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Canadian Intellectual Property Office

CA 2979517 C 2023/08/15

(11)(21) **2 979 517**

(12) **BREVET CANADIEN**
CANADIAN PATENT

(13) **C**

(86) **Date de dépôt PCT/PCT Filing Date:** 2016/03/31
(87) **Date publication PCT/PCT Publication Date:** 2016/10/06
(45) **Date de délivrance/Issue Date:** 2023/08/15
(85) **Entrée phase nationale/National Entry:** 2017/09/12
(86) **N° demande PCT/PCT Application No.:** IL 2016/050345
(87) **N° publication PCT/PCT Publication No.:** 2016/157189
(30) **Priorité/Priority:** 2015/04/03 (US62/178,207)

(51) **Cl.Int./Int.Cl.** ***A61B 1/00*** (2006.01),
A61B 1/012 (2006.01)

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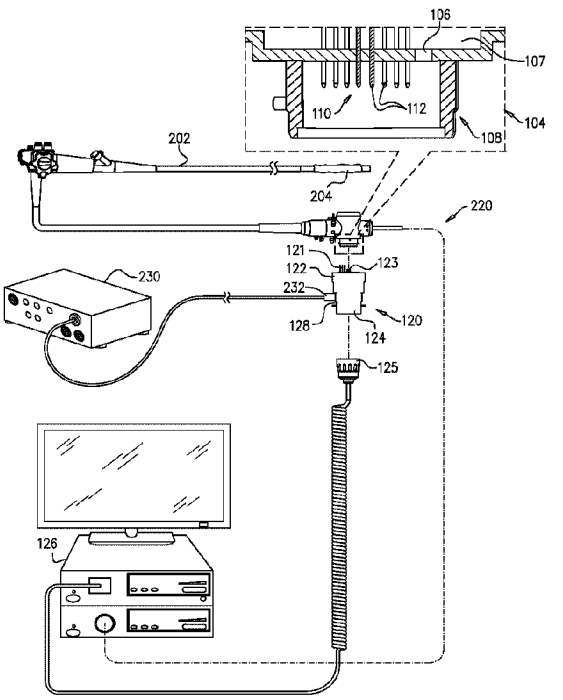
(54) **Titre : ADAPTATEUR ELECTRO-PNEUMATIQUE D'ENDOSCOPE**
(54) **Title: ENDOSCOPE ELECTRO-PNEUMATIC ADAPTOR**



(57) **Abrégé/Abstract:**
An endoscope system including an endoscope including an endoscope electro-pneumatic connection assembly having a leak test port, an endoscope electro- optic subsystem which is connectable to the endoscope via the endoscope electro- pneumatic connection assembly in a manner which precludes access to the leak test port when the endoscope electro-optic subsystem and the endoscope are connected at the electro-pneumatic connection assembly and an electro-pneumatic adaptor, which is connectable to the endoscope at the electro-pneumatic connection assembly and includes an adaptor electro-pneumatic connection assembly, including a leak test port connector for connection to the leak test port of the endoscope, an adaptor electrical port assembly to which the endoscope electro-optic subsystem is connectable and a pneumatic port.

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

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
6 October 2016 (06.10.2016)

WIPO | PCT

(10) International Publication Number
WO 2016/157189 A1

(51) International Patent Classification:
A61B 1/00 (2006.01) *A61B 1/012* (2006.01)

(21) International Application Number:
PCT/IL2016/050345

(22) International Filing Date:
31 March 2016 (31.03.2016)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
62/178,207 3 April 2015 (03.04.2015) US

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

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

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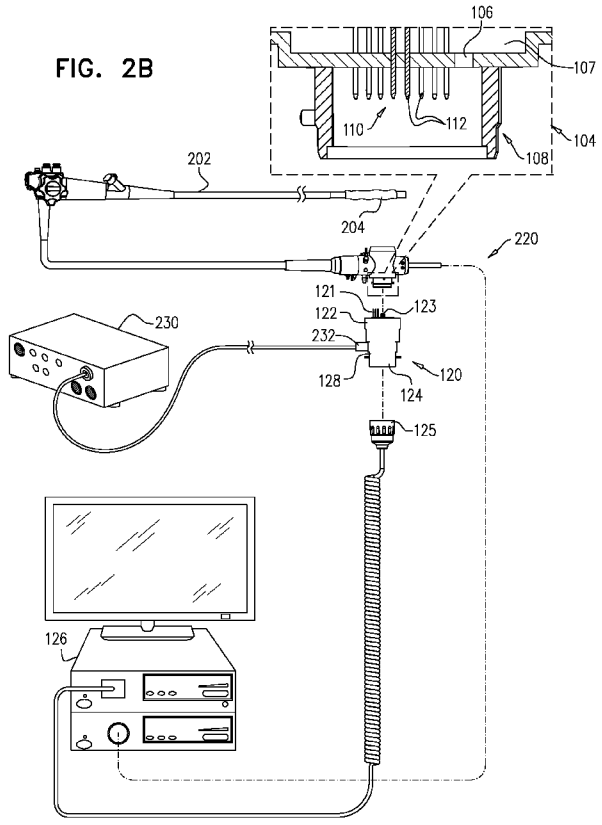
(54) Title: ENDOSCOPE ELECTRO-PNEUMATIC ADAPTOR

FIG. 2B



(57) Abstract: An endoscope system including an endoscope including an endoscope electro-pneumatic connection assembly having a leak test port, an endoscope electro- optic subsystem which is connectable to the endoscope via the endoscope electro- pneumatic connection assembly in a manner which precludes access to the leak test port when the endoscope electro-optic subsystem and the endoscope are connected at the electro-pneumatic connection assembly and an electro-pneumatic adaptor, which is connectable to the endoscope at the electro-pneumatic connection assembly and includes an adaptor electro-pneumatic connection assembly, including a leak test port connector for connection to the leak test port of the endoscope, an adaptor electrical port assembly to which the endoscope electro-optic subsystem is connectable and a pneumatic port.

WO 2016/157189 A1

WO 2016/157189 A1

Published:

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

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

ENDOSCOPE ELECTRO-PNEUMATIC ADAPTOR

REFERENCE TO RELATED APPLICATIONS

This application claims priority to U.S. Patent Application Serial No. 62/178,207, filed April 3, 2015 and entitled ADAPTOR FOR USE WITH AN ENDOSCOPE.

Reference is also made to applicant's Published PCT Patent Applications WO2011/111040; WO/2012/120492; WO/2014/068569 and WO2014/188402.

FIELD OF THE INVENTION

The present invention relates to endoscope systems generally and more particularly to adaptors useful in endoscope systems.

BACKGROUND OF THE INVENTION

Various types of endoscope systems are known.

Date Reçue/Date Received 2022-06-16

SUMMARY OF THE INVENTION

The present invention seeks to provide an improved endoscope system.

There is thus provided in accordance with a preferred embodiment of the present invention an endoscope system including an endoscope including an endoscope electro-pneumatic connection assembly having a leak test port, an endoscope electro-optic subsystem which is connectable to the endoscope via the endoscope electro-pneumatic connection assembly in a manner which precludes access to the leak test port when the endoscope electro-optic subsystem and the endoscope are connected at the electro-pneumatic connection assembly and an electro-pneumatic adaptor, which is connectable to the endoscope at the electro-pneumatic connection assembly and includes an adaptor electro-pneumatic connection assembly, including a leak test port connector for connection to the leak test port of the endoscope, an adaptor electrical port assembly to which the endoscope electro-optic subsystem is connectable and a pneumatic port.

In accordance with a preferred embodiment of the present invention the pneumatic port includes a pneumatic connector assembly. Additionally or alternatively, the electro-pneumatic adaptor is removably connectable to the endoscope at the electro-pneumatic connection assembly. Alternatively or additionally, the leak test port communicates with an interior volume of the endoscope.

Preferably, the electro-pneumatic adaptor includes an electrical connector for connection to an electrical connector of the endoscope, a pneumatic connector portion for connection to the endoscope electro-pneumatic connection assembly and a leak test port connector for connection to the leak test port.

In accordance with a preferred embodiment of the present invention the endoscope is a balloon endoscope and the endoscope system also includes a balloon inflation/deflation subsystem which is connected to the pneumatic port. Additionally, the balloon inflation/deflation subsystem is adapted to provide inflation and deflation of the balloon via the pneumatic port of the adaptor, the leak test port and an interior volume of the endoscope.

In accordance with a preferred embodiment of the present invention the electro-pneumatic adaptor is constructed such that the adaptor electro-pneumatic connection assembly, the adaptor electrical port assembly and the pneumatic port are directed at mutually different angles.

Preferably, the electro-pneumatic adaptor includes a conduit pneumatically connecting the leak test port of the endoscope to the pneumatic port of the adaptor. Additionally or alternatively, the pneumatic port of the adaptor is fixedly connected to at least one of a leak tester and a balloon inflation/deflation subsystem.

In accordance with a preferred embodiment of the present invention the endoscope system also includes a leak tester which is connected to the pneumatic port.

Preferably, the balloon inflation/deflation subsystem is removably connected to the pneumatic port.

There is also provided in accordance with another preferred embodiment of the present invention an electro-pneumatic adaptor for use with an endoscope including an endoscope electro-pneumatic connection assembly having a leak test port, the electro-pneumatic adaptor being connectable to the endoscope at the electro-pneumatic connection assembly and including an adaptor electro-pneumatic connection assembly, including a leak test port connector for connection to the leak test port of the endoscope, an adaptor electrical port assembly and a pneumatic port.

In accordance with a preferred embodiment of the present invention the pneumatic port includes a pneumatic connector assembly. Additionally or alternatively, the electro-pneumatic adaptor is connectable to the endoscope at the electro-pneumatic connection assembly. Preferably, the leak test port communicates with an interior volume of the endoscope.

In accordance with a preferred embodiment of the present invention the adaptor electro-pneumatic connection assembly includes a pneumatic connector portion for connection to the endoscope electro-pneumatic connection assembly and a leak test port connector for connection to the leak test port.

Preferably, the endoscope is a balloon endoscope and the pneumatic port of the electro-pneumatic adaptor is connected to a balloon inflation/deflation subsystem. Additionally, the balloon inflation/deflation subsystem is adapted to provide inflation and

deflation of the balloon via the pneumatic port of the adaptor, the leak test port and an interior volume of the endoscope.

In accordance with a preferred embodiment of the present invention the electro-pneumatic adaptor is constructed such that the adaptor electro-pneumatic connection assembly, the adaptor electrical port assembly and the pneumatic port are directed at mutually different angles.

Preferably, the electro-pneumatic adaptor also includes a conduit pneumatically connecting the leak test port of the endoscope to the pneumatic port of the adaptor.

In accordance with a preferred embodiment of the present invention the pneumatic port is fixedly connected to at least one of a leak tester and a balloon inflation/deflation subsystem.

Preferably, the pneumatic port of the electro-pneumatic adaptor is connected to a leak tester. In accordance with a preferred embodiment of the present invention the pneumatic port is removably connected to the balloon inflation/deflation subsystem.

There is further provided in accordance with yet another preferred embodiment of the present invention a method of employing an endoscope system which includes an endoscope including an endoscope electro-pneumatic connection assembly having a leak test port, an endoscope electro-optic subsystem which is connectable to the endoscope via the endoscope electro-pneumatic connection assembly in a manner which precludes access to the leak test port when the endoscope electro-optic subsystem and the endoscope are connected at the electro-pneumatic connection assembly and an electro-pneumatic adaptor, which is connectable to the endoscope at the electro-pneumatic connection assembly and includes an adaptor electro-pneumatic connection assembly, including a leak test port connector for connection to the leak test port of the endoscope, an adaptor electrical port assembly to which the endoscope electro-optic subsystem is connectable and a pneumatic port, the method including connecting the electro-pneumatic adaptor to the endoscope at the electro-pneumatic connection assembly and connecting the endoscope electro-optic subsystem to the adaptor port assembly of the

electro-pneumatic adaptor and connecting at least one of a leak tester and a balloon inflation/deflation subsystem to the pneumatic port.

Preferably, at least one of the connecting steps includes removably connecting. Additionally or alternatively, the connecting at least one of the leak tester and the balloon inflation/deflation subsystem to the pneumatic port connects the at least one of the leak tester and the balloon inflation/deflation subsystem to an interior volume of the endoscope.

In accordance with a preferred embodiment of the present invention the method also includes connecting an electrical connector of the adaptor to an electrical connector of the endoscope, connecting a pneumatic connector portion of the adaptor to the endoscope electro-pneumatic connection assembly and connecting the leak test port connector for connection to the leak test port of the endoscope.

Preferably, the endoscope is a balloon endoscope and the method also includes removably connecting the balloon inflation/deflation subsystem to the pneumatic port. Additionally, the balloon inflation/deflation subsystem provides inflation and deflation of the balloon via the pneumatic port of the adaptor, the leak test port and an interior volume of the endoscope.

Preferably, the pneumatic port of the adaptor is fixedly connected to at least one of the leak tester and the balloon inflation/deflation subsystem.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will be understood and appreciated more fully from the drawings in which:

Fig. 1 is a simplified illustration of an endoscope system constructed and operative in accordance with a preferred embodiment of the present invention;

Figs. 2A and 2B are simplified illustrations of a balloon endoscope system constructed and operative in accordance with another preferred embodiment of the present invention showing respective connections to a leak testing subsystem and to a balloon inflation/deflation subsystem;

Figs. 3A, 3B and 3C are respectively pictorial assembled, sectional assembled and exploded view illustrations of an electro-pneumatic adaptor forming part of the endoscope systems of Figs. 1, 2A and 2B, Fig. 3B being a sectional illustration taken along lines IIIB – IIIB in Fig. 3A;

Figs. 4A, 4B and 4C are simplified illustrations of a first pneumatic connector element, forming part of the electro-pneumatic adaptor of Figs. 3A - 3C, Fig. 4C being a sectional illustration taken along lines IVC – IVC in Fig. 4A;

Figs. 5A, 5B, 5C and 5D are simplified illustrations of a main body portion of the electro-pneumatic adaptor of Figs. 3A - 3C, Figs. 5A and 5B being pictorial illustrations taken along mutually opposite directions and Fig. 5C & 5D being respective pictorial and plan view sectional illustrations taken along lines VC - VC in Fig. 5A;

Fig. 6 is a simplified illustration of an adaptor electrical connector assembly forming part of the electro-pneumatic adaptor of Figs. 3A - 3C;

Figs. 7A, 7B and 7C are simplified illustrations of an electrical connector support block, forming part of the electro-pneumatic adaptor of Figs. 3A - 3C, Fig. 7C being a sectional illustration taken along lines VIIC – VIIC in Fig. 7A;

Figs. 8A, 8B, 8C and 8D are simplified illustrations of a bayonet connection subassembly forming part of the electro-pneumatic adaptor of Figs. 3A - 3C, Figs. 8A and 8B being pictorial illustrations taken along mutually opposite directions and

Fig. 8C & 8D being sectional illustrations taken along respective lines VIIIC – VIIIC and VIIID - VIIID in Fig. 8A taken along mutually opposite directions;

Fig. 9A, 9B, 9C and 9D are simplified illustrations of the electro-pneumatic adaptor of Figs. 3A - 3C without the main body portion and without the bayonet connection subassembly, Figs. 9A and 9B being pictorial illustrations taken along mutually opposite directions and Fig. 9C & 9D being respective pictorial and plan view sectional illustrations taken along lines IXC - IXC in Fig. 9A;

Figs. 10A and 10B are simplified illustrations showing two operative orientations of the electro-pneumatic adaptor of Figs. 3A – 3C relative to an endoscope forming part of the balloon endoscope system of Figs. 2A and 2B;

Figs. 11A and 11B are simplified illustrations showing two operative orientations of the electro-pneumatic adaptor of Figs. 3A – 3C when connected to an electro-optic subsystem forming part of the balloon endoscope system of Figs. 2A and 2B;

Figs. 12A and 12B are simplified illustrations showing two operative orientations of the electro-pneumatic adaptor of Figs. 3A – 3C when connected to the leak testing subsystem forming part of the balloon endoscope system of Fig. 2A; and

Figs. 13A and 13B are simplified illustrations showing two operative orientations of the electro-pneumatic adaptor of Figs. 3A – 3C relative to the inflation/deflation subsystem forming part of the balloon endoscope system of Fig. 2B.

DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT

Reference is now made to Fig. 1, which is a simplified illustration of an endoscope system constructed and operative in accordance with a preferred embodiment of the present invention.

As seen in Fig. 1, there is provided an endoscope system 100 comprising an endoscope 102, which may be a suitable conventional endoscope, such as a CF-H180AL colonoscope, commercially available from Olympus Europe GmbH, of Wendenstraße 14–18, 20097, Hamburg, Germany. Endoscope 102 includes an endoscope electro-pneumatic connection assembly 104, including a leak test port 106 communicating with an interior volume 107 of endoscope 102, and includes a pneumatic connector portion 108 and an electrical connector 110 including a plurality of male pins 112.

