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(54) **Title**: TRACEABLE FIBER OPTIC CABLE ASSEMBLY WITH ILLUMINATION STRUCTURE AND TRACING OPTICAL FIBERS FOR CARRYING LIGHT RECEIVED FROM A LIGHT LAUNCH DEVICE

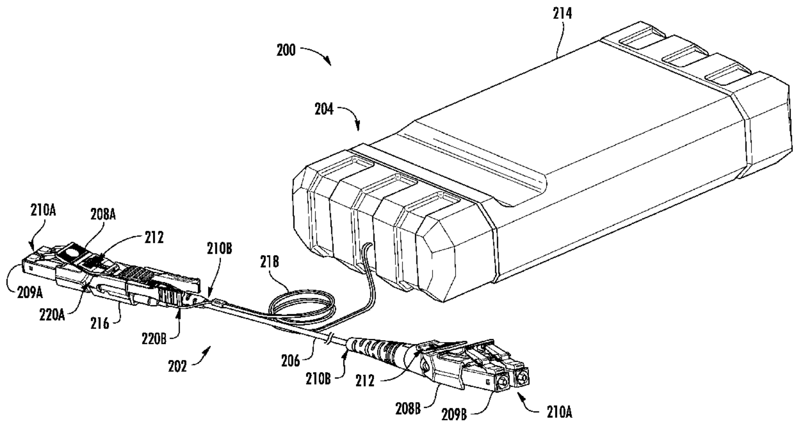

FIG. 2A

(57) **Abstract**: A traceable fiber optic cable assembly with an illumination structure and tracing optical fibers for carrying light received from a light launch device is disclosed herein. The traceable fiber optic cable assembly and light launch device provide easy tracing of the traceable fiber optic cable assembly using fiber optic tracing signals. Further, the launch connector is easily attached to and removed from the fiber optic connector with repeatable and reliable alignment of optic fibers, even when the fiber optic connector is mechanically and/or optically engaged with a network component. The fiber optic connectors are configured to efficiently illuminate an exterior of the connector for effective visibility for a user to quickly locate the fiber optic connector.

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TRACEABLE FIBER OPTIC CABLE ASSEMBLY WITH ILLUMINATION STRUCTURE AND TRACING OPTICAL FIBERS FOR CARRYING LIGHT RECEIVED FROM A LIGHT LAUNCH DEVICE

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of priority to U.S. Provisional Patent Application Serial No. 62/320,024, filed April 8, 2016, and U.S. Patent Application Serial No. 15/411,198, filed January 20, 2017, the content of each of which is relied upon and incorporated herein by reference in its entirety.

BACKGROUND

[0002] This disclosure relates generally to fiber optic cable assemblies having tracing waveguides configured to receive light from a light launch device to facilitate location of portions (e.g., end points) of a fiber optic cable assembly.

[0003] Computer networks continue to increase in size and complexity. Businesses and individuals rely on these networks to store, transmit, and receive critical data at high speeds. Even with the expansion of wireless technology, wired connections remain critical to the operation of computer networks, including enterprise data centers. Portions of these wired computer networks are regularly subject to removal, replacement, upgrade, or other moves and changes. To ensure the continued proper operation of each network, the maze of cables connecting the individual components must be precisely understood and properly connected between specific ports.

[0004] In many cases, a network's cables, often called patch cords, can be required to bridge several meters across a data center, among other uses (e.g., within high performance computers). These cables are used between racks of servers, storage, switches, and patch panels. The cables may begin in one equipment rack, run through the floor or other conduit, and terminate at a component in a second equipment rack. Data center operators may need to reconfigure patch panel endpoints to adapt to changes in use patterns or to turnover in equipment, which requires knowing the attachment location of both ends of the cable. To change the configuration of a patch cord, an operator needs to know where both ends of the cord are attached. However, in practice, it is not unusual for the operators to only know where one end of the patch cord is connected. To determine where the other end is can be time consuming and fraught with risk.

[0005] **FIGS. 1A-1B** are views of network cables (e.g., patch cords **100**) used in fiber optic equipment. More specifically, **FIG. 1A** is a perspective view of an equipment rack **102** supporting patch cords **100**, and **FIG. 1B** is a perspective view of an under-floor cable tray **104** supporting patch cords **100**. **FIGS. 1A-1B** illustrate a problem that occurs in data centers or similar network locations, which is congestion and clutter caused by large quantities of patch cords **100**. Network operators frequently need to change connections to accommodate moves, additions, and changes in the network. However, operators find it difficult to trace a particular patch cord **100** from the source to the receiver (e.g., ends of the patch cords **100**) when the network location is congested, as illustrated in **FIGS. 1A** and **1B**.

[0006] However, even when cable ends are illuminated, they may not be easily visible to the operator, such as if the cable ends are using low intensity lighting, have small or obscured lighting portions, etc. Further, in some cases, the operator must remove a first cable end to use a tracing tool to find the second cable end. In addition to being cumbersome and time consuming, removal of cable ends increases the risk of network routing accidents and mistakes (e.g., reinserting a removed cable end into the wrong port). Even still, some cables may use electrical components for tracing endpoints of the cable, but for fiber optic cables this may be undesirable, for example, due to the desire to have an "all optical" system.

[0007] As a result, there is a need for a traceable cable and/or light launch device that allows a network operator to quickly identify the terminal end of a given cable (e.g., such as those that are being replaced, relocated, or tested) with the lowest possible risk of error.

[0008] No admission is made that any reference cited herein constitutes prior art. Applicant expressly reserves the right to challenge the accuracy and pertinency of any cited documents.

SUMMARY

[0009] Embodiments of the disclosure are directed to a traceable fiber optic cable assembly with an illumination structure and tracing optical fibers for carrying light received from a light launch device. In an exemplary embodiment, the traceable fiber optic cable assembly comprises a traceable fiber optic cable connectorized by a first fiber optic connector and a second fiber optic connector each disposed at end portions of the fiber optic cable. The traceable fiber optic cable comprises at least one data transmission fiber (e.g., transmit and receive optical data fibers) for data communication of an optical data signal therethrough.

The traceable fiber optic cable also includes a tracing optical fiber comprising a launch end and a first emission end. The tracing optical fiber is configured to receive an optical tracing signal (e.g., light) from a launch light source and carry the received optical tracing signal from the first launch end to the first emission end for tracing the traceable fiber optic cable. For example, if the first launch end of the tracing optical fiber is located at the first fiber optic connector and the first emission end of the tracing optical fiber is located at the second fiber optic connector, optical tracing signal launched into the first launch end and emitted to the first emission end of the tracing optical fiber may illuminate a portion of the second fiber optic connector to be human perceptible to allow a person to trace the second fiber optic connector of the traceable fiber optic cable. To facilitate the launching of an optical tracing signal into the tracing optical fiber, in certain examples disclosed herein, the first fiber optic connector contains a registration feature (e.g., connector fiber guide) that is configured to interface (in some cases toollessly) with a removable launch connector when it is desired to launch an optical tracing signal from the launch light source to the launch end of the tracing optical fiber. The launch connector is configured to toollessly engage to the first fiber optic connector to direct the optical tracing signal emitted by the launch light source through the launch connector and to the launch end of the tracing optical fiber at the first fiber optic connector when tracing is desired. The launch connector can be removed from the first fiber optic connector after tracing is completed. In other examples, the traceable fiber optic cable may also include a second tracing optical fiber comprising a second launch end at the second fiber optic connector and a second emission end at the first fiber optic connector to allow interfacing of a launch connector for tracing the first fiber optic connector of the traceable fiber optic connector.

[0010] To facilitate the ability to launch an optical tracing signal in the tracing optical fibers disposed at the first and/or second fiber optic connectors of the traceable fiber optic cable assembly, the first and/or second fiber optic connector comprise a housing defining an interior comprising a connector fiber guide. The connector fiber guide comprises a planar surface, a launch opening defined in the planar surface, and at least one alignment surface proximate the first planar surface. The launch end of the first and/or second tracing optical fibers are positioned in the housing of the first and/or second fiber optic connectors, respectively. The emission end of the first and second tracing optical fibers are positioned in the housings of the second and/or first fiber optic connectors, respectively. The planar surface provides cleaving access to the launch end of the first and/or second tracing optical fibers. The at least one alignment surface is configured to axially align the launch optical fiber of the launch connector with the launch end of the first and/or second tracing optical fibers when the launch connector is engaged to a first or second fiber optic connector. The first and/or second fiber optic connector further comprises a translucent internal illumination structure positioned within the interior of the housing and a translucent external illumination structure positioned at the exterior of the housing. The translucent internal and external illumination structures are configured to redirect and/or disperse at least a portion of an optical tracing signal when emitted from the launch end of the tracing fiber (e.g., by total internal reflection).

[0011] Accordingly, the traceable fiber optic cable assembly facilitates the easy tracing of the traceable fiber optic cable assembly using fiber optic tracing signals (in some cases without the need for additional electrical components). Further, the launch connector is easily engaged to and removed from the fiber optic connector with repeatable and reliable alignment of optical fibers, even when the fiber optic connector is mechanically and/or electronically engaged with a fiber optic component. The traceable fiber optic cable assembly connectors are configured to efficiently illuminate at least a portion of the fiber optic connector for effective visibility for a user to quickly locate the traceable fiber optic cable assembly connector.

[0012] One embodiment of the disclosure relates to a cable tracing system comprising a fiber optic connector. The fiber optic connector comprises a housing, a translucent internal illumination structure, at least one data transmission element, a first launch end of a first tracing optical fiber, and a second emission end of a second tracing optical fiber. The housing defines an interior and comprising a launch opening. The translucent internal illumination structure is positioned within the interior of the housing. At least a portion of the at least one data transmission element is positioned within the interior of the housing for communication of an optical data signal. The first launch end is positioned within the launch opening of the housing and accessible from an exterior of the housing for receiving a first optical tracing signal from a launch optical fiber to direct the first optical tracing signal to a first emission end of the first tracing optical fiber. The second emission end of the second tracing optical fiber is positioned within the housing. The translucent internal illumination structure is configured to redirect at least a primary portion of the second optical tracing signal when emitted from the second launch end.

[0013] An additional embodiment of the disclosure relates to a cable tracing system comprising a traceable fiber optic cable assembly, a fiber optic connector, a translucent first internal illumination structure, a second fiber optic connector, and a translucent second internal illumination structure. The traceable fiber optic cable comprises at least one data transmission element for communication of an optical data signal, a first tracing optical fiber comprising a first launch end and a first emission end, and a second tracing optical fiber comprising a second launch end and a second emission end. The first fiber optic connector is provided at a first end of the traceable fiber optic cable, the first fiber optic connector comprising a first housing defining a first interior and comprising a first launch opening. The translucent first internal illumination structure positioned within the first interior of the first housing. The second fiber optic connector is provided at a second end of the traceable fiber optic cable. The second fiber optic connector comprises a second housing defining a second interior and comprising a second launch opening. The translucent second internal illumination structure is positioned within the second interior of the second housing. The first launch end of the first tracing optical fiber is positioned within the first launch opening of the first housing of the first fiber optic connector and the first emission end of the first tracing optical fiber is positioned within the second housing of the second fiber optic connector. The second launch end of the second tracing optical fiber is positioned within the second launch opening of the second housing of the second fiber optic connector and the second emission end of the second tracing optical fiber is positioned within the first housing of the first fiber optic connector. The first launch end is accessible from an exterior of the first housing for receiving a first optical tracing signal from a launch optical fiber for direction of the first optical tracing signal to the first emission end of the first tracing optical fiber. The second launch end is accessible from an exterior of the second housing for receiving a second optical tracing signal from the launch optical fiber for direction of the second optical tracing signal to the second emission end of the second tracing optical fiber. The translucent first internal illumination structure is configured to redirect at least a primary portion of the first optical tracing signal when emitted from the second launch end. The translucent second internal illumination structure is configured to redirect at least a primary portion of the second optical tracing signal when emitted from the first launch end.

[0014] An additional embodiment of the disclosure relates to a cable tracing system comprising a fiber optic connector. The fiber optic connector comprises a housing, a translucent internal illumination structure, at least one data transition element, and a first end of a tracing optical fiber. The housing defines an interior. The translucent internal illumination structure is positioned within the interior of the housing. At least a portion of the at least one data transmission element is positioned within the interior of the housing for communication of an optical data signal. The first end of the tracing optical fiber is positioned within the housing and accessible from an exterior of the housing for receiving an optical tracing signal from a launch optical fiber to direct the optical tracing signal to a second end of the tracing optical fiber. The translucent internal illumination structure is configured to redirect at least a primary portion of the second optical tracing signal when emitted from the first end.

[0015] An additional embodiment of the disclosure relates to a cable tracing system, comprising a fiber optic connector. The fiber optic connector comprises a housing, at least one data transmission element, a first launch end of a first tracing optical fiber, and a second emission end of a second tracing optical fiber. The housing defines an interior and comprises a connector fiber guide. The connector fiber guide comprises a planar surface, a launch opening defined in the planar surface, and at least one alignment surface proximate the planar surface. At least a portion of the at least one data transmission element is positioned within the interior of the housing for direction of an optical data signal. The first launch end is positioned within the launch opening of the housing and accessible from an exterior of the housing for receiving a first optical tracing signal from a launch optical fiber to direct the first optical tracing signal to a first emission end of the first tracing optical fiber. The second emission end is positioned within the housing. The at least one alignment surface is configured to axially align the launch optical fiber with the first launch end of the first tracing optical fiber.

[0016] An additional embodiment of the disclosure relates to a cable tracing system comprising a traceable fiber optic cable assembly. The traceable fiber optic cable assembly comprises a traceable fiber optic cable, a first fiber optic connector and a second fiber optic connector. The traceable fiber optic cable comprises at least one data transmission element for communication of an optical data signal, a first tracing optical fiber comprising a first launch end and a first emission end, and a second tracing optical fiber comprising a second launch end and a second emission end. The first fiber optic connector is provided at a first end of the traceable fiber optic cable. The first fiber optic connector comprises a first housing defining a first interior and comprises a first connector fiber guide. The first connector fiber guide comprises a first planar surface, a first launch opening defined in the first planar surface, and at least one first alignment surface proximate the first planar surface. The second fiber optic connector is provided at a second end of the traceable fiber optic cable. The second fiber optic connector comprises a second housing defining a second interior and comprises a second connector fiber guide. The second connector fiber guide comprises a second planar surface, a second launch opening defined in the second planar surface, and at least one second alignment surface proximate the first planar surface. The first launch end of the first tracing optical fiber is positioned within the first launch opening of the first housing of the first fiber optic connector and the first emission end of the first tracing optical fiber is positioned within the second housing of the second fiber optic connector. The second launch end of the second tracing optical fiber is positioned within the second launch opening of the second housing of the second fiber optic connector and the second emission end of the second tracing optical fiber is positioned within the first housing of the first fiber optic connector. The first launch end is accessible from an exterior of the second housing for receiving a first optical tracing signal from a launch optical fiber for direction of the first optical tracing signal to the first emission end of the first tracing optical fiber. The second launch end is accessible from an exterior of the first housing for receiving a second optical tracing signal from the launch optical fiber for direction of the second optical tracing signal to the second emission end of the second tracing optical fiber. At least a portion of a peripheral edge of the first planar surface is not enclosed by the at least one first alignment surface to provide cleaving access to the first launch end of the first tracing optical fiber. At least a portion of a peripheral edge of the second planar surface is not enclosed by the at least one second alignment surface to provide cleaving access to the second launch end of the second tracing optical fiber. The at least one first alignment surface is configured to axially align the launch optical fiber with the first launch end of the first tracing optical fiber. The at least one second alignment surface is configured to axially align the launch optical fiber with the second launch end of the second tracing optical fiber.

[0017] An additional embodiment of the disclosure relates to a cable tracing system comprising a fiber optic connector. The fiber optic connector comprises a housing, at least one data transmission element, and a first end of a tracing optical fiber. The housing defines an interior and comprises a connector fiber guide. The connector fiber guide comprises an opening, and at least one alignment surface proximate the opening. At least a portion of the at least one data transmission element is positioned within the interior of the housing for direction of an optical data signal. A first end of a tracing optical fiber is positioned within the opening of the housing and accessible from an exterior of the housing for receiving a first optical tracing signal from a launch optical fiber to direct the first optical tracing signal to a second end of the tracing optical fiber. The at least one alignment surface is configured to axially align the launch optical fiber with the first end of the tracing optical fiber.

[0018] An additional embodiment of the disclosure relates to a light launch device for a traceable fiber optic cable assembly. The light launch device comprising a light source, a launch connector, and a first launch optical fiber. The light source generates a first optical tracing signal. The launch connector comprises a housing and a first arm. The housing comprises a central channel with an open bottom configured to receive at least a portion of a fiber optic connector of the traceable fiber optic cable assembly. The first arm is movably connected to the housing and comprises a first launch fiber guide. The first launch fiber guide comprises a first emission opening and at least one first alignment surface proximate the first emission opening. The first arm is moveable from an engaged orientation to a disengaged orientation for engaging and disengaging the fiber optic connector of the traceable fiber optic cable assembly. The first launch optical fiber comprises a first launch end and a first emission end. The first emission end is positioned in the first emission opening of the first arm, and the first launch end is in communication with the light source to receive an optical tracing signal therefrom. The at least one first alignment surface is configured to axially align the first emission end of the first launch optical fiber with the first launch end of a first tracing optical fiber of the traceable fiber optic cable assembly for direction of the first optical tracing signal to the first tracing optical fiber.

[0019] An additional embodiment of the disclosure relates to a method of tracing a fiber optic cable. The method comprises positioning at least a portion of a first fiber optic connector of a traceable fiber optic cable assembly within a central channel with an open bottom of the housing of the launch connector of the light launch device. The traceable fiber optic cable assembly comprises the first fiber optic connector, a second fiber optic connector, and a traceable fiber optic cable therebetween. The method further comprises moving a first arm movably connected to the housing of the launch connector from a disengaged position to an engaged position to mechanically engage the launch connector to the first fiber optic connector. A first launch fiber guide of the first arm of the light launch device mechanically interacts with a connector fiber guide during engagement to axially align a emission end of a launch optical fiber with a launch end of a tracing optical fiber of the first fiber optic connector. The method further comprises transmitting a first tracing signal from a light source of the light launch device, through the launch optical fiber, through the launch end of the tracing optical fiber positioned in the first fiber optic connector, through an emission end of the tracing optical fiber positioned in the second fiber optic connector.

[0020] An additional embodiment of the disclosure relates a method of manufacturing a light launch device for a traceable fiber optic cable assembly. The method comprises forming a launch connector. The launch connector comprises a housing and an arm. The housing comprises a central channel with an open bottom configured to receive at least a portion of a fiber optic connector of the traceable fiber optic cable assembly. The arm is movably connected to the housing and comprises a launch fiber guide. The launch fiber guide comprises an emission opening and at least one alignment surface proximate the emission opening. The arm is moveable from an engaged orientation to a disengaged orientation for engaging and disengaging the fiber optic connector of the traceable fiber optic cable assembly. The method further comprises forming a launch optical fiber comprising a launch end and a emission end. The method further comprises positioning the emission end in the emission opening of the arm. The method further comprises coupling the launch end with the light source to receive the first optical tracing signal therefrom. The at least one alignment surface is configured to axially align the emission end of the launch optical fiber with a launch end of a first tracing optical fiber of the traceable fiber optic cable assembly for direction of the first optical tracing signal to the first tracing optical fiber.

[0021] Additional features and advantages will be set forth in the detailed description which follows, and in part will be readily apparent to those skilled in the art from the description or recognized by practicing the embodiments as described in the written description and claims hereof, as well as the appended drawings.

[0022] It is to be understood that both the foregoing general description and the following detailed description are merely exemplary, and are intended to provide an overview or framework to understand the nature and character of the claims.

[0023] The accompanying drawings are included to provide a further understanding, and are incorporated in and constitute a part of this specification. The drawings illustrate one or more embodiment(s), and together with the description serve to explain principles and operation of the various embodiments.

BRIEF DESCRIPTION OF THE DRAWINGS

[0024] **FIG. 1A** is a perspective view of an equipment rack supporting patch cords;

[0025] **FIG. 1B** is a perspective view of an under-floor cable tray supporting patch cords;

[0026] **FIG. 2A** is a perspective view of an exemplary cable tracing system, such as for use with the patch cords of **FIGS. 1A-1B**;

[0027] **FIG. 2B** is a perspective view of the cable tracing system of **FIG. 2A** illustrating a launch connector disengaged from a first fiber optic connector;

[0028] **FIG. 2C** is a perspective view of the cable tracing system of **FIG. 2A** illustrating a launch connector engaged with the first fiber optic connector;

[0029] **FIG. 3A** is a schematic diagram of another embodiment of the exemplary cable tracing system in **FIGS. 2A-2C**;

[0030] **FIG. 3B** is a schematic diagram illustrating the cable tracing system of **FIG. 3A**;

[0031] **FIG. 3C** is another schematic diagram illustrating the cable tracing system of **FIG. 3A**;

[0032] **FIG. 4** is a more detailed schematic diagram of the cable tracing system of **FIGS. 2A-2C**;

[0033] **FIG. 5A** is a rear top perspective view of the launch connector of **FIGS. 2A-2C** and 4;

[0034] **FIG. 5B** is a front bottom perspective view of the launch connector of **FIG. 5A**;

[0035] **FIG. 5C** is a bottom view of the launch connector of **FIG. 5A**;

[0036] **FIG. 5D** is an exploded perspective view of the launch connector of **FIG. 5A**;

[0037] **FIG. 5E** is a top front perspective view of the front body of the launch connector of **FIG. 5A**;

[0038] **FIG. 5F** is a bottom front perspective view of the front body of the launch connector of **FIG. 5A**;

[0039] **FIG. 5G** is a top front perspective view of the rear body of the launch connector of **FIG. 5A**;

[0040] **FIG. 5H** is a bottom front perspective view of the rear body of the launch connector of **FIG. 5A**;

[0041] **FIG. 5I** is a top perspective view of the clip of the launch connector of **FIG. 5A** including an enlarged perspective view of a launch fiber guide;

[0042] **FIG. 5J** is a bottom perspective view of the clip of the launch connector of **FIG. 5A** including first and second launch optical fibers positioned therein;

[0043] **FIG. 5K** is a bottom view of the rear body, clip, and first and second launch optical fibers of the launch connector of **FIG. 5A**;

[0044] **FIG. 5L** is a flowchart illustrating an exemplary process for forming the launch connector of **FIGS. 2A-5L**;

[0045] **FIG. 6A** is a perspective view of the traceable fiber optic cable assembly of **FIGS. 2A-2C** and **4**;

[0046] **FIG. 6B** is a front perspective view of a connector fiber guide of the traceable fiber optic cable assembly of **FIG. 6A**;

[0047] **FIG. 6B** is a rear perspective view of a connector fiber guide of the traceable fiber optic cable assembly of **FIG. 6A**;

[0048] **FIG. 6C** is a side view of the connector fiber guide of the traceable fiber optic cable assembly of **FIG. 6A**;

[0049] **FIG. 6D** is a top view of the connector fiber guide of the traceable fiber optic cable assembly of **FIG. 6A**;

[0050] **FIG. 7A** is an exploded view of the first fiber optic connector of **FIGS. 2A-2C, 4,** and **6A-6F**;

[0051] **FIG. 7B** is a perspective view of the housing body of the first fiber optic connector of **FIG. 6A;**

[0052] **FIG. 7C** is a rear perspective view of a trigger casing of the first fiber optic connector of **FIG. 6A**;

[0053] **FIG. 7D** is a front perspective view of the trigger casing of the first fiber optic connector of **FIG. 6A**;

[0054] **FIG. 7E** is a rear perspective view of a locking member of the first fiber optic connector of **FIG. 6A**;

[0055] **FIG. 7F** is a front perspective view of the locking member of the first fiber optic connector of **FIG. 6A**;

[0056] **FIG. 7G** is a rear perspective view of the first fiber optic connector of **FIG. 6A** with the locking member in an unlocked orientation;

[0057] **FIG. 7H** is a front perspective view of the first fiber optic connector of **FIG. 6A** with the locking member in the unlocked orientation;

[0058] **FIG. 7I** is a rear perspective view of the first fiber optic connector of **FIG. 6A** with the locking member in a locked orientation;

[0059] **FIG. 7J** is a front perspective view of the first fiber optic connector of **FIG. 6A** the locking member in the locked orientation;

[0060] **FIG. 8A** is a cross-sectional top view of the first fiber optic connector of **FIGS. 2A-2C, 4,** and **6A-7J** and the launch connector of **FIGS. 2A-2C, 4,** and **5A-5L** disengaged from one another;

[0061] **FIG. 8B** is a top perspective view of the first fiber optic connector and launch connector of **FIG. 8A**;

[0062] **FIG. 8C** is a cross-sectional top view of the first fiber optic connector and launch connector of **FIG. 8A** as the launch connector engages the first fiber optic connector;

[0063] **FIG. 8D** is a top perspective view of the first fiber optic connector and launch connector of **FIG. 8C**;

[0064] **FIG. 8E** is a cross-sectional top view of the traceable fiber optic cable assembly and launch connector of **FIG. 8A** in an engaged position and sending a first optical tracing signal to the second fiber optic connector;

[0065] **FIG. 8F** is a top perspective view of the traceable fiber optic cable assembly and launch connector of **FIG. 8E**;

[0066] **FIG. 9A** is a cross-sectional view of the traceable fiber optic cable assembly of **FIGS. 2A-2C, 4,** and **6A-8F**;

[0067] **FIG. 9B** is a perspective view of the first fiber optic connector housing bottom clamshell of **FIG. 9A** with a launch end of the first tracing optical fiber and an emission end of the second tracing optical fiber positioned therein;

[0068] **FIG. 9C** is an enlarged perspective view of a fiber channel and alignment protrusion feature of **FIG. 9B**;

[0069] **FIG. 9D** is a cross-sectional side view of the fiber channel and alignment protrusion feature of **FIGS. 9B and 9C**;

[0070] **FIG. 9E** is a top view of the fiber channel and alignment protrusion feature of **FIGS. 9B-9D**;

[0071] **FIG. 10A** is a front perspective view of a fiber mount of the bottom clamshell of the first fiber optic connector of **FIGS. 2A-2C, 4,** and **6A-8F**, wherein the emission end of the second tracing optical fiber is secured on the fiber mount;

[0072] **FIG. 10B** is a rear perspective view of the emission end of the second tracing optical fiber secured on the fiber mount of the first fiber optic connector of **FIG. 10A**;

[0073] **FIG. 10C** is a front perspective view of the fiber mount of the first fiber optic connector of **FIG. 10A**;

[0074] **FIG. 10D** is a cross-sectional side view of the housing body of the first fiber optic connector of **FIG. 10A**;

[0075] **FIG. 10E** is a schematic back view of the first fiber optic connector of **FIG. 10A** illustrating emission of an optical tracing signal from the first fiber optic connector housing using an internal total internal reflection (TIR) surface;

[0076] **FIG. 10G** is a schematic side view of the first fiber optic connector of **FIG. 10E**;

[0077] **FIG. 10F** is a schematic back view of the first fiber optic connector of **FIG. 10A** illustrating emission of the optical tracing signal from the first fiber optic connector housing using an internal TIR structure and an external TIR structure;

[0078] **FIG. 10H** is a schematic side view of the first fiber optic connector of **FIG. 10F**;

[0079] **FIG. 10I** is a flowchart illustrating an exemplary process of using the light launch device of **FIGS. 2A-2C, 4-5L,** and **8A-8F** to trace a fiber optic connector of a traceable fiber optic cable assembly;

[0080] **FIG. 11A** is a perspective view of the first fiber optic connector of **FIGS. 2A-2C, 4, 6A-8F,** and **10A-10I** beginning the polarity reversal procedure by having the boot rotated so that the trigger mechanism may be removed;

[0081] **FIG. 11B** is a perspective view of the first fiber optic connector of **FIG. 11A** illustrating the polarity reversal procedure after one of the fiber optic connectors is fully rotated during the polarity reversal procedure; and

[0082] **FIG. 11C** is a perspective view of the first fiber optic connector of **FIG. 11A** after the polarity reversal is completed.

DETAILED DESCRIPTION

[0083] Embodiments of the disclosure are directed to a traceable fiber optic cable assembly with tracing optical fibers for carrying light received from a light launch device. In an exemplary embodiment, the traceable fiber optic cable assembly comprises a traceable fiber optic cable connectorized by a first fiber optic connector and a second fiber optic connector each disposed at end portions of the fiber optic cable. The traceable fiber optic cable comprises at least one data transmission fiber (e.g., transmit and receive optical data fibers) for data communication of an optical data signal therethrough. The traceable fiber optic cable also includes a tracing optical fiber comprising a launch end and a first emission end. The tracing optical fiber is configured to receive an optical tracing signal (e.g., light) from a launch light source and carry the received optical tracing signal from the first launch end to the first emission end for tracing the traceable fiber optic cable. For example, if the first launch end of the tracing optical fiber if located at the first fiber optic connector and the first emission end of the tracing optical fiber is located at the second fiber optic connector, optical tracing signal launched into the first launch end and emitted to the first emission end of the tracing optical fiber may illuminate a portion of the second fiber optic connector to be human perceptible to allow a person to trace the second fiber optic connector of the traceable fiber optic cable. To facilitate the launching of an optical tracing signal into the tracing optical fiber, in examples disclosed herein, the first fiber optic connector contains a registration feature (e.g., connector fiber guide) that is configured to toollessly interface with a removable launch connector when it is desired to launch an optical tracing signal from the launch light source to the launch end of the tracing optical fiber. The launch connector is configured to toollessly engage to the first fiber optic connector to direct the optical tracing signal emitted by the launch light source through the launch connector and to the launch end of the tracing optical fiber at the first fiber optic connector when tracing is desired. The launch connector can be removed from the first fiber optic connector after tracing is completed. In other examples, the traceable fiber optic cable may also include a second tracing optical fiber comprising a second launch end at the second fiber optic connector and a second emission end at the first fiber optic connector to allow interfacing of a launch connector for tracing the first fiber optic connector of the traceable fiber optic connector.

[0084] To facilitate the ability to launch an optical tracing signal in the tracing optical fibers disposed at the first and/or second fiber optic connectors of the traceable fiber optic cable assembly, the first and/or second fiber optic connector comprise a housing defining an interior comprising a connector fiber guide. The connector fiber guide comprises a planar surface, a launch opening defined in the planar surface, and at least one alignment surface proximate the first planar surface. The launch end of the first and/or second tracing optical fibers are positioned in the housing of the first and/or second fiber optic connectors, respectively. The emission end of the first and second tracing optical fibers are positioned in the housings of the second and/or first fiber optic connectors, respectively. The planar surface provides cleaving access to the launch end of the tracing optical fiber. The at least one alignment surface is configured to axially align the launch optical fiber of the launch connector with the launch end of the tracing optical fiber when the launch connector is engaged to a first or second fiber optic connector. The first and/or second fiber optic connector further comprises a translucent internal illumination structure positioned within the interior of the housing and a translucent external illumination structure positioned within the exterior of the housing. The translucent internal and external illumination structures are configured to redirect and/or disperse at least a portion of an optical tracing signal when emitted from the emission end of the tracing optical fiber (e.g., by total internal reflection).

[0085] Accordingly, the traceable fiber optic cable assembly facilitates the easy tracing of the traceable fiber optic cable assembly using fiber optic tracing signals. Further, the launch connector is easily engaged to and removed from the fiber optic connector with repeatable and reliable alignment of optic fibers, even when the fiber optic connector is mechanically and/or electronically engaged with a fiber optic component. The traceable fiber optic cable assembly connectors are configured to efficiently illuminate an exterior of the connector for effective visibility for a user to quickly locate the traceable fiber optic cable assembly connector.

[0086] Reference is now made in detail to exemplary embodiments of the disclosure, examples of which are illustrated in the accompanying drawings. Whenever possible, the same or similar reference numerals are used throughout the drawings to refer to the same or similar parts. It should be understood that the embodiments disclosed herein are merely examples, each incorporating certain benefits of the present disclosure. Various modifications and alterations may be made to the following examples within the scope of the present invention, and aspects of the different examples may be mixed in different ways to achieve yet further examples. Accordingly, the true scope of the invention is to be understood from the entirety of the present disclosure, in view of but not limited to the embodiments described herein.

[0087] The optical tracing signal, as used herein, includes light directed from a first end of an optical fiber to a second end of the optical fiber. The optical tracing signal is used as a visual indicator to alert a user to the location of a portion of the cable assembly. The optical tracing signal may pulse, fluctuate, or otherwise vary in some embodiments, may also include data in some embodiments, and may not include data in other embodiments.

[0088] **FIGS. 2A-2C** are views of an exemplary cable tracing system **200** that can be used to trace a fiber optic cable assembly **202**. The cable tracing system **200** facilitates the easy tracing of ends of a traceable fiber optic cable (e.g., fiber optic cable **206**) using fiber optic tracing signals. **FIG. 2A** is a perspective view of the exemplary cable tracing system **200**, such as for use with the patch cords **100** of **FIGS. 1A-1B**. The cable tracing system **200** comprises a traceable fiber optic cable assembly **202** and a light launch device **204**. As will be discussed by example in more detail below, the cable tracing system **200** allows a user to selectively attach the light launch device **204** to a part of the traceable fiber optic cable assembly **202** and use the light launch device **204** to inject one or more optical tracing signals (e.g., fiber optic tracing signal, a first optical tracing signal, second optical tracing signal, etc.) into the traceable fiber optic cable assembly **202**. This allows the user to trace the location of part or all of the traceable fiber optic cable assembly **202** based on the propagation of the optical tracing signals into the traceable fiber optic cable assembly **202**.

[0089] As discussed below in more detail, the traceable fiber optic cable assembly **202** and/or light launch device **204** includes one or more alignment features for quickly aligning optical fibers within the traceable fiber optic cable assembly **202** and the light launch device **204**. Further, the traceable fiber optic cable assembly **202** comprises one or more illumination components (e.g., illumination structures) to efficiently and effectively translate and disperse light for easily locating one or more portions of the traceable fiber optic cable assembly **202**. In this manner, the traceable fiber optic cable assembly **202** and light launch device **204** provide easy tracing of the traceable fiber optic cable assembly **202** using fiber optic tracing signals. Further, the light launch device **204** is easily attached to and removed from the traceable fiber optic cable assembly **202** with repeatable and reliable alignment of optical fibers (even when both ends of the traceable fiber optic cable assembly **202** are plugged in), and without the need for tools to interface the light launch device **204** with the fiber optic cable assembly **202**. The cable tracing system **200** is configured to efficiently illuminate a portion of the traceable fiber optic cable assembly **202** for effective visibility for a user to quickly locate one or more portions of the traceable fiber optic cable assembly **202**.

[0090] With reference to **FIGS. 2A-2C**, the traceable fiber optic cable assembly **202** comprises a fiber optic cable **206**, a first fiber optic connector **208A** (e.g., traceable fiber optic cable first connector, traceable fiber optic cable assembly first connector, etc.) at a first end of the fiber optic cable **206**, and a second fiber optic connector **208B** (e.g., traceable fiber optic cable second connector, traceable fiber optic cable assembly second connector, etc.) at a second end of the fiber optic cable **206**. The first fiber optic connector **208A** and the second fiber optic connector **208B** are present on opposite ends (e.g., first end **209A**, and second end **209B**) of the fiber optic cable **206** to allow the traceable fiber optic cable assembly **202** to act as a patch cord between components of a network. In use, the fiber optic cable **206** may extend between two locations, such as two equipment racks in a data center, telecommunications room, or the like. Further, in some embodiments, the fiber optic cable

206 may have a length between about zero meters and about 30 meters, and in some embodiments, the fiber optic cable **206** may have a length between about 1 meter and about 5 meters. In other embodiments, the fiber optic cable **206** may have a length of more than 30 meters.

[0091] The first and second fiber optic connectors **208A, 208B** are merely an example. Thus, although **FIGS. 2A-2C** (among other figures herein) illustrate the first and second fiber optic connectors **208A, 208B** as an LC duplex connector, the features described below may be applicable to different connector configurations and different connector sub-assembly designs. This includes simplex configurations of LC connector sub-assemblies, and both simplex and duplex configurations of different (i.e., non-LC) connector sub-assembly designs.

[0092] The first fiber optic connector **208A** and the second fiber optic connector **208B** each comprise a distal end **210A** and a proximal end **210B**. More specifically, the proximal end **210B** of the first fiber optic connector **208A** and the second fiber optic connector **208B** is towards a center of the fiber optic cable **206**. In other words, the distance between the proximal ends **210B** of the first and second fiber optic connectors **208A**, **208B** is less than the distance between the distal ends **210A** of the first and second fiber optic connectors **208A, 208B**.

[0093] Further, the first and second fiber optic connectors **208A, 208B** each comprise an illumination component **212** (e.g., illumination component that may include one or more total internal reflection (TIR) structures, etc.). The illumination component **212** directs (e.g., propagates) the light emitted from the fiber so that the fiber optic connector **208A, 208B** is easily visible to workers in a data center environment. For example, in some embodiments, the first illumination component **212** of the second fiber optic connector **208B** illuminates after receiving a first fiber optic tracing signal from the first fiber optic connector **208A** to communicate the location of the second fiber optic connector **208B**, and/or the second illumination component **212** of the first fiber optic connector **208A** illuminates after receiving a second fiber optic tracing signal from the second fiber optic connector **208B** to communicate the location of the first fiber optic connector **208A**. In particular, in some embodiments, the first and second fiber optic tracing signals are transmitted consecutively and/or not simultaneously (e.g., not concurrently). In this way, one or more tracing optical fibers within the fiber optic cable **206** provide for traceablility of the fiber optic cable **206** from one or both of the ends **209A, 209B** of the fiber optic cable **206**. As explained below, the cable tracing system **200** (e.g., traceable fiber optic cable assembly **202**) provides the ability to trace a fiber optic cable **206** without disconnecting the fiber optic cable **206** from corresponding receptacles.

[0094] In one embodiment, the traceable fiber optic cable assembly **202** comprises an end point only (EPO) configuration. In an EPO configuration, a far end of the traceable fiber optic cable assembly **202** (e.g., second fiber optic connector **208B**) illuminates (e.g., lights up) when a near end of the traceable fiber optic cable assembly **202** (e.g., a first fiber optic connector **208A**) is activated (e.g., receives an optical tracing signal). However, in another embodiment, the traceable fiber optic cable assembly **202** comprises an along the length (ATL) configuration. In an ATL configuration, at least a portion of the fiber optic cable **206** is illuminated (in some embodiments, the first fiber optic connector **208A** and/or the second fiber optic connector **208B** may also be illuminated). The description below is with respect to an EPO configuration, however, the teachings are also applicable to an ATL configuration.

