United States of America

To Promote the Progress of Science and Useful Arts

# The Director

of the United States Patent and Trademark Office has received an application for a patent for a new and useful invention. The title and description of the invention are enclosed. The requirements of law have been complied with, and it has been determined that a patent on the invention shall be granted under the law.

Therefore, this United States

# Patent

grants to the person(s) having title to this patent the right to exclude others from making, using, offering for sale, or selling the invention throughout the United States of America or importing the invention into the United States of America, and if the invention is a process, of the right to exclude others from using, offering for sale or selling throughout the United States of America, products made by that process, for the term set forth in 35 U.S.C. 154(a)(2) or (c)(1), subject to the payment of maintenance fees as provided by 35 U.S.C. 41(b). See the Maintenance Fee Notice on the inside of the cover.

John A. Jarvis

Director of the United States Patent and Trademark Office

## Maintenance Fee Notice

If the application for this patent was filed on or after December 12, 1980, maintenance fees are due three years and six months, seven years and six months, and eleven years and six months after the date of this grant, or within a grace period of six months thereafter upon payment of a surcharge as provided by law. The amount, number and timing of the maintenance fees required may be changed by law or regulation. Unless payment of the applicable maintenance fee is received in the United States Patent and Trademark Office on or before the date the fee is due or within a grace period of six months thereafter, the patent will expire as of the end of such grace period.

## Patent Term Notice

If the application for this patent was filed on or after June 8, 1995, the term of this patent begins on the date on which this patent issues and ends twenty years from the filing date of the application or, if the application contains a specific reference to an earlier filed application or applications under 35 U.S.C. 120, 121, 365(c), or 386(c), twenty years from the filing date of the earliest such application ("the twenty-year term"), subject to the payment of maintenance fees as provided by 35 U.S.C. 41(b), and any extension as provided by 35 U.S.C. 154(b) or 156 or any disclaimer under 35 U.S.C. 253.

If this application was filed prior to June 8, 1995, the term of this patent begins on the date on which this patent issues and ends on the later of seventeen years from the date of the grant of this patent or the twenty-year term set forth above for patents resulting from applications filed on or after June 8, 1995, subject to the payment of maintenance fees as provided by 35 U.S.C. 41(b) and any extension as provided by 35 U.S.C. 156 or any disclaimer under 35 U.S.C. 253.

US012527932B2

(12) **United States Patent**
**Harnish**

(10) **Patent No.: US 12,527,932 B2**
(45) **Date of Patent: Jan. 20, 2026**

(54) **ENDOTRACHEAL TUBE APPARATUS AND METHODS**

(71) Applicant: **WarriorNP LLC**, Bloomfield Hills, MI (US)

(72) Inventor: **Jessica Harnish**, Bloomfield Hills, MI (US)

(73) Assignee: **WarriorNP LLC**, Bloomfiled Hills, MI (US)

( * ) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 833 days.

(21) Appl. No.: **17/877,709**

(22) Filed: **Jul. 29, 2022**

(65) **Prior Publication Data**

US 2023/0031571 A1 Feb. 2, 2023

**Related U.S. Application Data**

(60) Provisional application No. 63/304,253, filed on Jan. 28, 2022, provisional application No. 63/293,485, filed on Dec. 23, 2021, provisional application No. 63/227,306, filed on Jul. 29, 2021.

(51) **Int. Cl.**
***A61M 16/04*** (2006.01)
*A61M 25/02* (2006.01)

(52) **U.S. Cl.**
CPC .... ***A61M 16/0497*** (2013.01); ***A61M 16/0463*** (2013.01); *A61M 2025/024* (2013.01); *A61M 2209/088* (2013.01)

(58) **Field of Classification Search**
CPC ..... A61M 16/0497
See application file for complete search history.

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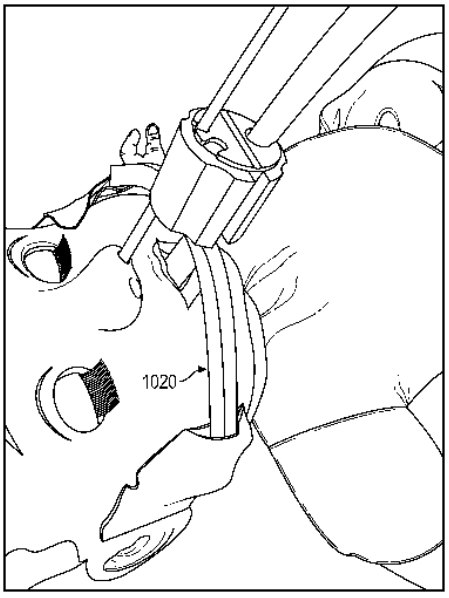
*Primary Examiner* — Bradley H Philips
(74) *Attorney, Agent, or Firm* — Carlson, Gaskey & Olds, P.C

(57) **ABSTRACT**

An endotracheal tube apparatus according to an example of this disclosure includes a brace for attachment to a patient's face, a support extending from the brace and including a groove for receiving an endotracheal tube. A clamp surrounds the support and the endotracheal tube. The clamp is comprised of a polymeric material.

**20 Claims, 42 Drawing Sheets**



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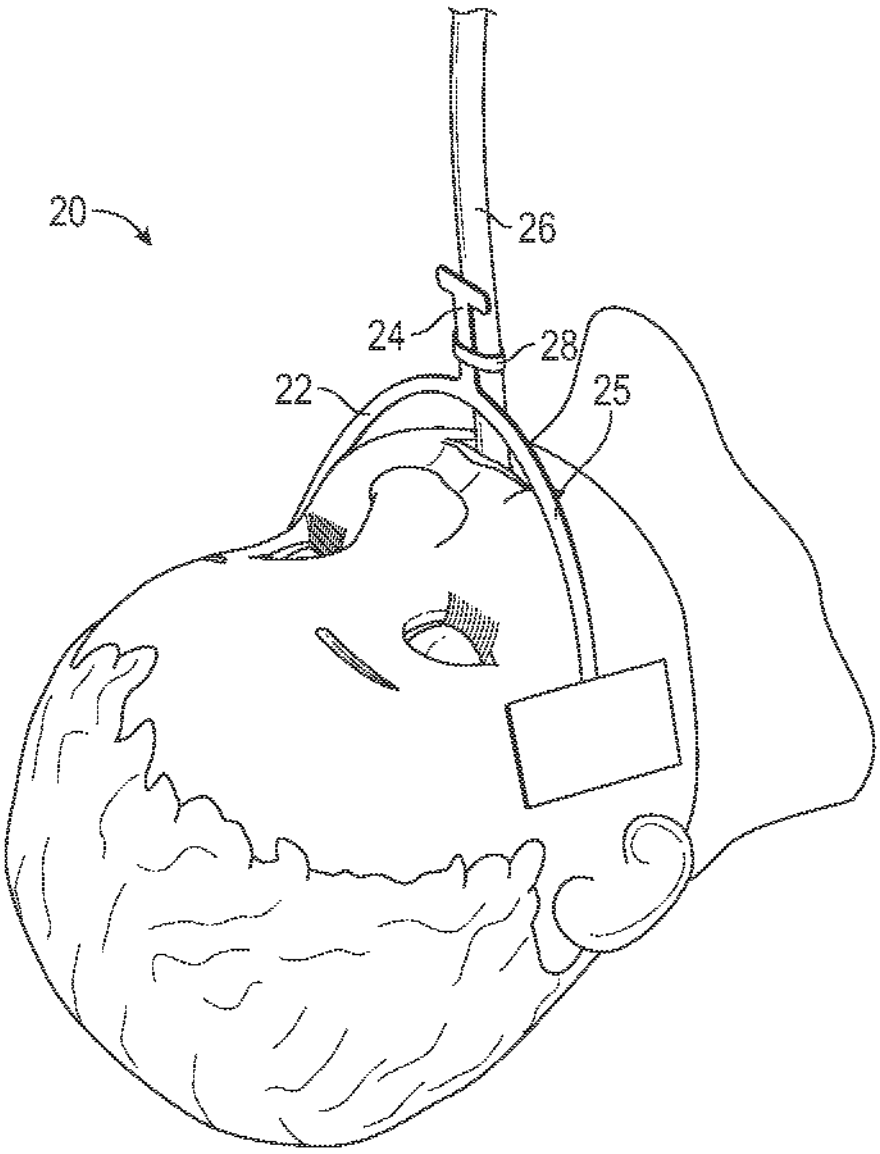



FIG. 1

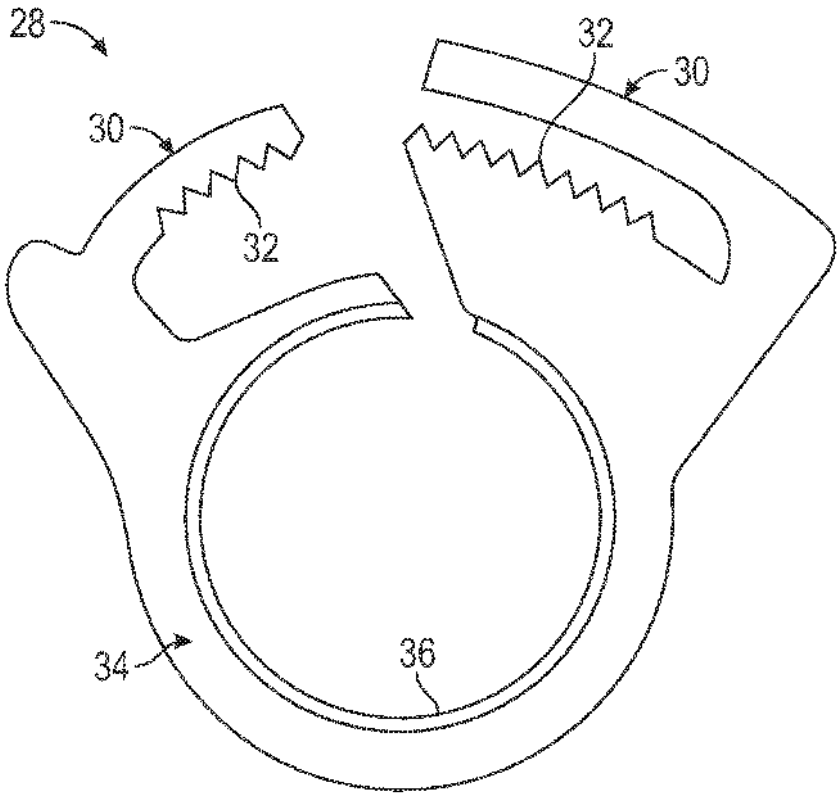



FIG. 2

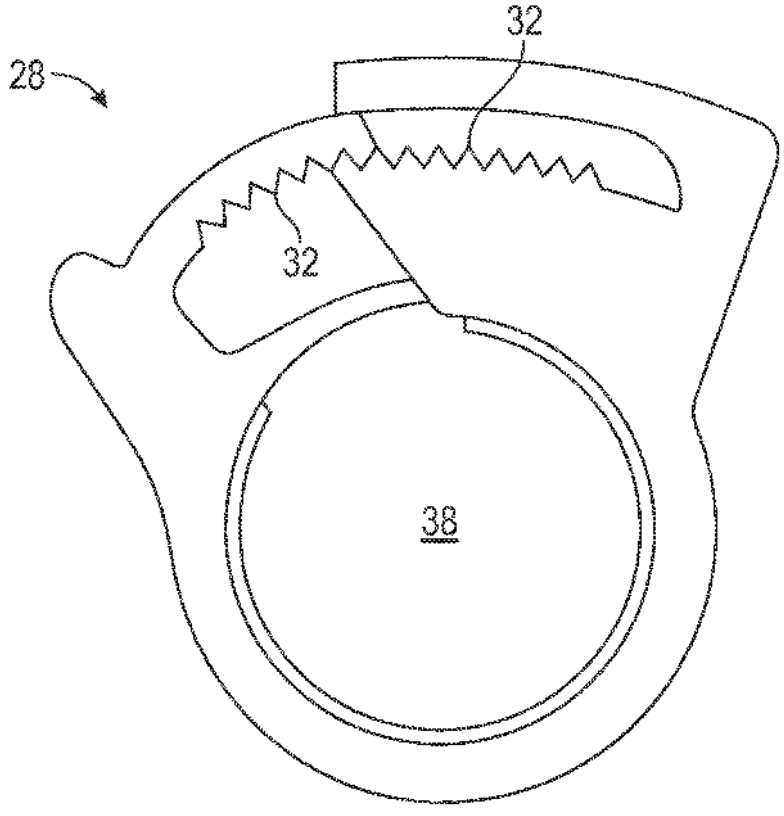
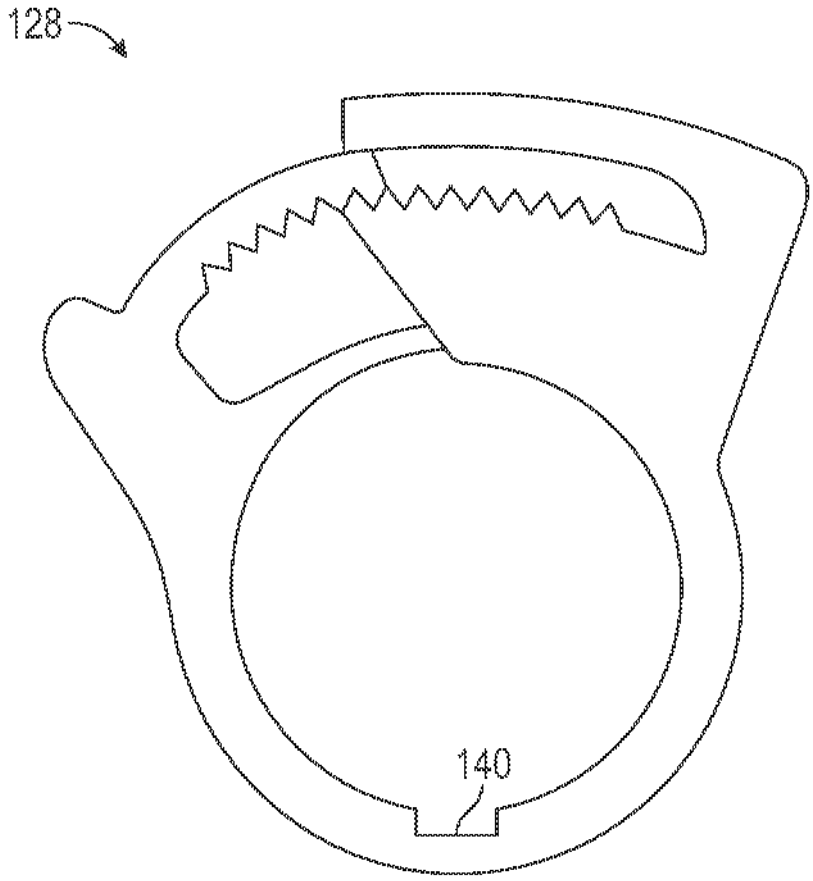



FIG. 3

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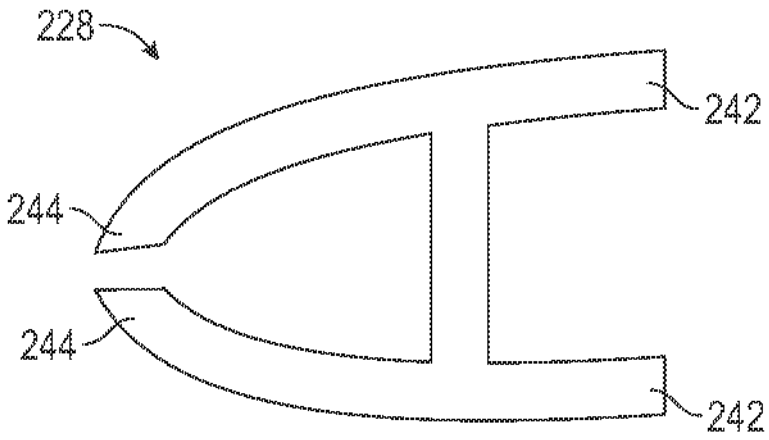



FIG. 5

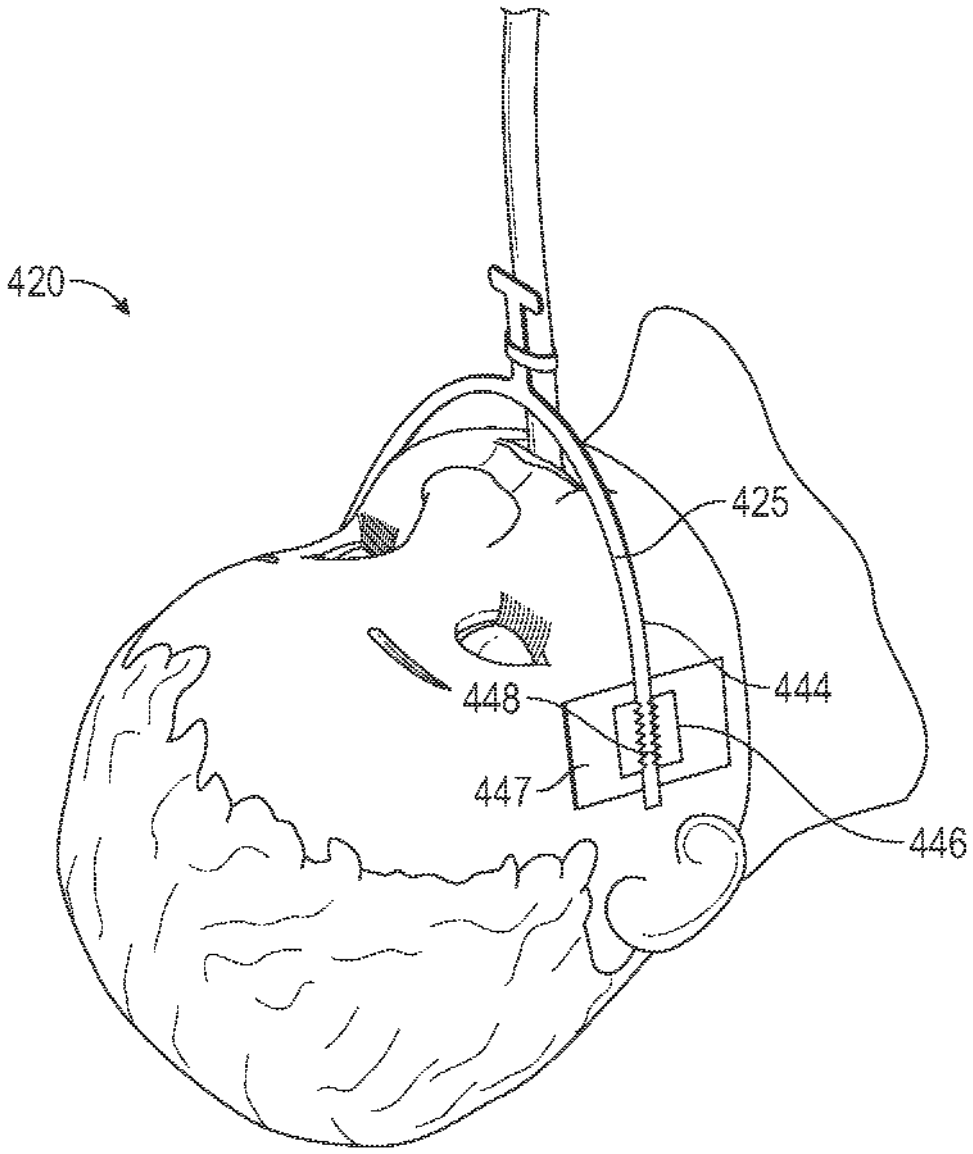
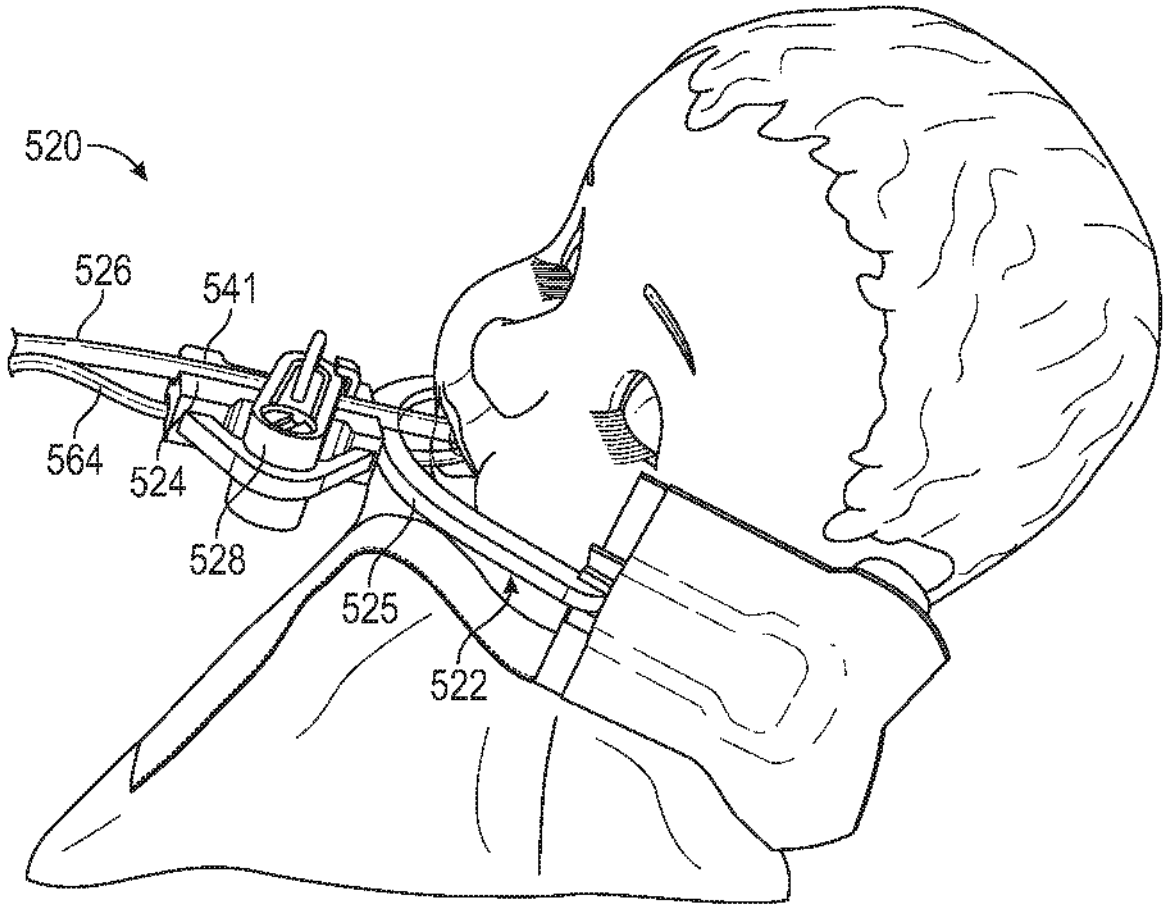



