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[Continued on next page]

(54) Title: DUPLEX FIBER OPTIC COMPONENTS SUITABLE FOR POLARITY REVERSAL

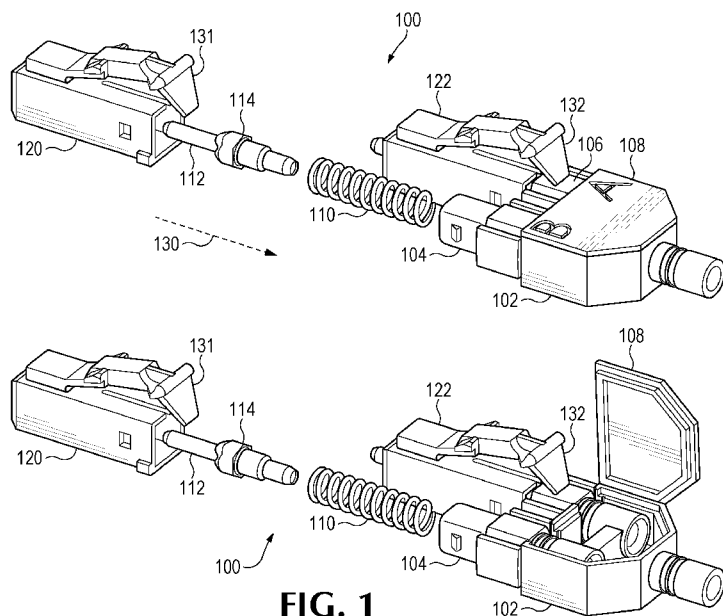


FIG. 1

(57) Abstract: Embodiments of the present disclosure provide techniques for a fiber optic connector assembly configured for polarity reversal in accordance with some embodiments. An assembly may include a housing to receive a fiber optic cable, at least one back post connected with the housing, a ferrule including at least an optical fiber of the fiber optic cable, insertable into the back post, and a connector component comprising a front housing. The front housing may hold at least a portion of the ferrule and detachably couple with the back post. The back post may include a retaining element to provide rotatable coupling of the front housing relative to the ferrule, the back post and the housing. Other embodiments may be described and/or claimed.

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DUPLEX FIBER OPTIC COMPONENTS SUITABLE FOR POLARITY REVERSAL**Field**

[0001] Embodiments of the present disclosure generally relate to the field of optical communications, and more particularly, to fiber optic connectors with components suitable for polarity reversal.

Background

[0002] Modern optical devices and optical communications systems widely use fiber optic connectors and cables. A typical fiber optic cable includes one or more optical fibers contained within a protective jacket.

[0003] A typical optical fiber includes a glass or plastic core surrounded by a cladding layer having a lower refractive index as compared to the refractive index of the core. The cladding causes a light signal to be confined to the core by total internal reflection at the boundary between the two components. The optical fiber of a typical fiber optic connector is retained within a ferrule assembly supported by a ferrule sleeve at a distal end of a connector housing. A spring may be used to bias the ferrule assembly in a distal direction relative to the connector housing. The ferrule assembly typically supports an end portion of at least one optical fiber but, in the case of a multi-fiber ferrule, supports the ends of multiple optical fibers.

[0004] The ferrule has a distal end face at which a polished end of the optical fiber is located. When two optical fibers are interconnected, the distal end faces of the ferrules abut one another and the ferrules are forced proximally relative to their respective connector housings against the bias of their respective springs. With the fiber optic connectors connected, their respective optical fibers are coaxially aligned such that the end faces of the optical fibers directly oppose one another. In this way, an optical signal may be transmitted from optical fiber to optical fiber through the aligned end faces of the optical fibers.

[0005] Fiber optic communication systems employ a network of fiber optic connectors and cables to transmit large volumes of data and voice signals over relatively long distances. Fiber optic connectors allow optical fibers to be quickly connected and disconnected without requiring the splicing together of separate optical fibers. Fiber optic

connectors can be used to optically interconnect two lengths of optical fiber as well as interconnecting lengths of optical fiber to passive and active equipment.

[0006] The capabilities of optical fiber, optical cable and fiber optic hardware including fiber optic connectors continuously improve through research and innovation to meet the demands of increasing numbers of users, such as increasing the bandwidth and the speed of signal transmission and the high density of connectivity. Each piece of equipment within the data center is interconnected to other equipment or to different components within the same cabinet using jumper, or patch, cables. Jumper cable assemblies typically comprise single fiber connectors and cables, i.e., simplex cable assemblies, usually arranged into sets of two, one receive and one transmit, i.e., duplex cable assemblies.

[0007] One method of duplexing simplex cable assemblies is to use a clip to couple two fiber optic connectors together. Another method of duplexing simplex cable assemblies is use of a single “unibody,” or “uniboot,” housing having just one cable input (containing two separate optical fibers) at one housing end and two separate fiber optic connector front connector housing elements at the opposing housing end. Increasing connectivity density in data centers, as well as the ability to efficiently manage connectivity challenges may be addressed by providing flexibility in signal transmit and receive configuration, to mitigate the ever increasing challenges of the modern data center.

Brief Description of the Drawings

[0008] Embodiments will be readily understood by the following detailed description in conjunction with the accompanying drawings. To facilitate this description, like reference numerals designate like structural elements. Embodiments are illustrated by way of example and not by way of limitation in the figures of the accompanying drawings.

[0009] FIG. 1 illustrates exploded perspective views of an example fiber optic connector assembly configured for polarity reversal in accordance with some embodiments.

[0010] FIG. 2 illustrates front and side views of the example assembly in assembled state, in accordance with some embodiments.

[0011] FIG. 3 illustrates perspective views of some components of the example assembly, in accordance with some embodiments.

[0012] FIG. 4 illustrates a perspective view of the example assembly prior to front housing rotation, in accordance with some embodiments.

[0013] FIG. 5 illustrates a perspective front view of the example assembly with some components shown in partially transparent view, in accordance with some embodiments.

[0014] FIG. 6 illustrates perspective views of the example assembly, during rotation of the front housing, in accordance with some embodiments.

[0015] FIG. 7 illustrates perspective views of the example assembly, in accordance with some embodiments.

[0016] FIG. 8 illustrates a perspective view of an example back post of the example assembly, in accordance with some embodiments.

[0017] FIG. 9 illustrates perspective views of the example assembly 100, in accordance with some embodiments.

[0018] FIGS. 9A-E illustrate different views of the example assembly of FIG. 9 with the back post including a step feature with lug provided on a back post, in accordance with some embodiments.

[0019] FIG. 10 illustrates a perspective view of another example back post of the example assembly, wherein the back post includes an extension, in accordance with some embodiments.

[0020] FIG. 11 illustrates a perspective view of the example assembly with the back post of FIG. 10, in accordance with some embodiments.

[0021] FIG. 12 illustrates a perspective view of another example of a back post of the example assembly, with an extension, in accordance with some embodiments.

[0022] FIG. 13 illustrates a perspective view of a partial assembly with the back post of FIG. 12, in accordance with some embodiments.

[0023] FIG. 14 illustrates a perspective view of another example back post of the assembly, wherein the back post includes an extension, in accordance with some embodiments.

[0024] FIG. 15 illustrates a perspective view of a portion of the assembly with the back post of FIG. 14, in accordance with some embodiments.

[0025] FIG. 16 illustrates a perspective view of another example back post of the assembly, wherein the back post includes an extension, in accordance with some embodiments.

[0026] FIG. 17 further illustrates a front view of a portion of the example assembly, in a partially assembled state, in accordance with some embodiments.

[0027] FIG. 18 illustrates an example process of a partial assembly of the simplex fiber optic connector assembly, in accordance with some embodiments.

[0028] FIG. 19 illustrates an example embodiment of a duplex fiber optic connector assembly comprised of two simplex fiber optic connector assemblies coupled together in duplex fashion, in accordance with some embodiments.

[0029] FIG. 20 illustrates the example fiber optic connector assembly in an assembled state, in accordance with some embodiments.

[0030] FIGS. 21-23 illustrate example embodiments of the assembly of FIG. 19, at partial rotation stage (FIG. 21) and completed rotation stage (FIGS. 22-23).

[0031] FIG. 24 illustrates an example assembly including the puller of FIG. 19, in accordance with some embodiments.

[0032] FIGS. 24A-B illustrate another example assembly with a puller, in accordance with some embodiments.

[0033] FIGS. 25-28 illustrate the steps in polarity reversal of a fiber optic connector in the assembly, in accordance with some embodiments.

Detailed Description

[0034] Some embodiments of the present disclosure include techniques and configurations for a fiber optic connector assembly that allows for the reversal of the polarity of the transmit and receive optical fibers in a duplex connector configuration in accordance with some embodiments.

[0035] FIG. 1 illustrates exploded perspective views of an example fiber optic connector assembly 100 configured for polarity reversal in accordance with some embodiments. As shown, the assembly 100 may include a housing 102 to accommodate the duplexed fiber optical connector assemblies, with connector housing back posts 104, 106 disposed within, and extending from, the housing 102. In other embodiments, housing 102 may be constructed to structurally and integrally include back posts 104, 106 extending from the distal face of housing 102. The back posts 104, 106 may have a rounded, rectangular outer periphery and include substantially round inner apertures (see, e.g., 306 in FIG. 3) to

allow at least some portion of the fiber optic connector assembly to extend through the housing 102.

[0036] In embodiments, the housing 102 may comprise a unibody housing, e.g., the housing 102 may be manufactured as a single-piece component having, for instance, a single fiber optic cable input at one end and duplexed fiber optic connector portions at an opposing end. The housing 102 may also be coupled with a housing lid 108 that may be hinged or otherwise movably attached to the housing 102 to cover the housing 102. The assembly 100 may further include a spring 110 and a ferrule 112 with a sleeve 114 to hold the ferrule 112. The ferrule 112 may include a fiber of a fiber optic cable.

[0037] The assembly 100 may further include connector portions to enable optical connections between the assembly 100 and another optical device (e.g., another assembly, not shown). The connector portions may comprise respective front housings 120 and 122 to house at least portions of respective ferrules 112, ferrule sleeves 114 and springs 110. In the example illustration of FIG. 1, the front housings 120, 122 correspond to respective connectors "B" (left side) and "A" (right side) as indicated on the housing 102. As shown, the front housings 120, 122 may include respective latches 131, 132 configured to provide reversibly latchable mechanical fixation between the front housings 120, 122 and another optical device (e.g., an adapter (not shown)) in order to keep the end face of ferrule 112 in a desired position for optimal optical connection with a mating connector.

[0038] To assemble the assembly 100, the ferrule 112 may be inserted into connector housing 120, 122, then the spring 110 is inserted onto the ferrule sleeve 114, then back post 104, 106 may be forced inside connector housing 120, 122 and held in place by coupling means 304, 404 (see FIGS. 3–5) between back post 104, 106 and connector housing 120, 122. The spring 110 may be loaded by applying a frontal force to the front housing and pushing the front housing 120 with the ferrule 112 toward (and into) the back post 104, as indicated by arrow 130. In response to application of the force indicated by arrow 130, the ferrule 112 may be at least partially inserted into the back post 104.

[0039] In some embodiments, the assembly 100 may be configured to allow independent rotation of the front housings 120 and 122 relative to their respective internal connector portions, e.g., ferrules 112, ferrule sleeves 114 and springs 110 and respective back posts (e.g., 104), wherein the rest of the assembly 100 may not be movable. For example, the ferrule 112, ferrule sleeve 114, spring 110 and the back post 104 may remain unmoved in

response to rotation of the front housing 120. The example embodiments of the assembly 100 that provide independent rotation of the front housings 120 and 122 are described below.

[0040] FIG. 2 illustrates front and side views of the example assembly 100 in assembled state, in accordance with some embodiments. As shown, the ferrule 112 may extend from the front housing 120 to mate with another connector assembly (e.g., another fiber optic connector within an adapter (not shown)).

[0041] FIG. 3 illustrates perspective views of some components of the example assembly 100, in accordance with some embodiments. More specifically, first view 300 of FIG. 3 illustrates the spring 110 insertable within inner aperture 306 of the back post 104. Second view 320 of FIG. 3 illustrates the spring 110 and the back post 104 in a disassembled state thereby revealing the flat shelf surface 302 inside the post of the back post 104 against which the spring 110 abuts when inserted within the inner aperture 306 of the back post 104. The back post 104 may include a retaining element, such as an ear or a lug 304, which is matable with a portion of the front housing 120 (see, e.g., matable window 404 in FIG. 4) to affix the front housing 120 to the back post 104 as described in greater detail below.

[0042] FIG. 4 illustrates a perspective view of the example assembly 100 prior to front housing rotation, in accordance with some embodiments. As noted in reference to FIG. 3, the lug 304 may be mated with, and partially extend out of, a corresponding window 404 of the front housing 120, in order to keep the front housing 120 fixably attached to the back post 104. As shown, the front housing 120 may include one or more slits 406 at least partially extending into sides of the body of the front housing 120. In some embodiments, the front housing 120 may include two or four slits 406, disposed on opposite sides or each side of the body of the front housing 120. The slits 406 may provide for desired flexibility of the body of the front housing 120 during rotation, in order for the window 404 to clear the lug 304 in response to either the initial insertion of the back post 104, 106 into the front connector housing 120, 122, or a rotational force 410 that may be applied to the front housing 120.

[0043] In embodiments, the assembly 100 may include an additional feature to allow rotation of the front housing 120 without damaging front connector housing 120, 122 or the slits 406. FIG. 5 illustrates a perspective front view of the example assembly 100 with some components shown in partially transparent view. As shown, the back post 104 may define, at its distal end, a substantially cam-shaped profile 502 configured to allow rotation of the front

housing 120 without plastically deforming slit 406 (FIG. 4) in response to application of a rotational force. When a rotational force is applied to the front housing 120, the body of the front housing 120 may flex due to the slits 406, and the window 404 may clear the lug 304 of the back post 104.

[0044] Accordingly, the assembly 100 may allow for independent rotation of front housings 120 and 122 about respective back post components 104, 106, while no other components of the assembly 100 may move.

[0045] FIG. 6 illustrates perspective views of the example assembly 100, during rotation of the front housing 120. More specifically, first view 602 of FIG. 6 illustrates the assembly 100 with the front housing 120 partially rotated relative to the back post 104 in response to application of the rotational force 410. Second view 604 of FIG. 6 illustrates the assembly 100 with the front housing 120 rotated relative to the back post 104 to an angle 180 degrees relative to its original position. In other words, the front housing 120, rotated as shown, may assume a position that is reversed relative to the original position of the front housing 120 in the assembly 100 (see, e.g., FIG. 4).

[0046] FIG. 7 illustrates perspective views of the example assembly 100, in accordance with some embodiments. View 702 illustrates a reversed position of front housings 120 and 122 with the housing in its original position. View 704 illustrates a state in which front housings 120 and 122 have been moved to their reversed positions relative to their original positions with the entire assembly rotated. As shown, the reversed positions of the front housings 120 and 122 in the assembly 100 effectively enable polarity reversal of the transmit and receive optical fibers for the assembly 100, without the necessity of having to disassemble any components of assembly 100. For example, as shown in the second view 704 of FIG. 7, following 180° rotation of each of front housings 120 (“B”) and 122 (“A”), the front housing 120 (“B”) is now on the right side of housing 102 and front housing 122 (“A”) is now on the left side of housing 102, relative to front housing 120 (“B”). In the example embodiments described above, the retention components for the front housing 120 on the assembly 100 comprise the window 404 provided on the body of the front housing 120 and corresponding lug 304 of the back post 104. As described, these components, in combination with slits 406, allow for independent rotation of the front housings 120 and 122 around their respective back posts 104, 106. However, different other embodiments of such retention components may be contemplated, as described below.

[0047] FIG. 8 illustrates a perspective view of a back post 104 of the example assembly 100. As shown, the back post 104 may include an annular ring 802 disposed about a frontwardly extending, annular portion of the back post 104 and configured to provide retention and rotation capabilities for a corresponding annular coupling member within the rearward portion of the front housing 120. The annular ring 802 may comprise different shapes, for example, may have different thicknesses around the body of the ring, as may be seen in FIG. 8.

[0048] FIG. 9 illustrates perspective views of the example assembly 100, in accordance with some embodiments. View 920 illustrates the assembly 100 with the front housing 120 partially rotated about the back post 104. View 930 illustrates the assembly 100 showing the back post 104 attached to the housing 102. It should be understood that the back post 104 may be structurally integral to, or separately structured from, housing 102. The annular ring 802 defined on the outer, annular surface of back post 104 may be seen through the transparent front housing 120 and slit 406 therein.

