

April 25th, 2018

Commissioner of Patents, USPTO

General Transmittal

Application No: 62/649,539

Confirmation No: 1013

Provisional processing fee of \$50 is posted.

Sincerely Yours,

/ESJ/

Edward Jarmolowicz

47,238

Electronic Patent Application Fee Transmittal

Application Number:	62649539			
Filing Date:	28-Mar-2018			
Title of Invention:	MICROCONNECTOR WITH A MULTI-PURPOSE BOOT			
First Named Inventor/Applicant Name:	Kazuyoshi Takano			
Filer:	Edward Jarmolowicz			
Attorney Docket Number:	Senko.09100US07			
Filed as Small Entity				
Filing Fees for Provisional				
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:				
PROCESSING FEE FOR PROVIS. APPLICATIONS	2807	1	50	50
Total in USD (\$)				50

Electronic Acknowledgement Receipt

EFS ID:	32438368
Application Number:	62649539
International Application Number:	
Confirmation Number:	1013
Title of Invention:	MICROCONNECTOR WITH A MULTI-PURPOSE BOOT
First Named Inventor/Applicant Name:	Kazuyoshi Takano
Customer Number:	152878
Filer:	Edward Jarmolowicz
Filer Authorized By:	
Attorney Docket Number:	Senko.09100US07
Receipt Date:	25-APR-2018
Filing Date:	28-MAR-2018
Time Stamp:	12:03:57
Application Type:	Provisional

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	\$50
RAM confirmation Number	042518INTEFSW12042200
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	Miscellaneous Incoming Letter	S09100Fee.pdf	41470	no	1
			d56a5ec7f4cc7c57ac177cb13c6ade4ceb1a52c8		
Warnings:					
Information:					
2	Fee Worksheet (SB06)	fee-info.pdf	30415	no	2
			add792a5feeaaab62293bedf8580880d28836c9		
Warnings:					
Information:					
Total Files Size (in bytes):			71885		
<p>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.</p> <p><u>New Applications Under 35 U.S.C. 111</u> If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.</p> <p><u>National Stage of an International Application under 35 U.S.C. 371</u> If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.</p> <p><u>New International Application Filed with the USPTO as a Receiving Office</u> If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.</p>					

To: patents@senko.com,uspatents@sennniger.com,
From: PAIR_eOfficeAction@uspto.gov
Cc: PAIR_eOfficeAction@uspto.gov
Subject: Private PAIR Correspondence Notification for Customer Number 152878

Apr 17, 2018 03:46:44 AM

Dear PAIR Customer:

Senko Advanced Components, Inc.
450 Donald Lynch Blvd
Unit D
Marlborough, MA 01752
UNITED STATES

The following USPTO patent application(s) associated with your Customer Number, 152878 , have new outgoing correspondence. This correspondence is now available for viewing in Private PAIR.

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

Disclaimer:

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

Application	Document	Mailroom Date	Attorney Docket No.
62649539	APP.FILE.REC	04/17/2018	S09100US00.7

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

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

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

Thank you for prompt attention to this notice,

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PATENT APPLICATION INFORMATION RETRIEVAL SYSTEM



UNITED STATES PATENT AND TRADEMARK OFFICE

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

APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY. DOCKET NO	TOT CLAIMS	IND CLAIMS
62/649,539	03/28/2018		340	S09100US00.7		

CONFIRMATION NO. 1013

FILING RECEIPT



0000000098822899

152878
Senko Advanced Components, Inc.
450 Donald Lynch Blvd
Unit D
Marlborough, MA 01752

Date Mailed: 04/17/2018

Receipt is acknowledged of this provisional patent application. It will not be examined for patentability and will become abandoned not later than twelve months after its filing date. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF APPLICANT, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection. Please verify the accuracy of the data presented on this receipt. **If an error is noted on this Filing Receipt, please submit a written request for a Filing Receipt Correction. Please provide a copy of this Filing Receipt with the changes noted thereon. If you received a "Notice to File Missing Parts" for this application, please submit any corrections to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections**

Inventor(s)

Kazuyoshi Takano, Southborough, MA;
Jun Fu CHANG, WORCESTER, MA;

Applicant(s)

SENKO Advanced Components, Inc., Marlborough, MA

Power of Attorney:

Edward Jarmolowicz--47238

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: 04/16/2018

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 62/649,539**

Projected Publication Date: None, application is not eligible for pre-grant publication

Non-Publication Request: No

Early Publication Request: No

**** SMALL ENTITY ****

Title

MICROCONNECTOR WITH A MULTI-PURPOSE BOOT

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications: No**PROTECTING YOUR INVENTION OUTSIDE THE UNITED STATES**

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

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

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

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

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

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

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

license has been issued under 37 CFR 5.15(b). The license is subject to revocation upon written notification. The date indicated is the effective date of the license, unless an earlier license of similar scope has been granted under 37 CFR 5.13 or 5.14.

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

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

NOT GRANTED

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

SelectUSA

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

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	S09100US00.7
		Application Number	
Title of Invention	MICROCONNECTOR WITH A MULTI-PURPOSE BOOT		
<p>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.</p> <p>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.</p>			

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					
Legal Name					
Prefix	Given Name	Middle Name	Family Name	Suffix	
	Kazuyoshi		Takano		
Residence Information (Select One) ☒ US Residency ☐ Non US Residency ☐ Active US Military Service					
City	Southborough	State/Province	MA	Country of Residence ⁱ	US
Mailing Address of Inventor:					
Address 1		11 Fiddle Neck Lane			
Address 2					
City	Southborough	State/Province	MA		
Postal Code	01772	Country ⁱ	US		
Inventor 2					
Legal Name					
Prefix	Given Name	Middle Name	Family Name	Suffix	
	Jun Fu		CHANG		
Residence Information (Select One) ☒ US Residency ☐ Non US Residency ☐ Active US Military Service					
City	WORCESTER	State/Province	MA	Country of Residence ⁱ	US
Mailing Address of Inventor:					
Address 1		52 Upland Street			
Address 2					
City	Worcester	State/Province	MA		
Postal Code	01607	Country ⁱ	US		
All Inventors Must Be Listed - Additional Inventor Information blocks may be generated within this form by selecting the Add button. <div style="text-align: right;"> <input type="button" value="Add"/> </div>					

Correspondence Information:

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	S09100US00.7
		Application Number	
Title of Invention	MICROCONNECTOR WITH A MULTI-PURPOSE BOOT		

Enter either Customer Number or complete the Correspondence Information section below.
For further information see 37 CFR 1.33(a).

☐ **An Address is being provided for the correspondence information of this application.**

Customer Number	152878		
Email Address	PATENTS@SENKO.COM	<input type="button" value="Add Email"/>	<input type="button" value="Remove Email"/>

Application Information:

Title of the Invention	MICROCONNECTOR WITH A MULTI-PURPOSE BOOT		
Attorney Docket Number	S09100US00.7	Small Entity Status Claimed	☒
Application Type	Provisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)	133	Suggested Figure for Publication (if any)	100

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	000152878		

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	S09100US00.7	
		Application Number		
Title of Invention	MICROCONNECTOR WITH A MULTI-PURPOSE BOOT			

Prefix	Given Name	Middle Name	Family Name	Suffix	<input type="button" value="Remove"/>
Registration Number					
Prefix	Given Name	Middle Name	Family Name	Suffix	<input type="button" value="Remove"/>
Registration Number					

Additional Representative Information blocks may be generated within this form by selecting the **Add** button.

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			<input type="button" value="Remove"/>
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)

Additional Domestic Benefit/National Stage Data may be generated within this form by selecting the **Add** button.

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) 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).

Application Number	Country ⁱ	Filing Date (YYYY-MM-DD)	Access Code ⁱ (if applicable)

Additional Foreign Priority Data may be generated within this form by selecting the **Add** button.

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	S09100US00.7
		Application Number	
Title of Invention	MICROCONNECTOR WITH A MULTI-PURPOSE BOOT		

☐ 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.

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	S09100US00.7
		Application Number	
Title of Invention	MICROCONNECTOR WITH A MULTI-PURPOSE BOOT		

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)

A. Priority Document Exchange (PDX) - Unless box A in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the European Patent Office (EPO), the Japan Patent Office (JPO), the Korean Intellectual Property Office (KIPO), the State Intellectual Property Office of the People's Republic of China (SIPO), the World Intellectual Property Organization (WIPO), and any other foreign intellectual property office participating with the USPTO in a bilateral or multilateral priority document exchange agreement in which a foreign application claiming priority to the instant patent application is filed, access to: (1) the instant patent application-as-filed and its related bibliographic data, (2) any foreign or domestic application to which priority or benefit is claimed by the instant application and its related bibliographic data, and (3) the date of filing of this Authorization. See 37 CFR 1.14(h)(1).

B. Search Results from U.S. Application to EPO - Unless box B in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the EPO access to the bibliographic data and search results from the instant patent application when a European patent application claiming priority to the instant patent application is filed. See 37 CFR 1.14(h)(2).

The applicant is reminded that the EPO's Rule 141(1) EPC (European Patent Convention) requires applicants to submit a copy of search results from the instant application without delay in a European patent application that claims priority to the instant application.

2. Opt-Out of Authorizations to Permit Access by a Foreign Intellectual Property Office(s)

- ☐ A. Applicant **DOES NOT** authorize the USPTO to permit a participating foreign IP office access to the instant application-as-filed. If this box is checked, the USPTO will not be providing a participating foreign IP office with any documents and information identified in subsection 1A above.
- ☐ B. Applicant **DOES NOT** authorize the USPTO to transmit to the EPO any search results from the instant patent application. If this box is checked, the USPTO will not be providing the EPO with search results from the instant application.

NOTE: Once the application has published or is otherwise publicly available, the USPTO may provide access to the application in accordance with 37 CFR 1.14.

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	S09100US00.7
		Application Number	
Title of Invention	MICROCONNECTOR WITH A MULTI-PURPOSE BOOT		

Applicant Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

Applicant 1

If the applicant is the inventor (or the remaining joint inventor or inventors under 37 CFR 1.45), this section should not be completed. The information to be provided in this section is the name and address of the legal representative who is the applicant under 37 CFR 1.43; or the name and address of the assignee, person to whom the inventor is under an obligation to assign the invention, or person who otherwise shows sufficient proprietary interest in the matter who is the applicant under 37 CFR 1.46. If the applicant is an applicant under 37 CFR 1.46 (assignee, person to whom the inventor is obligated to assign, or person who otherwise shows sufficient proprietary interest) together with one or more joint inventors, then the joint inventor or inventors who are also the applicant should be identified in this section.

☐ Assignee
☐ Legal Representative under 35 U.S.C. 117
☐ Joint Inventor

☐ Person to whom the inventor is obligated to assign.
☐ Person who shows sufficient proprietary interest

If applicant is the legal representative, indicate the authority to file the patent application, the inventor is:

Name of the Deceased or Legally Incapacitated Inventor:

If the Applicant is an Organization check here. ☒

Organization Name

Mailing Address Information For Applicant:

Address 1		450 Donald Lynch Blvd Unit D	
Address 2			
City	Marlborough	State/Province	MA
Country ⁱ	US	Postal Code	01752
Phone Number	9784937107	Fax Number	5
Email Address	patents@senko.com		

Additional Applicant Data may be generated within this form by selecting the Add button.

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	S09100US00.7
		Application Number	
Title of Invention	MICROCONNECTOR WITH A MULTI-PURPOSE BOOT		

Assignee Information including Non-Applicant Assignee Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

Assignee 1							
Complete this section if assignee information, including non-applicant assignee information, is desired to be included on the patent application publication. An assignee-applicant identified in the "Applicant Information" section will appear on the patent application publication as an applicant. For an assignee-applicant, complete this section only if identification as an assignee is also desired on the patent application publication.							
If the Assignee or Non-Applicant Assignee is an Organization check here.				☐			
Prefix	Given Name	Middle Name	Family Name	Suffix			
Mailing Address Information For Assignee including Non-Applicant Assignee:							
Address 1							
Address 2							
City			State/Province				
Country i			Postal Code				
Phone Number			Fax Number				
Email Address							
Additional Assignee or Non-Applicant Assignee Data may be generated within this form by selecting the Add button.							

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	S09100US00.7
		Application Number	
Title of Invention	MICROCONNECTOR WITH A MULTI-PURPOSE BOOT		

Signature:

NOTE: This Application Data Sheet must be signed in accordance with 37 CFR 1.33(b). **However, if this Application Data Sheet is submitted with the INITIAL filing of the application and either box A or B is not checked in subsection 2 of the "Authorization or Opt-Out of Authorization to Permit Access" section, then this form must also be signed in accordance with 37 CFR 1.14(c).**

This Application Data Sheet **must** be signed by a patent practitioner if one or more of the applicants is a **juristic entity** (e.g., corporation or association). If the applicant is two or more joint inventors, this form must be signed by a patent practitioner, **all** joint inventors who are the applicant, or one or more joint inventor-applicants who have been given power of attorney (e.g., see USPTO Form PTO/AIA/81) on behalf of **all** joint inventor-applicants.

See 37 CFR 1.4(d) for the manner of making signatures and certifications.

Signature	/Edward S. Jarmolowicz Reg. No. 47238/			Date (YYYY-MM-DD)	
First Name	E	Last Name	Jarmolowicz	Registration Number	47238
Additional Signature may be generated within this form by selecting the Add button.					

Abstract:

An optical connector holding two or more LC-type optical ferrules is provided. The optical connector includes an outer body, an inner front body accommodating the two or more LC-type optical ferrules, ferrule springs for urging the optical ferrules towards a mating connection, and a back body for supporting the ferrule springs. The outer body and the inner front body are configured such that two optical connectors having four LC-type optical ferrules are accommodated in a small form-factor pluggable (SFP) transceiver footprint or at least two optical connectors having eight LC-type optical ferrules are accommodated in a quad small form-factor pluggable (QSFP) transceiver footprint. A mating component (transceiver or adapter) includes a connector hook and a housing with an opening that accommodates the connector hook in a flexed position as the optical connector makes connection with the mating component by introducing the connector hook into an optical connector hook recess.

Claims:

1. In an optical connector holding two or more LC-type optical ferrules having an outer body, an inner front body accommodating the two or more LC-type optical ferrules, ferrule springs for urging the optical ferrules towards a mating connection, and a back body for supporting the ferrule springs, the improvement comprising configuring the outer body and the inner front body such that two optical connectors having four LC-type optical ferrules are accommodated in a small form-factor pluggable (SFP) transceiver footprint.

2. In an optical connector holding two or more LC-type optical ferrules having an outer body, an inner front body accommodating the two or more LC-type optical ferrules, ferrule springs for urging the optical ferrules towards a mating connection, and a back body for supporting the ferrule springs, the improvement comprising configuring the outer body and the inner front body such that at least two optical connectors having a total of eight LC-type optical ferrules are accommodated in a quad small form-factor pluggable (QSFP) transceiver footprint.

3. An optical connector for holding two or more LC-type optical ferrules, comprising:

an outer housing having a longitudinal bore;

at least one inner front body received in the outer housing longitudinal bore, the inner front body supporting two LC-type optical ferrules, the inner front body comprising top and bottom portions with open sidewalls, the inner front body further comprising a connector hook recess configured to receive a connector hook from a mating component;

ferrule springs for urging the optical ferrules towards a mating connection; and

a back body for supporting the ferrule springs.

4. The optical connector of claim 3, further comprising a flap in the outer housing having a retainer on the inner side thereof for holding the front body to the outer housing.

5 5. The optical connector of claim 3 further comprising a wall in the front body for separating the ferrule springs from each other.

6. The optical connector of claim 3 further comprising a push-pull tab on the outer housing for inserting or removing the optical connector from a
10 mating component.

7. The optical connector of claim 6 wherein the push-pull tab includes a recess or a release hole for insertion of a finger or a release tool.

15 8. The optical connector of claim 3 wherein the inner front body includes an alignment tab for aligning with a receiving recess on the back body.

9. A network system comprising:
an optical connector including a connector hook recess;
20 a mating component including a connector hook and a housing, the housing including a connector hook opening that accommodates the connector hook in a flexed position as the optical connector makes connection with the mating component by introducing the connector hook into the optical connector hook recess.

25 10. The network system of claim 4 wherein the mating component is an adapter.

30 11. The network system of claim 4 wherein the mating component is a transceiver.

MICRO CONNECTOR WITH A MULTI-PURPOSE BOOT

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5 **Cross Reference to Related Applications:**

[1] NONE

10 **Field of the Invention:**

[2] The present disclosure relates generally to ultra-small form factor optical connectors, termed "micro optical connectors," and related connections within adapters and optical transceivers.

15 **Background:**

[3] The prevalence of the Internet has led to unprecedented growth in communication networks. Consumer demand for service and increased competition has caused network providers to continuously find ways to improve quality of service while reducing cost.

20 [4] Certain solutions have included deployment of high-density interconnect panels. High-density interconnect panels may be designed to consolidate the increasing volume of interconnections necessary to support the fast-growing networks into a compacted form factor, thereby increasing quality of service and decreasing costs such as floor space and support overhead. However, room for improvement in the area of data centers, specifically as it relates to fiber optic connects, still exists. For example, manufacturers of connectors and adapters are always looking to reduce the size of the devices, while increasing ease of deployment, robustness, and modifiability after deployment. In particular, more optical connectors may need to be accommodated in the same footprint previously used for a smaller number of connectors in order to provide backward compatibility with existing data center equipment. For example, one current footprint is known as the small form-factor pluggable transceiver footprint (SFP). This footprint currently accommodates two LC-type ferrule optical connections. However, it may be desirable to accommodate four optical connections (two duplex connections of transmit/receive) within the same footprint. Another current footprint is the quad small

form-factor pluggable (QSFP) transceiver footprint. This footprint currently accommodates four LC-type ferrule optical connections. However, it may be desirable to accommodate eight optical connections of LC-type ferrules (four duplex connections of transmit/receive) within the same footprint.

5 [5] In communication networks, such as data centers and switching networks, numerous interconnections between mating connectors may be compacted into high-density panels. Panel and connector producers may optimize for such high densities by shrinking the connector size and/or the spacing between adjacent connectors on the panel. While both approaches may be effective to increase the panel connector density,
10 shrinking the connector size and/or spacing may also increase the support cost and diminish the quality of service.

 [6] In a high-density panel configuration, adjacent connectors and cable assemblies may obstruct access to the individual release mechanisms. Such physical obstructions may impede the ability of an operator to minimize the stresses applied to the
15 cables and the connectors. For example, these stresses may be applied when the user reaches into a dense group of connectors and pushes aside surrounding optical fibers and connectors to access an individual connector release mechanism with his/her thumb and forefinger. Overstressing the cables and connectors may produce latent defects, compromise the integrity and/or reliability of the terminations, and potentially cause
20 serious disruptions to network performance.

 [7] While an operator may attempt to use a tool, such as a screwdriver, to reach into a dense group of connectors and activate a release mechanism, adjacent cables and connectors may obstruct the operator's line of sight, making it difficult to guide the tool to the release mechanism without pushing aside the adjacent cables. Moreover, even
25 when the operator has a clear line of sight, guiding the tool to the release mechanism may be a time-consuming process. Thus, using a tool may not be effective at reducing support time and increasing the quality of service.

Brief Description of the Drawings:

30 [8] FIG. 1A is a perspective view of a prior art standard 6.25mm pitch LC connector SFP;

[9] FIG. 1B is a perspective view of a prior art standard 6.25mm pitch LC adapter;

[10] FIG. 1C is a top view of the prior art adapter of FIG. 1B;

5 [11] FIG. 1D is a front view of the prior art adapter of FIG. 1B, showing the 6.25mm pitch;

[12] FIG. 2A is a perspective view of a prior art LC duplex connector;

[13] FIG. 2B is a perspective view of a prior art LC duplex connector with a remote release pull tab;

10 [14] FIG. 2C is a top view of a prior art LC connector used in the embodiments shown in FIGS. 2A and 2B;

[15] FIG. 2D is a side view of the prior art LC connector of FIG. 2C;

[16] FIG. 3 is an exploded view of one embodiment of a CS connector;

[17] FIG. 4 is a perspective view of one embodiment of a CS connector;

15 [18] FIG. 4B is a perspective view of one embodiment of a CS connector with the outer housing removed from the front body;

[19] FIG. 5 is a perspective view of one embodiment of a CS connector;

[20] FIG. 5B is a perspective view of one embodiment of a CS connector with the outer housing removed from the front body;

20 [21] FIG. 5C is a perspective view of one embodiment of a CS connector with a MPO ferrule assembly;

[22] FIG. 5D is a perspective view of another embodiment of multiple CS connectors ganged into a duplex outer housing;

[23] FIG. 5E is a perspective of FIG. 5D the boot and cabling ganged together;

25 [24] FIG. 6 is a perspective view of one embodiment of a duplex CS connector;

[25] FIGS. 6B and 6C are a side view and perspective view of another embodiment of a CS connector;

[26] FIG. 7 is a perspective view of another embodiment of a duplex CS connector;

30 [27] FIG. 8 is a perspective view of one embodiment of a quad CS connector;

[28] FIG. 9 is another perspective view of one embodiment of a quad CS connector;

[29] FIG. 10 is a perspective view of another embodiment of a quad CS connector;

5 [30] FIG. 11 is a perspective view of multiple CS connectors inserted into an adapter;

[31] FIG. 11B is a side view of a CS connector fully inserted into an adapter;

[32] FIG. 11C is a side view of a CS connector being removed from an adapter;

10 [33] FIG. 12 illustrates the interchangeable use of CS connector front bodies with simplex, duplex and quad adapters;

[34] FIG. 13 further illustrates the interchangeable use of CS connector front bodies with simplex and duplex adapters;

15 [35] FIGS. 14-C are illustrative examples of cable management using various embodiments of CS connectors;

[36] FIG. 15-B are illustrative examples of cable management using multiple fiber strands per jacket;

[37] FIG. 16 is an illustrative example of using a cable management system using multiple fiber strands per jacket.

20 [38] FIG. 17 is another illustrative example of using a cable management system using multiple fiber strands per jacket.

[39] FIG. 18 is a perspective view of CS connectors in an adapter connector to a transceiver housing according to an embodiment of a CS connector and transceiver system;

25 [40] FIG. 19 is an exploded view of a transceiver housing;

[41] FIG. 19B is an exploded view of an alternative embodiment of a CS connector and transceiver system;

[42] FIG. 20 is a cross-section view of another embodiment of a CS connector partially inserted in an adapter housing;

30 [43] FIG. 21 is an exploded view of a micro optical connector according to an embodiment.

[44] FIG. 21B is a perspective view of the assembled micro optical connector of FIG 21.

[45] FIG. 22 is a front view of the micro optical connector of FIG. 21B showing overall connector dimensions and ferrule pitch.

5 [46] FIG. 23 is a cross-sectional view of the micro optical connector of FIG. 21B latched into the adapter of FIG. 24.

[47] FIG. 23B is a cross-sectional view of the micro optical connectors of FIG. 21B unlatched from the adapter of FIG. 24.

10 [48] FIG. 24 is an exploded view of an adapter for the micro optical connectors of FIG. 21B.

[49] FIG. 25 is a cross-sectional view of the adapter of FIG. 24, assembled.

[50] FIG. 25B is a cross-sectional side view of the adapter housing of FIG. 24.

[51] FIG. 26 is a front view of the assembled adapter of FIG. 24.

15 [52] FIG. 27 is an isometric view of the front body of the micro optical connector of FIG. 21.

[53] FIG. 27B is a right side view of the front body of FIG. 27.

[54] FIG. 28 is an isometric view of the back body of the micro optical connector of FIG. 21.

20 [55] FIG. 28B is a side view of the back body of FIG. 28.

[56] FIG. 29 is an isometric view of the outer housing of the micro optical connector of FIG. 21.

[57] FIG. 29B is a front view of the outer housing of FIG. 29.

25 [58] FIG. 29C is a cross-sectional view of the outer housing of FIG. 29 showing the top of an orientation protrusion.

[59] FIG. 29D is an inner view of the outer housing of FIG. 29;

[60] FIG. 30 is a side view of an adapter hook of the adapter of FIG. 24.

[61] FIG. 31 is an isometric view of the adapter of FIG. 24 assembled with the micro optical connectors of FIG. 21B.

30 [62] FIG. 32 is cross-sectional view of an adapter showing a latch gap.

[63] FIG. 32B is a cross-sectional view of the micro optical connector of FIG. 21B latched (left) and unlatched (right) within the adapter of FIG. 24, assembled.

[64] FIG. 33 depicts the micro optical connector of FIG. 21B in a QSFP footprint, depicting dimensions in millimeters.

5 [65] FIG. 33B depicts the micro optical connectors of FIG. 21B in an SFP footprint, depicting dimensions in millimeters.

[66] FIG. 34-34C depicts adapter hooks interacting with the micro optical connectors of FIG. 21B before (FIG. 34), during (FIG. 34B), and after (FIG. 34C) latching.

10 [67] FIG. 35-35C depicts the micro optical connector of FIG. 21B side flap operation before (FIG. 35), during (FIG. 35B), and after (FIG. 35C) latching.

[68] FIG. 36 depicts plural micro optical connectors in a transceiver.

[69] FIG. 36B is a perspective view of a connector installed in a transceiver;

[70] FIG. 36C is a front view of the transceiver of FIG. 36;

15 [71] FIG. 37 is an exploded view of a micro optical connector according to a further embodiment.;

[72] FIG. 38 is an isometric view of a front body of the micro optical connector of FIG. 37;

[73] FIG. 39 is an isometric view of a back body of the micro optical connector of FIG. 37;

20 [74] FIGS. 40, 40B, and 40C depict a technique for reversing polarity of the optical connector of FIG. 37;

[75] FIG. 41 is an exploded view of a micro optical connector according to a further embodiment;

25 [76] FIG. 42 is an isometric view of the front body of the micro optical connector of FIG. 41;

[77] FIG. 42B is a side view of the front body of FIG. 42;

[78] FIG. 43 is an isometric view of the back body of the micro optical connector of FIG. 41;

30 [79] FIGS. 44, 44B, and 44C are isometric views of the outer housings that may be used with any of the micro optical connectors of FIGS. 21, 37, and 41;

[80] FIG. 45 is an exploded view of an adapter according to a further embodiment;

[81] FIG. 46 is a cross-section of the adapter of FIG. 45, assembled;

5 [82] FIG. 47 is an exploded view of a connector according to another embodiment;

[83] FIG. 48 is an isometric view of the back body and the back post of the connector of FIG. 47;

[84] FIG. 49 is a cross-section of the back post of FIG. 47 assembled with optical fibers;

10 [85] FIG. 50 is a front view of the connector of FIG. 47;

[86] FIG. 51 is an isometric view of the boot of the connector of FIG. 47;

[87] FIG. 52 is a perspective view with a partial cutout illustrating the CS connector of FIG. 52C fully inserted in the adapter of FIG. 52B;

15 [88] FIG. 52B is a perspective view with a top portion removed illustrating the internal structure of an embodiment of an CS configured adapter;

[89] FIG. 52C is a side view of a CS connector according to another embodiment, the CS connector pull tab is partially lifting connector structure;

[90] FIG. 52D is a side view of the CS connector of FIG. 52C in its original position biased forward;

20 [91] FIG. 52E is a perspective view of an embodiment of the CS connector with its pull tab removed illustrating a change in polarity for the CS connector;

[92] FIG. 53 is another embodiment of a CS micro connector having a duplex dust cover attached at a proximal end;

[93] FIG. 53B is a perspective view of the outer housing of FIG. 53;

25 [94] FIG. 53C is a cross section side view of the micro connector of FIG. 53;

[95] FIG. 53D is an end view of a plural of FIG. 53 micro connectors illustrating the offset alignment tab between two or more micro connec

[96] FIGS. 54-54D illustrate polarity changing according to an embodiment of the present invention for a CS connector of FIG. 53;

30 [97] FIG. 55 illustrates the embodiment of inserting a CS connector of FIG. 53 into an adapter of FIG. 57;

[98] FIG. 56 is a perspective view of an embodiment of an adapter without a similar adapter alignment assembly of FIG. 24;

[99] FIG. 57 is a perspective view of an embodiment of an adapter with a similar adapter alignment assembly of FIG. 24 inserted therein;

5 [100] FIG. 58 is a perspective view of an embodiment of an adapter of FIG. 57 with a CS connector of FIG. 53 inserted therein;

[101] FIG. 59 is a perspective view of an embodiment of an adapter of FIG. 57 with a four CS connectors of FIG. 53 inserted therein further illustrating a mating of CS connector outer housing structure;

10 [102] FIGS. 60-60B is a top perspective view of FIG. 59 with a cutout view (FIG. 60B) of mating of CS connector structure;

[103] FIG. 61 is a perspective view of another embodiment of a front body;

[104] FIG. 62 is a perspective view of another embodiment of an adapter alignment assembly of FIG. 24;

15 [105] FIG. 63 is a perspective view of another embodiment of a back body;

[106] FIG. 64 is a perspective view of a crimp ring assembly according to an embodiment of the present invention;

[107] FIG. 64B is a perspective view of a boot according to an embodiment of the present invention;

20 [108] FIG. 65 is a perspective view of uni-dustcover according to an embodiment of the present invention;

[109] FIG. 65B is a perspective view of a duplex dust cover according to an embodiment of the present invention;

25 [110] FIG. 66 is a side of a micro connector disclosed herein inserted into an adapter on the top, and a behind the wall (BTW) micro connector inserted into an adapter according to the present invention;

[111] FIG. 67 is a first embodiment of the BTW micro connector prior to insertion and partially inserted into an adapter according to the present invention;

30 [112] FIG. 68 is another embodiment of a BTW micro connector inserted into an adapter, before insertion into the adapter, and with a ferrule assembly removed comprising a ferrule flange, spring and ferrule;

[113] FIG. 69 is a perspective view of FIG. 68 looking into a plural of adapter receptacles, a first receptacle having a ferrule assembly inserted therein, a second receptacle having a BTW micro connector fully inserted therein, and a third receptacle just prior to insertion of a BTW micro connector according to the present invention;

5 [114] FIG. 70 is a top, rear view of FIG. 69, illustrating a pair of ferrule assembly position vertical outside the BTW micro connector without a housing;

[115] FIG. 71 is a perspective view a second embodiment of a BTW micro connector showing a plural of adapter receptacles with connectors inserted therein, and the BTW micro connector prior to insertion into a receptacle according to the present invention;

10 [116] FIG. 72 is a perspective view of the first BTW micro connector showing a plural of adapter receptacles with connectors inserted therein, and the BTW micro connector prior to insertion into a receptacle according to the present invention;

15 [117] FIG. 73 is a perspective view of the second BTW micro connector just prior to insertion into an adapter receptacle, and BTW connectors inserted into the adapter according to the present invention, and

[118] FIG. 74 is a perspective view of the first BTW micro connector inserted into a plural of adapter receptacles according to the present invention.

20 [119] FIG. 75A is a perspective view of a group of micro connectors similar to FIG. 53B.

[120] FIG. 75B is a perspective view of FIG. 75A illustrating the configuration of FIG. 60B.

[121] FIG. 76 is a perspective top view of a group of micro connectors with a push/pull tab similar to the connector of FIG. 37.

25 [122] FIG. 77 is a perspective view of a micro connector similar to FIG. 37.

[123] FIG. 78 is a perspective view of a group of micro connectors of FIG. 76 with a removal tool attached at a distal end of the connectors pull/push tab.

[124] FIG. 79.1 is perspective top view of a group of micro connectors similar to FIG. 76 just prior to the insertion of a removal tool shown fully inserted at FIG. 68.

30 [125] FIG. 79.2 is a perspective view of a removal tool according an embodiment of the present invention.

[126] FIG. 79.3 is a perspective top view of the removal tool of FIG. 79.2 inserted at a distal end of the group of micro connectors as shown in FIG. 79.1

[127] FIG. 80 is a top perspective view of a group of micro connectors with an alternative push/pull tab configured to accept a removal tool according to an embodiment of the present invention.

[128] FIG. 81 is a cut away view of the removal tool of FIG. 78 and FIG. 79.2 inserted on a distal end of a push/pull tab of a micro connector.

[129] FIG. 82 is a top perspective view of another embodiment of a removal tool attached to a distal end of a push/pull tab of a group of micro connectors.

[130] FIG. 83 is a cut away view of the removal tool of FIG. 82 attached to a distal end of a push/pull tab of a micro connector of the present invention.

[131] FIG. 84 is a top perspective view of another embodiment of a removal tool attached to a distal end of a push/pull tab of a group of micro connectors.

[132] FIG. 85A is a cut away view of the removal tool of FIG. 84, the removal tool is in an unlocked position attached to a distal end of a push/pull tab of a micro connector of the present invention.

[133] FIG. 85B is a cut away view of the removal tool of FIG. 84 in a locked position attached to a distal end of a push/pull tab of a micro connector for removal thereof according to the present invention.

[134] FIG. 86 is a top perspective view of another embodiment of a removal tool attached to a distal end of a push/pull tab of a group of micro connectors.

[135] FIG. 87A is a cut away view of the removal tool prior to an unlocked position to unlock a micro connector with the removal tool of FIG. 86

[136] FIG. 87B is a cut away view of the removal tool locking a micro connector using the removal tool of FIG. 86.

[137] FIG. 88 is a perspective view of the removal tool of FIG. 86 with removal tool release arms in an asymmetric layout.

[138] FIG. 89A is a perspective view of a plural of micro connectors without a removal tool of FIG. 89C attached at a distal end of the connectors.

[139] FIG. 89B is a perspective view of the removal tool of FIG. 89C inserted at a distal end of a group of micro connectors.

[140] FIG. 89C is a perspective view of another embodiment of a removal tool.

[141] FIG. 89D is a cross section of the removal tool inserted into recesses at a distal end of the micro connectors.

[142] FIG. 90A is a perspective view of another embodiment of a removal tool.

5 [143] FIG. 90B is a perspective view of the removal tool of FIG. 90A attached to a distal end of a micro connector.

[144] FIG. 90C is a perspective view of a group of micro connectors including the removal tool of FIG. 90A attached as shown in FIG. 90B.

10 [145] FIG. 91A is a perspective view of a micro connector with a push/pull boot and rotatable boot for polarity changing.

[146] FIG. 91B is a perspective view of a multi-purpose boot with an alignment and offset key releasable attached.

15 [147] FIG. 92A is a perspective view of an outer housing of the micro connector of FIG. 91 showing how a multi-purpose boot assembly is inserted at a distal end (arrow I) and secured to the outer housing.

[148] FIG. 92B is a perspective view of a multi-purpose boot assembly.

[149] FIG. 93A is a perspective view of the micro connector of FIG. 91 with a multi-purpose boot prior to rotating to change polarity of the connector in a first polarity position.

20 [150] FIG. 93B is a perspective view of the connector of FIG. 93A partially rotated in the direction "R".

[151] FIG. 93C is a perspective view of the connector of FIG. 93B further rotated in direction "R".

25 [152] FIG. 93D is a perspective view of the connector of FIG. 93A in a second polarity position.

[153] FIG. 94 is side view of the connector of FIG. 91 with a cross section cut "A-A".

[154] FIG. 94A is a view along cross section cut "A-A" of the connector of FIG. 91 in a first polarity change position.

30 [155] FIG. 94A.1a is an end view of the boot assembly illustrating an opening for fiber optic cabling.

[156] FIG. 94A.1b is a perspective view of end of a back body, with fiber optic cabling, configured to accept FIG. 94A.1a boot opening.

[157] FIG. 94B is perspective view along cross section "A-A" at a start of boot rotation to change a micro connector from a first polarity to a second polarity.

5 [158] FIG. 94C.1 is perspective view along cross section "A-A" in furtherance of boot rotation to change a micro connector from a first polarity to a second polarity.

[159] FIG. 94C.2 is a perspective view of micro connector FIG. 91 in furtherance of boot rotation as shown in FIG. 94C.1.

10 [160] FIG. 94D.1 is a perspective view along cross section "A-A" just prior to completion to a second polarity of FIG. 91 micro connector.

[161] FIG. 94D.2 is a perspective view of micro connector FIG. 91 in just prior to completion to a second polarity of FIG. 91 micro connector.

[162] FIG. 94E is a perspective view along cross section "A-A" of micro connector FIG. 91 in a second polarity position.

15 [163] FIG. 95 is a perspective view of an alignment tab releasably attached to a multi-purpose boot of micro connector of FIG. 91.

[164] FIG. 96 is a perspective view of an alignment and offset tab releasably attached to a multi-purpose boot of the micro connector of FIG. 91.

20 [165] FIG. 97 is a perspective view of a removal clip with an offset releasably attached to a multi-purpose boot of micro connector of FIG. 91.

[166] FIG. 97.1 is perspective view of a clip of FIG. 97 attached to a plural of FIG. 91 multi-purpose boot of a micro connector of FIG. 91 secured to an adapter hook assembly of FIG. 24.

25 [167] FIG. 98 is a perspective view of a removal clip releasably attached to a multi-purpose boot of micro connector of FIG. 91.

[168] FIG. 99 is a perspective end view of a plural of micro connector of FIG. 91 inserted into an adapter similar to FIG. 97.1 with a cross section "B-B".

30 [169] FIG. 100A is a perspective view along cross section "B-B" of a micro connector of FIG. 91, latched into an adapter receptacle of similar to FIG. 24 with multi-purpose boot pushed in fully forward position.

[170] FIG. 100B is a perspective view along cross section "B-B" of a micro connector of FIG. 91 as multi-purpose boot (FIG. 92B) is partially pulled in direction "p".

5 [171] FIG. 100C is a perspective view along cross section "B-B" of a micro connector of FIG. 91 as multi-purpose boot (FIG. 92B) is release from adapter hook but still under influence of pulling force "P".

[172] FIG. 101 is an exploded view of another embodiment of a micro connector with a releasably attached clip defining a first and a second polarity.

10 [173] FIG. 101A is an assembly view of the micro connector of FIG. 101 in a first polarity.

[174] FIG. 101B is an assembled view of the micro connector of FIG. 101 in a second polarity.

15 [175] FIG. 102A is an assembled view of a plural of micro connectors with a removal clip attached to multi-purpose boot and inserted into an adapter similar to FIG. 24.

[176] FIG. 102B is the perspective view of FIG. 102A with the adapter housing removed.

[177] FIG. 103A is a perspective view of a flexible cable with an alignment and offset tab of FIG. 91 attached at a proximal end of a multi-purpose boot of FIG. 92B.

20 [178] FIG. 103B is a perspective view of a flexible cable in a flexed position with an alignment and offset tab of FIG. 91 attached at a proximal end of a multi-purpose boot of FIG. 92B.

Detailed Description:

5 [180] 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.

10 [181] 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.”

15 [182] The following terms shall have, for the purposes of this application, the respective meanings set forth below.

20 [183] A connector, as used herein, refers to a device and/or components thereof that connects a first module or cable to a second module or cable. The connector may be configured for fiber optic transmission or electrical signal transmission. The connector may be any suitable type now known or later developed, such as, for example, a ferrule connector (FC), a fiber distributed data interface (FDDI) connector, an LC connector, a mechanical transfer (MT) connector, a square connector (SC) connector, an SC duplex connector, or a straight tip (ST) connector. The connector may generally be defined by a connector housing body. In some embodiments, the housing body may incorporate any or all of the components described herein.

25 [184] A “fiber optic cable” or an “optical cable” refers to a cable containing one or more optical fibers for conducting optical signals in beams of light. The optical fibers can be constructed from any suitable transparent material, including glass, fiberglass, and plastic. The cable can include a jacket or sheathing material surrounding the optical fibers. In addition, the cable can be connected to a connector on one end or on
30 both ends of the cable.

[185] Various embodiments described herein generally provide a remote release mechanism such that a user can remove cable assembly connectors that are closely spaced together on a high density panel without damaging surrounding connectors, accidentally disconnecting surrounding connectors, disrupting transmissions through surrounding connectors, and/or the like. Various embodiments also provide narrow pitch LC duplex connectors and narrow width multi-fiber connectors, for use, for example, with future narrow pitch LC SFPs and future narrow width SFPs. The remote release mechanisms allow use of the narrow pitch LC duplex connectors and narrow width multi-fiber connectors in dense arrays of narrow pitch LC SFPs and narrow width multi-fiber SFPs.

[186] FIG. 1A shows a perspective view of a prior art standard 6.25mm pitch LC connector SFP 100. The SFP 100 is configured to receive a duplex connector and provides two receptacles 102, each for receiving a respective LC connector. The pitch 104 is defined as the axis-to-axis distance between the central longitudinal axes of each of the two receptacles 102. FIG. 1B shows a perspective view of a prior art standard 6.25 mm pitch LC adapter 106. The adapter 106 is also configured to receive a duplex connector, and provides two receptacles 108, each for receiving a respective LC connector. FIG. 1C is a top view of the adapter 106 of FIG. 1B. The pitch of the adapter 106 is defined similarly to that of the SFP 100, as the axis-to-axis distance between the central longitudinal axes of each of the two receptacles 108, as illustrated in FIG. 1D, which shows a front view of the adapter 106.

[187] FIG. 2A shows a prior art LC duplex connector 200 that may be used with the conventional SFP 100 and the conventional adapter 106. The LC duplex connector 200 includes two conventional LC connectors 202. FIG. 2B shows another prior art LC duplex connector 204 having a remote release pull tab 206, and including two conventional LC connectors 208. As shown, the remote release pull tab includes two prongs 210, each configured to couple to the extending member 212 of a respective LC connector 208. FIGS. 2C and 2D show top and side views, respectively, of the conventional LC connector 208, having a width of 5.6 mm, and further showing the extending member 212.

[188] As discussed herein, current connectors may be improved by various means, such as, for example, reducing the footprint, increasing the structural strength, enabling polarity changes, etc. Various embodiments disclosed herein offer improvements over the current state of the art, as will be further discussed below.

5 [189] In some embodiments, as shown in FIG. 3, a CS connector 300 may comprise various components. Referring to FIG. 3, an illustrative embodiment of a CS connector 300 is shown in an exploded view to display detail. In some embodiments, and as discussed further herein, a CS connector 300 may have an outer housing 301, a front body 302, a latch 301.2 one or more ferrules 303, one or more ferrule flanges 304, one or
10 more springs 305, a back body 306, a back post 307, a crimp ring 308, and a boot 309. In some embodiments, the back body 306 may comprise one or more protrusions 306.1 which may interlock with a window/cutout 319 for backbody protrusion 306.1 in the front body 302. This may allow for the back body 306 and the front body 302 to be securely fastened together around the ferrule(s) 303, ferrule flange(s) 304, and the
15 spring(s) 333.

[190] Referring now to FIG. 4, an embodiment is shown wherein the CS connector 400 is assembled. In some embodiments, the assembled CS connector may have an outer housing 401, a front body 402, one or more ferrules 403, one or more ferrule flanges (not shown), one or more springs (not shown), a back body 406, a back
20 post (not shown), a crimp ring (not shown), a boot 409, and a push-pull tab 410.

[191] In some embodiments, the CS connector may have one or more latching mechanisms made up of a window 412 on the outer housing 401 near the push-pull tab 410 and a protrusion 413 on the front body. The latching mechanism made up of the window 412 and protrusion 413 securely attaches the outer housing 401 to the front body
25 (not shown). In a further embodiment, the outer housing 401 may have a catch 401.2a to receive a locking tab or latch 401.2 attached to the outer housing 401. The latch 401.2 of the outer housing 401 is used to interlock with the pull tab 410 to release the CS connector 400 from and to an adapter (not shown). As would be understood by one skilled in the art, the push-pull tab 410 enables removal of the CS connector from the
30 adapter without requiring additional tools.

[192] As shown in FIG. 4B, in some embodiments, the latching mechanism of the CS connector 400 with the outer housing 401 may be made up of two main parts: a window 412 and one or more protrusions 413. As illustrated in FIG. 4B, the outer housing 401 can slide on to or be removed from the front body 402 by disengaging the latching mechanisms formed by the protrusion 413 exiting through the window, whereby it contacts a rear wall of the window (refer to FIG. 4 for an illustrated example of the outer housing being attached to the front body via the latching mechanism). In some embodiments, the push-pull tab 410 may be permanently attached to the outer housing 401, as shown.

[193] In a further embodiment, the front body 402 may be removed from the outer housing 401, rotated 180° as indicated by arrow 420, and re-inserted into the outer housing. This allows for a change in the polarity of the front body 402, as shown by the arrow diagram in FIG. 4, and therefore the ferrules can switch quickly and easily without unnecessarily risking the delicate fiber cables and ferrules.

[194] Referring now to FIG. 5, an embodiment is shown wherein the CS connector 500 is assembled. In some embodiments, the assembled CS connector may have an outer housing 501, a front body 502, one or more ferrules 503, one or more ferrule flanges (not shown), one or more springs (not shown), a back body 506, a back post (not shown), a crimp ring (not shown), a boot 509, and a push-pull tab 510. A window or cutout 512 captures a protrusion 513 on the front body 502 to lock the front body within the outer housing 510. A pull tab 510 is integrated with the outer housing 501 that upon pulling away from the proximal end or the ferrule 503 end of the connector, a recess 511 releases a latch or hook (not shown) on the adapter (not shown) to allow the user to remove the connector 500 from an adapter.

[195] Referring to FIG. 5B, and unlike FIG. 4B, the polarity change mechanism is the removal of the front body 502 from within the outer housing 501 by depressing the protrusion 513 through the window 512, and pulling on the pull tab 510 in a distal or rearward direction. The front body is then rotated in the direction of the arrow 520 (or in the opposite direction of the arrow without departing from the scope of the present invention), and the front body is then reinserted into an opening at the distal end of the outer housing until the protrusion 513 is seated within the window 512 thereby

locking the front body 502 into the outer housing 501 forming the CS connector with an opposite polarity.

5 [196] The polarity of a connector is the relative location of the Tx (transmit signal fiber path) and the Rx (read signal fiber path) when inserted into a fixed adapter. The fiber optic pathways are formed within a ferrule 503, with one fiber per a ferrule.

10 [197] Referring FIG. 5C another embodiment of a CS connector 400 is disclosed. The ferrule assembly or LC type assembly of FIG. 5 is replaced with a MPO ferrule assembly 570 with four fiber optic pathway. The MPO ferrule assembly can have any number of fiber optic pathways contained therein without departing from the scope of the present invention. Any one of the LC type ferrule assemblies of the disclosed CS connectors including but not limited to FIGS. 3, 4 and 5 may be replaced with the MPO fiber optic assembly 570 without departing from the scope of the present invention. Referring to FIGS. 5D and 5E, the connector assembly 540 has a dual boot 509 each with a corresponding backbody 506 housing and the boot and backbody are ganged or
15 combined into one boot and cable (refer to FIG. 15B) in FIG. 5E to reduce overall duplex connector assembly width. The figure numbers in 5D and 5E correspond to FIGS. 5 and 5B.

20 [198] In some embodiments, it may be beneficial to connect two or more CS connectors together to increase structural integrity, reduce the overall footprint, and cut manufacturing costs. Accordingly, as shown in FIG. 6, a CS connector 600 may in some embodiments, utilize an outer housing 601 that is capable of holding two front bodies 602. Various other embodiments are disclosed herein, and it should be noted that the embodiments disclosed herein are all non-limiting examples shown for explanatory purposes only.

25 [199] Accordingly, although the embodiment shown in FIG. 6 utilizes a duplex outer housing 601, additional or alternative embodiments may exist with more capacity. As shown in FIG. 6, in some embodiments, the outer housing 601 may accept two front bodies 602, each with two separate ferrules 603. As shown, the front body(s) 602 may securely fasten to the outer housing 601 via the latching mechanism 612 and 613. In
30 additional embodiments, the push-pull tab 610 may be modified, as shown, such that a single tab can be used to free the two or more CS connectors from an adapter. The pull

tab 610 further comprises a catch 601.2a that depresses latches 601.2, in the direction of the arrow, when the pull tab is retracted distally or rearward. As illustrated in FIG. 6, the uni-body push-pull tab 610 and the outer housing 601 may have two windows 612 with which to receive multiple protrusions 613 of the front body(s) 602. As discussed herein the recesses 611 of the outer housing 601 are used to secure the CS connectors to an adapter (not shown). In one or more further embodiments, the CS connectors may have individual back bodies 606 and boots 609 (i.e., one back body/boot per front body) as shown.

[200] Referring FIG. 6B is another embodiment of a CS connector with a different release mechanism. The pull tab 610 is integrated to the latch 601.2 that when the tab 610 is pulled rearward, the latch 601.2 is pulled downward releasing it from a corresponding structure located within an adapter (not shown). The latch 601.2 is attached to the latch 601.2,

[201] Alternatively, in some embodiments, such as that shown in FIG. 7, the CS connector 700 may have a single boot 709 and a duplex (i.e., uni-body) back body 706 instead of individual back bodies (e.g., such as shown in FIG. 6). In some embodiments, the duplex back body 706 may have different dimensions than that of the individual back bodies of FIG. 6, such as, for example, they may be longer to accommodate the need for routing the fiber after it exits the boot 709. As with other embodiments discussed herein, the CS connector shown in FIG. 7 may also include an outer housing (e.g., duplex outer housing) 701, one or more ferrules 703, at least one latching mechanism formed by the protrusion (not shown) exiting through one or more windows 712, and a push-pull tab 710 engaging a plural of latches 701.2. The boot 709 is a single boot rather than a pair of boots as shown in FIG. 6, to reduce the overall width of the CS connector and to help reduce cabling entanglement.

[202] As stated, it may be beneficial to connect two or more CS connectors together to increase structural integrity, reduce the overall footprint, and cut manufacturing costs. Accordingly, similar to FIG. 6, FIG. 8 shows a CS connector 800 that may, in some embodiments, utilize an outer housing 801 that is capable of holding multiple (e.g., four) front bodies 802.

[203] As shown in FIG. 8, some embodiments may have an outer housing 801 able to accept up to four front bodies 802, each with one or more ferrules 803. As shown, each front body 802 may securely fasten to the outer housing 801 via the latching mechanism 812 and 813. In additional embodiments, the push-pull tab 810 may be modified such that a single tab can be used to free the up to four SC connectors from an adapter. As illustrated in FIG. 8, the push-pull tab 810 may depress a plural of four latches 801.2, which as discussed herein are used to secure the connector to an adapter (not shown). In one or more further embodiments, the SC connectors may have individual back bodies 806 and boots 809 (i.e., one back body/boot per front body) as shown.

[204] Similar to FIG. 8, FIG. 9 shows an embodiment where the outer housing 901 is able to accept up to four front bodies 902, each with one or more ferrules 903. As shown, each front body 902 may securely fasten to the outer housing 901 via the latching mechanism 912 and 913. In additional embodiments, the push-pull tab 910 may be modified such that a single tab can be used to free the up to four CS connectors from an adapter. As illustrated in FIG. 9, the push-pull tab 910 may depress a plural of latches 901.2, which as discussed herein are used to secure the connector to an adapter (not shown). Unlike FIG. 8, an alternative embodiment, such as that shown in FIG. 9 maybe utilize a single back body 906 and a single boot 909 for the CS connector of FIG. 8. In one or more further embodiments, the CS connectors may have individual back bodies 906 and boots 909 (i.e., one back body/boot for all four front bodies) as shown. The backbody 906 may be reduced as shown in FIG. 10 1006 comprising a single boot 1009 that consolidates 909 boots, as shown in FIG. 10.

[205] Referring now to FIG. 10, various embodiments, as discussed herein, may exist such as adapter 1006 which receives a plural of connectors 300. The connector boots 309 are ganged into a single boot 1009. The pull tab 1010 depresses a plural of latches 1001.2 on connector 300 to release the connector 1000 from the adapter 1006. It should be understood by one skilled in the art that various other embodiments may exist that are not explicitly shown. For example, an adapter with the capacity for 5, 6, 7, 8, 9, 10 or more connectors may be utilized for various embodiments disclosed herein.

[206] Alternatively, in some embodiments the CS connector may utilize one or more duplex back bodies with a single boot, similar to that shown in FIG. 7. Thus, similar to FIG. 7, an embodiment may allow for a further reduced footprint, less cabling, and easier maintenance of the CS connector. Accordingly, one or more embodiments may have an outer housing that may accept up to four front bodies, each with one or more ferrules. In some embodiments, each front body may securely fasten to the outer housing via a latching mechanism. In additional embodiments, the push-pull tab may be modified such that a single tab can be used to free the up to four front bodies from an adapter. The push-pull tab may include four openings with which to receive multiple locking tabs of the outer housing. As discussed herein the locking tabs of the outer housing are used to secure the CS connectors to an adapter (not shown).

[207] In further embodiments, the CS connector may utilize a single uni-body back body with a single boot (i.e., that shown in FIG. 9). Thus, an embodiment may allow for a further reduced foot print, even less cabling, and easier maintenance of the CS connector. Accordingly, one or more embodiments may have an outer housing that may accept up to four front bodies, each with one or more ferrules. Each front body may securely fasten to the outer housing via the latching mechanism as discussed herein. In additional embodiments, the push-pull tab may be modified such that a single tab can be used to free up to four CS connectors from an adapter. The push-pull tab may include four openings with which to receive multiple locking tabs of the outer housing. As discussed herein the locking tabs of the outer housing are used to secure the SC connectors to an adapter.

[208] Referring to FIG. 11, a set of four CS connectors 400 are inserted into an adapter 1114. As discussed herein, and shown in FIG. 11B, an outer housing 1101 may comprise one or more recesses 1111. As discussed and shown herein, the one or more recesses may allow for an adaptor 1114 to securely connect to the connector 300. Accordingly, in some embodiments, the adapter 1114 may have an adapter hook 1115, which is flexible and can secure the connector 300 into the adapter via latching onto the wall of the recess 1111, as shown. This latching takes place when the outer housing 1101 is pushed forward into the adapter 1114. The sloped portions of the outer housing 1101

allow the adapter hook 1115 to slide up and over the front of the outer housing thereby securing the connector 300 into the adapter.

[209] Additionally or alternatively, in some embodiments, such as that shown in FIG. 11C, a connector 300 may be removed from an adapter 1114 by pulling the connector away from the adapter as indicated by the directional arrow. In some embodiments, the force may be applied by a user via the push-pull tab 1110. As shown in FIG. 11C, as the connector 300 is removed from the adapter 1114, the flexible adapter hooks 1115 separate and slide up the slope of the end of the connector and allow for removal of the connector from the adapter.

[210] Referring to FIG. 12 and FIG. 13 the interchangeable capability of the CS connectors described herein helps reduce configuration time. Referring to FIG. 12, a CS connector 400 similar to FIG. 5, is reconfigured to have its front body inserted into a duplex adapter 700 then reconfigured to be inserted into a quad adapter 900. Turning to FIG. 13, the front body 502 is removed from its outer housing 501 and converted from the duplex connector assembly 700 into two single connector assemblies 1100A. The user may mix and match CS connector embodiments without departing from the scope of the invention.

[211] Various benefits and details have been discussed herein with regard to the CS connectors and their modular ability (e.g., to include multiple connectors into a single unit). In addition to the reduced footprint, structural improvements, and cost reduction, various embodiments herein may also be beneficial with regard to reducing the burden of cabling in a data center environment. Illustrative embodiments shown in FIGS. 14 through 14C depict cable configurations that can be used to reduce the complexity of optical cables in a compact environment. Note that any of the optical connectors described in this disclosure may be used in these embodiments, including the micro optical connectors of FIGS. 21B, 37, and 41, to be discussed in detail below. FIG. 14 shows two duplex cables similar to the cable shown in FIG. 6. In some embodiments, one or more detachable clips 1401 may be attached to two or more zip cables to prevent the zip cables from splitting. This allows for two or more cables to be bundled and reduce the risk of entanglement with additional cables. FIG. 14B is an illustrative example of how easily an embodiment can separate into two individual CS connectors by unbinding the

cables and thus quickly and easily creating two independent fiber optic channels that can move independently. FIG. 14C shows an embodiment in which a duplex CS connector like that of FIGS. 6 and 14 is connected to two separate individual CS connectors.

5 [212] In addition to binding existing fiber cables, some embodiments herein may utilize a new four fiber zip cable. Referring now to FIG. 15, a conventional zip cable (i.e., one with a single fiber strand 1520 per jacket 1521) is shown in comparison with an embodiment in which two fibers 1522 per jacket 1523 are utilized. It should be understood that this is merely a non-limiting example. In some embodiments, multiple fibers may be included per jacket, such as, for example, four fibers per jacket in order to
10 utilize the single boot 909 and uni-body rear body 906 of the CS connector shown in FIG. 9.

 [213] A specific example using multi-strand cables is shown in FIG. 16 for illustrative purposes only. It should be understood that numerous alternatives and modifications are possible, such as, for example, that shown in FIGS. 18-18B and FIGS.
15 19-19D. As shown, a switch (e.g., 100G switch) 1630 is shown with a transceiver (e.g., 100G transceiver) 1631. The transceiver 1631 has an adapter to receive two mini CS duplex connectors 1632. From each of the two duplex connectors 1632, a four fiber cable 1633 extends to connect to various other connectors and transceivers. In some embodiments, as discussed herein, a clip (e.g., detachable clip) 1640 may connect two or
20 more cables (e.g., 1633) to ensure the zip cables do not come apart. As shown, one four fiber cable 1633 is split into two two-fiber cables 1634, which are then attached to a single CS simplex connector 1635 and placed into a transceiver (e.g., 25G transceiver) 1636. As further shown, one of the four fiber cables 1637 is connected to a single mini CS duplex connector 1638, which is then inserted into another transceiver (e.g., 50G
25 transceiver) 1639.

 [214] An additional or alternative embodiment is shown in FIG. 17. As shown, one or more switches (e.g., 400G switches) 1730 and 1732 are shown with a transceiver (e.g., 400G transceiver) 1731 and 1733. The first transceiver 1731 has an adapter that is receiving two mini CS simplex (single) connectors 1734 and one mini CS duplex (dual)
30 connectors 1735. From each of the two simplex connectors 1734, a two fiber cable 1736 extends to connect to various other connectors and transceivers. Similar to FIGS. 14 and

16, some embodiments may have a clip (e.g., detachable clip) 1740 that may connect two or more cables (e.g., 1736, 1738, etc.) to ensure the zip cables do not come apart. From the mini CS duplex connector 1735 a four fiber cable 1737 is split into two two-fiber cables 1738, which are then attached to a single CS simplex connector each and placed into a transceiver (e.g., 400G transceiver).

[215] Referring to FIG. 18, a transceiver containing a quad of CS connectors 2100 is shown 1800 assembled. The transceiver uses the same adapter structure (FIG. 24) to secure a CS connector therein. A transceiver converts the fiber optic signal to electrical signal for use by a computer system. An exemplary transceiver is shown in FIG. 36C. Referring to FIG. 19, a lower housing 1915 of the transceiver 1900 accepts an adapter alignment assembly 2446 and a fiber stub assembly 1967, where the stub assembly is attachable to the alignment assembly 2446. This is inserted into grooves located in the transceiver inner housing as shown. Referring to FIG. 19B, fiber optic stubs 1964 that are electrically connected to the computer network as inserted into the stub assembly 1967 via alignment sleeves 2448.

[216] Referring to FIG. 20, a cross section of a CS connector herein is partially inserted into the transceiver housing. The connector alignment key 2105 is partially within the transceiver housing 1915 when the connector front body 502 begins to engage connector hooks 2425 formed as part of the adapter alignment assembly 2446. This aids the user in orientating the connectors into the transceiver before latching begins.

[217] Accordingly, embodiments described herein allow for improvements over the current state of the art. By way of specific example, connectors generally have three types of fixed cables. Moreover, some cables may be bifurcated. As such, the cable cannot be split once installed and the polarity of the cables cannot be changed. Alternatively, the embodiments discussed herein may allow a user to change from a four way to a 2-Duplex, to a 4-simplex connector, etc. (e.g., FIGS. 12, 13). Moreover, as discussed herein, the individual CS connectors can be split into individual connectors anytime, even after deployment. Additionally, as discussed herein, the polarity can be changed within the CS connectors easily in a manner that does not risk damage to the one or more ferrules. It should also be noted, as discussed herein that CS connectors are used herein merely for simplicity purposes, and that various other connectors may be used in

any embodiment (e.g., an MT connector, such as that shown in FIGS. 5C, and the micro optical connectors of FIGS. 4, 5, 7, 21, 37, and 41).

5 [218] FIG. 21 depicts an embodiment of a micro optical connector 2100, shown in exploded view while FIG. 21B depicts the micro optical connector 2100 in an assembled view. Micro optical connector 2100 may include an outer housing 2101, a front body 2102, one or more ferrules 2103, one or more ferrule flanges 2124, one or more springs 2133, a back body 2106, a back post 2107, a crimp ring 2108, and a boot 2109. The outer housing 2101 may include a longitudinal bore for accommodating the front body 2102 and a ferrule 2103, springs 2133 and backbody 2106, a connector alignment key 2105 used during interconnection, a connector flap 2101.1 and an optional pull tab 2110 to facilitate removal of the connector 2100 when connected in a dense array of optical connectors. Optionally, the ferrules may be LC-type ferrules having an outer diameter of 1.25 mm.

15 [219] Referring to FIG. 21B, the proximal end of connector has a ramp 2150 that engages an adapter connector hook 2425 surface. A recess 2111 at the connector proximal end accepts the hook 2425 to secure the CS connector within the adapter 2400. A connector flap 2101.1 is configured to lock the front body 2102.

20 [220] In prior art optical connectors, an inner enclosed housing was used in place of open front body 2102. Front body 2102 includes top and bottom portions but no sidewalls, termed "open sidewalls" in this embodiment. By using front body 2102, space occupied by the prior art inner housing sidewalls becomes available to increase the density of optical connectors within a given footprint, an advantage over prior art connectors. It was determined by the present inventors that the outer housing 2101, combined with the front body 2102, provided sufficient mechanical strength and ferrule protection, advantageously providing the space for additional optical connectors. Removal of sidewalls increases available space by 1-2 millimeters.

25 [221] Note that, in this embodiment, the outer housing is configured to hold two optical ferrules 2103. Typically, two optical ferrules may be used in a "transmit" and "receive" pairing of optical fibers, called a duplex connector. However, the outer housing may be configured to hold more or fewer optical ferrules including a single optical ferrule, multiples of single optical ferrules, or multiple pairs of optical ferrules,

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depending upon the application. Further, the front body 2102 may be removed from the outer housing 2110 and the front body placed in a larger outer housing with other front bodies to form a larger optical connector in a manner to be discussed in more detail below. In particular, two front bodies may be used with a four-ferrule outer housing or
5 four front bodies may be used with an eight-ferrule outer housing.

[222] Referring to FIG. 22, CS connector front body 2102 is shown secured into the outer housing 2101. The outer dimensions of the assembled CS connector are shown as height 2297, width 2298 and ferrule pitch 2296.

[223] Referring to FIG. 23, a pair of CS connectors (300, 2100) as disclosed
10 herein are inserted on opposing sides into an adapter 2400. The connector hook 2425 is captured in a connector recess 2311 (refer to recess 511 at FIG. 5 or 2111 at FIG. 21). FIG. 23 call outs are directed to the front body 2102 and back body 2106 of the connector 2100. Referring to FIG. 23B, the connectors 2100 are partially withdrawn where the adapter assembly connector hook 2425 is out of the connector recess 2111.

[224] FIG. 24 shows an embodiment of an adapter used to secure one or more
15 CS connectors. Referring to FIG. 19, portions of the adapter structure disclosed herein are used with a transceiver 1900 to secure one or more of the connectors disclosed herein. The adapter 2400 comprises an adapter alignment assembly 2446 that is inserted into an adapter housing 2440 and secured therein by an adapter housing hook 2442 further
20 comprising an adapter housing hook face 2442b engaging with a corresponding adapter surface 4520 within the adapter housing 2440. Prior to insertion of the adapter assembly 2446, an alignment sleeve 2448 with a cutout 2449 is inserted into an alignment sleeve opening 2445a of an alignment sleeve holder 2445. The alignment sleeve cutouts 2449 allow the alignment sleeve to be compressed upon press fitting the sleeve into the sleeve
25 holder for a secure fit. The adapter housing 2440 has a row of connector hook openings 2443 and connector alignment slots 2447. The openings 2443 allow the connector hook 2425 to be displaced through the openings 2443 upon insertion of a connector 2100 into the adapter where the connector ramp 2150 engages and lifts up the connector hook 2425 through an opening 2443, and the hook 2425 then rests in a connector recess 2111 upon
30 full connector insertion. This operation secures a connector in the adapter and is shown in FIG. 34. The alignment slot 2447 engages a corresponding connector alignment key

2105 the ensure the connector is not inserted off-center and helps prevent the connector from getting stuck. The flex tab 2441 allows one to remove and secure the adapter 2400 within a rack (not shown) of adapter housings. Referring to FIG. 25, a cross section of the FIG. 24 illustrates the adapter alignment assembly 2446 without connectors inserted, the connector hooks 2425 are not protruding through the adapter connector hook openings 2443. Turning to FIG. 25, the corresponding adapter 2400 housing opening 2443 has a protrusion (refer to FIG. 45 at 4520) that engages an adapter housing 2442 hook to secure the adapter alignment assembly 2446 within the adapter 2400. FIG. 25B shows the adapter housing 2440 without the adapter alignment assembly 2446 inserted therein.

[225] Referring to FIGS. 28 and 28B isometric and side view of the back body 2106. The protrusion 2106.1 engages and locks in back body hook cutout 2119 that secures the back body to the front body 2102, and further compresses ferrule springs 2133 biasing the ferrules 2103 forward. A chamfer 2806.2 on the front portion of the protrusion 2106.1 allows for a smooth transition of the protrusion 2106 into the back body cutout 2119. The protrusion 2810 is used for molding purposes. The ferrule spring guides 2815 position the ferrule springs and accept the ferrule flange.

[226] Turning to FIGS. 29 and 29B isometric and front views of the outer housing 2101 are shown. As seen in the front view of FIG. 29B and the cross-sectional view of FIG. 29C, connector orientation protrusions 2910 are provided within the interior of the outer housing 2101. Connector protrusion 2910 is further seen in the inner view of the housing, FIG. 29D. When the front body is inserted within a longitudinal bore of outer housing 2101 at the proximal end of the front body 2702, the outer housing connector flap 2101.1 locks the outer housing 2101 to the front body 2702 in the following manner. As the front body 2702 is inserted into the outer housing 2101 in the direction of a front body guide 2920, the outer housing locking surface 2113 located on the front body 2702, best seen in FIG. 27 and FIG. 27B, engages the connector orientation protrusion 2910, seen in an inside view of the outer housing in FIG. 29B, and FIG. 29D labelled as "Flap A", flexing the connector flap 2101.1 outwardly from the outer housing body 2101, depicted in the insert of FIG. 29C. The flap protrusion mating location is indicated at "mating place" in FIG. 29C. Once the locking surface 2113 passes

beyond the orientation protrusion 2910, the connector flap 2101.1 returns to its original position (FIG. 29), and the protrusion 2910 engages locking surface 2113 at a flat 2730 that prevents any withdrawal of the front body assembly from the outer housing 210. This is prevented as the proximal end face 2830 of the connector flap 2101.1 is stopped by protrusion 2910. To remove, the connector flap 2101.1 must be depressed.

[227] FIGS. 35-35C depict the sequence of operations to remove an assembled front body from the outer housing in order to reverse polarity or to aggregate plural connectors in a multi-connector housing. To separate the front body from the outer housing, the connector flap 2101.1 is flexed outward using a finger or a tool, as depicted in FIG. 35B. Flexing the connector flap 2101.1 outwardly causes the protrusion 2910 to disengage from the front body's locking surface 2730, permitting the front body 2102 to be removed from the outer housing. This may be performed when it is desired to reverse the polarity of the connector (to be discussed below) or when desiring to aggregate plural connectors into a larger connector housing as discussed above. The separated components are depicted in FIG. 35C.

[228] In some embodiments, the back body 2106 may comprise one or more protrusions or hooks 2106.1, best seen in FIGS. 28 and 28B, which may interlock with a back body hook window/cutout 2119 in the front body 2102. This may allow for the back body 2106 and the front body 2102 to be securely fastened together around the ferrule(s) 2103, ferrule flange(s) 2124, and the spring(s) 2133.

[229] During assembly, the ferrule flanges 2124 fit into ferrule flange alignment slots 2793 (see FIGS. 27 and 27B) of the front body 2102, compressing the springs 2133 (preloaded) which are positioned along front body spring holders 2192. The ends of the springs 2133 are secured on spring guides 2192 (FIGS. 28, 28B) of back body 2106 by spring tension. As seen in the assembled cross-sectional views of FIGS. 23 and 23B, the springs 2133 are positioned to urge the ferrules 2103 into contact with mating connectors or transceiver optics, ensuring minimum insertion loss. The flat 2720 engages the adapter hook 2425 surface to lock the connector within the adapter housing.

[230] Further reductions in connector size may be obtained by reducing the size of springs 2133. By using a maximum spring outer diameter of 2.5 mm, the pitch of the ferrules, that is to say, the spacing between adjacent ferrules, may be reduced to 2.6

mm when coupled with the removal of inner housing walls and walls separating adjacent ferrules. This advantage is best seen in FIG. 22 which depicts the front of connector 2100 showing overall connector dimensions and ferrule pitch. The connector size 4.2 x 8.96 x 30.85mm (excluding optional pull tab 2110 and connector alignment key 2105) with a ferrule pitch of 2.6 mm.

[231] As best seen in FIG. 21B, the outer housing 2101 and the front body 2102 together provide a connector ramp 2950 (on the outer housing) used to guide a connector hook into a connector hook recess 2111 (in the front body 2102), also shown in FIGS. 27 and 27B. The connector hook, to be discussed in more detail below, may be from an adapter or a transceiver to secure the optical connector 2100 herein.

[232] The micro optical connectors 2100 may be used in a variety of connection environments. In some applications, the optical connectors 2100 will mate with other optical connectors. Typically this mating will occur within an adapter such as the adapter 2400 depicted in FIG. 24 in an exploded view and depicted in FIG. 31 having four mating pairs of optical connectors 2100 latched therein. In other applications, as when an optical signal is to be converted to an electrical signal, the micro optical connectors 2100 will mate with an optical receptacle in a transceiver assembly 1900 as further shown in FIG. 36. Typically, transceiver 1900 may be found in a data center, switching center, or any other location where optical signals are to be converted to electrical signals. Transceivers are often a part of another electrical device such as a switch or a server, as is known in the art. Although much of the connection operation of this embodiment will be described with respect to an adapter, 2400, it is understood that substantially similar mechanical retention mechanisms are positioned within transceiver 1900 so that any description of connector retention in adapter 2400 applies in a substantially similar way to retention within transceiver 1900. An example of a transceiver front end is depicted in FIG. 36B; as seen in FIG. 36B, the connection environment is substantially similar to one-half of an adapter 2400. Referring to FIG. 36B, the reduced sized connectors, as described herein, are shown with improved non-limiting and approximate dimensions with an adapter or transceiver housing.

[233] Turning again to FIG. 24, further size reductions in the overall optical assembly of connectors plus adapter or connectors plus transceiver may be obtained

through various connection mechanisms to be described with respect to the adapter 2400 but also apply to optical connection features within the front end of transceiver 3600. The adapter 2400 includes an adapter housing 2440 having an adapter alignment assembly 2446 positioned therein. The adapter alignment assembly 2446 includes alignment sleeves 2448 positioned within alignment sleeve openings 2445a of alignment sleeve holders 2445. The adapter alignment assembly further includes connector hooks 2425 that will grip optical connectors 2100 through front body connector hook recess 2111 of FIG. 21B. As seen in FIG. 30, connector hooks 2425 include an inner surface 3010. The inner surface engages with the connector ramp area 2150 lifting the connector hooks 2425 as discussed herein. The adapter alignment assembly 2446 further includes connector alignment slots 2445a that mate with the ferrule 2103 of FIG. 21. The connectors 2100 are received through an opening of the adapter housing 2440.

[234] Another improvement in adapter size is obtained by removing prior art adapter walls between adjacent connectors. This is best seen in the front view of an assembled adapter shown in FIG. 26. As seen, pairs of ferrule alignment sleeves are separated only by connector gap 2610 with a 4.35 mm pitch between adjacent connectors. The adapter size is 19.0 x 10.71 x 32.5mm (excluding the adapter flange). The reduced pitch is accomplished by removing side walls as shown in FIG.1 between the receptacles 102, 108.

[235] FIG. 31 depicts the adapter 2400 with four pairs of mating connectors 2100 latched therein. Note that in the latched configuration FIG. 34, connector hooks 2425 do not extend through the adapter housing opening 2443 when the connector 2100 is latched in the adapter housing. This is further visible in the cross-sectional view of an assembled adapter 2400 of FIG. 25. Connector alignment keys 2105 are positioned within connector alignment slots 2447. As seen in the cross-sectional view of FIG. 23, the push-pull tab 2010 may extend beyond the connector boot 2109 providing clearance to easily grip the tab and remove a connector. The flap 2401.3 secures the adapter housing into a rack or panel.

[236] To further reduce the size of optical connectors and associated mating components, the adapter housing 2440 includes connector hook openings 2443. Connector hook openings 2443 accommodate the clearance required by connector hooks

2425 when they flex upwards prior to latching with connectors 2100. The interaction of the connector hook 2425, having an inclined inner surface 3010, with the connector hook opening 2443 is best seen in FIGS. 32B and 34-C. Prior to latching (FIG. 34), the connector hook 2425 is in an unflexed condition within the adapter or transceiver. As the connector 2100 is inserted into the adapter housing 2440 or the transceiver 1900, the connector ramp 2450 pushes against the connector hook inner surface 3010, flexing connector hook 2425 into the connector hook opening 2443. Without providing the opening, additional clearance would need to be provided to accommodate the flexing of the connector hook 2425 as depicted in the prior art connector/adapter of FIG. 32. As seen in FIG. 32, a connector latch gap 3210 must be provided in the prior art to accommodate the prior art connector hooks, increasing the overall footprint of the prior art connector. By providing connector hook openings 2443, approximately 2.25mm of valuable footprint real estate is obtained which may be used to increase connector density. Referring to FIG. 32, the reduction in the connector latch gap 3210 is shown with the use of the connector hook openings 2443 in the call out rectangle.

[237] Referring to FIGS. 34, 34B and 34C, the position of the connector hook 2425 is illustrated before, during and after latching as a connector disclosed herein is pushed into an adapter receptacle. As the front surface 301 is lifted by the connector ramp 2450 (FIG. 34B), the full insertion of the connector herein results in the connector hook 2425 engaging the connector recess 2711.

[238] Through the various features described above, the density of optical connectors 2100 that may be provided in the standard transceiver footprint connector spaces may be doubled. For example, in a small form factor pluggable (SFP) footprint of 14 x 12.25 mm, two connectors 2100 having four LC-type ferrules 2103 of 1.25 mm outer diameter may be accommodated as seen in FIG. 33B. Similarly, in a quad small form factor pluggable (QSFP) footprint of 13.5 x 19mm, four connectors 2100 having a total of eight LC-type ferrules 2103 may be accommodated as seen in FIG. 33. Further, by providing the connectors in transmit and receive pairs, greater flexibility in optical routing is obtained, as demonstrated by previous FIGS. 16 and 17.

[239] Turning to FIG. 37, another embodiment of a micro optical connector is depicted. In this embodiment, the last two digits of each element correspond to the

similar elements in the micro optical connector of FIG. 21 et seq. In FIG. 37, connector 3700 may include an outer housing 3701, a front body 3702, a connector ramp 3750, one or more ferrules, one or more ferrule flanges, one or more springs, a back body 3706, a back body protrusion 3706.1, a back post, a crimp ring (depicted with an optional heat shrink tube extending therefrom), and a boot. The outer housing 3710 may include a longitudinal bore at the distal end for accommodating the front body 3702 and a ferrule assembly, a connector alignment key 3705 used during interconnection, a connector flap 3701.1 and an optional pull tab to facilitate removal of the connector 3700 when connected in a dense array of optical connectors. Optionally, the ferrules may be LC-type ferrules having an outer diameter of 1.25 mm.

[240] In FIG. 38 an isometric view of the front body 3802 is depicted. In this embodiment, the back body hook cutout 3819 has been moved forward, advantageously strengthening the assembled connector in side load environments. An alignment tab 3820 is provided for mating with a receiving recess 3980 on the back body. The connector hook recess 3811 operates in a substantially similar manner to the recess of FIG. 21, described above. A ferrule flange alignment slot 3810 is also provided.