FIG. 6

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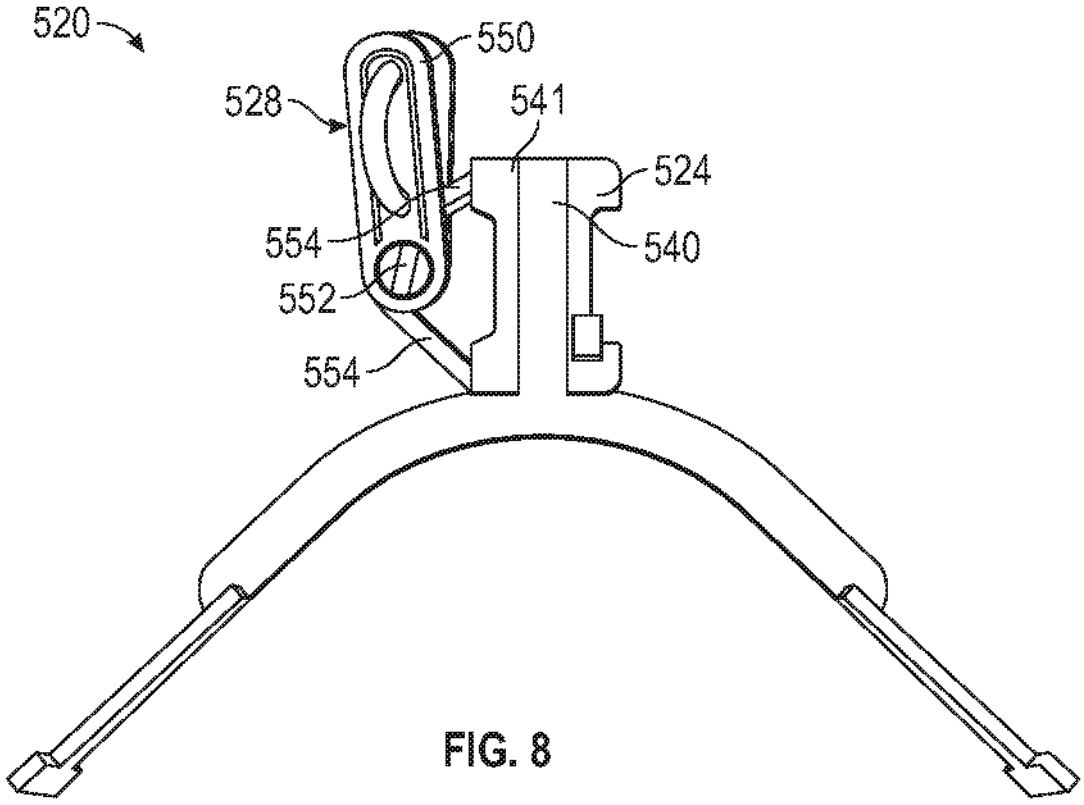


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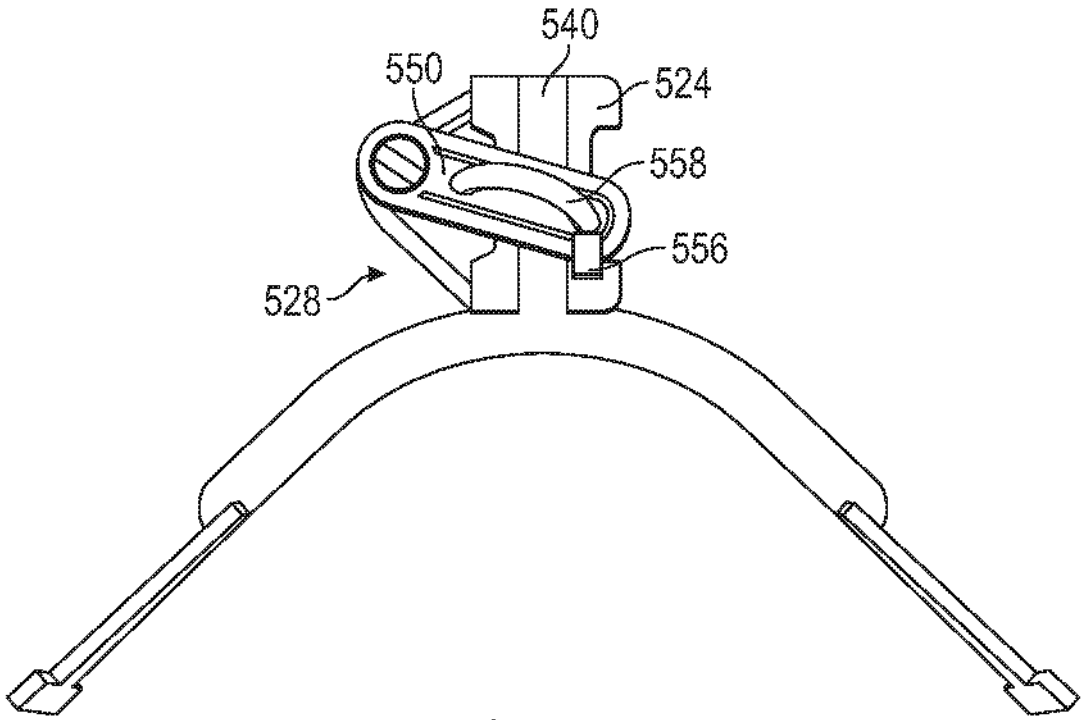



FIG. 9

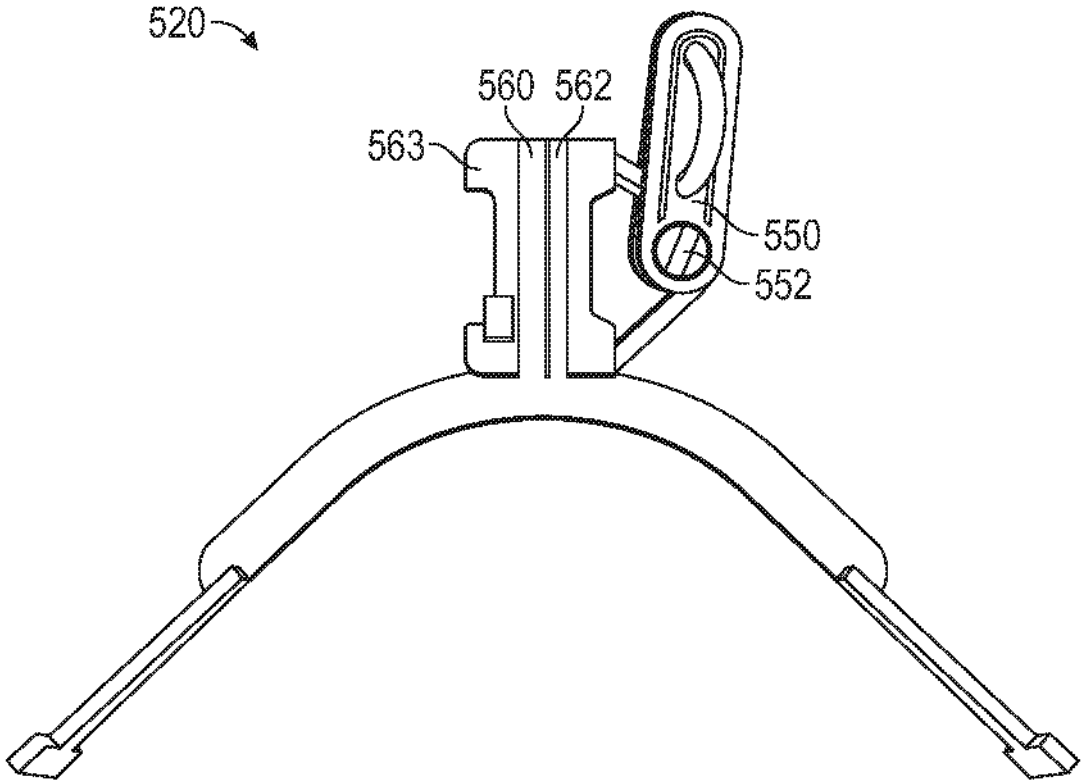
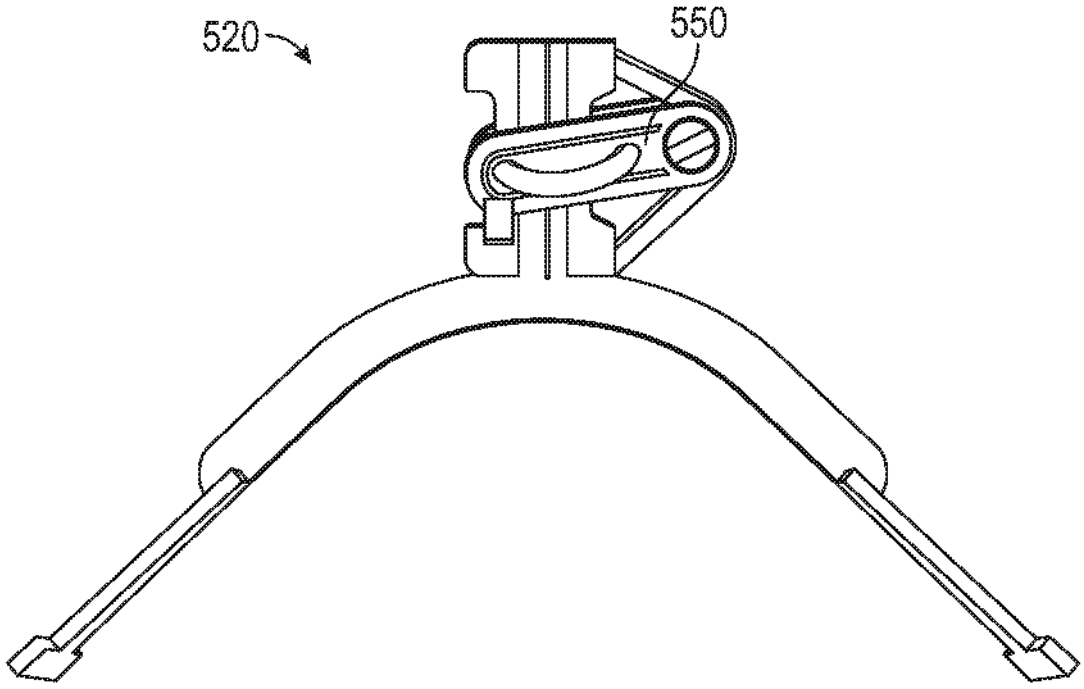



FIG. 10

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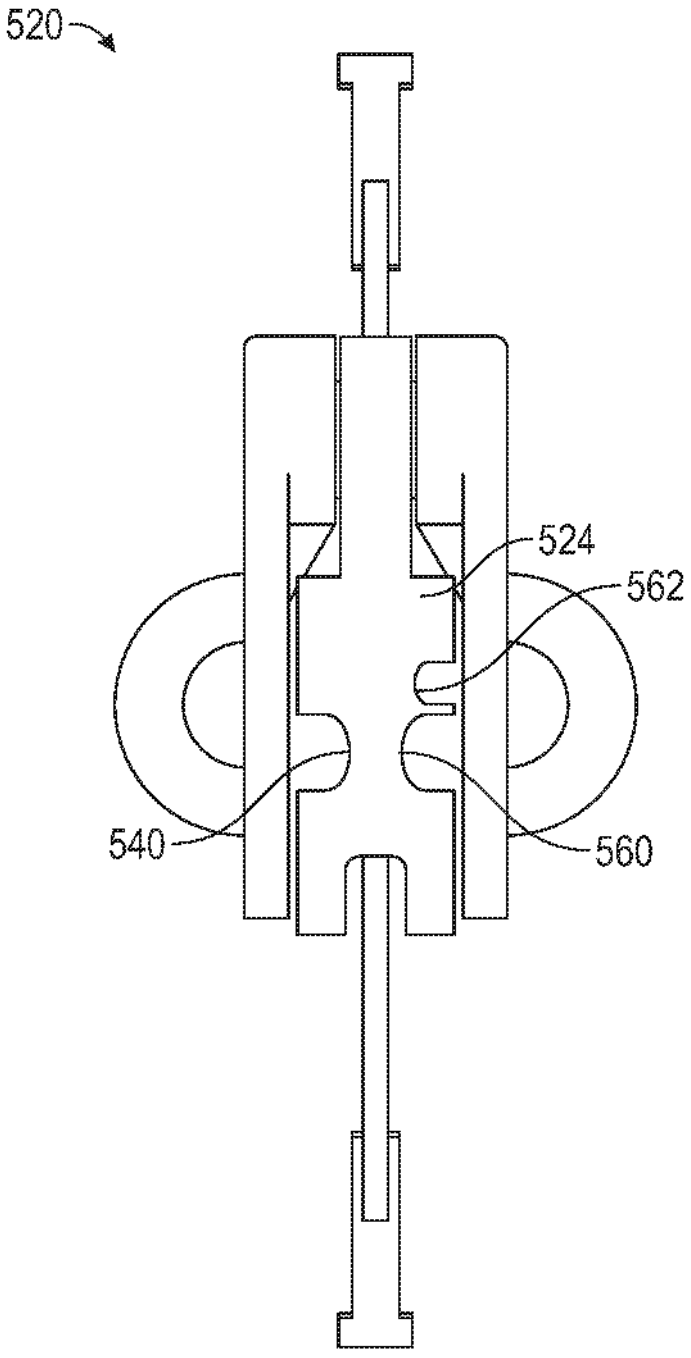


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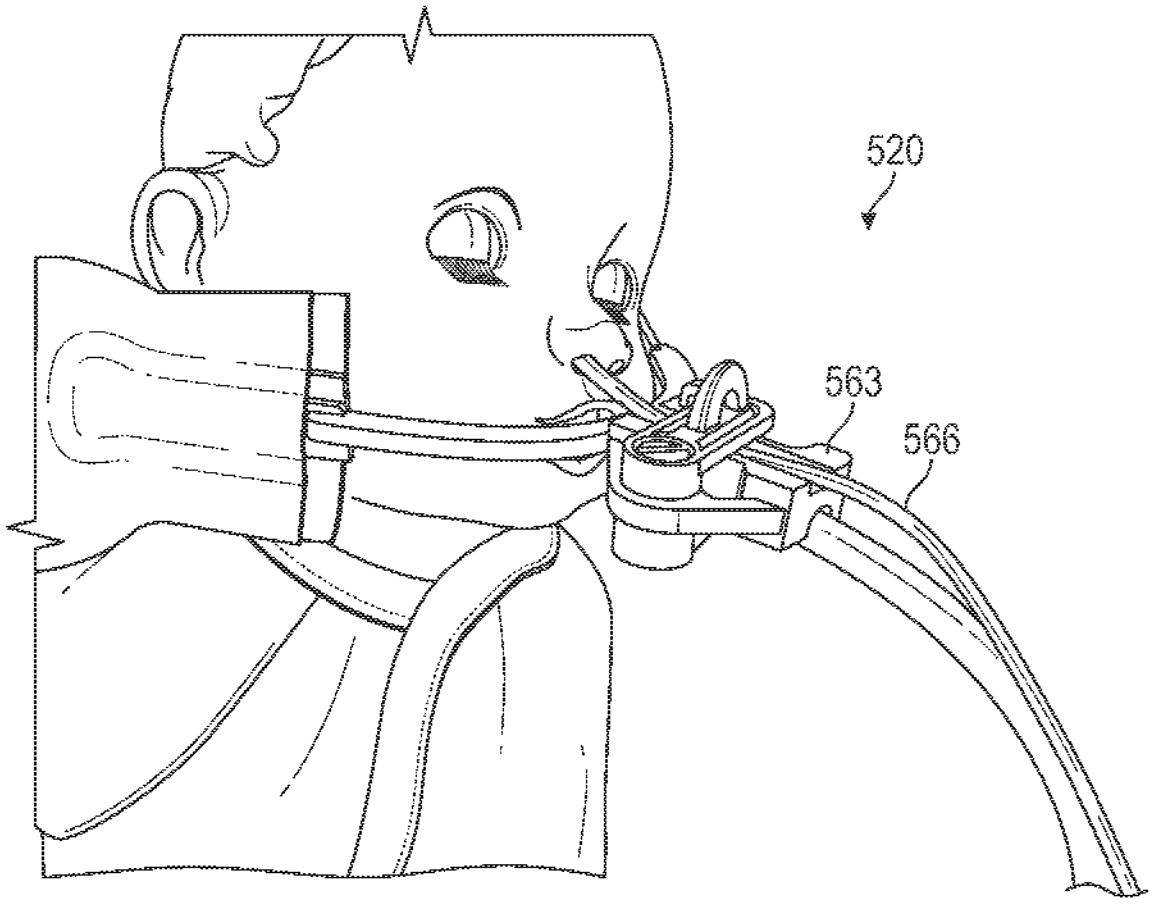


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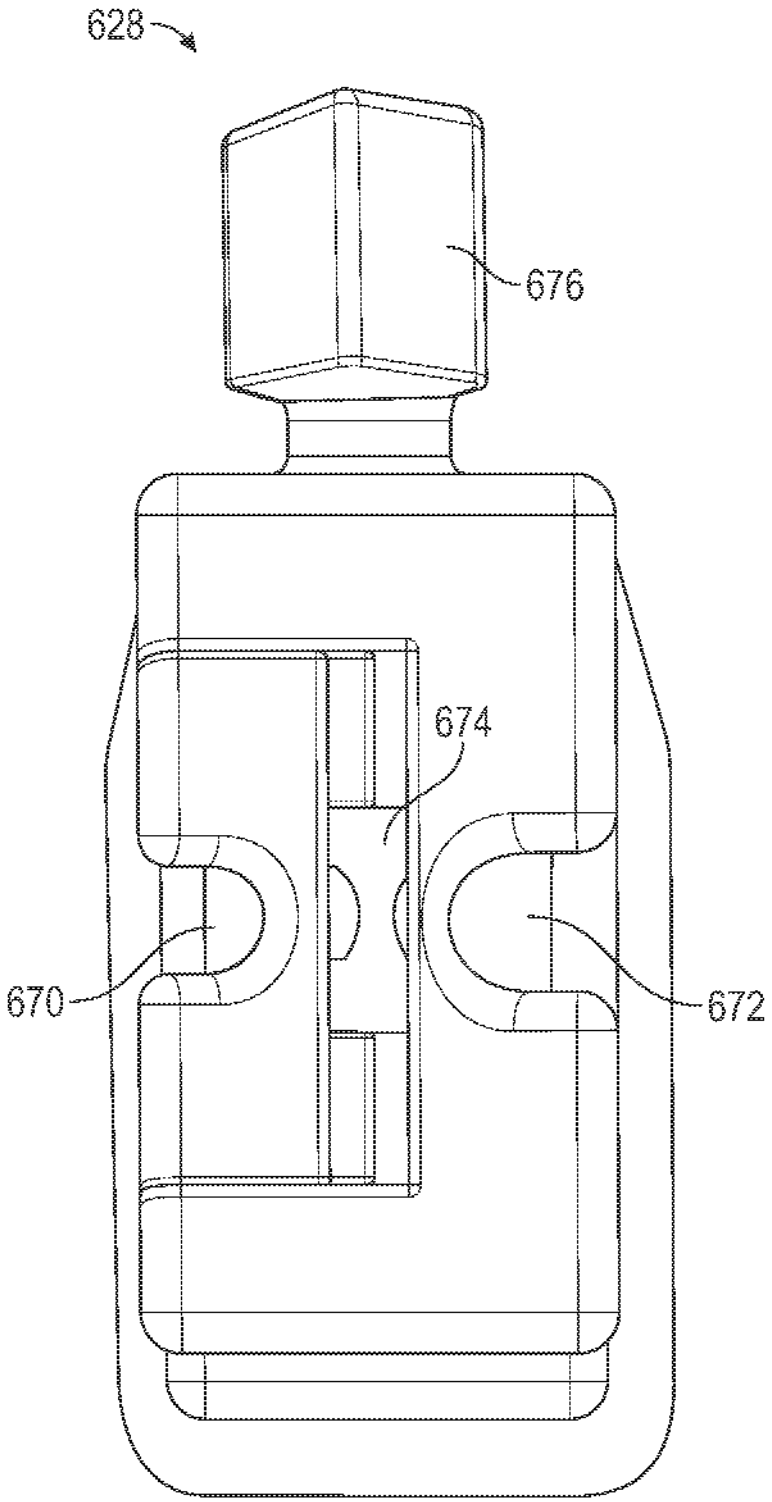


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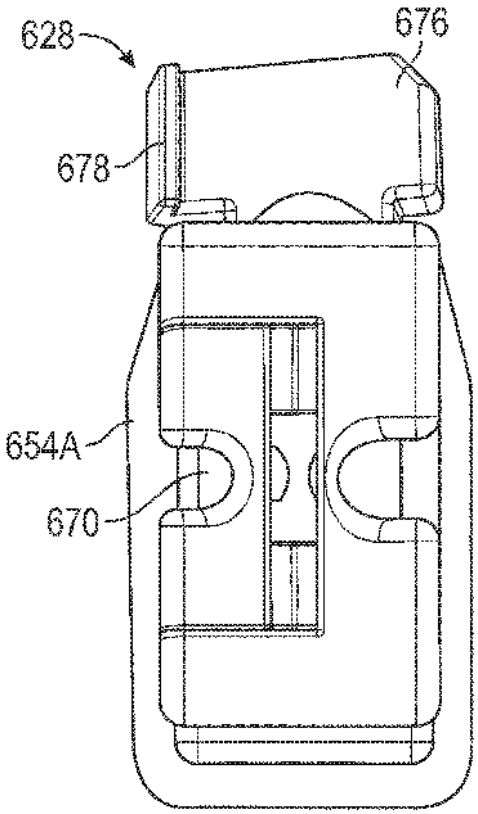


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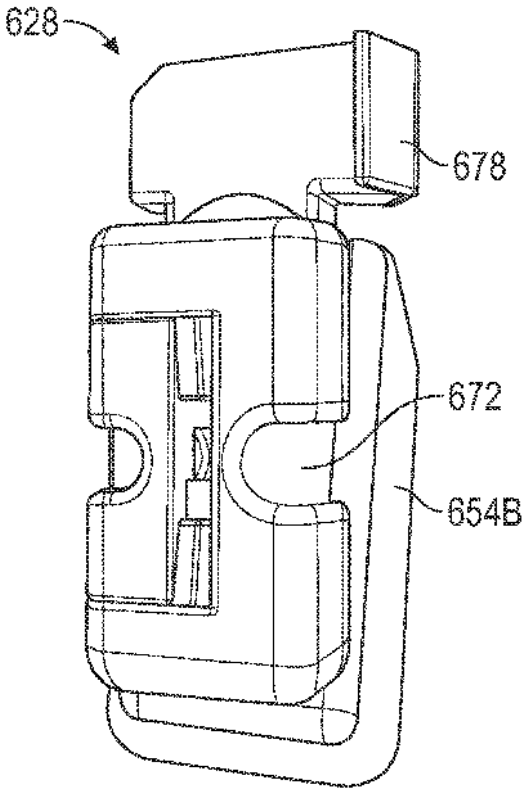