[0049] The inner profile of the front housing 120 may include annular groove 902 that may be coupled with the annular ring 802 to secure front housing 120 to back post 104. For example, to assemble the assembly 100, the front housing 120 may be pushed on the back post 104, as indicated by the arrow 910, until the annular ring 802 receives the annular groove 902. The front housing 120 may thus be affixed on the back post 104. In response to application of rotational force 410, the front housing 120 may freely rotate about the annular ring 802 with its annular groove 902. In some embodiments, engagement of annular ring 802 with annular groove 902 may replace the engagement means of lug 304 and window 404 (see, e.g., FIG. 4).

[0050] In some embodiments, the rotation of the front housing 120 about the back post 104 may cause undesired rotation of the ferrule 112, due, for example, to an incidental frictional force between the conical front surface of sleeve 114 of the ferrule 112 and the inner, corresponding concave profile of the rearward inner surface of the front housing 120 as may best be seen in FIGS. 2, 5 through transparent front connector housing 120. The example embodiments described below provide solutions that may prevent undesired rotation of the ferrule 112, ferrule sleeve 114 and spring 110 along with the front housing 120.

[0051] FIGS. 9A-E illustrate different views of the example assembly of FIG. 9 with the back post including a step feature with lug provided on a back post, in accordance with

some embodiments. The step feature with lug may be applied to a unibody housing embodiment as shown. For purposes of illustration, in FIGS. 9A-E the step feature with lug is indicated by the numeral 940, the step feature is indicated by the numeral 942, and the lug is indicated by the numeral 944.

[0052] FIGS. 9A-B illustrate perspective views of the example assembly having a step feature with lug 940, FIG. 9C illustrates a side view of the example assembly with the step feature with lug 940, FIG. 9D illustrates a bottom view of the example assembly with the step feature with lug 940, and FIG. 9E illustrates a view of the back post of the example assembly with the step feature with lug 940.

[0053] The step feature with lug shown in FIGS. 9A-9E may accomplish the same function as the annular ring feature described above. The feature may provide the main retention interface between the front housing and back post, while allowing the front housing to rotate. The “lug” addition to the “step” may create a small amount of resistance to rotation and may locate the front housing at 0, 90, and 180 degrees when rotating about the back post.

[0054]

[0055] FIG. 10 illustrates a perspective view of another example of the back post 104 of the example assembly 100, wherein the back post 104 includes an extension 1000, in accordance with some embodiments. As shown, the extension 1000 may comprise a holder in a shape of a cradle 1002 disposed at the end of the extension 1000.

[0056] FIG. 11 illustrates a perspective view of the example assembly 100 with the back post 104 of FIG. 10, in accordance with some embodiments. As shown, the extension 1000 is configured as a keying element to interface with, for example, at least some portion of a key comprising a hexagonal shaped front face 1100 of the ferrule sleeve 114 to prevent rotation of the ferrule 112, and spring 110 of the assembly 100.

[0057] FIG. 12 illustrates a perspective view of another example of a back post 104 of the assembly 100, wherein the back post 104 includes an extension 1200, in accordance with some embodiments. As shown, the extension 1200 is comprised of side hooks 1202, 1204.

[0058] FIG. 13 illustrates a perspective view of a partial assembly with the back post of FIG. 12, in accordance with some embodiments. The extension 1200 may be configured as a keying element to interface with, for example, at least some portion of the hexagonal shaped front face 1100 of ferrule sleeve 114 (FIG. 11) to prevent the rotation of the ferrule 112, ferrule sleeve 114 and spring 110 of the assembly 100.

[0059] FIG. 14 illustrates a perspective view of another example back post 104 of the assembly 100, wherein the back post 104 includes an extension 1400, in accordance with some embodiments. As shown, the extension 1400 comprises a holder in a shape of a cage 1402 configured as a keying element such as a partial hexagonal-shaped receptor 1404.

[0060] FIG. 15 illustrates a perspective view of a portion of the assembly with the back post 104 of FIG. 14, in accordance with some embodiments. The extension 1400 may interface with, for example, at least a portion of the hexagonal shaped front face 1100 of the ferrule sleeve 114 to prevent the rotation of the ferrule 112, ferrule sleeve 114 and spring 110 of the assembly 100. In some embodiments, the cage 1402 assembly is a self-contained sub-assembly of the duplexed connector assembly because once ferrule 112, ferrule sleeve 114 and spring 110 are loaded into cage 1402, and no additional components are required to keep the assembly intact. The annular ring 802 of the back post 104 is also indicated in FIGS. 14-15.

[0061] FIG. 16 illustrates a perspective view of another example back post 104 of the assembly 100, wherein the back post 104 includes an extension 1600, in accordance with some embodiments. As shown, the extension 1600 comprises a substantially cylinder-shaped holder 1602 with a partial hexagonal-shaped ending 1604 configured as a keying element to interface with, for example, at least a portion of the hexagonal shaped front face 1100 of the ferrule sleeve 114 to prevent the rotation of the ferrule 112, ferrule sleeve 114 and spring 110 of the assembly 100 (these components are shown in FIGS. 1 and 11). As shown, the ending 1604 may include one or more fingers 1606 configured to retain the hexagonal shaped front face 1100 of the ferrule 112.

[0062] FIG. 17 illustrates a front view of a portion of the example assembly 100, in a partially assembled state, in accordance with some embodiments. The front connector housing 120 corresponding to the ferrule 112 is not shown for ease of understanding of the application of the holder 1602. As shown, the holder 1602 may interface with and at least partially retain a hexagonally shaped portion (front face 1100) of the ferrule sleeve 114 with its receptor (partial hexagonal-shaped ending 1604), thus preventing the ferrule 112, ferrule sleeve 114 and spring 110 from rotation.

[0063] FIG. 18 illustrates an example process of partial assembly of the simplex fiber optic connector assembly 100 (see FIG. 1) comprised of back post 104 with forward extending holder 1602 with fingers 1606 having annular ring 802 on the peripheral surface

thereof, in accordance with some embodiments. As shown, the back post 104 includes the holder 1602 described in reference to FIGS. 16-17. The spring 110 may be forced inside the fingers 1606 of the holder 1602 prior to affixation of the front connector housing 120 to the holder 1602 of back post 104.

[0064] As described above with reference to FIG. 1, the housing 102 of the assembly 100 may comprise a unibody, or “uniboot,” housing, configured to receive fiber optic cable (not shown) into a single, rearward cable channel and provide the separation of the two fibers of the cable into two portions, corresponding to connections “A” and “B” indicated on the housing 102, for a “one input-two outputs” configuration. In some embodiments, the housing 102 may comprise a shape (e.g., a duplexing clip) that may provide for two separate cable inputs and two corresponding outputs as described below.

[0065] FIG. 19 illustrates an example embodiment of a duplex fiber optic connector assembly 1900 comprised of two simplex fiber optic connector assemblies coupled together in duplex fashion by means of clip 1910 having hooks 1912, 1914 (and corresponding hooks on the opposing side of the clip 1910, not visible in FIG. 19), in accordance with some embodiments. Because assembly 1900 is comprised of two simplex fiber optic connector assemblies, assembly 1900 has two separate cable inputs 1902, 1904 coupled to the corresponding two separate back posts 104, 106 and two separate front connector housings 120, 122. For ease of understanding, the like components of assemblies 100 and 1900 are indicated by the same numerals.

[0066] The assembly 1900 may further include a puller 1920 configured to engage with connector latches 131, 132 (see FIG. 1) and which, upon pulling rearwardly in a horizontal plane, may cause the depression of connector latches 131, 132 to facilitate withdrawal and removal of front connector housings 120, 122 from engagement with another optical device (e.g., an adapter (not shown)) in order to keep the end face of ferrule 112 within front connector housings 120, 122 in a desired position for optimal optical connection with a matable connector.

[0067] FIG. 20 illustrates the example fiber optic connector assembly 1900 in an assembled state, in accordance with some embodiments. The duplex clip 1910 may retain both back posts 104, 106 with hooks 1912, 1914 that may be inserted into corresponding grooves (e.g., 2002) of the back posts 104, 106. As may be seen, the back post 104 may include the same retaining component as one described in reference to FIG. 8. For example,

the back post 104 may include annular ring 802 that may provide for seamless rotation of the front housing 120 relative to the back post 104, as well as coupling of the front housing 120 with the back post 104 during rotation of the front housing 120, as described in reference to FIGS. 8-9.

[0068] Accordingly, the assembly 1900 may provide for polarity reversal of the transmit and receive optical fibers of the circuit similarly to that of the assembly 100. For example, the front housings 120, 122 may be independently rotatable relative to their respective back posts 104, 106 (e.g., in opposing directions) until they reach their respective fully reversed positions, thus providing for polarity reversal, similar to the embodiments described in reference to FIGS. 6-7 for the unibody embodiment.

[0069] FIGS. 21-23 illustrate example embodiments of the assembly 1900, at partial rotation stage (FIG. 21) and completed rotation stage (FIGS. 22-23), in accordance with some embodiments. The front housing 120 is shown as partially rotated in FIG. 21, while FIG. 22 illustrates the assembly 1900 in which both front housings 120 and 122 reached their respective reversed positions, thus providing for polarity reversal, similar to the embodiment described in reference to FIG. 7. The assembly 1900 of FIG. 22 may be “flipped” as shown in FIG. 23 to position the connector housing surfaces upon which are disposed connector latches 131, 132 on the upward facing surfaces of the duplexed fiber optic connectors (comprising front housings 120, 122). As evident from FIG. 23, the front housing 120 (“B”), which used to be in the left side of the assembly 1900 of FIG. 22, is now located on the right side of the assembly 1900 of FIG. 23. Similarly, the front housing 122 (“A”), which used to be in the right side of the assembly 1900 of FIG. 22, is now located on the left side of the assembly 1900 of FIG. 23. Accordingly, the polarity of the transmit and receive optical fibers of assembly 1900 have been reversed.

[0070] FIG. 24 illustrates an example assembly 100 including the puller 1920 in accordance with some embodiments. As shown, the puller 1920 may include a hammer head element 2400 having opposing lateral extensions at the forward end of puller 1920, to engage the latches 131, 132 of the front connector housings 120 and 122. Connector latches 131, 132 (see, e.g., FIG. 1) may be depressed, in a downwardly direction, upon the downward, sliding engagement of the lateral extensions of hammer head 2400 of puller 1920 with latches 131, 132 when puller 1920 is pulled rearward. The depression of connector latches 131, 132

facilities the removal of the duplexed connector assembly from mating connectors (e.g., an adapter (not shown)).

[0071] FIGS. 24A-B illustrate another example assembly with a puller, in accordance with some embodiments. FIG. 24A illustrates a perspective view of the unibody embodiment of the example assembly with a puller 2410, and FIG. 24B illustrates a perspective view of the duplex embodiment of the example assembly with a puller 2420. The unibody and duplex puller embodiments are variations on the rear “touch point” of the puller where the user may grab and pull to release the connector from a fiber adaptor. Both embodiments are intended to be low profile and resist snagging on adjacent fiber cables when removed from a high density fiber patching array. There are two embodiments because the puller may interface with a single cable in the case of the unibody embodiment (FIG. 24A), and may interface with TWO cables (zipcord) in the duplex embodiment (FIG. 24B).

[0072] FIGS. 25-28 illustrate, in sequential order, the steps in polarity reversal of fiber optic connector “B” (e.g., left side of duplex, front housing 120) vis-à-vis fiber optic connector “A” (e.g., right side of duplex, front housing 122). The steps may be the same in both the unibody housing 102 and the duplex clip 1910 configurations. Accordingly, FIGS. 25-28 illustrate a unibody housing 102 embodiment, and FIGS. 19-23 illustrate a clip 1910 embodiment.

[0073] In both cases, polarity reversal is started with the initial counterclockwise rotation 2500 of fiber optic connector “B” with the rearward directed free end of its latch 131 sliding out from under the lateral projection of hammer head 2400 of puller 1920. Likewise, initiation of the clockwise rotation of fiber optic connector “A” causes the rearward directed free end of its latch 132 to slide out from under the opposing lateral projection from the hammer head 2400 of puller 1920. Once both fiber optic connectors “B” and “A” are partially or fully rotated 180° in opposite directions, puller 1920 may be disengaged from the duplexed fiber optic connector assembly 100, 1900 and re-engaged to the opposing side of the duplexed fiber optic connector assembly 100, 1900. The resultant fiber optic connector assembly 100, 1900 will now have fiber optic connector “B” on the opposite side of fiber optic connector “A,” i.e., the polarity of the transmit and receive optical fibers in fiber optic connectors “B” and “A” is reversed from the original configuration.

Claims

What is claimed is:

1. A fiber optic connector assembly, comprising:
a housing to receive a fiber optic cable;
at least one back post connected with the housing;
a ferrule including at least an optical fiber of the fiber optic cable, wherein the ferrule is insertable into the back post; and
a connector component comprising a front housing, wherein the front housing is to hold at least a portion of the ferrule and to detachably couple with the back post, wherein the back post includes a retaining element to provide rotatable coupling of the front housing relative to the ferrule, the back post and the housing.
2. The fiber optic connector assembly of claim 1, wherein the housing includes a first end to receive the fiber optic cable, and a second end, wherein the back post extends from the second end of the housing.
3. The fiber optic connector assembly of claim 1, wherein the retaining element comprises a lug disposed on the back post, wherein the front housing includes a window matable with the lug, to enable detached coupling between the back post and the front housing.
4. The fiber optic connector assembly of claim 3, wherein the front housing further includes at least one slit provided at least partially along one side of the front housing, to enable flexing of the front housing in response to application of a rotational force to the front housing.
5. The fiber optic connector assembly of claim 1, further comprising a spring to be provided around the ferrule, wherein the spring is loadable in response to application of a pressing force to the front housing in a direction of the back post, wherein in a loaded state, an end of the spring is to abut a corresponding end of the back post.

6. The fiber optic connector assembly of claim 1, wherein the retaining element comprises an annular ring disposed around a portion of the back post, wherein the front housing is to receive the portion of the back post in response to application of a pressing force to the front housing in a direction of the back post.

7. The fiber optic connector assembly of claim 6, wherein an inner profile of the front housing forms a groove matable with the annular ring of the front housing, in response to application of the pressing force to the front housing in the direction of the back post, wherein the annular ring is to interact with the groove of the front housing to enable a rotation of the front housing, in response to application of a rotational force to the front housing.

8. The fiber optic connector assembly of claim 7, wherein the back post includes an extension component, to retain the ferrule, and to prevent the ferrule from rotation in response to application of a rotational force to the front housing.

9. The fiber optic connector assembly of claim 2, wherein the at least one back post is a first back post, wherein the ferrule is a first ferrule, wherein the front housing is a first front housing, wherein the retaining element is a first retaining element, wherein the assembly further includes:

a second back post couplable with the housing;

a second ferrule including at least another fiber of the fiber optic cable, wherein the second ferrule is insertable into the second back post to provide optic connection for the other fiber; and

a second connector component comprising a second front housing, to provide optic connection between the other fiber of the fiber optic cable and another optical apparatus, wherein the second front housing is to hold at least a portion of the second ferrule and to detachably couple with the second back post,

wherein the second back post includes a second retaining element to provide coupling with, and rotation of, the second front housing about the second back post.

10. The fiber optic connector assembly of claim 9, wherein the housing includes a first end to receive the fiber optic cable, and a second end, wherein the second back post extends from the second end of the housing.

11. The fiber optic connector assembly of claim 10, wherein the housing comprises a unibody housing.

12. The fiber optic connector assembly of claim 9, wherein the housing comprises a duplex clip, wherein the duplex clip includes first and second retaining components, to affixably retain the first and second back posts respectively.

13. The fiber optic connector assembly of claim 12, wherein the first and second retaining components comprise first and second hooks, and third and fourth hooks respectively.

14. The fiber optic connector assembly of claim 12, wherein the fiber optic cable includes first and second portions insertable into the first and second back posts respectively.

15. The fiber optic connector assembly of claim 1, wherein the back post is structurally integrated as part of the housing thereby comprising a single structure composed of a housing having back post extensions extending from a surface thereof.

16. The fiber optic connector assembly of claim 15, wherein the back post extension of the housing comprises a keying element configured to at least partially interface with, and retain, a corresponding key disposed on the ferrule.