[241] In FIG. 39, the back body 3906 is depicted, showing alignment tab recess 3980 for receiving alignment tab 3820. The back body hook 3906.1 is configured to engage and be seated into a hook recess 3819 at the back side of a front body 3802 on of the back body through extended hook arm 3996. Through the extended hook arm 3996 and the alignment tab 3820, breakage during side loads is reduced as the load is redistributed more evenly across the entire connector, reducing stress on the back post. A chamfer 3924 is added to reduce stress on the front body cutout 3810, as the chamfer engages the underside of the alignment tab 3820 and lifts it until the hook 3906.1 is seated in the cutout 3819.

[242] As seen in FIGS. 40-40C, the assembled front body 3702 may be removed from the outer housing 3701, rotated 180° as indicated by the arrow (FIG. 40B), and re-inserted into the outer housing (FIG. 40C). This allows for a change in the polarity of the connector by removing and rotating the front body 3702, and therefore the ferrules can be switched quickly and easily without unnecessarily risking the delicate fiber cables and ferrules. Referring to FIG. 40, the micro connector 3700 is fully assembled. To

remove a front body 3702 to change connector polarity, as shown in FIG. 40B, one or more flex tab 3703 are lifted outward to release the front body 372 for removal in rearward in the direction of the arrow "R". Referring to FIG. 40C, to complete the polarity change, after rotating the front body 3702 by 180 degrees as shown in FIG. 40B, the front body 3702 is inserted into the outer housing in the direction of arrow "F". As described previously with respect to FIGS. 35-35C, connector flap 3701.1 is flexed outward to release the front body from the outer housing.

[243] Turning to FIG. 41, another embodiment of a micro optical connector is depicted. In this embodiment, the last two digits of each element correspond to the similar elements in the micro optical connectors of FIG. 21 and FIG. 37. In FIG. 41, connector 4100 may include an outer housing 4101, a front body 4102 one or more ferrules 4103, one or more springs 4133, a back body 4106, a back post (not shown in FIG. 41) a crimp ring 4108, and a boot 4109. The outer housing 4101 may include a connector flap 4101.1 and an optional pull tab 4110 to facilitate removal of the connector 4100 when connected in a dense array of optical connectors. Optionally, the ferrules may be LC-type ferrules having an outer diameter of 1.25 mm.

[244] As seen in FIG. 42, the front body 4101 in this embodiment includes a middle wall 4260 interposed between the ferrules and springs when the front body is assembled. This middle wall reduces the possibility of the springs becoming entangled with each other, binding the connector and breaking the optical fibers. The front body 4101 also includes an alignment cut out guide 4625, seen in the side view of FIG. 42B. The alignment cut out guides the back body 4106 into the front body 4101 during assembly of the connector, and also further reduces the side load that leads to connector breakage or disconnection of the front body and the back body 4106.

[245] Back body 4106, depicted in FIG. 43, includes an alignment guide 4377 that fits into the alignment cut out guide 4625 of FIG. 42B. The wall structure 4378 act as a stop with the front body to prevent over-compressing of the springs, and provides strength under a side load.

[246] Various modifications to the outer housing, depicted in FIGS. 44-44C, may be used with any of the micro optical connectors depicted in FIGS. 21, 37, and 41 or earlier embodiments. In FIG. 44, the push-pull tab 3810 may include a release recess

4473. Release recess 4473 permits insertion of a tool or fingernail to remove the connector from an adapter or transceiver, without disturbing adjacent connectors. Similarly, FIG 44B depicts a release hole 4499 in push-pull tab 3710 to permit insertion of an extraction tool to remove the connector from an adapter or transceiver. FIG. 44C shows a modified connector flap 3756 with an increased cutout size of 1 mm to make it easier to insert a tool or a finger to flex the flap 3701.1 and remove the front body assembly when making a polarity change or aggregating the front body with other front bodies in a larger outer housing.

[247] Another embodiment of an adapter/transceiver front end is depicted in FIG. 45. Unlabeled elements are substantially similar to elements depicted in FIG. 24. In this FIG., adapter housing hooks 4542 can be seen along with connector hooks 4525. Turning to the cross-sectional view of the assembled adapter in FIG. 46, the engagement of these elements may be seen. The adapter housing hook 4542 engages and locks behind protrusion 4520 on the inside wall of the adapter housing 4540.

[248] Another embodiment of an optical connector 4700 is depicted in FIG. 47. Here, many of the elements are substantially similar to earlier embodiments with the emphasis being on the back body, 4706. A more detailed view of the back body 4706 is presented in FIG. 48. In this embodiment, the back post 4808 flange has a rectangular shape in order to narrow the overall connector profile by approximately .5 mm. Back post overmolding 4859 accommodates the back post flange 4857 and reduces the potential for back post breakage. The back wall 4853 is extended in length to 3 mm from 1.5 mm to improve the side load strength of the overall connector. The crimp ring positioning 4855 is inverse from earlier embodiments to improve holding of aramid fiber from an optical fiber cable, improving cable retention of the back post.

[249] Many advantages are achieved by the backpost of FIG. 48. In addition to increased connector strength, a longer fiber path 4928 is provided as shown in FIG. 49. This longer fiber path, approximately 1.5 mm longer than in previous embodiments, allows for a gentler curve as the fibers are split from the fiber optic cable, improving insertion and return loss of the fibers. In FIG. 49, the back wall 4853 can be seen as a portion of the back body 4706.

[250] In view of the various modifications of this embodiment, FIG. 50 depicts a connector 4700 front view showing overall reduced connector width of 3.85 mm. Such a size reduction permits 4 optical connectors (a total of 8 ferrules) to be accommodated in a transceiver or connector footprint of 16mm (including tolerances). Thus the connectors of the present invention may be used to connect 8 LC-ferrule-housed fibers it a QSFP footprint.

[251] To further decrease the space required by the optical connectors, a side thickness reduction is carried out on the boot of connector 4700. Side thickness reduction 5135 narrows the thickness of the boot on either side, reducing the space required by the boot to the 3.85 mm profile of connector 4700. Thus four connectors will fit in the fixed QSFP transceiver footprint. This footprint is shown in the adapter front view of FIG. 52 as noted above, the front view of an adapter and that of a transceiver are substantially similar from the optical perspective. In this FIG. 52, the adapter inner wall is reduced from 17.4 mm to 16 mm. All of the modifications set forth in the FIG. 47 et seq. embodiment make it possible for a plural of connectors to fit in the profile of FIG. 52.

[252] Referring to FIG. 52, a perspective view of another adapter/connector system is disclosed. The adapter housing 5244 has a cutout opening as shown that gives a user access to lift latch 5212 to release connector hook 5225 and allow a user to withdraw the connector 5200 using pull tab 5210 from the adapter housing 5244. The adapter housing 5240, FIG. 52B, does not have a connector hook 2425 required, as the latch 5212 engages the backside of a connector hook face 5287 to secure the connector in the adapter, as shown in FIG. 52, the underside latch 5212a engages the hook surface 5225. Turning to FIG. 52C, the hook surfaces 5225 of the pull tab are lifting the latch 5212 that releases the connector from the adapter. FIG 52D illustrates the pull tab inserted in the adapter housing with the latch 5213 locking down the tab 5225 by the elastic force of the pull tab in the direction of the arrow. FIG. 52E shows polarity change where the pull tab 5210 has been removed from the front body 5202 flipped and just prior to insertion onto the latch as shown in the direction of the arrows.

[253] Referring to FIG. 53 another embodiment of CS connector 5300 is disclosed. In this embodiment, the last two digits of each element correspond to the

similar elements in the micro optical connector of FIG. 21 et seq. The pull tab 5310 is removable by inserting a tool into an access slot 5329 and lifting the pull tab 5310 off the outer housing 5301, and exposing the front body 5302. The operation of the polarity change mechanism is shown in FIG. 54. The wing 5327 (bottom wing not shown) aid in the removed of the outer housing 5301. In FIG. 53, an offset alignment tab 5305 is move toward the distal end of the pull tab 5310, this allowed the adapter alignment slot 5705 to be reduced in size increasing adapter housing strength. A chamfer was added to the connector ramp 5710, to remove tightness on the CS connector 2100 upon insertion. As discussed herein, the adapter walls where reduced providing a gap 2610 that allows more connectors to fit within the standardized adapter opening. The connector recess 5311 was increased to remove the side cutouts 4301.1 for example further reducing overall connector width when the opposing structure on the front body 5302 neared the outer housing wall was removed. The removed material was added to the middle wall to increase strength to hold ferrule springs in place. The side bar 5323 provides an adjacent connector support and aids in removing and releasing the connector when the side bar is chamfered. The opposing side comprises an alignment cutout 5324 which is shown in FIG. 59. Turning to FIGS. 53B and 63, the back post 6330 top surface 6379 engages with corresponding outer housing cutout 5379 and bottom surface 6379b engages with corresponding outer housing cutout 5379b. This secures the back post and front body 5302 within the outer housing 5301. The back post front body hook 6324 top surface (as shown) is configured to mate with outer housing 5301 top surface 5379 for aligning the backpost 6330 within the outer housing.

[254] Referring to FIG. 53C, a cross section side view of the micro connector or FIG. 53 further comprises an outer housing latch 5301a located on one or both sides of the housing 5301 to secure the outer housing 5301 to a front body 5302 via a corresponding front body cutout 5302a. Comparing to FIG. 40 to FIG. 40C, a flex tab 3703 was lifter outward to remove a front body 3702 from an outer housing 3701 to change connector polarity. Referring to FIG. 53C, a latch 5301a replaces the flex tabs on the outer housing 5301. Lifting the latch 5301a out of cutout 5302a, and pulling rearward the outer housing 5301, then the front body 5302 can be rotated 180 degrees as shown in FIG. 40B to change polarity upon reinserting the front body 5302 back into the outer

housing 5301 similar shown in FIG. 40C. Moving the outer housing release to the top of the connector provides for easier access to change connector polarity.

5 [255] Turning to FIG. 54, the operation of the polarity change mechanism using the outer housing 5301, where the pull tab 5310 is integrated with the outer housing. In FIG. 54, the CS connector 53 is fully assembled. The user inserts a tool in access slot 5329 and lifts off the outer housing 5301. The front body 5302 is removed with the boot and cable attached as shown. Turning to FIG. 54C, the outer housings rotated 180 degrees, as shown by the arrow, and placed back over the front body 5302 in the direction of the second arrow as shown. The reversed polarity CS connector 5300 is shown fully assembled in FIG. 54D.

10 [256] Referring to FIG. 55, the connector 5300 is shown just prior to insertion into the adapter at the top view. The connector is partially inserted in the center view, where an connector hook (or adapter hook) 5525 has not yet been seated in the connector recess 5511, and the bottom view shows the hook 5525 seated in the recess 5511. This operation is similar to the operation shown in FIG. 34.

15 [257] Referring to FIG. 56, the adapter 5600 is shown without the adapter alignment assembly inserted therein. The connector hook openings 2443 were changed over to a rectangular shape 5643 for ease of machining and access to the connector hook in case of a connector getting stuck. The opening 5644 accepts the adapter hook 5442 to secure the adapter alignment assembly 5746 in the adapter housing. Raised grooves 5631 where added align the connectors and to provide some support as separating walls of the prior art adapter are removed, as discussed herein increasing the overall available space for multiple CS connectors with an adapter housing.

20 [258] Referring to FIG. 58, the adapter 5700 is shown with a CS connector 5300 fully inserted therein. The raised grooves 5831 engage the outer housing 5302 and help reduce the connector from jumping into the next adapter port upon insertion. The distance between the raised grooves corresponds to the width of the outer housing. The raised grooves eliminated the inner walls of the adapter that created adapter ports or receptacles.

30 [259] Referring to FIG. 59, is a close view of two connectors with the side bar 5325 of the first connector overlapping with the side bar 5325 of the second connector, as

shown. This allows the close placement of a plurality of connectors within an adapter. Turning to FIG. 60, a top view of the plurality of connectors illustrates the compactness of the connectors and the interaction between connectors to support one another while in the adapter. FIG. 60B shows pictorial the overlapping of the side bar with the outer housing of the connector next to the first connector.

[260] Referring to FIG. 61, the front body 6102 has two cutouts 6119 and 6121 and an extended middle wall 6110. The cutout 6121 engages the outer housing hooks (not shown) that replaced the flex tab 4301 to secure the outer housing to the front body. Cutout 6121 secures the polarity change tab 5310. Cutout 6119 secures backpost to front body 6102 via backpost front body hook 6324. The material saved at the backpost overmolding 6310 and at the back wall 6379 by not using the flex tab was used to reinforce the middle wall to better support the ferrule springs from bending and this distorting the ferrules. This distortion can increase insertion loss. The connector recess 6111 is located at the proximal end of the front body 6102, and the recess engages and locks with the connector hook 2425 (shown in FIGS. 24, 30, 32 or 58). Referring to FIG. 63, the front body hook 6324 was reduced in height to relax the spring force. Referring to FIG. 62, the adapter hook 6246 added chamfers to the connector hook surface 6226 to improve installation of the connector into the adapter when the connector ramps 2150 engage the hook 2425.

[261] FIG. 64 shows the crimp ring assembly 6408 with a crimp ring attached to a heat sink tube. FIG. 64B shows a boot 6409 with cutouts on the outer surface to increase flexibility. FIG. 65 is a dust cap 6589 and FIG. 65B is a duplex dust cap 6588.

[262] Referring to FIG. 66, a comparison of a LC micro connector 2100 is inserted into an adapter 2400 as shown in the top view has an overall greater length than a BTW micro connector 6600 inserted into an adapter, as shown in the bottom view. Referring to FIG. 67, a behind the wall or BTW connector 6700 comprises a housing 6701 further comprising sleeve holders 6745, a connector to adapter latching assembly 6746b further comprising a connector hook 6725, an adapter housing hook 6742 and an adapter housing hook face 6742b that form a protrusion 6713 that latches into an adapter opening 6743. The BTW micro connector is sometimes called a spring push as discussed herein. In the BTW micro connector, as shown in the various embodiments, an adapter

hook 6742 may be integrated into the connector, as shown in BTW micro connectors (6700, 6800), or the adapter hook is integrated into an adapter housing. In all BTW embodiments, a protrusion (6713, 7113) is located on one or both sides of the BTW housing. The protrusion latches into a corresponding adapter opening (6743, 6843a), as further described herein. The adapter housing 6740 illustrates a plural of spring push holders inserted into therein.

[263] Referring to FIG. 68, a second embodiment of an adapter hook assembly 6846b is illustrated with the hook assembly integrated as part of the spring push holder or housing 6801. The assembly further comprises a recess 6811a that receives a sleeve holder 6845. In all BTW embodiments, the spring push holder will go directly over an adapter sleeve holder 6845. The assembly further comprises a protrusion 6913. The protrusion 6913 latches into a corresponding adapter housing opening 6843a. As the spring push 6800 is pushed into an adapter receptacle an adapter hook 6825 passes beyond the adapter opening 6843a and comes to a stop as seen through adapter opening 6843. The inclined surface 6826 of hook 6825 lifts adapter housing tab 6843b, and the face 6842 further lifts the tab 6843b until the protrusion 6913 locks in opening 6843a. A protrusion face 6842b locks in place within opening 6843a.

[264] Referring to FIG. 69, a ferrule flange 6904 is shown fully inserted into a sleeve holder 6945. A spring 6733 is over the flange 6904 and up against a flange collar 6804a. Referring to FIG. 70, as a spring push holder 6800 is inserted into an adapter receptacle, the protrusion 6813 latches into the adapter housing opening 6843a. This compresses the springs 6833, which in turn lock the ferrule flanges in position. A fully inserted push spring holder 7000b is ready for use with a corresponding ferrule or transceiver interface on an opposite side of the adapter housing 6840.

[265] Referring to FIGS. 71 and 72, an adapter housing (7140, 7240) further comprises an adapter latch area 7120 integrated into the housing. Turning FIG. 71, a first embodiment of a spring push holder comprises a protrusion 7113 with a face 7142b that latches into adapter latch area 7120. Turning to FIG. 72, a second embodiment of a spring push comprises a latch 7201.2. The push spring holder is inserted into an adapter receptacle when the spring push is moved in the direction of a first arrow 7200a to a second arrow 7200b into an adapter receptacle. The spring and ferrule flange assembly

enter a sleeve holder 7245 opening and the spring push housing 7101 goes over the holder 7245, and a face 7142b of the latch 7201.2 engages a corresponding latch area 7220 in the adapter housing 7240.

5 [266] FIG. 73 illustrates a spring push holder, for example as shown in FIG. 71 is moved in a first direction 7300a, and a ferrule flange and spring assembly moves in a second direction 7300b. The flange and spring assembly is fully inserted and seated in the adapter receptacle when the spring holder protrusion (shown at top) is seated in the adapter latch area 7320. Referring to FIG. 74, the spring push holder housing 7101 is latched into a receptacle of an adapter 7400b. The spring push holder housing 7101 is
10 inserted over an alignment sleeve holder 7245 when the housing 7101 is fully inserted into the adapter 7400a.

[267] FIG. 75A illustrates a group of micro connectors 7500A inserted into an adapter 5700. FIG. 75B illustrates the alignment tab off-set 7500B configuration of FIG. 60B, with a group of micro connectors 7500A of FIG. 75A. FIG. 76 show a plural 7600
15 of micro connector (2100, 3700) prior to insertion into an adapter (not shown). FIG. 77 shows a single micro connector (2100, 3700) configured to accept a removal tool at a release recess 4473.

[268] FIG. 78 shows a removal tool 7870 attached to a distal end of a plural of micro connector 7600. The removal tool further comprises a release arm 7875 for each
20 micro connector (for example 2100, 3700, or 5300) group together. In operation, a user would pull up in the direction of arrow "A" a release arm 7875, then pull in direction of arrow "B" to remove one or more micro connector for which the arm is not activated or pulled up.

[269] Referring to FIGS. 79.1 to 79.3, another embodiment of a removal tool 7975 is shown. Referring to FIG. 79.1, the tool 7975 further comprises a guide block 7976 that is configured to engage and be inserted into a corresponding opening 5376
25 located at a distal end of a micro connector 5300, located at FIG. 79.2. The connector 5310 further comprises a push/pull tab release 5310. Referring to FIG. 79.2, the tool contains a plural of release arms 7975 that in operation are pulled up when removing the tool, as described below. In FIG. 79.2, each connector further comprises a release recess 4473. Referring to FIG. 79.1 and FIG. 79.2, the removal tool 7975 is inserted at the
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distal end of a plural of micro connector 5300 as shown in the direction of arrow "C". Referring to FIG. 79.3, upon insertion each release arm 7975 engages a release recess 4473, and upon removing the tool in the direction of arrow "B" all micro connectors would be removed from an adapter (not shown). Pulling up one or more release arms 7975 in the direction of arrow "A" and removing the tool in the direction of arrow "B", these connectors would remain in an adapter receptacle (not shown). Referring to FIG. 80, a plural of micro connectors with an alternative pull/push tab release 8010. The release 8010 comprises a handle 8010a at the distal end. Each release tool can be configured, similar to the tool in FIG. 79.1 to accept a handle at a distal end of the push/pull tab.

[270] Referring to FIG. 81, the removal tool 8170 is shown locked onto a distal end of a push/pull release 8110, when a release arm 8175 protrusion 8175a engages an opening 8843 in the release 8110. To disengage the lock formed between the protrusion 8175a and opening 8843, the release arm is lifted up. When the tool is pulled rearward, in the direction of arrow "A", the micro connector (for example 3700 or 5300) is not removed from an adapter (not shown).

[271] Referring to FIG. 82, a second embodiment of a removal tool 8270 is shown connected at a distal end of a plural of micro connectors 3700. The tool further comprises a release arm 8275 for each micro connector. Referring to FIG. 83, a cut away view of a micro connector, as shown in the assembly of connectors 8200, is shown in a locked position at the distal end of a micro connector (3700, 5300).

[272] Referring to FIG. 83, a third embodiment of a removal tool 8370 is shown connected at a distal end of one of a plural of micro connectors 8200. The removal tool 8370 further comprises a release arm 8375 at a first end, a protrusion 8375a at a second end and a release arm locking protrusion 8375c along a first or second side of the arm. The protrusion 8375a engages a corresponding opening 8373 located in a push/pull tab on the connector 3700 to lock the removal tool 8370 at the distal end of plural of micro connectors. The removal tool housing further comprises a recess 8370a that is configured to accept the release arm locking protrusion 8375c. Upon insertion of the tool 8370 onto the distal end of the plural of micro connectors 8200, the tool locks via protrusion 8375a and opening 8373 and protrusion 8375a in recess 8370a. To release an

individual lock, depress the release arm 8375 in the direction of the arrow "D", which results in the locking protrusion 8375c moving out of recess 8370a, and the removal tool 8370 is pulled rearward. When release arm is depressed the corresponding micro connector is retained in an adapter (not shown), while the remaining corresponding micro connectors, of the plural of micro connectors 8200, are removed from an adapter (not shown).

[273] Referring to FIG. 84, a third embodiment of a removal tool 8470 comprises a plural release arms 8475 corresponding to the number of micro connectors 3700. It is understood the plural of micro connectors can be a micro connector 2100 or 5300 with departing from the scope of the invention. Referring to FIGS. 85A to 85C, the operation of the tool 8470 is disclosed. In FIG. 85A, a release arm 8575 is in an unlocked position with its corresponding release arm locking protrusion 8575c disengage from a corresponding recess 8570c located in the tool 8570. Referring to FIG. 85B, the release arm 8575 (in a locked position) is moved to a proximal end or in the direction of arrow "A" (refer to FIG. 85A), and the release arm locking protrusion 8575c engages a flexible latch 8570b integrated with a housing of the removal tool 8570, and moves into a recess 8573 located at a distal end of a pull/push tab release 8510 attached to micro connector 5300 or 3700. In a locked position, upon removing the tool 8570 or pulling it rearward one or more micro connectors are removed or unlatched from an adapter (not shown). If the release arm is in an unlocked position, upon removing the tool 8570 the one or more micro connectors are not removed or remain latched in an adapter (not shown). Without departing from the scope of the invention, one or more micro connectors of a plural of micro connectors, with any of the removal tools, the release arm may be positioned in an unlocked or locked configuration, and upon pulling the removal tool rearward, the corresponding micro connector that corresponds to a release arm is not removed or removed from an adapter.

[274] Referring to FIGS. 86, 87A-87B, a fourth embodiment of a removal tool to remove one or more micro connectors from an adapter (not shown) is fully assembled 8600 in FIG. 86. Still referring to FIG. 86, the plural of micro connectors 3700 or micro connectors 5300 without departing from the scope of the invention, have attached at the distal end of a pull/push tab 8610 a removal tool 8670. The removal tool further

comprises a housing 8670e, one or more release arms 8675, and each release arm further comprises one or more release arm protrusion 8675b. Each release arm 8675 corresponds to a micro connector 3600 more specifically the removal tool is configured to attach to and integrate with a pull/push tab 8610 of a micro connector.

5 [275] Referring to FIG. 87A, a removal tool release arm 8675, of FIG. 86, now 8775 is being pushed down, in the direction of arrow "D", to an unlocked position from a locked position as shown in FIG. 87B. As the release arm 8775 is being depressed, the release arm locking protrusion 8775c moves out of recess 8773 or beyond wall 8773a, which allows the release arm 8775 to be pulled rearward to unlock the release arm so
10 upon rearward movement of the removal tool 8770, the micro connector corresponding to a release arm, the connector is not removed from an adapter (not shown).

 [276] Referring to FIG. 87B, the release arm 8775 is in a locked position at a distal end of the pull/push tab of the release arm corresponding micro connector 3700. In a locked position, upon pulling the removal tool rearward or in the arrow direction "R",
15 the release arm engaged with its corresponding micro connector will remove the micro connector from an adapter (not shown). The removal tool housing 8770e further comprises an integrated release arm 8775, a pair of locking recesses 8775e, and a release arm latch 8775d. Upon full insertion of the removal tool over a distal end of a micro connector pull/push tab 8710, the latch 8775d is locked into the distal recess 8775e. This
20 prevents further rearward movement of a release arm 8775 from the removal tool 8770 thereby destroying the tool. The arm 8775 further comprises a release arm protrusion 8875b, the protrusion causes the release arm locking protrusion to move out of recess 8773 when the arm 8775 is move forward. As the arm 8775 is moved forward, the latch 8775d moves out of the distal locking recess 8775e to a proximal locking recess 8775e, and after the proximal locking of latch 8775d, the release arm is in an unlocked position.
25 In an unlocked position, the micro connector is not removed from an adapter (not shown). In a locked position, FIG. 87B, the release arm will remove the micro connector from the adapter (not shown) when the arm 8775 is pulled in the direction of arrow "R".

 [277] Referring to FIG. 88, a plural of micro connector 3700 or 5300
30 comprising a plural of release arm 8875 configure asymmetric or offset for easy access. The offset release arms 8875 are shorted from left to right, while the arms may be longer

from left to right or another arrangement depending on the application. The operation of removal tool 8870 is the same as 8770 as described in FIGS. 87B and 87C.

[278] Referring to FIGS. 89A to 89D, a fifth embodiment of a removal tool and its operation is disclosed. Referring to FIG. 89A, a plural of micro connectors 8900 each comprises a pull/push tab 8910 and a recess 8973 at the distal end of the tab 8910. Referring to FIG. 89B, a removal tool 8975 of FIG. 89C is installed into the recesses 8973 of the plural of micro connectors. Referring to FIG. 89C, the tool 8975 has a pair of flexible arms 8975f with a corresponding chamfer 8975g. The set of arms 8975f is inserted into a recess 8973 of a corresponding pull tab 8910. The chamfer 8975g aids in the insertion of the arms into the recess, and orientation of the chamfer, as shown, ensures an arm flexes inward as the chamfer engages with the pull tab wall 8773a upon insertion of the tool 8975 into the recesses 8973. Referring to FIG. 89D, a cross section of the tool 8975 is shown inserted into the recesses 8973 of the plural of push/pull tab 8910. Without departing from the scope of the invention, the tool 8975 may have two or more arm sets side by side or spaced apart for insertion in any number of recess of a plural of micro connectors.

[279] Referring to FIGS. 90A to 90C, a sixth embodiment of a removal tool is disclosed. Referring to FIG. 90A, a removal tool 9075 extends the overall length of a pull/push tab 9010 as shown in FIG. 90B. The tool 9075 or extender further comprises a pair of extender arms 9075h each with a wing 9075j. Referring to FIG. 90B, the extender arms 9075h snap into a recess 9073 (refer to FIG. 90C) at the distal end of the pull tab 9010. The extender length may be varied to accommodate an asymmetric configuration similar to FIG. 88. Referring to FIG. 90C, a single tool 9075 is installed at the distal end of a plural of micro connectors.

[280] Referring to FIGS. 91A-91B, FIG. 91A micro connector 9100 comprises an alignment and offset tab 9105.1 having an offset portion 9123. The offset 9123 engages a top surface of a side bar 9124 (similar to operation as described in FIG. 53) for aligning the connector 9100 into a multi-receptacle adapter next to another micro connector. Unlike the connector in FIG. 53, the side bar 9124 is located further back or nearer a distal end of a connector (e.g. closer to the cable) where the side bar 9124 is part of a multi-purpose boot 9109.1. The micro connector 9100 outer housing 9101 is secured

to the boot 9100.1 via boot hook 9109.5 (FIG. 91B) that engages a second slot 9201.4 in a front body 9201. Referring to FIG. 91B, the multi-purpose boot 9109.1 comprises a releasably attached alignment and offset tab 9105.1. The tab 9105.1 has a protrusion 9105.2 at a proximal end that engages a first slot 9201.3 in the front body 9201 to further secure the multi-purpose boot 9109.1 to the front body 9101.

[281] Referring to FIG. 92A, a front body 9210 is shown in a second polarity orientation "B" comprising a first slot 9201.3 and a second slot 9201.4. The multi-purpose boot assembly 9209.1 (FIG. 92B) is inserted at a distal end of the front body 9201 shown in the direction of arrow "I". Referring to FIG. 92B, a multi-purpose boot assembly 9209.1 comprises an alignment and offset tab 9205.1, as described herein, a boot hook 9209.5, a side bar 9024 that is configured (as described herein) to engage a back body 9206, a front body 9201 and a plural of ferrules 9202. The proximal end of the assembly 9209.1 is inserted into a distal end of the outer housing 9210 (FIG. 92A) in the direction of arrow "I". Upon insertion, the outer housing 9201 engages with multi-purpose boot 9209.1 as shown by the dotted lines between a first slot 9201.3 and a second slot 9201.4, engaging protrusion (not shown) on alignment key 9205.1 and boot wing 9209.5 respectively.

[282] Referring to FIG. 93A, the front body 9201 and assembly 9209.1 are assembled. Referring to FIG. 93B, the multi-purpose boot assembly 9209.1 is rotated in the direction "R" to convert from a first polarity (FIG. 93A) to a second polarity (FIG. 93D). The boot hook 9209.5 further comprises a chamfer 9309.2. The chamfer engages a wall 9301.5 and lifts the hook 9209.5 out of the distal end of front body 9301, and the protrusion 9105.2 lifts out of the second slot 9201.4 thereby allowing the boot assembly to rotate as shown in the direction "R", FIG. 93B. Referring to FIG. 94C, further rotation of boot assembly 9309.1 results in a change to a second polarity shown in FIG. 93D. FIG. 93D, the side bar 9324 (as well as alignment key 9305.1) are in a "2nd Polarity" position, and when the micro connector is inserted into an adapter (not shown), the micro connector is oriented with the key 9305.1 "up" so as not to get block by corresponding adapter structure (refer to FIG. 24). The ferrules are reversed the top ferrule is now the bottom ferrule, and this results in a second polarity configuration. The second polarity

being different from the first polarity, that is, Rx receive signal is now Tx transmit signal path and vice versa.

[283] FIG. 94 is the micro connector 9100 with a cross section along "A-A" line as further shown in FIGS. 94A through 94E further illustrating polarity change using the multi-purpose boot 9209.1. Referring to FIG. 94A, a front view of the cross-section cut "A-A" of the micro connector of FIG. 94 (FIG. 91) further comprises an opening through which fiber cabling (not shown) travels, and a crimp ring surface 9407.1 that is further surrounded by an inner round 9409.4. Referring to FIG. 94A.1a, the inner round 9409.4 engages a back post surface 9406.7, FIG. 94A.1b, as the assembly 9209.1 is rotated. Referring back to FIG. 94A, the boot hook 9109.5 further comprises a first chamfer 9409.2a and a first stopping wall 9409.3a, and a second chamfer 9409.2b and a second stopping wall 9409.3a, in a first polarity position.

[284] Referring to FIG. 94B, rotating of the boot assembly is started and chamfer 9409.2a engages wall 9301.5 and begins to lift tab 9405.1 out of the second slot 9201.4. Referring to FIG. 94C.1 upon further rotation in direction "R", the tab 9401.5 is lift out of slot 9201.4 at a top and bottom surface of the outer housing 9401. Referring to FIG. 94C.2, the rotation of the boot assembly 9409.1 is shown as it exits the outer housing of connector 9100. The chamfer 9409.2b exits first from this view. The tab 9405.1 is moving around the outer housing body in a clockwise direction, in this view.

[285] Referring to FIG. 94D.1, the tab 9405.1 is almost in a second polarity position as shown, with the chamfer 9409.2b in an opposite orientation to itself in FIG. 94A. Referring to FIG. 94D.2, the connector 9100 shows the chamfer 9409.2b in the opposite position to that of FIG. 94C.2, indicating the connector is close to its second polarity configuration. The tab 9405.1 is at bottom surface of outer housing 9401. FIG. 94E shows the connector 9100 along cross section "A-A" in its second polarity position, with chamfer 9409.2b in the second slot 9401.4 at the top surface of outer housing 9401. The polarity tab 9405.1 is at the bottom surface of the outer housing 9401 indicating the connector is in a second polarity configuration.

[286] Referring to FIG. 95, a second embodiment of the polarity changer comprises an alignment and offset tab 9540 that further comprises a clip 9580 that releasably attaches to the boot assembly 9209.1 at clipping surface 9957, FIG. 101. Clip

9580 further comprises a side bar 9524, and the securing portion comprises a wing 9580.2, a support surface 9580.1 and chamfer 9680.3 (FIG. 96). Referring to FIG. 96, an offset 9623 for alignment is shown, and a polarity key 9640.1 as described here.

5 [287] Referring to FIG. 97, an individual clip 9780 is shown with an offset 9723 and a surface having a code or indicator such as color. Referring to FIG. 98, the individual clip 9880 has no offset. The wing 9880.2 has a chamfer 9880.3 (also shown in FIGS. 95-97). As the clip is pushed onto the clipping surface 9957, the chamfer allows the wings to spread over the surface 9957, and then snap into place to secure the clip/tab of FIGS. 95-98. Referring to FIG. 97.1, a plural of connectors 9100 are inserted into an
10 adapter similar to FIG. 24, comprising individual clips 9780.

[288] Referring to FIG. 99 a plural of micro connectors 9100 (as shown in FIG. 97.1) is viewed from a proximal end of the adapter housing 2440. As configured a first connector side bar 9923 rests on a second connector surface 9924.

15 [289] Referring to FIG. 100A a micro connector 9100 is shown along cross section "B-B" in a latched position within a receptacle of an adapter. During rotation of the multi-purpose boot assembly 9209.1, the boot wing 9209.5 operates as described above in FIGS. 94A-94E. This is accomplished by a gap 9209.6 between the boot assembly 9209.1 that allows "free-wheeling" about the crimp ring 9207 as the inner round 9409.4 engages the back post face surface 9406.7 as described in FIGS. 94A1.a-
20 94A1.b. In the latched position, the boot assembly wing 9209.5 facing surface is in contact with a facing surface of the back post 9206, as shown at interface 9100.8. Still referring to FIG. 100A, the boot wing 9209.5 face engages and releaseably locks with a corresponding surface 9301.4a of the second slot 9201.4 of the outer housing 9201, FIG. 92A and FIG. 93C. The micro connector 9100 is latched and unlatched in an adapter receptacle, as described in FIGS. 34-34C. The adapter hook 2425 is seated in connector
25 recess 9211 located in front body 9202. In this position, the boot assembly 9209.1 is up against back body 9206 as shown at interface 9100.8, as shown by direction of arrow "Pushed In".

30 [290] Referring to FIG. 100B, the boot assembly 9209.1 is being pulled rearward in the direction of "P". As the boot 9209.1 is pulled, a release distance "d" results at interface 9100.8. At the same time, the adapter hook 2425 is being lifted out

the connector recess 9211 (and described in FIGS. 34-34C). The distance "d" occurs because the boot wing 9209.5 engages the outer housing face 9301.4a, and pulls the outer housing 9201 rearward. As the outer housing 9201 is pulled rearward the connector is released from the adapter receptacle. The interface 9100.8 distance "d" or the amount of separation between the distal of the back body and proximal end of the boot assembly 9209.1 will continue to increase to a maximum distance "dmax", FIG. 100C.

[291] Referring to FIG. 100C, once the boot assembly 9209.1 is pull "P", the connector 9100 is released from within the adapter. The adapter hook 2425 is completely out of the connector recess 9211, and "dmax" is obtained at the interface 9100.8. The connector release is also shown at FIGS. 37-37C. Once the pull force, "P", is release from boot 9209.1, the interface 9100.8 returns to that of FIG. 100A.

[292] Referring to FIG. 101, another embodiment of a polarity change is disclosed using the clip/tab 9600 of FIG. 96. The alignment/offset clip 9600 is attached to boot clip surface 9975 as shown by the dotted line. Attaching the clip 9600 to a first side of the boot 9209.1 is in first polarity configuration, and attaching clip 9600 is a second side is in a second polarity configuration. Referring to FIG. 101A, a first polarity configuration is assembled with clip 9600 attached to boot 9209.1 of connector 9100. Referring to FIG. 101B, a second polarity configuration is assembled with clip 9600 attached to the opposite side of boot 9209.1.

[293] Referring to FIG. 102A, a plural of connectors 9100 is inserted into an adapter (similar to FIG. 24), with a removal clip 8975 attached to a distal end of the boot assembly 9209.1. Unlike shown in FIG. 89, the gang clip is attached to the boot. The clip 8975a may be attached at an opposite side and indicate the opposing polarity. As described herein, the gang clip will remove the plural of connectors from the housing together as a single unit. Referring to FIG. 102B, the adapter housing 2440 is removed showing the adapter hook system (FIG. 62) that secures the plural of connectors 9100 into the adapter.

[294] Referring to FIG. 103A, a flexible cable is attached at the distal end of the boot assembly 9209.1. FIG 103B shows the cable flexed.

[295] 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.

[296] 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.

[297] 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.

[298] 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," et cetera). 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."

5 [299] 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.

10 [300] 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, et cetera. As a non-limiting example, each range discussed herein can be readily broken
15 down into a lower third, middle third and upper third, et cetera. 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
20 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.

 [301] 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
25 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.

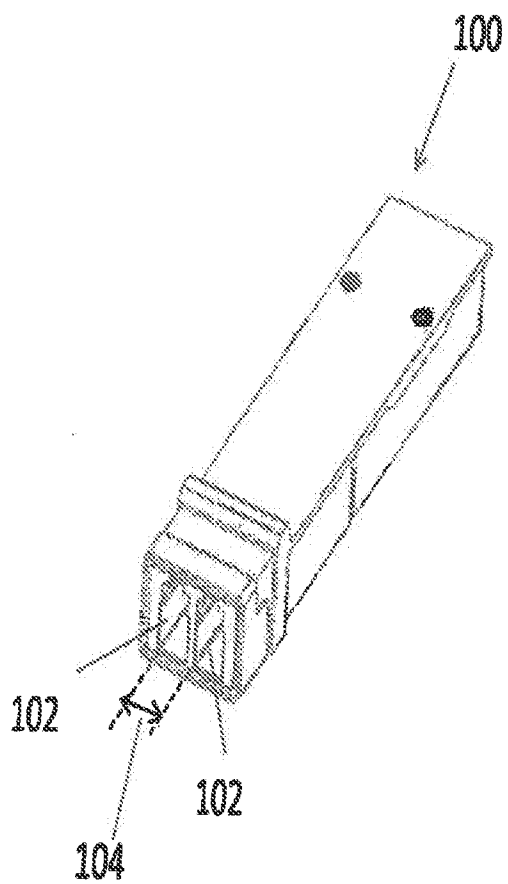


FIG. 1A
(Prior Art)

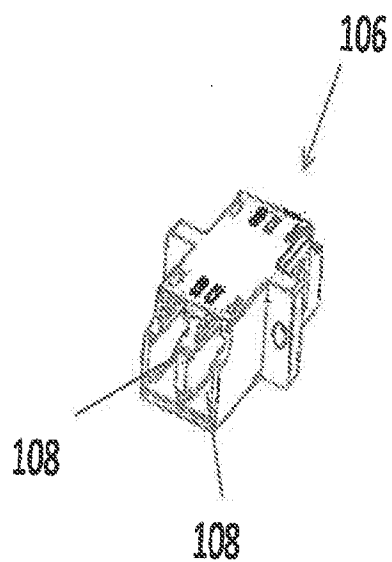


FIG. 1B
(Prior Art)

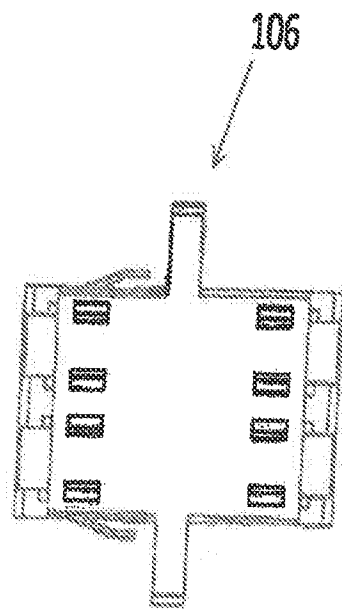


FIG. 1C
(Prior Art)

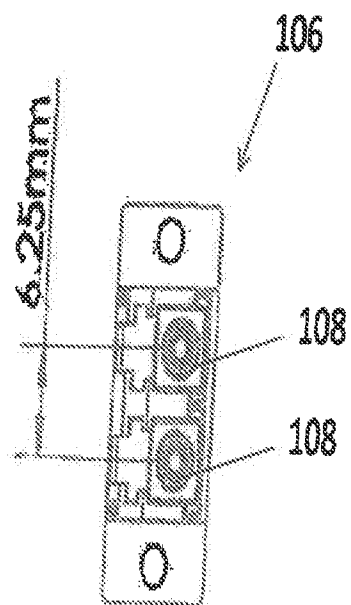


FIG. 1D
(Prior Art)

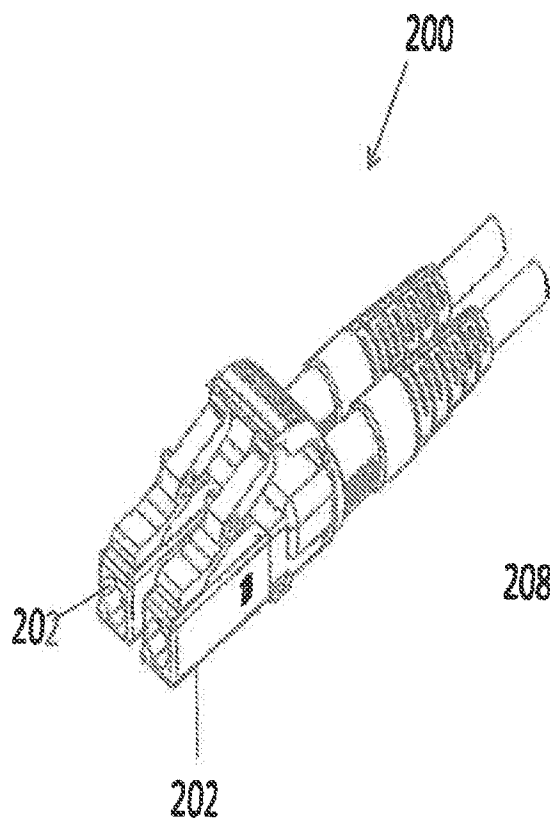


FIG. 2A
(Prior Art)

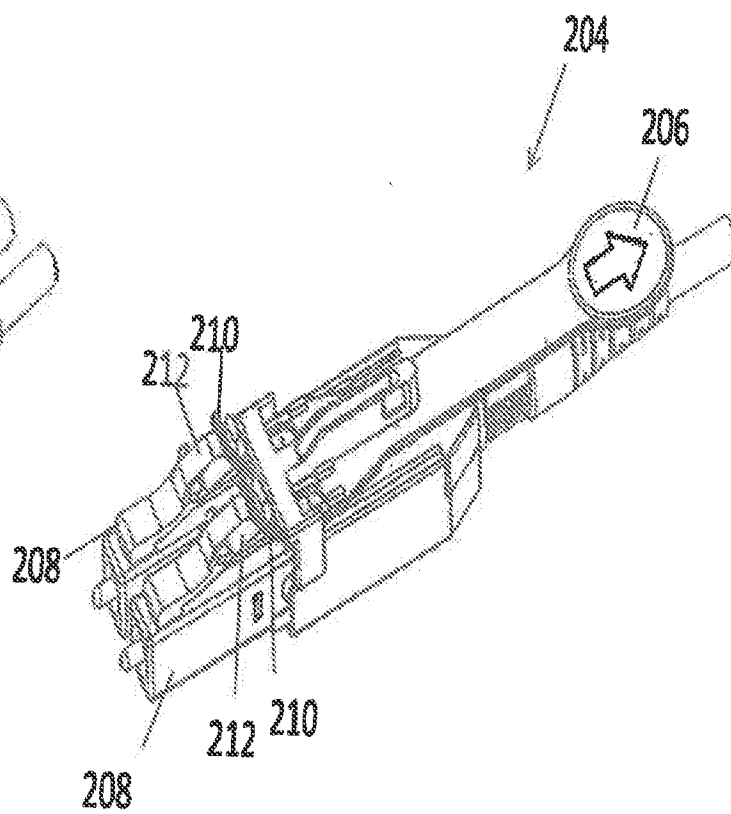


FIG. 2B
(Prior Art)

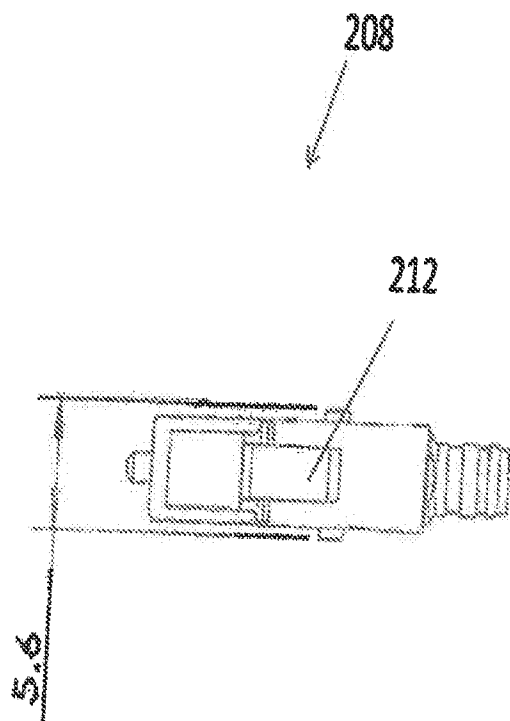


FIG. 2C
(Prior Art)

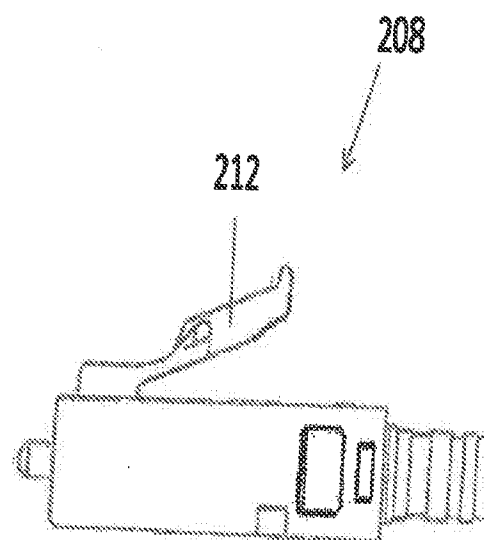


FIG. 2D
(Prior Art)

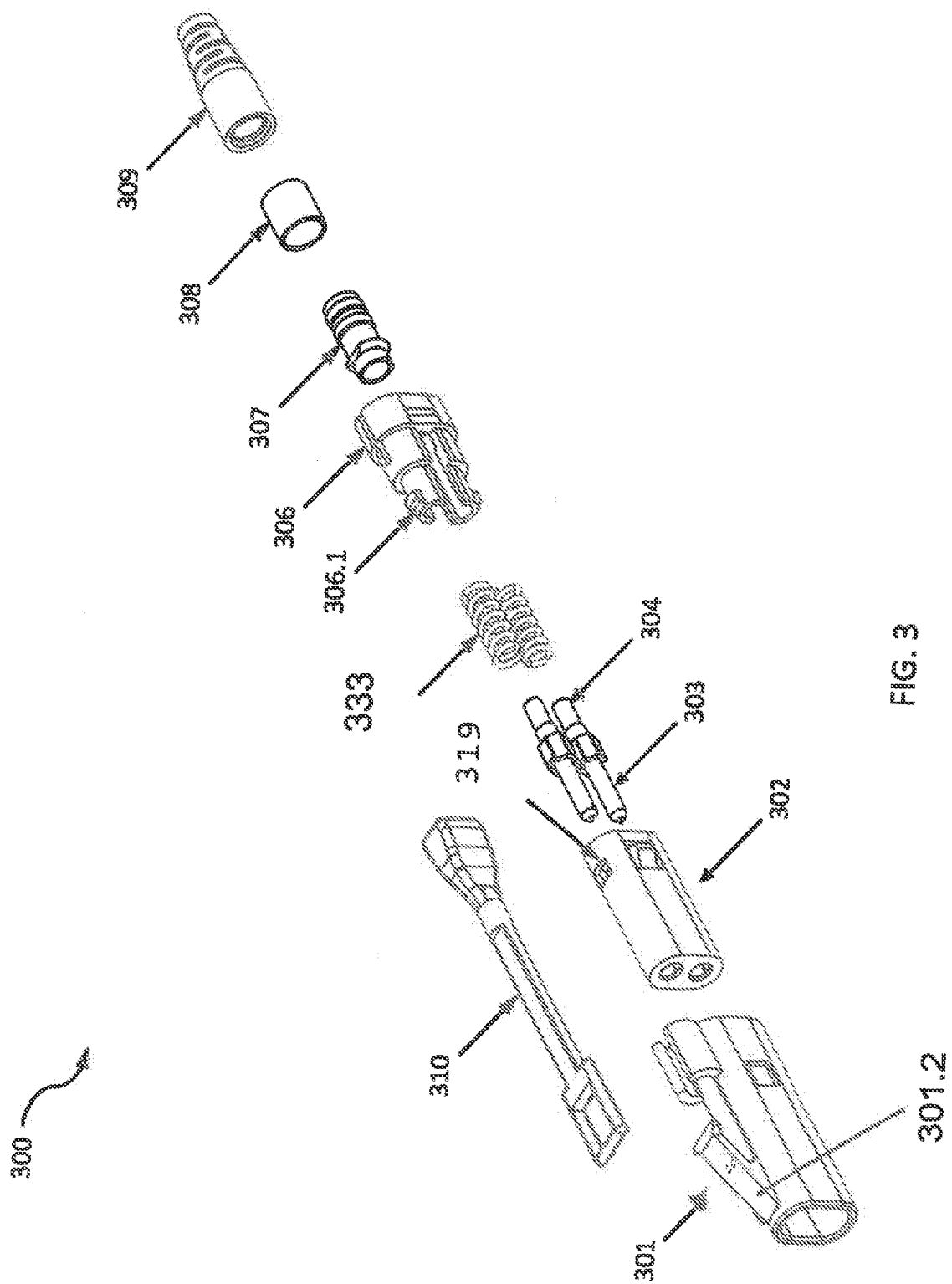


FIG. 3

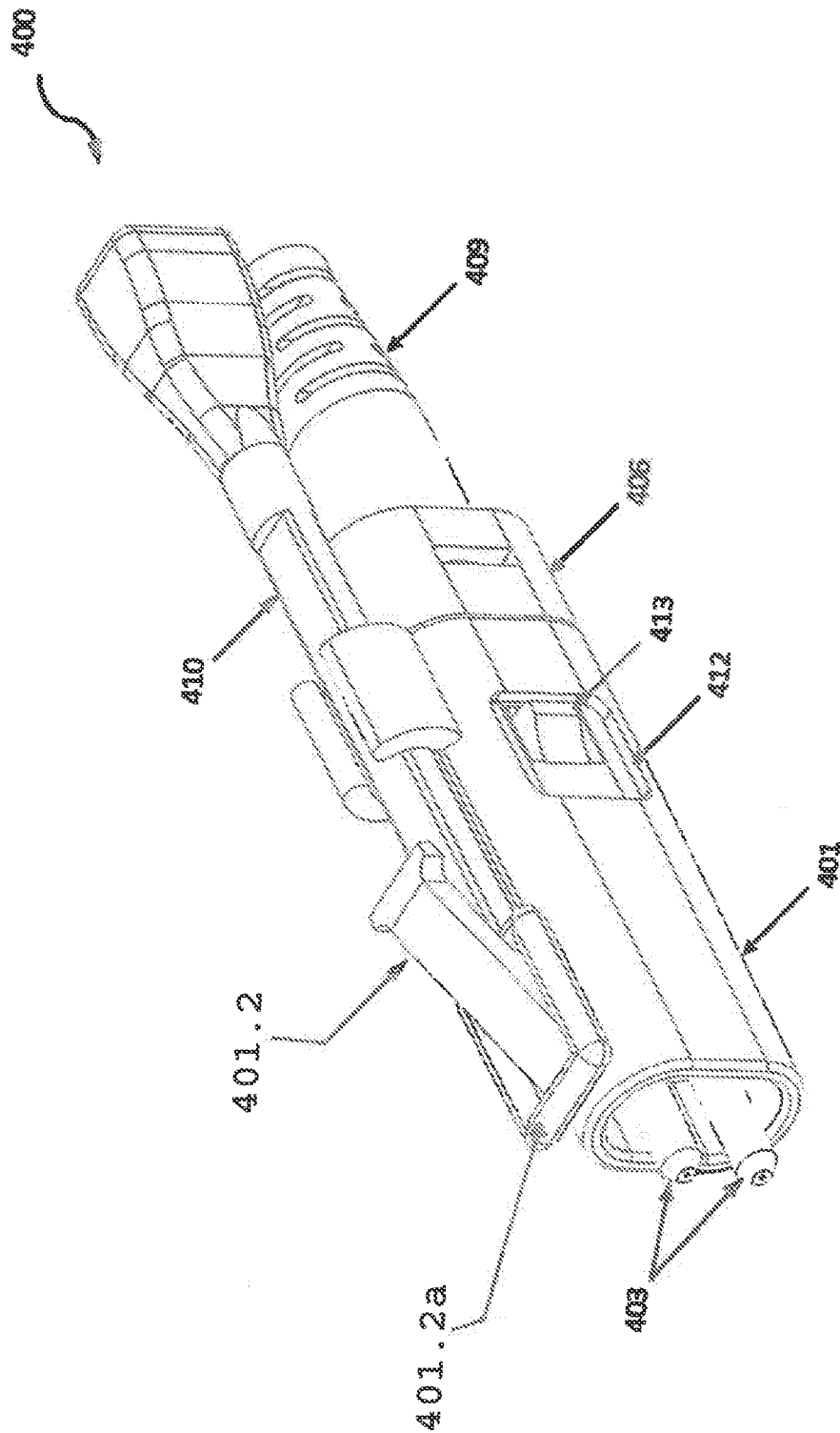


FIG. 4

400

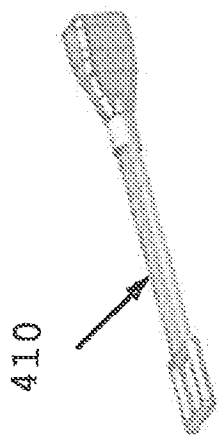
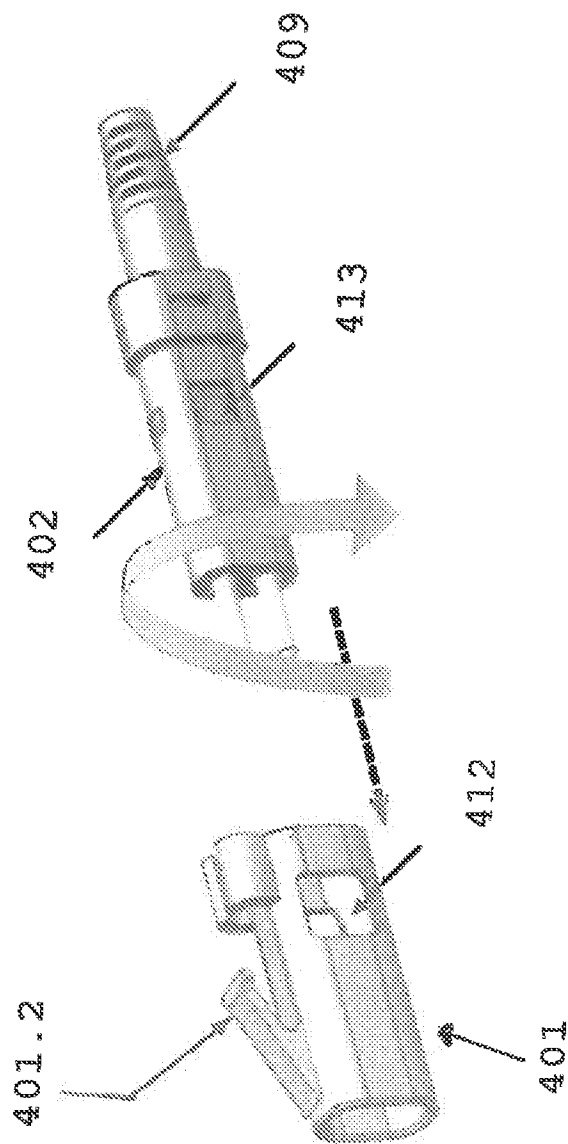


FIG. 4B

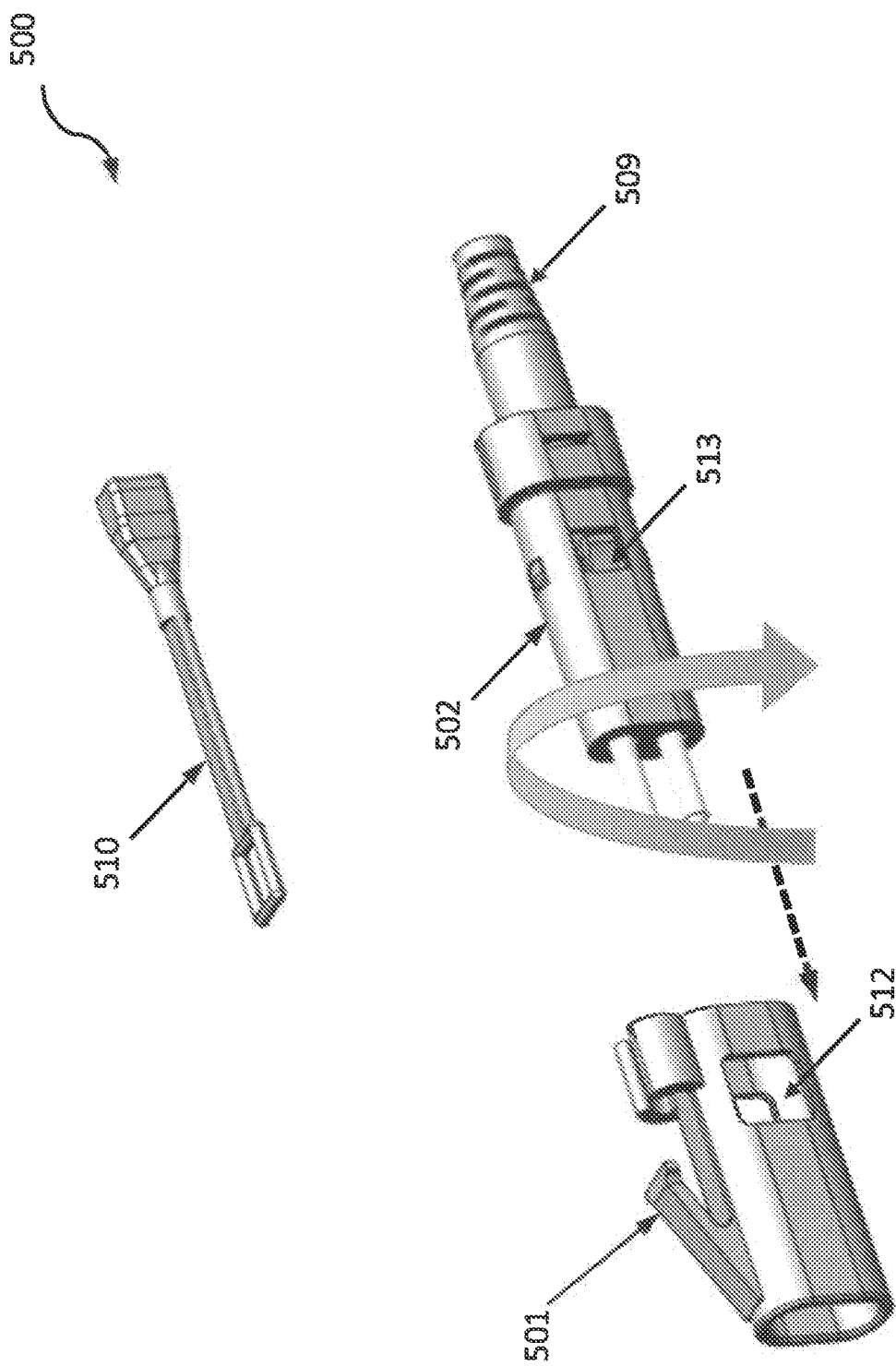


FIG. 5

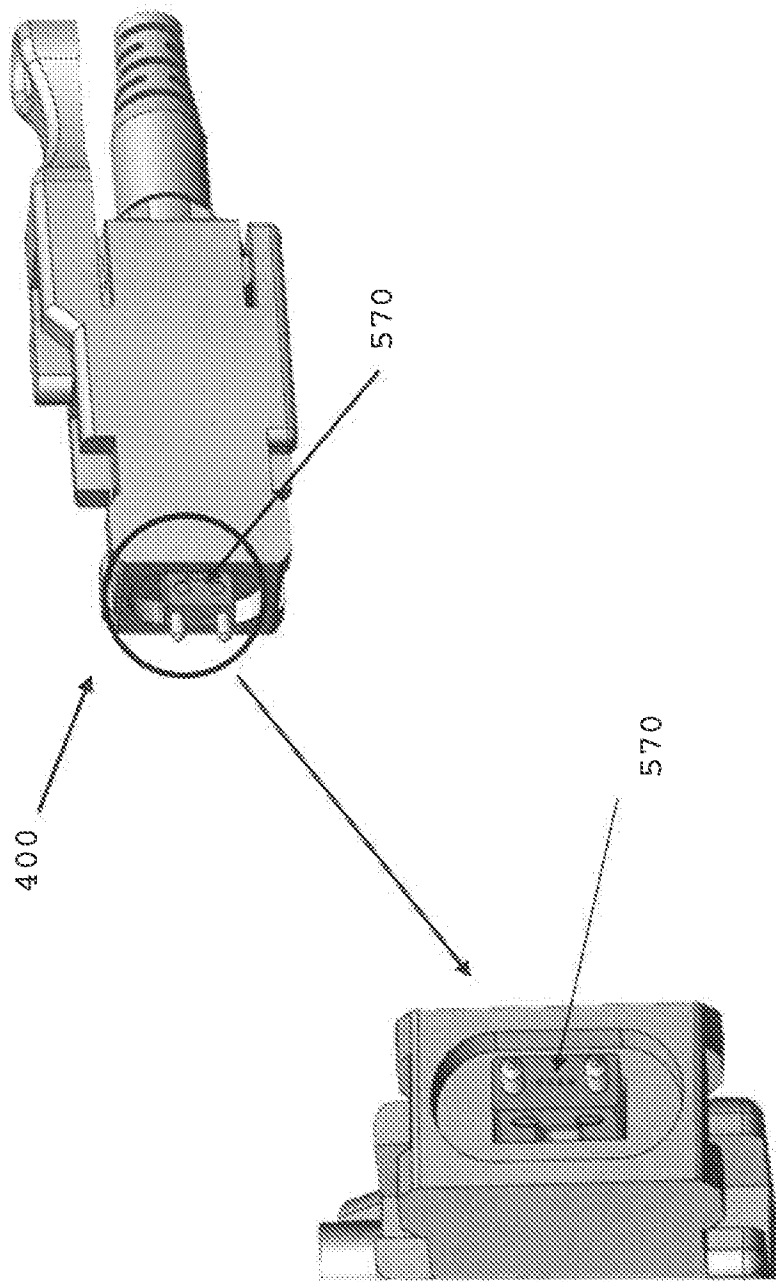


FIG. 5C

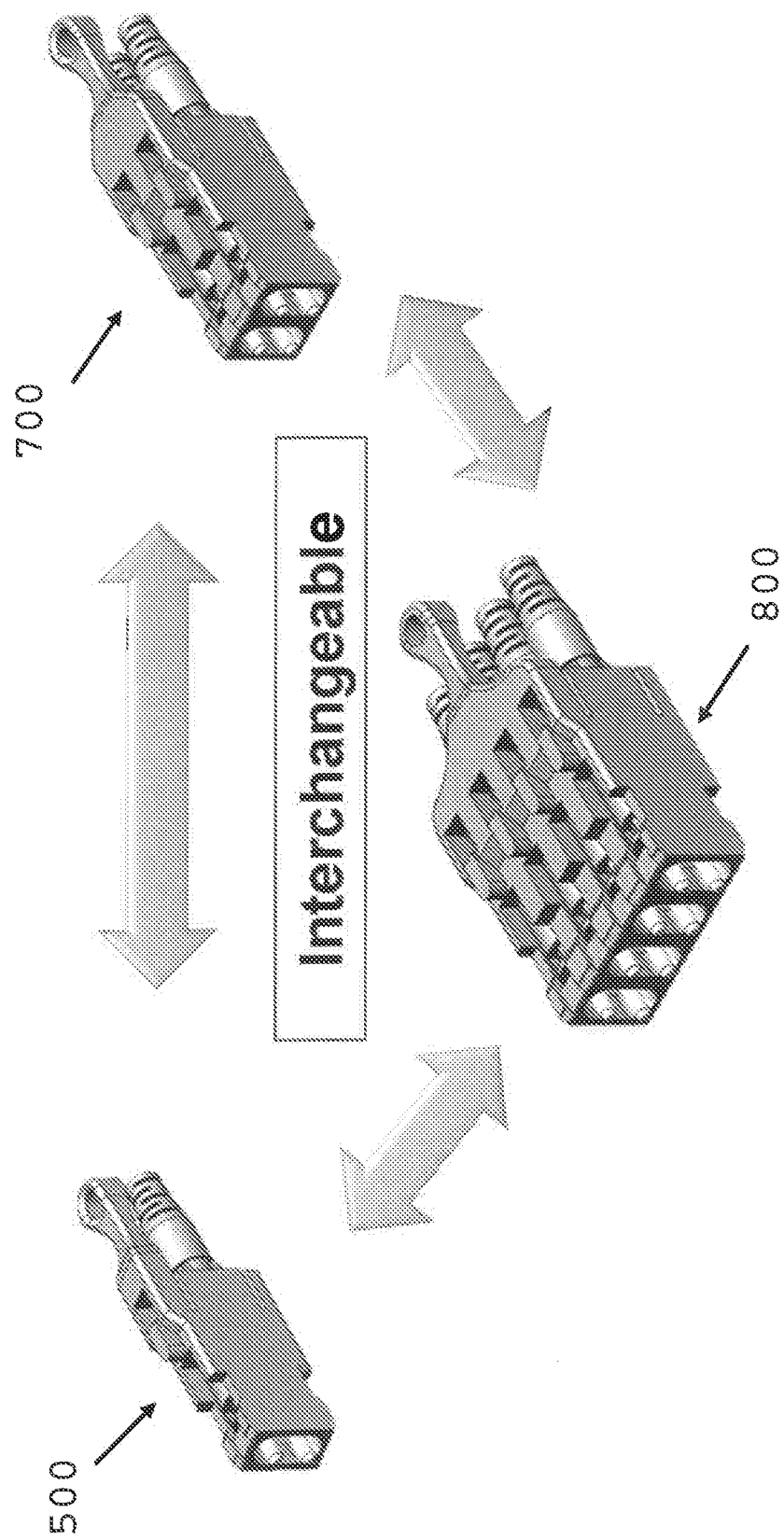


FIG. 12

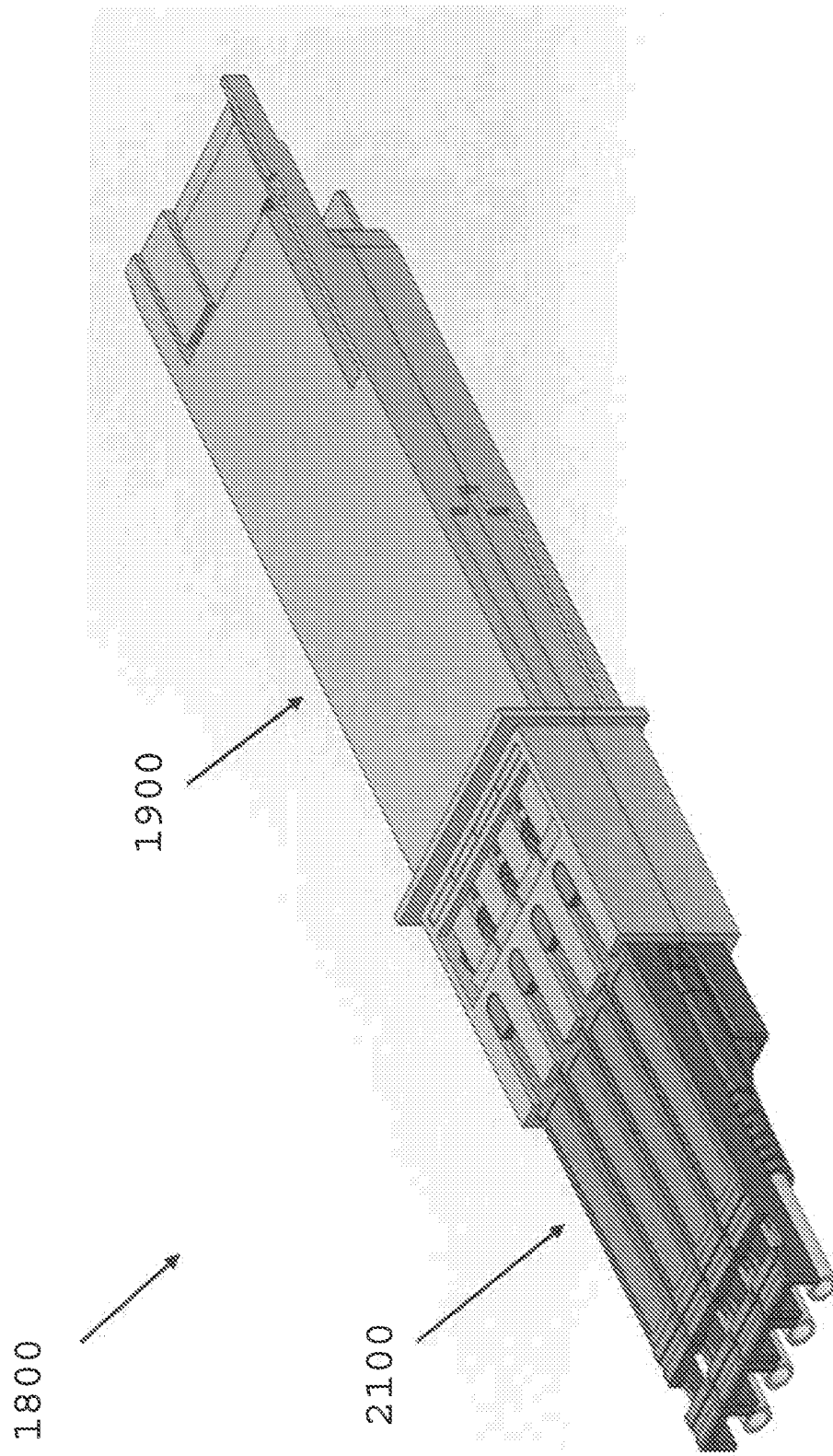


FIG. 18

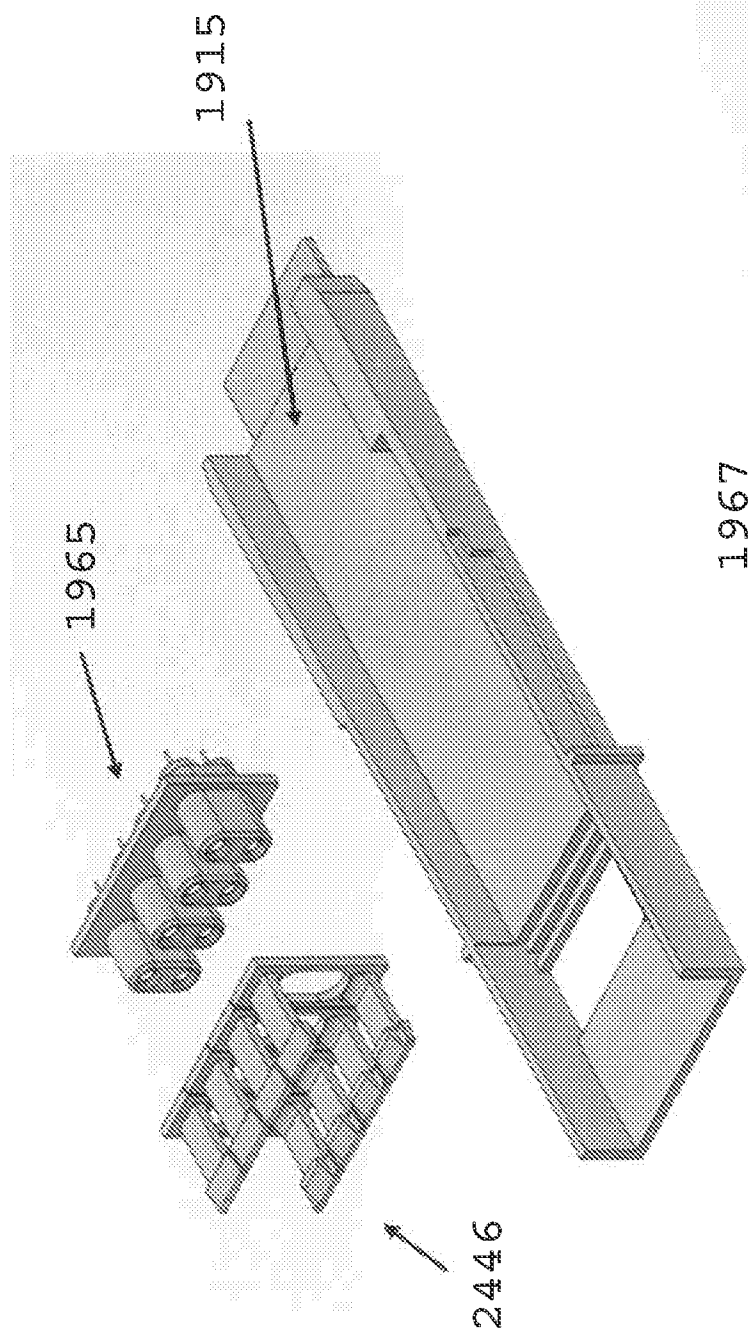
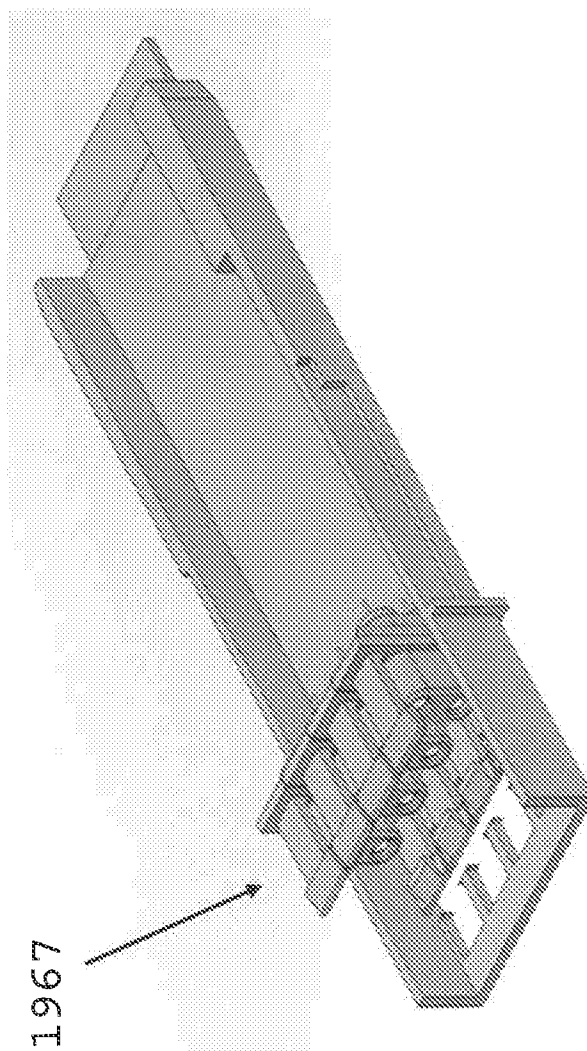