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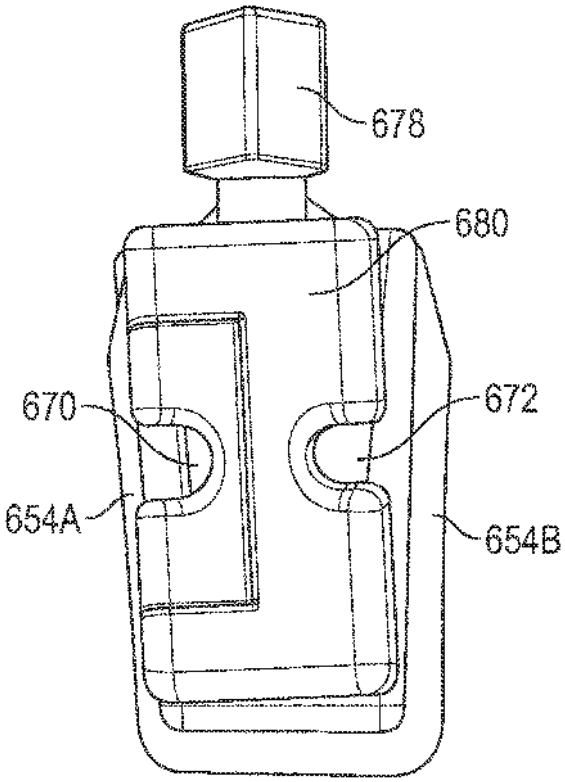


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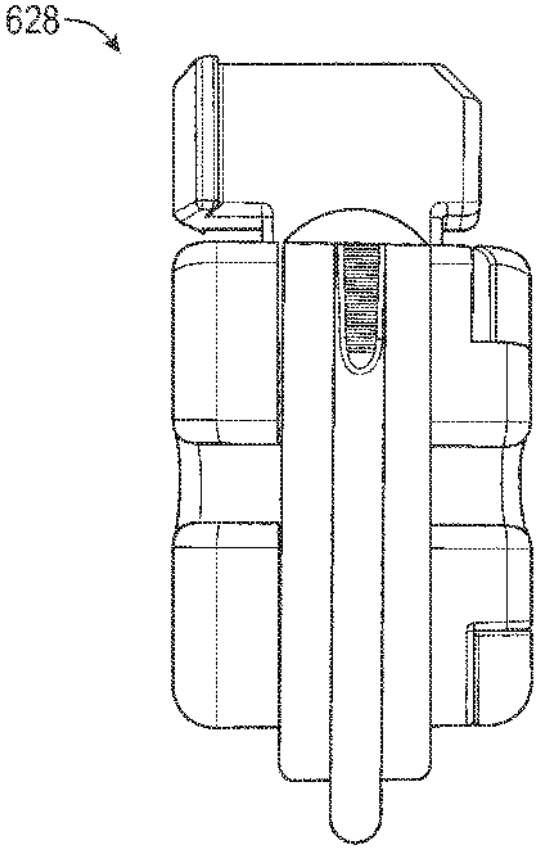


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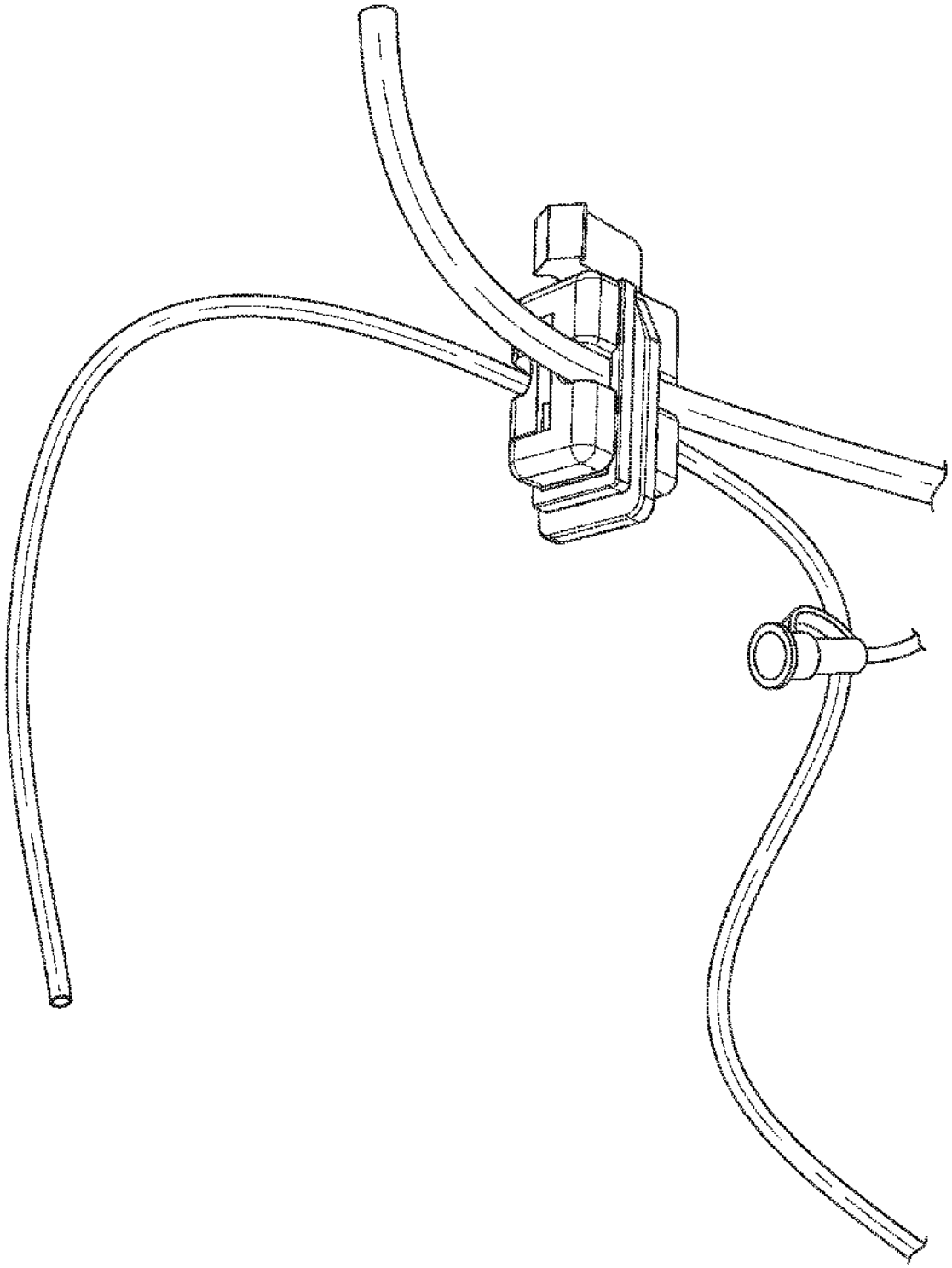


FIG. 19

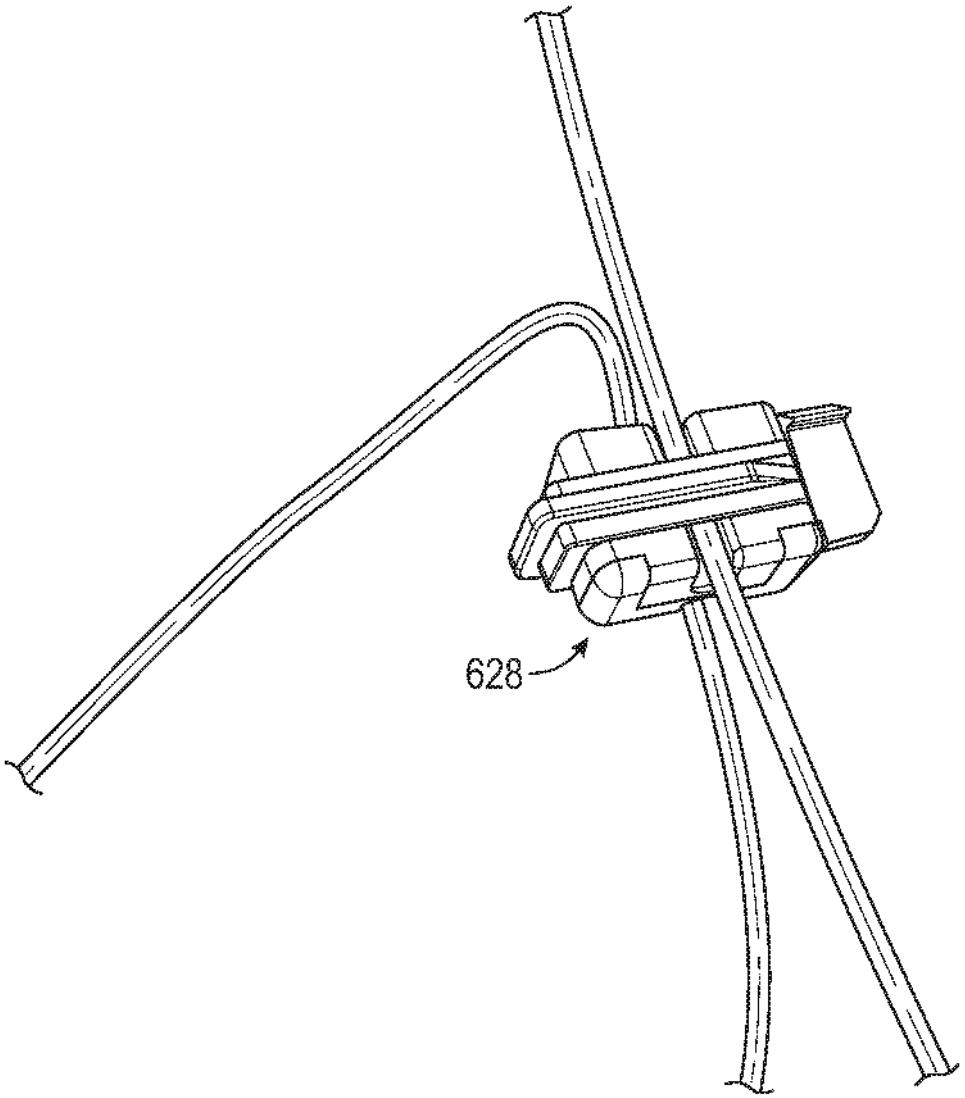



FIG. 20

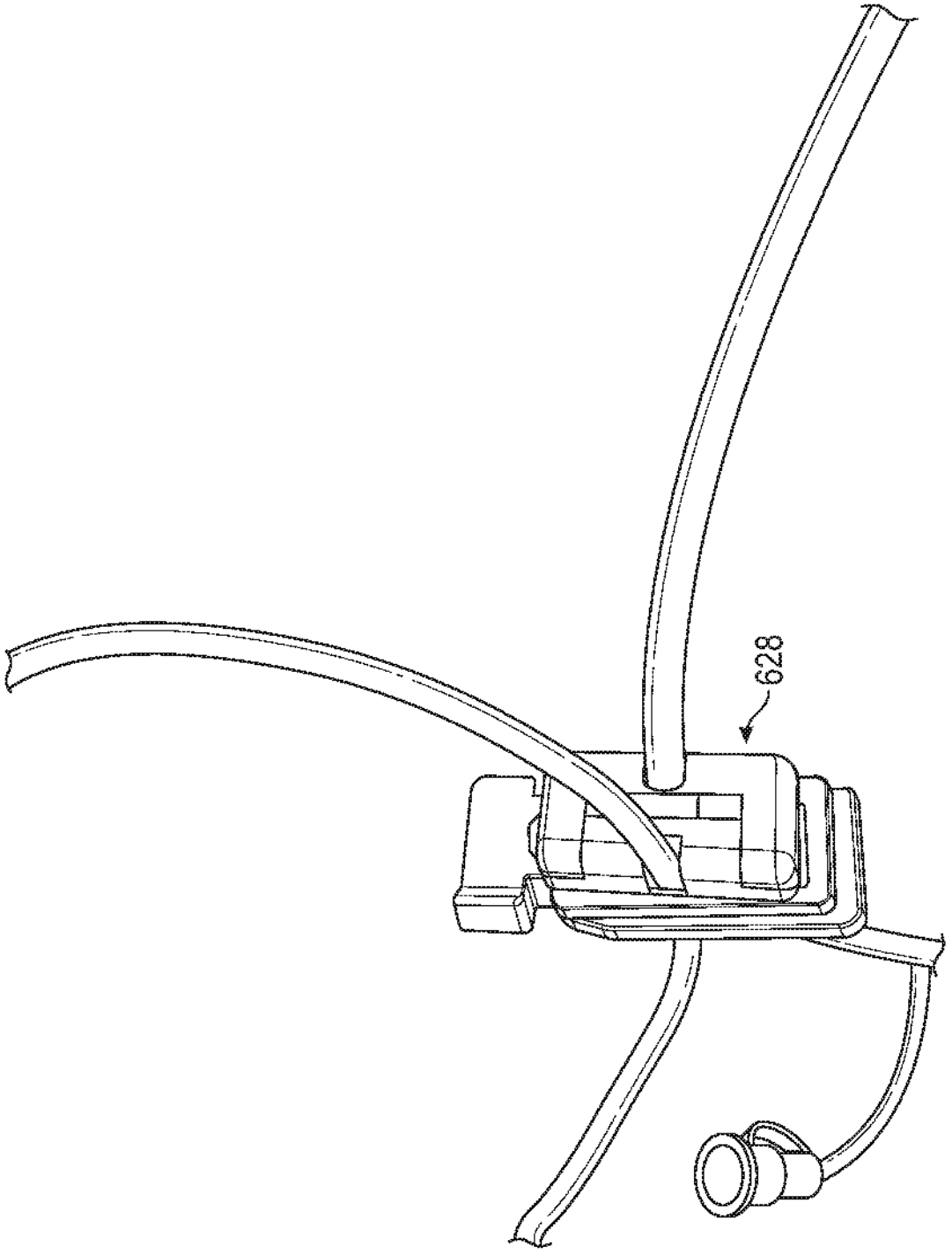
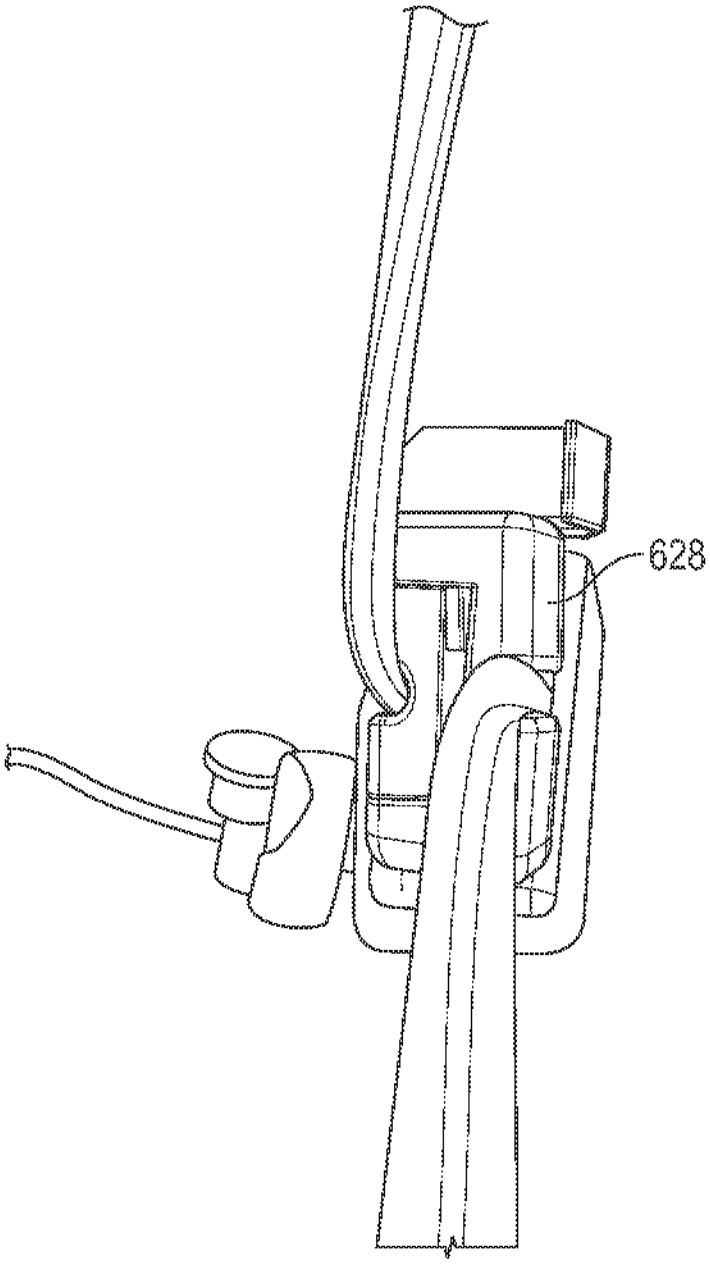



FIG. 21

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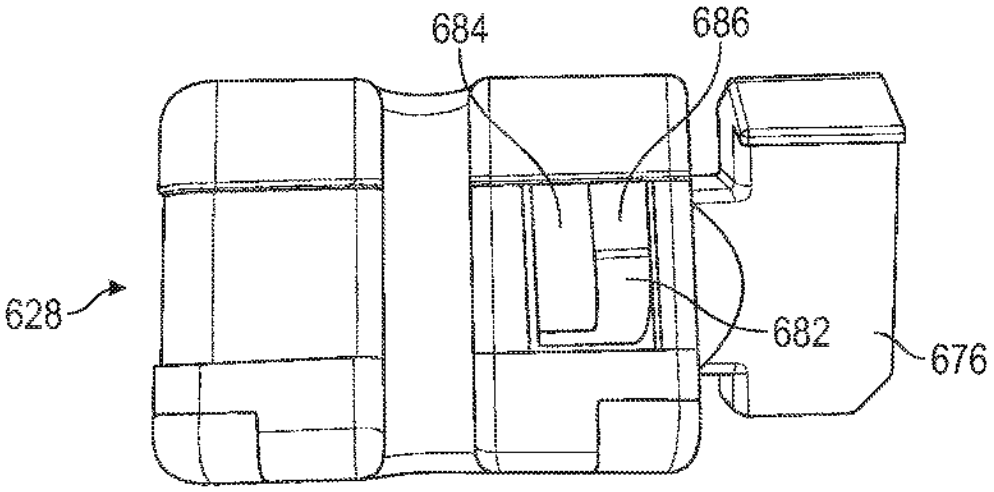


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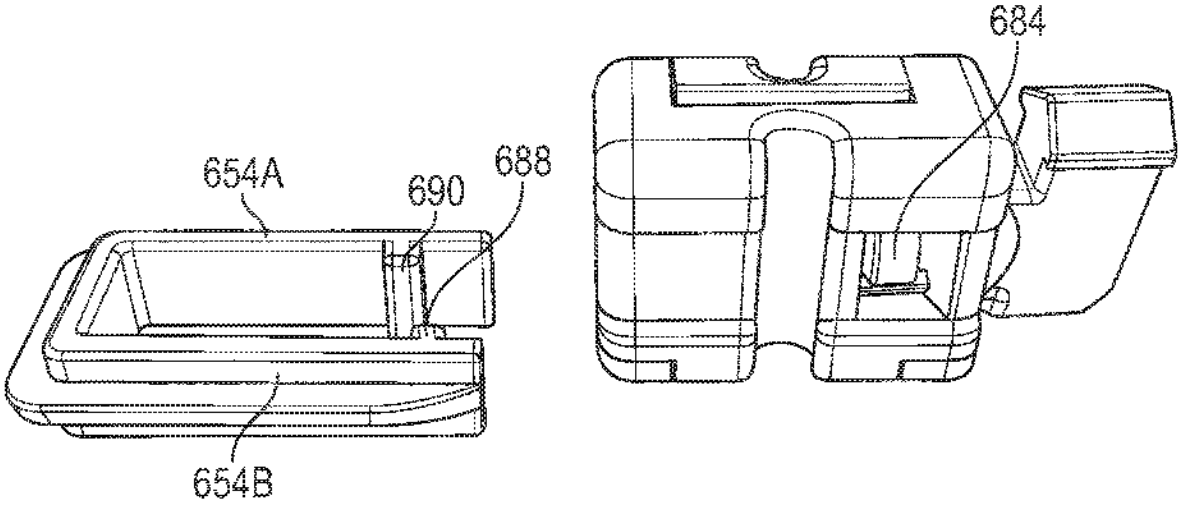


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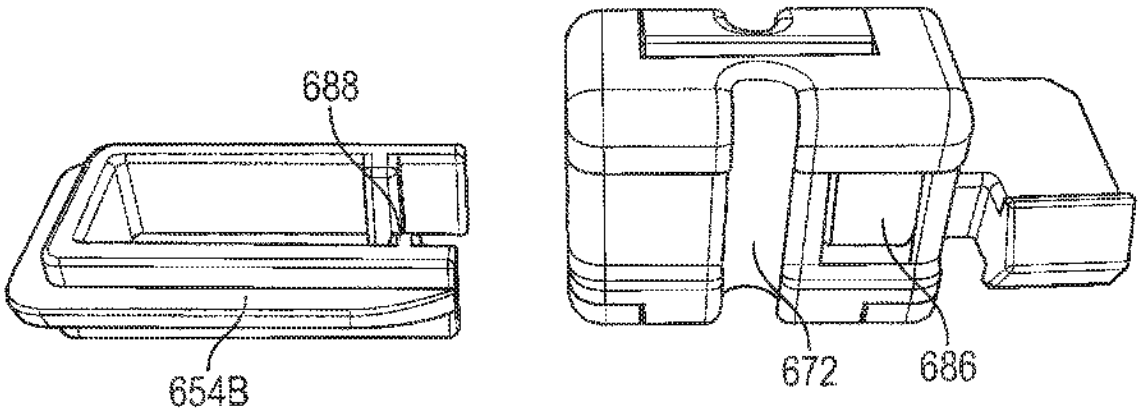



FIG. 25

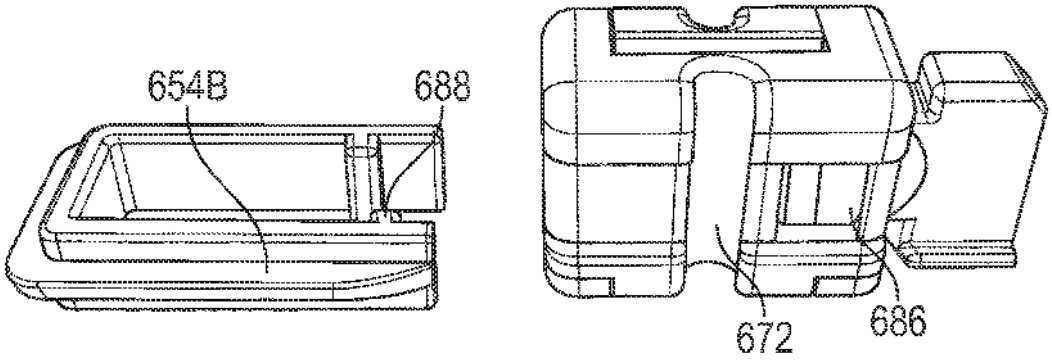
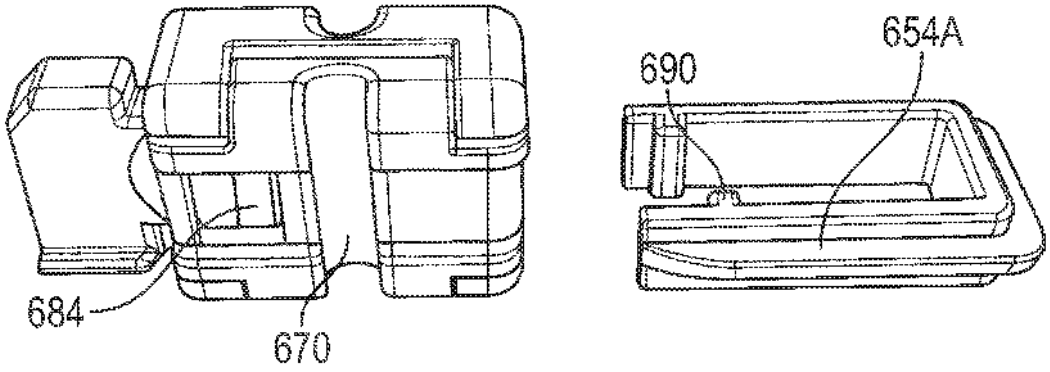