[0095] The light launch device **204** comprises a launch module **214**, a launch connector **216**, and a launch cable **218** therebetween. The launch module **214** generates the fiber optic tracing signal for direction through the traceable fiber optic cable assembly **202**. The launch connector **216** is selectively attachable to and removable from the first fiber optic connector **208A** and/or second fiber optic connector **208B**. The launch cable **218** directs (e.g., propagates) the fiber optic tracing signal from the launch module **214** to the first fiber optic connector **208A** or the second fiber optic connector **208B**. In this way, one or more launch optical fibers within the launch cable **218** provide for injection of the fiber optic tracing signal into the fiber optic cable **206** for traceablility of the fiber optic cable **206** from one or both the ends **209A, 209B** of the fiber optic cable **206**. The launch connector **216** comprises a distal end **220A** and a proximal end **220B**.

[0096] **FIG. 2B** is a perspective view of the cable tracing system **200** of **FIG. 2A** illustrating the launch connector **216** of the light launch device **204** disengaged from the first fiber optic connector **208A** in a disengaged position (e.g., disconnected position, detached position, etc.). **FIG. 2C** is a perspective view of the cable tracing system **200** of **FIG. 2A** illustrating the launch connector **216** of the light launch device **204** engaged with the first fiber optic connector **208A** in an engaged position (e.g., connected position, attached position, etc.).

[0097] Referring specifically to **FIG. 2B** and as explained below in more detail, to facilitate the launching of an optical tracing signal into the fiber optic cable **206** (e.g., having one or more optical tracing fibers), in examples disclosed herein, the first and/or second fiber optic connectors **208A, 208B** contain a registration feature **222** (e.g., first and second connector fiber guides) that is configured to interface with a removable launch connector **216** of the light launch device **204** when it is desired to launch an optical tracing signal from the light launch device **204** to the launch cable **218**. In particular, the launch connector **216** is configured to engage to the first fiber optic connector **208A** to direct the optical tracing signal emitted from the light launch device **204** through the launch connector **216** and to the fiber optic cable **206** at the first fiber optic connector **208A** when tracing is desired. The launch connector **216** can be removed from the first fiber optic connector **208A** after tracing is completed. More specifically, for example, an optical tracing fiber of the fiber optic cable **206** comprises a first end face (which may be polished) positioned within the registration feature **222** of the first fiber optic connector **208A** and exposed to the environment. An optical launch fiber of the launch cable **218** comprises a first end face (which may be polished) positioned within a registration feature **224** (e.g., first and second launch fiber guides) of the launch connector **216**. The registration feature **222** (e.g., v-groove, shape and configuration of surfaces of the registration feature **222**) and registration feature **224** are configured to easily and effectively mechanically engage the first fiber optic connector **208A** and align the first end face of the optical tracing fiber of the fiber optic cable **206** with the first end face of the optical launch fiber of the launch cable **218** to establish optical connection therebetween when the launch connector **216** is engaged to the first fiber optic connector **208A**. In this way, the light launch device **204** transmits an optical tracing signal from the light launch device **204** into the first fiber optic connector **208A** to illuminate the second fiber optic connector **208B** to trace ends of the fiber optic cable assembly **202**. In some embodiments, the registration feature **222** comprises cleaving access (e.g., a planar surface) to form a launch end for a launch fiber of the fiber optic cable **206** positioned in the registration feature **222**, as will be described in more detail below.

[0098] A user operates the launch connector **216** to selectively engage (e.g., connect, attach, etc.) the launch connector **216** with the first fiber optic connector **208A** (or the second fiber optic connector **208B**). The launch connector **216** can be attached or removed even when the first fiber optic connector **208A** and/or second fiber optic connector **208B** is engaged with another fiber optic component (e.g., patch panel, first fiber optic component, second fiber optic component, etc.), or any other network component. For example, the launch connector **216** may vertically or axially (e.g., from a proximal end **210B** of the first or second fiber optic connector **208A, 208B**) engage the first or second fiber optic connector **208A, 208B**.

[0099] The launch connector **216** and the first fiber optic connector **208A** (or second fiber optic connector **208B**) mechanically interact with one another to align their respective optical fibers (discussed in more detail below) to direct an optical tracing signal therebetween. In particular, once engaged, the user operates the light launch device **204** to inject an optical tracing signal into the first fiber optic connector **208A** (or second fiber optic connector **208B**) to illuminate the second fiber optic connector **208B** (or first fiber optic connector **208A**) through the fiber optic cable **206**.

[00100] In this way, a user can quickly and easily locate the ends **209A, 209B** of the traceable fiber optic cable assembly **202** (e.g., the first fiber optic connector **208A** and the second fiber optic connector **208B**), which streamlines and simplifies the process of tracing or otherwise identifying a fiber optic cable **206** in a congested environment. As a result, the technician can reliably identify the fiber optic cable **206** in question (which may be a telecommunication patch cord) from amongst many other cables (which may also be telecommunication patch cords). The cable tracing system **200** may also have the advantage of being an optically-activated cable tracing system using only passive tracing elements associated with the fiber optic cable **206** (although active tracing elements may still be provided in addition to the passive tracing elements, if desired).

[00101] Once completed, a user can then operate the launch connector **216** to selectively disengage the launch connector **216** from the first fiber optic connector **208A** (or the second fiber optic connector **208B**).

[00102] **FIGS. 3A-3C** are schematic diagrams of another embodiment of the exemplary cable tracing system in **FIGS. 2A-2C** providing a general overview of the cable tracing system **300** and how the cable tracing system **300** selectively sends signals to illuminate ends of a cable, thereby allowing a user to trace the ends of a cable. More specifically, **FIG. 3A** is a schematic diagram of another embodiment of an exemplary cable tracing system **300** of **FIG. 2A**. The cable tracing system **300** comprises a traceable cable assembly **302** and a light launch device **304** (as similarly described above with **FIGS. 2A-2C**). As shown, the traceable cable assembly **302** comprises a first connector **308A** and a second connector **308B**, and a fiber optic cable **306** therebetween. In some embodiments, the fiber optic cable **306** may be more appropriately referred to as a conduit, without having any data transmission elements. It should be noted that other environments could use this tracing concept like other fiber optic deployment applications, electrical interconnects, and potentially liquid or gas conduits, etc. For example, the fiber optic cable **306** may direct fluids such as air or liquid and may be appropriate for use in a medical setting such as IV lines or oxygen tubing.

[00103] Any suitable type of connector could be used with the cable tracing system **300**. The first connector **308A** and the second connector **308B** may vary widely depending on the nature of the cable and the components being connected. The specific type of connectors should match the port configuration of the network component and will vary based upon the quantity and type of signals being directed by the cable. The first connector **308A** includes a first illumination component **310A**, and the second connector **308B** includes a second illumination component **310B** (as similarly described above with **FIGS. 2A-2C** and described in more detail below). The fiber optic cable **306** may have a different design or configuration depending on the types of connectors used.

[00104] The traceable cable assembly **302** further comprises a data transmission element **312** (e.g., optical data fiber), as well as a first tracing element **314A** (e.g., first tracing optical fiber) and/or second tracing element **314B** (e.g., second tracing optical fiber) extending between the first connector **308A** and the second connector **308B**. The data transmission element **312** extends between the first connector **308A** and the second connector **308B** to carry transmission of one or more data signals (e.g., optical data signals) therebetween. Generally, the data transmission element **312** is a structure capable of carrying a data signal from one end of the fiber optic cable 3**06** (or any other type of cable) to the other. The data transmission element **312** may be configured to direct an electrical signal, for example, using a copper wire or other electrically conductive material. Alternatively, or in addition, the data transmission element **312** may be configured to direct an optical signal by conducting electromagnetic waves such as ultraviolet, infrared, or visible light to carry data from one location to another. The data transmission element **312** could comprise one or more data transmission elements, which may be of the same type or different types as compared to one another.

[00105] The first tracing element **314A** and the second tracing element **314B** are used to allow for accurate identification of ends of the traceable cable assembly **302**. In particular, the first tracing element **314A** comprises a first launch end **316A** and a first emission end **318A**. The first launch end **316A** is positioned within the first connector **308A** and the first emission end **318A** is positioned within or external to the second connector **308B** and is in communication with the second illumination component **310B**. The second tracing element

314B comprises a second launch end **316B** positioned within the second connector **308B** and a second emission end **318B** positioned within or external to the first connector **308A** and in communication with the first illumination component **310A**. It is noted that although two tracing elements are shown, in certain embodiments, only one tracing element may be used. In some embodiments, the operator can visually identify the first tracing element **314A** and/or the second tracing element **314B** with or without special equipment, such as an IR camera. In some embodiments, discussed below, the first tracing element **314A** and the second tracing element **314B** are in the form of tracing optical fibers configured to direct and emit tracer light for visualization purposes.

[00106] As explained below, the light launch device **304** comprises a launch fiber **320** to insert a tracing signal into one or both of the first tracing fiber **314A** and the second tracing fiber **314B**. The first and second launch ends **316A, 316B** may be flat cleaved, flat polished or otherwise prepared to efficiently receive the light from the light launch device **304** and may be positioned flush with the connector wall, slightly inside the first and second connectors **308A, 308B** or slightly outside the first and second connectors **308A, 308B**. Further, one or more illumination components are positioned at the tracing optical fiber emission ends **318A, 318B** which provide optical directing and/or optical scattering features to illuminate the first and second connectors **308A, 308B** to be easily found by operators.

[00107] **FIG. 3B** is an exemplary schematic diagram illustrating the cable tracing system **300** of **FIG. 2A**. As shown, the first connector **308A** is mechanically engaged with and in communication with a first network component **322A**, and the second connector **308B** is mechanically engaged with and in communication with a second network component **322B**. Additionally, the launch fiber **320** of the light launch device **304** is in communication with the first launch end **316A** of the first tracing element **314A**. The light launch device **304** emits an optical tracing signal (e.g., first optical tracing signal) through the first launch end **316A** through the first tracing element **314A** and exits through the first emission end **318A** in the second illumination component **310B** thereby illuminating the second illumination component **310B**. In this way, a user can connect the light launch device **304** to the first connector **308A** to locate the second connector **308B** by illumination thereof.

[00108] **FIG. 3C** is another exemplary schematic diagram illustrating the cable tracing system **300** of **FIG. 2A**. Here, the first connector **308A** is not mechanically engaged or in communication with a network component, but the second connector **308B** is mechanically engaged and in communication with the second network component **322B**. In this configuration, the launch fiber **320** of the light launch device **304** is in communication with the second launch end **316B** of the second tracing element **314B**. The light launch device **304** emits a second tracing signal through the second launch end **316B** through the second tracing element **314B** and exits through the second emission end **318B** in the first illumination component **310A** thereby illuminating the first illumination component **310A**. In this way, a user can connect the light launch device **304** to the second connector **308B** to locate the first connector **308A** by illumination thereof, regardless of whether the first connector **308A** and the second connector **308B** are connected to a first network component **322A** or a second network component **322B** (e.g., when the second connector **308B** is connected to a second network component **322B**, and the first connector **308A** is not connected to a first network component **322A**).

[00109] Now that a general overview of the cable tracing system **300** has been provided, a more detailed discussion of the cable tracing system **200** (using optical tracing signals and/or optical data signals) will be discussed.

[00110] To explain tracing of the fiber optic cable **206** and flow of the optical tracing signal, **FIG. 4** is provided. **FIG. 4** is a more detailed schematic diagram illustrating an exemplary embodiment of the cable tracing system **200** of **FIGS. 2A-2C**. As shown, the cable tracing system **200** comprises the traceable fiber optic cable assembly **202** and the light launch device **204**. The traceable fiber optic cable assembly **202** comprises the fiber optic cable **206**, the first fiber optic connector **208A**, and the second fiber optic connector **208B**. The fiber optic cable **206** comprises a first data transmission fiber **400A** (e.g., first data optical fiber, first data transmission element) and a second data transmission fiber **400B** (e.g., second data optical fiber, first data transmission element). The first data transmission fiber **400A** comprises a first end **402A** and a second end **404A**, and the second data transmission fiber **400B** comprises a first end **402B** and a second end **404B**. The first data transmission fiber **400A** and the second data transmission fiber **400B** carry optical data signals from the first fiber optic connector **208A** to (and through) the second fiber optic connector **208B**, and/or vice versa. Any number of data transmission fibers could be used, such as depending on networking requirements, data transmission requirements, etc.

[00111] Further, the fiber optic cable **206** comprises a first tracing optical fiber **406A** and a second tracing optical fiber **406B** for direction of a fiber optic tracing signal therethrough, thereby facilitating a user in tracing the ends of the fiber optic cable **206**. As noted above, one example of tracing elements is tracing optical fibers **406A**, **406B**. In particular, the first tracing optical fiber **406A** extends along the length of the fiber optic cable **206**, and the second tracing optical fiber **406B** extends along the length of the fiber optic cable **206** in the opposite direction. The first tracing optical fiber **406A** comprises a first launch end **408A** and a first emission end **410A**, and the second tracing optical fiber **406B** comprises a second launch end **408B** and a second emission end **410B**. The first launch end **408A** of the first tracing optical fiber **406A** and the second emission end **410B** of the second tracing optical fiber **406B** are positioned within the first fiber optic connector **208A**, and the first emission end **410A** of the first tracing optical fiber **406A** and the second launch end **408B** of the second tracing optical fiber **406B** are positioned within the second fiber optic connector **208B**.

[00112] Each of the first and second launch ends **408A**, **408B** comprise a bend (at or proximate thereto), and each of the first and second emission ends **410A**, **410B** are generally straight (at or proximate thereto). The bend of the first and second launch ends **408A, 408B** allow injection of an optical tracing signal into one or more sides of the first and/or second fiber optic connectors **208A, 208B**. The straight first and second emission ends **410A, 410B** allow emission of an optical tracing signal into a center of the first and/or second fiber optic connectors **208A, 208B**, and in particular, into an internal illumination structure at a center of the first and/or second fiber optic connectors **208A, 208B** (described in more detail below). In some embodiments, the emission ends of the tracing optical fibers may also be bent. For example, in some embodiments, the emission ends include a bend of between 0 and 90 degrees. The first and second launch ends **408A**, **408B** are configured to receive light from the light launch device **204** while the emission ends **410A**, **410B** are configured to emit light. The bends at or near the first and second launch ends **408A**, **408B** may be about 90 degrees (or any other angle) to allow for convenient injection of light into the first and second tracing optical fibers **406A, 406B**.

[00113] Note that in certain embodiments the fiber optic cable **206** only uses one of the first tracing optical fiber **406A** and the second tracing optical fiber **406B**. As discussed above, the first tracing optical fiber **406A** and the second tracing optical fiber **406B** enable an operator to identify the fiber optic cable **206** (e.g., ends thereof) by injecting light into ends of the fiber optic cable **206** using a light launch device **204**.

[00114] The fiber optic cable **206** further comprises a jacket **412** (e.g., hollow tube forming a conduit) substantially surrounding at least a portion of the first data transmission fiber **400A**, the second data transmission fiber **400B**, the first tracing optical fiber **406A**, and the second tracing optical fiber **406B** for protection thereof. Alternatively, the first and second data transmission fibers **400A, 400B** and/or the first and second tracing optical fibers **406A, 406B** may be only partially embedded within the jacket **412** and/or mounted to an outer surface of the jacket **412**, or otherwise attached to the jacket **412**. The first data transmission fiber **400A** and/or the second data transmission fiber **400B** may have a core and/or cladding. Further, there may be strength members (e.g., aramid yarns) or other elements located within the fiber optic cable **206** between the first and second data transmission fibers **400A**, **400B** and the jacket **412**.

[00115] With continuing reference to **FIG. 4**, the light launch device **204** is used to inject an optical tracing signal into one of the first or second fiber optic connectors **208A, 208B** for transmission of the optical tracing signal to emit from an opposite end of the fiber optic cable **206** for a user to quickly and easily trace the ends **209A, 209B** of the fiber optic cable **206**. The light launch device **204** comprises the launch module **214**, the launch connector **216**, and the launch cable **218** therebetween. As shown, the launch connector **216** is attached to the first fiber optic connector **208A**. The launch module **214** comprises a housing **414**, and may have a number of elements stored in the housing **414**. The launch module **214** further comprises a light source **416** (e.g., laser source), an electrical power source **418** (e.g., batteries), control circuitry **420** respectively connected to other components of the light launch device **204** (e.g., to control the light source **416** and power usage), a receiver **422** or other wireless communication components (e.g., to receive commands from an external controller), a speaker **424** (to allow for the generation of audible signals), a switch **426** (e.g., an on-off switch), and/or one or more user interface features. One or more of these could be included in (e.g., inside), on, and/or outside the housing **414** of the light launch device **204**. For example, in some embodiments the light source **416** (e.g., a red or green laser) is located at the launch connector **216** rather than in the housing **414**. In certain embodiments, the housing **414** may be approximately the size of a standard flashlight or much smaller or larger depending on the application. The housing **414** should be sufficiently durable to protect the components contained within the housing **414** (e.g., in the event of a drop onto a hard surface).

[00116] In one embodiment, the light source **416** may emit a wavelength that is chosen to enhance visibility, such as a wavelength as near to 555 nm as possible. In some embodiments, the light source **416** is a 520-540 nm green laser diode, LED (light emitting diode) or super-luminescent diode (SLD). Alternatively, other colors/wavelengths may be emitted, such as red light from approximately 620-650 nm. In other embodiments, non-laser light sources may be used, such as LEDs. Several factors may be considered when selecting an appropriate light source **416**, and the factors may include, but are not limited to, visibility, cost, eye safety, peak power, power consumption, size, and commercial availability. While the light source **416** is shown as part of the housing **414**, in other embodiments the light source **416** may be part of the launch connector **216** or may be located elsewhere on the light launch device **204**, such as on the launch cable **218**. In some embodiments, the power of the light source **416** is as high as can be used safely according to industry safety standards, such as a green laser up to 40 mW coupled to a multimode delivery waveguide fiber with core diameter of about 50 microns or more and a numerical aperture about 0.2 or more.

[00117] The launch cable **218** (e.g., delivery waveguide, umbilical, etc.) may comprise a first launch fiber **428A** (e.g., first launch optical fiber) and a second launch fiber **428B** (e.g., second launch optical fiber). In one embodiment, each first and second launch fiber **428A, 428B** direct green, 520 nm semiconductor lasers and are a high numerical aperture, wide mode field, multimode fiber. The fibers could be 0.5 NA, 125 micron core delivery fibers that have a low index of refraction polymer cladding layer directly outside of the core glass.

[00118] The first launch fiber **428A** comprises a first launch end **430A** and a second emission end **432A**, and the second launch fiber **428B** comprises a second launch end **430B** and a second emission end **432B**. The first and second launch ends **430A, 430B** are optically connected with the light source **416**. In this way, the launch cable **218** provides a path for directing light and/or electrical power to one or more of the first and second emission ends **432A, 432B**. The launch cable **218** may be several meters in length, for example, so that the housing **414** of the light launch device **204** can be placed on the ground while the launch connector **216** is at least indirectly coupled with the traceable fiber optic cable assembly **202** several meters away. The launch connector **216** may be mounted to, or otherwise provided at or near the first launch end **408A** of the first tracing optical fiber **406A** or the second launch end **408B** of the second tracing optical fiber **406B**. The launch connector **216** may help provide a high efficiency launch of light into the first tracing optical fiber **406A** and/or the second tracing optical fiber **406B**.

[00119] In particular, as shown, the launch connector **216** is attached to the first fiber optic connector **208A**, and the first emission end **432A** of the first launch fiber **428A** of the launch cable **218** is aligned with the first launch end **408A** of the first tracing optical fiber **406A**. In this way, a first optical tracing signal is generated by the light source **416**, and directed through the first and second launch fibers **428A, 428B**. The first optical tracing signal then exits the first emission end **432A** of the first launch fiber **428A** and enters the first launch end **408A** of the first tracing optical fiber **406A** positioned in the first fiber optic connector **208A**. The first optical tracing signal then travels through the first tracing optical fiber **406A** until it exits the first emission end **410A** of the first tracing optical fiber **406A** positioned in the second fiber optic connector **208B**. Accordingly, a user can use the light launch device **204** to locate a second end **209B** of the fiber optic cable **206** after attaching the light launch device **204** to a first end **209A** of the fiber optic cable **206**.

[00120] The allowed mechanical tolerances for the first and second launch fibers **428A, 428B** to the first and second tracing optical fibers **406A, 406B** (e.g., tracing fiber) may be less than about +/- 100 microns, and preferably less than about +/- 50 microns, although broader tolerances are also useable in some embodiments. For example, the first and second launch fibers **428A, 428B** and first and second the tracing optical fibers **406A, 406B** could be selected to enable a larger tolerance. In some embodiments, the first and second launch fibers **428A, 428B** have a significantly narrower core diameter and mode field diameter (MFD) than the first and second tracing optical fibers **406A, 406B**. In some embodiments, the first and second tracing optical fibers **406A, 406B** will be a 240 micron diameter core 0.5 numerical aperture (NA) plastic optical fiber (POF). In such embodiments, there is 100% spatial overlap of the first and second launch fibers **428A, 428B** to the first and second tracing optical fibers **406A, 406B** for any lateral offset below 57.5 microns. The NA of the two fibers are the same so very little light will be lost from typical angular misalignments of a few degrees. In some embodiments, launch fibers **428A, 428B** are used with smaller MFDs than 125 microns and lower NAs if the tolerance stack up requires it (e.g., Corning VSDN fiber with an 80 micron MFD and a 0.29 NA).

[00121] **FIGS. 5A-5K** are views of the launch connector **216** of the light launch device **204** of **FIGS. 2A-2C**. The launch connector **216** engages one of the first or second fiber optic connectors **208A, 208B** (without any need for removal of the first or second fiber optic connectors **208A, 208B** from a network component) to facilitate alignment and injection of an optical tracing signal into (e.g., optical communication between, optical connection between) the first or second launch ends **430A, 430B** of first or second launch fibers **428A, 428B** of the fiber optic cable **206** to trace the ends **209A, 209B** of the fiber optic cable **206**. In particular, **FIGS. 5A-5D** provide an overview of the launch connector **216** where **FIG. 5A** is a rear top perspective view, **FIG. 5B** is a front bottom perspective view, **FIG. 5C** is a bottom view, and **FIG. 5D** is an exploded perspective view. The launch connector **216** comprises a housing **500,** a clip **502** secured to the housing **500** and pivotable therein to engage one of the first and second fiber optic connectors **208A, 208B**. The launch connector **216** also includes a first tension relief member **504A** and a second tension relief member **504B** at a proximal end **220B** of the housing **500** to relieve strain on the first and second launch fibers **428A, 428B** entering the housing **500**. In particular, the housing **500** comprises a front body **506** and a rear body **508** with the clip **502** positioned and secured therebetween. The housing **500** (e.g., front body **506** and rear body **508**) defines a central channel **510** (with an open bottom) to receive at least a portion of the first fiber optic connector **208A** or the second fiber optic connector **208B** therein. Parts of the clip **502** pivot to secure (e.g., engage, attach, etc.) the launch connector **216** to the first fiber optic connector **208A** or the second fiber optic connector **208B**.

[00122] Also as shown, the launch cable **218** comprises the first and second launch fibers **428A**, **428B**, with a first jacket **512A** surrounding the first launch fiber **428A**, and the second jacket **512B** surrounding the second launch fiber **428B** to protect the first and second launch fibers **428A, 428B**. Referring specifically to **FIG. 5D** the first launch fiber **428A** comprises an extended portion **514A** that extends past an end of the first jacket **512A**, and the second launch fiber **428B** comprises an extended portion **514B** that extends past an end of the second jacket **512B**. These extended portions **514A, 514B** are retained within the housing **500** and include the first and second emission ends **432A**, **432B** for directing optical tracing signals to the first fiber optic connector **208A** or second fiber optic connector **208B** (explained below in more detail).

[00123] **FIGS. 5E-5F** are views of the front body **506**. In some embodiments, the front body **506** provides for gross alignment (e.g., rough alignment, approximate alignment, etc.) of the first or second emission ends **432A**, **432B** of the first or second launch fibers **428A, 428B** with the first or second launch ends **408A, 408B** of the first or second tracing optical fiber **406A, 406B**. The front body **506** comprise a top panel **516**, a left sidewall **518A** extending from a left side of the top panel **516**, a right sidewall **518B** extending from a right side of the top panel **516**, a left rail **520A** (attached to a bottom of the left sidewall **518A** and at a left side of the top panel **516**), and a right rail **520B** (attached to a bottom of the right sidewall **518B** and at a right side of the top panel **516**). A proximal end **220B** of the top panel **516** extends past the left and right sidewalls **518A, 518B**. In particular, a distal end **220A** of the left rail **520A** is attached to and extends downwardly from a distal end **220A** of the left sidewall **518A**, and a distal end **220A** of the right rail **520B** is attached to and extends downwardly from a distal end **220A** of the right sidewall **518B**. Accordingly, a left groove **522A** is defined between a bottom of the left sidewall **518A** and a top of the left rail **520A**, and a right groove **522B** is defined between a bottom of the right sidewall **518B** and a top of the right rail **520B**. The left groove **522A** and right groove **522B** configured to receive portions of the clip **502** therein (explained in more detail below). Thus the left and right grooves **522A**, **522B** extend from a proximal end **220B** of the front body **506** to a distal end of the front body **506**. As shown, the top panel **516**, left and right sidewalls **518A**, **518B**, and/or left and right rails **520A, 520B** at least partly define the central channel **510**.

[00124] The top panel **516** comprises horizontal ribs **524** in a top surface thereof at a proximal end **220B** thereof. The horizontal ribs **524** or grooves (e.g., extending from the left side to the right side) allow a user better gripping access to the top of the launch connector **216** (e.g., to slidably engage the launch connector **216** with the first fiber optic connector **208A** or the second fiber optic connector **208B**). The top panel **516** further comprises an aperture **526** (e.g., between two of the horizontal ribs **524**) at a proximal end **220B** of the front body **506** to receive a portion of the rear body **508** to secure the rear body **508** to the front body **506**. Further, the distal end of the top panel **516** defines a recess **528** to provide clearance for a locking member of the first fiber optic connector **208A** or second fiber optic connector **208B**.

[00125] The left rail **520A** comprises a left flange **530A** extending inwardly from a bottom of the left rail **520A** with a left opening **532A** at a proximal end **220B** of the left rail **520A**. The right rail **520B** comprises a right flange **530B** extending inwardly from a bottom of the right rail **520B** with a right opening **532B** at a proximal end **220B** of the right rail **520B**. In this way, the left and right rails **520A, 520B** (and the left and right openings **532A, 532B**) are configured to receive a portion of the rear body **508** to secure the rear body **508** to the front body **506**. Additionally, or alternatively, the left and right rails **520A, 520B** (e.g., left and right flanges **530A, 530B**) may also be configured to slidably engage a portion of the first or second fiber optic connectors **208A**, **208B** (e.g., to allow axial engagement and prevent vertical engagement or disengagement with the first or second fiber optic connector **208A, 208B**).

[00126] **FIGS. 5G-5H** are views of the rear body **508**. The rear body **508** comprises a top panel **534**, a left sidewall **536A** extending from a left side of the top panel **534**, a right sidewall **536B** extending from a right side of the top panel **534**, a forwardly extending left rail

538A (attached to the left sidewall **536A** at a bottom thereof and at a left side of the top panel **534**), a forwardly extending right rail **538B** (attached to the right sidewall **536B** at a bottom thereof and at a right side of the top panel **534**), a rearwardly extending left strain relief cylinder **540A** (attached to the left sidewall **536A** at a bottom thereof and at a left side of the top panel **534**), and a rearwardly extending right strain relief cylinder **540B** (attached to the right sidewall **536B** at a bottom thereof and at a right side of the top panel **534**). An underside of the top panel **534**, and left and right sidewalls **536A, 536B** form a general archway, which define the central channel **510** and are configured to receive at least a portion of the first or second fiber optic connector **208A, 208B**.

[00127] The top panel **534** assembles the front body **506** to the rear body **508**, retains the clip **502** within the housing **500**, and/or limits the motion of the clip **502**. The top panel **534** comprises a forwardly extending overhang **542** with a left tapered sidewall **544A** and a right tapered sidewall **544B** (e.g., the left and right tapered sidewalls **544A**, **544B** form an angle to one another). In other words, the overhang **542** extends past a distal end **220A** of the left and right sidewalls **536A, 536B**. The left and right tapered sidewalls **544A**, **544B** are angled to provide clearance for and/or a limit to the pivoting (e.g., bending) of the clip **502**. The top panel **534** further comprises a horizontally extending engagement nub **546** with a front tapered surface **548**. The engagement nub **546** is configured to be inserted into the front body top panel aperture **526** to attach the rear body **508** to the front body **506**. The tapered surface **548** facilitates assembly of the rear body **508** to the front body **506** as the engagement nub **546** is inserted into and engages the front body top panel aperture **526**.

[00128] The left and right rails **538A, 538B** are used to assemble the front body **506** to the rear body **508** and to retain the launch connector **216** to the first or second fiber optic connectors **208A, 208B**. The left rail **538A** comprises an inwardly extending left flange **550A**, a downwardly extending engagement nub **552A** (extending from a bottom of the left rail **538A** and/or left flange **550A**) with a front taper **554A**. The right rail **538B** comprises an inwardly extending right flange **550B**, a downwardly extending engagement nub **552B** (extending from a bottom of the right rail **538B** and/or right flange **550B**) with a front taper **554B**. The left and right rails **538A 538B** are configured to slide onto the left and right rails **520A, 520B** of the front body **506**, such that the left and right rail engagement nubs **552A, 552B** of the rear body **508** insert into and are retained within the left and right rail openings **532A, 532B** of the front body **506**. The front tapers **554A**, **554B** facilitate engagement of left and right rail engagement nubs **552A, 552B** of the rear body **508** with the left and right rail openings **532A, 532B** of the front body **506**.

[00129] The left strain relief cylinder **540A** defines a channel **556A**, and the right strain relief cylinder **540B** defines a channel **556B**. The outsides of the left and right strain relief cylinders **540A, 540B** are configured to be inserted into left and right tension relief members **504A, 504B**, respectively. The channels **556A**, **556B** are configured to receive the first and second launch fiber extended portions **514A, 514B** of the launch cable **218** therethrough, respectively, to relieve strain and prevent over bending of the first and second launch fiber extended portions **514A, 514B**.

[00130] FIGS. 5I-5K are views of the clip **502**. The clip **502** comprises a bar **558**, a left engagement arm **560A** (e.g., first engagement arm) forwardly extending from a left end of the bar **558**, a right engagement arm **560B** (e.g., second engagement arm) forwardly extending form a right end of the bar **558**, a left handle **562A** rearwardly extending from a left end of the bar **558** (and axially aligned with the left engagement arm **560A**), and a right handle **562B** rearwardly extending from a right end of the bar **558** (and axially aligned with the right engagement arm **560B**). The bar **558** flexes to allow the left and right engagement arms **560A, 560B** to pivot away from each other when the left and right handles **562A, 562B** are pushed inwardly towards each other.

[00131] The bar **558** comprises a central disc **564** with a left connection member **566A** extending to the rear and left and a right connection member **566B** extending to the rear and right. In other words, the left and right connection members **566A, 566B** extend rearwardly (toward a proximal end **220B** from the central disc **564** and at an angle from one another. This allows the bar **558** to bend and absorb the resulting strain without fracturing.

[00132] A top surface of the left and right handles **562A**, **562B** is approximately flush (e.g., level) with a top surface of the bar **558**. Comparatively, a top surface (and/or axis) of the left and right engagement arms **560A**, **560B** is offset (e.g., lower) from the top surface (and/or axis) of the bar **558** and/or left and right handles **562A**, **562B**. In this way, when assembled with the front body **506** and rear body **508**, the left and right engagement arms **560A, 560B** are positioned in the front body left and right grooves **522A, 522B**. The clip **502** is secured within the housing **500** by vertical constrainment between the front body top panel **516** and the front body left and right rails **520A, 520B** and the rear body left and right rails **538A, 538B**. The clip **502** is secured within the housing **500** by horizontal constrainment by positioning the top panel **534** of the rear body **508** and the left and right sidewalls **536A,**

536B of the rear body **508** between and at a distal end of the left and right handles **562A, 562B** of the clip **502**. The clip **502** is secured within the housing **500** by axial constrainment (e.g., forward and backward) by positioning of the bar central disc **564** of the clip **502** proximate the overhang **542** of the rear body **508** and positioning of a front of the left and right handles **562A, 562B** of the clip **502** proximate the proximal end of the left and right sidewalls **518A, 518B** of the front body **506**.

[00133] The left engagement arm **560A** comprises a left launch fiber guide **568A** (at a distal end thereof) and an underside groove **570A** (along a length thereof), and the right engagement arm **560B** comprises a right launch fiber guide **568B** (at a distal end thereof) and an underside groove **570B** (along a length thereof). The left and right launch fiber guides **568A, 568B** are configured to engage the first and second fiber optic connectors **208A, 208B**, and the underside grooves **570A, 570B** are configured to retain a portion of the first and second launch fiber extended portions **514A, 514B** of the launch cable **218**, such that first and second launch ends **430A, 430B** of the first and second launch fibers **428A, 428B** are positioned in the left and right launch fiber guides **568A, 568B**. The first and second launch fiber extended portions **514A, 514B** as held in the underside groove **570A, 570B** will keep the first and second launch fiber extended portions **514A, 514B** from bending below the minimum allowed bend radius (e.g., 2.4 mm).

[00134] The left and right launch fiber guides **568A, 568B** provide for fine alignment (e.g., precise alignment, etc.) of the first or second emission ends **432A**, **432B** of the first or second launch fibers **428A, 428B** with the first or second launch ends **408A, 408B** of the first or second tracing optical fiber **406A, 406B**.

[00135] Each of the left and right launch fiber guides **568A, 568B** comprises a front alignment surface **572A** (towards a distal end **220A**) and a rear alignment surface **572B** (towards a proximal end **220B**) with a planar surface **574** (e.g., substantially planar surface) positioned therebetween. The front and rear alignment surfaces **572A**, **572B** extend inwardly, thereby forming a triangular prism. As shown, the first emission end **432A** of the first launch fiber **428A** may be flush with the planar surface **574** of the left launch fiber guide **568A**, and retained in place by a fastening element (e.g., adhesive) in an emission opening **575** defined in the planar surface **574** by the underside groove **570A, 570B**.

[00136] The front alignment surface **572A** comprises a first gradient that varies along a first axis A-A perpendicular to a central axis B-B of the first or second emission end **432A**, **432B** of the first or second launch fibers **428A, 428B**. The rear alignment surface **572B** comprises a second gradient that varies along the first axis A-A in a direction opposite from the first gradient. In this way, for example, the left launch fiber guide **568A** aligns the first emission end **432A** of the launch fiber **428A** with the first launch end **408A** of the first tracing optical fiber **406A** in a horizontal direction.

[00137] Each of the left and right launch fiber guides **568A, 568B** comprises a top alignment surface **576A** (towards a distal end **220A** of the left and right handles **562A, 562B**, and proximate and proximal of the rear alignment surface **572B**) and a rear alignment surface **576B** (towards a distal end of the left and right handles **562A, 562B**, and proximate and proximal of the rear alignment surface **572B**). The top and bottom alignment surfaces **576A, 576B** extend between the planar surface **574** and an inside surface of the left and right handles **562A, 562B**. The top alignment surface **576A** comprises a third gradient that varies along a second axis C-C perpendicular to the first axis A-A and perpendicular to the central axis B-B of the first or second launch fiber emission end **432A, 432B**. The bottom alignment surface **576B** comprises a fourth gradient that varies along the second axis C-C in a direction opposite from the third gradient. Thus, the top and bottom alignment surfaces **576A, 576B** form a concavity. In this way, for example, the left launch fiber guide **568A** aligns the first launch fiber emission end **432A** with the first tracing optical fiber launch end **408A** in a vertical direction.

[00138] In this way, at least a portion of the first, second, third, and/or fourth alignment surfaces comprise planar and/or curved surfaces. Further, in some embodiments more or fewer alignment surfaces and/or gradients may be used. For example, in one embodiment, only the front and rear alignment surfaces **572A, 572B** are used with a planar surface **574** (e.g., substantially planar surface) positioned in between (e.g., creating a cone bifurcated by the planar surface). As explained in more detail below, the left and right launch fiber guides **568A, 568B** (e.g., the alignment surfaces **472A, 472B, 476A, 476B**) mate with corresponding surfaces on the first or second fiber optic connectors **208A, 208B** to align, for example, the first launch fiber emission end **432A** with the first tracing optical fiber launch end **408A** for efficient coupling. In this way, the left and right launch fiber guides **568A, 568B** (e.g., the first, second, third, and/or fourth alignment surfaces thereof) may form all or a portion of any of a plurality of suitable shapes. For example, the left and right launch fiber guides **568A, 568B** (e.g., the first, second, third, and/or fourth alignment surfaces thereof) may form part or all of a cone, cylinder, sphere, prism (e.g., triangular, rectangular, etc.), and/or pyramid (e.g., triangular, rectangular, etc.), or combinations thereof. In particular, the left and right launch fiber guides **568A, 568B** provide lateral alignment (e.g., horizontal and vertical alignment, such as along axes A-A and C-C), proximal alignment (e.g., along axis B-B), and angular alignment (e.g., in line with axis B-B). However, in certain embodiments, for example, misalignment tolerances of the first launch fiber emission end **432A** with the first tracing optical fiber launch end **408A** can be up to 200 microns (e.g., up to 100 microns, up to 50 microns, etc.).

[00139] Further, in certain embodiments the left engagement arm **560A** further comprises a sidewall notch **578A**, and the right engagement arm **560B** further comprises a sidewall notch **578B** to provide access to the first and second launch ends **430A**, **430B** of the first and second launch fibers **428A** after assembly of the clip **502** to the housing **500** (e.g., for polishing or otherwise finishing of the first and second launch ends **430A**, **430B** of the first and second launch fibers **428A, 428B**).

[00140] **FIG. 5L** is a flowchart illustrating an exemplary process **580** for forming (e.g., manufacturing) the launch connector of **FIGS. 2A-5L**. Step **582** comprises forming a launch connector **216** comprising a housing **500** (e.g., body) comprising the central channel **510** with an open bottom configured to receive at least a portion of a fiber optic connector **208A, 208B** of the traceable fiber optic cable assembly **202**, and the left engagement arm **560A** movably connected to the housing **500** (e.g., body) and comprising a left launch fiber guide **568A**, the left launch fiber guide **568A** comprising an emission opening **575** and at least one alignment surface (e.g., front or rear alignment surfaces **572A, 572B,** top or bottom alignment surfaces **576A, 576B**) proximate the emission opening **575**, the left engagement arm **560A** moveable from an engaged orientation to a disengaged orientation for engaging and disengaging the fiber optic connector **208A, 208B** of the traceable fiber optic cable assembly **202**. Step **584** comprises forming a launch fiber **428A** comprising a launch end **430A** and an emission end **432A**. Step **586** comprises positioning the emission end **432A** in the emission opening **575** of the left engagement arm **560A**. Step **588** comprises coupling the launch end **430A** with the light source **416** to receive the first optical tracing signal therefrom, wherein the at least one alignment surface (e.g., front or rear alignment surfaces **572A, 572B,** top or bottom alignment surfaces **576A, 576B**) is configured to axially align the emission end **432A** of the launch fiber **428A** with a launch end **408A** of a first tracing optical fiber **406A** of the traceable fiber optic cable assembly **202** for direction of the first optical tracing signal to the first tracing optical fiber **406A**.