17. The fiber optic connector assembly of claim 1, wherein the back post is reversibly couplable with the housing.

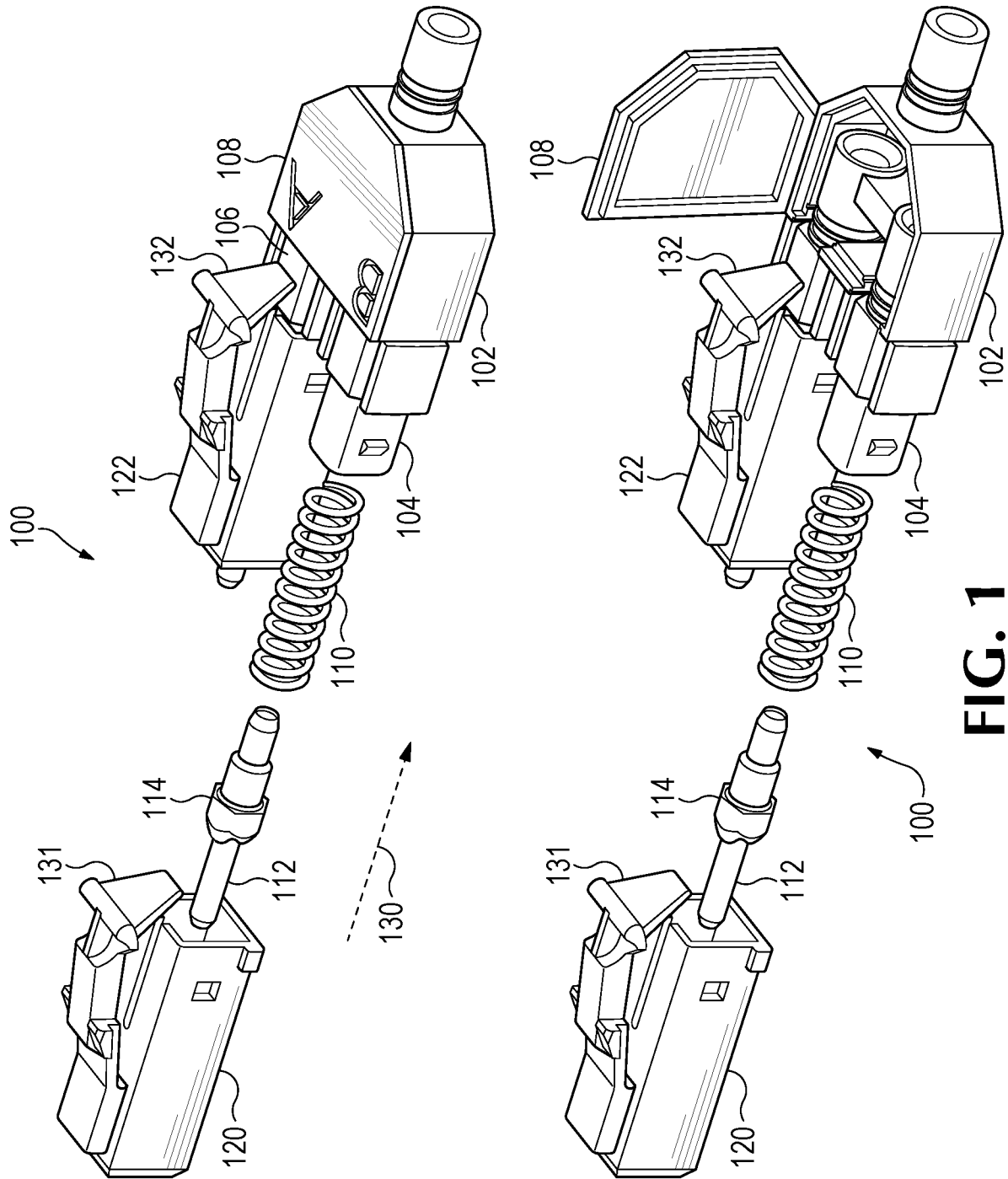


FIG. 1

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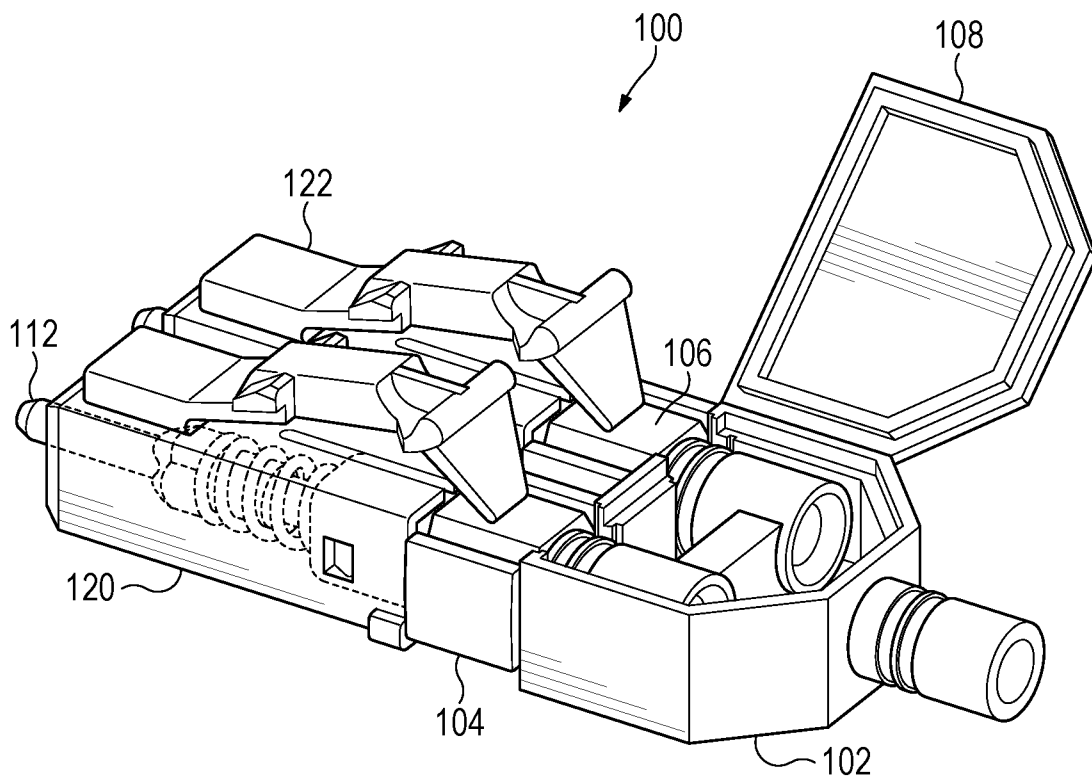
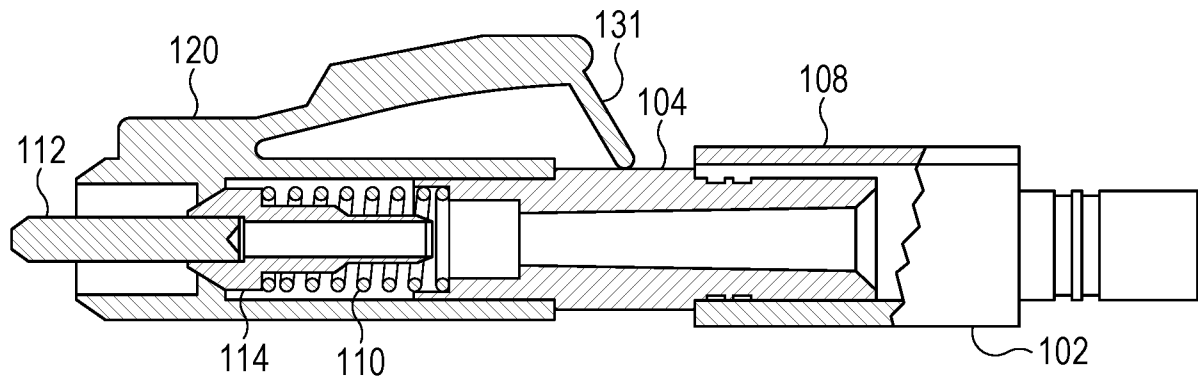
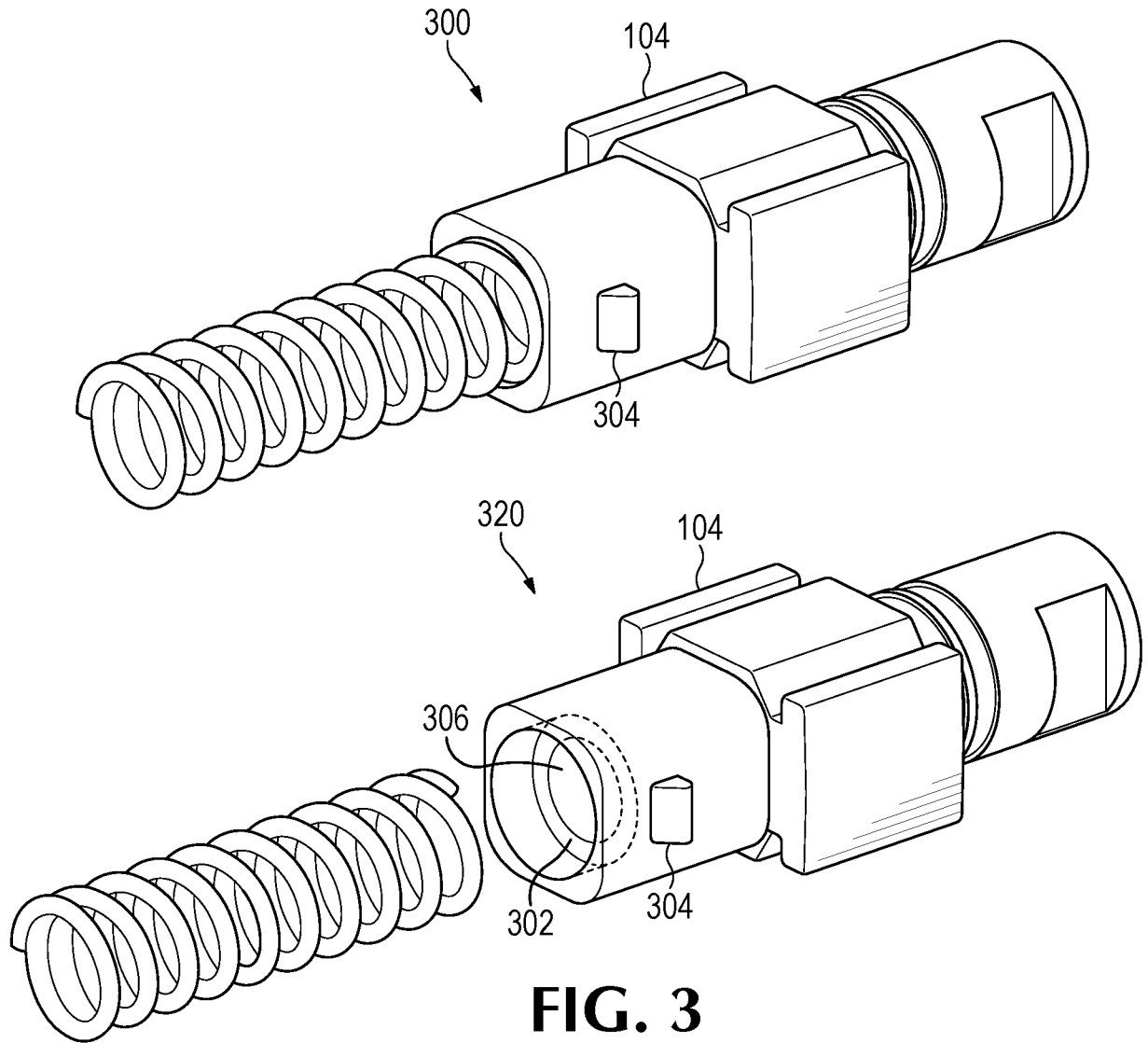


FIG. 2

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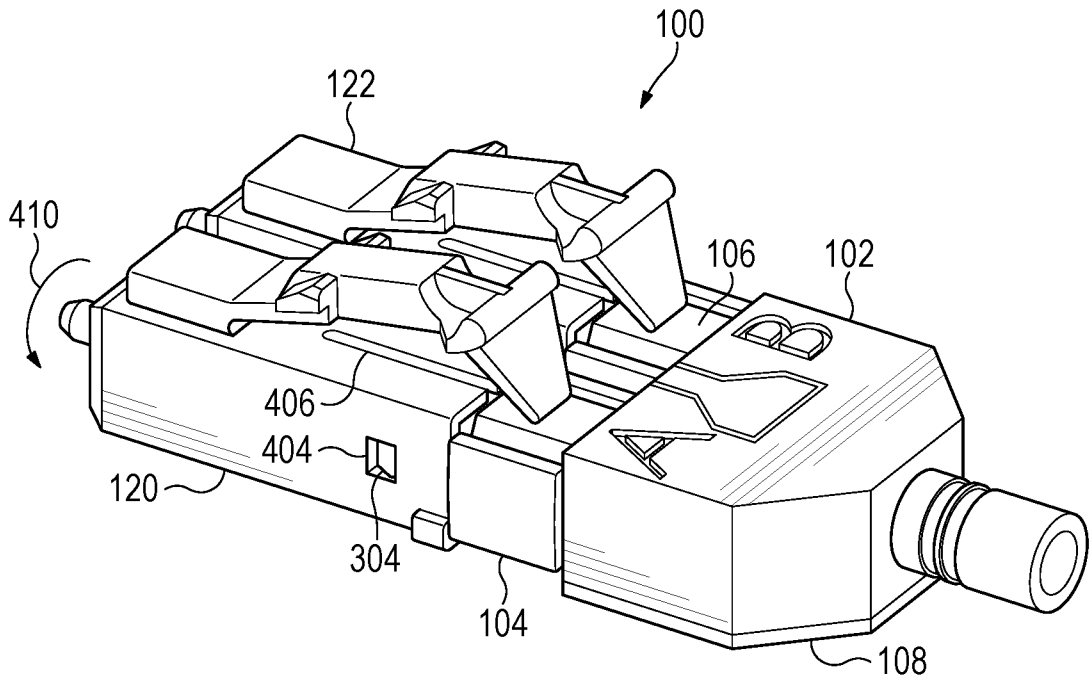