FIG. 26

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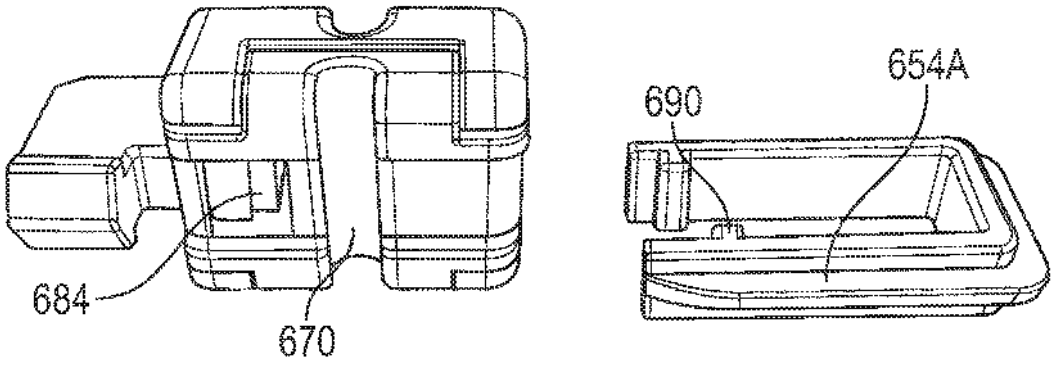
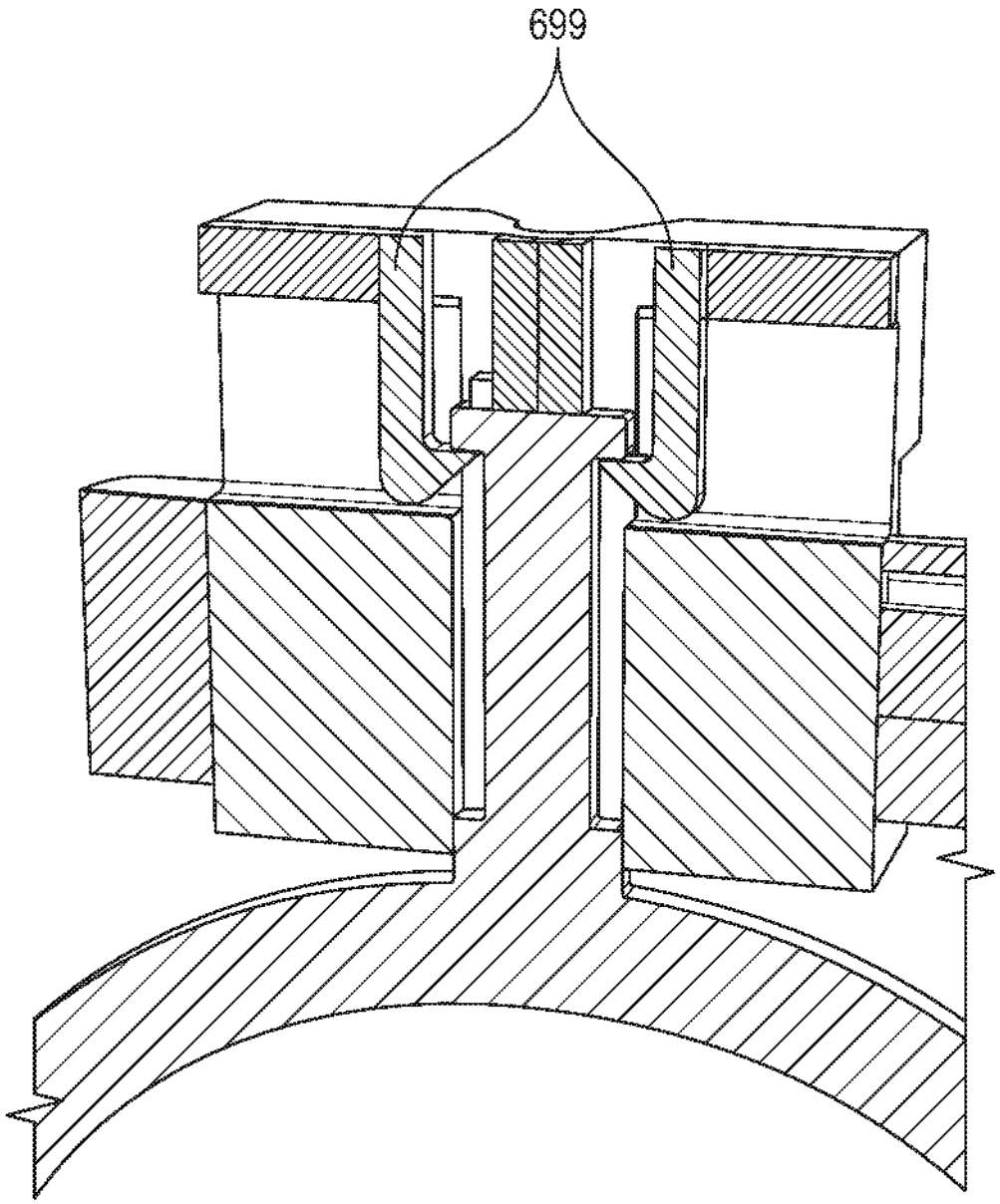



FIG. 28

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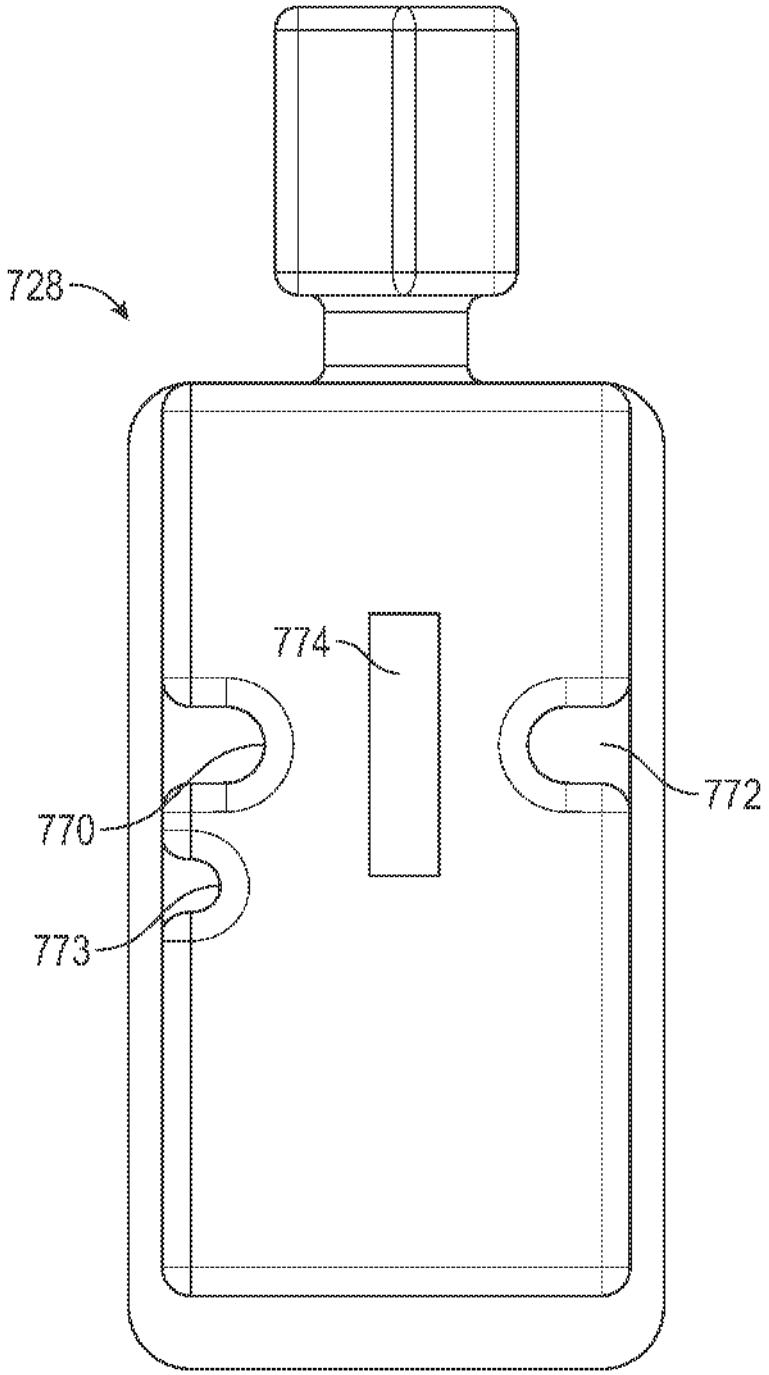


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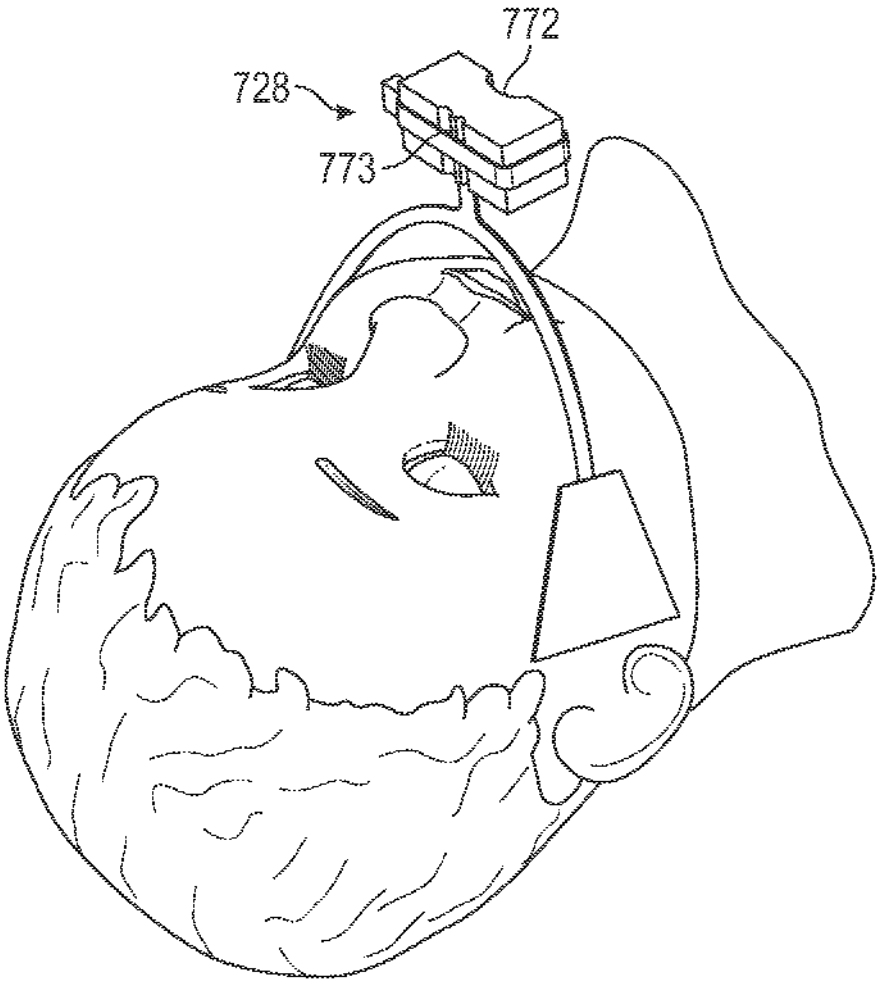


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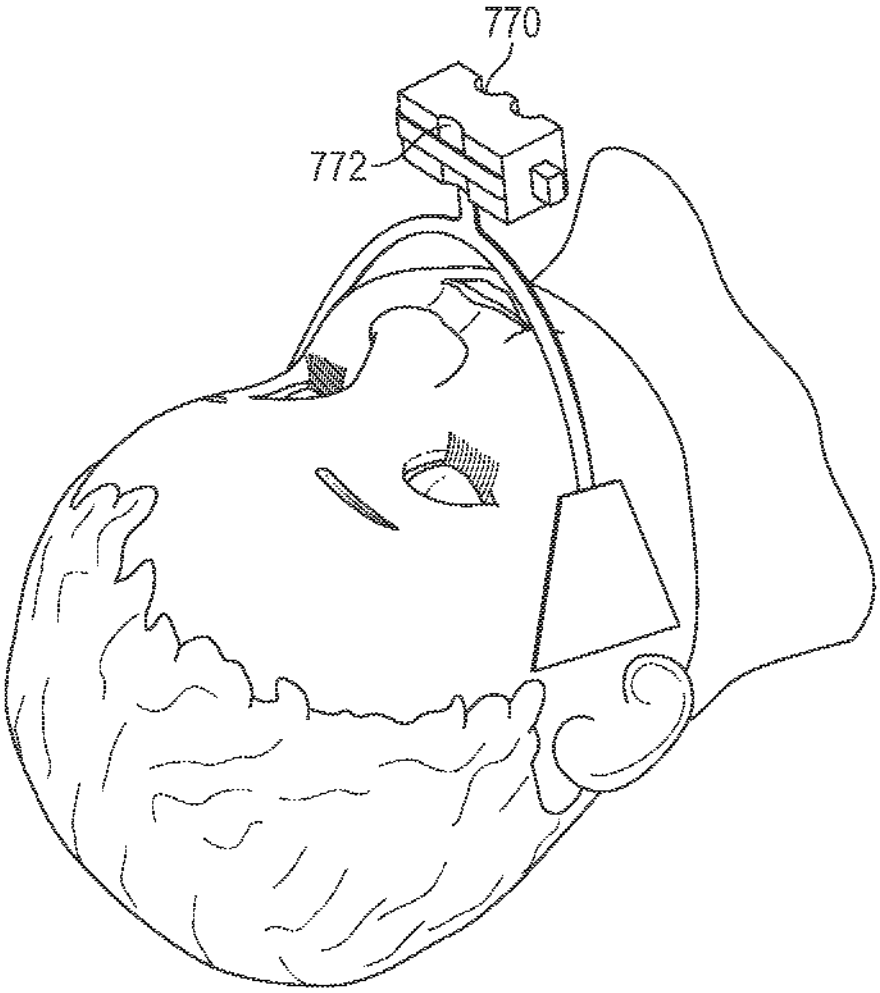


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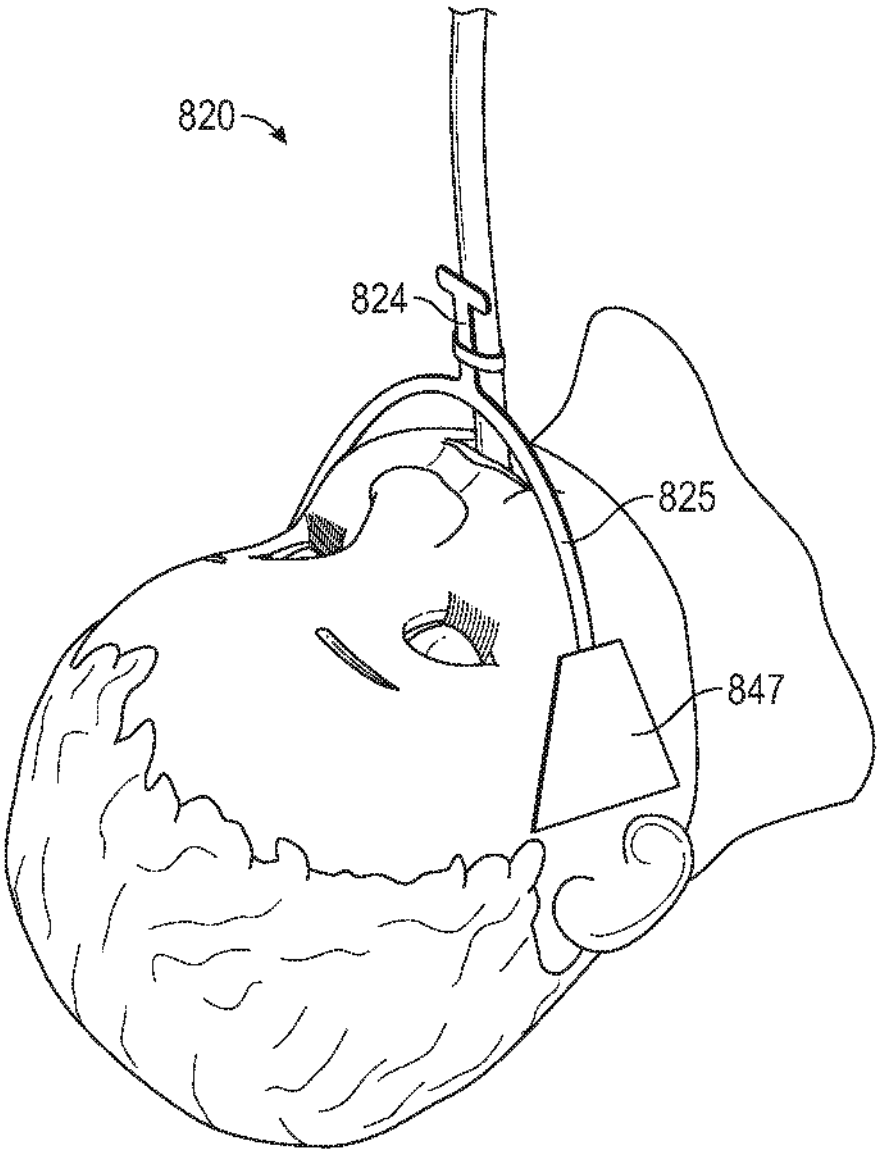



FIG. 33

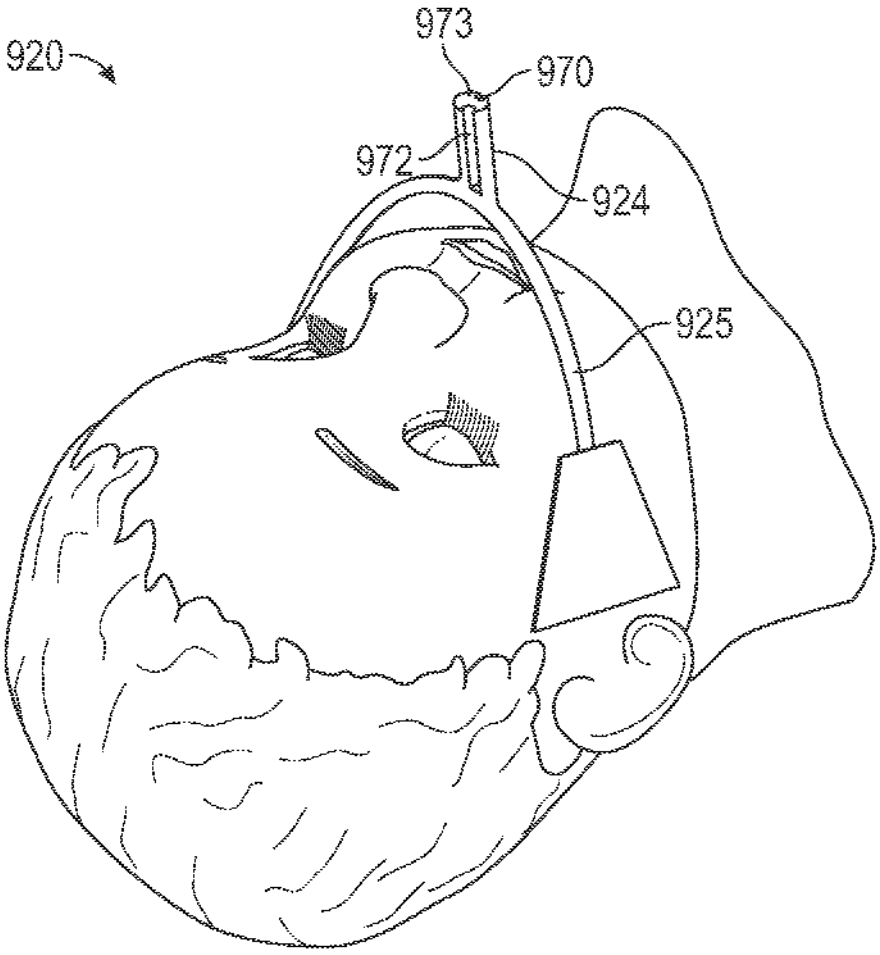
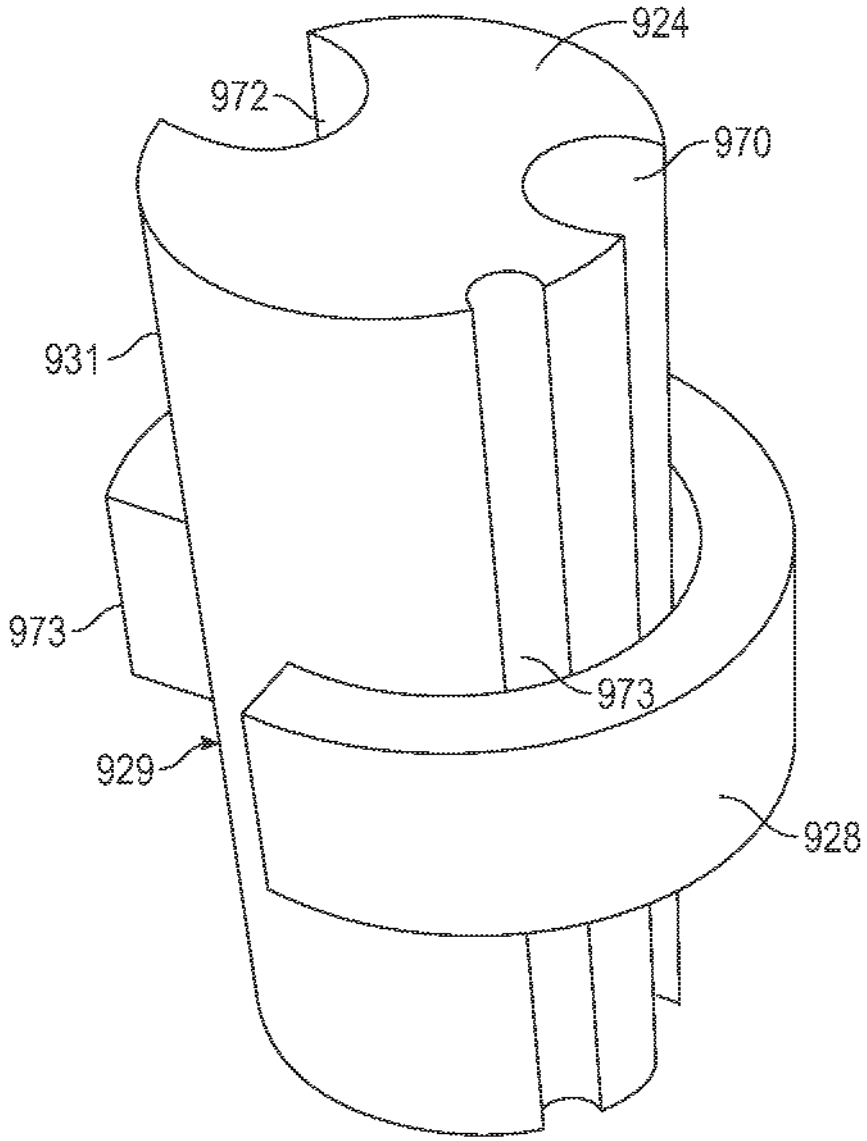