FIG. 19

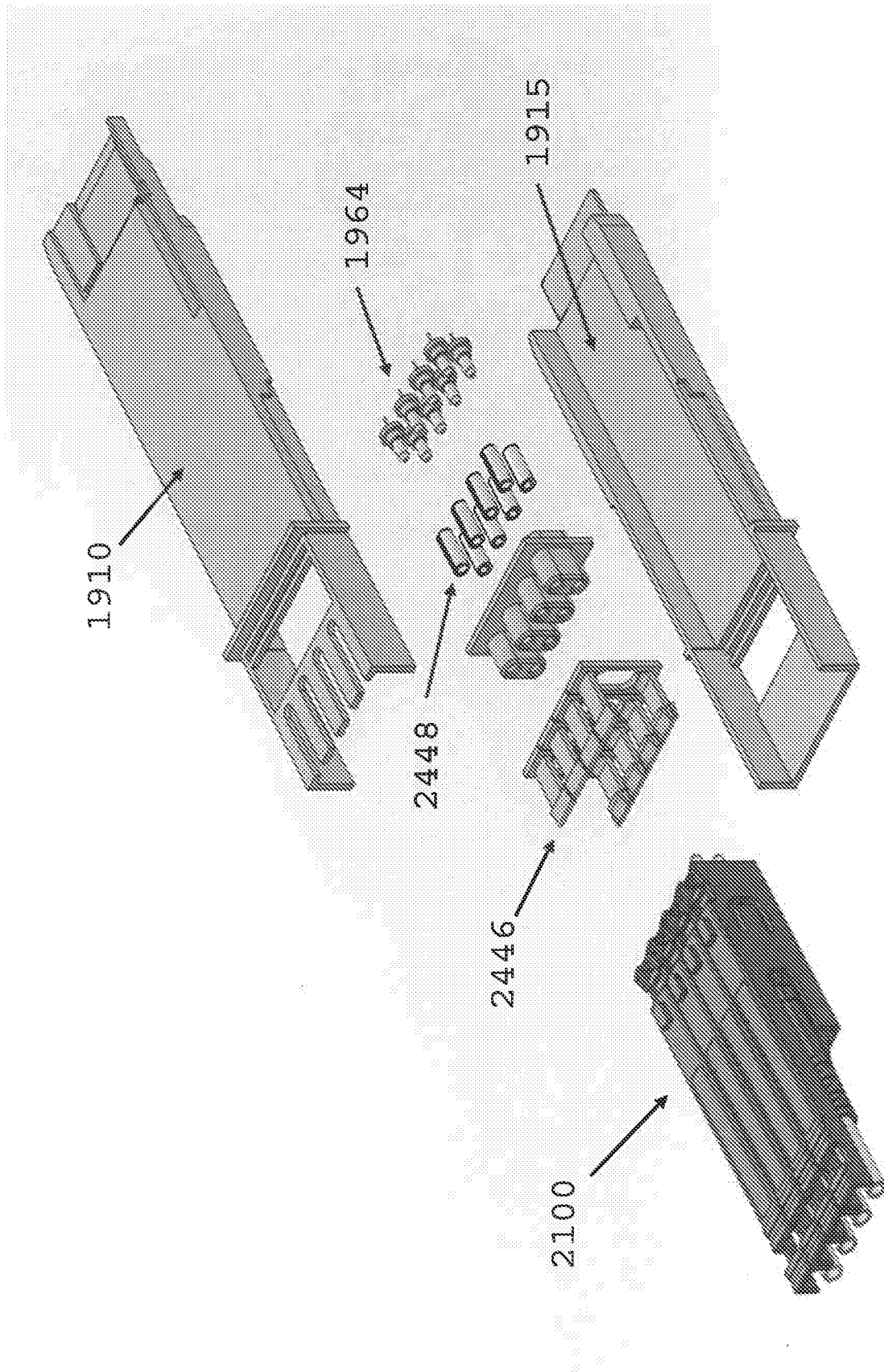


FIG. 19B

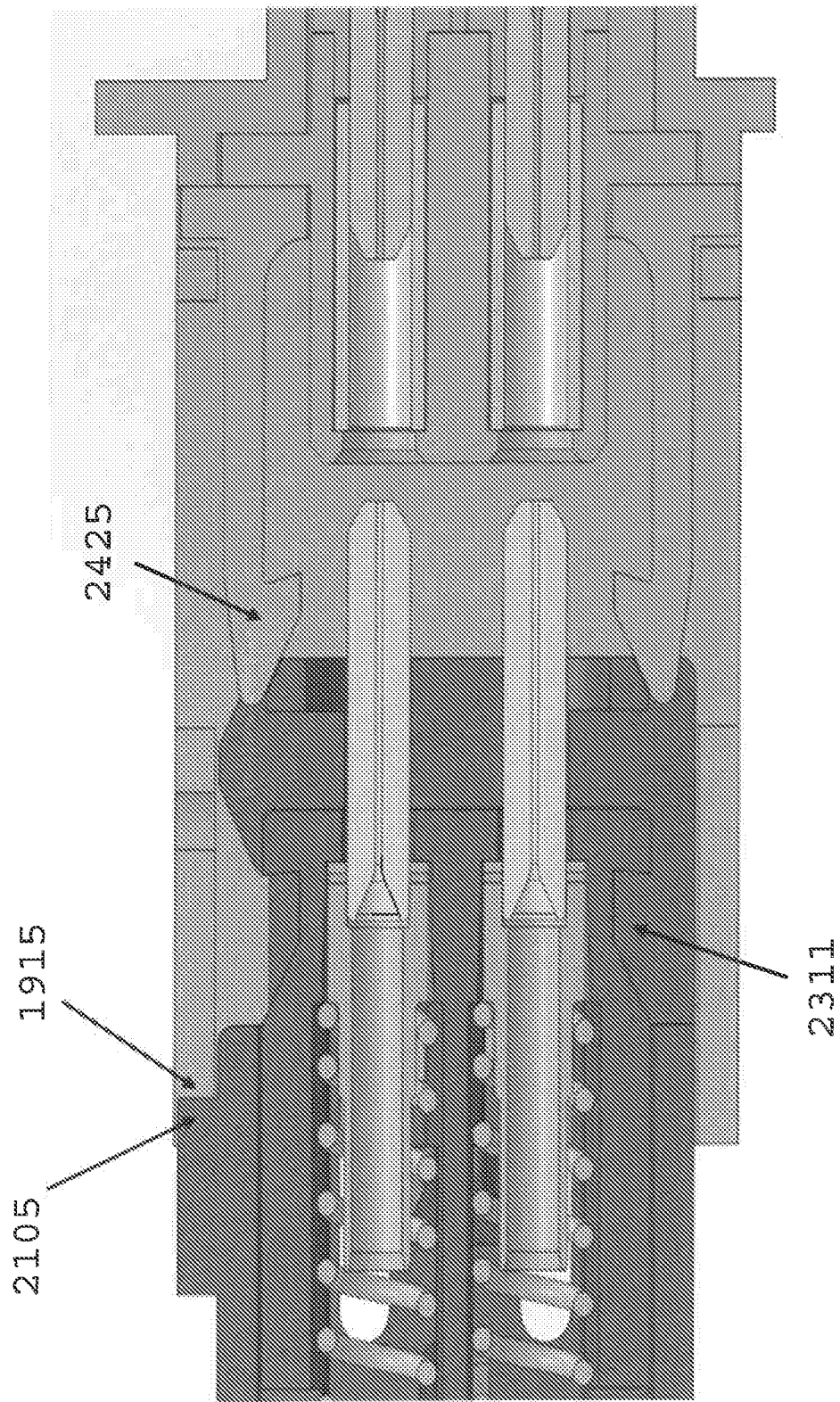


FIG. 20

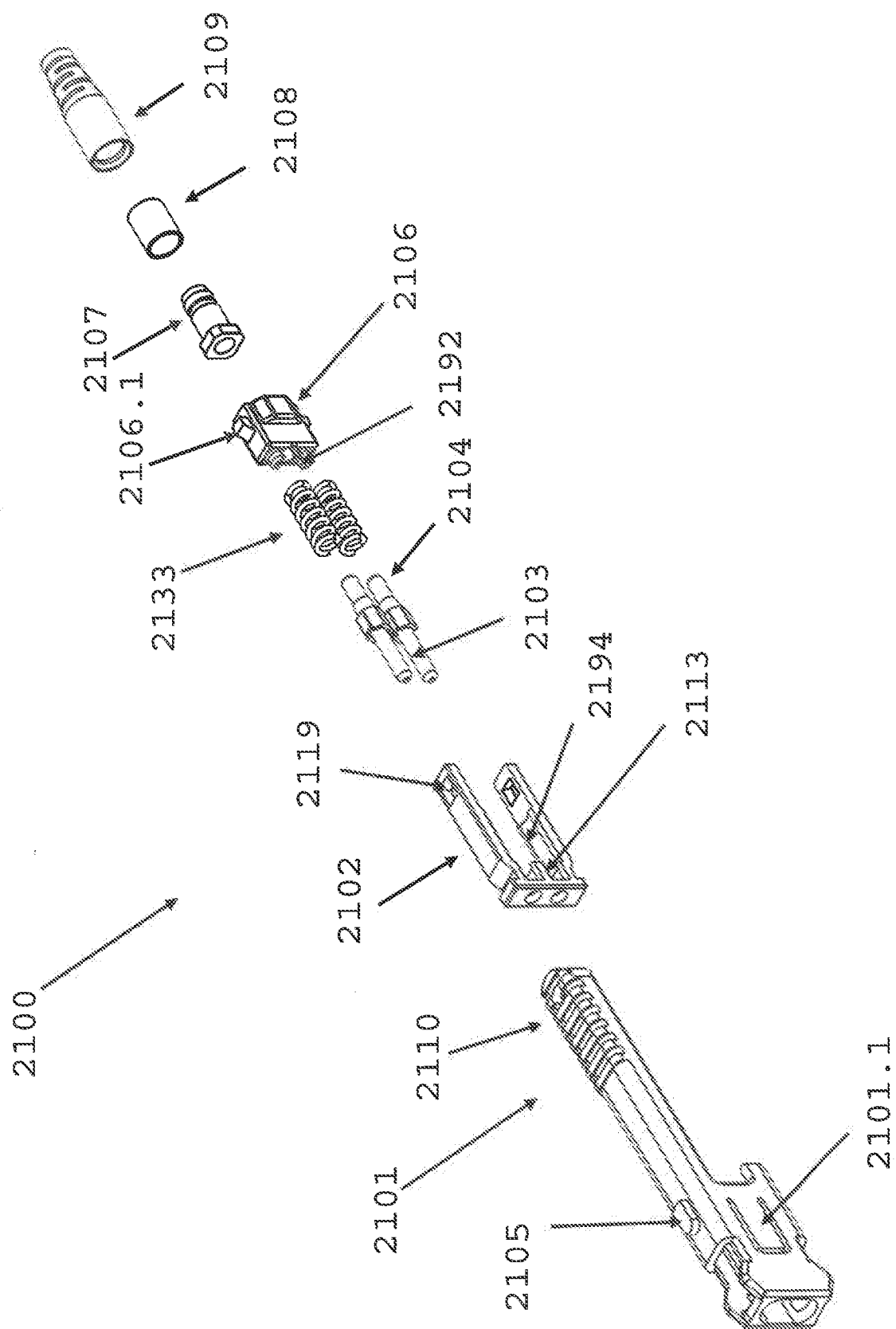
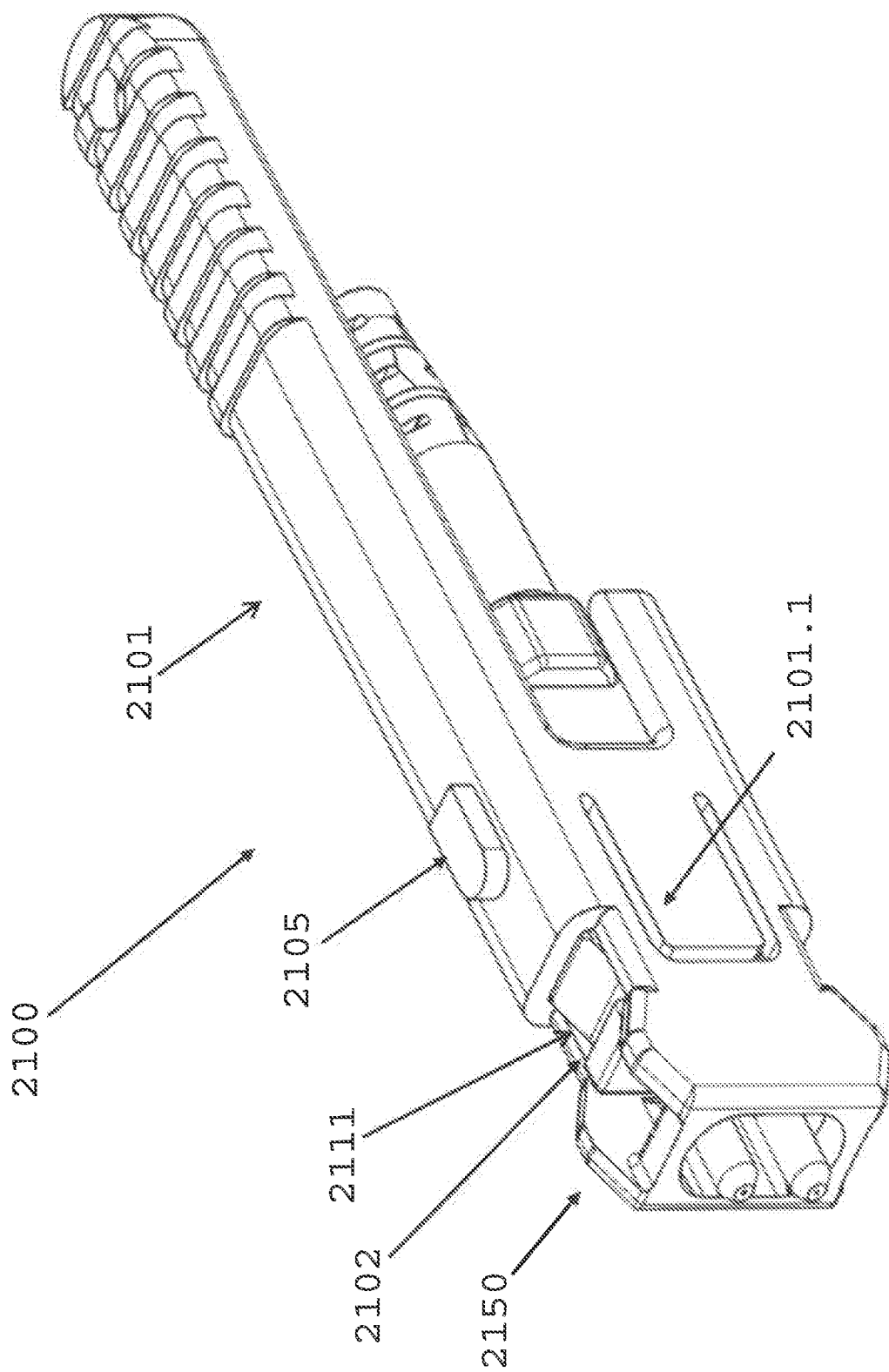


FIG. 21



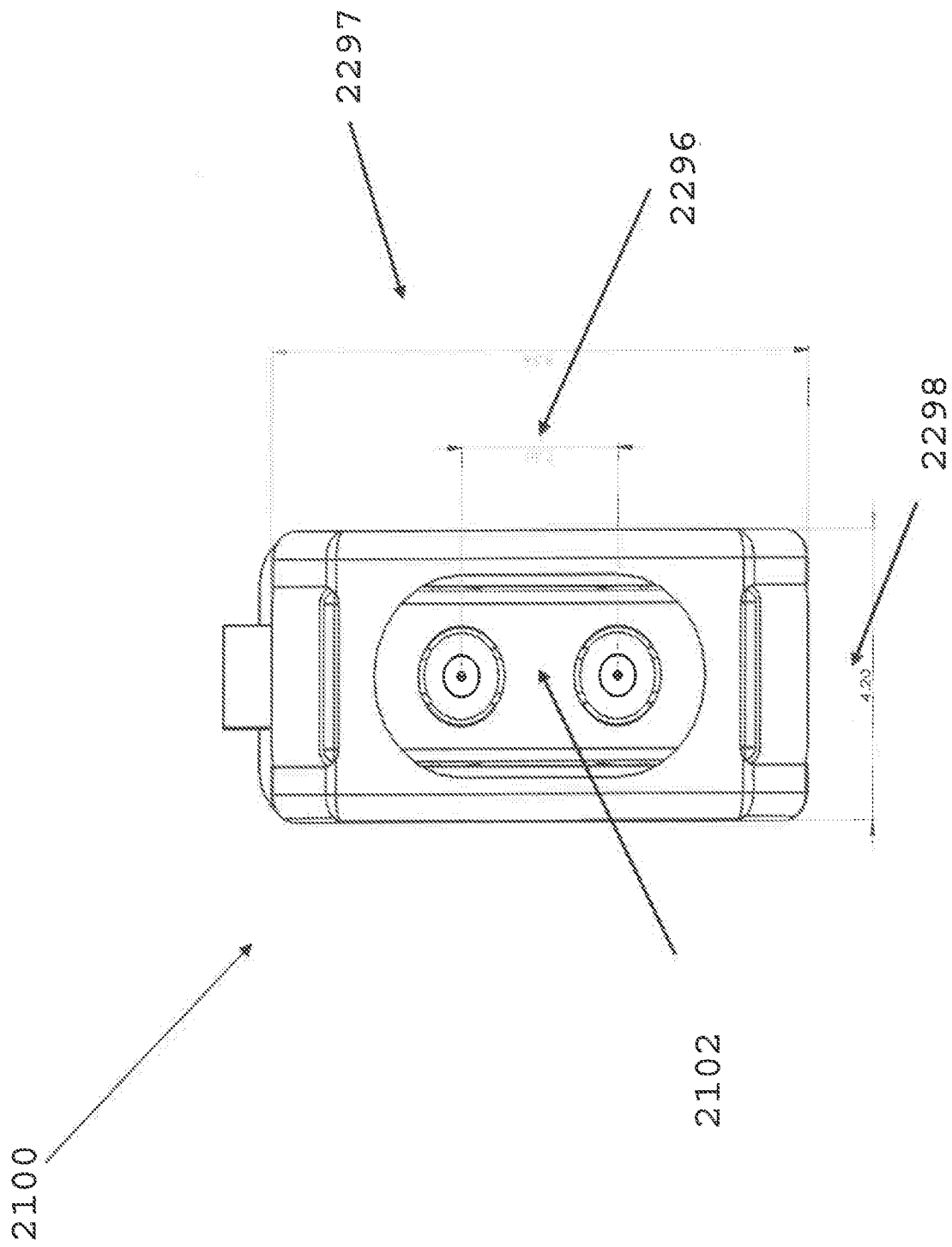


FIG. 22

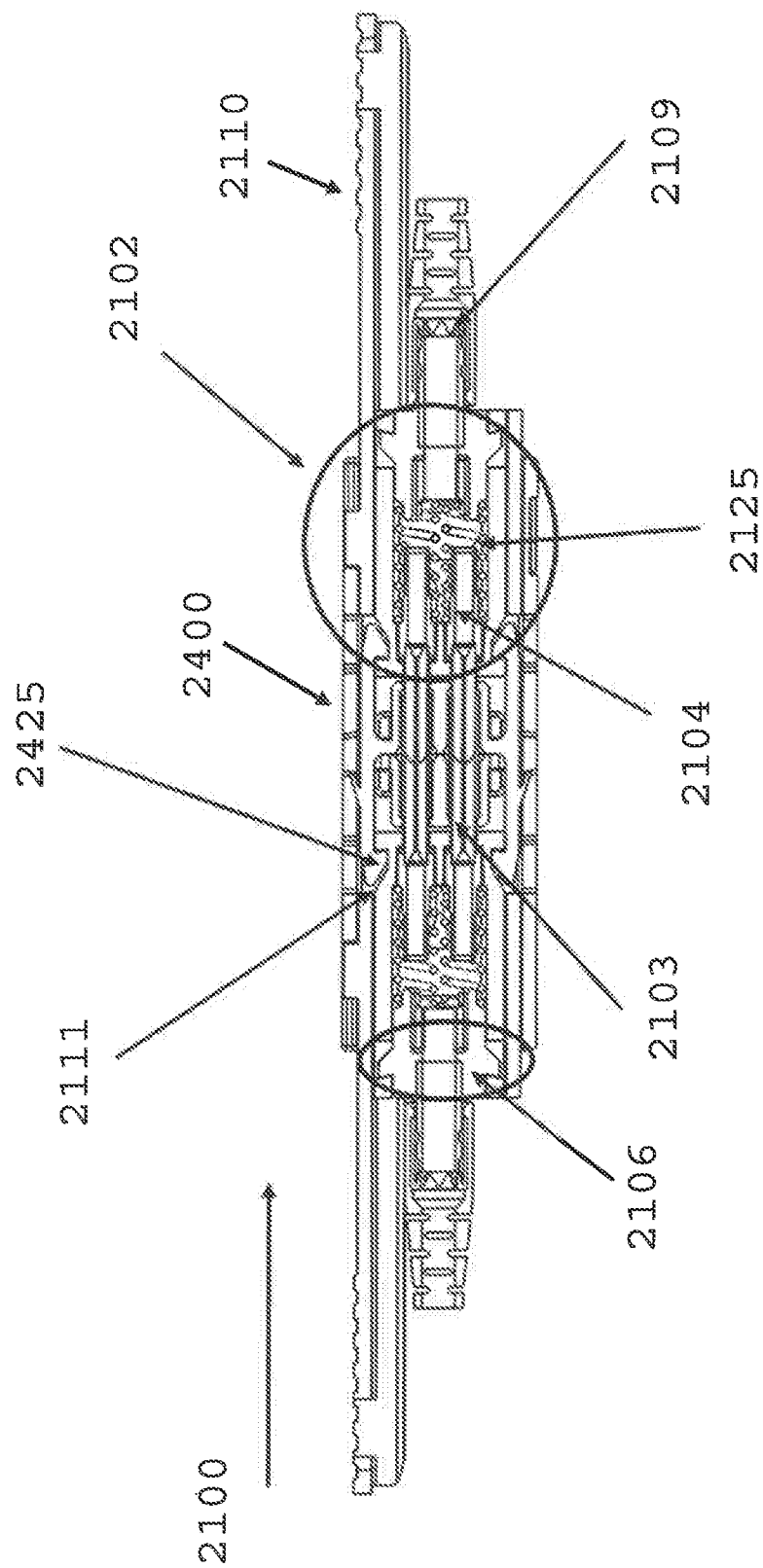


FIG. 23

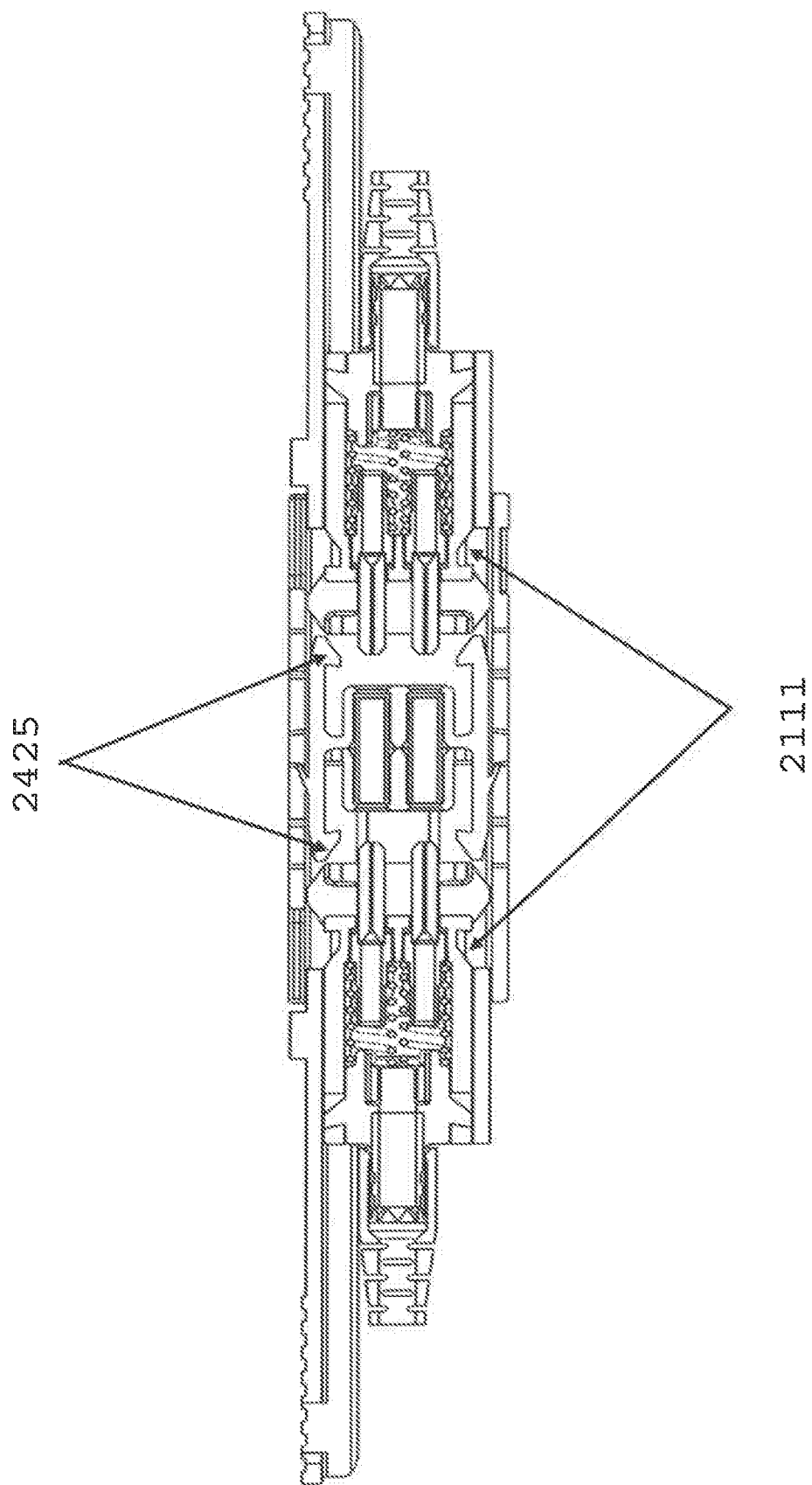


FIG. 23B

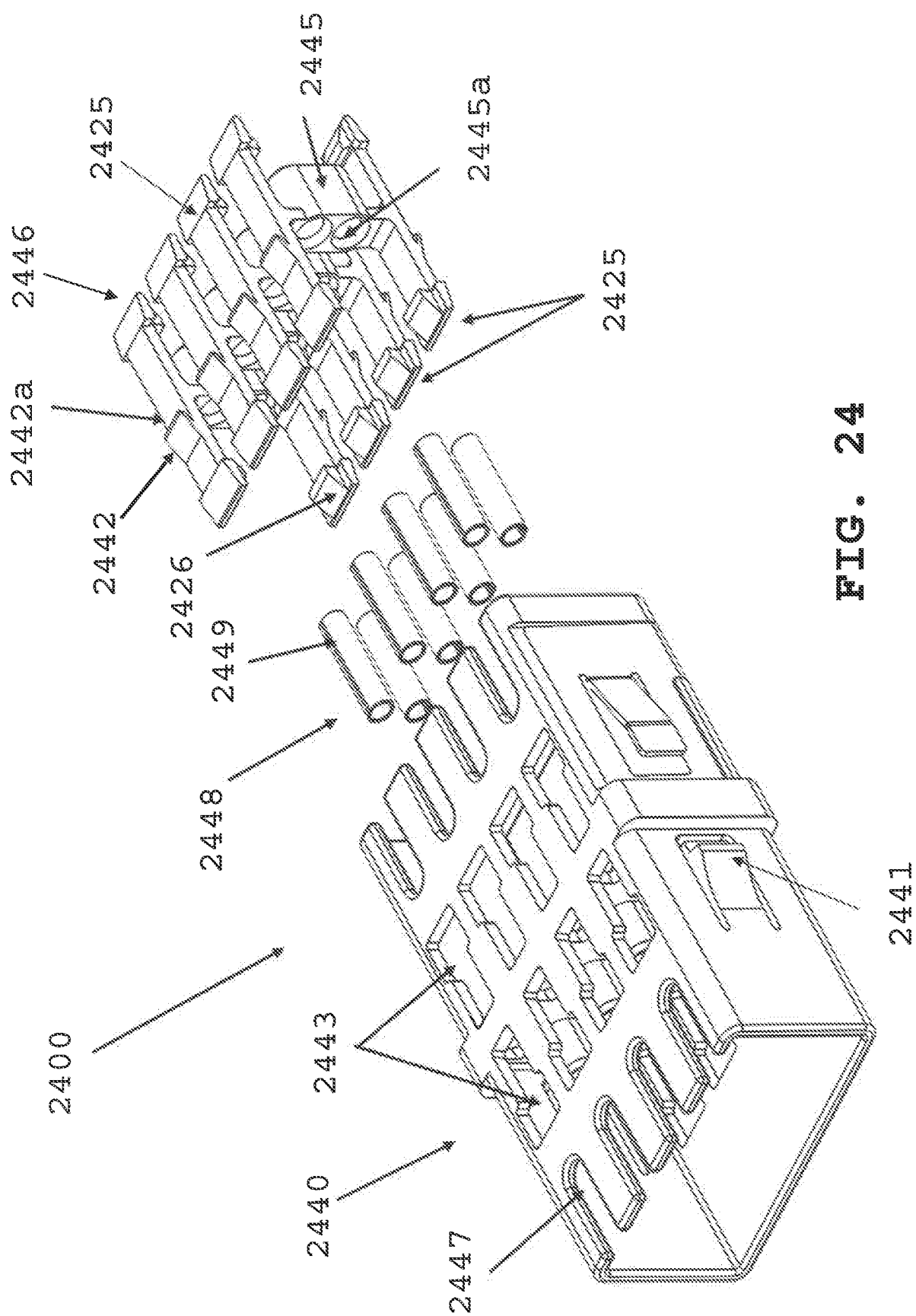


FIG. 24

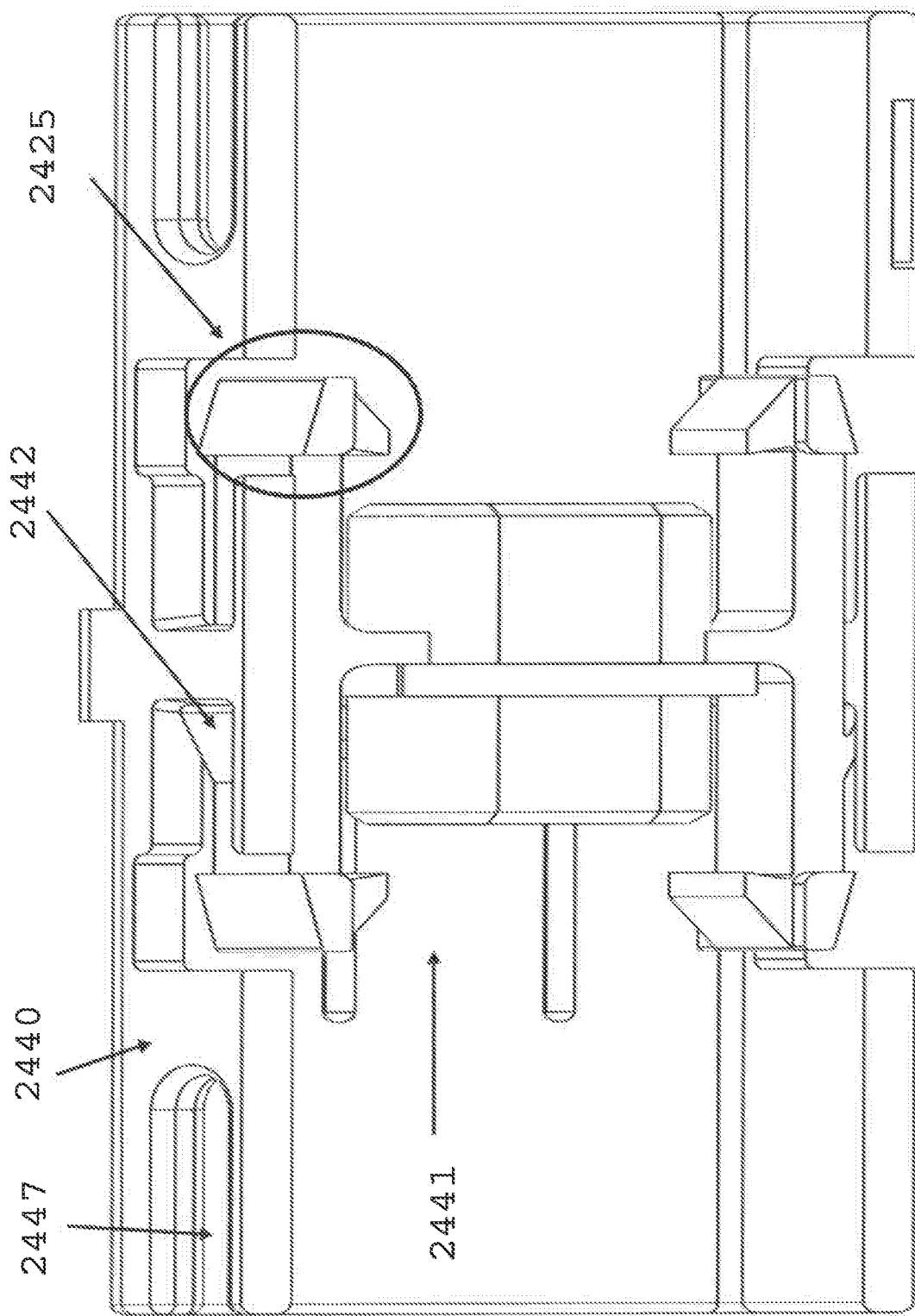


FIG. 25

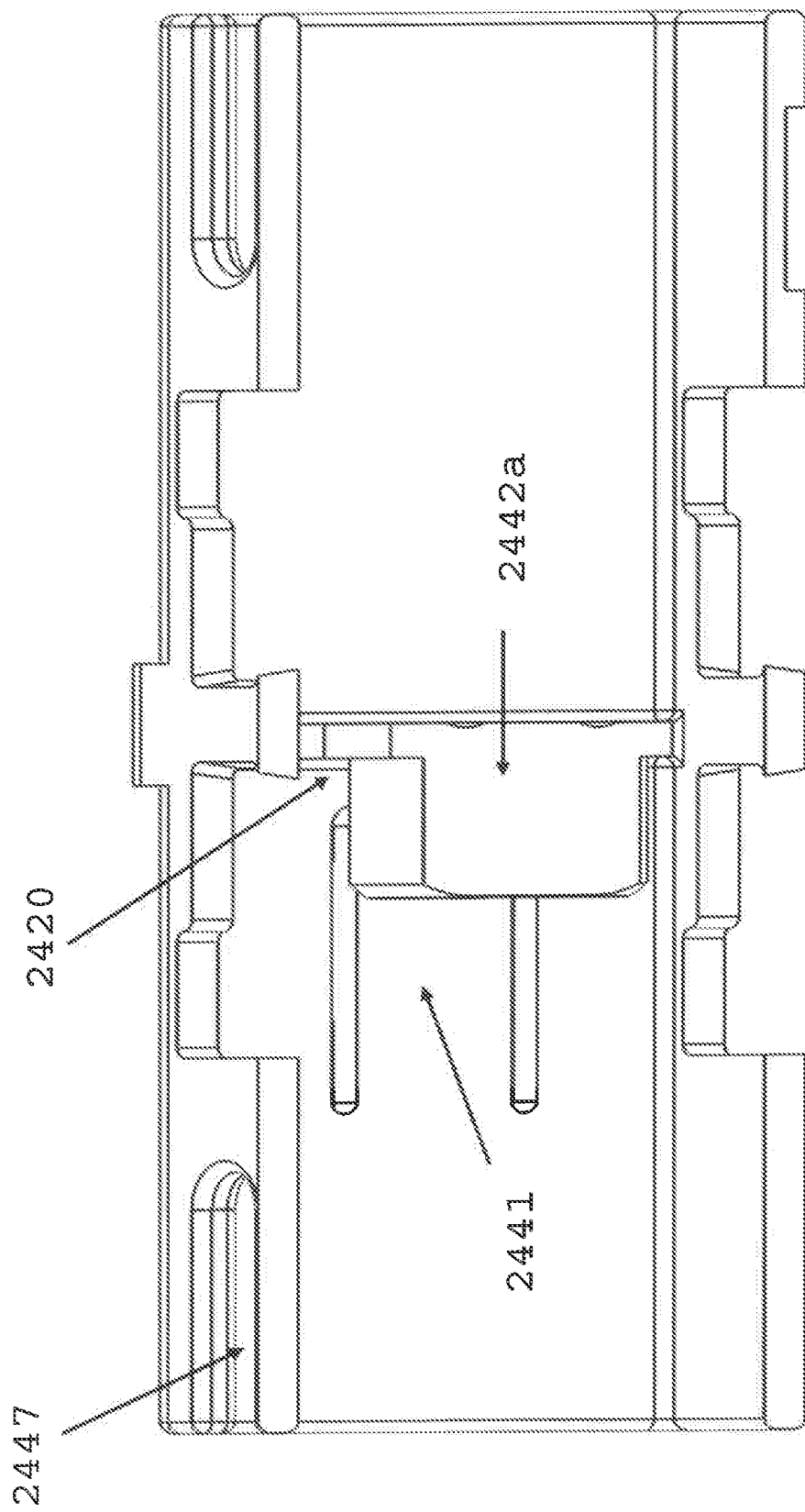


FIG. 25B

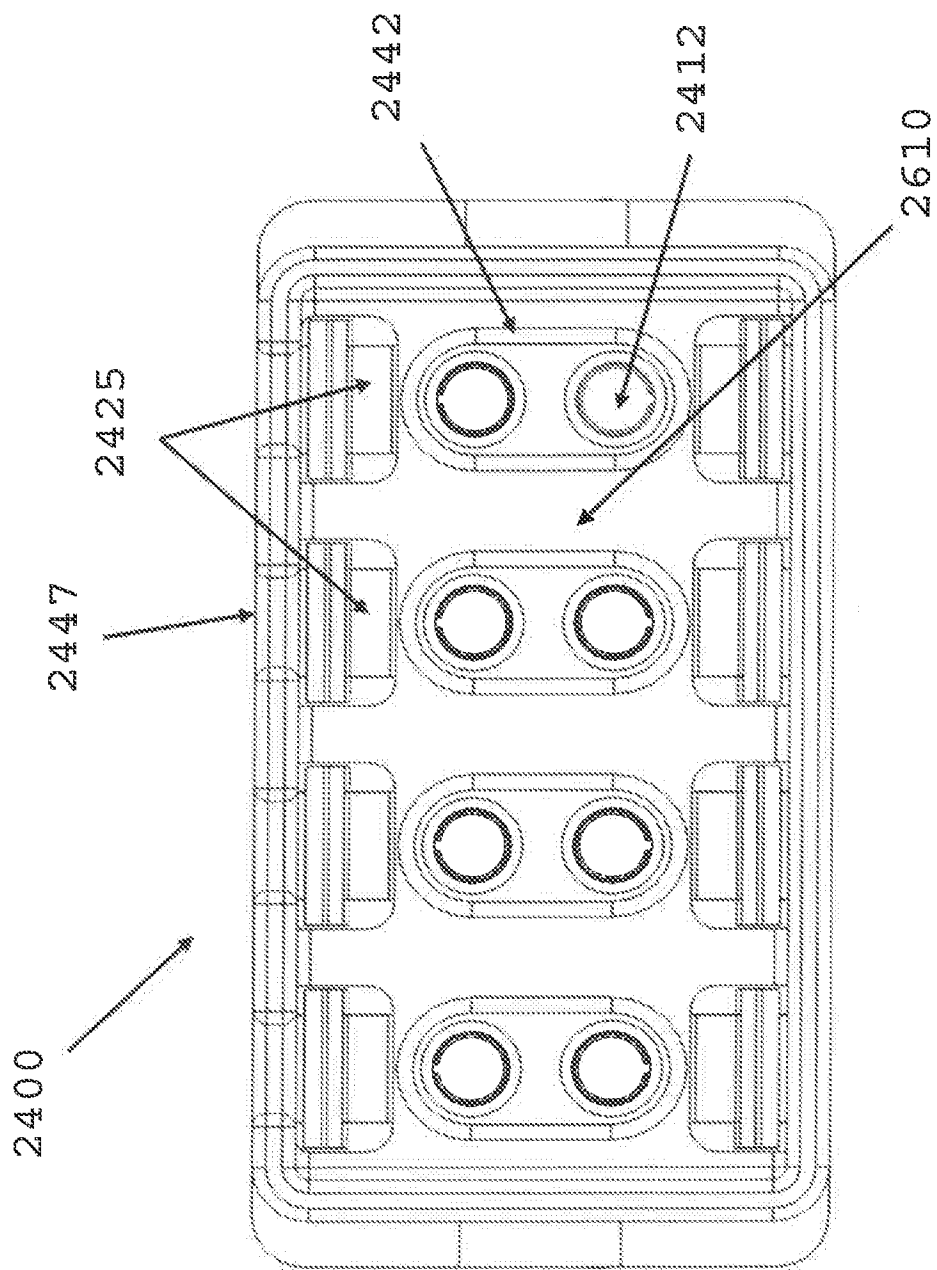


FIG. 26

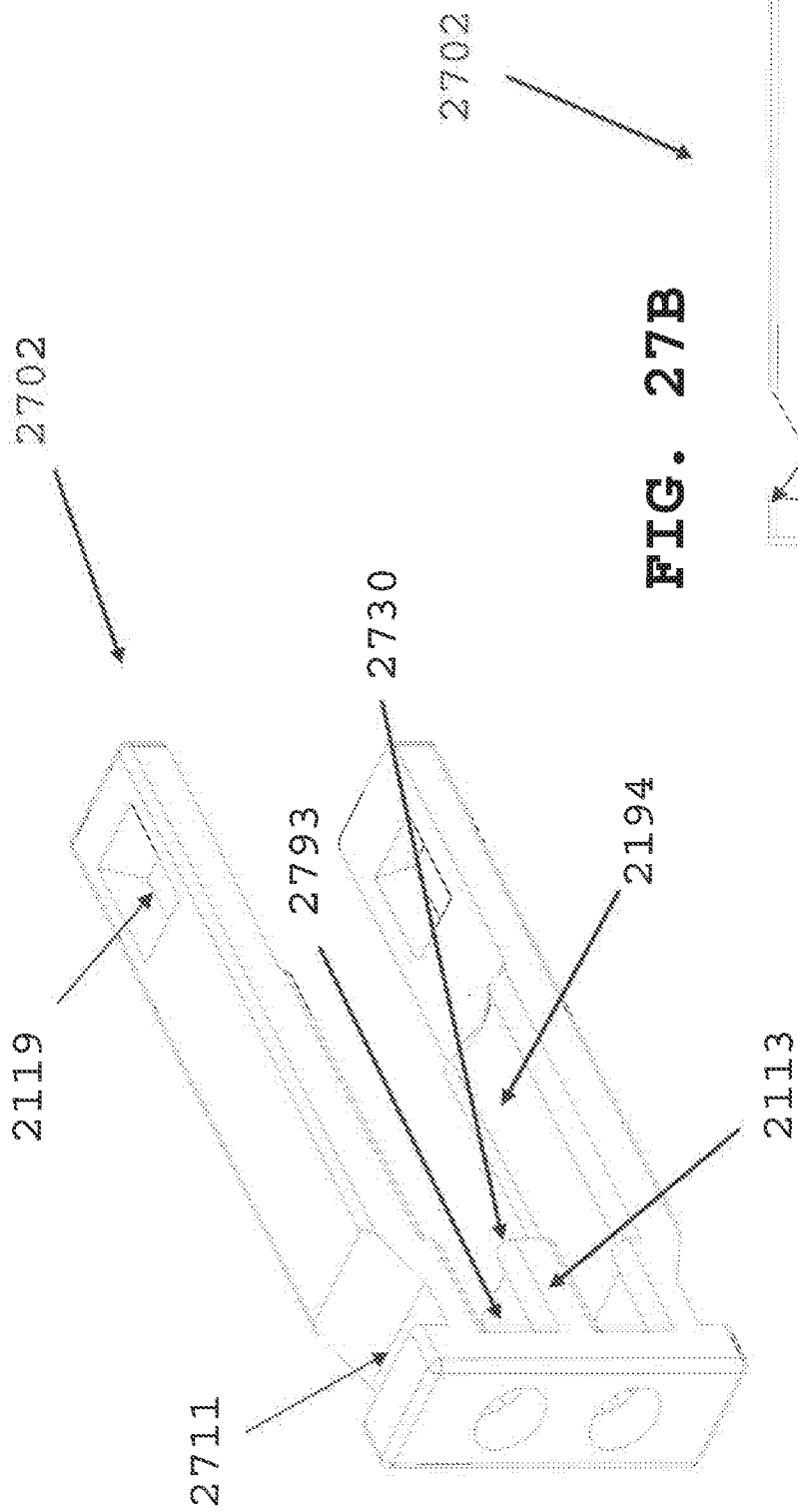


FIG. 27B

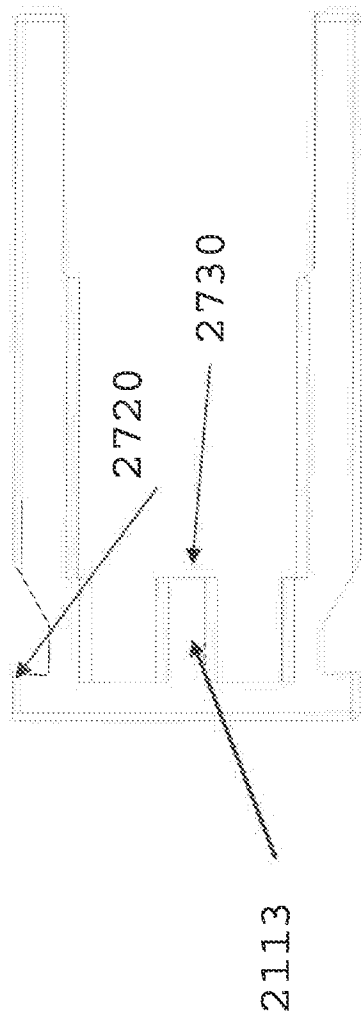


FIG. 27

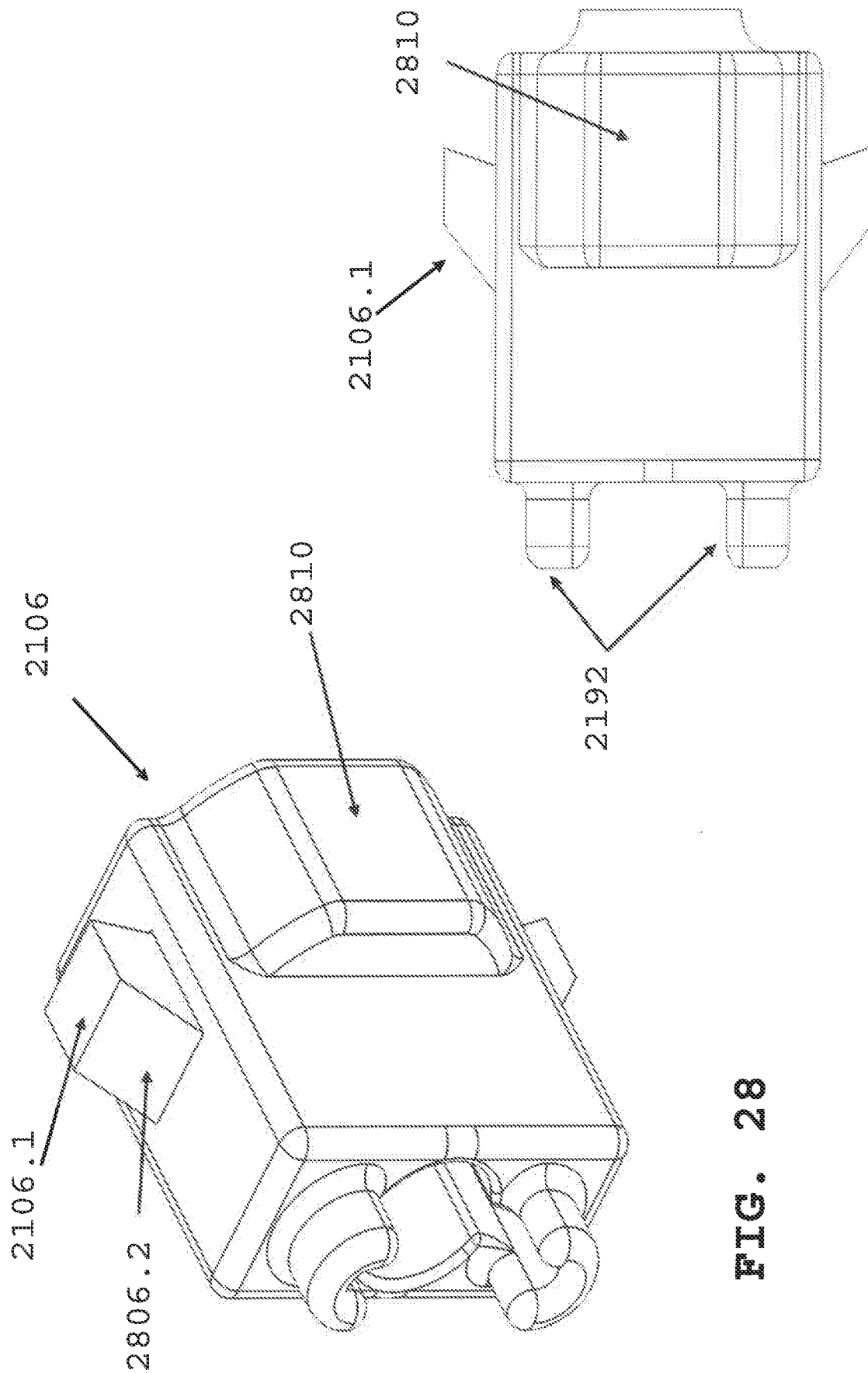


FIG. 28

FIG. 28B

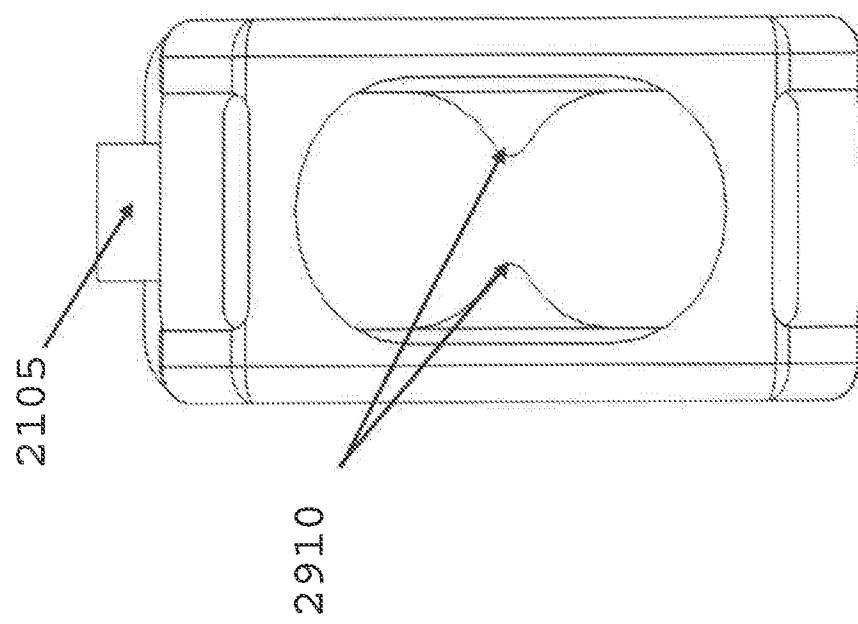


FIG. 29B

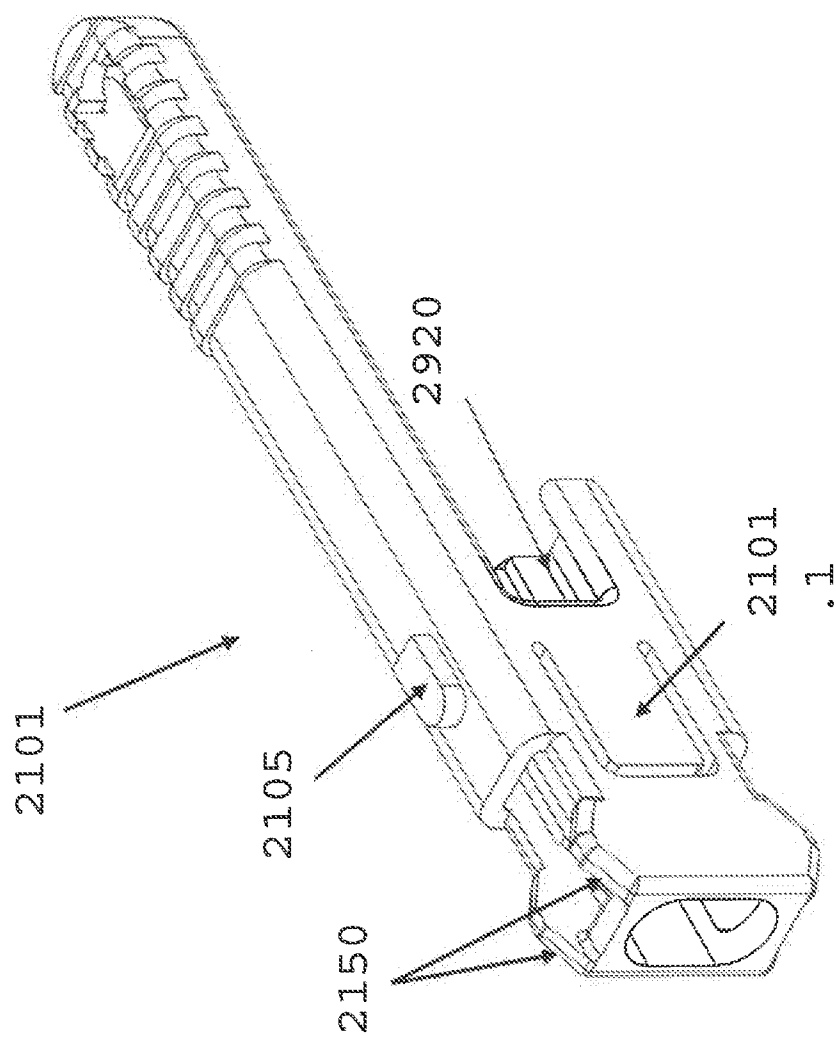


FIG. 29

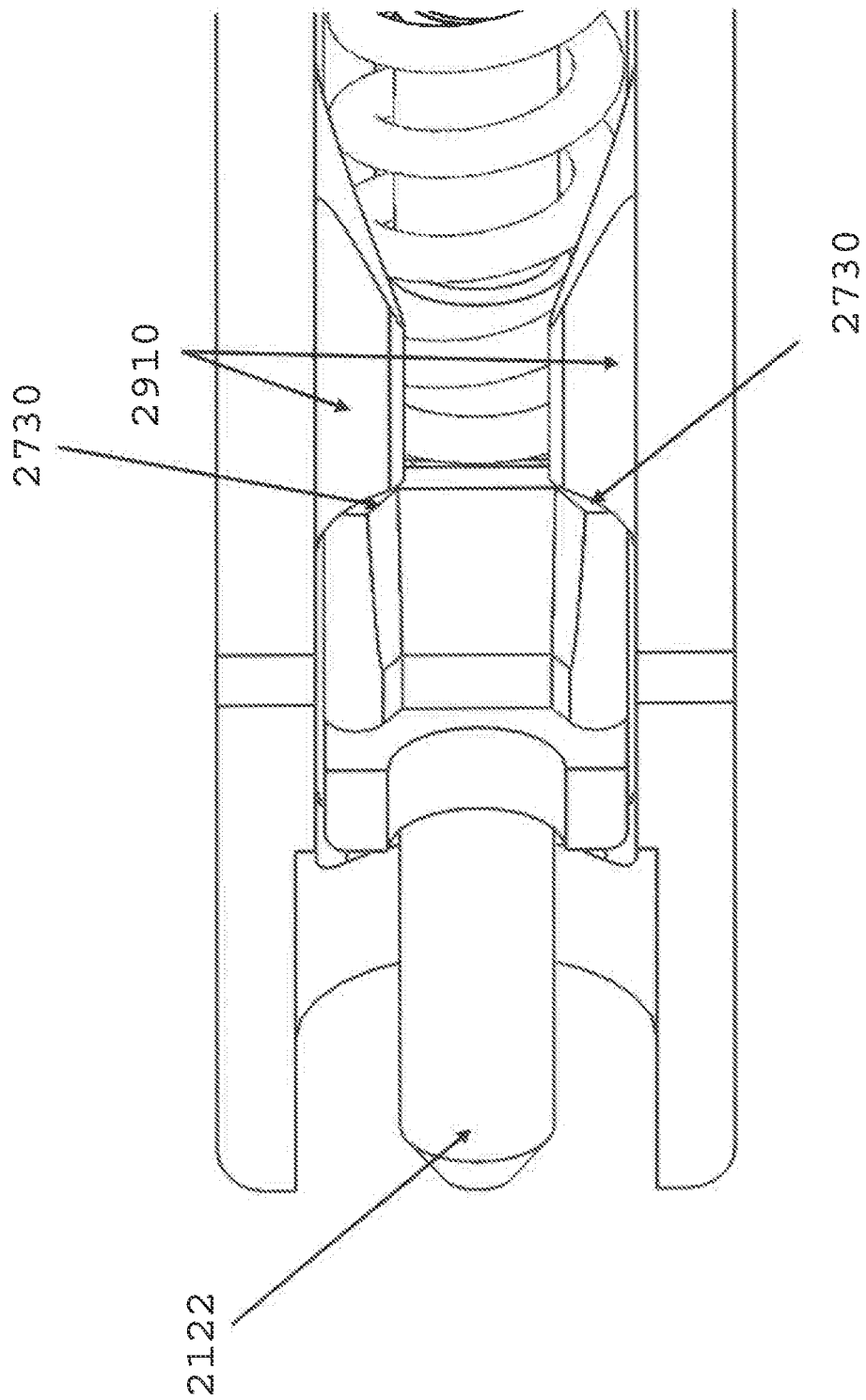
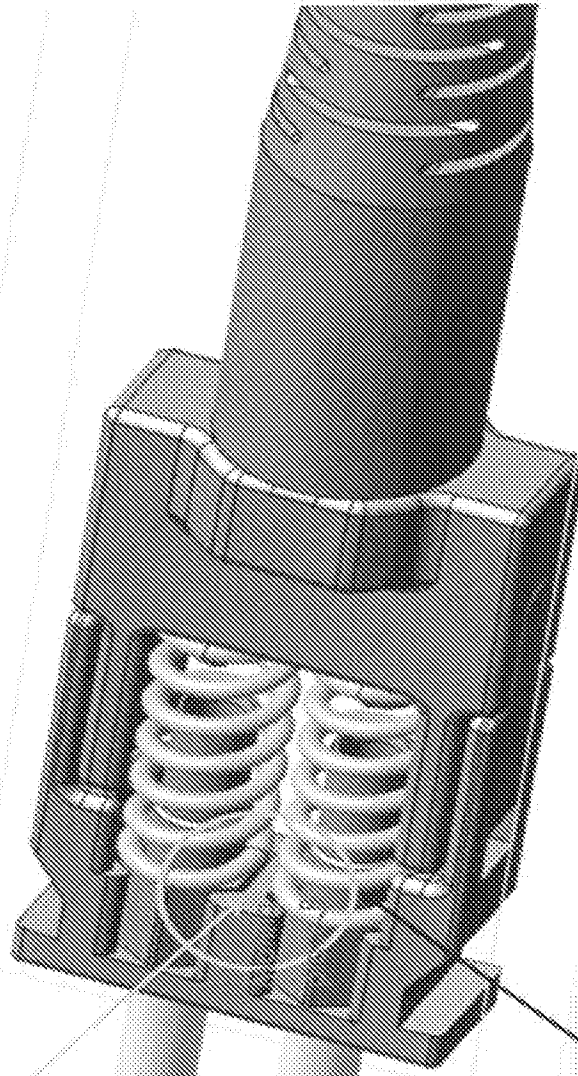


FIG. 29C

FLAP "A"