In accordance with a preferred embodiment of the present invention there is provided an electro-pneumatic adaptor 120, which is removably connectable to endoscope 102 at the endoscope electro-pneumatic connection assembly 104 and includes an electrical connector 121, comprising a plurality of pins, for connection to electrical connector 110 of endoscope 102, a pneumatic connector portion 122 for connection to the pneumatic connector portion 108 of the endoscope electro-pneumatic connection assembly 104 and a leak test port connector 123 which engages the leak test port 106. The electro-pneumatic adaptor 120 also includes an adaptor electrical port connector 124 to which a connector 125 of an endoscope electro-optic subsystem 126 is connectable and a pneumatic connector assembly 128 for connection to a leak testing subsystem 130 via a leak testing subsystem connector 132. Leak testing subsystem connector 132 may be any suitable pneumatic connector, and preferably is similar to a conventional connector, forming part of conventional leak tester such as model SHA-P5, commercially available from Pentax Europe GmbH, of 104 Julius-Vosseler St., 22527 Hamburg, Germany.

In accordance with a preferred embodiment of the present invention the leak testing subsystem 130 communicates with the interior volume 107 of the endoscope 102 via leak test port 106.

Endoscope electro-optic subsystem 126 is a conventional endoscope electro-optical subsystem such as a CV-180 video processor, commercially available from Olympus Europe GmbH, of Wendenstraße 14 – 18, 20097, Hamburg, Germany.

It is appreciated that during conventional clinical use of endoscope 102 in performing an endoscopy examination, as known in the art, the endoscope 102 is connected directly to endoscope electro-optic subsystem 126, by connecting the connector 125 to endoscope electro-pneumatic connection assembly 104, thereby precluding access to leak test port 106 during the endoscopy procedure. It is further appreciated that preclusion of pneumatic access to leak test port 106 and thus to the interior volume 107 of endoscope 102, when said endoscope electro-optic subsystem 126 and said endoscope 102 are connected at said electro-pneumatic connection assembly 104, prevents leak testing of endoscope 102 during the endoscopy examination.

It is a particular feature of the present invention that electro-pneumatic adaptor 120 enables simultaneous electrical connection of endoscope 102 and endoscope electro-optic subsystem 126, and pneumatic communication between an external pneumatic device such as leak tester 130 and the leak test port 106 of endoscope 102, thereby enabling leak testing of endoscope 102 during an endoscopy examination.

Reference is now made to Fig. 2A, which is a simplified illustration of a balloon endoscope system constructed and operative in accordance with a preferred embodiment of the present invention.

As seen in Fig. 2A, there is provided a balloon endoscope system 200 comprising a balloon endoscope 202, which may be a suitable conventional balloon endoscope, such as a G-EYE™ H180AL colonoscope, commercially available from Smart Medical Systems, of 10 Hayetsira street, 4366356, Ra'anana, Israel. Aside from including a balloon 204, balloon endoscope 202 may be identical in all relevant respects to endoscope 102 (Fig. 1) and balloon endoscope system 200 may be identical in all relevant respects to endoscope system 100, identical elements being designated by

identical reference numerals. Adaptor 120 is connected to a leak testing subsystem 130 via connector 132.

It is a particular feature of the present invention that electro-pneumatic adaptor 120 enables simultaneous electrical connection of balloon endoscope 202 and endoscope electro-optic subsystem 126, and pneumatic communication between an external pneumatic device such as leak tester 130 and the leak test port 106 of balloon endoscope 202, thereby enabling leak testing of balloon endoscope 202 during an endoscopy examination. Reference is now made to Fig. 2B, which is a simplified illustration of a balloon endoscope system 220, which is identical to the balloon endoscope system 200 of Fig. 2A but is connected to an inflation/deflation subsystem 230, via a connector 232, which may be identical to connector 132, instead of to a leak testing subsystem 130 as in the embodiment of Fig. 2A. In accordance with a preferred embodiment of the present invention the inflation/deflation subsystem communicates with the interior volume of the endoscope via leak test port 106 and provides inflation and deflation of the balloon 204 via the interior volume 107.

It is appreciated that had balloon endoscope 202 been connected directly to endoscope electro-optic subsystem 126 while performing an endoscopy examination, by connecting the connector 125 to endoscope electro-pneumatic connection assembly 104 as commonly known in the art, this would have precluded access to leak test port 106 and consequently would have precluded inflation and deflation of balloon 204 through interior volume 107 by inflation/deflation subsystem 230 during the endoscopy examination.

It is a particular feature of the present invention that electro-pneumatic adaptor 120 enables simultaneous electrical connection of balloon endoscope 202 and endoscope electro-optic subsystem 126, and pneumatic communication between an external pneumatic device such as inflation/deflation subsystem 230 and the interior of balloon endoscope 202, via the leak test port 106, thereby enabling inflation and deflation of balloon 204 of balloon endoscope 202 during an endoscopy examination.

Reference is now made to Figs. 3A, 3B and 3C, which are respectively pictorial assembled, sectional assembled and exploded view illustrations of electro-pneumatic adaptor 120, forming part of the endoscope systems of Figs. 1 and 2.

As seen in Figs. 3A, 3B and 3C, the electro-pneumatic adaptor 120 comprises a main body portion 300, an adaptor electrical connector assembly 302, an electrical connector support block 304 and a bayonet connector assembly 306, for connection to endoscope electro-pneumatic connection assembly 104 (Fig. 1). Retaining shims 307, 308 and 309 are employed to retain adaptor electrical connector assembly 302 in main body portion 300.

A pneumatic conduit 310 extends through a channel 312 formed in electrical connector support block 304 and is coupled at one end 314 thereof to pneumatic connector assembly 128 (Fig. 1). It is seen clearly in Figs. 3B and 3C that pneumatic connector assembly 128 includes first and second pneumatic connector elements 316 and 318.

First pneumatic connector element 316 is illustrated in Figs. 4A – 4C, to which reference is now made, and includes a generally circular cylindrical portion 320, having a longitudinal axis 322, which is integrally formed with a generally square flange portion 324, which extends in a plane generally perpendicular to longitudinal axis 322. An inner portion 326 extends inwardly from flange portion 324 and includes a bore 328 which extends along an axis 332, which intersects and is perpendicular to longitudinal axis 322.

Generally circular cylindrical portion 320 includes an outer bore portion 334, inwardly of which is defined an inner bore portion 336, both of which extend along longitudinal axis 322. Inner bore portion 336 terminates in a bore 338, which also extends along longitudinal axis 322 and intersects with and joins bore 328 at a 90 degree junction 340.

Second pneumatic connector element 318 may be a conventional pneumatic connector, such as EOG valve assembly model number D201-V2330-1, commercially available from Pentax Europe GmbH, of 104 Julius-Vosseler St., 22527 Hamburg, Germany.

Pneumatic conduit 310 is arranged to be coupled at an end 350 thereof, which constitutes leak test port connector 123 (Fig. 1) and is preferably equipped with an O-ring 352, to leak test port 106 (Fig. 1).

Main body portion 300 is illustrated in detail in Figs. 5A – 5D, to which reference is now made. As seen in Figs. 5A – 5D, main body portion 300 is a generally circularly symmetric integrally formed element arranged about a longitudinal axis 400 which includes a first generally circular cylindrical portion 402 having a generally circular cylindrical inner surface 404 and a generally circular cylindrical outer surface 406. Formed on generally circular cylindrical outer surface 406 are a plurality of mutually spaced generally rectangular radial protrusions 408, whose azimuthal distribution is shown in a sectional view portion of Fig. 5A.

Generally circular cylindrical outer surface 406 extends from an edge 410 to a shallow circumferential undercut 412. Adjacent undercut 412 is a circumferential protrusion 414 having formed therein a plurality of mutually spaced, radially extending apertures 416. Generally circular cylindrical inner surface 404 extends from edge 410 to a shoulder 418.

Axially adjacent first generally circular cylindrical portion 402 is a second generally circular cylindrical portion 422, having a generally circular cylindrical inner surface 424 and a generally circular cylindrical outer surface 426.

Generally circular cylindrical outer surface 426 extends from a shoulder 428 axially to a generally circular flange 430, axially adjacent to which is a relative undercut portion 432. Generally circular cylindrical outer surface 426 includes a circumferential protrusion 434 having formed therein a side aperture 436. Generally circular cylindrical inner surface 424 extends from shoulder 418 to a shoulder 438 and includes a side recess 440 surrounding side aperture 436.

Axially adjacent second generally circular cylindrical portion 422 is a third generally circular cylindrical portion 442, having a generally circular cylindrical inner surface 444 and a generally circular cylindrical outer surface 446.

Generally circular cylindrical outer surface 446 extends from flange 434 to an edge 448 and includes a forward undercut portion 450 and a chamfered portion 452 adjacent edge 448. Generally circular cylindrical inner surface 444 extends from shoulder 438 to edge 448. Disposed within and adjacent generally circular cylindrical inner surface 444 are mutually azimuthally spaced retaining shims 307, 308 and 309 (Fig. 3C), which are employed to retain adaptor electrical connector assembly 302 in main body portion

300. Shims 307, 308 and 309 are attached to main body portion, preferably by screws 454 which extend via apertures 456 formed in main body portion 300 and into correspondingly positioned threaded recesses 458 formed on outer surfaces of shims 307, 308 and 309.

Shims 307, 308 and 309 are attached to main body portion 300 only after insertion of adaptor electrical connector assembly 302 into main body portion 300 and are located so as to define therebetween a circumferential edge recess 460 and a plurality of axial recesses 462 which extend from circumferential edge recess 460 to shoulder 438.

A plurality of radially extending apertures 464 are formed in third generally circular cylindrical portion 442 and retain therein radially outwardly extending pins 466.

Adaptor electrical connector assembly 302 is illustrated in Fig. 6, to which reference is now made, and includes a base element 500 having a plurality of mutually spaced pin apertures 502 extending therethrough from a first generally planar surface 504 to a second planar surface 506. Second planar surface 506 is provided with an azimuthal orientation protrusion 508.

A plurality of electrical contact pin assemblies 510 are mounted onto base element 500, each at a pin mounting aperture 502, extending through base element 500. Each of electrical contact pin assemblies 510 preferably includes a male pin element 520 which is configured to be seated in and extend through base element 500, a generally circularly cylindrical intermediate pin shaft 522, and a female pin element 524.

Male pin element 520 is preferably an integrally formed element and includes an axial pin portion 530 and a socket 532 for retainably receiving a first end of intermediate pin shaft 522. Generally circularly cylindrical intermediate pin shaft 522 is preferably an elongate shaft, preferably having end slits 534 formed therein to provide resiliency. Female pin element 524 preferably is an integrally formed hollow cylindrical element, one end of which defines a socket 536 for retainably receiving a second end of intermediate pin shaft 522.

Electrical connector support block 304 is illustrated in Figs. 7A – 7C, to which reference is now made. As seen in Figs. 7A – 7C, electrical connector support block 304 is preferably an integrally formed, generally cylindrical element extending

along an axis 550 and is preferably formed of a dielectric material such as DELRIN, ABS, or OKOLON.

Electrical connector support block 304 is preferably formed with a plurality of throughgoing generally circular cylindrical bores 552 which extend from a first end 554 of block 304 to a second end 556 of block 304. Bores 552 having a generally uniform cross-sectional radius along most of their extent 557 from first end 554 and have a short extent 558 adjacent second end 556 which has a lesser cross sectional radius. Each electrical contact pin assembly 510 is retained in an extent 557 of a bore 552. A recess 559 is formed at first end 554 of block 304 to accommodate azimuthal orientation protrusion 508 (Fig. 6).

As seen particularly in Fig. 7C, channel 312 terminates in a recess 560, which lies within an external recess 562, both of which accommodate an end of first pneumatic connector element 316.

Bayonet connector assembly 306 is illustrated in Figs. 8A – 8D, to which reference is now made. The overall construction and operation of bayonet connector assembly 306 is similar to that in Olympus MAJ-1430 Pigtail, commercially available from Olympus Europe GmbH, of Wendenstraße 14 – 18, 20097, Hamburg, Germany. Briefly stated, the bayonet connector assembly 306 includes a main cylindrical portion 570 having a pair of angled circumferential bayonet pin receiving slits 572 formed therein. A locking ring assembly 574, including a forward portion 576 and a rearward portion 578, cooperates with main cylindrical portion 570 in a conventional manner and is preferably spring loaded in a conventional manner. Details of the conventional bayonet connector assembly 306 are not shown or described in detail.

Figs. 9A – 9D illustrate the assembly of elements 302, 304, 310, 316 and 318 as described in detail hereinabove.

Reference is now made to Figs. 10A and 10B, which are simplified illustrations showing two operative orientations of the electro-pneumatic adaptor of Figs. 3A – 3C relative to an endoscope forming part of the balloon endoscope system of Figs. 2A and 2B. In Fig. 10A, it is seen that the electro-pneumatic adaptor 120 is entirely disconnected from the balloon endoscope 202.

In Fig. 10B, it is seen that the electro-pneumatic adaptor 120 is connected to the balloon endoscope 202, such that the pneumatic conduit 310 is sealingly coupled at an end 350 thereof, which constitutes leak test port connector 123 (Fig. 1) and is equipped with an O-ring 352, to leak test port 106 (Fig. 1) of balloon endoscope 202. It is also seen that male pins 112 of electrical connector 110 of balloon endoscope 202 are each inserted into a corresponding female pin element 524 of electrical contact pin assembly 510 of adaptor 120.

Reference is now made to Figs. 11A and 11B, which are simplified illustrations showing two operative orientations of the electro-pneumatic adaptor of Figs. 3A – 3C relative to an electro-optic subsystem forming part of the balloon endoscope system of Figs. 2A and 2B. In Fig. 11A, it is seen that the electro-pneumatic adaptor 120 is connected to the balloon endoscope 202 but is entirely disconnected from the electro-optic subsystem 126 and connector 125 (Fig. 1).

In Fig. 11B, it is seen that axial pin portions 530 of electrical contact pin assemblies 510 of adaptor 120 are each inserted into a corresponding pin socket in connector 125. It is also seen that male pins 520 of electrical contact pin assembly 510 of adaptor 120 are each inserted into a corresponding female pin socket 580 of connector 125.

Reference is now made Figs. 12A and 12B, which are simplified illustrations showing two operative orientations of the electro-pneumatic adaptor of Figs. 3A – 3C relative to the leak testing subsystem forming part of the balloon endoscope system of Fig. 2A. In Fig. 12A, it is seen that the electro-pneumatic adaptor 120 is connected to the balloon endoscope 202 and to electro-optic subsystem 126 via connector 125 (Fig. 1) but is entirely disconnected from leak testing subsystem 130.

In Fig. 12B, it is seen that second pneumatic connector element 318 is connected to leak testing subsystem 130 via connector 132, which preferably is bayonet connected to second pneumatic connector element 318 in a conventional manner.

Reference is now made to Figs. 13A and 13B, which are simplified illustrations showing two operative orientations of the electro-pneumatic adaptor of Figs. 3A – 3C relative to the inflation/deflation subsystem 230 forming part of the balloon endoscope system of Fig. 2B. In Fig. 13A, it is seen that the electro-pneumatic adaptor

120 is connected to the balloon endoscope 202 and to electro-optic subsystem 126 via connector 125 (Fig. 1) but is entirely disconnected from inflation/deflation subsystem 230 and from connector 232.

In Fig. 13B, it is seen that second pneumatic connector element 318 is connected to inflation/deflation subsystem 230 via connector 232, which preferably is bayonet connected to second pneumatic connector element 318 in a conventional manner.

It will be appreciated by persons skilled in the art that the scope of the present invention is not limited by what has been particularly shown and described hereinabove. Rather the scope of the present invention includes the combinations and subcombinations of the features described hereinabove as well as modifications thereof which are not in the prior art.

CLAIMS

1. An endoscope system comprising:

an endoscope including an endoscope electro-pneumatic connection assembly having a leak test port;

an endoscope electro-optic subsystem which is connectable to said endoscope via said endoscope electro-pneumatic connection assembly in a manner which precludes access to said leak test port when said endoscope electro-optic subsystem and said endoscope are directly connected at said electro-pneumatic connection assembly; and

an electro-pneumatic adaptor, which is connectable to said endoscope at said electro-pneumatic connection assembly and comprises:

an adaptor electro-pneumatic connection assembly, comprising: an electrical connector for connection to an electrical connector of said endoscope, a pneumatic connector portion for electrical connection to a pneumatic connector portion of said endoscope electro-pneumatic connection assembly, and a leak test port connector for connection to said leak test port of said endoscope;

an adaptor electrical port assembly to which said endoscope electro-optic subsystem is connectable; and

a pneumatic port with a conduit pneumatically connecting the pneumatic port to said leak test port connector.

2. The endoscope system according to claim 1 and wherein said pneumatic port includes a pneumatic connector assembly.

3. The endoscope system according to claim 1 or claim 2 and wherein said electro-pneumatic adaptor is removably connectable to said endoscope at said electro-pneumatic connection assembly.

4. The endoscope system according to any one of claims 1 to 3 and wherein said leak test port communicates with an interior volume of said endoscope.

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5. The endoscope system according to any one of claims 1 to 4 and wherein said endoscope is a balloon endoscope and wherein said endoscope system also comprises:

a balloon inflation/deflation subsystem, which is connected to said pneumatic port.

6. The endoscope system according to claim 5 and wherein said balloon inflation/deflation subsystem is adapted to provide inflation and deflation of said balloon via said pneumatic port of said adaptor, said leak test port and an interior volume of said endoscope.

7. The endoscope system according to any one of claims 1 to 4 and wherein said pneumatic port of said adaptor is fixedly connected to at least one of a leak tester and a balloon inflation/deflation subsystem.

