the public side of the Patent Application Information and Retrieval (PAIR) system. The direct link to access this status information is currently https://portal.uspto.gov/pair/PublicPair. Prior to publication, such status information is confidential and may only be obtained by applicant using the private side of PAIR.

Further assistance in electronically accessing the publication, or about PAIR, is available by calling the Patent Electronic Business Center at 1-866-217-9197.

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

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www.uspto.gov

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
18/057,342	11/21/2022	Jason Higley	USCO-089-US1-02

CONFIRMATION NO. 4719

152017
Us Conec Ltd.
1138 25th Street Southeast
Hickory, NC 28602

POA ACCEPTANCE LETTER

OC000000054293844

Date Mailed: 03/02/2023

NOTICE OF ACCEPTANCE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 02/27/2023.

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.

Questions about the contents of this notice and the requirements it sets forth should be directed to the Office of Data Management, Application Assistance Unit, at **(571) 272-4000** or **(571) 272-4200** or **1-888-786-0101**.

/dtdinh/

Doc Code: PA..
Document Description: Power of Attorney

PTO/AIA/82A (07-13)
Approved for use through 03/31/2021. OMB 0651-0035
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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TRANSMITTAL FOR POWER OF ATTORNEY TO ONE OR MORE REGISTERED PRACTITIONERS

NOTE: This form is to be submitted with the Power of Attorney by Applicant form (PTO/AIA/82B) to identify the application to which the Power of Attorney is directed, in accordance with 37 CFR 1.5, unless the application number and filing date are identified in the Power of Attorney by Applicant form. If neither form PTO/AIA/82A nor form PTO/AIA82B identifies the application to which the Power of Attorney is directed, the Power of Attorney will not be recognized in the application.

Application Number	18/057,342
Filing Date	2022-11-21
First Named Inventor	Jason Higley
Title	MINI DUPLEX CONNECTOR WITH PUSH-PULL POLARITY MECHANISM AND CARRIER
Art Unit	OPAP
Examiner Name	Docket CENTRAL
Attorney Docket Number	USCO-089-US1-02

SIGNATURE of Applicant or Patent Practitioner

Signature	/Michael L. Leetzow/	Date (Optional)	2023-02-27
Name	Michael L. Leetzow	Registration Number	35932
Title (if Applicant is a juristic entity)	Patent Practitioner		
Applicant Name (if Applicant is a juristic entity)	US Conec Ltd.		

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 _____ 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.**

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PTO/AIA/80 (07-12)
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POWER OF ATTORNEY TO PROSECUTE APPLICATIONS BEFORE THE USPTO

I hereby revoke all previous powers of attorney given in the application identified in the attached statement under 37 CFR 3.73(c).

I hereby appoint:

■ Practitioners associated with Customer Number: 152017

OR

☐ Practitioner(s) named below (if more than ten patent practitioners are to be named, then a customer number must be used):

Name	Registration Number	Name	Registration Number

As attorney(s) or agent(s) to represent the undersigned before the United States Patent and Trademark Office (USPTO) in connection with any and all patent applications assigned only to the undersigned according to the USPTO assignment records or assignments documents attached to this form in accordance with 37 CFR 3.73(c).

Please change the correspondence address for the application identified in the attached statement under 37 CFR 3.73(c) to:

■ The address associated with Customer Number: 152017

OR

☐	Firm or Individual Name			
	Address			
	City		State	Zip
	Country			
	Telephone		Email	

Assignee Name and Address: US Conec, Ltd.
1138 25th Street SE
Hickory NC 28603

A copy of this form, together with a statement under 37 CFR 3.73(c) (Form PTO/AIA/96 or equivalent) is required to be Filed in each application in which this form is used. The statement under 37 CFR 3.73(c) may be completed by one of The practitioners appointed in this form, and must identify the application in which this Power of Attorney is to be filed.

SIGNATURE of Assignee of Record

The individual whose signature and title is supplied below is authorized to act on behalf of the assignee

Signature		Date	
Name	Joseph L. Graham	Telephone	828 267 6323
Title	President		

This collection of information is required by 37 CFR 1.31, 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.

PTO/AIA/96 (08-12)
Approved for use through 01/31/2013. OMB 0651-0031
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 displays a valid OMB control number.

STATEMENT UNDER 37 CFR 3.73(c)

Applicant/Patent Owner: US Conec Ltd.

Application No./Patent No.: 18/057,342 Filed/Issue Date: 2022-11-21

Titled: MINI DUPLEX CONNECTOR WITH PUSH-PULL POLARITY MECHANISM AND CARRIER

US Conec Ltd., a corporation

(Name of Assignee) (Type of Assignee, e.g., corporation, partnership, university, government agency, etc.)

states that, for the patent application/patent identified above, it is (choose **one** of options 1, 2, 3 or 4 below):

1. ☒ The assignee of the entire right, title, and interest.

2. ☐ An assignee of less than the entire right, title, and interest (check applicable box):

   ☐ The extent (by percentage) of its ownership interest is _____%. Additional Statement(s) by the owners holding the balance of the interest must be submitted to account for 100% of the ownership interest.

   ☐ There are unspecified percentages of ownership. The other parties, including inventors, who together own the entire right, title and interest are:

   Additional Statement(s) by the owner(s) holding the balance of the interest must be submitted to account for the entire right, title, and interest.

3. ☐ The assignee of an undivided interest in the entirety (a complete assignment from one of the joint inventors was made). The other parties, including inventors, who together own the entire right, title, and interest are:

   Additional Statement(s) by the owner(s) holding the balance of the interest must be submitted to account for the entire right, title, and interest.

4. ☐ The recipient, via a court proceeding or the like (*e.g.*, bankruptcy, probate), of an undivided interest in the entirety (a complete transfer of ownership interest was made). The certified document(s) showing the transfer is attached.

The interest identified in option 1, 2 or 3 above (not option 4) is evidenced by either (choose **one** of options A or B below):

A. ☒ An assignment from the inventor(s) of the patent application/patent identified above. The assignment was recorded in the United States Patent and Trademark Office at Reel 062764, Frame 0599, or for which a copy thereof is attached.

B. ☐ A chain of title from the inventor(s), of the patent application/patent identified above, to the current assignee as follows:

   1. From: _____ To: _____

      The document was recorded in the United States Patent and Trademark Office at

      Reel _____, Frame _____, or for which a copy thereof is attached.

   2. From: _____ To: _____

      The document was recorded in the United States Patent and Trademark Office at

      Reel _____, Frame _____, or for which a copy thereof is attached.

This collection of information is required by 37 CFR 3.73(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.

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STATEMENT UNDER 37 CFR 3.73(c)

3. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at

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4. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at

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5. From: _____ To: _____

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6. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at

Reel _____, Frame _____, or for which a copy thereof is attached.

☐ Additional documents in the chain of title are listed on a supplemental sheet(s).

☐ As required by 37 CFR 3.73(c)(1)(i), the documentary evidence of the chain of title from the original owner to the assignee was, or concurrently is being, submitted for recordation pursuant to 37 CFR 3.11.

[NOTE: A separate copy (i.e., a true copy of the original assignment document(s)) must be submitted to Assignment Division in accordance with 37 CFR Part 3, to record the assignment in the records of the USPTO. See MPEP 302.08]

The undersigned (whose title is supplied below) is authorized to act on behalf of the assignee.

/Michael L. Leetzow/	2023-02-27
Signature	Date
Michael L. Leetzow	35932
Printed or Typed Name	Title or Registration Number

[Page 2 of 2]

Electronic Acknowledgement Receipt

EFS ID:	47597568
Application Number:	18057342
International Application Number:	
Confirmation Number:	4719
Title of Invention:	MINI DUPLEX CONNECTOR WITH PUSH-PULL POLARITY MECHANISM AND CARRIER
First Named Inventor/Applicant Name:	Jason Higley
Customer Number:	152017
Filer:	MICHAEL LEETZOW
Filer Authorized By:	
Attorney Docket Number:	USCO-089-US1-02
Receipt Date:	27-FEB-2023
Filing Date:	21-NOV-2022
Time Stamp:	16:35:01
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	POAUSCO089US102.pdf	260190 a785e25e81297da747e3d80b180cb94b4dca42e0	no	2

Warnings:

Information:					
2	Assignee showing of ownership per 37 CFR 3.73	AssigneeStatement.pdf	103624 dba56f963504eee7606944d98b522d67dff9fb03	no	2
Warnings:					
Information:					
			Total Files Size (in bytes):	363814	

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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UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
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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
18/057,342	11/21/2022		1820	USCO-089-US1-02	17	1

CONFIRMATION NO. 4719

152017
Us Conec Ltd.
1138 25th Street Southeast
Hickory, NC 28602

FILING RECEIPT

OC000000051535863

Date Mailed: 12/09/2022

Receipt is acknowledged of this non-provisional utility 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 FIRST INVENTOR, 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 corrected Filing Receipt, including a properly marked-up ADS showing the changes with strike-through for deletions and underlining for additions. If you received a "Notice to File Missing Parts" or other Notice requiring a response for this application, please submit any request for correction 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 provided that the request is grantable.

Inventor(s)

Jason Higley, Hickory, NC;
Jillcha F. Wakjira, Hickory, NC;
Mitchell Cloud, Hickory, NC;
Darrell R. Childers, Hickory, NC;
Michael E. Hughes, Hickory, NC;

Applicant(s)

US Conec Ltd, Hickory, NC;

Power of Attorney: None

Domestic Priority data as claimed by applicant

This application is a CON of 17/328,574 05/24/2021 PAT 11,506,848
which is a CON of 16/462,897 05/21/2019 PAT 11,016,250
which is a 371 of PCT/US2018/066518 12/19/2018
which claims benefit of 62/634,271 02/23/2018
and claims benefit of 62/607,555 12/19/2017

Foreign Applications for which priority is claimed (You may be eligible to benefit from the **Patent Prosecution Highway** program at the USPTO. Please see http://www.uspto.gov for more information.) - None.
Foreign application information must be provided in an Application Data Sheet in order to constitute a claim to foreign priority. See 37 CFR 1.55 and 1.76.

Permission to Access Application via Priority Document Exchange: Yes

Permission to Access Search Results: Yes

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: 12/07/2022
The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 18/057,342**
Projected Publication Date: 03/16/2023
Non-Publication Request: No
Early Publication Request: No
Title

MINI DUPLEX CONNECTOR WITH PUSH-PULL POLARITY MECHANISM AND CARRIER

Preliminary Class

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

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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 AssetsControl, Department of Treasury (31 CFR Parts 500+) and the Department of Energy.

NOT GRANTED

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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.

PATENT APPLICATION FEE DETERMINATION RECORD

Substitute for Form PTO-875

Application or Docket Number: 18/057,342

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY FEE($)
BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A			N/A	320
SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A			N/A	700
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A			N/A	800
TOTAL CLAIMS (37 CFR 1.16(i))	17 minus 20 =	* 0			OR	x =	0
INDEPENDENT CLAIMS (37 CFR 1.16(h))	1 minus 3 =	*				x =	0
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
MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))							0
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL			TOTAL	1820

APPLICATION AS AMENDED - PART II

		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY ADDITIONAL FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY ADDITIONAL FEE($)
AMENDMENT A	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))									
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE($)	ADDITIONAL FEE($)		RATE($)	ADDITIONAL FEE($)
AMENDMENT B	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))									
	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.

PTO/AIA/15 (10-17)
Approved for use through 11/30/2020. 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 displays a valid OMB control number.

UTILITY PATENT APPLICATION TRANSMITTAL

(Only for new nonprovisional applications under 37 CFR 1.53(b))

Attorney Docket No.	USCO-089-US1-02
First Named Inventor	Jason Higley
Title	MINI DUPLEX CONNECTOR WITH PUSH-PULL POLARITY MECHANISM AND CAR
Priority Mail Express® Label No.	Via Patent Center

APPLICATION ELEMENTS

See MPEP chapter 600 concerning utility patent application contents.

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* 29] 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* 37]
6. **Inventor's Oath or Declaration** [*Total Pages* 5] *(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

ADDRESS TO: **Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450**

ACCOMPANYING APPLICATION PAPERS

10. [ ] **Assignment Papers** (cover sheet & document(s)) Name of Assignee _____
11. [ ] **37 CFR 3.73(c) Statement** (*when there is an assignee*) [ ] **Power of Attorney**
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:** DOCx File and pdf of Application

*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: 152017 **OR** [ ] Correspondence address below

Name					
Address					
City		State		Zip Code	
Country		Telephone		Email	

Signature	/Michael L. Leetzow/	Date	2022-11-21
Name (Print/Type)	Michael L. Leetzow	Registration No. (Attorney/Agent)	35932

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.

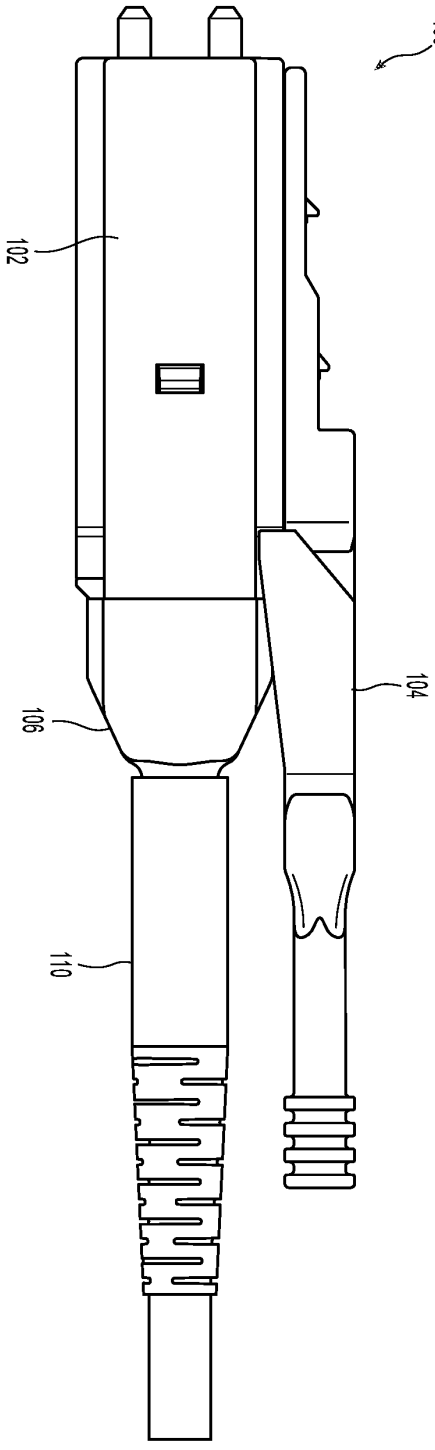


Fig. 1

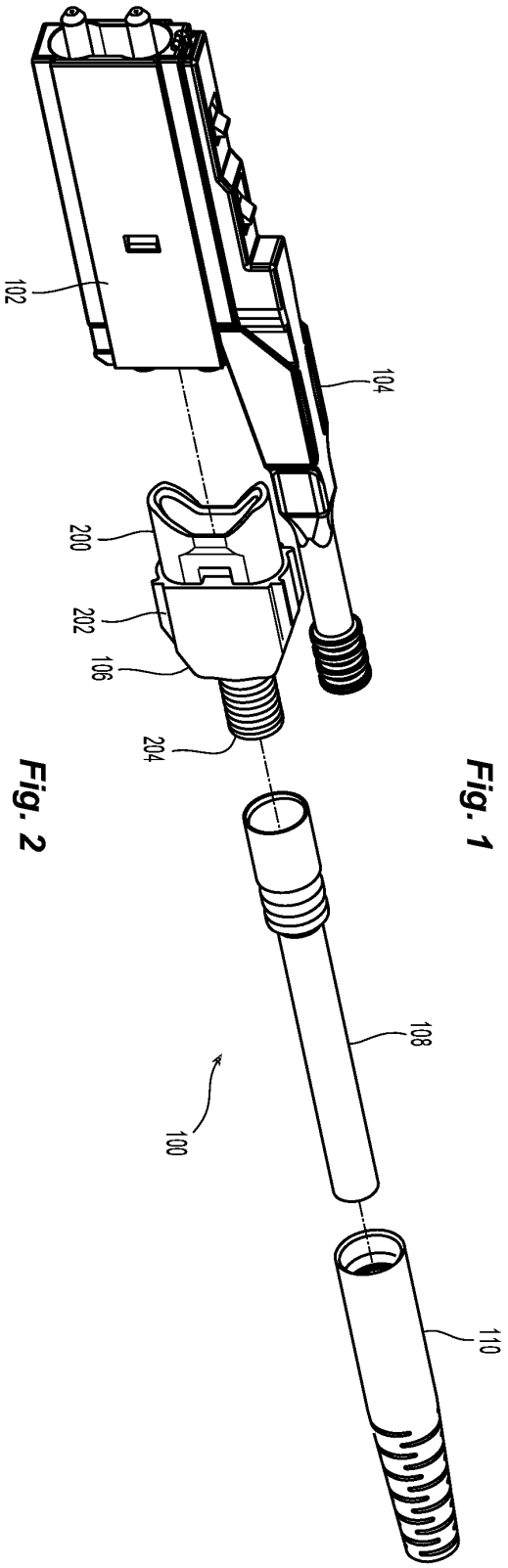


Fig. 2

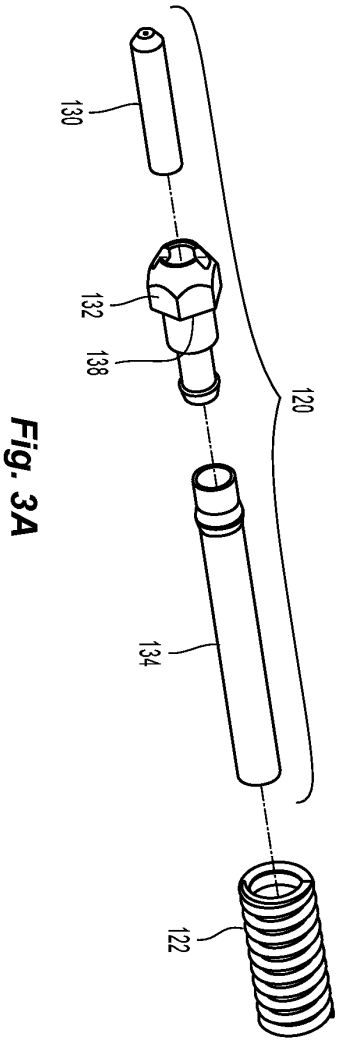

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Fig. 3A

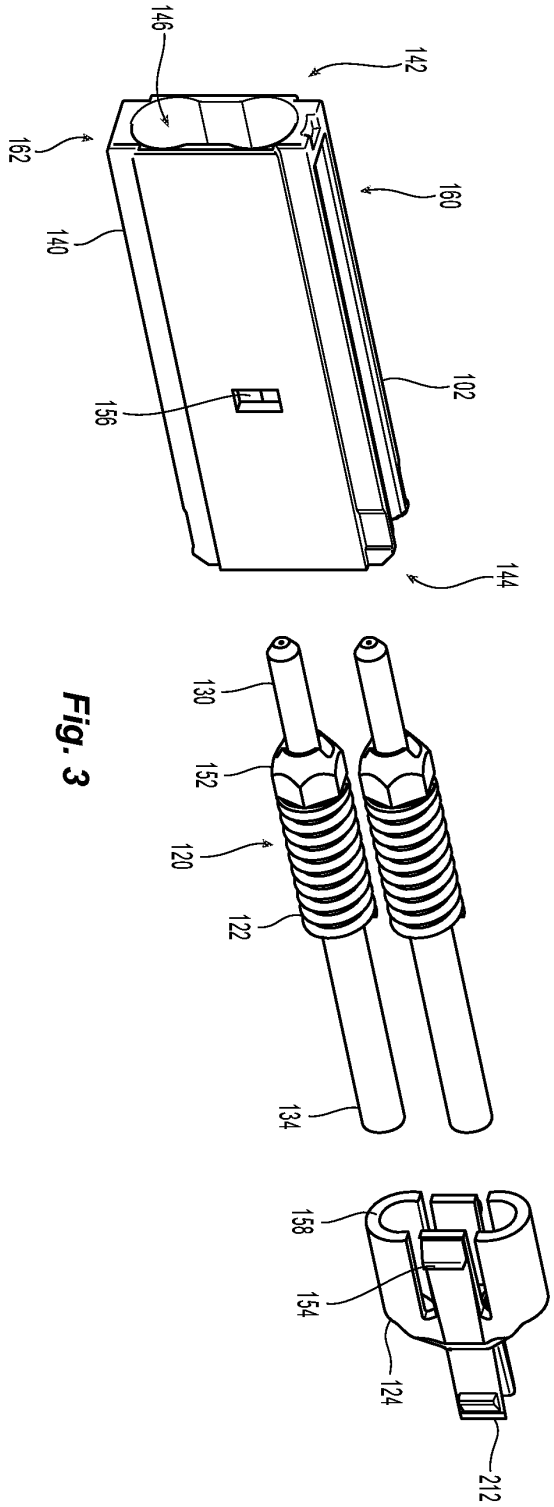

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Fig. 3

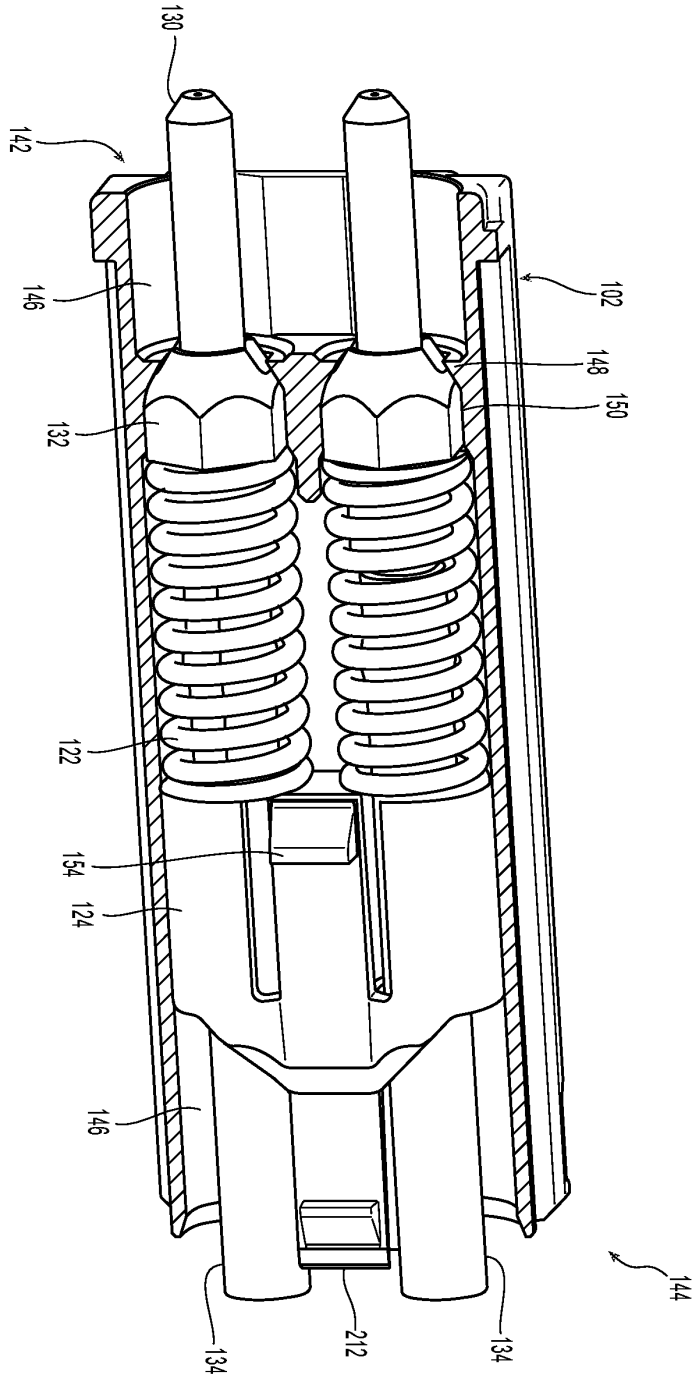


Fig. 4

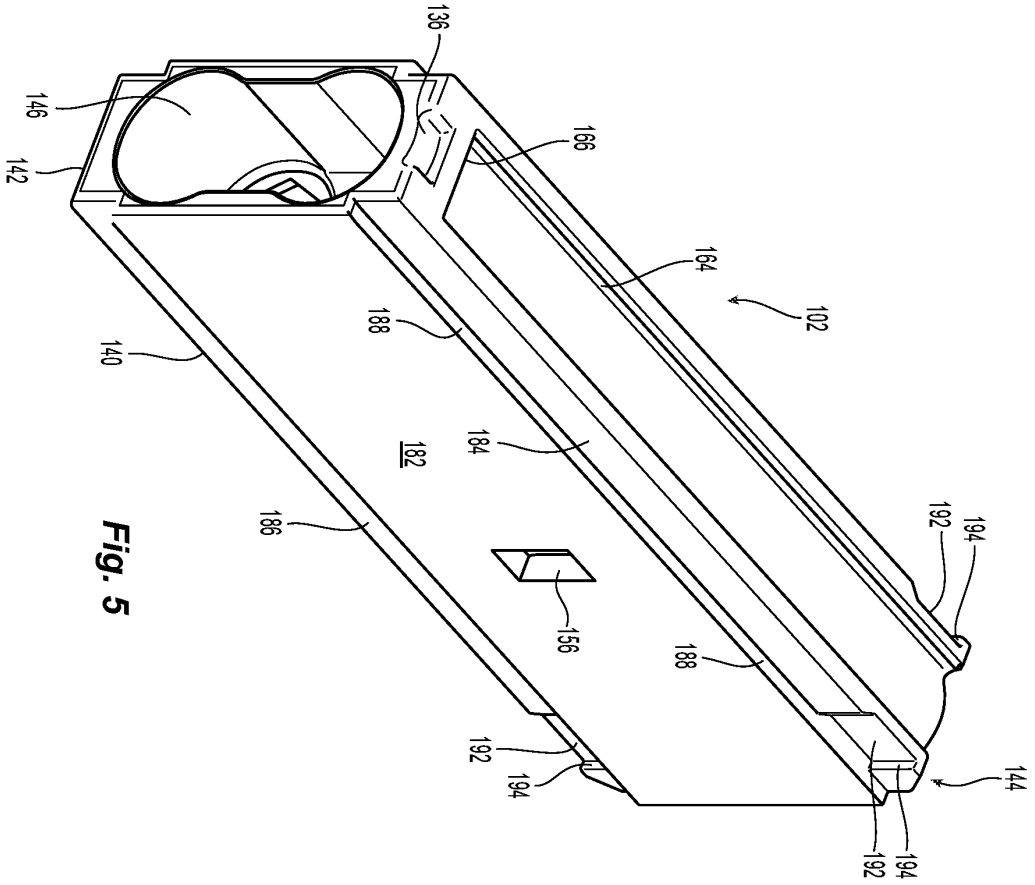


Fig. 5

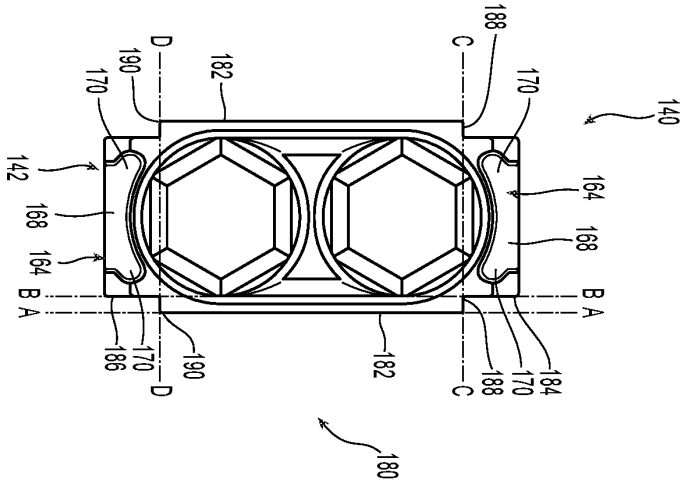


Fig. 6

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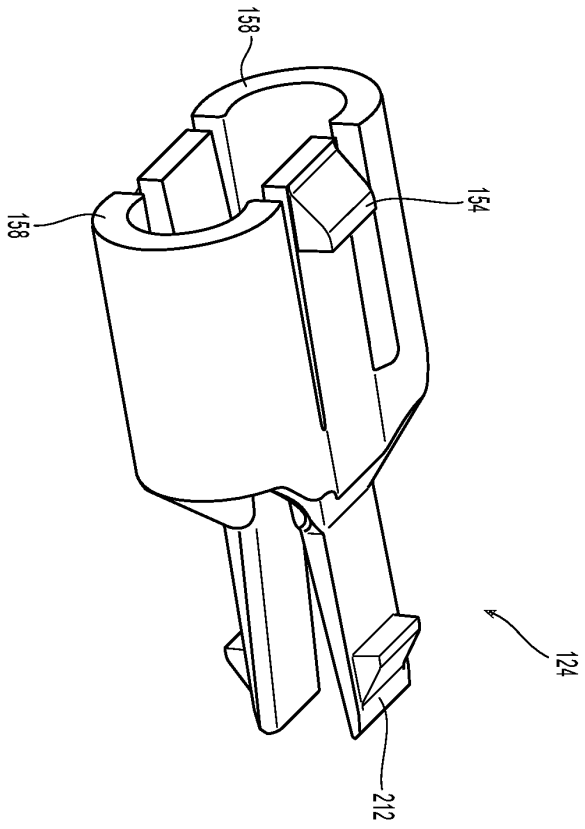