[00141] The launch connector **216** is configured to selectively engage to and disengage from the traceable fiber optic cable assembly **202** for tracing ends **209A, 209B** of the fiber optic cable **206** be injection of an optical tracing signal into the fiber optic cable **206**. In particular, the left and right launch fiber guides **568A, 568B** are configured to interact with and mate with the left and right connector fiber guides **600A, 600B** for alignment and injection of the optical tracing signal from the launch connector **216** into the first or second fiber optic connector **208A, 208B**. In this way, the left and right launch fiber guides **568A, 568B** and the left and right connector fiber guides **600A, 600B** are not limited to any particular shape or configuration, but could be anything to register the launch fiber **428A** with the first or second tracing optical fiber **406A, 406B**.

[00142] **FIGS. 6A-6E** are views of the traceable fiber optic cable assembly **202** of **FIGS. 2A-2C** and **4**. In particular, **FIG. 6A** is a perspective view of the traceable fiber optic cable assembly **202**. As discussed above, the traceable fiber optic cable assembly **202** comprises a fiber optic cable **206**, a first fiber optic connector **208A**, and a second fiber optic connector **208B**. Each of the first and second fiber optic connectors **208A**, **208B** comprise a left connector fiber guide **600A** (e.g., first connector fiber guide) and a right connector fiber guide **600B** (e.g., second connector fiber guide).

[00143] **FIGS. 6B-6E** are views of the right connector fiber guide **600B**. Each of the left and right connector fiber guides **600A**, **600B** comprises a front alignment surface **602A** (towards a distal end **210A**) and a rear alignment surface **602B** (towards a proximal end **210B**) with a planar surface **604** (e.g. substantially planar surface) positioned therebetween. The planar surface **604** comprises a launch opening **606** approximately centered therein to receive the first or second tracing optical fibers **406A**, **406B**. As shown, the first tracing optical fiber launch end **408A** may be flush with the planar surface **604**. The front and rear alignment surfaces **602A, 602B** extend outwardly (e.g., from a left and right side or peripheral edge of the planar surface **604**), thereby forming a concavity. Further, a top and bottom edge of the planar surface **604** is unimpeded, and is not proximate any alignment surface. This provides access to cleave, for example, the first tracing optical fiber **406A** from the launch end **408A**, when the first tracing optical fiber **406A** is positioned within the left or right connector fiber guide **600B**. In some embodiments, the first and second launch ends **408A, 408B** may be cleaved before insertion (e.g., pre-cleaved) into the left and right connector fiber guides **600A, 600B**.

[00144] The front alignment surface **602A** comprises a first gradient that varies along a first axis D-D perpendicular to a central axis E-E of the first tracing optical fiber launch end **408A**. The rear alignment surface **602B** comprises a second gradient that varies along the first axis D-D in a direction opposite from the first gradient. In this way, for example, the left connector fiber guide **600A** aligns the launch end **408A** of the first tracing optical fiber **406A** with the first emission end **432A** of the first launch fiber **428A** in a horizontal direction.

[00145] Each of the connector fiber guides **600A, 600B** comprises a top alignment surface **608A** (proximate and proximal of the rear alignment surface **602B**) and a bottom alignment surface **608B** (proximate and proximal of the rear alignment surface **602B**). The top alignment surface **608A** comprises a third gradient that varies along a second axis F-F perpendicular to the first axis D-D and perpendicular to the central axis E-E of the first or second launch end **408A, 408B** of the first or second tracing optical fibers **406A, 406B**. The bottom alignment surface **608B** comprises a fourth gradient that varies along the second axis F-F in a direction opposite from the third gradient. Thus, the top and bottom alignment surfaces **608A, 608B** extend outwardly forming a raised curved protrusion. In this way, for example, the left connector fiber guide **600A** aligns the first launch end **408A** of the first tracing optical fiber **406A** with the first launch fiber emission end **432A** in a vertical direction.

[00146] In this way, at least a portion of the first, second, third, and/or fourth alignment surfaces comprise planar and/or curved surfaces. Further, in some embodiments more or fewer alignment surfaces and/or gradients may be used. For example, in one embodiment, only the front and rear alignment surfaces **602A, 602B** are used with a planar surface **604** (e.g., substantially planar surface) positioned in between (e.g., creating a cone bifurcated by the planar surface). In this way, the left and right connector fiber guides **600A, 600B** (e.g., the first, second, third, and/or fourth alignment surfaces thereof) may form all or a portion of any of a plurality of suitable shapes. For example, the left and right connector fiber guides **600A, 600B** (e.g., the first, second, third, and/or fourth alignment surfaces thereof) may form part or all of a cone, cylinder, sphere, prism (e.g., triangular, rectangular, etc.), and/or pyramid (e.g., triangular, rectangular, etc.), or combinations thereof. In particular, the left and right connector fiber guides **600A, 600B** provide lateral alignment (e.g., horizontal and vertical alignment, such as along axes D-D and F-F), proximal alignment (e.g., along axis E-E), and angular alignment (e.g., in line with axis E-E). However, in certain embodiments, for example, misalignment tolerances of the first launch fiber emission end **432A** with the first

tracing optical fiber launch end **408A** can be up to 200 microns (e.g., up to 100 microns, up to 50 microns, etc.).

[00147] As explained in more detail below, the left and right connector fiber guides **600A, 600B** (e.g., the alignment surfaces **602A, 602B, 608A, 608B**) mate with corresponding surfaces on the left and right launch fiber guides **568A, 568B** to align, for example, the first launch end **408A** of the first tracing optical fiber **406A** with the first emission end **432A** of the first launch fiber **428A** for efficient coupling.

[00148] Further, the left and/or right connector fiber guide **600A, 600B** may further comprise an engagement taper **610** (proximate and proximal to the top and bottom alignment surfaces **608A, 608B**) to facilitate engagement of the clip **502** to the first or second fiber optic connectors **208A, 208B**, as described below.

[00149] **FIG. 7A** is an exploded view of the first fiber optic connector of **FIGS. 2A-2C, 4,** and **6A-6F**. The first and second fiber optic connectors **208A, 208B** (e.g., optical connector, connector, etc.) are in the form of an LC duplex connector (although other types of connectors could be used). Each of the first and second fiber optic connector **208A, 208B** comprises a housing **700**, a connection interface **702**, a locking member **704** (e.g., lock feature), a boot **706**, and a crimp band **708**, as explained below in more detail. The connection interface **702** comprises first and second LC connector sub-assemblies **710A, 710B**. As shown, each connector sub-assembly **710A, 710B** includes a ferrule **712** configured to support an optical fiber (e.g., the first and second data transmission fibers **400A, 400B**) and a ferrule casing **714** (e.g., connector sub-assembly housing, housing, etc.) surrounding a portion of the ferrule **712**. The ferrule **712** extends from a ferrule holder **716** (shown in **FIG. 9A**) that is retained in the ferrule casing **714** by a cap **718** or internal geometry of the ferrule casing **714**. A spring (also not shown) biases the ferrule holder **716** forward within the ferrule casing **714** so that a front end of the ferrule **712** projects beyond the ferrule casing **714**. The front end presents the optical fiber (e.g., data transmission fiber **400A, 400B**) for optical coupling with a mating component (e.g., another fiber optic connector).

[00150] Each connector sub-assembly **710** also includes a latch arm **720** extending outwardly and rearwardly from a portion of the ferrule casing **714**. Thus, the latch arm **720** has a proximal end coupled to the ferrule casing **714** and a distal end spaced from the ferrule casing **714**. The distal end of the latch arm **720** may be depressed toward the ferrule casing **714** for mating purposes, as will be described in greater detail below.

[00151] The housing **700** of the first fiber optic connector **208A** includes a body **722** in which a rear portion of each connector sub-assembly **710** (e.g., rear portions of ferrule casing **714**) is received. The body **722** comprises a top clamshell **724A** and a bottom clamshell **724B** (e.g., a two-piece construction). At least a portion of the body **722** is translucent to allow at least a portion of the optical tracing signal to exit the housing **700**. Note that translucent, at least as used herein, comprises semi-transparent and transparent. In particular, as used herein, the term semi-transparent identifies objects that allow at least some light to pass through at least part of the object and transparent identifies objects that allow substantially all light to pass through all or part of the object. In some embodiments, at least part of the body **722** is semi-transparent (e.g., translucent but not transparent). In yet other embodiments, at least part of the body **722** is transparent. Top and bottom clamshells **724A, 724B** attach together to define an interior **726** (e.g., of the housing **700)**. The first and second data transmission fibers **400A, 400B** (e.g., first and second optical data fibers) are routed through the interior **726** from the rear of the housing **700** to the connector sub-assemblies **710**. The top and bottom surface of the body **722** is mostly flat as this is where the light exits the body **722,** and it is desirable to leave the light path uninterrupted until it reaches the locking member **704** (described below in more detail).

[00152] The housing **700** further comprises a trigger casing **728** with a trigger arm **730** extending forward and outwardly from a top of the trigger casing **728** (and/or body **722**). The trigger arm **730** is depressible and biased upward (e.g., away from the body **722**). The trigger arm **730** extends outwardly from the body **722** and over the distal end of the latch arm **720**. This advantageously allows the trigger arm **730** to engage and disengage both latch arms **720** at the same time with a single trigger, and also inhibits fiber optic cables from snagging on the latch arms **720**. The locking member **704** moves relative to the housing **700** (including the trigger casing **728** and trigger arm **730**) to allow or prevent the trigger arm **730** from depressing and activating the latch arms **720**. The trigger casing **728** is slidably removable from the body **722**, such as to reverse polarity of the first fiber optic connector **208A** (explained in more detail below).

[00153] The trigger arm **730** is shown as a separate component (e.g., a clip) removably attached to the body **722**, but may alternatively be integrally formed with the body **722** so as to be part of a unitary (i.e., monolithic) structure with the body **722**. However, providing the trigger arm **730** as a removable component may provide certain benefits. For example, it may be possible to remove the trigger arm **730** and attach it to the opposite side of the body

722. The connector sub-assemblies **710** may also be configured to independently rotate within the body **722** so the latch arms **720** can be orientated on the opposite side of the body **722** as well. Repositioning the trigger arm **730** and connector sub-assemblies **710** in such a manner reverses the polarity scheme of the first fiber optic connector **208A**. Additional details and advantages of such polarity reversal, and an exemplary configuration of the trigger arm **730** and body **722** in general, are described in U.S. Patent No. 8,152,385, whose disclosure of these aspects is herein incorporated by reference.

[00154] The housing **700** may be attached to a fiber optic cable **206** that includes the first and second data transmission fibers **400A, 400B** (e.g., first and second optical data fibers and first and second tracing optical fibers **406A, 406B**). For example, the optical fibers may be un-buffered fibers extending from within a cable jacket **412** of the fiber optic cable **206**. One or more strength members (e.g., aramid yarn) may extend from the cable jacket **412**. The strength members may be secured to a rear of the housing **700** by a crimp band **708** that is crimped onto the rear of the housing **700**. In other embodiments, the fiber optic cable **206** may have a different configuration or be secured to the housing **700** or other part of the first fiber optic connector **208A** in a different manner (e.g., using an adhesive).

[00155] To help prevent sharp bends in the optical fibers where the fiber optic cable **206** is secured to the housing **700**, the first fiber optic connector **208A** further includes a boot **706** extending over a portion of the fiber optic cable **206** and the housing **700**. The boot **706** comprises a substantially flat proximal surface **732** (e.g., with a substantially rectangular cross section). Slots 734 provide controlled bending for fiber optic cable **206**. Boot **706** is rotatably attached to the housing **700**. More specifically, boot **706** is able to be rotated at least about 45 degrees in both directions, thereby allowing removal of the trigger arm **730** for polarity reversal (explained in more detail below).

[00156] Further, the housing **700** may further comprise a metal guide tube **736** at a rear of the housing **700** to further prevent sharp bends in the optical fibers as the optical fibers enter the body **722**. More specifically, the metal guide tube **736** comprises a cylindrical body **738** with a first tapered end **740A** and a second tapered end **740B** opposite thereto. The first and second tapered ends **740A, 740B** further prevent sharp bends. The metal guide tube **736** prevents the optical fibers from being pinched during assembly of the top clamshell **724A** to the bottom clamshell **724B**.

[00157] **FIG. 7B** is a perspective view of the body **722** of the first fiber optic connector **208A** of **FIG. 7A**. As shown, the body 722 comprises a top clamshell **724A** and a bottom clamshell **724B**. In this embodiment, the top clamshell **724A** and bottom clamshell **724B** are substantially identical, but other embodiments can use body portions that are not identical. The top clamshell **724A** and bottom clamshell **724B** attach together and form first and second front apertures **742A, 742B** (e.g., two substantially parallel apertures **742**) for receiving first and second connector subassemblies **710A, 710B**. First front aperture **742A** and second front aperture **742B** are configured to receive and retain a portion of the first and second connector subassemblies **710A, 710B** in such a manner as to allow rotation for polarity reversal.

[00158] The housing **700** further comprises a rear aperture **744** opposite from the first and second front apertures **742A, 742B** that is at least partially defined from the mating of the top and bottom clamshells **724A, 724B**. The rear aperture **744** is in continuous communication with the first and second front apertures **742A, 742B** by body **722** through interior **726**. The rear aperture **744** is configured to interact with fiber optic cable **206** and crimp band **708** to allow ingress of optical fibers through its passage and for securing the fiber optic cable **206** to the housing **700** at the outer periphery. Further the rear aperture **744** is configured to receive the metal guide tube **736** therein. However, as noted above, the connector described is merely exemplary, and other types of connectors are within the scope of this disclosure.

[00159] **FIGS. 7C** and **7D** are views of the trigger casing **728** of the first fiber optic connector of **FIG. 7A**. The trigger casing **728** is substantially rectangular with a substantially rectangular through passage. The trigger arm **730** comprises a flexible arm attached to a top surface of the trigger casing **728** and extending angularly away from it. The trigger casing **728** further comprises a lateral gap **746** in a bottom thereof, to allow the trigger casing **728** to be removed from the body **722**. The rectangular shape of the trigger casing **728** and passage prevent accidental rotation of the trigger casing **728** relative to the body **722**. The trigger casing **728** may have a lateral gap **746** in the trigger arm **730** towards a bottom of the trigger arm **730**, to receive a portion of the locking member **704** therethrough, as explained in more detail below. Further, the trigger casing **728** may comprise a top opening **748** to receive a portion of the locking member **704** therein. Further, the trigger casing **728** may comprise side apertures **749** to facilitate removal of the trigger casing **728** from the body **722** and to receive the left or right connector fiber guide **600A, 600B** therein.

[00160] **FIGS. 7E** and **7F** are views of the locking member **704** of the first fiber optic connector **208A**. The locking member **704** is translucent to allow passage of the optical tracing signal therethrough so that the optical tracing signal exits the housing **700**. The locking member **704** comprises a proximal portion **750** and a distal portion **752**, the proximal portion **750** wider than the distal portion **752**. The proximal portion **750** may, for example, have a front end with a width greater than that of the top opening **748** of the trigger casing **728** in the trigger arm **730**, but equal to or less than that of the trigger arm **730** in general. In the embodiment shown, the proximal portion **750** includes a first segment **754** and a second segment **756** bent or otherwise inclined relative to the first segment **754**. Such a configuration enables the proximal portion **750** to have a shape generally conforming to or otherwise complementing that of the trigger arm **730**, as will be described in greater detail below. The first segment **754** may also include a ramp, flange, ledge or other raised gripping element **758** at a rear of the locking member **704** to make it easier for a user to move the locking member **704** between its forward and rearward positions (explained in more detail below). The design of the locking member **704** as an illumination component may be further optimized by reducing the height and area of the gripping element **758** which may be raised and block light.

[00161] The second segment **756** comprises left gripping ridges **760A**, right gripping ridges **760B**, and an external TIR structure **762** positioned therebetween. In particular, the illumination component **212** comprises the external TIR structure **762**. The left and right gripping ridges **760A, 760B** are used to facilitate sliding of the locking member **704**. The external TIR structure **762** extends from the front to the back of the locking member **704**. The locking member **704** comprises a major forward TIR surface **764**, a major rearward TIR surface **766**, and a plurality of minor TIR surfaces **768**. The plurality of minor TIR surfaces **768** could be positioned between the major forward TIR surface **764** and the major rearward TIR surface **766**, positioned on both sides of the major forward TIR surface **764**, and/or positioned on both sides of the major rearward TIR surface **766**. As explained in more detail below, the major forward TIR surface **764**, major rearward TIR surface **766**, and/or plurality of minor TIR surfaces **768** redirect an emitted optical tracing signal proximally (e.g., toward a user). However, the major forward TIR surface **764**, major rearward TIR surface **766**, and/or minor TIR surfaces **768** may redirect the emitted optical tracing signal at different angles and may depend on the position of the locking member **704** relative to the housing **700** (explained in more detail below). The top of the major forward TIR surface **764** and/or major rearward TIR surface **766** could be the same height as the left and right gripping ridges **760A, 760B** to provide a consistent horizontal height for comfort of a user when gripping the locking member **704**.

[00162] The distal portion **752** in the embodiment shown includes axial or elongated bars **770** that are spaced apart from each other. The elongated bars **770** extend forward from an underside of the second segment **756** to a crossbar **772**, which extends between the elongated bars **770**. The distal portion **752** may also include one or more locking features configured to cooperate with complementary locking features on the trigger arm **730** to removably secure the locking member **704** in the forward position, rearward position, or both.

[00163] **FIGS. 7G** and **7H** are views of the locking member **704** in an unlocked orientation (e.g., slid forward). The underside of the trigger arm **730** includes a wedge **774** between axial slots left and right elongated bars **770** of the locking member **704**. The wedge **774** may initially be positioned above the elongated bars **770** of the locking member **704**, as may be the case, for example, when the trigger arm **730** has not yet been depressed or otherwise moved in a direction toward the body **722**. The wedge **774** is sized to fit within space between the elongated bars **770**. Additionally, when the locking member **704** is in its forward position, the crossbar **772** of the locking member **704** is positioned forward of the wedge **774**. Thus, in the forward position of the locking member **704**, the wedge **774** can be received between the elongated bars **770** to allow the trigger arm **730** to move toward the body **722** and trigger casing **728** far enough to depress the distal ends of the latch arms **720**. In other words, the crossbar **772** does not interfere or interact with the wedge **774** in the forward position of the locking member **704**.

[00164] **FIGS. 7I** and **7J** are views of the locking member **704** in a locked orientation (e.g., slid backward). In contrast, the crossbar **772** is positioned under the wedge **774** when the locking member **704** is in its rearward position. Such an arrangement effectively prevents the trigger arm **730** from being moved towards the body **722** and trigger casing **728**, or at least moved to an extent that may result in the latch arms **720** being depressed by the trigger arm **730** and moving from an initial position. For example, there may be contact between the wedge **774** and the crossbar **772** when the trigger arm **730** has not been moved at all from an initial position toward the body **722** and the trigger casing **728**. Alternatively, there may be contact very soon after such movement so that only a limited range of movement is possible. The trigger arm **730** and latch arms **720** in such alternative embodiments may be configured so that the trigger arm **730** does not depress the distal ends of the latch arms **720** despite the limited range of movement.

[00165] As can be appreciated, the crossbar **772** defines a stop feature on the distal portion **752** of the locking member **704** in the embodiment shown. In other embodiments, the locking member **704** may have a different shape or configuration, yet still include a stop feature that functions in a manner similar to the crossbar **772**. Thus, the stop feature may be in a form other than the crossbar **772**.

[00166] **FIGS. 8A-8F** are views of attachment and use of the light launch device **204** with the traceable fiber optic cable assembly **202**. In particular, **FIGS. 8A** and **8B** are views of the launch connector **216** in a detached position relative to the first fiber optic connector **208A**. As shown, the distance between the planar surfaces **574** of the left and right launch fiber guides **568A, 568B** is less than the distance between the farthest point of the top and bottom alignment surfaces **608A, 608B** of the left and right connector fiber guides **600A**, **600B**. Further, each of the first and second fiber optic connectors **208A, 208B** comprise an illumination component **212**. As shown, the illumination component **212** comprises a top primary illumination component **800** and a side secondary illumination component **802**. In particular, the illumination component **212** comprises the top primary illumination component **800** and the side secondary illumination component **802**, wherein the top primary illumination component **800** comprises the external TIR structure **762**, and wherein the side secondary illumination component **802** comprises the internal TIR structure (described below). The top primary illumination component **800** (and external TIR structure **762**) comprises the locking member **704** and the side secondary illumination component **802** (and internal TIR structure) comprises the left and/or right connector fiber guide **600A, 600B** which protrudes through side apertures **749** of the trigger casing **728**. In this embodiment, the trigger casing **728** is opaque, but in other embodiments, the trigger casing **728** could be translucent. The trigger casing **728** may be opaque for reasons related to communicating information to a user (e.g., type of connector).

[00167] **FIGS. 8C** and **8D** are views of the launch connector **216** as it engages the first fiber optic connector **208A**. In particular, a user presses the left and right handles **562A, 562B** of the launch connector clip **502** towards each other which causes the left and right launch fiber guides **568A, 568B** to pivot away from each other, increasing the distance between them. Accordingly, the distance between the left and right launch fiber guides **568A, 568B** is increased to be at least the distance between the farthest point of the top and bottom surfaces **608A, 608B** of the left and right connector fiber guides **600A**, **600B**, which is sufficient to move the left and right launch fiber guides **568A, 568B** past the farthest point of the top and bottom surfaces **608A, 608B** of the left and right connector fiber guides **600A**, **600B** as the launch connector **216** axially moves towards the distal end of the first fiber optic connector

208A. Further, the engagement taper **610** of the left and/or right connector fiber guide **600A, 600B** is angled to interact with the front tapered surface **572** of the left and/or right launch fiber guides **568A, 568B** of the left and right engagement arms **560A, 560B** facilitating separation of the left and right launch fiber guides **568A, 568B** as the launch connector **216** moves axially towards the distal end of the first fiber optic connector **208A**.

[00168] FIGS. 8E and **8F** are views of the launch connector **216** in an attached position relative to the first fiber optic connector **208A**. As shown, the left and right handles **562A, 562B** of the launch connector clip **502** have been released which causes the left and right launch fiber guides **568A, 568B** towards away from each other, decreasing the distance (e.g., launch fiber guide separation distance) between them. The distance between the planar surfaces **574** of the clip left and right launch fiber guides **568A, 568B** has decreased such that it is less than the distance between the farthest point of the top and bottom surfaces **608A, 608B** of the left and right connector fiber guides **600A**, **600B**, thereby axially retaining the launch connector **216** relative to the first fiber optic connector **208A**. More specifically, the left and/or right connector fiber guide **600A, 600B** is complementary in size and shape to the left and/or right launch fiber guide **568A, 568B** to mate the left and/or right launch fiber guide **568A, 568B** to the left and/or right connector fiber guide **600A, 600B**. Further, the alignment surfaces **602A, 602B, 608A, 608B** of the left and/or right connector fiber guides **600A, 600B** and the alignment surfaces **572A, 572B, 576A, 576B** of the left and/or right launch fiber guides **568A, 568B** interact with one another to align the launch ends **408A, 408B** of the first and second tracing optical fibers **406A, 406B** with the emission ends **432A, 432B** of the first and second launch fibers **428A, 428B**. More specifically, for example, the top alignment surface **608A** of the left connector fiber guide **600A** mates with the top alignment surface **576A**, of the left launch fiber guide **568A**, the bottom alignment surface **608B** of the left connector fiber guide **600A** mates with the bottom alignment surface **576B** of the left launch fiber guide **568A**, the front alignment surface **602A** of the left connector fiber guide **600A** mates with front alignment surface **572A** of the left launch fiber guide **568A**, the rear alignment surface **602B** of the left connector fiber guide **600A** mates with the rear alignment surface **572B** of the left launch fiber guide **568A**, and the planar surface **604** of the left connector fiber guide **600A** mates with the planar surface **574** of the left launch fiber guide **568A**. Accordingly, the first or second launch fiber **428A, 428B** is axially aligned with the first or second tracing optical fiber **406A, 406B** (e.g., horizontally and/or vertically aligned).

[00169] Once engaged, the launch module **214** of the light launch device **204** generates an optical tracing signal which is directed through the first and second launch fibers **428A, 428B**. As shown, the optical tracing signal is directed to both of the launch openings **606** of the left and right connector fiber guides **600A**, **600B**, even though only one of those launch openings **606** includes a tracing optical fiber (e.g., the first tracing optical fiber **406A**). This is because the ability to reverse the polarity of the connector changes the orientation of the body **722**, where doing so switches whether the first tracing optical fiber **406A** is positioned on the left or right side.

[00170] Thus, for example, a first optical tracing signal is directed from the first emission end **432A** of the first launch fiber **428A** to the first launch end **408A** of the first tracing optical fiber **406A** in the first fiber optic connector **208A** to the first emission end **410A** of the first tracing optical fiber **406A** in the second fiber optic connector **208B**. Once emitted, any exposed areas (e.g., the connector fiber guides **600A, 600B**) of the body **722** of the first fiber optic connector **208A** allows emission the first optical tracing signal out of the second fiber optic connector housing **700** to the user (explained below in more detail). Additionally, the locking member **704** also allows emission of the first optical tracing signal out of the housing **700** second fiber optic connector **208B** to the user (explained below in more detail). Note that the first optical tracing signal could be a steady signal or a pulsing signal. An advantage of a pulsing signal is that it is more visible to a user (even with the same peak power), and it is also more energy efficient (e.g., uses less power).

[00171] **FIGS. 9A-9E** are views of the interior of the first and second fiber optic connectors **208A, 208B**, and in particular of the mounting of the optical fibers within the housing **700** of the first and second fiber optic connector **208A**, **208B**. As shown, the bottom clamshell **724B** is the same for both the first and second fiber optic connectors **208A, 208B**. As shown, the traceable fiber optic cable assembly **202** comprises first and second data transmission fibers **400A, 400B**. In particular, the first end **402A** of the first data transmission fiber **400A** is positioned within a first fiber optic cable ferrule in the first fiber optic connector **208A**. The second end **402B** of the second data transmission fiber **400B** is positioned within the second fiber optic cable ferrule in the second fiber optic connector **208B**. Further, the second data transmission fiber first end **402A** is positioned within a second fiber optic cable ferrule in the first fiber optic connector **208A**, and the second end **402B** of the second data transmission fiber **400B** is positioned within the first fiber optic cable ferrule in the second fiber optic connector **208B**.

[00172] Further, as mentioned above, each body **722** comprises a left and right connector fiber guide **600A**, **600B** at opposite sides of the body. Each of the left and right connector fiber guides **600A, 600B** comprises a launch opening **606** in communication with a fiber channel **900** extending from the body interior **726** to external of the left and right connector fiber guides **600A, 600B**.

[00173] In the first fiber optic connector **208A**, the first launch end **408A** of the first tracing optical fiber **406A** is positioned in the launch opening **606** of the left connector fiber guide **600A** and extends through the fiber channel **900**. The first emission end **410A** of the first tracing optical fiber **406A** is centrally mounted in the second fiber optic connector **208B** (discussed in more detail below). Similarly, in the second fiber optic connector **208B**, the second launch end **408B** of the second tracing optical fiber **406B** is positioned in the launch opening **606** of the left connector fiber guide **600A** and extends through the fiber channel **900**. The second tracing optical fiber emission end **410B** is centrally mounted in the second fiber optic connector **208A** (discussed in more detail below).

[00174] **FIG. 9B** is a perspective view of the bottom clamshell **724B** of the housing **700** of the first and second fiber optic connector **208A, 208B**, and **FIGS. 9C-9E** are views of a fiber channel **900** and alignment protrusion feature of **FIG. 9B**. Alignment protrusion features **902** cooperate with corresponding alignment cavity features **904**, respectively, providing alignment and preventing lateral and axial translation. The alignment features are shown by way of example and in no way limit the possible configurations of such features. Although the top and bottom clamshells **724A, 724B** are identical, as discussed above, in other embodiments top and bottom clamshells **724A, 724B** may not be substantially identical, such as one half may comprise all the alignment cavity features and the other half comprise all the alignment protrusion features. Likewise, other configurations are possible for securing the housing components together. Other variations include a housing formed from a single component that has an upper and lower portion connected by a living hinge.

[00175] As shown, the first launch end **408A** of the first tracing optical fiber **406A** is positioned in the launch opening **606** of the left connector fiber guide **600A** and extends through the fiber channel **900**. The fiber channel **900** of the left connector fiber guide **600A** comprises an access port **906** at least partially positioned beneath the alignment protrusion feature **902**. The access port **906** extends through the bottom clamshell **724B** to provide access to the fiber channel **900** (as explained in more detail below). The fiber channel **900** is positioned between the rear aperture **744** and the alignment protrusion feature **902**, where at

least a portion of the alignment protrusion feature **902** can be positioned above the fiber channel **900** to define an overhang **908**.

[00176] During assembly, the first tracing optical fiber **406A** is bent and positioned in the fiber channel **900**, and is biased towards a straight orientation. Accordingly, the overhang **908** and position of the alignment protrusion feature **902** on a side of the fiber channel **900** opposite from the rear aperture **744** act as a hook and prevent the first tracing optical fiber **406A** from accidentally disengaging from the fiber channel **900**. Further, the overhang **908** prevents any accidental pinching or damage to the first tracing optical fiber **406A** when the top and bottom clamshells **724A, 724B** are assembled together because the first tracing optical fiber **406A** is more enclosed by the overhang **908**.

[00177] Once the top and bottom clamshells **724A, 724B** are assembled, a syringe (or other device) can be inserted into the access port **906** (in some embodiments having a diameter of 0.5 mm, 1 mm, 1.5 mm, etc.) to inject an adhesive or epoxy within the fiber channel **900** to fix the first tracing optical fiber **406A** within the fiber channel **900**. As shown, the central axis G-G of the alignment protrusion feature **902** is offset from the central axis H-H of the access port **906**. This offset facilitates manufacture of the overhang **908**.

[00178] **FIGS. 10A-10H** are views of the second emission end **410B** of the second tracing optical fiber **406B** mounted within the first fiber optic connector **208A** and illustrating emission of a fiber optical signal into the first fiber optic connector **208A**. In particular, **FIGS. 10A-10D** are views of the second emission end **410B** of the second tracing optical fiber **406B** mounted within the first fiber optic connector **208A**. As shown, the top and bottom clamshells **724A**, **724B** each comprise an internal TIR structure **1000** for mounting the first or second emission end **410A, 410B** of the first or second tracing optical fiber **406A, 406B** within the body **722** of the first and second fiber optic connector **208A, 208B**. In particular, the illumination component **212** comprises the internal TIR structure **1000**. In particular, the illumination component **212** comprises the top primary illumination component **800** and the side secondary illumination component **802**, wherein the top primary illumination component **800** comprises the external TIR structure **762** (e.g., external illumination component), and wherein the side secondary illumination component **802** comprises the internal TIR structure **1000** (e.g., internal illumination component). The top primary illumination component **800** (and external TIR structure **762**) comprises the locking member **704** and the side secondary illumination component **802** (and internal TIR structure **1000**) comprises the left and/or right connector fiber guide **600A, 600B**.

[00179] The internal TIR structure **1000** comprises a center column **1002** with an open channel **1004** defined in a top thereof. At a distal end of the center column **1002** is a vertical planar face **1006**. Proximate, but distal of the vertical planar face **1006** are left and right stabilizing columns **1008A, 1008B**. These stabilizing columns **1008A, 1008B** are staggered from one another for proper mating with the stabilizing columns **1008A, 1008B** for the top clamshell **724A** (which is identical to the bottom clamshell **724B**). The stabilizing columns **1008A, 1008B** are proximate the vertical planar face **1006** to keep the second emission end 410B of the second tracing optical fiber **406B** in place.

[00180] Extending from a top of the vertical planar face **1006** is a horizontal mating face **1010**. In this way, the horizontal mating face **1010** of the bottom clamshell **724B** is configured to mate with the horizontal mating face **1010** of the top clamshell **724A**. Accordingly, as shown, when the second tracing optical fiber **406B** is positioned in the open channel **1004** of the internal TIR structure **1000**, the second emission end **410B** of the second tracing optical fiber **406B** abuts the vertical planar face **1006** to the top and bottom clamshells **724A**, **724B**. This forces the first optical signal to emit through the vertical planar face **1010** and enter the material of the top and bottom clamshells **724A, 724B** without any redirection or distortion.

[00181] Extending from a distal edge of the horizontal mating face **1010** is a sloping TIR surface **1012**, the sloping TIR surface **1012** sloping downward (e.g., outward) from the top of the horizontal mating face **1010**. The sloping TIR surface **1012** could be planar and/or curved. Further, the sloping TIR surface **1012** is narrower at the top (e.g., inward) then the bottom (e.g., outward) to compensate for the spreading the optical tracing signal as it exits the second emission end **410B** of the second tracing optical fiber **406B**.

[00182] When the top and bottom clamshells **724A, 724B** are mated to one another, the proximal edge of the top and bottom sloping TIR surface **1012** from a wedge that splits the emitting fiber optic signal such that half of the fiber optic signal is redirected upward, and half the fiber optic signal is redirected downward. This is because the orientation of the body **722** may be flipped to reverse polarity (discussed in more detail below). The distance of the proximal edge of the sloping TIR surface **1012** to the second emission end **410A** of the second tracing optical fiber **406B** may vary to optimize optical redirection. TIR is advantageous because it is essentially lossless redirection. Further, the slope of the sloping TIR surface **1012** is partly to redirect the emitted fiber optic signal which creates a cone shape as it exits the second emission end **410B** of the second tracing optical fiber **406B**.

[00183] **FIGS. 10D-10F** are views of the first fiber optic connector **208A** with the optical tracing signal redirected upward and downward by the internal TIR structure **1000**. However, the first fiber optic connector **208A** shown in **FIGS. 10E** and **10F** has a locking member **704** without any external TIR structure. In other words, the locking member **704** does not redirect any of the emitted fiber optic signal. As shown, the internal TIR structure **1000** redirects a primary portion **1014** of the optical tracing signal such that a first half **1016A** of the optical tracing signal is directed upward through the top clamshell **724A**, through an aperture in a top of the trigger casing **728**, and through the locking member **704**, and a second half **1016B** of the optical tracing signal is directed downward through the bottom clamshell **724B**.

[00184] **FIG. 10G** and **10H** are views of the first fiber optic connector **208A** with the optical tracing signal redirected upward and downward by the internal TIR structure **1000** and redirected backward (e.g., proximally) by the external TIR structure **762**. The first fiber optic connector **208A** shown in these figures has a locking member **704** with an external TIR structure **762**. Accordingly, as shown, the internal TIR structure **1000** redirects a primary portion **1014** of the optical tracing signal such that a first half **1016A** of the optical tracing signal is directed upward through the top clamshell **724A**, through an aperture in a top of the trigger casing **728**, and through the locking member **704**, and a second half **1016B** of the optical tracing signal is directed downward through the bottom clamshell **724B**. The locking member **704** redirects a secondary portion **1018** of the primary portion **1014** of the emitted fiber optic signal. In particular, **FIG. 10H** shows first bands **1020** of the fiber optic signal redirected by the rearward major TIR surface **766**, second bands **1022** of the fiber optic signal redirected by the minor TIR surface **768**. Note that this is when the locking member **704** is in the locked position. In the unlocked position, the locking member **704** would slide to the right, and the major forward TIR surface **764** would redirect more fiber optic signal, and the rearward TIR surface **766** would redirect less fiber optic signal.

[00185] It is noted that optical tracing signal may experience loss as it is injected from the light launch device **204** through the fiber optic cable **206**. For example, the optical tracing signal may experience insertion loss (e.g., less than about 9 decibels (db)). Further, the optical tracing signal may experience loss between the input power (e.g., as the optical tracing signal is injected into the first launch end **408A** of the first tracing optical fiber **406A** positioned in the first fiber optic connector **208A**), and the emission power (e.g., as the optical tracing signal is emitted from a first emission end **410A** of the first tracing optical fiber **406A** positioned in the second fiber optic connector **208B**). The loss, input power, and/or output power are dependent upon the wavelength of the optical tracing signal, aperture size, and divergence angle.

[00186] It is further noted that calibration of the input power and/or output power are dependent on energy and/or eye safety considerations. In particular, in some embodiments, the input power may be between about 10 microwatts and about 100 milliwatts, or between about 100 microwatts and about 50 milliwatts. In some embodiments, the output power may be between about 10 microwatts and about 50 milliwatts. Further, the input power may be calibrated based on the eye safe limit of the output power, where the eye safe limit is about 50 milliwatts. For example, the input power may be calibrated to about 100 milliwatts to provide an output power of 40 milliwatts. In another embodiment, the input power is calibrated to the eye safe limit (e.g., 50 milliwatts), to ensure that the output power does not exceed this eye safe limit. In other words, if the input power is limited to the eye safe limit, then the output power provided cannot exceed the eye safe limit.

[00187] The first and second fiber optic connectors can comprise polyethermide, polybutyleneterephthalate (PBT), polycarbonate (PC), and/or copolyester. In particular, polycarbonate is preferred for the body, the locking feature, and/or any other part that has the data optical signal (e.g., light) travel through it. In some embodiments, the locking member **704** is made of a material that has optical scattering elements on at least part of the surface or within it (e.g., Ultem filled with silica particles).

[00188] **FIG. 10I** is a flowchart illustrating an exemplary process **1024** for using the light launch device **204** of **FIGS. 2A-2C, 4-5L,** and **8A-8F** to trace a fiber optic cable **206**. Step **1026** comprises positioning at least a portion of a first fiber optic connector **208A** of a traceable fiber optic cable assembly **202** within the central channel **510** with an open bottom of a housing **500** (e.g., body) of a launch connector **216** of the light launch device **204**, the traceable fiber optic cable assembly **202** comprising the first fiber optic connector **208A**, a second fiber optic connector **208B**, and a fiber optic cable **206** (e.g., traceable cable) therebetween. Step **1028** comprises moving a first engagement arm **560A** movably connected to the housing **500** (e.g., body) of the launch connector **216** from a disengaged position to an engaged position to mechanically engage the launch connector **216** to the first fiber optic connector **208A**, a left launch fiber guide **568A** of the left engagement arm **560A** of the light launch device **204** mechanically interacting with a left or right connector fiber guide **600A, 600B** during engagement to axially align an emission end **432A** of a launch fiber

428A with a launch end **408A** of a tracing optical fiber **406A** of the first fiber optic connector **208A**. Step **1030** comprises directing a first tracing signal from the light source **416** of the light launch device **204**, through the launch fiber **428A**, through the launch end **408A** of the tracing optical fiber **406A** positioned in the first fiber optic connector **208A**, through an emission end **410A** of the tracing optical fiber **406A** positioned in the second fiber optic connector **208B**.