8. The endoscope system according to any one of claims 5 to 7 and wherein said balloon inflation/deflation subsystem is removably connected to said pneumatic port.

9. The endoscope system according to any one of claims 1 to 4 and also comprising a leak tester which is connected to said pneumatic port.

10. The endoscope system according to any one of claims 1 to 9 and wherein said electro-pneumatic adaptor is constructed such that said adaptor electro-pneumatic connection assembly, said adaptor electrical port assembly and said pneumatic port are directed at mutually different angles.

11. A method of employing an endoscope system which comprises:

an endoscope including an endoscope electro-pneumatic connection assembly having a leak test port;

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an endoscope electro-optic subsystem which is connectable to said endoscope via said endoscope electro-pneumatic connection assembly in a manner which precludes access to said leak test port when said endoscope electro-optic subsystem and said endoscope are connected at said electro-pneumatic connection assembly; and

an electro-pneumatic adaptor, which is connectable to said endoscope at said electro-pneumatic connection assembly and comprises:

an adaptor electro-pneumatic connection assembly, comprising: an electrical connector for connection to an electrical connector of said endoscope; a pneumatic connector portion for connection to a pneumatic connector portion of said endoscope electro-pneumatic connection assembly; and a leak test port connector for connection to said leak test port of said endoscope;

an adaptor electrical port assembly to which said endoscope electro-optic subsystem is connectable; and

a pneumatic port with a conduit pneumatically connecting the pneumatic port to said leak test port connector, the method comprising:

connecting said electro-pneumatic adaptor to said endoscope at said electro-pneumatic connection assembly; and

connecting said endoscope electro-optic subsystem to said adaptor electrical port assembly of said electro-pneumatic adaptor; and

connecting at least one of a leak tester and a balloon inflation/deflation subsystem to said pneumatic port.

12. The method of employing an endoscope system according to claim 11 and wherein at least one of said connecting steps comprises removably connecting.

13. An endoscope system comprising:

an endoscope including an endoscope electro-pneumatic connection assembly having a leak test port;

an endoscope electro-optic subsystem which is connectable to said endoscope via said endoscope electro-pneumatic connection assembly in a manner which precludes access to said leak test port when said endoscope electro-optic subsystem and

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said endoscope are directly connected at said electro-pneumatic connection assembly; and

an electro-pneumatic adaptor being connectable to said endoscope at said electro-pneumatic connection assembly and comprising:

a plurality of adaptor connectors, including an electrical connector for connection to an electrical connector of said endoscope, a pneumatic connector portion for connection to a pneumatic connector portion of said endoscope electro-pneumatic connection assembly, and a leak test port connector for connection to said leak test port of said endoscope,

an adaptor electrical port connector to which said endoscope electro-optic subsystem is connectable, and

a pneumatic connector assembly with a pneumatic conduit pneumatically connecting said pneumatic connector assembly to said leak test port connector.

14. The endoscope system according to claim 13 and wherein said leak test port communicates with an interior volume of said endoscope.

15. The endoscope system according to claim 13 or 14 and wherein:

said endoscope is a balloon endoscope; and

said pneumatic connector assembly of said electro-pneumatic adaptor is connected to a balloon inflation/deflation subsystem.

16. The endoscope system according to claim 15 and wherein said balloon inflation/deflation subsystem is adapted to provide inflation and deflation of said balloon via said pneumatic connector assembly of said adaptor, said leak test port and an interior volume of said endoscope.

17. The endoscope system according to claim 13 or 14 and wherein said pneumatic connector assembly is fixedly connected to at least one of a leak tester and a balloon inflation/deflation subsystem.

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18. The endoscope system according to any one of claims 15 to 17 and wherein said pneumatic connector assembly is removably connected to said balloon inflation/deflation subsystem.

19. The endoscope system according to claim 13 or 14 and wherein said pneumatic connector assembly of said electro-pneumatic adaptor is connected to a leak tester.

20. The endoscope system according to any one of claims 13 to 19 and wherein said electro-pneumatic adaptor is constructed such that said plurality of adaptor connectors, said adaptor electrical port assembly and said pneumatic connector assembly are directed at mutually different angles.

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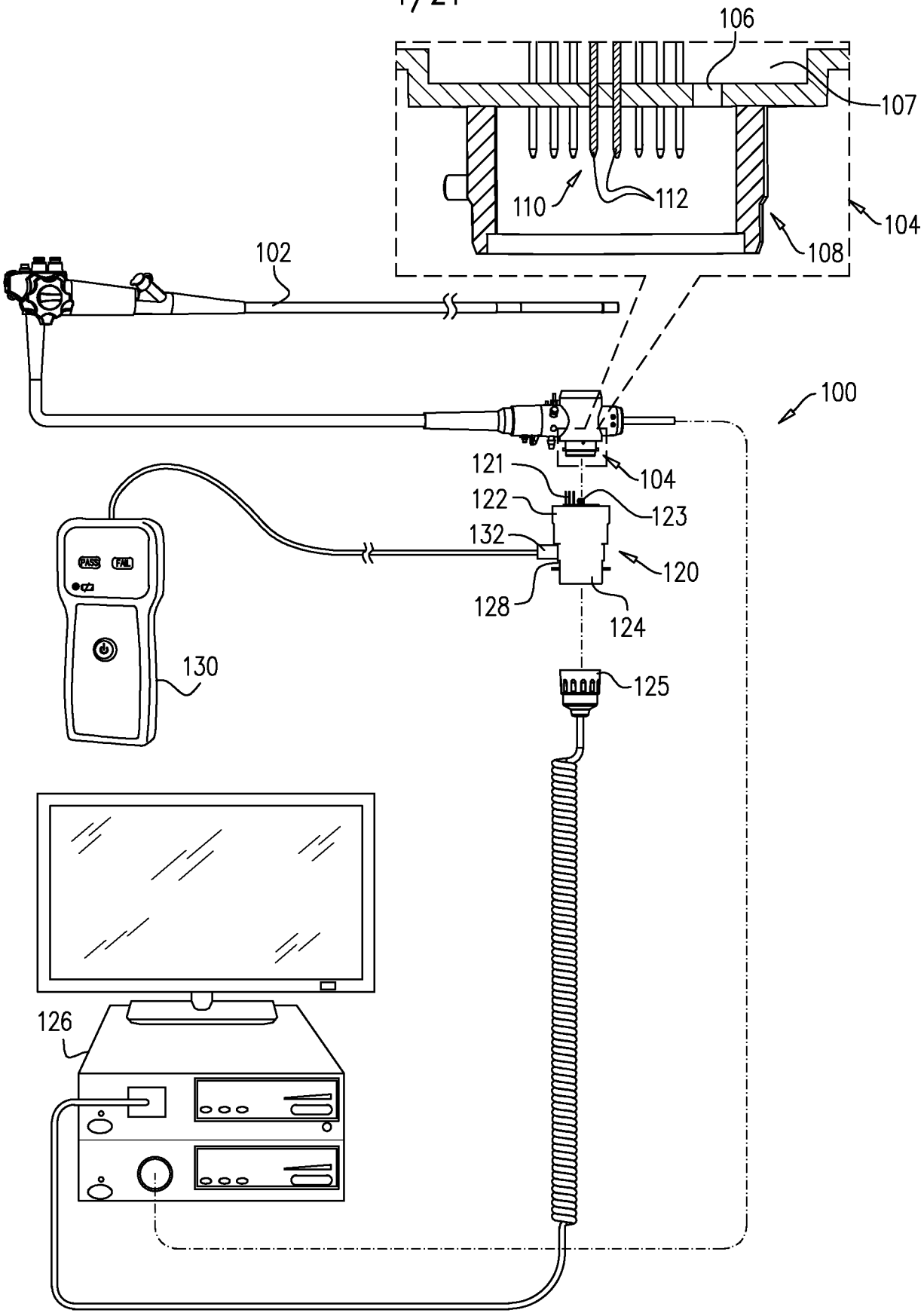
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122
123
132
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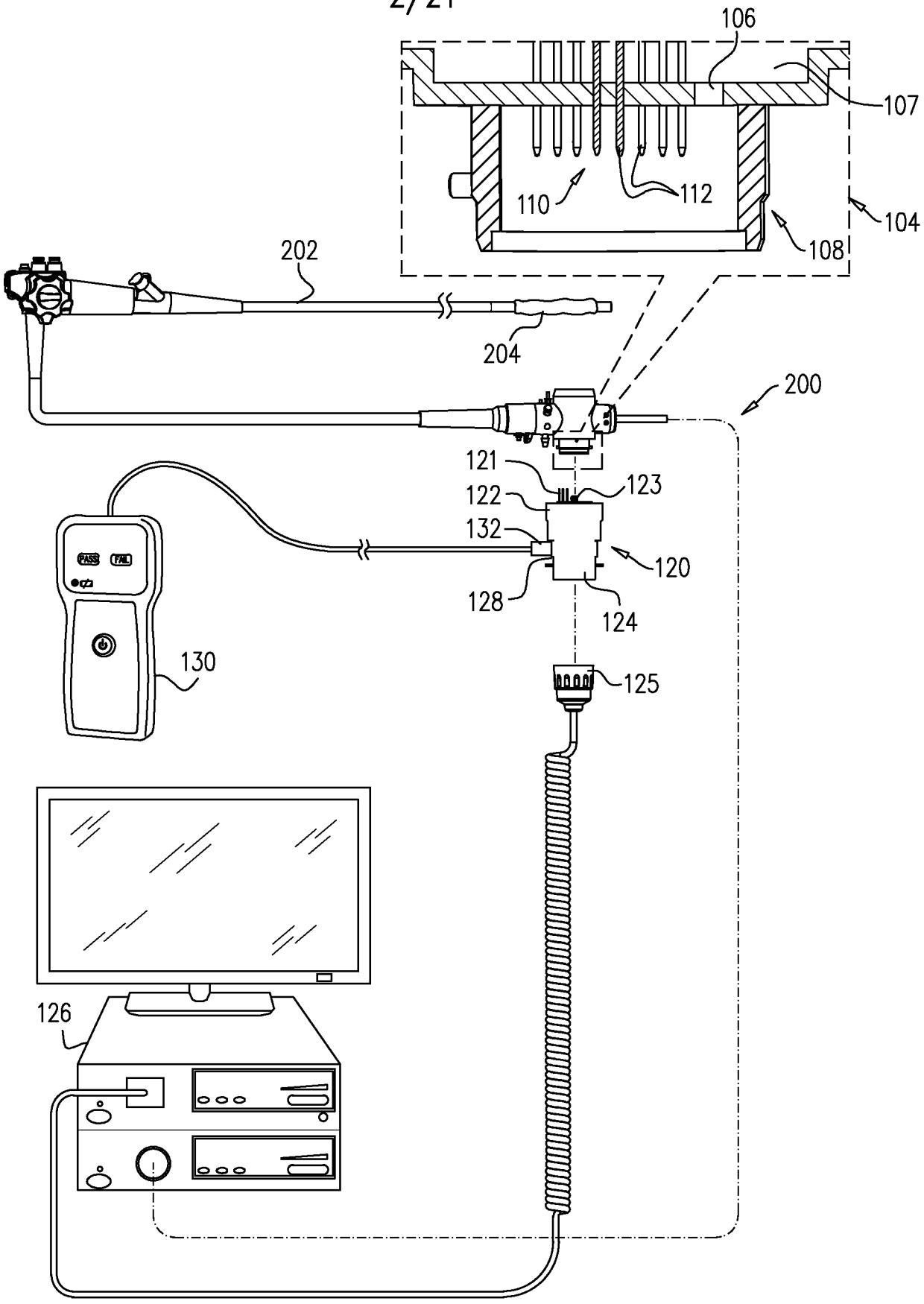
128
124
125
PASS
FAIL
130
126

FIG. 1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200
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122
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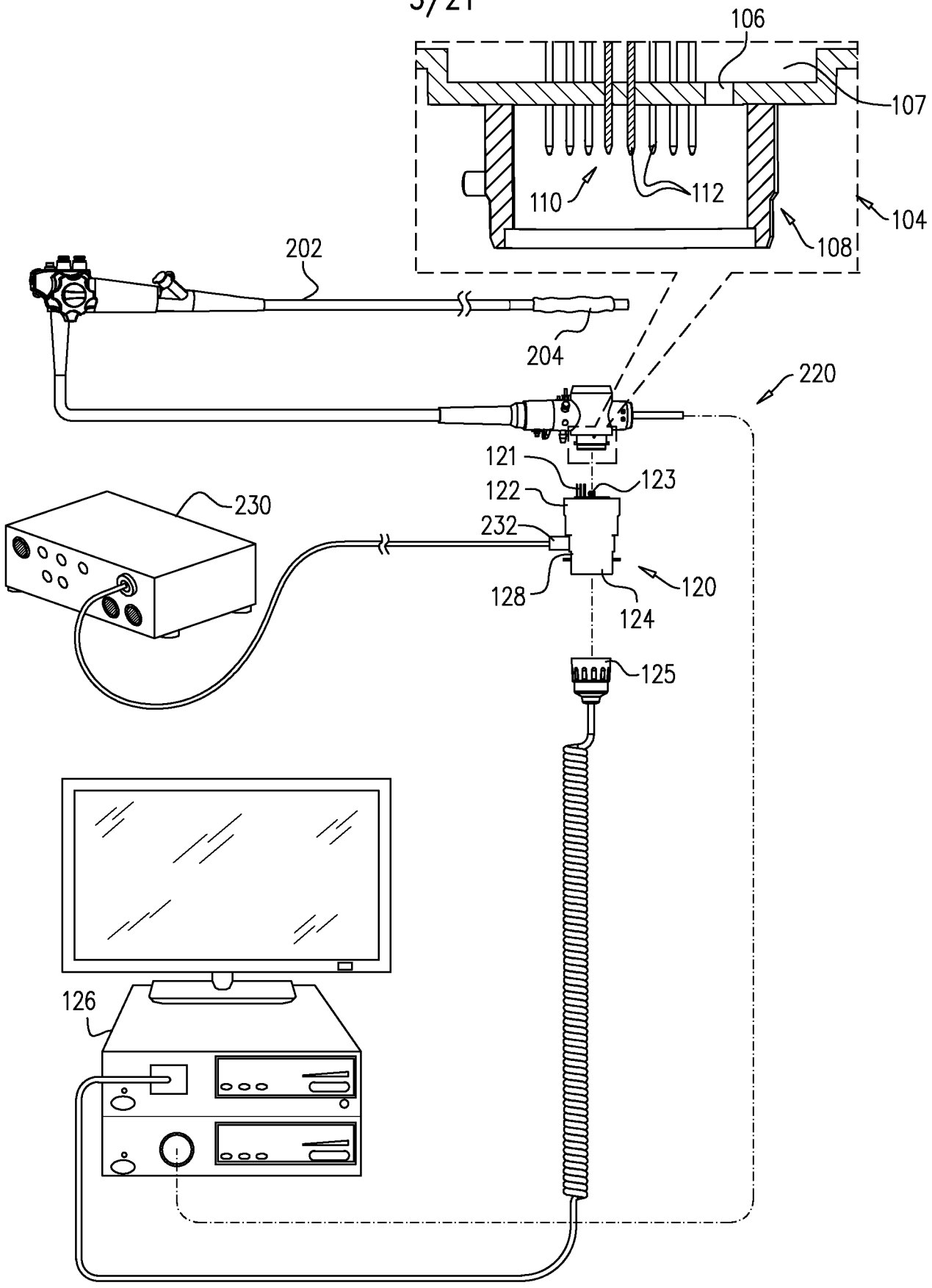
124
PASS
FAIL
130
125
126