Fig. 7

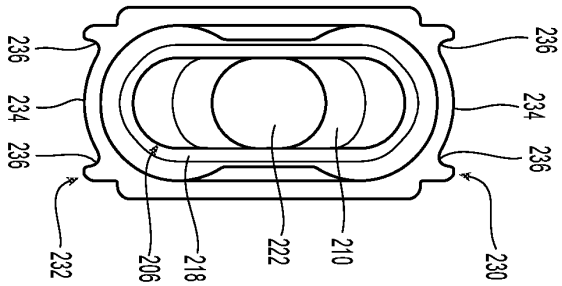

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Fig. 8

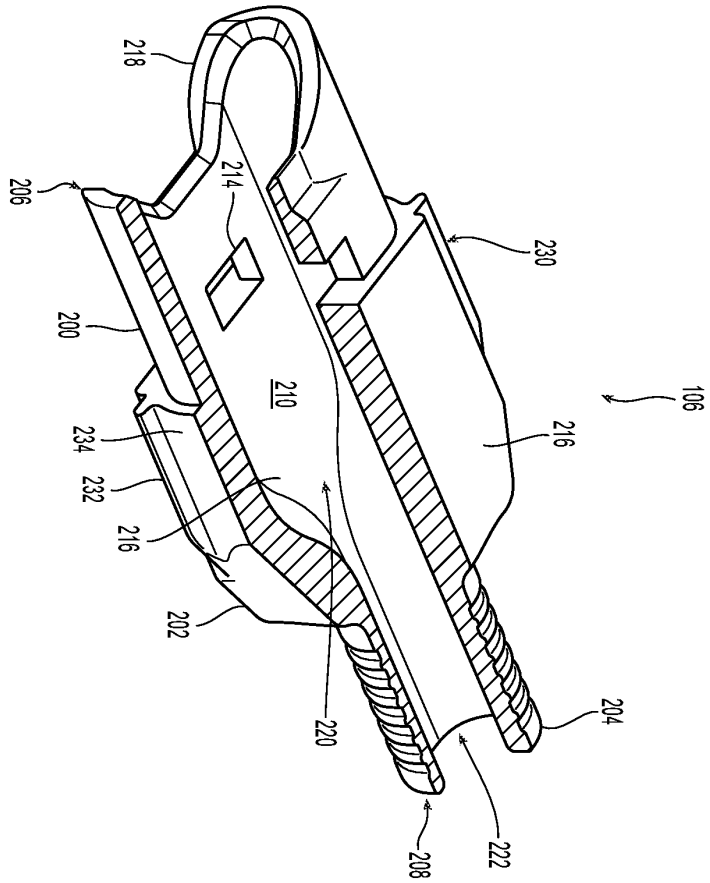

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Fig. 9

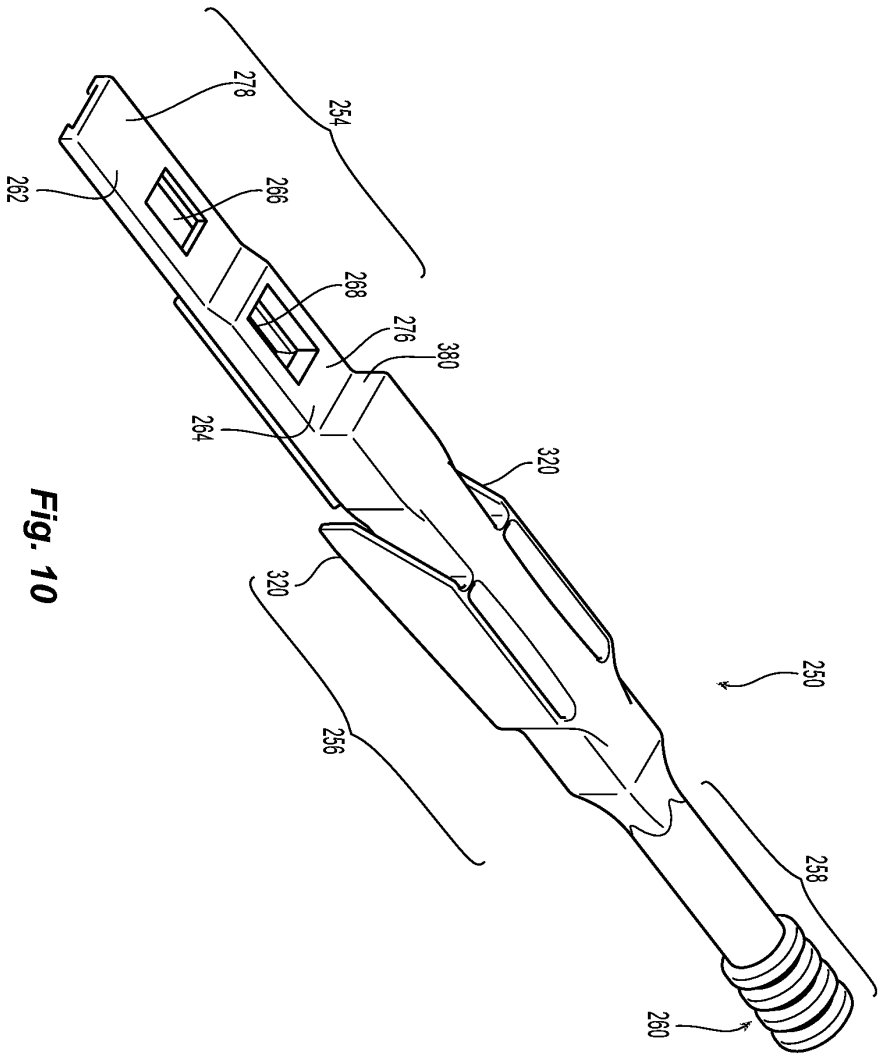


Fig. 10

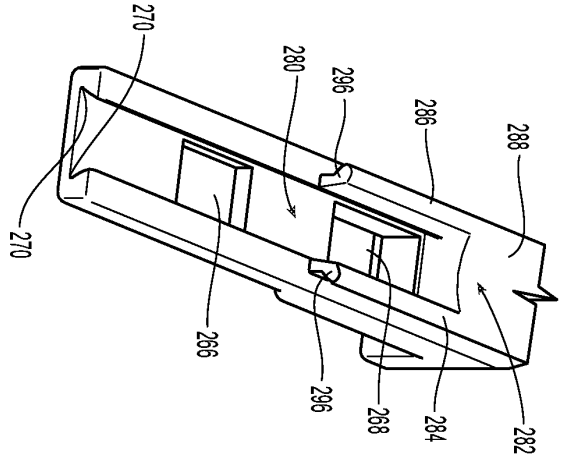


Fig. 10A

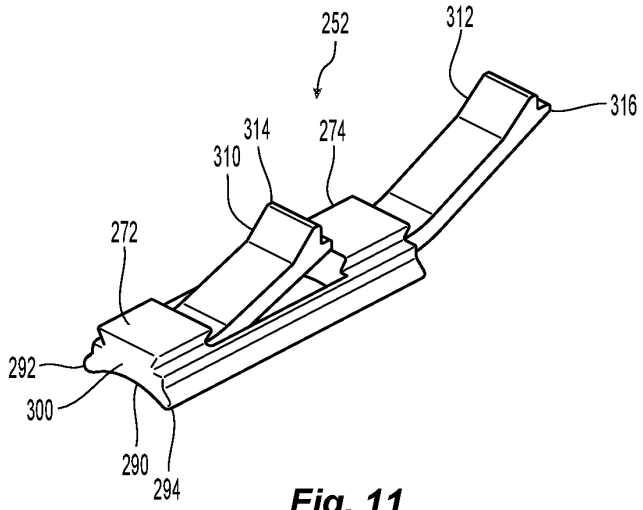


Fig. 11

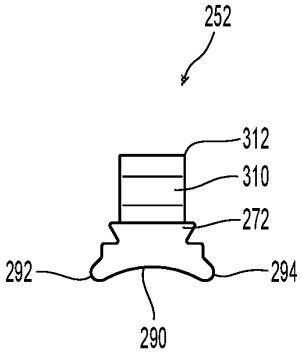


Fig. 12

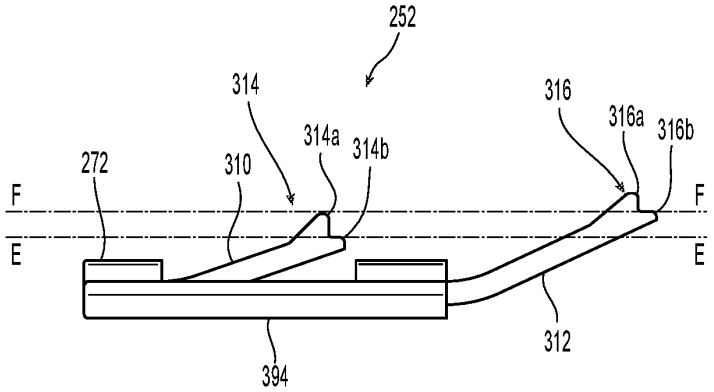


Fig. 13

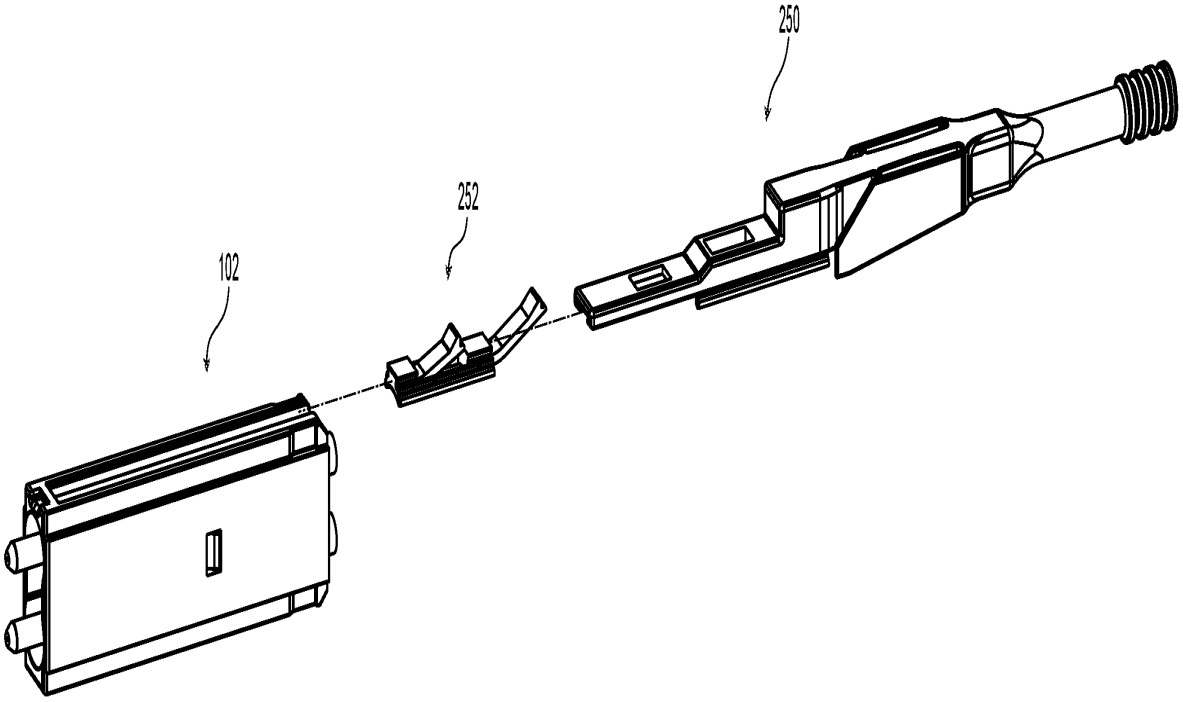


Fig. 14

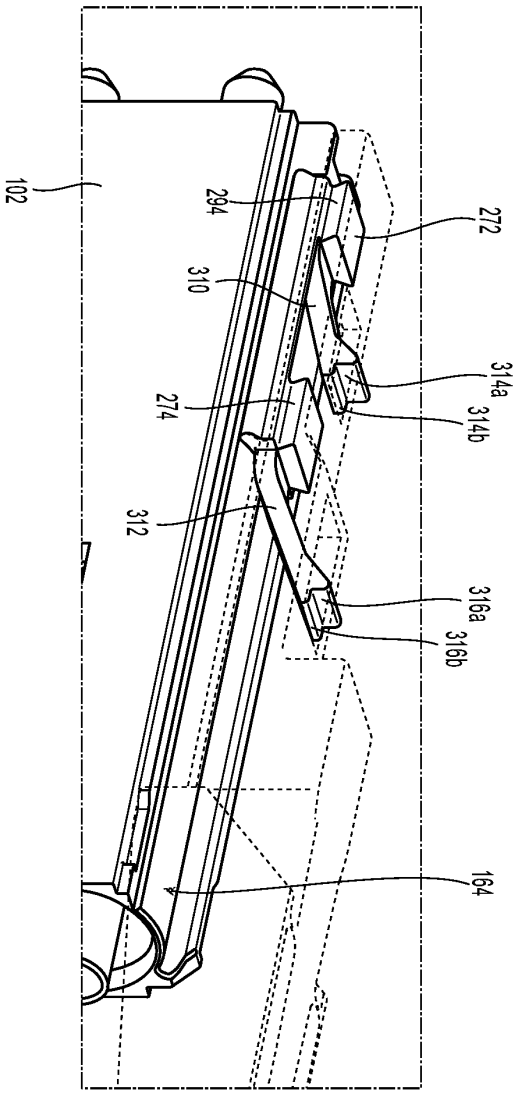


Fig. 15

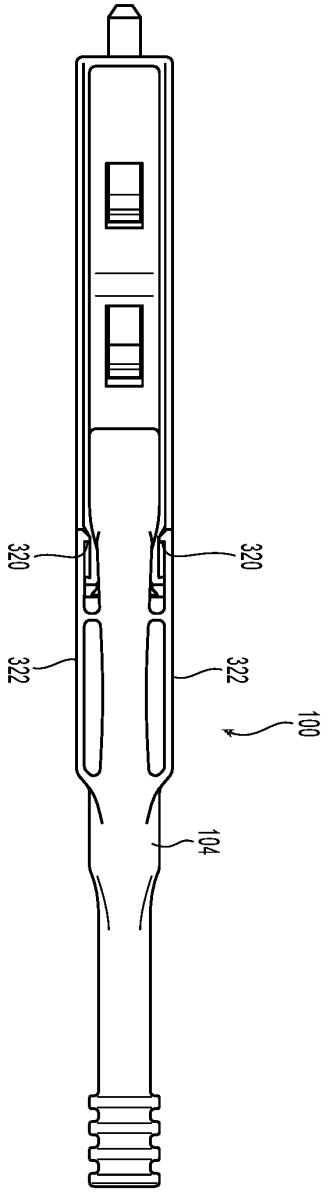


Fig. 16

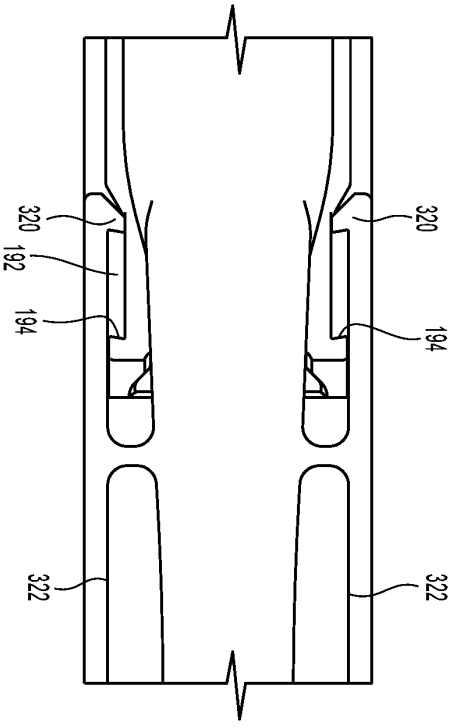


Fig. 17

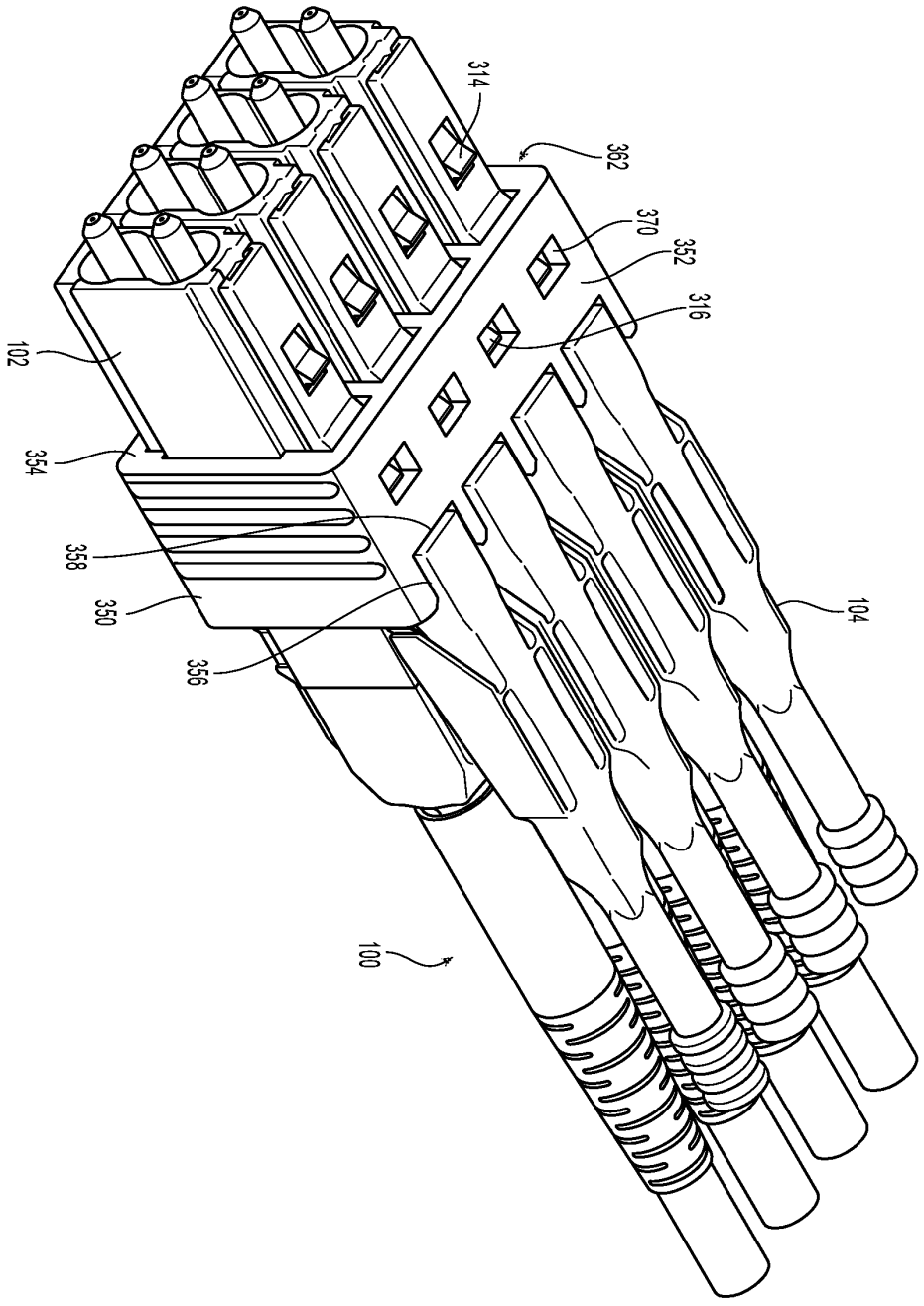


Fig. 18

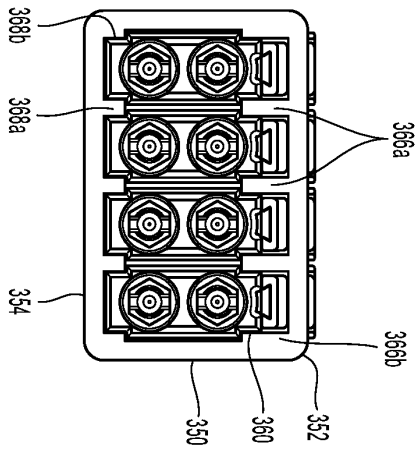

368b
368a
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Fig. 19

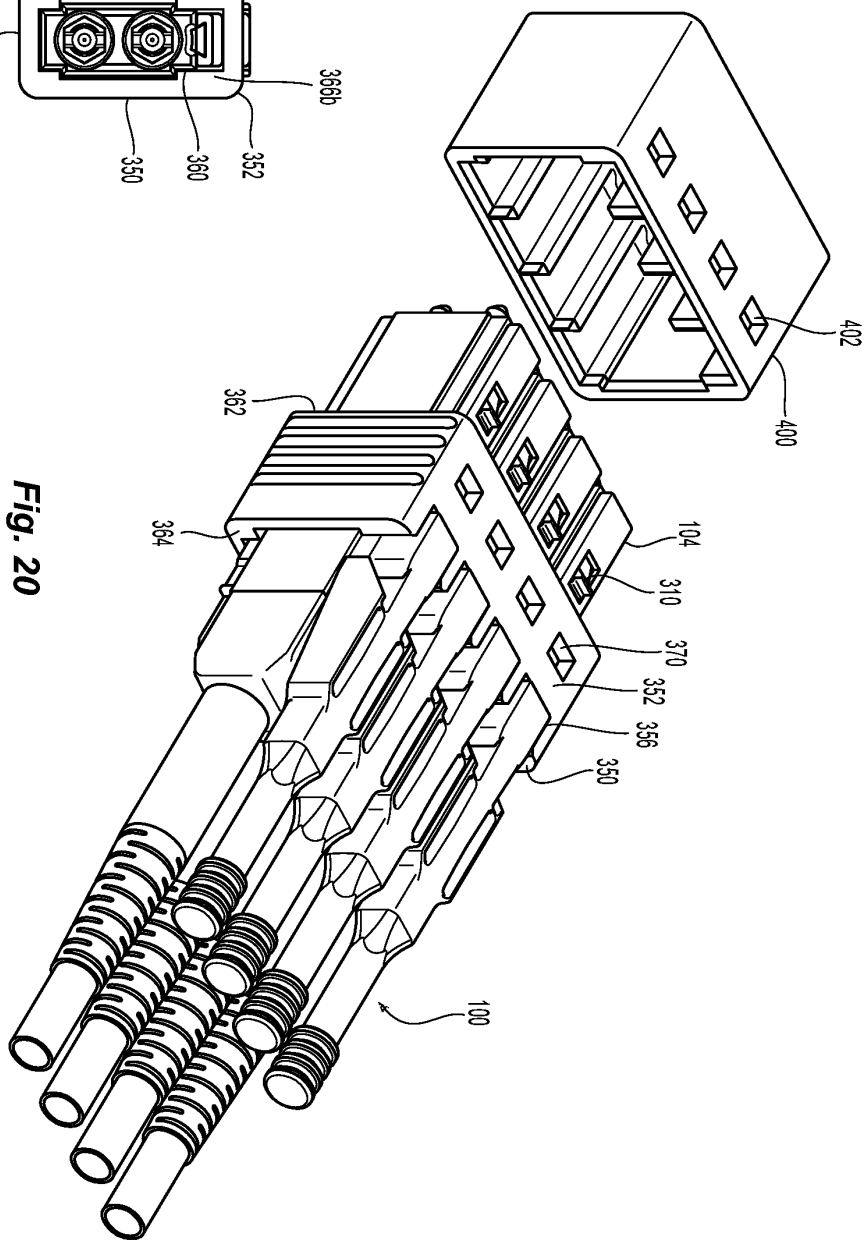

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Fig. 20

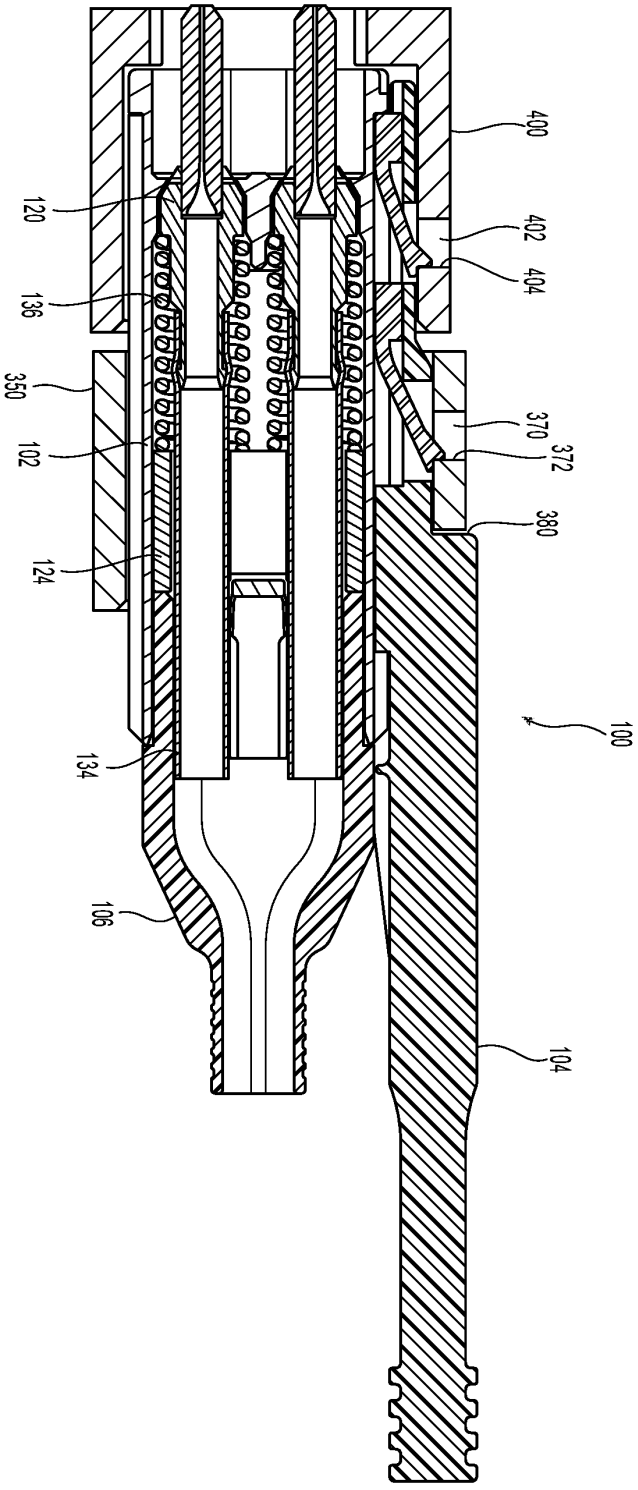


Fig. 21

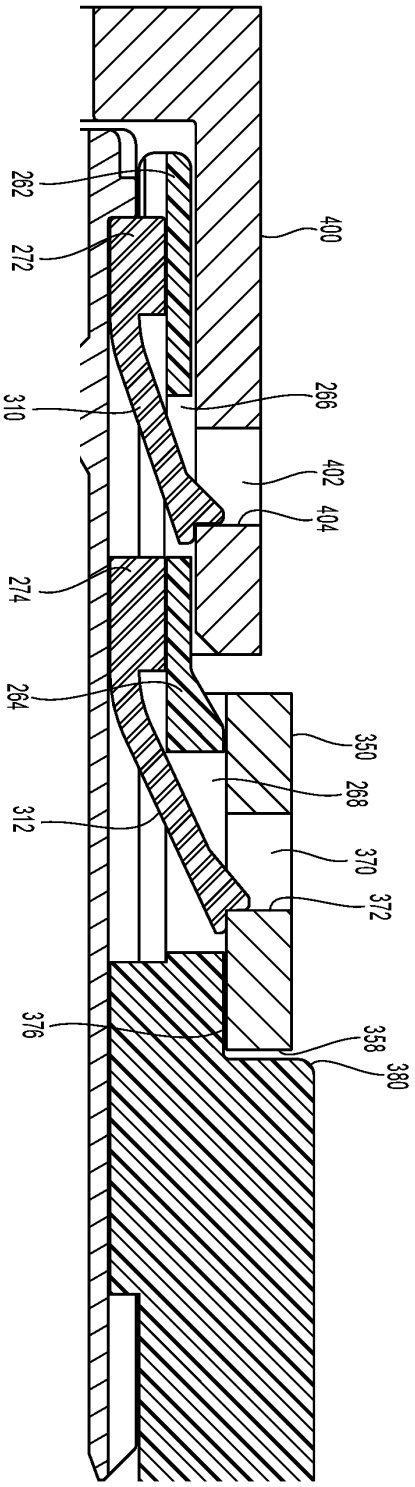

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Fig. 22

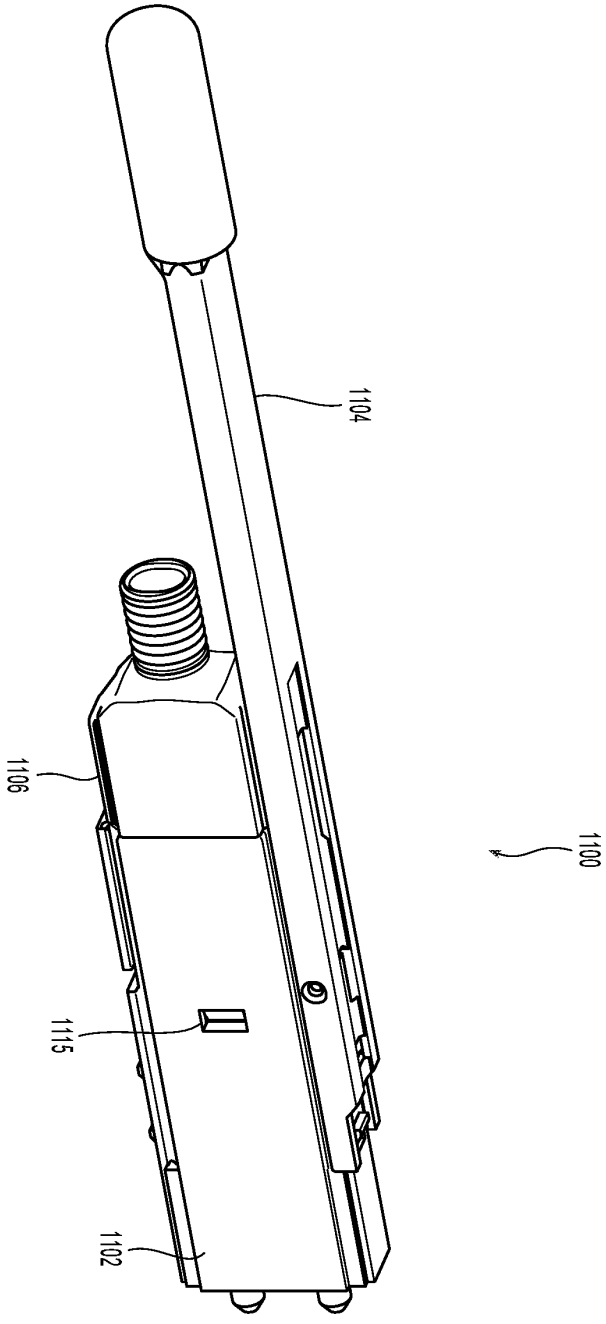


Fig. 23

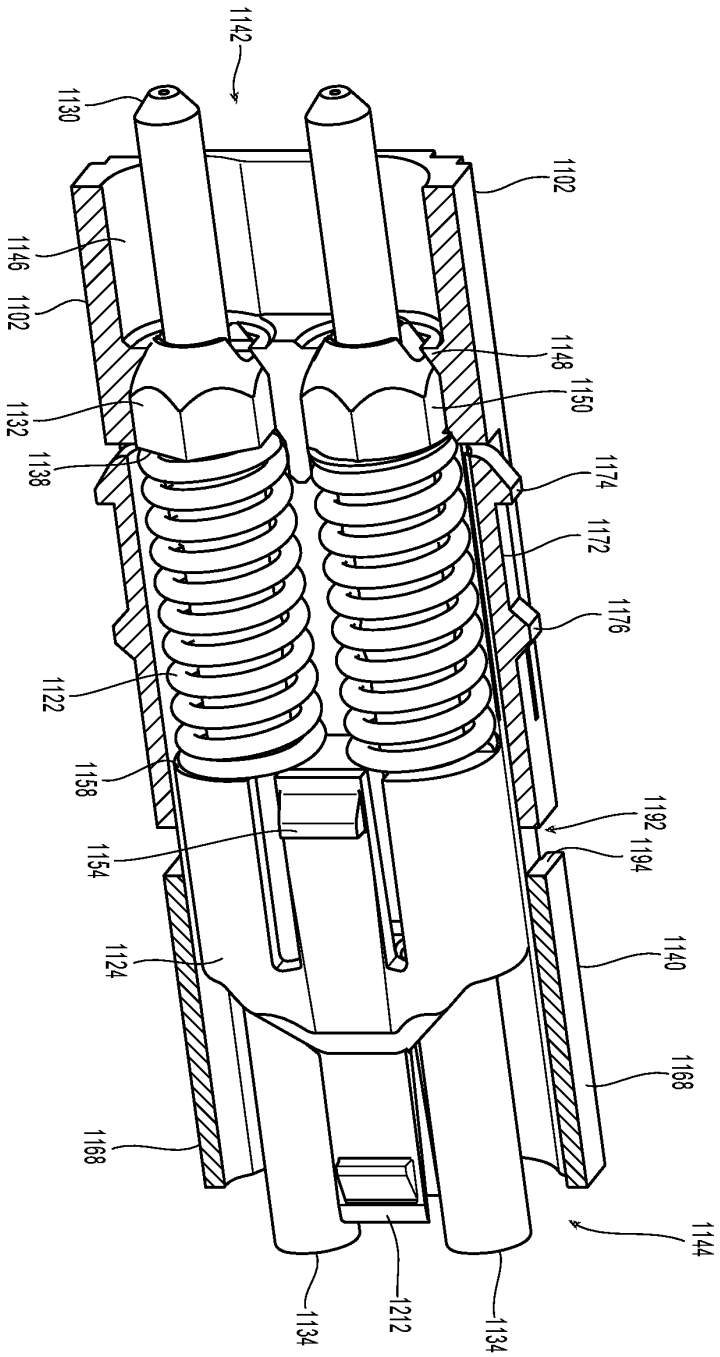

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Fig. 24

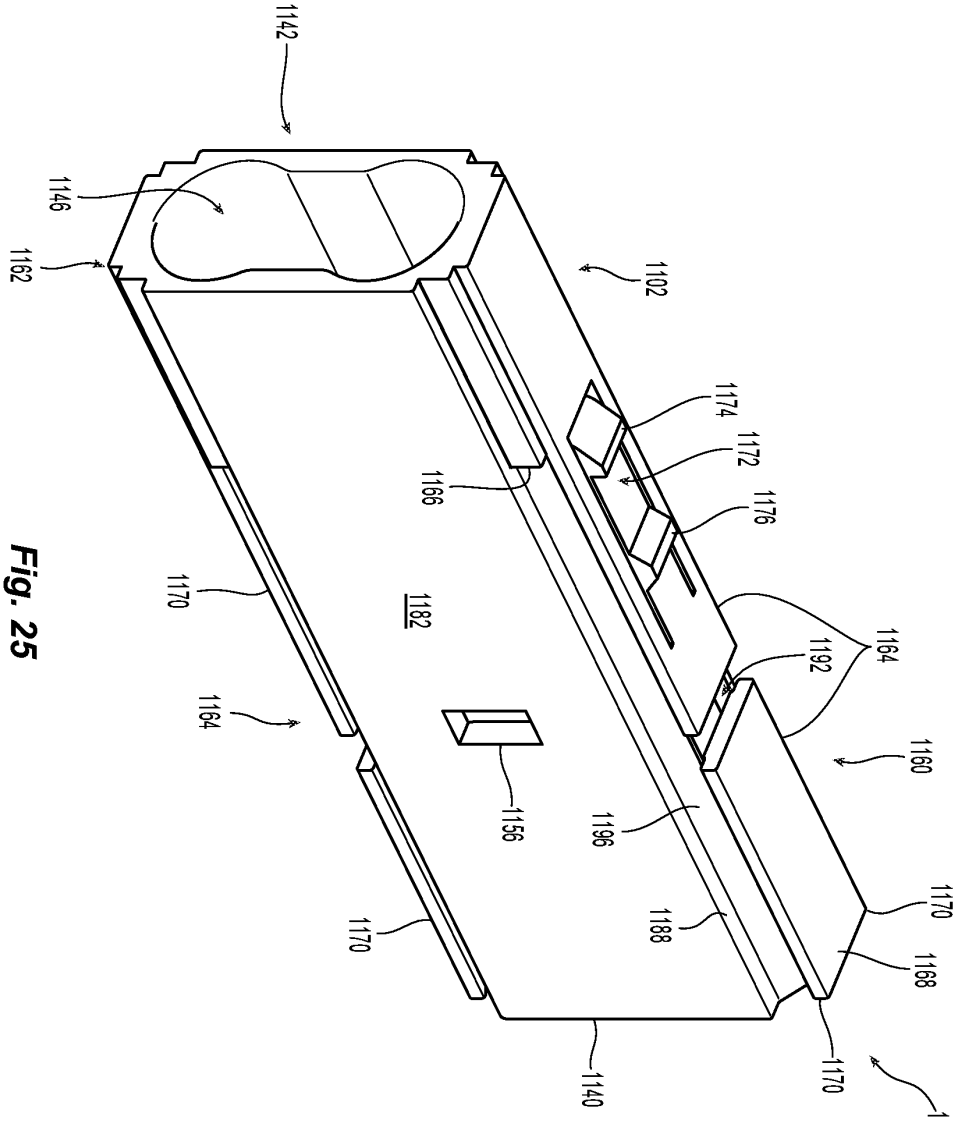

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Fig. 25

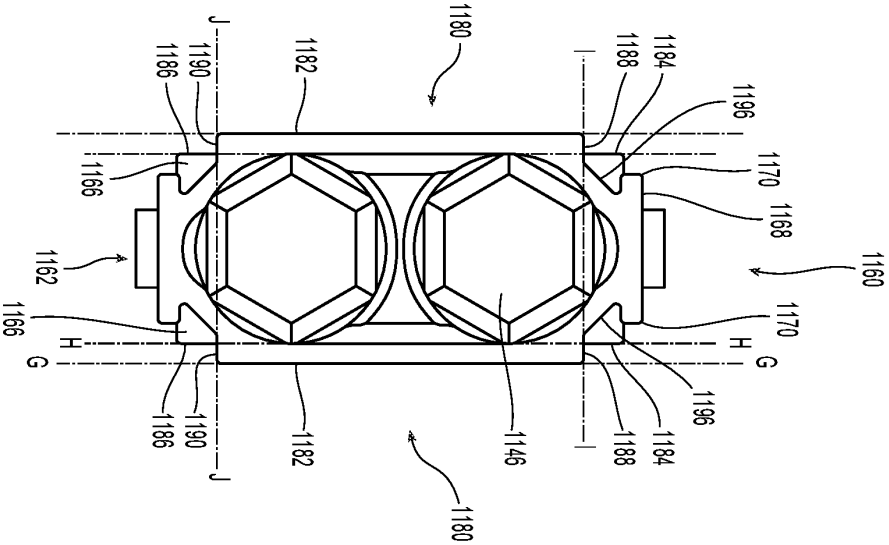

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Fig. 26

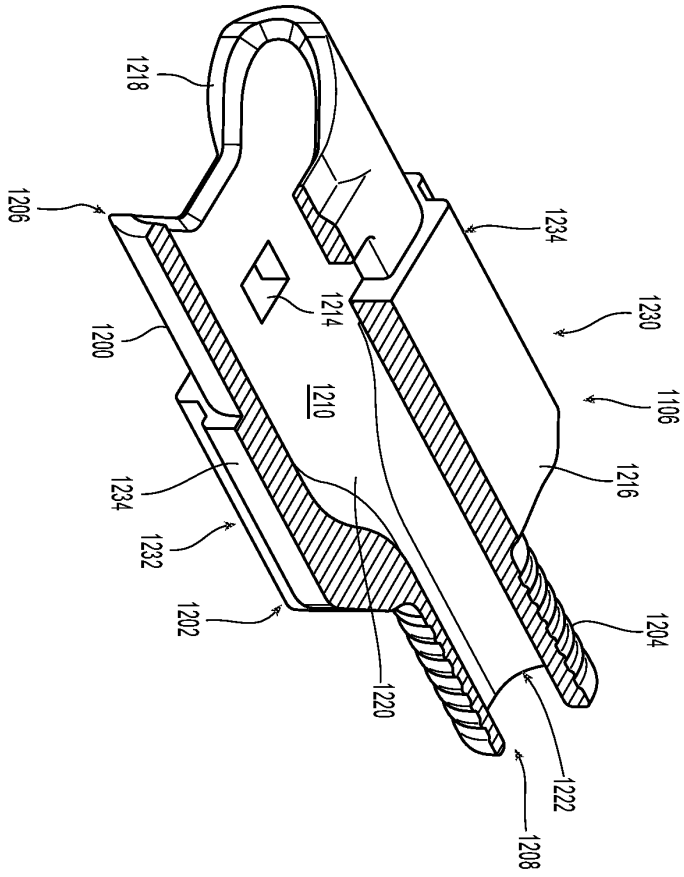

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Fig. 27

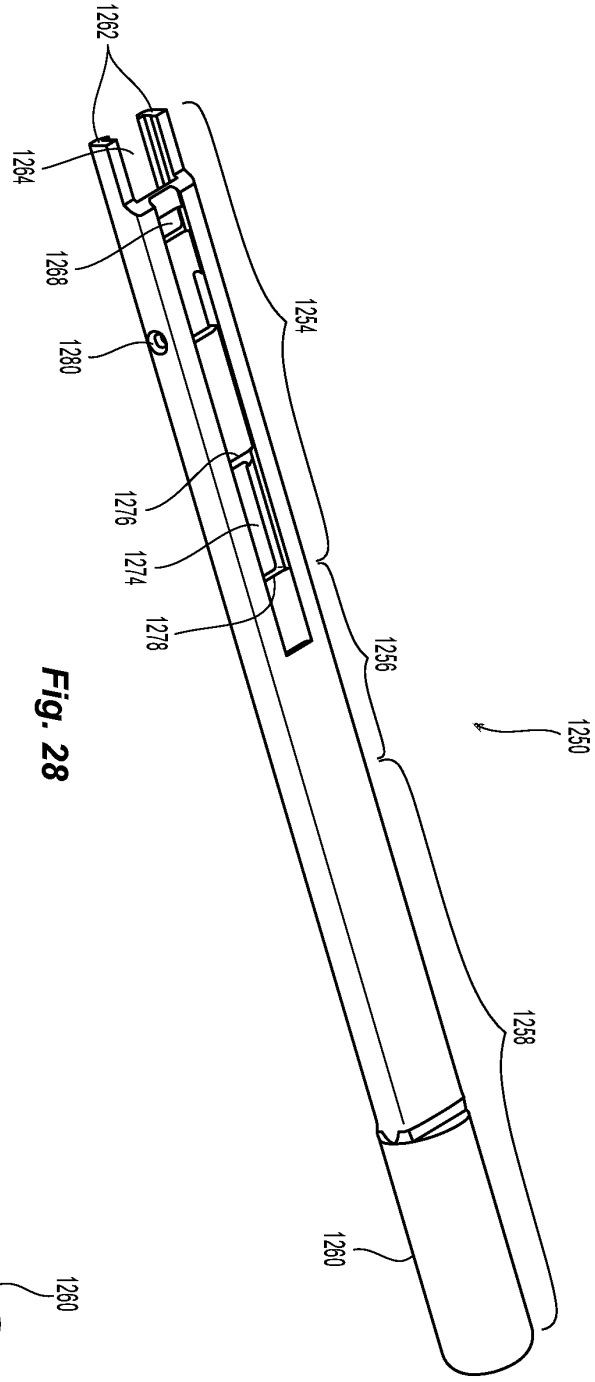

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Fig. 28

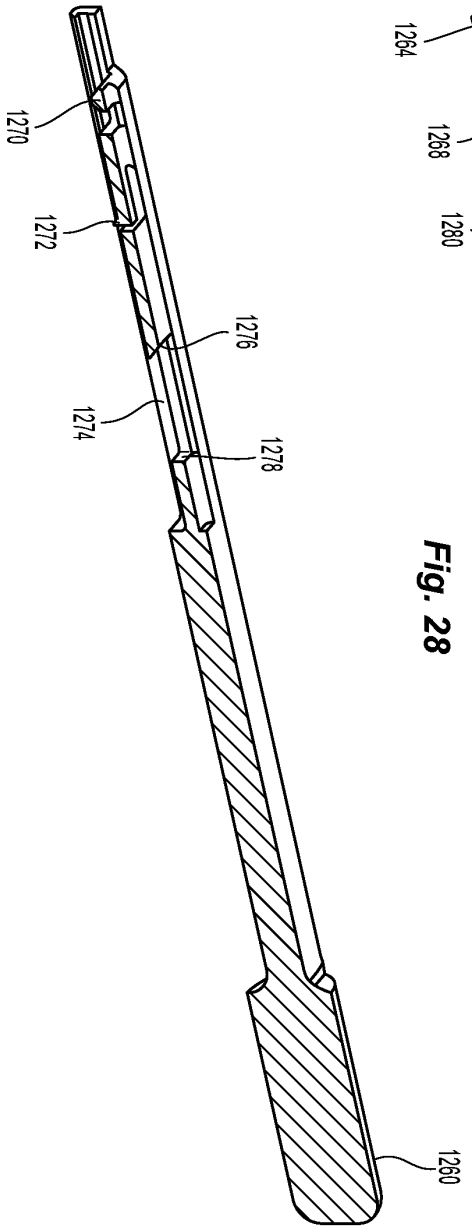

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Fig. 29

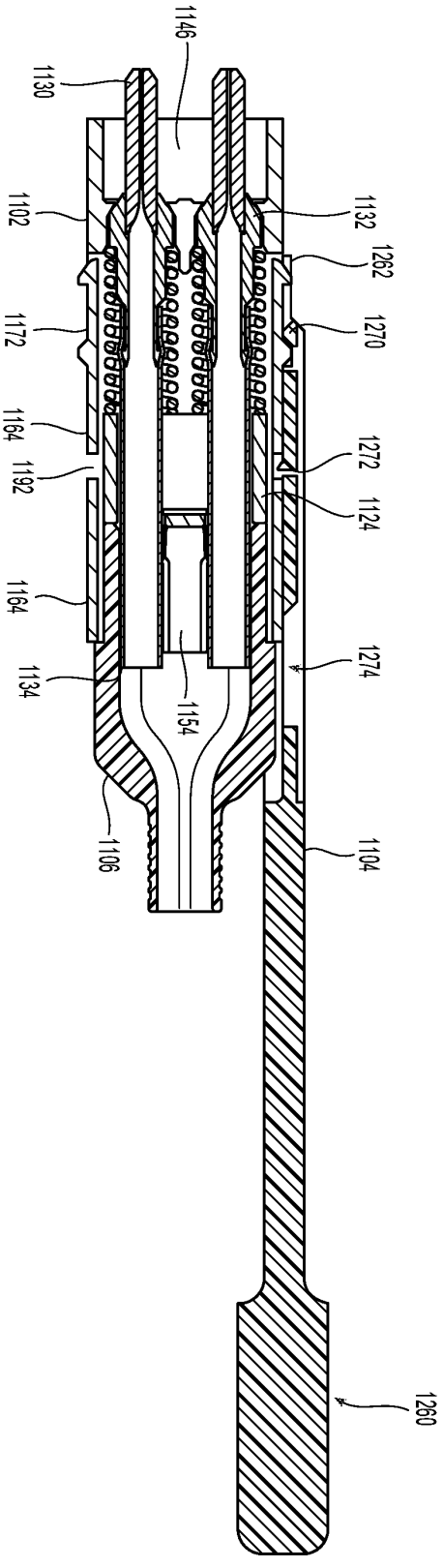

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Fig. 30

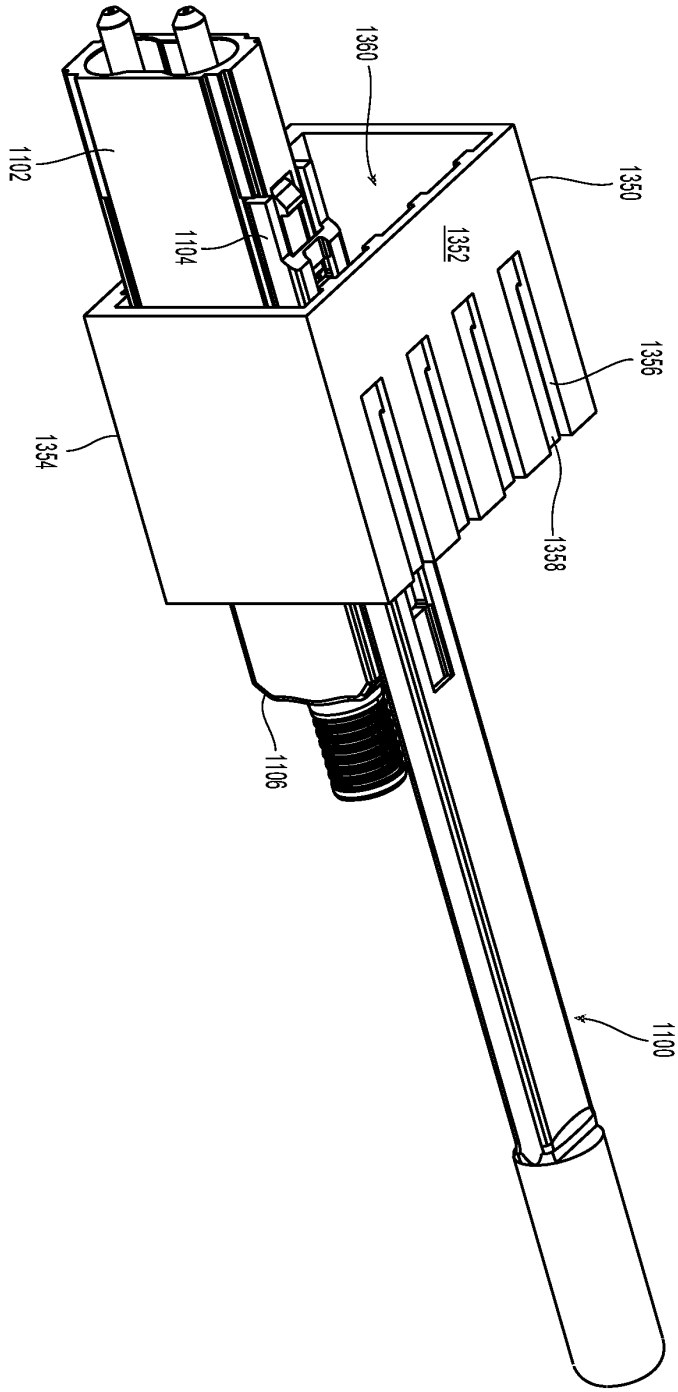


Fig. 31

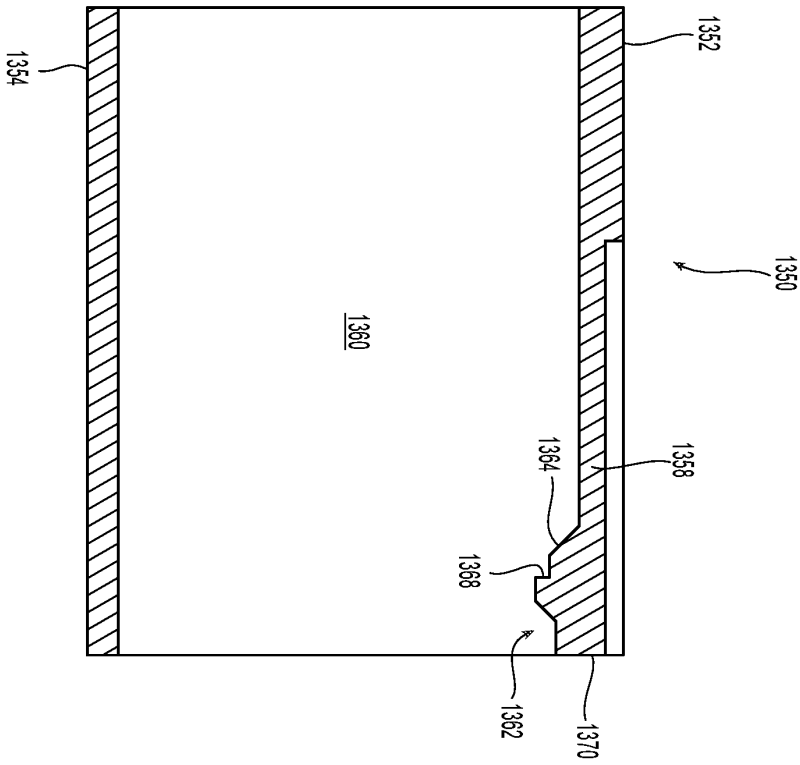


Fig. 32

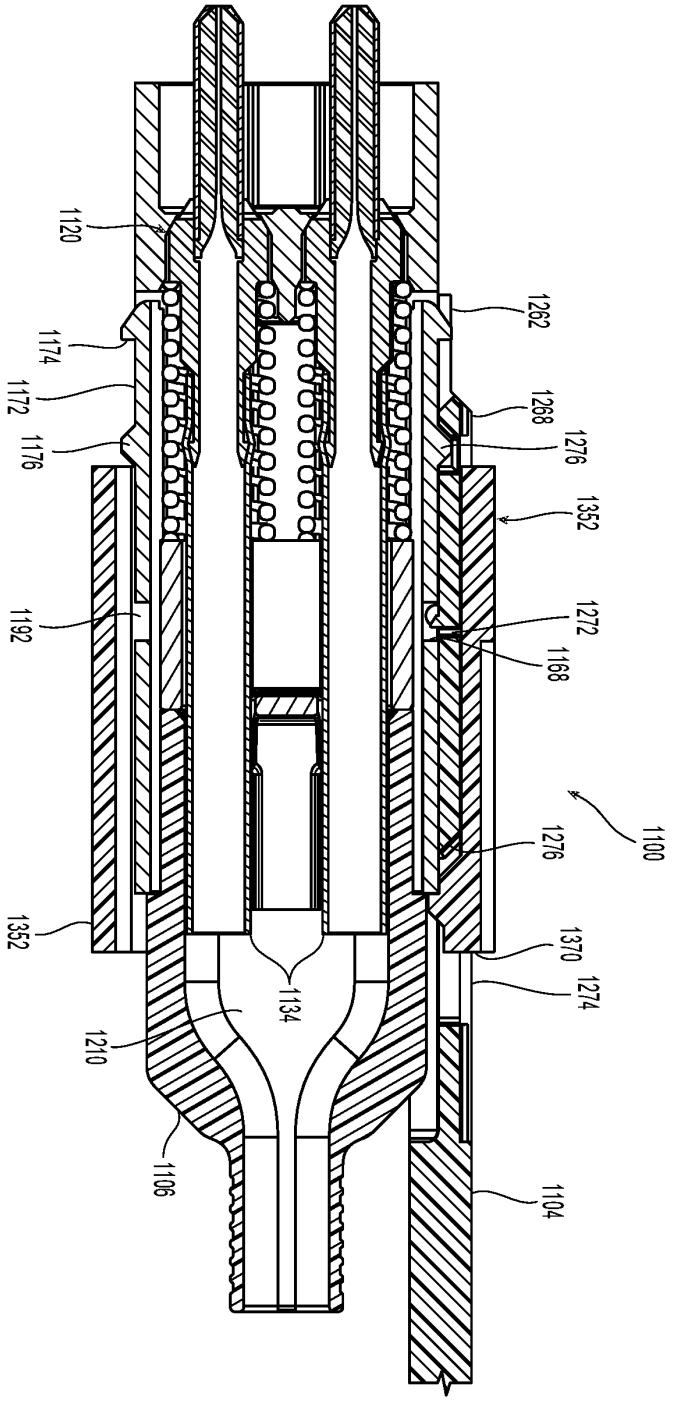

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Fig. 33

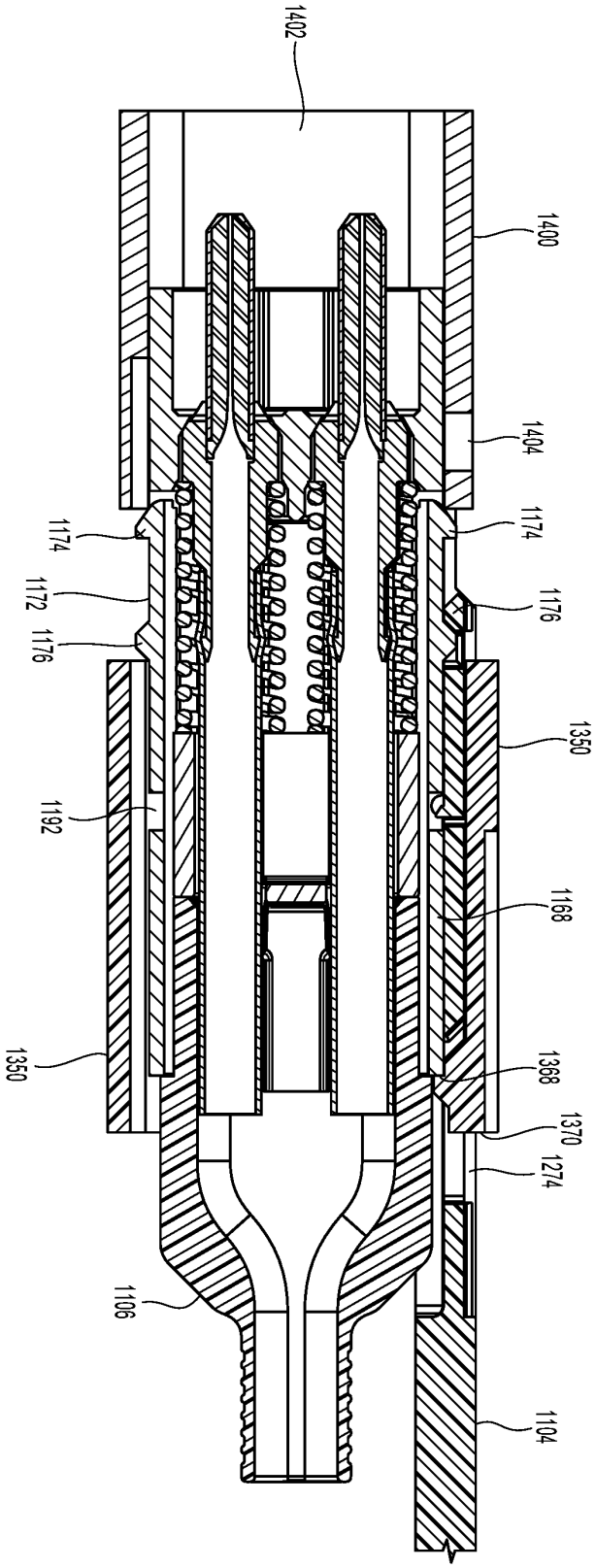

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Fig. 34

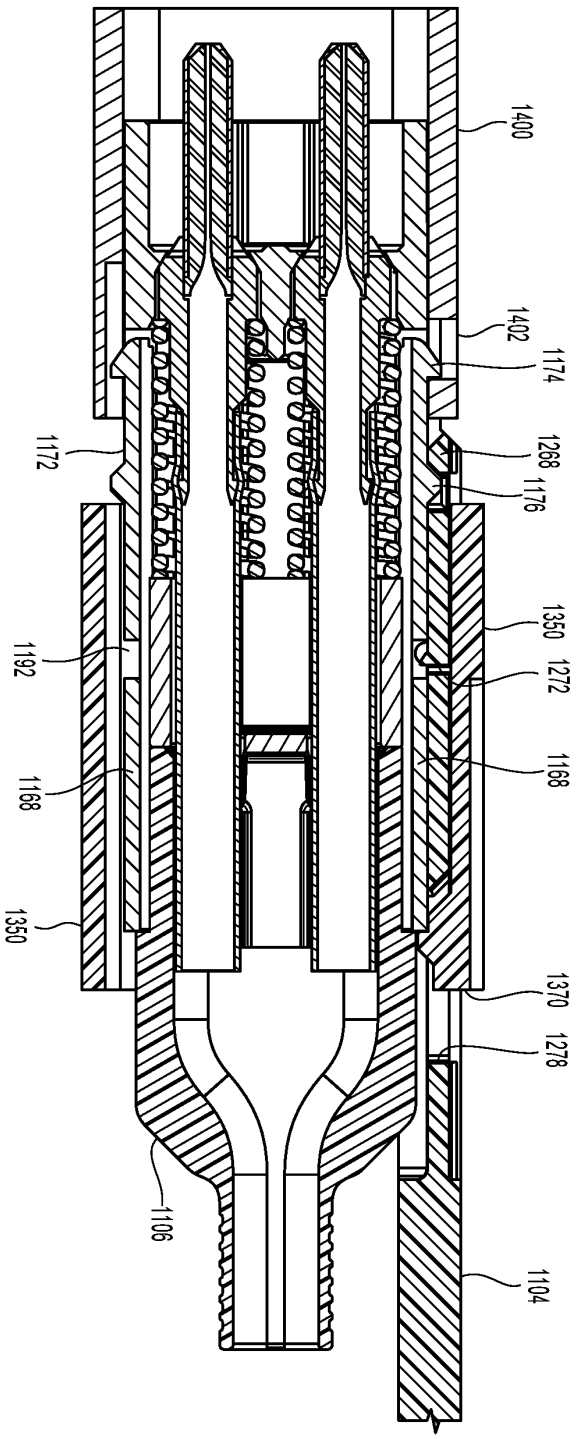

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Fig. 35

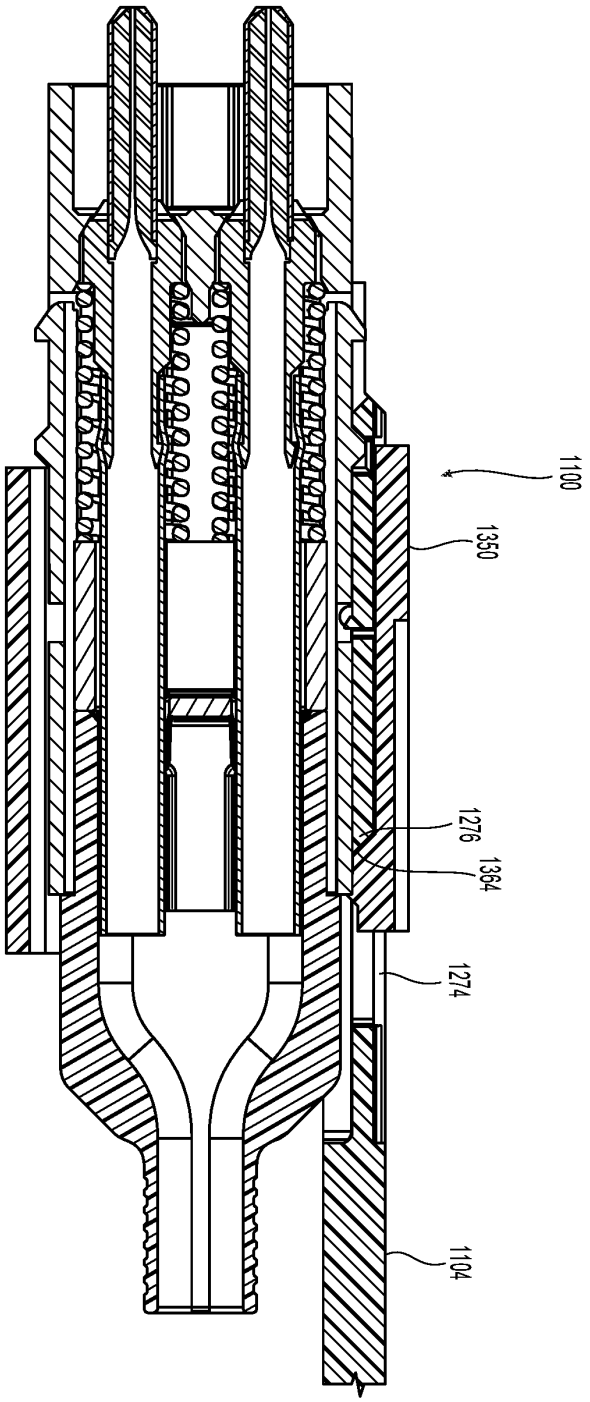


Fig. 36

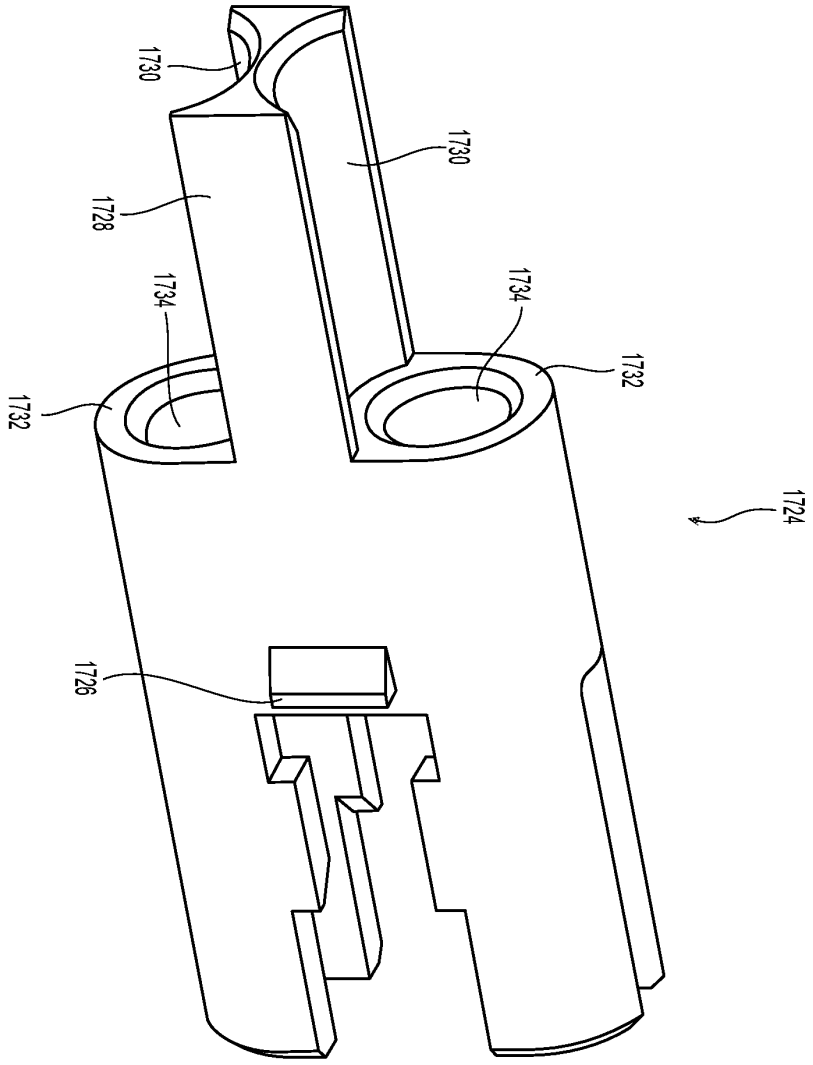


Fig. 37

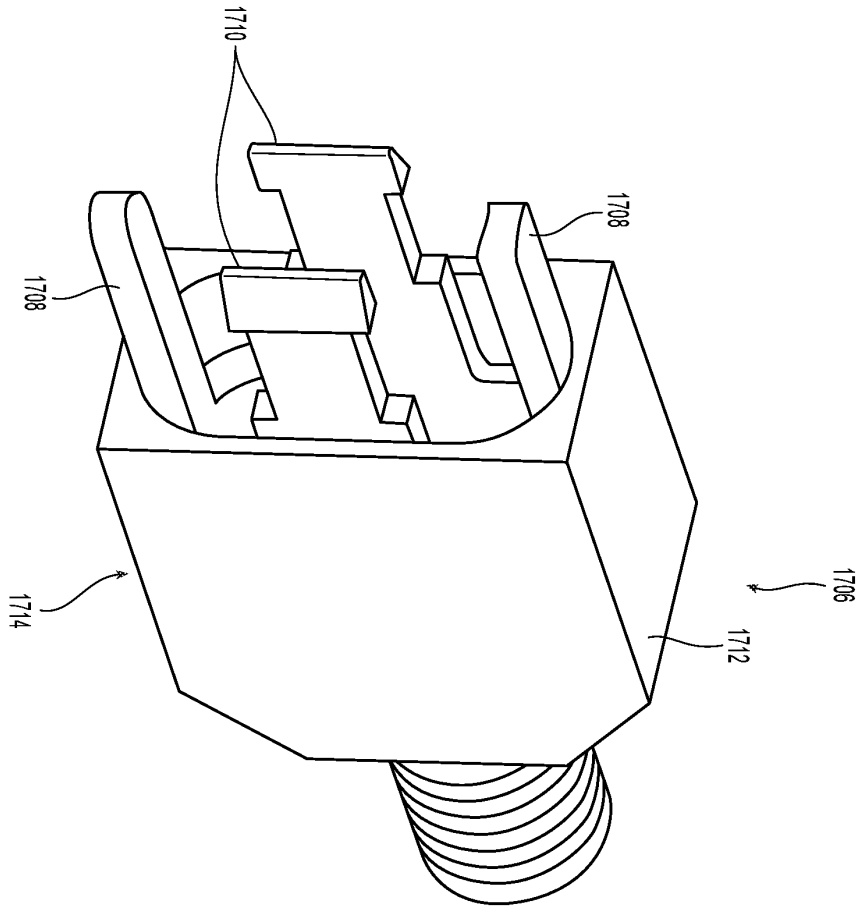


Fig. 38

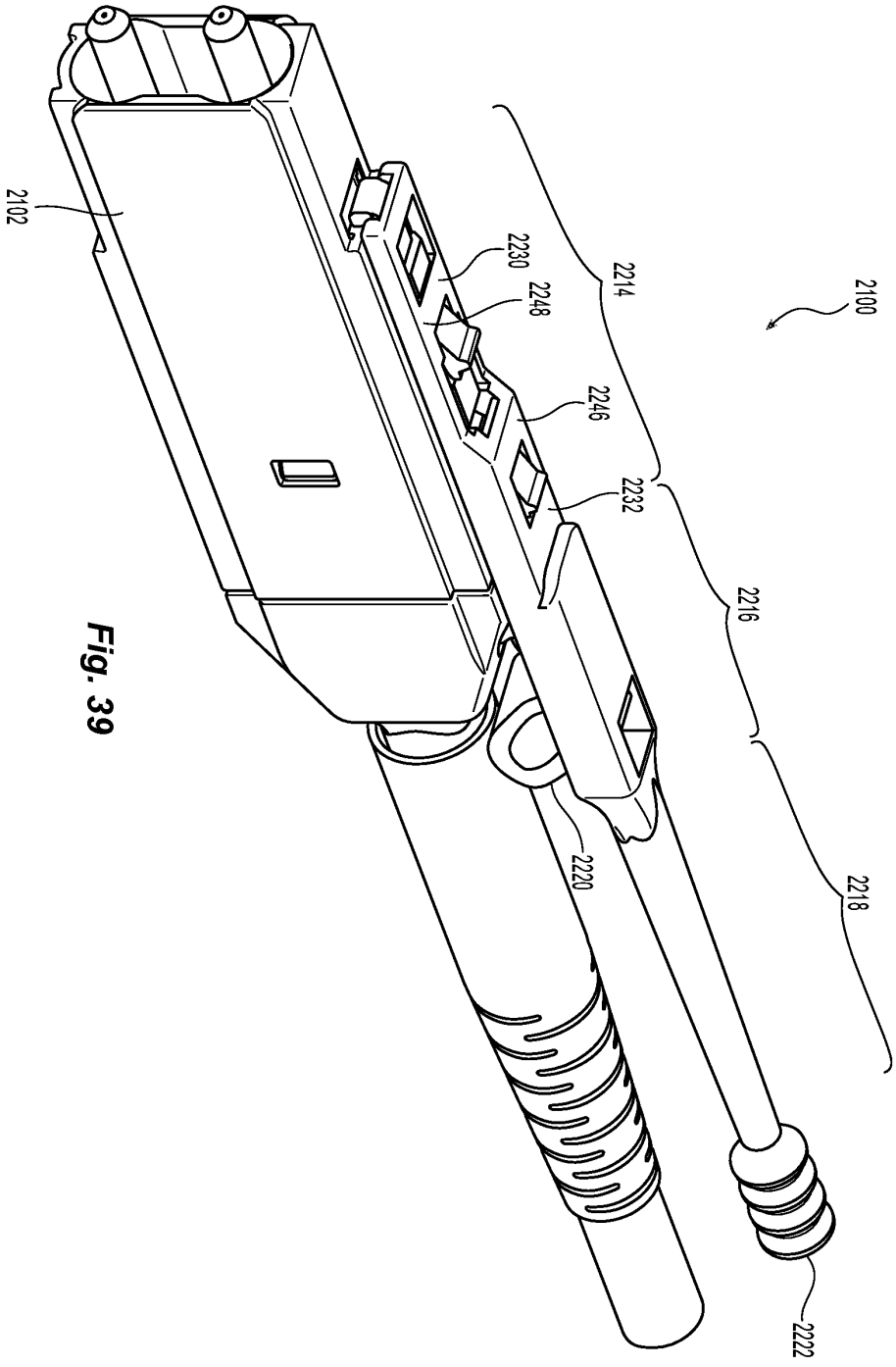


Fig. 39

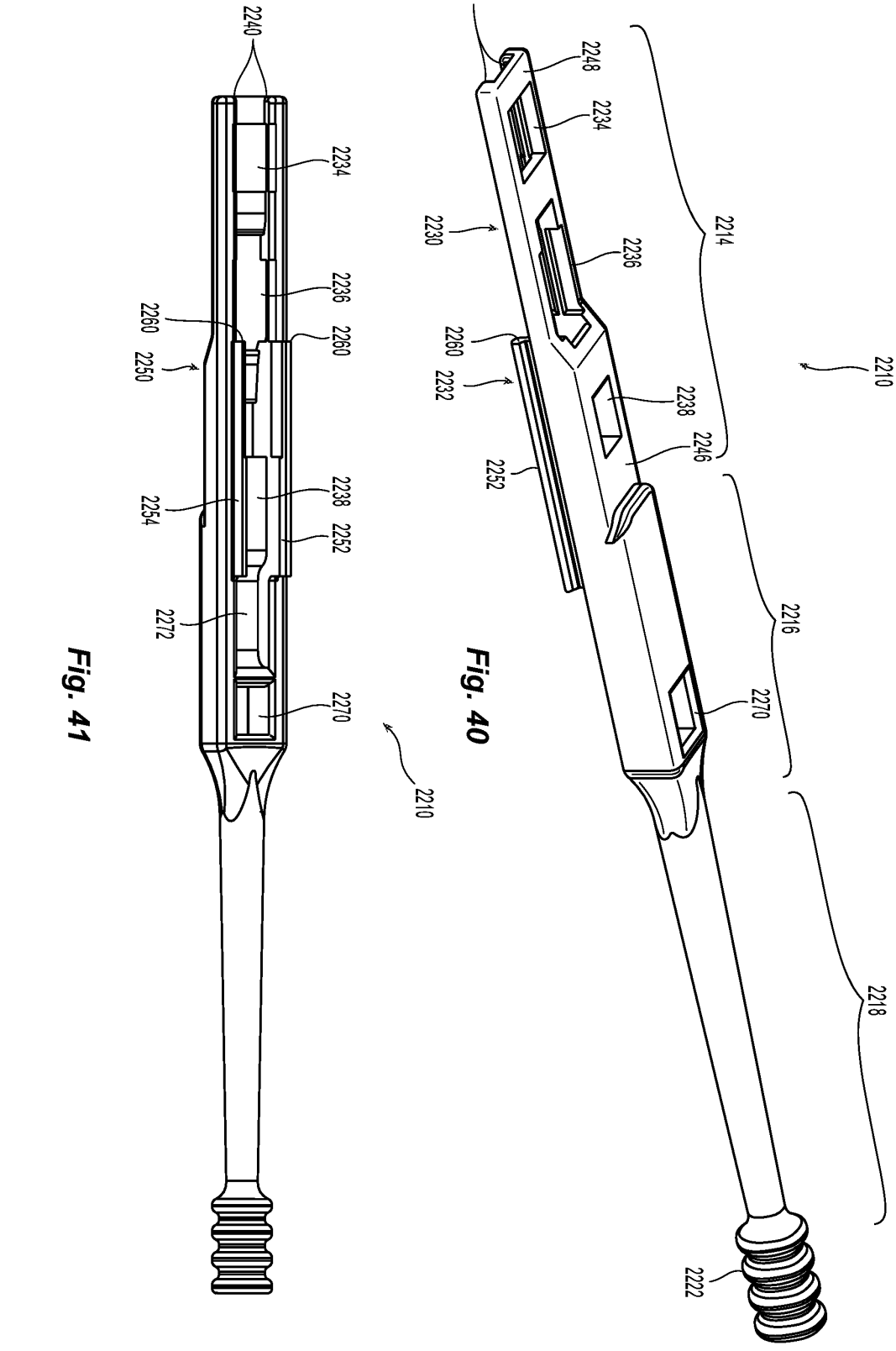

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Fig. 40

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Fig. 41

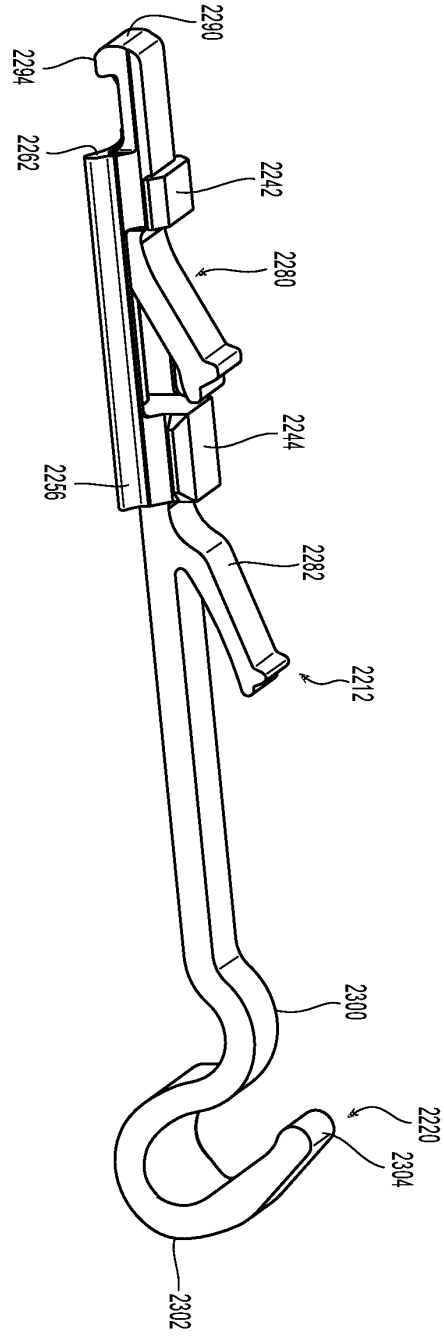

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Fig. 42

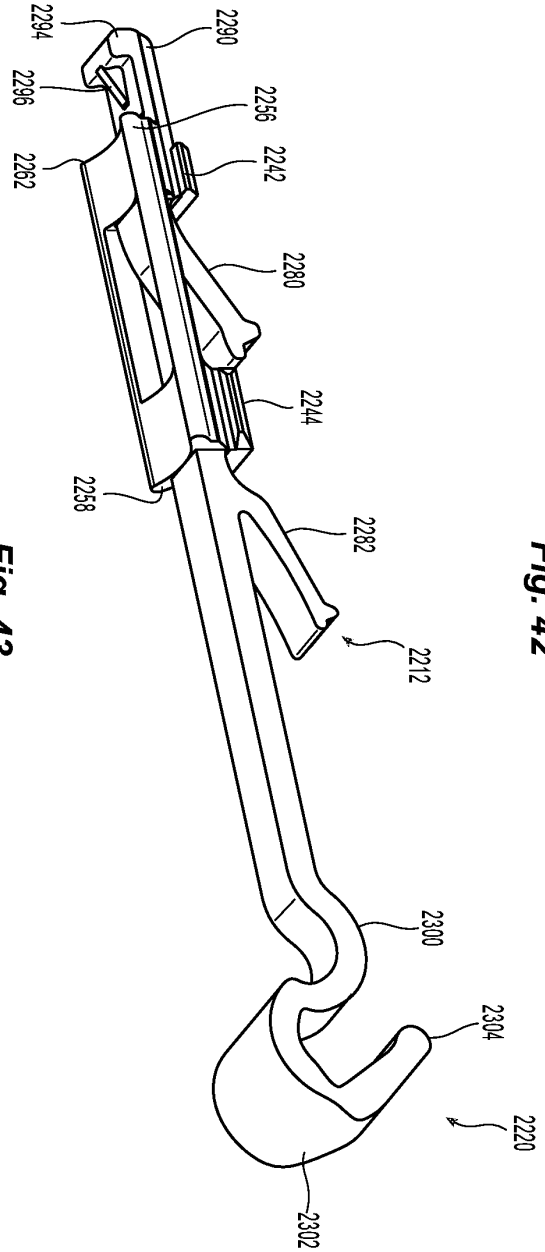

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Fig. 43

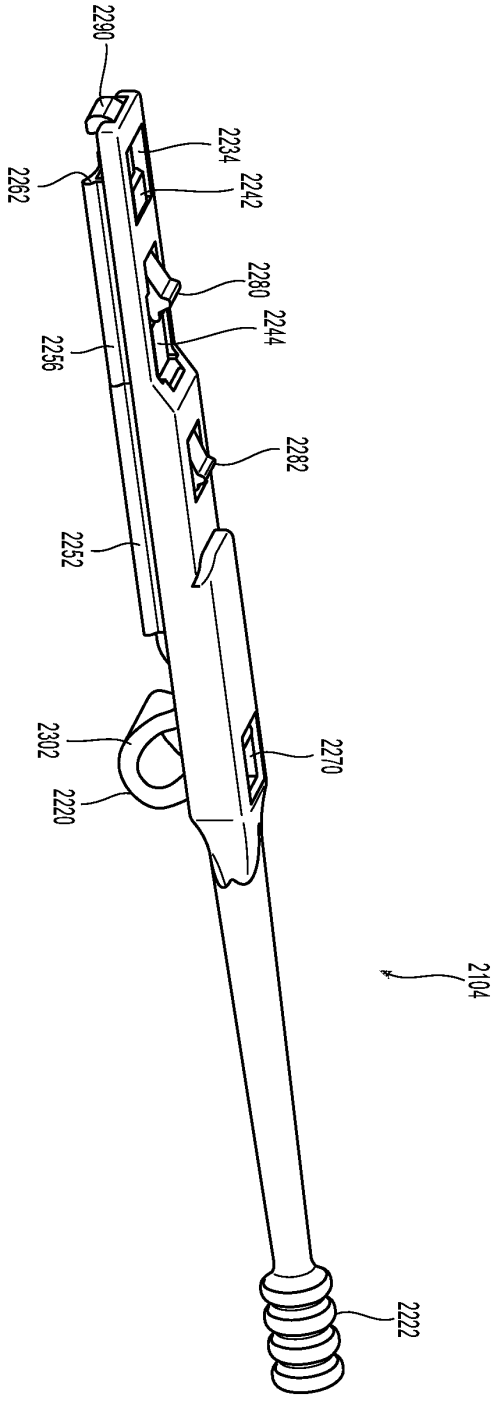

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Fig. 44

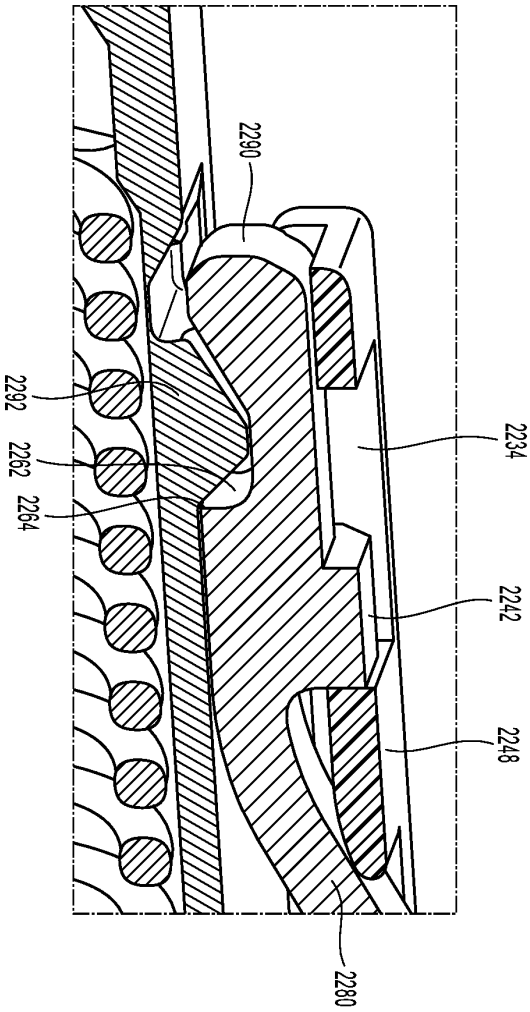


Fig. 45

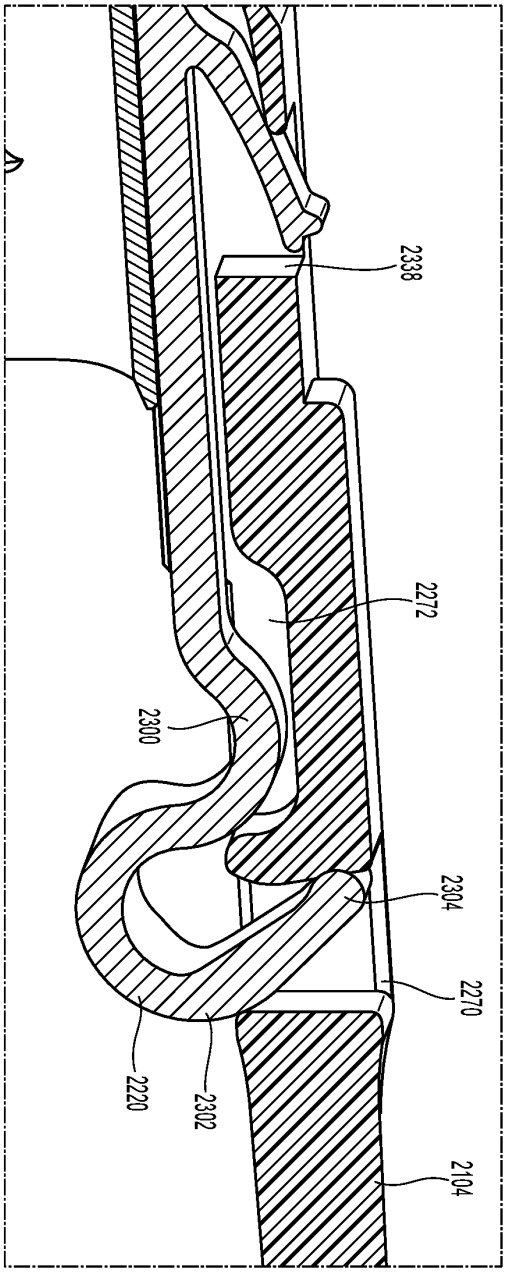


Fig. 46

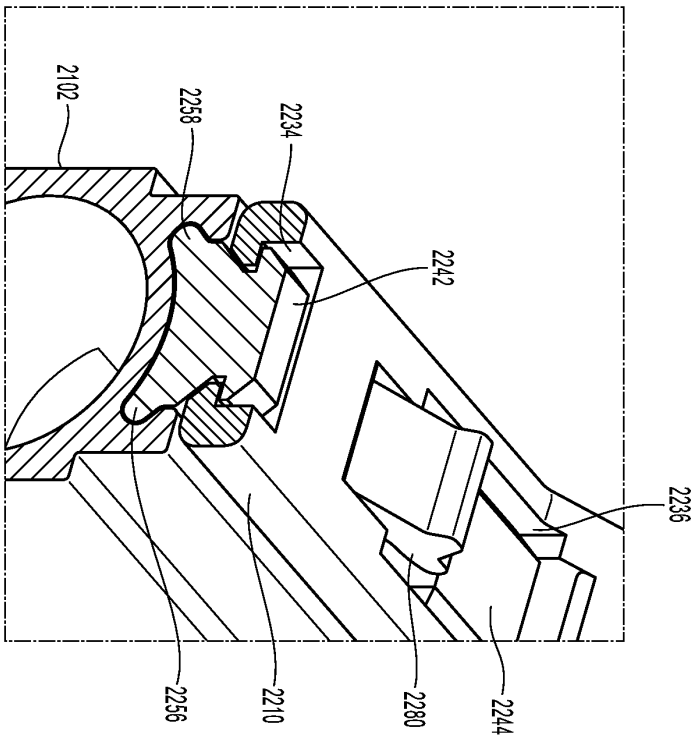


Fig. 47

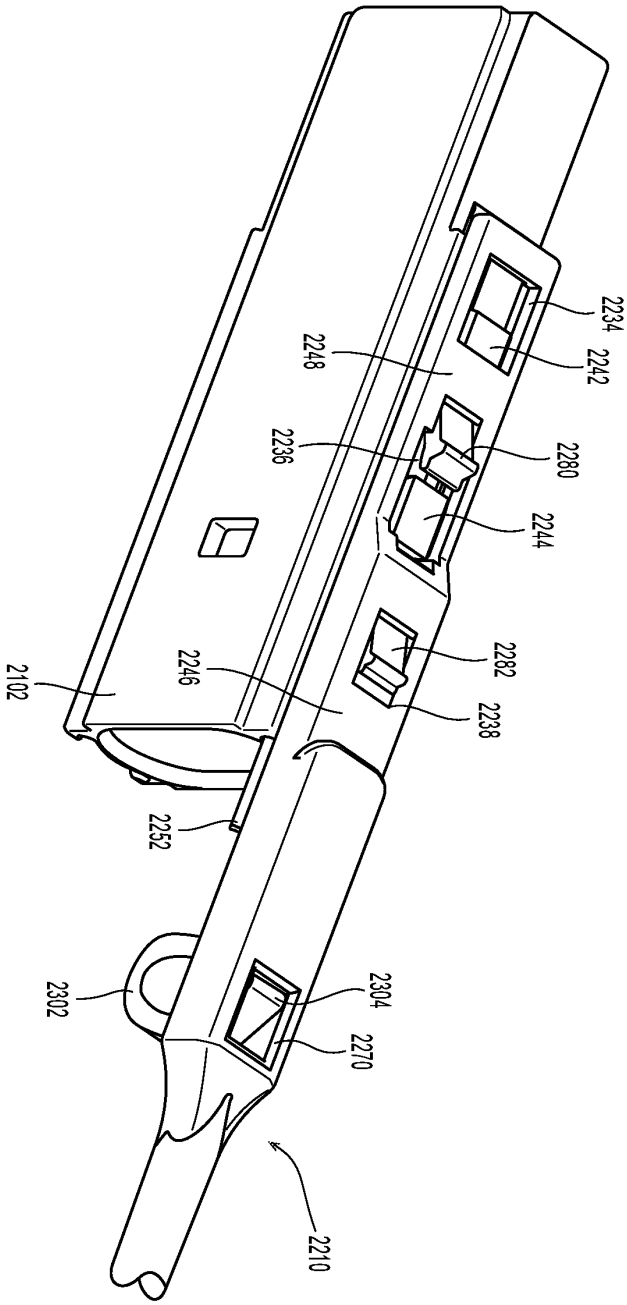

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Fig. 48