[00189] **FIGS. 11A-11C** are perspective views of the first fiber optic connector **208A** as the polarity is reversed. The first and second fiber optic connectors **208A, 208B** may independently rotate along their respective longitudinal axes for polarity reversal within their respective body **722**.

[00190] **FIG. 11A** is a perspective view illustrating the beginning of the polarity reversal procedure. For convenience and clarity first fiber optic connector **208A** is labeled with “A” and “B” to indicate a beginning polarity orientation. The polarity of the traceable fiber optic cable assembly **202** may be changed to a second polarity configuration by rotating the boot **706**, removing the trigger casing **728**, rotating the fiber optic connectors **208A, 208B** in opposite directions and replacing the trigger casing **728** on the other side of the connector housing, and then rotating the boot **706** to a home position. In particular, boot **706** is rotated about 45 degrees from its home position so that it is generally aligned with side apertures **749** of the trigger casing **728**. Trigger casing **728** is then translated axially, over boot **706** and fiber optic cable **206** until finally lifted off of the assembly via lateral gap **746**.

[00191] **FIG. 11B** is a perspective view of the first fiber optic connector **208A** of **FIG. 11A** illustrating the polarity reversal procedure after one of the fiber optic connector is fully rotated. The left connector subassembly **710A** is rotated for about 180 degrees until fiber optic connector **208A** is in the position shown. As shown, left and right connector subassemblies **710A, 710B** are 180 degrees opposite each other. Then the right connector subassembly **710A** is rotated 180 degrees. Next, trigger casing **728** is reinstalled similar to that described above with respect to **FIG. 11A**, but in the reverse order and on the other side of the body **722**.

[00192] **FIG. 11C** is a perspective view of the first fiber optic connector **208A** of **FIG. 11A** after the polarity reversal is completed. Accordingly, the polarity has been reversed. In other words, the ‘A’ and ‘B’ positions of the fiber optic connectors are reversed. The polarity reversal procedure is completely reversible and in no way affects the performance of the fiber optic connector used in the duplex assembly. While optical fibers may undergo a maximum of about 180 degrees of rotation, assembly methods can reduce the maximum rotation experienced, thereby mitigating any torsional affects. For instance, the fiber optic connector may be installed such that when in a relaxed state, the connectors are oriented at 9 o'clock and 3 o'clock (i.e., positioned in the outward direction instead of up or down), whereas for illustration the connectors are shown both at 12 o'clock in this disclosure. Consequently, the optical fibers only experience a net rotation of only +90° or −90° in any polarity orientation.

[00193] Accordingly, as disclosed herein, the light launch device and fiber optic connectors have been designed to keep the cost of the high volume fiber optic cable assembly as low cost as possible by using the fewest connector parts and by minimizing the number of added fabrication steps, while moving functionality and cost to the low volume launch tool wherever possible. The fiber optic connectors have the ability to reverse polarity, as well as a sliding lock. Further, the cable tracing system achieves high optical efficiency coupling into and out of the tracing fiber that efficiently illuminate the connector so observers can easily see it.

[00194] Optical fibers may be referred to interchangeably as optical waveguides herein. Therefore this disclosure does not intend to differentiate between the terms “optical fiber” and “optical waveguide” per se. The optical fibers may conduct nonvisible light or visible light, such as green light at approximately 532 nm. Red light, blue light, or a combination thereof could also be used to assist with tracing the fiber optic cable **206**. Green light may be used due to the relative high degree of sensitivity of the human eye to green light.

[00195] In some embodiments, the optical fibers each include a core and a cladding. The core may be made from glass, particularly silica-based glass, having a first index of refraction. Alternatively, the core may be formed from a polymer. The size of the core is not particularly limited, but in some embodiments diameters may be between about 100 microns and about 250 microns. The core may be, for example, 125 microns. Cores that are significantly smaller may be subject to damage from handling, and cores that are significantly larger may be subject to damage when bending.

[00196] The cladding can be made from glass or a polymer, such as fluoro-acrylate. The material for the cladding may be selected to have an index of refraction that differs from the index of refraction of the core. In some embodiments, the index of refraction of the cladding is lower than that of the core. The indices of refraction may produce a step-index optical fiber. In other embodiments, the optical fibers may be trapezium or triangular index fibers. The cladding closely surrounds the core to help maintain light within the tracing optical fibers. The cladding may have a thickness between about 4% and about 40% of the diameter of the core. For example, the cladding may be between about 5 and about 50 microns thick from the surface of the core to an exterior surface of the cladding when the core has a diameter of 125 microns. The optical fibers may be single mode fibers or multi-mode fibers.

[00197] Unless otherwise expressly stated, it is in no way intended that any method set forth herein be construed as requiring that its steps be performed in a specific order. Accordingly, where a method claim does not actually recite an order to be followed by its steps or it is not otherwise specifically stated in the claims or descriptions that the steps are to be limited to a specific order, it is no way intended that any particular order be inferred.

[00198] It will be apparent to those skilled in the art that various modifications and variations can be made without departing from the spirit or scope of the invention. Since modifications combinations, sub-combinations and variations of the disclosed embodiments incorporating the spirit and substance of the invention may occur to persons skilled in the art, the invention should be construed to include everything within the scope of the appended claims and their equivalents.

What is claimed is:

1. A traceable fiber optic cable assembly, comprising:

a first fiber optic connector comprising a housing defining an interior and comprising a first connector fiber guide, the first connector fiber guide comprising a launch opening and at least one alignment surface;

a data transmission element, wherein at least a portion of the data transmission element is positioned within the interior of the housing of the first fiber fiber optic connector; and

a first tracing optical fiber having a first launch end and a first emission end opposite from the first launch end, wherein the first launch end is positioned in the launch opening of the housing and is accessible from an exterior of the housing for receiving a first optical tracing signal.

2. The traceable fiber optic cable assembly of claim 1, wherein the launch opening is located in the at least one alignment surface.

3. The traceable fiber optic cable assembly of claim 2, wherein the at least one alignment surface comprises:

a first surface portion having a first gradient varying along a first axis perpendicular to a central axis of the launch opening;

a second surface portion having a second gradient varying along the first axis in a direction opposite from the first gradient of the first surface; and

a third surface portion located between the first surface portion and the second surface portion.

4. The traceable fiber optic cable assembly of claim 3, wherein the launch opening is located in the third surface portion.

5. The traceable fiber optic cable assembly of claim 4, wherein at least a portion of a peripheral edge of the third surface portion is not enclosed by the first surface portion and the second surface portion to provide cleaving access to the first launch end of the first tracing optical fiber.

6. The traceable fiber optic cable assembly of claim 5, wherein the third surface portion is planar.

7. The traceable fiber optic cable assembly of claim 6, wherein the first launch end of the first tracing optical fiber is flush with the third planar surface portion.

8. The traceable fiber optic cable assembly of claim 3, wherein the first connector fiber guide further comprises a protrusion from the housing, wherein the protrusion comprises a fourth surface portion having a fourth gradient varying along a second axis perpendicular to the first axis and the central axis, and wherein the protrusion further comprises a fifth surface portion having a fifth gradient varying along the second axis in a direction opposite from the fourth gradient of the fourth surface, wherein the first, second, and third surfaces form a cutout portion in the protrusion.

9. The traceable fiber optic cable assembly of claim 8, wherein at least a portion of the first surface portion, the second surface portion, the fourth surface portion, and the fifth surface portion forms a curved surface.

10. The traceable fiber optic cable assembly of any of claims 1-9, further comprising a second connector fiber guide, wherein the second connector fiber guide is located on an opposite side of the housing from the first connector fiber guide.

11. The traceable fiber optic cable assembly of any of claims 1-10, further comprising a second tracing optical fiber having a second launch end and a second emission end opposite from the second launch end, wherein the second emission end is positioned in the interior of the housing of the first fiber optic connector.

12. The traceable fiber optic cable assembly of claim 11, wherein at least a portion of the first fiber optic connector comprises a translucent material configured to receive at least a portion of a second optical tracing signal emitted from the second emission end of the second tracing optical fiber.

13. The traceable fiber optic cable assembly of claim 11, wherein the first fiber optic connector further comprises a translucent external illumination structure positioned at least partially outside the housing, the translucent external illumination structure configured to receive at least a portion of a second optical tracing signal emitted from the second emission end of the seocnd tracing optical fiber.

14. The traceable fiber optic cable assembly of claim 13, wherein the translucent external illumination structure comprises a connector locking member.

15. A traceable fiber optic cable assembly, comprising:

a traceable fiber optic cable, comprising:

at least one data transmission element;

a first tracing optical fiber for communicating a first optical tracing signal, the first tracing optical fiber comprising a first launch end and a first emission end; and

a second tracing optical fiber for communicating a second optical tracing signal, the second tracing optical fiber comprising a second launch end and a second emission end;

a first fiber optic connector at a first end of the traceable fiber optic cable, the first fiber optic connector comprising a first housing defining a first interior and a first connector fiber guide, the first connector fiber guide comprising a first alignment surface and a first launch opening defined in the first alignment surface; and

a second fiber optic connector at a second end of the traceable fiber optic cable, the second fiber optic connector comprising a second housing defining a second interior and comprising a second connector fiber guide, the second connector fiber guide comprising a second alignment surface and a second launch opening defined in the second alignment surface;

the first launch end of the first tracing optical fiber positioned in the first launch opening of the first housing of the first fiber optic connector and the first emission end of the first tracing optical fiber positioned in the second interior of the second housing of the second fiber optic connector;

the second launch end of the second tracing optical fiber positioned in the second launch opening of the second housing of the second fiber optic connector and the second emission end of the second tracing optical fiber positioned in the first interior of the first housing of the first fiber optic connector.

16. The traceable fiber optic cable assembly of claim 15, wherein the first alignment surface comprises a first cleaving surface to provide cleaving access to the first launch end of the first tracing optical fiber and the second alignment surface comprises a second cleaving surface to provide cleaving access to the second launch end of the second tracing optical fiber.

17. The traceable fiber optic cable assembly of any of claims 15 and 16, wherein:

at least a portion of the first fiber optic connector comprises a first translucent material to allow at least a portion of the second optical tracing signal to exit the first interior of the first housing; and

at least a portion of the second fiber optic connector comprises a second translucent material to allow at least a portion of the first optical tracing signal to exit the second interior of the second housing.

18. The traceable fiber optic cable assembly of any of claims 15-17, wherein:

the first fiber optic connector further comprises a first internal illumination structure for redirecting at least part of the second optical tracing signal when emitted from the second emission end; and

the second fiber optic connector further comprises a second internal illumination structure for redirecting at least part of the first optical tracing signal when emitted from the first emission end.

19. The traceable fiber optic cable assembly of claim 18, wherein:

the first internal illumination structure comprises a first total internal reflection surface; and

the second internal illumination structure comprises a second total internal reflection surface.

20. The traceable fiber optic cable assembly of claim 18, wherein:

the first fiber optic connector further comprises a first translucent external illumination structure positioned at least partially outside the housing and comprising a first connector locking member; and

the second fiber optic connector further comprises a second translucent external illumination structure positioned at least partially outside the housing and comprising a second connector locking member.

21. A method of manufacturing a traceable fiber optic cable assembly, comprising:

securing a first fiber optic connector at a first end of a traceable fiber optic cable, the traceable fiber optic cable comprising a data transmission element, a first tracing optical fiber comprising a first launch end and a first emission end, and a second tracing optical fiber comprising a second launch end and a second emission end, the first fiber optic connector comprising a first housing defining a first interior and comprising a first connector fiber guide, the first connector fiber guide comprising a first alignment surface and a first launch opening defined in the first alignment surface; and

securing a second fiber optic connector at a second end of the traceable fiber optic cable, the second fiber optic connector comprising a second housing defining a second interior and comprising a second connector fiber guide, the second connector fiber guide comprising a second alignment surface and a second launch opening defined in the second alignment surface;

positioning the first launch end of the first tracing optical fiber in the first launch opening of the first housing of the first fiber optic connector;

positioning the first emission end of the first tracing optical fiber in the second interior of the second housing of the second fiber optic connector;

positioning the second launch end of the second tracing optical fiber in the second launch opening of the second housing of the second fiber optic connector; and

positioning the second emission end of the second tracing optical fiber in the first interior of the first housing of the first fiber optic connector.

22. The method of claim 21, further comprising:

forming a first planar surface in the first alignment surface; and

forming a second planar surface in the second alignment surface.

23. The method of any of claims 21 and 22, further comprising:
forming the first launch opening in the first planar surface; and
forming the second launch opening in the second planar surface.

24. The method of claim 23, further comprising:
cleaving the first launch end of the first tracing optical fiber such that the first launch end is flush with the first planar surface; and
cleaving the second launch end of the second tracing optical fiber such that the second launch end is flush with the first planar surface.

25. The method of any of claims 21-24, further comprising:
forming at least a portion of the first fiber optic connector of a translucent material; and
forming at least a portion of the second fiber optic connector of the translucent material.

26. The method of any of claims 21-24, further comprising:
securing a first, translucent locking feature to the first fiber optic connector such that the first locking feature is translatable relative to the first housing between a first lock orientation preventing disengagement of the first fiber optic connector from a first fiber optic component and an unlock orientation allowing disengagement of the first fiber optic connector from the first fiber optic component; and
securing a second, translucent locking feature to the second fiber optic connector such that the second locking feature is translatable relative to the second housing between a second lock orientation preventing disengagement of the second fiber optic connector from a second fiber optic component and an unlock orientation allowing disengagement of the second fiber optic connector from the second fiber optic component.