FIG. 2A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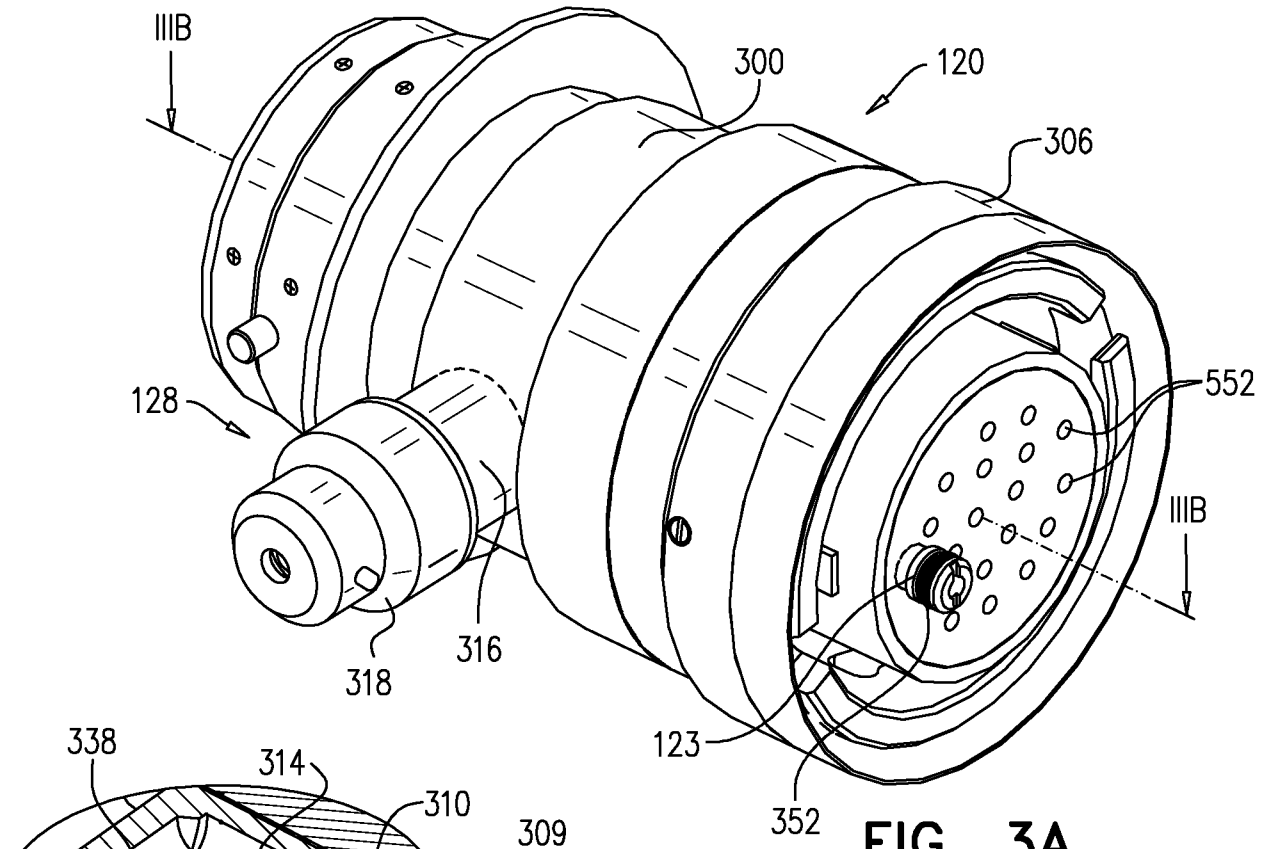
124
125
126

FIG. 2B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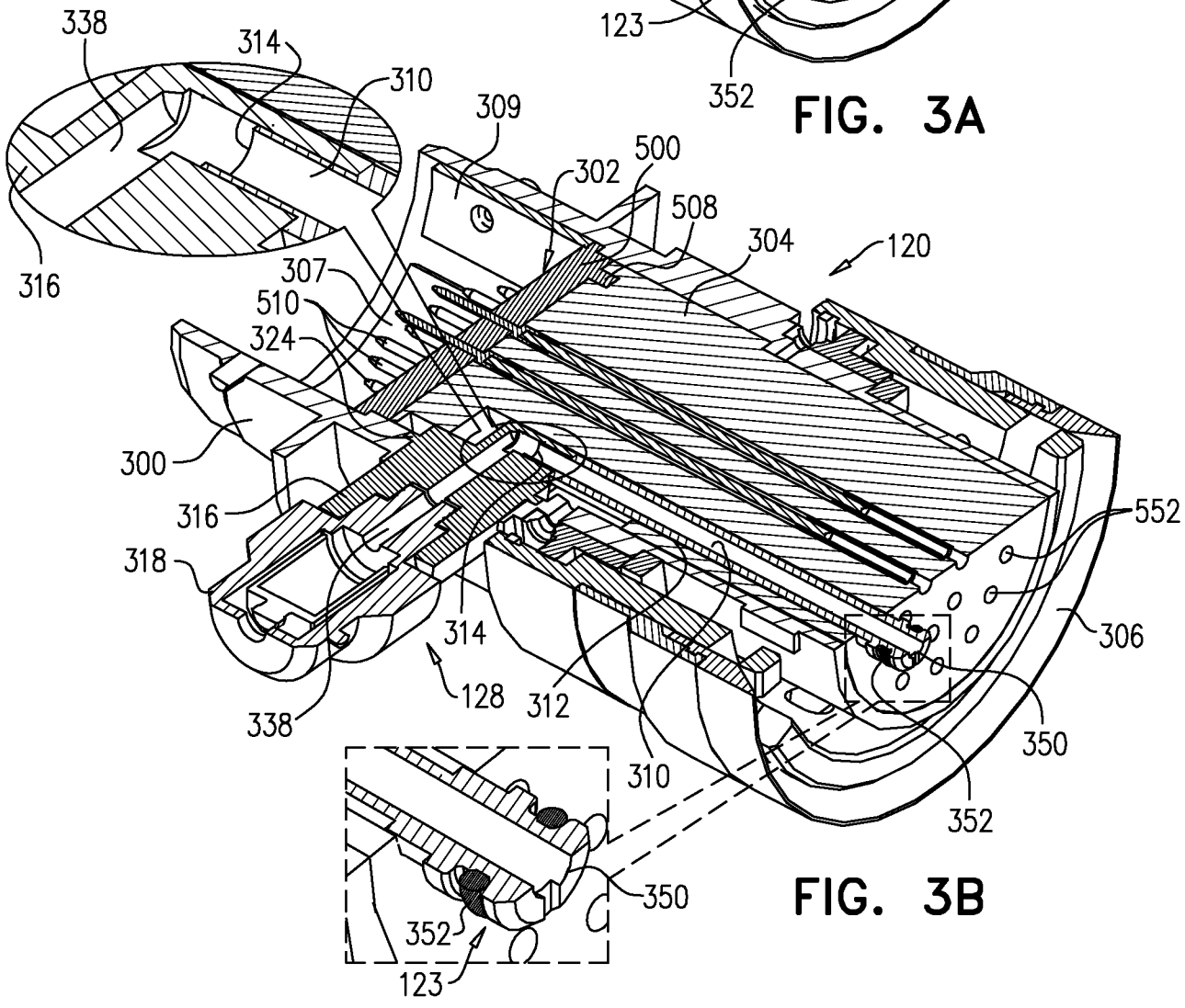
123
352

FIG. 3A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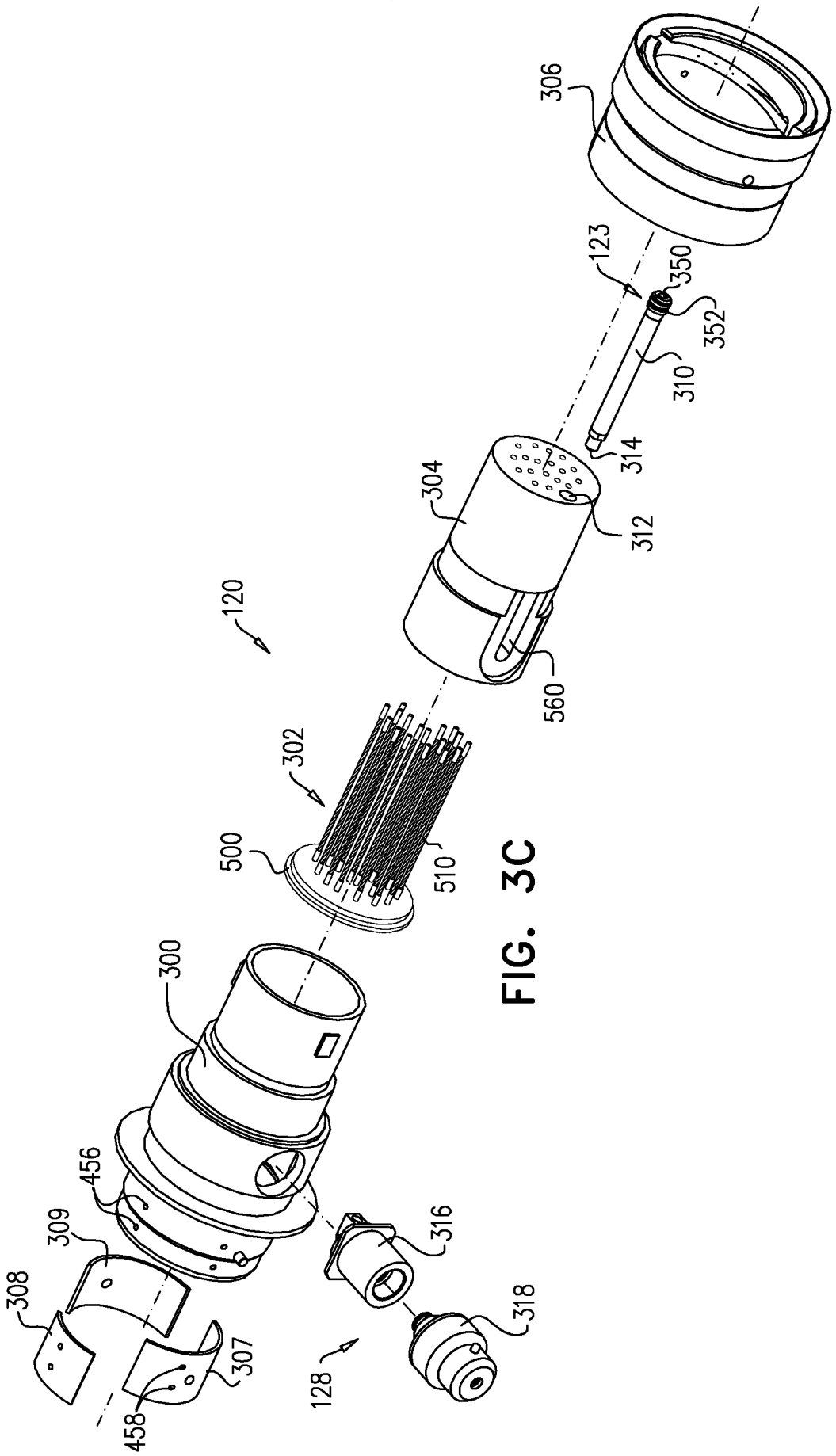
123

FIG. 3B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307
128
458

FIG. 3C

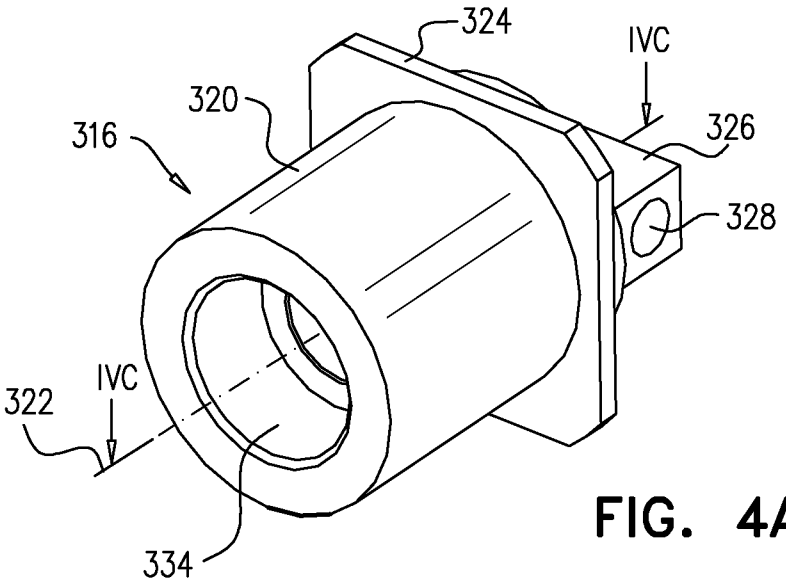


FIG. 4A

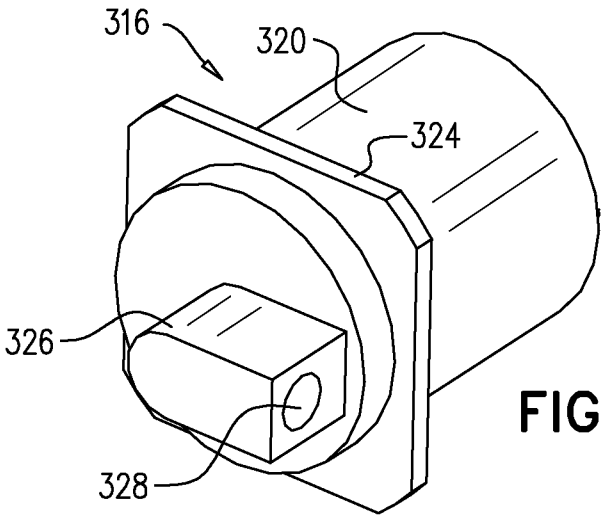


FIG. 4B

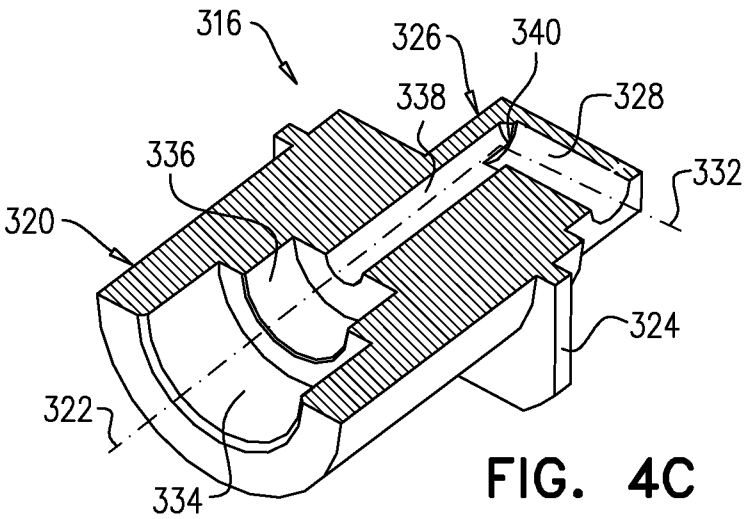
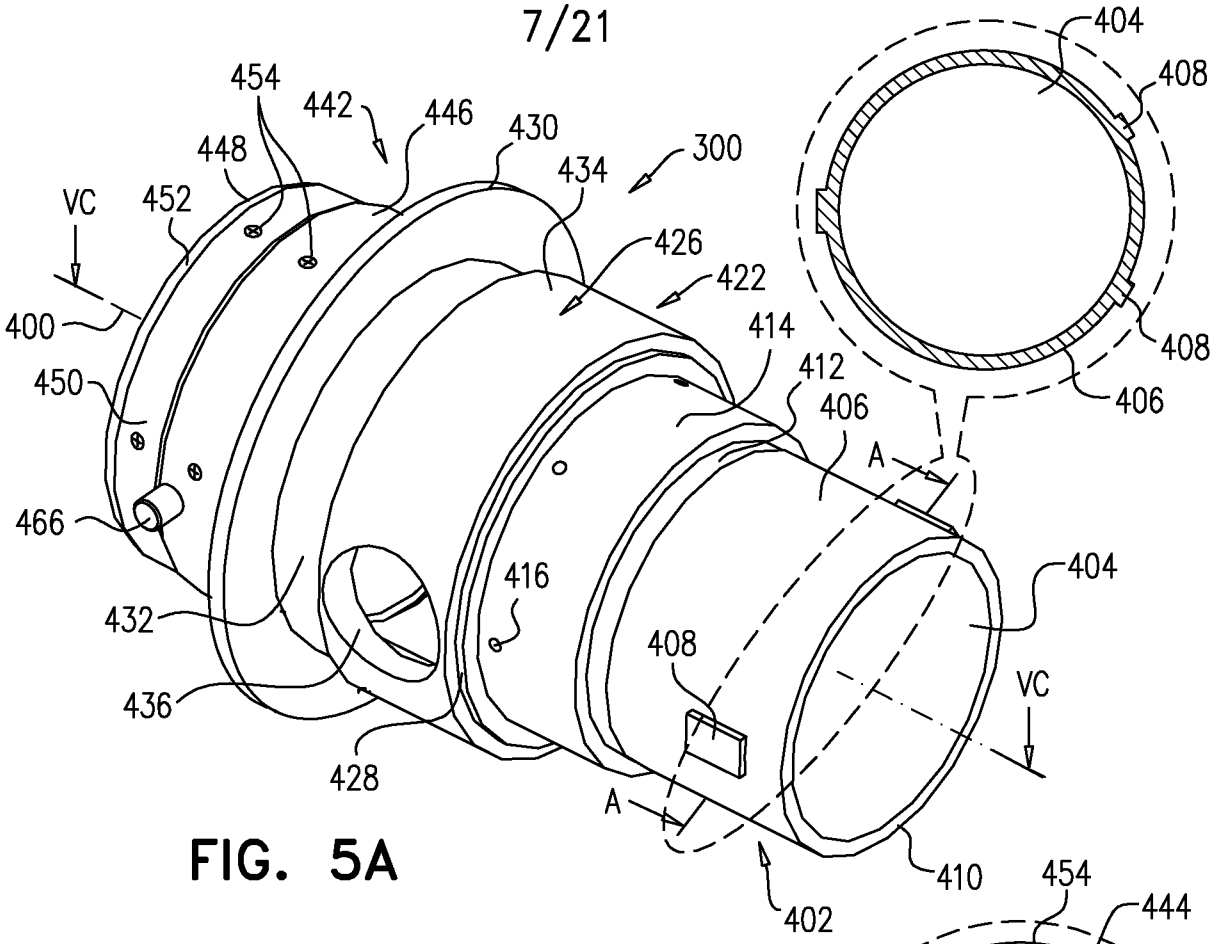