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DECLARATION (37 CFR 1.63) FOR UTILITY OR DESIGN APPLICATION USING AN APPLICATION DATA SHEET (37 CFR 1.76)

Title of Invention	MINI DUPLEX CONNECTOR WITH PUSH-PULL POLARITY MECHANISM AND CARRIER

As the below named inventor, I hereby declare that:

This declaration is directed to:

- [x] The attached application, or
- [ ] United States application or PCT international application number _____ filed on _____.

The above-identified application was made or authorized to be made by me.

I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

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.

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LEGAL NAME OF INVENTOR

Inventor: Michael E. Hughes Date (Optional): 5/3/19

Signature: Michael E. Hughes

Note: An application data sheet (PTO/SB/14 or equivalent), including naming the entire inventive entity, must accompany this form or must have been previously filed. Use an additional PTO/AIA/01 form for each additional inventor.

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LEGAL NAME OF INVENTOR

Inventor: Darrell R. Childers Date (Optional): _____

Signature: _____

Note: An application data sheet (PTO/SB/14 or equivalent), including naming the entire inventive entity, must accompany this form or must have been previously filed. Use an additional PTO/AIA/01 form for each additional inventor.

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- [ ] United States application or PCT international application number _____ filed on _____.

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I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

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LEGAL NAME OF INVENTOR

Inventor: Jillcha F. Wakjira Date (Optional): 4/29/19

Signature: Jillcha F. Wakjira

Note: An application data sheet (PTO/SB/14 or equivalent), including naming the entire inventive entity, must accompany this form or must have been previously filed. Use an additional PTO/AIA/01 form for each additional inventor.

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DECLARATION (37 CFR 1.63) FOR UTILITY OR DESIGN APPLICATION USING AN APPLICATION DATA SHEET (37 CFR 1.76)

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This declaration is directed to:

- [X] The attached application, or
- [ ] United States application or PCT international application number _____ filed on _____.

The above-identified application was made or authorized to be made by me.

I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

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.

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LEGAL NAME OF INVENTOR

Inventor: Jason Higley Date (Optional): 4/29/2019

Signature: Jason Higley

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DECLARATION (37 CFR 1.63) FOR UTILITY OR DESIGN APPLICATION USING AN APPLICATION DATA SHEET (37 CFR 1.76)

Title of Invention	MINI DUPLEX CONNECTOR WITH PUSH-PULL POLARITY MECHANISM AND CARRIER

As the below named inventor, I hereby declare that:

This declaration is directed to:

- [x] The attached application, or
- [ ] United States application or PCT international application number _____ filed on _____.

The above-identified application was made or authorized to be made by me.