FIG. 4

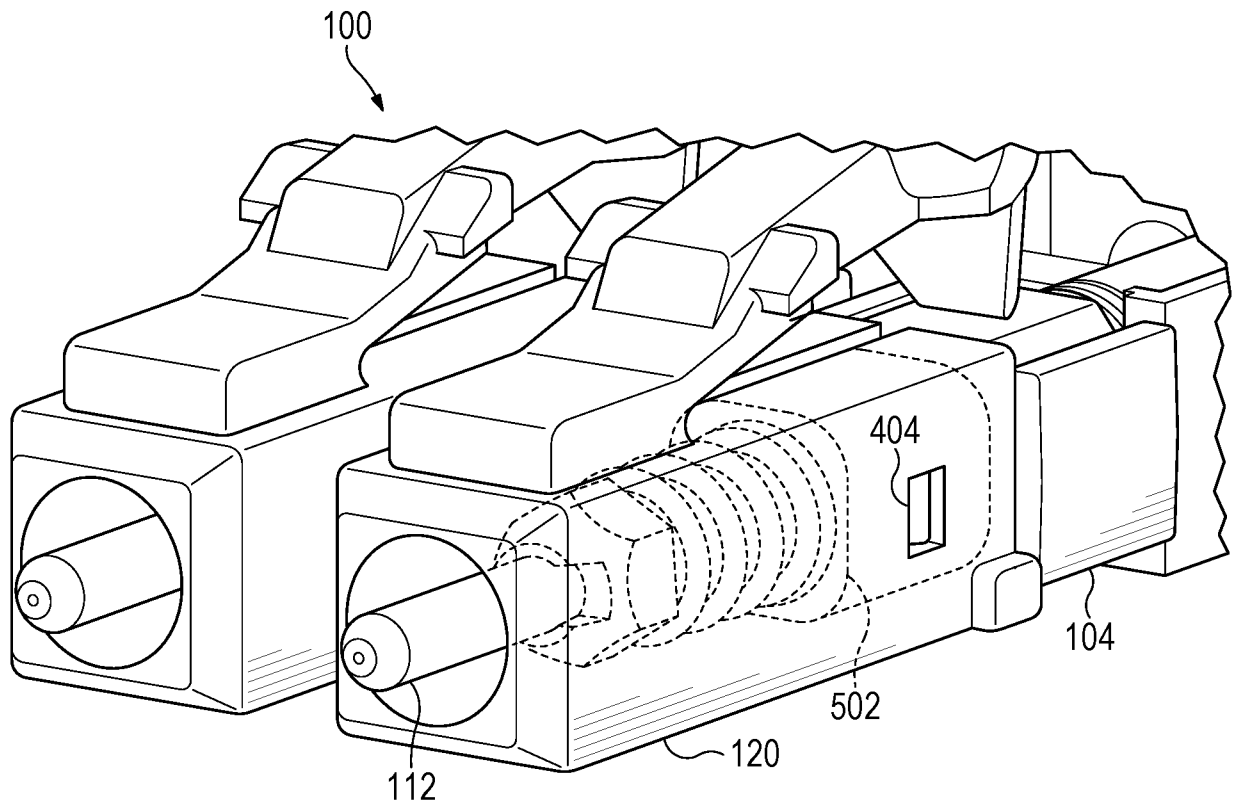


FIG. 5

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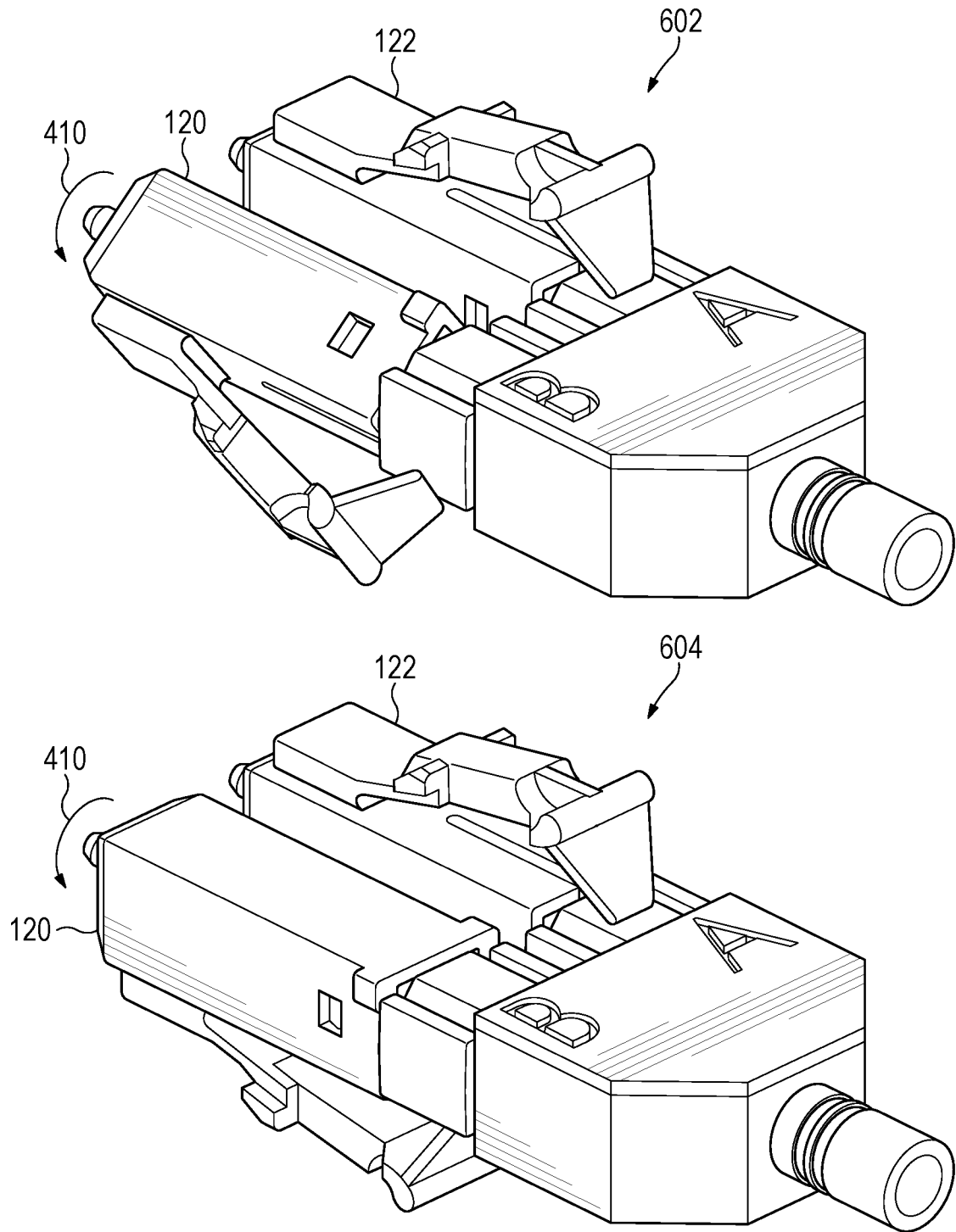


FIG. 6

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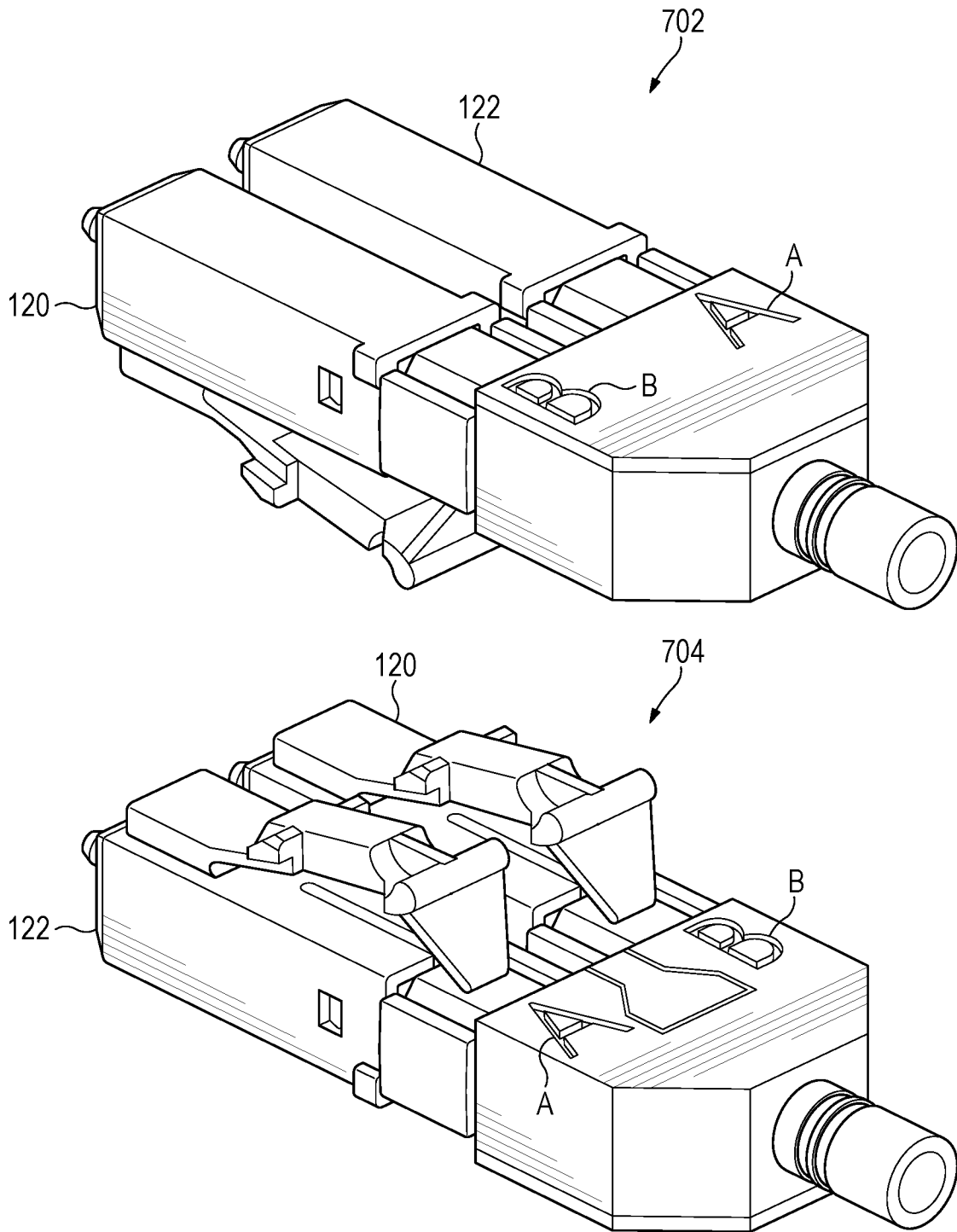


FIG. 7

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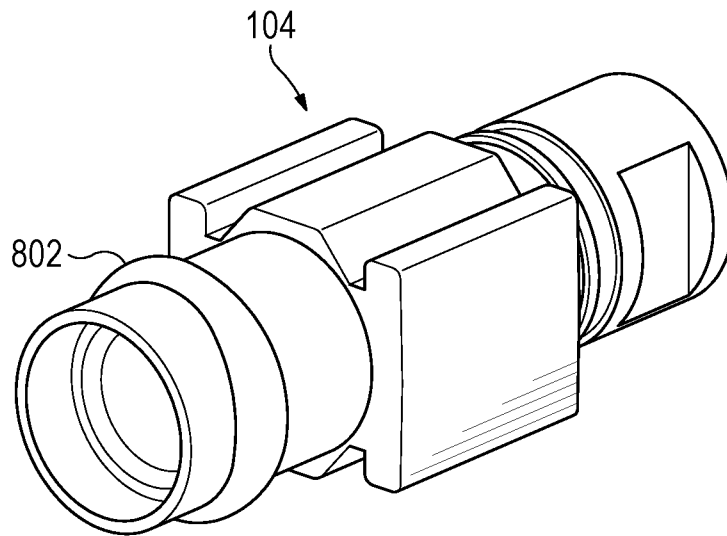


FIG. 8

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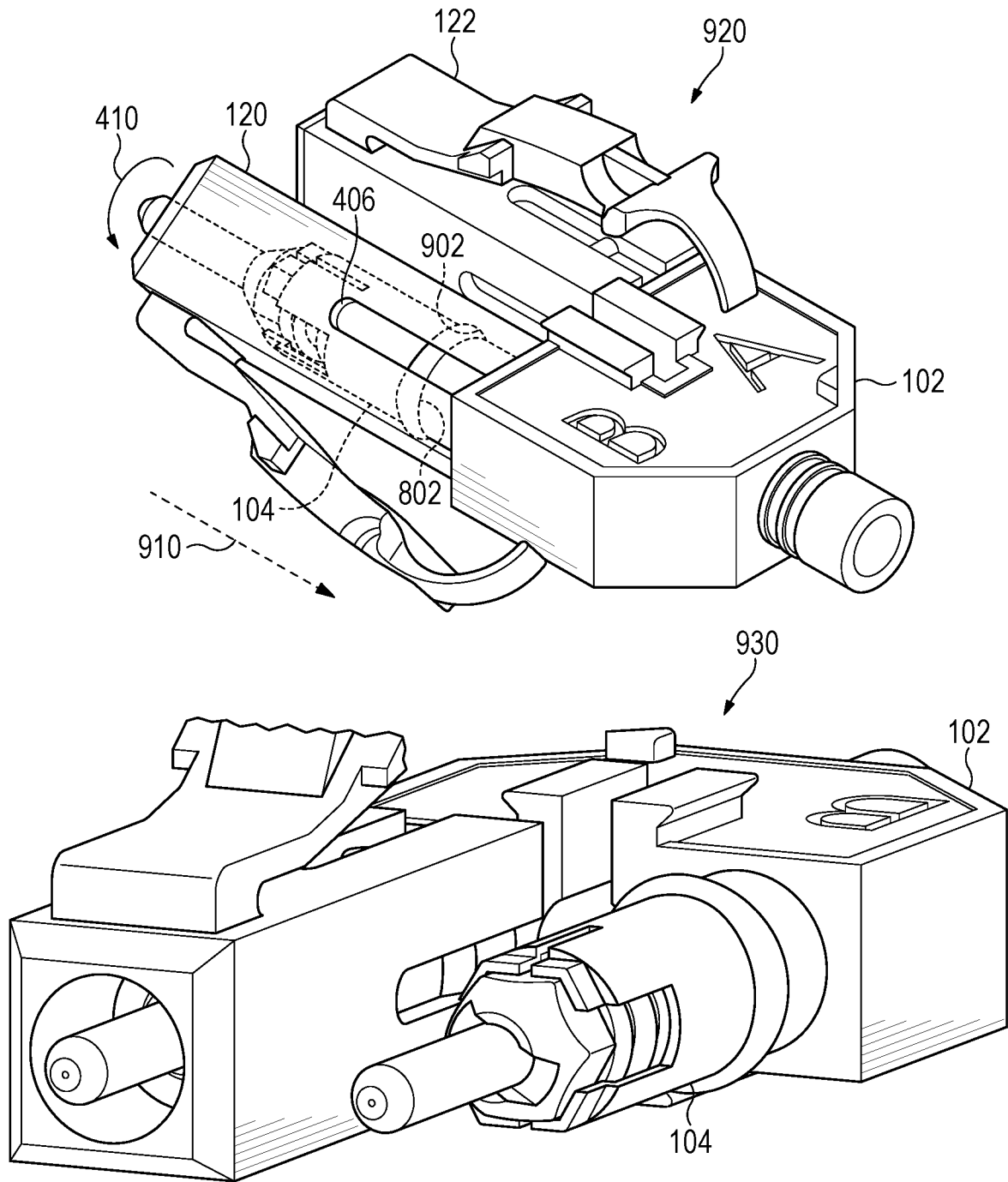


FIG. 9

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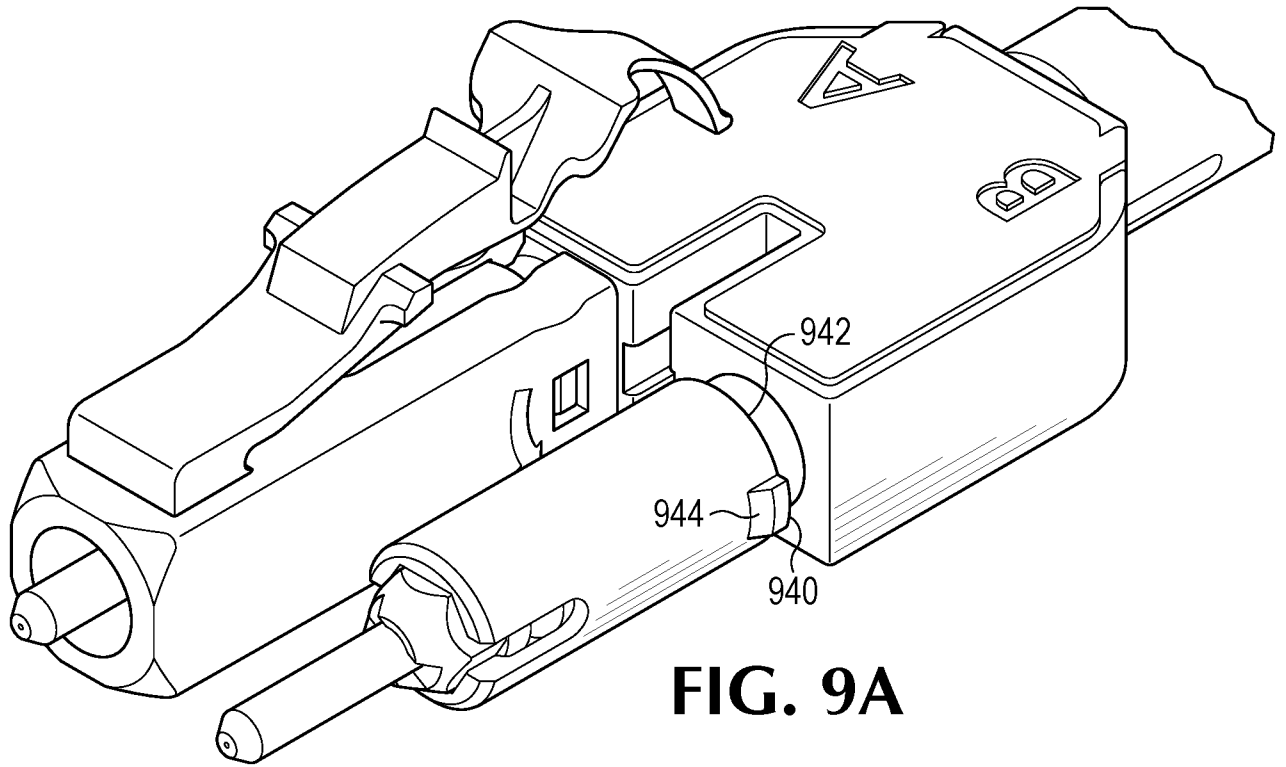