FIG. 34

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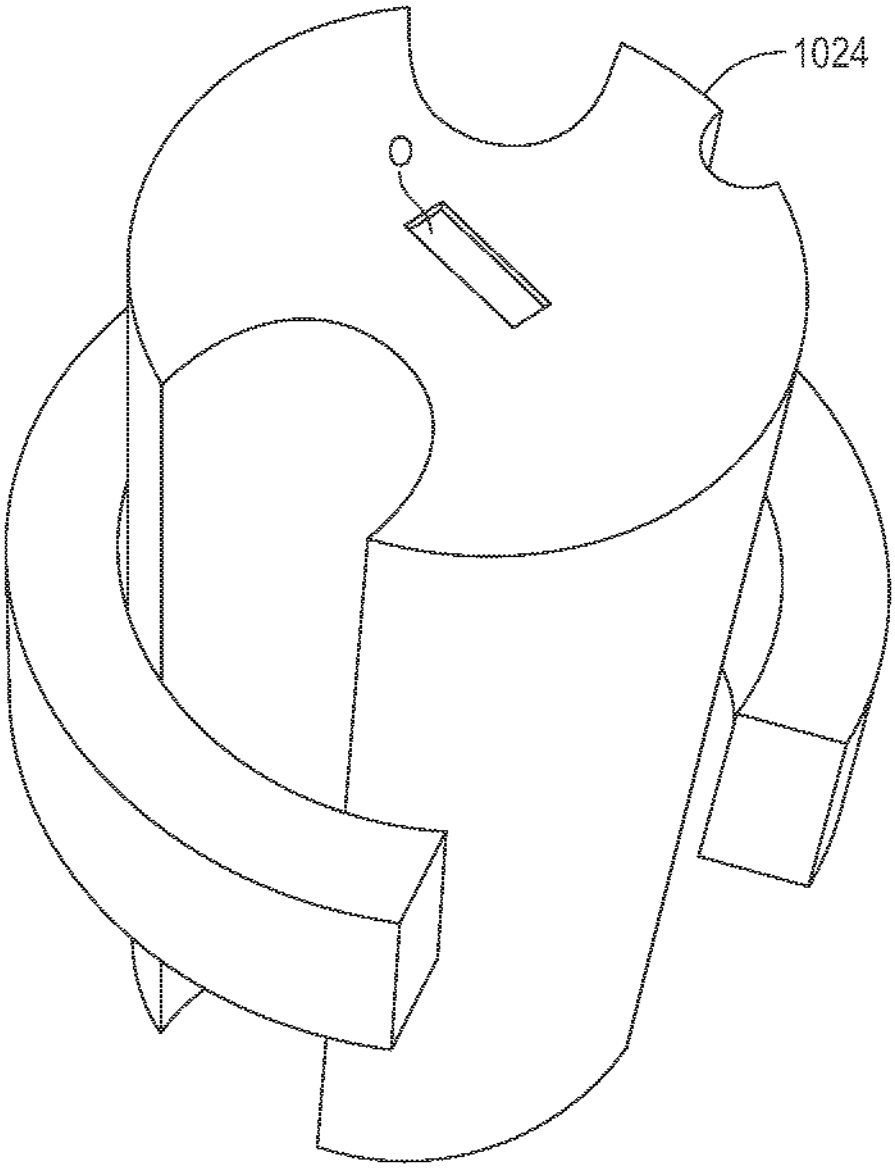


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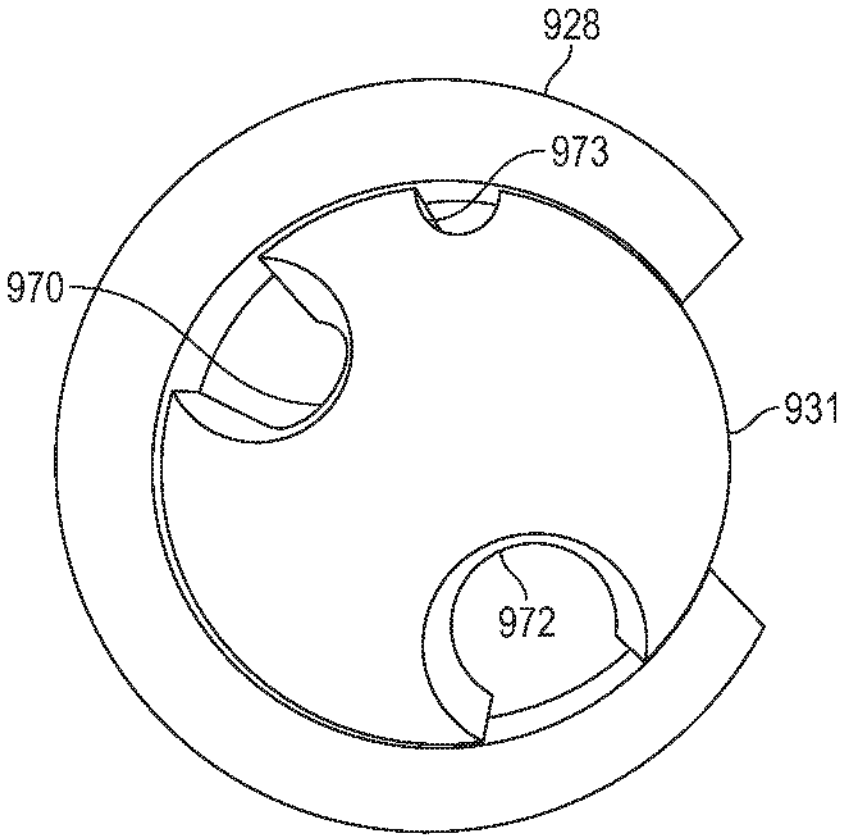


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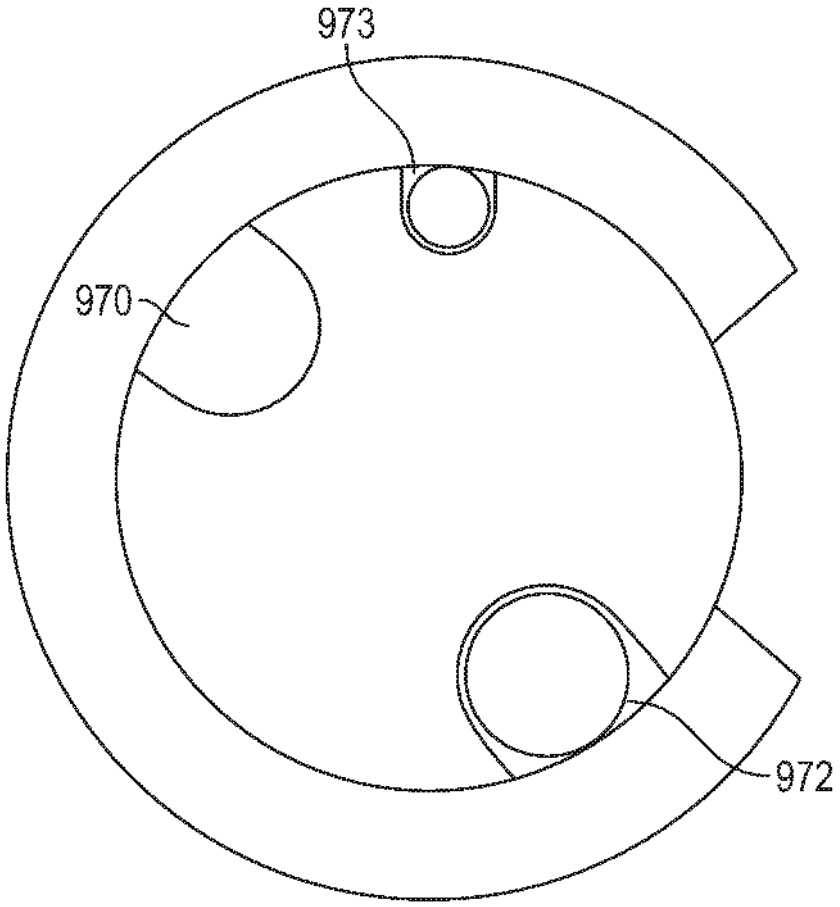
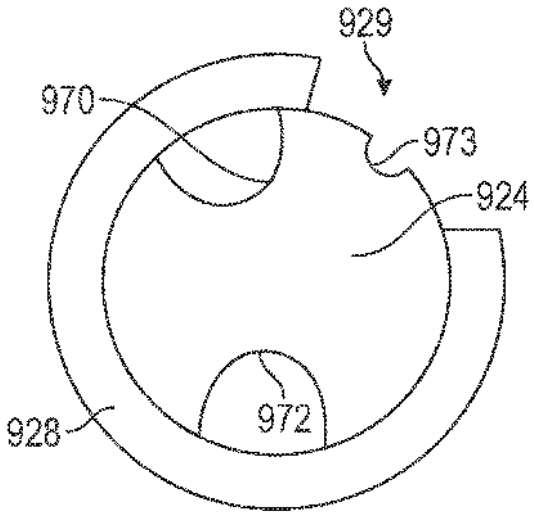



FIG. 38

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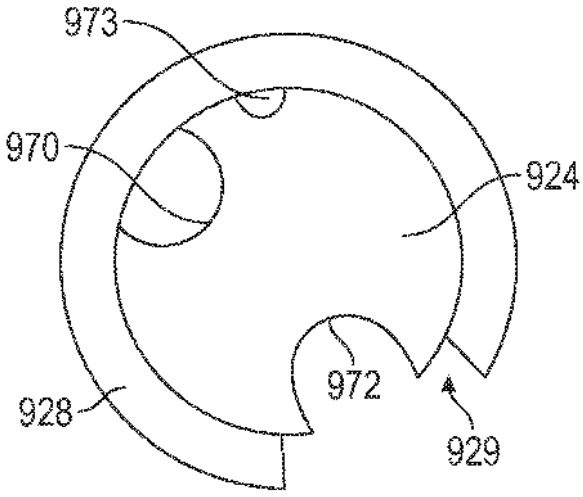