FIG. 4C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408
436
VC
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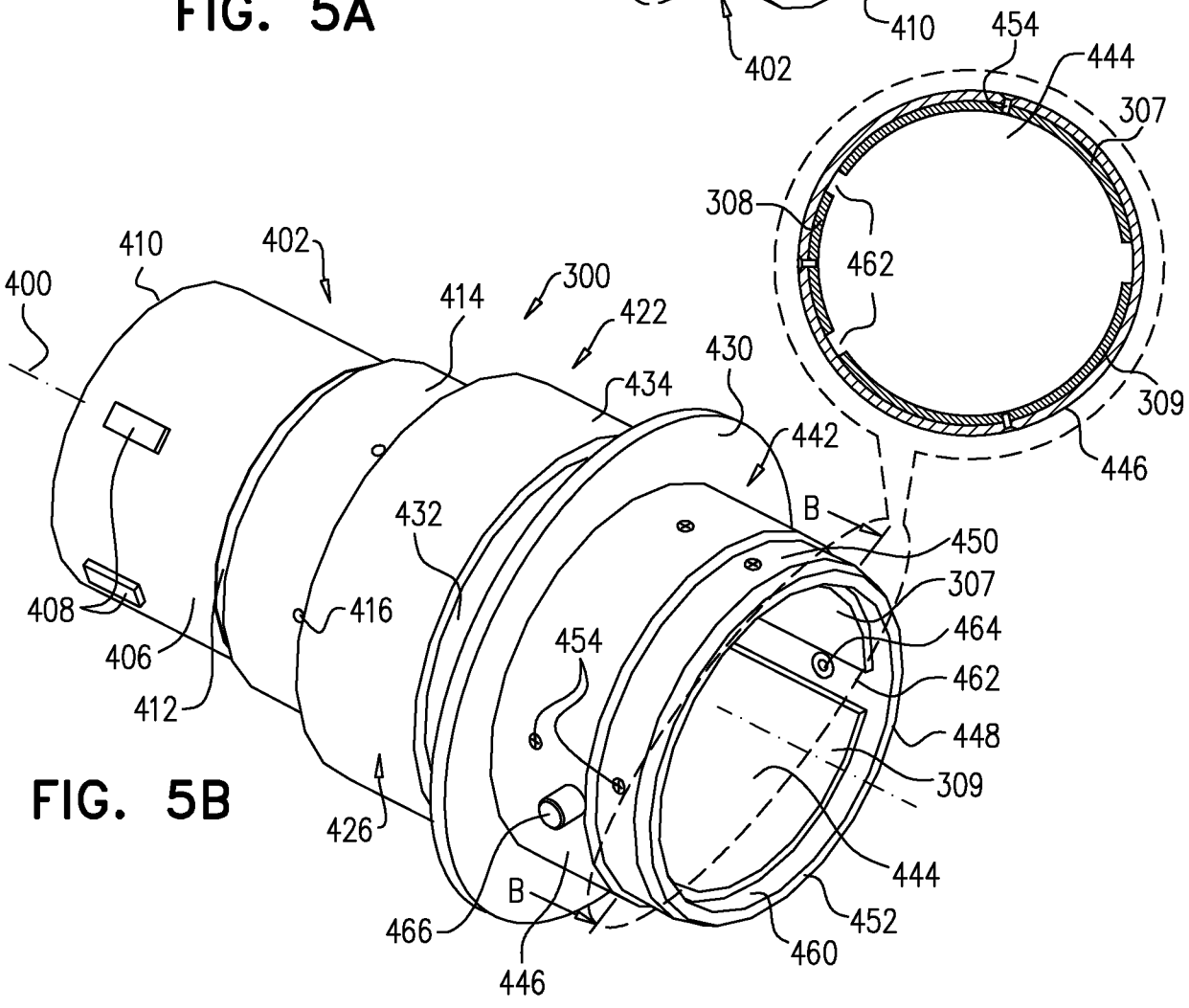
A
410
402

FIG. 5A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B
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B
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466
460
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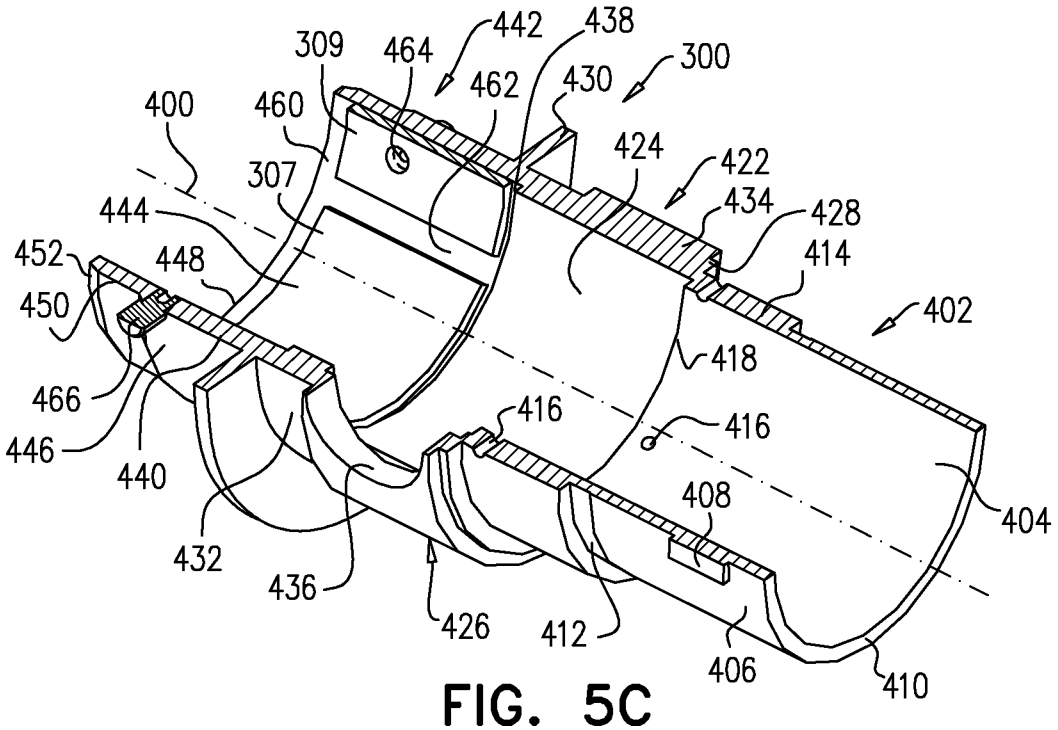
FIG. 5B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440
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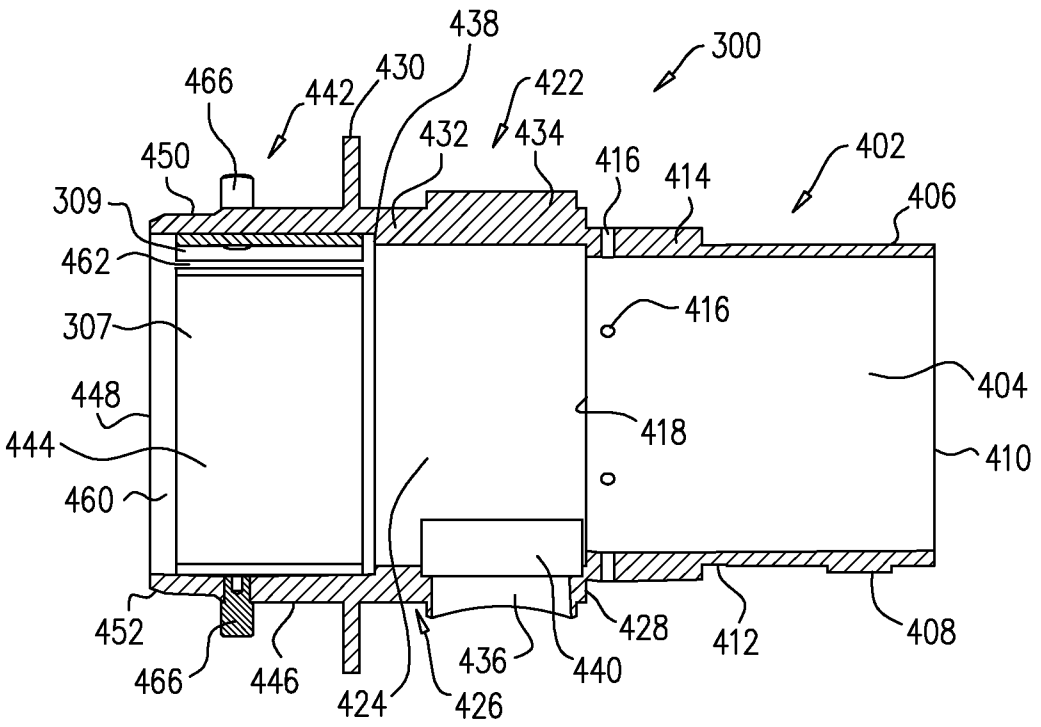
404
432
436
426
412
406
410

FIG. 5C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436
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424
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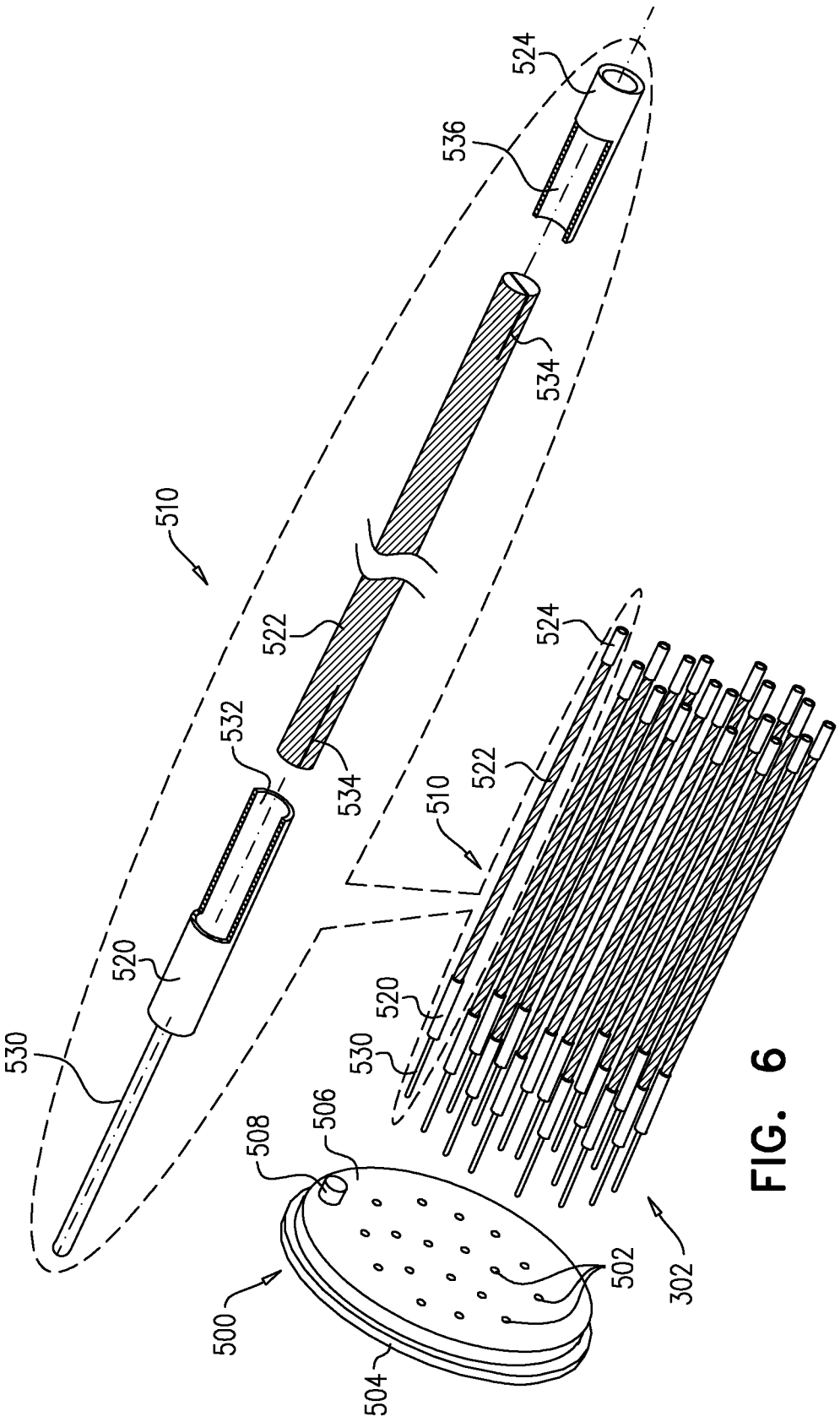
FIG. 5D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502
504
302