FIG. 9A

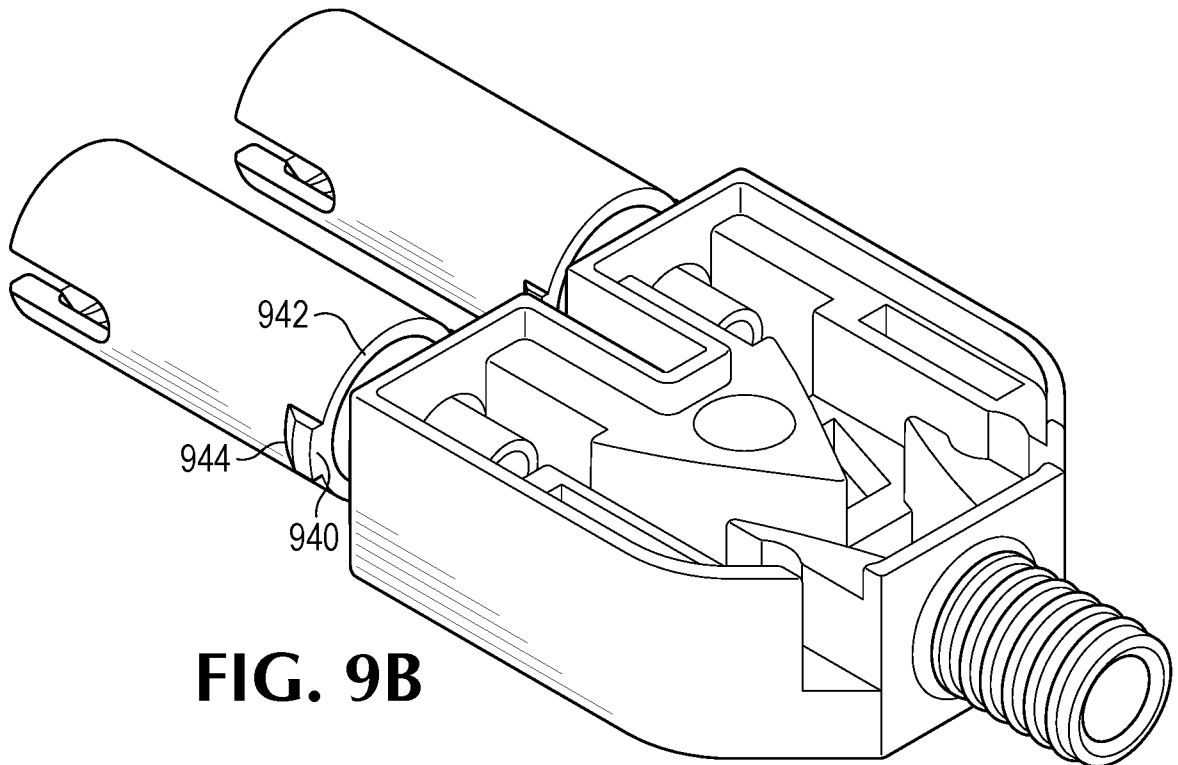


FIG. 9B

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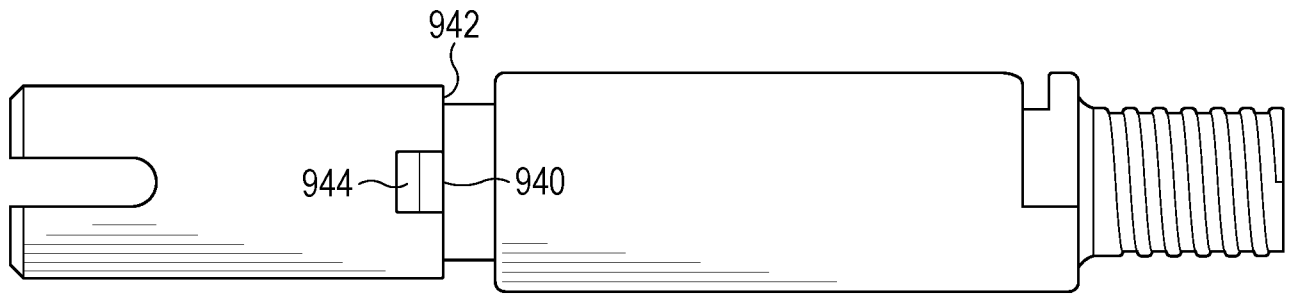


FIG. 9C

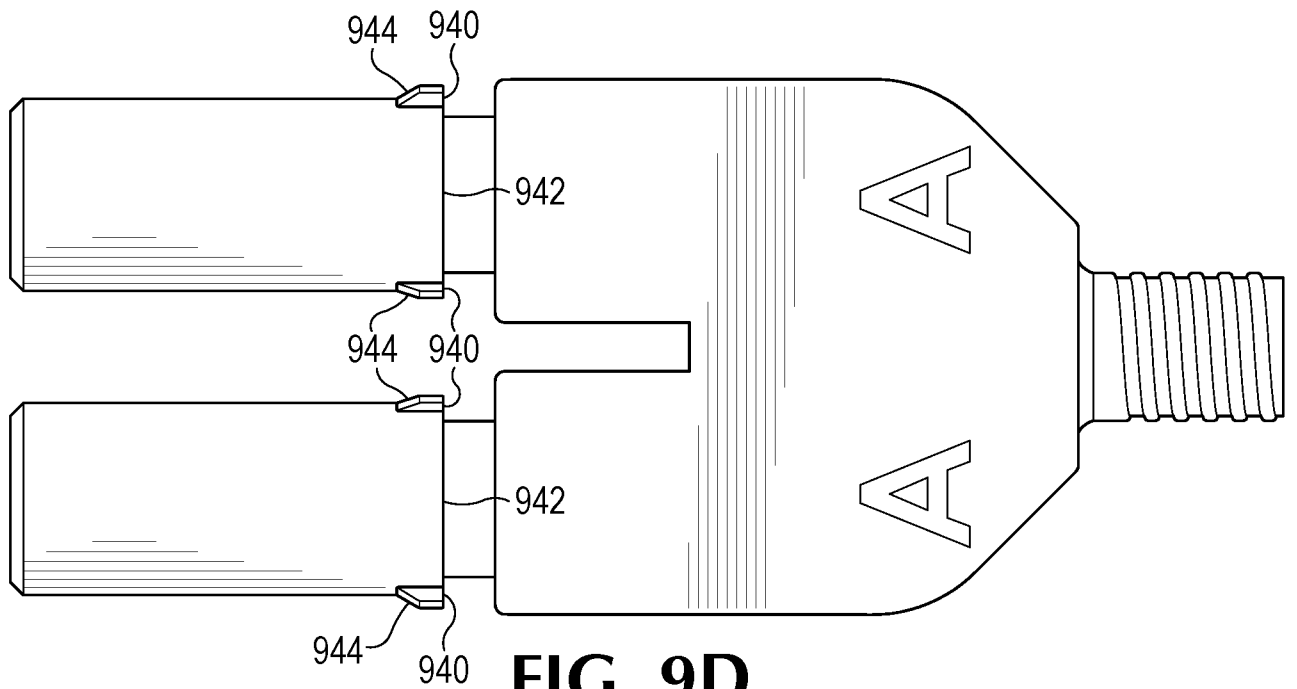


FIG. 9D

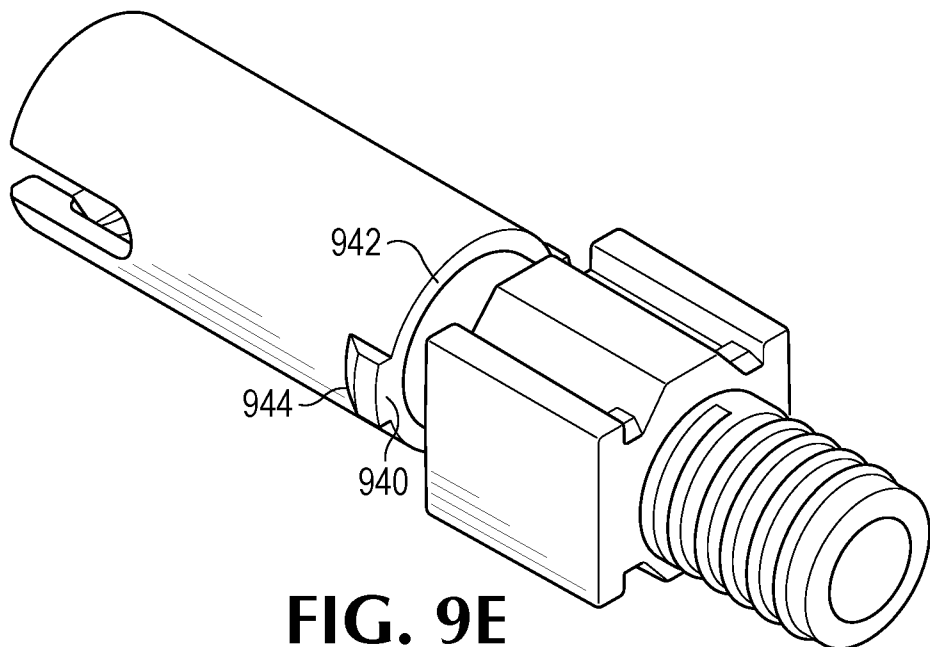
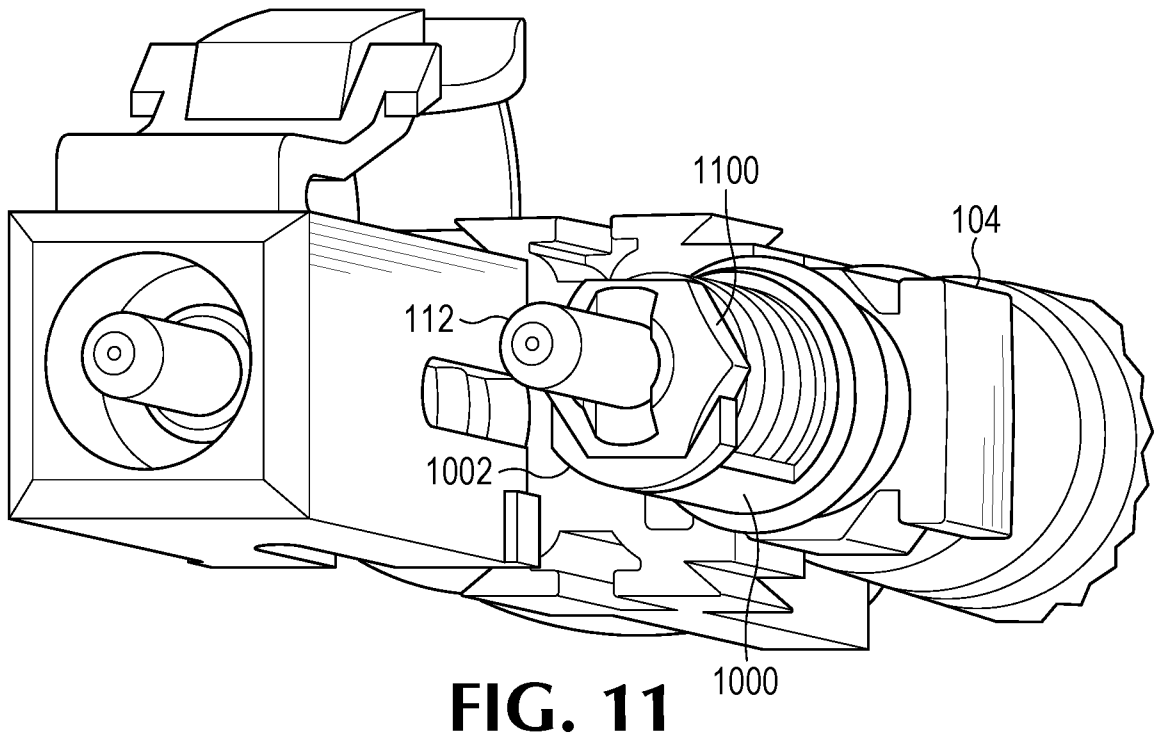
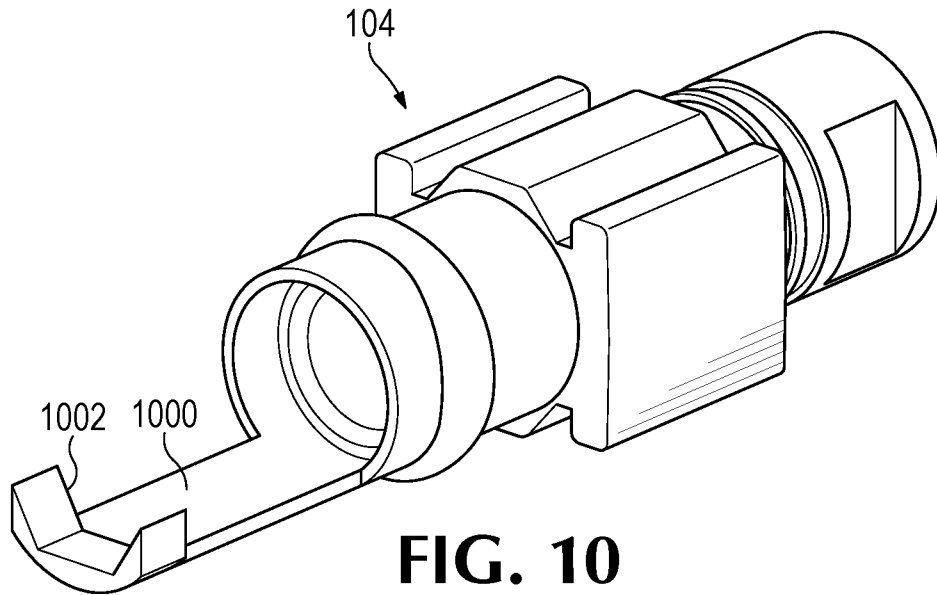
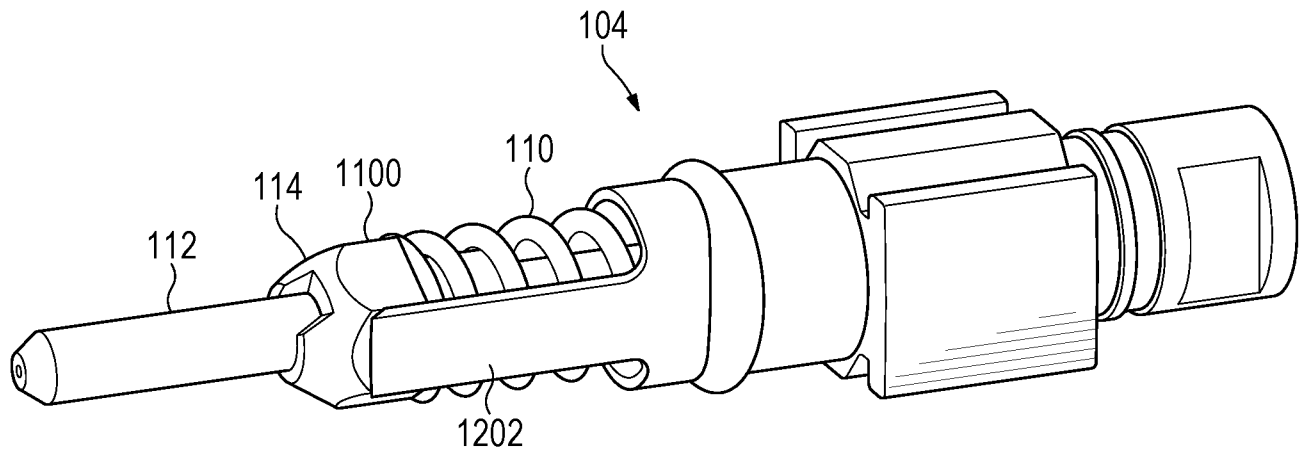
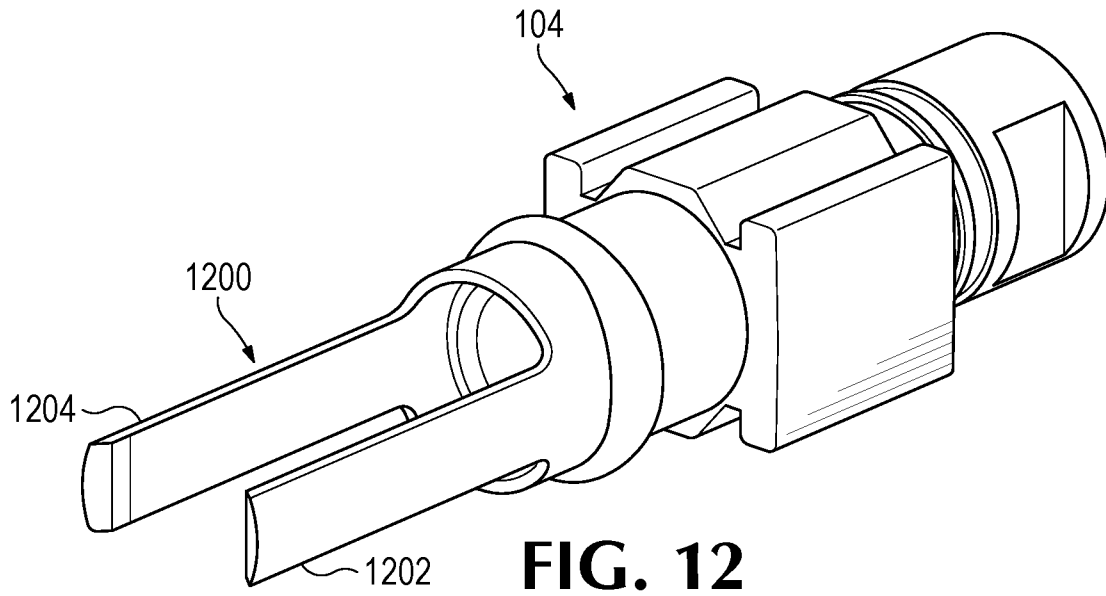