I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

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.

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LEGAL NAME OF INVENTOR

Inventor: Mitchell Cloud Date (Optional) :_____

Signature: Mitchell Cloud

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MINI DUPLEX CONNECTOR WITH PUSH-PULL POLARITY MECHANISM AND CARRIER

BACKGROUND OF THE INVENTION

[0001] This application claims priority to U.S. Provisional Patent Application serial number 62/607,555, filed on December 19, 2017 and Provisional Patent Application serial number 62/634,271, filed on February 23, 2018, and under 35 U.S.C. § 120 to U.S. Patent No. 11,016,250, issued on March 25, 2021, and to U.S. Patent No. 11,506,848, issued on November 22, 2022, the contents of all of which are incorporated by reference.

FIELD OF THE INVENTION

[0002] In the small form-factor pluggable (SFP and QSFP) industry, there are a number of different ferrules and designs that are used. In some applications, an MT ferrule is used, while in others it is the LC form that is used. The LC connector uses a single optical fiber and fiber optic ferrule per housing. In higher density applications, the LC connector may not be used because the space that each of the LC connectors use. Thus, it would beneficial to reduce the footprint of the LC connector by reducing the pitch between the fiber optic ferrules.

[0003] Applicant has a new design for a fiber optic connector using the LC fiber optic ferrule to reduce the overall footprint of the fiber optic connector. In addition, an insertion/removal tool has been included to allow for the reduced footprint, allowing a user to more easily insert and remove the new fiber optic connectors. The fiber optic connector and the insertion/removal tool may also provide a way to ensure the correct polarity of the fiber optic connector and to even change the polarity in the field.

[0004] Finally, the insertion/removal tool may include a way for it to be self-returning after a user inserts/removes the fiber optic connector.

SUMMARY OF THE INVENTION

[0005] The present invention is directed to a fiber optic connector that includes a housing having a main body extending between a front end and a rear end and having an opening extending therebetween, two ferrule assemblies disposed within the opening of the housing, each of the ferrule assemblies including a fiber optic ferrule, a ferrule holder and a lead-in tube, the fiber optic ferrule being inserted into a front end of a ferrule holder and extending away from the

front end of the ferrule holder, and the lead-in tube attached the ferrule holder and extending rearwardly and away from the fiber optic ferrule, two springs, each spring engaging a rearward facing surface of a respective ferrule holder and extending towards the rear end of the housing, and a spring push engaging a rear portion of each of the two springs to bias the ferrule assemblies toward the front end of the housing, the spring push engaging a portion of the housing in the opening to retain the spring push within the opening, wherein each of the lead-in tubes extend through at least a portion of a respective spring and beyond a rear end of the spring push.