FIG. 6

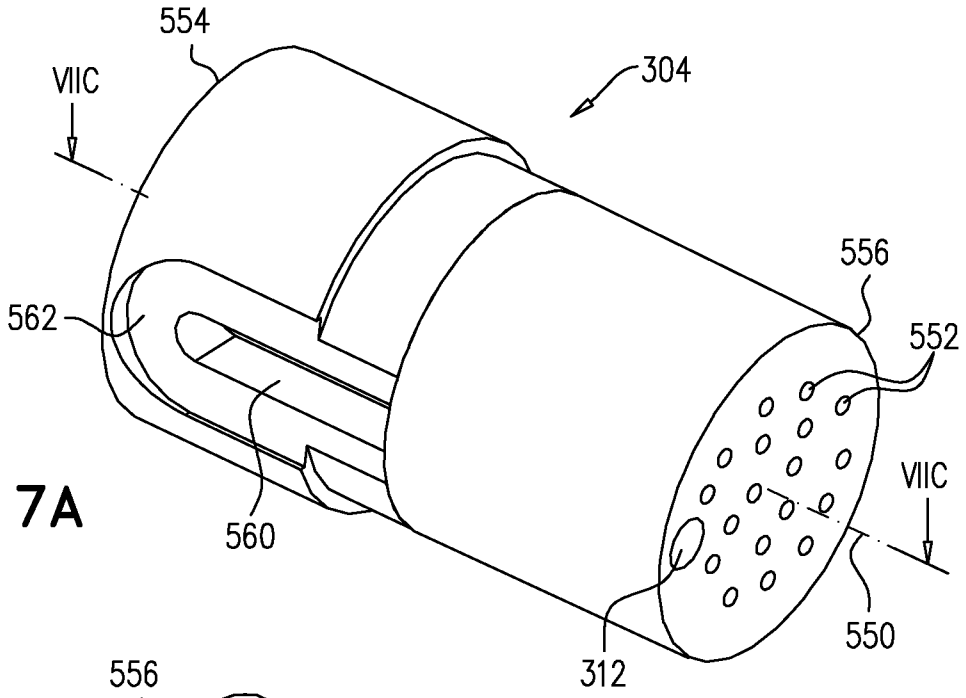


FIG. 7A

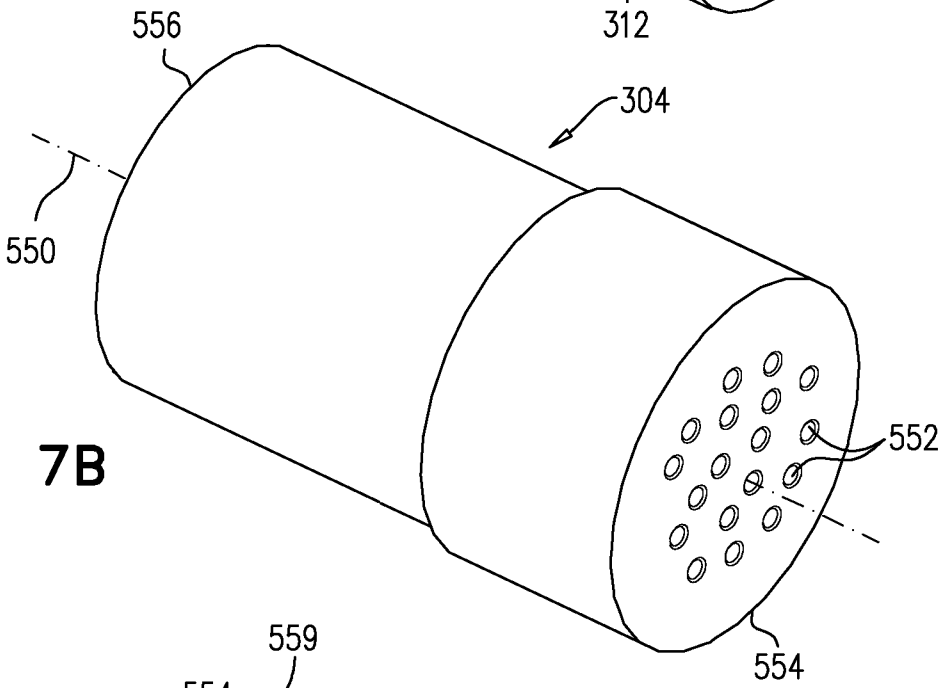


FIG. 7B

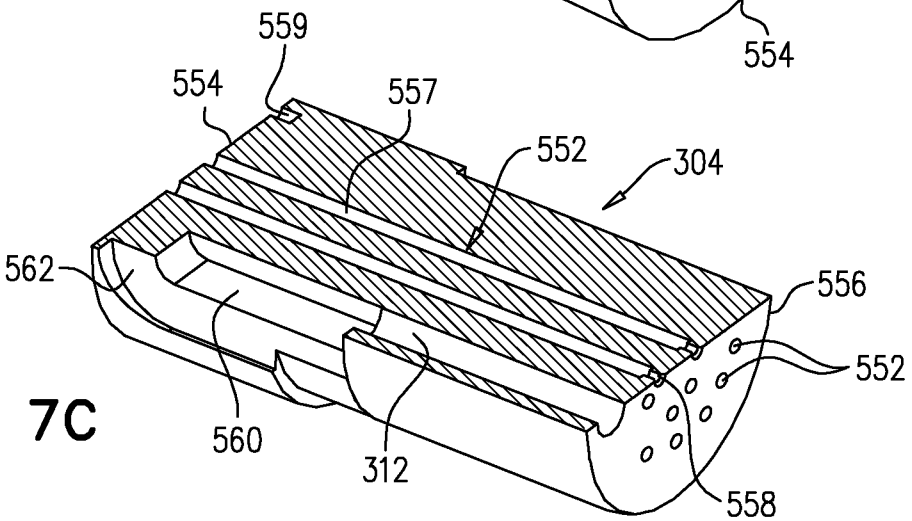


FIG. 7C

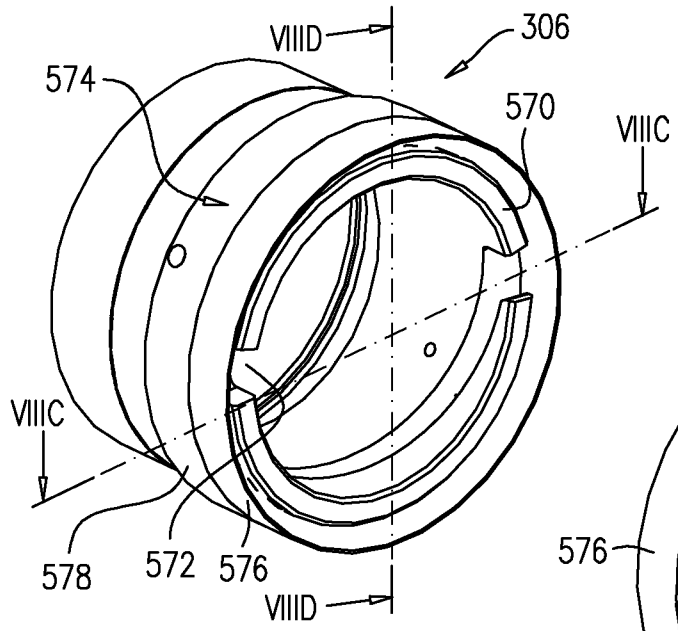


FIG. 8A

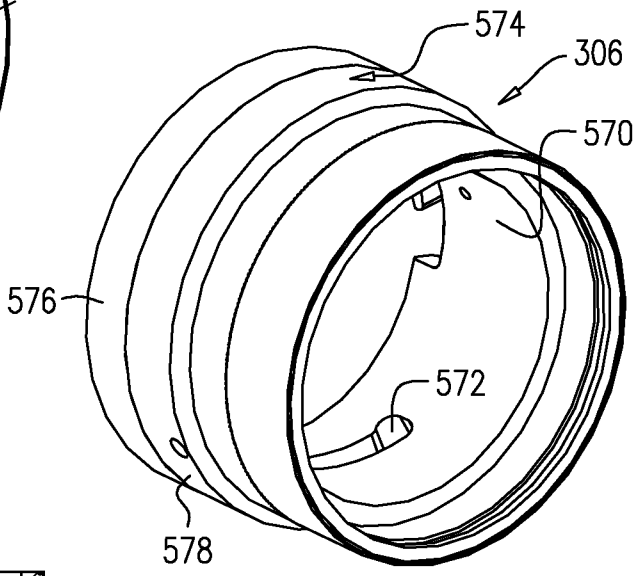


FIG. 8B

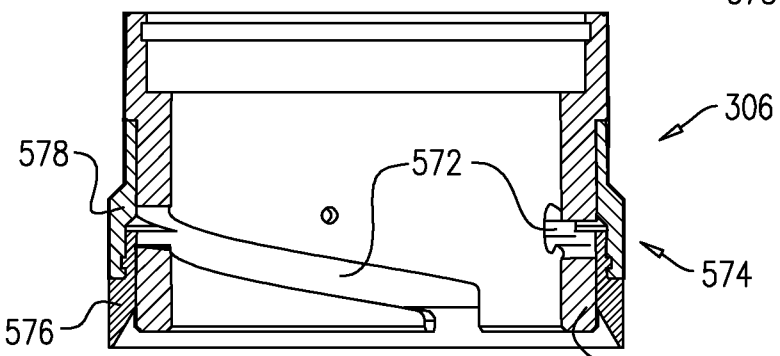


FIG. 8C

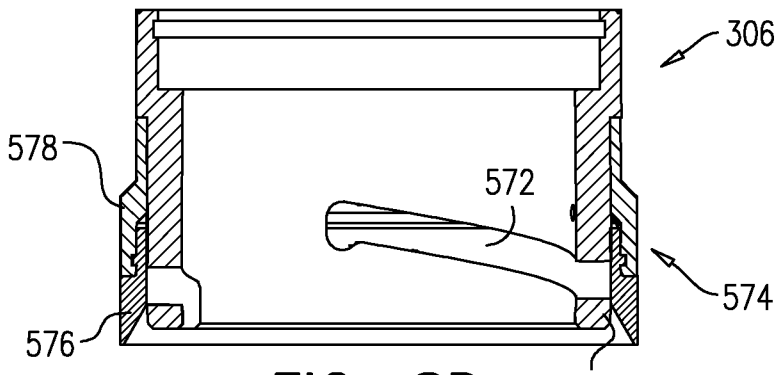
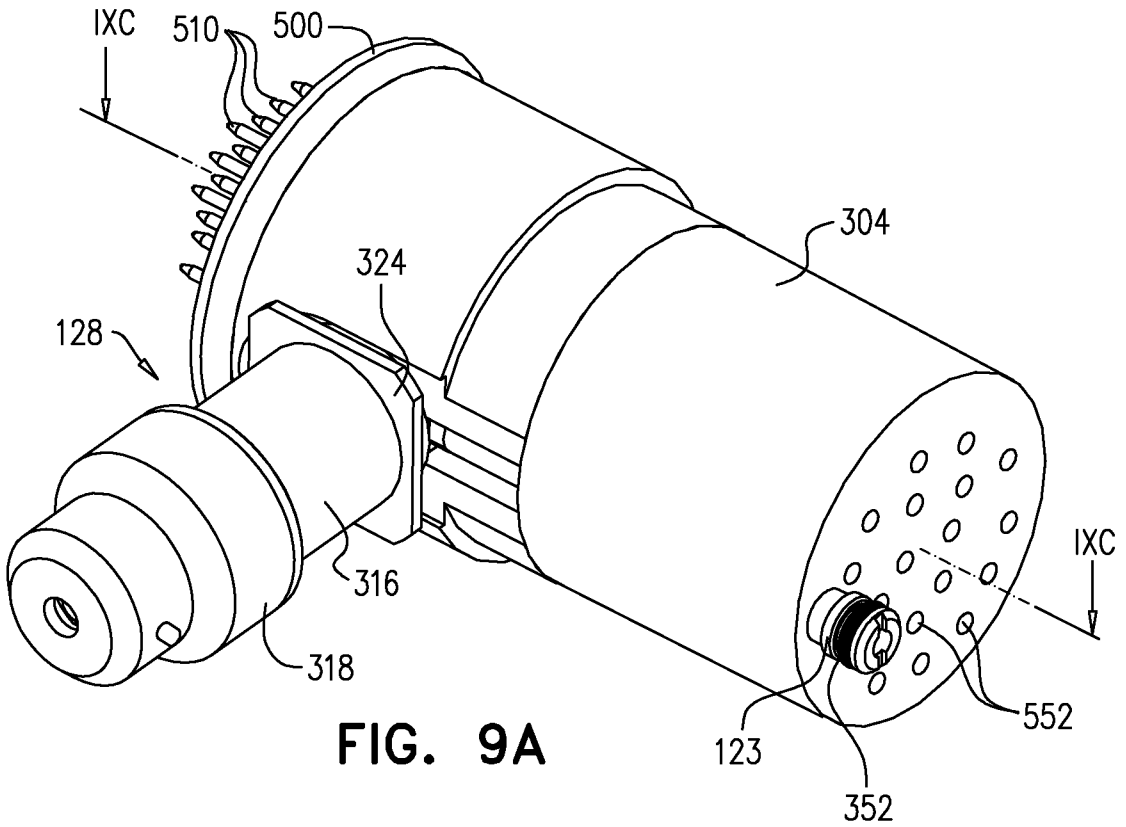


FIG. 8D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IXC
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352

FIG. 9A

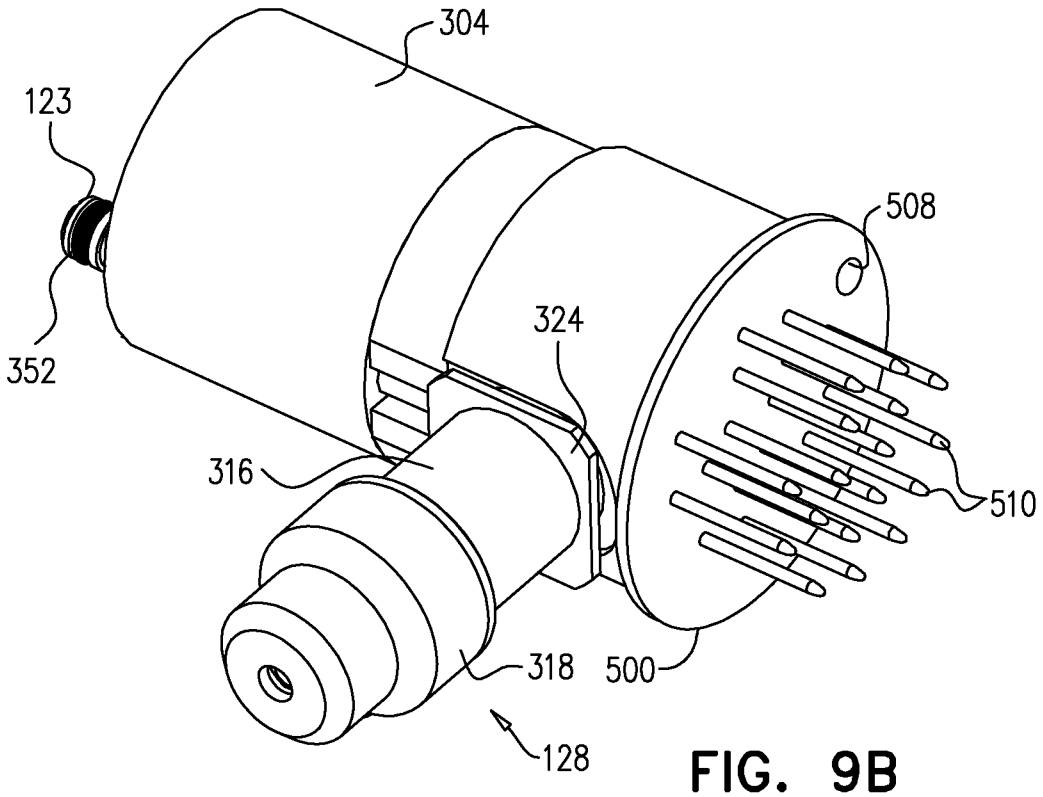
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FIG. 9B

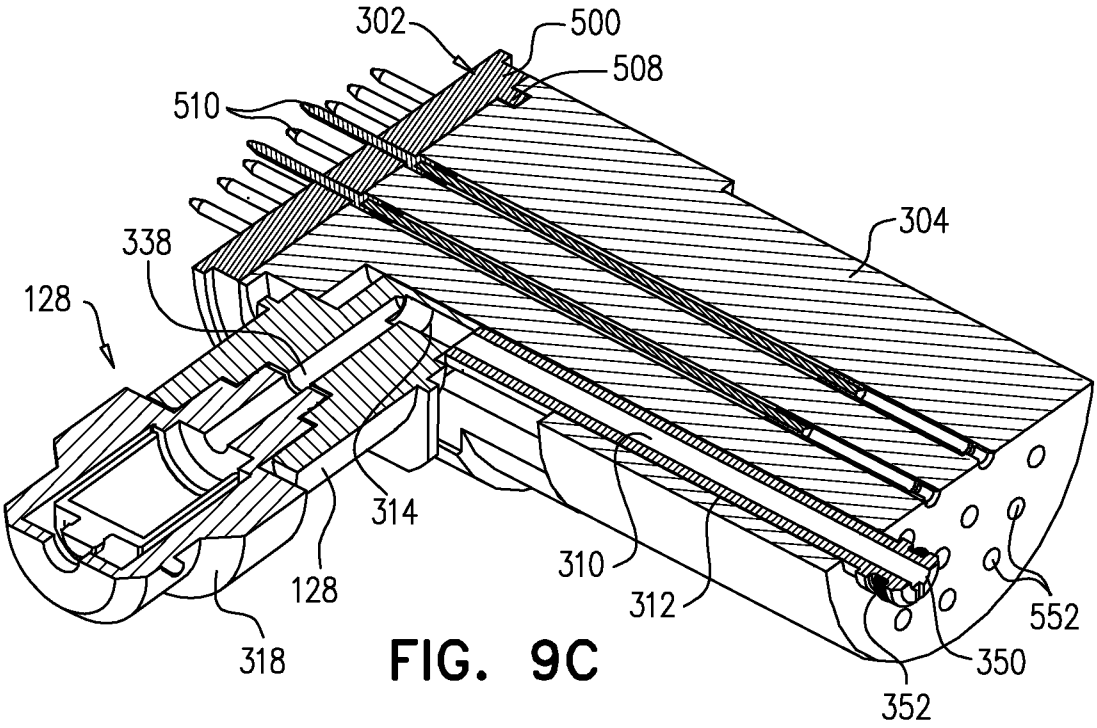
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FIG. 9C