Connector Side Flap Operation

Inward Flap A on outer housing will click on to
inside housing mating place B



MATING
PIECE B

FIG. 29D

deleted

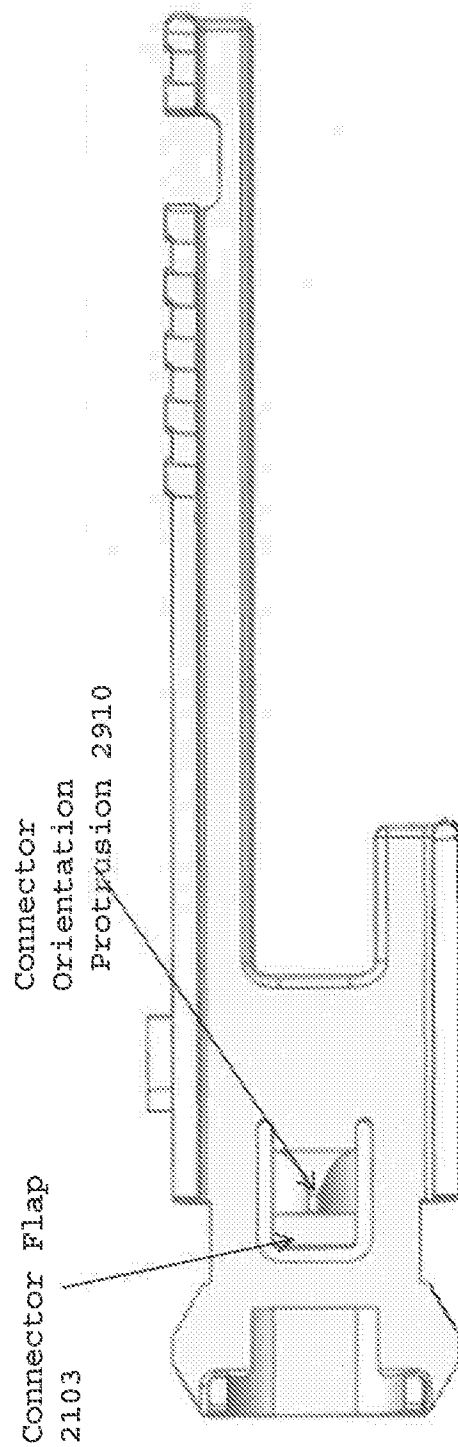


FIG. 29E Inner View of Outer
Housing

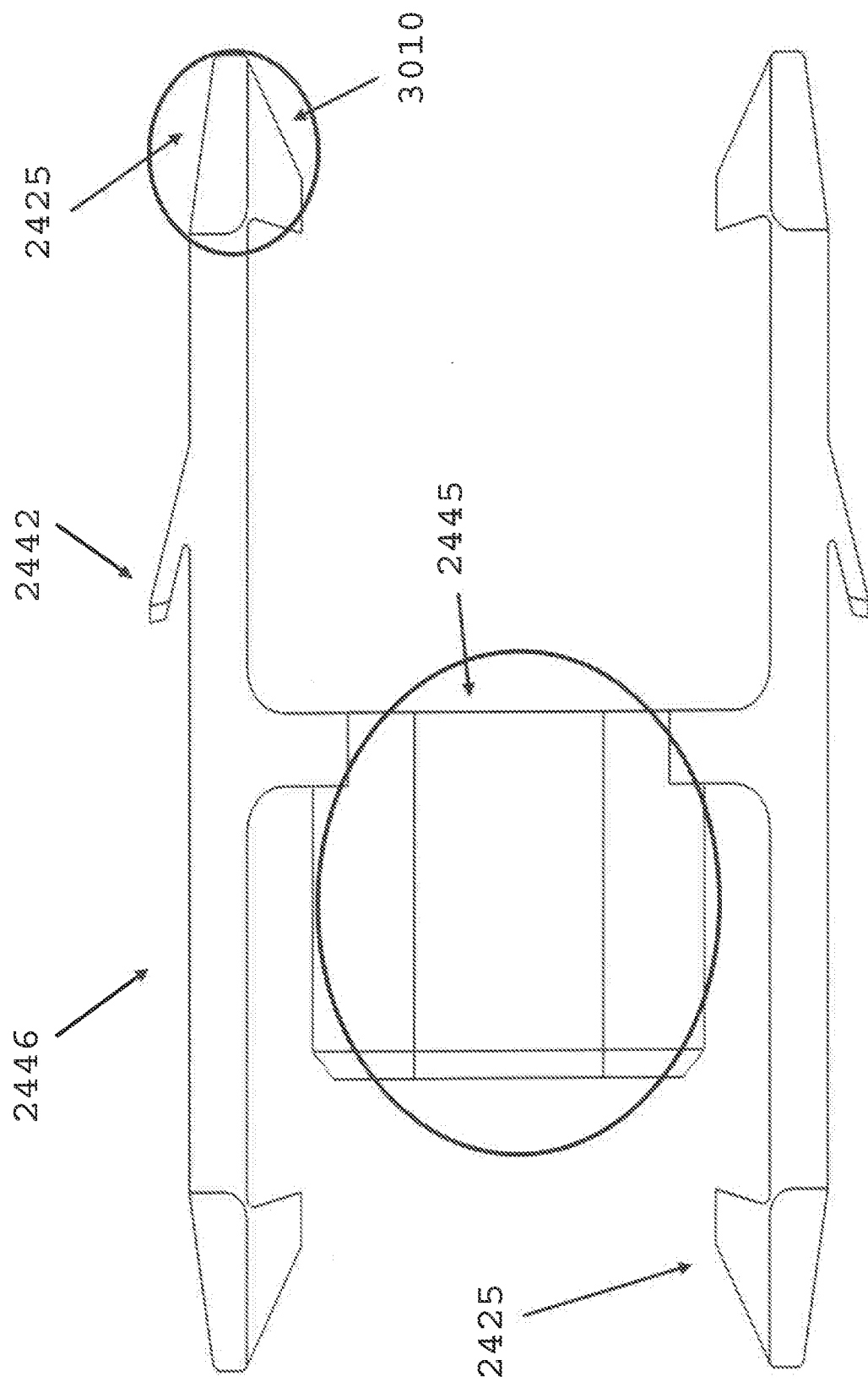


FIG. 30

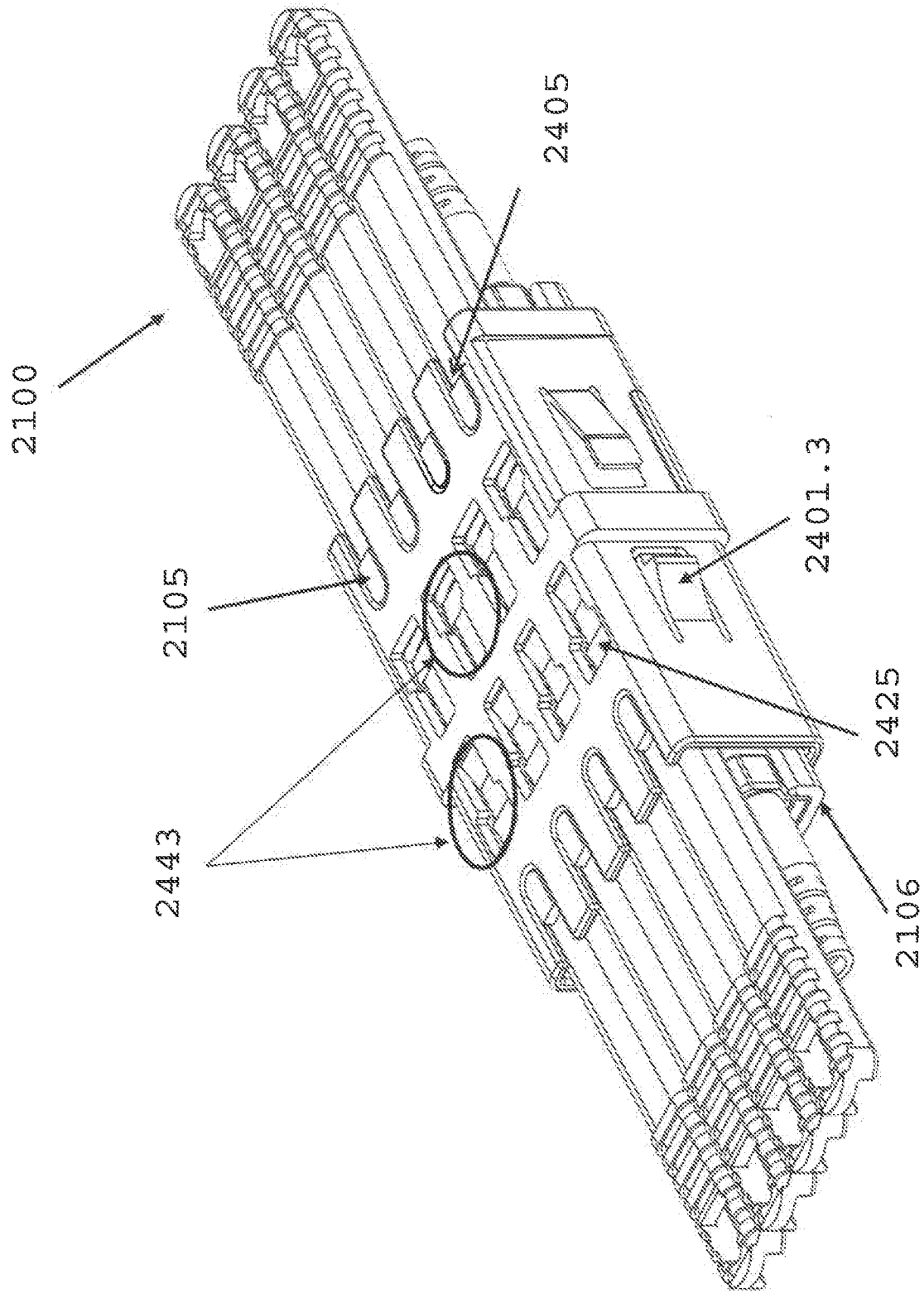


FIG. 31

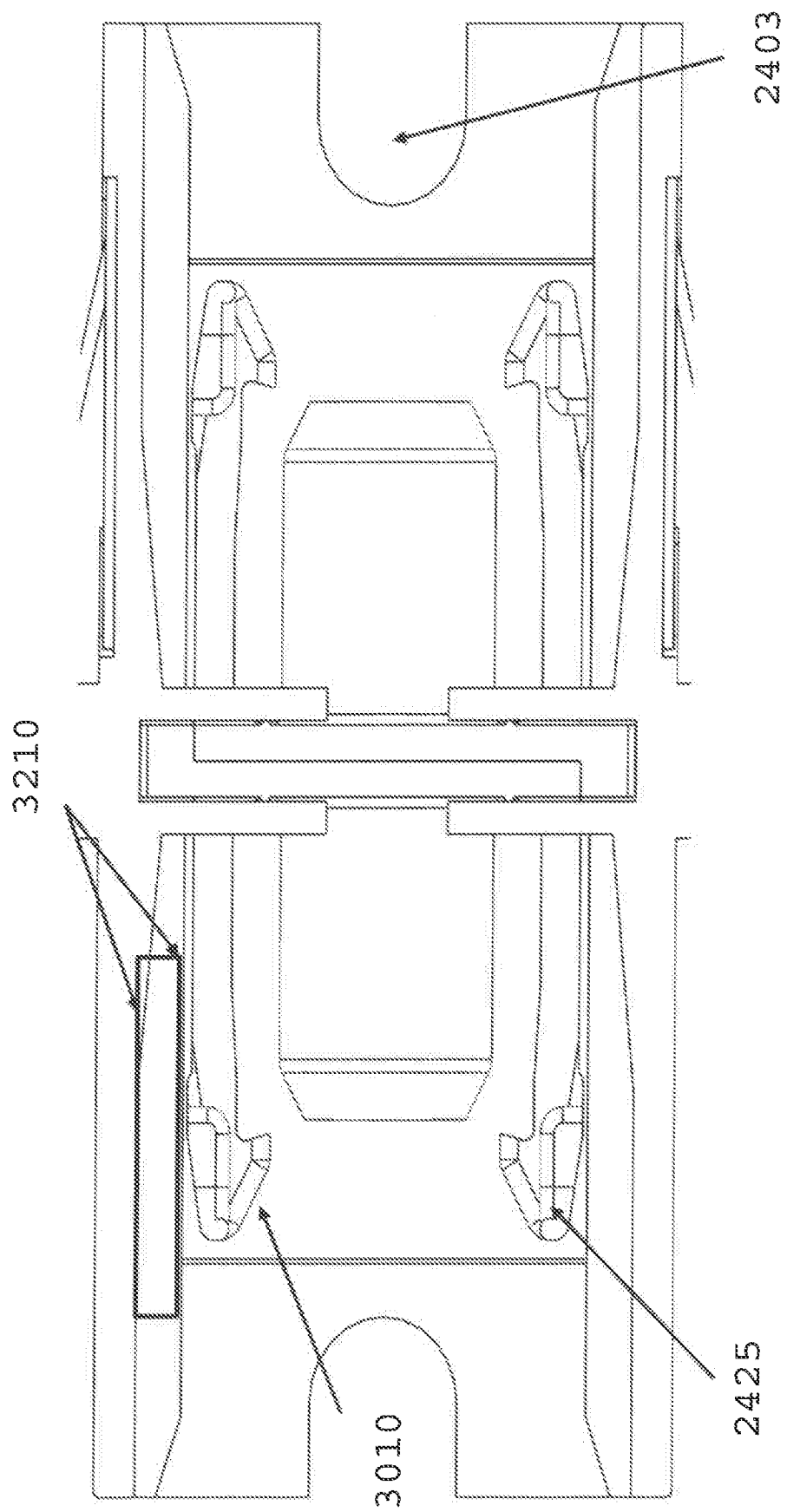


FIG. 32

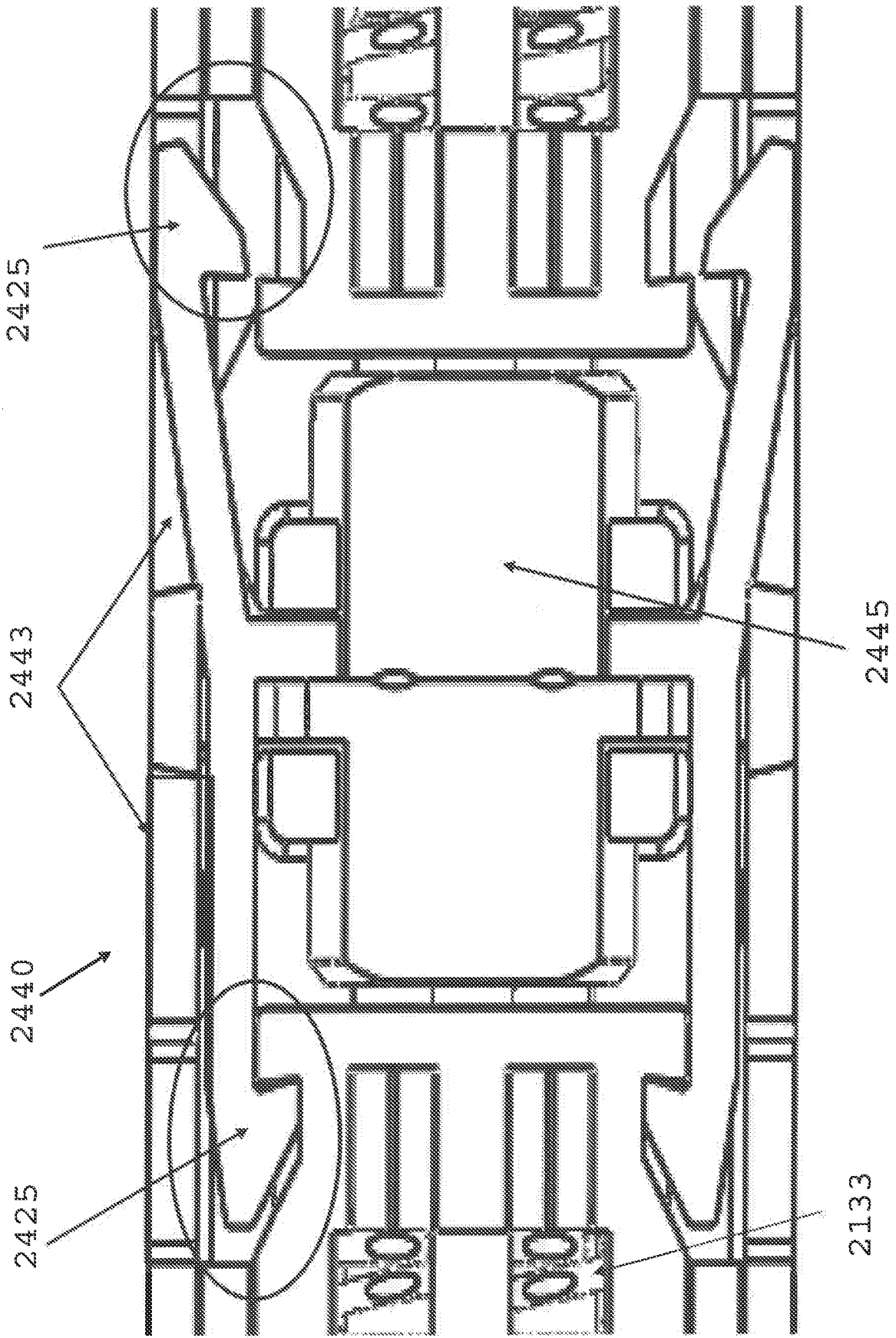


FIG. 32B

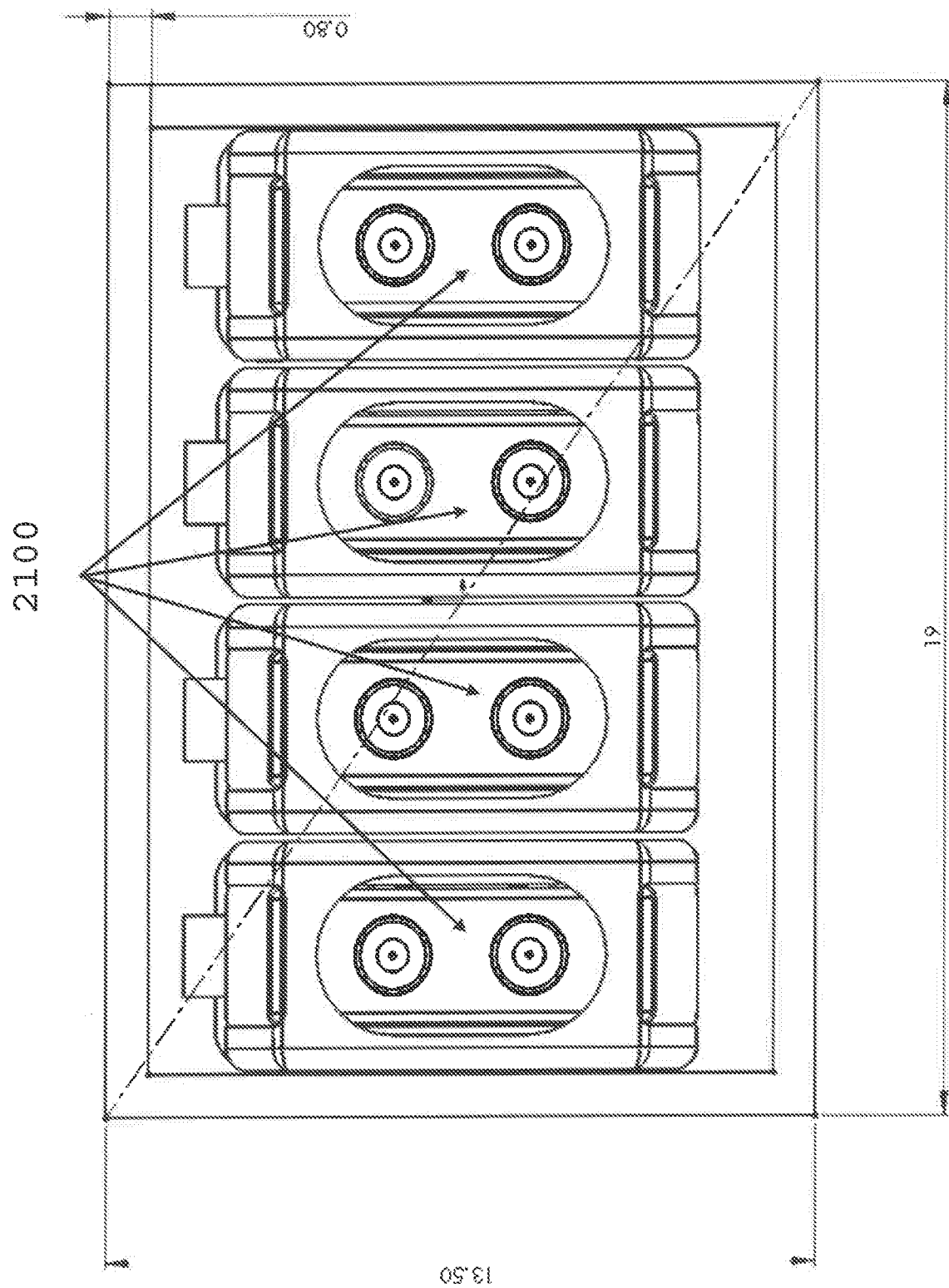


FIG. 33

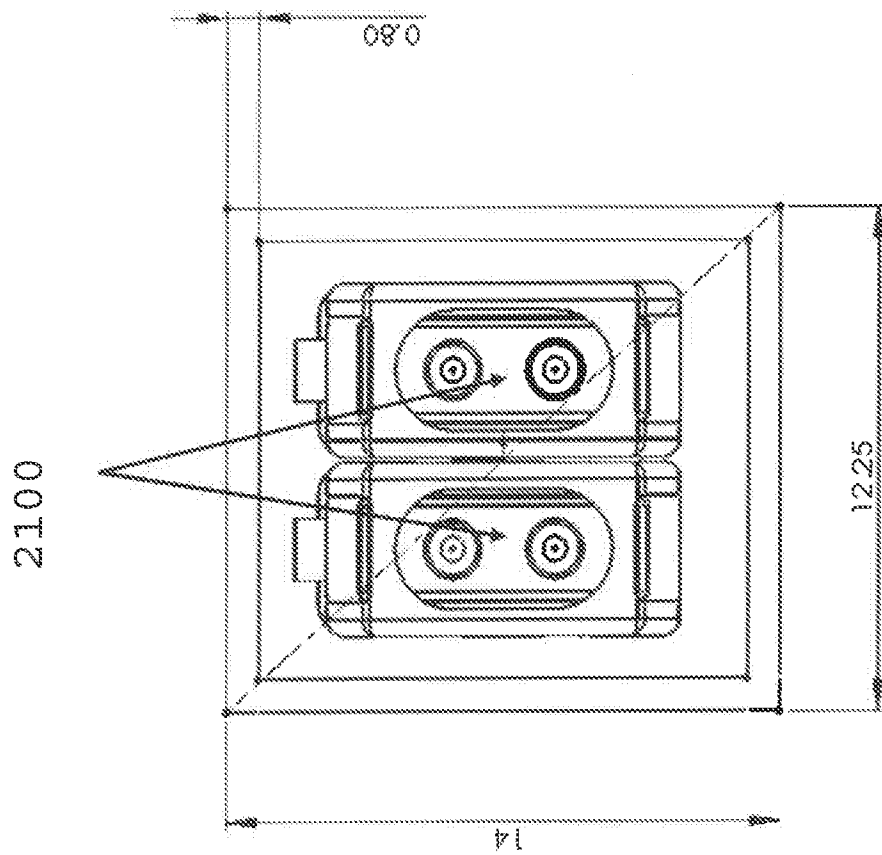


FIG. 33B

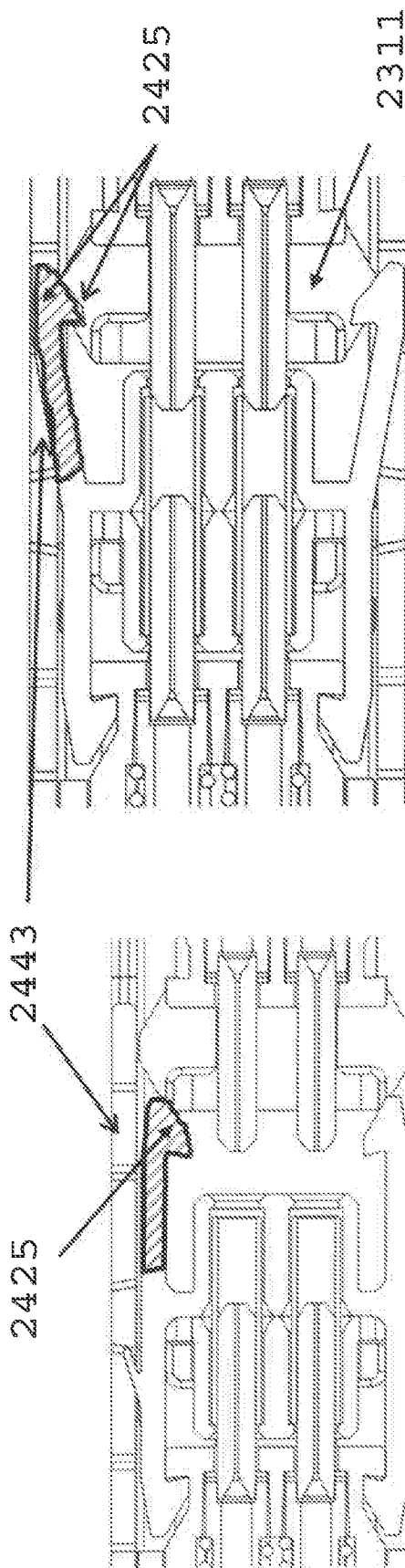


FIG. 34B During Latching

FIG. 34 Before Latching

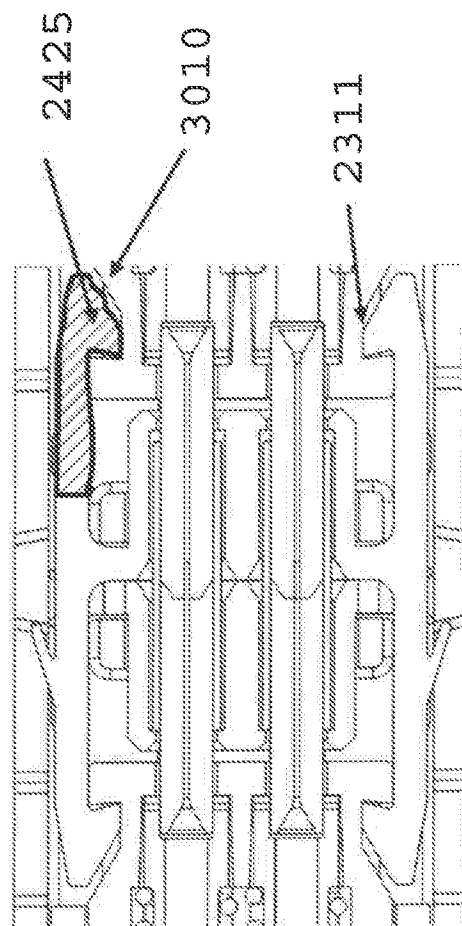


FIG. 34C Latched

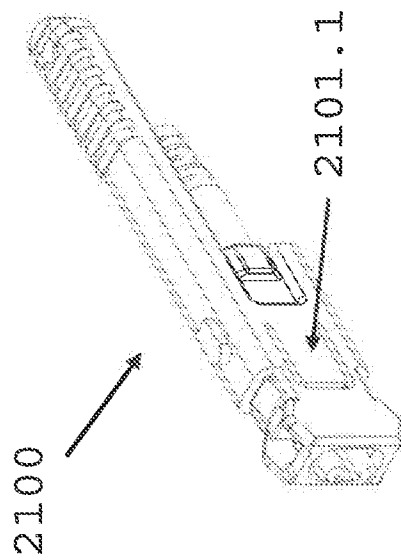


FIG. 35 Before Disconnect

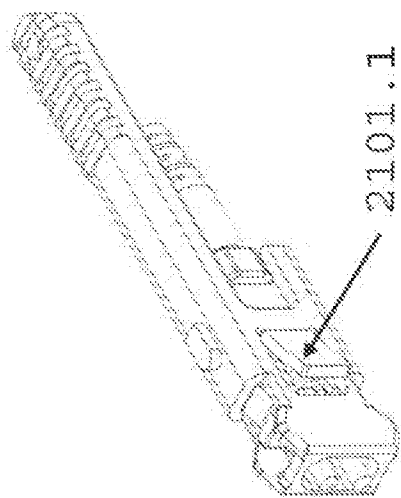


FIG. 35B During Disconnect

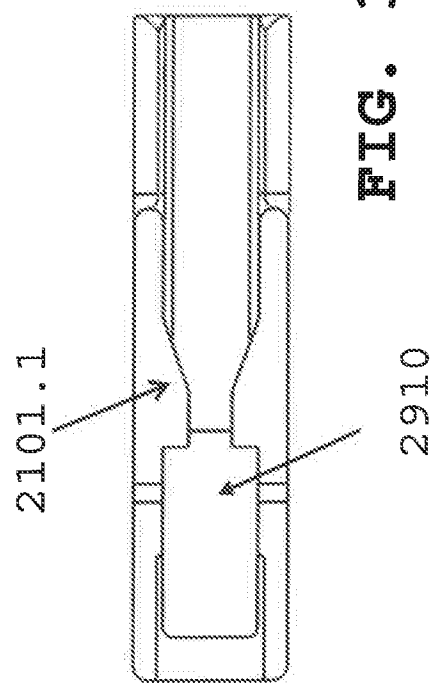
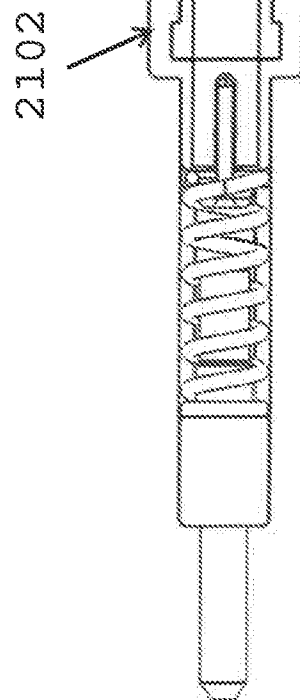


FIG. 35C After Disconnect



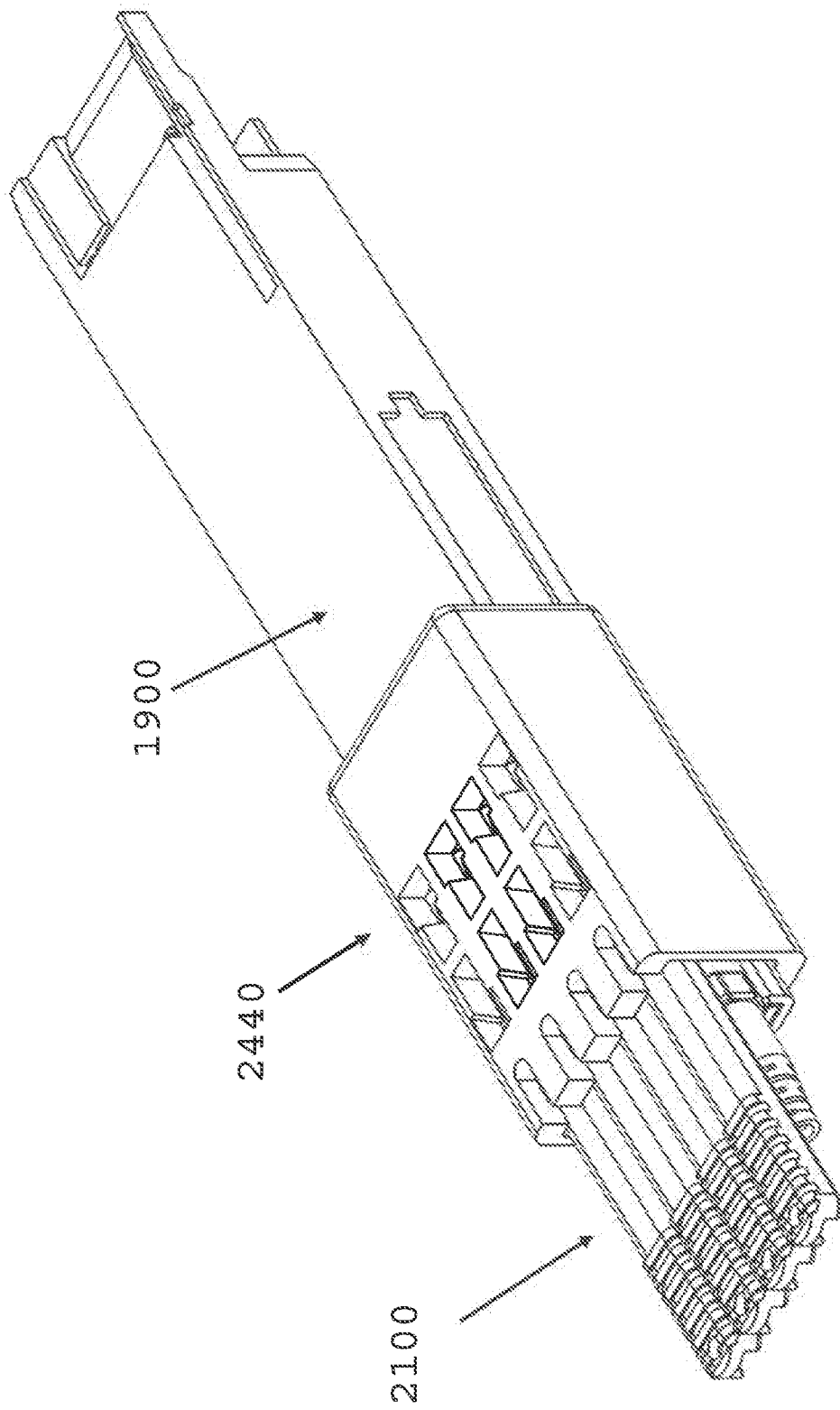


FIG. 36

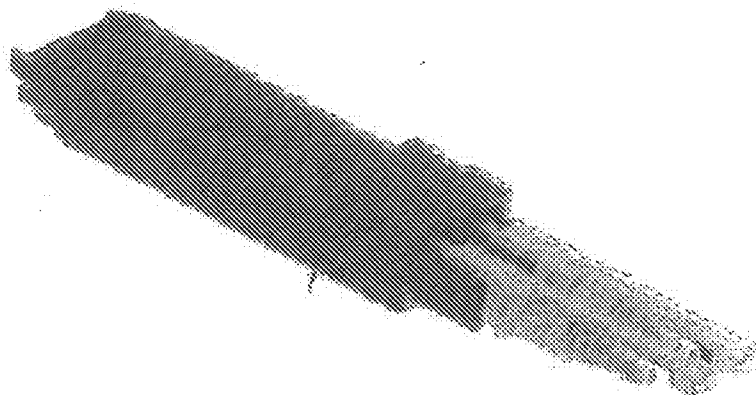


FIG. 36B Perspective View of Connector installed in a Transceiver

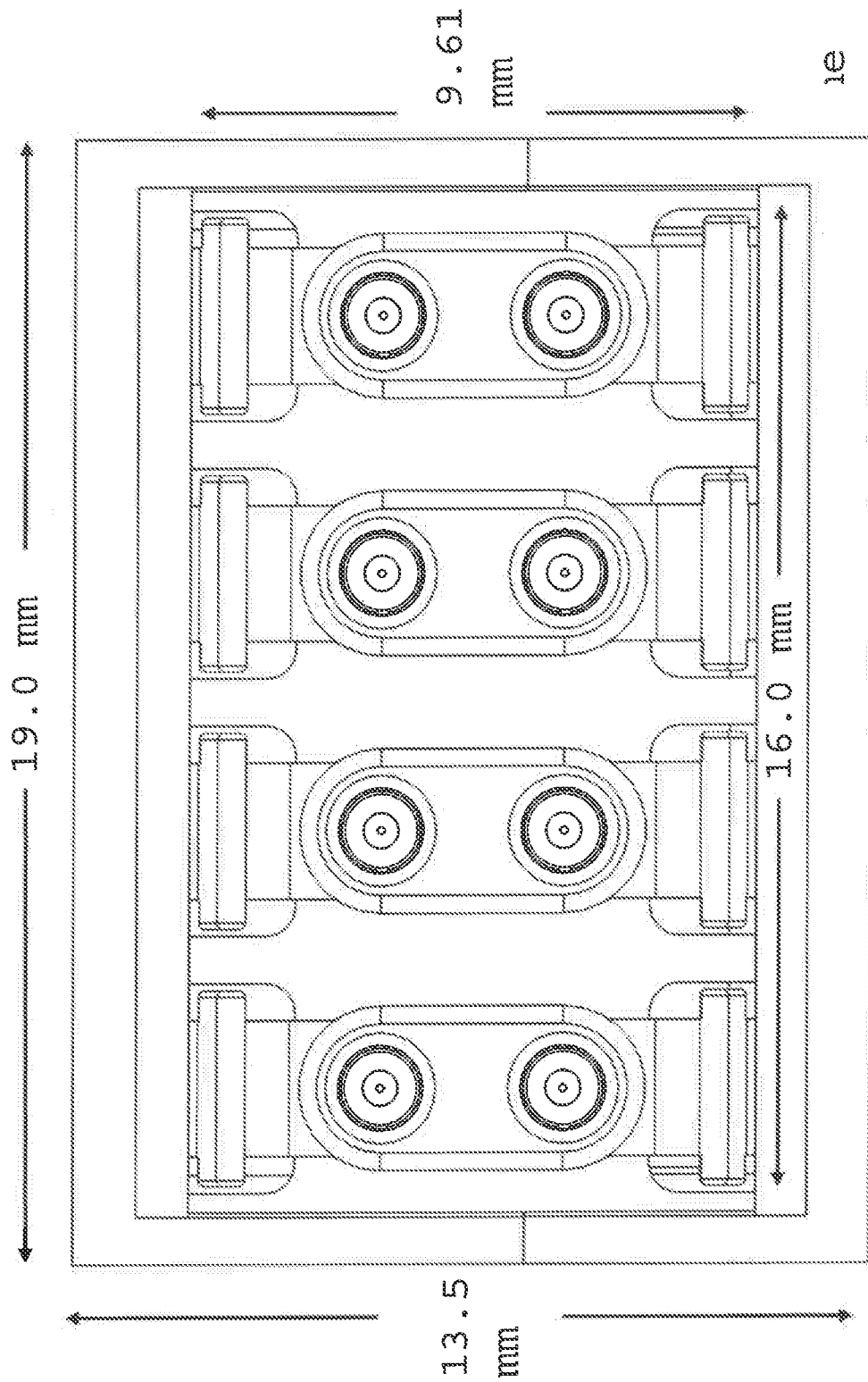


FIG. 36C

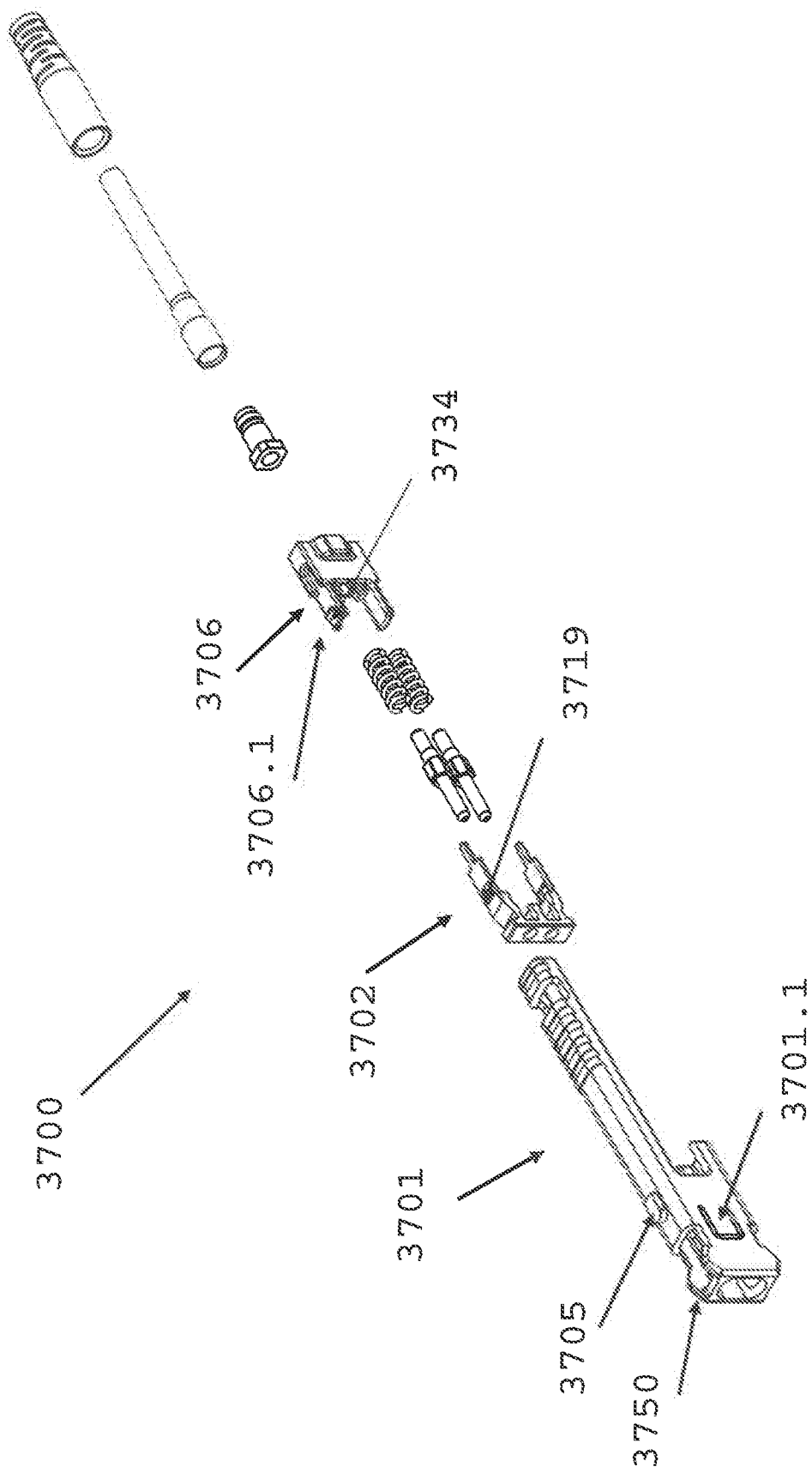


FIG. 37

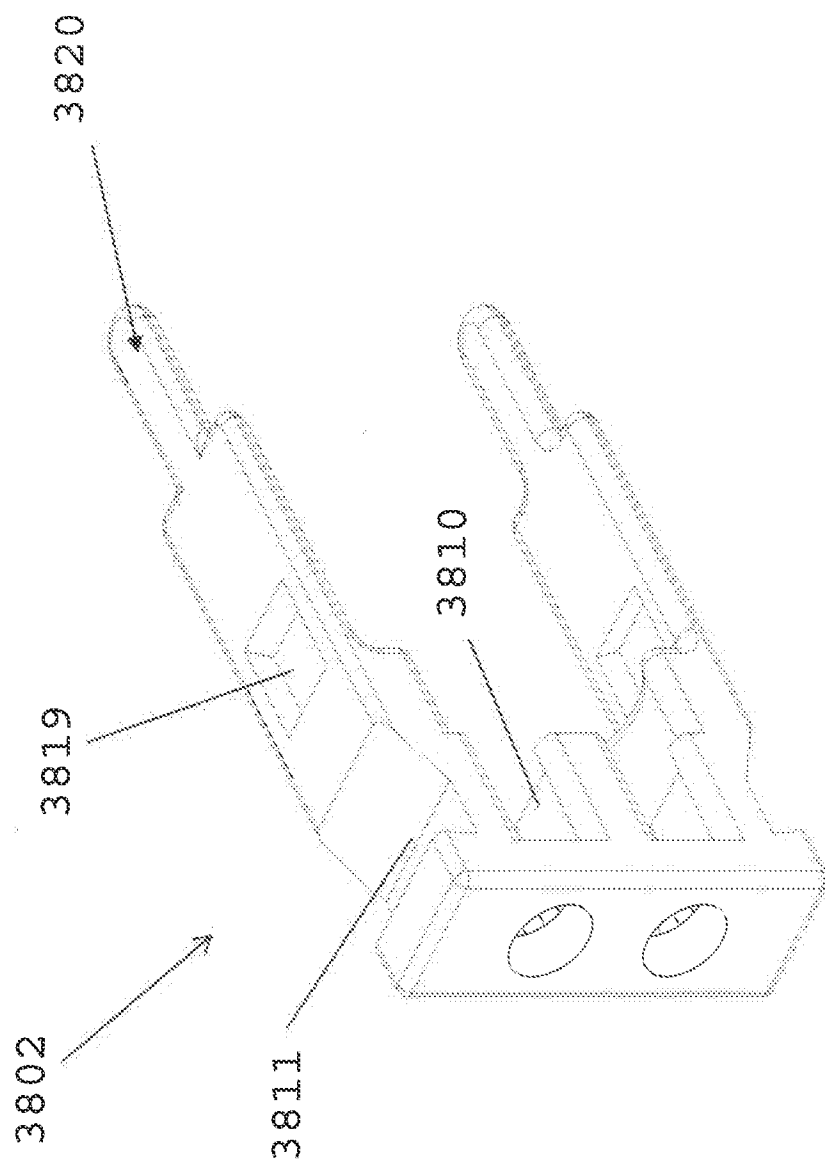


FIG. 38

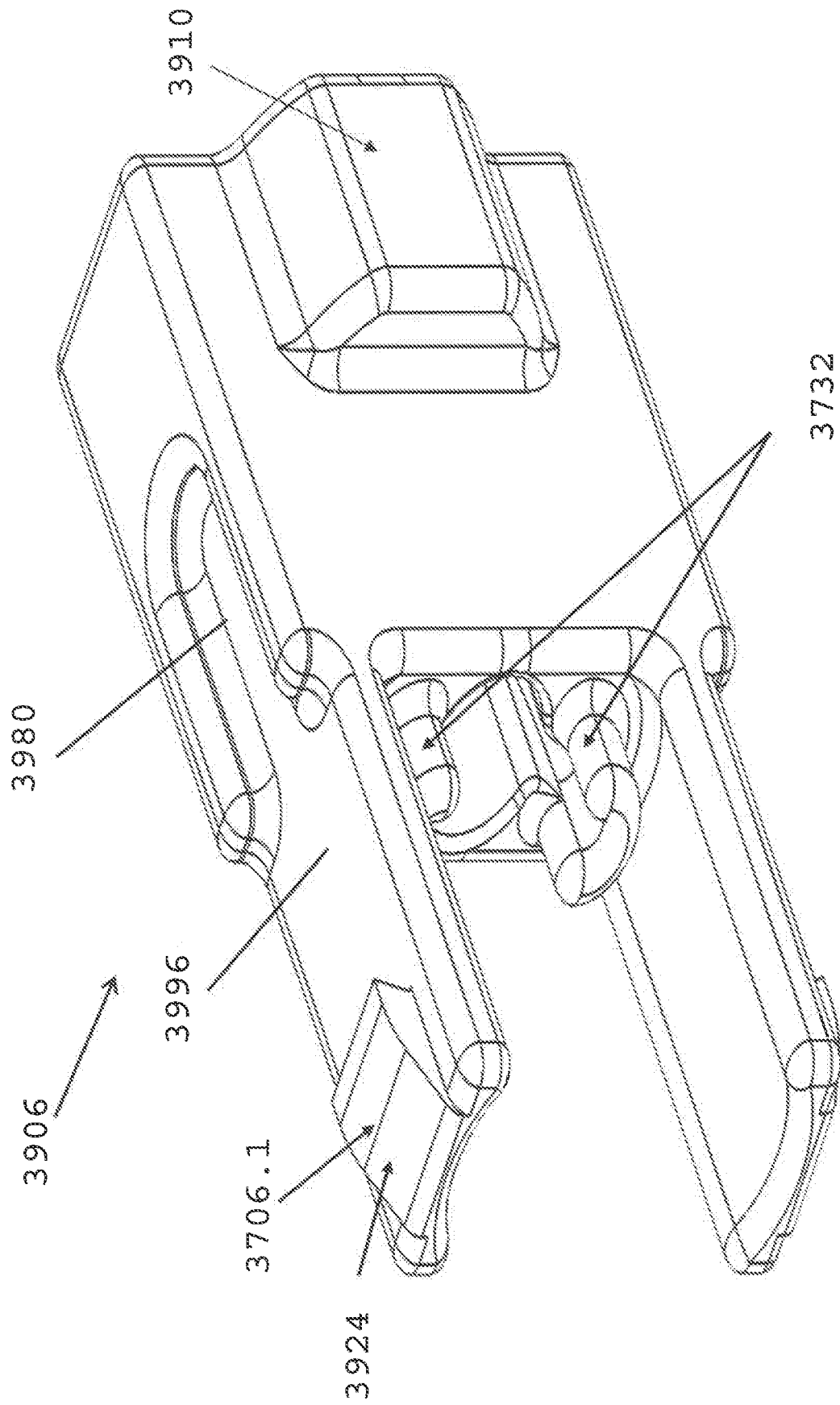


FIG. 39

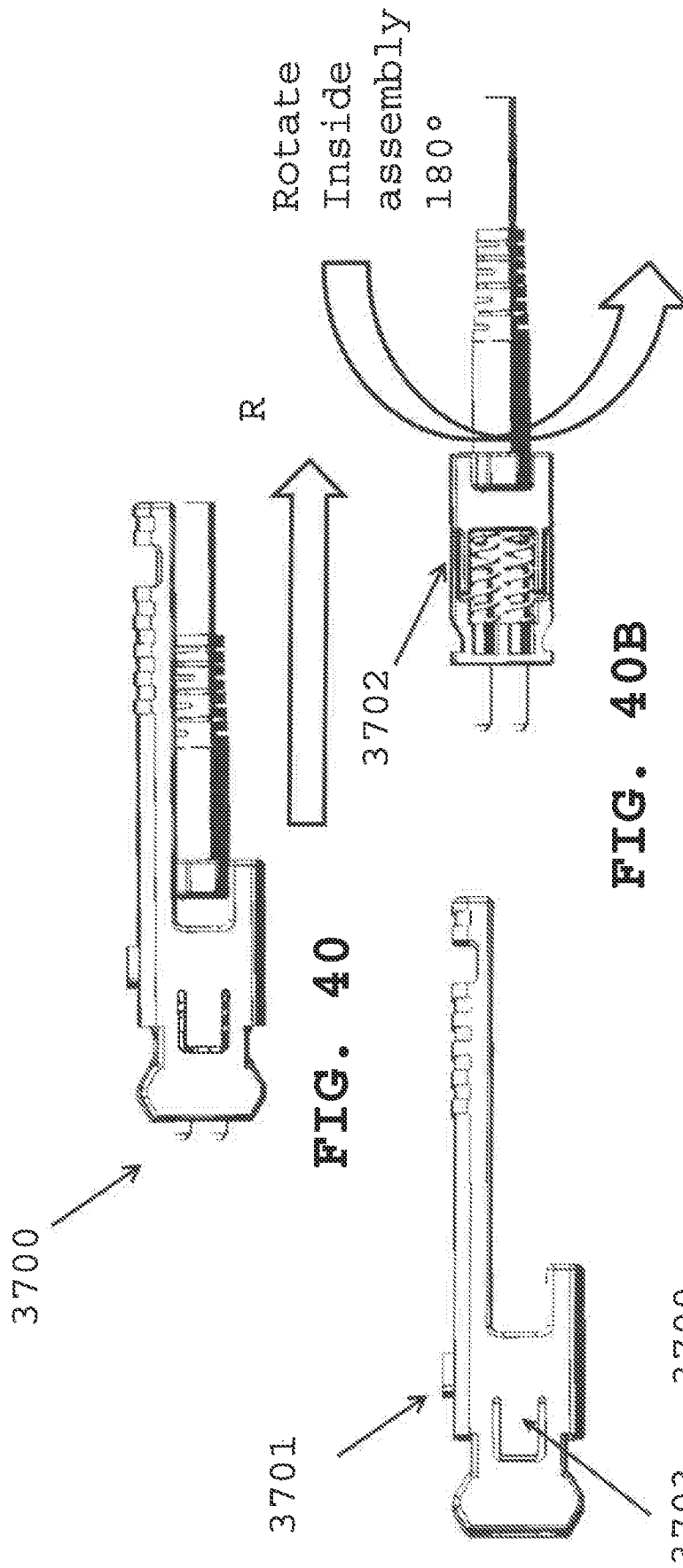


FIG. 40B

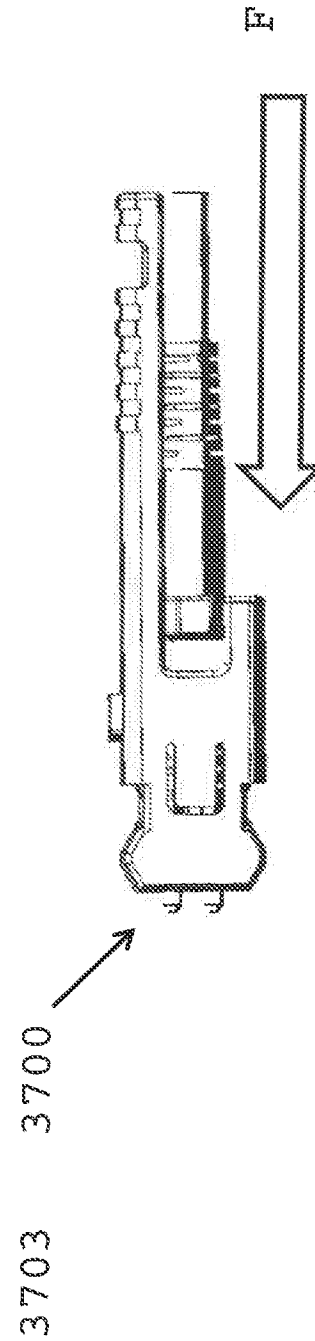
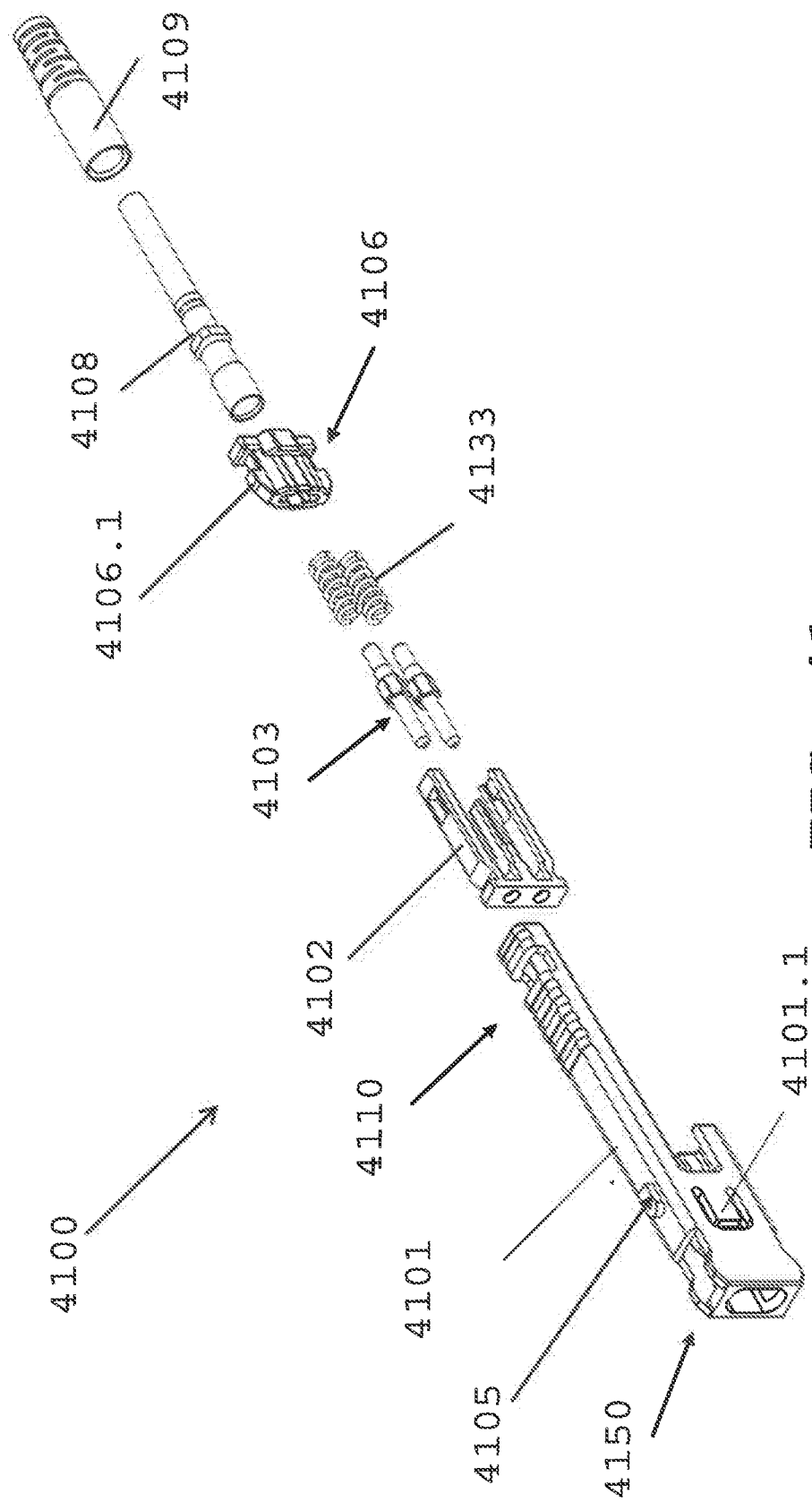


FIG. 40C



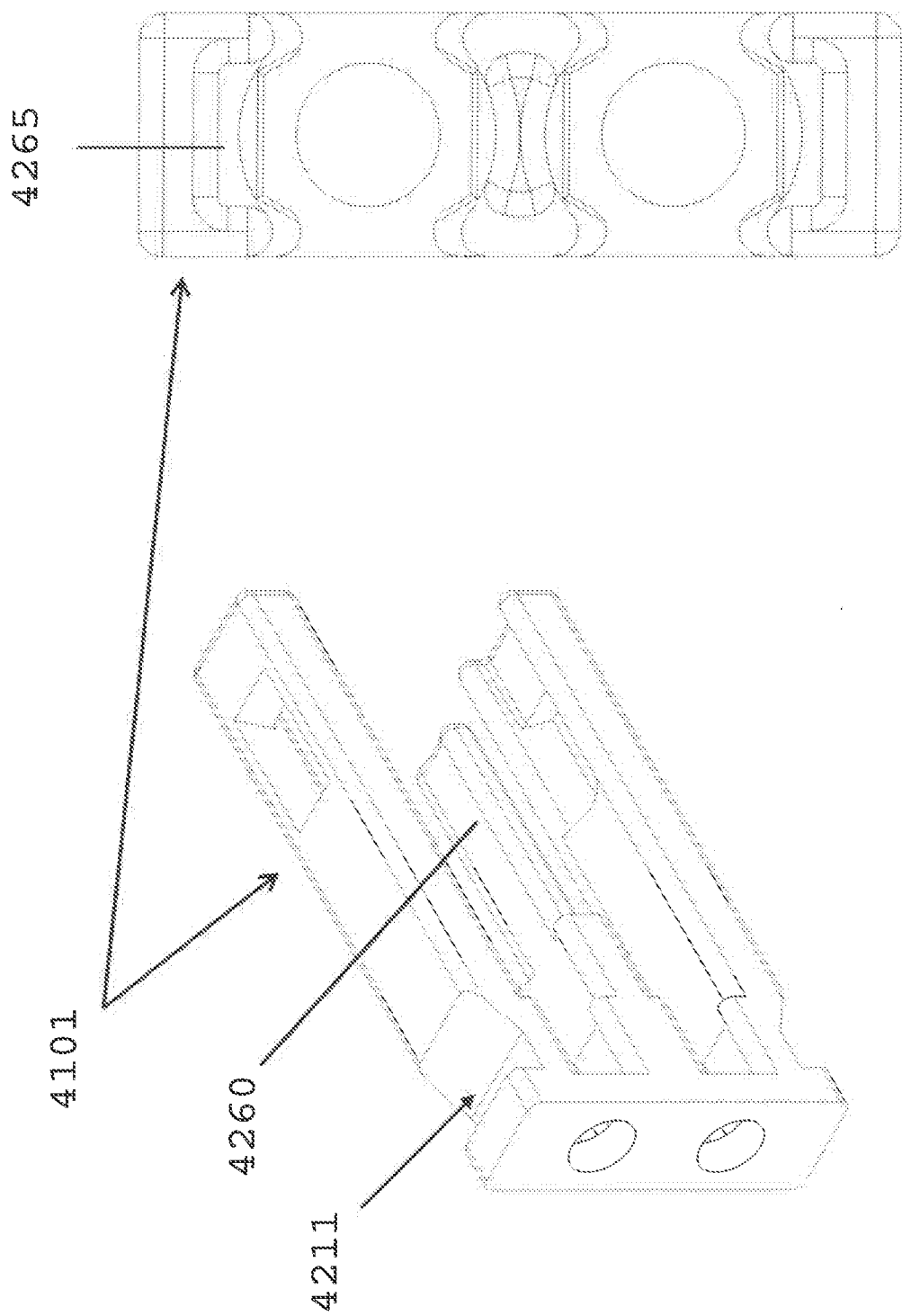


FIG. 42

FIG. 42B

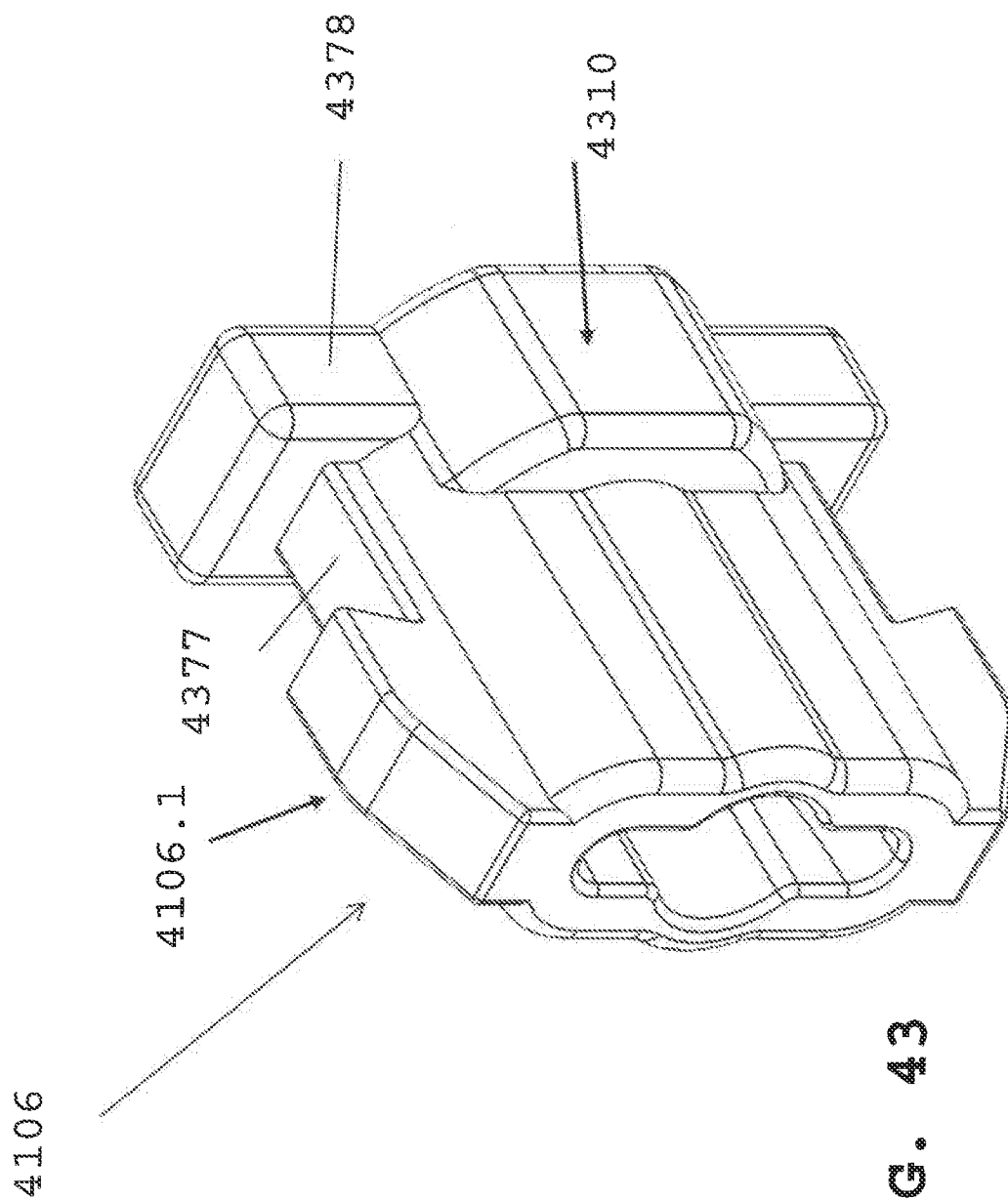


FIG. 43

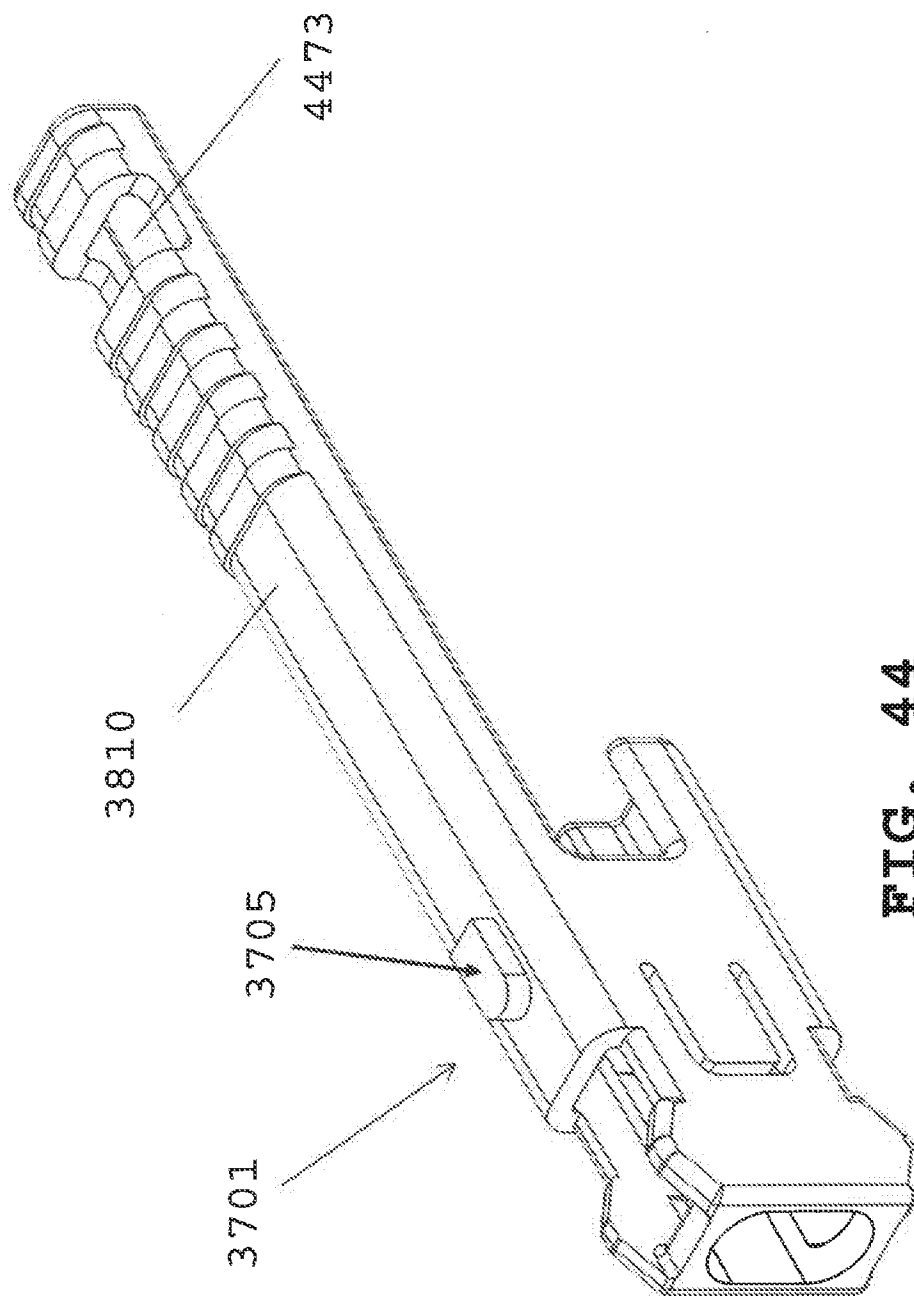


FIG. 44

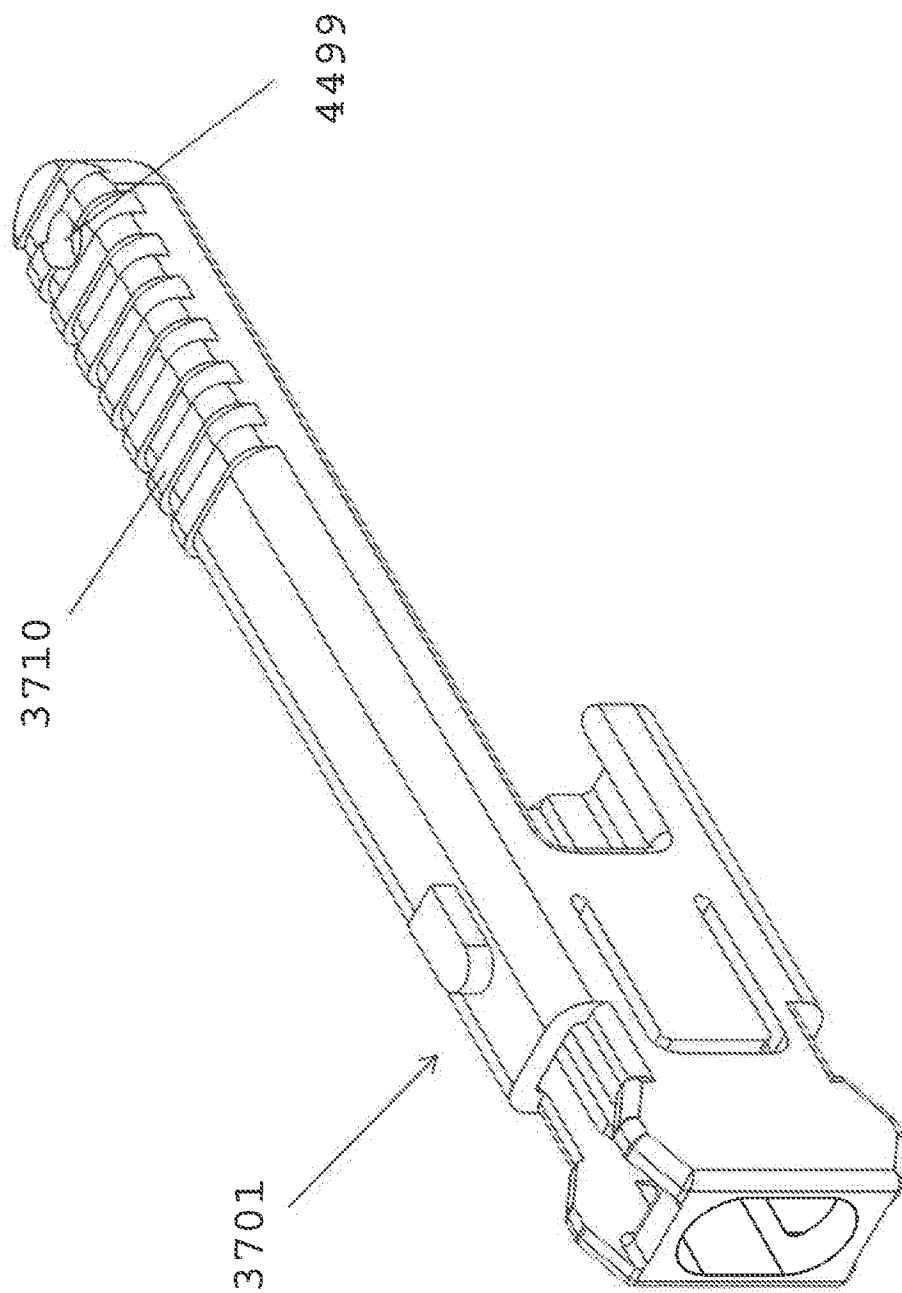


FIG. 44B

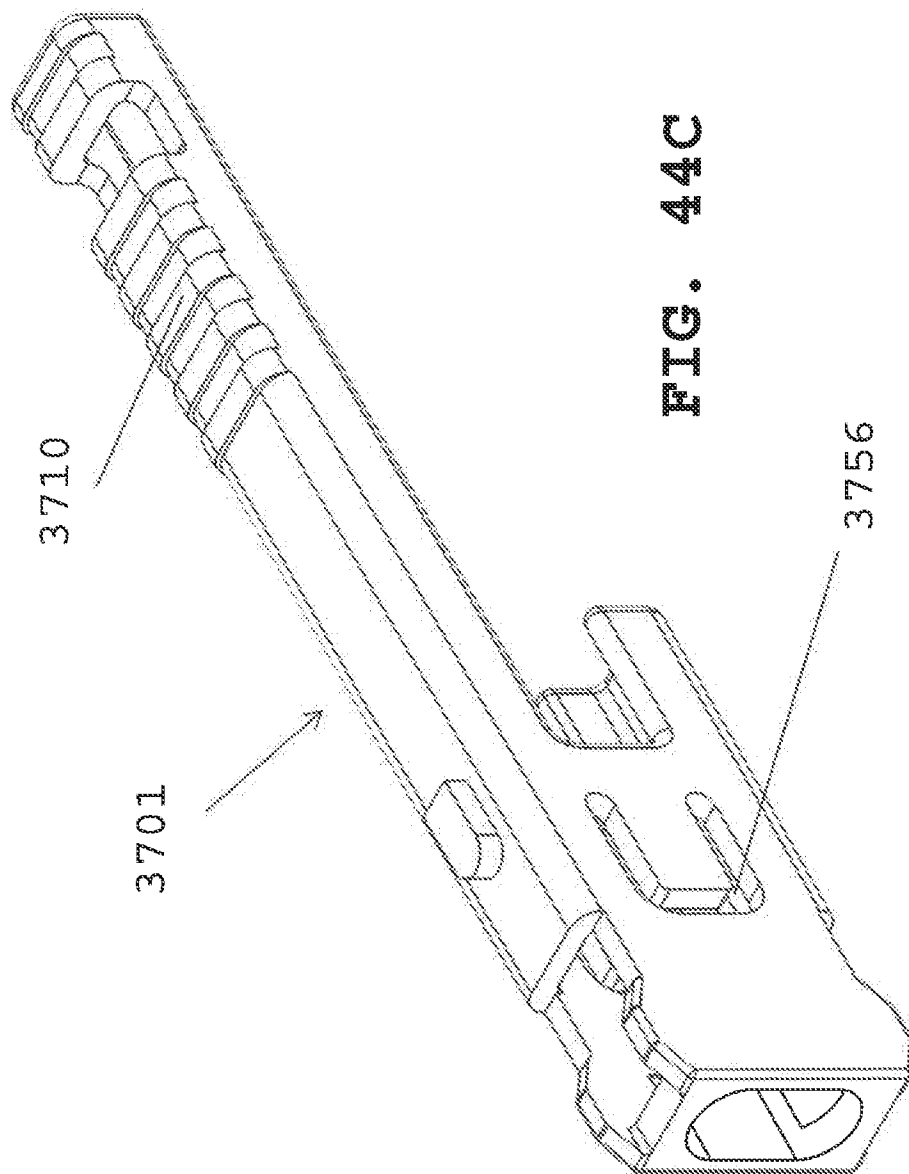


FIG. 44C

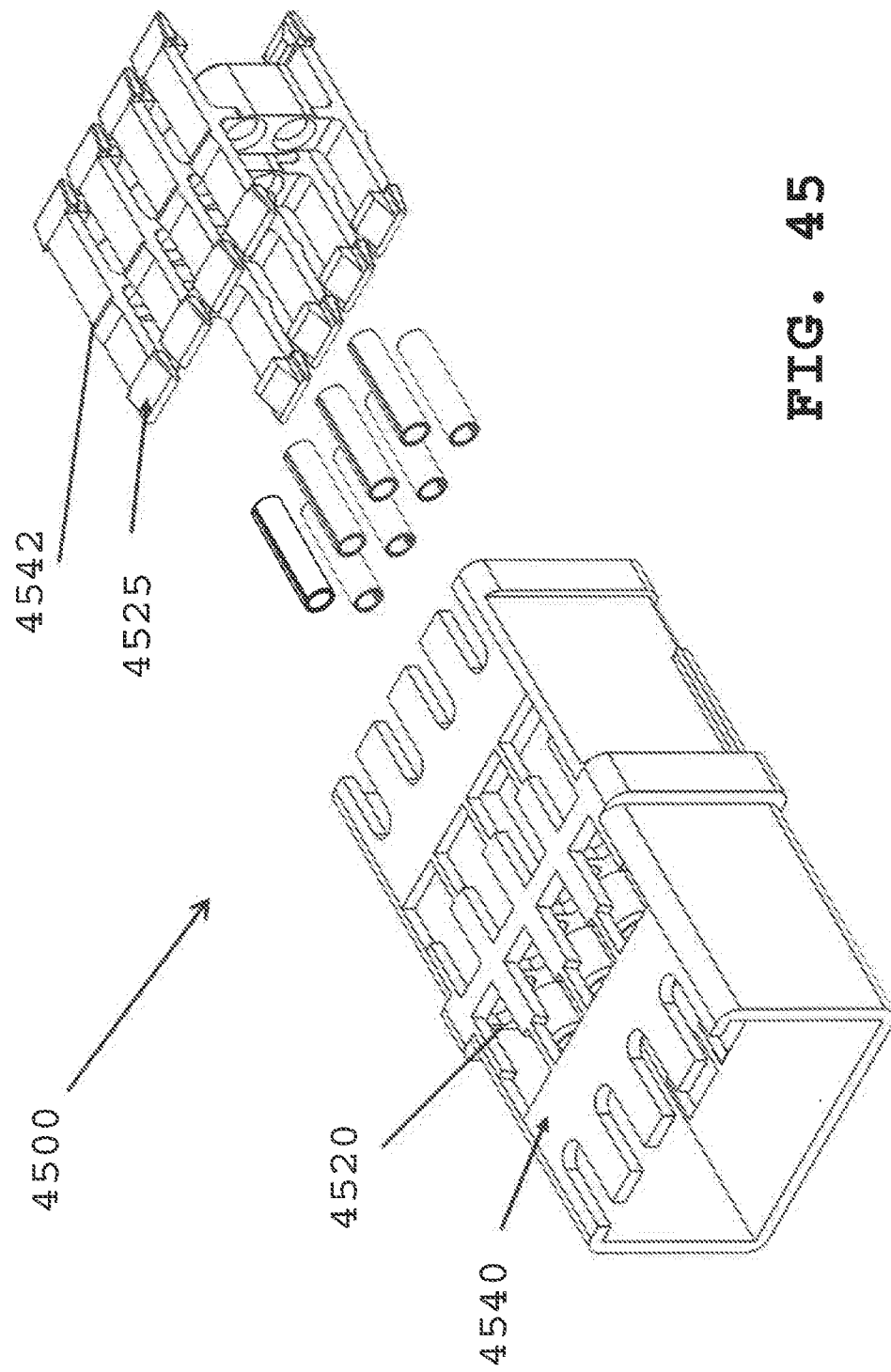


FIG. 45

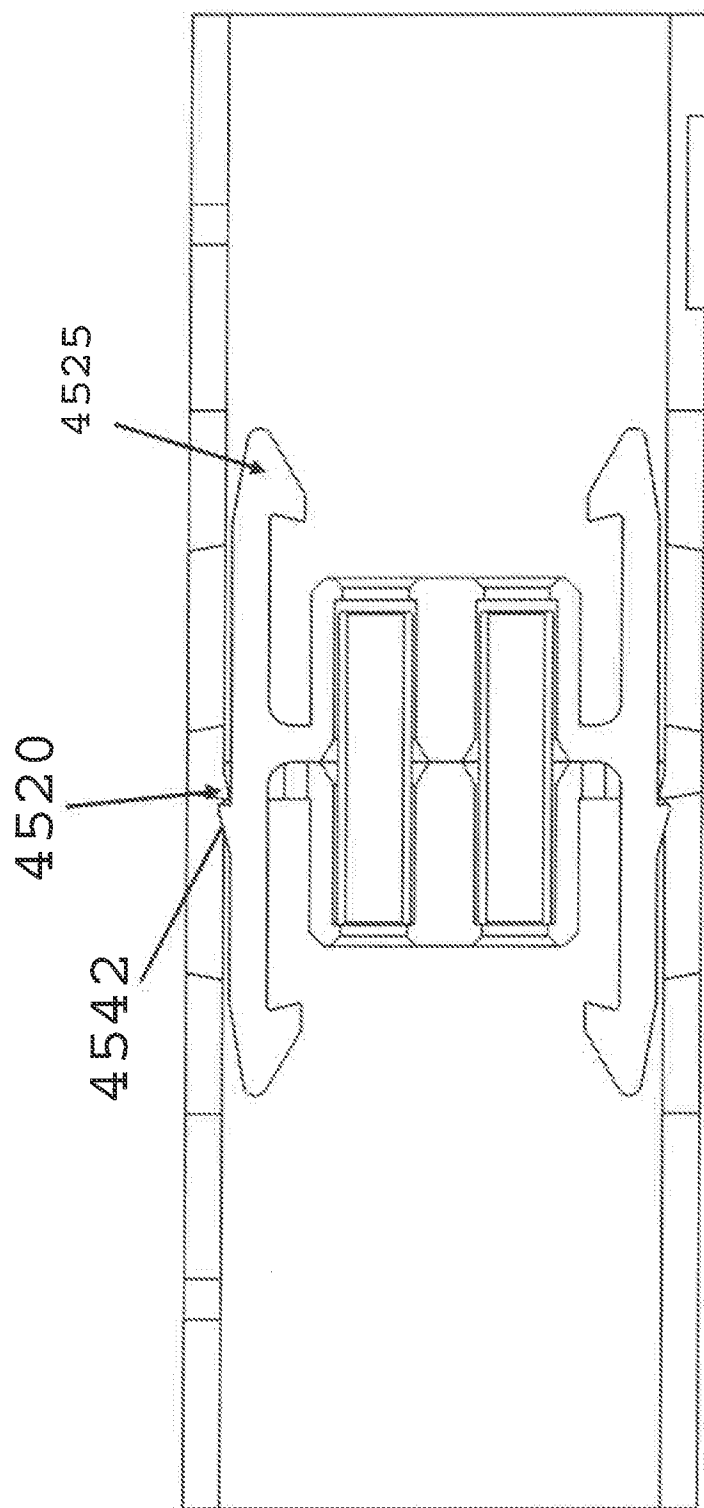


FIG. 46

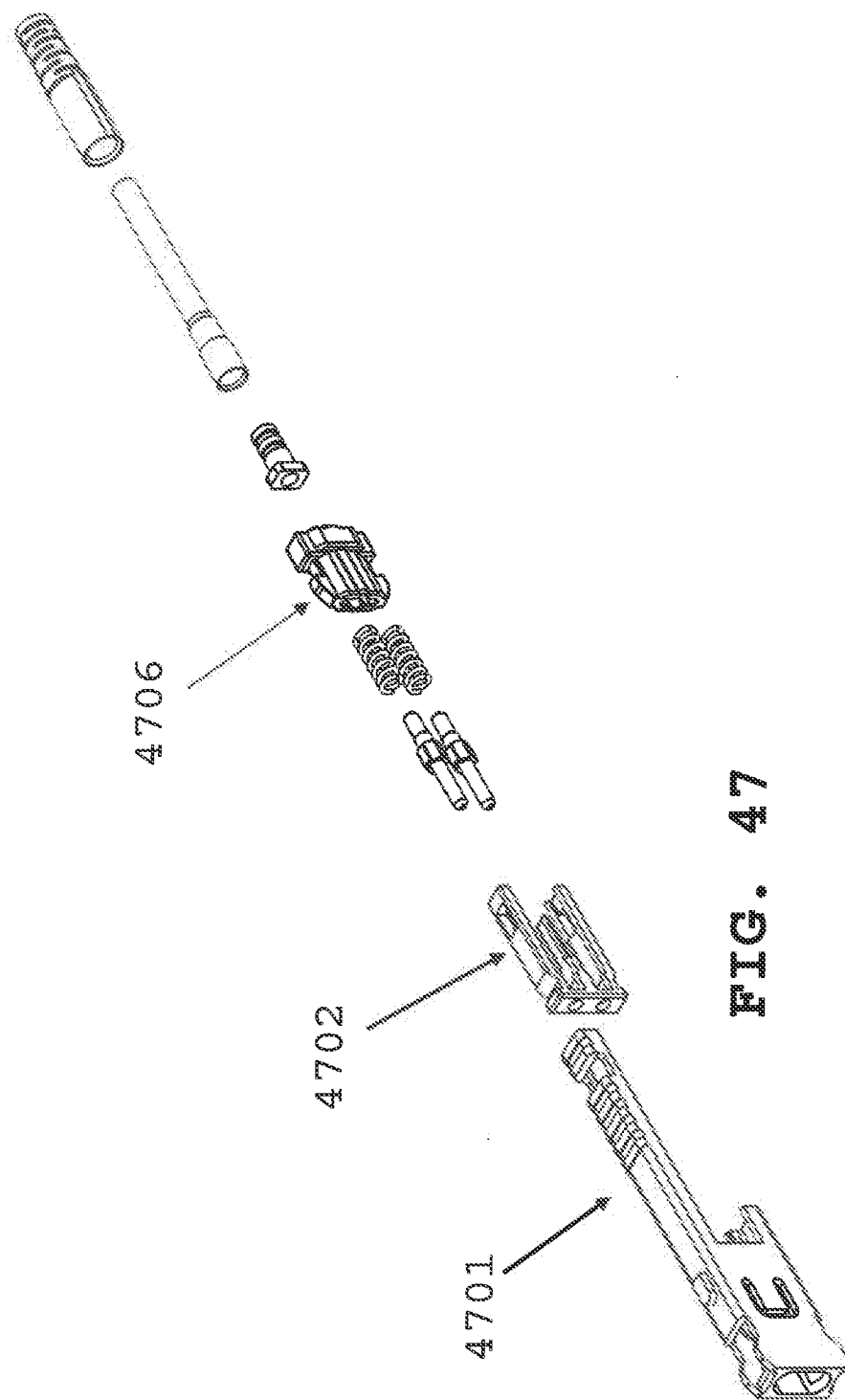


FIG. 47

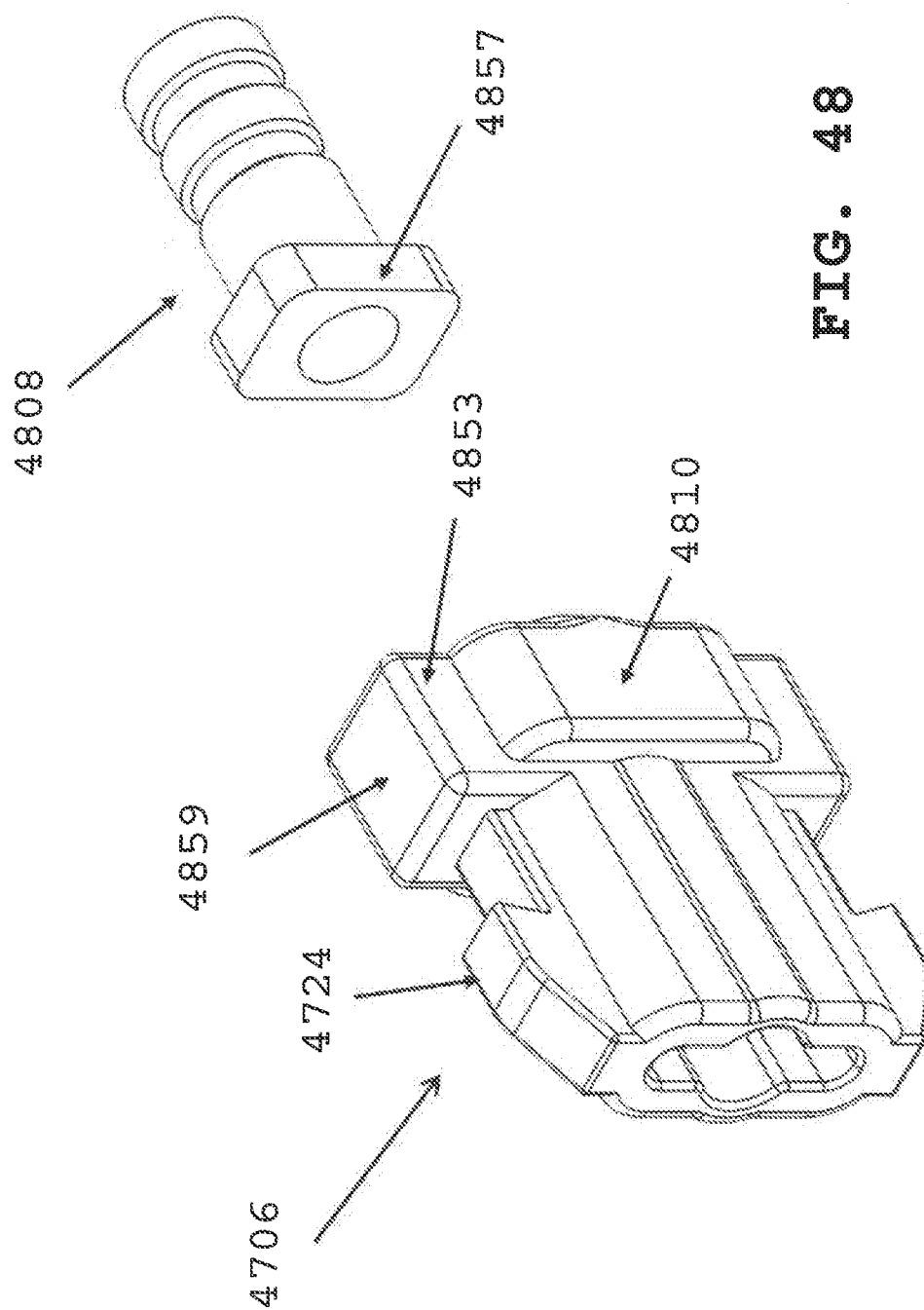


FIG. 48

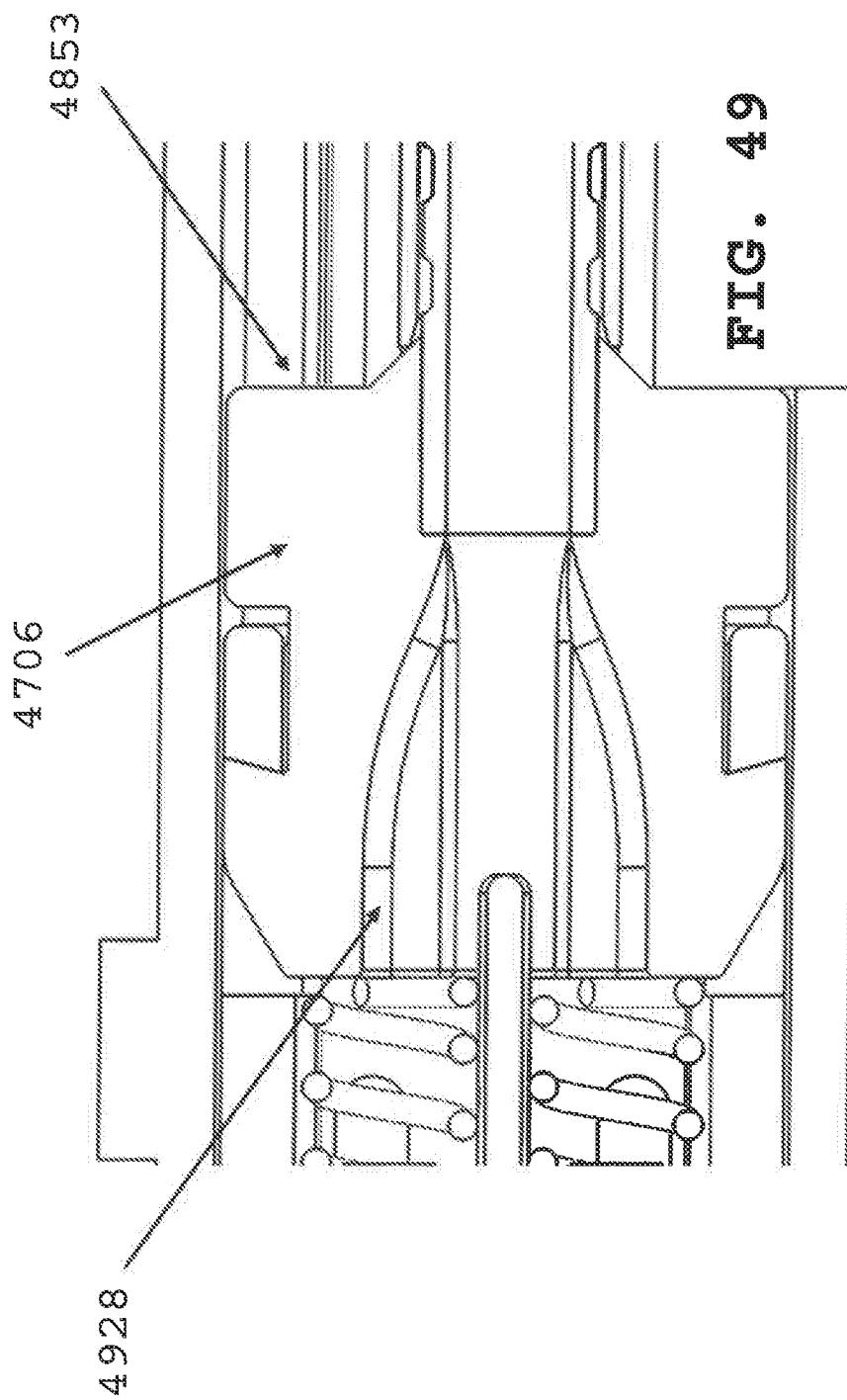


FIG. 49

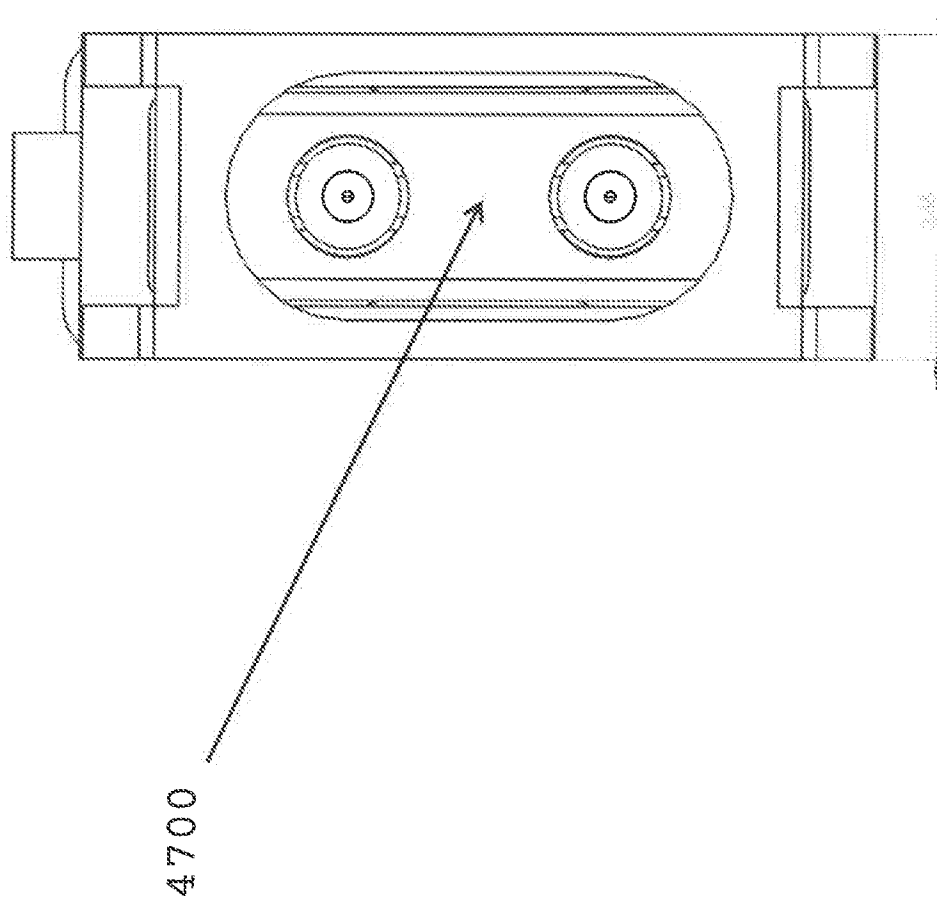


FIG. 50

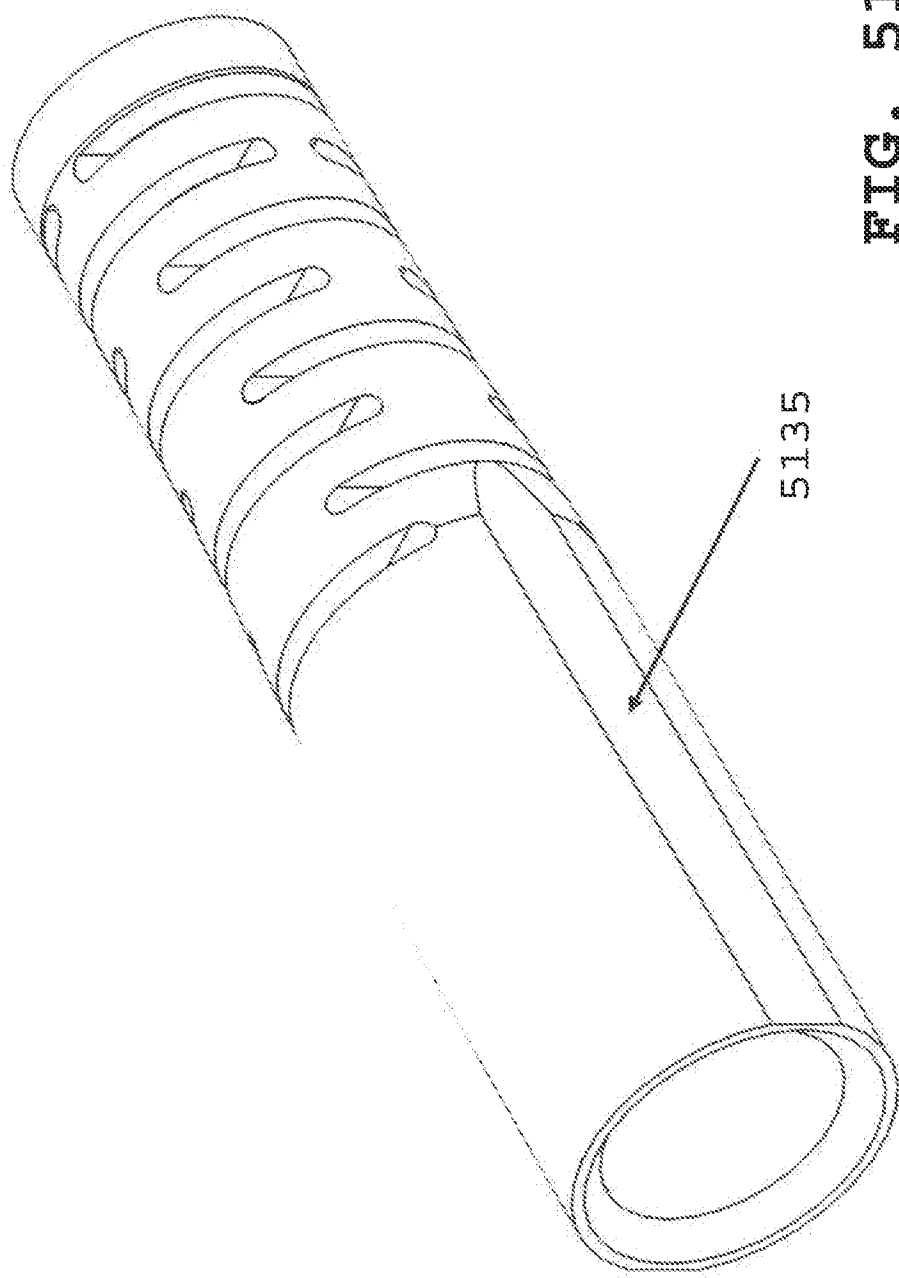
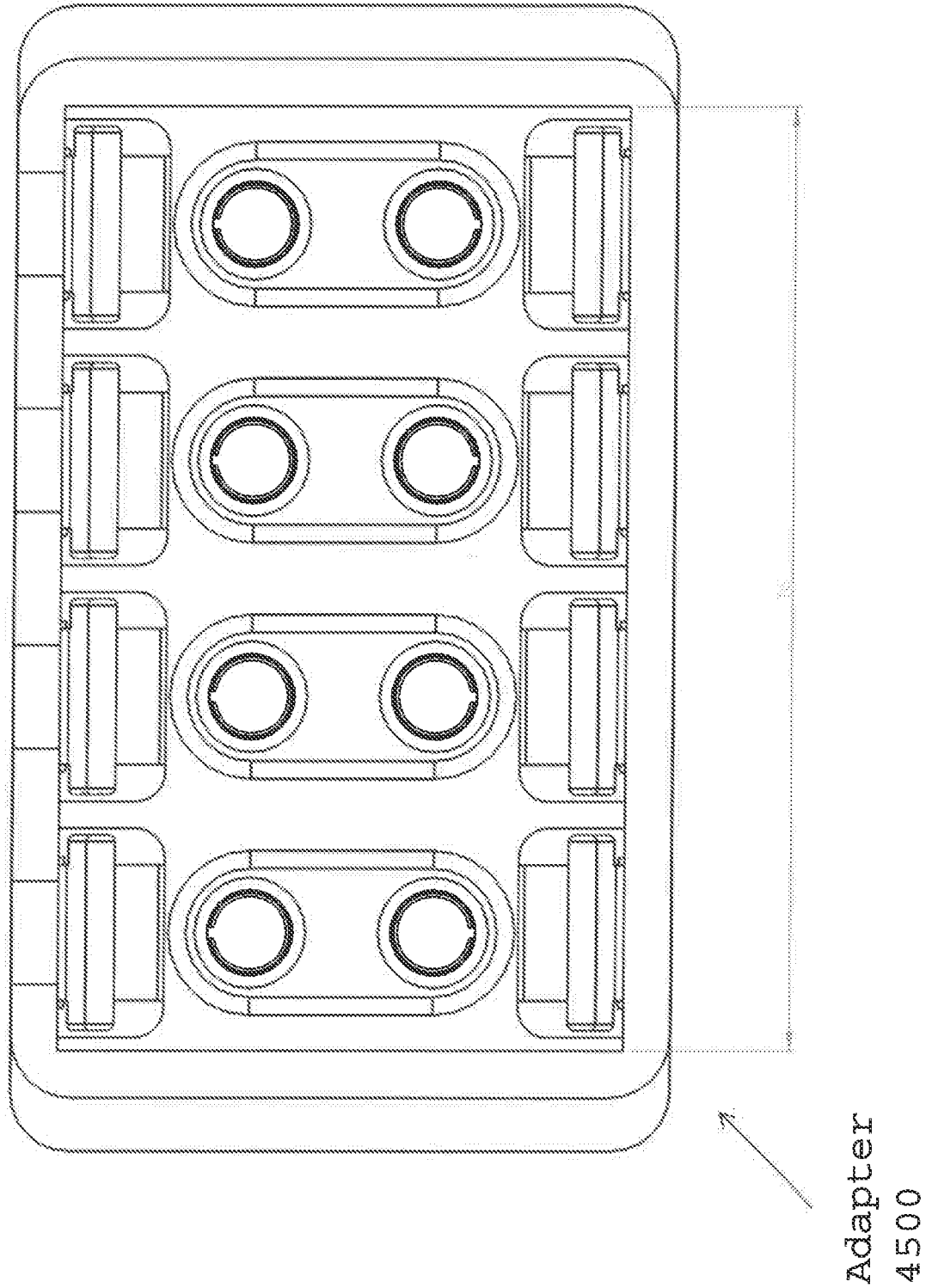