[0006] In some embodiments, the fiber optic connector includes a crimp body having a transition portion to receive an optical fiber extending from each of the lead-in tubes between the front end and a singular opening at a rear end, the rear end having an outer surface to receive a crimp band therearound.

[0007] In some embodiments, the housing has a rail receiving portion configured to receive a latch component.

[0008] In some embodiments, the latch component is a push-pull mechanism.

[0009] In another aspect, the invention is directed to a method of assembling a fiber optic connector that includes the steps of inserting into a housing having a main body, the main body extending between a front end and a rear end and having an opening extending therebetween two ferrule assemblies, each of the ferrule assemblies comprising a fiber optic ferrule, a ferrule holder and a lead-in tube, the fiber optic ferrule being inserted into a front end of a ferrule holder and extending away from the front end of the ferrule holder, and the lead-in tube attached the ferrule holder and extending rearwardly and away from the fiber optic ferrule, inserting on to each of the ferrule assemblies a spring engaging a rearward facing surface of the ferrule holder and extending towards the rear end of the housing, inserting into the housing a spring push to engage a rear portion of each of the springs to bias the ferrule assemblies toward the front end of the housing, the spring push engaging a portion of the housing in the opening to retain the spring push within the opening, inserting an adhesive into each of the lead-in tubes to secure an optical fiber within each of the ferrule assembly, and allowing the adhesive to cure with an optical fiber within each of the ferrule assemblies.

[0010] Additional features and advantages of the invention will be set forth in the detailed description which follows, and in part will be readily apparent to those skilled in the art from that description or recognized by practicing the invention as described herein, including the detailed description which follows, the claims, as well as the appended drawings.

[0011] It is to be understood that both the foregoing general description and the following detailed description of the present embodiments of the invention, and are intended to provide an overview or framework for understanding the nature and character of the invention as it is claimed. The accompanying drawings are included to provide a further understanding of the invention, and are incorporated into and constitute a part of this specification. The drawings illustrate various embodiments of the invention, and together with the description serve to explain the principles and operations of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] FIG. 1 is a side elevational view of one embodiment of a fiber optic connector with a push-pull mechanism, crimp body, and boot according to the present invention;

[0013] FIG. 2 is an exploded perspective view of the fiber optic connector in FIG. 1;

[0014] FIG. 3 is a perspective view of a portion of the fiber optic connector in FIG. 1, which includes the housing with two ferrule assemblies and a spring push;

[0015] FIG. 3A is an exploded perspective view of the ferrule assembly and spring in FIG. 3;

[0016] FIG. 4 is a partial cross section of the housing with two assembled ferrule assemblies and the spring push in FIG. 3;

[0017] FIG. 5 is a perspective view of the housing of the fiber optic connector in FIG. 1 and FIG. 3;

[0018] FIG. 6 is a rear elevational view of the housing in FIG. 5;

[0019] FIG. 7 is a perspective view of spring push in FIG. 3;

[0020] FIG. 8 is a front elevational view of the crimp body in FIG. 1;

[0021] FIG. 9 is a partial cut away perspective view of the crimp body in FIG. 8;

[0022] FIG. 10 is a perspective view of the push-pull mechanism of FIG. 1;

[0023] FIG. 10A is a perspective view of the underside of the push-pull mechanism of FIG. 10;

[0024] FIG. 11 is a perspective view of a latch body used with the push-pull mechanism in FIG. 10;

[0025] FIG. 12 is a front elevational view of the latch body in FIG. 11;

[0026] FIG. 13 is a side elevational view of the latch body in FIG. 11;

[0027] FIG. 14 is a perspective view of the push-pull mechanism and latch body illustrating how the latch body attaches to the push-pull mechanism;

[0028] FIG. 15 is a partial, perspective view of the push-pull mechanism and latch body in FIG. 14 ;

[0029] FIG. 16 is a top view of the push-pull mechanism in FIG. 14 attached to the fiber optic connector in FIG. 1;

[0030] FIG. 17 is an enlarged view of the connection of the push-pull mechanism and housing in FIG. 16;

[0031] FIG. 18 is a front perspective view of a plurality of fiber optic connectors and push-pull mechanisms mounted in a carrier according to one embodiment of the present invention;

[0032] FIG. 19 is a front view of the plurality of fiber optic connectors and push-pull mechanisms mounted in the carrier in Fig 18;

[0033] FIG. 20 is a rear perspective view of the plurality of fiber optic connectors and push-pull mechanisms mounted in the carrier in Fig 18 in preparation to be inserted into one embodiment of a fiber optic connector adapter according to the present invention;

[0034] FIG. 21 is a cross section of the assembly of the push-pull mechanism and latch body and the fiber optic connector, all mounted in the carrier and inserted into the adapter;

[0035] FIG. 22 is a cross section of a smaller portion of the assembly shown in FIG. 21 illustrating push-pull mechanism and latch body mounted in the carrier and the fiber optic connector adapter;

[0036] FIG. 23 is an elevational view of a second embodiment of a fiber optic connector with a push-pull mechanism, crimp body, and boot according to the present invention;

[0037] FIG. 24 is a partial cross sectional view of the housing with the two ferrule assemblies and a spring push of the fiber optic connector in FIG. 23;

[0038] FIG. 25 is a perspective view of the housing of the fiber optic connector in FIG. 23;

[0039] FIG. 26 is a rear elevational view of the housing in FIG. 25;

[0040] FIG. 27 is partial cross section of a second embodiment of a crimp body according to the present invention and shown in FIG. 23;

[0041] FIG. 28 is a perspective view of the second embodiment of a push-pull mechanism according to the present invention and shown in FIG. 23;

[0042] FIG. 29 is a cross section view of the push-pull mechanism in FIG. 27;

[0043] FIG. 30 is cross section of the fiber optic connector with a push-pull mechanism and crimp body of FIG. 23;

[0044] FIG. 31 is a perspective view of a fiber optic connector and push-pull mechanisms of FIG. 23 mounted in a carrier;

[0045] FIG. 32 is a cross section view of the carrier of FIG. 30 without the fiber optic connector;

[0046] FIG. 33 is a cross section view of the fiber optic connector with a push-pull mechanism and crimp body of FIG. 23 in an embodiment of a carrier;

[0047] FIG. 34 is a cross section view of fiber optic connector with a push-pull mechanism and crimp body in a carrier being inserted into an adapter;

[0048] FIG. 35 a cross section view of fiber optic connector with a push-pull mechanism and crimp body in a carrier being removed from the adapter;

[0049] FIG. 36 is a cross section view of fiber optic connector with a push-pull mechanism and crimp body being removed from a carrier;

[0050] FIG. 37 is a perspective view of a second embodiment of a spring push according to the present invention;

[0051] FIG. 38 is a perspective view of a second embodiment of a crimp body according to the present invention;

[0052] FIG. 39 is an elevational view of another embodiment of a fiber optic connector with a push-pull mechanism, crimp body, and boot according to the present invention;

[0053] FIG. 40 is a right top perspective view of the push-pull mechanism of FIG. 39;

[0054] FIG. 41 is a bottom perspective view of the push-pull mechanism of FIG. 39;

[0055] FIG. 42 is a right perspective view of the latch body with a flexure mechanism of FIG. 39;

[0056] FIG. 43 is a right bottom perspective view of the latch body and flexure mechanism of FIG. 39

[0057] FIG. 44 is a right perspective view of the push-pull mechanism with latch body and flexure mechanism;

[0058] FIG. 45 is an enlarged cross sectional view of a portion of the push-pull mechanism, latch body, and fiber optic connector of FIG. 39;

[0059] FIG. 46 is enlarged cross sectional view of a portion of the push-pull mechanism, latch body, and fiber optic connector of FIG. 41 at a different location from FIG. 47;

[0060] FIG. 47 is a cross sectional view of the push-pull mechanism, latch body, and housing; and

[0061] FIG. 48 is a top perspective view of the push-pull mechanism, latch body, and housing.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0062] Reference will now be made in detail to the present preferred embodiment(s) of the invention, examples of which are illustrated in the accompanying drawings. Whenever possible, the same reference numerals will be used throughout the drawings to refer to the same or like parts.

[0063] Applicant notes that the term "front" or "forward" means that direction where the fiber optic connector would meet with another fiber optic connector or device, while the term "rear" or "rearward" is used to mean the direction from which the optical fibers enter into the fiber-optic ferrule or fiber optic connector. Thus, "front" is that part of the housing **102** on the left side of FIG. 1 and "forward" is out and to the left. "Rear" is that part of the housing **102** that is on the right side of the page and "rearward" is toward the right.

[0064] One embodiment of a fiber optic connector **100** according to the present invention is illustrated in FIGS 1-22. The fiber optic connector **100**, in FIGS. 1 and 2, may include a housing **102**, a latch component (push-pull mechanism) **104**, a crimp body **106**, a crimp ring and heat shrink tube **108**, and a strain relief boot **110**. As discussed in more detail below, the housing **102** and its components, the latch component **104,** and the crimp body **106** are the focus of this application. The crimp ring and heat shrink tube **108** and a strain relief boot **110** are generally known components.

[0065] Turning to FIGS. 3 and 3A, inside the housing **102** are two ferrule assemblies **120**, two springs **122**, and a spring push **124**. The two ferrule assemblies **120** each include a fiber optic ferrule **130** (generally a 1.25 mm LC fiber optic ferrule), a ferrule holder **132**, and a lead-in tube **134**. The spring **122** is added later. The ferrule assemblies **120** are preferably preassembled and are inserted into the housing **102** without needing any further processing.

[0066] The housing **102** has a main body **140** extending between a front end **142** and a rear end **144**, and has an opening **146** extending therebetween. The opening **146** of the housing **102** may also have structures **148** that orient and retain the ferrule assemblies **120** in the housing **102**. In this case, there are flat surfaces **150** that engage corresponding flat surfaces **152** on the ferrule holder **132**, to keep the ferrule assemblies **120** from rotating within the housing **102**.

[0067] Once the ferrule assemblies **120** are disposed within the housing **102**, the springs **122** are placed around the lead-in tube **134** and against a back end **138** of the ferrule holder **132**. The spring push **124** is then inserted into the opening **146** of the housing **102**. The spring push **124** has a pair of latches **154** that engage corresponding openings **156** in the opposite sides of the main body **140** of the housing **102** to retain the spring push **124** in the opening **146**. The spring push **124** has a forward facing surface **158** to engage the rear ends of the springs **122**. The forward facing surface **158** generally corresponds to the two springs **122** to ensure that that the spring push **124** stays engaged with the springs **122**. This configuration biases the ferrule assemblies **120** toward the front end **142** of the housing **102**. While not shown, two optical fibers enter into the ferrule assemblies **120** through the spring push **124** and into the lead-in tubes **134**.

[0068] The lead-in tubes **134** are connected to and extend from the ferrule holder **132**. Preferably, the lead-in tubes **134** are secured to the ferrule holder **132**, e.g. by adhesives, press-fit. The lead-in tubes **134** also extend beyond the rear end of the ferrule holder **132**. See FIG. 4. This allows for injection of epoxy or other adhesives into the ferrule assemblies **120** through the lead-in tubes **134** to secure the optical fibers therein. With the lead-in tubes **134** extending so far rearwardly, there is no concern that the epoxy or adhesives will interfere with the springs **134**, the spring push **124**, or other structures in the fiber optic connector **100**. Typically, the adhesive is cured with the lead-in tubes **134** exposed in prior to adding any additional components.

[0069] The housing **102** may also have an indicia **136** of the polarity of the fiber optic connector **100**. See FIG. 5. Depending on the application, one of the ferrule assemblies **120** may be a receiving or a transmitting side with the other of the ferrule assemblies **120** being the other. It is important for the user or technician to know which of the ferrule assemblies **120** is which. The indicia **136**, an indentation in this case, makes the orientation or the polarity of the fiber optic connector **100** clearly visible. Other types of indicia may be used and still fall within the scope of the present invention.

[0070] The outside of the housing **102** has many features that are integral to its use. See FIGS. 5 and 6. First are the top surface **160** and the bottom surface **162**. The top and bottom surfaces **160**,**162** are preferably the same, with the exception of the indicia **136**, as one of the two surfaces **160**,**162** would not have it. Extending from the rear end **144** towards the front **142** of the housing **140** on both the top surface **160** and the bottom surface **162** is a rail receiving portion **164**. As will be discussed in more detail below, the rail receiving portion

164 will stop just before the front end **142** as it will therefore create a stop surface **166**. The latch component (push-pull mechanism) **104** will make use of the stop surface **166** to insert the fiber optic connector **100** into various structures.

[0071] The rail receiving portion **164** has a central portion **168** and then two lobe sections **170**, one lobe on each side of the central portion **168**. As best seen in FIG. 6, the rail receiving portion **164** looks like part of a profile of a dog bone. This configuration matches that of the bottom surface of the latch component (push-pull mechanism) **104** to form a sliding dove-tail configuration. Other configurations are possible, such as, for example, the second version illustrated below - a cap with undercuts (essentially an umbrella or a T-shape configuration). See FIG. 26.

[0072] The next feature of the housing **102** and main body **140** are the two side surfaces **180**. The two side surfaces **180** are those opposite to one another and separated by the top surface **160** and the bottom surface **162**. Referring to FIG. 6 in particular, each of the sides **180** are divided into three portions. The first portion is a longitudinal central portion **182** extending in a first plane **A**. The second portion is a longitudinal top portion **184** extending in a second plane **B**, the first plane **A** is parallel to and offset from the second plane **B**. The third portion is a longitudinal bottom portion **186** extending in the second plane **B**. The longitudinal top portion **184** preferably is divided from the longitudinal central portion **182** by a shoulder **188**. The shoulder **188** preferably has a surface that is in plane **C** and is perpendicular to both planes **A** and **B**. Similarly, the longitudinal bottom portion **186** preferably is divided from the longitudinal central portion **182** by a shoulder **190**. The shoulder **190** preferably has a surface that is in plane **D** and is perpendicular to both planes **A** and **B**.

[0073] The two longitudinal top portions **184** and the two longitudinal bottom portions **186** function to align the fiber optic connector **100** in a horizontal direction in various structures, e.g., a carrier and an adapter. On the other hand, it is the shoulders **188**,**190** that align the fiber optic connector **100** in a vertical direction. These will be discussed in more detail below. See also FIGS. 19 and 20.

[0074] Referring to FIG. 5, there are also two indentations **192** in the longitudinal top portion **184** on both sides of the main body and adjacent the rear end **144**. The indentations **192** form a forward facing surfaces **194** that are used by two housing latches in the latch component (push-pull mechanism) **104**. As described more later, the latch component (push-pull mechanism) **104** engages the forward facing surfaces **194** when removing the fiber optic connector **100**.

[0075] Returning to the crimp body **106**, it is illustrated in FIG. 1 and also in FIGS. 8 and 9. The crimp body **106** has a front portion **200** that is designed to interact and connect with the spring push **124** and also is disposed within the opening **146** of the housing **102** when installed. The crimp body **106** has a rear portion **202** that extends behind the housing **102** and provides an outer surface **204** to receive a crimp band (e.g., crimp ring and heat shrink tube **108)** therearound. Extending from a front end **206** to the rear end **208** is an opening **210**. The opening **210** at the front portion **200** receives at least a portion of each of the lead-in tubes **134**. The spring push **124** has two tabs **212** on opposites sides thereof and extend in a rear ward direction in the opening **210** to engage an opening **214** in side walls **216** of the crimp body **106**. The front end **206** also has a forward facing surface **218** that complements the rear of the spring push and, together with the tabs **212** keeps the crimp body **106** securely fixed to fiber optic connector **100**. Although the crimp body **106** is illustrated as being attached to the spring push **124**, alternatively the crimp body **106** could be attached to the housing **102**.

[0076] The opening **210** in the crimp body **106** rearwardly of the lead-in tubes provides a transition portion **220** for the optical fibers that are secured in the fiber optic ferrules **130**. Since the crimp body **106** has a singular opening **222** at the rear end thereof, the optical fibers need to be able to exit that singular opening **222** in a smooth fashion so they are not bent beyond their bend radius, thereby damaging or breaking the optical fibers. The transition portion **220** provides for this function.

[0077] The crimp body **106** also has a top surface **230** and the bottom surface **232**. The top surface **230** and the bottom surface **232** may be configured with a central portion **234** that is similar to the central portion **168** of the rail receiving portion **164** above. However, the crimp body **106** has two outer trough portions **236** that are open to the space above the crimp body **106**. The central portion **234** and the two outer trough portions **236** function as an alignment feature of the rail receiving portion **164**. As discussed more below, the latch component (push-pull mechanism) **104** can be better aligned with the rail receiving portion **164** by using the central portion **234** and the two outer trough portions **236** on the crimp body **106**.

[0078] While the crimp body **106** is illustrated as a single, unitary body (i.e., molded at one time with one material), it could also be molded as two pieces and then later the two pieces secured to one another.

[0079] The latch component (push-pull mechanism) **104** is illustrated in more detail in FIGS. 10-17. The latch component (push-pull mechanism) **104** has a main body **250** and a latch body **252** that attaches to the main body **250**. See FIGS. 10 and 11-13. The main body **250** has a front portion **254**, a middle portion **256**, and a rear portion **258**. Generally, the front portion **254** is where the latch body **252** attaches to the main body **250** and provides for the latching of the fiber optic connector **100** to the adapter and carrier. The middle portion **256** provides for latching of latch component (push-pull mechanism) **104** to the housing **102**. The rear portion **258** has a grasping portion **260** to allow a user to push and pull the latch component (push-pull mechanism) **104** to engage and disengage the fiber optic connector **100** and the latch component (push-pull mechanism) **104** from the adapter and/or carrier.

[0080] The front portion **254** is divided into a first front portion **262** and a second front portion **264**. The first front portion **262** and the second front portion **264** both have a window **266**, **268**, respectively to receive a latch from the latch body **252** therethrough. An underside of the first portion **262** has a groove **270** on either side to receive attachment members **272**, **274** from the latch body **252** (see FIGS. 10A and 11) to secure the latch body **252** to the main body **250**. The attachment members **272**, **274** (and thus the latch body **252**) are able to slide within the grooves **270** to allow for the latching and unlatching the fiber optic connector **100**. The grooves **270** should extend the length of the first portion **254**.

[0081] The second front portion **264** has an upper surface **276** that is higher than an upper surface **278** of the first front portion **262**. This allows for the latching of a carrier and an adapter with the same device, as noted in more detail below. On the bottom side **280** of the second front portion **264** is a rail portion **282** that includes two extensions **284**, **286** that are joined by a central portion **288**, all having a complementary configuration of the rail receiving portion **164** of the housing **102**. See FIG. 10A. The latch body **252** also has the same rail portion configuration (central portion **290** and two extensions **292, 294**) on the bottom thereof. This allows the main body **250** and the latch body **252** to be slidingly attached to the rail receiving portion **164** of housing **102**. When the latch body **252** is inserted into the first front portion **262**, a front surface **296** of the rail portion **282** provides a pushing surface by which the main body **250** can push the latch body **252** in the rail receiving portion **164** of the housing **102**. See also FIG. 21. The front surface **300** of the latch body **252** also provides a pushing surface to be used against the stop surface **166** of the housing **102**. This allows for the user to exert a force on the latch component (push-pull

mechanism) **104** which is transferred through the main body **250** to the latch body **252** and to the housing **102** to insert the fiber optic connector **100** into a carrier and/or adapter.

[0082] Returning to FIGS. 11-13, the latch body **252** has two latches, an adapter latch **310** and a carrier latch **312**. The latch body may only have one of the latches, depending upon its uses and the needs of the user. The adapter latch **310** extends from a forward portion of the latch body **252** and protrudes through window **266** of the main body **250**. The carrier latch **312** also extends from the latch body **252**, from a rear portion thereof, and protrudes through the window **268** of the main body **250**. As is recognized from FIG. 13, the adapter latch **310** does not rise as high as the carrier latch **312** (plane **E** versus plane **F**) so that when the fiber optic connector **100** is inserted into or removed from a carrier, the adapter latch **310** will not engage the carrier.

[0083] Each of the latches, adapter latch **310** and a carrier latch **312**, each have a proximal end **314**, **316**, to engage an adapter and a carrier, respectively. Each of the proximal ends, **314**, **316**, have a rearward facing surface **314a**, **316a** and an upward facing surface, **314b**,**316b**. The proximal ends **314**, **316** will engage an opening in an adapter or a carrier. See, e.g., FIG. 21.

[0084] The latch component (push-pull mechanism) **104** is removably connected to the rail receiving portion **164** of the housing **102** as described above. However, the connections so far described do not prevent the latch component (push-pull mechanism) **104** from being removed toward the rear of the housing **102** when, for example, the grasping portion **260** is pulled rearwardly. However, in the middle portion **256**, there are two latches **320** that extend from the latch component (push-pull mechanism) **104** inward and will move along rear portions of the longitudinal top portions **184** on each side of the housing **102**. See FIGS. 1, 18, and 20. In particular, the housing **102** has indentations **192** for the latches **320** and will engage the forward facing surfaces **194** when the latch component (push-pull mechanism) **104** is pulled rearwardly. This will allow for the user to remove the fiber optic connector **100** from a carrier and/or adapter as will now be described. It should be noted that the latches **320** are cantilevered latches and thus pushing on area **322** (see FIGS. 16 and 17) will cause the latches to move away from the housing **102**, and will release the housing **102** from the latch component (push-pull mechanism) **104**.

[0085] Turning to FIGS. 1, 14, 15, and 18, the latch component (push-pull mechanism) **104** is connected to the fiber optic connector **100**. The fiber optic connector **100** can be inserted into a carrier **350** (FIG. 18) and/or an adapter **400** (FIG. 20). The carrier **350**

provides the user with a convenient way to insert into and remove 4 fiber optic connectors **100** (could also have more or fewer connectors, but usually in groups of two) from an adapter (or other telecommunications structure) rather than one at a time. It provides a cost savings time wise and also assists in preventing the stubbing of or breaking fiber optic connectors.

[0086] The carrier **350** has a few features that enable the use of the carrier **350** to correctly orient the fiber optic connectors **100** (polarity) and also to align the fiber optic connectors **100** to one another for insertion into the adapter. The carrier **350** has a top **352** and a bottom **354** and the top **352** has a cut out **356** for each of the fiber optic connectors **100**, or the latch component (push-pull mechanism) **104**. If the fiber optic connector **100** is inserted into the carrier **350** incorrectly (wrong polarity) then the fiber optic connector **100** will not seat in the carrier **350** correctly. The cut out **356** also has a rearward facing surface **358** that is used to remove all of the fiber optic connectors **100** from an adapter as discussed in more detail below.

[0087] The carrier **350** has an opening **360** extending between the front end **362** and the rear end **364**. Inside the opening **360** are projections to accurately orient the fiber optic connectors **100** in the carrier **350**. Extending from the top **352** into the opening **360** are the top extensions **366a**. Along the corner of the top and the sides of the carrier **350** are partial top extensions **366b**, which perform the same function as top extensions **366a**. Similarly, there are bottom extensions **368a** and partial bottom extensions **368b**. As best seen in FIG. 19, the top extensions **366a** are longer and extend down into the opening **360** farther than the bottom extensions **368a** extend upward into the opening **360**. The distance between corresponding top and bottom extensions **366a**, **368a** provide the vertical alignment of the fiber optic connector **100** within the carrier **350**. Referring back to FIG. 6, the shoulders **188** and **190** and, more particularly, the distance between them and their vertical location along the sides **180** of the housing **102** orients the fiber optic connectors **100** vertically within the carrier **350**. As can be gleamed from FIG. 19, if one of the fiber optic connectors **100** is oriented incorrectly, the longitudinal top portions **184** and the two longitudinal bottom portions **186** will be in the incorrect location and the latch component (push-pull mechanism) **104** will hit the carrier and prevent the fiber optic connector **100** from being fully inserted.

[0088] The horizontal alignment of the fiber optic connectors **100** is also controlled by the top extensions **366a** and the bottom extensions **370**. However, it is the longitudinal top portions **184** and the two longitudinal bottom portions **186** (the distance therebetween) engaging

the top extensions **366a** and the bottom extensions **370** that controls. FIG. 19 also shows that there is very limited space between the fiber optic connectors **100** and allows for a higher density of fiber optic connectors **100**.

[0089] Once the fiber optic connectors **100** with the latch component (push-pull mechanism) **104** are correctly inserted into the carrier **350**, a latch stop **380** on the latch component (push-pull mechanism) **104** will engage the rearward facing surface **358** of the carrier **350**. The carrier **350** is captured between the latch stop **380** and rearward facing surface **316a** of carrier latch **312**. This will expose enough of the latch component (push-pull mechanism) **104** and, in particular, the first front portion **262**. At the same time, the top **352** of the carrier **350** has windows **370** to receive the carrier latch **312** from each latch body **252**, and in particular the proximal end **316**. See FIGS. 21 and 22. However, as the fiber optic connector **100** passes into the and through carrier **350**, the adapter latch **310** is too short to engage the carrier **350**.

[0090] With the carrier latch **312** now in the window **370** and engaging surface **372** created by the window **370**, the carrier **350** or the latch component (push-pull mechanism) **104** can be used to insert the fiber optic connectors **100** into the adapter **400**. As clear from FIGS. 21 and 22, if the carrier **350** is used to insert the ganged fiber optic connectors **100** (in the carrier **350** in Fig. 20), then the carrier **350** will push on the carrier latch **312**, which is on the latch body **252** and has front surface **300** of the latch body **252**, which then pushes against the stop surface **166** of the housing **102** to secure the ganged fiber optic connectors **100**. Thus, all of the fiber optic connectors **100** will be pushed simultaneously into the adapter. On the other hand, one could also used the latch component (push-pull mechanism) **104** to insert them as well.

[0091] As the ganged fiber optic connectors **100** are inserted into the adapter **400**, each of the adapter latches **310** will pop up into a respective window **402**. With the adapter latch **310** now in the window **402** and engaging surface **404** created by the window **402**, the ganged fiber optic connectors **100** are secured within the adapter **400**. The adapter **400** has the same projections to accurately orient the fiber optic connectors **100** in the adapter **400**. Thus, applicant will not repeat the same structures here.

[0092] The fiber optic connectors **100** can be removed from the adapter **400** one at a time or all at the same time with the carrier **350**. To remove one fiber optic connector **100** from the adapter **400** (if only in the adapter) or the adapter **400** and the carrier **350**, one only need to pull on the grasping portion **260** of the latch component (push-pull mechanism) **104**. As

the latch component (push-pull mechanism) **104** is pulled backward, it moves rearward relative to the latch body **252** (because the adapter latch **310** and the carrier latch **312** are against the engaging surfaces **372, 404**, respectively) and the portions forward of the windows **266, 268**, will move over the adapter latch **310** and a carrier latch **312**, pushing them down and out of the windows **370**, **402**. Continued pulling on the grasping portion **260** of the latch component (push-pull mechanism) **104** causes the latches **320** to engage the forward facing surfaces **194** of the housing **102** and the whole fiber optic connector can be removed.

[0093] If the ganged fiber optic connectors **100** are to be removed together and only from the adapter **400**, then the user will pull on the carrier **350** (while the adapter **400** remains fixed relative thereto). The carrier **350** and, in particular, the rearward facing surface **358** will engage latch stop **380** on the latch component (push-pull mechanism) **104** of each of the fiber optic connectors **100**. As noted above, the portions forward of the windows **266, 268**, will move over the adapter latch **310** (and carrier latch **312**, but the carrier **350** will retain the fiber optic connectors **100)**, pushing them down and out of the windows **370**, **402**. Continued pulling on the carrier causes the latches **320** to engage the forward facing surfaces **194** of the housing **102** and all of the ganged fiber optic connectors **100** can be removed from the adapter **400**. The fiber optic connector 100 can be inserted into and removed the same adapter **400** without a carrier **350** present. A partially populated carrier in the adapter can how a single fiber optic connectors removed for install, while the carrier will stay connected to the fiber optic connectors that remain in the adapter. When the last fiber-optic connector is removed is from the adapter, it will bring the carrier with it.

[0094] A second embodiment of a fiber optic connector **1100** according to the present invention is illustrated in FIGS 23-36. The fiber optic connector **1100**, in FIG. 23, may include a housing **1102**, a latch component (push-pull mechanism) **1104**, and a crimp body **1106**. As discussed in more detail below, the housing **1102** and its components, the latch component **1104,** and the crimp body **1106** are the focus here. It is also preferred that there by a crimp ring and heat shrink tube and a strain relief boot as with the prior embodiment, but since the crimp ring and heat shrink tube and a strain relief boot are generally known components, they are omitted here for clarity.

[0095] Turning to FIG. 24, inside the housing **1102** are two ferrule assemblies **1120** (which may be the same as ferrule assemblies **120**), two springs **1122**, and a spring push **1124**. The two ferrule assemblies **1120** each include a fiber optic ferrule **1130** (generally a

1.25 mm LC fiber optic ferrule), a ferrule holder **1132**, and a lead-in tube **1134**. The spring **1122** is added later. The ferrule assemblies **1120** are preferably preassembled and are inserted into the housing **1102** without needing any further processing.

[0096] The housing **1102** has a main body **1140** extending between a front end **1142** and a rear end **1144**, and has an opening **1146** extending therebetween. The opening **1146** of the housing **1102** may also have structures **1148** that orient and retain the ferrule assemblies **1120** in the housing **1102**. In this case, there are flat surfaces **1150** that engage corresponding flat surfaces **1152** on the ferrule holder **1132**, to keep the ferrule assemblies **1120** from rotating within the housing **1102**.

[0097] Once the ferrule assemblies **1120** are disposed within the housing **1102**, the springs **1122** are placed around the lead-in tube **1134** and against a back end **1138** of the ferrule holder **1132**. The spring push **1124** is then inserted into the opening **1146** of the housing **1102**. The spring push **1124** has a pair of latches **1154** that engage corresponding openings **1156** in the opposite sides of the main body **1140** of the housing **1102** to retain the spring push **1124** in the opening **1146**. The spring push **1124** has a forward facing surface **1158** to engage the rear ends of the springs **1122**. The forward facing surface **1158** generally corresponds to the two springs **1122** to ensure that that the spring push **1124** stays engaged with the springs **1122**. This configuration biases the ferrule assemblies **1120** toward the front end **1142** of the housing **1102**. While not shown, two optical fibers enter into the ferrule assemblies **1120** through the spring push **1124** and into the lead-in tubes **1124**.

[0098] The lead-in tubes **1134** are connected to and extend from the ferrule holder **1132**. Preferably, the lead-in tubes **1134** are secured to the ferrule holder **1132**, e.g. by adhesives, press-fit. The lead-in tubes **1134** also extend beyond the rear end of the ferrule holder **132** and the springs **1122** and the spring push **1124**. See FIG. 24. This allows for injection of epoxy or other adhesives into the ferrule assemblies **1120** through the lead-in tubes **1134** to secure the optical fibers therein. With the lead-in tubes **1134** extending so far rearwardly, there is no concern that the epoxy or adhesives will interfere with the springs **1122**, the spring push **1124**, or other structures in the fiber optic connector **1100**.

[0099] The housing **1102** may also have an indicia of the polarity of the fiber optic connector **1100** as with the prior embodiment. Similarly, an indentation or other mark may be present on the housing **1102**.

[0100] The outside of the housing **1102** has many features that are integral to its use. See FIGS. 25 and 26. First are the top surface **1160** and the bottom surface **1162**. The top and

bottom surfaces **1160**,**1162** are preferably the same, but may have some differences and still fall within the scope of the present invention. Extending from the rear end **1144** towards the front **1142** of the housing **11020** on both the top surface **1160** and the bottom surface **1162** is a rail receiving portion **1164**. As will be discussed in more detail below, the rail receiving portion **1164** will stop before the front end **1142** as it will therefore create a stop surface **1166**. The latch component (push-pull mechanism) **1104** will make use of the stop surface **1166** to insert the fiber optic connector **1100** into various structures.