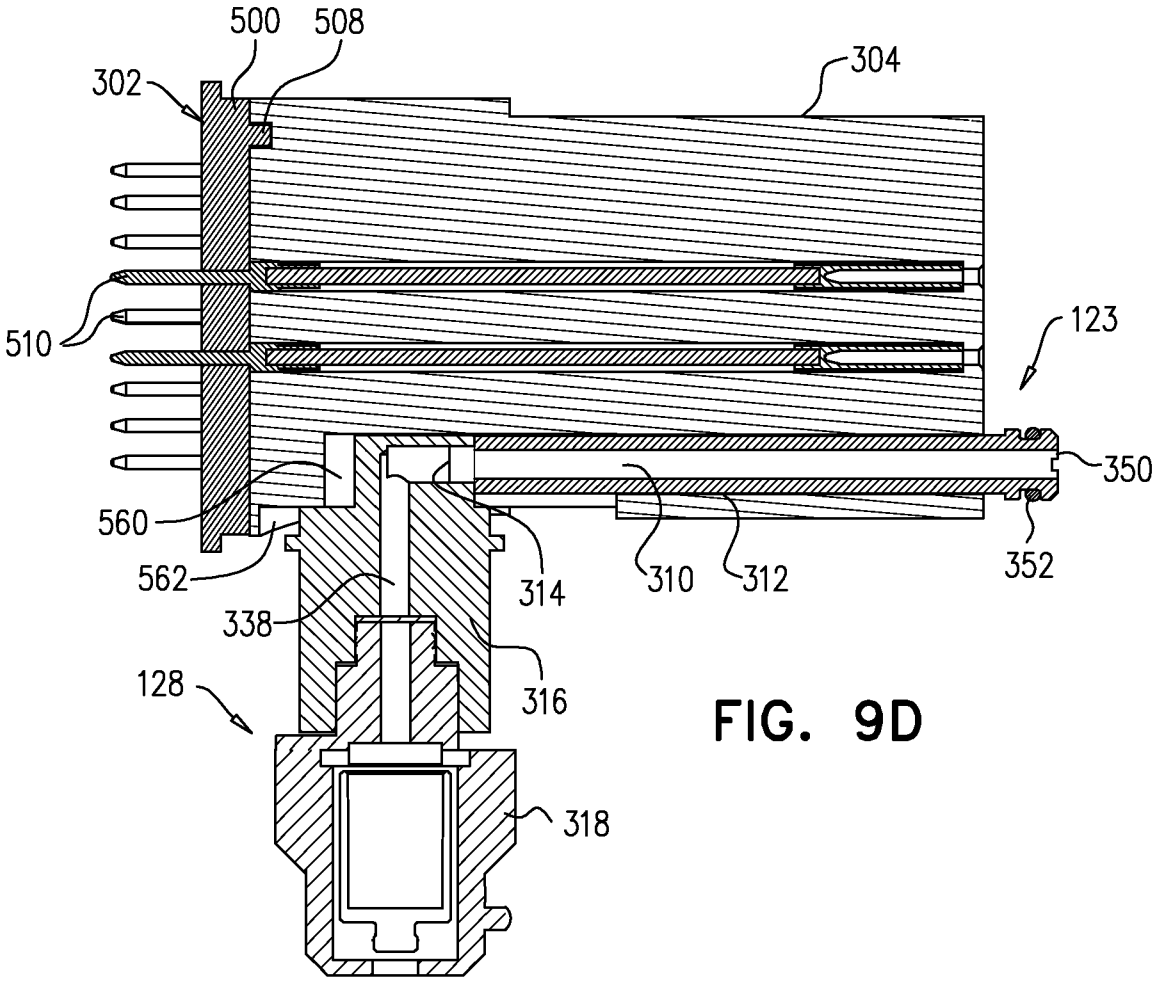
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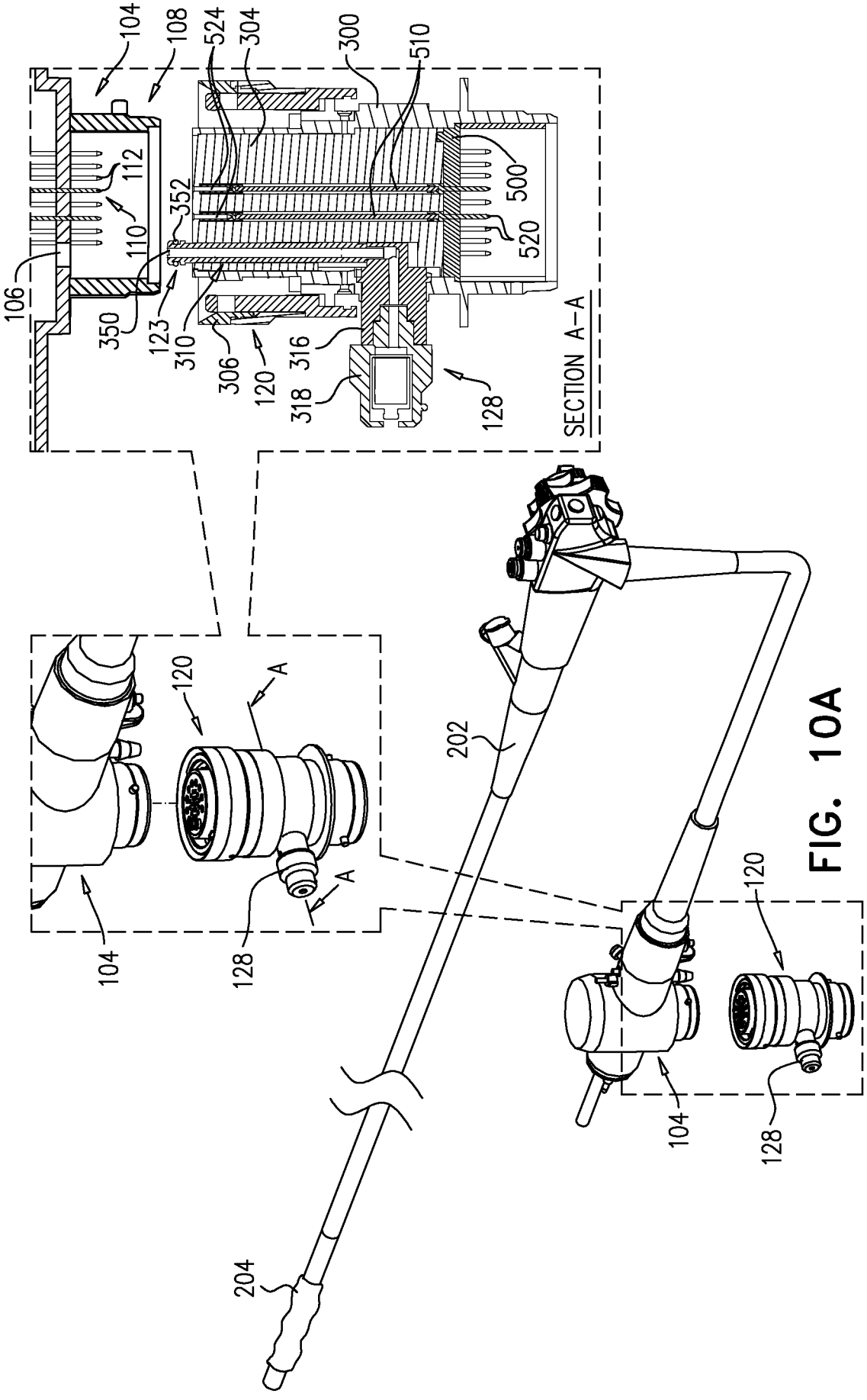
FIG. 9D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A
A
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128
202
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128
204

FIG. 10A

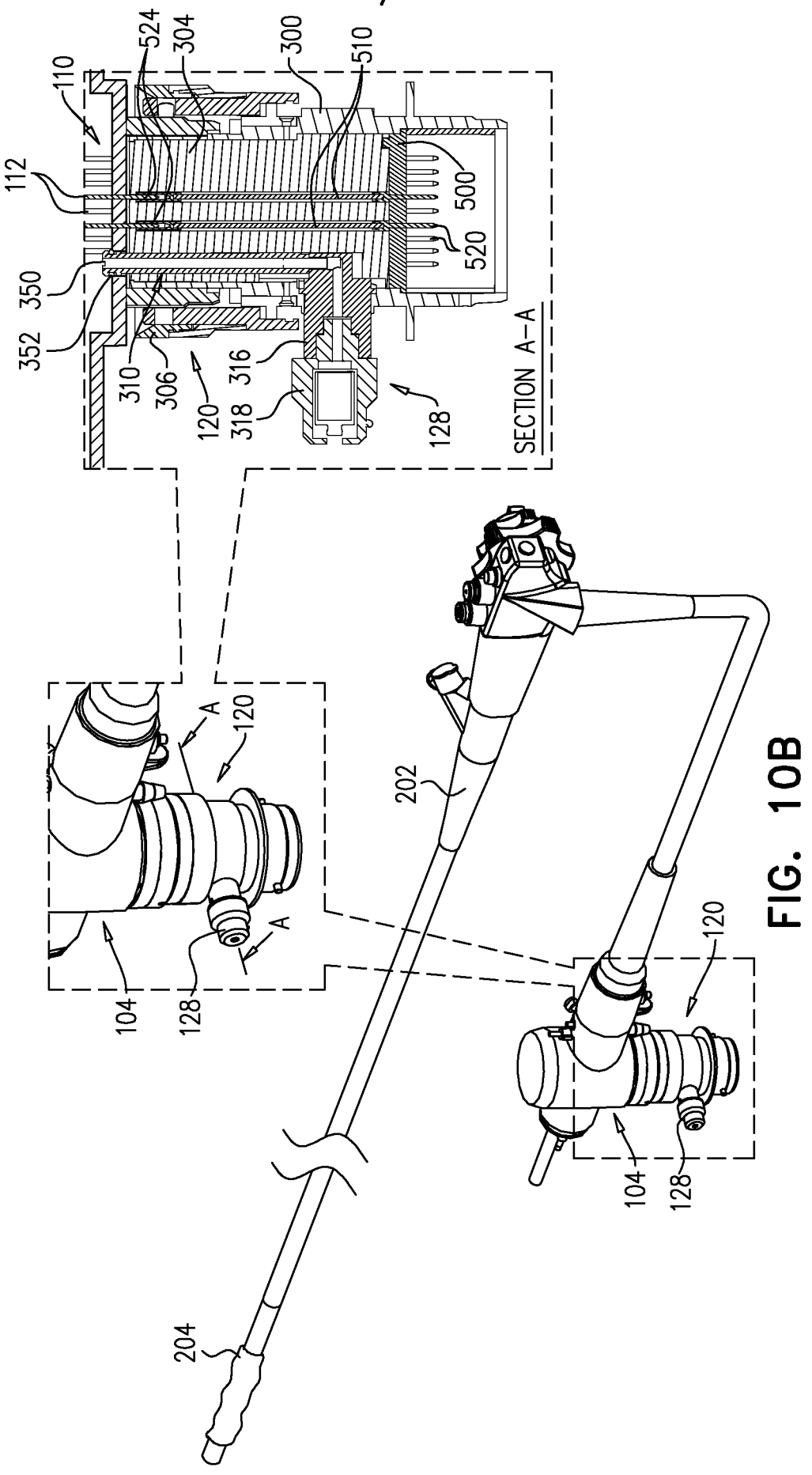
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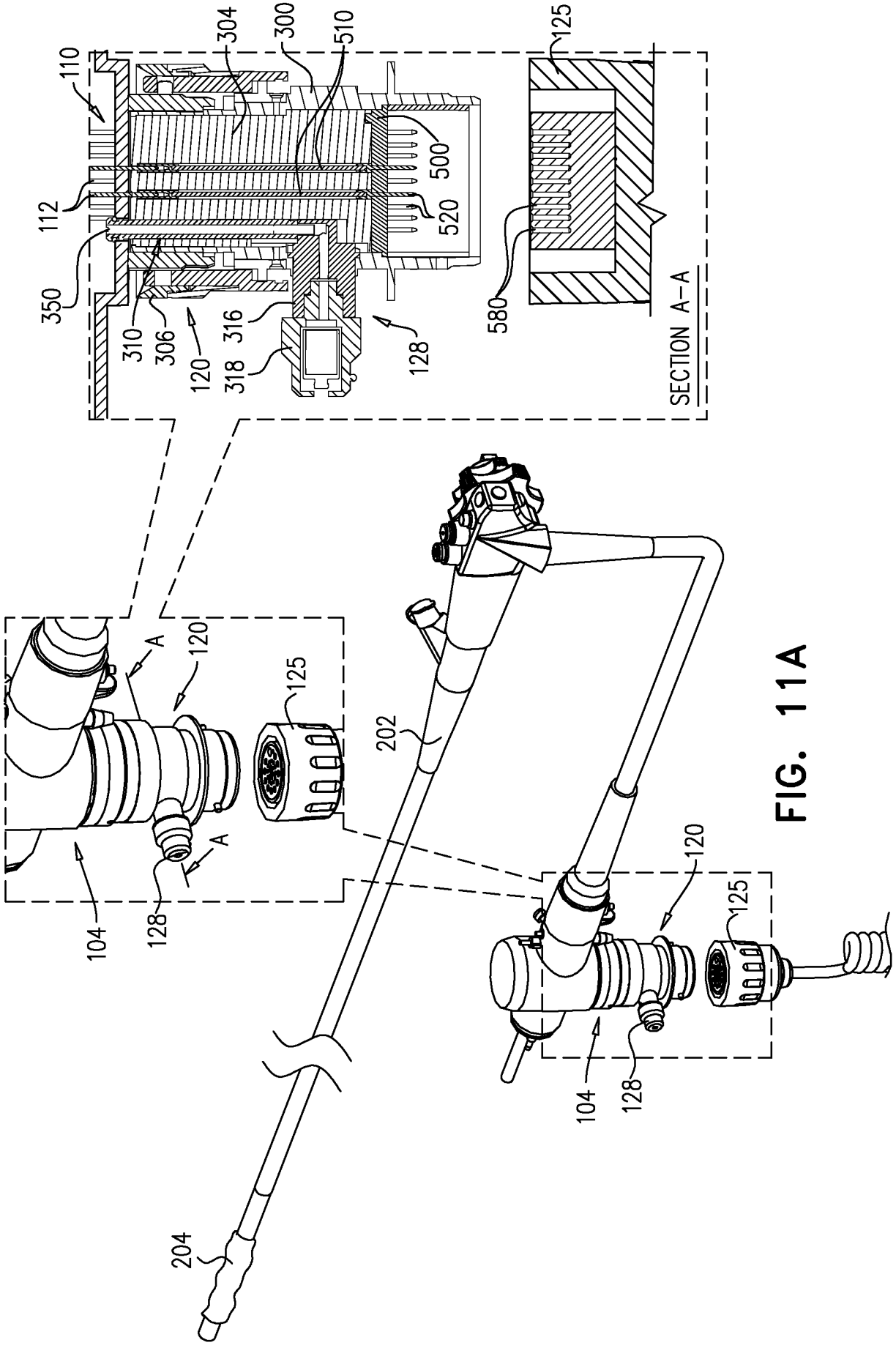
FIG. 10B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580
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104
128
202
204

FIG. 11A

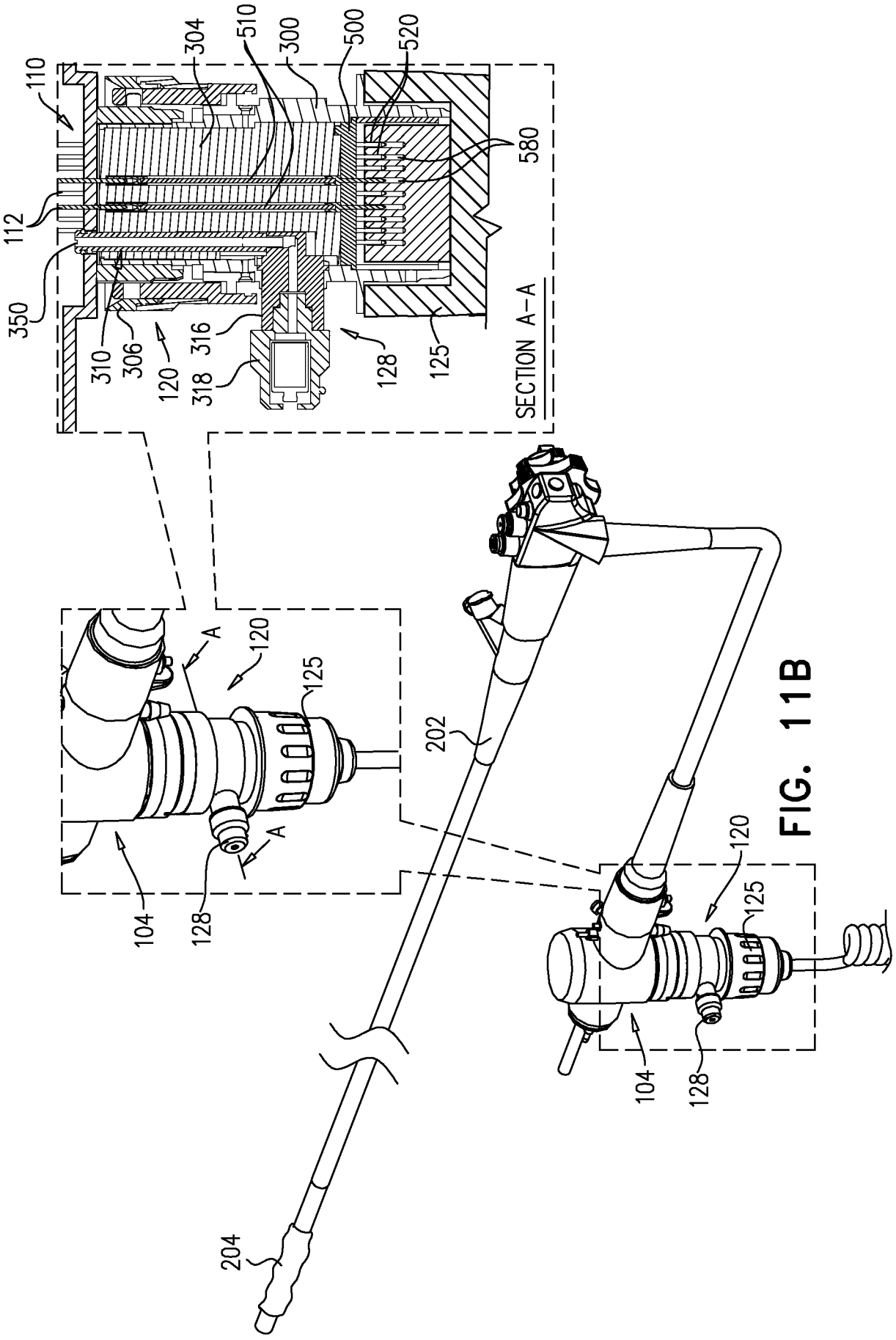
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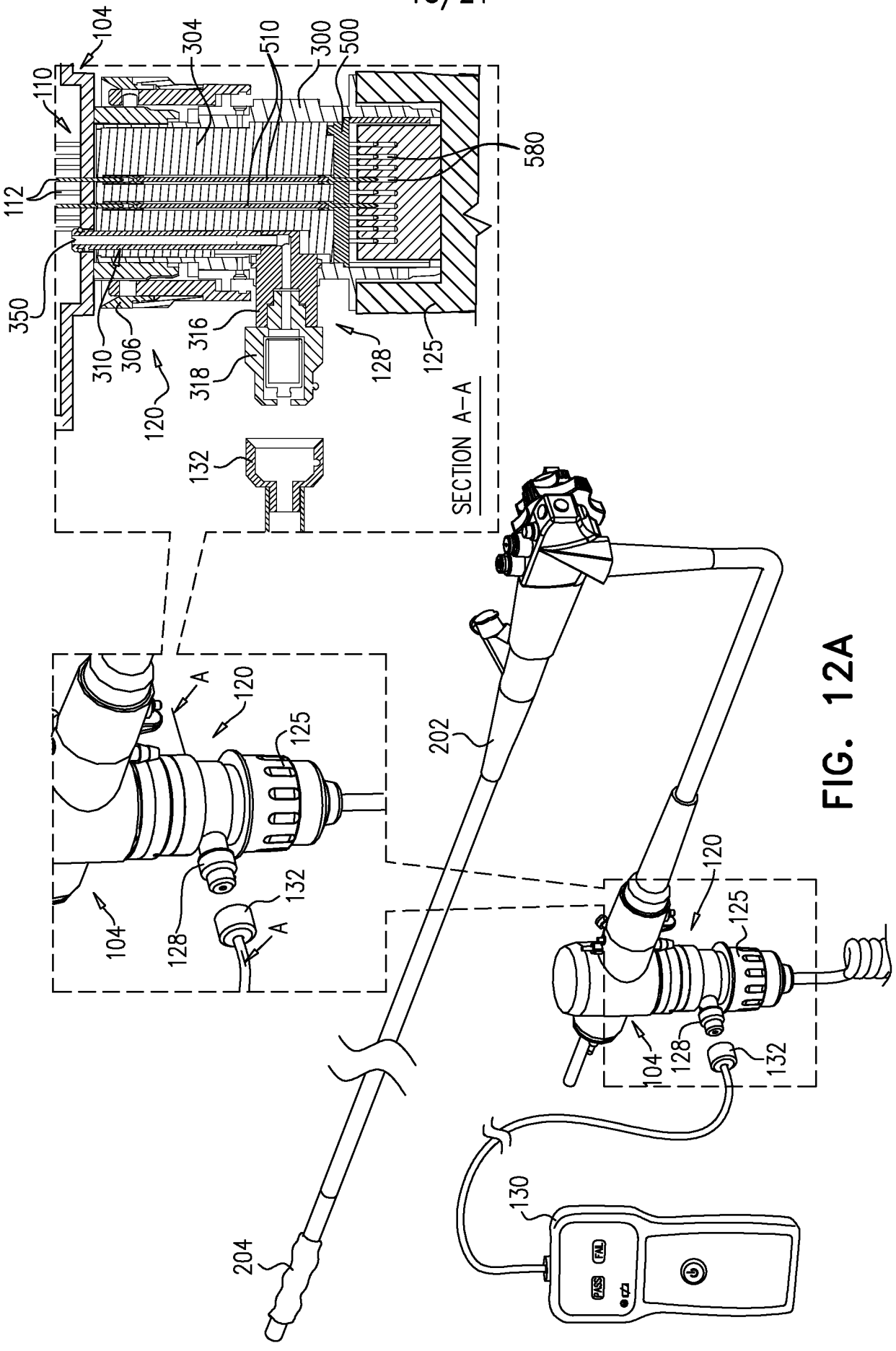
FIG. 11B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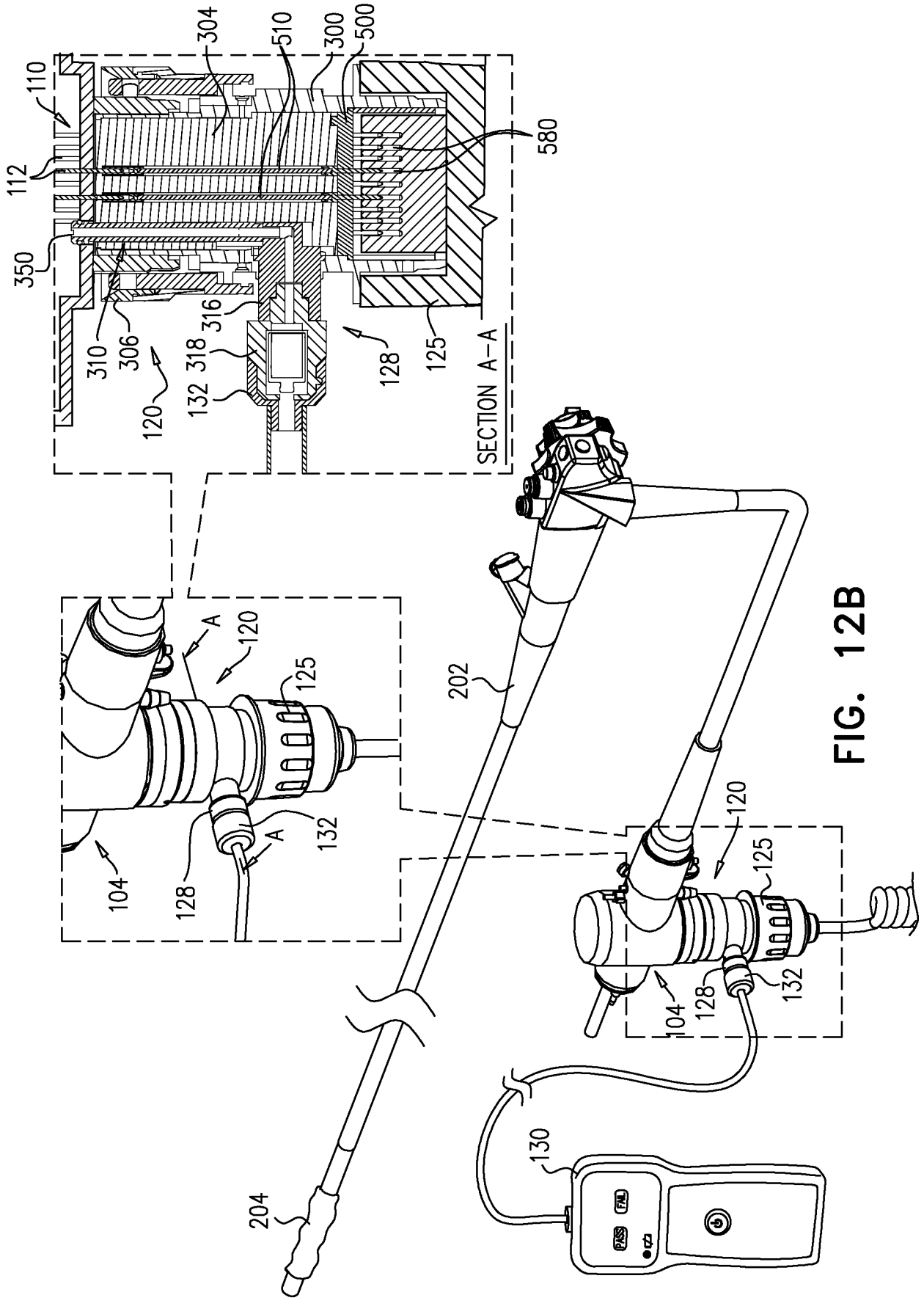
PASS
FAIL