FIG. 40

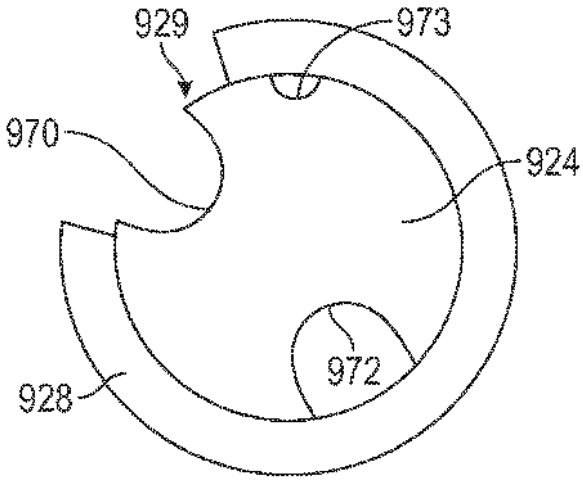


FIG. 41

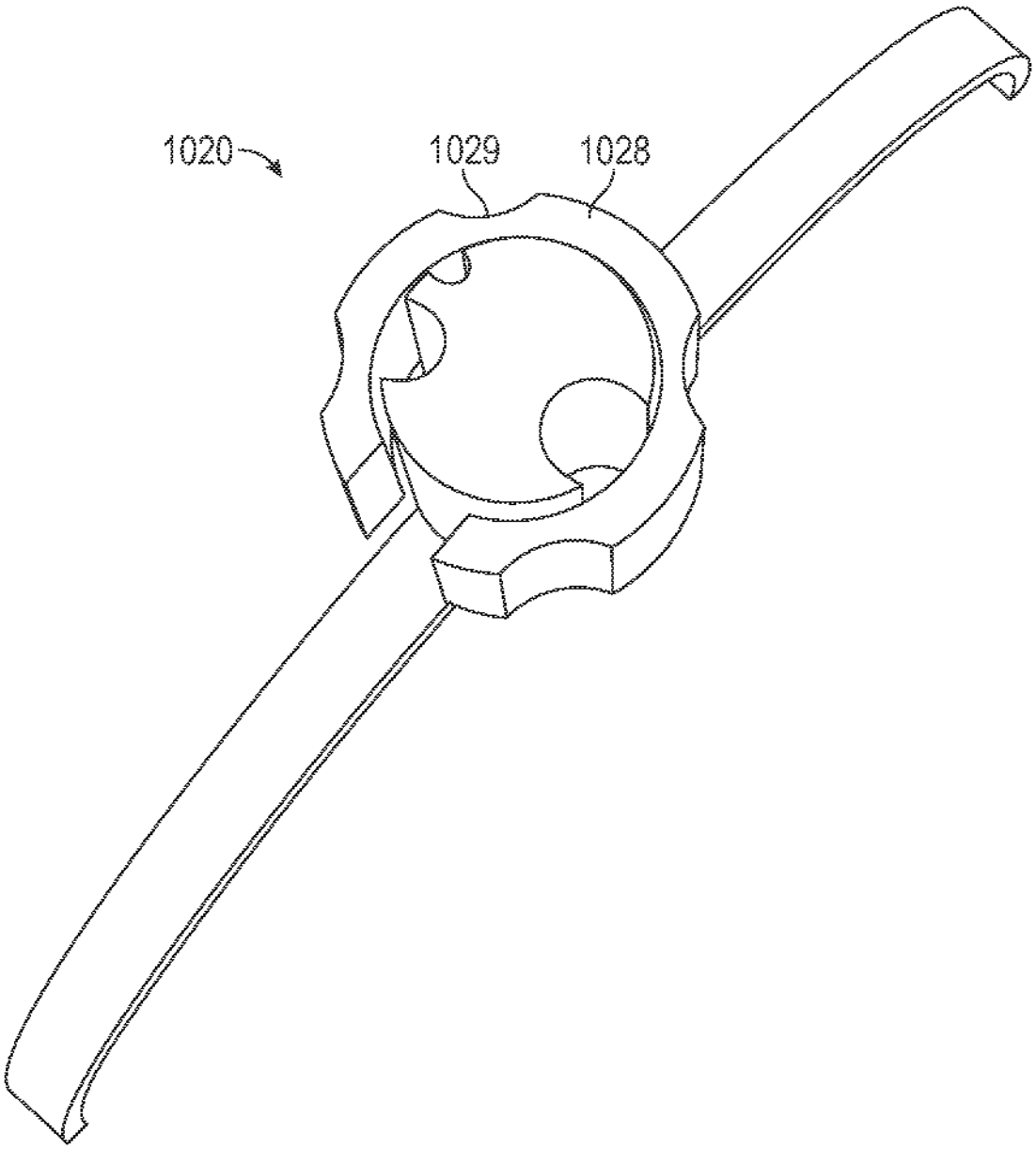


FIG. 42

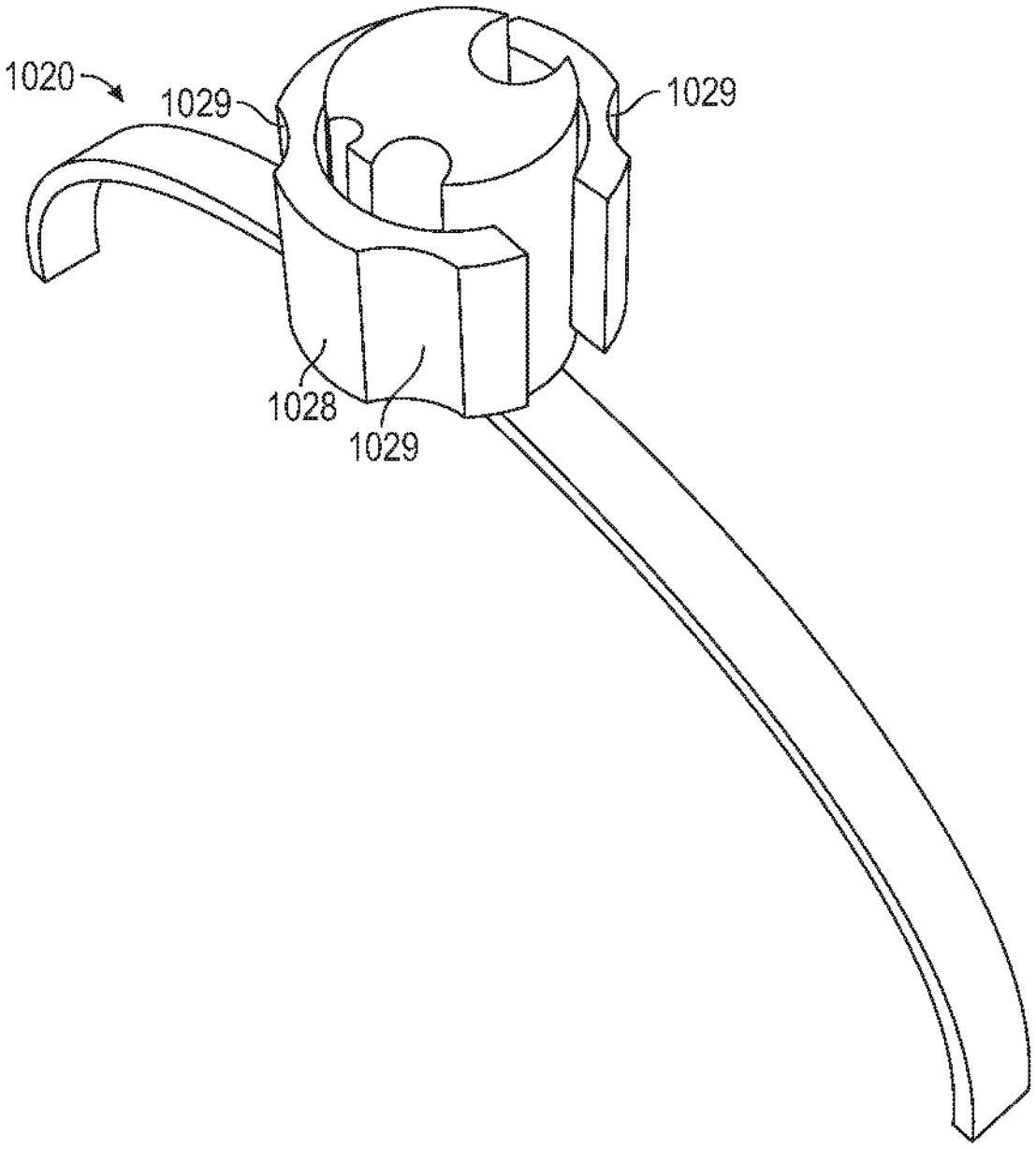


FIG. 43

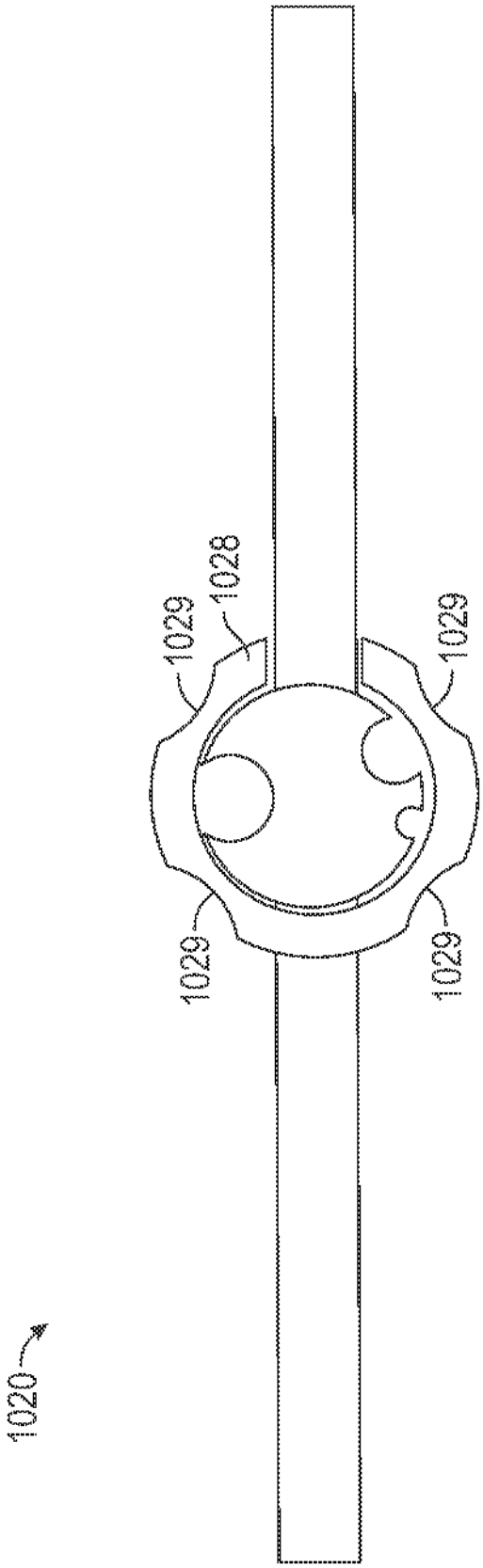


FIG. 44

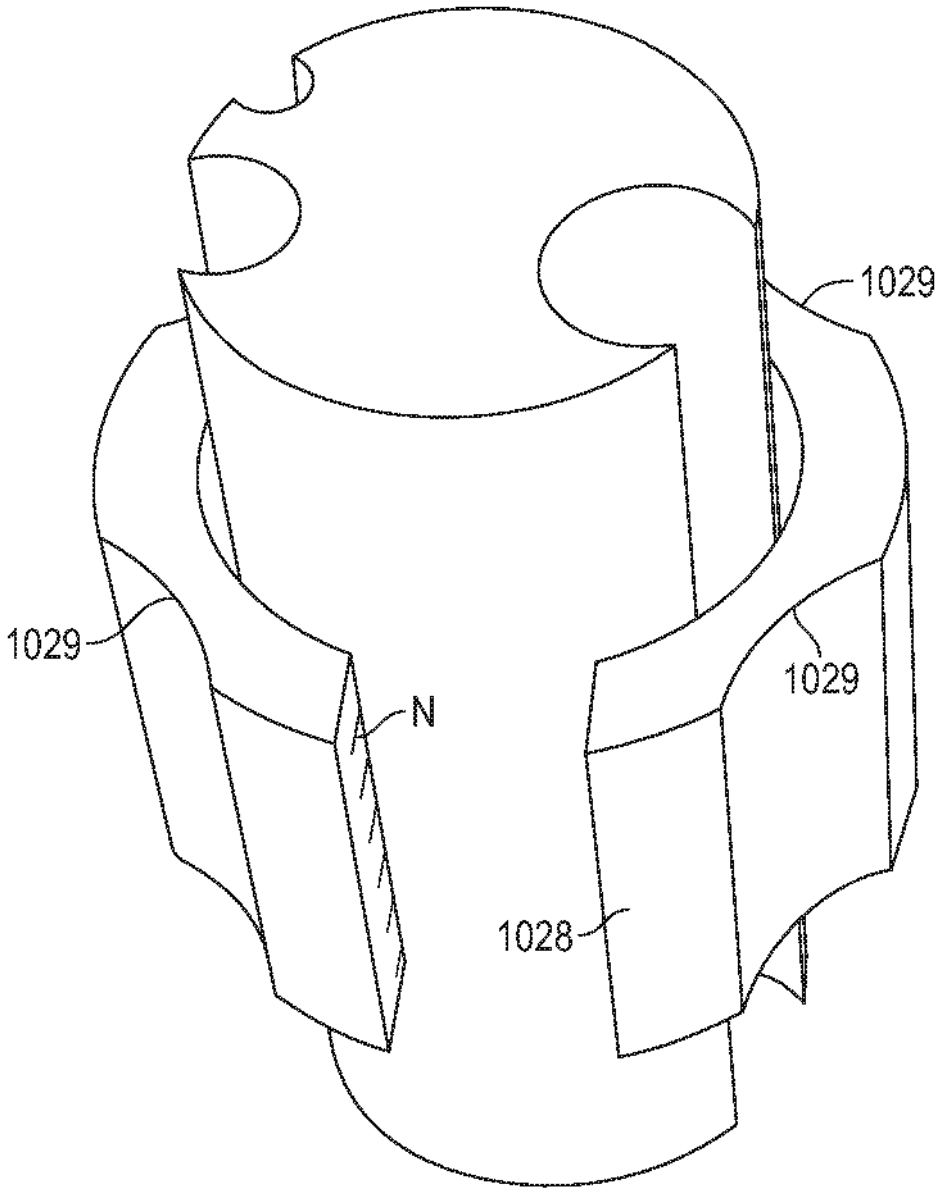


FIG. 45

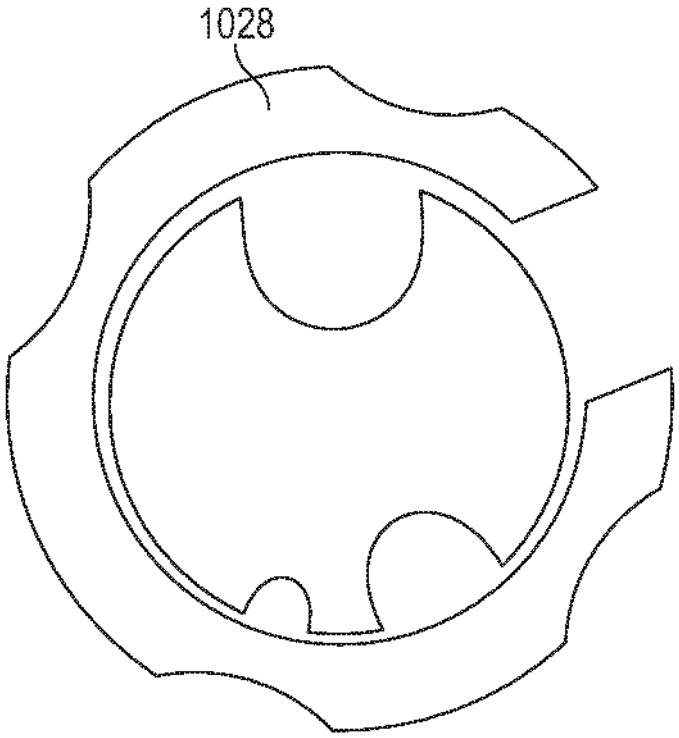


FIG. 46

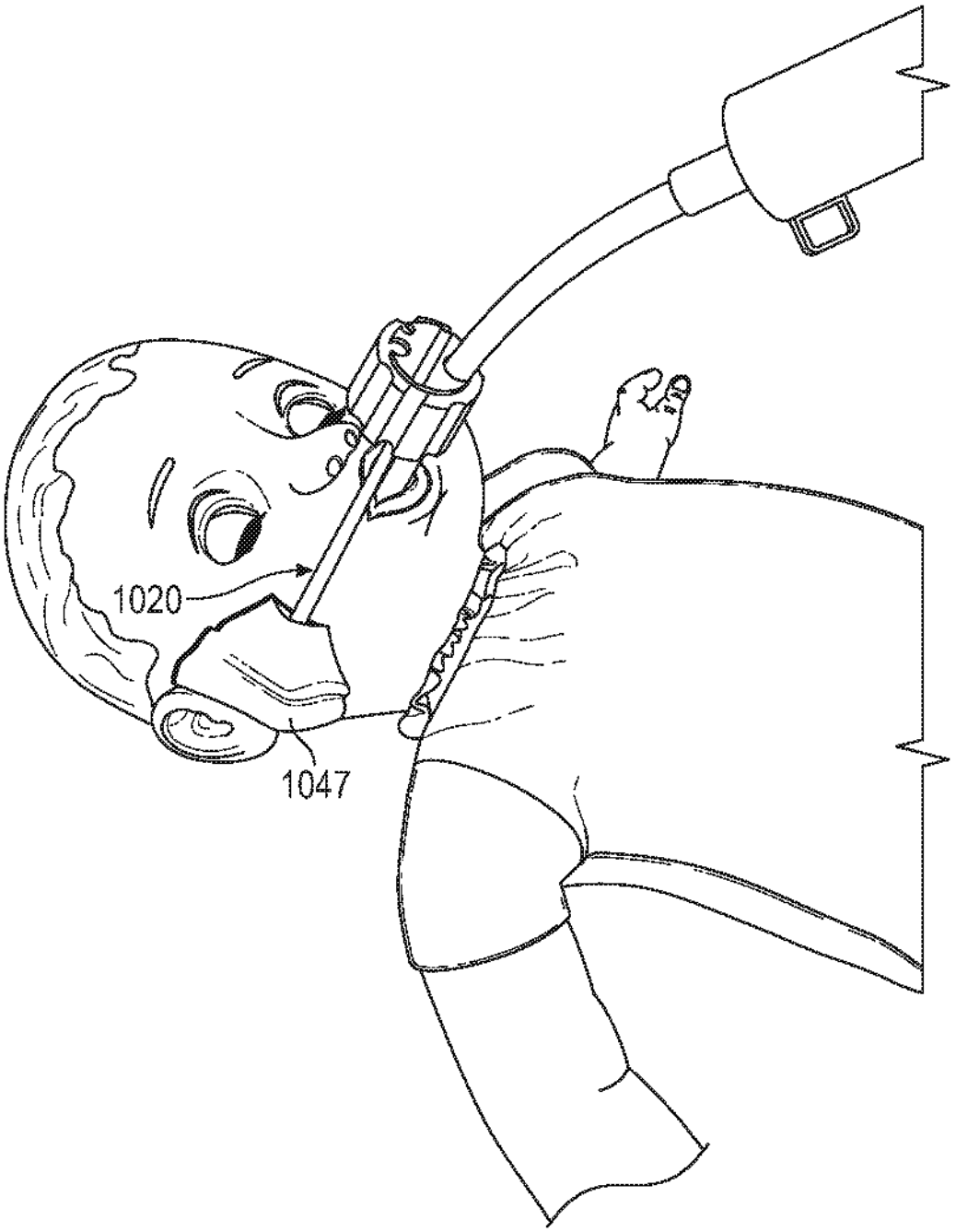


FIG. 47

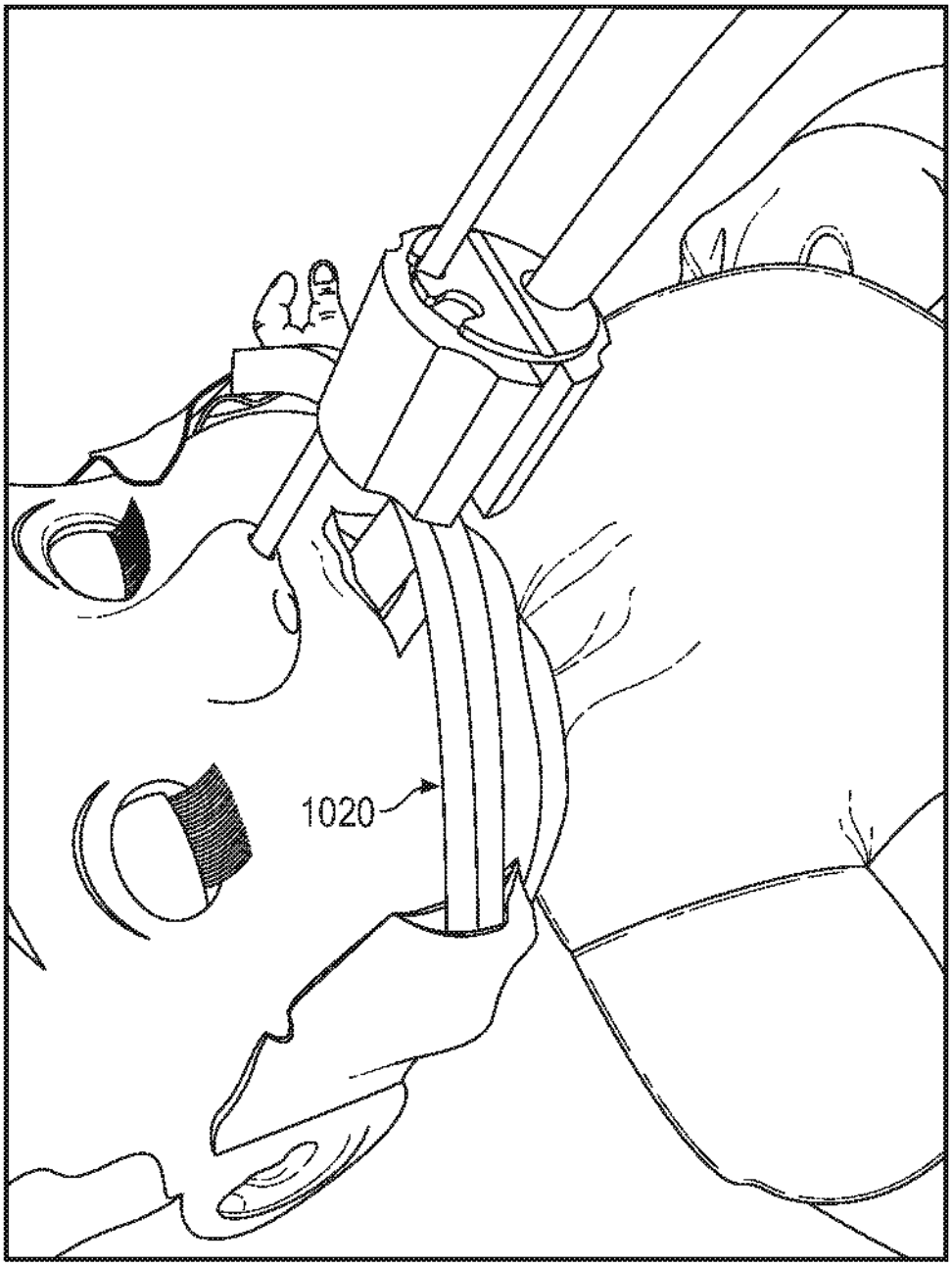


FIG. 48A

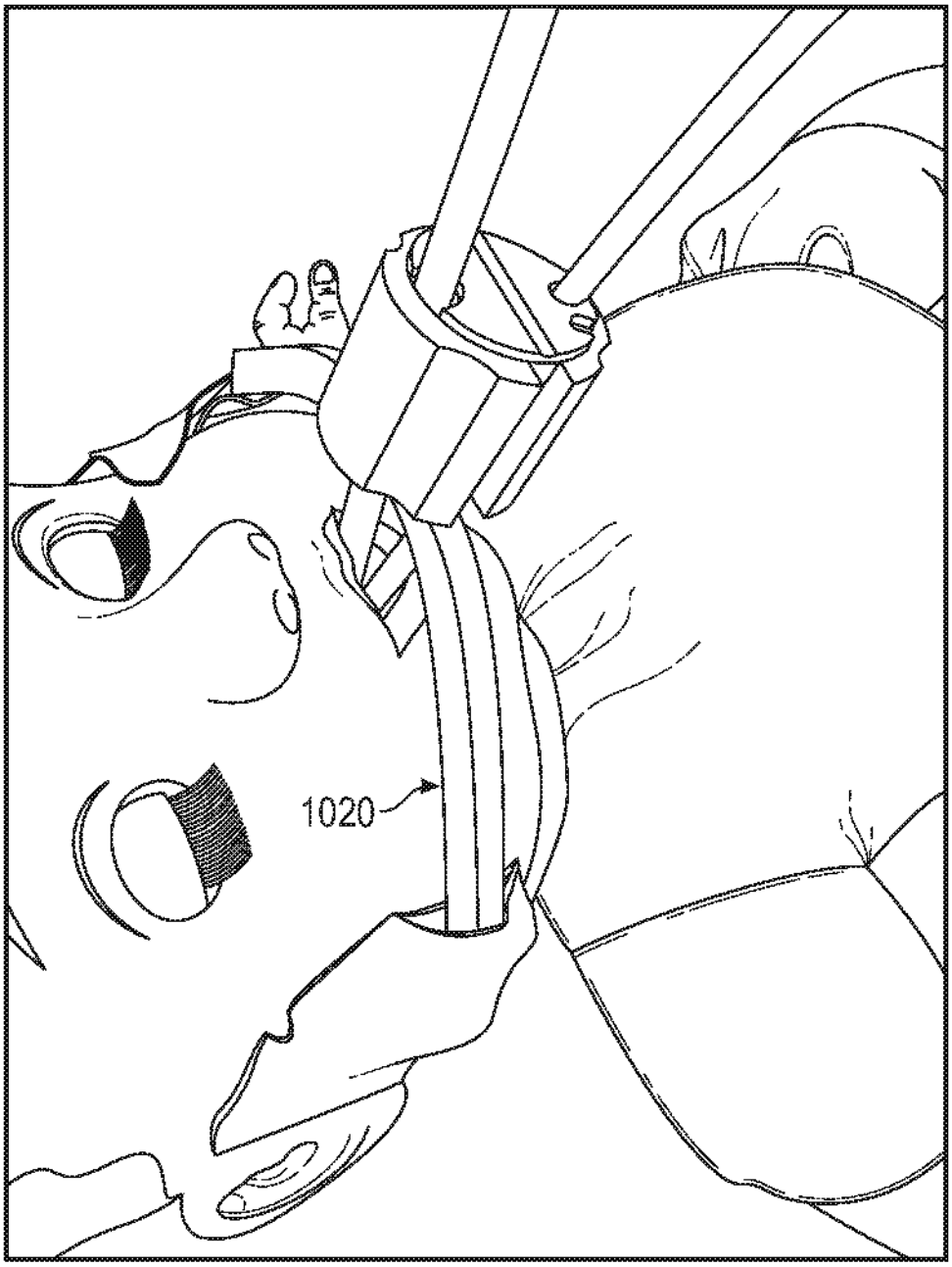


FIG. 48B

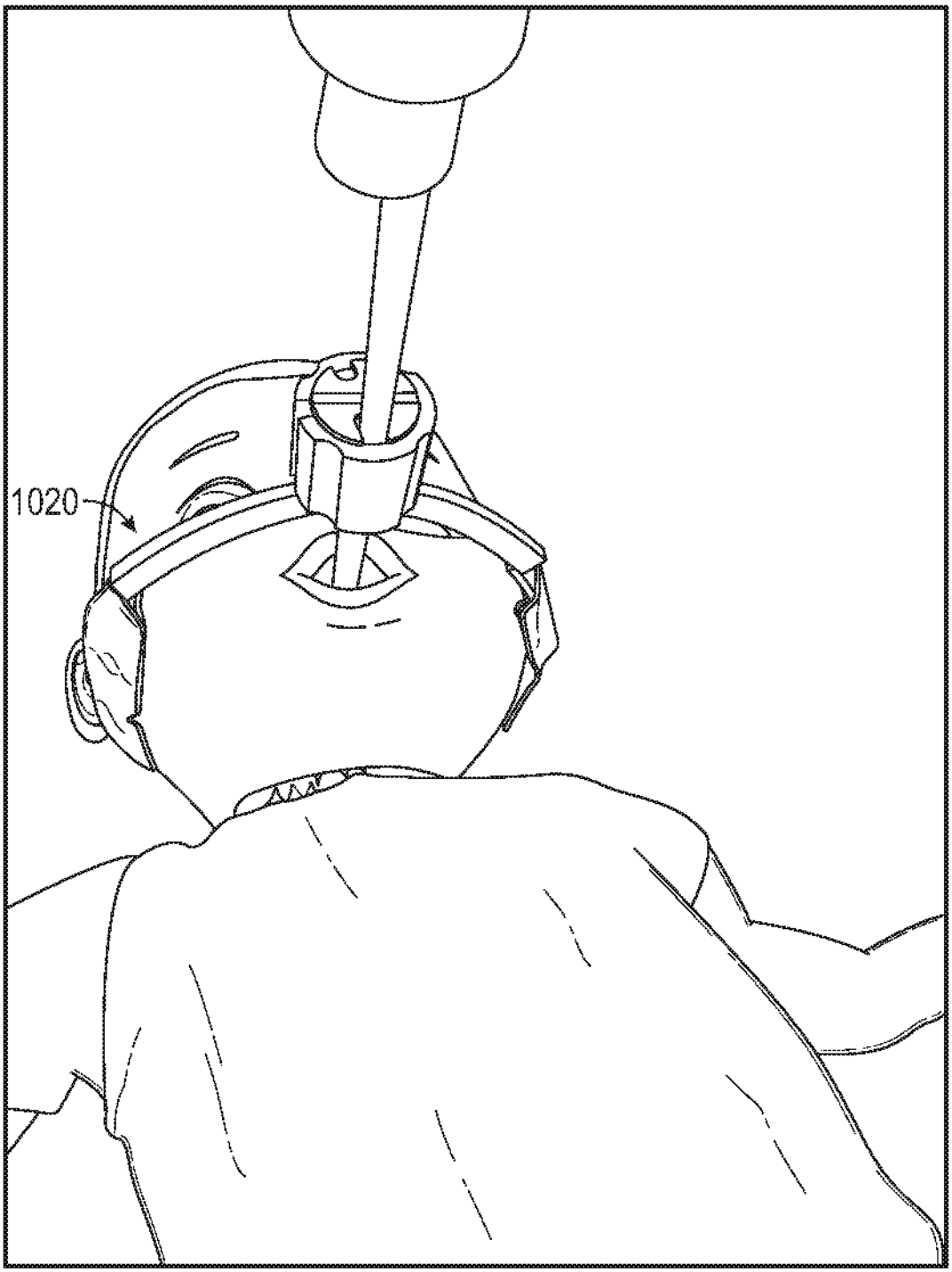


FIG. 49

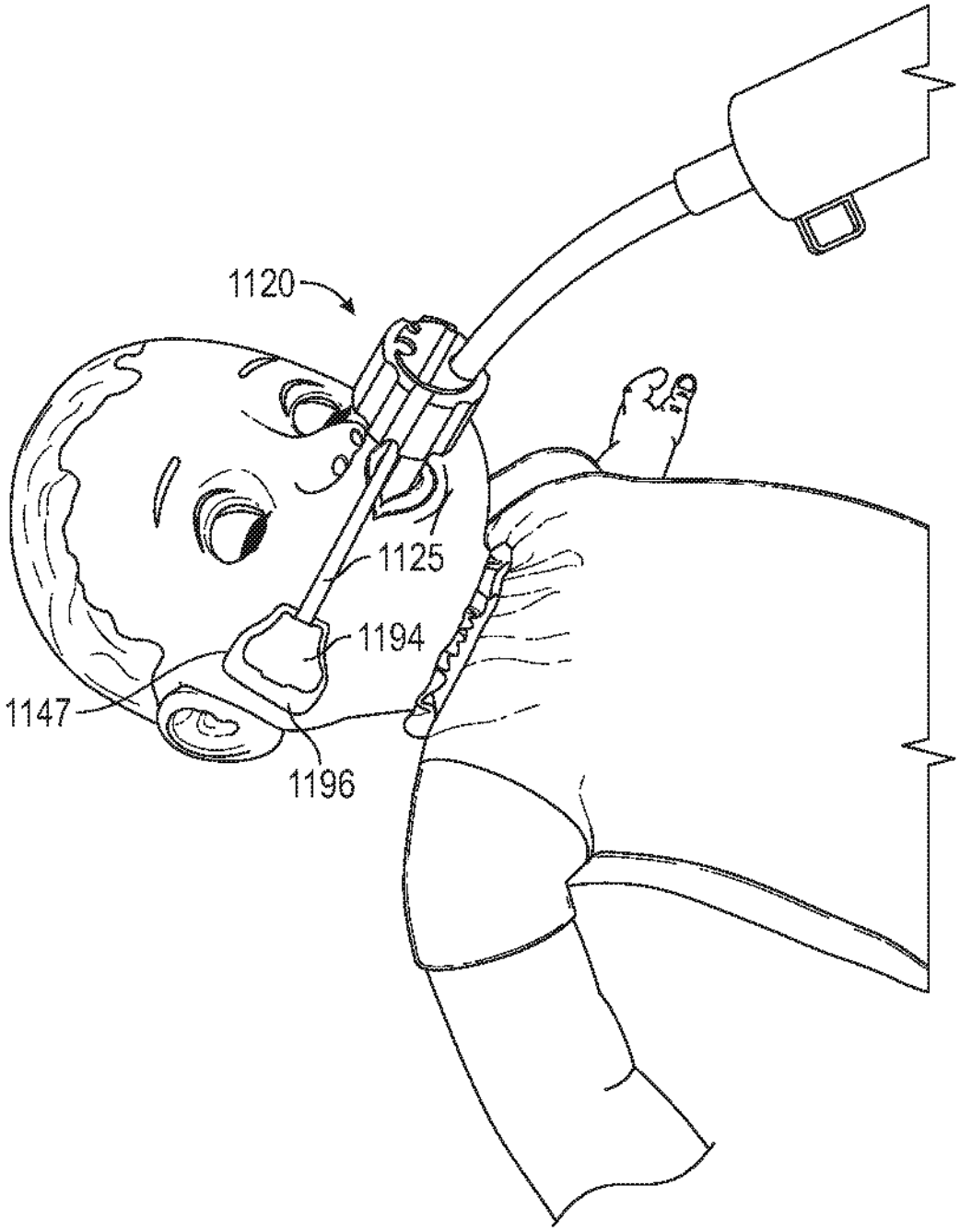


FIG. 50

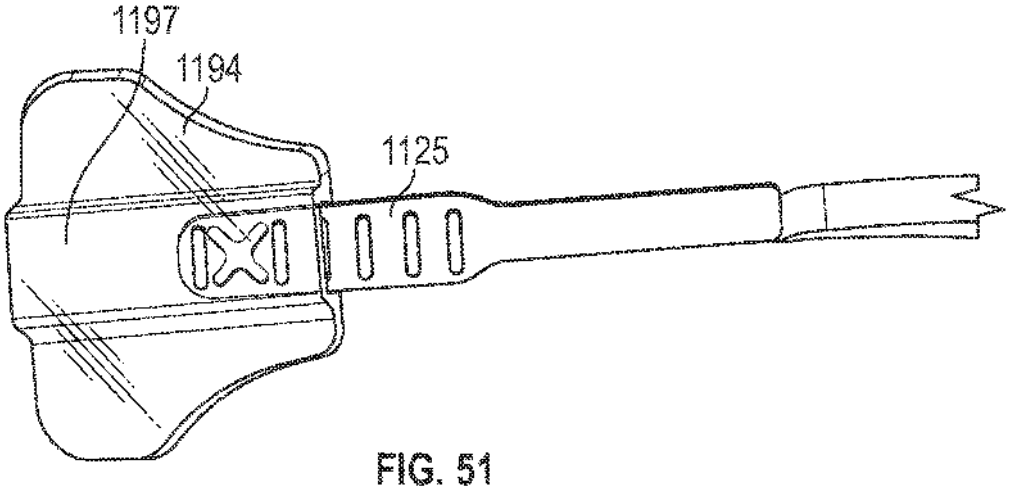


FIG. 51

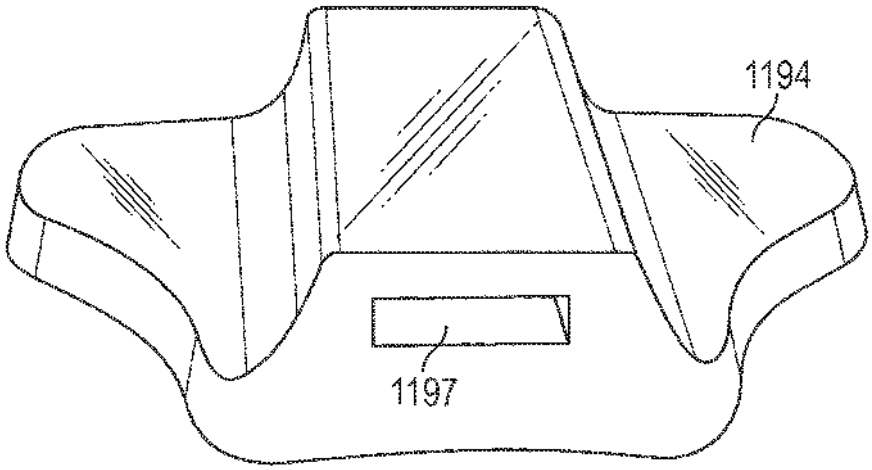


FIG. 52

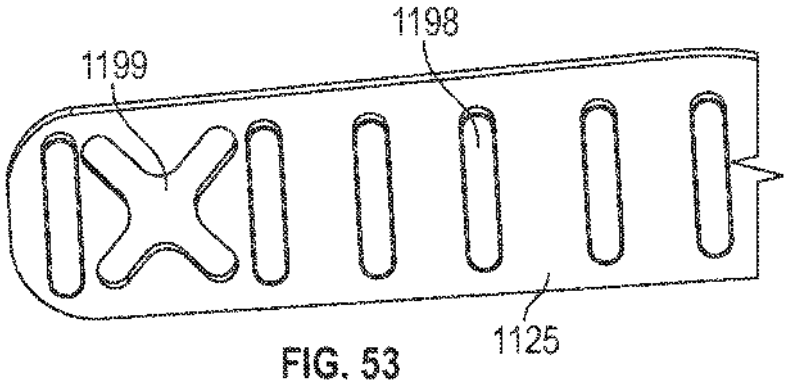


FIG. 53

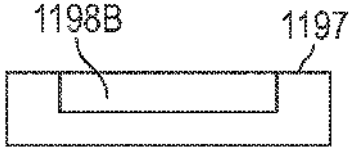


FIG. 54

# ENDOTRACHEAL TUBE APPARATUS AND METHODS

## CROSS-REFERENCED TO RELATED APPLICATION

This application claims priority to U.S. Provisional Application No. 62/227,306, which was filed on Jul. 29, 2021, and U.S. Provisional Application No. 62/293,485, which was filed on Dec. 23, 2021, and U.S. Provisional Application No. 63/304,253, which was filed on Jan. 28, 2022.

## BACKGROUND

Endotracheal intubation is a medical procedure in which a flexible tube is placed through the mouth or nose into the windpipe (trachea) to help a patient breathe. In some instances, endotracheal intubation is an emergency procedure that is performed on a patient who may be unconscious or who cannot breathe on their own.

Nasogastric tubes or orogastric tubes are small tubes placed either through the nose or the mouth and end with the tip in the stomach or the small intestines. Nasogastric tubes or orogastric tubes may be used for feedings, medication administration, or removal of contents from the stomach via aspiration, suction, or gravity drainage.

Gastric suction is a procedure to empty the contents of your stomach. Gastric suction is performed to empty the contents of the stomach before it passes through the rest of the digestive tract.

## SUMMARY

An endotracheal tube apparatus according to an example of this disclosure includes a brace for attachment to a patient's face, a support extending from the brace and including a groove for receiving an endotracheal tube. A clamp surrounds the support and the endotracheal tube. The clamp is comprised of a polymeric material.

In a further example of the foregoing, the clamp includes a plastic body.

In a further example of any of the foregoing, the clamp is generally C-shaped.

In a further example of any of the foregoing, the clamp includes an open circumferential portion.

In a further example of any of the foregoing, the support includes a second groove configured to receive a second tube.

In a further example of any of the foregoing, the second tube is a feeding tube or a gastric suction tube.

In a further example of any of the foregoing, the support includes a third groove. The first, second, and third grooves are sized differently, and the third groove is closer circumferentially to the second groove than the first groove.

In a further example of any of the foregoing, the open circumferential portion is sized such that it is received over a radially outer surface of the support when tubes are to be secured in the first and second groove.

In a further example of any of the foregoing, the open circumferential portion has an arc length greater than or equal to the arc length of the largest groove, and the open circumferential portion arc length is less than the arc length of at least one of the radially outer surfaces of the support.

In a further example of any of the foregoing, the first and second groove are positioned such that when the endotracheal tube is to be adjusted or replaced, the clamp can be rotated in a clockwise or counterclockwise direction so that the open circumferential portion is circumferentially aligned with the first groove, while the clamp secures the second tube in the second groove.

In a further example of any of the foregoing, the first and second groove are positioned such that when the second tube is to be adjusted or replaced, the clamp can be rotated in a clockwise or counterclockwise direction so that the open circumferential portion is circumferentially aligned with the second groove, while the clamp secures the endotracheal tube in the first groove.

A method of intubating a patient according to an example of this disclosure includes attaching a brace to the patient's face. The brace includes a support extending away from the patient's face. An endotracheal tube is clamped within a groove of the support with a clamp that surrounds the endotracheal tube and the support. The clamp is comprised of a polymeric material.

In a further example of the foregoing, the clamp is generally C-shaped.

In a further example of any of the foregoing, the clamp includes an open circumferential portion.

In a further example of any of the foregoing, the support includes a second groove, which is configured to receive a second tube. The second tube is a feeding tube or a gastric suction tube. The method further includes clamping the second tube within the second groove with the clamp.

In a further example of any of the foregoing, the open circumferential portion is sized such that it is received over a radially outer surface of the support when the endotracheal and second tubes are secured in the first and second groove

In a further example of any of the foregoing, the open circumferential portion has an arc length greater than the arc length of the largest groove.

In a further example of any of the foregoing, the open circumferential portion arc length is less than the arc length of at least one of the radially outer surfaces of the support.

In a further example of any of the foregoing, the method includes adjusting or replacing the endotracheal tube. The first and second groove are positioned such that when the endotracheal tube is to be adjusted or replaced, the adjusting or replacing includes rotating the clamp in a clockwise or counterclockwise direction so that the open circumferential portion is circumferentially aligned with the first groove, while the clamp secures the second tube in the second groove.

In a further example of any of the foregoing, the method includes adjusting or replacing the second tube. The first and second groove are positioned such that when the second tube is to be adjusted or replaced, the adjusting or replacing includes rotating the clamp in a clockwise or counterclockwise direction so that the open circumferential portion is circumferentially aligned with the second groove, while the clamp secures the endotracheal tube in the first groove.

These and other features may be best understood from the following specification and drawings, the following of which is a brief description.

## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** illustrates an example endotracheal tube support apparatus.

FIG. **2** illustrates an example clamp for an endotracheal tube support apparatus.

FIG. **3** illustrates the example clamp of FIG. **2** in an engaged position.

FIG. **4** illustrates another example clamp.

FIG. **5** illustrates yet another example clamp.

FIG. **6** illustrates another example endotracheal tube support apparatus.

FIG. **7** illustrates another example endotracheal tube support apparatus.

FIG. **8** illustrates the example endotracheal tube support apparatus of FIG. **7**.

FIG. **9** illustrates the example endotracheal tube support apparatus of FIGS. **7** and **8** in an engaged position.

FIG. **10** illustrates the example endotracheal tube support apparatus of FIGS. **7**-**10** at an opposite side of that shown in FIGS. **8** and **9**.

FIG. **11** illustrates the example endotracheal tube support apparatus of FIGS. **7**-**10** in an engaged position and at an opposite side of that shown in FIGS. **8** and **9**.

FIG. **12** illustrates a top view of the example endotracheal tube support apparatus of FIGS. **7**-**11**.

FIG. **13** illustrates the example endotracheal tube support apparatus of FIGS. **7**-**12** supporting a nasogastric feeding tube.

FIG. **14** illustrates a bottom view of another example clamp.

FIG. **15** illustrates the example clamp of FIG. **14** in a first disengaged position.

FIG. **16** illustrates the example clamp of FIGS. **14** and **15** in a second disengaged position.

FIG. **17** illustrates the example clamp of FIGS. **14**-**16** in a third disengaged position.

FIG. **18** illustrates a side view of the example clamp of FIGS. **14**-**17**.

FIG. **19** illustrates the example clamp of FIGS. **14**-**18** receiving tubes.

FIG. **20** illustrates the example clamp of FIGS. **14**-**19** receiving tubes.

FIG. **21** illustrates the example clamp of FIGS. **14**-**20** receiving tubes.

FIG. **22** illustrates the example clamp of FIGS. **14**-**21** receiving tubes.

FIG. **23** illustrates the example clamp of FIGS. **14**-**22** with the bars removed.

FIG. **24** illustrates the example clamp of FIGS. **14**-**23** in the engaged position and with the bars removed.

FIG. **25** illustrates the example clamp of FIGS. **14**-**24** in the second disengaged position and with the bars removed.

FIG. **26** illustrates the example clamp of FIGS. **14**-**25** in the third disengaged position and with the bars removed.

FIG. **27** illustrates the example clamp of FIGS. **14**-**26** in the third disengaged position and with the bars removed.

FIG. **28** illustrates the example clamp of FIGS. **14**-**27** in the first disengaged position and with the bars removed.

FIG. **29** illustrates internal spring hook engagement of the example clamp of FIGS. **14**-**28**.

FIG. **30** illustrates another example clamp.

FIG. **31** illustrates the example of FIG. **30** received on a brace on a patient.

FIG. **32** illustrates the example of FIGS. **30** and **31** received on a brace on a patient and in a different orientation than that shown in FIG. **31**.

FIG. **33** illustrates another example endotracheal tube support apparatus.

FIG. **34** illustrates another example endotracheal tube support apparatus.

FIG. **35** illustrates the support and clamp of the example endotracheal tube support apparatus of FIG. **34**.

FIG. **36** illustrates the support and clamp of the example endotracheal tube support apparatus of FIGS. **34** and **35**.

FIG. **37** illustrates a top view of the support and clamp of the example endotracheal tube support apparatus of FIGS. **34**-**36**.

FIG. **38** illustrates a top view of the support and clamp of the example endotracheal tube support apparatus of FIGS. **34**-**37** with tubes secured in two of the grooves.

FIG. **39** illustrates a first disengaged position of the clamp and support of the example endotracheal tube support apparatus of FIGS. **34**-**38**.

FIG. **40** illustrates a second disengaged position of the clamp and support of the example endotracheal tube support apparatus of FIGS. **34**-**39**.

FIG. **41** illustrates a third disengaged position of the clamp and support of the example endotracheal tube support apparatus of FIGS. **34**-**40**.

FIG. **42** illustrates another example endotracheal tube support apparatus.

FIG. **43** illustrates the example endotracheal tube support apparatus of FIG. **42**.

FIG. **44** illustrates the example endotracheal tube support apparatus of FIGS. **42**-**43**.

FIG. **45** illustrates the support and clamp of the example endotracheal tube support apparatus of FIGS. **42**-**44**.

FIG. **46** illustrates the support and clamp of the example endotracheal tube support apparatus of FIGS. **42**-**44**.

FIG. **47** illustrates the example endotracheal tube support apparatus of FIGS. **42**-**46** utilized on a patient after an endotracheal intubation.

FIG. **48**A illustrates the example endotracheal tube support apparatus of FIGS. **42**-**47** utilized on a patient after an endotracheal intubation and further supporting a nasogastric tube.

FIG. **48**B illustrates the example endotracheal tube support apparatus of FIGS. **42**-**47** utilized on a patient after an endotracheal intubation and further supporting a orogastric tube and in a flipped orientation to that shown in FIG. **48**A.

FIG. **49** the example endotracheal tube support apparatus of FIGS. **42**-**48**B utilized on a patient after an endotracheal intubation.

FIG. **50** illustrates another example endotracheal tube support apparatus.

FIG. **51** illustrates a curved portion and receiver pad of the example endotracheal tube support apparatus shown in FIG. **50**.

FIG. **52** illustrates the example receiver pad of FIGS. **50** and **51**