[0101] The rail receiving portion **1164** has a central portion **1168** and two lobe sections **1170**, one lobe on each side of the central portion **1168**. As best seen in FIG. 26, the rail receiving portion **1164** has a T-shape configuration. This configuration matches that of the bottom surface of the latch component (push-pull mechanism) **1104** to form a sliding configuration. Other configurations are possible, as noted above.

[0102] The next feature of the housing **1102** and main body **1140** are the two side surfaces **1180**. The two side surfaces **1180** are those opposite to one another and separated by the top surface **1160** and the bottom surface **1162**. Referring to FIG. 26 in particular, each of the sides **1180** are divided into at least three portions. The first portion is a longitudinal central portion **1182** extending in a first plane **G**. The second portion is a longitudinal top portion **1184** extending in a second plane **H**, the first plane **G** is parallel to and offset from the second plane **H**. The third portion is a longitudinal bottom portion **1186** extending in the second plane **H**. The longitudinal top portion **1184** preferably is divided from the longitudinal central portion **1182** by a shoulder **1188**. The shoulder **1188** preferably has a surface that is in plane **I** and is perpendicular to both planes **G** and **H**. Similarly, the longitudinal bottom portion **1186** preferably is divided from the longitudinal central portion **1182** by a shoulder **1190**. The shoulder **1190** preferably has a surface that is in plane J and is perpendicular to both planes **G** and **H**. There is also an inclined wall **1196** between the bottom of the central portion **1168** and the shoulder **1188**. A portion of the latch component (push-pull mechanism) **1104** uses this inclined wall **1196** as a reference surface while moving along the housing **1102**. See Fig. 26. The inclined wall **1196** ends at the stop surface **1166**, where the latch component (push-pull mechanism) **1104** engages the stop surface **1166** to move the fiber optic connector **1100** as discussed below.

[0103] The two longitudinal top portions **1184** and the two longitudinal bottom portions **1186** function to align the fiber optic connector **1100** in a horizontal direction in various structures, e.g., a carrier and an adapter. On the other hand, it is the shoulders **1188**,**1190** that align the fiber

optic connector **1100** in a vertical direction as was discussed in detail above. As such, this discussion is not included here.

[0104] Also on the top surface **1160** and the bottom surface **1162** is a latch **1172** with an engagement surface **1174** and a release ramp **1176**. The latch **1172** is a cantilevered latch that works with the latch component (push-pull mechanism) **1104** to engage and disengage from an adapter. Finally, on the top surface **1160** and the bottom surface **1162** is an opening **1192** in the rail receiving portion **1164** for an extension from the latch component (push-pull mechanism) **1104**. As described in more detail below, the extension from the latch component (push-pull mechanism) **1104** engages a forward facing surface **1194** to remove the fiber optic connector **1100** from the adapter and or carrier. See FIG. 24.

[0105] The crimp body **1106** has a front portion **1200** that is designed to interact and connect with the spring push **1124** and also is disposed within the opening **1146** of the housing **1102** when installed, which is usually after the epoxy used to secure the optical fibers in the ferrules **1130** has cured. The crimp body **1106** has a rear portion **1202** that extends behind the housing **1102** and provides an outer surface **1204** to receive a crimp band (e.g., crimp ring and heat shrink tube) therearound. Extending from a front end **1206** to the rear end **1208** is an opening **1210**. The opening **1210** at the front portion **1200** receives at least a portion of each of the lead-in tubes **1134**. The spring push **1124** has two tabs **1212** (FIG. 24) on opposites sides thereof and extend in a rearward direction in the opening **1210** to engage an opening **1214** in side walls **1216** of the crimp body **1106**. The front end **1206** also has a forward facing surface **1218** that complements the rear of the spring push **1124** and, together with the tabs **1212**, keeps the crimp body **1106** securely fixed to fiber optic connector **1100**.

[0106] The opening **1210** in the crimp body **1106** rearwardly of the lead-in tubes provides a transition portion **1220** for the optical fibers that are secured in the fiber optic ferrules **1130**. Since the crimp body **1106** has a singular opening **1222** at the rear end thereof, the optical fibers need to be able to exit that singular opening **1222** in a smooth fashion so they are not bent beyond their bend radius, thereby damaging or breaking the optical fibers. The transition portion **1220** provides for this function.

[0107] The crimp body **1106** also has a top surface **1230** and the bottom surface **1232**. The top surface **1230** and the bottom surface **1232** may be configured with an area **1234** that complements the central portion **1168** and two lobe sections **1170** of the rail receiving portion **1164** above. The area **1234** functions as an alignment feature of the rail receiving portion **1164**. As discussed more below, the latch component (push-pull mechanism) **1104**

can be better aligned with the rail receiving portion **1164** by using the area **1234** on the crimp body **1106**.

[0108] While the crimp body **1106** is illustrated as a single, unitary body (i.e., molded at one time with one material), it could also be molded as two pieces and then later the two pieces secured to one another.

[0109] The latch component (push-pull mechanism) **1104** is illustrated in more detail in FIGS. 28-29. The latch component (push-pull mechanism) **1104** has a main body **1250**, with a front portion **1254**, a middle portion **1256**, and a rear portion **1258**. Generally, the front portion **1254** is where the latch component **1104** engages the fiber optic connector **1100** and controls connections to an adapter and carrier. The middle portion **1256** generally provides for latching of latch component (push-pull mechanism) **1104** to a carrier. The rear portion **1258** has a grasping portion **1260** to allow a user to push and pull the latch component (push-pull mechanism) **1104** to engage and disengage the fiber optic connector **1100** (push-pull mechanism) **1104** from the adapter and/or carrier.

[0110] When the latch component (push-pull mechanism) **1104** is installed on the housing **1102**, the front portion **1254** has two rails **1262** to engage the stop surface **1166** to push the fiber optic connector **1100**. Pushing on the latch component (push-pull mechanism) **1104** causes the force to be transferred to the rails **1262**. There is a space **1264** between the rails **1262** to allow for the engagement surface **1174** of the latch **1172** to pass therebetween. The front portion **1254** then, moving rearwardly, has an opening **1268**. The opening **1268** receives the release ramp **1176**. A front portion of the opening **1268** has a chamfered surface **1270** to engage the chamfered surface of the release ramp **1176**. See also FIGS. 28 and 29. Behind the opening **1268** is a downward extension **1272** to fit within the opening **1192** in the rail receiving portion **1164** and to engage the forward facing surface **1194** when removing the fiber optic connector **1100** as discussed below. See also FIG. 24.

[0111] The next feature of the latch component (push-pull mechanism) **1104** is in the middle portion **1256** and is an opening **1274** that receives a part of a carrier for a number of fiber optic connectors **1100**. As noted above, sometimes it is beneficial for a number of fiber optic connectors **1100** to be linked to one another. This opening **1274** along with another embodiment of a carrier **1350** allows for the insertion/removal of the fiber optic connectors **1100** from an adapter **1400**. The opening **1274** is partially formed by a chamfered front surface **1276** and a generally flat rear surface **1278**.

[0112] The rear portion **1258** of the latch component (push-pull mechanism) **1104** has a grasping portion **1260**. Finally, a release **1280** is disposed on the side of the latch component (push-pull mechanism) **1104**. The release **1280** is an opening that provides access to the downward extension **1272** that fits within the opening **1192**. As noted above, the downward extension **1272** keeps the latch component (push-pull mechanism) **1104** positioned with the housing **1102**. To disengage the latch component (push-pull mechanism) **1104** from the housing **1102**, a pin or other small tool can be inserted into the release **1280** and deflect downward extension **1272** upward and out of the opening **1192**. The latch component (push-pull mechanism) **1104** can now be moved rearwardly from the housing **1102**.

[0113] FIG. 30 illustrates the fiber optic connector **1100** fully assembled and ready to be used. The major components of the fiber optic connector **1100** are labeled and the latch component (push-pull mechanism) **1104** in position to insert the fiber optic connector **1100** into a carrier **1350** and/or an adapter **1400**. As can be seen, the latch component (push-pull mechanism) **1104** is fully engaged and the two rails **1262** have engaged the stop surface **1166.**

[0114] Turning to FIGS. 30, 31, 33, and 36, the fiber optic connector can be inserted into a carrier **1350** (FIGS. 30 and 31) and/or an adapter **1400** (FIG. 34). The carrier **1350** provides the user with a convenient way to insert into and remove 4 fiber optic connectors **1100** (could also have more or fewer connectors, but usually in groups of two) from an adapter (or other telecommunications structure) rather than one at a time. It provides a cost savings time wise and also assists in preventing the stubbing of or breaking fiber optic connectors.

[0115] The carrier **1350** has a few features that enable the use of the carrier **1350** to correctly orient the fiber optic connectors **1100** (polarity) and also to align the fiber optic connectors to one another for insertion into the adapter. The carrier **1350** has a top **1352** and a bottom **1354** and the top **1352** has a cut out **1356** for each of the fiber optic connectors **1100**, or the latch component (push-pull mechanism) **1104**. Each of the cut outs **1356** has a cantilevered latch **1358** that protrudes into an opening **1360** of the carrier **1350**. If the fiber optic connector **1100** is inserted into the carrier **1350** incorrectly (wrong polarity) then the fiber optic connector **1100** will not seat in the carrier **1350** correctly. The combination of the latch 1**358** and the bottom **1354** prevent the fiber optic connectors **1100** from being inserted incorrectly. The cantilevered latches **1358** have a projection **1362** that extends into the opening **1360** (FIG. 32) and, when a fiber optic connector is inserted, rests in the opening

1274. The first surface **1364** of projection **1362** is chamfered and is to engage the chamfered front surface **1276** of the latch component (push-pull mechanism) **1104** during removal of the fiber optic connector **1100**. The forward facing surface **1368** used to engage a rear surface of the housing **1102** when the carrier **1350** is used to insert the fiber optic connectors **1100** into the adapter **1400**. Finally, the rear facing surface **1370** used to engage the generally flat rear surface **1278** of opening **1274** when the carrier **1350** is used to remove the fiber optic connectors **1100** from the adapter **1400**.

[0116] Installation of the fiber optic connector **1100** into the carrier **1350** is illustrated in FIG. 33. Using the latch component (push-pull mechanism) **1104**, the fiber optic connector **1100** is inserted into the carrier **1350** because the two rails **1262** to engage the stop surface **1166** thereby pushing the fiber-optic connector **1100** through the carrier **1350**. The release ramp **1176** is disclosed in the opening **1268** of the front portion **1254**. Similarly, the projection **1362** on the latch **1358** is disposed in the opening **1274** of the latch component (push-pull mechanism) **1104**. This method is repeated for each of the fiber optic connectors 1100 that are to be inserted into the carrier **1350**.

[0117] The fiber optic connectors **1100** can be inserted into the adapter **1400** is illustrated in FIG. 34. As with the prior embodiment, fiber optic connectors **1100** can be inserted into the adapter **1400** one at a time, or in multiples using the carrier **1350**. Once the fiber of the connectors are aligned with the adapter **1400**, a user can grasp the carrier **1350** to push fiber optic connectors **1100** into the opening **1402** of the adapter **1400**. The forward facing surface **1368** on the projection **1362** engages the rear surface the housing **1102** and, more particularly, the rear surface of the central portion **1168** of the rail receiving portion **1164**. That causes the latch **1172** with an engagement surface **1174** to deflect downward as it enters into the adapter **1400**, and once it reaches the window **1404**, latch **1172** will return and position itself in the window **1404**.

[0118] The removal of the fiber optic connectors **1100** be explained with reference to FIG. 35. Fiber optic connectors **1100** can be removed from the adapter **1400** by using the carrier **1354** or the latch component (push-pull mechanism) **1104**. If the user is going to use the latch component (push-pull mechanism) **1104**, the user will pull on the grasping portion **1260**. This will cause the chamfered surface **1270** to engage the release ramp **1176**. This will cause the latch **1172** to be biased downward freeing the engagement surface **1174** from the adapter window **1402**. Further pulling on the latch component (push-pull mechanism) **1104**

will pull the fiber optic connector **1100** from the adapter **1400** as the rearward facing surface **1272** engages surface **1194** in the opening **1192**.

[0119] If the carrier **1350** is to be used, the carrier **1350** is moved rearwardly relative to the latch component (push-pull mechanism) **1104**. The rear facing surface **1370** of the carrier **1350** engages the generally flat rear surface **1278** of opening **1274**, causing the chamfered surface **1270** to engage the release ramp **1176**. This releases all of the fiber optic connectors **1100** from the adapter **1400**.

[0120] Finally, with reference to FIG. 36, the fiber optic connector **1100** can be removed from the carrier **1350**. While holding the carrier **1350** steady, the user can pull on the latch component (push-pull mechanism) **1104**, which causes the chamfered service **1276** in the opening **1274** to engage the first surface **1364** of projection **1362** of the carrier **1350**. This will cause the cantilevered latch **1358** to deflect upward and out-of-the-way so that the latch component (push-pull mechanism) **1104** can be removed from the fiber optic connector.

[0121] An alternative spring push **1724** is illustrated in FIG. 37. The spring push **1724** has a pair of detents **1726** that frictionally engage an inside surface of the housing. This would eliminate the need for any openings in the housing as there are no latches to be secured. The spring push **1724** includes an extension **1728** with opposing sides **1730** that are semi-circular and provide more support to the springs **122**. The extension **1728** terminates at two circular surfaces **1732** that engages the end of the springs **122**. There are openings **1734** in the middle of the circular surfaces **1732** to receive lead-in tubes, that extend out the back of the spring push **1724**. The back end of the spring push **1724** may also have a different connection system for a crimp band.

[0122] An alternative crimp_body **1706** is illustrated in FIG. 38. The crimp body **1706** has two projections **1708** and two t-shaped extensions **1710** directed toward the front thereof. The crimp body **1706** provides the same function as the crimp bands in the two prior embodiments. While not shown, the top and bottom surfaces **1712** and **1714** may be configured to assist with the alignment of a push-pull mechanism. The crimp body **1706** also provides an internal space that allows for a smooth transition of the optical fibers through the openings **1734** and the lead-in tubes of any associated fiber optic connector..

[0123] A third embodiment of a fiber optic connector **2100** according to the present invention is illustrated in FIGS. 39-49. The fiber optic connector **2100** is similar to the other embodiments in that the majority of the parts of the fiber optic connector **2100** are the same, except that the latch component (push-pull mechanism) **2104** is a self-returning latch

component (push-pull mechanism) **2104**. That is, that if the user pulls rearwardly on the latch component (push-pull mechanism) **2104**, then the latch component (push-pull mechanism) **2104** will return to its original position (a forward position) without having to be returned manually. In the prior embodiments, if the latch component (push-pull mechanism) **104, 1104** were to be pulled (to remove the fiber optic connectors from the adapter/carrier, then the latch component (push-pull mechanism) would remain in a rearward position. The present embodiment is biased such that the latch component (push-pull mechanism) **2104** will automatically return to the forward position.

[0124] Given the similarities between this embodiment of a fiber optic connector and those discussed above, particularly the first embodiment, only a discussion about the new components will be included. Thus, the discussion will be about the latch component (push-pull mechanism) **2104** and small changes to the housing **2102**.

[0125] The latch component (push-pull mechanism) **2104** is illustrated in more detail in FIGS. 40-48. The latch component (push-pull mechanism) **2104** has a main body **2210** and a latch body **2212** that attaches to the main body **2210**. See FIGS. 40-43. The main body **2210** has a front portion **2214**, a middle portion **2216**, and a rear portion **2218.** Generally, the front portion **2214** is where the latch body **2212** attaches to the main body **2210** and provides for the latching of the fiber optic connector **2100** to an adapter and carrier as discussed above. The middle portion **2216** provides an area for the flexure member **2220** and to engage the latch component (push-pull mechanism) **2104**. The rear portion **2218** has a grasping portion **2222** to allow a user to push and pull the latch component (push-pull mechanism) **2104** to engage and disengage the fiber optic connector **2100** from the adapter and/or carrier.

[0126] The front portion **2214** is divided into a first front portion **2230** and a second front portion **2232.** The first front portion **2230** has two windows **2234** and **2236** and the second front portion **2232** has a window **2238**. The second window **2236** of the first front portion **2230** and window **2238** are to receive a latch from the latch body **2212** therethrough. The first window **2234** (and the third window **2238** as well) is to receive a latch pad on the latch body **2212**. An underside of the first portion **2214** has a groove **2240** on either side to receive an extended portion of the latch pads **2242**,**2244** from the latch body **2212** (see FIGS. 43 and 47) to secure the latch body **2212** to the main body **2210**. The extended portion of the latch pads **2242**,**2244** (and thus the latch body **2212**) are able to slide within the grooves

2240 to allow for the latching and unlatching the fiber optic connector **2100**. The grooves **2240** should extend the length of the first portion **2214**.

[0127] The second front portion **2232** has an upper surface **2246** that is higher than an upper surface **2248** of the first front portion **2214**. This allows for the latching of a carrier and an adapter with the same device, as described above for the other embodiments. On the bottom side **2250** of the second front portion **2232** are two extensions **2252**, **2254** that are a complementary configuration of a rail receiving portion of the housing **2102**. See FIG. 41. The latch body **2212** also has the same rail portion configuration of two extensions **2256, 2258** on the bottom thereof. This allows the main body **2210** and the latch body **2212** to be slidingly attached to the rail receiving portion of the housing **2102**. When the latch body **2212** is inserted into the first front portion **2230**, a front surface **2260** of the two extensions **2252**, **2254** provides a pushing surface by which the main body **2210** can push the latch body **2212** in the rail receiving portion. See also FIG. 44. The front surface **2262** of the two extensions **2256, 2258** also provides a pushing surface to be used against the stop surface **2264** of the housing **2102**. See FIGS. 45 and 48 .This allows for the user to exert a force on the latch component (push-pull mechanism) **2104** which is transferred through the main body **2210** to the latch body **2212** and to the housing **2102** to insert the fiber optic connector **2100** into a carrier and/or adapter.

[0128] The middle portion **2216** also has a window **2270** to receive a portion of the flexure member **2220**, which extends from the latch body **2212**. The middle portion **2216** also has on the bottom side **2250** a cavity or space **2272** to receive any other portions of the flexure member **2220** that may be needed.

[0129] Turning to FIGS. 42 and 43, the latch body **2212** has two latches, an adapter latch **2280** and a carrier latch **2282**. The latch body **2212** may only have one of the latches, depending upon its uses and the needs of the user. The adapter latch **2280** extends from a forward portion of the latch body **2212** and protrudes through window **2236** of the main body **2210**. The carrier latch **2282** also extends from the latch body **2212**, from a rear portion thereof, and protrudes through the window **2238** of the main body **2210**. As is recognized from FIG. 44, the adapter latch **2280** does not rise as high as the carrier latch **2282** as in the other embodiments as well. The discussion from those embodiments with regard to the position and the composition of the ends of the latches is adopted for this embodiment as well.

[0130] The latch body **2212** has a connector latch **2290** as well. The connector latch **2290** extends forward beyond the front surface **2262** of the two extensions **2256**, **2258** to engage a latch stop **2292** at the stop surface **2264**. The connector latch **2290** has a downward curling portion **2294** that provides a surface to engage the latch stop **2292**. The connector latch **2290** may also have a latch rib **2296** that connects the curling portion **2294** to the remainder of the connector latch **2290**. The latch stop **2292** may also have a groove **2298** there-in to receive the latch rib **2296**. It is the connector latch **2290** that retains the latch body **2212** with the housing **2102**. As described below in more detail, when the latch component (push-pull mechanism) **2104** is pulled rearwardly, the connection of the connector latch **2290** with the housing **2102** allows the main body **2210** to move relative to the latch body **2212.**

[0131] The latch body **2212** also has two latch pads **2242**,**2244**. The latch pads **2242**,**2244** have two functions: first to help retain the latch body **2212** in the main body **2210**, and second to limit the movement of the latch component (push-pull mechanism) **2104** relative to the housing **2102**. As seen in FIGS. 39, 45, and 48, the first latch pad **2242** is disposed within the first window **2234** of the main body **2210**. It is evident that as the main body **2210** is pulled relative to the latch body **2212**, the first latch pad **2242** will slide relative to the first window **2234** only for certain distance before it engages a portion of the main body **2210**. This is true with regard to the second latch pad **2244** as well. Second latch pad **2244** is disposed in the second window **2236** along with the carrier latch **2282**. As the main body **2210** is pulled relative to the latch body **2212**, the main body **2210** pushes on the adapter latch **2280** (and the carrier latch **2282)** in downward out of the window **2236**. As the main **2210** body continues in a rearward direction, it will engage the front end of the second pad **2244**, prohibiting any further movement of the main body **2210** to the latch body **2212**. See FIG. 48.

[0132] Turning to FIGS. 42, 43, 46, the flexure member **2220** will now be described. With particular reference to FIGS. 42 and 43, the flexure member **2220** extends from the rear portion of the latch body **2212**. In the embodiment illustrated in the figures, the flexure member **2220** has a first curved portion **2300** and a second curved portion **2302**. Second curved portion **2302** terminates at terminal end **2304**. The terminal end **2304** is preferably disposed with in the third window **2270** and also preferably makes contact with at least one of the surfaces that define window **2270**. See FIG. 46. The first curve portion **2300** also partially resides in the cavity or space **2272**. It is also possible that the flexure member **2220**

only has one of the two curved portions **2300**,**2302**, depending upon the amount of force required to main body **2210** relative to the latch body **2212**.

[0133] As the main body **2210** is pulled rearwardly relative to the latch body **2212**, the latches **2280**, **2282** are moved downward (as also described above) releasing the fiber optic connector **2100** from any adapter and/or carrier. During this movement, the flexure member **2220** is put under tension (the curved portions begin to straighten out or alter from the shape in their state) as the terminal end **2304** presses against the wall of opening **2270**. Once the fiber optic connector **2100** is free from the adapter and/or carrier and the user releases the grasping portion **2222**, the main body **2210** will return to its original state as the flexure member pulls on the main body **2210**. See FIG. 39. The flexure member **2220** acts as a self-return mechanism for the latch component (push-pull mechanism) **2104**. Accordingly, there are other self-returning mechanisms that may be used instead of the particular embodiment of the flexure member **2220**. For example, a spring could be used to bias the main body **2210** relative to the latch body **2212**.

[0134] It will be apparent to those skilled in the art that various modifications and variations can be made to the present invention without departing from the spirit and scope of the invention. Thus it is intended that the present invention cover the modifications and variations of this invention provided they come within the scope of the appended claims and their equivalents.

What is claimed:

1. A fiber optic connector comprising:

a housing having a main body extending between a front end and a rear end and having an opening extending therebetween, the housing having a top surface and a bottom surface bound by two opposing side surfaces such that a lateral width between the two opposing side surfaces is less than a separation between the top surface and the bottom surface;

two ferrule assemblies disposed within the opening of the housing, each of the ferrule assemblies comprising a fiber optic ferrule and a ferrule holder to hold the fiber optic ferrule, the fiber optic ferrule extending forwardly of and away from the front end of the ferrule holder;

two springs, each of the two springs engaging a rearward facing surface of a respective ferrule holder and extending towards the rear end of the housing to bias the ferrule assemblies toward the front end of the housing and retained within the housing;

a crimp body secured to the fiber optic connector having a front end at least partially disposed in the opening at the rear end of the housing, the crimp body having a rear end forming a singular opening for optical fibers;

an alignment feature on at least one of the top surface and the bottom surface of the housing configured to guide the fiber optic connector into an adapter; and

a strain relief boot coupled to the rear end of the crimp body and having a longitudinal opening in continuum with the singular opening of the crimp body through which optical fibers pass.

2. The fiber optic connector according to claim 1, wherein the alignment feature is positioned rearward of the front end of the housing and extends away from the front end of the housing.

3. The fiber optic connector according to claim 1, further comprising a spring push engaging a rear portion of each of the two springs.

4. The fiber optic connector according to claim 1, further comprising an indicia of polarity on the housing.

5. The fiber optic connector according to claim 1, further comprising:

a crimp band secured around an outer surface of the rear end of the crimp body, and wherein the strain relief boot extends rearwardly away from the housing.

6. The fiber optic connector according to claim 1, wherein the top surface of the housing includes a rail receiving portion extending along at least a portion of the housing.

7. The fiber optic connector according to claim 6, wherein the rail receiving portion has a dove tail configuration or an undercut configuration to receive a latch component.

8. The fiber optic connector according to claim 7, wherein the latch component is a push-pull mechanism.

9. The fiber optic connector according to claim 1, wherein the front end of the housing fits in a QSFP footprint.

10. The fiber optic connector according to claim 3, wherein the spring push is separate from the crimp body.

11. The fiber optic connector according to claim 1, wherein the crimp body is a two-piece crimp body.

12. The fiber optic connector according to claim 6, wherein the alignment feature includes the rail receiving portion.

13. The fiber optic connector according to claim 1, wherein the alignment feature includes a vertical alignment feature and a horizontal alignment feature.

14. The fiber optic connector according to claim 1, wherein each of the ferrule assemblies is separated from the other ferrule assembly by a wall between respective ferrule seats of the fiber optic ferrules of each of the ferrule assemblies, the wall extending rearward into the housing and away from each of the respective ferrule seats.

15. The fiber optic connector according to claim 14, wherein there is a gap between a ferrule holder of each of the fiber optic ferrules and the wall.

16. The fiber optic connector according to claim 3, wherein the spring push engages the rear portion of each of the two springs simultaneously.

17. The fiber optic connector according to claim 1, further comprising a lead-in tube attached to each of the ferrule holders, the lead-in tube extending past the rear end of the main body of the housing and configured to avoid leakage of an adhesive inserted into the lead-in tube into the main body.

MINI DUPLEX CONNECTOR WITH PUSH-PULL POLARITY MECHANISM AND CARRIER

ABSTRACT OF THE INVENTION

A new fiber optic connector provides a smaller form factor by including two ferrule assemblies in a housing. The housing accepts a push-pull mechanism that allows for insertion and removal from a carrier as well as an adapter. The push-pull mechanism may also include a flexure member to return the push-pull mechanism. Polarity of the fiber optic connector may also be selected by use of the push-pull mechanism.

UNITED STATES
PATENT AND TRADEMARK OFFICE

P.O. Box 1450
Alexandria, VA 22313 - 1450
www.uspto.gov

ELECTRONIC PAYMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
18/057,342	11/21/2022 01:09:29 PM ET	USCO-089-US1-02

Title of Invention

MINI DUPLEX CONNECTOR WITH PUSH-PULL POLARITY MECHANISM AND CARRIER

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	4719	FILED BY	Michael Leetzow
PATENT CENTER #	61203896	AUTHORIZED BY	-
CUSTOMER #	152017	FILING DATE	-
CORRESPONDENCE ADDRESS	-	FIRST NAMED INVENTOR	Jason Higley

Payment Information

PAYMENT METHOD	PAYMENT TRANSACTION ID	PAYMENT AUTHORIZED BY
CARD / 1000	E2022AKD10193091	Michael Leetzow

FEE CODE	DESCRIPTION	ITEM PRICE($)	QUANTITY	ITEM TOTAL($)
1111	UTILITY PATENT APPL. SEARCH FEE	700.00	1	700.00
1011	BASIC FILING FEE - UTILITY (PAPER FILING ALSO REQUIRES NON-ELECTRONIC FILING FEE UNDER 1.16(T))	320.00	1	320.00
1311	PATENT APPL. EXAMINATION FEE	800.00	1	800.00
			TOTAL AMOUNT:	$1,820.00

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 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 Data Sheet 37 CFR 1.76	Attorney Docket Number	USCO-089-US1-02
	Application Number	
Title of Invention	MINI DUPLEX CONNECTOR WITH PUSH-PULL POLARITY MECHANISM AND CARRIER	

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
	Jason		Higley	

Residence Information (Select One) ● US Residency Non US Residency Active US Military Service

City	Hickory	State/Province	NC	Country of Residence	US

Mailing Address of Inventor:

Address 1	3709 6th St. NE
Address 2	

City	Hickory	State/Province	NC
Postal Code	28601	Country	US

Inventor 2 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Jillcha	F.	Wakjira	

Residence Information (Select One) ◉ US Residency Non US Residency Active US Military Service

City	Hickory	State/Province	NC	Country of Residence	US

Mailing Address of Inventor:

Address 1	2032 19th Ave Cir NE
Address 2	

City	Hickory	State/Province	NC
Postal Code	28601	Country	US

Inventor 3 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Mitchell		Cloud	

Residence Information (Select One) ◉ US Residency Non US Residency Active US Military Service

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	USCO-089-US1-02
	Application Number	
Title of Invention	MINI DUPLEX CONNECTOR WITH PUSH-PULL POLARITY MECHANISM AND CARRIER	

City	Hickory	State/Province	NC	Country of Residence	US

Mailing Address of Inventor:

Address 1	1952 9th St PL SE		
Address 2			
City	Hickory	State/Province	NC
Postal Code	28602	Country	US

Inventor 4 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Darrell	R.	Childers	

Residence Information (Select One) ◉ US Residency ○ Non US Residency ○ Active US Military Service

City	Hickory	State/Province	NC	Country of Residence	US

Mailing Address of Inventor:

Address 1	364 6th St. NW		
Address 2			
City	Hickory	State/Province	NC
Postal Code	28601	Country	US

Inventor 5 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Michael	E.	Hughes	

Residence Information (Select One) ◉ US Residency ○ Non US Residency ○ Active US Military Service

City	Hickory	State/Province	NC	Country of Residence	US

Mailing Address of Inventor:

Address 1	350 16th Ave Ln. NW		
Address 2			
City	Hickory	State/Province	NC
Postal Code	28601	Country	US

All Inventors Must Be Listed - Additional Inventor Information blocks may be generated within this form by selecting the **Add** button. Add

Correspondence Information:

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.**

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	USCO-089-US1-02
	Application Number	
Title of Invention	MINI DUPLEX CONNECTOR WITH PUSH-PULL POLARITY MECHANISM AND CARRIER	

Customer Number	152017		
Email Address	michael@leetzow.com	Add Email	Remove Email
Email Address	ssengupta@usconec.com	Add Email	Remove Email

Application Information:

Title of the Invention	MINI DUPLEX CONNECTOR WITH PUSH-PULL POLARITY MECHANISM AND CARRIER		
Attorney Docket Number	USCO-089-US1-02	**Small Entity Status Claimed**	☐
Application Type	Nonprovisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)	37	**Suggested Figure for Publication (if any)**	2

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	152017		

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	USCO-089-US1-02
	Application Number	
Title of Invention	MINI DUPLEX CONNECTOR WITH PUSH-PULL POLARITY MECHANISM AND CARRIER	

Domestic Benefit/National Stage Information:

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121, 365(c), or 386(c) or indicate National Stage entry from a PCT application. Providing benefit claim 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" field blank.

Prior Application Status	Pending		Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
	Continuation of	17328574	2021-05-24
Prior Application Status	Patented		Remove

Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
17328574	Continuation of	16462897	2019-05-21	11016250	2021-05-25

Prior Application Status	Pending		Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
16462897	a 371 of international	PCTUS1866518	2018-12-19
Prior Application Status	Expired		Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
PCTUS1866518	Claims benefit of provisional	62634271	2018-02-23
Prior Application Status	Expired		Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
PCTUS1866518	Claims benefit of provisional	62607555	2017-12-19

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. When priority is claimed to a foreign application that is eligible for retrieval under the priority document exchange program (PDX)[i] the information will be used by the Office to automatically attempt retrieval pursuant to 37 CFR 1.55(i)(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).