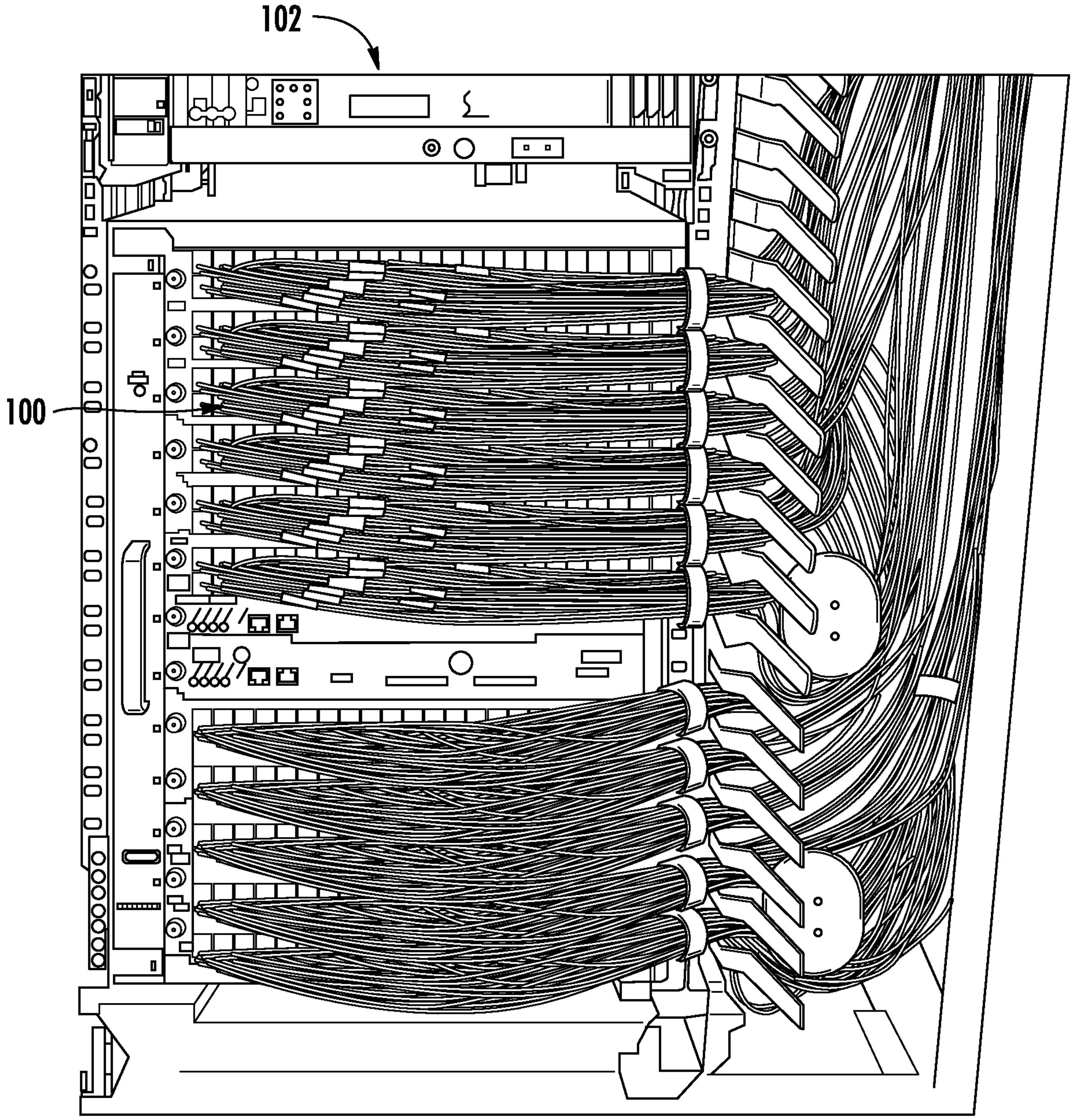


FIG. 1A

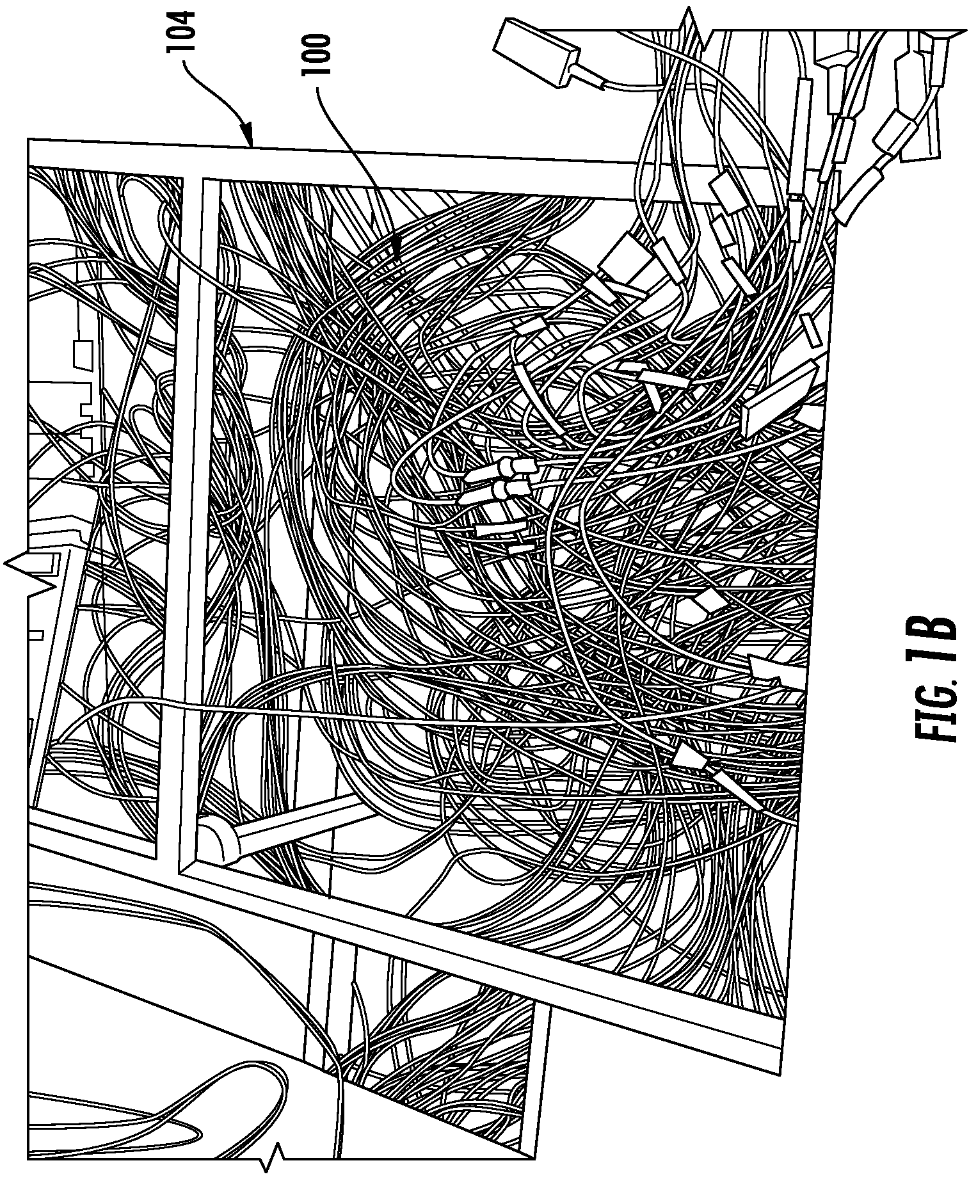


FIG. 1B

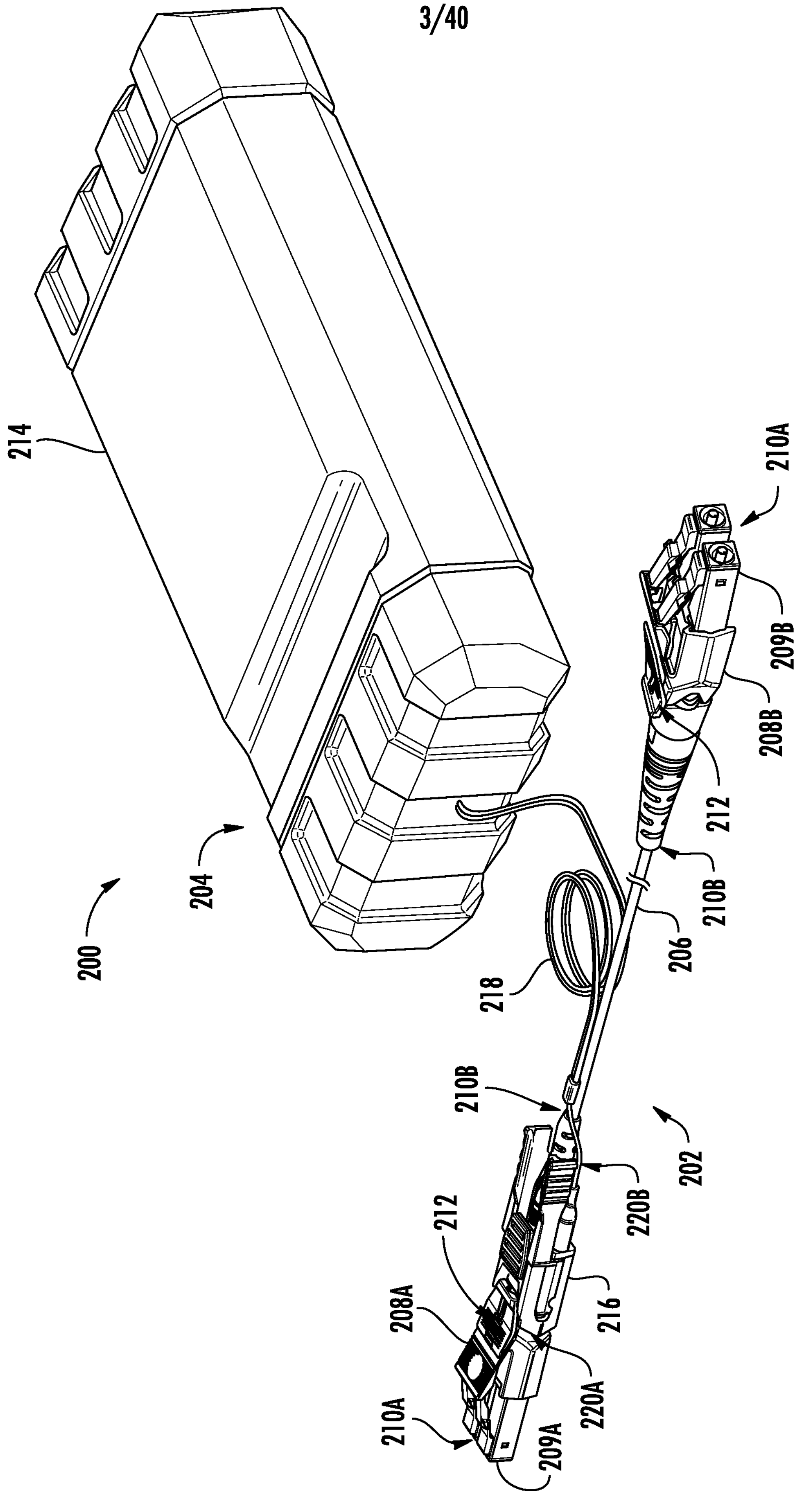

200
204
214
202
206
218
210A
209B
208B
212
210B
210B
220B
212
208A
216
220A
210A
209A

FIG. 2A

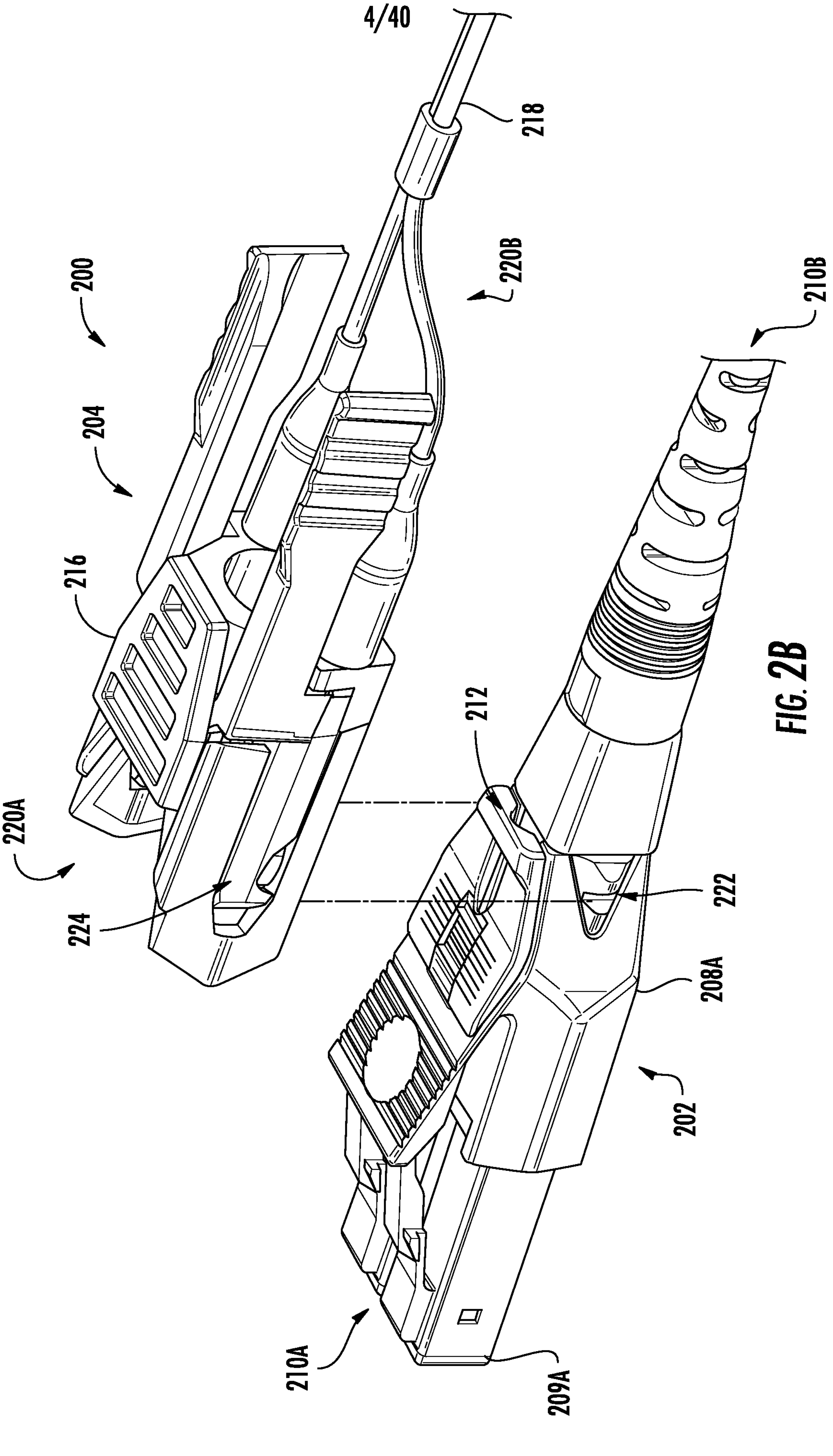


FIG. 2B

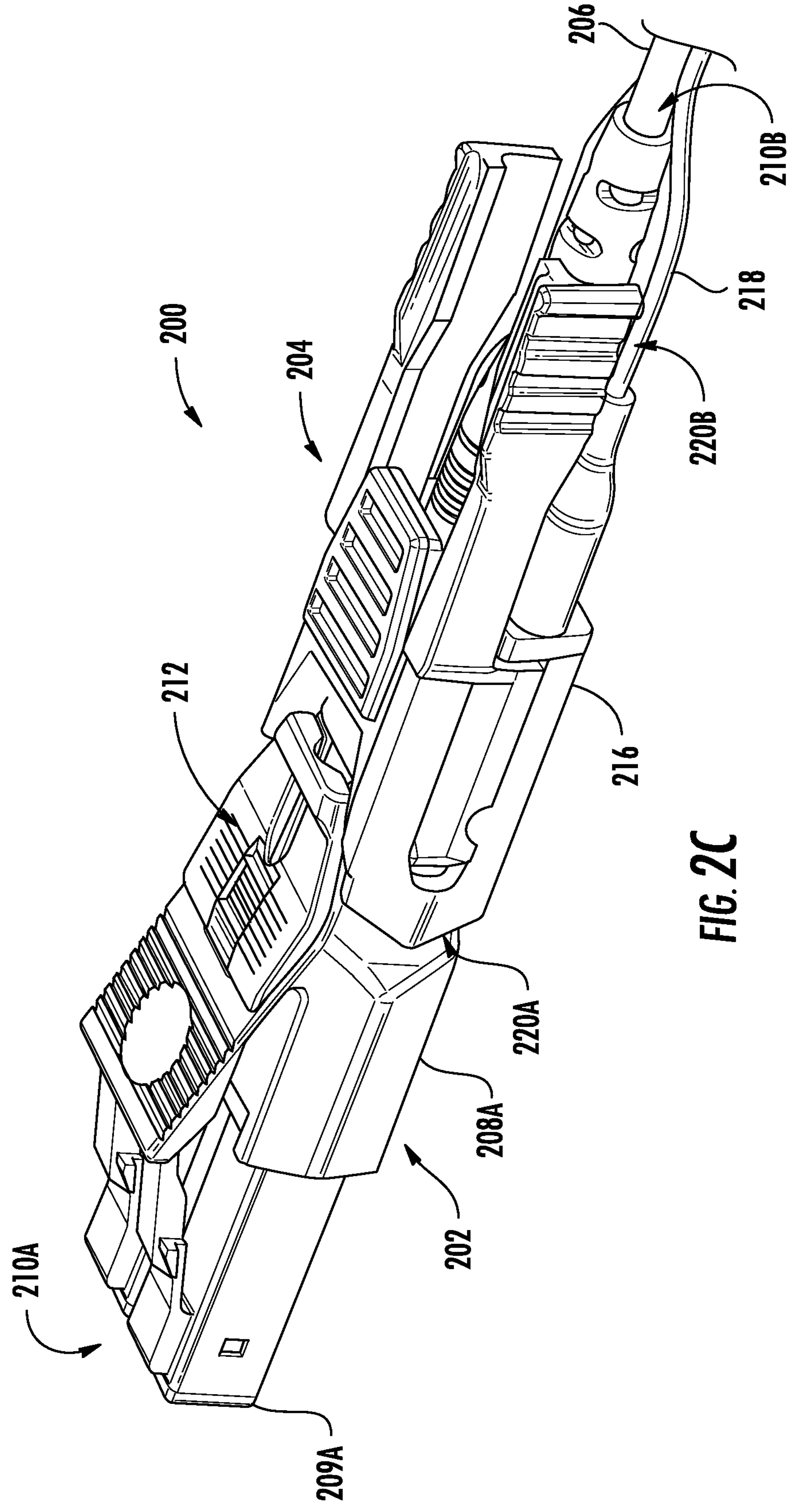


FIG. 2C

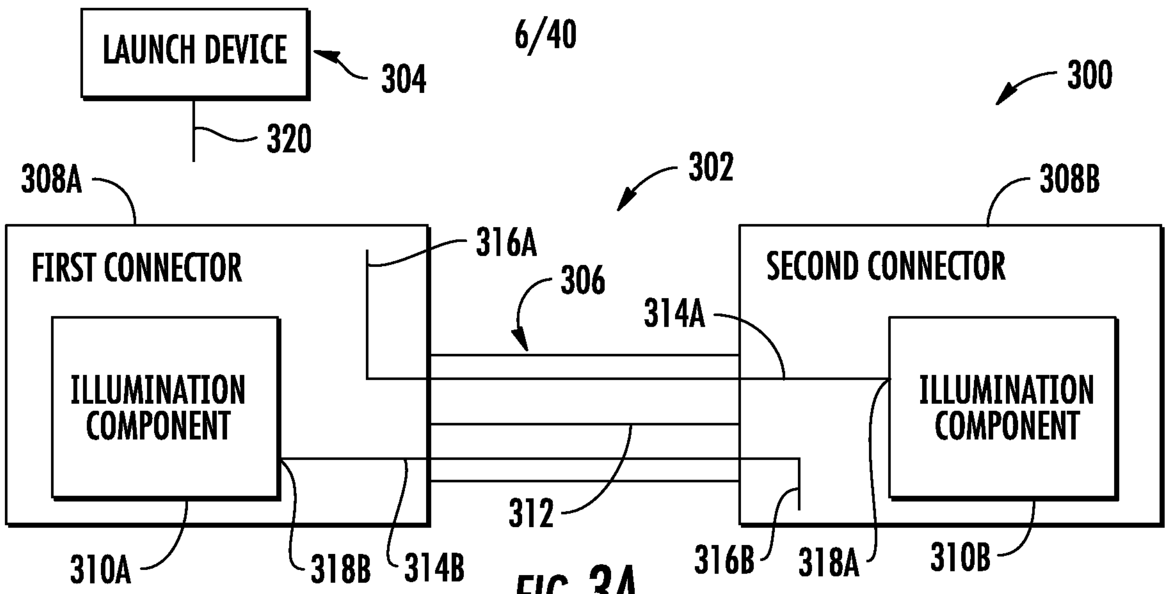


FIG. 3A

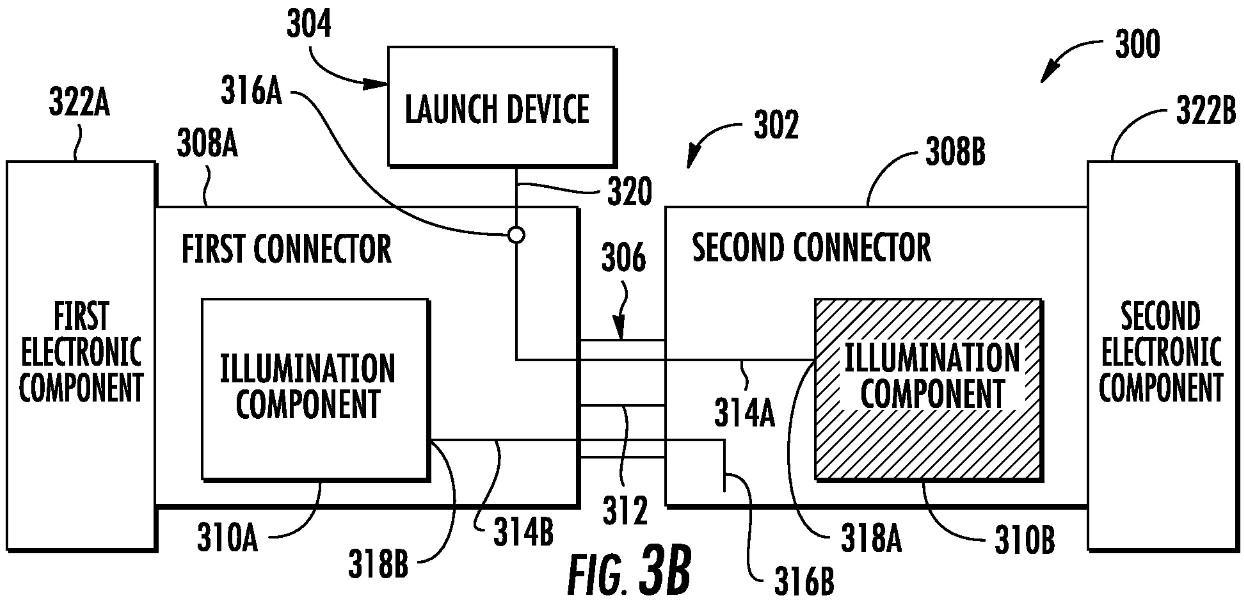


FIG. 3B

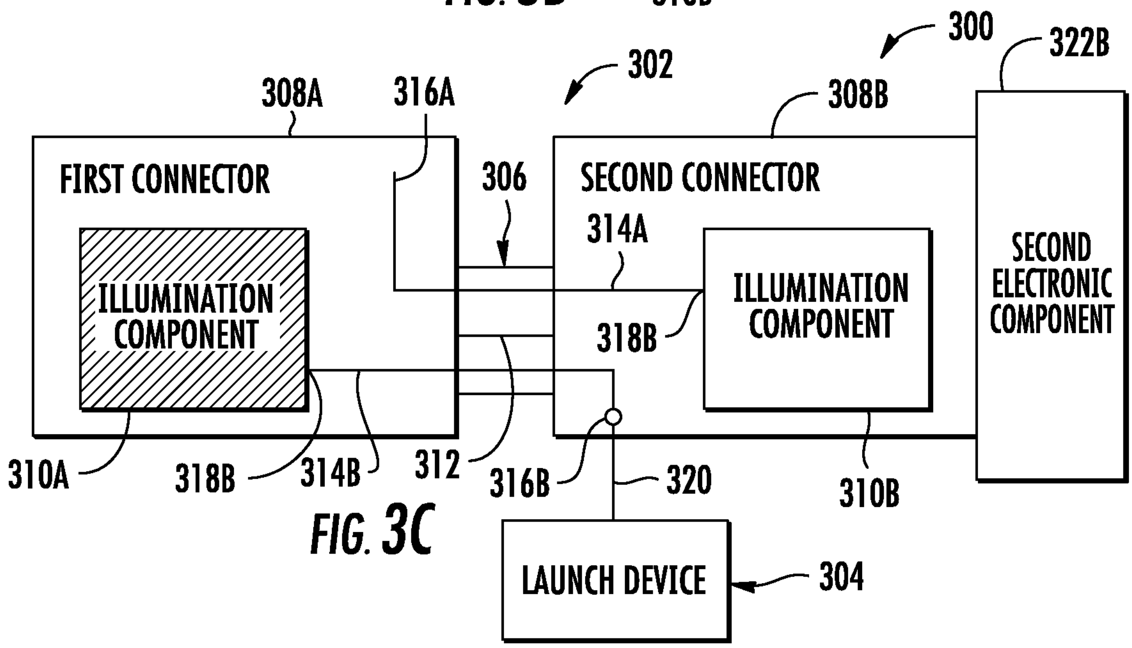


FIG. 3C

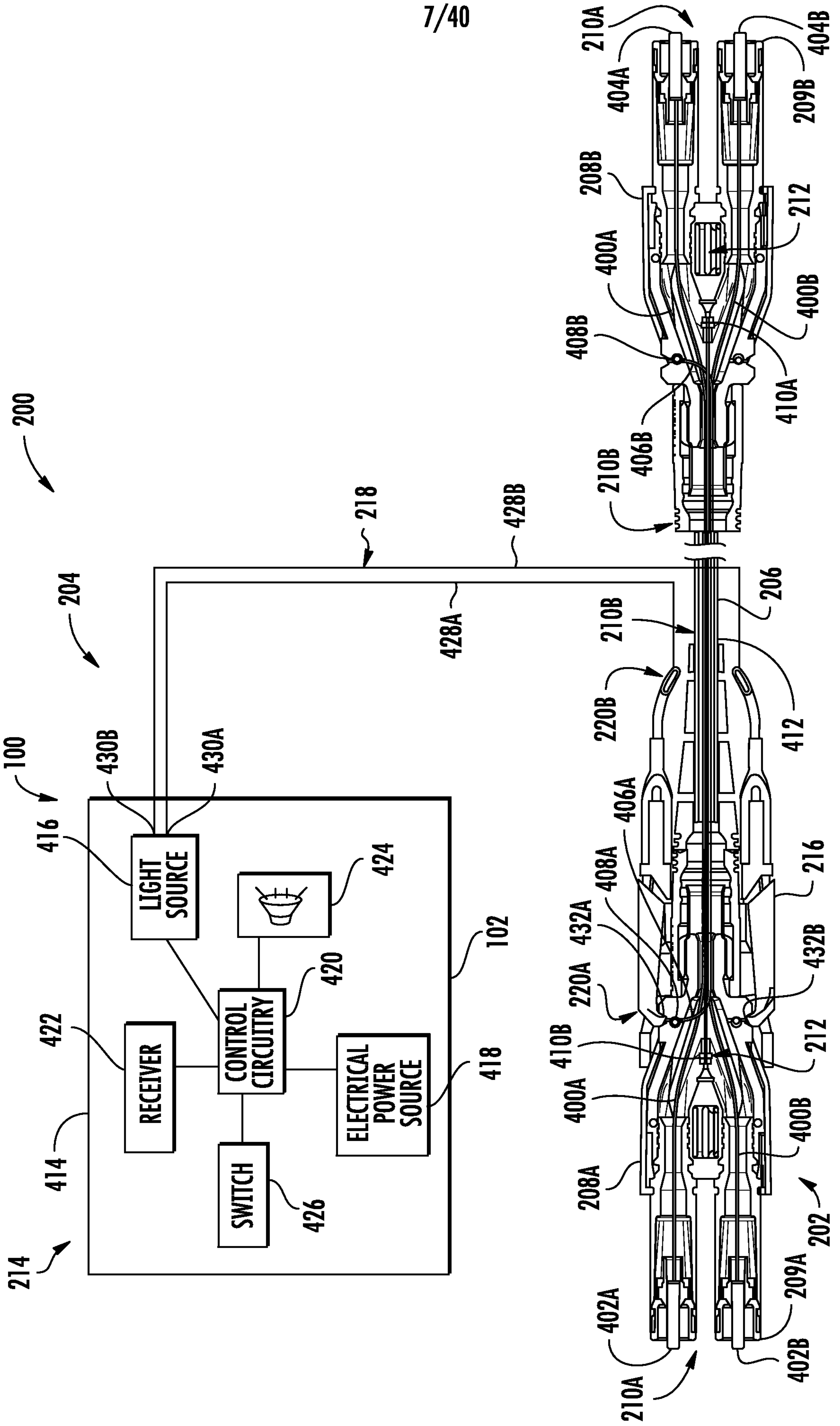
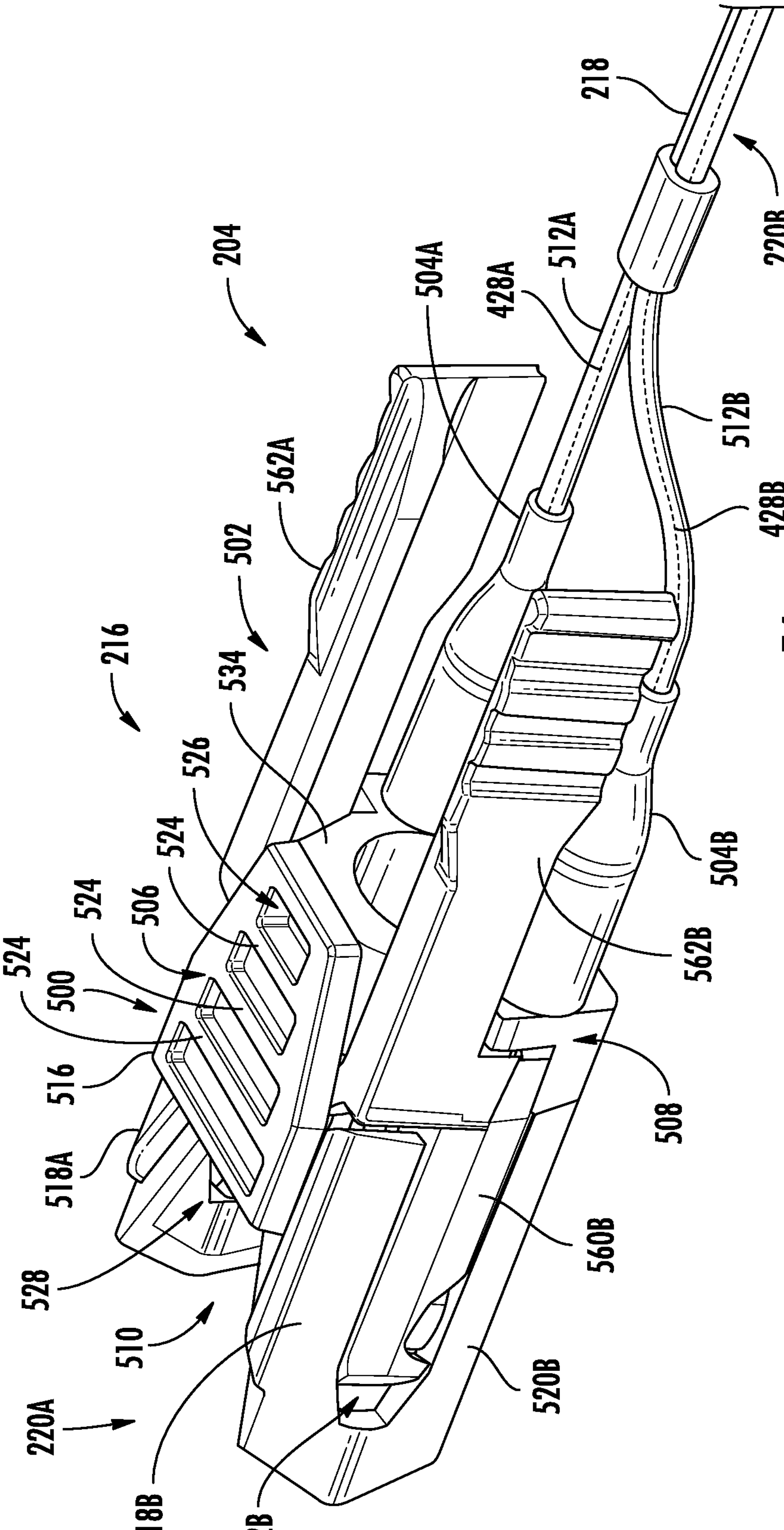

200
204
100
214
LIGHT SOURCE
CONTROL CIRCUITRY
RECEIVER
SWITCH
ELECTRICAL POWER SOURCE
416
430B
430A
424
420
422
418
426
414
102
218
428B
428A
206
202
208A
208B
209A
209B
210A
210B
212
216
220A
220B
400A
400B
402A
402B
404A
404B
406A
406B
408A
408B
410A
410B
412
432A
432B

FIG. 4



204
218
220B
512A
504A
428A
512B
428B
562A
502
216
534
526
524
524
506
524
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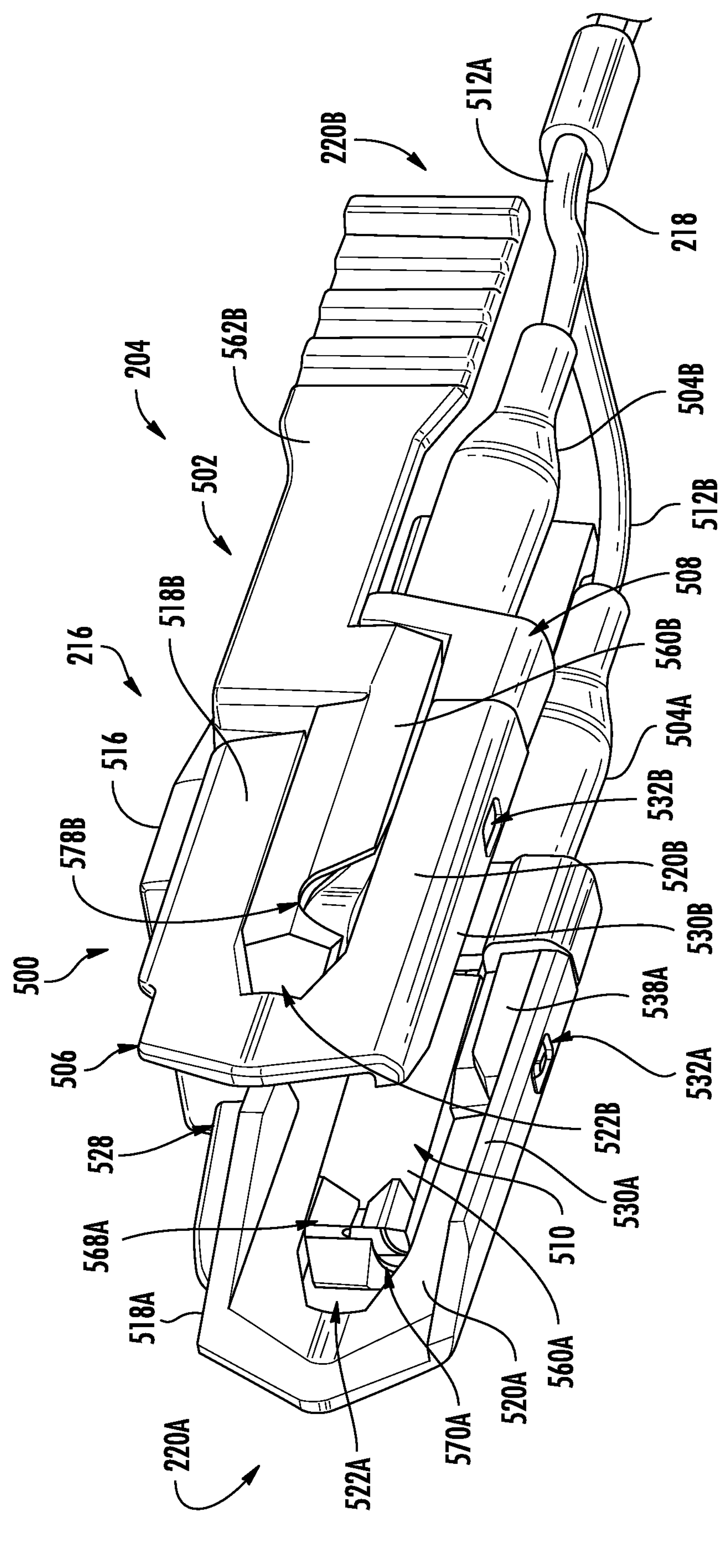
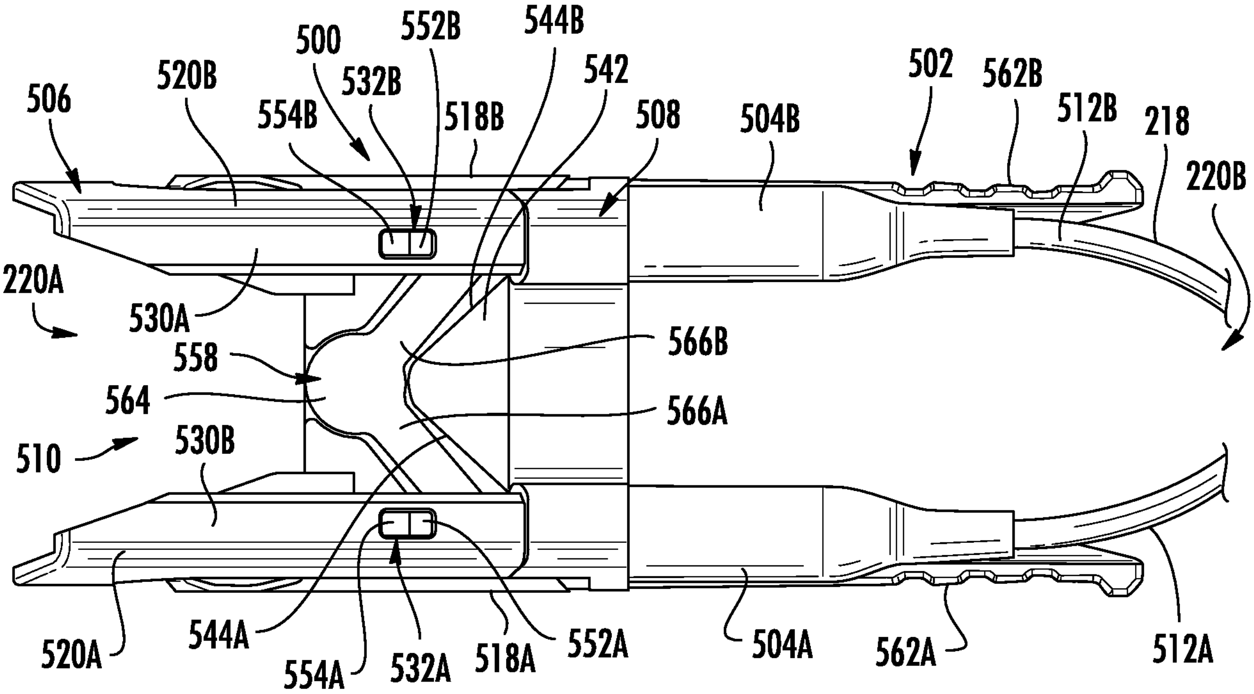
516
518A
528
510
220A
518B
522B
520B
560B
508
562B
504B

FIG. 5A



220B
512A
218
204
562B
504B
502
512B
508
216
518B
560B
516
504A
532B
578B
520B
530B
500
538A
506
532A
522B
528
530A
510
568A
518A
560A
520A
570A
220A
522A

FIG. 5B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552B
544B
542
502
562B
512B
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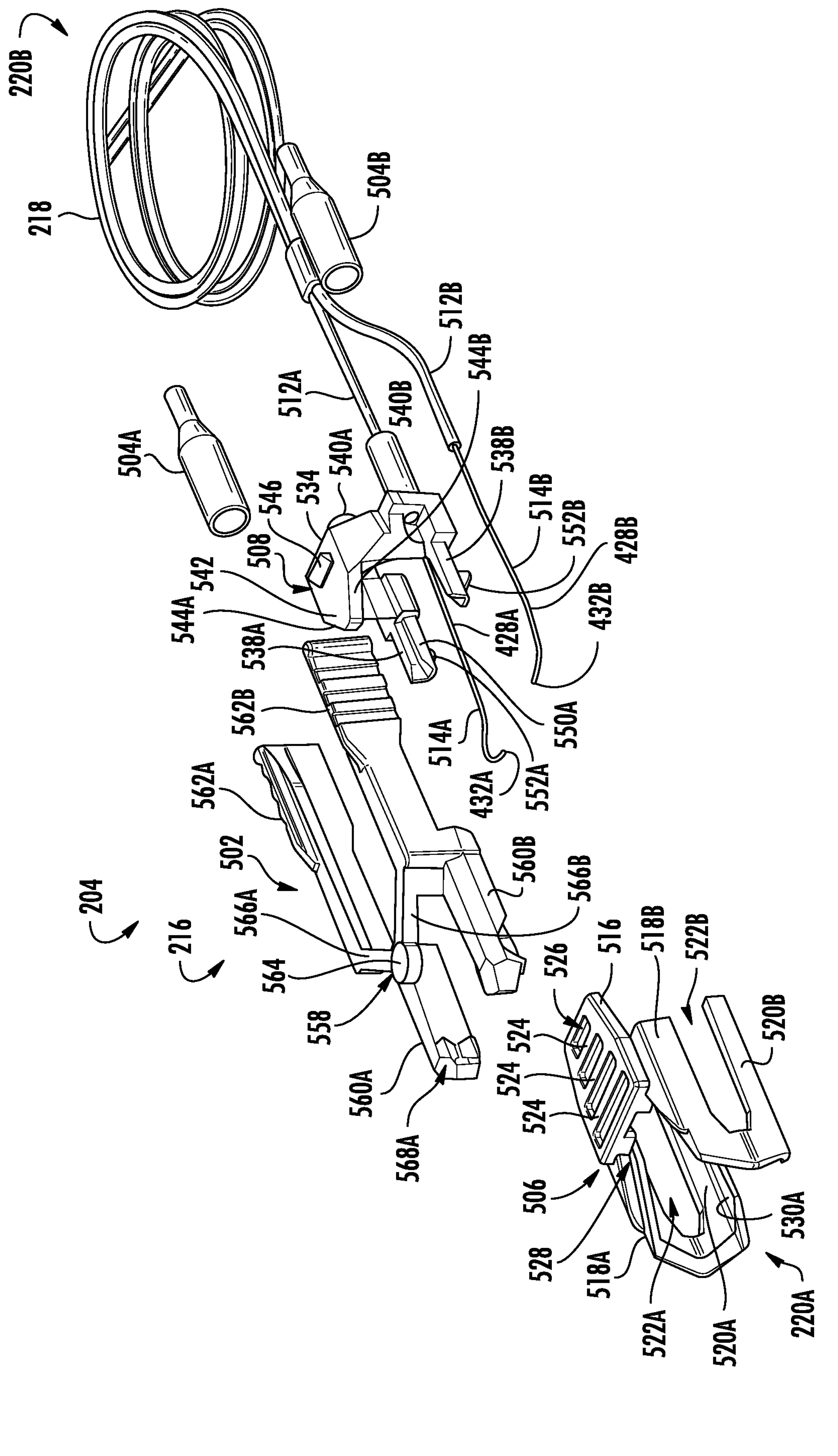
220B
506
520B
532B
554B
518B
508
504B
220A
530A
558
564
510
530B
566B
566A
544A
554A
532A
518A
552A
504A
562A
512A
520A

FIG. 5C


220B
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504B
512B
512A
544B
540B
504A
538B
546
534
540A
514B
508
552B
542
428B
544A
428A
538A
432B
562B
550A
514A
562A
432A
552A
502
560B
566B
204
216
566A
516
518B
522B
564
526
558
524
520B
524
524
560A
524
568A
506
530A
528
518A
522A
520A
220A

FIG. 5D

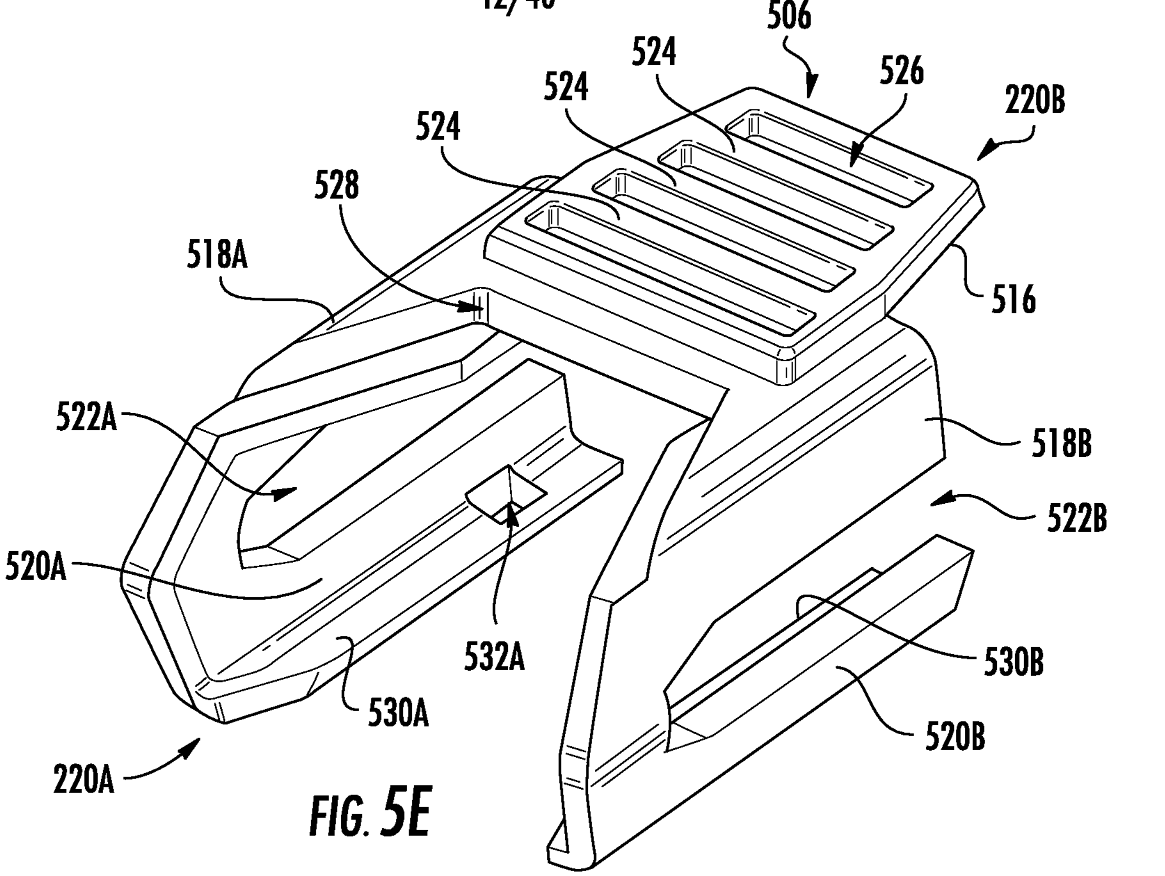
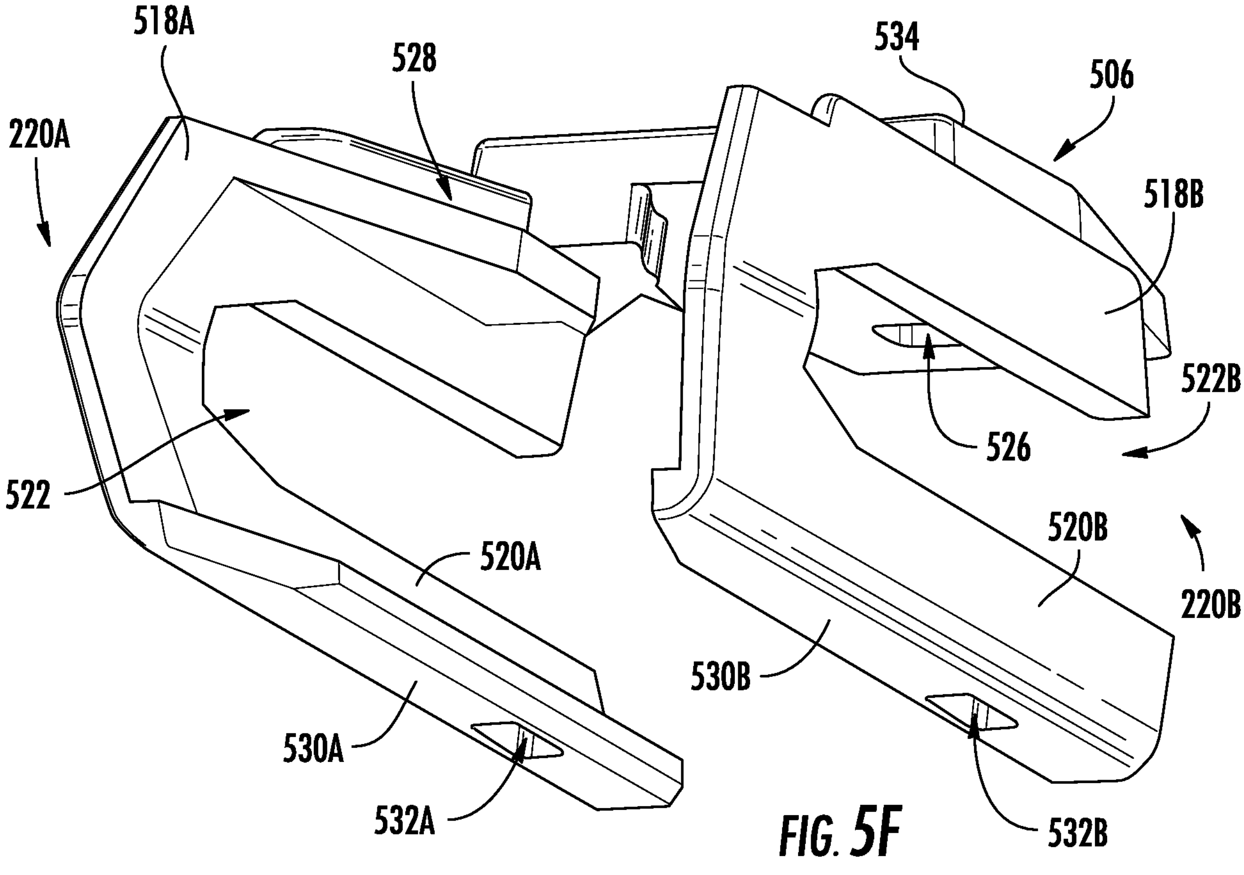

506
524
526
220B
524
524
528
518A
516
522A
518B
522B
520A
532A
530B
530A
520B
220A

FIG. 5E


518A
534
528
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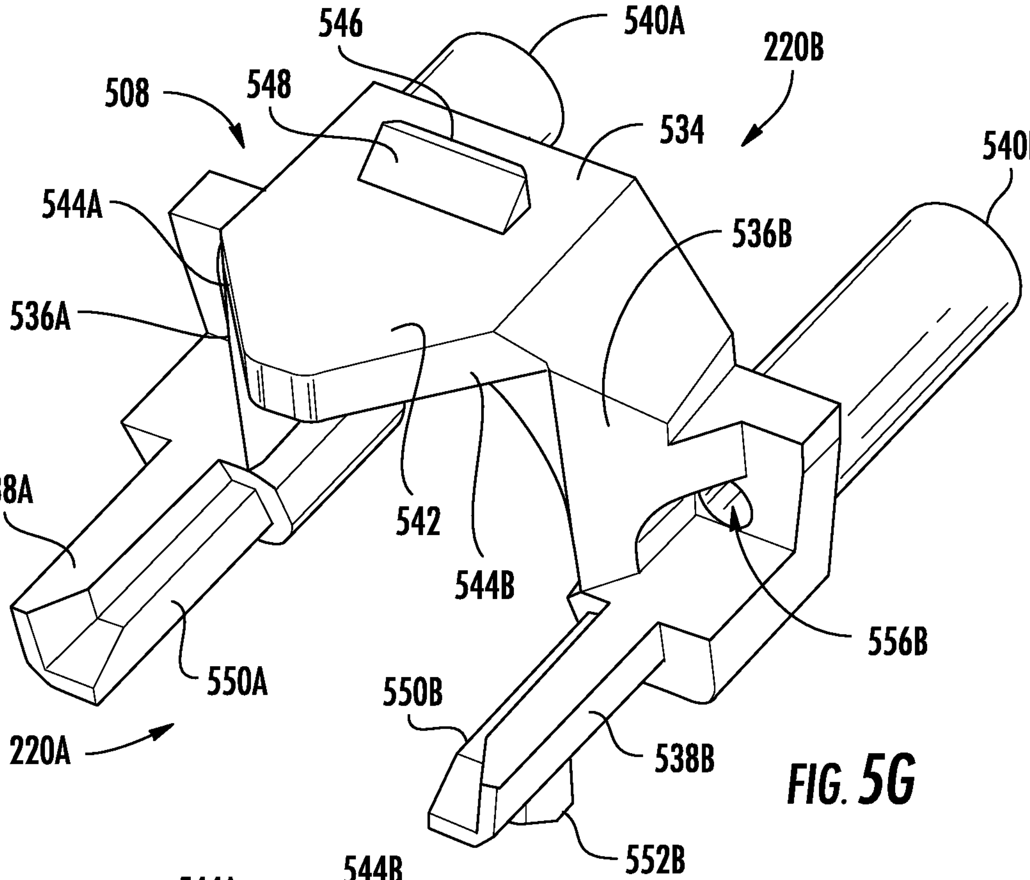
220A
518B
522B
526
522
520B
520A
220B
530B
530A
532A
532B

FIG. 5F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540A
220B
508
548
534
540B
544A
536B
536A
538A
542
544B
556B
550A
550B
538B
220A
552B

FIG. 5G

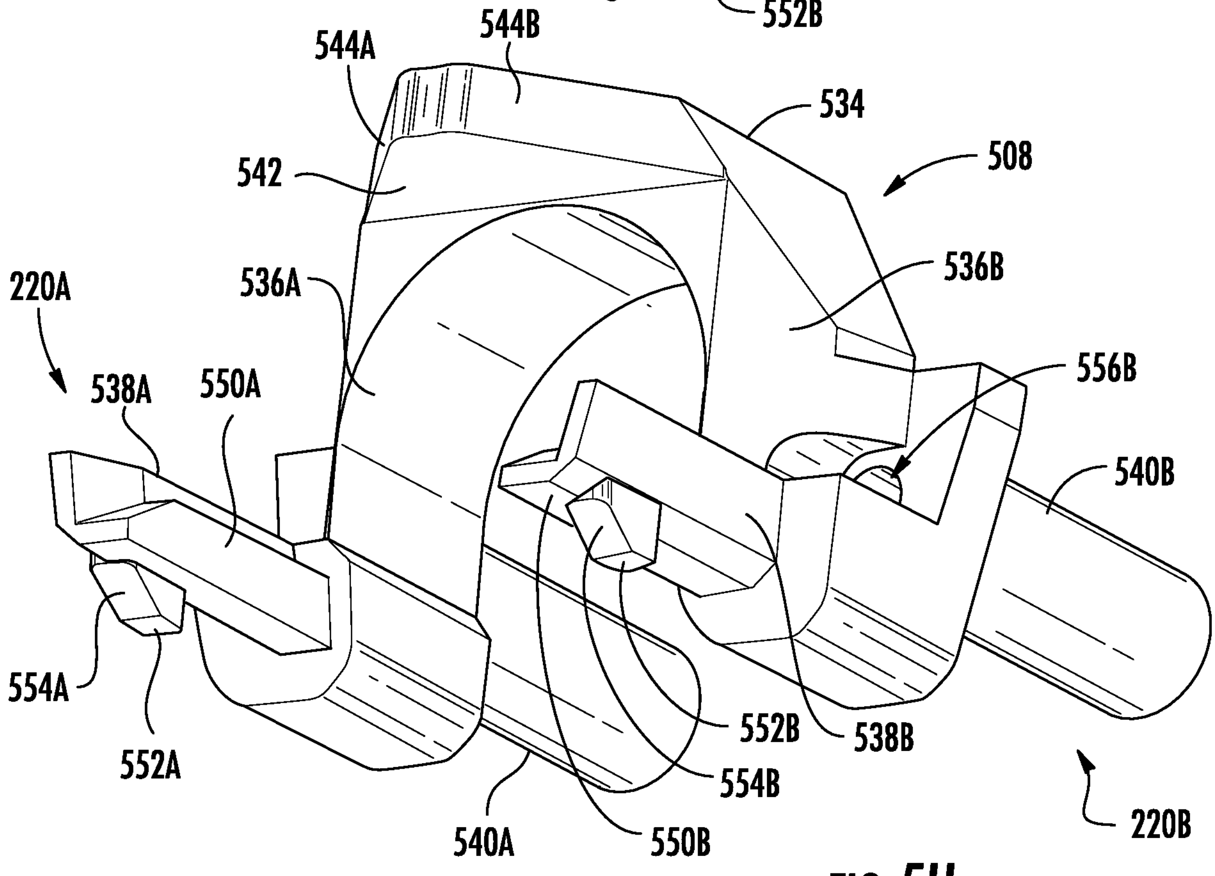

544B
544A
534
508
542
536A
536B
220A
538A
550A
556B
540B
554A
552B
538B
552A
554B
540A
550B
220B

FIG. 5H

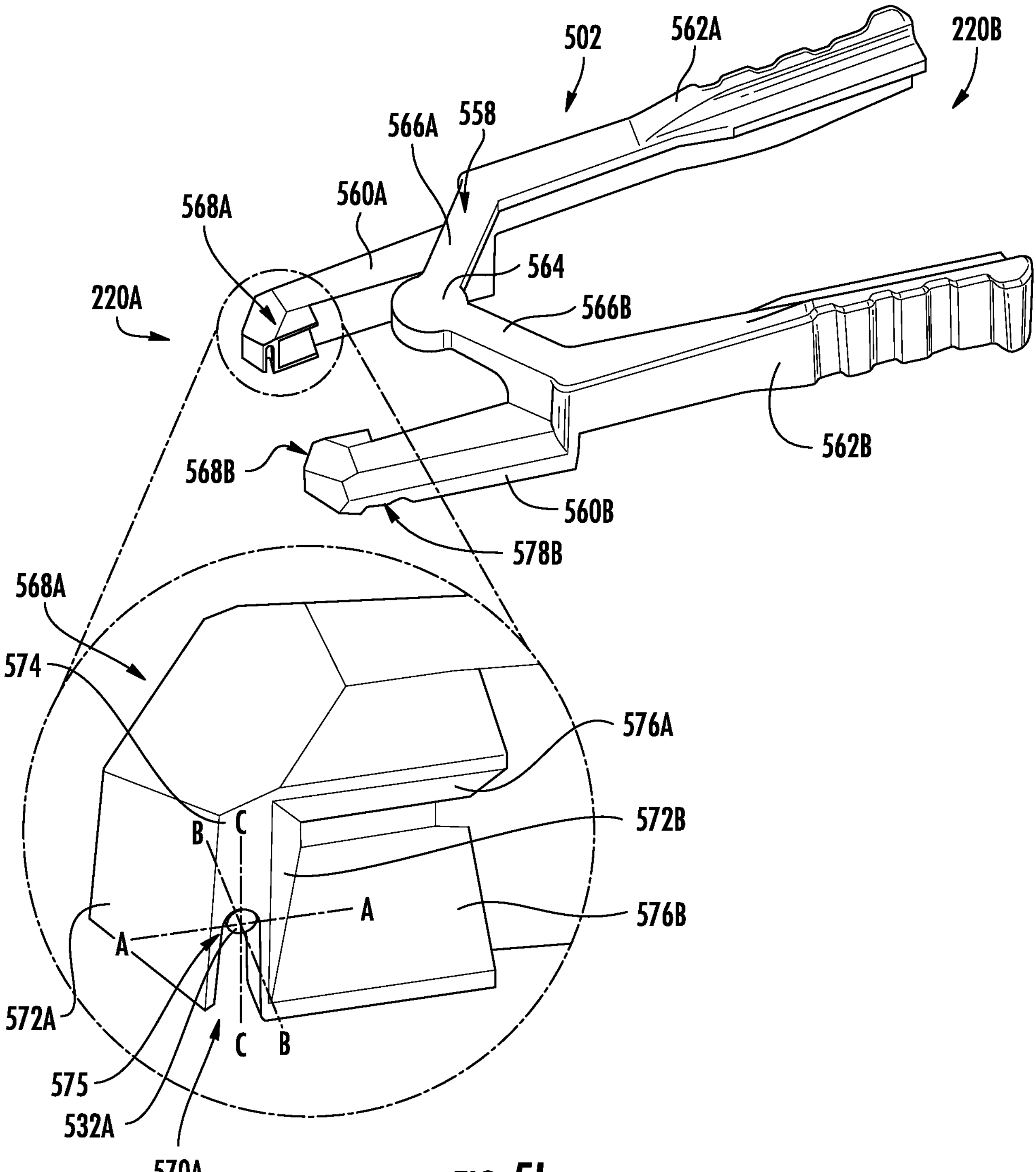

502
562A
220B
566A
558
560A
568A
564
220A
566B
562B
568B
560B
578B
568A
574
576A
C
B
572B
A
576B
A
572A
C
B
575
532A
570A