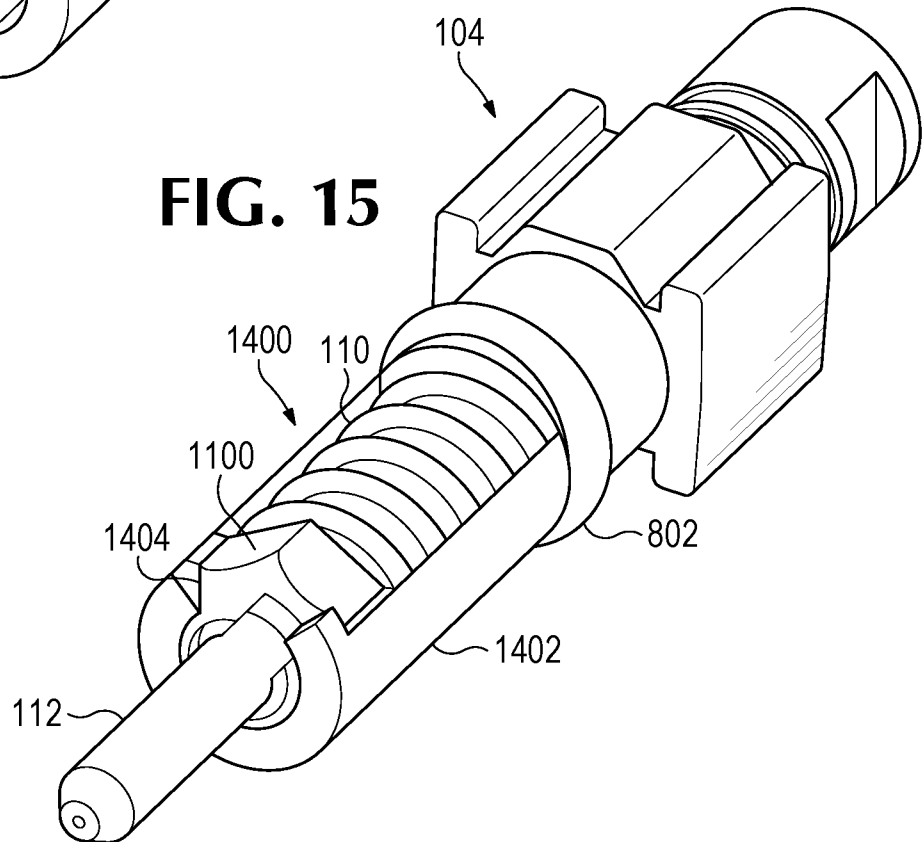
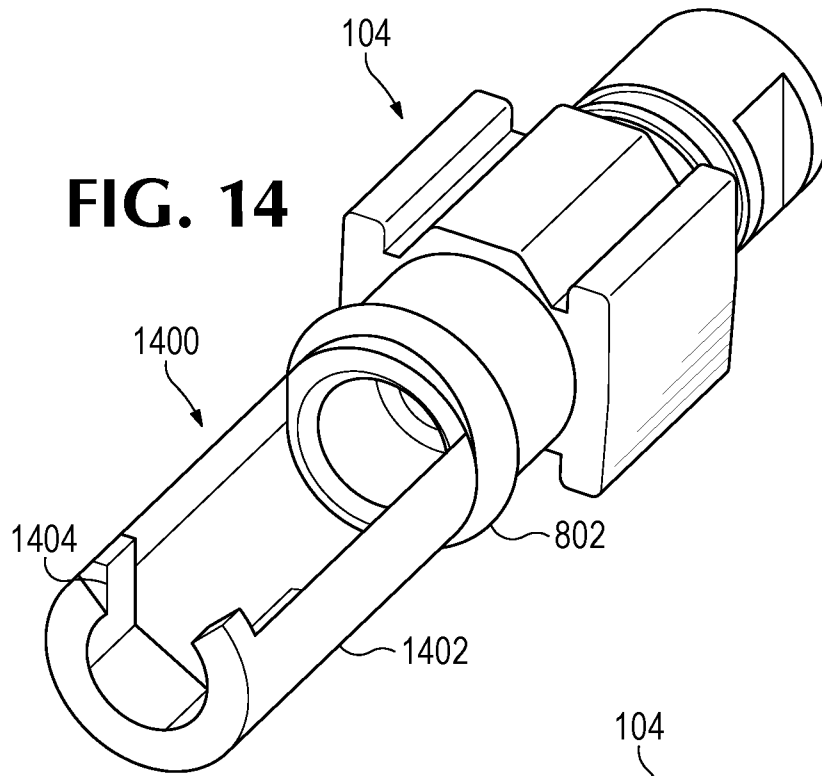
FIG. 9E

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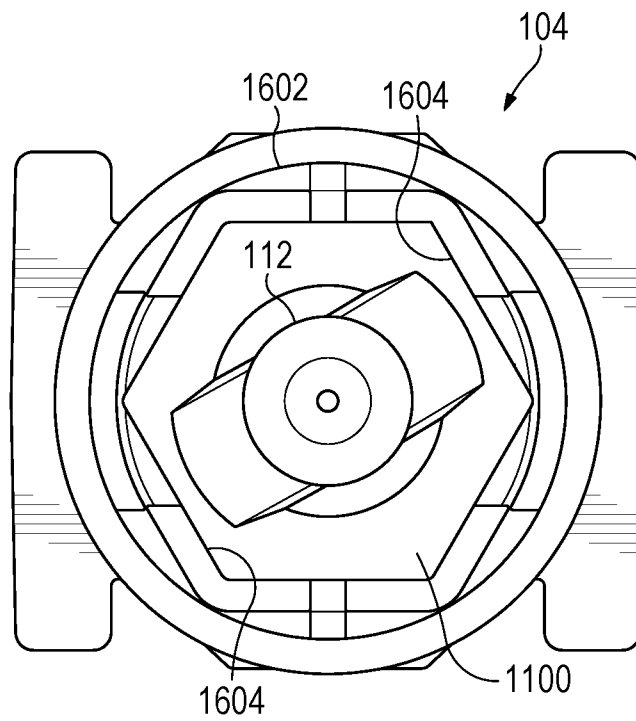
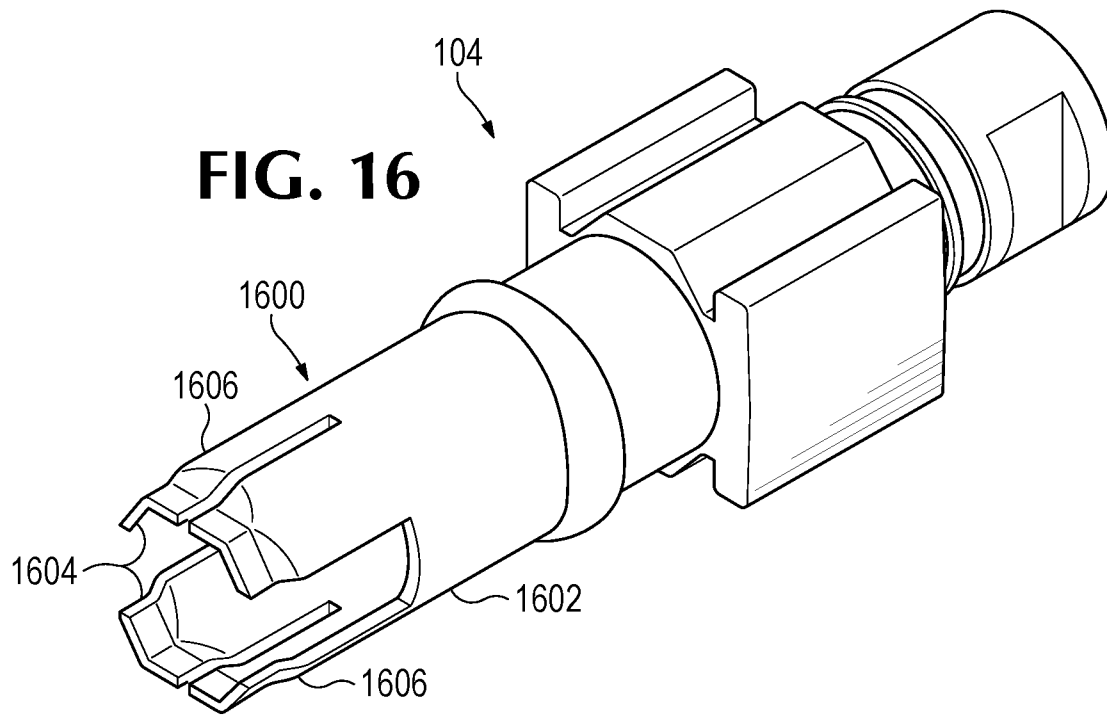


FIG. 17

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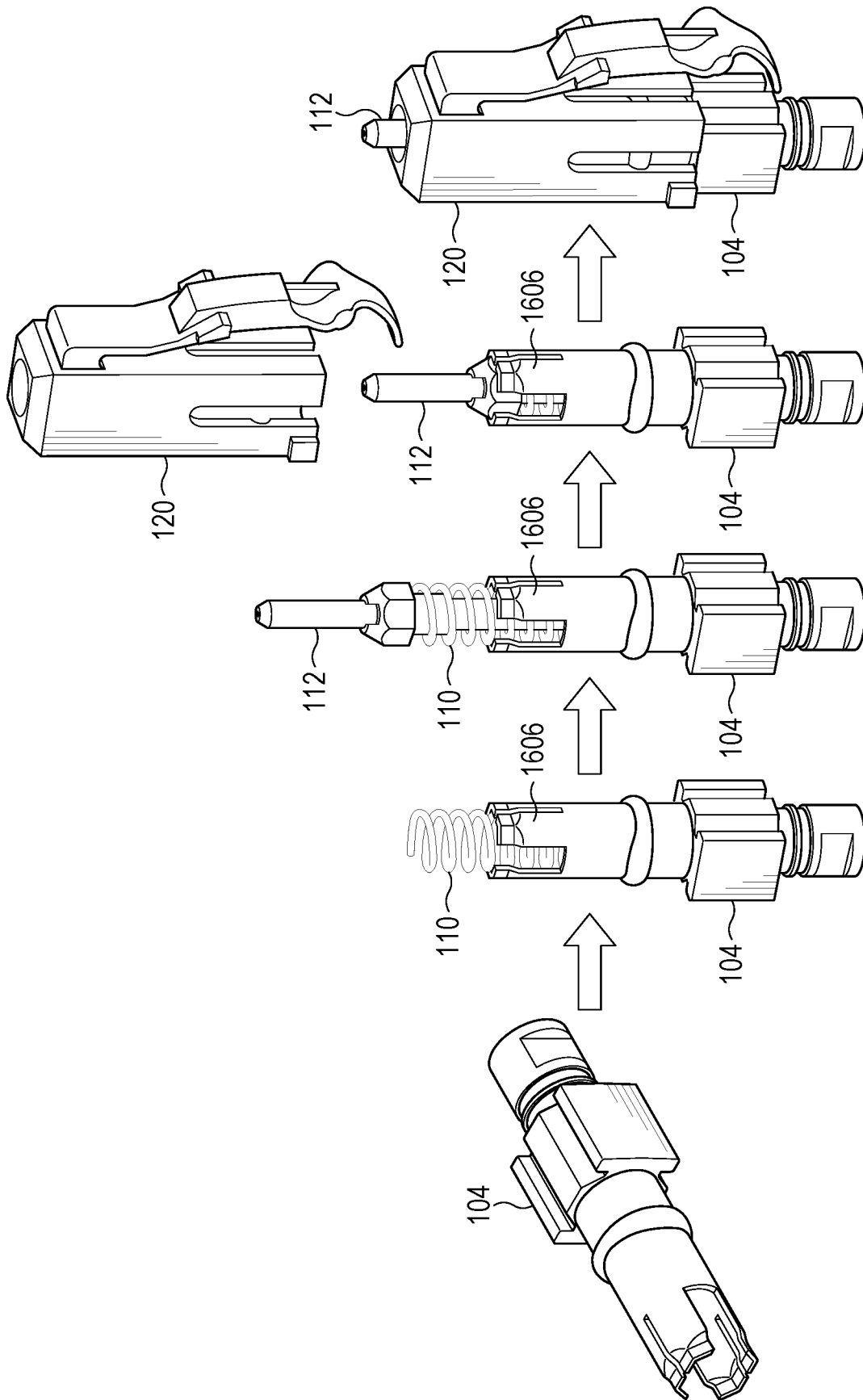


FIG. 18

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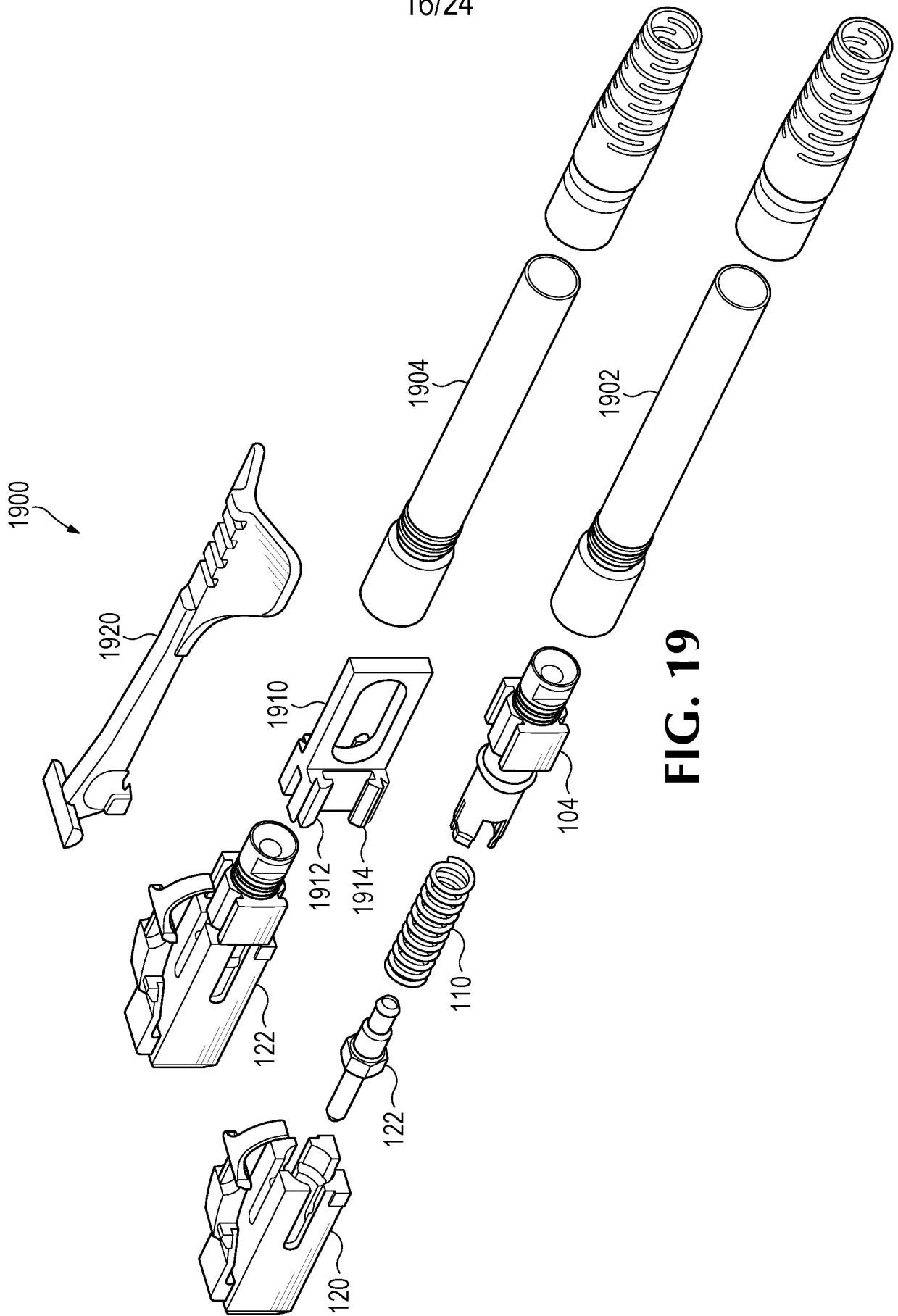