FIG. 51

delete

FIG. 52



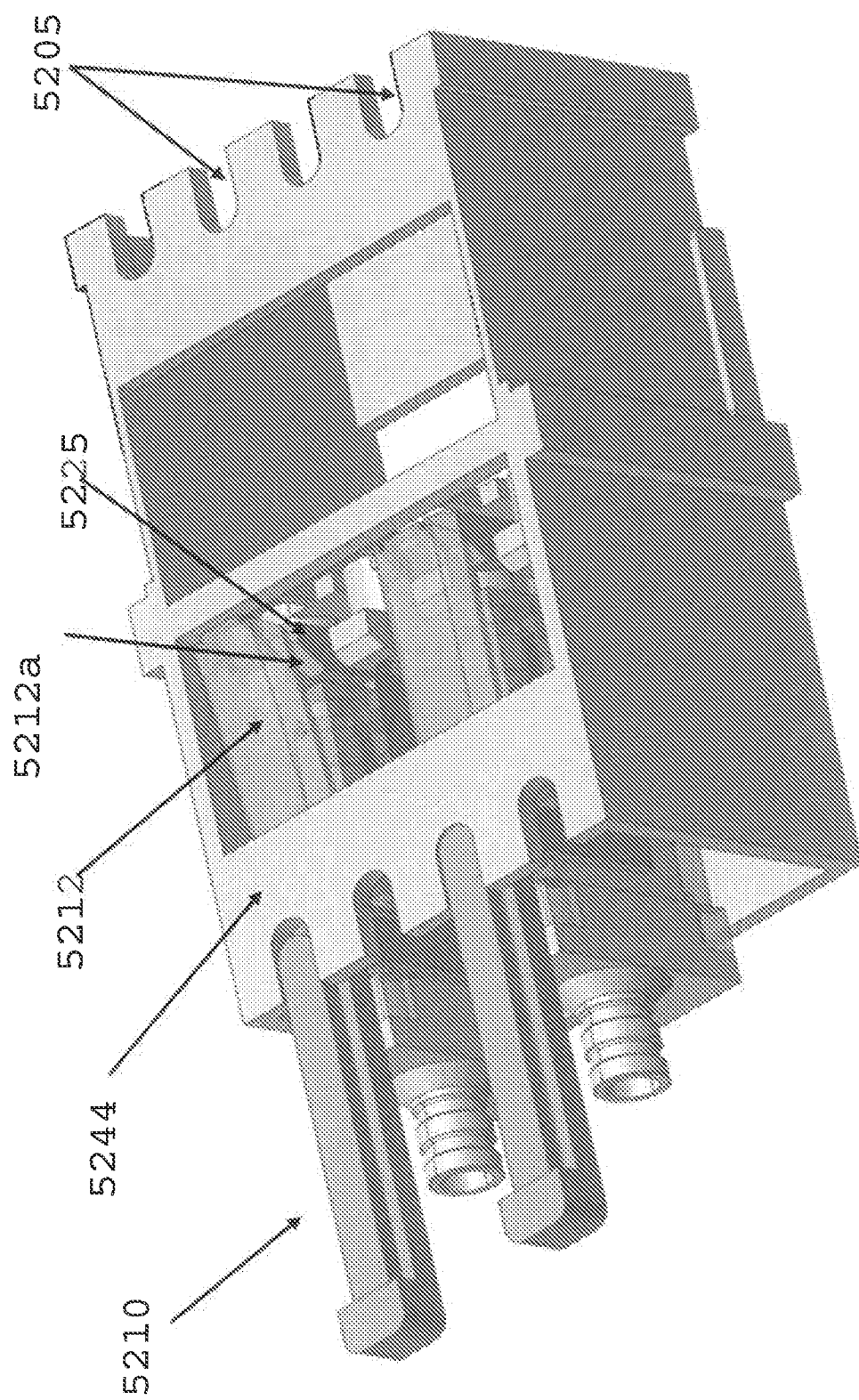


FIG. 52

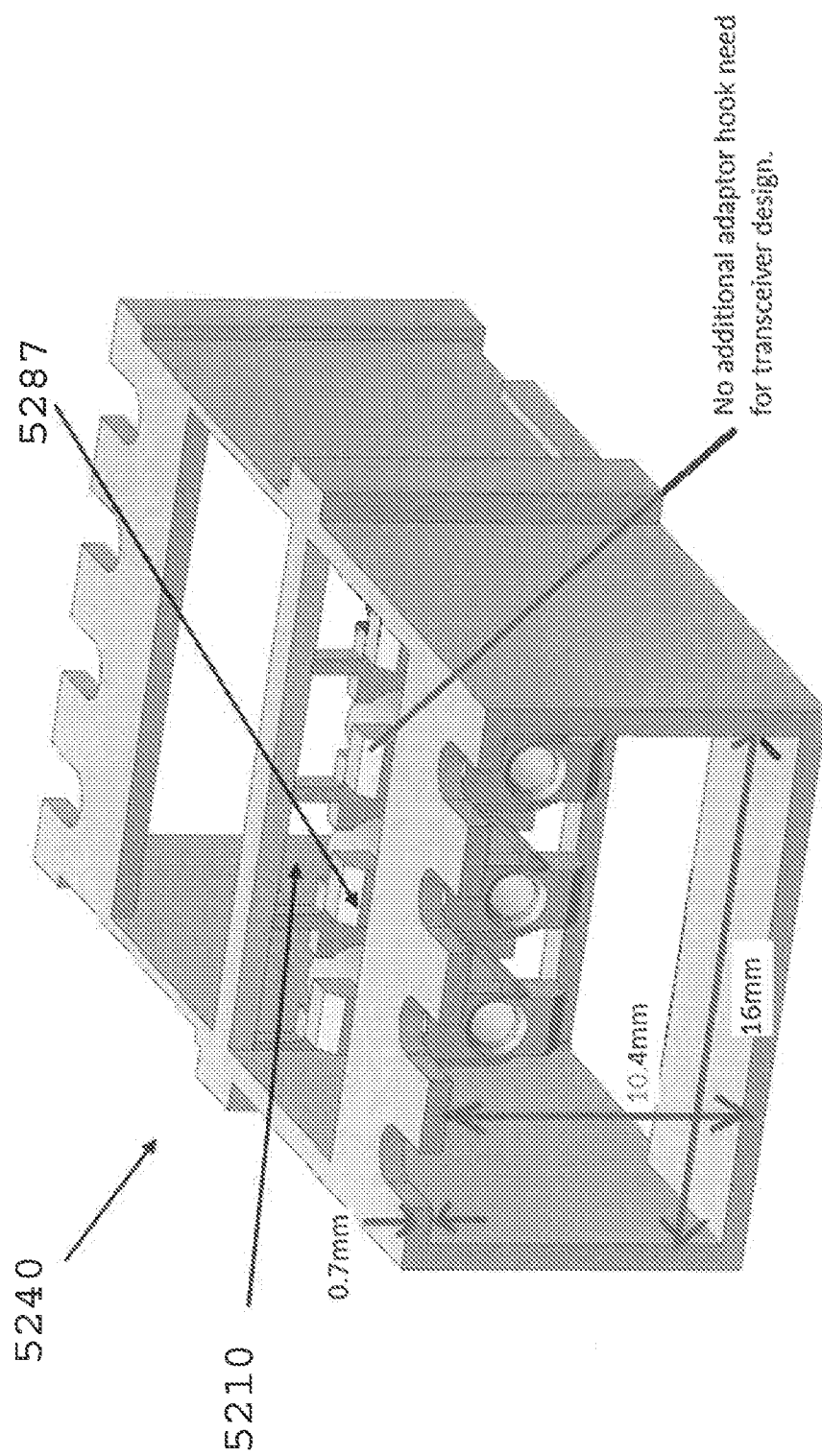
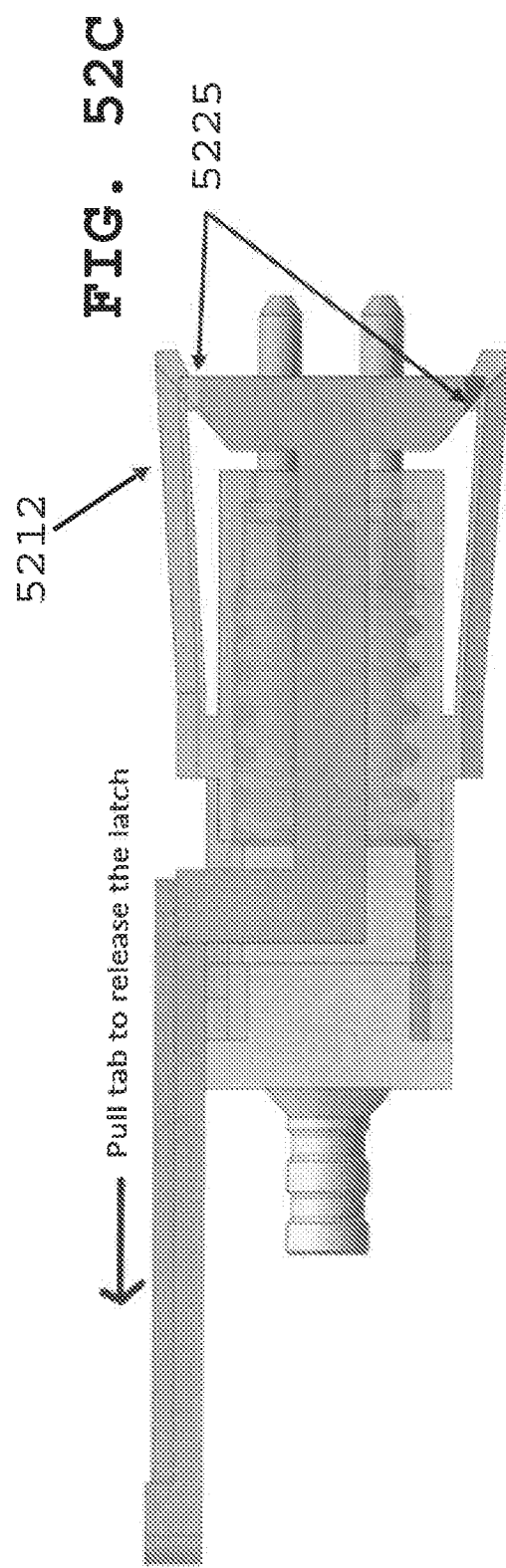
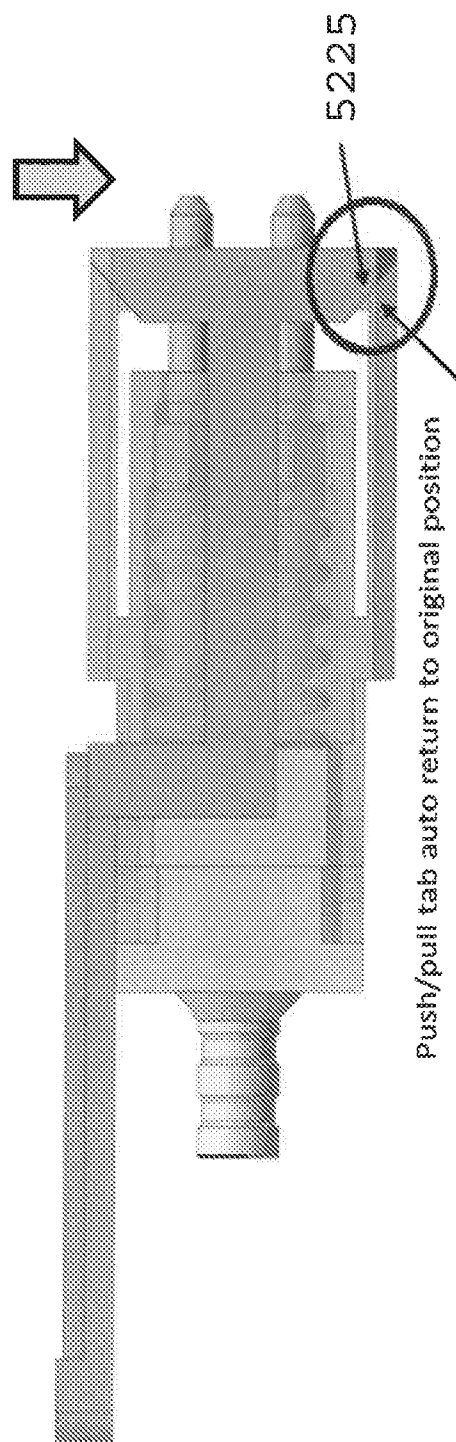