FIG. 5I

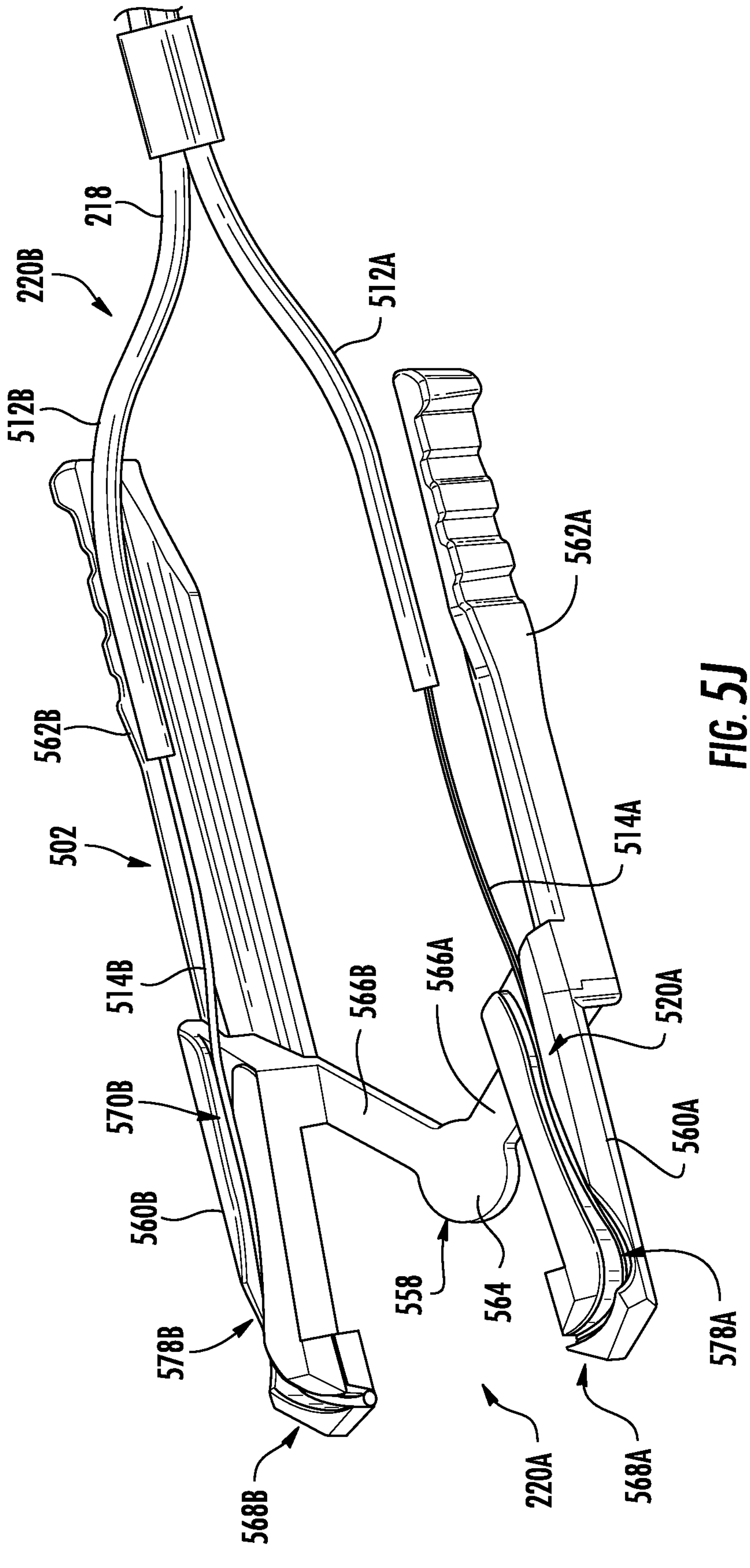
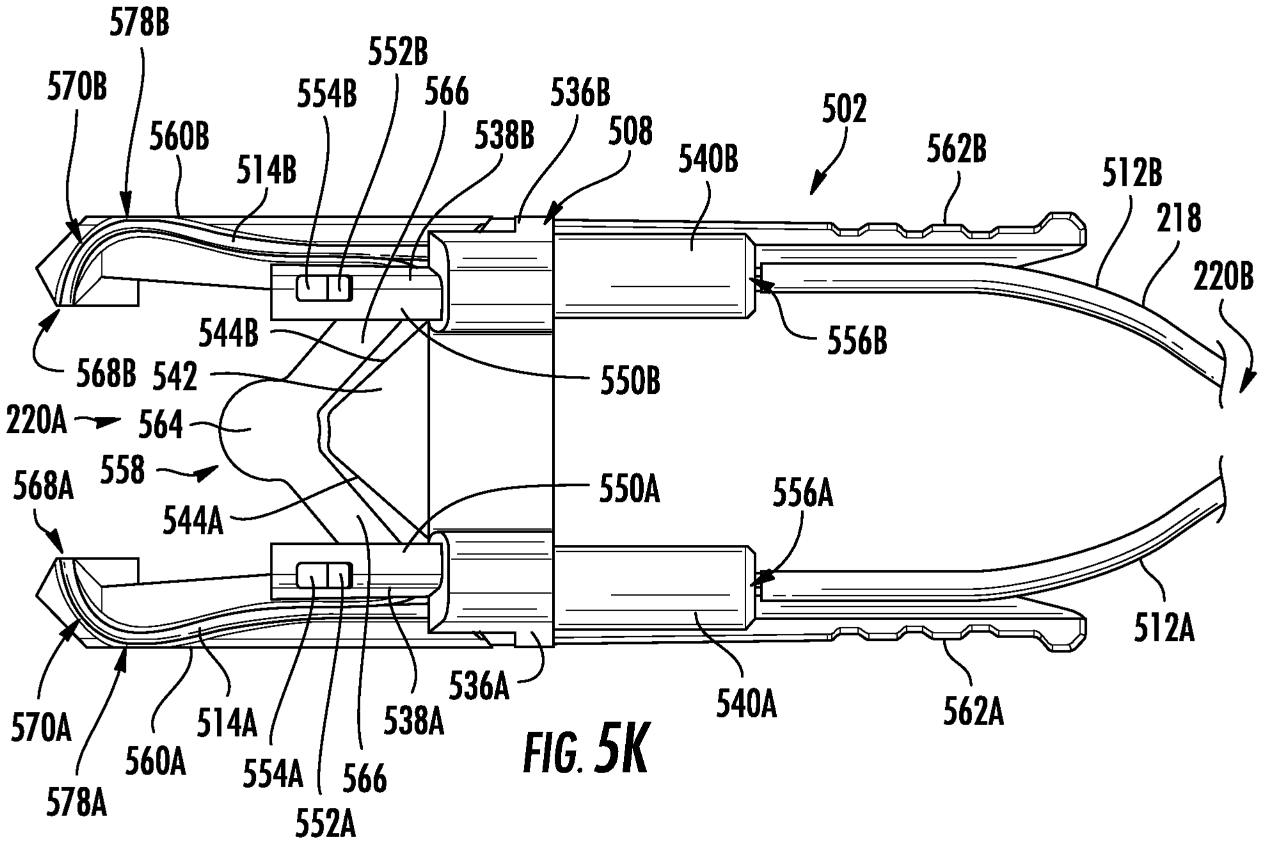

218
220B
512A
512B
562A
562B
502
514A
514B
566B
566A
520A
570B
560A
560B
558
564
578A
578B
568A
568B
220A

FIG. 5J


578B
570B
560B
514B
554B
552B
566
538B
536B
508
540B
502
562B
512B
218
220B
568B
542
544B
550B
556B
220A
564
558
568A
544A
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570A
560A
514A
554A
552A
566
538A
536A
540A
562A
578A

FIG. 5K

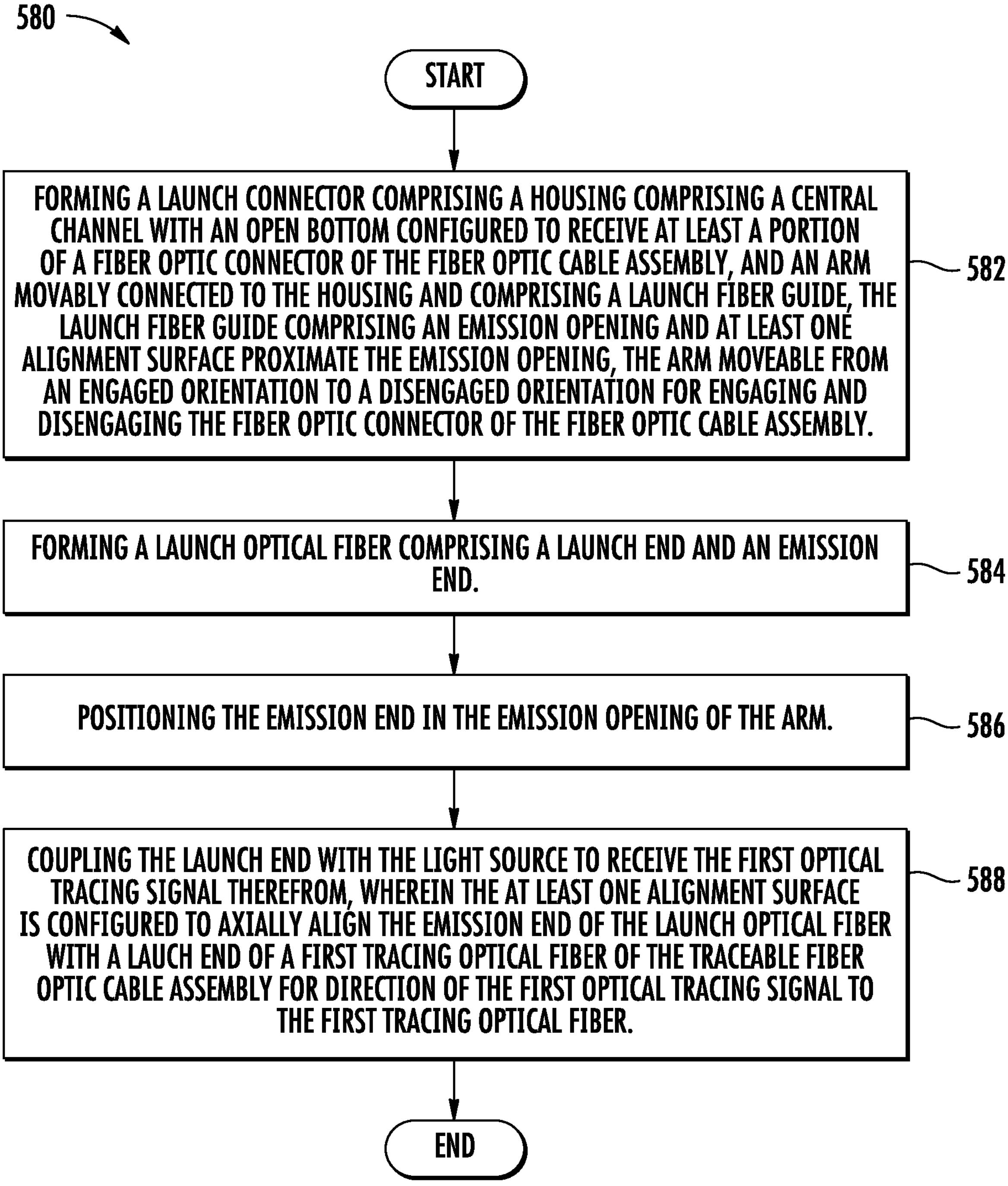

580
START
FORMING A LAUNCH CONNECTOR COMPRISING A HOUSING COMPRISING A CENTRAL CHANNEL WITH AN OPEN BOTTOM CONFIGURED TO RECEIVE AT LEAST A PORTION OF A FIBER OPTIC CONNECTOR OF THE FIBER OPTIC CABLE ASSEMBLY, AND AN ARM MOVABLY CONNECTED TO THE HOUSING AND COMPRISING A LAUNCH FIBER GUIDE, THE LAUNCH FIBER GUIDE COMPRISING AN EMISSION OPENING AND AT LEAST ONE ALIGNMENT SURFACE PROXIMATE THE EMISSION OPENING, THE ARM MOVEABLE FROM AN ENGAGED ORIENTATION TO A DISENGAGED ORIENTATION FOR ENGAGING AND DISENGAGING THE FIBER OPTIC CONNECTOR OF THE FIBER OPTIC CABLE ASSEMBLY.
582
FORMING A LAUNCH OPTICAL FIBER COMPRISING A LAUNCH END AND AN EMISSION END.
584
POSITIONING THE EMISSION END IN THE EMISSION OPENING OF THE ARM.
586
COUPLING THE LAUNCH END WITH THE LIGHT SOURCE TO RECEIVE THE FIRST OPTICAL TRACING SIGNAL THEREFROM, WHEREIN THE AT LEAST ONE ALIGNMENT SURFACE IS CONFIGURED TO AXIALLY ALIGN THE EMISSION END OF THE LAUNCH OPTICAL FIBER WITH A LAUCH END OF A FIRST TRACING OPTICAL FIBER OF THE TRACEABLE FIBER OPTIC CABLE ASSEMBLY FOR DIRECTION OF THE FIRST OPTICAL TRACING SIGNAL TO THE FIRST TRACING OPTICAL FIBER.
588
END

FIG. 5L

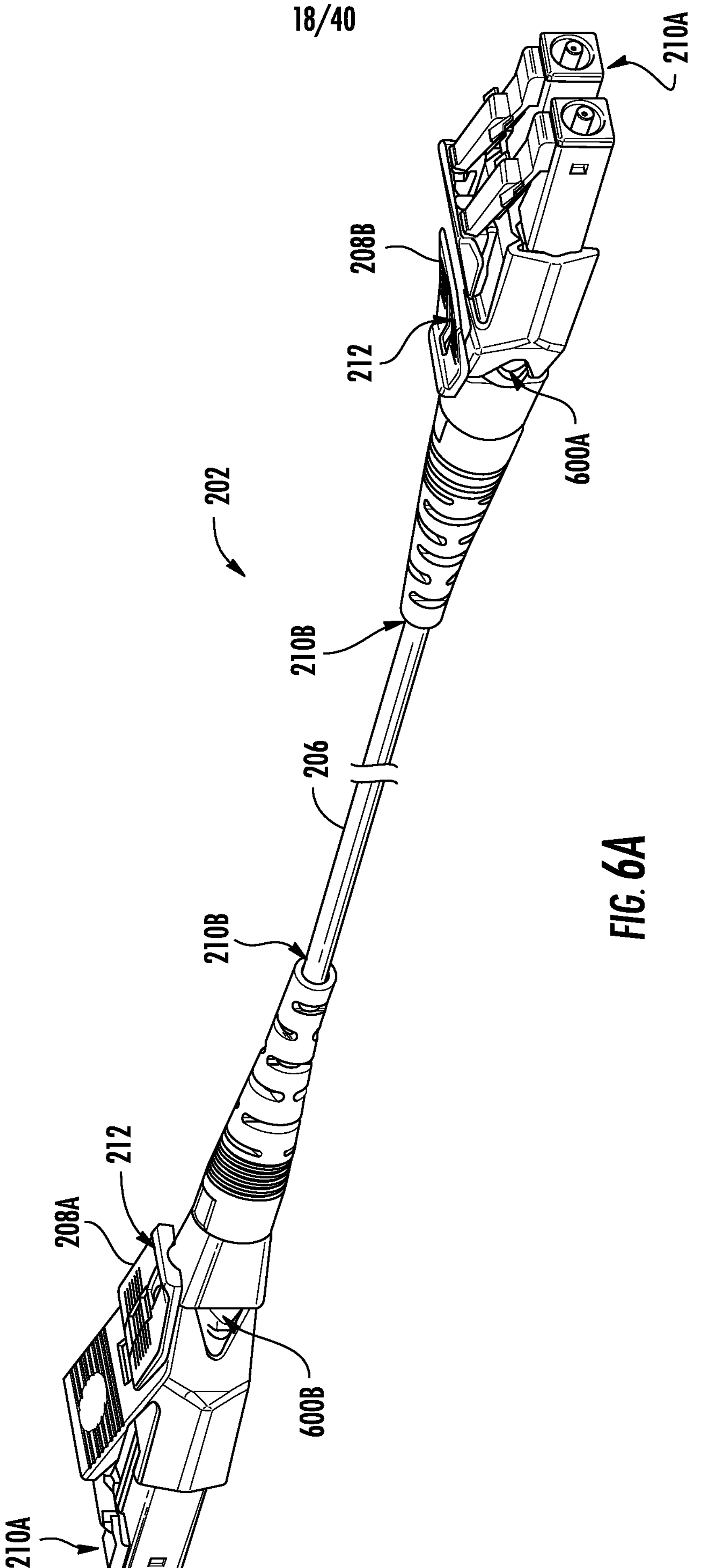


FIG. 6A

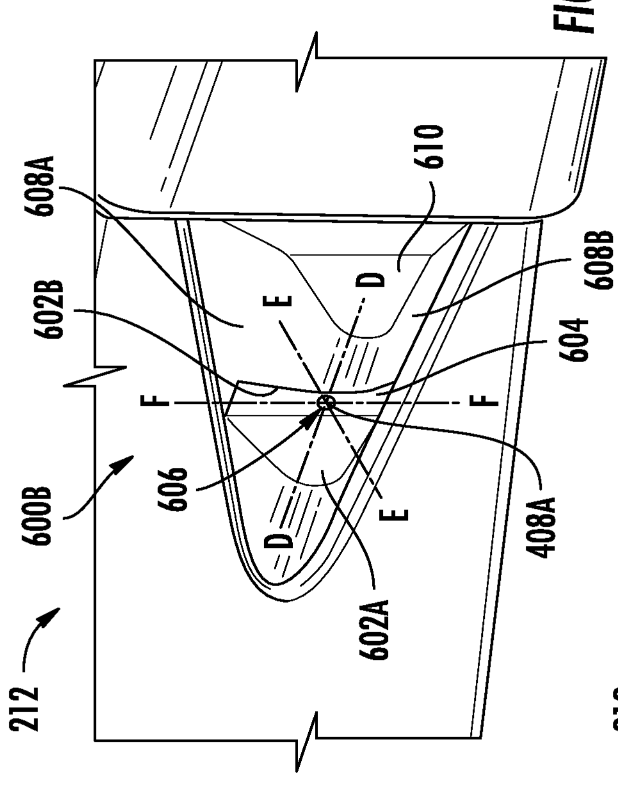


FIG. 6B

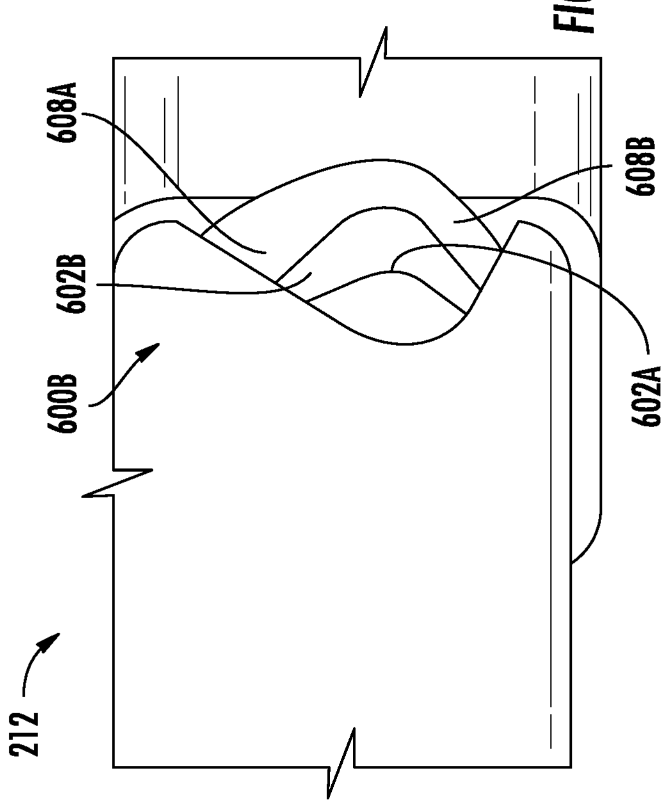


FIG. 6C

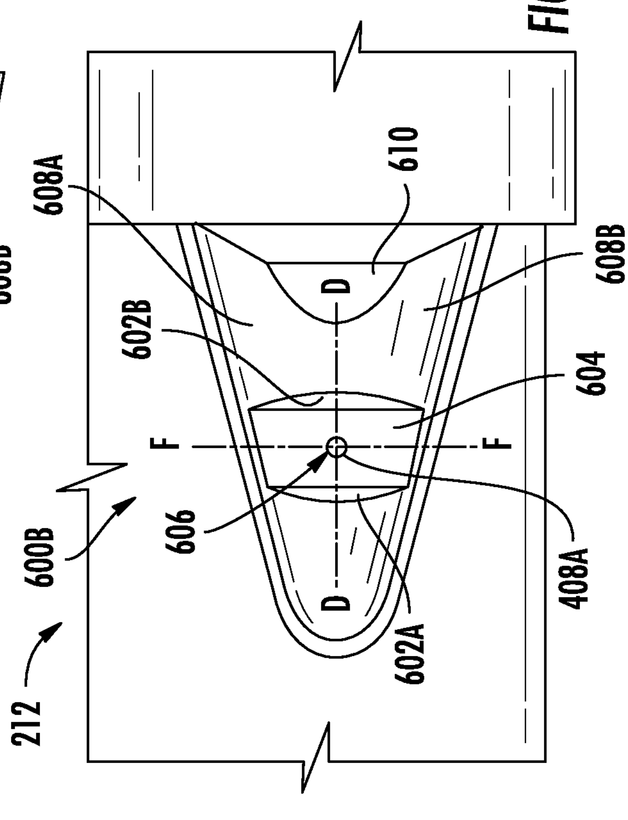


FIG. 6D

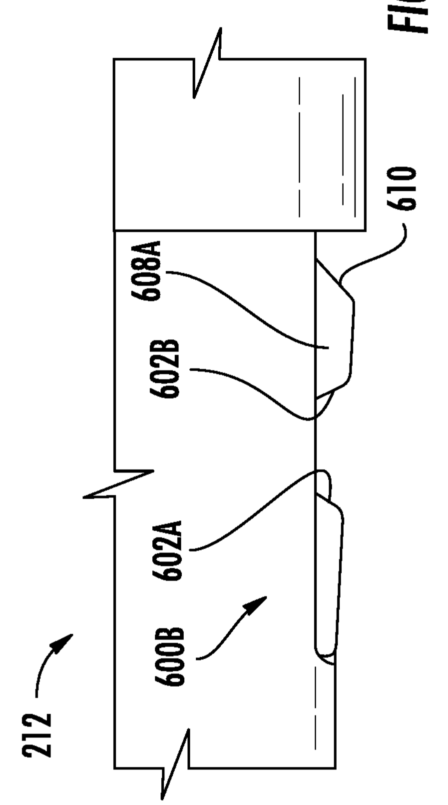


FIG. 6E

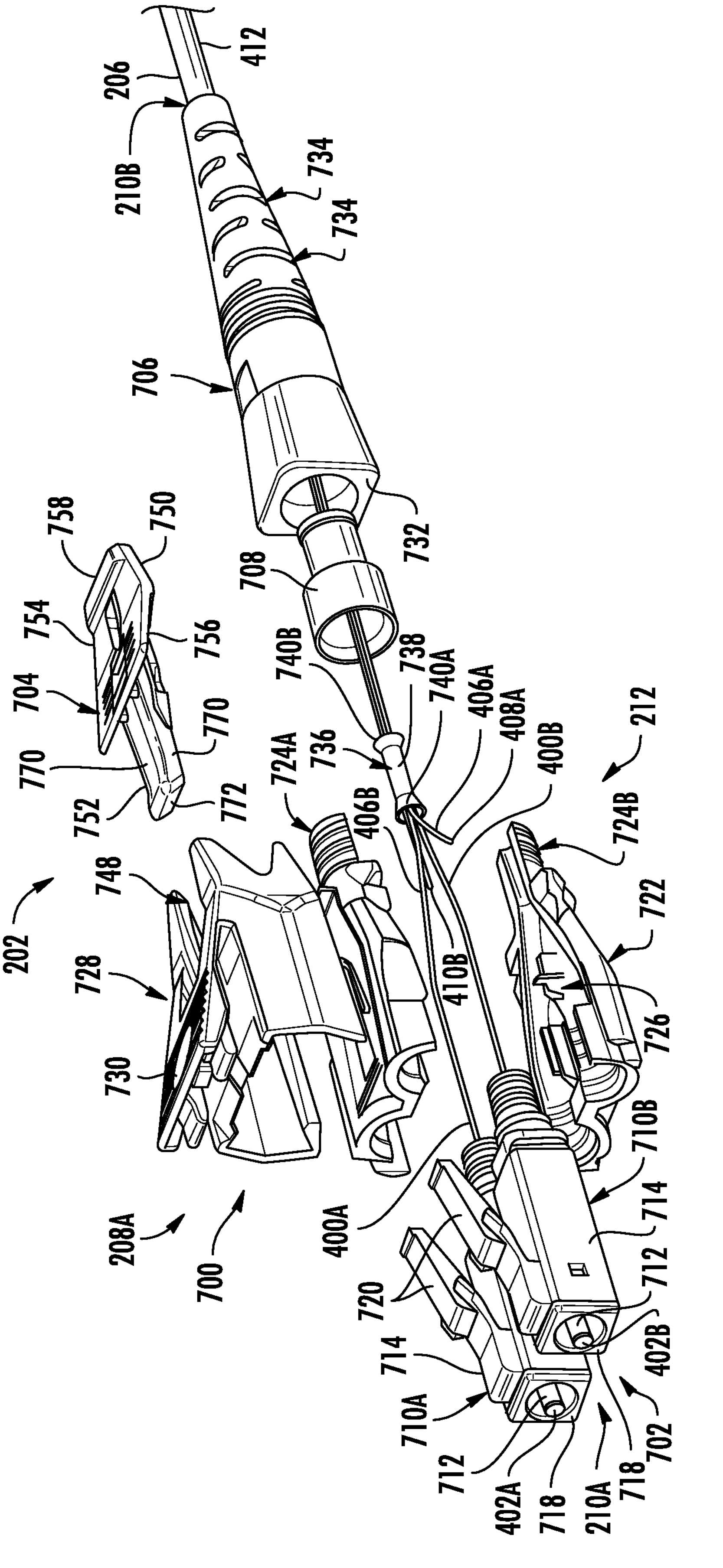

412
206
210B
734
734
706
732
708
758
750
754
756
704
770
770
752
772
740B
738
740A
406A
408A
400B
736
724A
406B
410B
212
724B
722
726
202
748
728
730
710B
714
712
402B
702
718
210A
718
402A
712
710A
714
720
400A
700
208A