FIG. 19

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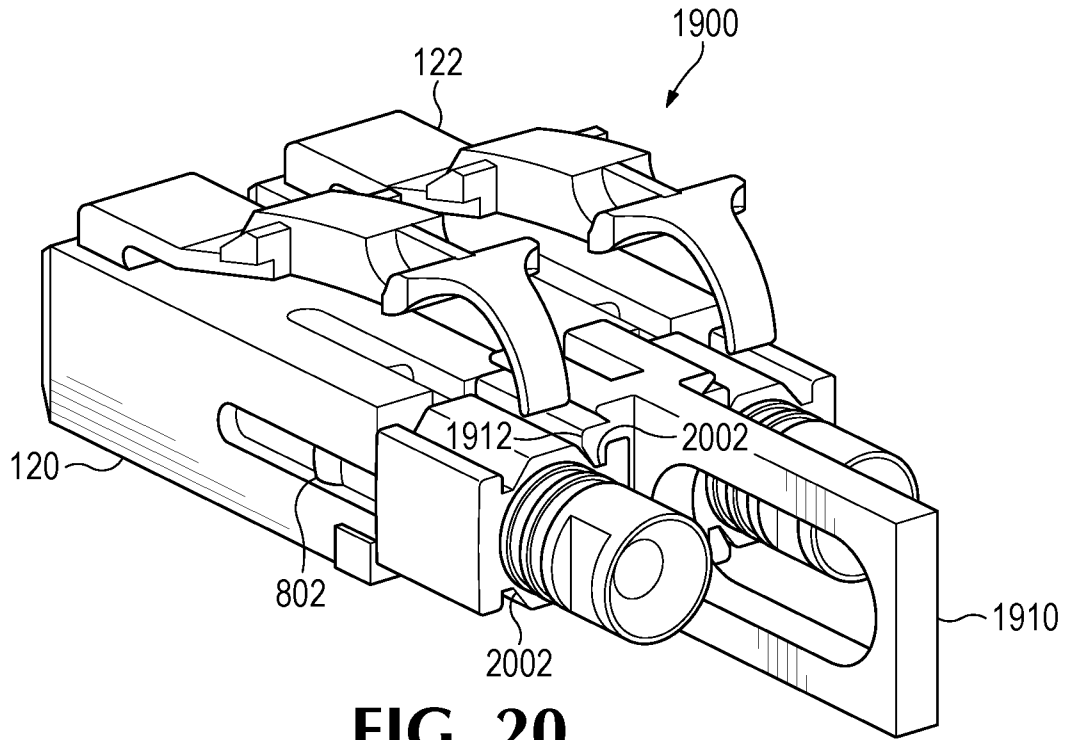


FIG. 20

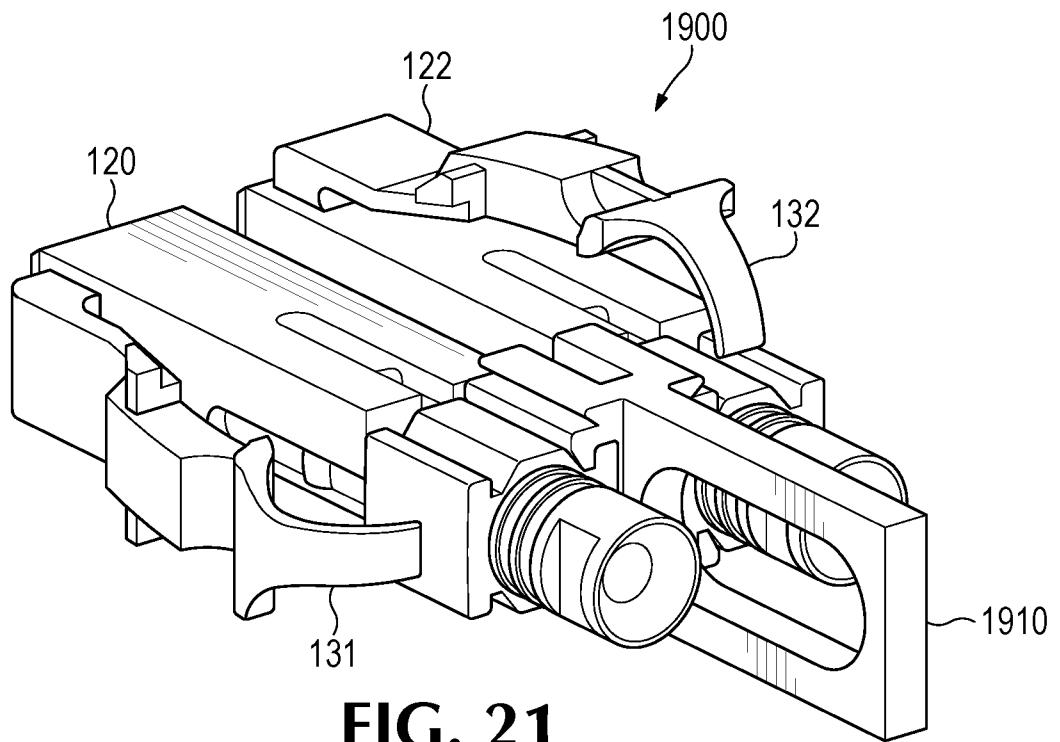


FIG. 21

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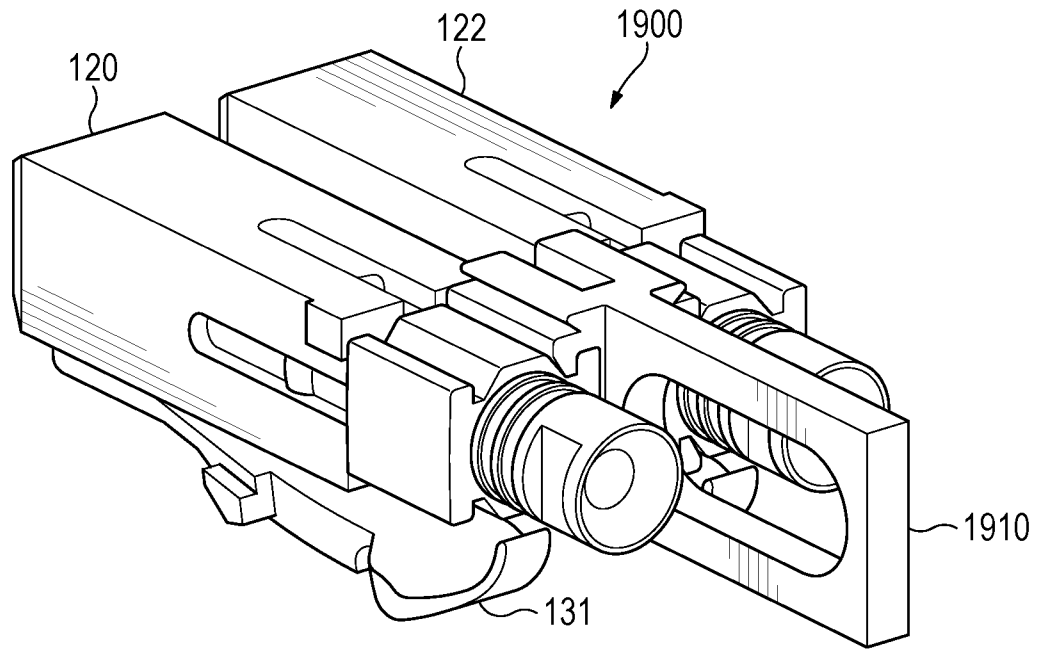


FIG. 22

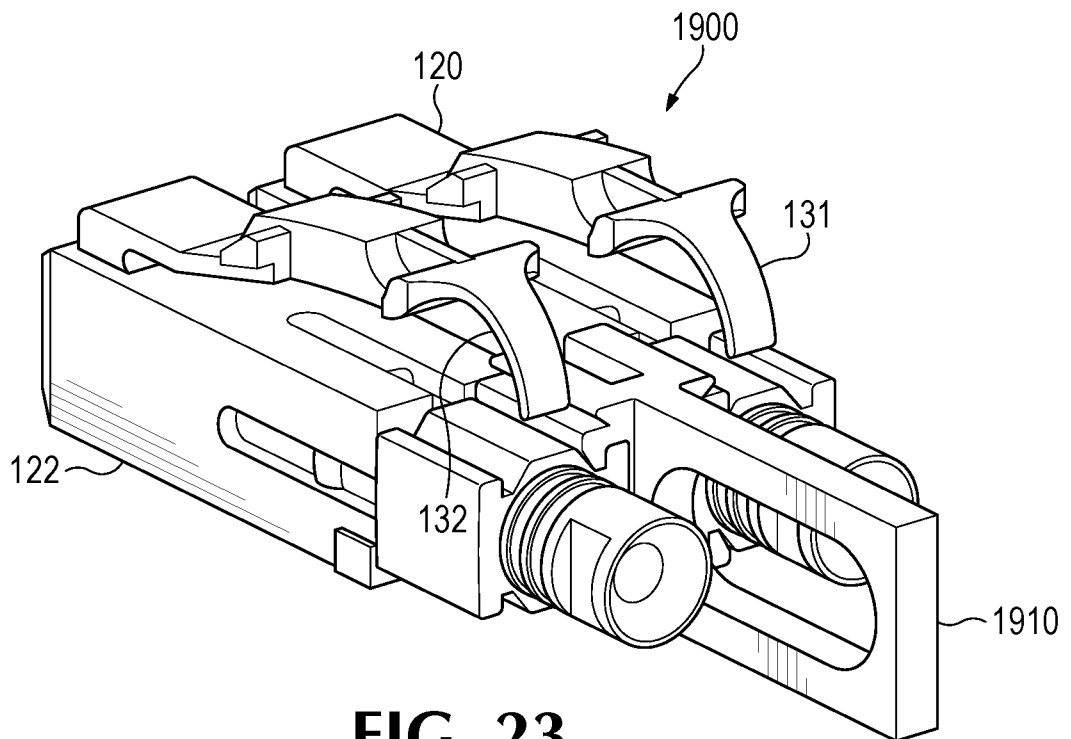
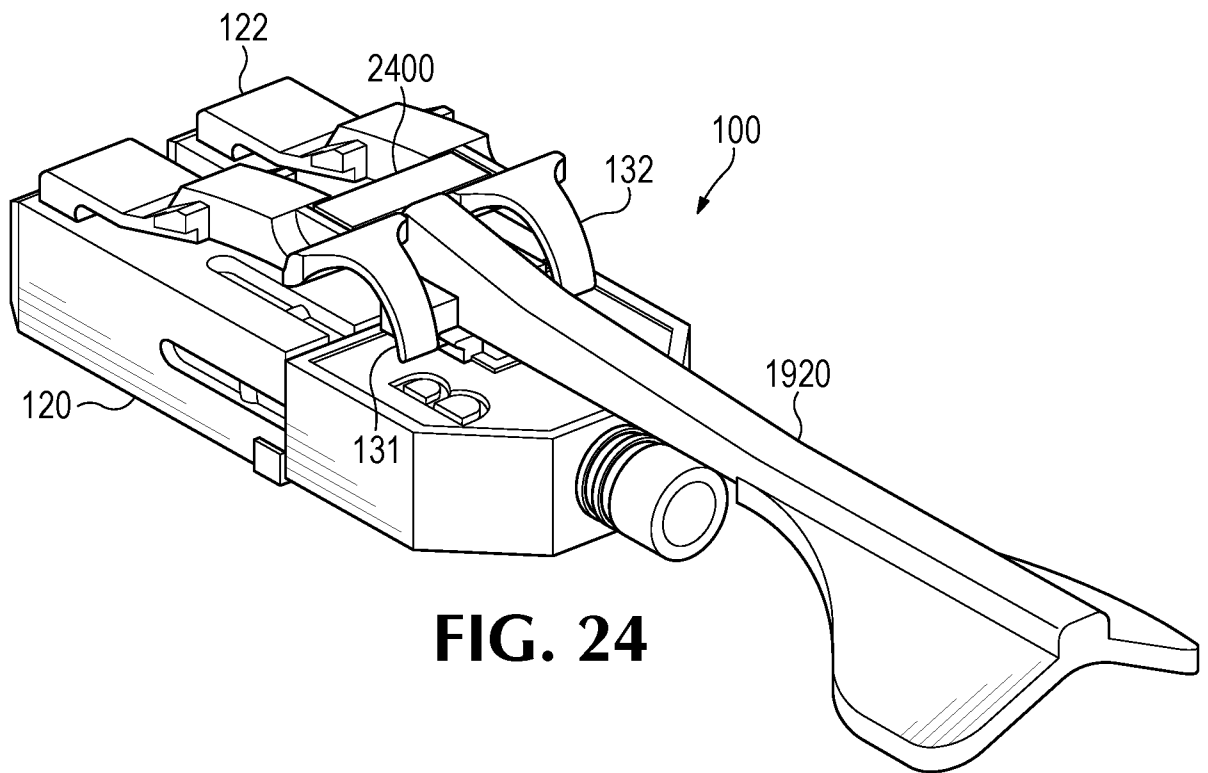


FIG. 23



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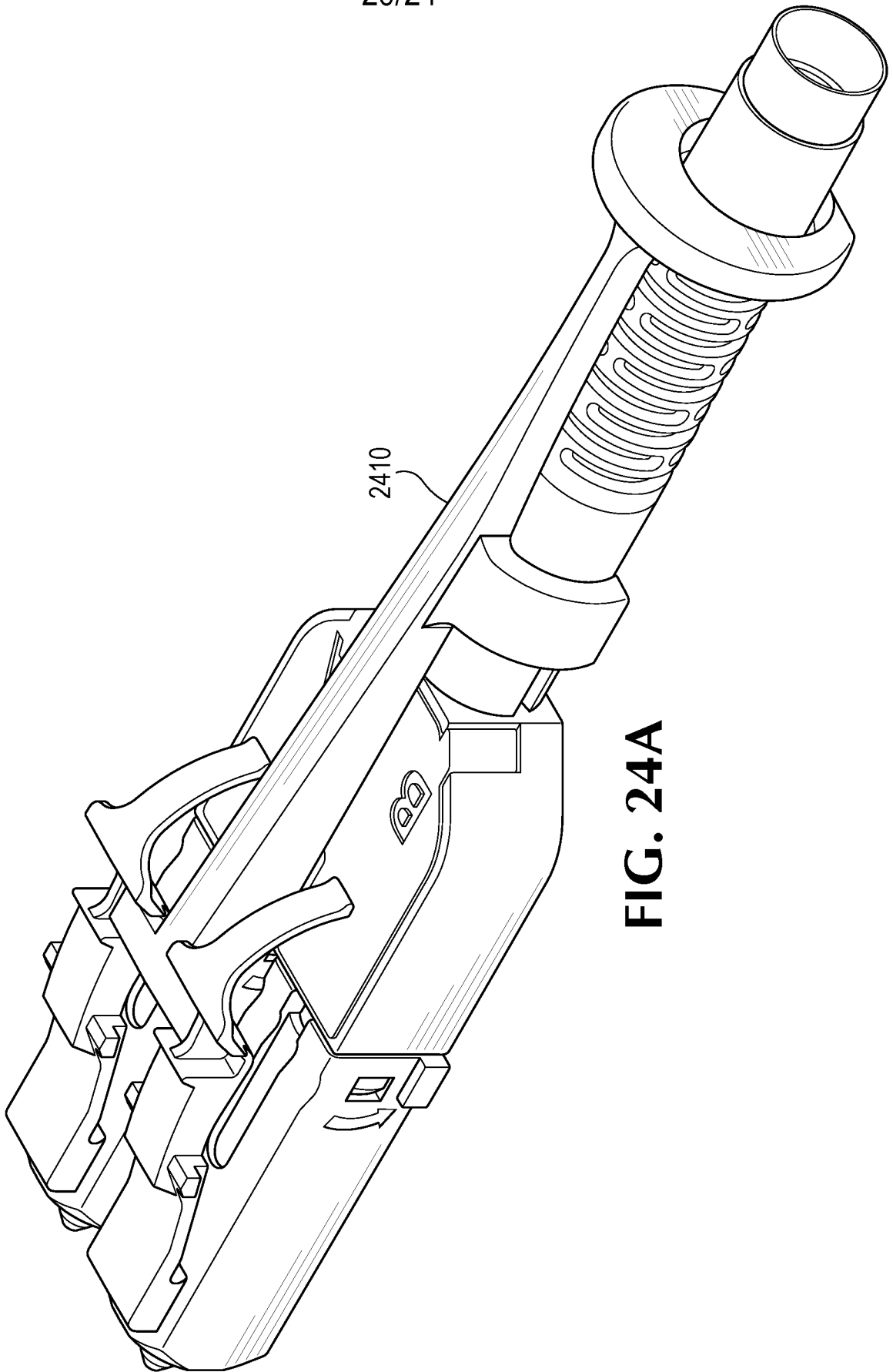