FIG. 52B



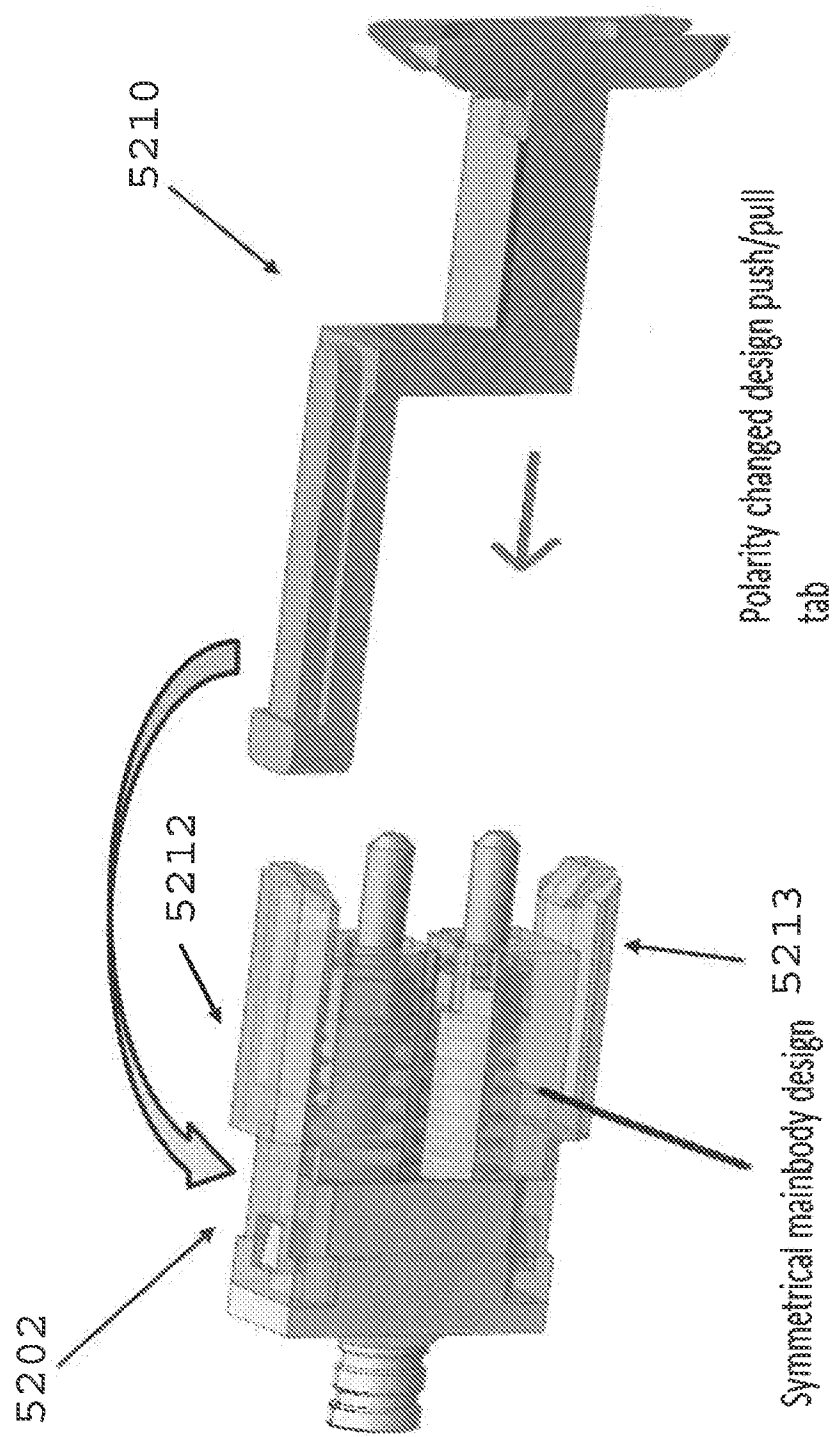


FIG. 52E

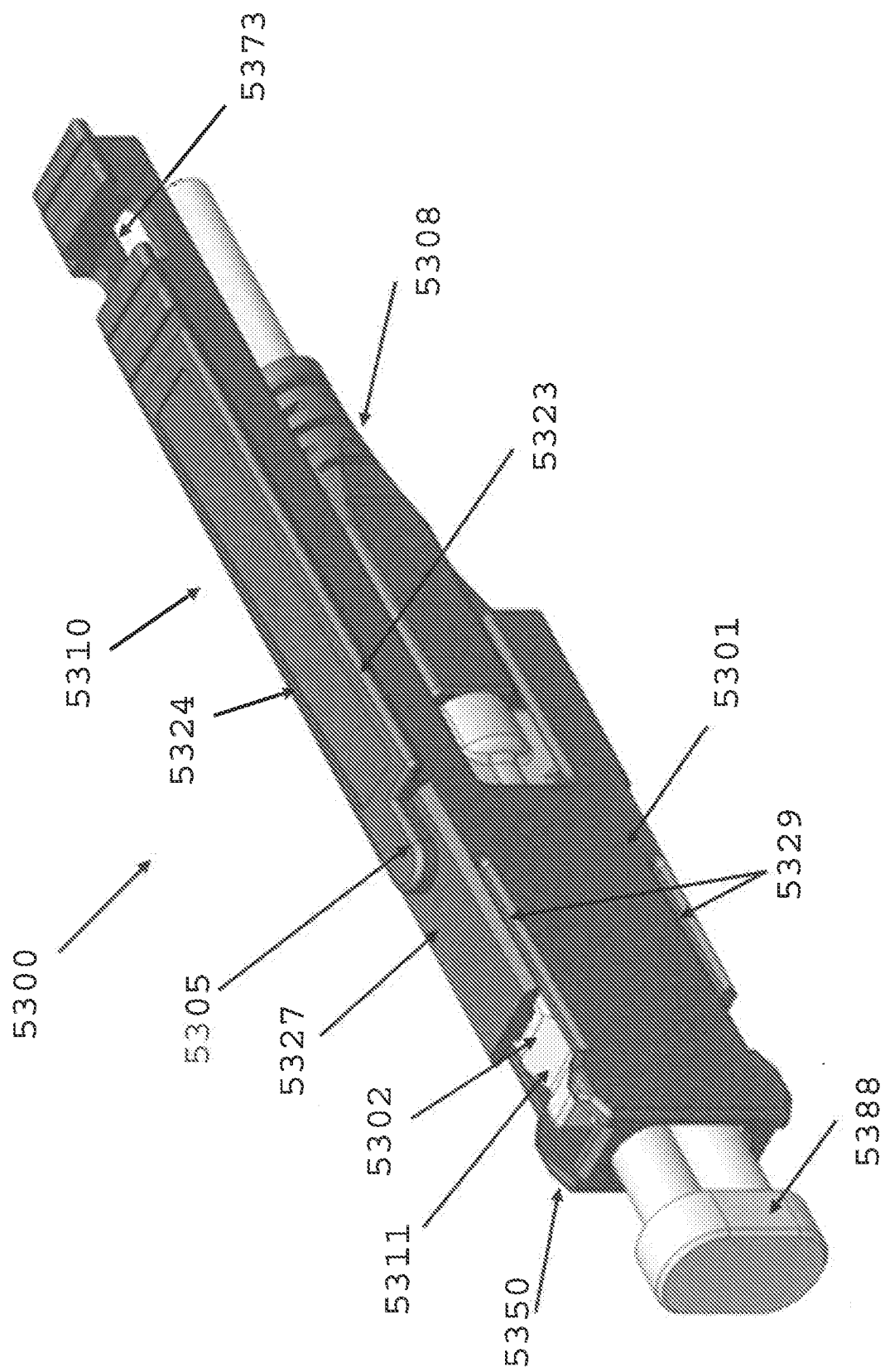


FIG. 53

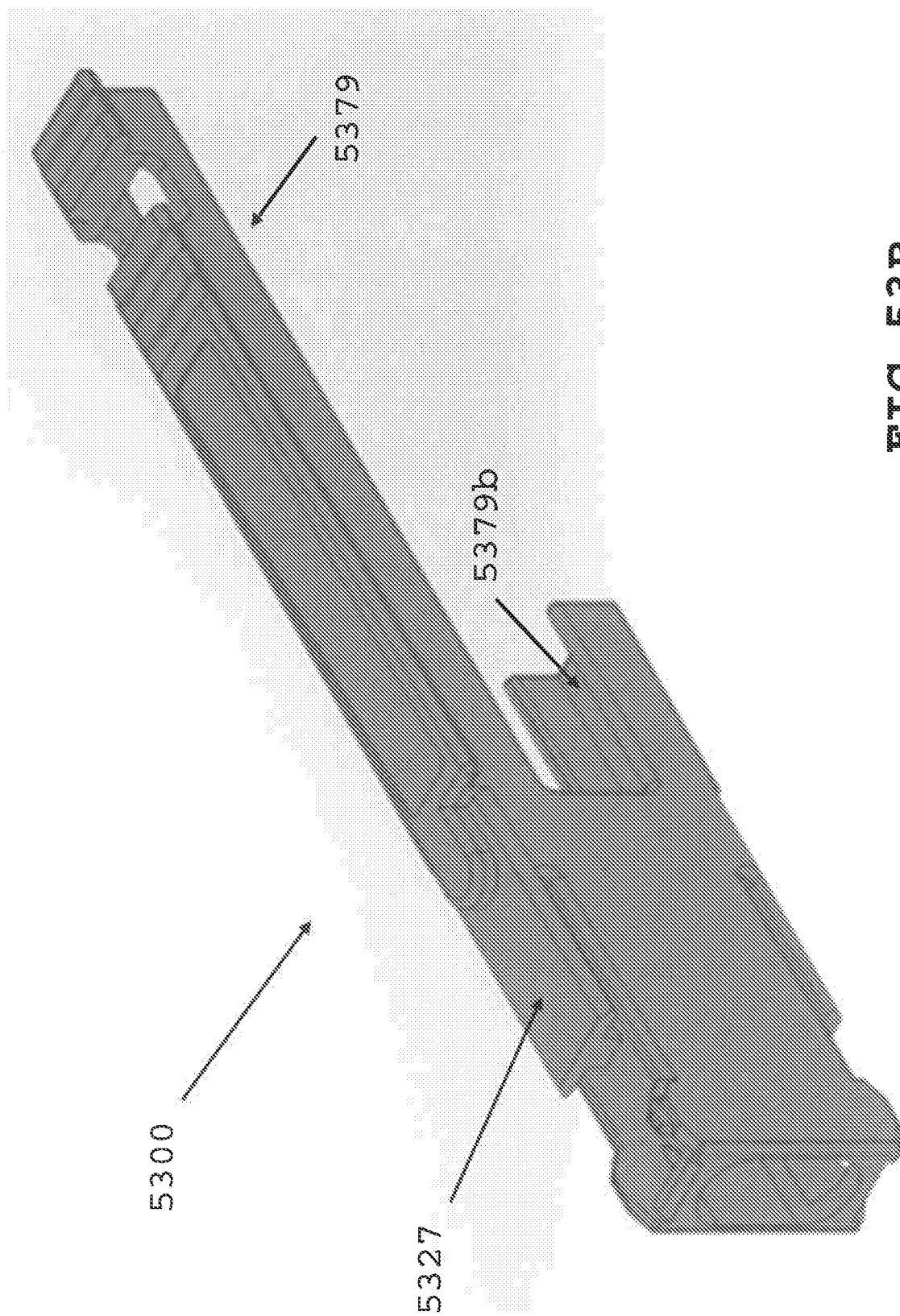


FIG. 53B

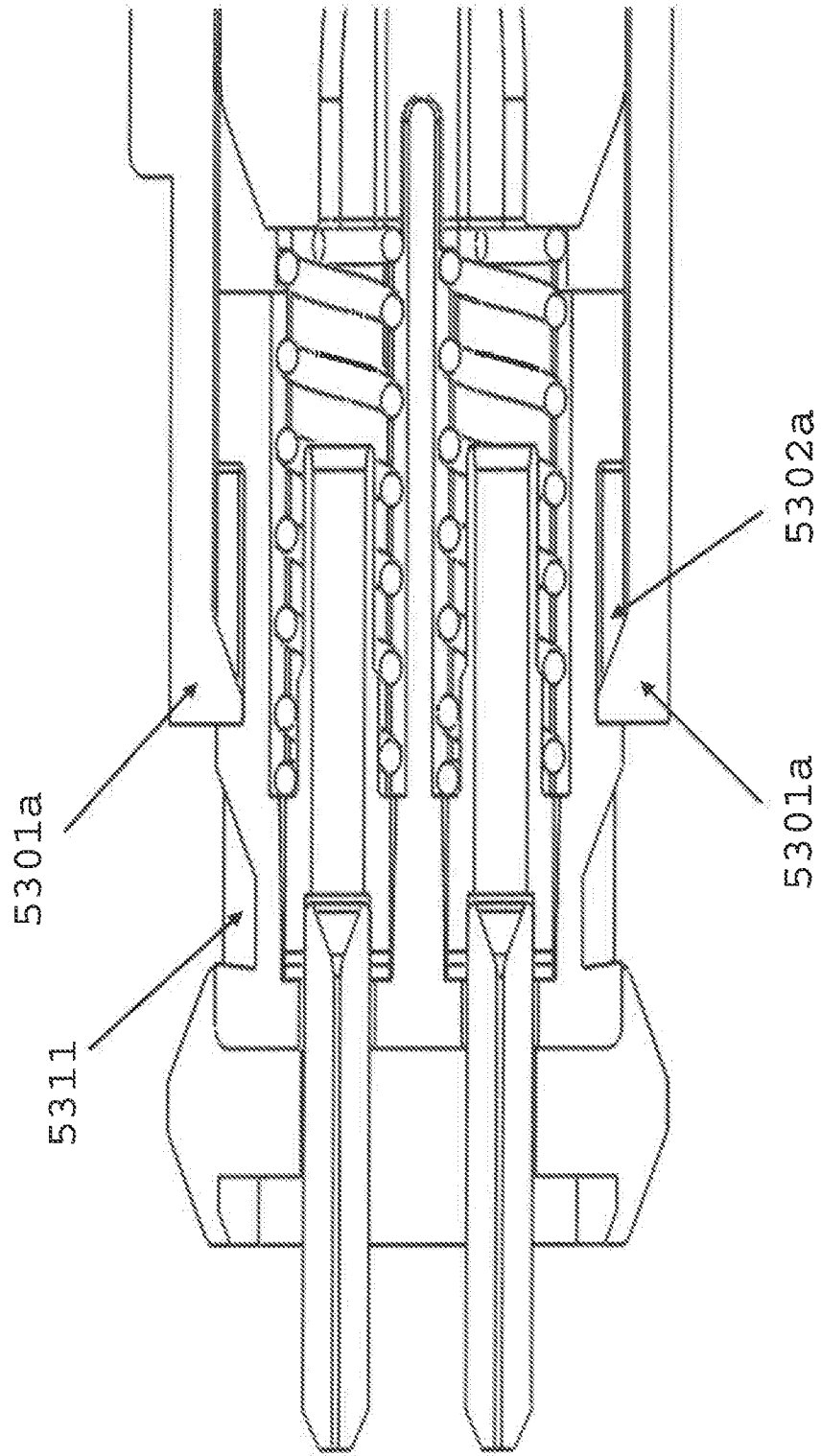


FIG. 53C

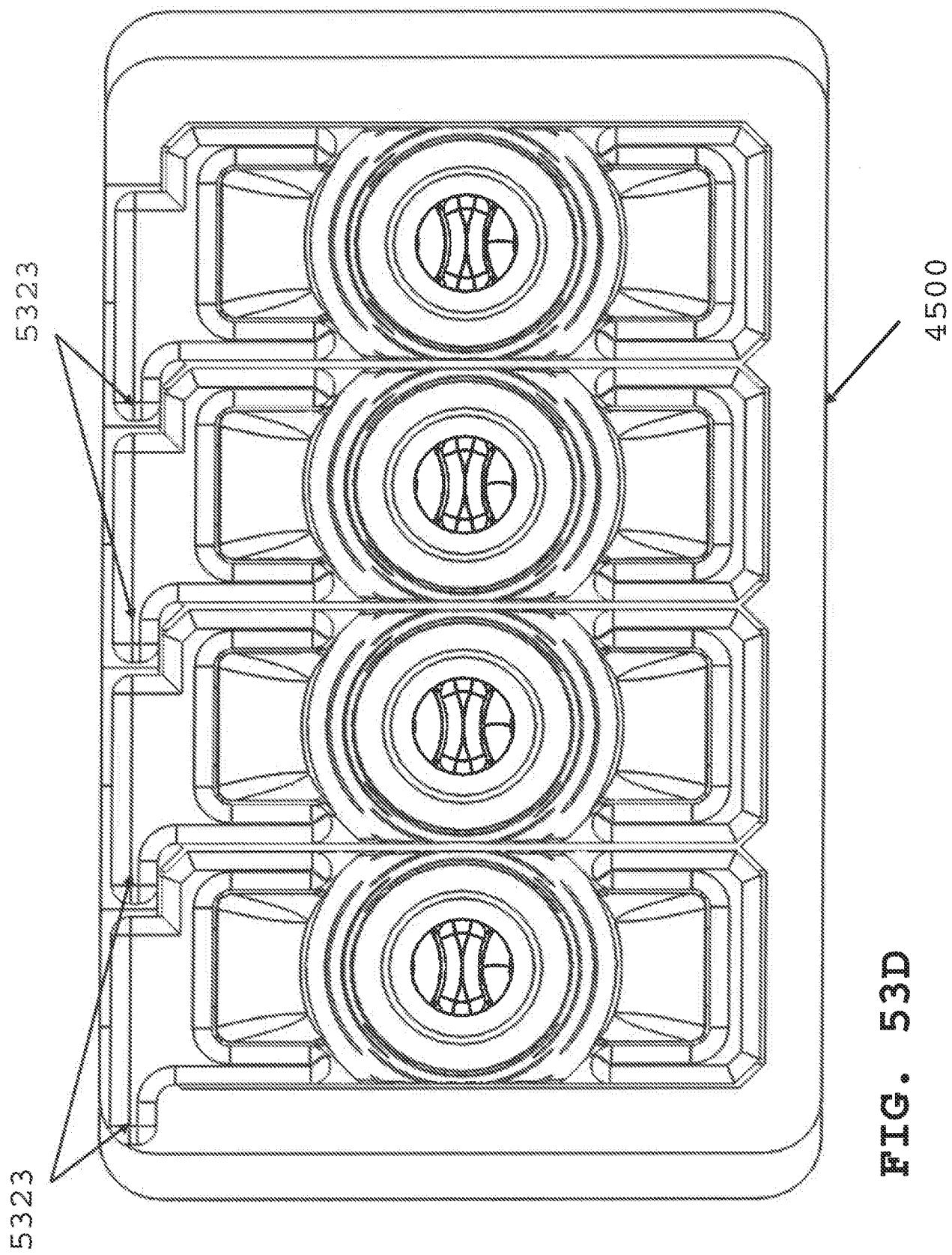


FIG. 53D

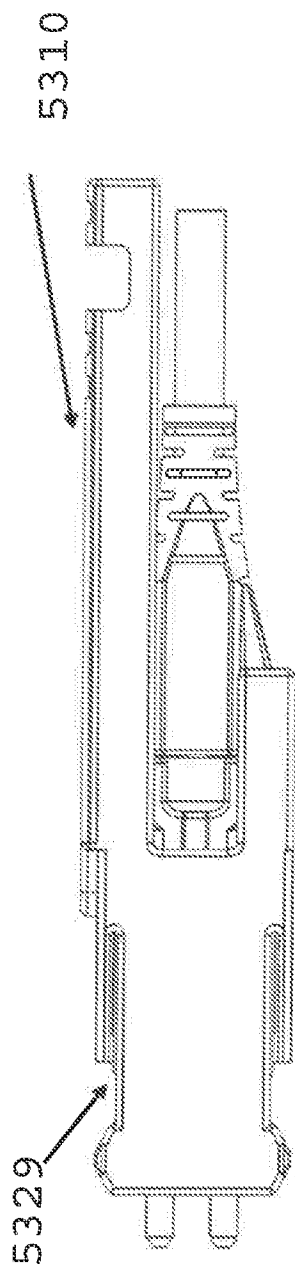


FIG.
54

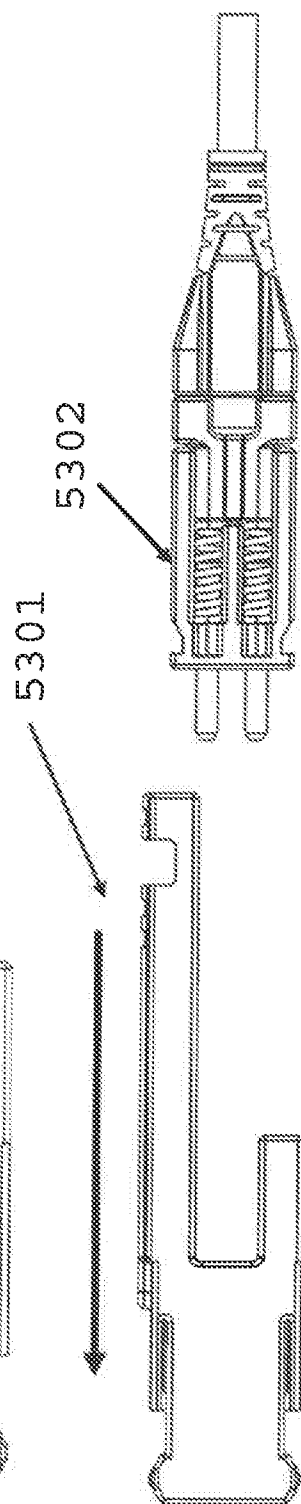


FIG.
54B

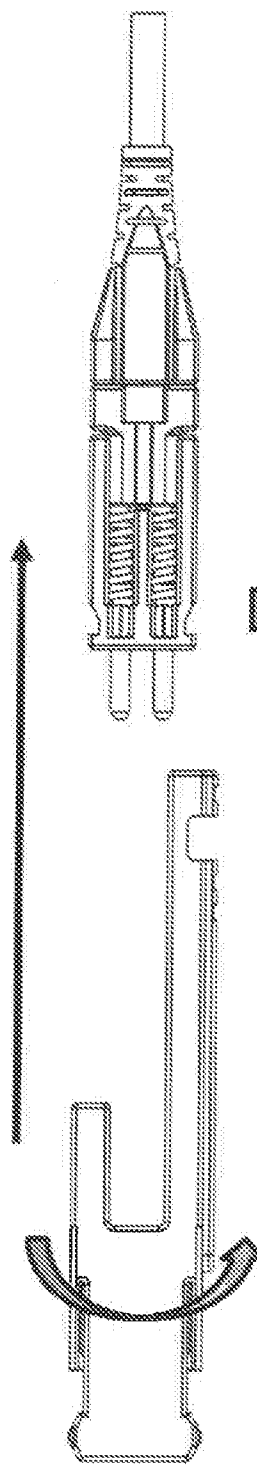


FIG.
54C

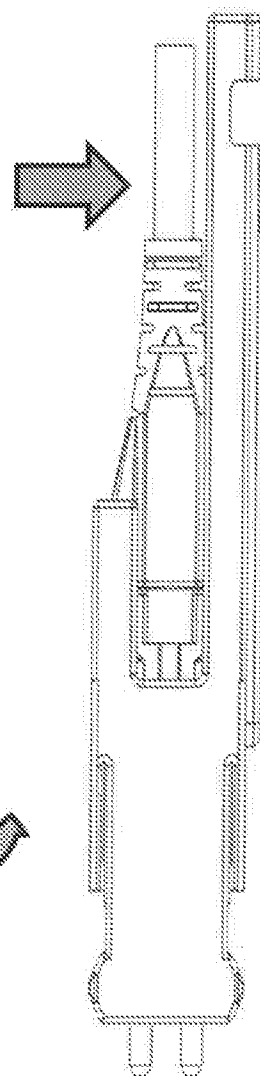


FIG.
54D

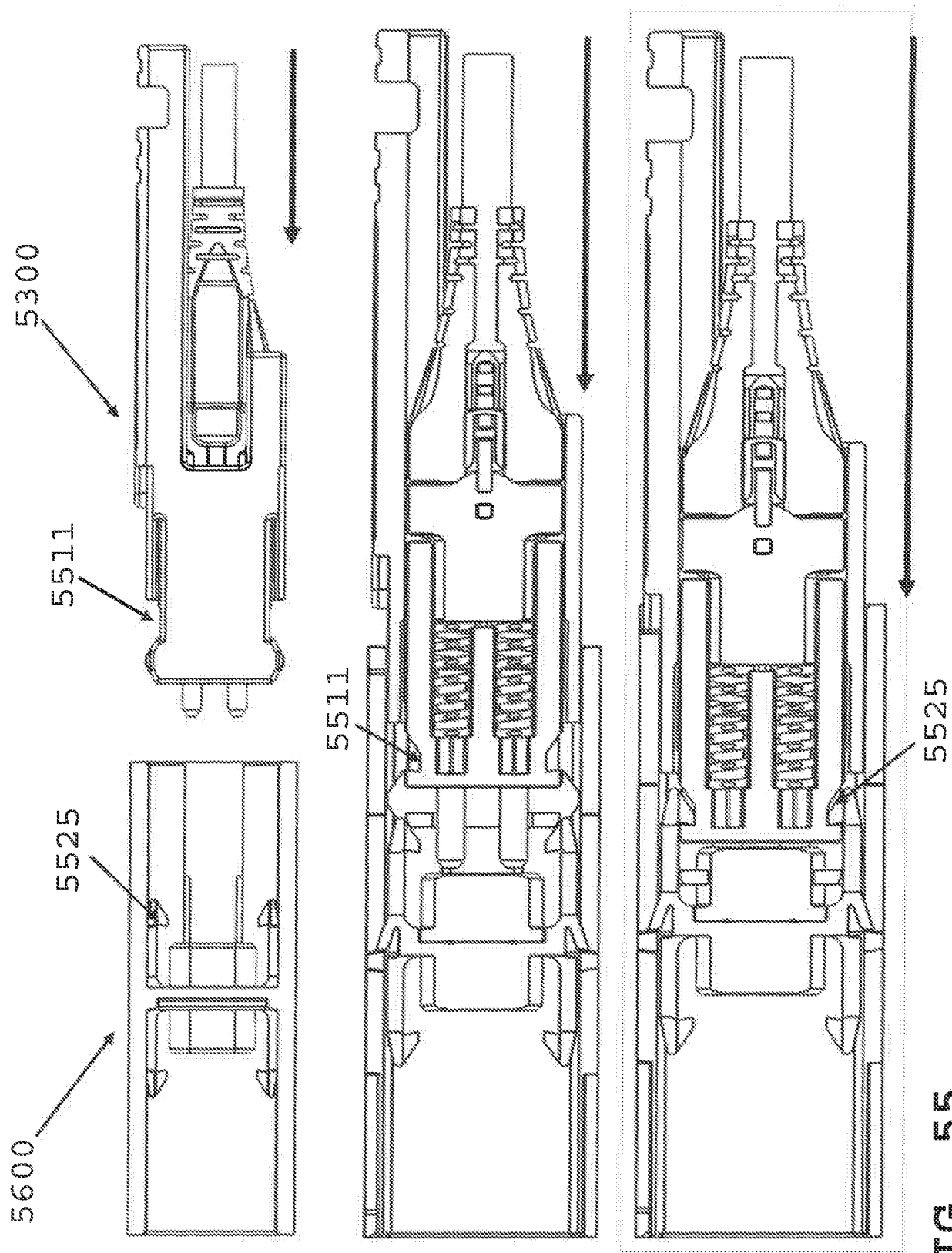


FIG. 55

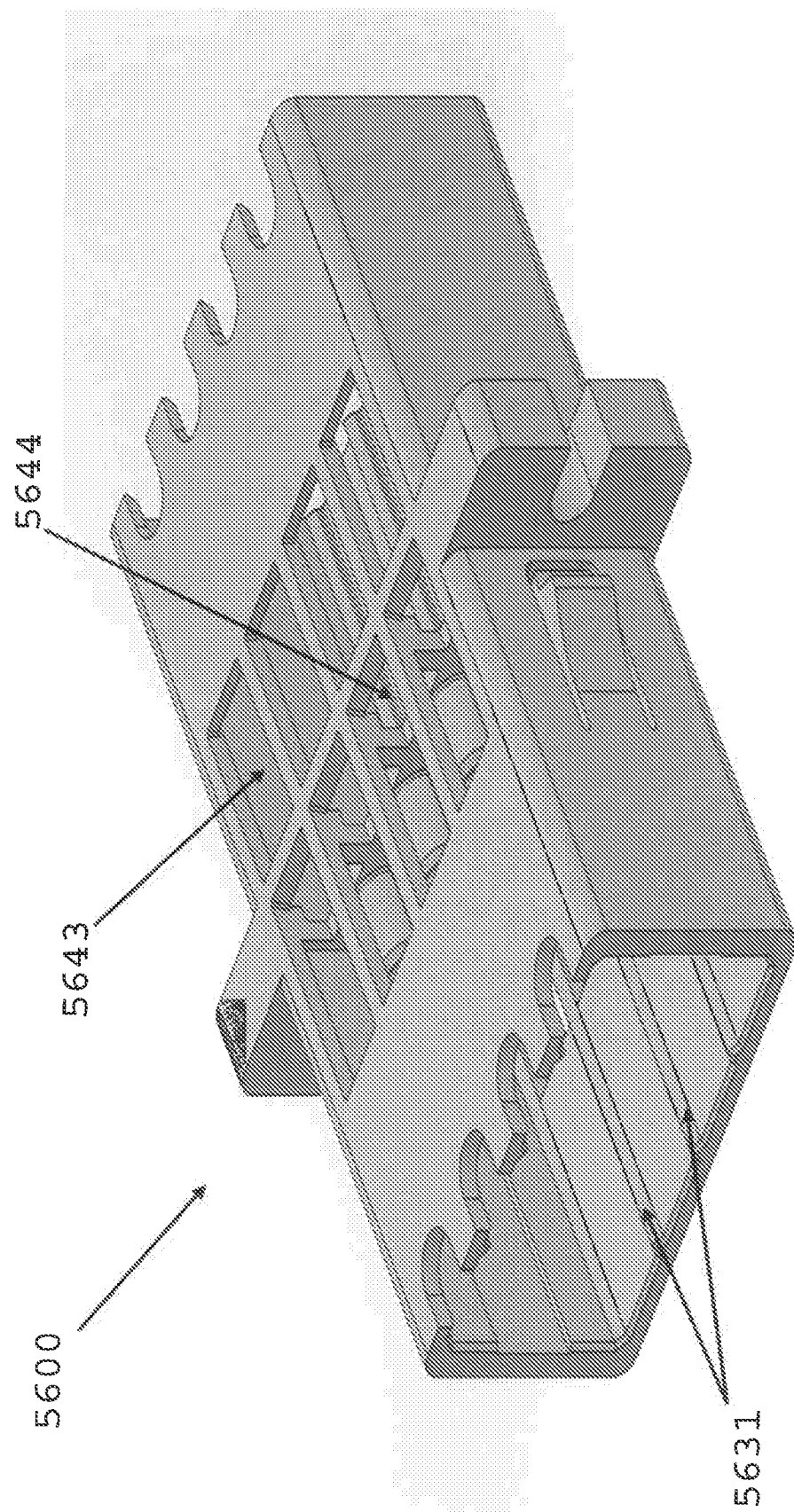


FIG. 56

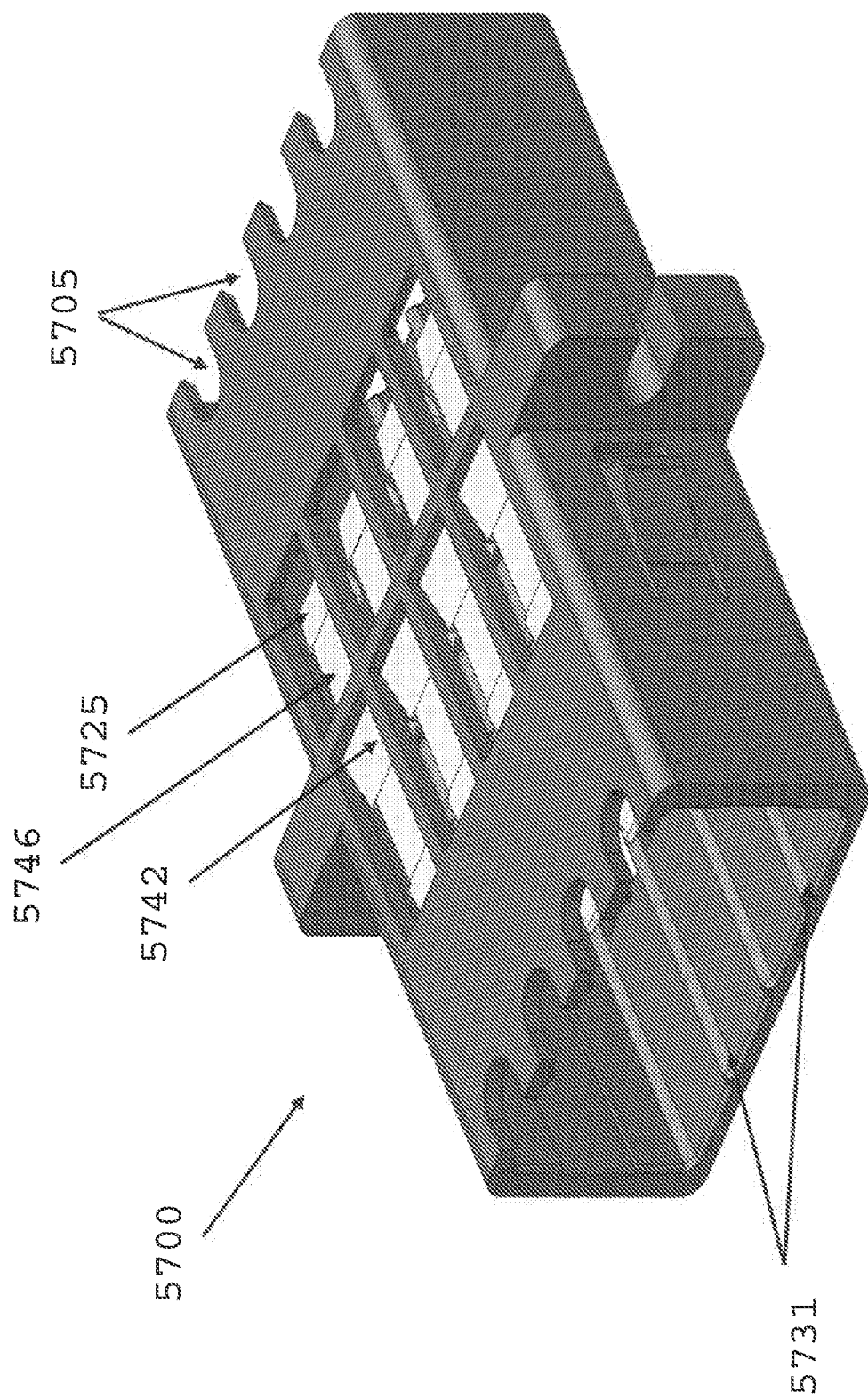


FIG. 57

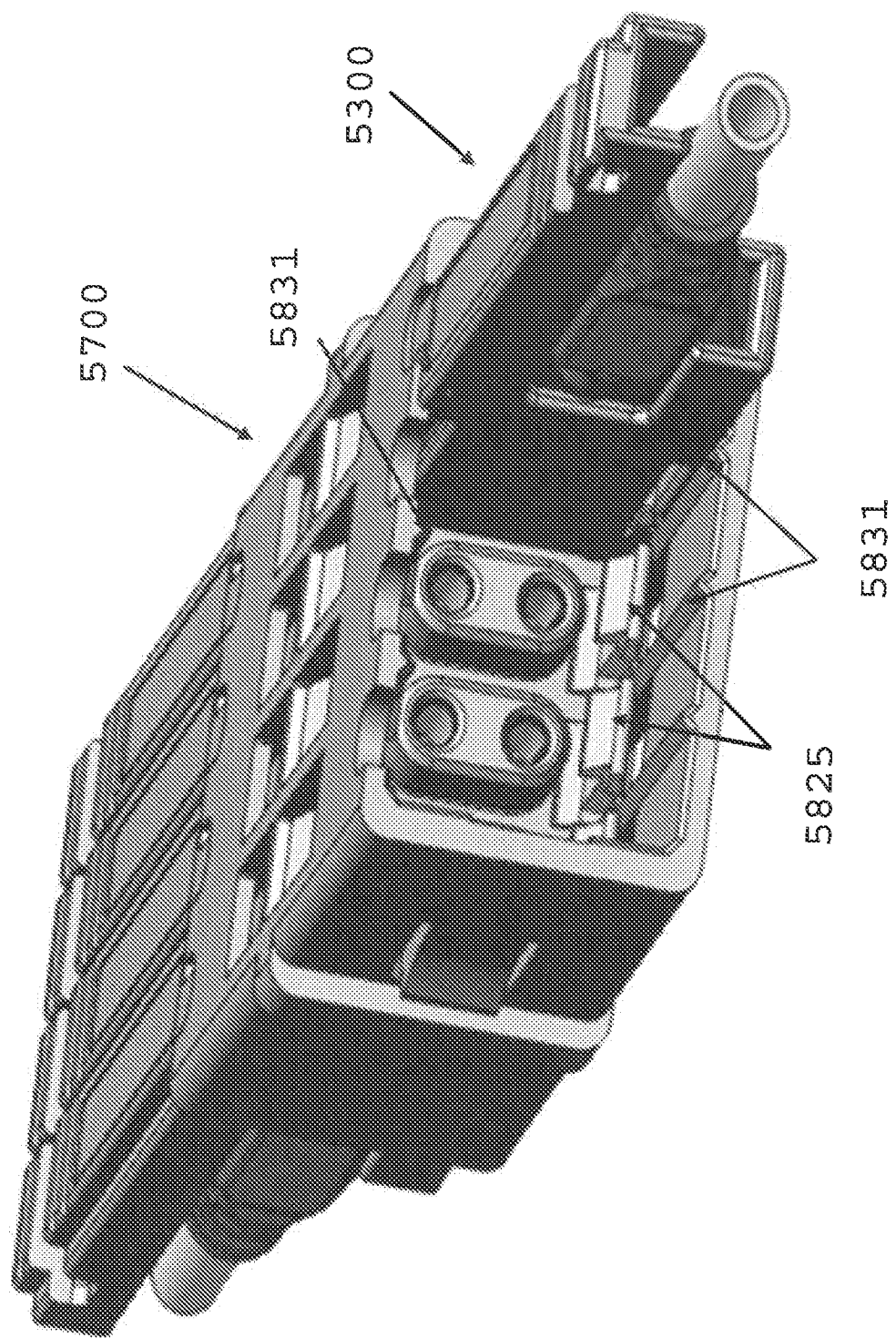


FIG. 58

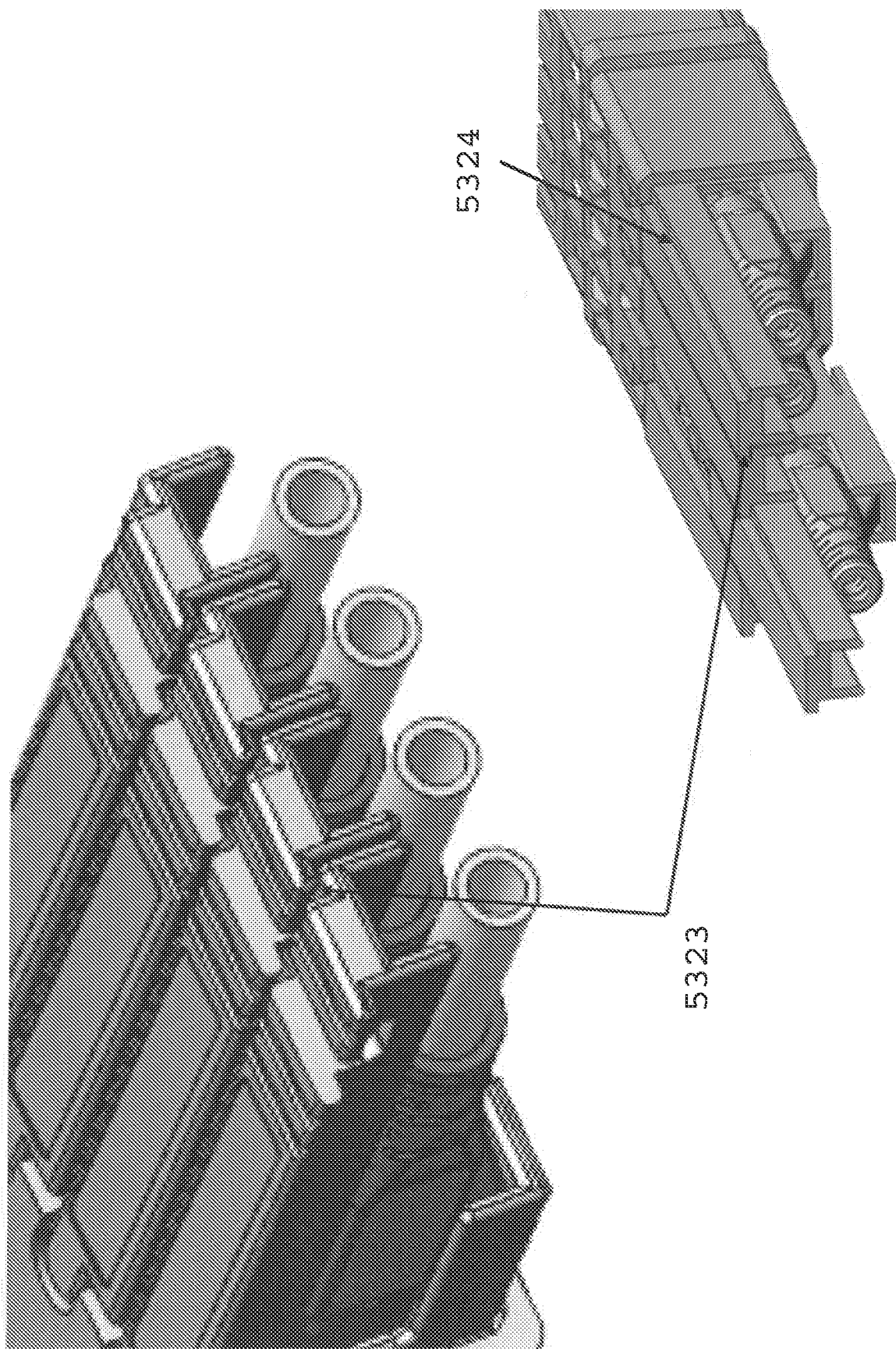


FIG. 59

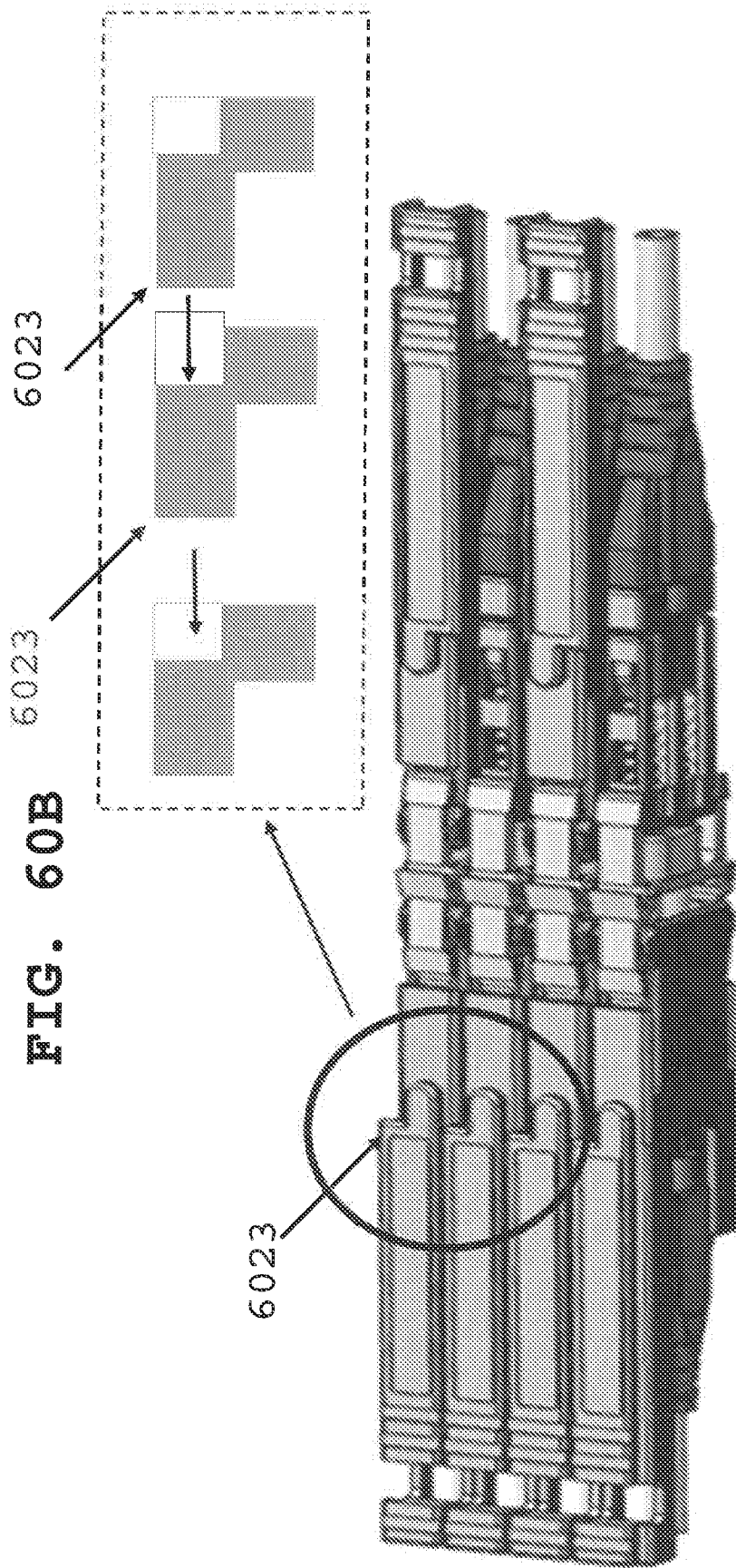


FIG. 60B

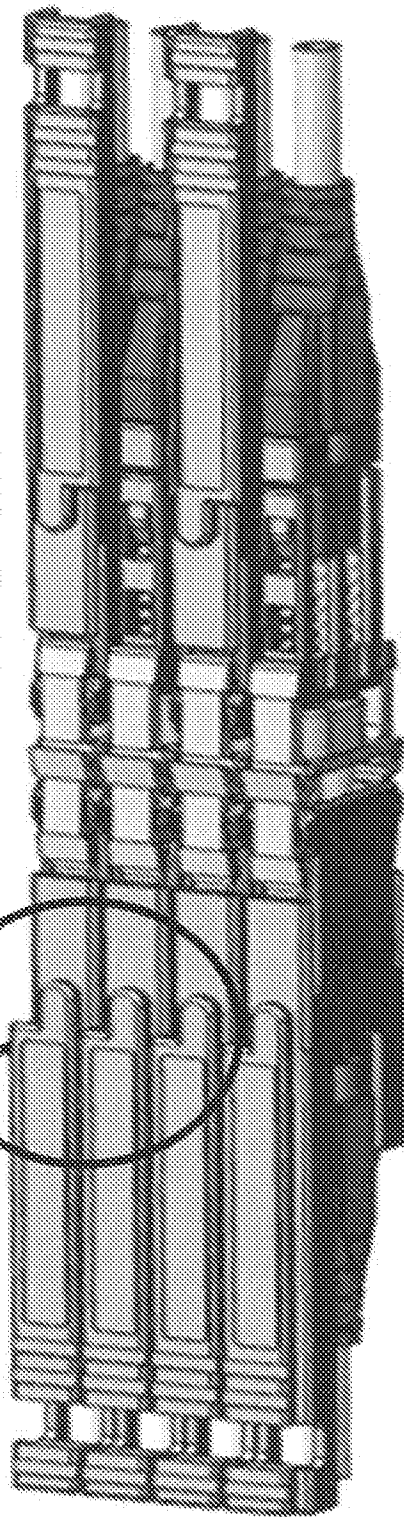


FIG. 60

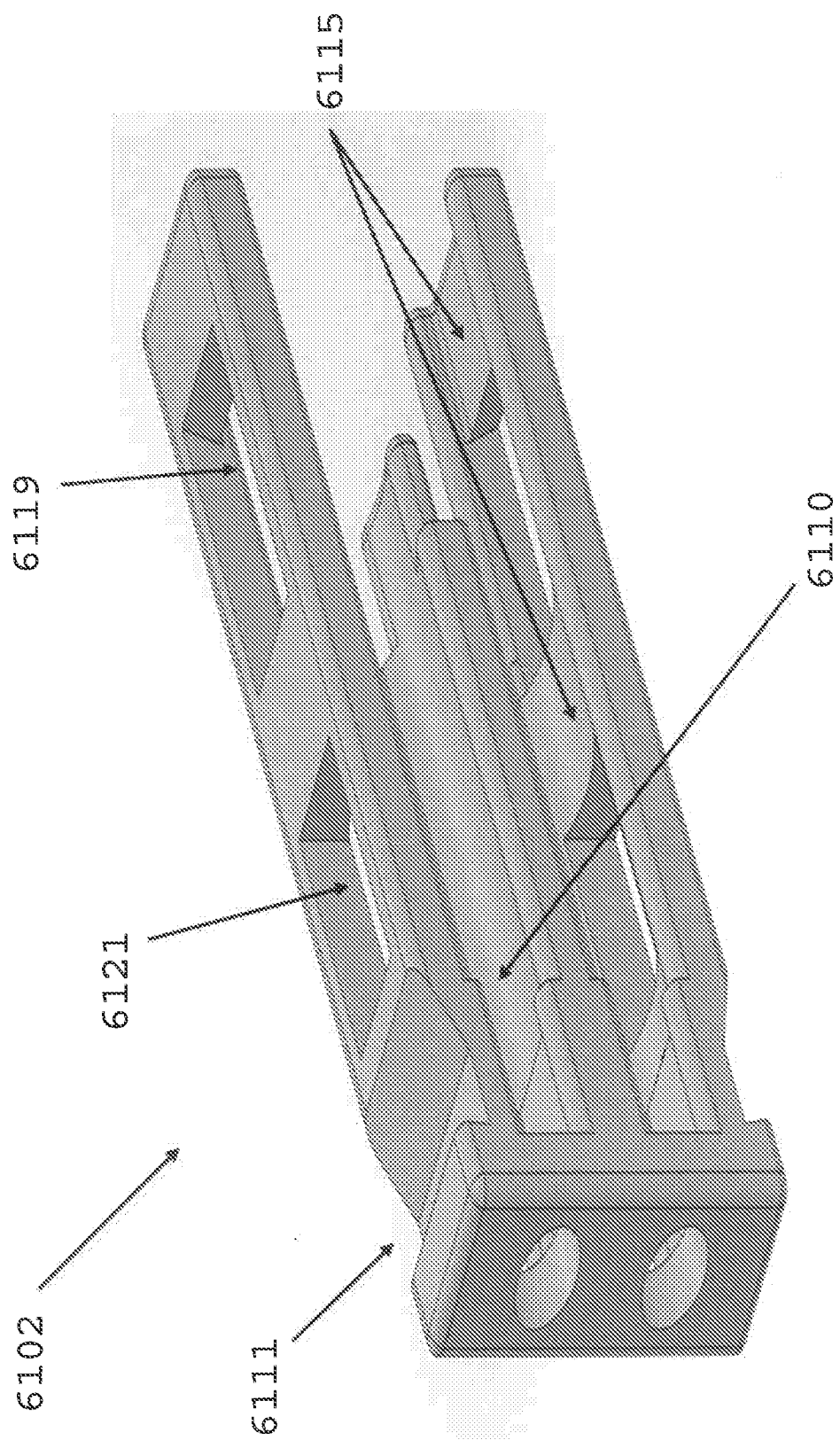


FIG. 61

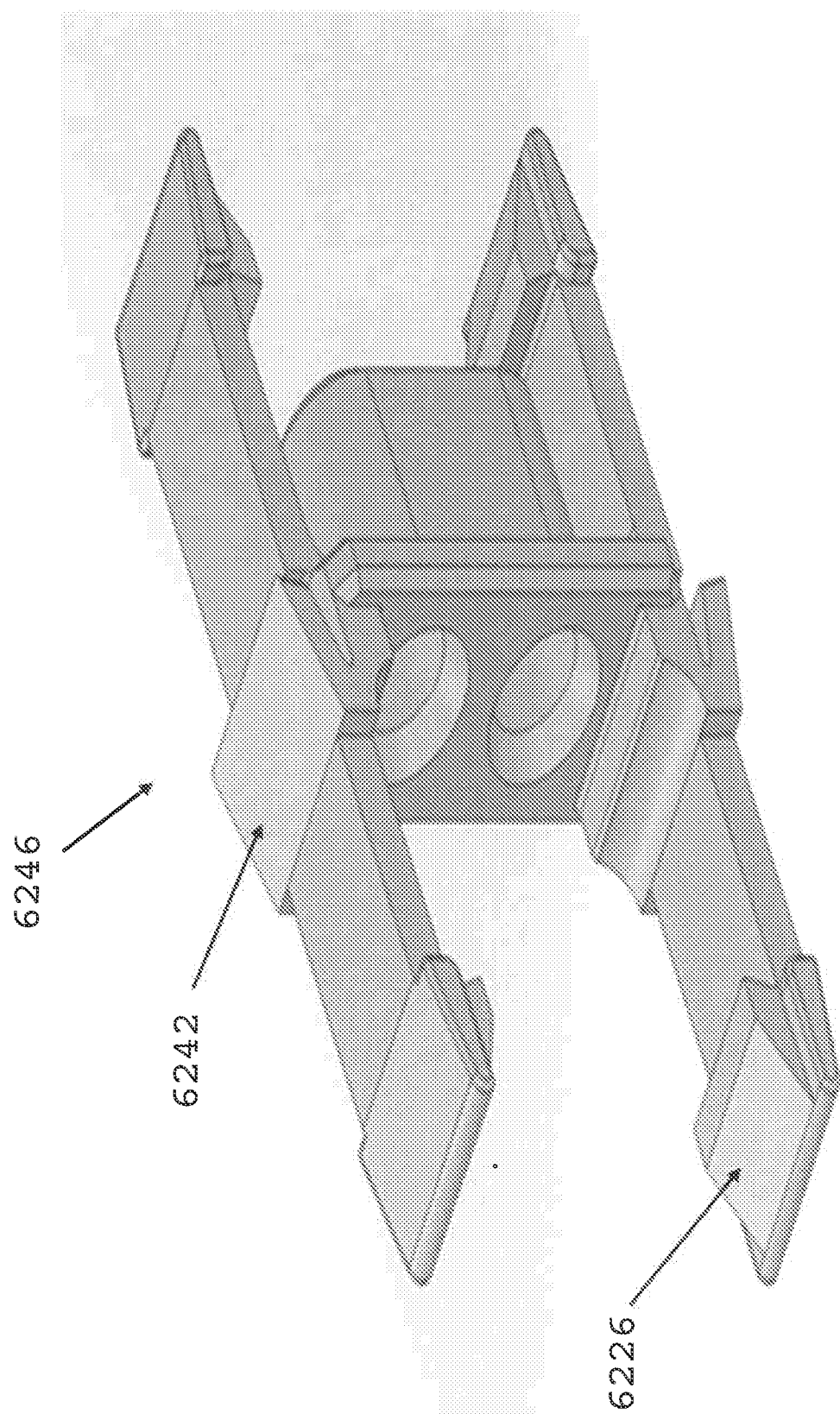


FIG. 62

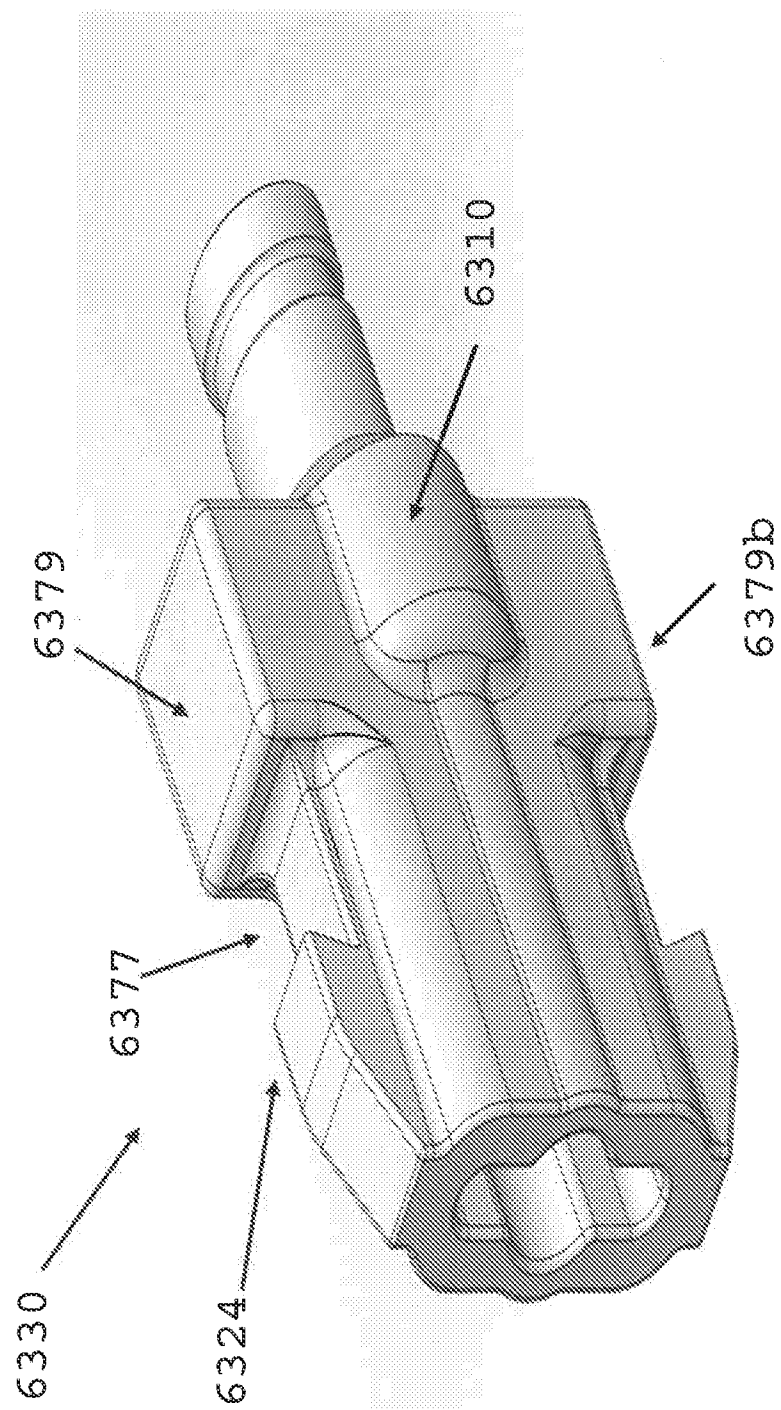


FIG. 63

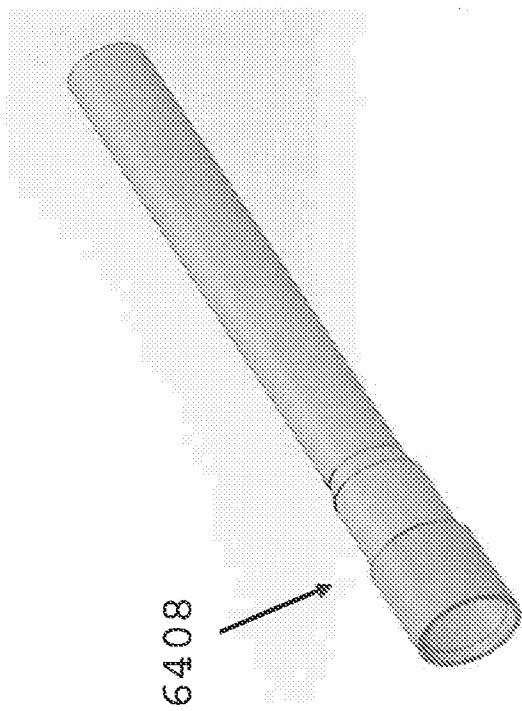


FIG. 64

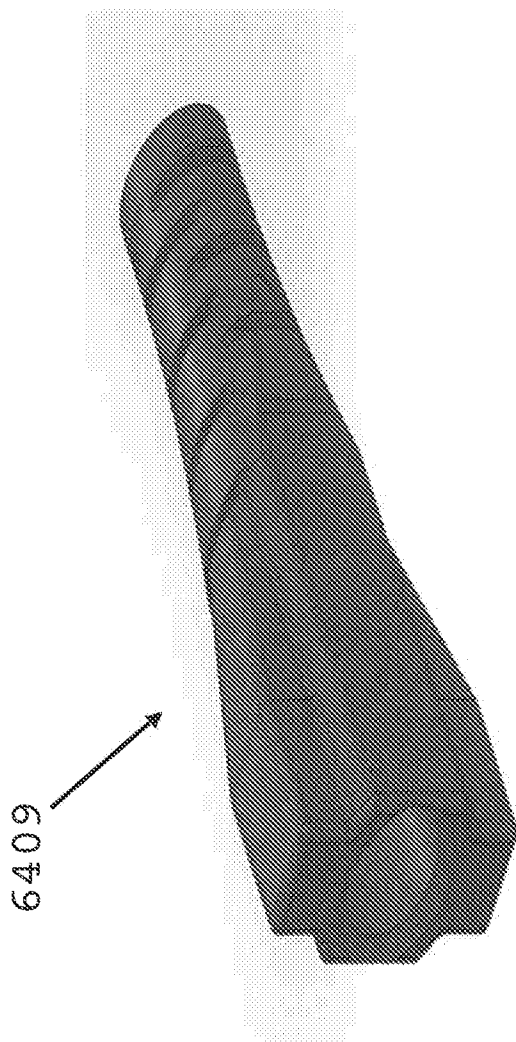


FIG. 64B

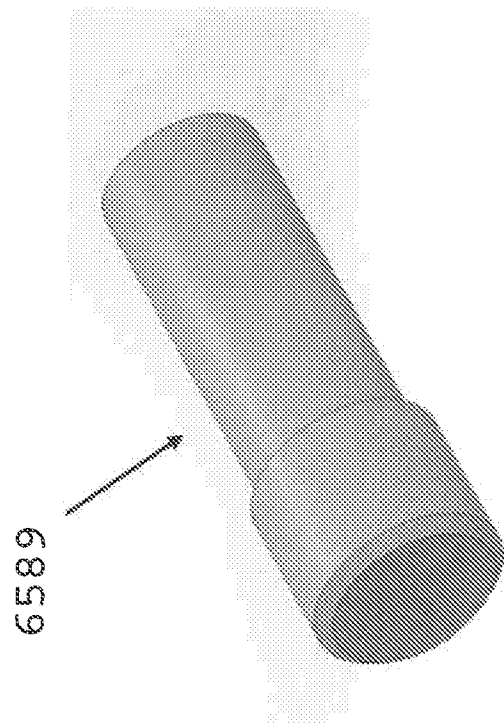


FIG. 65

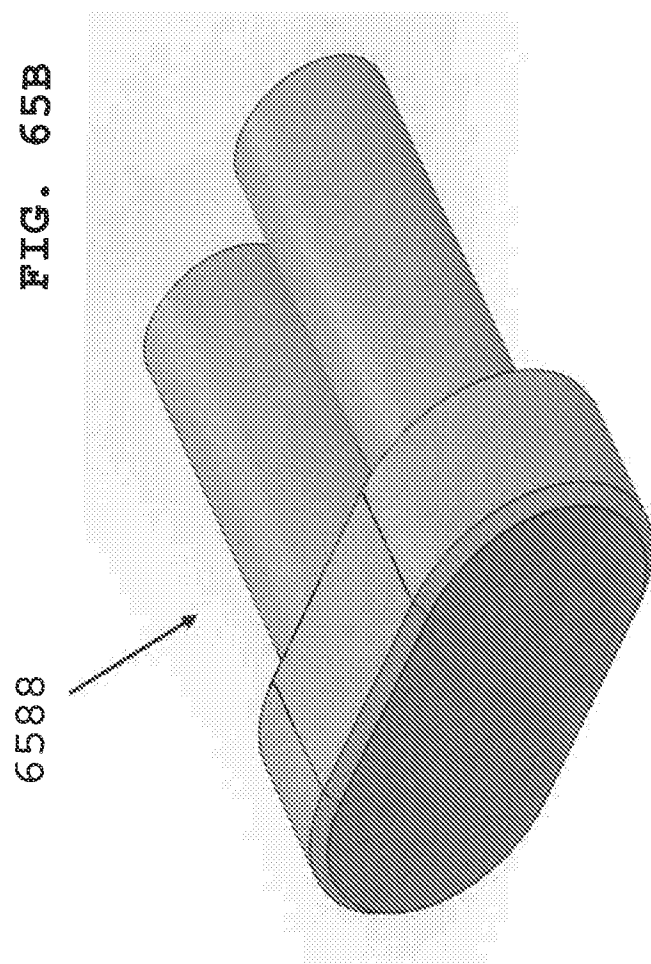


FIG. 65B

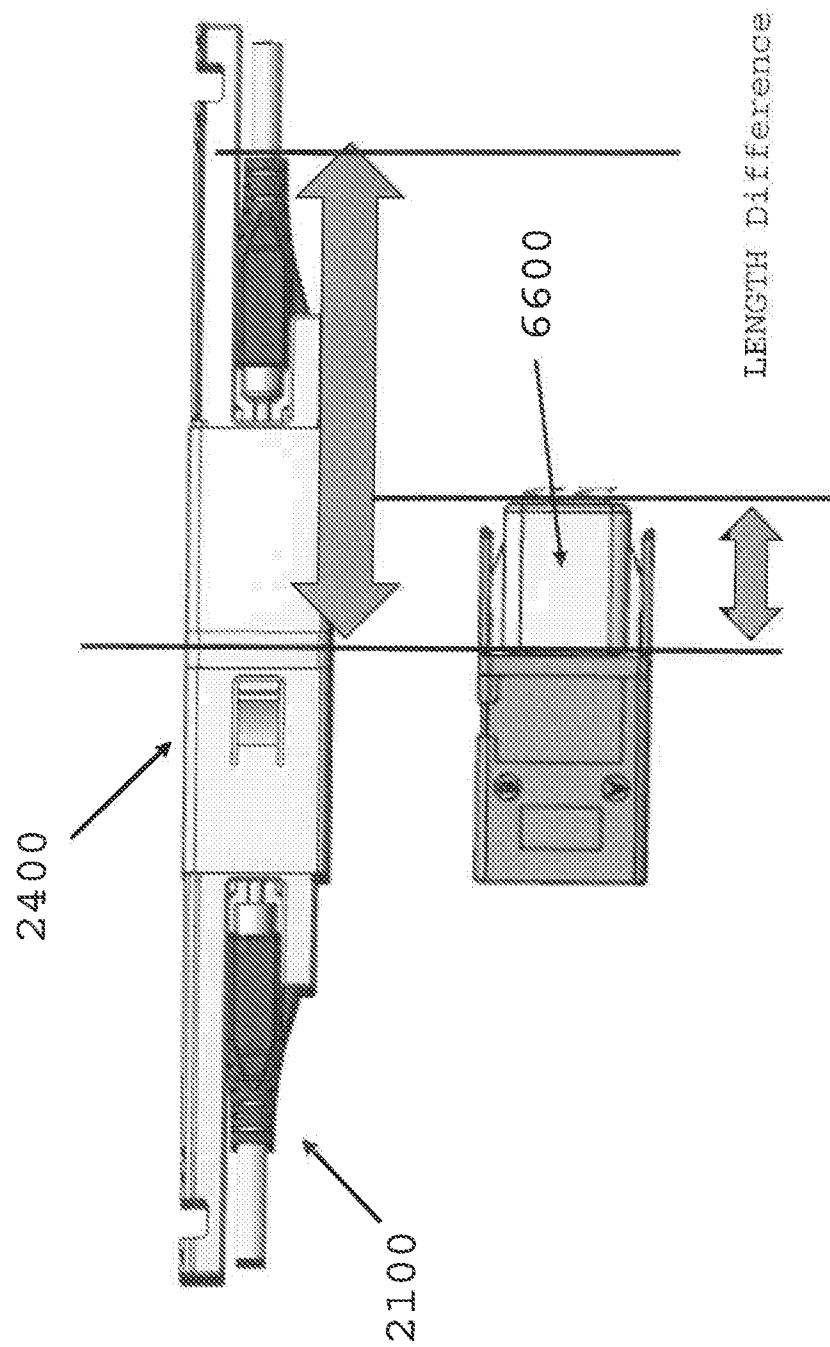


FIG. 66

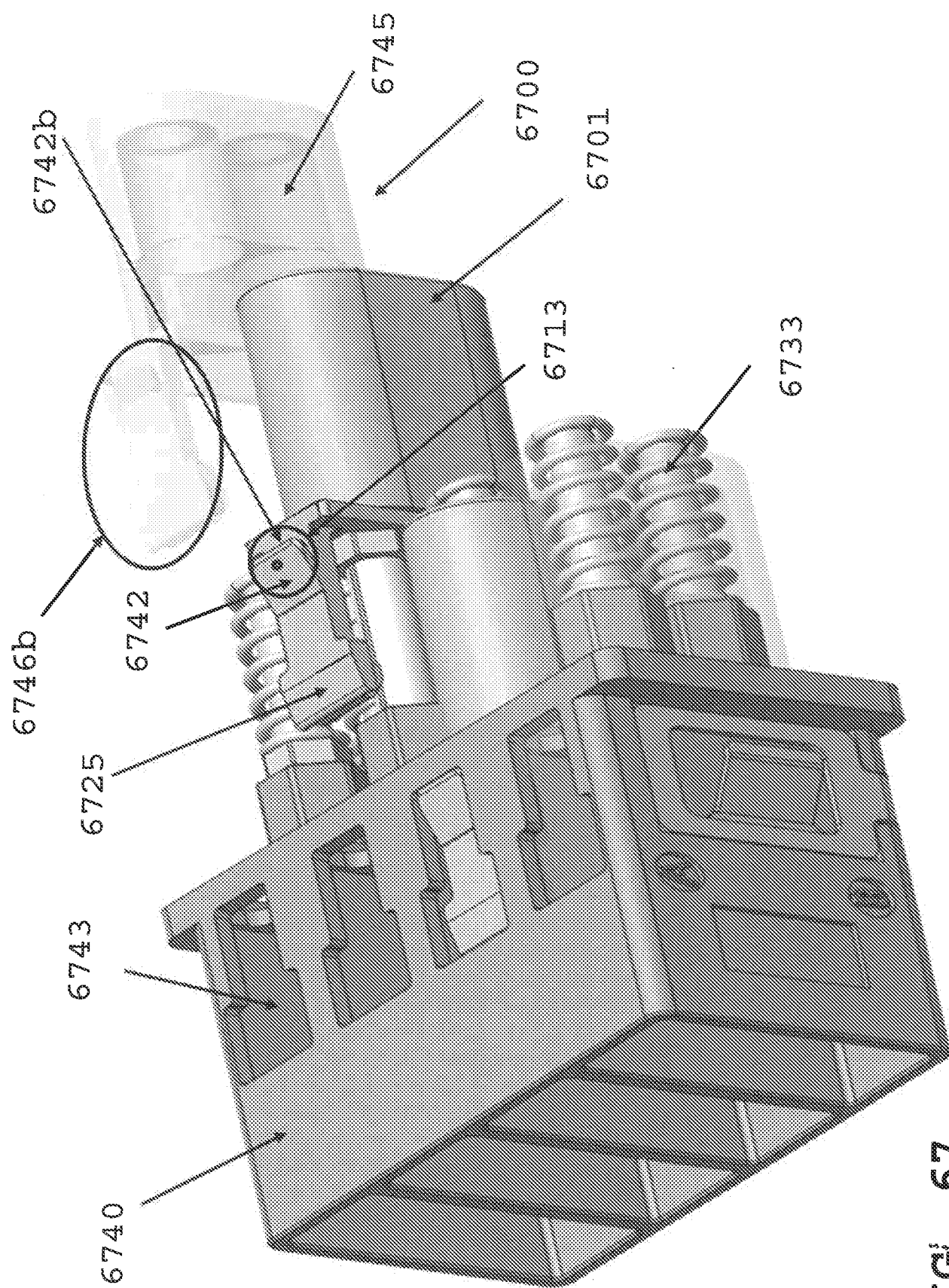


FIG. 67

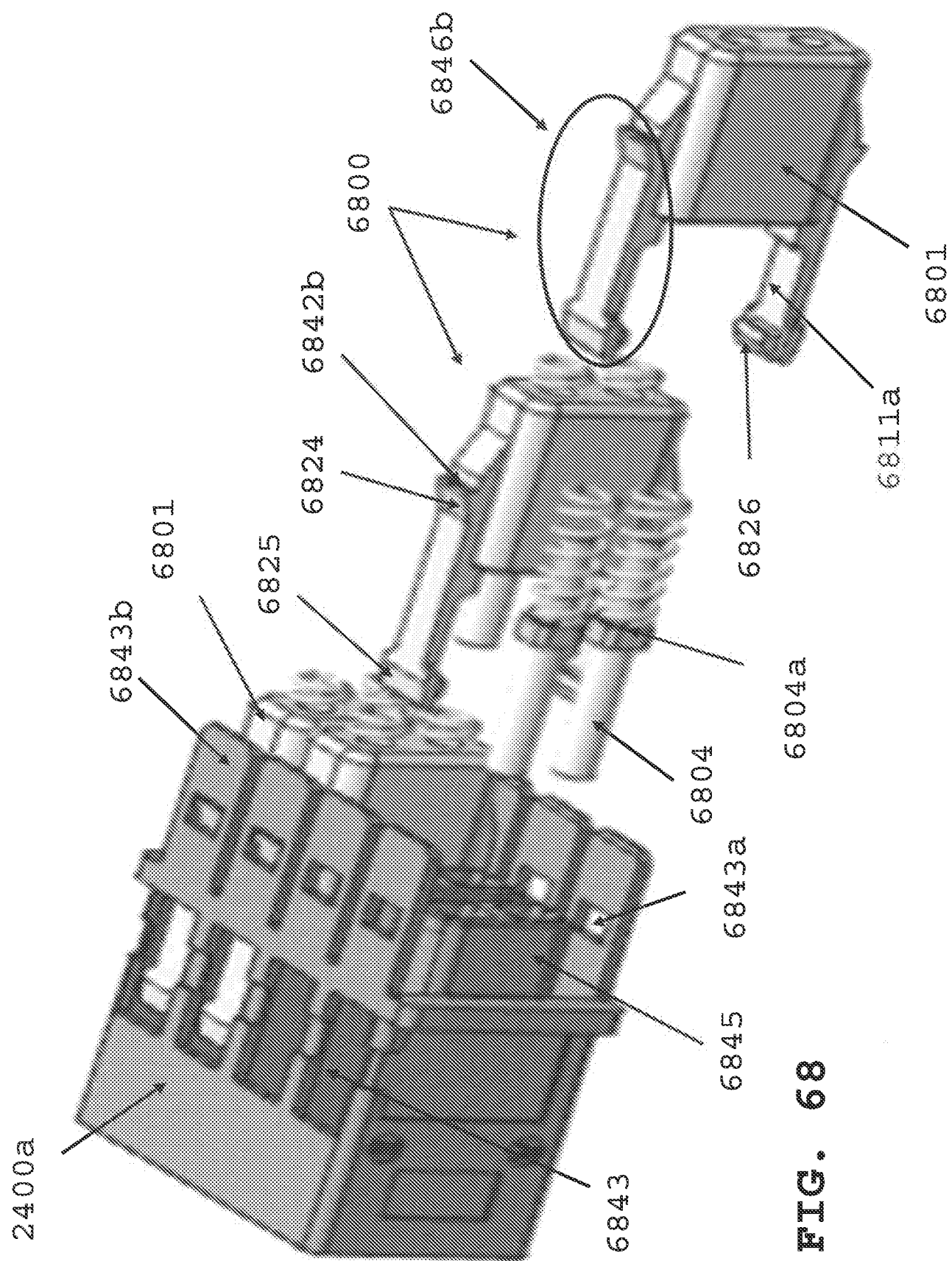


FIG. 68

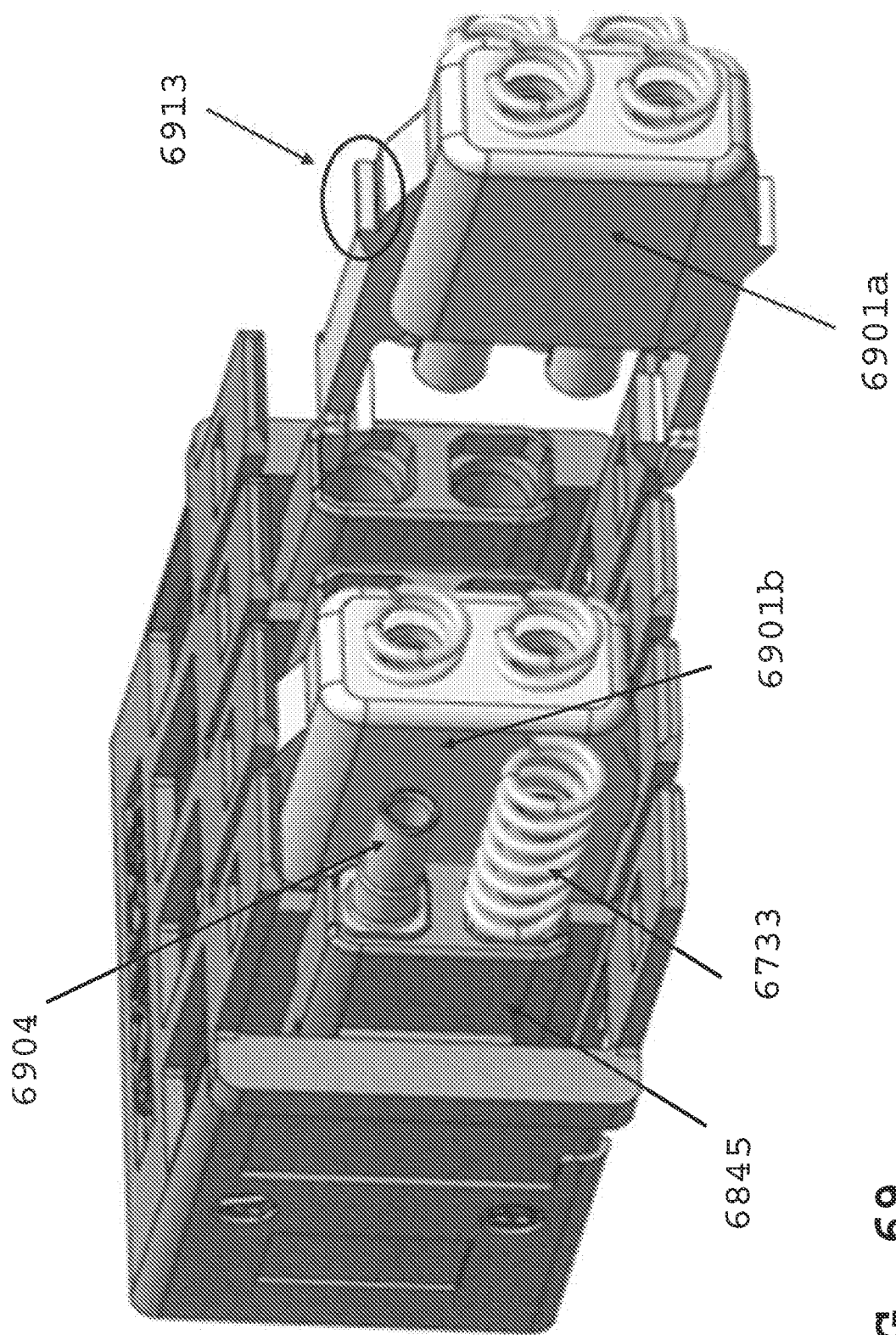


FIG. 69

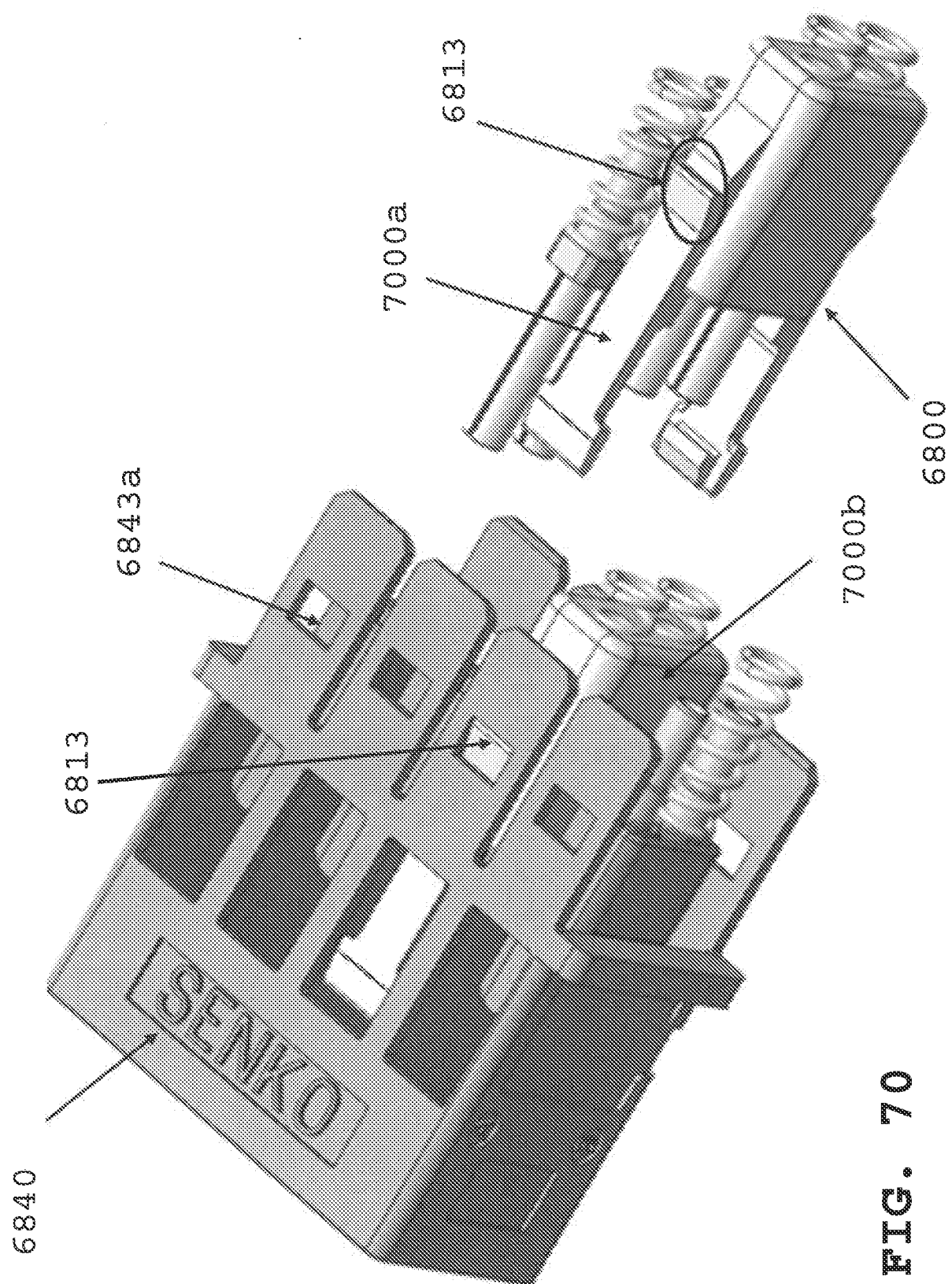


FIG. 70

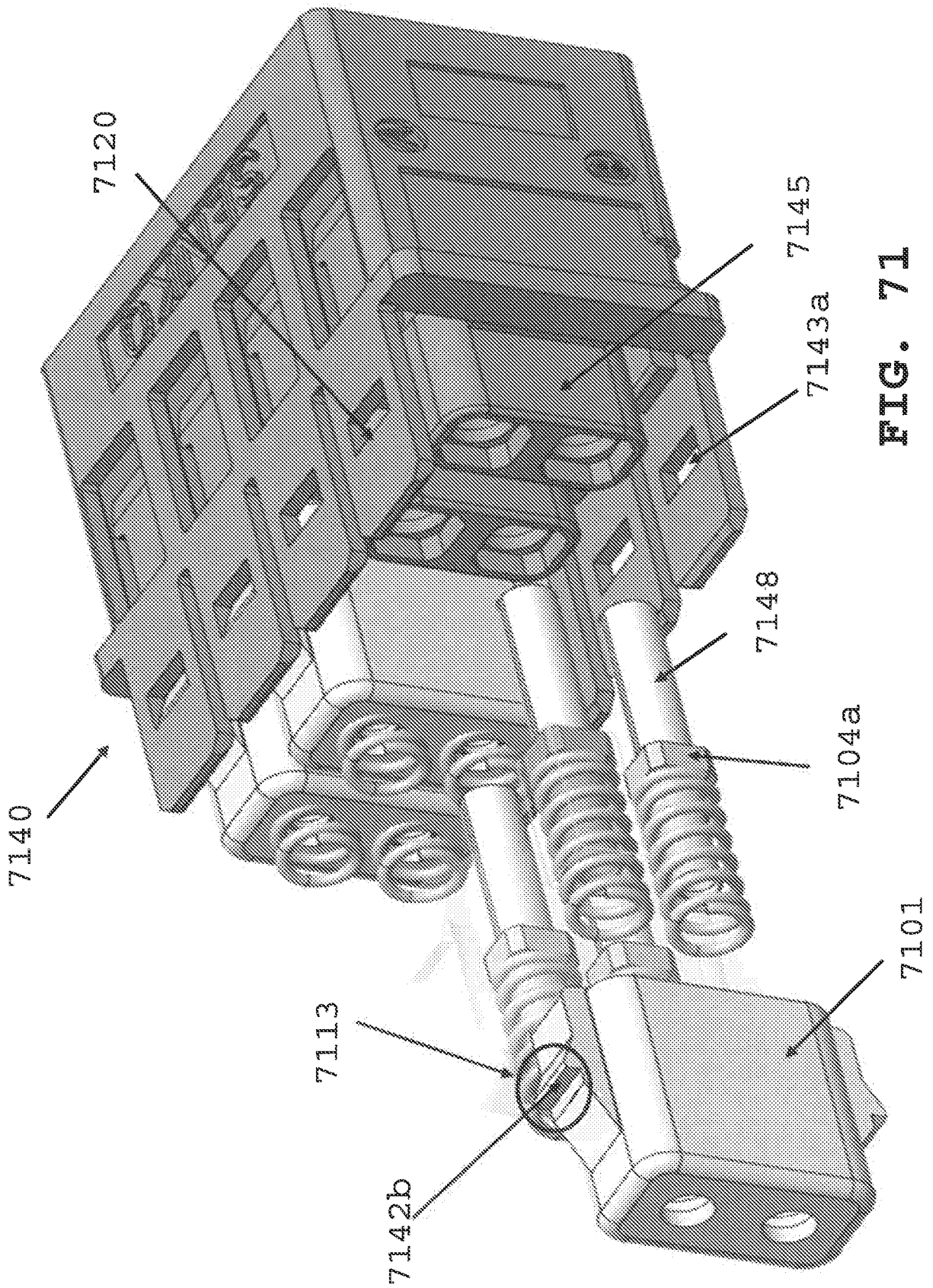


FIG. 71

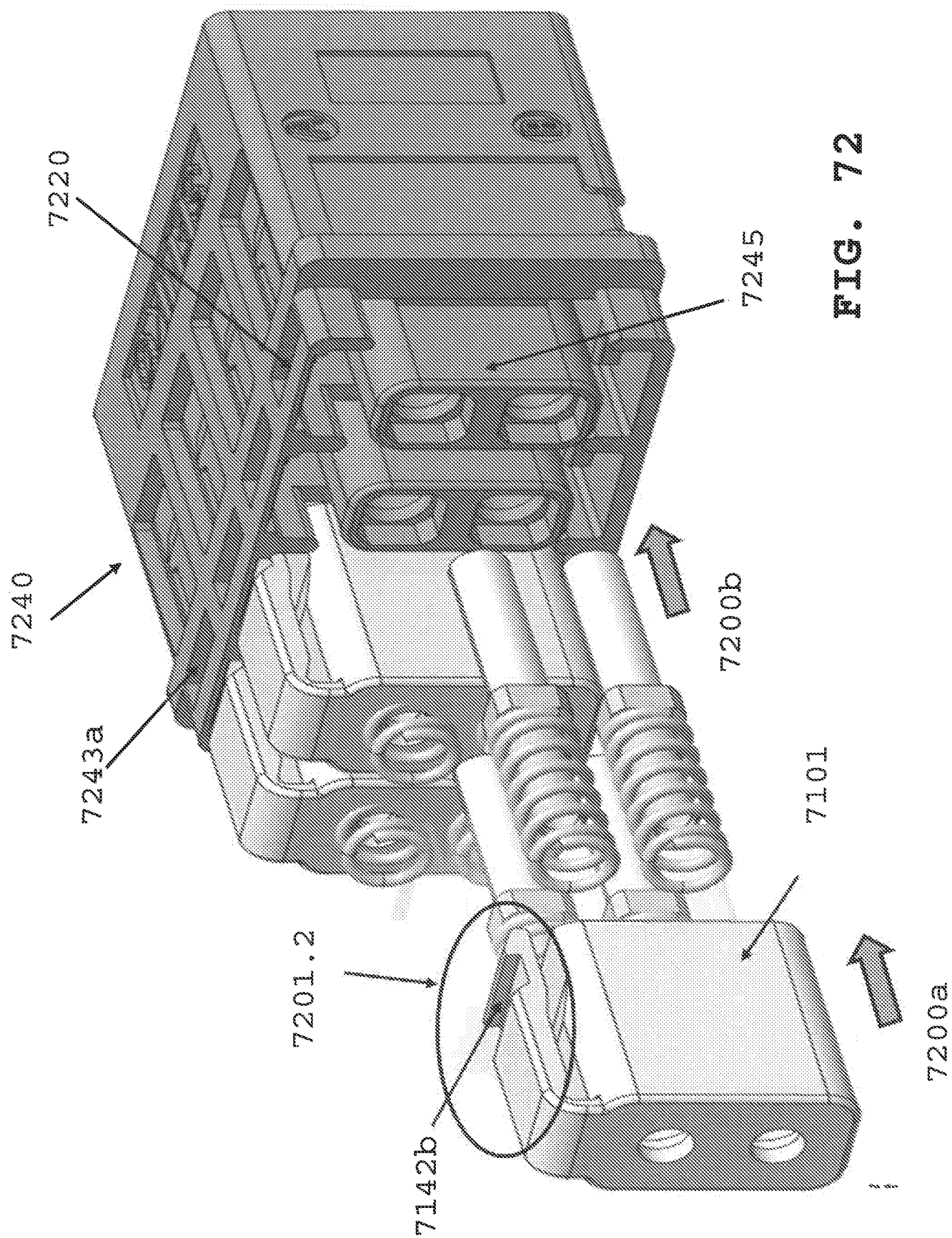


FIG. 72

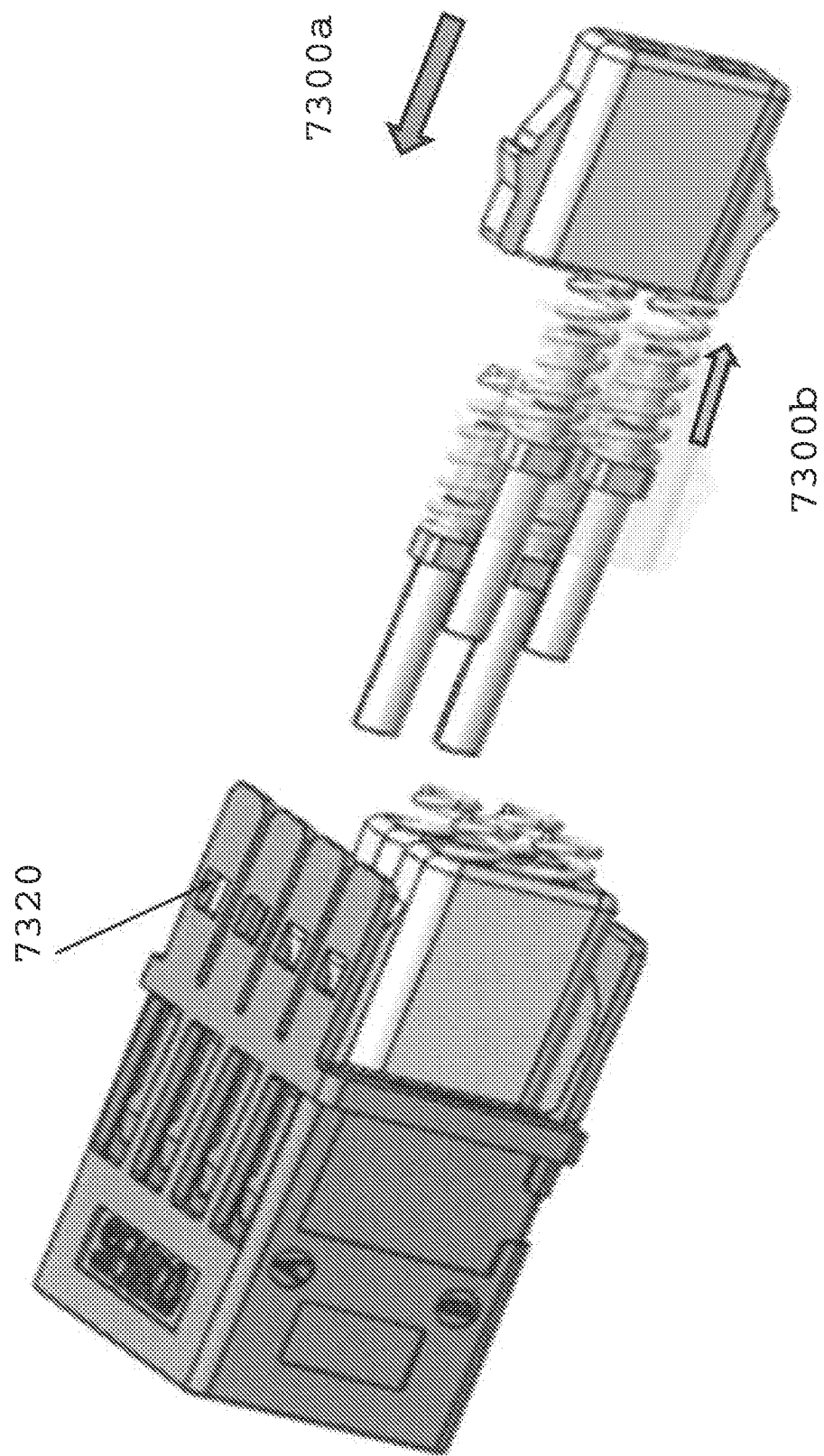


FIG. 73

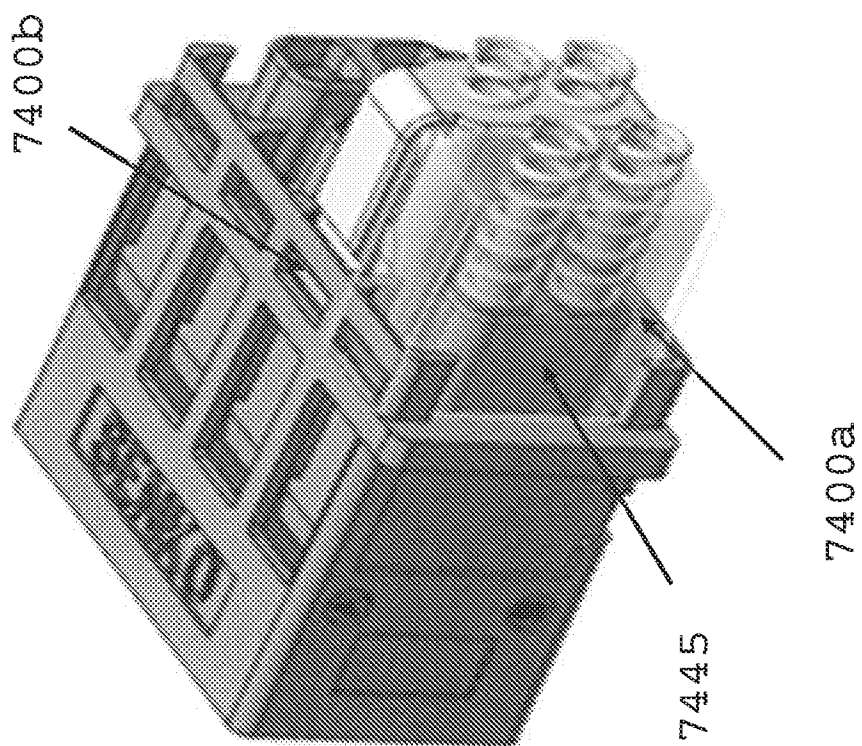
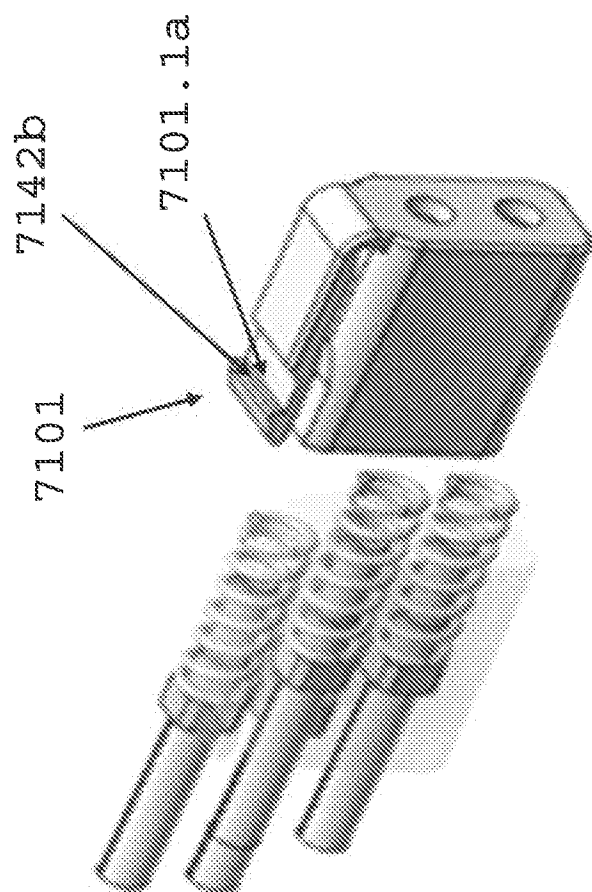


FIG. 74

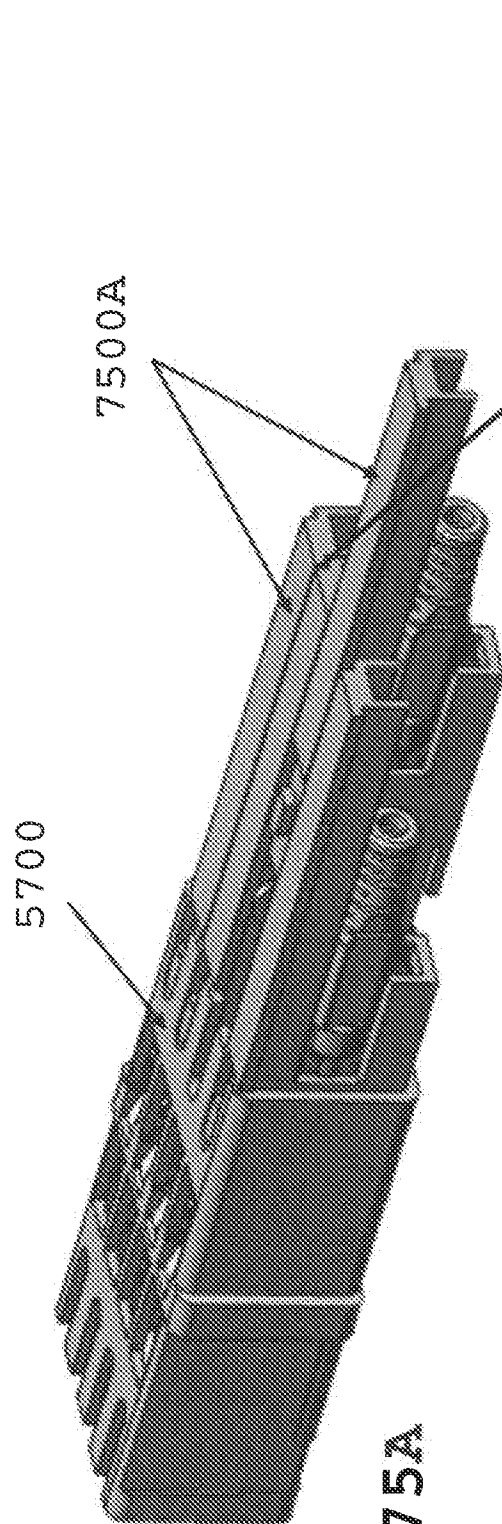


FIG. 75A

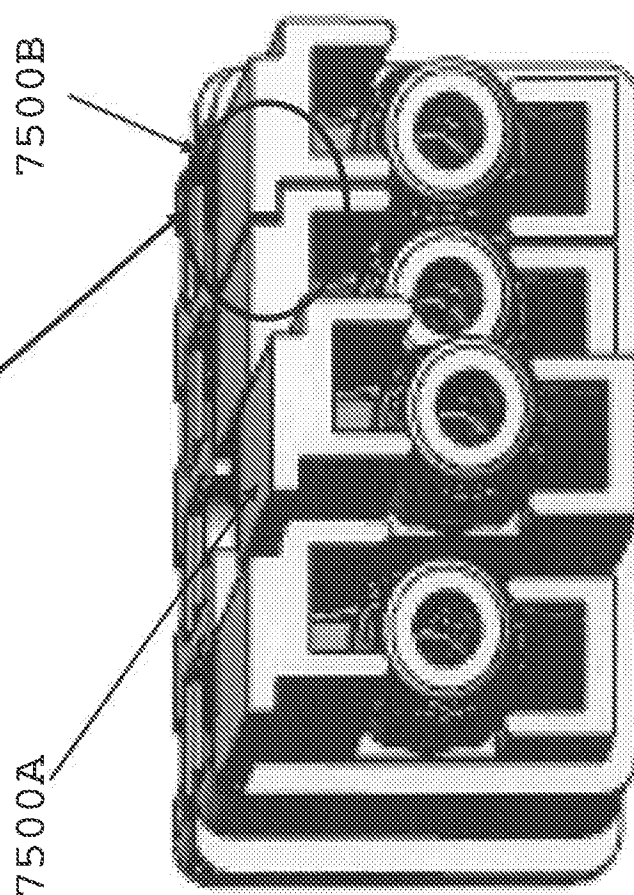


FIG. 75B

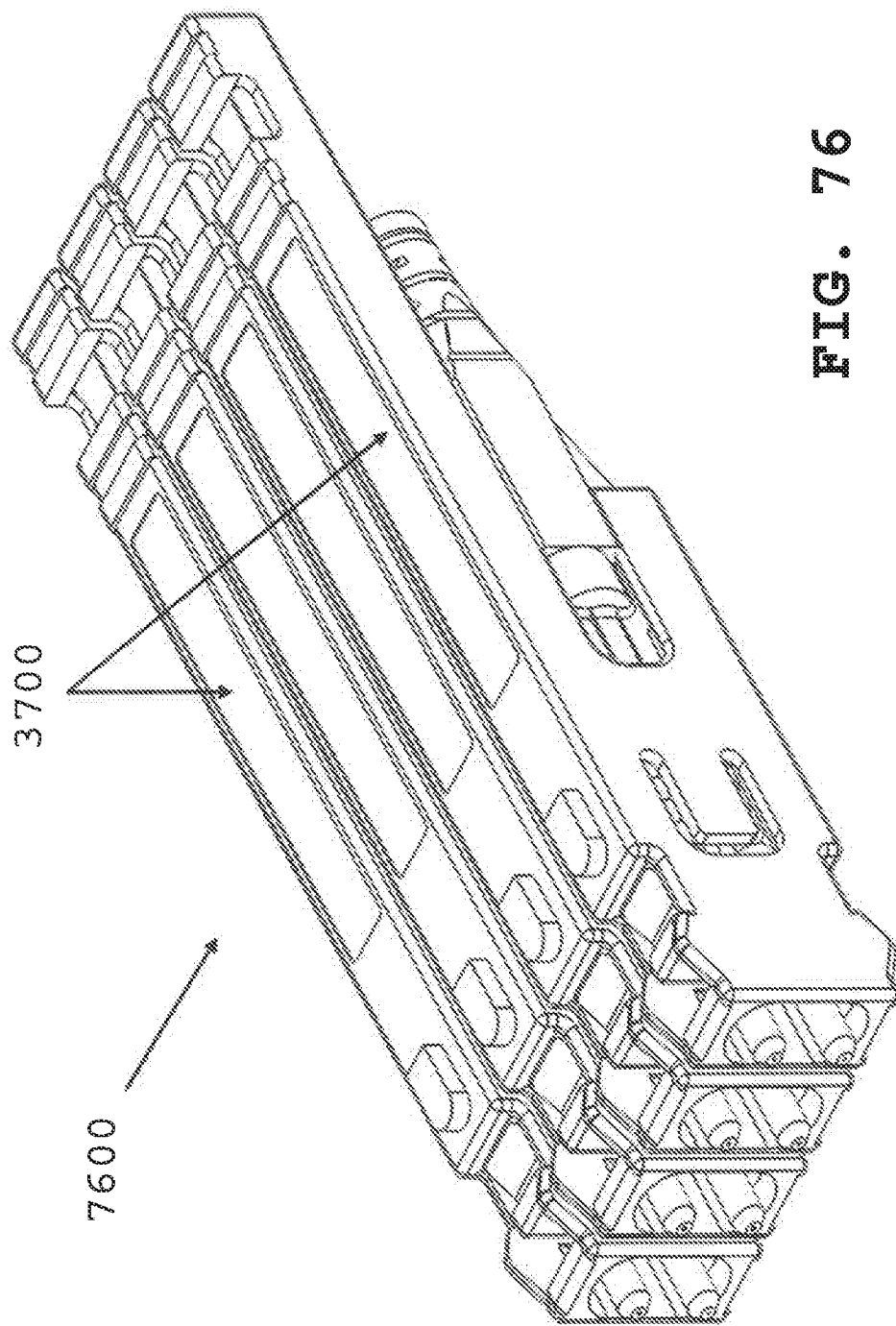


FIG. 76

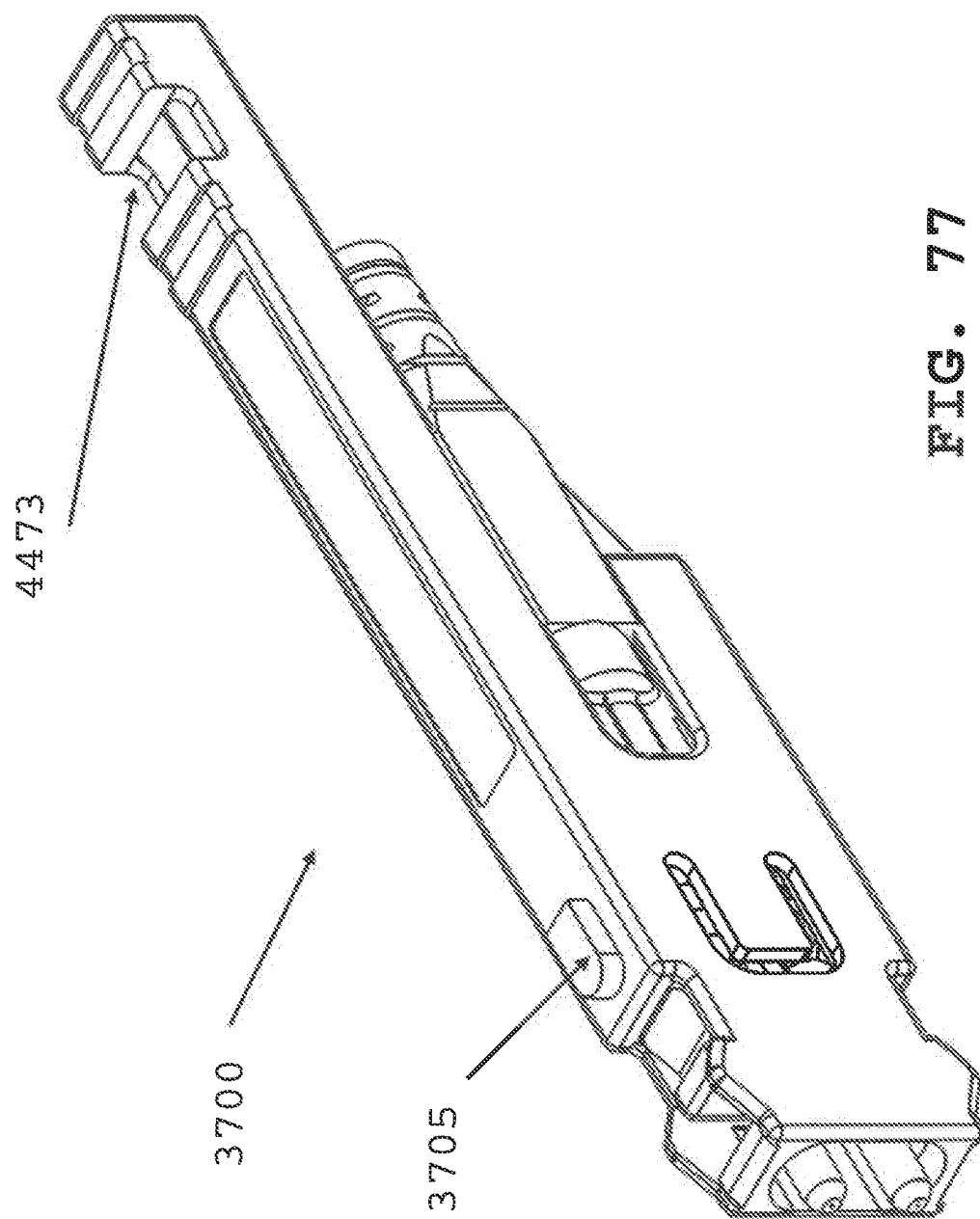


FIG. 77

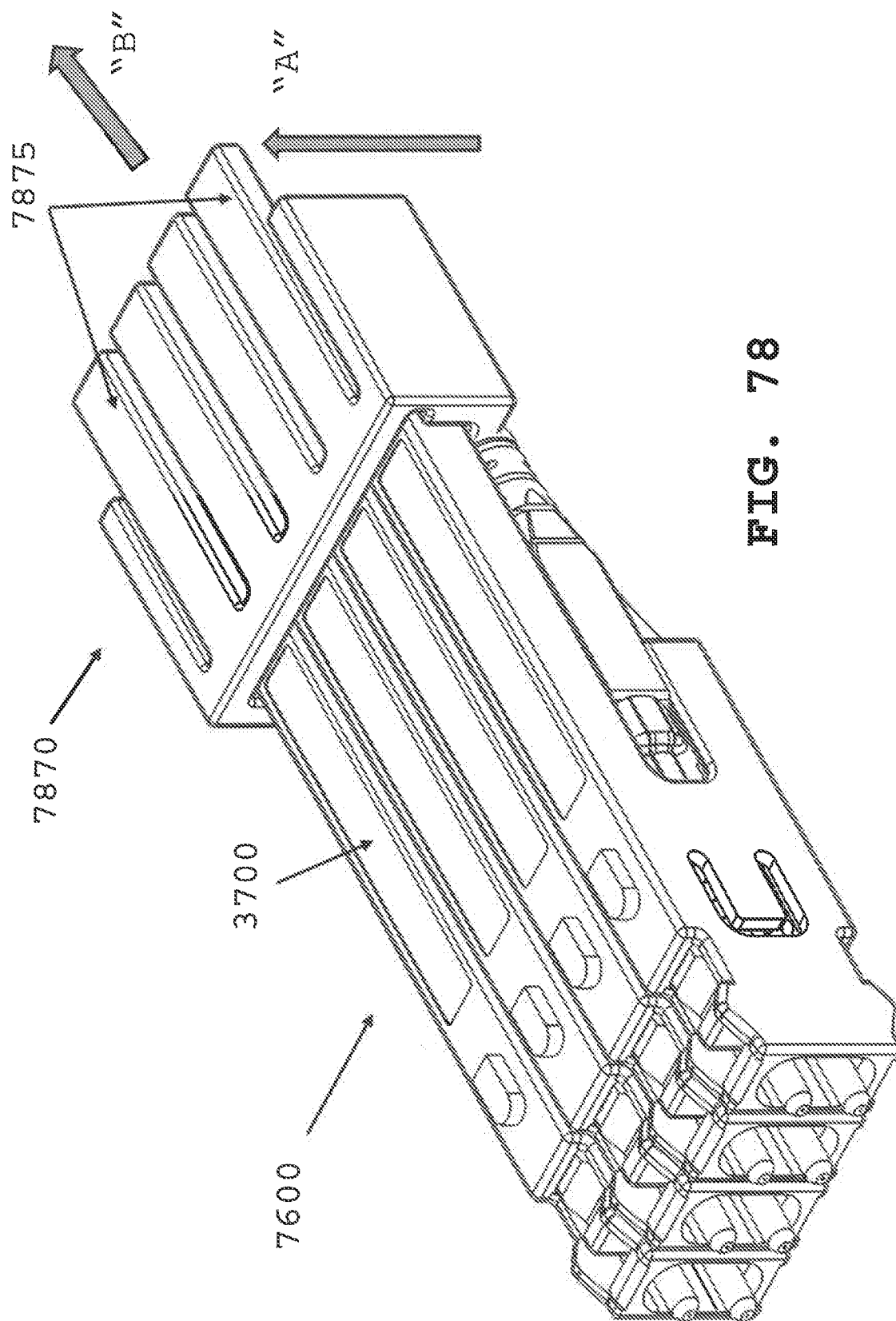


FIG. 78

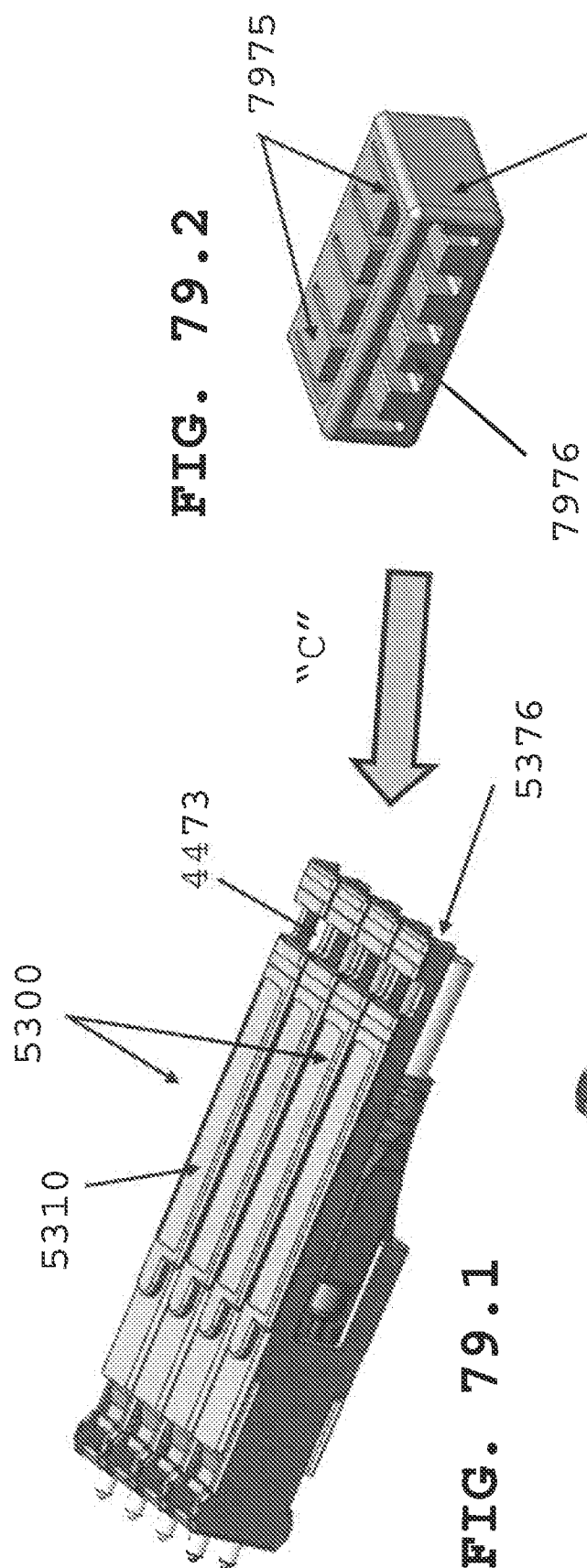


FIG. 79.2

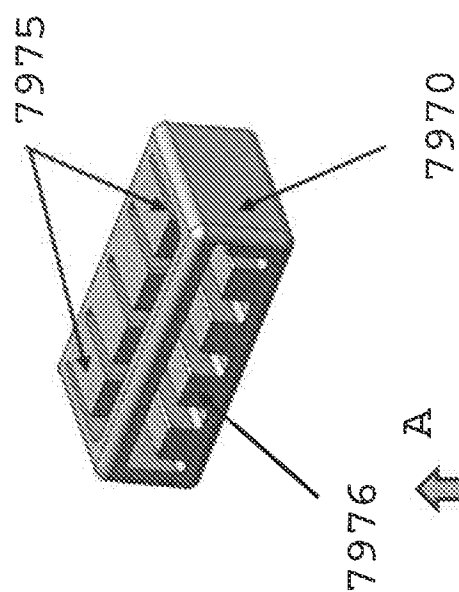
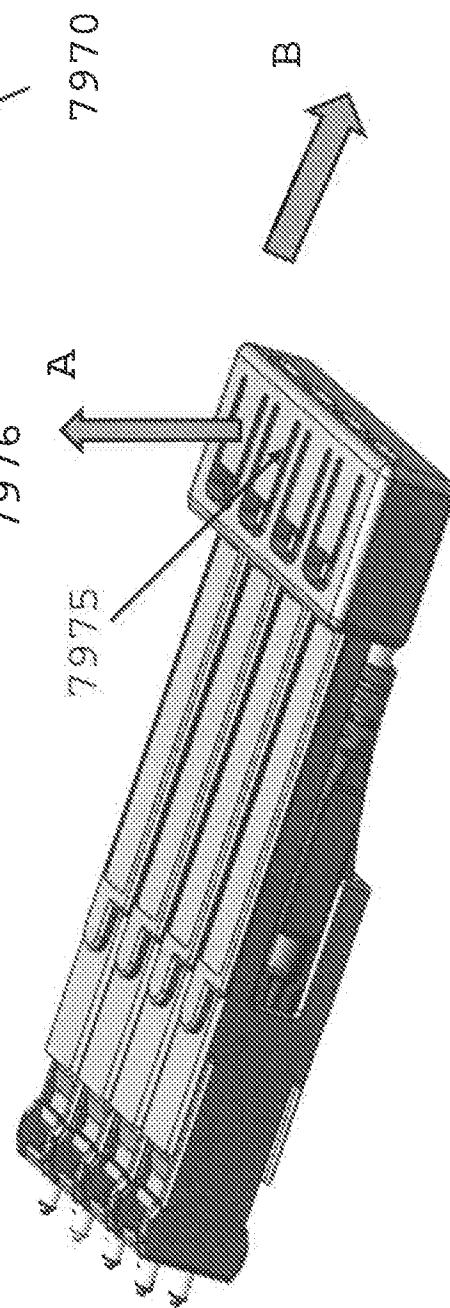