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	USCO-089-US1-02
	Application Number	
Title of Invention	MINI DUPLEX CONNECTOR WITH PUSH-PULL POLARITY MECHANISM AND CARRIER	

Application Number	Country[i]	Filing Date (YYYY-MM-DD)	Access Code[i] (if applicable)

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Additional Foreign Priority Data may be generated within this form by selecting the **Add** button. Add

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.

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	USCO-089-US1-02
	Application Number	
Title of Invention	MINI DUPLEX CONNECTOR WITH PUSH-PULL POLARITY MECHANISM AND CARRIER	

Authorization or Opt-Out of Authorization to Permit Access:

When this Application Data Sheet is properly signed and filed with the application, applicant has provided written authority to permit a participating foreign intellectual property (IP) office access to the instant application-as-filed (see paragraph A in subsection 1 below) and the European Patent Office (EPO) access to any search results from the instant application (see paragraph B in subsection 1 below).

Should applicant choose not to provide an authorization identified in subsection 1 below, applicant **must opt-out** of the authorization by checking the corresponding box A or B or both in subsection 2 below.

NOTE: This section of the Application Data Sheet is **ONLY** reviewed and processed with the **INITIAL** filing of an application. After the initial filing of an application, an Application Data Sheet cannot be used to provide or rescind authorization for access by a foreign IP office(s). Instead, Form PTO/SB/39 or PTO/SB/69 must be used as appropriate.

1. Authorization to Permit Access by a Foreign Intellectual Property Office(s)

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	USCO-089-US1-02
	Application Number	
Title of Invention	MINI DUPLEX CONNECTOR WITH PUSH-PULL POLARITY MECHANISM AND CARRIER	

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Address 1	1138 25th Street SE		
Address 2			
City	Hickory	**State/Province**	NC
Country	US	Postal Code	28603
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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	USCO-089-US1-02
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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	USCO-089-US1-02
	Application Number	
Title of Invention	MINI DUPLEX CONNECTOR WITH PUSH-PULL POLARITY MECHANISM AND CARRIER	

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APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
18/057,342	**11/21/2022 01:09:29 PM ET**	**USCO-089-US1-02**

Title of Invention

MINI DUPLEX CONNECTOR WITH PUSH-PULL POLARITY MECHANISM AND CARRIER

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	4719	FILED BY	Michael Leetzow
PATENT CENTER #	61203896	FILING DATE	-
CUSTOMER #	152017	FIRST NAMED INVENTOR	Jason Higley
CORRESPONDENCE ADDRESS	-	AUTHORIZED BY	-

Documents

TOTAL DOCUMENTS: 6

DOCUMENT	PAGES	DESCRIPTION	SIZE (KB)
USCO-089-US1-02_USPTO_AIA14_20221120_212442.pdf	10	Application Data Sheet	2225 KB
USCO-089-US1-02_USPTO_AIA15_20221120_212454.pdf	2	Transmittal of New Application	303 KB
SignedDeclarationsUSCO089US1 copy.pdf	5	Oath or Declaration filed	603 KB
USCO089PCTConnectorUS1-02-APP.TEXT.docx	29	Application body structured text document	44 KB

USCO089I1I2FinalDWGS copy.pdf	37	Drawings-only black and white line drawings	1551 KB
USCO089PCTConnectorUS1 -02.pdf	29	Auxiliary PDF of Application	537 KB

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MINI DUPLEX CONNECTOR WITH PUSH-PULL POLARITY MECHANISM AND CARRIER

BACKGROUND OF THE INVENTION

[0001] This application claims priority to U.S. Provisional Patent Application serial number 62/607,555, filed on December 19, 2017 and Provisional Patent Application serial number 62/634,271, filed on February 23, 2018, and under 35 U.S.C. § 120 to U.S. Patent No. 11,016,250, issued on March 25, 2021, and to U.S. Patent No. 11,506,848, issued on November 22, 2022, the contents of all of which are incorporated by reference.

FIELD OF THE INVENTION

[0002] In the small form-factor pluggable (SFP and QSFP) industry, there are a number of different ferrules and designs that are used. In some applications, an MT ferrule is used, while in others it is the LC form that is used. The LC connector uses a single optical fiber and fiber optic ferrule per housing. In higher density applications, the LC connector may not be used because the space that each of the LC connectors use. Thus, it would beneficial to reduce the footprint of the LC connector by reducing the pitch between the fiber optic ferrules.

[0003] Applicant has a new design for a fiber optic connector using the LC fiber optic ferrule to reduce the overall footprint of the fiber optic connector. In addition, an insertion/removal tool has been included to allow for the reduced footprint, allowing a user to more easily insert and remove the new fiber optic connectors. The fiber optic connector and the insertion/removal tool may also provide a way to ensure the correct polarity of the fiber optic connector and to even change the polarity in the field.

[0004] Finally, the insertion/removal tool may include a way for it to be self-returning after a user inserts/removes the fiber optic connector.

SUMMARY OF THE INVENTION

[0005] The present invention is directed to a fiber optic connector that includes a housing having a main body extending between a front end and a rear end and having an opening extending therebetween, two ferrule assemblies disposed within the opening of the housing, each of the ferrule assemblies including a fiber optic ferrule, a ferrule holder and a lead-in tube, the fiber optic ferrule being inserted into a front end of a ferrule holder and extending away from the

front end of the ferrule holder, and the lead-in tube attached the ferrule holder and extending rearwardly and away from the fiber optic ferrule, two springs, each spring engaging a rearward facing surface of a respective ferrule holder and extending towards the rear end of the housing, and a spring push engaging a rear portion of each of the two springs to bias the ferrule assemblies toward the front end of the housing, the spring push engaging a portion of the housing in the opening to retain the spring push within the opening, wherein each of the lead-in tubes extend through at least a portion of a respective spring and beyond a rear end of the spring push.

[0006] In some embodiments, the fiber optic connector includes a crimp body having a transition portion to receive an optical fiber extending from each of the lead-in tubes between the front end and a singular opening at a rear end, the rear end having an outer surface to receive a crimp band therearound.

[0007] In some embodiments, the housing has a rail receiving portion configured to receive a latch component.

[0008] In some embodiments, the latch component is a push-pull mechanism.

[0009] In another aspect, the invention is directed to a method of assembling a fiber optic connector that includes the steps of inserting into a housing having a main body, the main body extending between a front end and a rear end and having an opening extending therebetween two ferrule assemblies, each of the ferrule assemblies comprising a fiber optic ferrule, a ferrule holder and a lead-in tube, the fiber optic ferrule being inserted into a front end of a ferrule holder and extending away from the front end of the ferrule holder, and the lead-in tube attached the ferrule holder and extending rearwardly and away from the fiber optic ferrule, inserting on to each of the ferrule assemblies a spring engaging a rearward facing surface of the ferrule holder and extending towards the rear end of the housing, inserting into the housing a spring push to engage a rear portion of each of the springs to bias the ferrule assemblies toward the front end of the housing, the spring push engaging a portion of the housing in the opening to retain the spring push within the opening, inserting an adhesive into each of the lead-in tubes to secure an optical fiber within each of the ferrule assembly, and allowing the adhesive to cure with an optical fiber within each of the ferrule assemblies.

[0010] Additional features and advantages of the invention will be set forth in the detailed description which follows, and in part will be readily apparent to those skilled in the art from that description or recognized by practicing the invention as described herein, including the detailed description which follows, the claims, as well as the appended drawings.

[0011] It is to be understood that both the foregoing general description and the following detailed description of the present embodiments of the invention, and are intended to provide an overview or framework for understanding the nature and character of the invention as it is claimed. The accompanying drawings are included to provide a further understanding of the invention, and are incorporated into and constitute a part of this specification. The drawings illustrate various embodiments of the invention, and together with the description serve to explain the principles and operations of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] FIG. 1 is a side elevational view of one embodiment of a fiber optic connector with a push-pull mechanism, crimp body, and boot according to the present invention;

[0013] FIG. 2 is an exploded perspective view of the fiber optic connector in FIG. 1;

[0014] FIG. 3 is a perspective view of a portion of the fiber optic connector in FIG. 1, which includes the housing with two ferrule assemblies and a spring push;

[0015] FIG. 3A is an exploded perspective view of the ferrule assembly and spring in FIG. 3;

[0016] FIG. 4 is a partial cross section of the housing with two assembled ferrule assemblies and the spring push in FIG. 3;

[0017] FIG. 5 is a perspective view of the housing of the fiber optic connector in FIG. 1 and FIG. 3;

[0018] FIG. 6 is a rear elevational view of the housing in FIG. 5;

[0019] FIG. 7 is a perspective view of spring push in FIG. 3;

[0020] FIG. 8 is a front elevational view of the crimp body in FIG. 1;

[0021] FIG. 9 is a partial cut away perspective view of the crimp body in FIG. 8;

[0022] FIG. 10 is a perspective view of the push-pull mechanism of FIG. 1;

[0023] FIG. 10A is a perspective view of the underside of the push-pull mechanism of FIG. 10;

[0024] FIG. 11 is a perspective view of a latch body used with the push-pull mechanism in FIG. 10;

[0025] FIG. 12 is a front elevational view of the latch body in FIG. 11;

[0026] FIG. 13 is a side elevational view of the latch body in FIG. 11;

[0027] FIG. 14 is a perspective view of the push-pull mechanism and latch body illustrating how the latch body attaches to the push-pull mechanism;

[0028] FIG. 15 is a partial, perspective view of the push-pull mechanism and latch body in FIG. 14 ;

[0029] FIG. 16 is a top view of the push-pull mechanism in FIG. 14 attached to the fiber optic connector in FIG. 1;

[0030] FIG. 17 is an enlarged view of the connection of the push-pull mechanism and housing in FIG. 16;

[0031] FIG. 18 is a front perspective view of a plurality of fiber optic connectors and push-pull mechanisms mounted in a carrier according to one embodiment of the present invention;

[0032] FIG. 19 is a front view of the plurality of fiber optic connectors and push-pull mechanisms mounted in the carrier in Fig 18;

[0033] FIG. 20 is a rear perspective view of the plurality of fiber optic connectors and push-pull mechanisms mounted in the carrier in Fig 18 in preparation to be inserted into one embodiment of a fiber optic connector adapter according to the present invention;

[0034] FIG. 21 is a cross section of the assembly of the push-pull mechanism and latch body and the fiber optic connector, all mounted in the carrier and inserted into the adapter;

[0035] FIG. 22 is a cross section of a smaller portion of the assembly shown in FIG. 21 illustrating push-pull mechanism and latch body mounted in the carrier and the fiber optic connector adapter;

[0036] FIG. 23 is an elevational view of a second embodiment of a fiber optic connector with a push-pull mechanism, crimp body, and boot according to the present invention;

[0037] FIG. 24 is a partial cross sectional view of the housing with the two ferrule assemblies and a spring push of the fiber optic connector in FIG. 23;

[0038] FIG. 25 is a perspective view of the housing of the fiber optic connector in FIG. 23;

[0039] FIG. 26 is a rear elevational view of the housing in FIG. 25;

[0040] FIG. 27 is partial cross section of a second embodiment of a crimp body according to the present invention and shown in FIG. 23;

[0041] FIG. 28 is a perspective view of the second embodiment of a push-pull mechanism according to the present invention and shown in FIG. 23;

[0042] FIG. 29 is a cross section view of the push-pull mechanism in FIG. 27;

[0043] FIG. 30 is cross section of the fiber optic connector with a push-pull mechanism and crimp body of FIG. 23;

[0044] FIG. 31 is a perspective view of a fiber optic connector and push-pull mechanisms of FIG. 23 mounted in a carrier;

[0045] FIG. 32 is a cross section view of the carrier of FIG. 30 without the fiber optic connector;

[0046] FIG. 33 is a cross section view of the fiber optic connector with a push-pull mechanism and crimp body of FIG. 23 in an embodiment of a carrier;

[0047] FIG. 34 is a cross section view of fiber optic connector with a push-pull mechanism and crimp body in a carrier being inserted into an adapter;

[0048] FIG. 35 a cross section view of fiber optic connector with a push-pull mechanism and crimp body in a carrier being removed from the adapter;

[0049] FIG. 36 is a cross section view of fiber optic connector with a push-pull mechanism and crimp body being removed from a carrier;

[0050] FIG. 37 is a perspective view of a second embodiment of a spring push according to the present invention;

[0051] FIG. 38 is a perspective view of a second embodiment of a crimp body according to the present invention;

[0052] FIG. 39 is an elevational view of another embodiment of a fiber optic connector with a push-pull mechanism, crimp body, and boot according to the present invention;

[0053] FIG. 40 is a right top perspective view of the push-pull mechanism of FIG. 39;

[0054] FIG. 41 is a bottom perspective view of the push-pull mechanism of FIG. 39;

[0055] FIG. 42 is a right perspective view of the latch body with a flexure mechanism of FIG. 39;

[0056] FIG. 43 is a right bottom perspective view of the latch body and flexure mechanism of FIG. 39

[0057] FIG. 44 is a right perspective view of the push-pull mechanism with latch body and flexure mechanism;

[0058] FIG. 45 is an enlarged cross sectional view of a portion of the push-pull mechanism, latch body, and fiber optic connector of FIG. 39;

[0059] FIG. 46 is enlarged cross sectional view of a portion of the push-pull mechanism, latch body, and fiber optic connector of FIG. 41 at a different location from FIG. 47;

[0060] FIG. 47 is a cross sectional view of the push-pull mechanism, latch body, and housing; and

[0061] FIG. 48 is a top perspective view of the push-pull mechanism, latch body, and housing.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0062] Reference will now be made in detail to the present preferred embodiment(s) of the invention, examples of which are illustrated in the accompanying drawings. Whenever possible, the same reference numerals will be used throughout the drawings to refer to the same or like parts.

[0063] Applicant notes that the term "front" or "forward" means that direction where the fiber optic connector would meet with another fiber optic connector or device, while the term "rear" or "rearward" is used to mean the direction from which the optical fibers enter into the fiber-optic ferrule or fiber optic connector. Thus, "front" is that part of the housing **102** on the left side of FIG. 1 and "forward" is out and to the left. "Rear" is that part of the housing **102** that is on the right side of the page and "rearward" is toward the right.

[0064] One embodiment of a fiber optic connector **100** according to the present invention is illustrated in FIGS 1-22. The fiber optic connector **100**, in FIGS. 1 and 2, may include a housing **102**, a latch component (push-pull mechanism) **104**, a crimp body **106**, a crimp ring and heat shrink tube **108**, and a strain relief boot **110**. As discussed in more detail below, the housing **102** and its components, the latch component **104,** and the crimp body **106** are the focus of this application. The crimp ring and heat shrink tube **108** and a strain relief boot **110** are generally known components.

[0065] Turning to FIGS. 3 and 3A, inside the housing **102** are two ferrule assemblies **120**, two springs **122**, and a spring push **124**. The two ferrule assemblies **120** each include a fiber optic ferrule **130** (generally a 1.25 mm LC fiber optic ferrule), a ferrule holder **132**, and a lead-in tube **134**. The spring **122** is added later. The ferrule assemblies **120** are preferably preassembled and are inserted into the housing **102** without needing any further processing.

[0066] The housing **102** has a main body **140** extending between a front end **142** and a rear end **144**, and has an opening **146** extending therebetween. The opening **146** of the housing **102** may also have structures **148** that orient and retain the ferrule assemblies **120** in the housing **102**. In this case, there are flat surfaces **150** that engage corresponding flat surfaces **152** on the ferrule holder **132**, to keep the ferrule assemblies **120** from rotating within the housing **102**.

[0067] Once the ferrule assemblies **120** are disposed within the housing **102**, the springs **122** are placed around the lead-in tube **134** and against a back end **138** of the ferrule holder **132**. The spring push **124** is then inserted into the opening **146** of the housing **102**. The spring push **124** has a pair of latches **154** that engage corresponding openings **156** in the opposite sides of the main body **140** of the housing **102** to retain the spring push **124** in the opening **146**. The spring push **124** has a forward facing surface **158** to engage the rear ends of the springs **122**. The forward facing surface **158** generally corresponds to the two springs **122** to ensure that that the spring push **124** stays engaged with the springs **122**. This configuration biases the ferrule assemblies **120** toward the front end **142** of the housing **102**. While not shown, two optical fibers enter into the ferrule assemblies **120** through the spring push **124** and into the lead-in tubes **134**.

[0068] The lead-in tubes **134** are connected to and extend from the ferrule holder **132**. Preferably, the lead-in tubes **134** are secured to the ferrule holder **132**, e.g. by adhesives, press-fit. The lead-in tubes **134** also extend beyond the rear end of the ferrule holder **132**. See FIG. 4. This allows for injection of epoxy or other adhesives into the ferrule assemblies **120** through the lead-in tubes **134** to secure the optical fibers therein. With the lead-in tubes **134** extending so far rearwardly, there is no concern that the epoxy or adhesives will interfere with the springs **134**, the spring push **124**, or other structures in the fiber optic connector **100**. Typically, the adhesive is cured with the lead-in tubes **134** exposed in prior to adding any additional components.

[0069] The housing **102** may also have an indicia **136** of the polarity of the fiber optic connector **100**. See FIG. 5. Depending on the application, one of the ferrule assemblies **120** may be a receiving or a transmitting side with the other of the ferrule assemblies **120** being the other. It is important for the user or technician to know which of the ferrule assemblies **120** is which. The indicia **136**, an indentation in this case, makes the orientation or the polarity of the fiber optic connector **100** clearly visible. Other types of indicia may be used and still fall within the scope of the present invention.

[0070] The outside of the housing **102** has many features that are integral to its use. See FIGS. 5 and 6. First are the top surface **160** and the bottom surface **162**. The top and bottom surfaces **160**,**162** are preferably the same, with the exception of the indicia **136**, as one of the two surfaces **160**,**162** would not have it. Extending from the rear end **144** towards the front **142** of the housing **140** on both the top surface **160** and the bottom surface **162** is a rail receiving portion **164**. As will be discussed in more detail below, the rail receiving portion

164 will stop just before the front end **142** as it will therefore create a stop surface **166**. The latch component (push-pull mechanism) **104** will make use of the stop surface **166** to insert the fiber optic connector **100** into various structures.

[0071] The rail receiving portion **164** has a central portion **168** and then two lobe sections **170**, one lobe on each side of the central portion **168**. As best seen in FIG. 6, the rail receiving portion **164** looks like part of a profile of a dog bone. This configuration matches that of the bottom surface of the latch component (push-pull mechanism) **104** to form a sliding dove-tail configuration. Other configurations are possible, such as, for example, the second version illustrated below - a cap with undercuts (essentially an umbrella or a T-shape configuration). See FIG. 26.

[0072] The next feature of the housing **102** and main body **140** are the two side surfaces **180**. The two side surfaces **180** are those opposite to one another and separated by the top surface **160** and the bottom surface **162**. Referring to FIG. 6 in particular, each of the sides **180** are divided into three portions. The first portion is a longitudinal central portion **182** extending in a first plane **A**. The second portion is a longitudinal top portion **184** extending in a second plane **B**, the first plane **A** is parallel to and offset from the second plane **B**. The third portion is a longitudinal bottom portion **186** extending in the second plane **B**. The longitudinal top portion **184** preferably is divided from the longitudinal central portion **182** by a shoulder **188**. The shoulder **188** preferably has a surface that is in plane **C** and is perpendicular to both planes **A** and **B**. Similarly, the longitudinal bottom portion **186** preferably is divided from the longitudinal central portion **182** by a shoulder **190**. The shoulder **190** preferably has a surface that is in plane **D** and is perpendicular to both planes **A** and **B**.

[0073] The two longitudinal top portions **184** and the two longitudinal bottom portions **186** function to align the fiber optic connector **100** in a horizontal direction in various structures, e.g., a carrier and an adapter. On the other hand, it is the shoulders **188**,**190** that align the fiber optic connector **100** in a vertical direction. These will be discussed in more detail below. See also FIGS. 19 and 20.

[0074] Referring to FIG. 5, there are also two indentations **192** in the longitudinal top portion **184** on both sides of the main body and adjacent the rear end **144**. The indentations **192** form a forward facing surfaces **194** that are used by two housing latches in the latch component (push-pull mechanism) **104**. As described more later, the latch component (push-pull mechanism) **104** engages the forward facing surfaces **194** when removing the fiber optic connector **100**.

[0075] Returning to the crimp body **106**, it is illustrated in FIG. 1 and also in FIGS. 8 and 9. The crimp body **106** has a front portion **200** that is designed to interact and connect with the spring push **124** and also is disposed within the opening **146** of the housing **102** when installed. The crimp body **106** has a rear portion **202** that extends behind the housing **102** and provides an outer surface **204** to receive a crimp band (e.g., crimp ring and heat shrink tube **108)** therearound. Extending from a front end **206** to the rear end **208** is an opening **210**. The opening **210** at the front portion **200** receives at least a portion of each of the lead-in tubes **134**. The spring push **124** has two tabs **212** on opposites sides thereof and extend in a rear ward direction in the opening **210** to engage an opening **214** in side walls **216** of the crimp body **106**. The front end **206** also has a forward facing surface **218** that complements the rear of the spring push and, together with the tabs **212** keeps the crimp body **106** securely fixed to fiber optic connector **100**. Although the crimp body **106** is illustrated as being attached to the spring push **124**, alternatively the crimp body **106** could be attached to the housing **102**.

[0076] The opening **210** in the crimp body **106** rearwardly of the lead-in tubes provides a transition portion **220** for the optical fibers that are secured in the fiber optic ferrules **130**. Since the crimp body **106** has a singular opening **222** at the rear end thereof, the optical fibers need to be able to exit that singular opening **222** in a smooth fashion so they are not bent beyond their bend radius, thereby damaging or breaking the optical fibers. The transition portion **220** provides for this function.

[0077] The crimp body **106** also has a top surface **230** and the bottom surface **232**. The top surface **230** and the bottom surface **232** may be configured with a central portion **234** that is similar to the central portion **168** of the rail receiving portion **164** above. However, the crimp body **106** has two outer trough portions **236** that are open to the space above the crimp body **106**. The central portion **234** and the two outer trough portions **236** function as an alignment feature of the rail receiving portion **164**. As discussed more below, the latch component (push-pull mechanism) **104** can be better aligned with the rail receiving portion **164** by using the central portion **234** and the two outer trough portions **236** on the crimp body **106**.

[0078] While the crimp body **106** is illustrated as a single, unitary body (i.e., molded at one time with one material), it could also be molded as two pieces and then later the two pieces secured to one another.

[0079] The latch component (push-pull mechanism) **104** is illustrated in more detail in FIGS. 10-17. The latch component (push-pull mechanism) **104** has a main body **250** and a latch body **252** that attaches to the main body **250**. See FIGS. 10 and 11-13. The main body **250** has a front portion **254**, a middle portion **256**, and a rear portion **258**. Generally, the front portion **254** is where the latch body **252** attaches to the main body **250** and provides for the latching of the fiber optic connector **100** to the adapter and carrier. The middle portion **256** provides for latching of latch component (push-pull mechanism) **104** to the housing **102**. The rear portion **258** has a grasping portion **260** to allow a user to push and pull the latch component (push-pull mechanism) **104** to engage and disengage the fiber optic connector **100** and the latch component (push-pull mechanism) **104** from the adapter and/or carrier.

[0080] The front portion **254** is divided into a first front portion **262** and a second front portion **264**. The first front portion **262** and the second front portion **264** both have a window **266**, **268**, respectively to receive a latch from the latch body **252** therethrough. An underside of the first portion **262** has a groove **270** on either side to receive attachment members **272**, **274** from the latch body **252** (see FIGS. 10A and 11) to secure the latch body **252** to the main body **250**. The attachment members **272**, **274** (and thus the latch body **252**) are able to slide within the grooves **270** to allow for the latching and unlatching the fiber optic connector **100**. The grooves **270** should extend the length of the first portion **254**.

[0081] The second front portion **264** has an upper surface **276** that is higher than an upper surface **278** of the first front portion **262**. This allows for the latching of a carrier and an adapter with the same device, as noted in more detail below. On the bottom side **280** of the second front portion **264** is a rail portion **282** that includes two extensions **284**, **286** that are joined by a central portion **288**, all having a complementary configuration of the rail receiving portion **164** of the housing **102**. See FIG. 10A. The latch body **252** also has the same rail portion configuration (central portion **290** and two extensions **292, 294**) on the bottom thereof. This allows the main body **250** and the latch body **252** to be slidingly attached to the rail receiving portion **164** of housing **102**. When the latch body **252** is inserted into the first front portion **262**, a front surface **296** of the rail portion **282** provides a pushing surface by which the main body **250** can push the latch body **252** in the rail receiving portion **164** of the housing **102**. See also FIG. 21. The front surface **300** of the latch body **252** also provides a pushing surface to be used against the stop surface **166** of the housing **102**. This allows for the user to exert a force on the latch component (push-pull

mechanism) **104** which is transferred through the main body **250** to the latch body **252** and to the housing **102** to insert the fiber optic connector **100** into a carrier and/or adapter.

[0082] Returning to FIGS. 11-13, the latch body **252** has two latches, an adapter latch **310** and a carrier latch **312**. The latch body may only have one of the latches, depending upon its uses and the needs of the user. The adapter latch **310** extends from a forward portion of the latch body **252** and protrudes through window **266** of the main body **250**. The carrier latch **312** also extends from the latch body **252**, from a rear portion thereof, and protrudes through the window **268** of the main body **250**. As is recognized from FIG. 13, the adapter latch **310** does not rise as high as the carrier latch **312** (plane **E** versus plane **F**) so that when the fiber optic connector **100** is inserted into or removed from a carrier, the adapter latch **310** will not engage the carrier.

[0083] Each of the latches, adapter latch **310** and a carrier latch **312**, each have a proximal end **314**, **316**, to engage an adapter and a carrier, respectively. Each of the proximal ends, **314**, **316**, have a rearward facing surface **314a**, **316a** and an upward facing surface, **314b**,**316b**. The proximal ends **314**, **316** will engage an opening in an adapter or a carrier. See, e.g., FIG. 21.

[0084] The latch component (push-pull mechanism) **104** is removably connected to the rail receiving portion **164** of the housing **102** as described above. However, the connections so far described do not prevent the latch component (push-pull mechanism) **104** from being removed toward the rear of the housing **102** when, for example, the grasping portion **260** is pulled rearwardly. However, in the middle portion **256**, there are two latches **320** that extend from the latch component (push-pull mechanism) **104** inward and will move along rear portions of the longitudinal top portions **184** on each side of the housing **102**. See FIGS. 1, 18, and 20. In particular, the housing **102** has indentations **192** for the latches **320** and will engage the forward facing surfaces **194** when the latch component (push-pull mechanism) **104** is pulled rearwardly. This will allow for the user to remove the fiber optic connector **100** from a carrier and/or adapter as will now be described. It should be noted that the latches **320** are cantilevered latches and thus pushing on area **322** (see FIGS. 16 and 17) will cause the latches to move away from the housing **102**, and will release the housing **102** from the latch component (push-pull mechanism) **104**.

[0085] Turning to FIGS. 1, 14, 15, and 18, the latch component (push-pull mechanism) **104** is connected to the fiber optic connector **100**. The fiber optic connector **100** can be inserted into a carrier **350** (FIG. 18) and/or an adapter **400** (FIG. 20). The carrier **350**

provides the user with a convenient way to insert into and remove 4 fiber optic connectors **100** (could also have more or fewer connectors, but usually in groups of two) from an adapter (or other telecommunications structure) rather than one at a time. It provides a cost savings time wise and also assists in preventing the stubbing of or breaking fiber optic connectors.

[0086] The carrier **350** has a few features that enable the use of the carrier **350** to correctly orient the fiber optic connectors **100** (polarity) and also to align the fiber optic connectors **100** to one another for insertion into the adapter. The carrier **350** has a top **352** and a bottom **354** and the top **352** has a cut out **356** for each of the fiber optic connectors **100**, or the latch component (push-pull mechanism) **104**. If the fiber optic connector **100** is inserted into the carrier **350** incorrectly (wrong polarity) then the fiber optic connector **100** will not seat in the carrier **350** correctly. The cut out **356** also has a rearward facing surface **358** that is used to remove all of the fiber optic connectors **100** from an adapter as discussed in more detail below.

[0087] The carrier **350** has an opening **360** extending between the front end **362** and the rear end **364**. Inside the opening **360** are projections to accurately orient the fiber optic connectors **100** in the carrier **350**. Extending from the top **352** into the opening **360** are the top extensions **366a**. Along the corner of the top and the sides of the carrier **350** are partial top extensions **366b**, which perform the same function as top extensions **366a**. Similarly, there are bottom extensions **368a** and partial bottom extensions **368b**. As best seen in FIG. 19, the top extensions **366a** are longer and extend down into the opening **360** farther than the bottom extensions **368a** extend upward into the opening **360**. The distance between corresponding top and bottom extensions **366a**, **368a** provide the vertical alignment of the fiber optic connector **100** within the carrier **350**. Referring back to FIG. 6, the shoulders **188** and **190** and, more particularly, the distance between them and their vertical location along the sides **180** of the housing **102** orients the fiber optic connectors **100** vertically within the carrier **350**. As can be gleamed from FIG. 19, if one of the fiber optic connectors **100** is oriented incorrectly, the longitudinal top portions **184** and the two longitudinal bottom portions **186** will be in the incorrect location and the latch component (push-pull mechanism) **104** will hit the carrier and prevent the fiber optic connector **100** from being fully inserted.

[0088] The horizontal alignment of the fiber optic connectors **100** is also controlled by the top extensions **366a** and the bottom extensions **370**. However, it is the longitudinal top portions **184** and the two longitudinal bottom portions **186** (the distance therebetween) engaging

the top extensions **366a** and the bottom extensions **370** that controls. FIG. 19 also shows that there is very limited space between the fiber optic connectors **100** and allows for a higher density of fiber optic connectors **100**.

[0089] Once the fiber optic connectors **100** with the latch component (push-pull mechanism) **104** are correctly inserted into the carrier **350**, a latch stop **380** on the latch component (push-pull mechanism) **104** will engage the rearward facing surface **358** of the carrier **350**. The carrier **350** is captured between the latch stop **380** and rearward facing surface **316a** of carrier latch **312**. This will expose enough of the latch component (push-pull mechanism) **104** and, in particular, the first front portion **262**. At the same time, the top **352** of the carrier **350** has windows **370** to receive the carrier latch **312** from each latch body **252**, and in particular the proximal end **316**. See FIGS. 21 and 22. However, as the fiber optic connector **100** passes into the and through carrier **350**, the adapter latch **310** is too short to engage the carrier **350**.

[0090] With the carrier latch **312** now in the window **370** and engaging surface **372** created by the window **370**, the carrier **350** or the latch component (push-pull mechanism) **104** can be used to insert the fiber optic connectors **100** into the adapter **400**. As clear from FIGS. 21 and 22, if the carrier **350** is used to insert the ganged fiber optic connectors **100** (in the carrier **350** in Fig. 20), then the carrier **350** will push on the carrier latch **312**, which is on the latch body **252** and has front surface **300** of the latch body **252**, which then pushes against the stop surface **166** of the housing **102** to secure the ganged fiber optic connectors **100**. Thus, all of the fiber optic connectors **100** will be pushed simultaneously into the adapter. On the other hand, one could also used the latch component (push-pull mechanism) **104** to insert them as well.

[0091] As the ganged fiber optic connectors **100** are inserted into the adapter **400**, each of the adapter latches **310** will pop up into a respective window **402**. With the adapter latch **310** now in the window **402** and engaging surface **404** created by the window **402**, the ganged fiber optic connectors **100** are secured within the adapter **400**. The adapter **400** has the same projections to accurately orient the fiber optic connectors **100** in the adapter **400**. Thus, applicant will not repeat the same structures here.