FIG. 7A

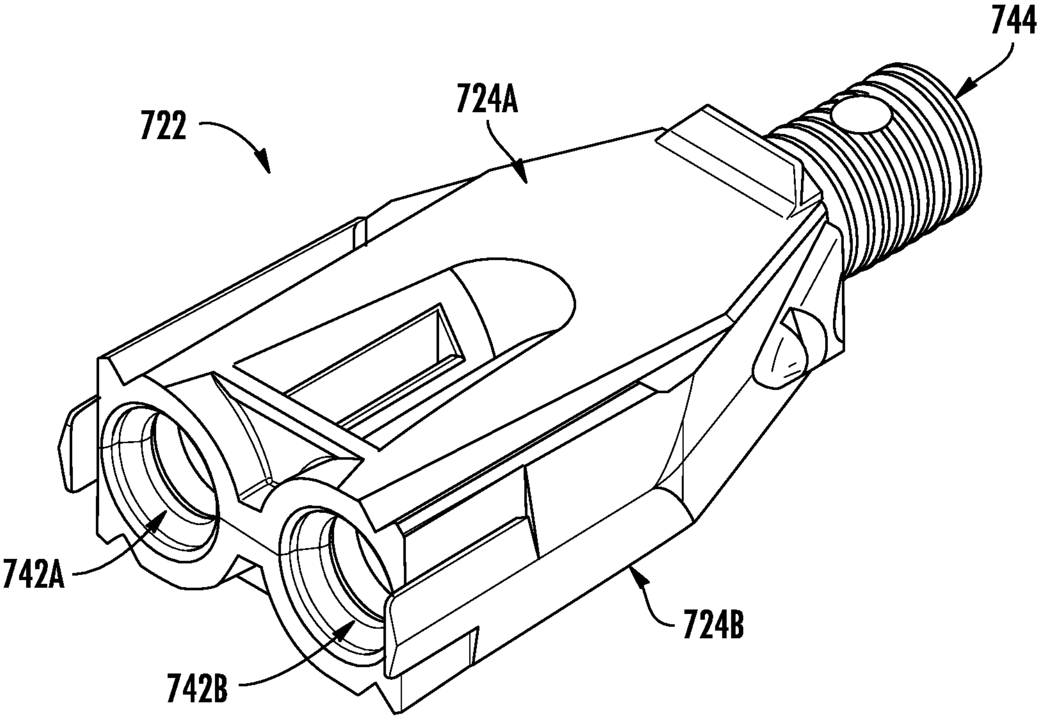


FIG. 7B

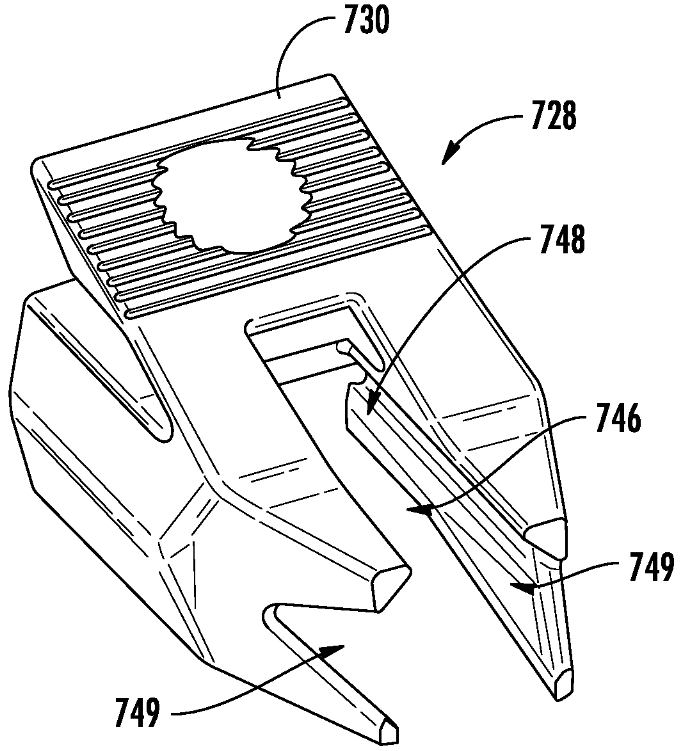


FIG. 7C

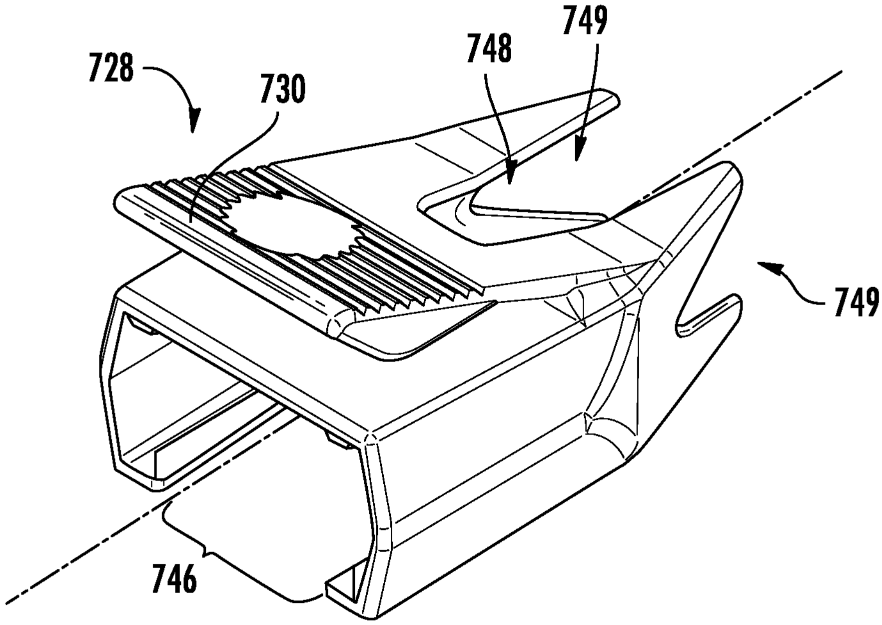


FIG. 7D

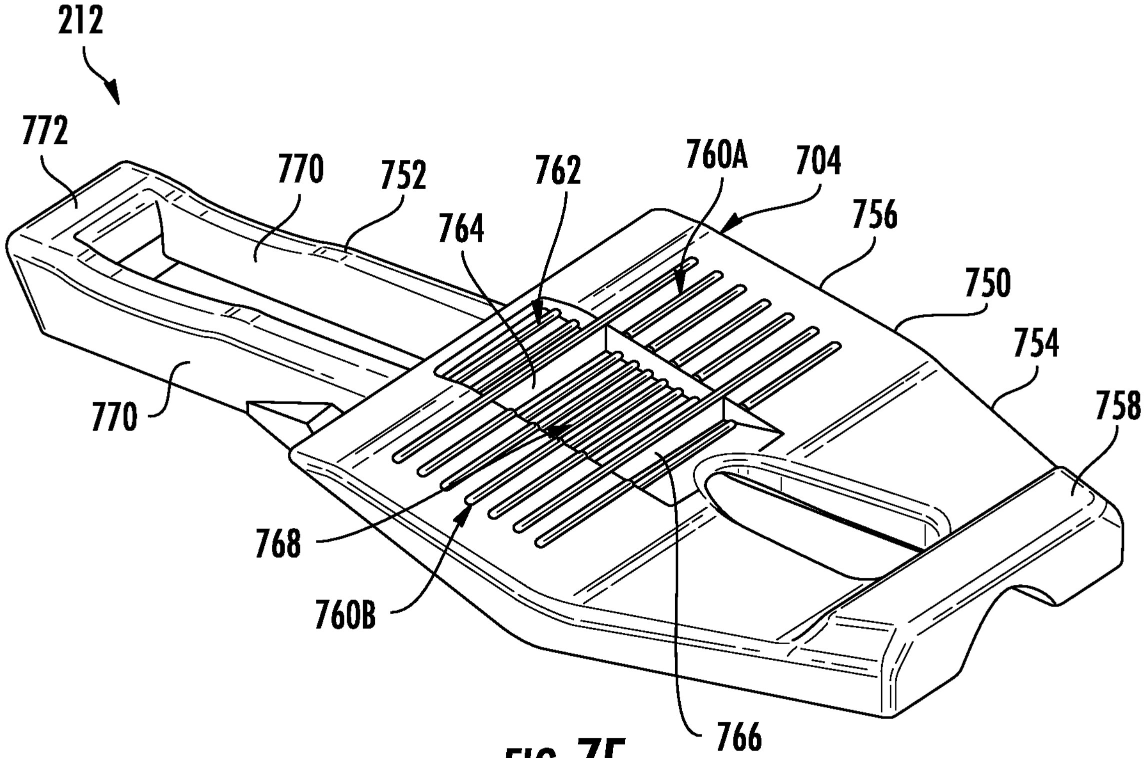

212
772
770
752
762
760A
704
756
764
750
754
758
770
768
760B
766

FIG. 7E

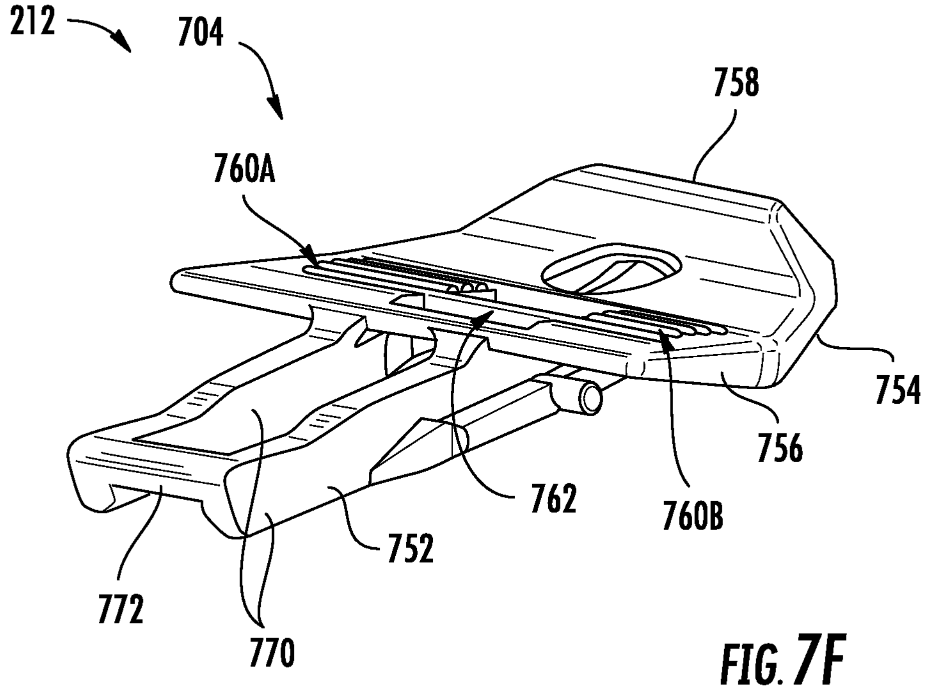

212
704
758
760A
754
756
762
760B
752
772
770

FIG. 7F

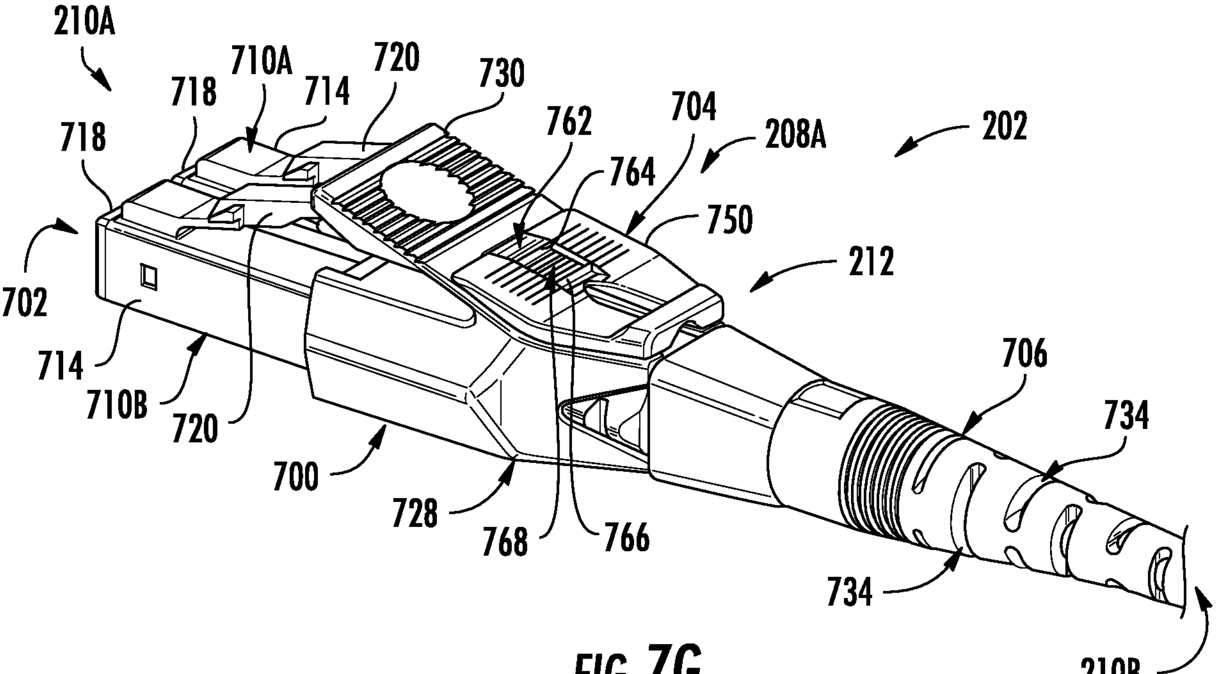

210A
710A
718
714
720
730
718
762
704
208A
202
764
750
702
212
714
710B
720
706
734
700
728
768
766
734
210B

FIG. 7G

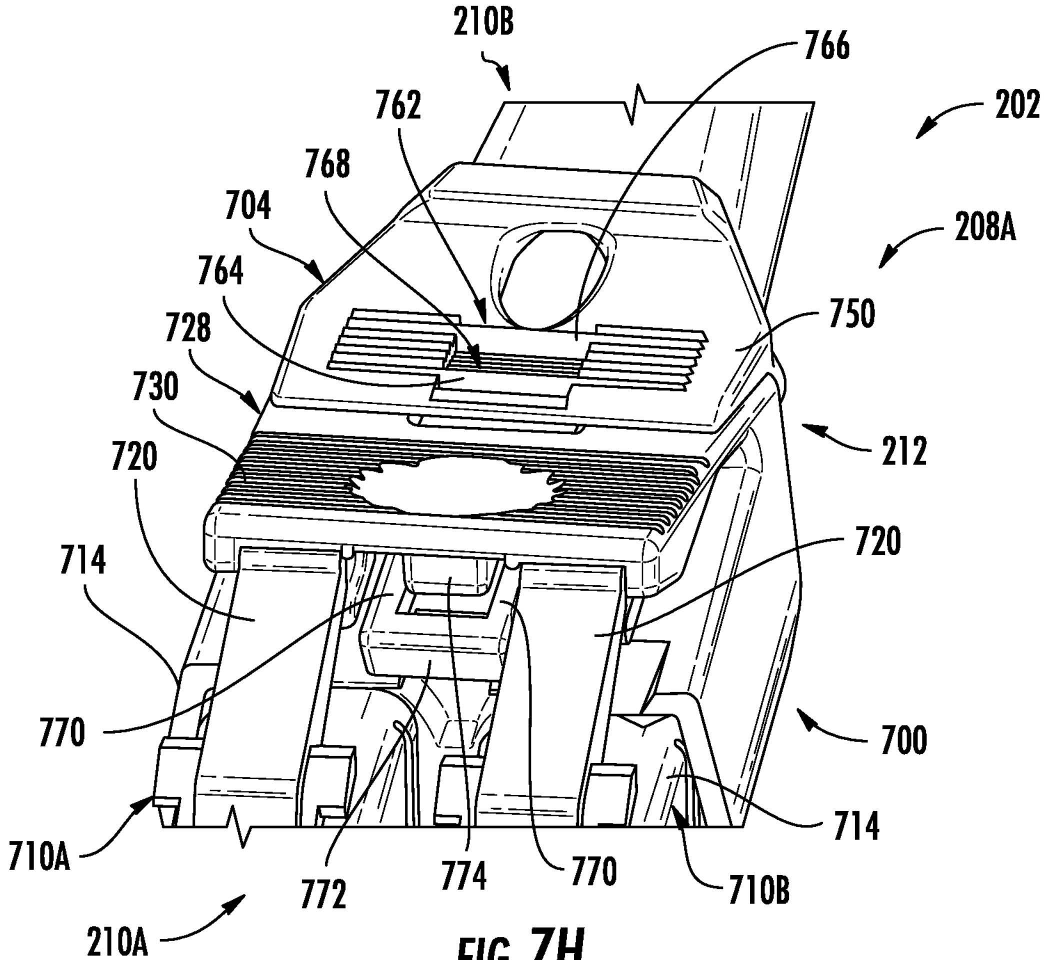

210B
766
202
762
768
704
208A
764
750
728
730
212
720
720
714
770
700
714
710A
772
774
770
710B
210A

FIG. 7H

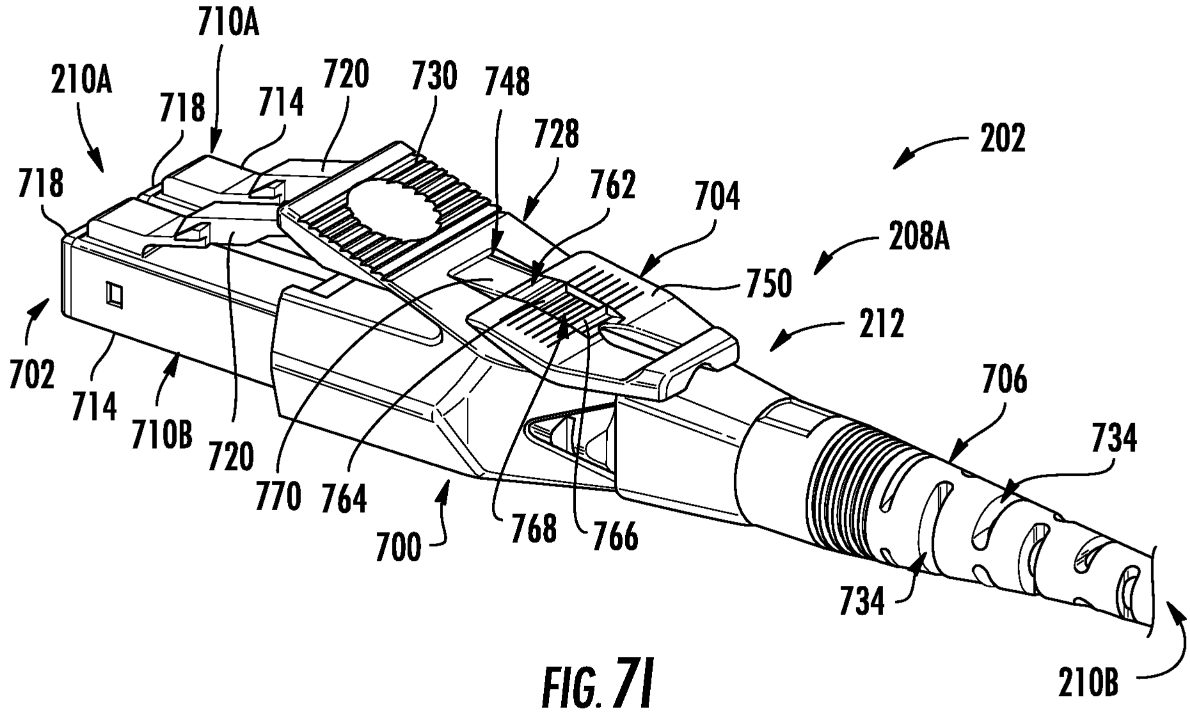
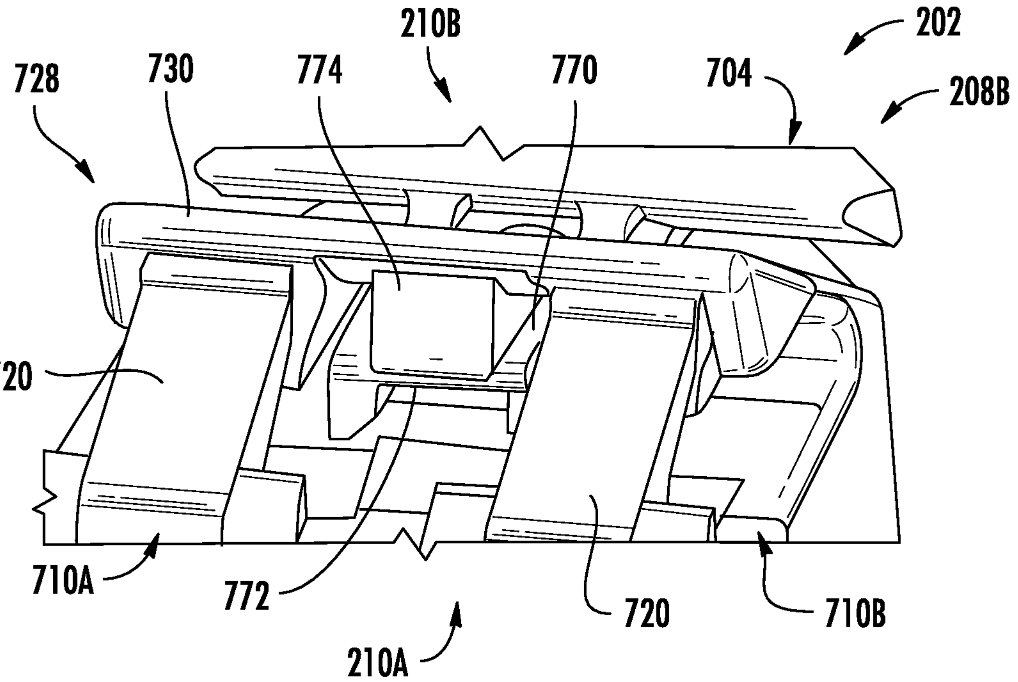

710A
210A
718
714
720
730
748
728
762
704
202
208A
718
750
212
702
714
710B
720
770
764
700
768
766
706
734
734
210B

FIG. 7I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202
728
730
774
770
704
208B
720
710A
772
720
710B
210A

FIG. 7J

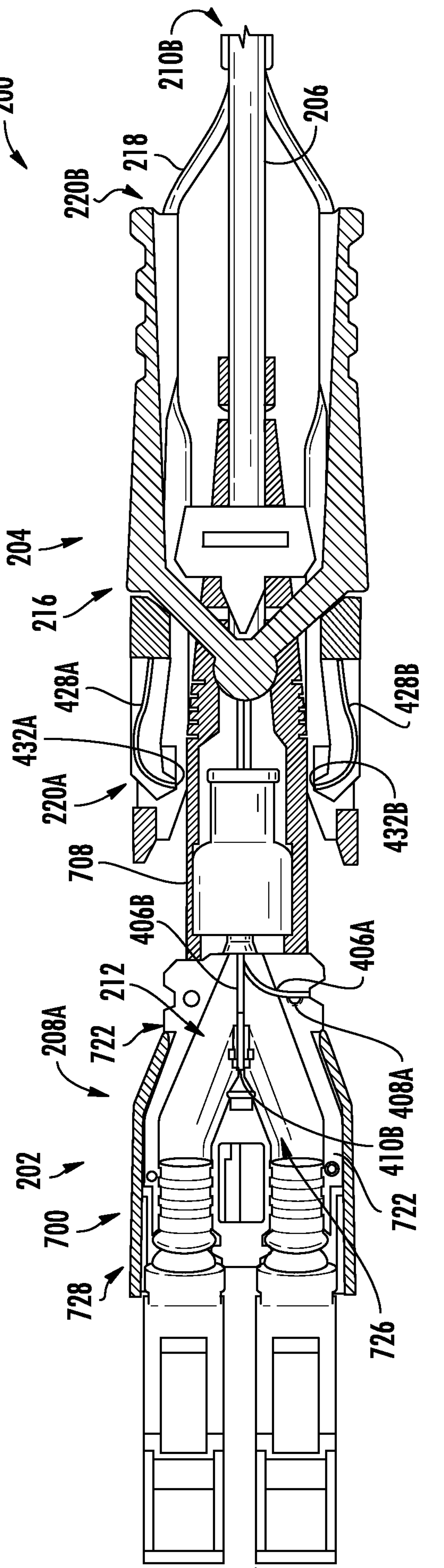
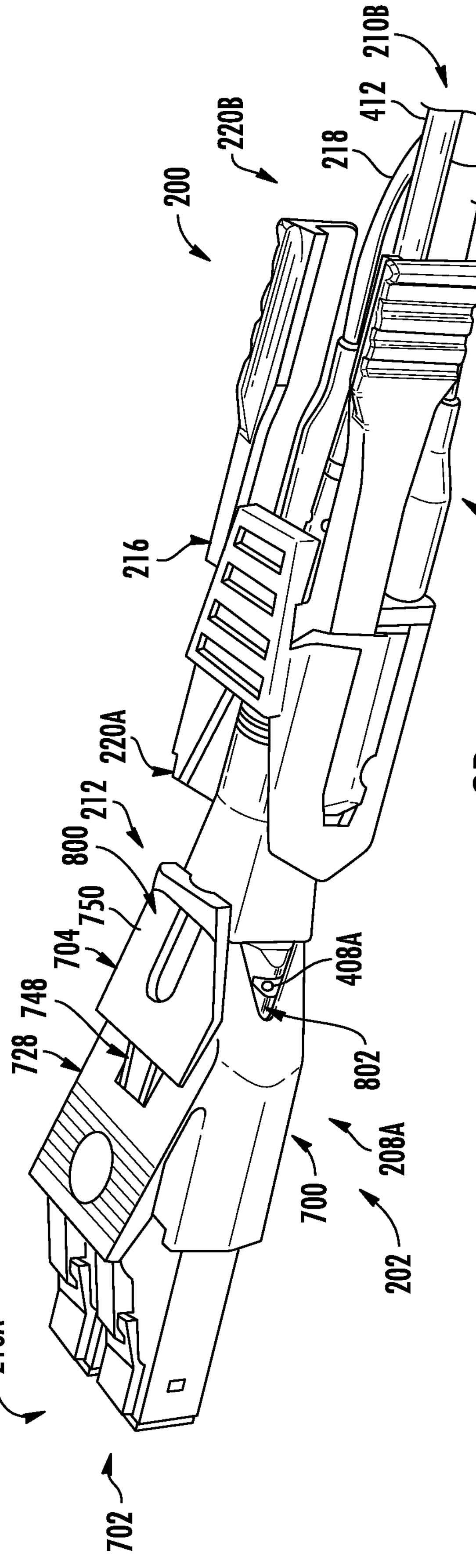

200
210B
206
218
220B
204
216
428A
428B
432A
432B
220A
708
406B
406A
212
208A
722
408A
410B
202
722
700
726
728
210A
702

FIG. 8A


210B
412
206
218
220B
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220A
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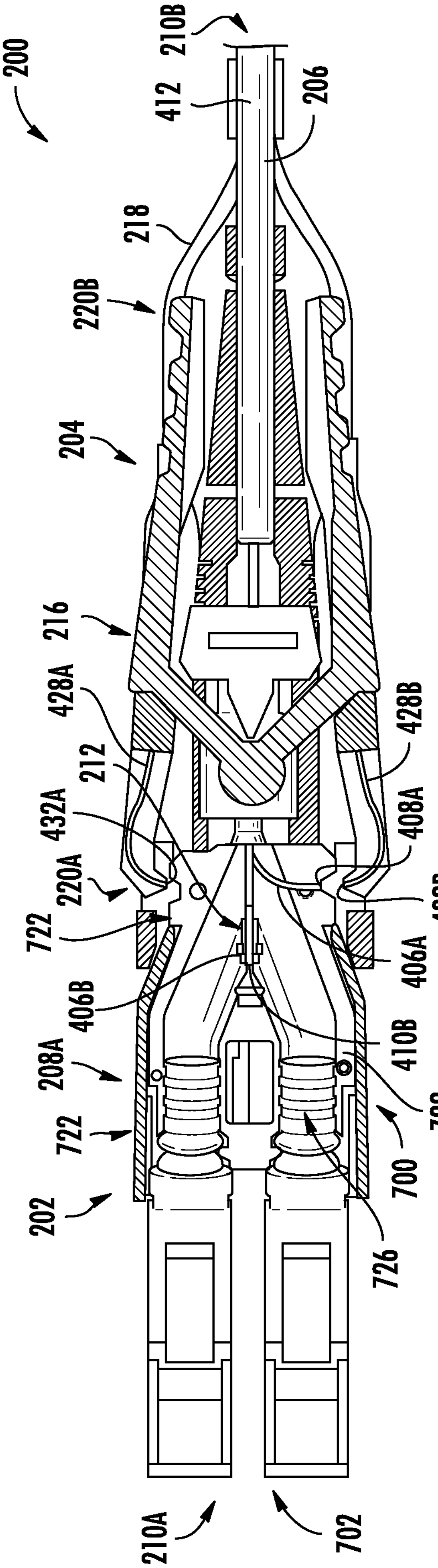
800
750
704
408A
748
728
802
208A
700
202
210A
702

FIG. 8B


200
210B
412
206
218
220B
204
216
428A
428B
212
432A
408A
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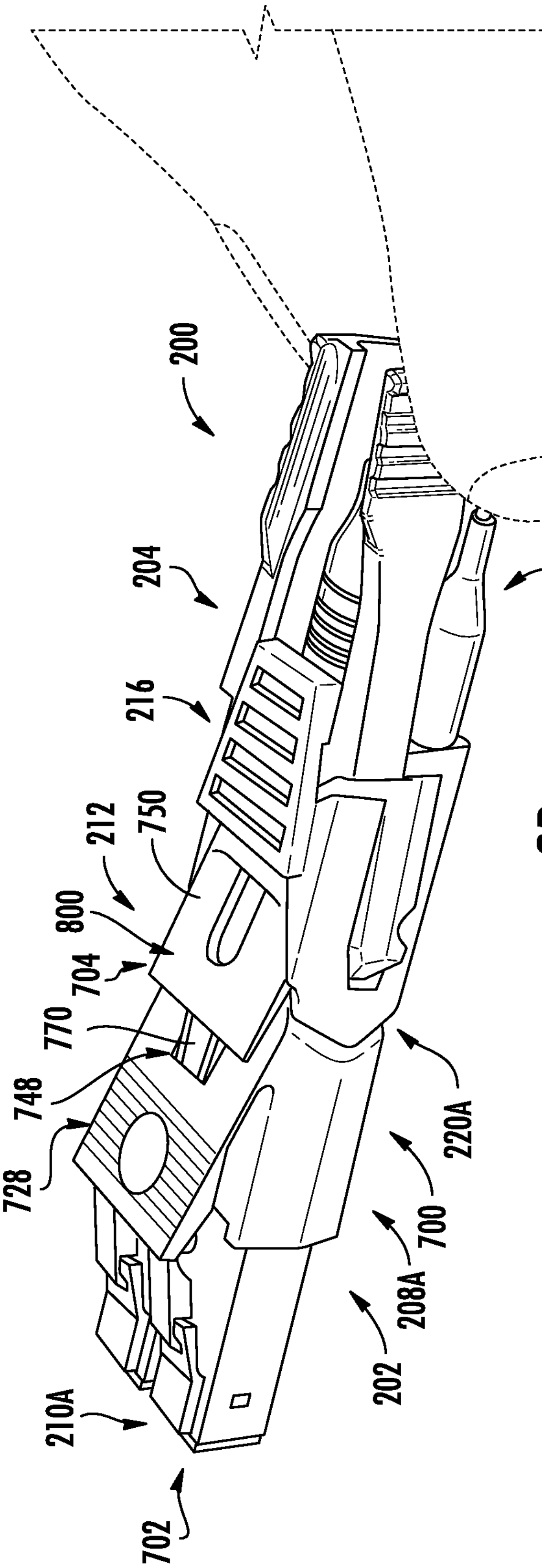
432B
722
406A
406B
410B
208A
722
722
700
202
726
210A
702

FIG. 8C


200
204
220B
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212
750
800
704
770
748
728
220A
700
208A
202
210A
702

FIG. 8D

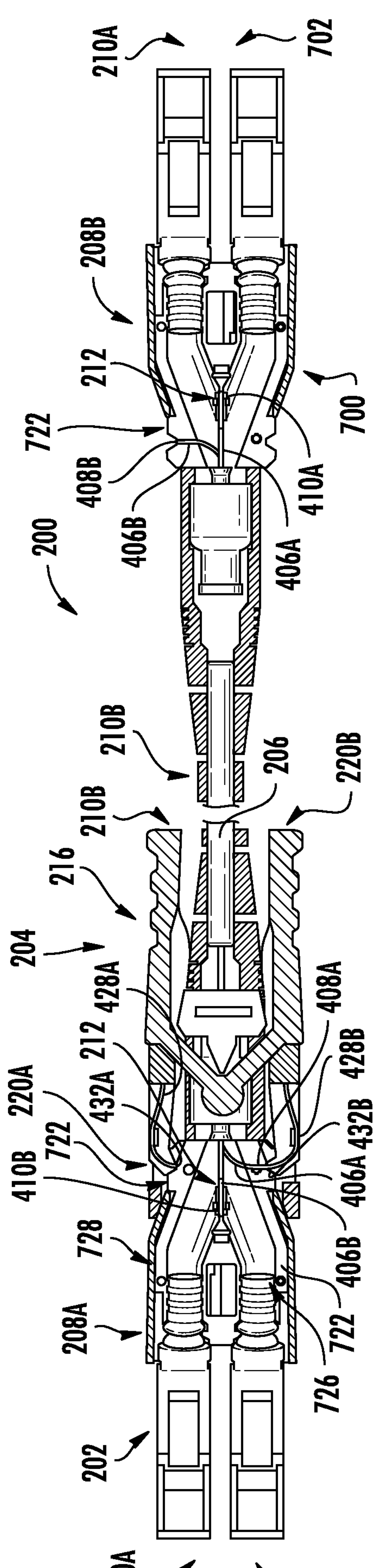
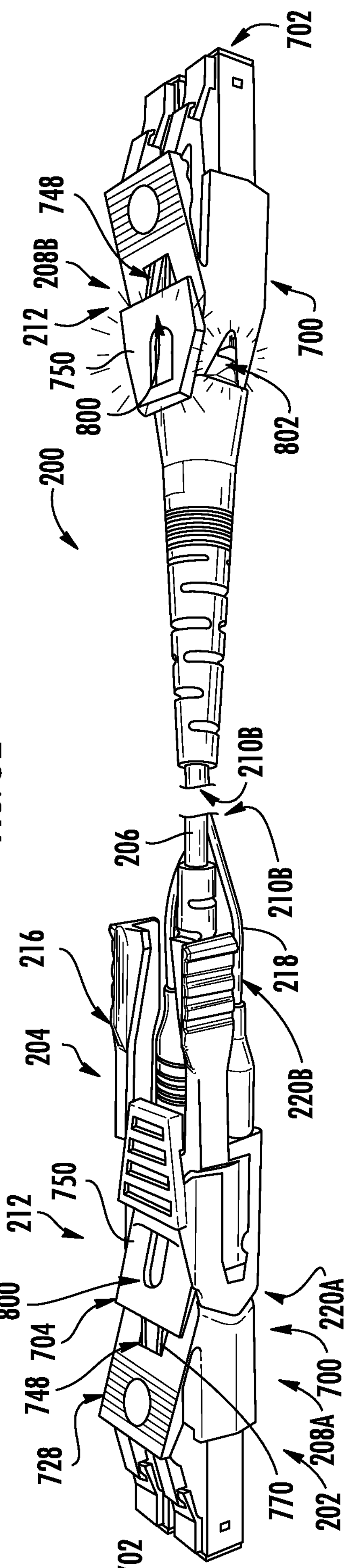

210A
702
208B
212
722
408B
406B
200
406A
410A
700
210B
206
220B
216
204
428A
408A
212
220A
432A
428B
432B
722
410B
406A
406B
728
208A
722
726
202
210A
702

FIG. 8E


702
748
208B
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750
800
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700
200
210B
206
210B
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220B
212
750
800
704
748
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220A
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208A
770
202
702

FIG. 8F

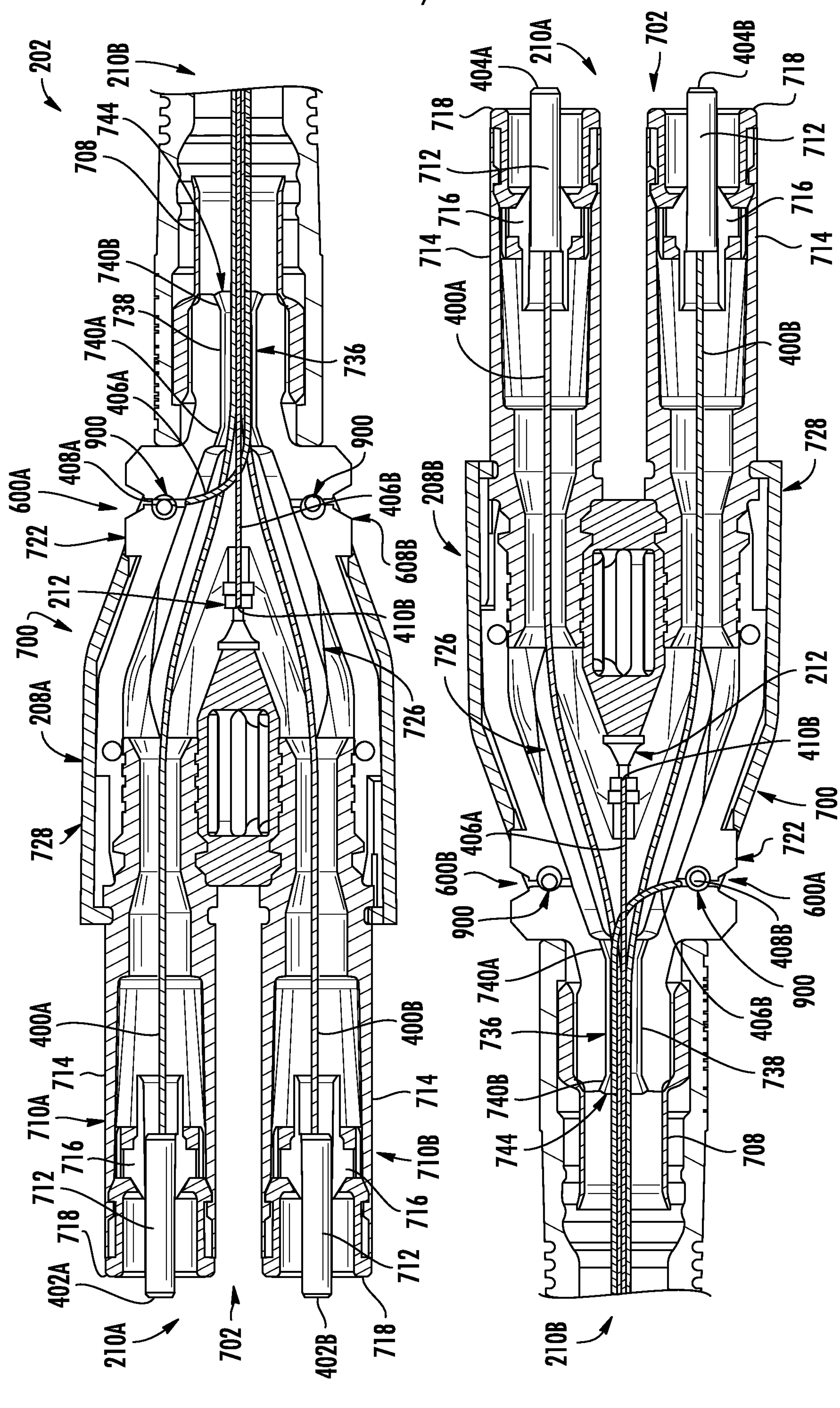
202
210B
744
708
740B
738
740A
736
406A
900
408A
600A
722
406B
608B
212
410B
700
726
208A
728
400A
714
710A
716
712
718
402A
210A
702
402B
400B
710B
404A
404B
208B
600B
408B

FIG. 9A

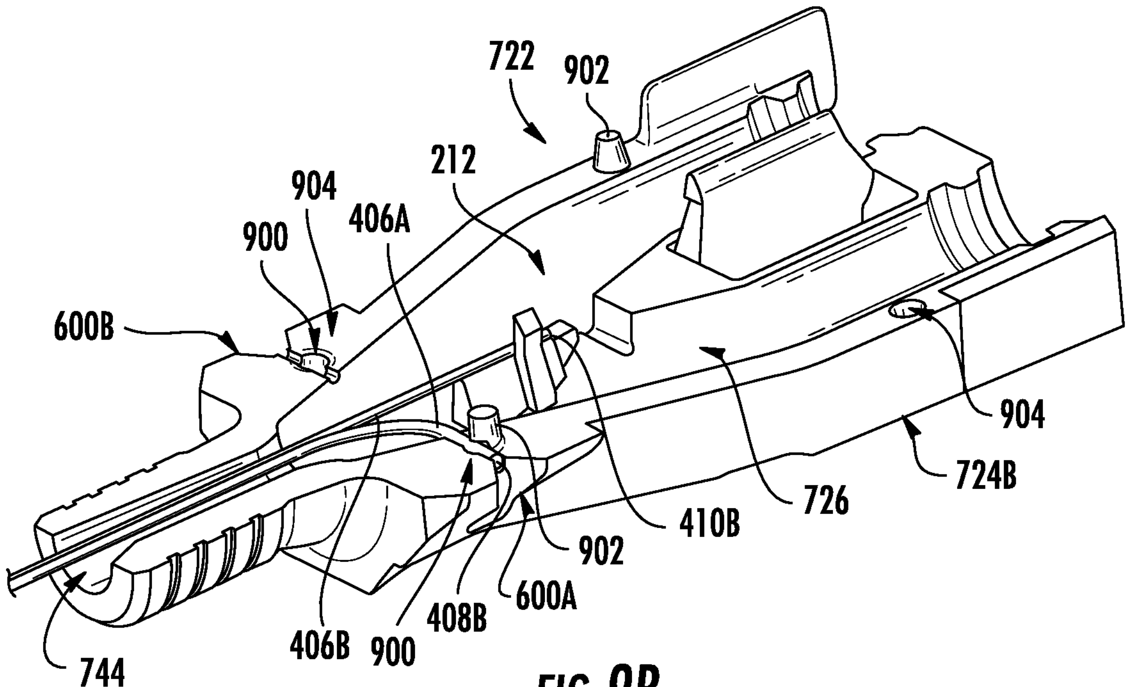
722
902
212
904
406A
900
600B
904
724B
726
410B
902
600A
408B
900
406B
744