FIG. **53** illustrates an end of the example curved portion.

FIG. **54** schematically illustrates a protrusion in the channel of the receiver pad shown in FIGS. **50**-**52**.

## DETAILED DESCRIPTION

This application is related to apparatuses and methods for supporting endotracheal, feeding, and/or gastric suction tubes. In some prior art apparatuses, tape is used to secure the tube, such as an endotracheal tube, to a brace. Applicant has identified certain disadvantages of using tape. When infants are intubated and premature, they are often subjected to humidity for 30 or more days, which can make the tape less effective at securing and possibly lead to the tube coming out of position. Another drawback of tape is that medical professionals often have to remove their gloves before taping, removing the tape, or adjusting the tape, adding time and difficulty to the procedure. Still another drawback of tape is that intubated infants often vomit, which also can make the tape less effective at securing if the vomit

contacts the tape. Yet another drawback of these prior art devices is that they often require 2-3 medical professionals to perform adjustments.

The example clamps and associated apparatuses and methods disclosed herein overcome the Applicant-identified disadvantages with prior art apparatuses, including those that use tape. For example, clamps with polymeric and/or elastomeric materials for securing a tube to a brace are relatively unaffected by humidity and vomit. Further, clamps with polymeric and/or elastomeric materials are easy to quickly adjust. In some examples, the clamps may lack metal so that patients can undergo procedures such as magnetic resonance imaging while remaining intubated. In some examples, the braces, clamps, and/or supports disclosed herein may be plastic. In some examples, the braces, clamps, and/or supports disclosed herein may be made of medical grade polypropylene. Further, the examples disclosed herein allow a single medical professional to make an adjustment. Examples disclosed further eliminate the need for paper or plastic tape measures to be placed against the lip of the patient for measuring and adjusting tube depth.

Further, the examples disclosed herein allow multiple tubes to be secured with one clamp at once, and further allow one of those tubes to be selectively removed or adjusted while the other tube remains secured, i.e., held in place longitudinally to control the depth of the tube in the patient. The benefits described herein are not limited to intubation procedures and may be achieved by other procedures, including feeding or gastric suction tube procedures. Further, while procedures regarding infants are described in some of the example embodiments, procedures for other patients of various ages may benefit from this disclosure.

FIG. **1** illustrates an example endotracheal tube support apparatus **20** including a brace **22** for attachment to a patient's face. The brace **22** may include a support **24** extending away from the patient's face as shown. The example support **24** extends from a curved portion **25** that is contoured to complement the patient's face and secured to the patient's face at its ends. An endotracheal tube **26** is received against the support **24** and placed through the mouth of the patient. A clamp **28** is provided to secure the tube **26** to the support **24** and surrounds both the tube **26** and the support **24**. The example clamp **28** is made of one or more polymeric materials. The term polymer is used herein to refer generally to plastics, elastomers, thermoplastic elastomers, or other natural or synthetic materials that contain repeating molecule subunits. In some examples, the clamp **28** is plastic.

In the example shown, the patient is a newborn child, but intubations of other patients of various ages may benefit from this disclosure. Because of the small size of newborn children, the slightest adjustment in position of the tube can mean the difference of the infant receiving oxygen and not receiving oxygen. Accordingly, the examples disclosed herein provide improved securement of the endotracheal tube. Additionally, procedures involving nasogastric tubes, orogastric tubes, and gastric suction may benefit from this disclosure.

In some prior art apparatuses, tape is used to secure the endotracheal tube to the brace. Applicant has identified certain disadvantages of using tape. When infants are intubated, they are often subjected to humidity, which can make the tape less effective at securing and possibly lead to the tube coming out of position. Another drawback of tape is that medical professionals often have to remove their gloves before taping, removing the tape, or adjusting the tape, adding time and difficulty to the procedure. Still another drawback of tape is that intubated infants often vomit, which also can make the tape less effective at securing if the vomit contacts the tape.

FIG. **2** illustrates one example clamp **28**. The clamp **28** may include opposing finger portions **30**, and each finger portion **30** may provide a respective ratchet surface **32** for engaging a ratchet surface **32** of the other finger portion **30**. The ratchet surfaces **32** may be utilized to achieve adjustable tightness and securement of the clamp **28**. In some examples, as shown, the clamp **28** includes a plastic outer portion **34** at its outer diameter and an elastomeric inner portion **36** at its inner diameter. The elastomeric inner portion **36** may be compressible and/or may have a higher coefficient of friction than the plastic so as to be securely received against at least one of the endotracheal tube **26** and the support **24** (see FIG. **1**) for secure clamping.

FIG. **3** illustrates the example clamp **28** of FIG. **2** in an engaged position, with respective ratchet surfaces **32** engaged. A substantially cylindrical opening **38** may be provided at the inner diameter to accommodate the support **24** and tube **26** (see FIG. **1**).

In another example, as shown in FIG. **4**, and with reference to FIG. **1**, the inner diameter of the clamp **128** is contoured to complement the shape of the tube **26** and support **24**, such as by providing a groove **140** to receive the support **124**. It should be understood that like reference numerals identify corresponding or similar elements throughout the several drawings.

FIG. **5** illustrates another example clamp **228** including backside tabs **242** that can be pinched to open and close to moving opposing fingers **244** that may surround the tube **26** and support **24** (FIG. **1**).

Like the examples shown in FIGS. **2** and **3**, the example clamps **128/228** of FIGS. **4** and **5** may include polymeric and/or elastomeric materials. Although exemplary clamp designs are shown in FIGS. **2-5**, other clamp designs, including those having similar materials, and including those additional examples discussed below, are contemplated. Although the example clamps are disclosed as used with one example brace **22**, the clamps disclosed herein may be utilized with other braces.

FIG. **6** illustrates another example endotracheal tube support apparatus **420**. The curved portion **425** includes a ratchet surface **444** that may be received in a bracket **446** on a pad **447** for attachment to the patient's face. The bracket **446** includes an opposing ratchet surface **448** for engaging the surface **444**. The example apparatus **420** is therefore adjustable to accommodate patient faces of various sizes and shapes.

Additionally or alternatively, in some examples, the curved portion **425** may include two or more ratcheting portions (not shown) that adjust relative to one another for similar adjustability. Additionally or alternatively, in some examples, the pad **447** attaches to a second pad (not shown), such as by a hook and loop engagement, and the second pad is attached to the patient's face. Although one pad **447** is shown in the drawing, there may be one or more pads at each end of the curved portion **425**.

An example method of intubating a patient may be said to include attaching a brace to the patient's face. The brace may include a support extending away from the patient's face. The example method may include clamping an endotracheal tube to the support with a clamp that surrounds the endotracheal tube and the support, and the clamp may include a polymeric material.

FIG. **7** illustrates an example endotracheal tube support apparatus **520** including a brace portion **522** for attachment

to a patient's face. A support **524** extends from the brace portion **522** and away from the patient's face as shown. The example support **524** extends from a curved portion **525** that is contoured to complement the patient's face and secured to the patient's face at its ends, such as by adhesive pads in some examples. An endotracheal tube **526** is received against the support **524** and may be inserted through the mouth of the patient in an intubation process.

A clamp **528** is provided to secure the tube **526** against movement relative to the support **524**. In some examples, the endotracheal tube support apparatus **520** may be manufactured using additive manufacturing. In some examples, the endotracheal tube support apparatus **520**, including the example clamp **528**, is made of one or more polymeric materials. The term polymer is used herein to refer generally to plastics, elastomers, thermoplastic elastomers, or other natural or synthetic materials that contain repeating molecule subunits. In some examples, the clamp the endotracheal tube support apparatus **520**, or at least portions thereof including the example clamp **528**, is plastic. In some examples, the endotracheal tube support apparatus **520**, or at least portions thereof including the example clamp **528**, is made of Acrylonitrile butadiene styrene.

In the example shown, the patient is a newborn child, but endotracheal intubations of other patients of various ages may benefit from this disclosure. Because of the small size of newborn children, the slightest adjustment in position of the endotracheal tube can mean the difference of the infant receiving oxygen and not receiving oxygen. Accordingly, the examples disclosed herein provide improved securement of the endotracheal tube.

FIG. **8** illustrates the example endotracheal tube support apparatus **520** of FIG. **7**. The support **524** includes a groove **540** provided in a first surface **541** of the support **524** for receiving a tube (not shown for ease of viewing). In some examples, the tube is an endotracheal tube, such as the endotracheal tube **526** shown in FIG. **7**. The example clamp **528** includes a bar **550** for securing the tube within the groove **540**. The example bar **550** pivots about a pivot joint **552** and is shown in a disengaged position. In some examples, the pivot joint **552** may include one or more fasteners to provide rotation. The example pivot joint **552** may be spaced from the support **524**, such as by one or more extending arms **554** extending away from the support **524** to the pivot joint **552**.

FIG. **9** shows the example clamp **528** in an engaged position. In the example shown, the bar **550** is pivoted to be secured in a notch provided by an extension **556** from the support **524**. The bar **550**, made of one or more polymeric materials, in turn secures the tube (not shown) against movement within the groove **540**. In some examples, as shown, the bar **550** may include a handle **558** for moving the bar **550** between the engaged and disengaged positions.

FIG. **10** illustrates the example endotracheal tube support apparatus **520** at an opposite side of that shown in FIGS. **8** and **9**. The opposite side is substantially similar to the side shown in FIGS. **8** and **9**, with one difference being that two grooves **560** and **562** are provided in a second surface **563** of the support **524**, with the second surface **563** being opposite the support **524** from the surface **541** (see FIG. **8**). In some examples, as shown, the grooves **560**, **562** have different widths from one another. In some examples, the grooves **560**, **562** are sized to accommodate feeding and/or gastric suction tubes of different diameters, including an orogastric tube and a nasogastric tube in some examples. A second bar **550** is provided and pivotable around the pivot joint **552** to secure one or more tubes (not shown for ease of viewing) in their respective grooves **560**, **562**.