FIG. 12A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128
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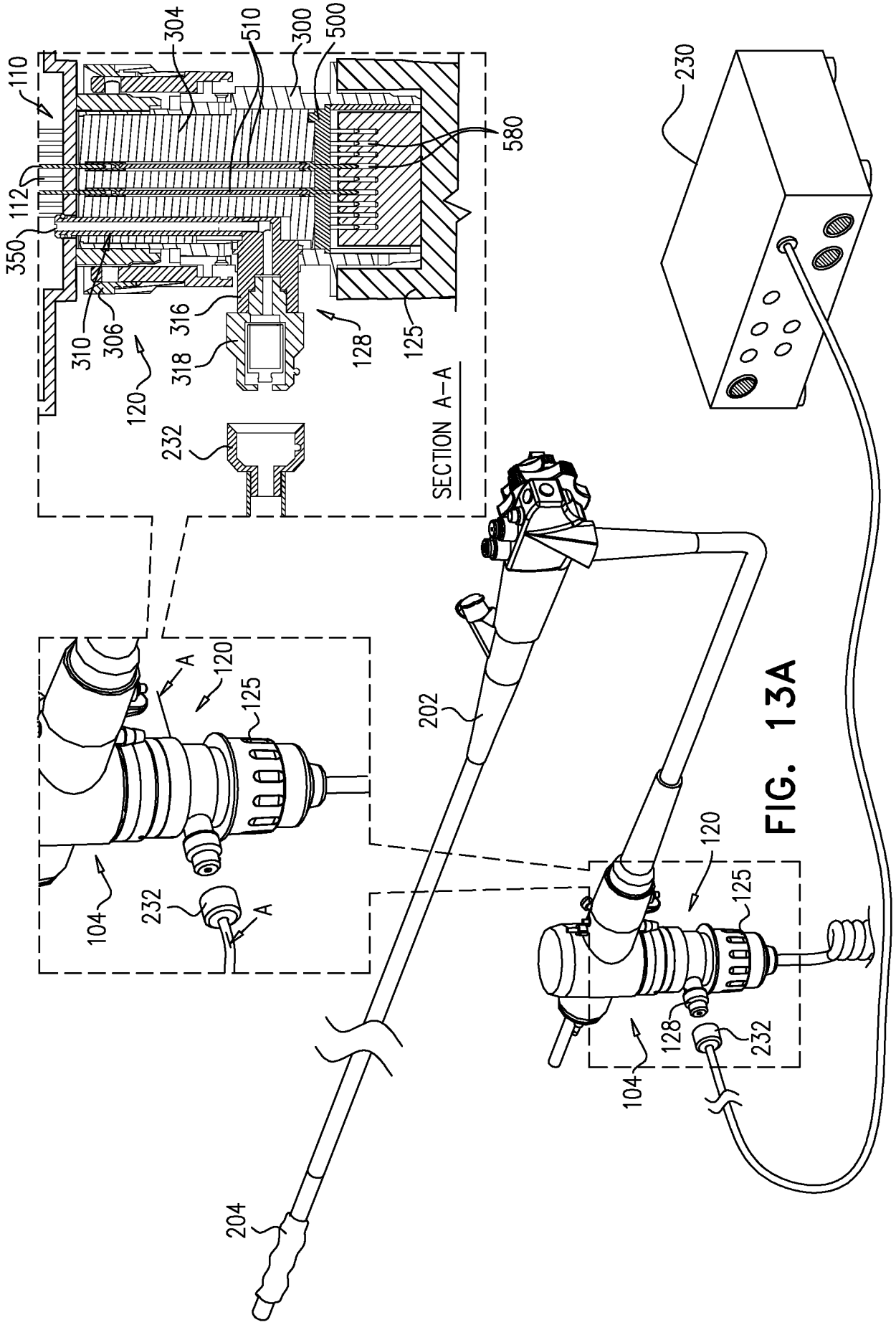
PASS
FAIL

FIG. 12B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125
SECTION A-A
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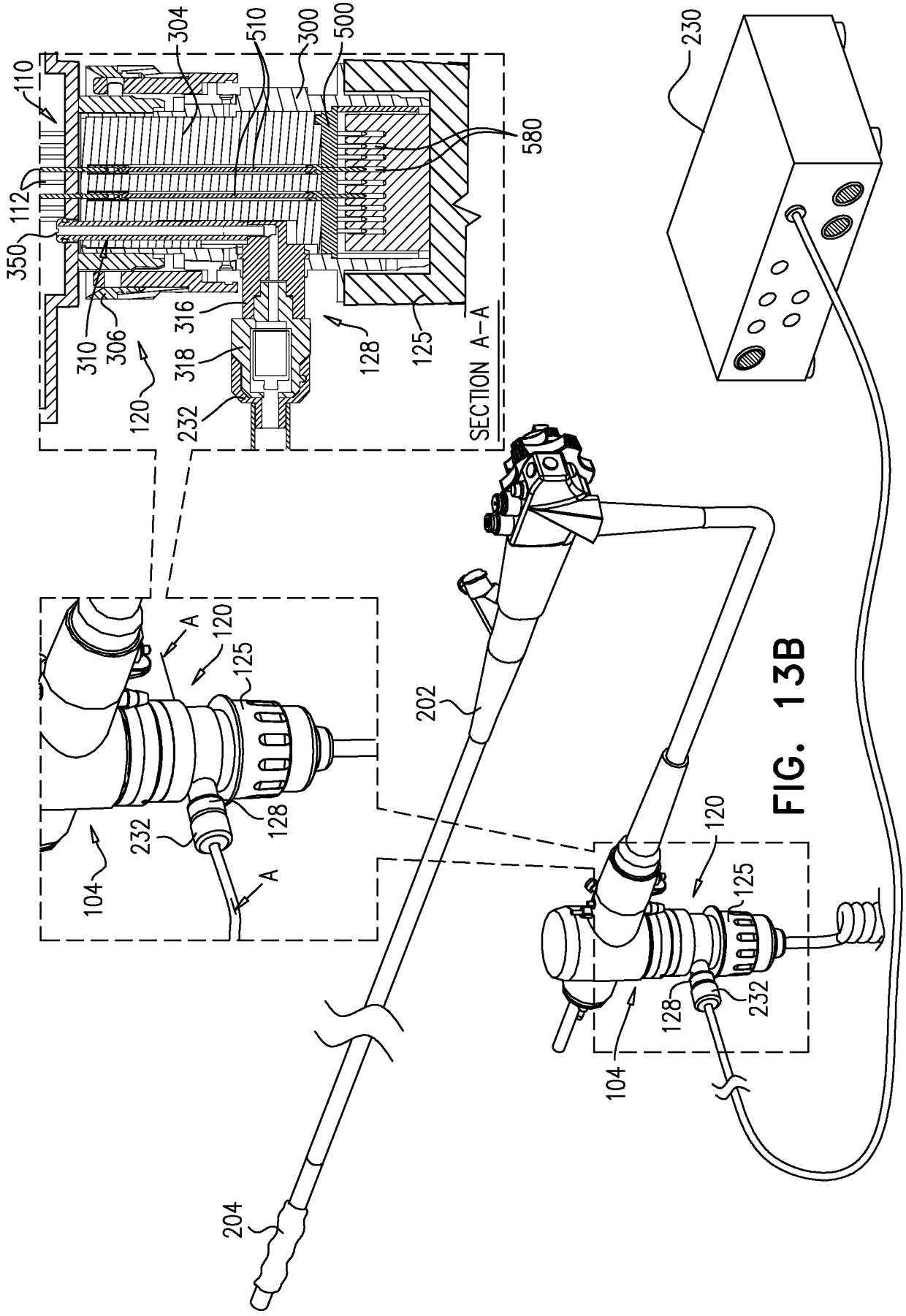
A
120
125
232
128
104

FIG. 13A


304
510
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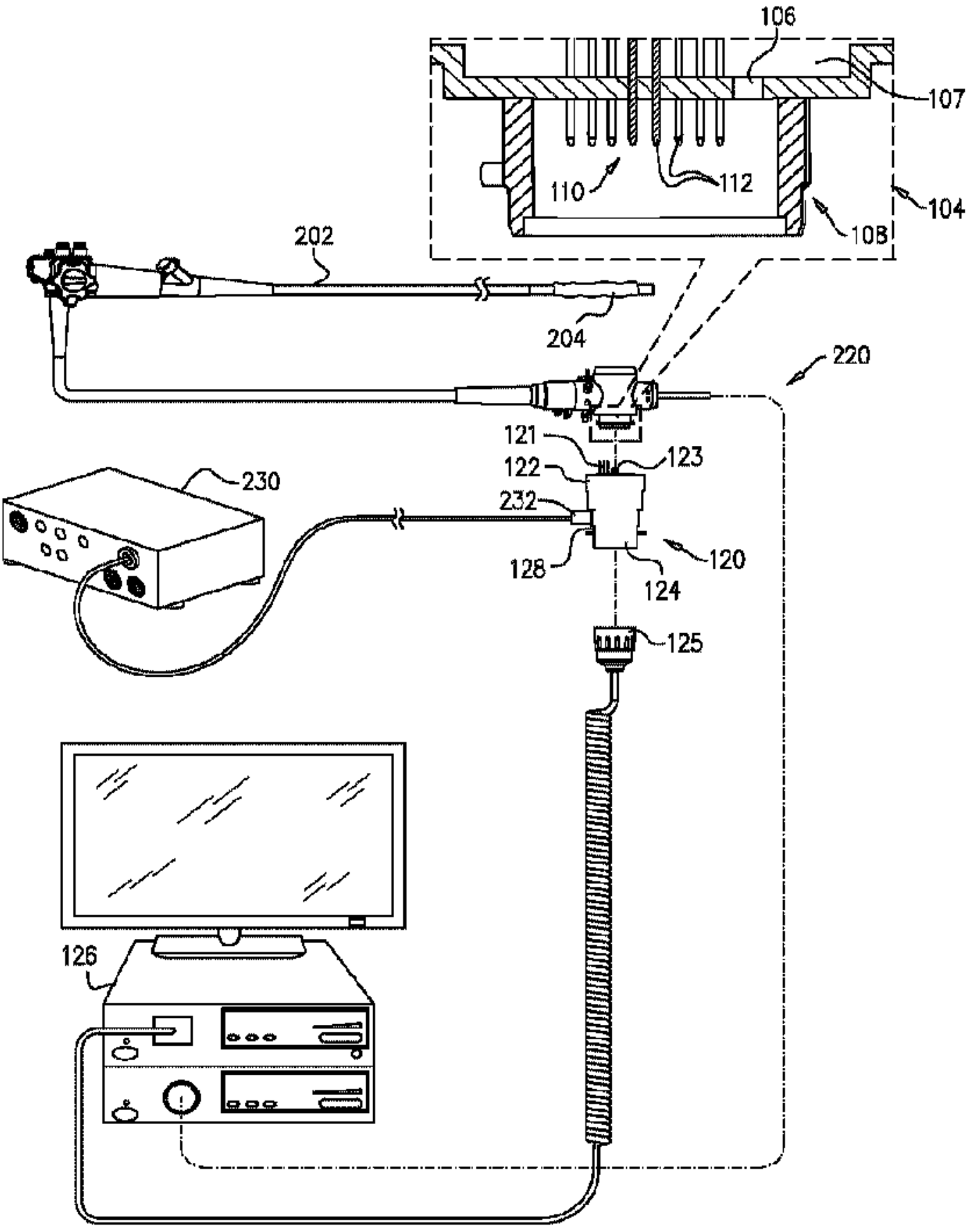
500
110
580
112
350
310
306
316
318
120
232
128
125
SECTION A-A
230
202
A
120
125
232
128
104
A
204

FIG. 13B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