[0092] The fiber optic connectors **100** can be removed from the adapter **400** one at a time or all at the same time with the carrier **350**. To remove one fiber optic connector **100** from the adapter **400** (if only in the adapter) or the adapter **400** and the carrier **350**, one only need to pull on the grasping portion **260** of the latch component (push-pull mechanism) **104**. As

the latch component (push-pull mechanism) **104** is pulled backward, it moves rearward relative to the latch body **252** (because the adapter latch **310** and the carrier latch **312** are against the engaging surfaces **372, 404**, respectively) and the portions forward of the windows **266, 268**, will move over the adapter latch **310** and a carrier latch **312**, pushing them down and out of the windows **370**, **402**. Continued pulling on the grasping portion **260** of the latch component (push-pull mechanism) **104** causes the latches **320** to engage the forward facing surfaces **194** of the housing **102** and the whole fiber optic connector can be removed.

[0093] If the ganged fiber optic connectors **100** are to be removed together and only from the adapter **400**, then the user will pull on the carrier **350** (while the adapter **400** remains fixed relative thereto). The carrier **350** and, in particular, the rearward facing surface **358** will engage latch stop **380** on the latch component (push-pull mechanism) **104** of each of the fiber optic connectors **100**. As noted above, the portions forward of the windows **266, 268**, will move over the adapter latch **310** (and carrier latch **312**, but the carrier **350** will retain the fiber optic connectors **100)**, pushing them down and out of the windows **370**, **402**. Continued pulling on the carrier causes the latches **320** to engage the forward facing surfaces **194** of the housing **102** and all of the ganged fiber optic connectors **100** can be removed from the adapter **400**. The fiber optic connector 100 can be inserted into and removed the same adapter **400** without a carrier **350** present. A partially populated carrier in the adapter can how a single fiber optic connectors removed for install, while the carrier will stay connected to the fiber optic connectors that remain in the adapter. When the last fiber-optic connector is removed is from the adapter, it will bring the carrier with it.

[0094] A second embodiment of a fiber optic connector **1100** according to the present invention is illustrated in FIGS 23-36. The fiber optic connector **1100**, in FIG. 23, may include a housing **1102**, a latch component (push-pull mechanism) **1104**, and a crimp body **1106**. As discussed in more detail below, the housing **1102** and its components, the latch component **1104,** and the crimp body **1106** are the focus here. It is also preferred that there by a crimp ring and heat shrink tube and a strain relief boot as with the prior embodiment, but since the crimp ring and heat shrink tube and a strain relief boot are generally known components, they are omitted here for clarity.

[0095] Turning to FIG. 24, inside the housing **1102** are two ferrule assemblies **1120** (which may be the same as ferrule assemblies **120**), two springs **1122**, and a spring push **1124**. The two ferrule assemblies **1120** each include a fiber optic ferrule **1130** (generally a

1.25 mm LC fiber optic ferrule), a ferrule holder **1132**, and a lead-in tube **1134**. The spring **1122** is added later. The ferrule assemblies **1120** are preferably preassembled and are inserted into the housing **1102** without needing any further processing.

[0096] The housing **1102** has a main body **1140** extending between a front end **1142** and a rear end **1144**, and has an opening **1146** extending therebetween. The opening **1146** of the housing **1102** may also have structures **1148** that orient and retain the ferrule assemblies **1120** in the housing **1102**. In this case, there are flat surfaces **1150** that engage corresponding flat surfaces **1152** on the ferrule holder **1132**, to keep the ferrule assemblies **1120** from rotating within the housing **1102**.

[0097] Once the ferrule assemblies **1120** are disposed within the housing **1102**, the springs **1122** are placed around the lead-in tube **1134** and against a back end **1138** of the ferrule holder **1132**. The spring push **1124** is then inserted into the opening **1146** of the housing **1102**. The spring push **1124** has a pair of latches **1154** that engage corresponding openings **1156** in the opposite sides of the main body **1140** of the housing **1102** to retain the spring push **1124** in the opening **1146**. The spring push **1124** has a forward facing surface **1158** to engage the rear ends of the springs **1122**. The forward facing surface **1158** generally corresponds to the two springs **1122** to ensure that that the spring push **1124** stays engaged with the springs **1122**. This configuration biases the ferrule assemblies **1120** toward the front end **1142** of the housing **1102**. While not shown, two optical fibers enter into the ferrule assemblies **1120** through the spring push **1124** and into the lead-in tubes **1124**.

[0098] The lead-in tubes **1134** are connected to and extend from the ferrule holder **1132**. Preferably, the lead-in tubes **1134** are secured to the ferrule holder **1132**, e.g. by adhesives, press-fit. The lead-in tubes **1134** also extend beyond the rear end of the ferrule holder **132** and the springs **1122** and the spring push **1124**. See FIG. 24. This allows for injection of epoxy or other adhesives into the ferrule assemblies **1120** through the lead-in tubes **1134** to secure the optical fibers therein. With the lead-in tubes **1134** extending so far rearwardly, there is no concern that the epoxy or adhesives will interfere with the springs **1122**, the spring push **1124**, or other structures in the fiber optic connector **1100**.

[0099] The housing **1102** may also have an indicia of the polarity of the fiber optic connector **1100** as with the prior embodiment. Similarly, an indentation or other mark may be present on the housing **1102**.

[0100] The outside of the housing **1102** has many features that are integral to its use. See FIGS. 25 and 26. First are the top surface **1160** and the bottom surface **1162**. The top and

bottom surfaces **1160**,**1162** are preferably the same, but may have some differences and still fall within the scope of the present invention. Extending from the rear end **1144** towards the front **1142** of the housing **11020** on both the top surface **1160** and the bottom surface **1162** is a rail receiving portion **1164**. As will be discussed in more detail below, the rail receiving portion **1164** will stop before the front end **1142** as it will therefore create a stop surface **1166**. The latch component (push-pull mechanism) **1104** will make use of the stop surface **1166** to insert the fiber optic connector **1100** into various structures.

[0101] The rail receiving portion **1164** has a central portion **1168** and two lobe sections **1170**, one lobe on each side of the central portion **1168**. As best seen in FIG. 26, the rail receiving portion **1164** has a T-shape configuration. This configuration matches that of the bottom surface of the latch component (push-pull mechanism) **1104** to form a sliding configuration. Other configurations are possible, as noted above.

[0102] The next feature of the housing **1102** and main body **1140** are the two side surfaces **1180**. The two side surfaces **1180** are those opposite to one another and separated by the top surface **1160** and the bottom surface **1162**. Referring to FIG. 26 in particular, each of the sides **1180** are divided into at least three portions. The first portion is a longitudinal central portion **1182** extending in a first plane **G**. The second portion is a longitudinal top portion **1184** extending in a second plane **H**, the first plane **G** is parallel to and offset from the second plane **H**. The third portion is a longitudinal bottom portion **1186** extending in the second plane **H**. The longitudinal top portion **1184** preferably is divided from the longitudinal central portion **1182** by a shoulder **1188**. The shoulder **1188** preferably has a surface that is in plane **I** and is perpendicular to both planes **G** and **H**. Similarly, the longitudinal bottom portion **1186** preferably is divided from the longitudinal central portion **1182** by a shoulder **1190**. The shoulder **1190** preferably has a surface that is in plane J and is perpendicular to both planes **G** and **H**. There is also an inclined wall **1196** between the bottom of the central portion **1168** and the shoulder **1188**. A portion of the latch component (push-pull mechanism) **1104** uses this inclined wall **1196** as a reference surface while moving along the housing **1102**. See Fig. 26. The inclined wall **1196** ends at the stop surface **1166**, where the latch component (push-pull mechanism) **1104** engages the stop surface **1166** to move the fiber optic connector **1100** as discussed below.

[0103] The two longitudinal top portions **1184** and the two longitudinal bottom portions **1186** function to align the fiber optic connector **1100** in a horizontal direction in various structures, e.g., a carrier and an adapter. On the other hand, it is the shoulders **1188**,**1190** that align the fiber

optic connector **1100** in a vertical direction as was discussed in detail above. As such, this discussion is not included here.

[0104] Also on the top surface **1160** and the bottom surface **1162** is a latch **1172** with an engagement surface **1174** and a release ramp **1176**. The latch **1172** is a cantilevered latch that works with the latch component (push-pull mechanism) **1104** to engage and disengage from an adapter. Finally, on the top surface **1160** and the bottom surface **1162** is an opening **1192** in the rail receiving portion **1164** for an extension from the latch component (push-pull mechanism) **1104**. As described in more detail below, the extension from the latch component (push-pull mechanism) **1104** engages a forward facing surface **1194** to remove the fiber optic connector **1100** from the adapter and or carrier. See FIG. 24.

[0105] The crimp body **1106** has a front portion **1200** that is designed to interact and connect with the spring push **1124** and also is disposed within the opening **1146** of the housing **1102** when installed, which is usually after the epoxy used to secure the optical fibers in the ferrules **1130** has cured. The crimp body **1106** has a rear portion **1202** that extends behind the housing **1102** and provides an outer surface **1204** to receive a crimp band (e.g., crimp ring and heat shrink tube**)** therearound. Extending from a front end **1206** to the rear end **1208** is an opening **1210**. The opening **1210** at the front portion **1200** receives at least a portion of each of the lead-in tubes **1134**. The spring push **1124** has two tabs **1212** (FIG. 24) on opposites sides thereof and extend in a rearward direction in the opening **1210** to engage an opening **1214** in side walls **1216** of the crimp body **1106**. The front end **1206** also has a forward facing surface **1218** that complements the rear of the spring push **1124** and, together with the tabs **1212**, keeps the crimp body **1106** securely fixed to fiber optic connector **1100**.

[0106] The opening **1210** in the crimp body **1106** rearwardly of the lead-in tubes provides a transition portion **1220** for the optical fibers that are secured in the fiber optic ferrules **1130**. Since the crimp body **1106** has a singular opening **1222** at the rear end thereof, the optical fibers need to be able to exit that singular opening **1222** in a smooth fashion so they are not bent beyond their bend radius, thereby damaging or breaking the optical fibers. The transition portion **1220** provides for this function.

[0107] The crimp body **1106** also has a top surface **1230** and the bottom surface **1232**. The top surface **1230** and the bottom surface **1232** may be configured with an area **1234** that complements the central portion **1168** and two lobe sections **1170** of the rail receiving portion **1164** above. The area **1234** functions as an alignment feature of the rail receiving portion **1164**. As discussed more below, the latch component (push-pull mechanism) **1104**

can be better aligned with the rail receiving portion **1164** by using the area **1234** on the crimp body **1106**.

[0108] While the crimp body **1106** is illustrated as a single, unitary body (i.e., molded at one time with one material), it could also be molded as two pieces and then later the two pieces secured to one another.

[0109] The latch component (push-pull mechanism) **1104** is illustrated in more detail in FIGS. 28-29. The latch component (push-pull mechanism) **1104** has a main body **1250**, with a front portion **1254**, a middle portion **1256**, and a rear portion **1258**. Generally, the front portion **1254** is where the latch component **1104** engages the fiber optic connector **1100** and controls connections to an adapter and carrier. The middle portion **1256** generally provides for latching of latch component (push-pull mechanism) **1104** to a carrier. The rear portion **1258** has a grasping portion **1260** to allow a user to push and pull the latch component (push-pull mechanism) **1104** to engage and disengage the fiber optic connector **1100** (push-pull mechanism) **1104** from the adapter and/or carrier.

[0110] When the latch component (push-pull mechanism) **1104** is installed on the housing **1102**, the front portion **1254** has two rails **1262** to engage the stop surface **1166** to push the fiber optic connector **1100**. Pushing on the latch component (push-pull mechanism) **1104** causes the force to be transferred to the rails **1262**. There is a space **1264** between the rails **1262** to allow for the engagement surface **1174** of the latch **1172** to pass therebetween. The front portion **1254** then, moving rearwardly, has an opening **1268**. The opening **1268** receives the release ramp **1176**. A front portion of the opening **1268** has a chamfered surface **1270** to engage the chamfered surface of the release ramp **1176**. See also FIGS. 28 and 29. Behind the opening **1268** is a downward extension **1272** to fit within the opening **1192** in the rail receiving portion **1164** and to engage the forward facing surface **1194** when removing the fiber optic connector **1100** as discussed below. See also FIG. 24.

[0111] The next feature of the latch component (push-pull mechanism) **1104** is in the middle portion **1256** and is an opening **1274** that receives a part of a carrier for a number of fiber optic connectors **1100**. As noted above, sometimes it is beneficial for a number of fiber optic connectors **1100** to be linked to one another. This opening **1274** along with another embodiment of a carrier **1350** allows for the insertion/removal of the fiber optic connectors **1100** from an adapter **1400**. The opening **1274** is partially formed by a chamfered front surface **1276** and a generally flat rear surface **1278**.

[0112] The rear portion **1258** of the latch component (push-pull mechanism) **1104** has a grasping portion **1260**. Finally, a release **1280** is disposed on the side of the latch component (push-pull mechanism) **1104**. The release **1280** is an opening that provides access to the downward extension **1272** that fits within the opening **1192**. As noted above, the downward extension **1272** keeps the latch component (push-pull mechanism) **1104** positioned with the housing **1102**. To disengage the latch component (push-pull mechanism) **1104** from the housing **1102**, a pin or other small tool can be inserted into the release **1280** and deflect downward extension **1272** upward and out of the opening **1192**. The latch component (push-pull mechanism) **1104** can now be moved rearwardly from the housing **1102**.

[0113] FIG. 30 illustrates the fiber optic connector **1100** fully assembled and ready to be used. The major components of the fiber optic connector **1100** are labeled and the latch component (push-pull mechanism) **1104** in position to insert the fiber optic connector **1100** into a carrier **1350** and/or an adapter **1400**. As can be seen, the latch component (push-pull mechanism) **1104** is fully engaged and the two rails **1262** have engaged the stop surface **1166.**

[0114] Turning to FIGS. 30, 31, 33, and 36, the fiber optic connector can be inserted into a carrier **1350** (FIGS. 30 and 31) and/or an adapter **1400** (FIG. 34). The carrier **1350** provides the user with a convenient way to insert into and remove 4 fiber optic connectors **1100** (could also have more or fewer connectors, but usually in groups of two) from an adapter (or other telecommunications structure) rather than one at a time. It provides a cost savings time wise and also assists in preventing the stubbing of or breaking fiber optic connectors.

[0115] The carrier **1350** has a few features that enable the use of the carrier **1350** to correctly orient the fiber optic connectors **1100** (polarity) and also to align the fiber optic connectors to one another for insertion into the adapter. The carrier **1350** has a top **1352** and a bottom **1354** and the top **1352** has a cut out **1356** for each of the fiber optic connectors **1100**, or the latch component (push-pull mechanism) **1104**. Each of the cut outs **1356** has a cantilevered latch **1358** that protrudes into an opening **1360** of the carrier **1350**. If the fiber optic connector **1100** is inserted into the carrier **1350** incorrectly (wrong polarity) then the fiber optic connector **1100** will not seat in the carrier **1350** correctly. The combination of the latch 1**358** and the bottom **1354** prevent the fiber optic connectors **1100** from being inserted incorrectly. The cantilevered latches **1358** have a projection **1362** that extends into the opening **1360** (FIG. 32) and, when a fiber optic connector is inserted, rests in the opening

1274. The first surface **1364** of projection **1362** is chamfered and is to engage the chamfered front surface **1276** of the latch component (push-pull mechanism) **1104** during removal of the fiber optic connector **1100**. The forward facing surface **1368** used to engage a rear surface of the housing **1102** when the carrier **1350** is used to insert the fiber optic connectors **1100** into the adapter **1400**. Finally, the rear facing surface **1370** used to engage the generally flat rear surface **1278** of opening **1274** when the carrier **1350** is used to remove the fiber optic connectors **1100** from the adapter **1400**.

[0116] Installation of the fiber optic connector **1100** into the carrier **1350** is illustrated in FIG. 33. Using the latch component (push-pull mechanism) **1104**, the fiber optic connector **1100** is inserted into the carrier **1350** because the two rails **1262** to engage the stop surface **1166** thereby pushing the fiber-optic connector **1100** through the carrier **1350**. The release ramp **1176** is disclosed in the opening **1268** of the front portion **1254**. Similarly, the projection **1362** on the latch **1358** is disposed in the opening **1274** of the latch component (push-pull mechanism) **1104**. This method is repeated for each of the fiber optic connectors 1100 that are to be inserted into the carrier **1350**.

[0117] The fiber optic connectors **1100** can be inserted into the adapter **1400** is illustrated in FIG. 34. As with the prior embodiment, fiber optic connectors **1100** can be inserted into the adapter **1400** one at a time, or in multiples using the carrier **1350**. Once the fiber of the connectors are aligned with the adapter **1400**, a user can grasp the carrier **1350** to push fiber optic connectors **1100** into the opening **1402** of the adapter **1400**. The forward facing surface **1368** on the projection **1362** engages the rear surface the housing **1102** and, more particularly, the rear surface of the central portion **1168** of the rail receiving portion **1164**. That causes the latch **1172** with an engagement surface **1174** to deflect downward as it enters into the adapter **1400**, and once it reaches the window **1404**, latch **1172** will return and position itself in the window **1404**.

[0118] The removal of the fiber optic connectors **1100** be explained with reference to FIG. 35. Fiber optic connectors **1100** can be removed from the adapter **1400** by using the carrier **1354** or the latch component (push-pull mechanism) **1104**. If the user is going to use the latch component (push-pull mechanism) **1104**, the user will pull on the grasping portion **1260**. This will cause the chamfered surface **1270** to engage the release ramp **1176**. This will cause the latch **1172** to be biased downward freeing the engagement surface **1174** from the adapter window **1402**. Further pulling on the latch component (push-pull mechanism) **1104**

will pull the fiber optic connector **1100** from the adapter **1400** as the rearward facing surface **1272** engages surface **1194** in the opening **1192**.

[0119] If the carrier **1350** is to be used, the carrier **1350** is moved rearwardly relative to the latch component (push-pull mechanism) **1104**. The rear facing surface **1370** of the carrier **1350** engages the generally flat rear surface **1278** of opening **1274**, causing the chamfered surface **1270** to engage the release ramp **1176**. This releases all of the fiber optic connectors **1100** from the adapter **1400**.

[0120] Finally, with reference to FIG. 36, the fiber optic connector **1100** can be removed from the carrier **1350**. While holding the carrier **1350** steady, the user can pull on the latch component (push-pull mechanism) **1104**, which causes the chamfered service **1276** in the opening **1274** to engage the first surface **1364** of projection **1362** of the carrier **1350**. This will cause the cantilevered latch **1358** to deflect upward and out-of-the-way so that the latch component (push-pull mechanism) **1104** can be removed from the fiber optic connector.

[0121] An alternative spring push **1724** is illustrated in FIG. 37. The spring push **1724** has a pair of detents **1726** that frictionally engage an inside surface of the housing. This would eliminate the need for any openings in the housing as there are no latches to be secured. The spring push **1724** includes an extension **1728** with opposing sides **1730** that are semi-circular and provide more support to the springs **122**. The extension **1728** terminates at two circular surfaces **1732** that engages the end of the springs **122**. There are openings **1734** in the middle of the circular surfaces **1732** to receive lead-in tubes, that extend out the back of the spring push **1724**. The back end of the spring push **1724** may also have a different connection system for a crimp band.

[0122] An alternative crimp_body **1706** is illustrated in FIG. 38. The crimp body **1706** has two projections **1708** and two t-shaped extensions **1710** directed toward the front thereof. The crimp body **1706** provides the same function as the crimp bands in the two prior embodiments. While not shown, the top and bottom surfaces **1712** and **1714** may be configured to assist with the alignment of a push-pull mechanism. The crimp body **1706** also provides an internal space that allows for a smooth transition of the optical fibers through the openings **1734** and the lead-in tubes of any associated fiber optic connector..

[0123] A third embodiment of a fiber optic connector **2100** according to the present invention is illustrated in FIGS. 39-49. The fiber optic connector **2100** is similar to the other embodiments in that the majority of the parts of the fiber optic connector **2100** are the same, except that the latch component (push-pull mechanism) **2104** is a self-returning latch

component (push-pull mechanism) **2104**. That is, that if the user pulls rearwardly on the latch component (push-pull mechanism) **2104**, then the latch component (push-pull mechanism) **2104** will return to its original position (a forward position) without having to be returned manually. In the prior embodiments, if the latch component (push-pull mechanism) **104, 1104** were to be pulled (to remove the fiber optic connectors from the adapter/carrier, then the latch component (push-pull mechanism) would remain in a rearward position. The present embodiment is biased such that the latch component (push-pull mechanism) **2104** will automatically return to the forward position.

[0124] Given the similarities between this embodiment of a fiber optic connector and those discussed above, particularly the first embodiment, only a discussion about the new components will be included. Thus, the discussion will be about the latch component (push-pull mechanism) **2104** and small changes to the housing **2102**.

[0125] The latch component (push-pull mechanism) **2104** is illustrated in more detail in FIGS. 40-48. The latch component (push-pull mechanism) **2104** has a main body **2210** and a latch body **2212** that attaches to the main body **2210**. See FIGS. 40-43. The main body **2210** has a front portion **2214**, a middle portion **2216**, and a rear portion **2218.** Generally, the front portion **2214** is where the latch body **2212** attaches to the main body **2210** and provides for the latching of the fiber optic connector **2100** to an adapter and carrier as discussed above. The middle portion **2216** provides an area for the flexure member **2220** and to engage the latch component (push-pull mechanism) **2104**. The rear portion **2218** has a grasping portion **2222** to allow a user to push and pull the latch component (push-pull mechanism) **2104** to engage and disengage the fiber optic connector **2100** from the adapter and/or carrier.

[0126] The front portion **2214** is divided into a first front portion **2230** and a second front portion **2232.** The first front portion **2230** has two windows **2234** and **2236** and the second front portion **2232** has a window **2238**. The second window **2236** of the first front portion **2230** and window **2238** are to receive a latch from the latch body **2212** therethrough. The first window **2234** (and the third window **2238** as well) is to receive a latch pad on the latch body **2212**. An underside of the first portion **2214** has a groove **2240** on either side to receive an extended portion of the latch pads **2242**,**2244** from the latch body **2212** (see FIGS. 43 and 47) to secure the latch body **2212** to the main body **2210**. The extended portion of the latch pads **2242**,**2244** (and thus the latch body **2212**) are able to slide within the grooves

2240 to allow for the latching and unlatching the fiber optic connector **2100**. The grooves **2240** should extend the length of the first portion **2214**.

[0127] The second front portion **2232** has an upper surface **2246** that is higher than an upper surface **2248** of the first front portion **2214**. This allows for the latching of a carrier and an adapter with the same device, as described above for the other embodiments. On the bottom side **2250** of the second front portion **2232** are two extensions **2252**, **2254** that are a complementary configuration of a rail receiving portion of the housing **2102**. See FIG. 41. The latch body **2212** also has the same rail portion configuration of two extensions **2256, 2258** on the bottom thereof. This allows the main body **2210** and the latch body **2212** to be slidingly attached to the rail receiving portion of the housing **2102**. When the latch body **2212** is inserted into the first front portion **2230**, a front surface **2260** of the two extensions **2252**, **2254** provides a pushing surface by which the main body **2210** can push the latch body **2212** in the rail receiving portion. See also FIG. 44. The front surface **2262** of the two extensions **2256, 2258** also provides a pushing surface to be used against the stop surface **2264** of the housing **2102**. See FIGS. 45 and 48 .This allows for the user to exert a force on the latch component (push-pull mechanism) **2104** which is transferred through the main body **2210** to the latch body **2212** and to the housing **2102** to insert the fiber optic connector **2100** into a carrier and/or adapter.

[0128] The middle portion **2216** also has a window **2270** to receive a portion of the flexure member **2220**, which extends from the latch body **2212**. The middle portion **2216** also has on the bottom side **2250** a cavity or space **2272** to receive any other portions of the flexure member **2220** that may be needed.

[0129] Turning to FIGS. 42 and 43, the latch body **2212** has two latches, an adapter latch **2280** and a carrier latch **2282**. The latch body **2212** may only have one of the latches, depending upon its uses and the needs of the user. The adapter latch **2280** extends from a forward portion of the latch body **2212** and protrudes through window **2236** of the main body **2210**. The carrier latch **2282** also extends from the latch body **2212**, from a rear portion thereof, and protrudes through the window **2238** of the main body **2210**. As is recognized from FIG. 44, the adapter latch **2280** does not rise as high as the carrier latch **2282** as in the other embodiments as well. The discussion from those embodiments with regard to the position and the composition of the ends of the latches is adopted for this embodiment as well.

[0130] The latch body **2212** has a connector latch **2290** as well. The connector latch **2290** extends forward beyond the front surface **2262** of the two extensions **2256**, **2258** to engage a latch stop **2292** at the stop surface **2264**. The connector latch **2290** has a downward curling portion **2294** that provides a surface to engage the latch stop **2292**. The connector latch **2290** may also have a latch rib **2296** that connects the curling portion **2294** to the remainder of the connector latch **2290**. The latch stop **2292** may also have a groove **2298** there-in to receive the latch rib **2296**. It is the connector latch **2290** that retains the latch body **2212** with the housing **2102**. As described below in more detail, when the latch component (push-pull mechanism) **2104** is pulled rearwardly, the connection of the connector latch **2290** with the housing **2102** allows the main body **2210** to move relative to the latch body **2212.**

[0131] The latch body **2212** also has two latch pads **2242**,**2244**. The latch pads **2242**,**2244** have two functions: first to help retain the latch body **2212** in the main body **2210**, and second to limit the movement of the latch component (push-pull mechanism) **2104** relative to the housing **2102**. As seen in FIGS. 39, 45, and 48, the first latch pad **2242** is disposed within the first window **2234** of the main body **2210**. It is evident that as the main body **2210** is pulled relative to the latch body **2212**, the first latch pad **2242** will slide relative to the first window **2234** only for certain distance before it engages a portion of the main body **2210**. This is true with regard to the second latch pad **2244** as well. Second latch pad **2244** is disposed in the second window **2236** along with the carrier latch **2282**. As the main body **2210** is pulled relative to the latch body **2212**, the main body **2210** pushes on the adapter latch **2280** (and the carrier latch **2282)** in downward out of the window **2236**. As the main **2210** body continues in a rearward direction, it will engage the front end of the second pad **2244**, prohibiting any further movement of the main body **2210** to the latch body **2212**. See FIG. 48.

[0132] Turning to FIGS. 42, 43, 46, the flexure member **2220** will now be described. With particular reference to FIGS. 42 and 43, the flexure member **2220** extends from the rear portion of the latch body **2212**. In the embodiment illustrated in the figures, the flexure member **2220** has a first curved portion **2300** and a second curved portion **2302**. Second curved portion **2302** terminates at terminal end **2304**. The terminal end **2304** is preferably disposed with in the third window **2270** and also preferably makes contact with at least one of the surfaces that define window **2270**. See FIG. 46. The first curve portion **2300** also partially resides in the cavity or space **2272**. It is also possible that the flexure member **2220**

only has one of the two curved portions **2300**,**2302**, depending upon the amount of force required to main body **2210** relative to the latch body **2212**.

[0133] As the main body **2210** is pulled rearwardly relative to the latch body **2212**, the latches **2280**, **2282** are moved downward (as also described above) releasing the fiber optic connector **2100** from any adapter and/or carrier. During this movement, the flexure member **2220** is put under tension (the curved portions begin to straighten out or alter from the shape in their state) as the terminal end **2304** presses against the wall of opening **2270**. Once the fiber optic connector **2100** is free from the adapter and/or carrier and the user releases the grasping portion **2222**, the main body **2210** will return to its original state as the flexure member pulls on the main body **2210**. See FIG. 39. The flexure member **2220** acts as a self-return mechanism for the latch component (push-pull mechanism) **2104**. Accordingly, there are other self-returning mechanisms that may be used instead of the particular embodiment of the flexure member **2220**. For example, a spring could be used to bias the main body **2210** relative to the latch body **2212**.

[0134] It will be apparent to those skilled in the art that various modifications and variations can be made to the present invention without departing from the spirit and scope of the invention. Thus it is intended that the present invention cover the modifications and variations of this invention provided they come within the scope of the appended claims and their equivalents.

What is claimed:

1. A fiber optic connector comprising:

a housing having a main body extending between a front end and a rear end and having an opening extending therebetween, the housing having a top surface and a bottom surface bound by two opposing side surfaces such that a lateral width between the two opposing side surfaces is less than a separation between the top surface and the bottom surface;

two ferrule assemblies disposed within the opening of the housing, each of the ferrule assemblies comprising a fiber optic ferrule and a ferrule holder to hold the fiber optic ferrule, the fiber optic ferrule extending forwardly of and away from the front end of the ferrule holder;

two springs, each of the two springs engaging a rearward facing surface of a respective ferrule holder and extending towards the rear end of the housing to bias the ferrule assemblies toward the front end of the housing and retained within the housing;

a crimp body secured to the fiber optic connector having a front end at least partially disposed in the opening at the rear end of the housing, the crimp body having a rear end forming a singular opening for optical fibers;

an alignment feature on at least one of the top surface and the bottom surface of the housing configured to guide the fiber optic connector into an adapter; and

a strain relief boot coupled to the rear end of the crimp body and having a longitudinal opening in continuum with the singular opening of the crimp body through which optical fibers pass.

2. The fiber optic connector according to claim 1, wherein the alignment feature is positioned rearward of the front end of the housing and extends away from the front end of the housing.

3. The fiber optic connector according to claim 1, further comprising a spring push engaging a rear portion of each of the two springs.

4. The fiber optic connector according to claim 1, further comprising an indicia of polarity on the housing.

5. The fiber optic connector according to claim 1, further comprising:

a crimp band secured around an outer surface of the rear end of the crimp body, and wherein the strain relief boot extends rearwardly away from the housing.

6. The fiber optic connector according to claim 1, wherein the top surface of the housing includes a rail receiving portion extending along at least a portion of the housing.

7. The fiber optic connector according to claim 6, wherein the rail receiving portion has a dove tail configuration or an undercut configuration to receive a latch component.

8. The fiber optic connector according to claim 7, wherein the latch component is a push-pull mechanism.

9. The fiber optic connector according to claim 1, wherein the front end of the housing fits in a QSFP footprint.

10. The fiber optic connector according to claim 3, wherein the spring push is separate from the crimp body.

11. The fiber optic connector according to claim 1, wherein the crimp body is a two-piece crimp body.

12. The fiber optic connector according to claim 6, wherein the alignment feature includes the rail receiving portion.

13. The fiber optic connector according to claim 1, wherein the alignment feature includes a vertical alignment feature and a horizontal alignment feature.

14. The fiber optic connector according to claim 1, wherein each of the ferrule assemblies is separated from the other ferrule assembly by a wall between respective ferrule seats of the fiber optic ferrules of each of the ferrule assemblies, the wall extending rearward into the housing and away from each of the respective ferrule seats.

15. The fiber optic connector according to claim 14, wherein there is a gap between a ferrule holder of each of the fiber optic ferrules and the wall.

16. The fiber optic connector according to claim 3, wherein the spring push engages the rear portion of each of the two springs simultaneously.

17. The fiber optic connector according to claim 1, further comprising a lead-in tube attached to each of the ferrule holders, the lead-in tube extending past the rear end of the main body of the housing and configured to avoid leakage of an adhesive inserted into the lead-in tube into the main body.

MINI DUPLEX CONNECTOR WITH PUSH-PULL POLARITY MECHANISM AND CARRIER

ABSTRACT OF THE INVENTION

A new fiber optic connector provides a smaller form factor by including two ferrule assemblies in a housing. The housing accepts a push-pull mechanism that allows for insertion and removal from a carrier as well as an adapter. The push-pull mechanism may also include a flexure member to return the push-pull mechanism. Polarity of the fiber optic connector may also be selected by use of the push-pull mechanism.