FIG. 79.3

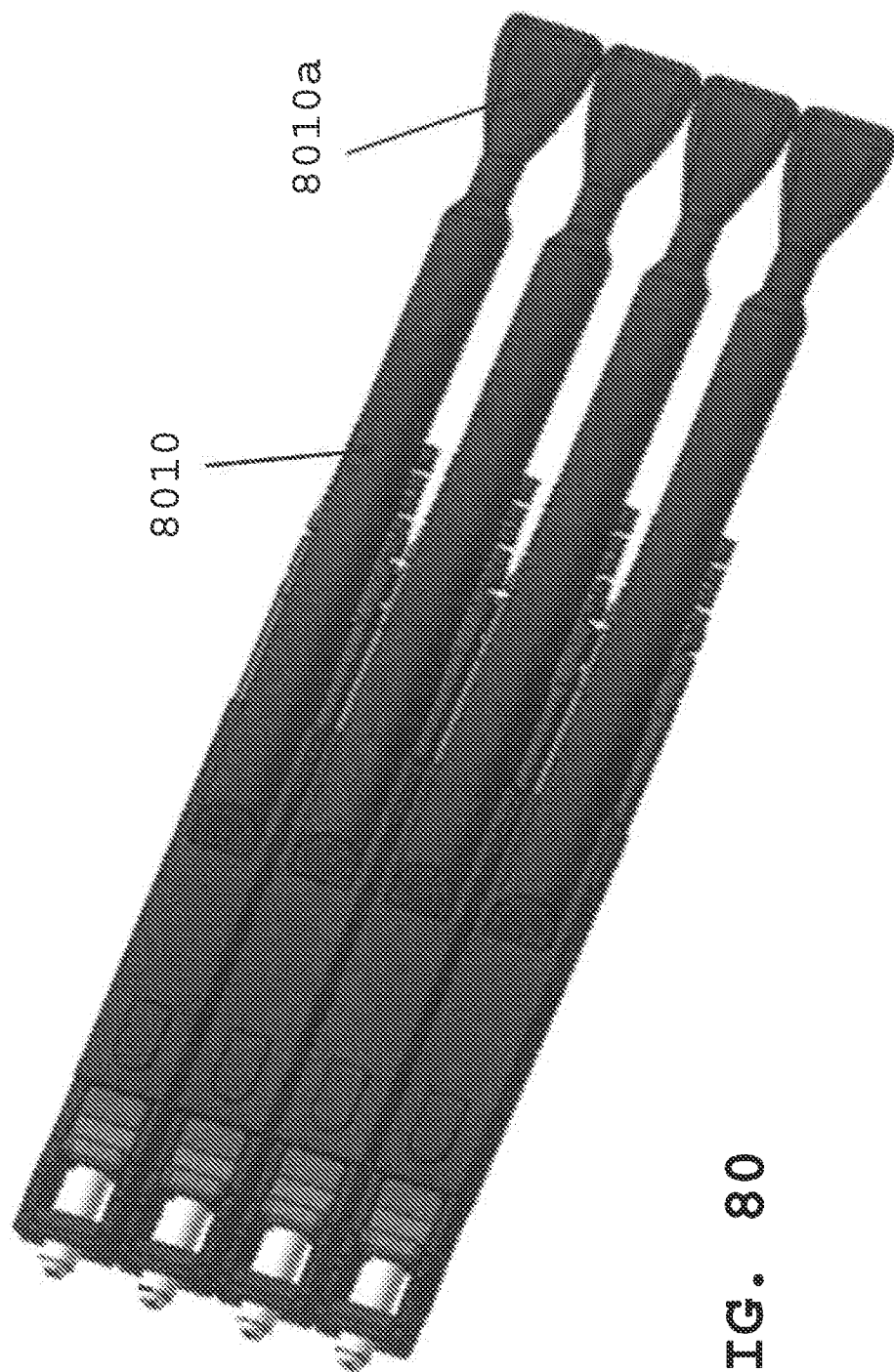


FIG. 80

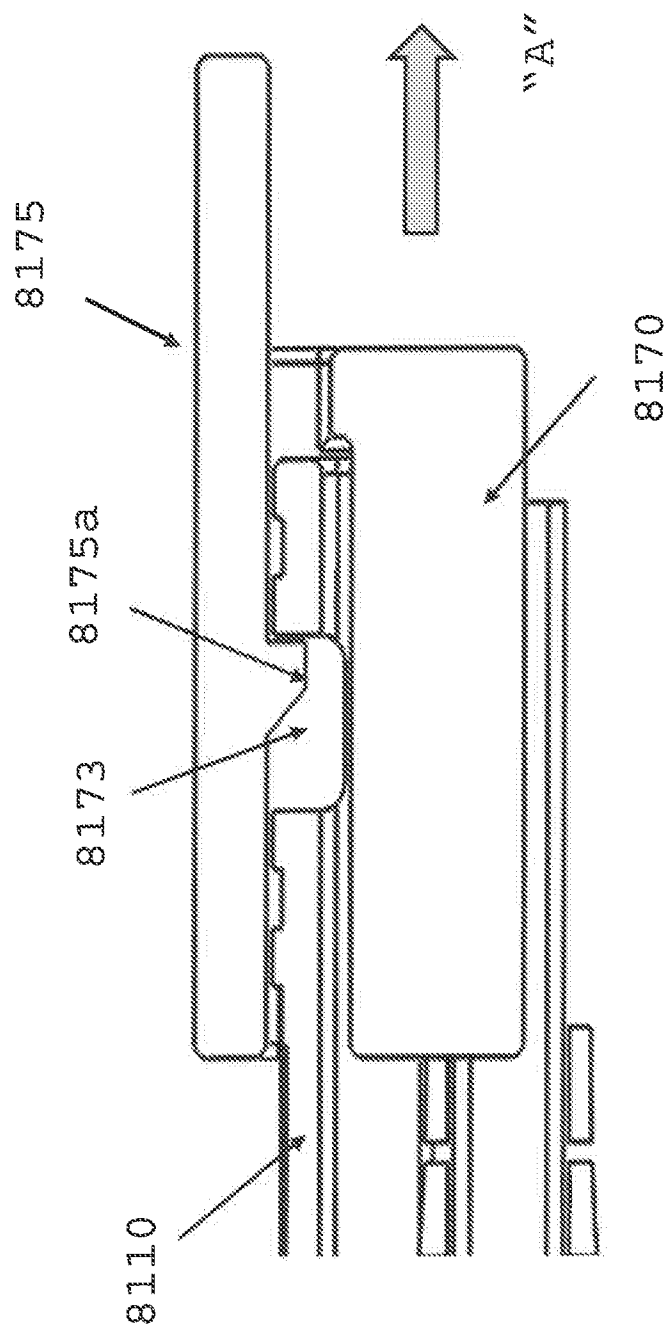


FIG. 81

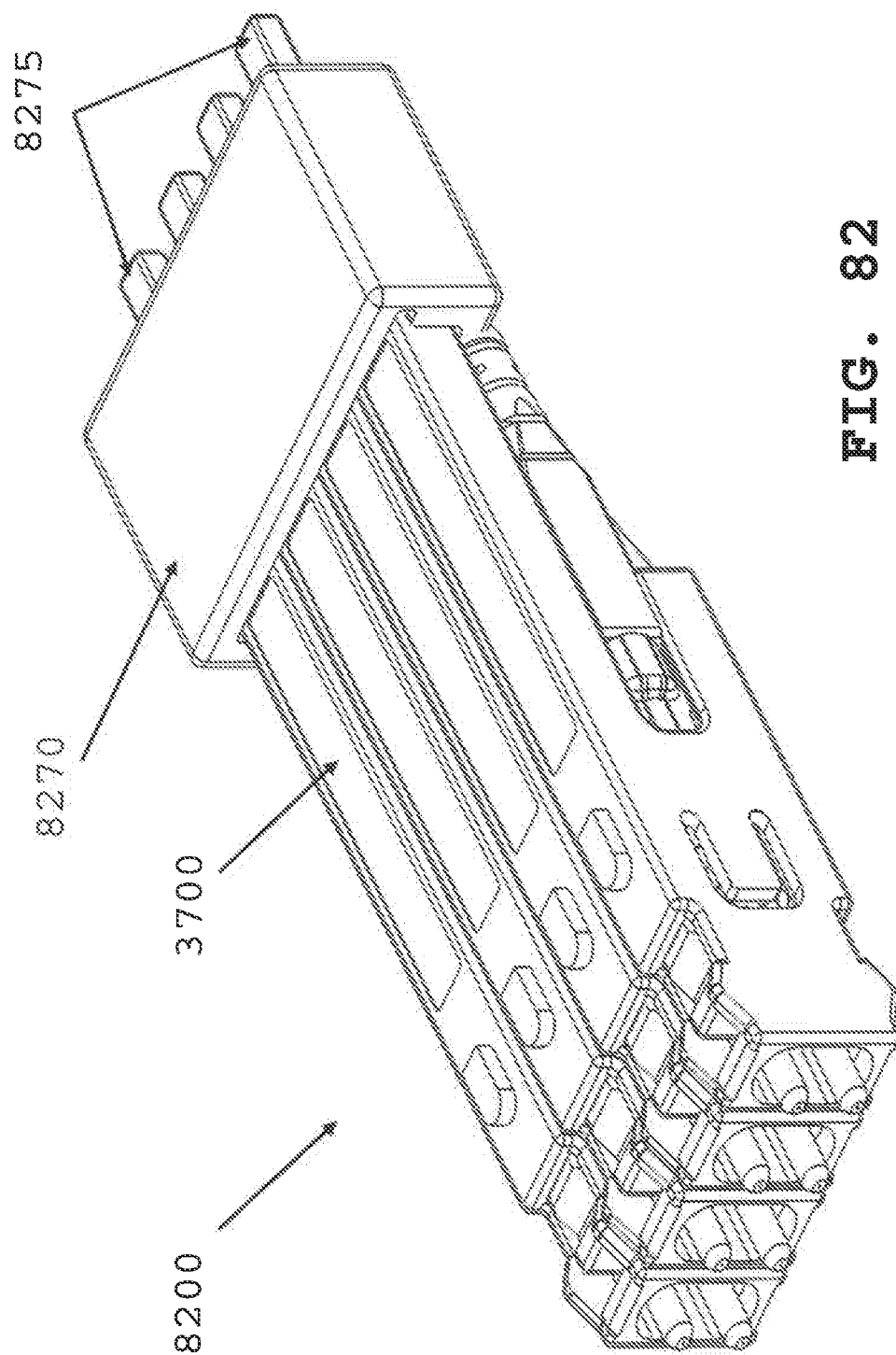


FIG. 82

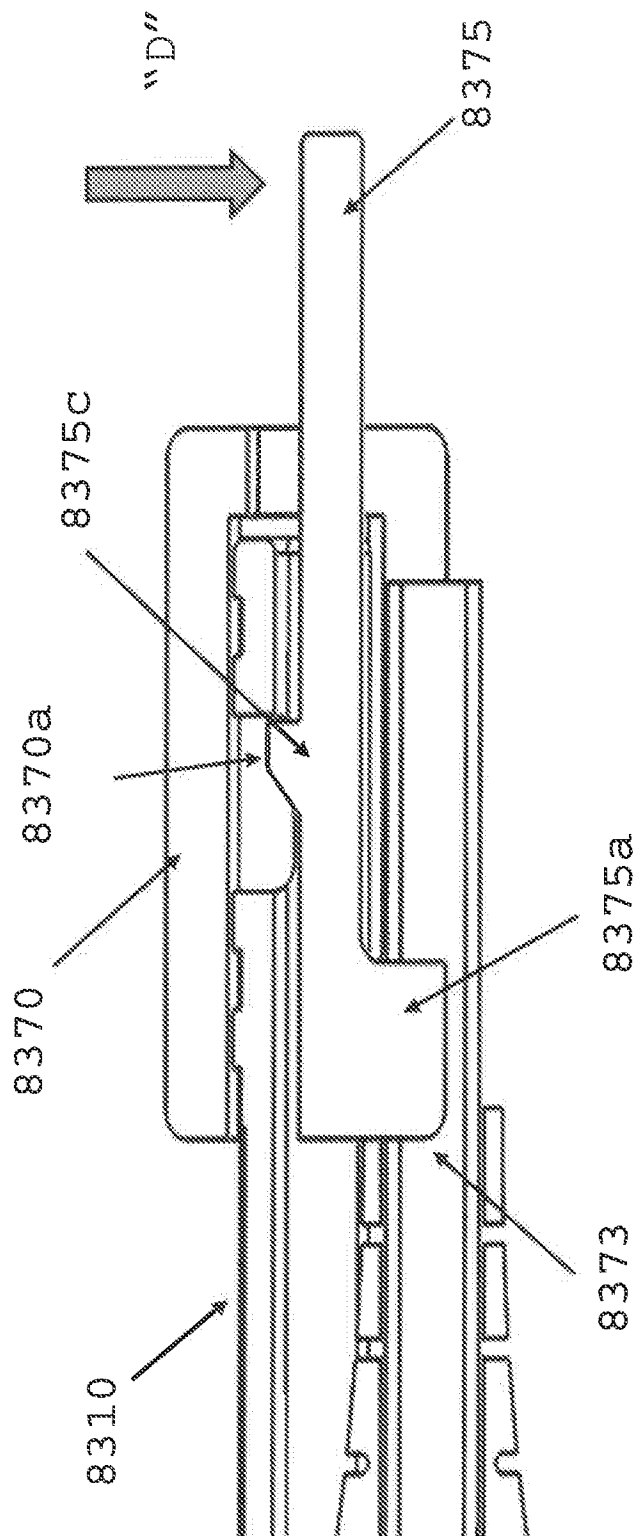


FIG. 83

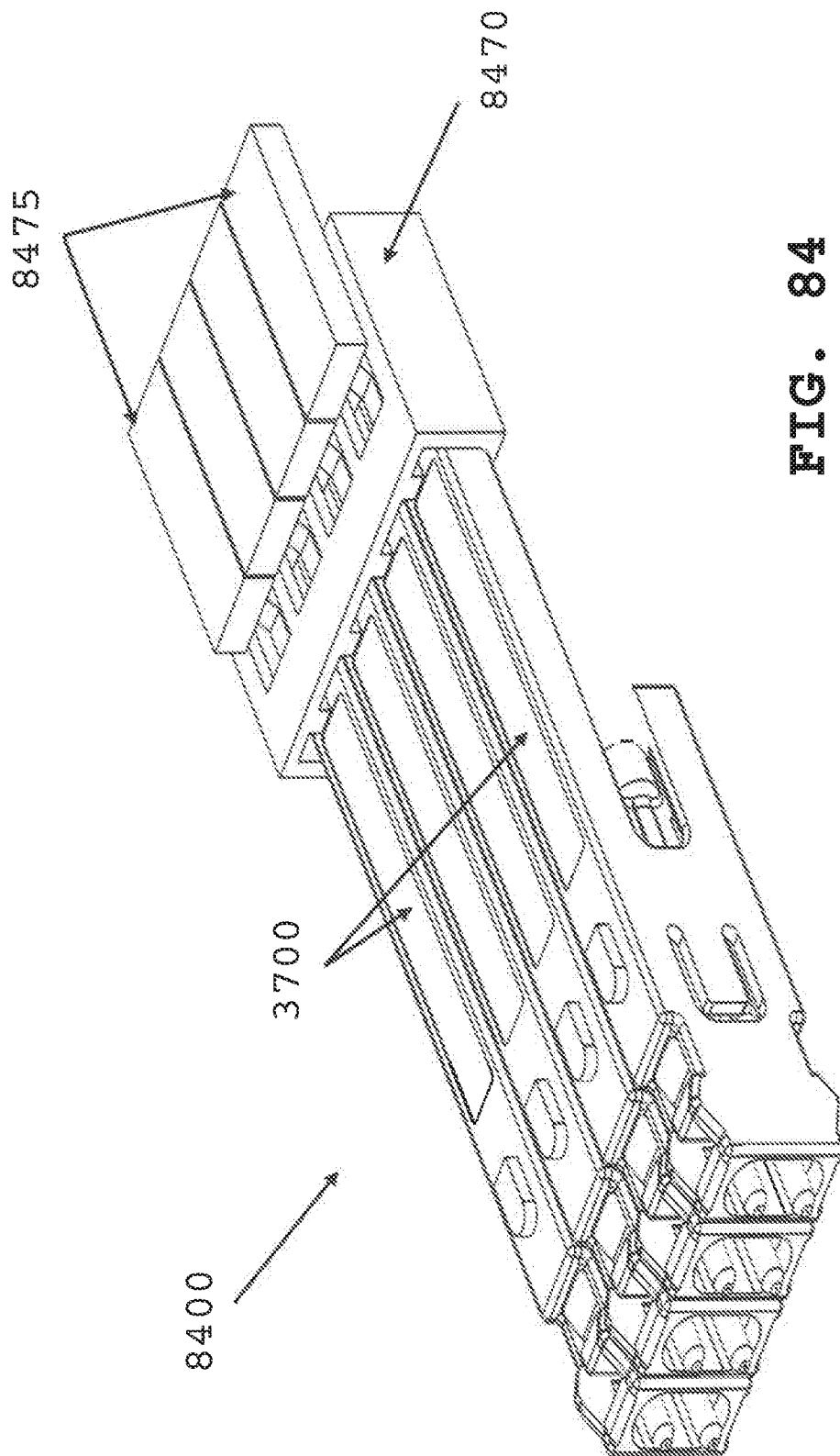


FIG. 84

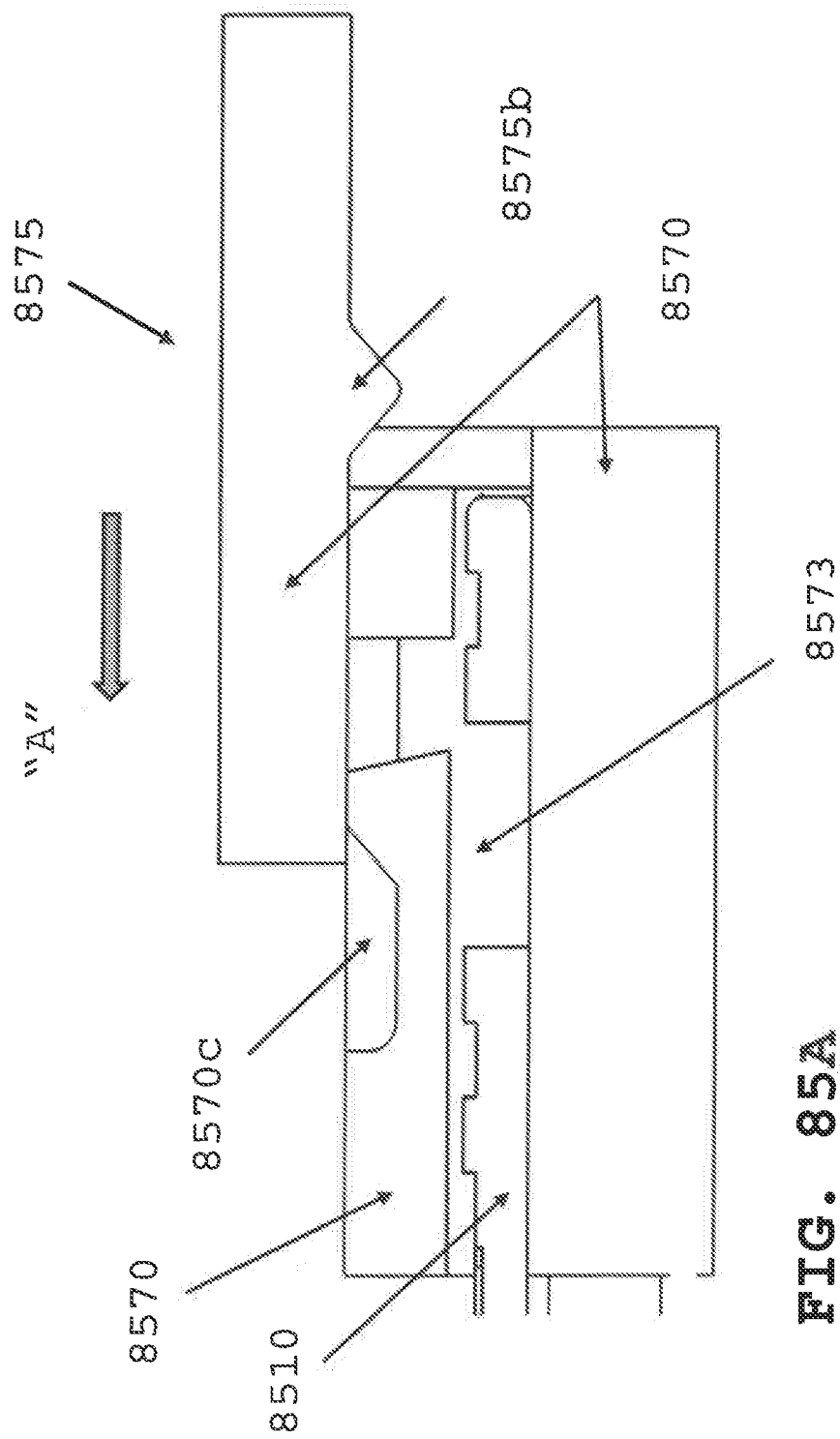


FIG. 85A

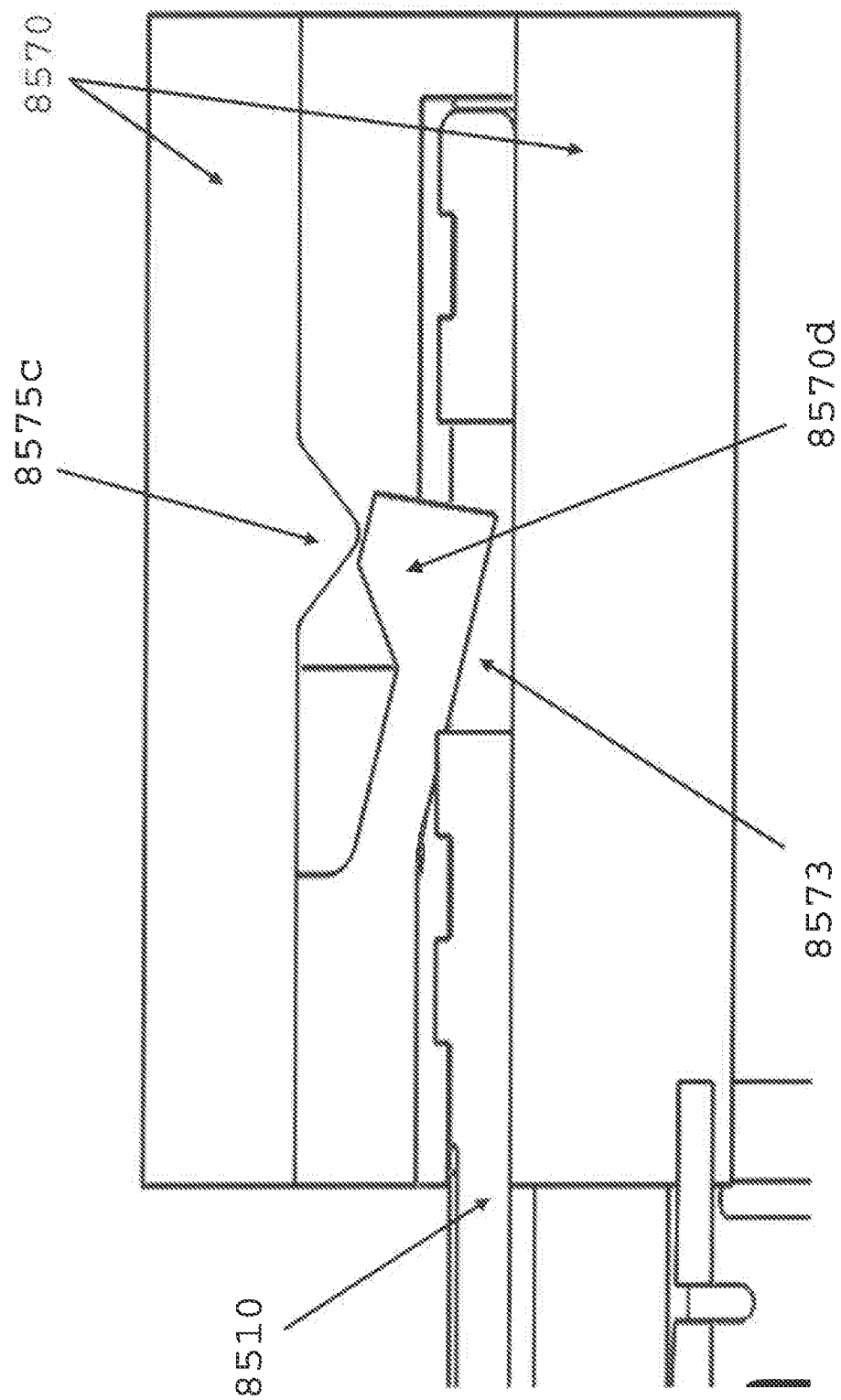


FIG. 85B

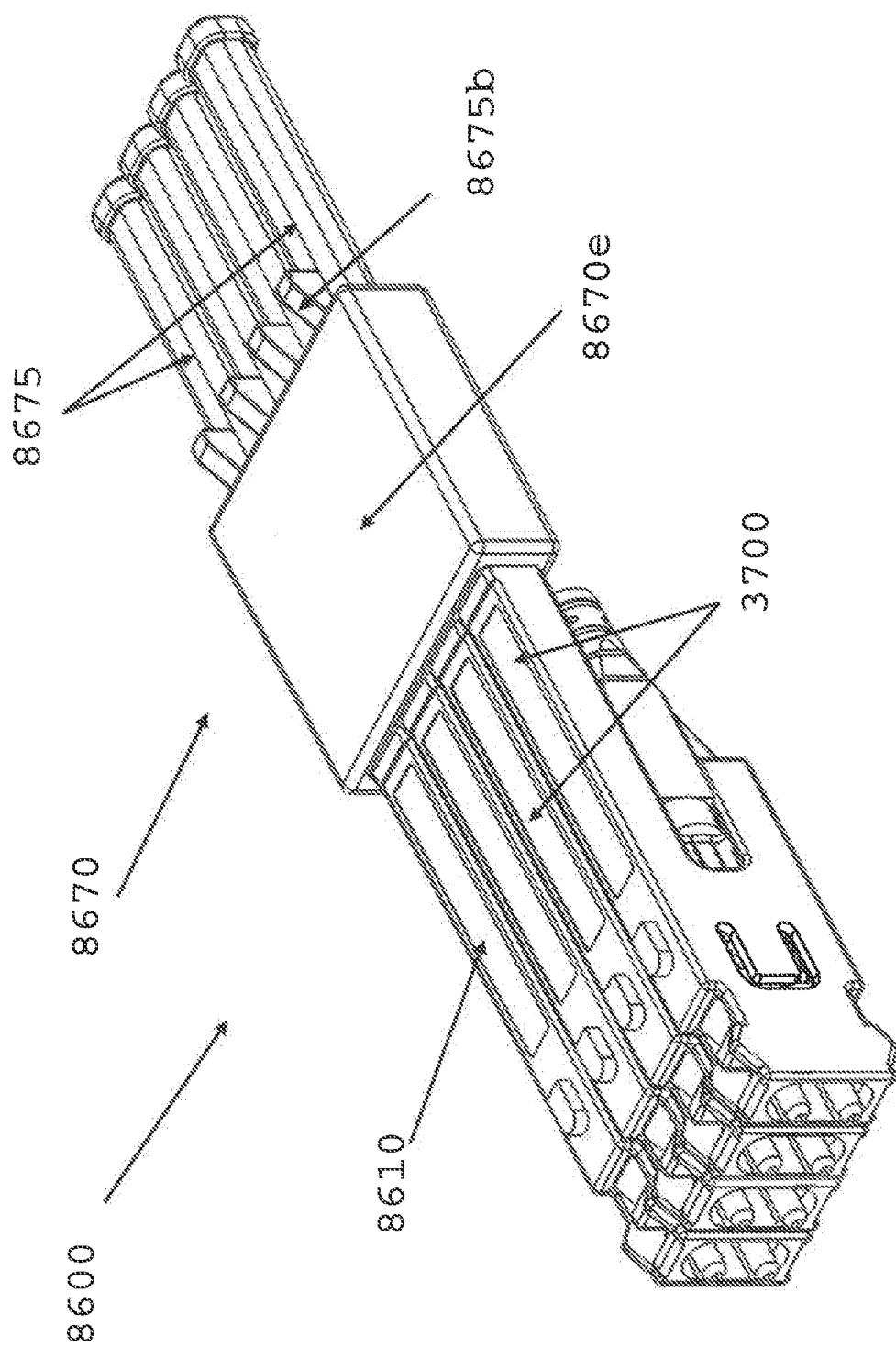


FIG. 86

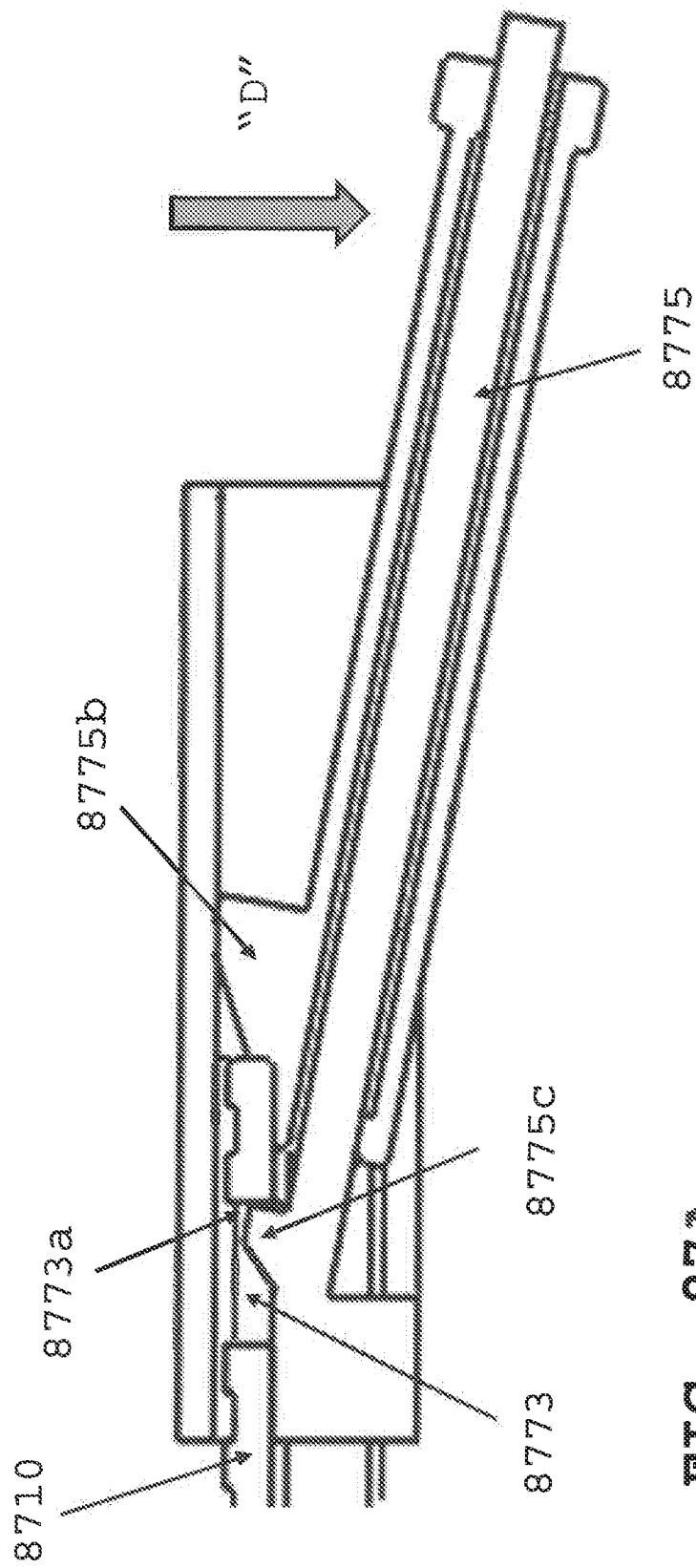


FIG. 87A

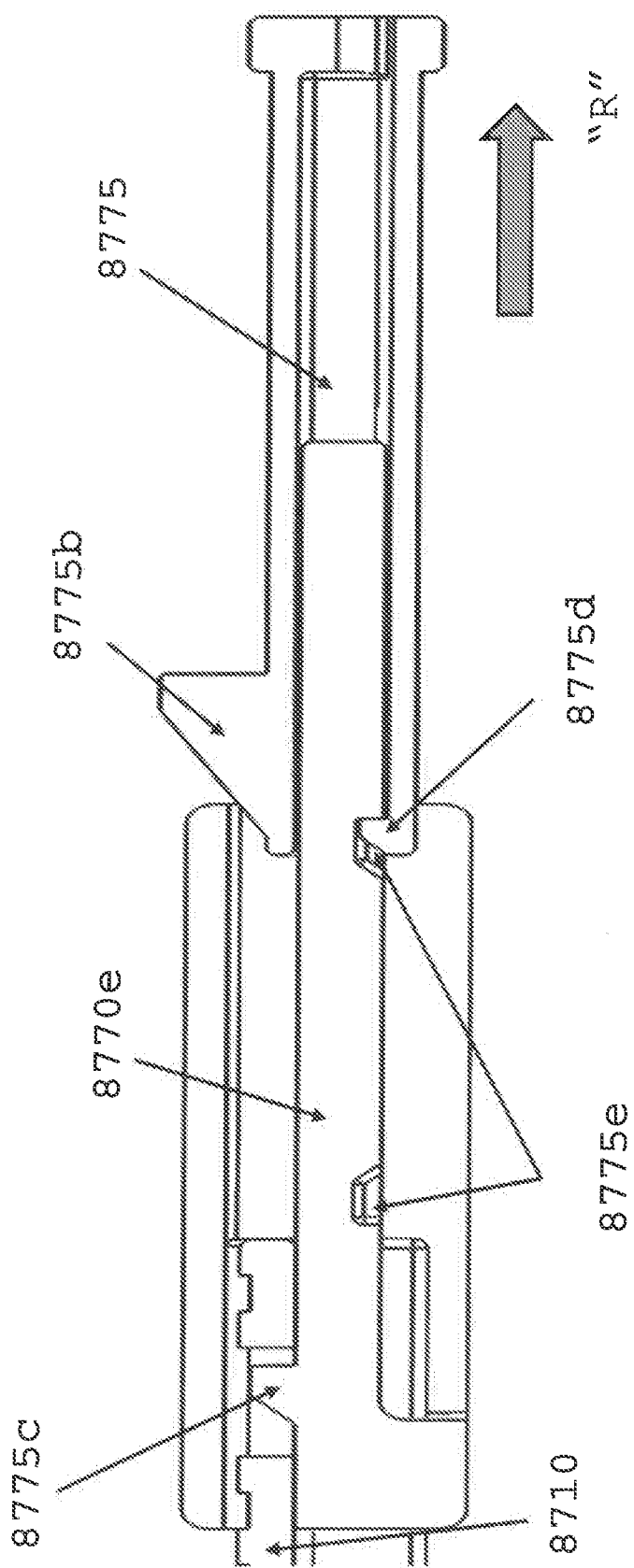


FIG. 87B

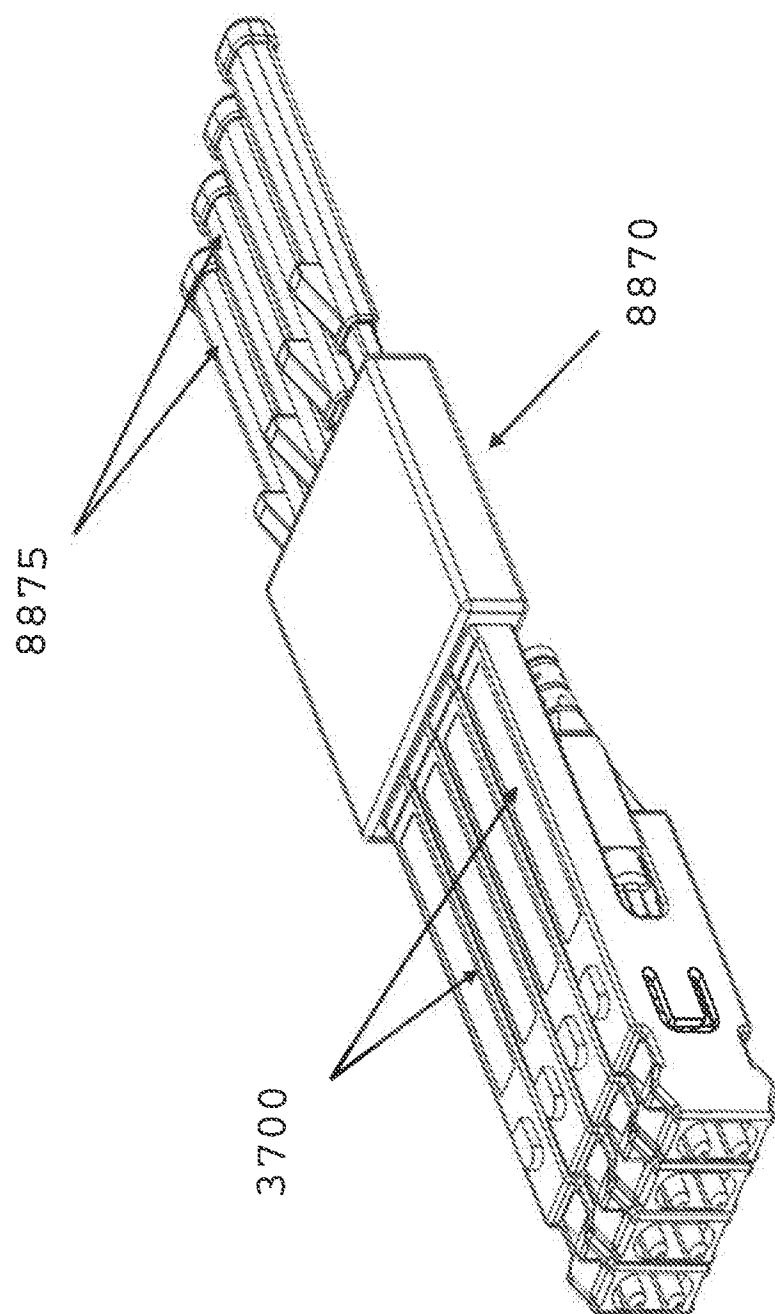


FIG. 88

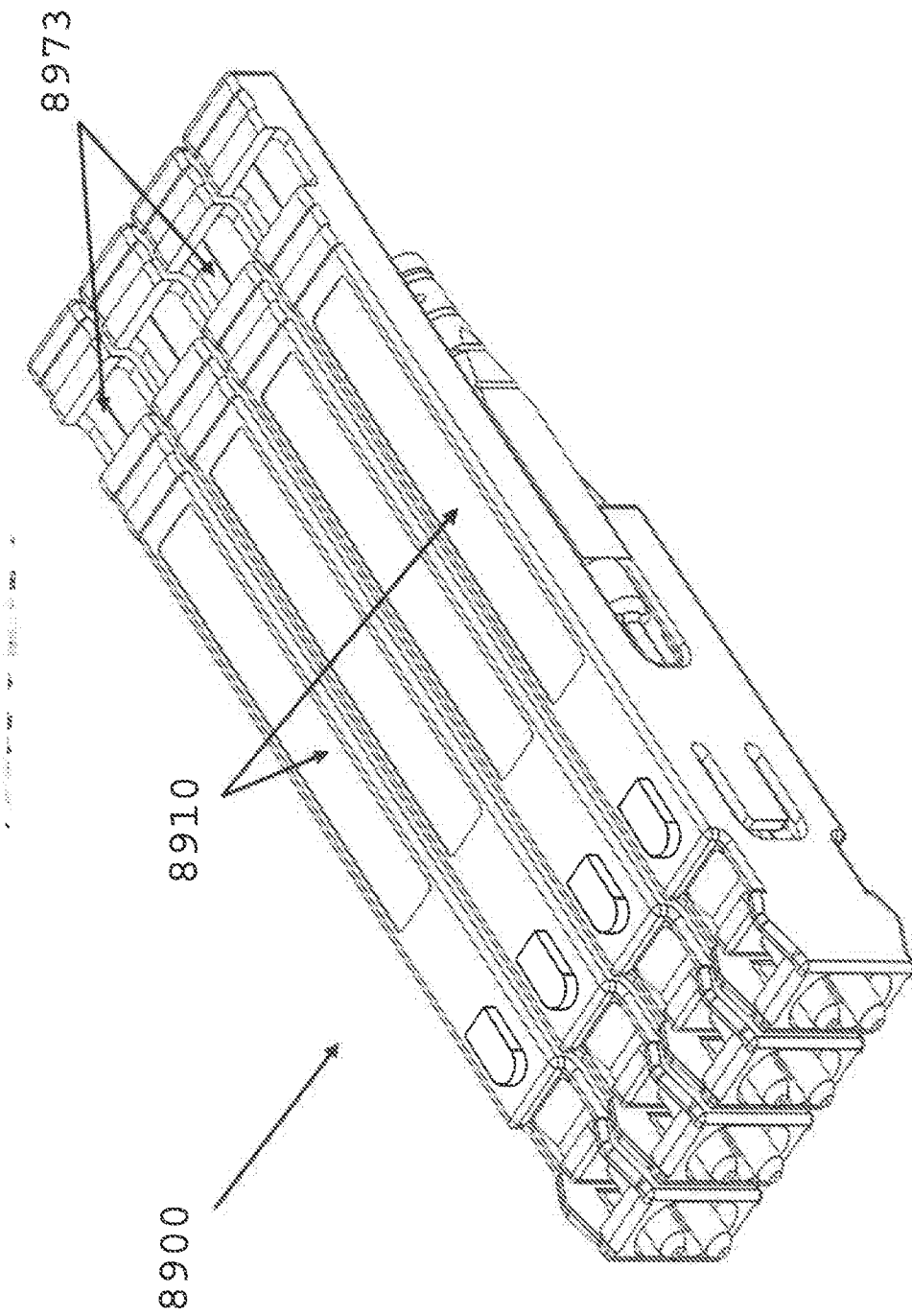


FIG. 89A

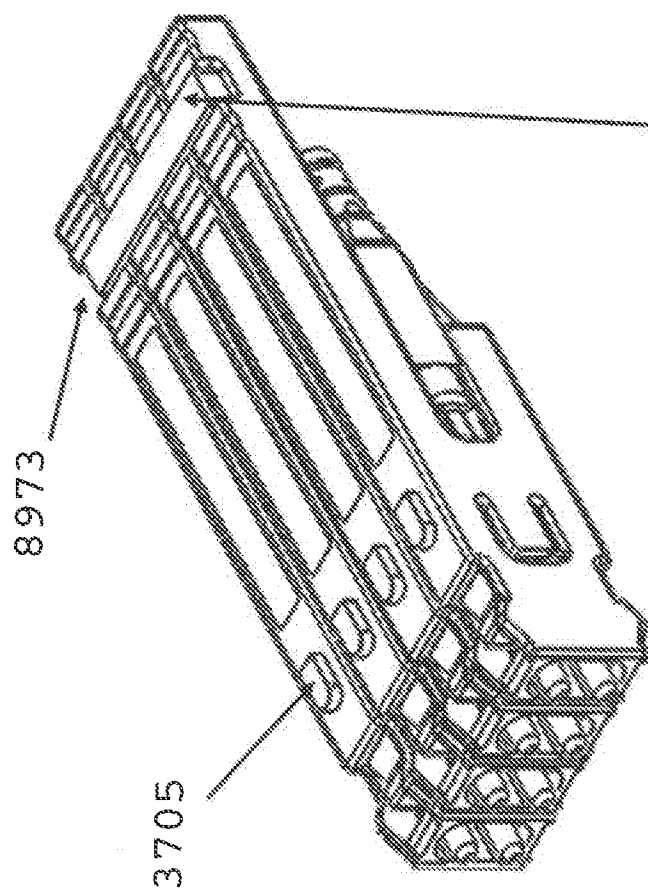


FIG. 89C

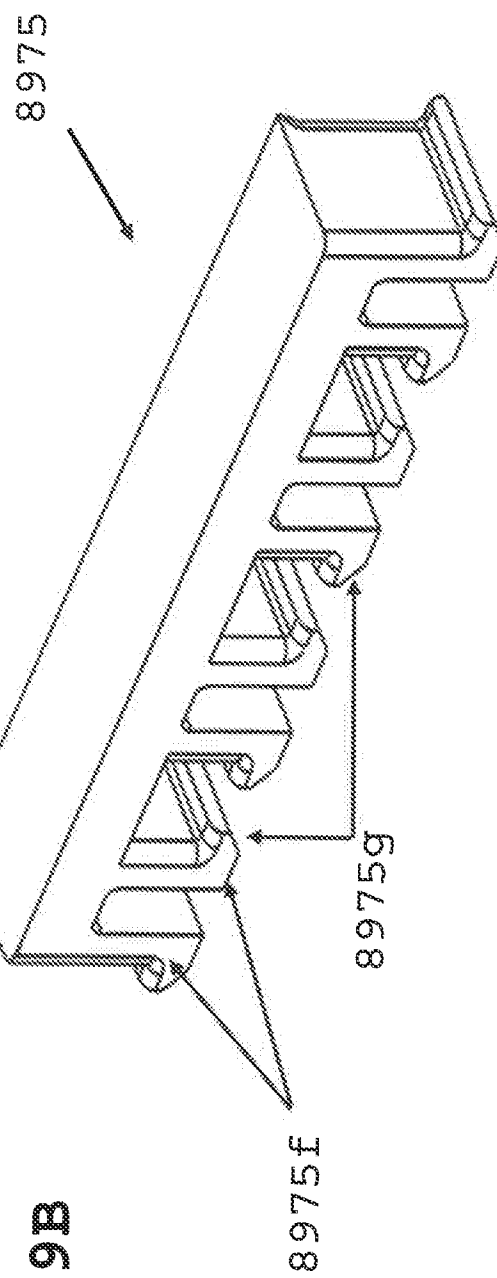


FIG. 89B

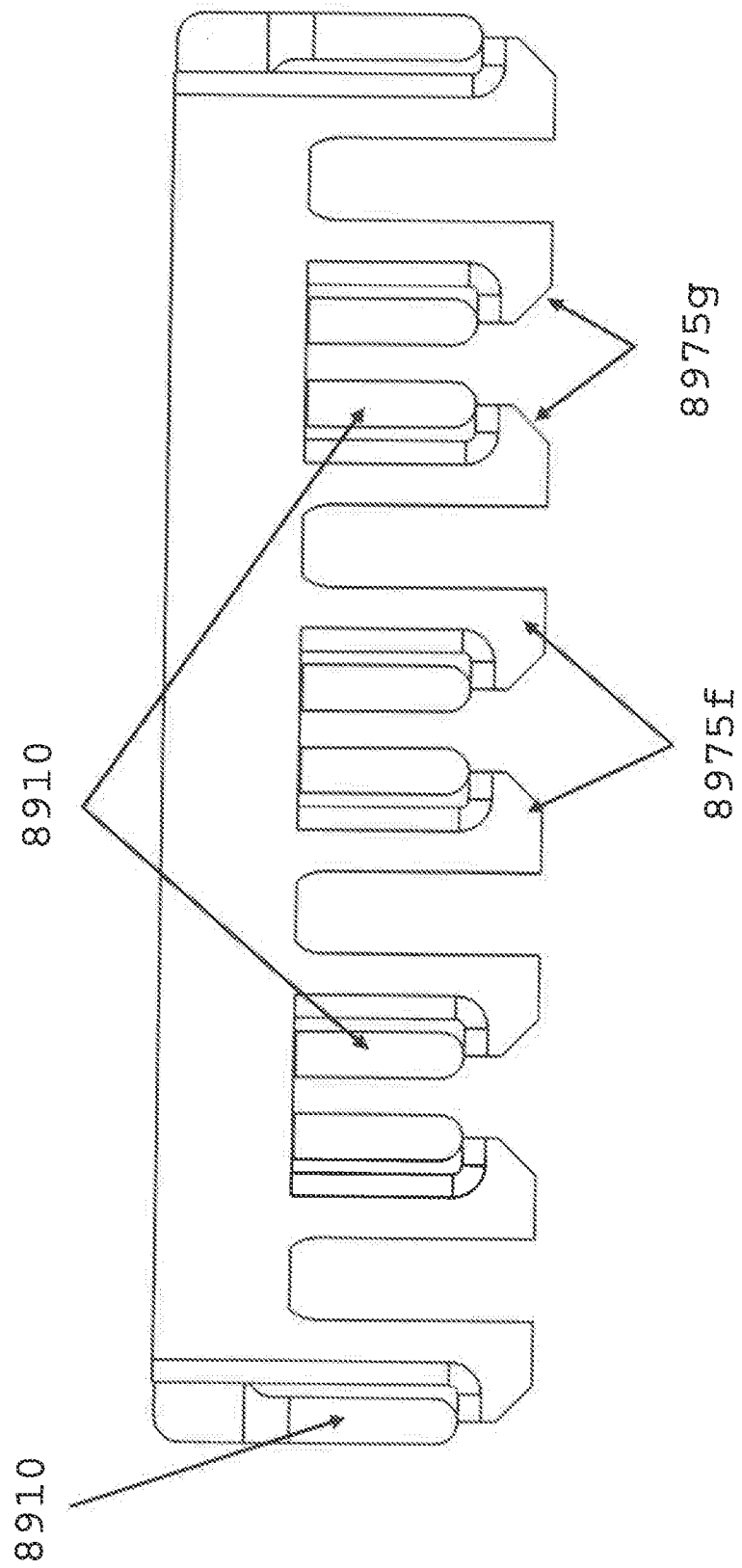


FIG. 89D

FIG. 90C

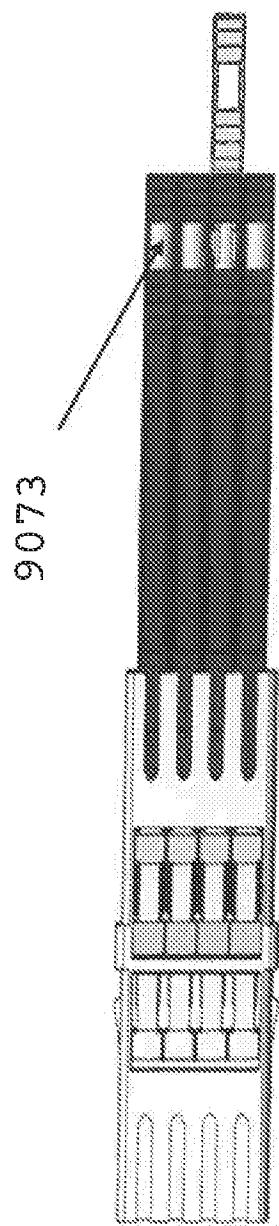
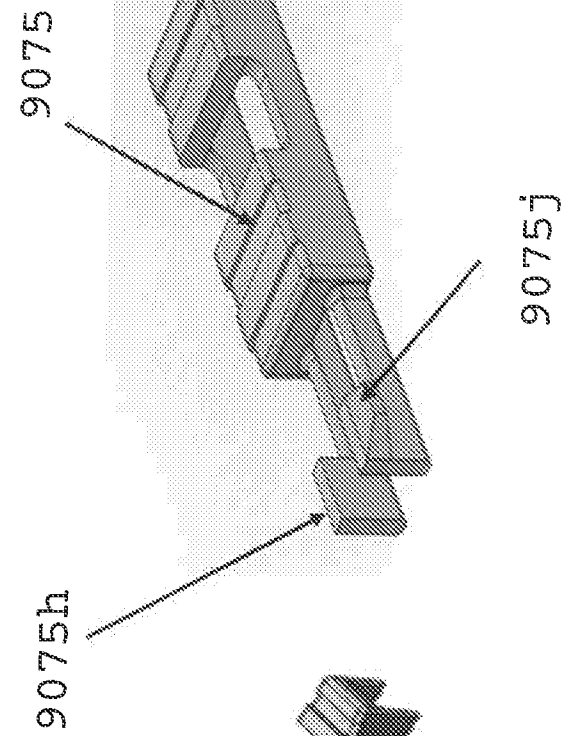


FIG. 90A



9010

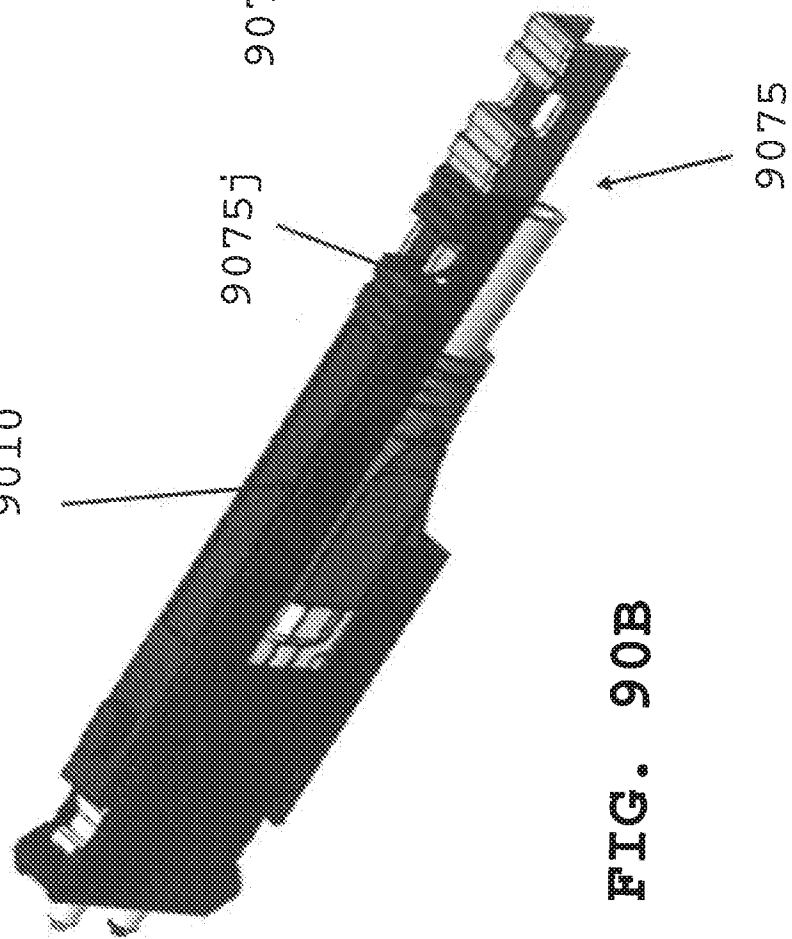


FIG. 90B

9100

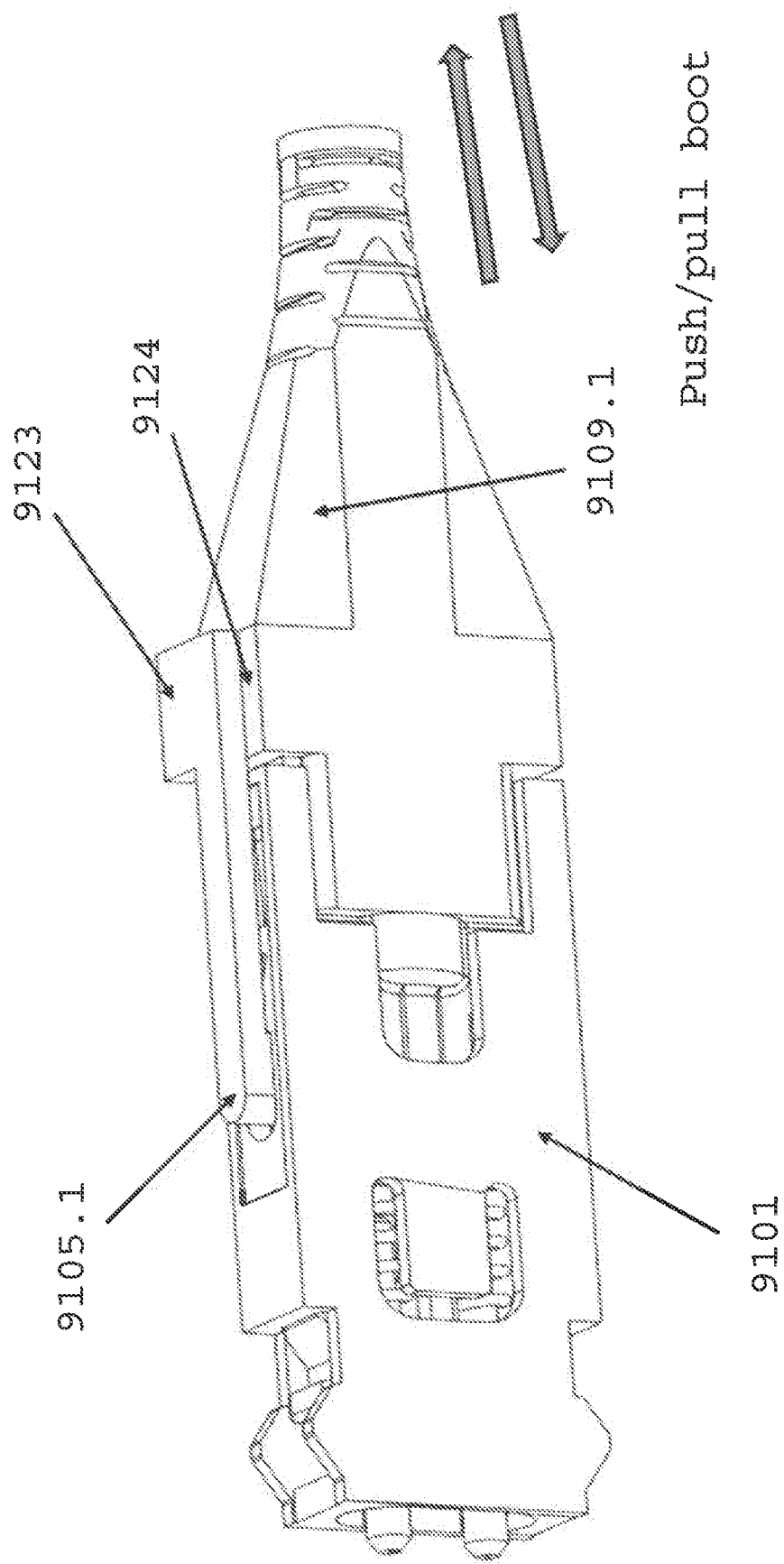


FIG. 91A

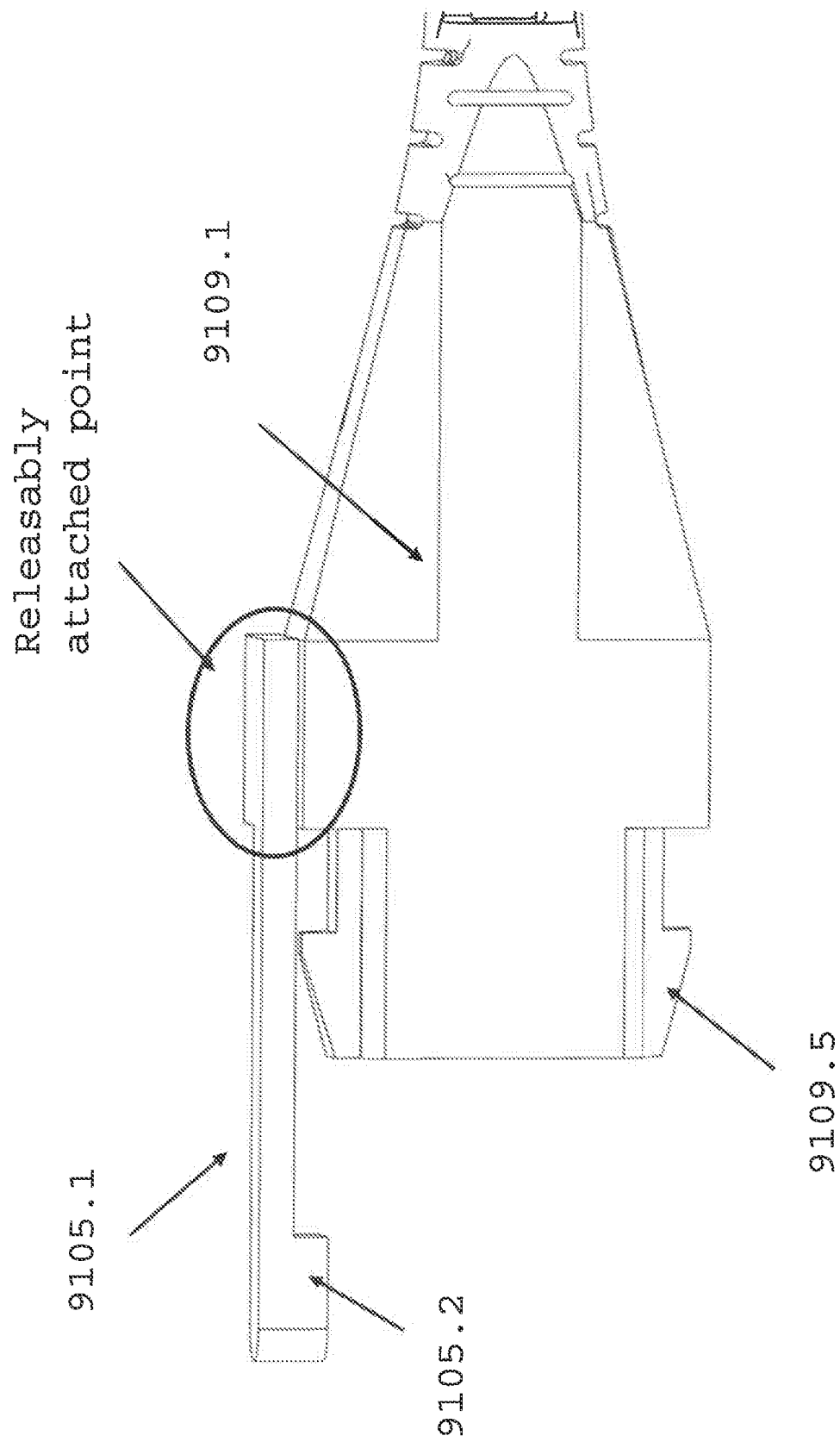


FIG. 91B

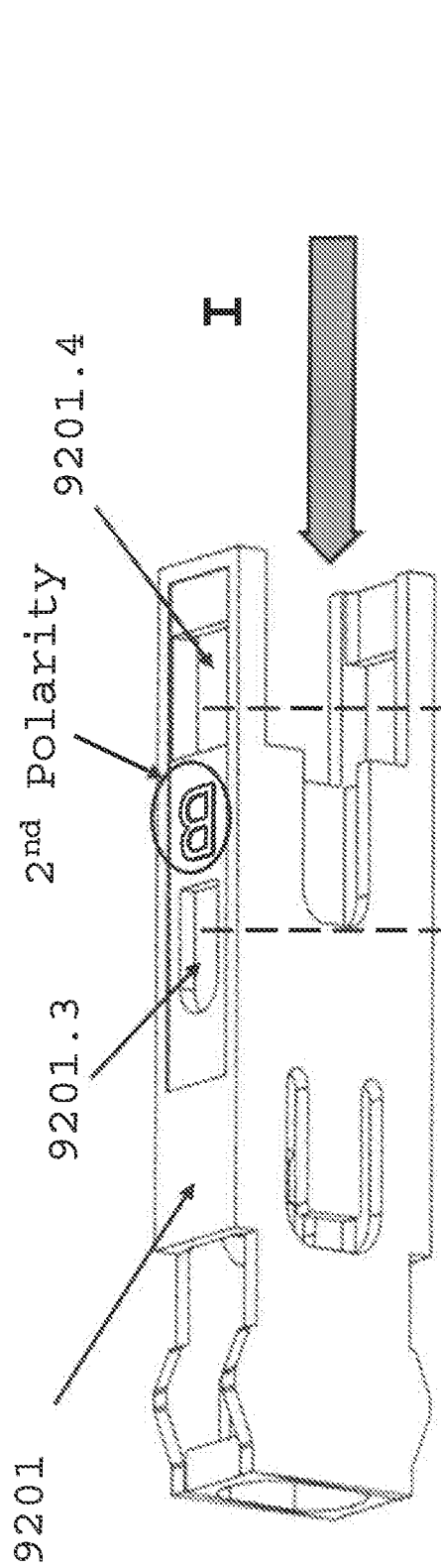


FIG. 92A

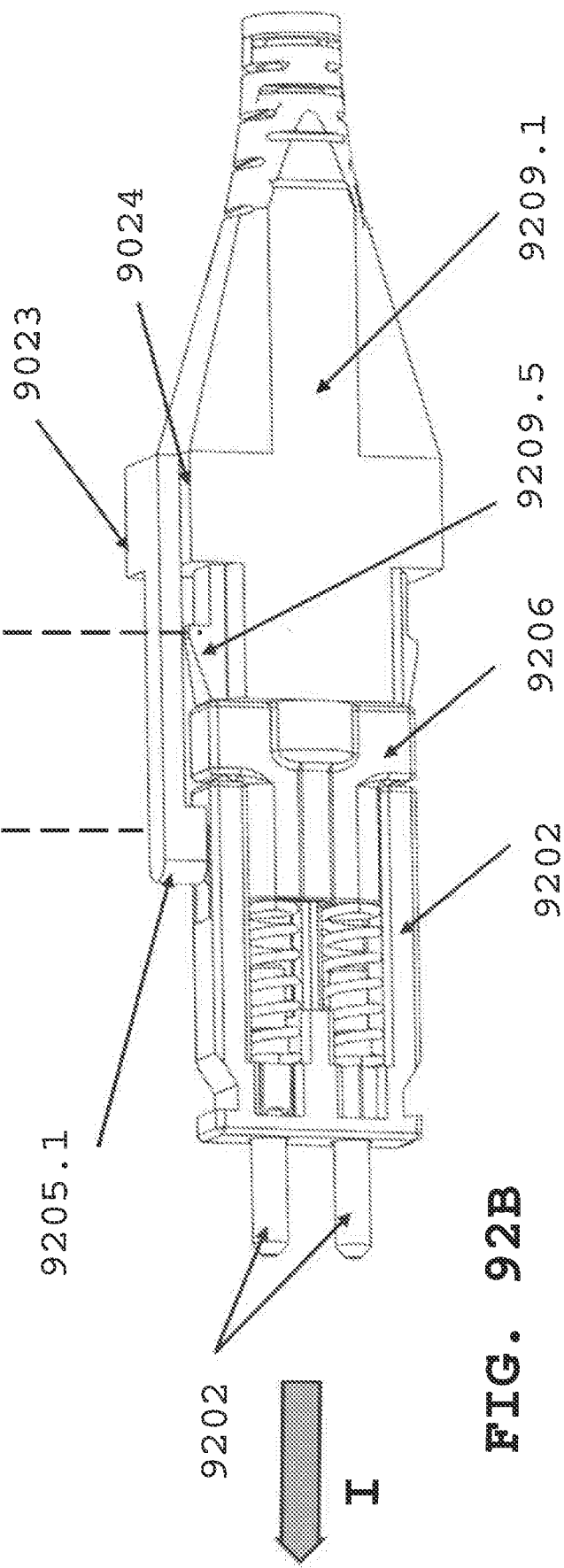
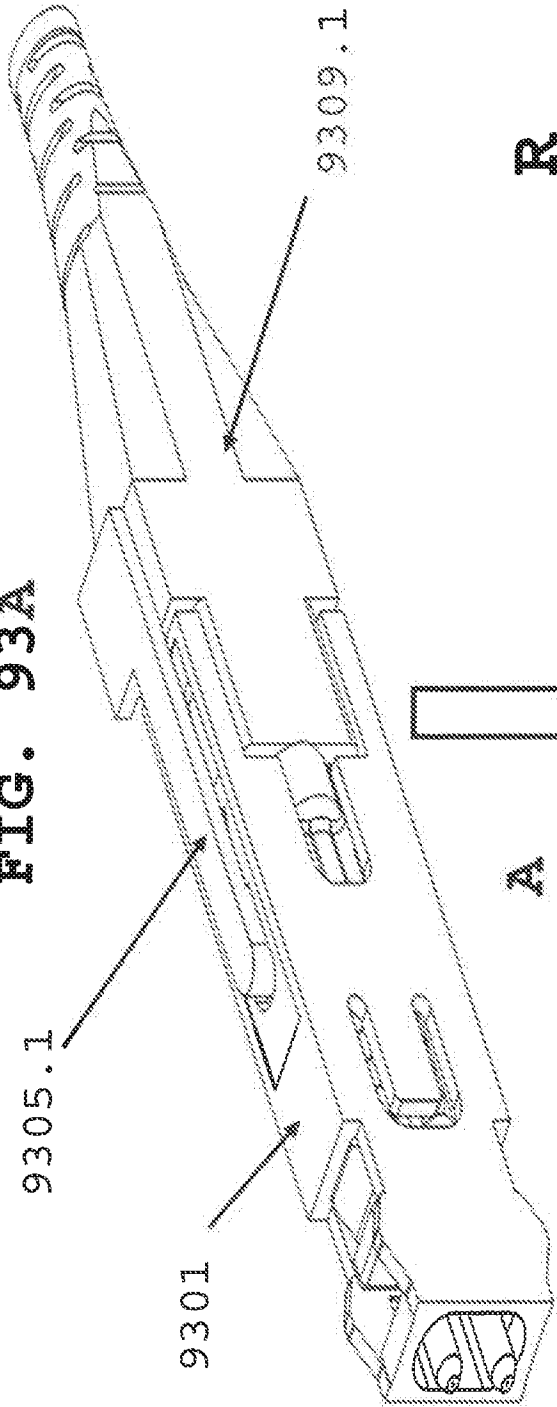


FIG. 92B

FIG. 93A



R

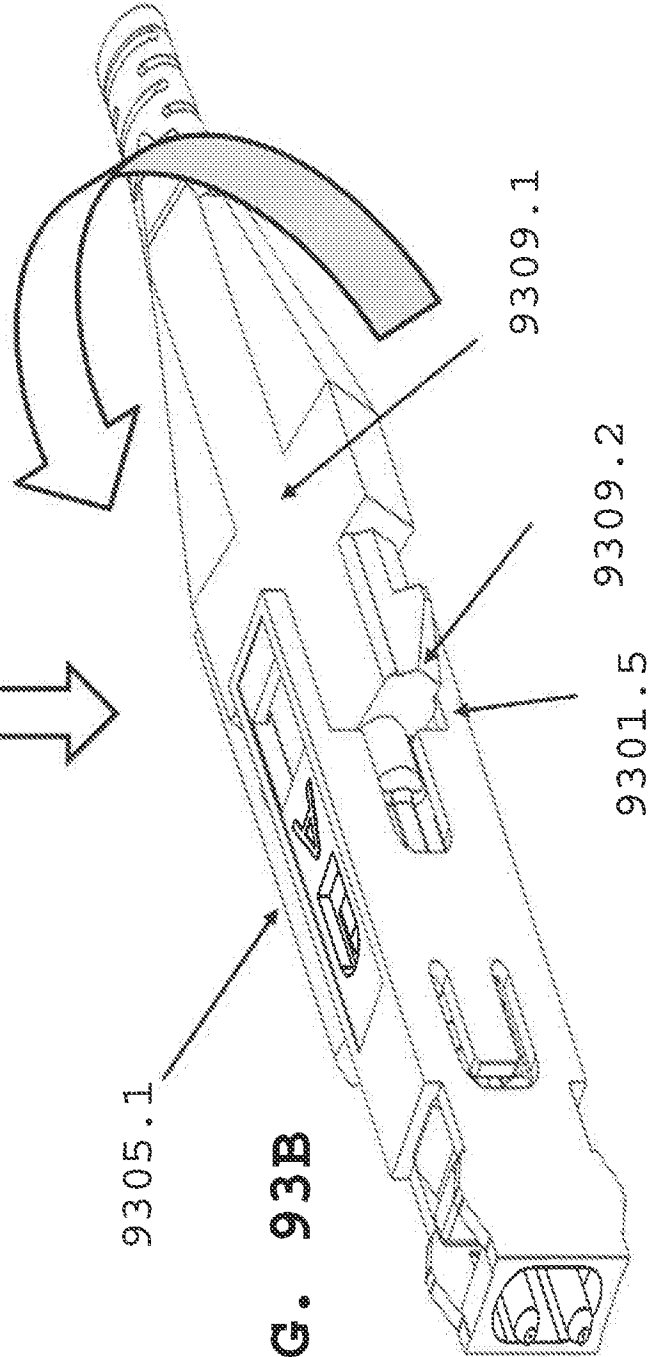


FIG. 93B

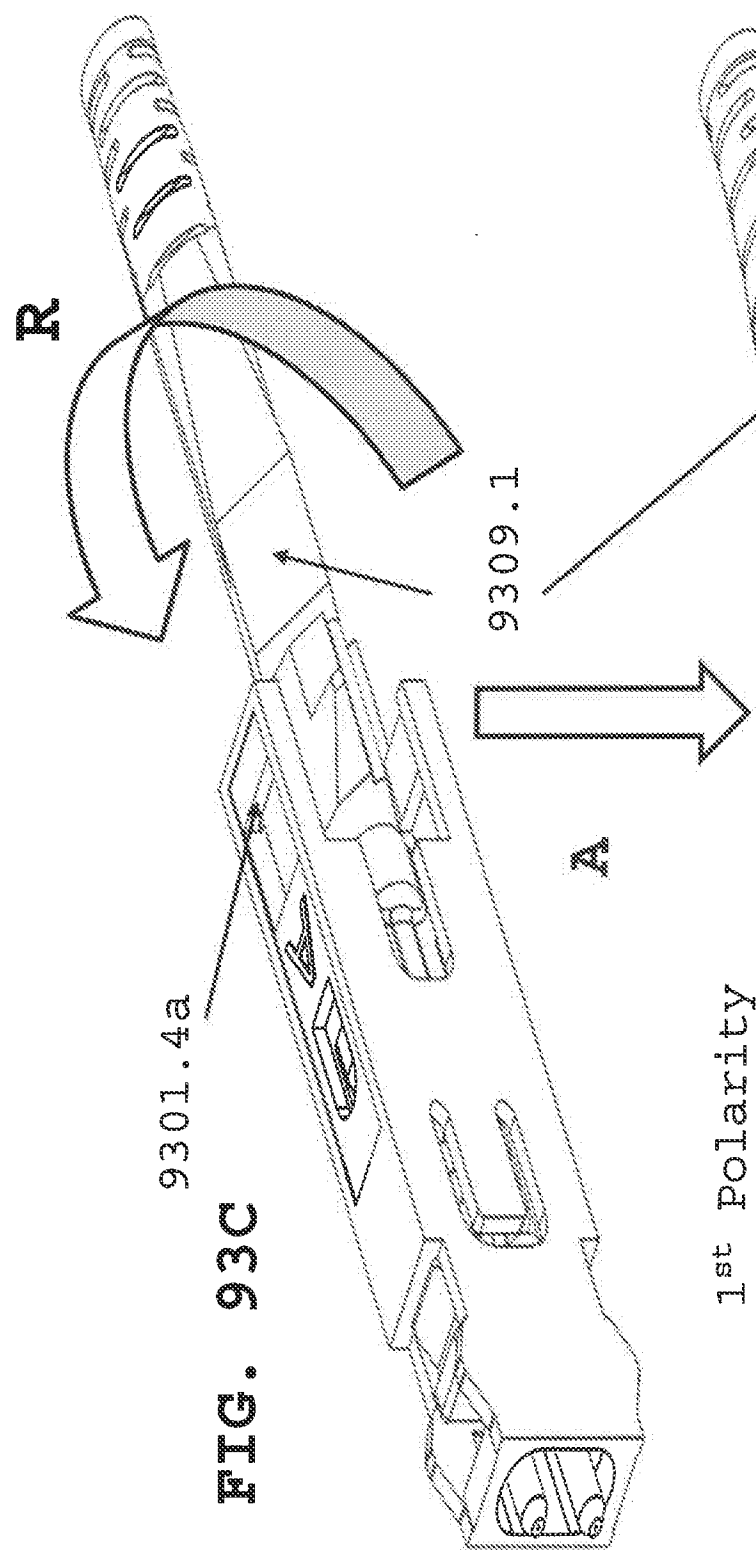
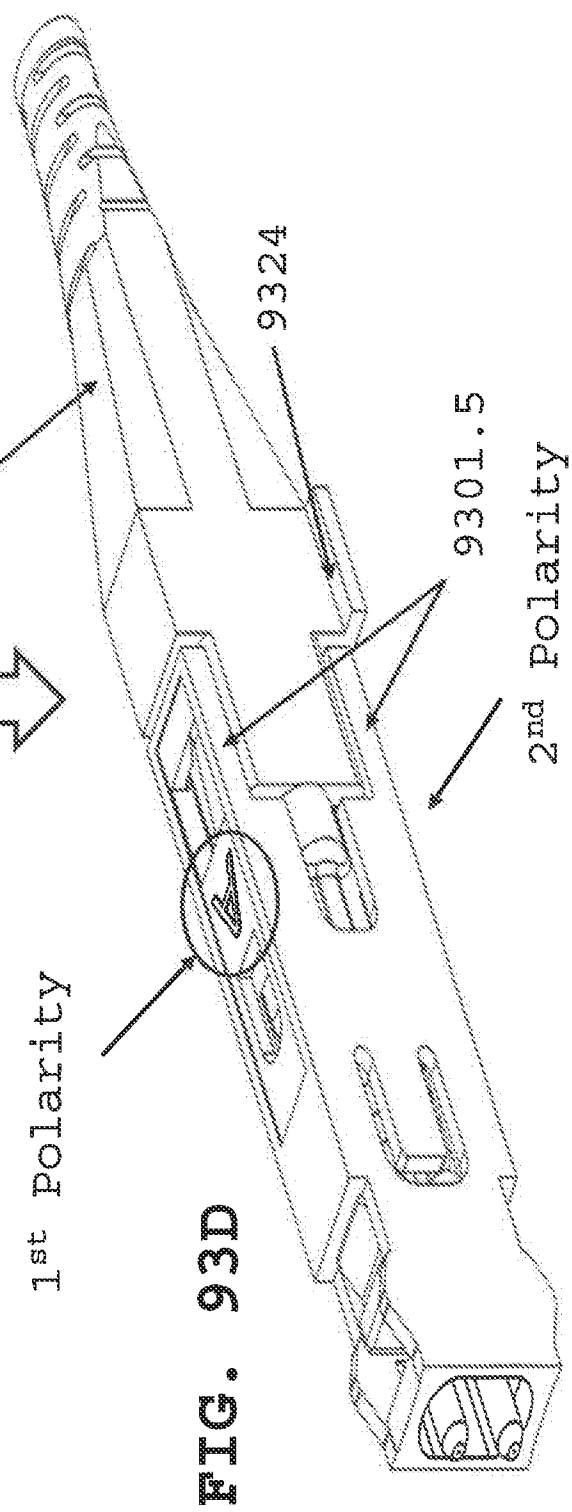
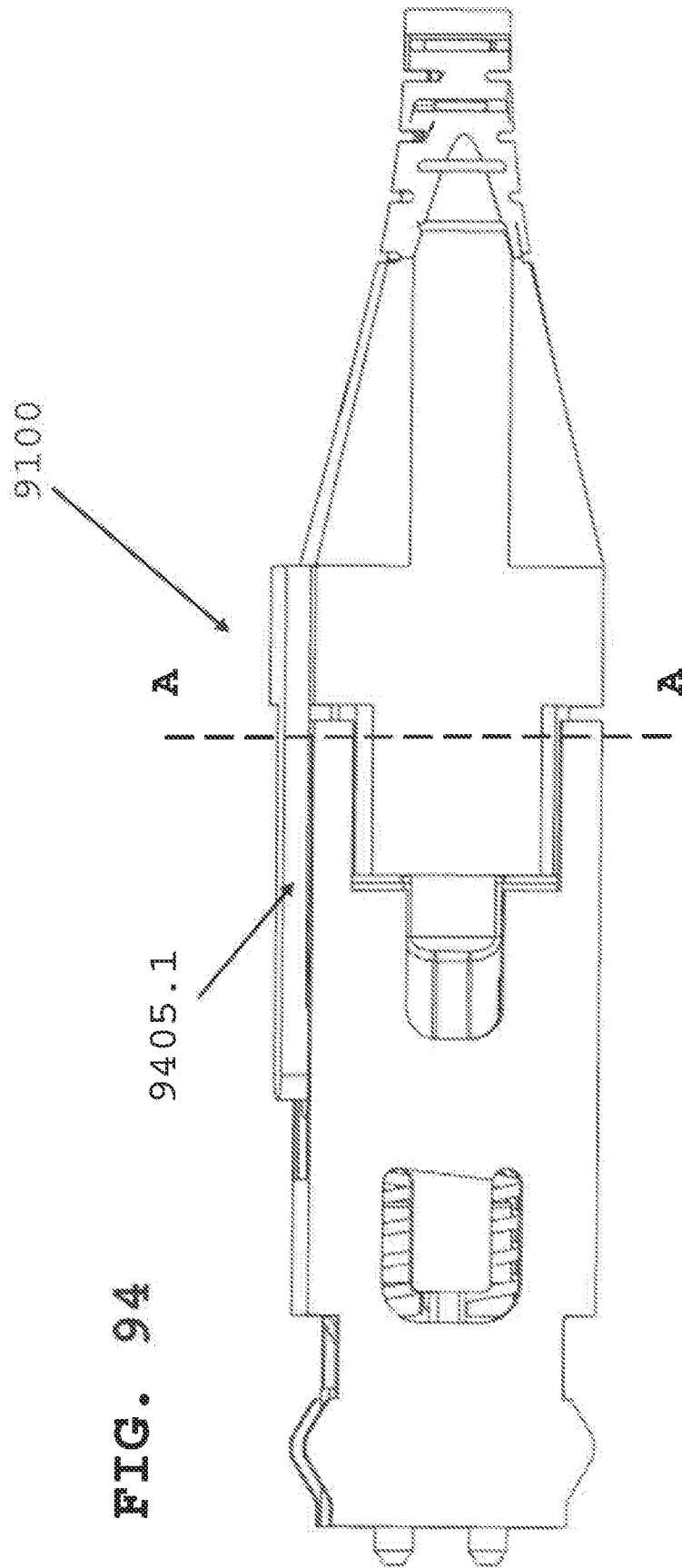