FIG. 24A

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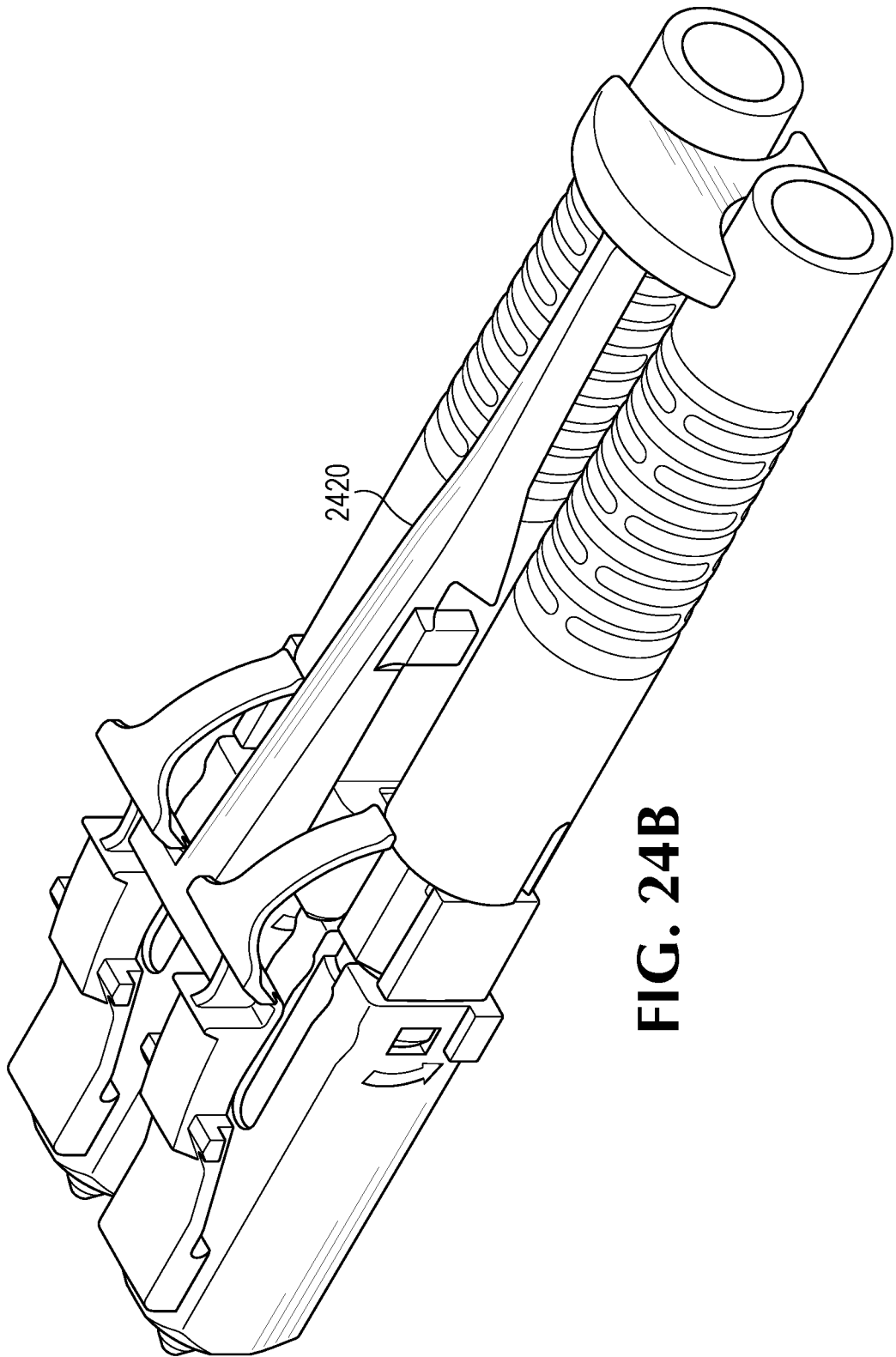


FIG. 24B

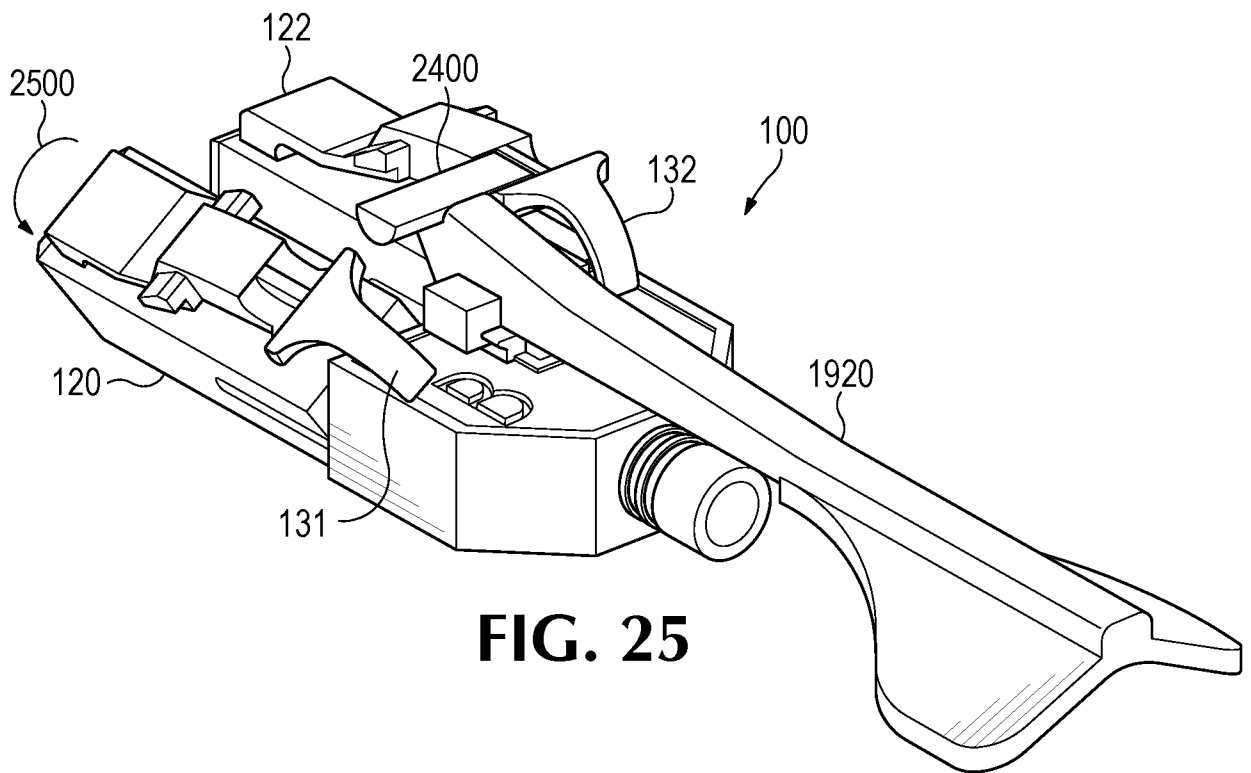


FIG. 25

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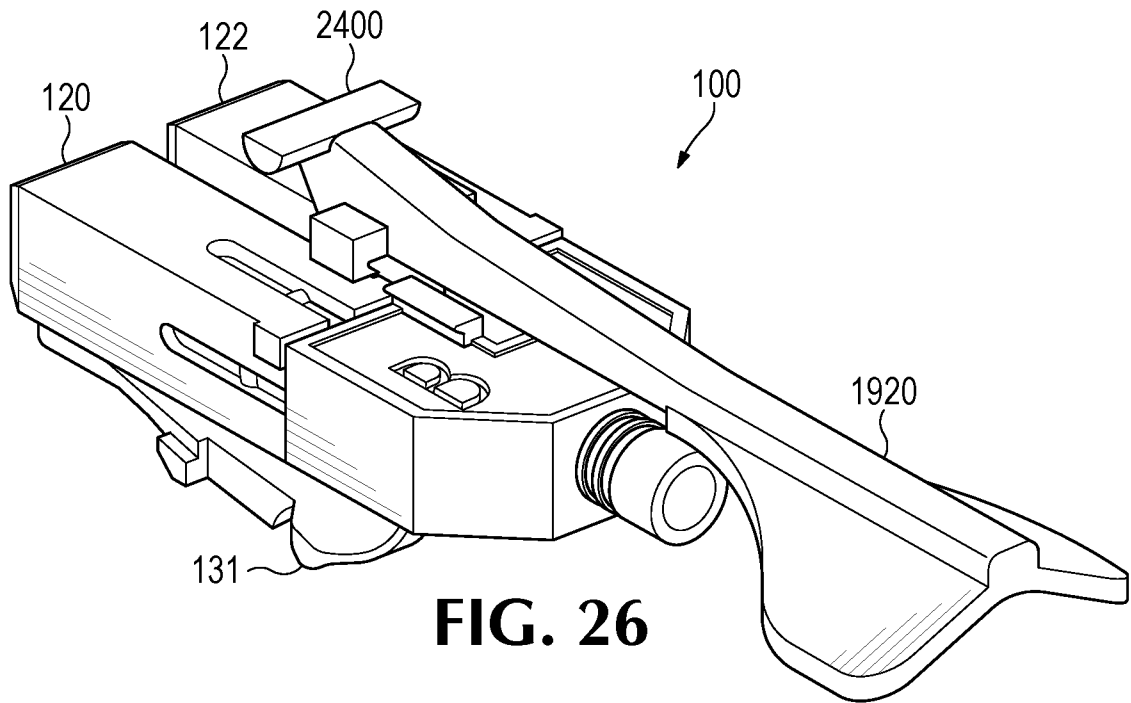


FIG. 26

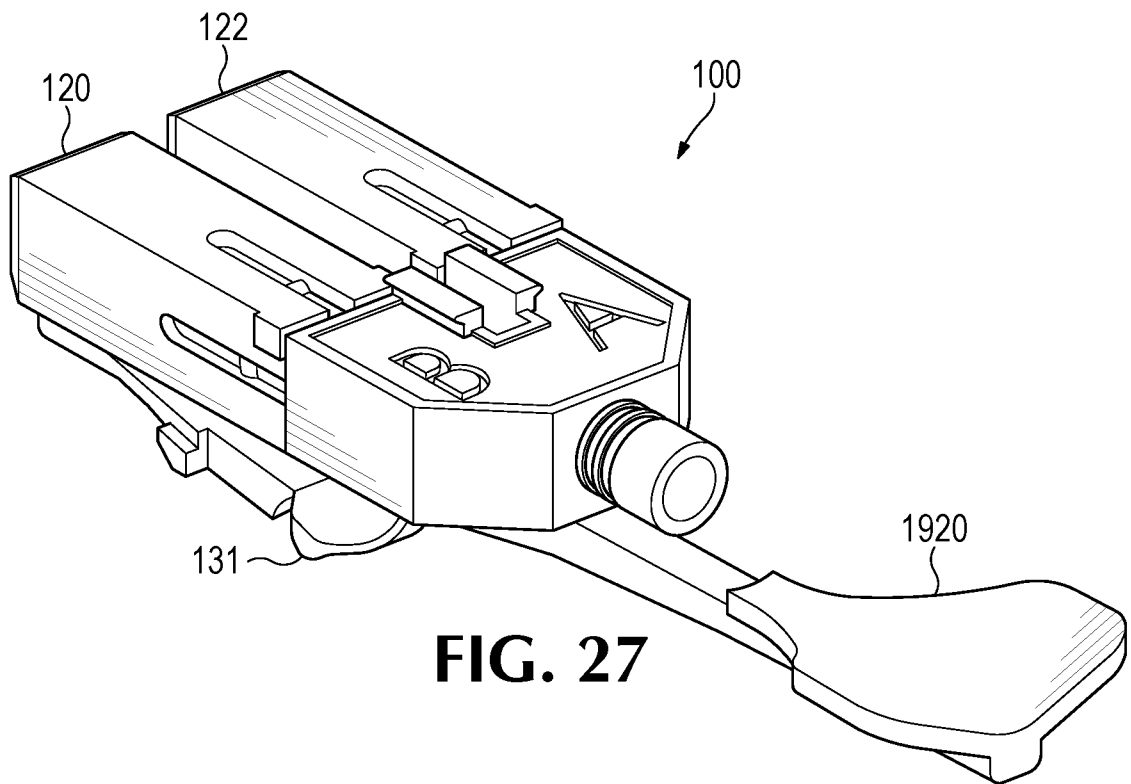


FIG. 27

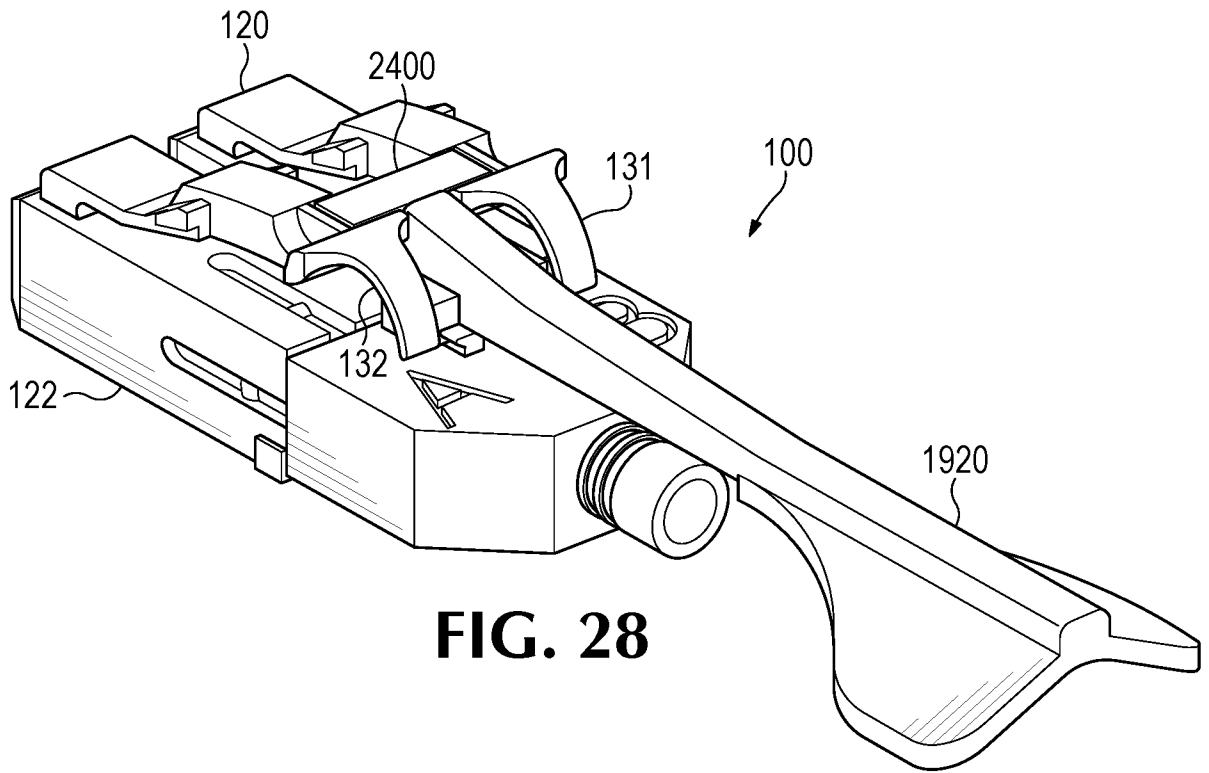


FIG. 28

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US2017/026486

A. CLASSIFICATION OF SUBJECT MATTER

IPC (2017.01) G02B 6/38

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC (2017.01) G02B 6/38

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

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

Databases consulted: Esp@cenet, Google Patents, FamPat database, PatBase, Derwent Innovation

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2015103783 A1 Murray et al. 16 Jul 2015 (2015/07/16)	1-17
A	US 2015277059 A1 Raven et al. 01 Oct 2015 (2015/10/01)	1-17

Further documents are listed in the continuation of Box C.

See patent family annex.

* Special categories of cited documents:

“A” document defining the general state of the art which is not considered to be of particular relevance

“E” earlier application or patent but published on or after the international filing date

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

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

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

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

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

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

“&” document member of the same patent family

Date of the actual completion of the international search

19 Jul 2017

Date of mailing of the international search report

26 Jul 2017

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Telephone No. 972-2-5651806

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/US2017/026486

Patent document cited search report	Publication date	Patent family member(s)	Publication Date
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