FIG. **11** illustrates the example endotracheal tube support apparatus **520** at the side shown in FIG. **10** and having the second bar **550** in an engaged position to secure a tube (not shown) against movement within either groove **560**, **562**.

In the examples shown, tubes may be selectively secured and unsecured in their respective grooves **540**, **560**, **562**. For example, a tube in groove **540** could be unsecured for adjustment while a tube in groove **560** remains secured. For example, a medical professional is able to adjust or remove an orogastric tube in a patient while keeping the endotracheal tube secured. As another example, a medical professional is able to adjust or remove an endotracheal tube in a patient while keeping an orogastric tube secured.

FIG. **12** illustrates a top down view of the example endotracheal tube support apparatus **520**. The groove **540** is at an opposite side of the support **524** from the grooves **560**, **562**.

Referring back to FIG. **7**, in the example shown, an orogastric feeding tube **564** is clamped within the groove **560** (see FIG. **10**), and the endotracheal tube **526** is clamped within the groove **540** (see FIG. **8**). As shown, the apparatus **520** is positioned such that the surface **541** is facing upward with respect to the orientation shown in FIG. **7**.

FIG. **13** illustrates the example endotracheal tube support apparatus **520** supporting a nasogastric feeding tube **566**. Here, the surface **563** is facing upward with respect to the orientation shown in FIG. **13**. That is, with reference back to FIG. **7**, the apparatus can be positioned such that either the surface **541** or the surface **563** is positioned facing upward, depending on whether an orogastric or nasogastric feeding tube is utilized.

The example tubes are secured such that the tubes are prevented from moving longitudinally within their respective grooves **540**, **560**, **562**, such as while a patient is on a ventilator for example.

In some examples, it is contemplated that the bars **550** may be provided by other components, including non-pivoting arrangements, such as a separate clamp in some configurations.

FIG. **14** illustrates another example clamp **628** that may be utilized with existing braces, such as NeoTech's NeoBar® brace. The example clamp **628** may include any of the materials listed above regarding the example apparatus **520**. The example clamp **628** includes grooves **670**, **672** for receiving endotracheal and feeding or gastric suction tubes. As shown herein, an endotracheal tube may be received in the groove **672** and a feeding tube is received in the groove **670** in some examples. A slot **674** is provided between the grooves **670**, **672** for receiving the support of a brace, such as NeoTech's NeoBar® brace. Internal spring hooks **699** within the slot **674** may engage the T-shaped end of the brace as shown in FIG. **29**. It is further contemplated that other examples may be utilized with other brace types. A knob **676** is provided for selectively moving the clamp **628** between multiple disengaged positions in which one or more tubes are freely slidable within the grooves **670**, **672** and an engaged position in which the tubes are secured against movement within the grooves **670**, **672**. FIG. **8** illustrates the example clamp **628** in an engaged position.

FIG. **15** illustrates the example clamp **628** in a first disengaged position. The knob **676** is turned toward the groove **670** to move a first bar portion **654**A away from the groove **670** such that a tube received in the groove **670** is freely slidable within the groove **670**. In some examples, as shown, the knob **676** has an indicator **678**, such as an arrow,

to aid a user in disengaging the desired tube in the desired groove. As shown, in the first disengaged position, the arrow **678** is pointing toward the groove **670**.

FIG. **16** illustrates the example clamp **628** in a second disengaged position. The knob **676** is turned toward the groove **672** to move a second bar portion **654**B away from the groove **672** such that a tube received in the groove **672** is freely slideable within the groove **672**. As shown, in the second disengaged position, the arrow **678** is pointing toward the groove **672**. Exemplary internal configurations for moving the bars **654**A and **654**B are explained further below.

FIG. **17** illustrates the example clamp **628** in a third disengaged position in which the arrow **678** is pointing to the upper surface **680** of the clamp **628** and tubes received in both grooves **670**, **672** are freely slidable within the grooves **670**, **672**. The example upper surface **680** is opposite a lower surface that includes the opening for the slot **674**.

FIG. **18** illustrates a side view of the example clamp **628**.

FIGS. **19**-**22** show the example clamp **628** receiving tubes. In some examples as shown, the example clamp can secure a feeding tube, a gastric suction tube, and/or an endotracheal tube within its grooves **670**, **672**.

FIG. **23** illustrates the example clamp **628** with the bars **654**A and **654**B removed. The knob **676** rotates with a shaft **682** including a first cam surface **684** and a second cam surface **686** axially adjacent and circumferentially offset from the first cam surface **684** relative to the rotational axis of the shaft **682**. Other configurations for moving the bars **654**A and **654**B, including other cam surface configurations, may be utilized in some examples.

FIG. **24** illustrates the example clamp **628** with the bars **654**A and **654**B removed from the main body and the clamp **628** in the engaged position and with the bars **654**A and **654**B located next to the main body **629** for reference. In some examples, the bars **654**A and **654**B may be parts of a separate U-shaped component as shown that may be securable to the main body by a snap fit or other securing arrangement. The bars **654**A and **654**B extend generally parallel to one another from ends of a cross member to free ends to form the U-shaped component. The bars **654**A and **654**B and the cross member are integrally molded of a suitable plastic to form the U-shaped component.

The inner surface of the bar **654**B includes a protrusion **688** and the inner surface of the bar **654**A includes a protrusion **690**. In the engaged position, the cam surface **684** does not engage the protrusion **690** and the cam surface **686** does not engage the protrusion **688**. The bars **654**A, **654**B are biased toward an engaged position, such that when the respective cam surfaces **684**, **686** do not abut the protrusions **688**, **690**, the bars **654**A, **654**B secure tubes within their respective grooves **670**, **672**.

FIG. **25** illustrates the example clamp **628** in the second disengaged position. The cam surface **686** abuts the protrusion **688** to push the bar **654**B away from the groove **672** so that a tube may be freely slidable within the groove **672**. The cam surface **684** does not abut the protrusion **690**.

FIGS. **26** and **27** illustrate the example clamp **628** in the third disengaged position. The cam surface **686** abuts the protrusion **688** to push the bar **654**B away from the groove **672** so that a tube may be freely slidable within the groove **672**. The cam surface **684** abuts the protrusion **690** to push the bar **654**A away from the groove **670** so that a tube may be freely slidable within the groove **670**. In the disengaged positions, the cam surfaces **684**, **686** selectively resiliently deform the outer ends of the bars **654**, **654**B outward away from the respective grooves **670**, **672**.

FIG. **28** illustrates the example clamp **628** in the first disengaged position. The cam surface **684** abuts the protrusion **690** to push the bar **654**A away from the groove **670** so that a tube may be freely slidable within the groove **670**. The cam surface **686** does not abut the protrusion **688**.

As shown, a portion of the shaft **682** is free of cam surfaces so as to selectively not abut the protrusions **688**, **690** in some positions.

FIG. **30** illustrates an example clamp **728** substantially similar to the clamp **628**, except that three grooves **770**, **772**, **773**, are provided. In some examples, the grooves **770**, **773** are sized differently from one another to accommodate feeding and/or gastric suction tubes of different diameters, such as an orogastric tube and a nasogastric tube in some examples. The groove **772** may be sized to accommodate an endotracheal tube in some examples. While three grooves **770**, **772**, **773** are shown in the illustrative example, more or fewer may be used in some examples.

In the example shown, the grooves **770** and **773** are opposite the slot **774** from the groove **772**. In this example, by having the grooves **770** and **773** that are opposite the slot **774** from the groove **772**, the orientation of the clamp **728** can be changed depending on whether an orogastric tube or a nasogastric tube is used. For example, as shown in FIG. **31**, if a nasogastric tube (removed for ease of viewing) is used in the groove **773**, the clamp **728** can be oriented so that the groove **773** is nearer the patient's nose. As shown in FIG. **32**, if the groove **770** is instead utilized for an orogastric tube (removed for ease of viewing), then the orientation of the clamp **728** can be rotated about 180° such that the groove **770** is nearer the patient's mouth.

FIG. **33** illustrates an example endotracheal tube support apparatus **820**, including a support **824** that extends from a curved portion **825** that is contoured to complement the patient's face and secured to the patient's face at its ends by adhesive pads **847**. One pad **847** is shown in the view shown in the drawing, but another similarly shaped and oriented pad may be used on the other side of the patient's face. The pads **847** may include a hydrocolloid base with a waterproof foam top layer, and are tapered in shape such that the width decreases as the pad **847** extends generally in a direction from the patient's ear toward the patient's mouth. The pads **847** may be anti-microbial. Applicant has identified problems with prior art attachment methods in which rectangular or square cloth pads are utilized and the corners of such pads nearest the patient's mouth lose adhesion, eventually leading to loss of adhesion in the entire pad and the need for replacement pads. The material and shape of Applicant's proposed pads overcome such deficiencies.

FIG. **34** illustrates another example endotracheal support apparatus **920** including a support **924** providing grooves **970**, **972**, **973**, for receiving tubes (removed for illustration purposes), including feeding and/or gastric suction tubes of different diameters, such as an orogastric tube and a nasogastric tube in some examples, as well as an endotracheal tube. In some examples, the endotracheal tube support apparatus **920**, including the example clamp **928** (see FIG. **35**), is made of one or more polymeric materials. In some examples, the endotracheal tube support apparatus **920**, including the example clamp **928** (see FIG. **35**), is made of plastic. In some examples, the endotracheal tube support apparatus **920**, including the example clamp **928** (see FIG. **35**), is made of medical grade polypropylene.

FIG. **35** illustrates a portion of the example endotracheal support apparatus **920** of FIG. **25** including the support **924** and a clamp **928**. In some examples, the support **924** may replace a support in an existing endotracheal support appa-

ratus, such as the support **824** in the embodiment in FIG. **33** or the equivalent support of the NeoTech® NeoBar®. In some examples, as shown in the embodiment in FIG. **36**, a support **1024** may be placed over such an existing support, such as by providing an opening O at the radial center of the support **1024** for receiving the existing support.

Referring back to FIG. **35**, the clamp **928** is generally C-shaped, including an open circumferential portion **929**. The open circumferential portion **929** is sized such that it is received over a radially outer surface **931** of the support **924** when tubes are to be secured in the grooves, such as by moving the clamp **928** in a direction generally perpendicular to the long axis of the support **924**. When one tube is to be adjusted, replaced, etc., the clamp **928** may be rotated in a clockwise or counterclockwise direction so that the open portion **929** is circumferentially aligned with the groove in which that tube is received. Therefore, one tube can be adjusted, replaced, etc., while one or more other tubes remain secured in their respective grooves. In the example, the open portion **929** has an arc length greater than or equal to the arc length of the largest groove. The open portion **929** may also have an arc length that is less than or equal to the arc length of at least one of the radially outer surfaces of the support **924**, such that the clamp **928** can be moved to a position in which all grooves are covered, such as that shown in FIG. **37**.

FIG. **37** illustrates an engaged position of the example clamp **928** and support **924** in which tubes can be secured in all three grooves **970**, **972**, **973**.

FIG. **38** illustrates the engaged position of the example clamp **928** and support **924** in which tubes are secured in grooves **970** and **972**. As shown, the tubes can be compressed slightly and/or the clamp **928** can be expanded slightly in order to hold the tubes in place longitudinally to control the depth of the tube in the patient.

FIG. **39** illustrates a first disengaged position of the example clamp **928** and support **924**, in which the open portion **929** is circumferentially aligned with the groove **973** and therefore the clamp **928** is disengaged with respect to the groove **973** such that a tube in the groove **973** can be removed, adjusted, etc., while tubes (not shown) in one or both of the grooves **972** and **970** remain secured.

FIG. **40** illustrates a second disengaged position of the example clamp **928** and support **924**, in which the open portion **929** is circumferentially aligned with the groove **972** and therefore the clamp **928** is disengaged with respect to the groove **972** such that a tube in the groove **972** can be removed, adjusted, etc., while tubes in one or both of the grooves **970** and **973** remain secured.

FIG. **41** illustrates a third disengaged position of the example clamp **928** and support **924**, in which the open portion **929** is circumferentially aligned with the groove **970** and therefore the clamp **928** is disengaged with respect to the groove **970** such that a tube in the groove **970** can be removed, adjusted, etc., while tubes in one or both of the grooves **973** and **972** remain secured.

While three grooves **970**, **972**, and **973** are shown in the examples, more or fewer grooves may be utilized in some examples. In some examples, other clamps could be used with the support **924**. In some examples, as shown, the grooves **970**, **972**, and **973** are of different sizes to accommodate differently sized tubes.

Referring back to FIG. **34**, in the example shown, the apparatus **920** including curved portion **925** lies substantially in a plane, and grooves **970**, **973** face one side of the plane, and the groove **972** faces an opposite side of the plane (see also FIG. **37**). In the orientation shown, one of grooves **970**, **973** can receive an orogastric tube, and the groove **972** receives an endotracheal tube. However, in an example in which a nasogastric tube is supported in one of the grooves **970**, **973** instead of an orogastric tube, the orientation of the apparatus **920** can be flipped about 180° such that the grooves **970**, **973** face the side of the plane that is nearer the nose. The example apparatus **1020** discussed below has similar capability, and is further illustrated at FIGS. **48**A and **48**B. In some examples, as shown, the groove **973** is closer circumferentially to the groove **970** than to the groove **972**.

FIGS. **42**-**49** illustrate another example endotracheal support apparatus **1020**, substantially similar to the endotracheal support apparatus, except that the clamp **1028** has outer grooves **1029** on its radially outer surface for ease of grip, such as by medical professionals. FIGS. **47**-**49** illustrate the example endotracheal support apparatus **1020** positioned on a patient during intubation. In some examples, as shown, the pads **1047** may be tapered like the pads **847** in FIG. **33**. FIG. **48**A illustrates an orientation of the example apparatus **1020** in which a nasogastric tube is supported. FIG. **48**B illustrates an orientation of the example apparatus **1020** flipped 180 degrees from the orientation shown in FIG. **48**A in which an orogastric tube is supported.

FIG. **50** illustrates another example endotracheal support apparatus **1120** in which the ends of the curved portion **1125** are received in a pad assembly **1147**, and more specifically in a receiver pad **1194** adhered to an adhesive pad **1196** adhered to the patient's skin proximal to the ear. In some examples, such as in infants, this area offers the most surface area for adhesion. In some examples, the pad assembly **1147** is adhered in a position closer to the patient's ear than to the patient's mouth. Although one end of the curved portion is shown in one pad assembly **1147** in the Figure, a similar arrangement is utilized proximal to the patient's other ear. In some examples, as shown, both the receiver pad **1194** and the adhesive pad **1196** are tapered, narrowing as they extend in the direction from the patient's ear to the mouth, such as like the tapered pads previously discussed in this disclosure. In some examples, the receiver pad **1194** includes silicon. In some examples, the adhesive pad **1196** is a hydrocolloid pad. Although the example adhesive pad **1196** appears larger than the example receiver pad **1194** for illustrative purposes, in some examples, the adhesive pad **1196** and the receiver pad **1194** are the same size and shape.

As shown in FIGS. **51** and **52**, the end of curved portion **1125** is received in a channel **1197** of the receiver pad **1194**. The end of the curved portion **1125** is adjustable within the channel **1197** to allow the example endotracheal support apparatus **1120** to be placed in an optimal position.

As shown in FIG. **53**, the curved portion **1125** may include protrusions **1198**, such as ribs in some examples for securement of the curved portion **1125** within the channel **1197** (FIGS. **51** and **52**). In some examples, as shown schematically in FIG. **54** the channel **1197** may include one or more similar protrusions **1198**B, such as on its upper surface in some examples, for engaging with protrusions **1198** on the curved portion **1125** and securing the curved portion **1125** in position once an optimal position is attained. An indicator **1199** may be included on the curved portion **1125** to signal to a medical professional when to stop pulling the curved portion **1125** out of the channel **1197** during an adjustment process to prevent the medical professional from pulling the curved portion **1125** completely out of the channel **1197**.

Regarding the example endotracheal support apparatus **1120** or other apparatus that use the pads **1147**, in an emergency, the brace can simply be pulled up and out of the

pads **1147**. The pads **1147** can remain on the patient's face until the emergency has been resolved. The brace can then be replaced into the pads **1147** and reused. This is an improvement over some prior art devices which suggest the device be cut with scissors and pulled off the patient's face. Further, the example pads **1147** are able to be cleaned with baby wipe or alcohol pad. Prior art pads could become soiled with vomit and/or saliva because they are cotton-topped and the whole apparatus would have to be changed out.

With reference to FIGS. **50**-**53**, an example method may include one or more of the following steps: intubating a patient, placing a pad assembly **1147** on the patient's cheek proximal to the patient's ear, placing a second pad assembly **1147** on the patient's cheek proximal to the patient's other ear, positioning the ends of the curved portion **1125** within the channels **1197** of each pad assembly **1147**, adjusting the ends of the curved portion **1125** within the channels **1197** of each pad assembly **1147** to an optimal brace position, and securing the endotracheal tube within the example endotracheal support apparatus **1120**. Although an example endotracheal support apparatus **1120** is shown, other apparatuses, including other examples in this disclosure, may be utilized with the pad assembly **1147**. In some examples, there is no need for an additional adhesive to be placed over the top of the receiver pad **1194**.

In some examples, the grooves receiving the tubes may have indicators, such as notches or raised portions in some examples, for reference against the tubes for adjustment and positioning of the tubes. In some examples, the indicators may be spaced apart in equal intervals. In some examples, the intervals may be 0.25 cm. In some examples, as shown in FIG. **45**, one or both of the circumferentially outer surfaces of the clamps **928/1028** may have notches N spaced apart in the same or different intervals for adjustment precision.

Although the different examples are illustrated as having specific components, the examples of this disclosure are not limited to those particular combinations. It is possible to use some of the components or features from any of the embodiments in combination with features or components from any of the other embodiments.

The foregoing description shall be interpreted as illustrative and not in any limiting sense. A worker of ordinary skill in the art would understand that certain modifications could come within the scope of this disclosure. For these reasons, the following claims should be studied to determine the true scope and content of this disclosure.

What is claimed is:

**1**. An endotracheal tube support apparatus, comprising:

a brace for attachment to a face of a patient;

a support extending from the brace and including a first groove for receiving an endotracheal tube and a second groove for receiving a second tube; and

a generally C-shaped clamp for surrounding the support and the endotracheal tube, the clamp including an open circumferential portion having an arc length greater than or equal to an arc length of a largest groove of the first and second grooves, and less than an arc length of at least one radially outer surface of the support,

wherein the first and second grooves are positioned such that the clamp can be selectively rotated in a clockwise or counterclockwise direction to circumferentially align the open circumferential portion with either of the first groove and the second groove, thereby allowing one of the endotracheal tube and the second tube to be adjusted or replaced while the other of the endotracheal tube and the second tube remains secured by the clamp against longitudinal movement.

**2**. The apparatus as recited in claim **1**, wherein the clamp includes a plastic body.

**3**. The apparatus as recited in claim **1**, wherein the second tube is a feeding tube or a gastric suction tube.

**4**. The apparatus as recited in claim **1**, wherein the support includes a third groove, and the first, second, and third grooves are sized differently, and the third groove is closer circumferentially to the second groove than the first groove.

**5**. The apparatus as recited in claim **1**, wherein the open circumferential portion is sized such that it is circumferentially aligned with a radially outer surface of the support when the endotracheal and second tubes are secured by the clamp against longitudinal movement in the first and second grooves.

**6**. The apparatus as recited in claim **1**, wherein an inner surface of the clamp is received against an outer surface of the endotracheal tube when the endotracheal tube is secured.

**7**. The apparatus as recited in claim **1**, further comprising cheek pads configured for attachment to the face, each cheek pad including a channel configured to receive an end portion of the brace.

**8**. The apparatus as recited in claim **7**, wherein the channel includes one or more protrusions for engaging corresponding protrusions on the brace to retain the brace in position.

**9**. The apparatus as recited in claim **1**, wherein the clamp comprises a polymeric material.

**10**. A method of intubating a patient, the method comprising:

attaching a brace to a face of the patient, wherein the brace includes a support extending away from the face, and having a first groove for receiving an endotracheal tube and a second groove for receiving a second tube;

clamping the endotracheal tube within the first groove of the support with a generally C-shaped clamp that surrounds the endotracheal tube and the support, the clamp including an open circumferential portion having an arc length greater than or equal to an arc length of a largest groove of the first and second grooves and less than an arc length of at least one radially outer surface of the support; and

adjusting or replacing one of the endotracheal tube and the second tube while the other of the endotracheal tube and the second tube remains secured, wherein the first and second grooves are positioned such that the clamp is rotatable in a clockwise or counterclockwise direction to circumferentially align the open circumferential portion with either of the first and second groove, wherein the adjusting or replacing includes rotating the clamp in a clockwise or counterclockwise direction.

**11**. The method as recited in claim **10**, wherein the second tube is a feeding tube or a gastric suction tube, the method further comprising clamping the second tube within the second groove with the clamp.

**12**. The method as recited in claim **10**, wherein the open circumferential portion is sized such that it is circumferentially aligned with a radially outer surface of the support when the endotracheal and second tubes are secured by the clamp against longitudinal movement in the first and second groove.

**13**. The method as recited in claim **10**, the method comprising clamping the second tube within the second groove with the clamp.

**14**. The method as recited in claim **10**, further comprising attaching cheek pads to the face, each cheek pad including a channel, and inserting end portions of the brace into the respective channels.

**15**. The method as recited in claim **14**, wherein inserting the end portions includes sliding the end portions of the brace within the channels to adjust the position of the brace on the face.

**16**. The method as recited in claim **15**, wherein the channels include one or more protrusions that engage corresponding protrusions on the brace to retain the brace in position after adjustment.

**17**. The method as recited in claim **10**, wherein the clamp comprises a polymeric material.

**18**. An endotracheal tube support apparatus, comprising:

a first cheek pad configured for attachment to a face of a patient and including a first channel;

a second cheek pad configured for attachment to a face of a patient and including a second channel;

a brace having first and second end portions to be received in the first and second channels;

a support extending from the brace and including a first groove for receiving an endotracheal tube and a second groove for receiving a second tube; and

a single clamp movable between a first position in which the endotracheal tube and the second tube are secured against longitudinal movement within the first groove and the second groove, a second position in which the endotracheal tube is secured against longitudinal movement within the first groove and the second tube is longitudinally adjustable within the second groove and removable from the second groove while the endotracheal tube is secured, and a third position in which the second tube is secured against longitudinal movement within the second groove and the endotracheal tube is longitudinally adjustable within the first groove and removable from the first groove while the second tube is secured.

**19**. The apparatus of claim **18**, wherein each of the first and second channel includes one or more protrusions for engaging corresponding protrusions on the brace to retain the brace in position.

**20**. The apparatus as recited in claim **18**, wherein the clamp is generally C-shaped and includes an open circumferential portion, the open circumferential portion being circumferentially aligned with a radially outer portion of the support in the first position, with the second groove in the second position, and with the first groove in the third position.

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