FIG. 9B

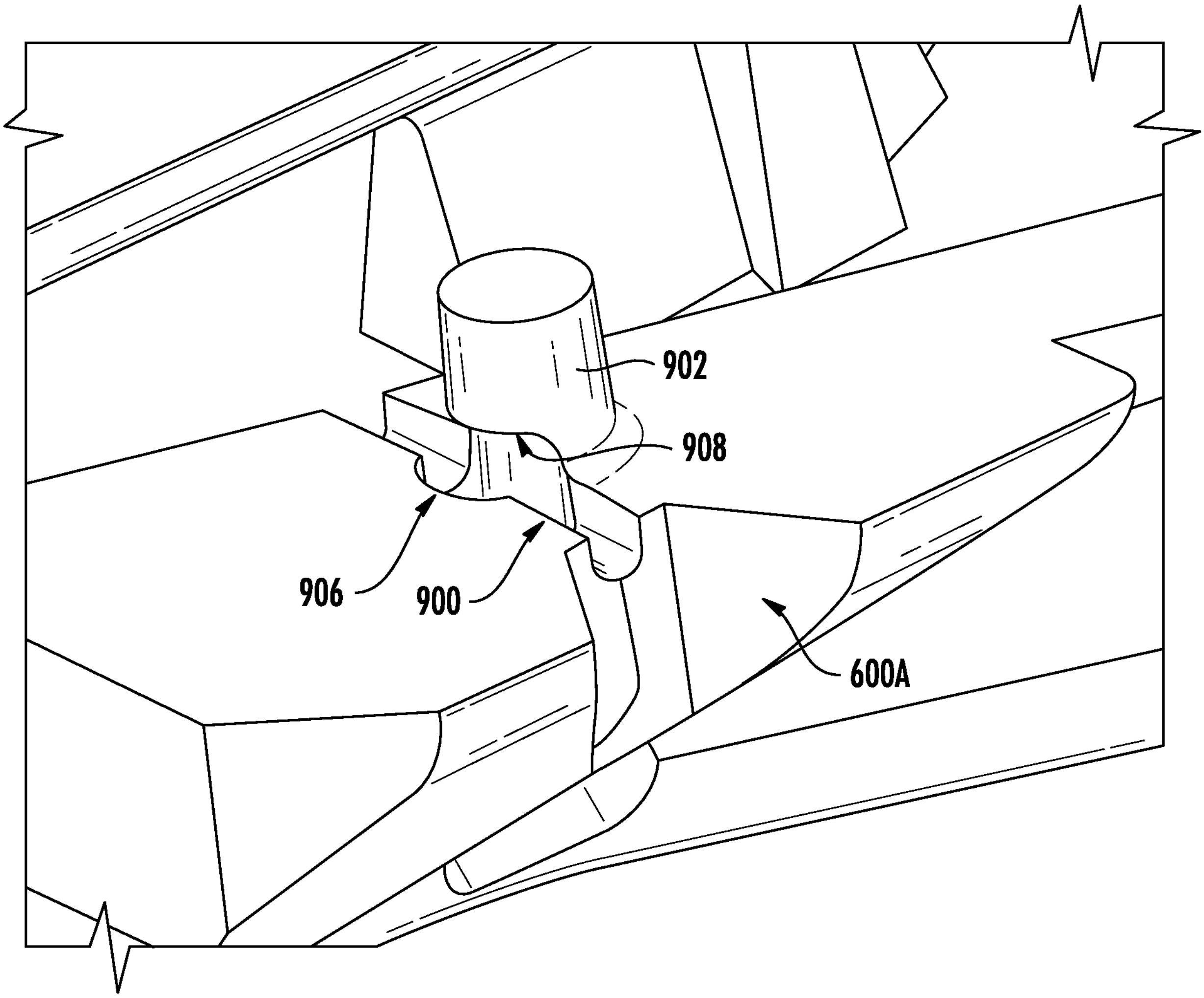

FIG. 9C

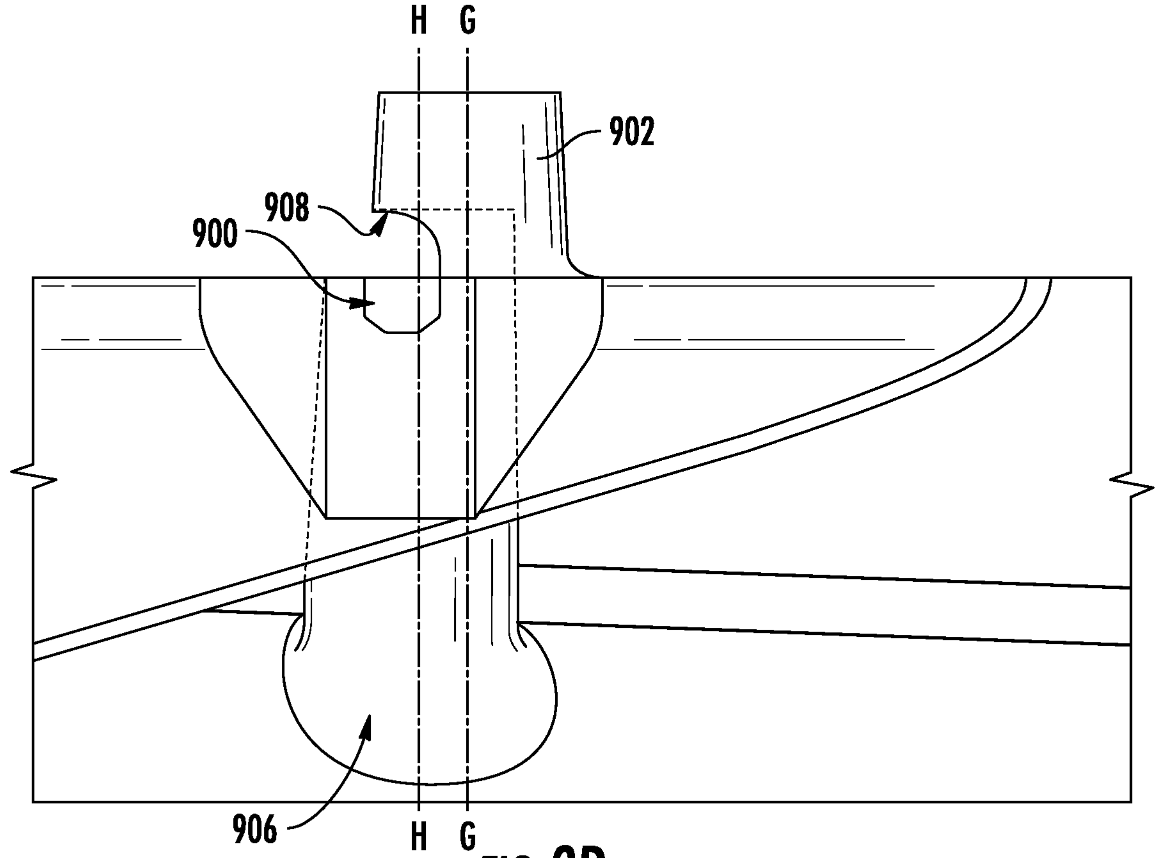

FIG. 9D

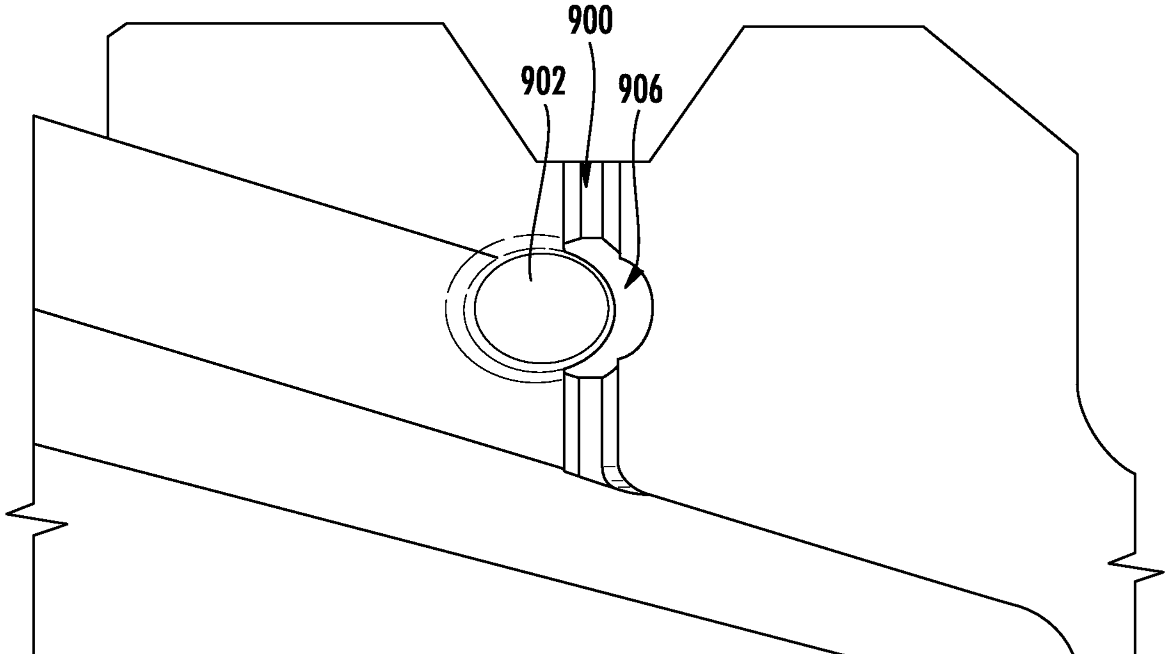

FIG. 9E

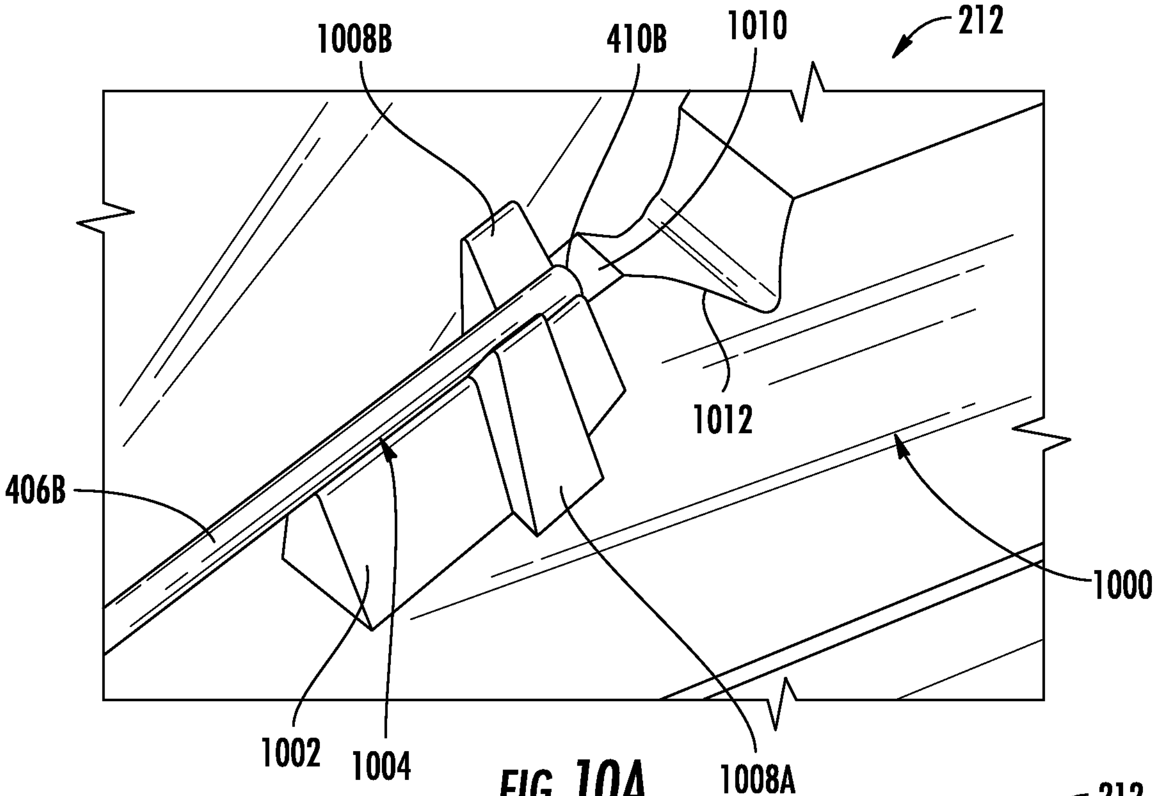

FIG. 10A

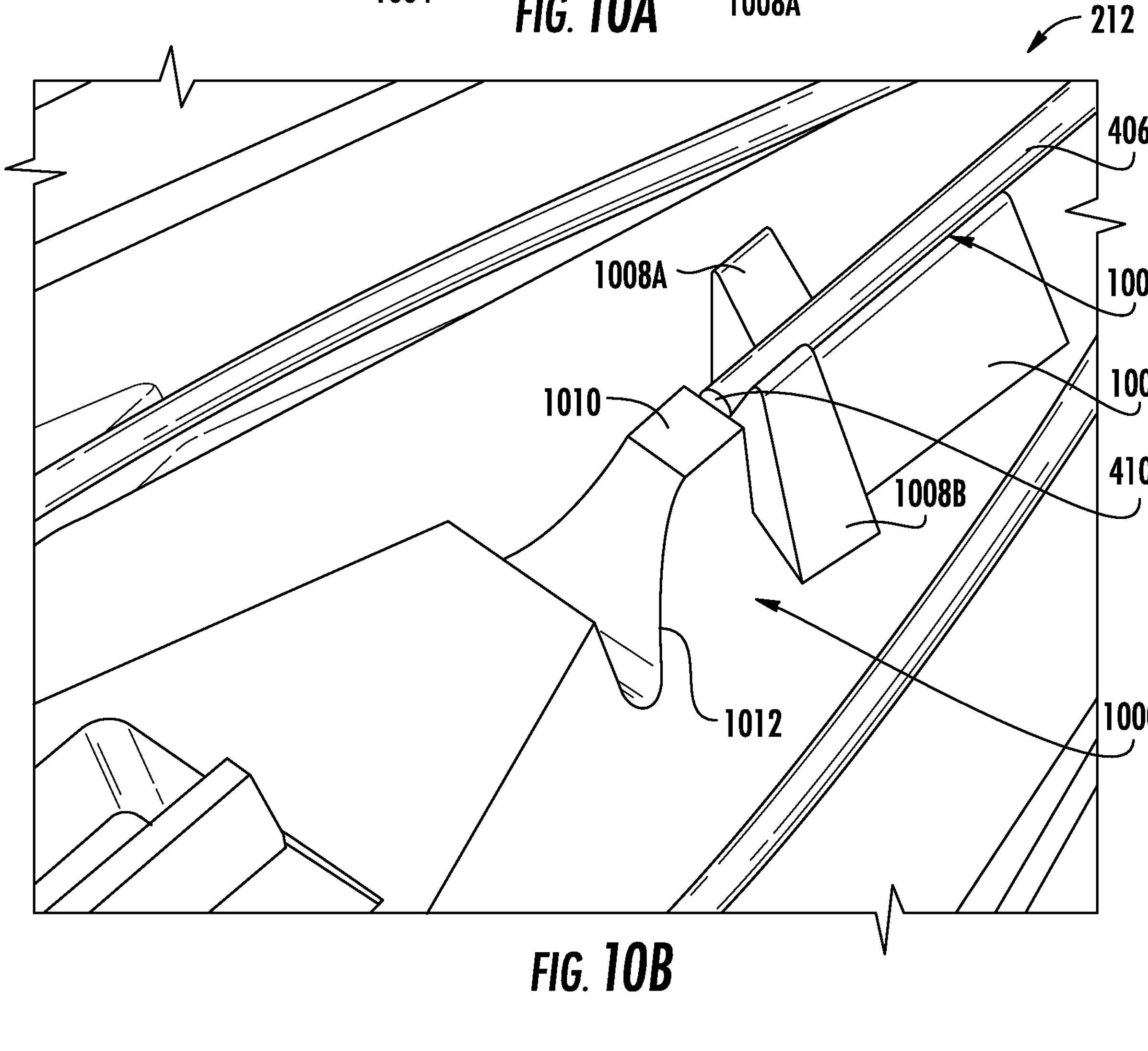

FIG. 10B

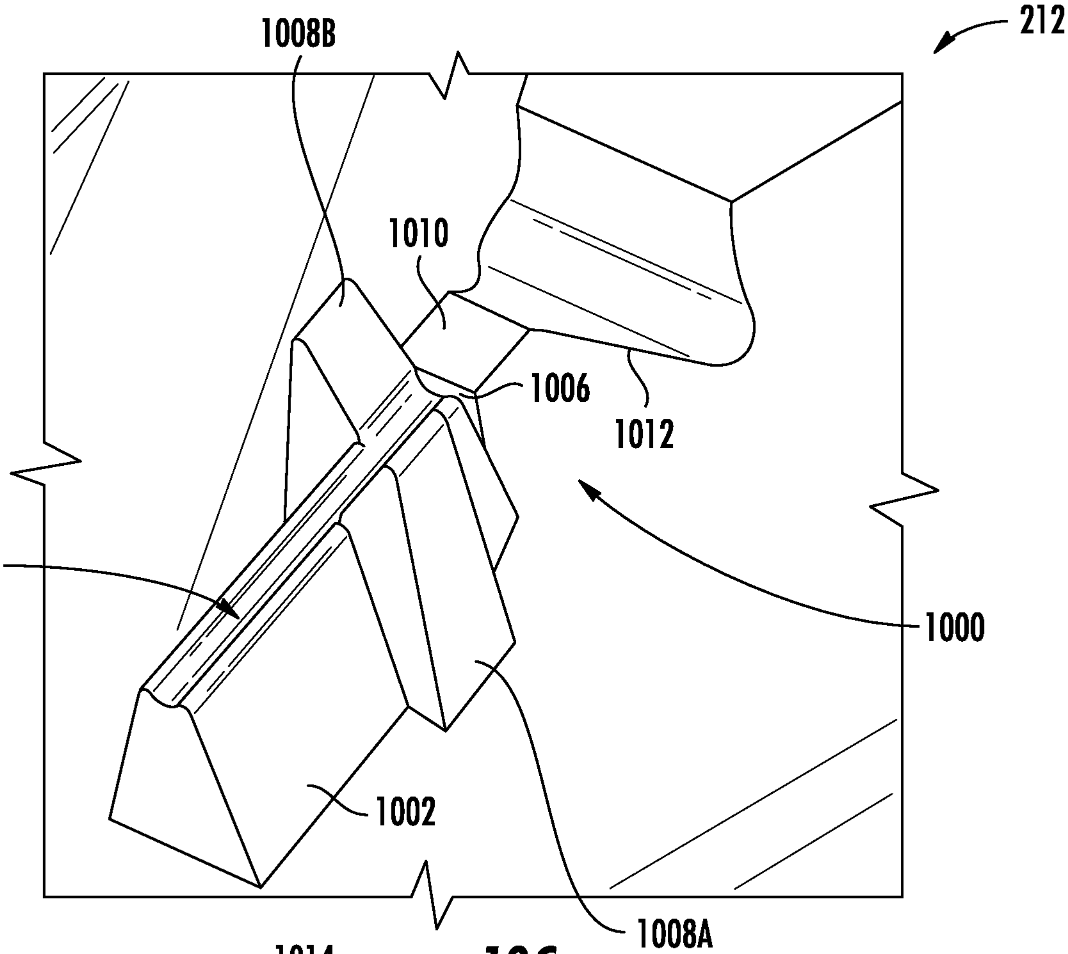

FIG. 10C

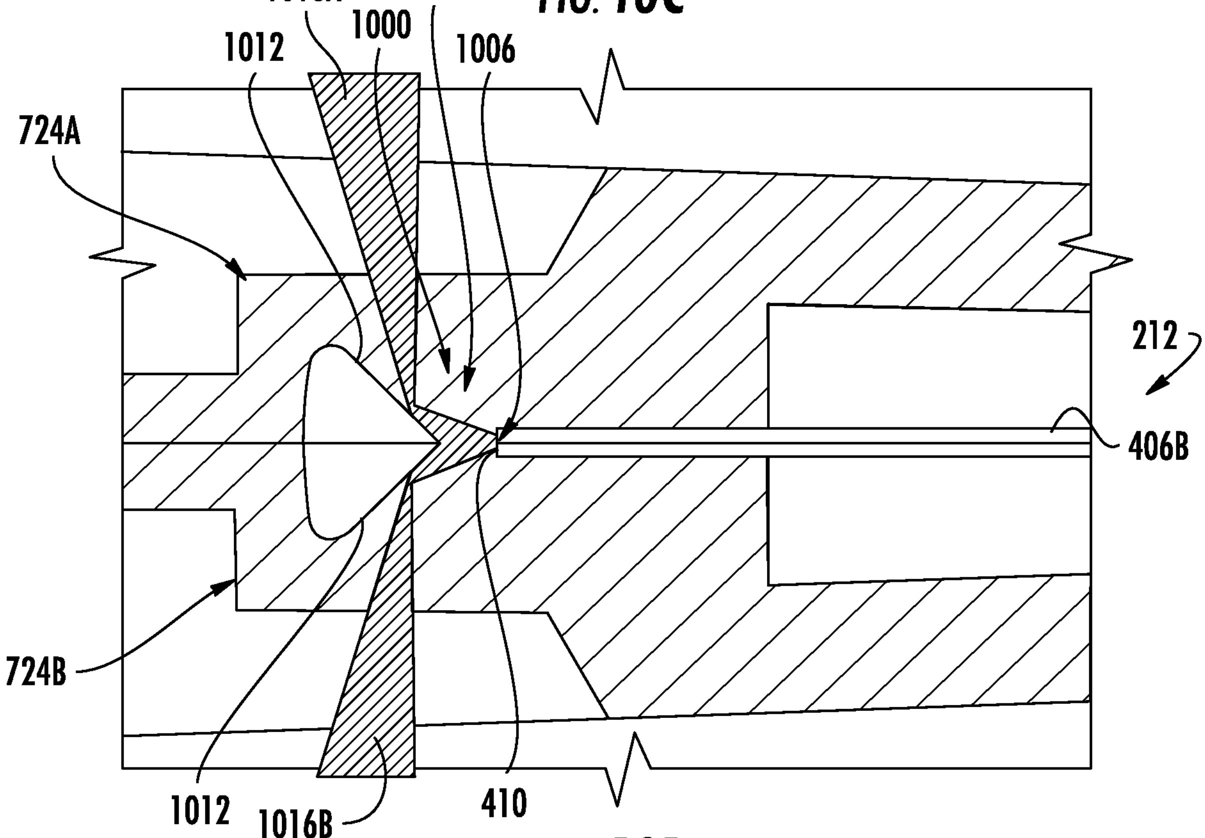

FIG. 10D

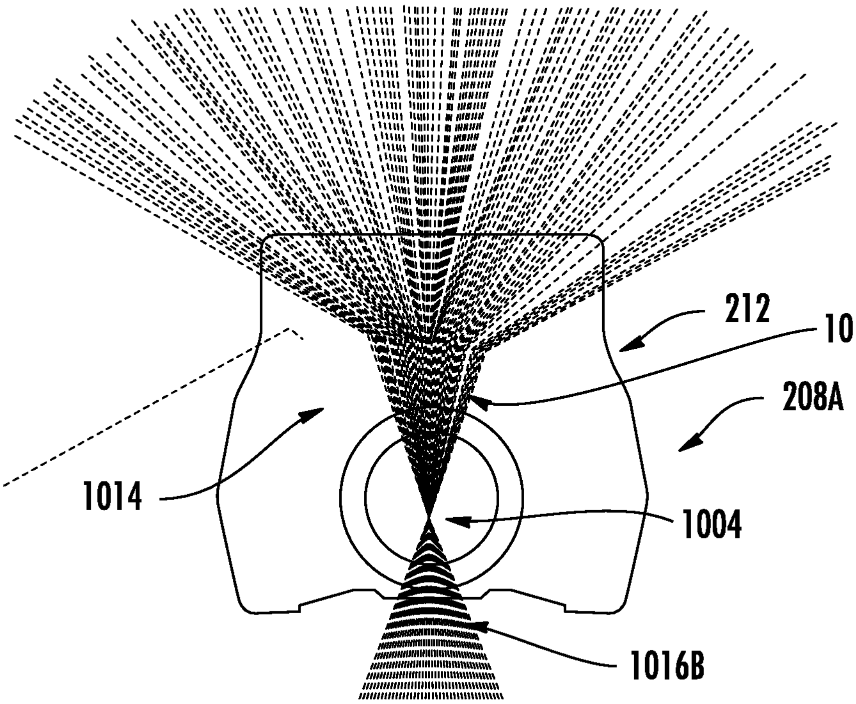

FIG. 10E

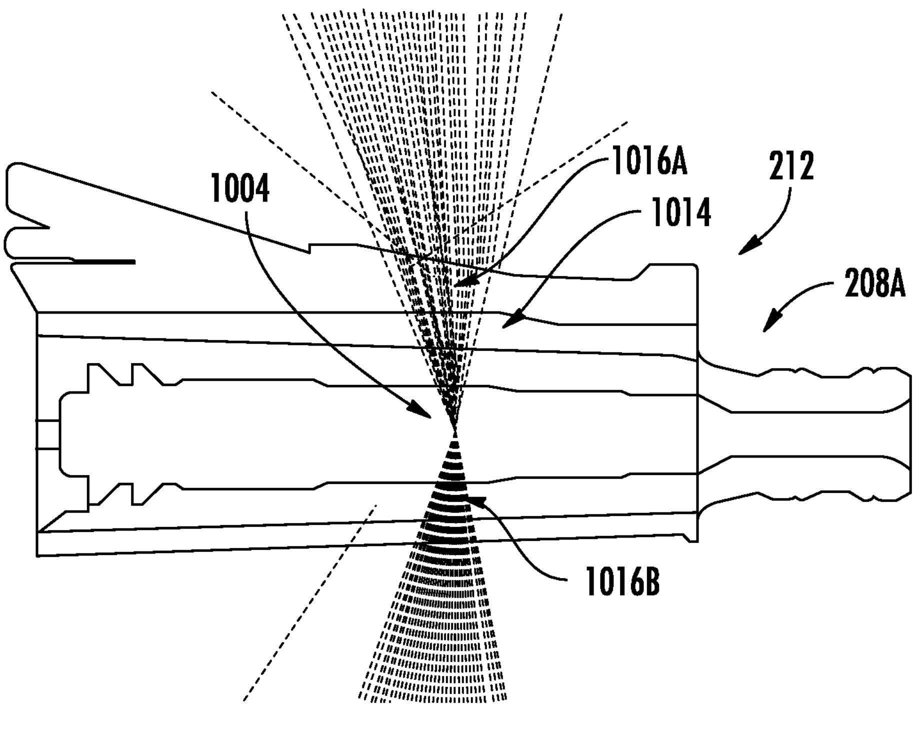

FIG. 10F

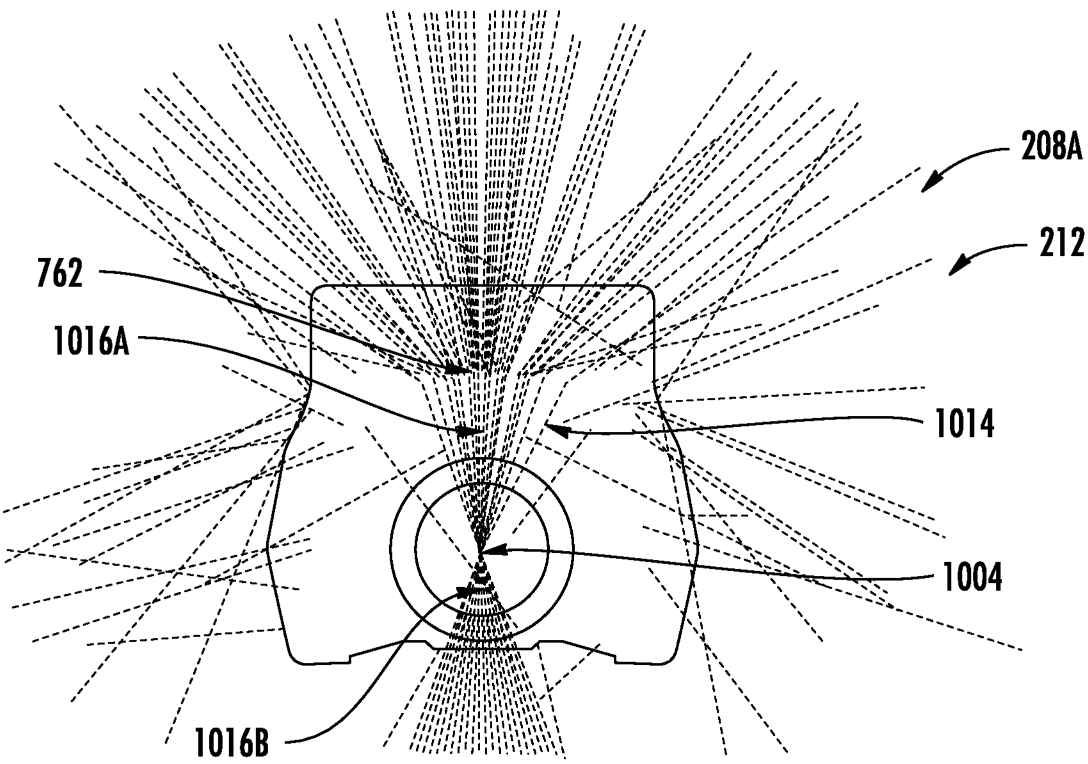

FIG. 10G

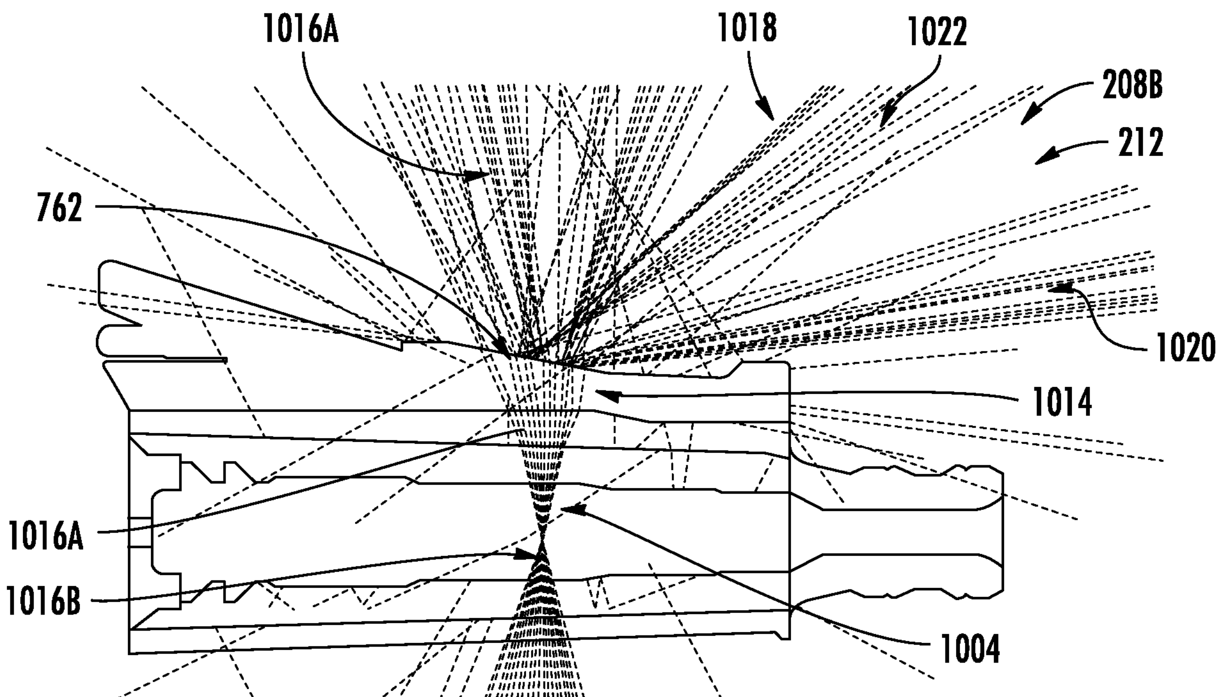

FIG. 10H

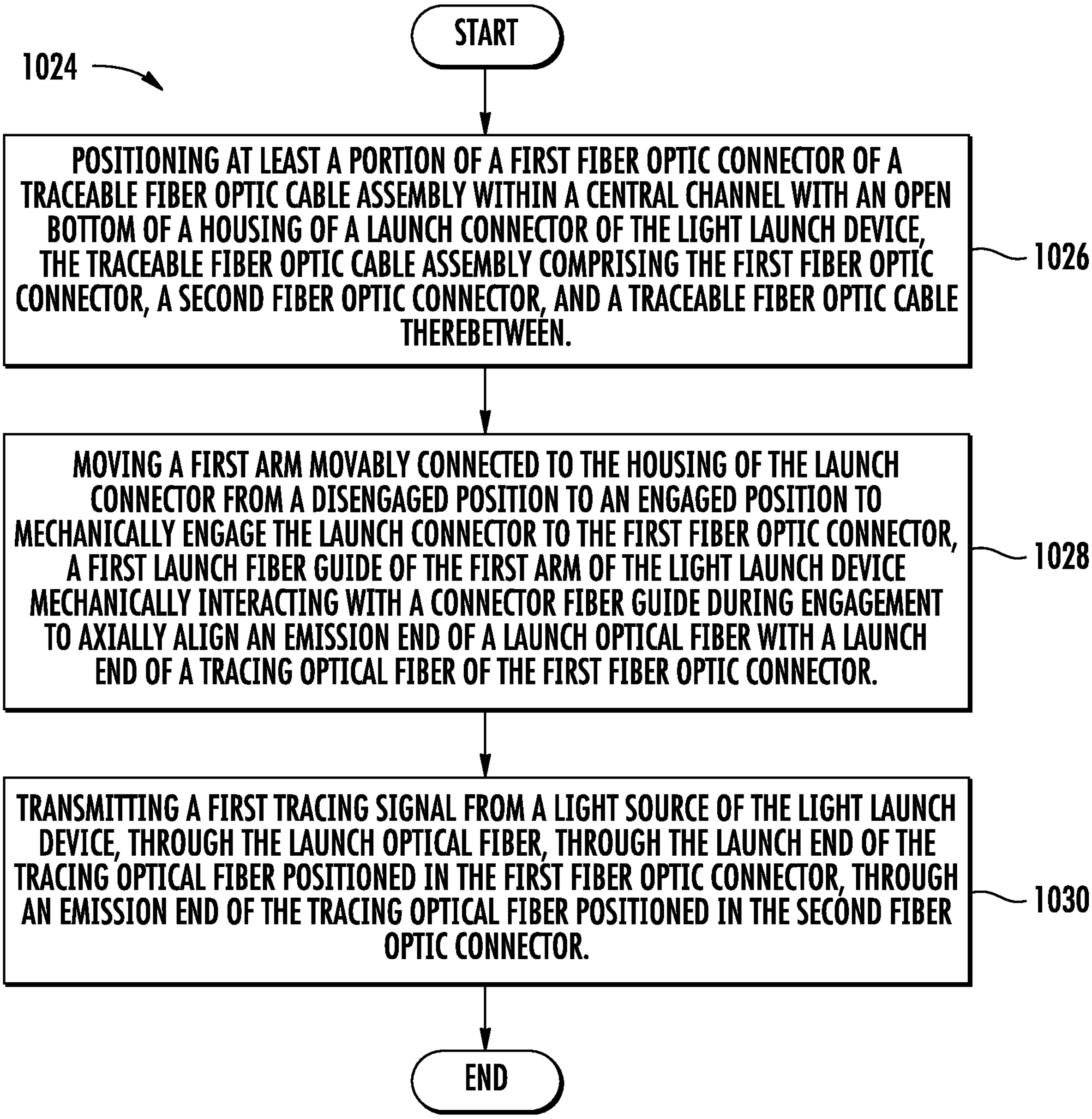
START
1024
POSITIONING AT LEAST A PORTION OF A FIRST FIBER OPTIC CONNECTOR OF A TRACEABLE FIBER OPTIC CABLE ASSEMBLY WITHIN A CENTRAL CHANNEL WITH AN OPEN BOTTOM OF A HOUSING OF A LAUNCH CONNECTOR OF THE LIGHT LAUNCH DEVICE, THE TRACEABLE FIBER OPTIC CABLE ASSEMBLY COMPRISING THE FIRST FIBER OPTIC CONNECTOR, A SECOND FIBER OPTIC CONNECTOR, AND A TRACEABLE FIBER OPTIC CABLE THEREBETWEEN.
1026
MOVING A FIRST ARM MOVABLY CONNECTED TO THE HOUSING OF THE LAUNCH CONNECTOR FROM A DISENGAGED POSITION TO AN ENGAGED POSITION TO MECHANICALLY ENGAGE THE LAUNCH CONNECTOR TO THE FIRST FIBER OPTIC CONNECTOR, A FIRST LAUNCH FIBER GUIDE OF THE FIRST ARM OF THE LIGHT LAUNCH DEVICE MECHANICALLY INTERACTING WITH A CONNECTOR FIBER GUIDE DURING ENGAGEMENT TO AXIALLY ALIGN AN EMISSION END OF A LAUNCH OPTICAL FIBER WITH A LAUNCH END OF A TRACING OPTICAL FIBER OF THE FIRST FIBER OPTIC CONNECTOR.
1028
TRANSMITTING A FIRST TRACING SIGNAL FROM A LIGHT SOURCE OF THE LIGHT LAUNCH DEVICE, THROUGH THE LAUNCH OPTICAL FIBER, THROUGH THE LAUNCH END OF THE TRACING OPTICAL FIBER POSITIONED IN THE FIRST FIBER OPTIC CONNECTOR, THROUGH AN EMISSION END OF THE TRACING OPTICAL FIBER POSITIONED IN THE SECOND FIBER OPTIC CONNECTOR.
1030
END

FIG. 10I

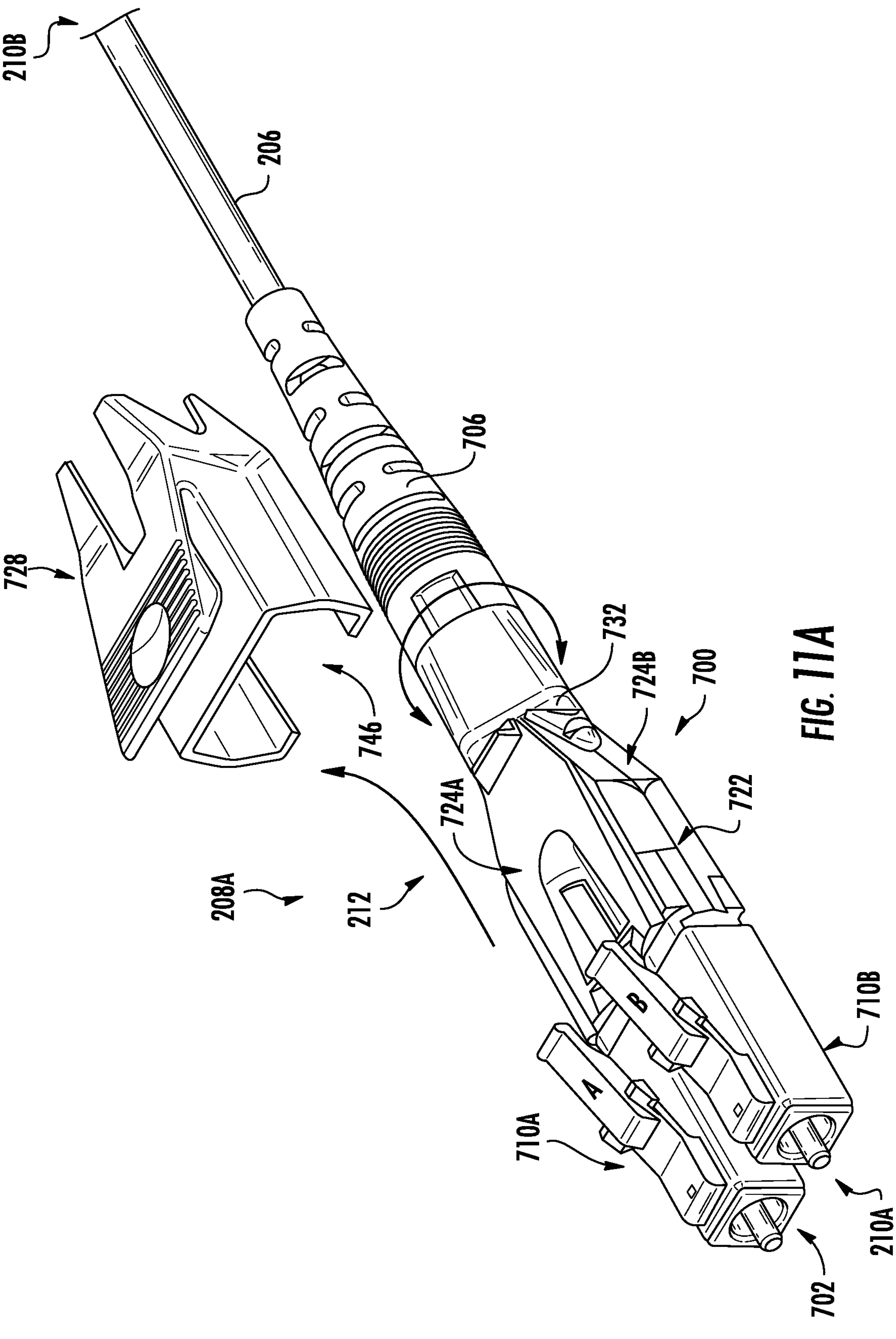
210B
206
706
728
732
724B
700
746
724A
722
208A
212
710B
710A
210A
702
A
B

FIG. 11A

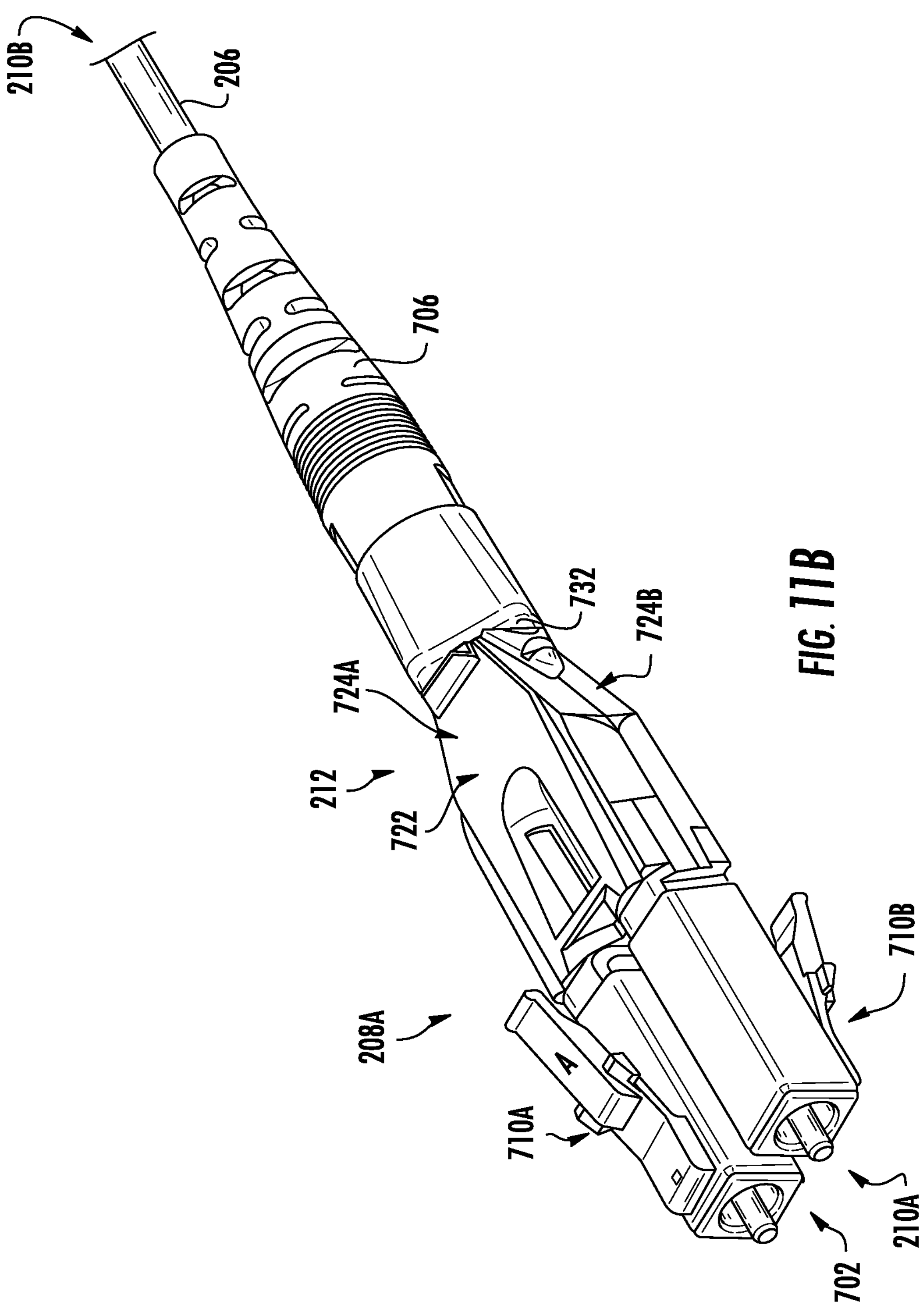

FIG. 11B

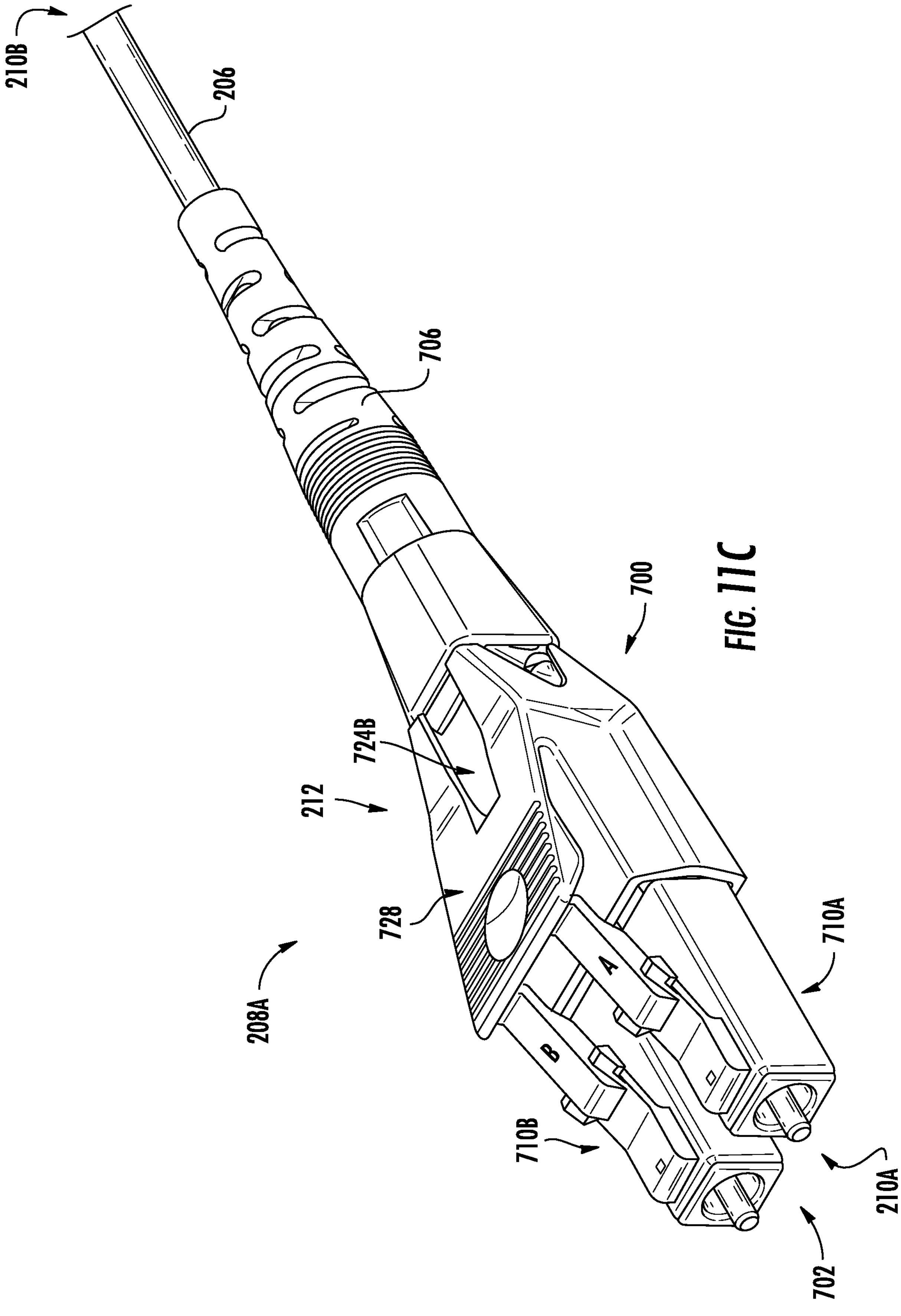

FIG. 11C