FIG. 94



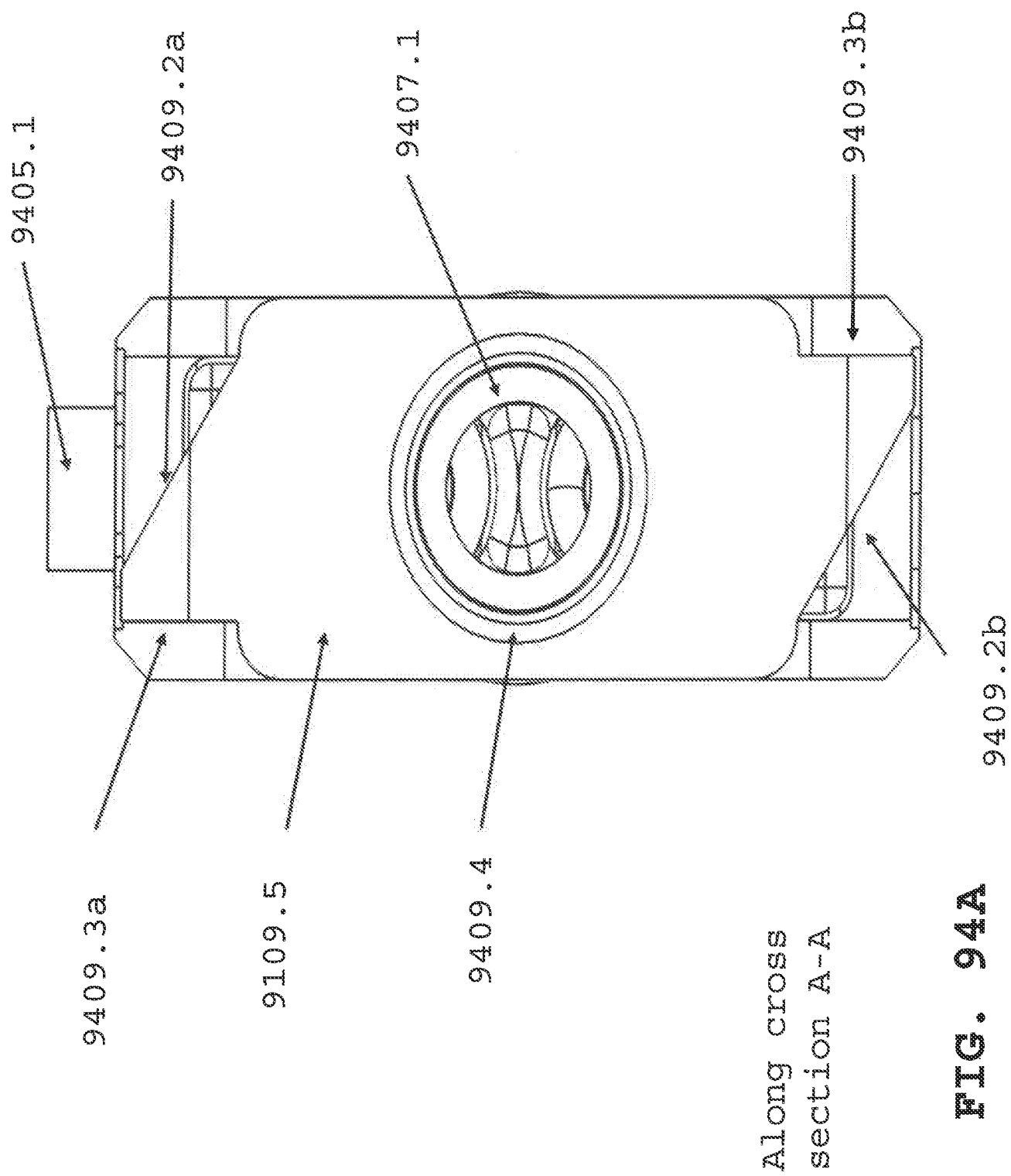


FIG. 94A.1a

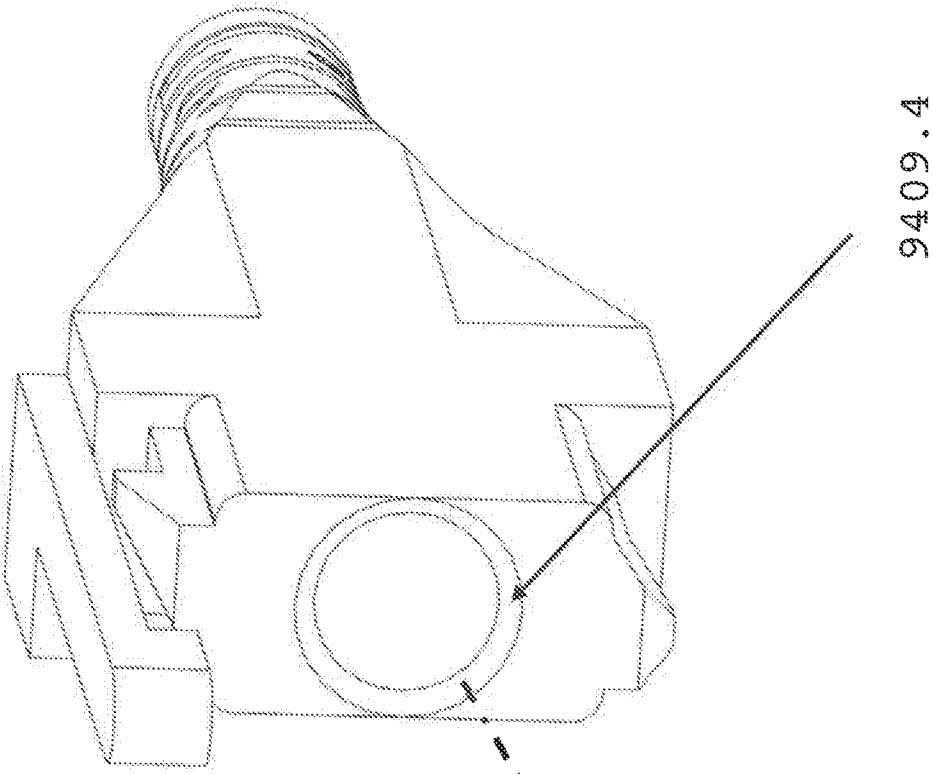
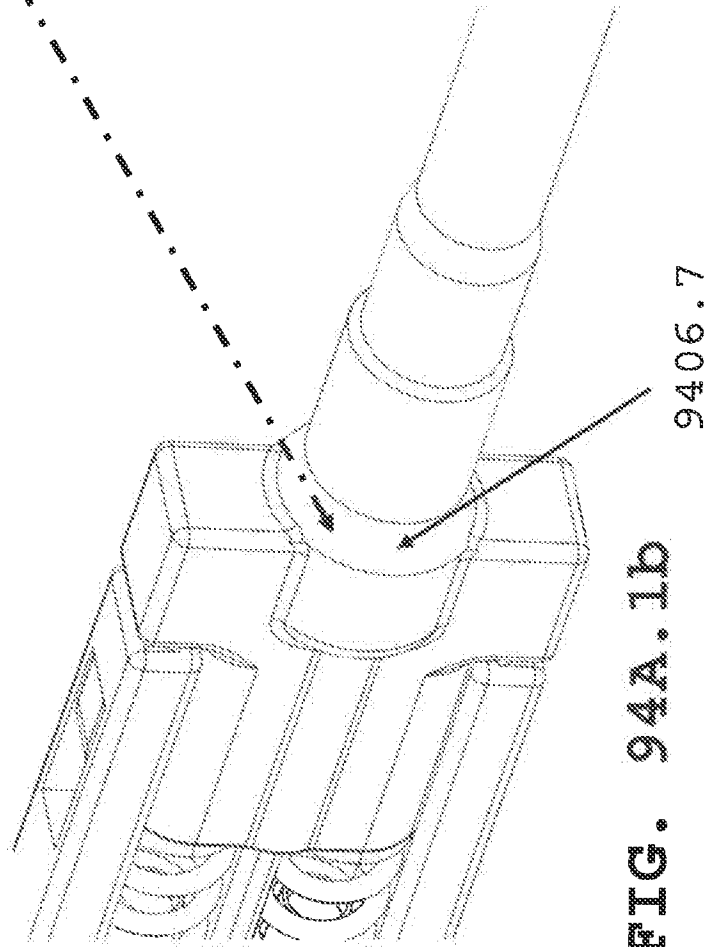


FIG. 94A.1b



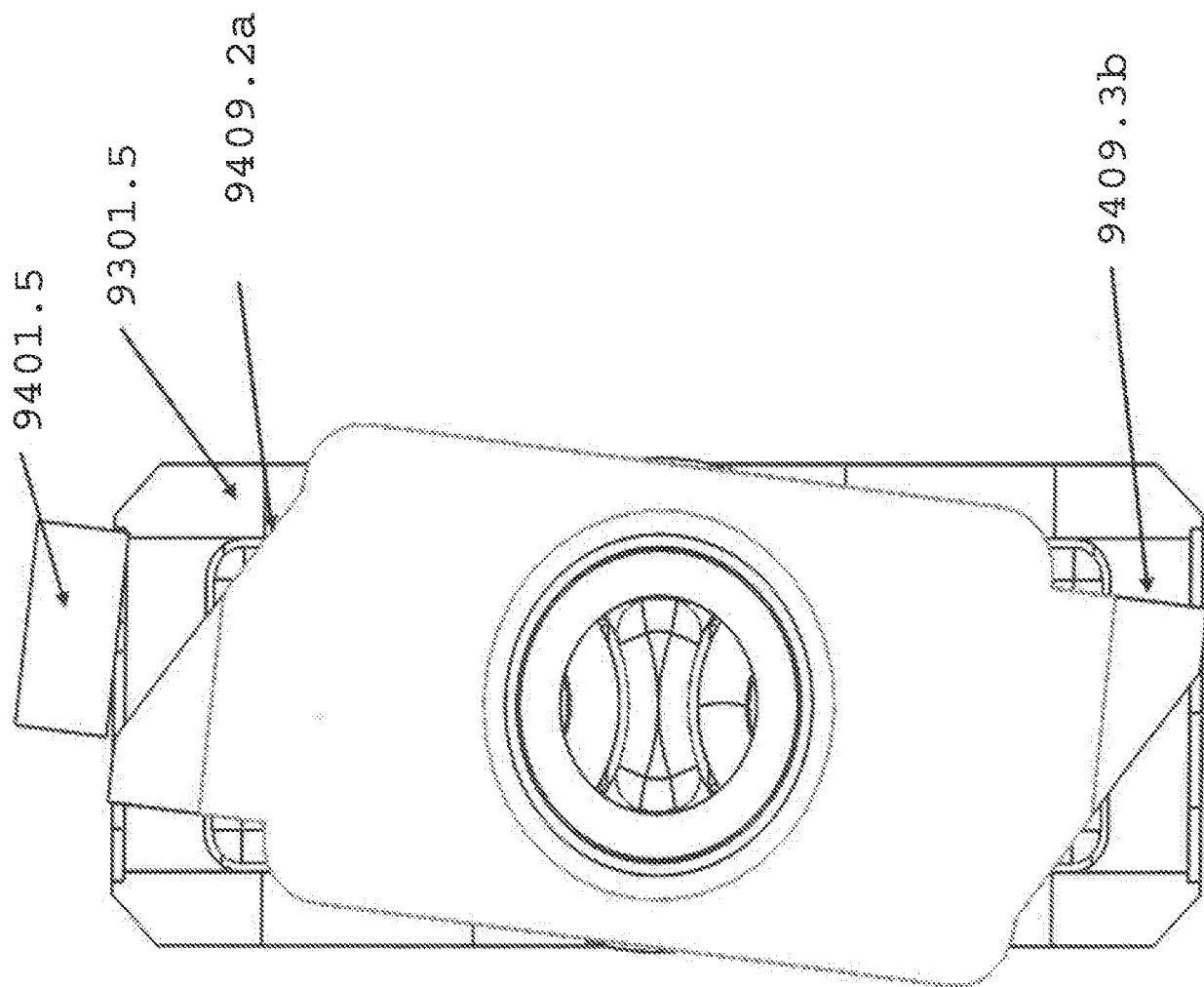
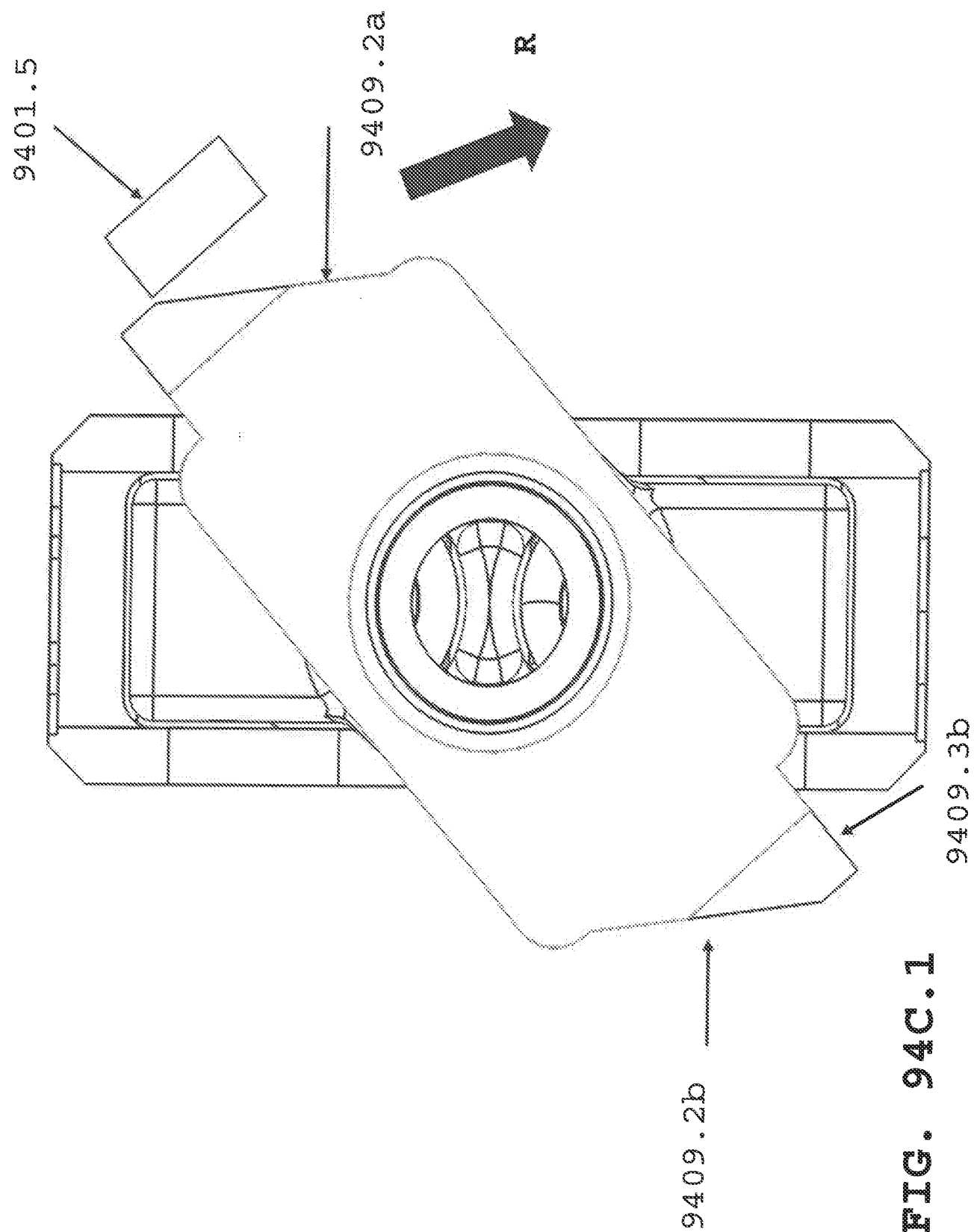


FIG. 94B



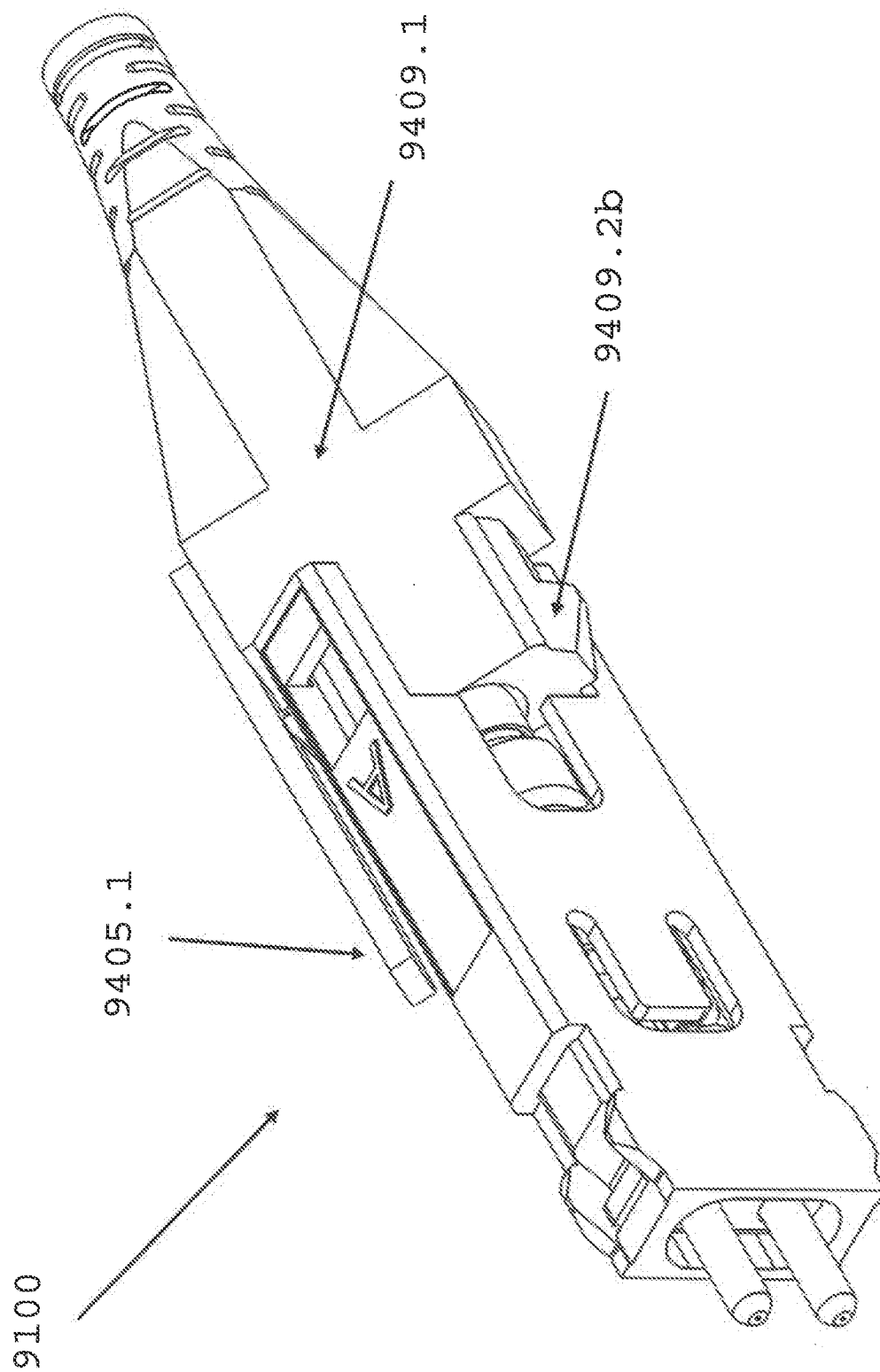


FIG. 94C.2

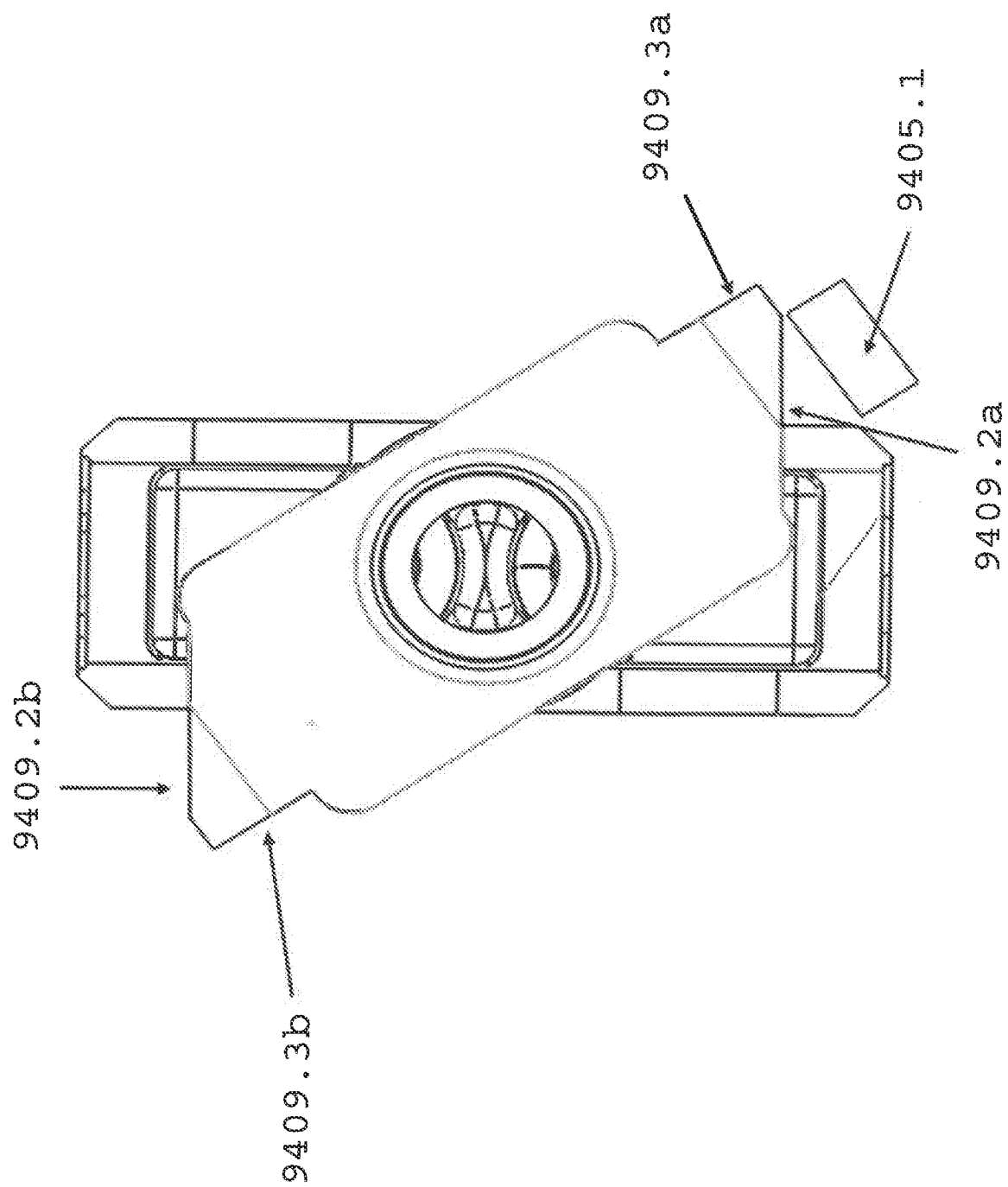


FIG. 94D.1

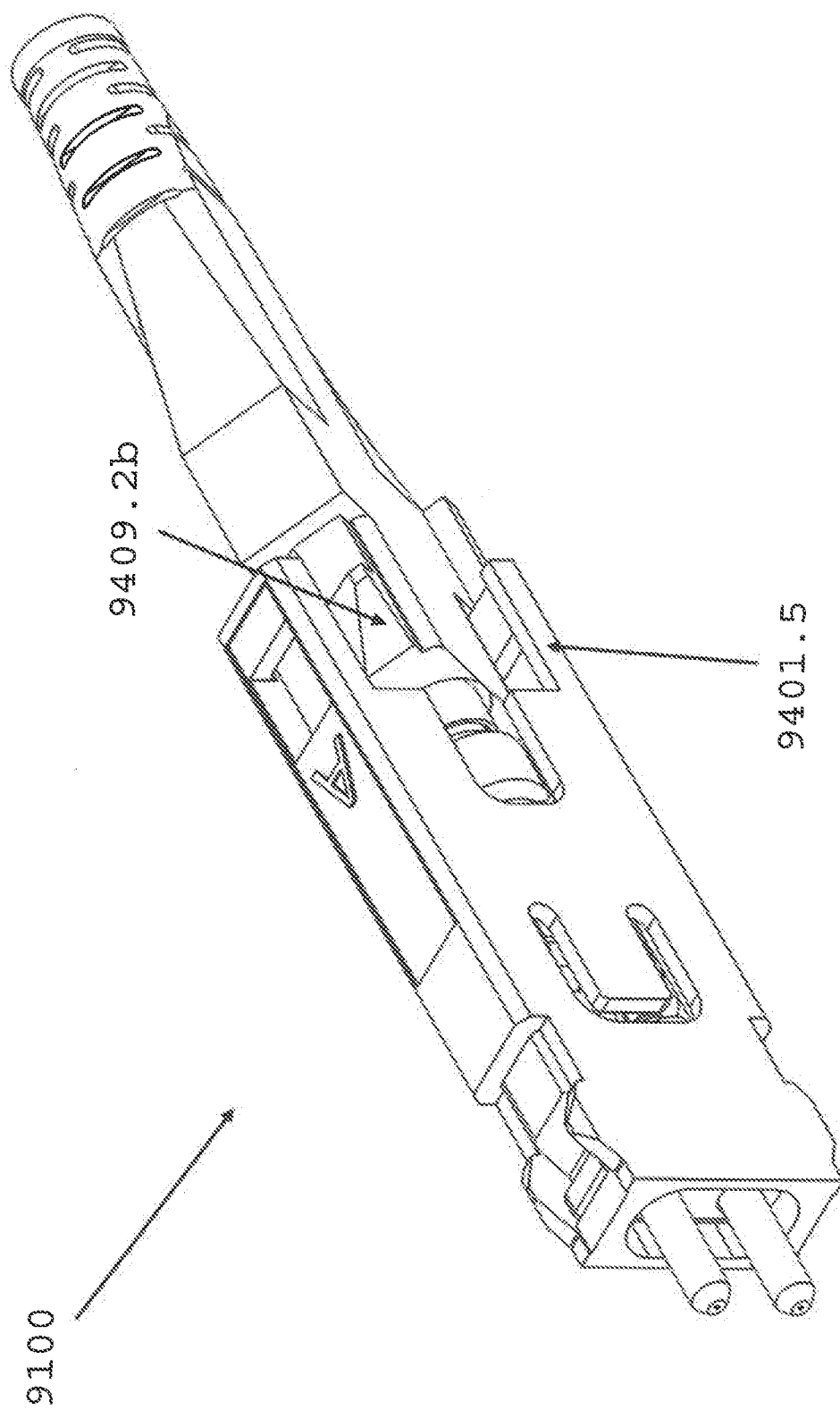


FIG. 94D.2

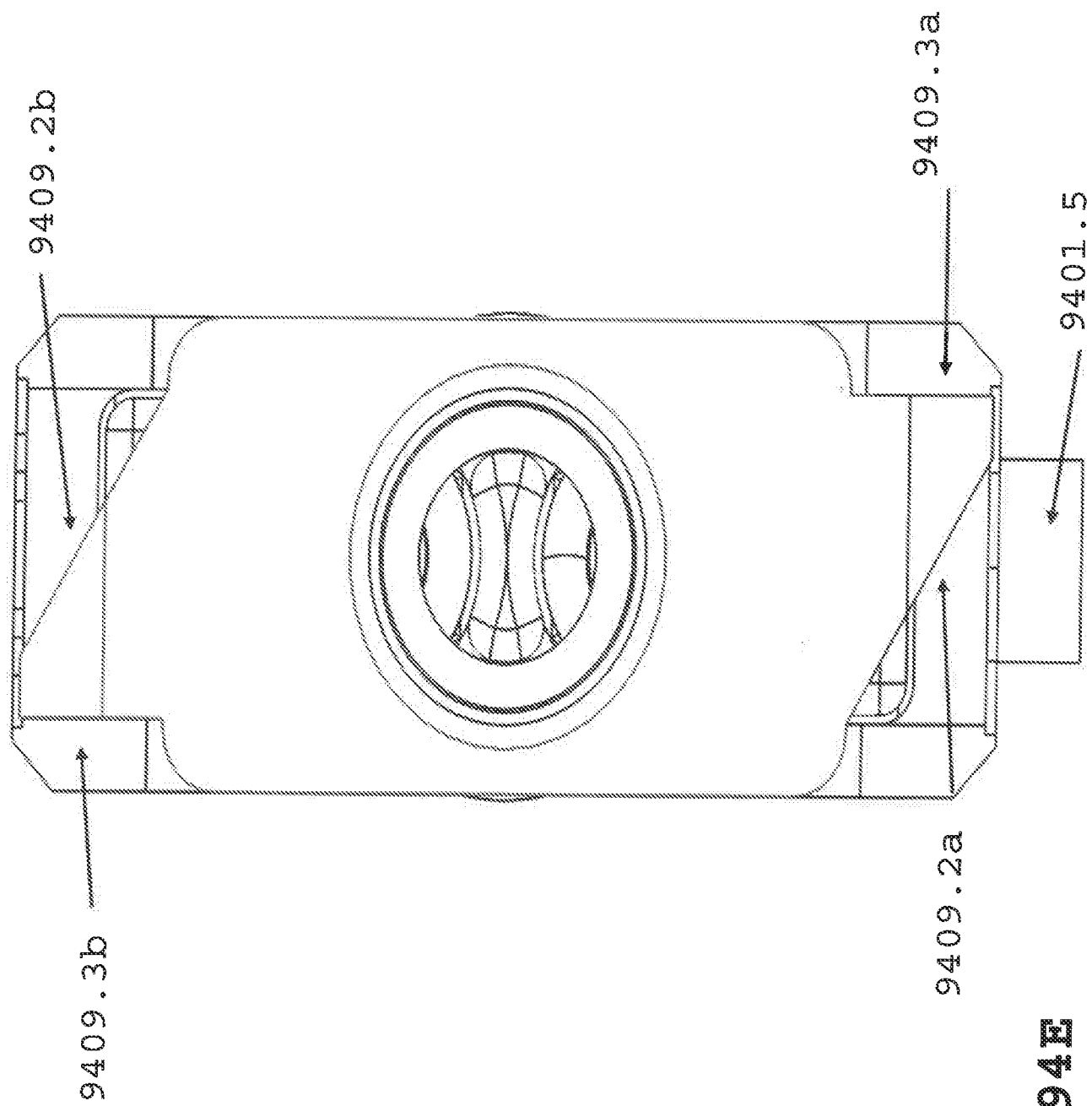


FIG. 94E

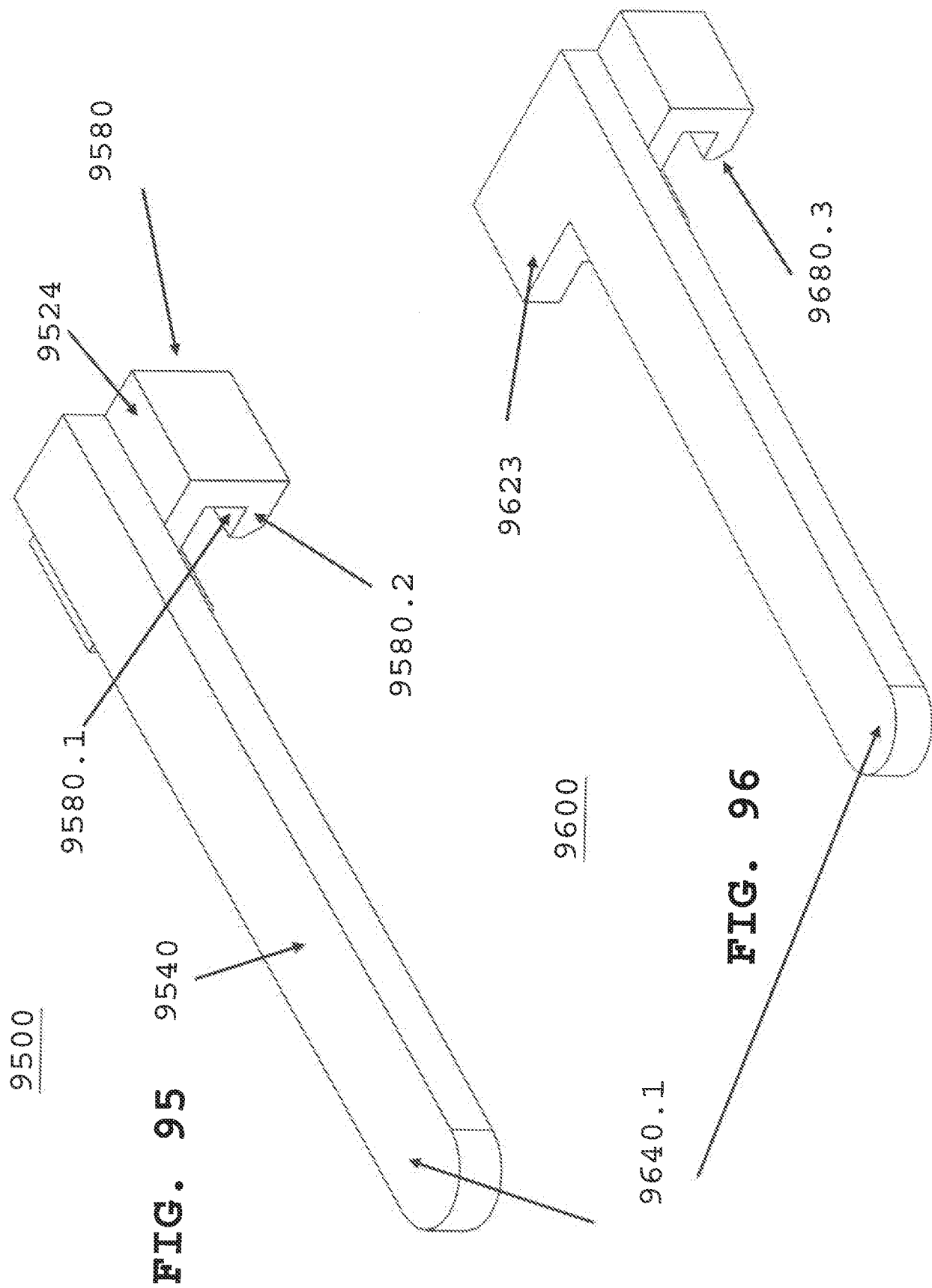


FIG. 97

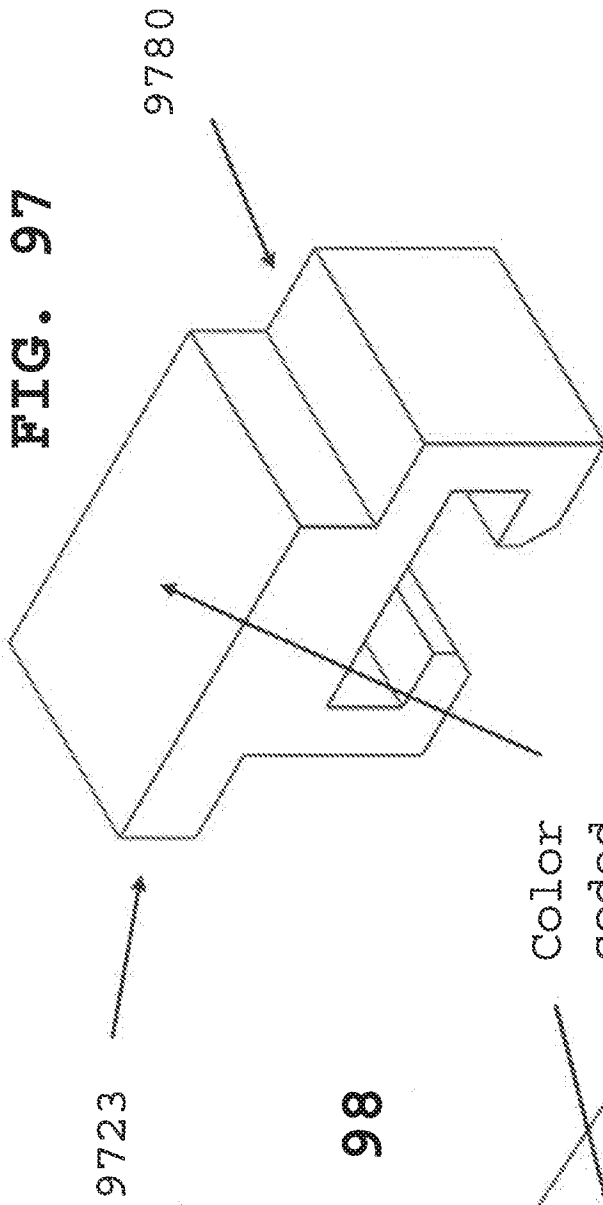
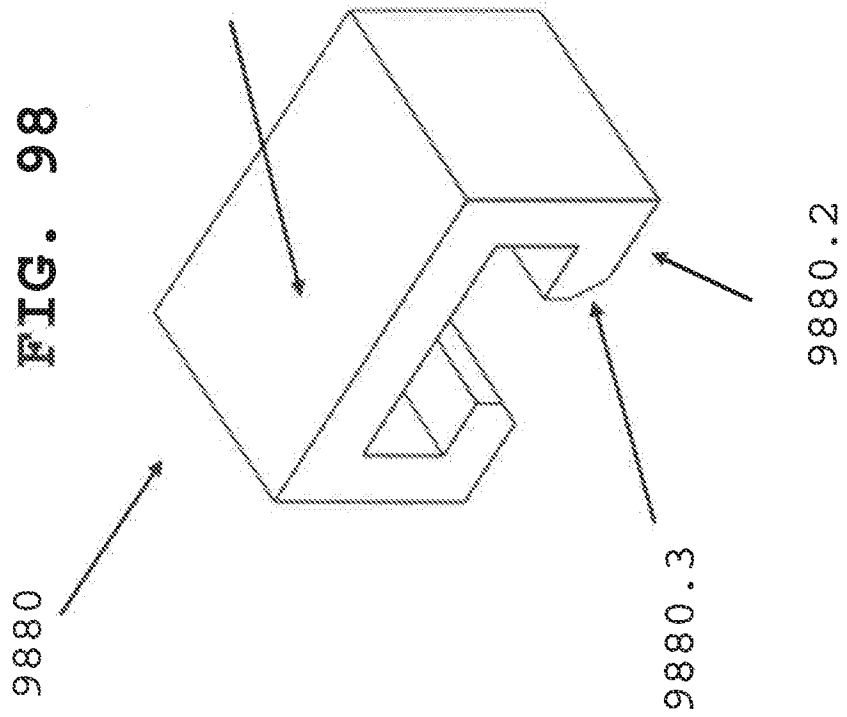


FIG. 98



9700

FIG. 97

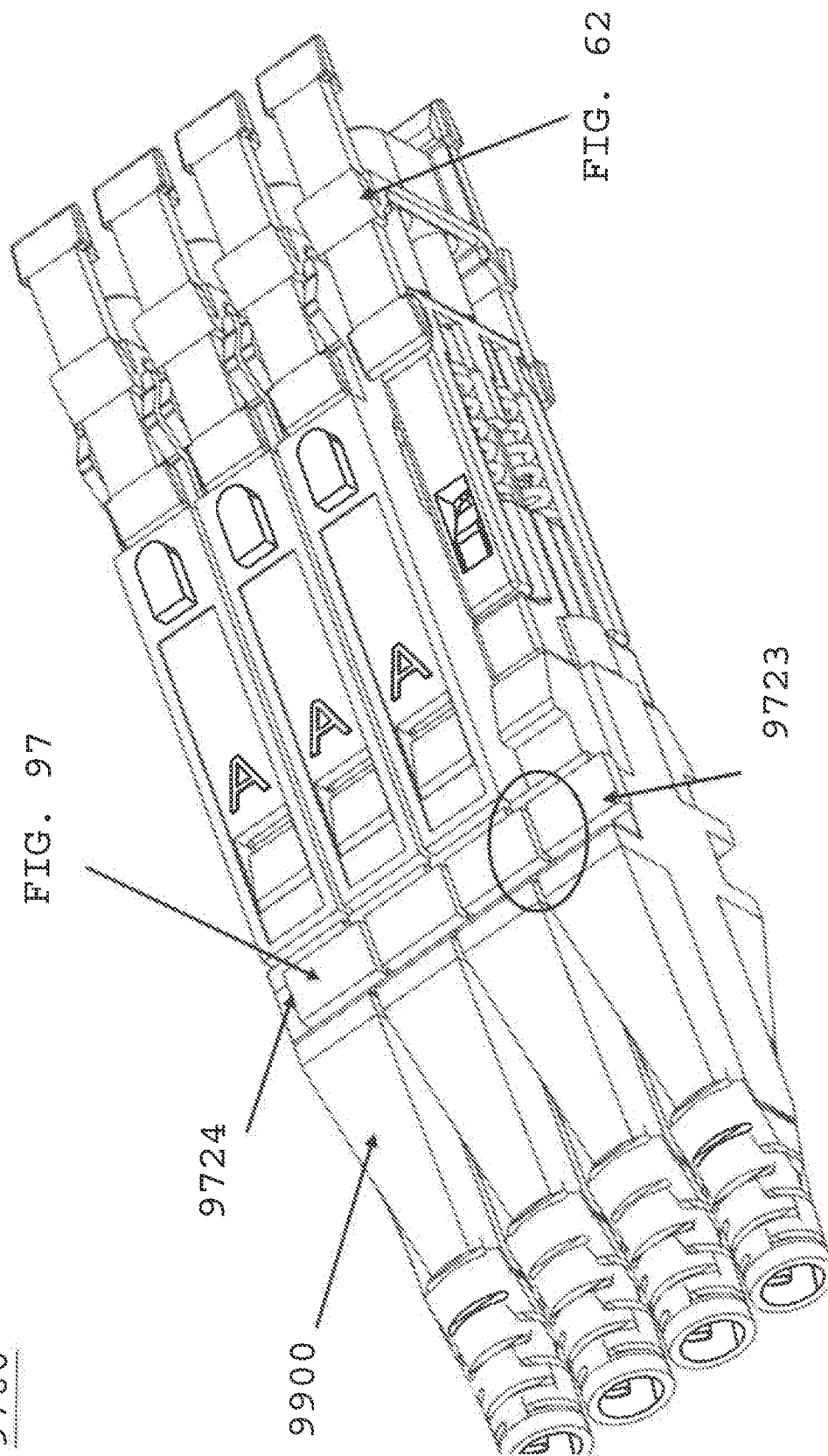


FIG. 97.1

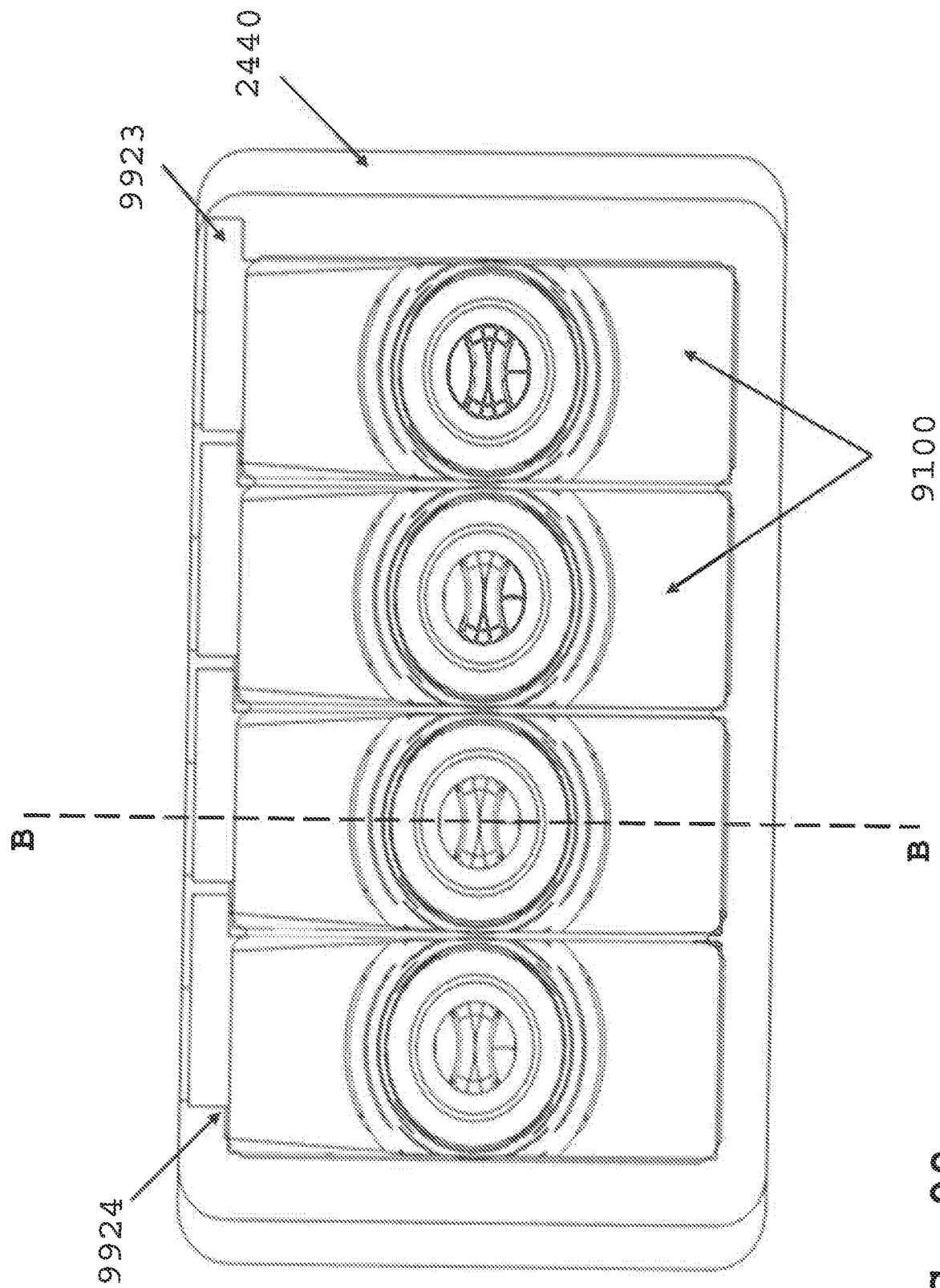
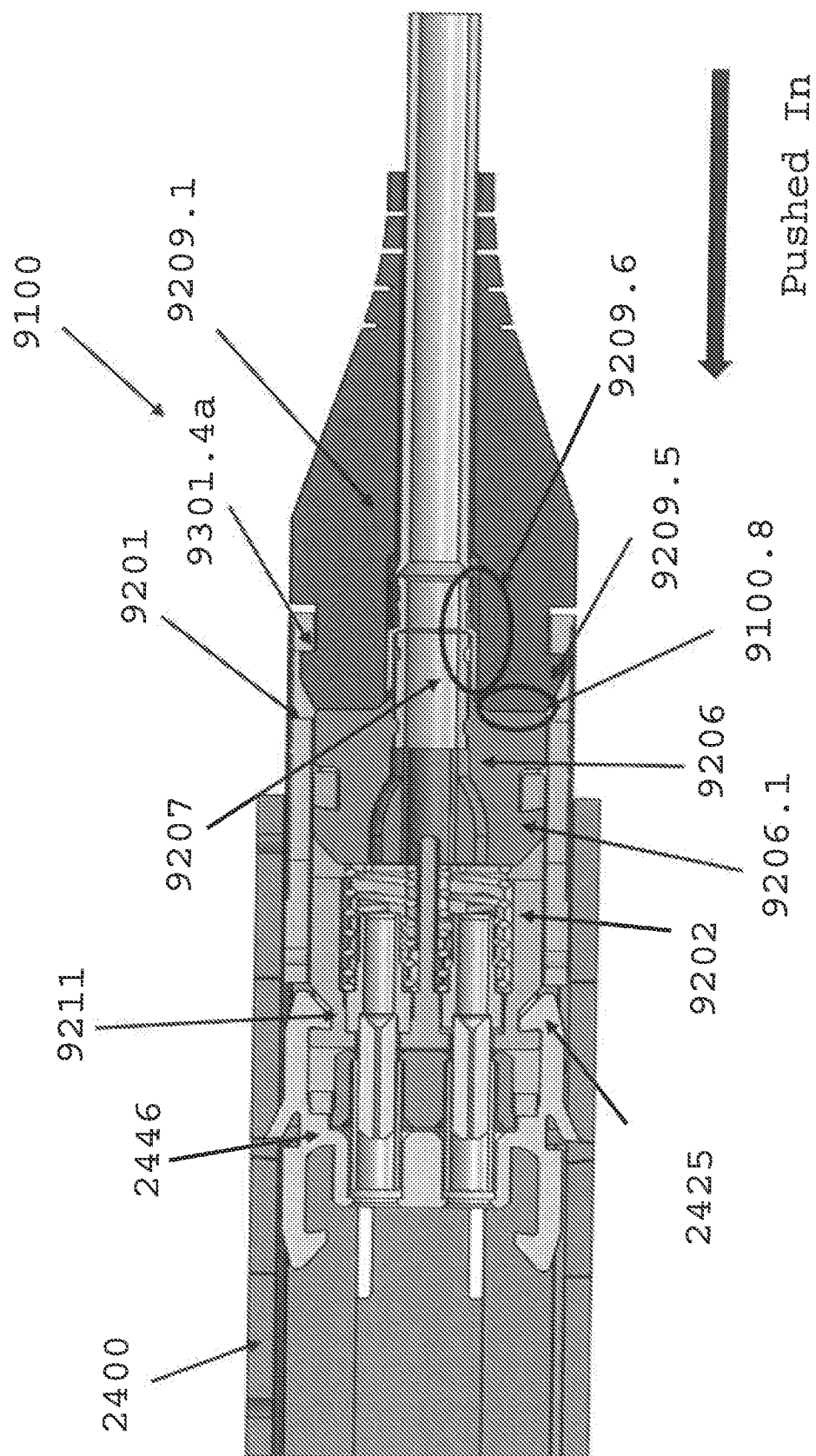


FIG. 99



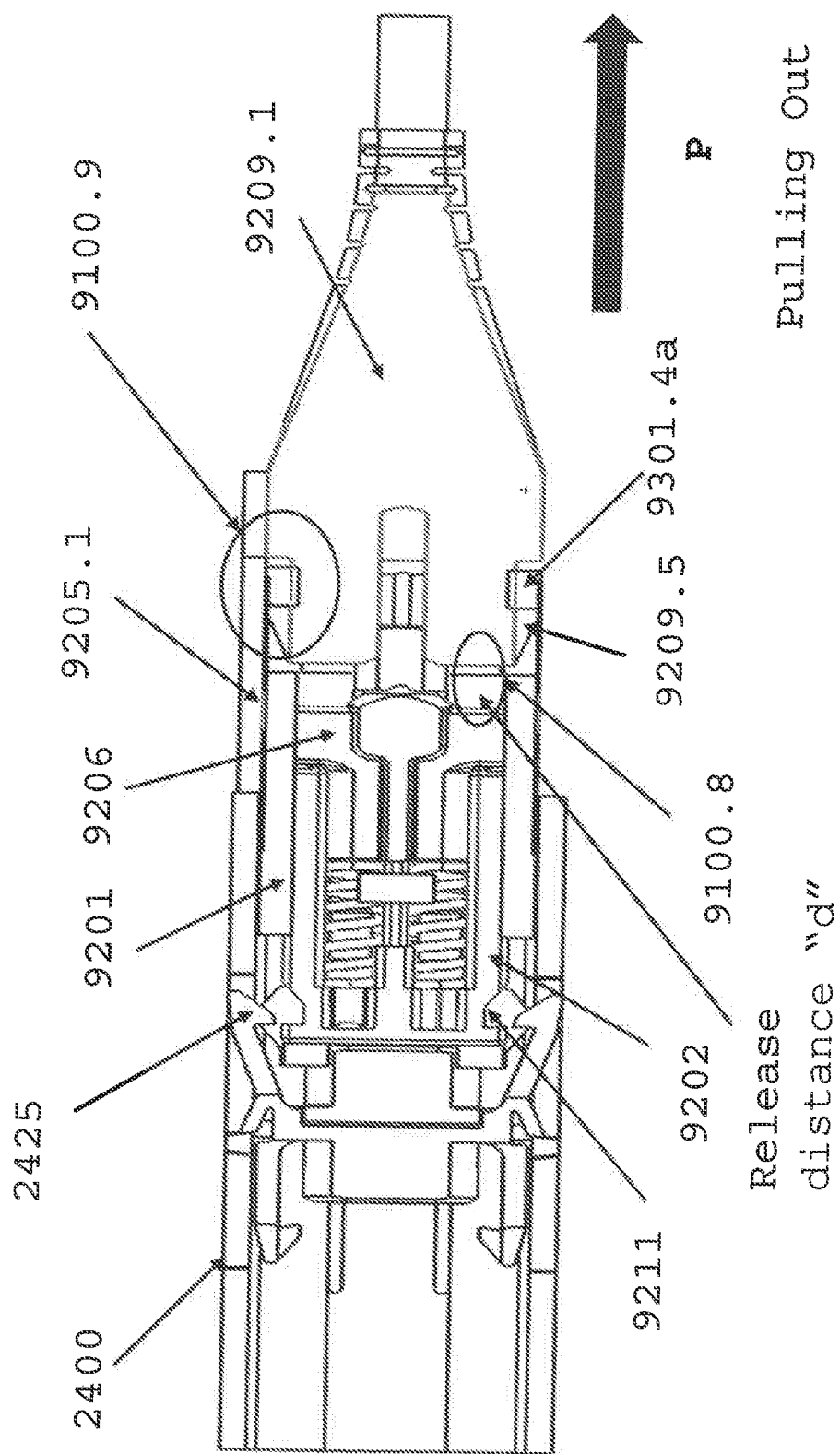


FIG. 100B

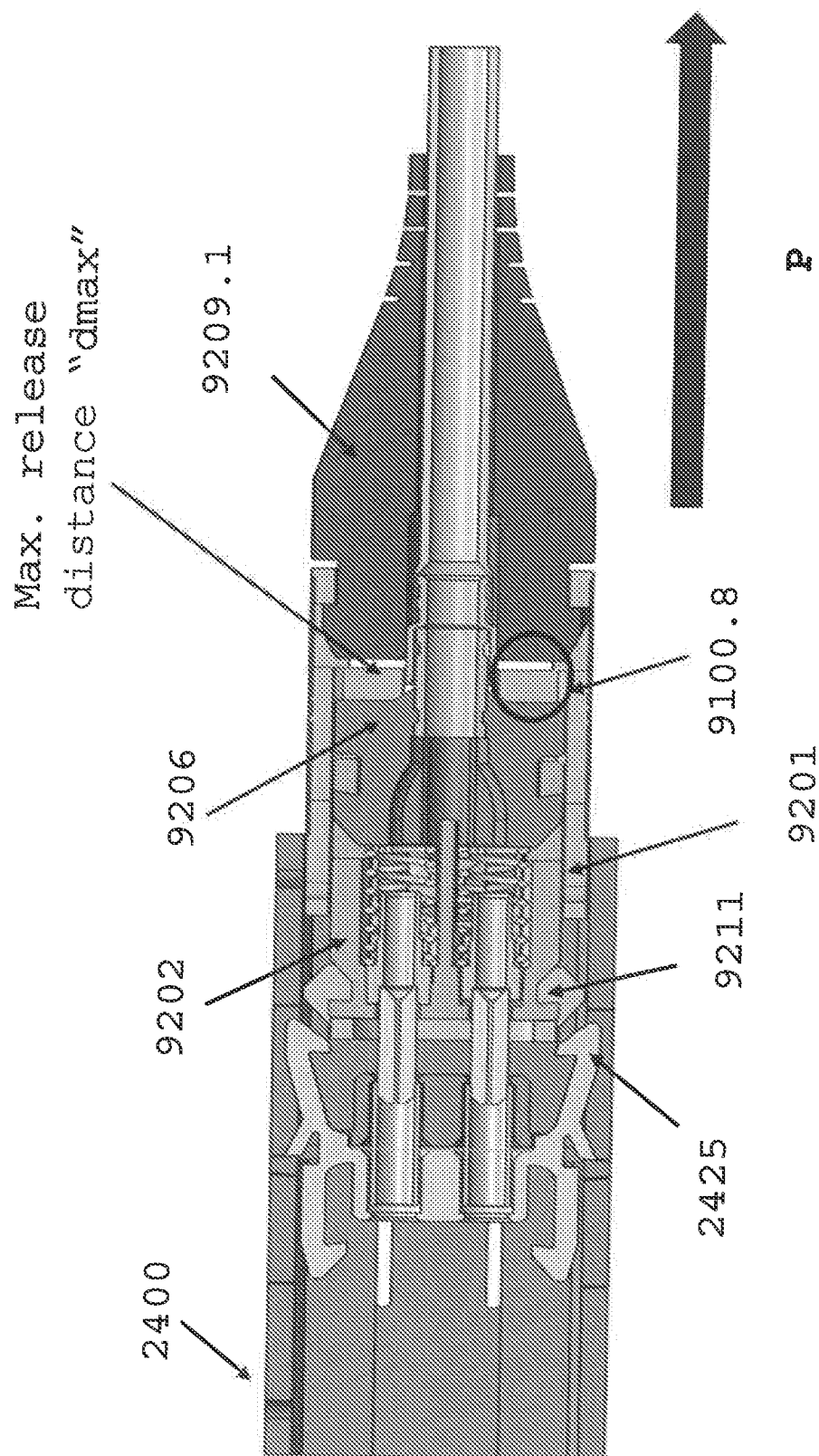


FIG. 100C

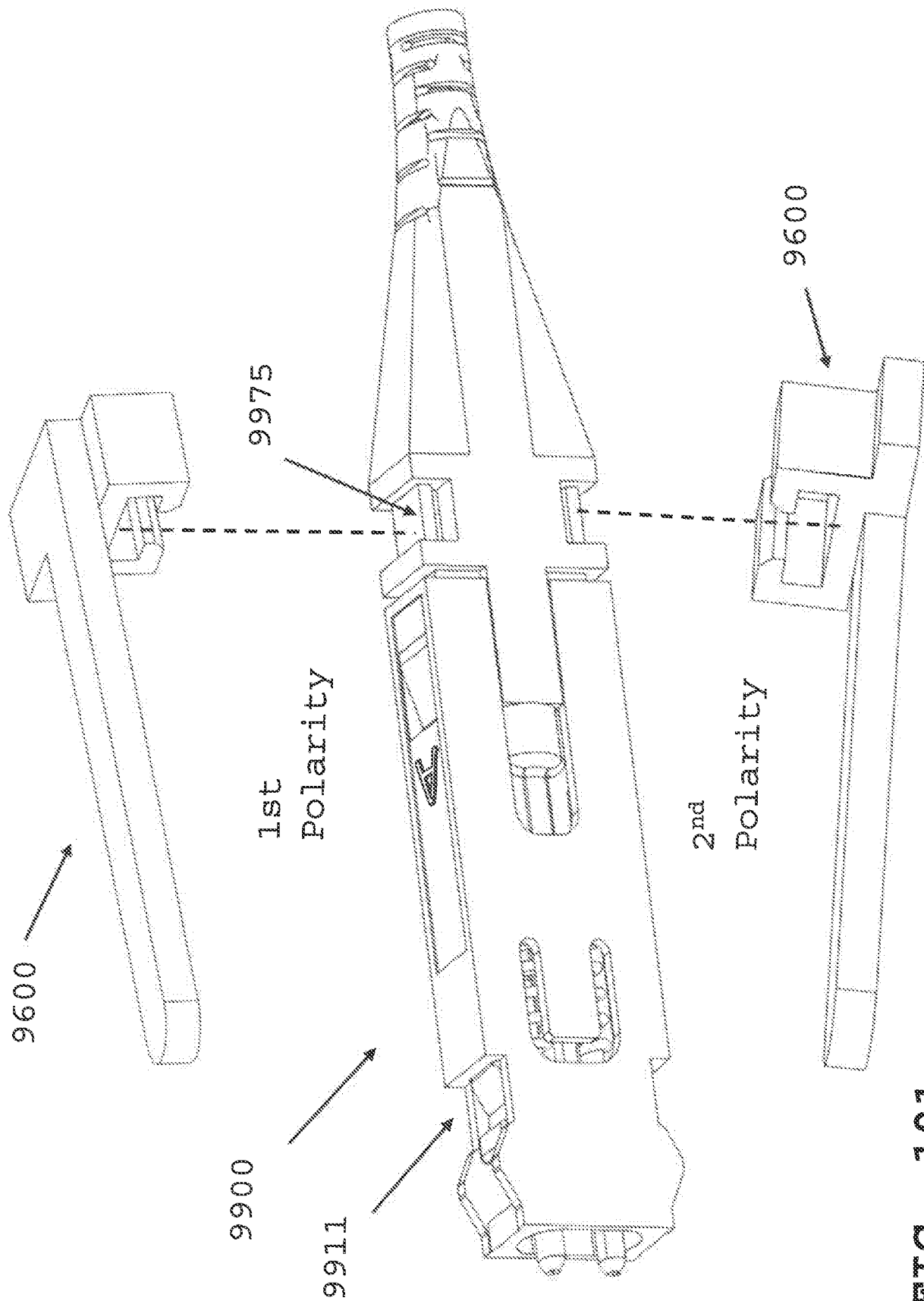


FIG. 101

FIG. 101A

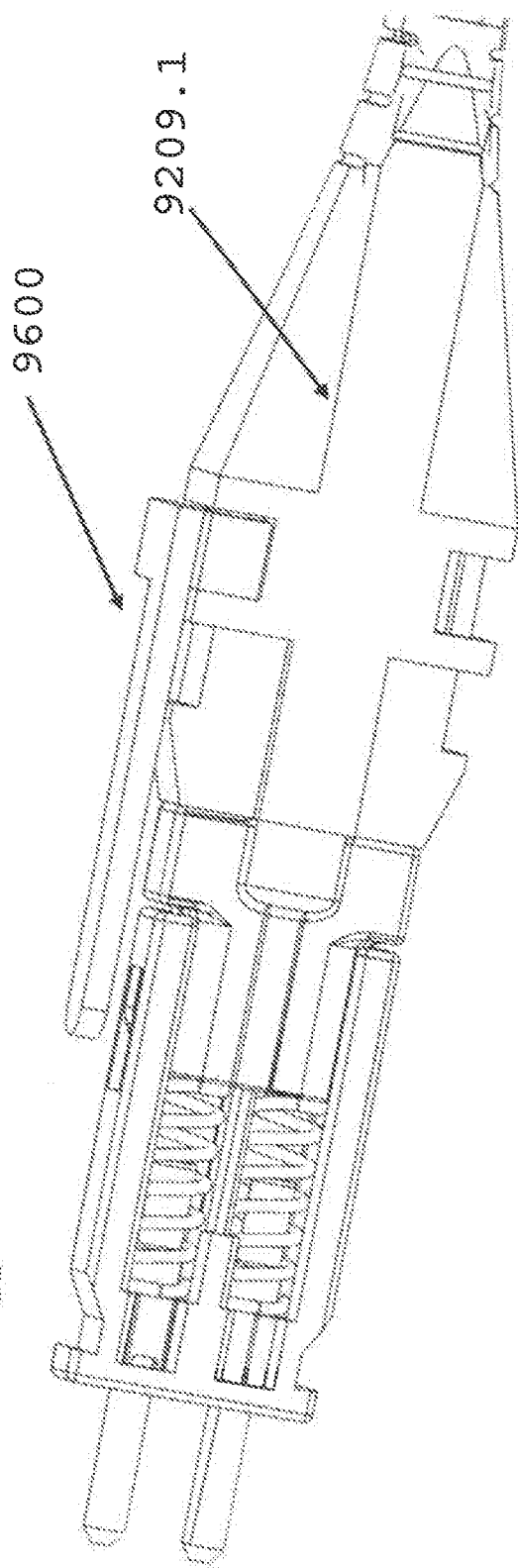
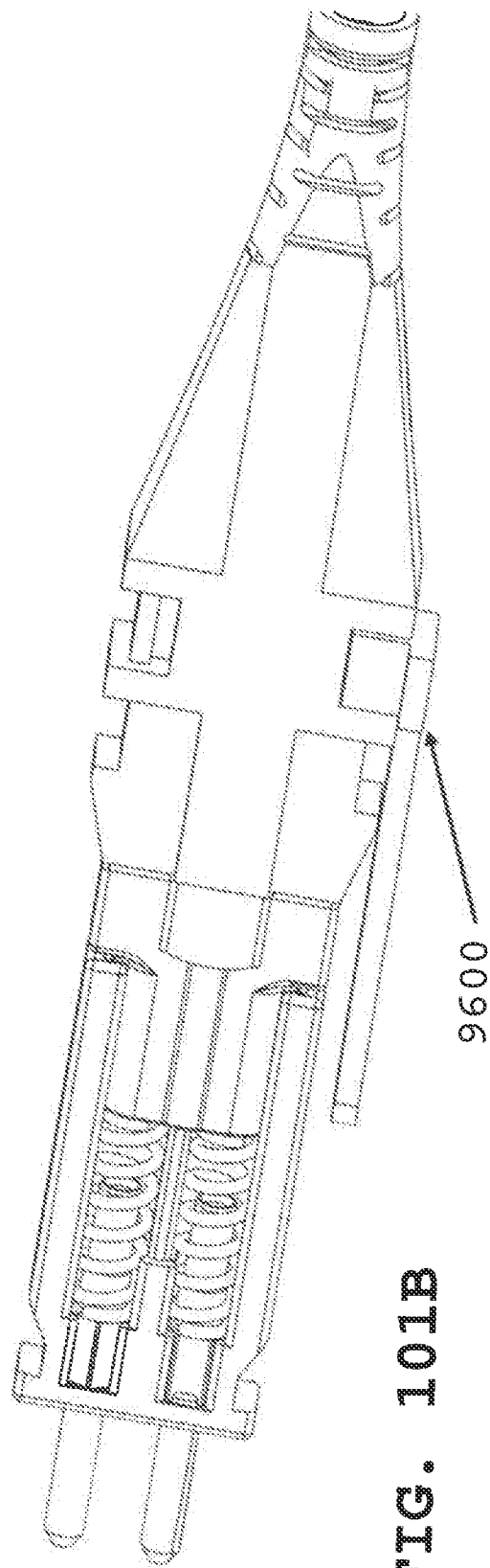


FIG. 101B

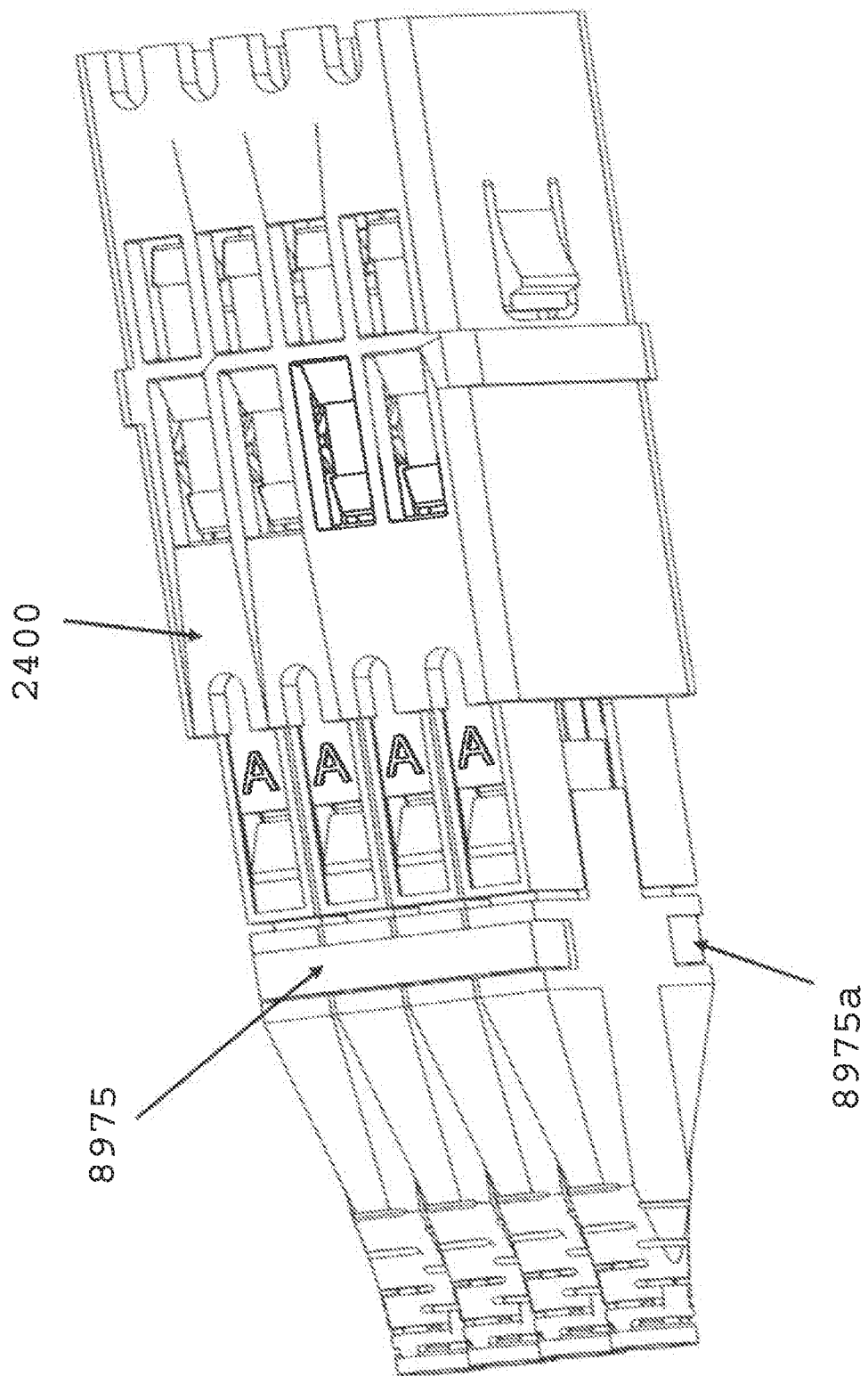


FIG. 102A

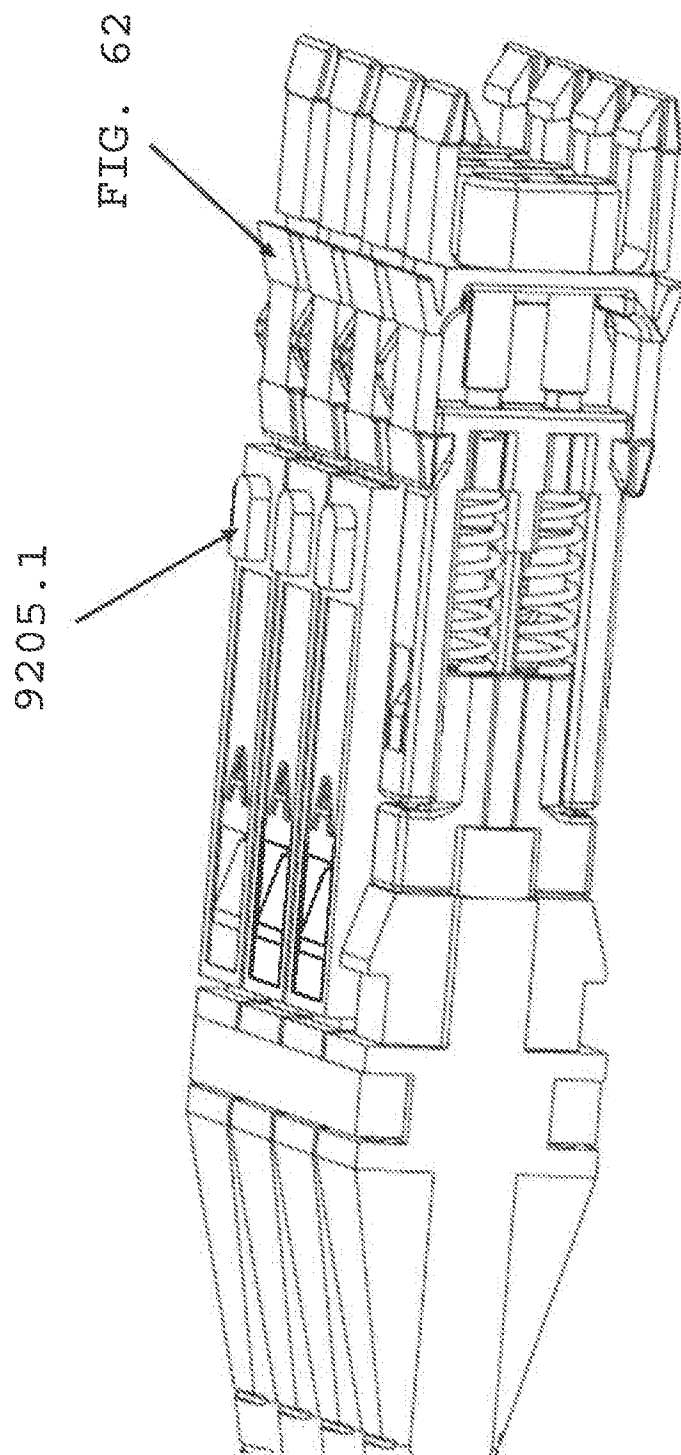
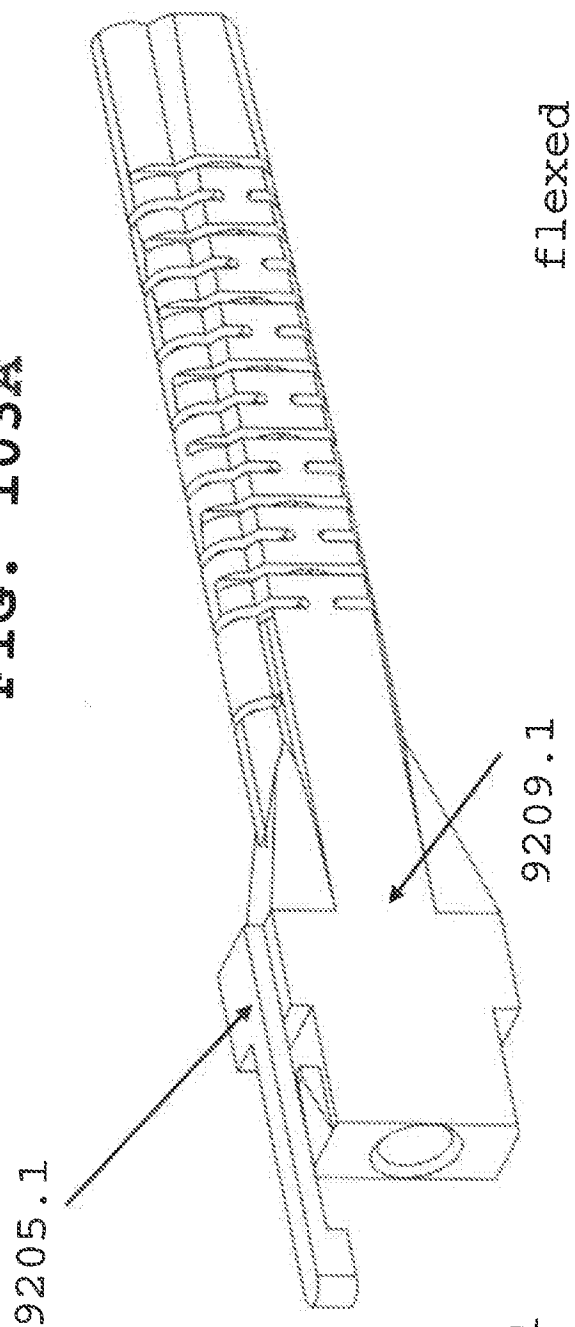


FIG. 102B

FIG. 103A



9205.1

flexed

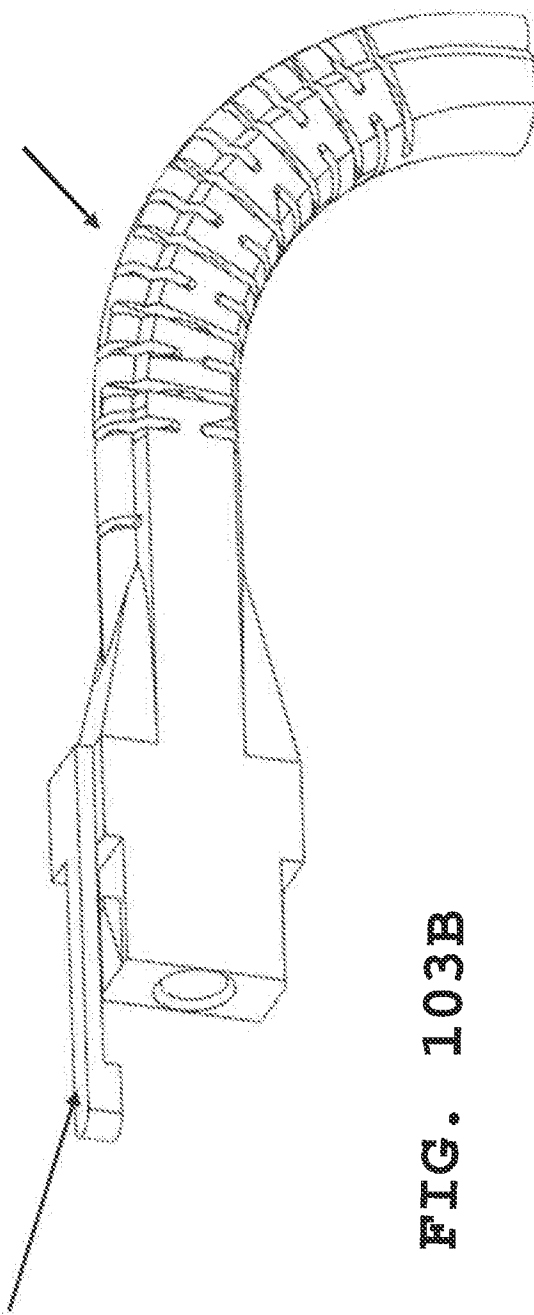


FIG. 103B

Electronic Patent Application Fee Transmittal				
Application Number:				
Filing Date:				
Title of Invention:		MICROCONNECTOR WITH A MULTI-PURPOSE BOOT		
First Named Inventor/Applicant Name:		Kazuyoshi Takano		
Filer:		Edward Jarmolowicz		
Attorney Docket Number:		S09100US00.7		
Filed as Small Entity				
Filing Fees for Provisional				
Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Basic Filing:				
PROVISIONAL APPLICATION FILING FEE	2005	1	140	140
Pages:				
PROVIS. APPL SIZE FEE PER 50 SHEETS >100	2085	1	200	200
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Miscellaneous:				
Total in USD (\$)				340

Electronic Acknowledgement Receipt

EFS ID:	32189559
Application Number:	62649539
International Application Number:	
Confirmation Number:	1013
Title of Invention:	MICROCONNECTOR WITH A MULTI-PURPOSE BOOT
First Named Inventor/Applicant Name:	Kazuyoshi Takano
Customer Number:	152878
Filer:	Edward Jarmolowicz
Filer Authorized By:	
Attorney Docket Number:	S09100US00.7
Receipt Date:	28-MAR-2018
Filing Date:	
Time Stamp:	21:27:04
Application Type:	Provisional

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Payment Type	CARD
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Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Application Data Sheet	WebADS.pdf	127486	no	8
			a3dc79b75d0a182565e3156874c575d9ac67c7bf		
Warnings:					
Information:					
2		S09100US07SPEC.pdf	3020628	yes	54
			fb15522fa8d21d3d9ee2adcb4d9df5044678896f		
	Multipart Description/PDF files in .zip description				
	Document Description		Start	End	
	Abstract		54	54	
	Claims		52	53	
	Specification		1	51	
Warnings:					
Information:					
3	Drawings-only black and white line drawings	S09100US07FIGURES.pdf	5066564	no	133
			b17b6cf86e8e272f2c2fa8cf5efcc926118586bc		
Warnings:					
Information:					
4	Fee Worksheet (SB06)	fee-info.pdf	31740	no	2
			25d7c0d74ae7089794aa6d050d8d77b55c4086b9		
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