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KR, KW, 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.

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(54) Title: MICRO DROP ADAPTER FOR DROPPER BOTTLES

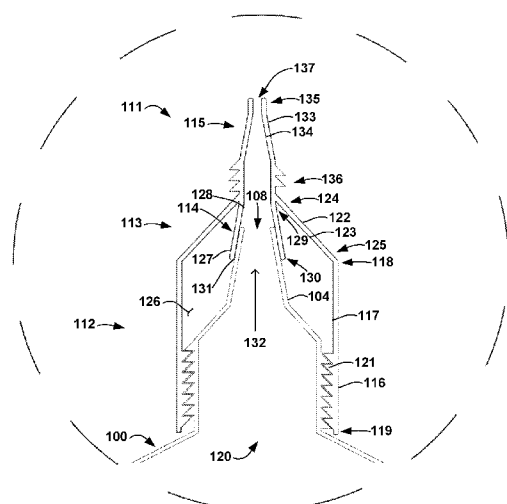


FIG. 5

(57) Abstract: A micro drop adapter that is adapted to engage with dropper bottles. The micro drop adapter engages with and surrounds the original tip of the bottle. The micro drop adapter comprises at least one inner tube that is urged against the original tip of the bottle forming a seal and a channel in fluid connection with the bottle. The micro drop adapter comprises an adapter tip that dispenses micro drops, which are drops having a volume of less than approximately 50 microliters. The micro drop adapter further comprises a cap.



MICRO DROP ADAPTER FOR DROPPER BOTTLES**BACKGROUND**

An eye drop bottle typically dispenses about 50 microliters per drop, which is about twice the volume the eye can hold. As early as 1992, certain researchers advocated for the use of a "micro drop" in eye drop bottles. The proposed micro drop would consist of drop volumes of about 16 microliters, since the research indicated that the medicinal efficacy was not affected while patients experienced fewer side effects. For purposes of the present disclosure, a micro drop will be understood to be any drop having less than the typical 50 microliters volume. Additionally, it was found that patients preferred the micro drops. However, to date the use of micro drops has never been adopted by the pharmaceutical companies or bottle manufacturers. There may be various industry pressures or motivations preventing adoption of this technology by the manufacturers considering that if the drop is half the size, then the bottle will last twice as long, potentially resulting in sales volumes and profits being cut in half. However, that may not be true considering that shelf life limits extended or multiple uses of many medicinal drops. Therefore, production costs could be lowered for a company making smaller volume bottles without affecting sales.

Nevertheless, since current bottles do not make use of micro drops, there is a long felt patient need for a more efficient and comfortable drop applicator. Additionally, there are many non-medicinal use instances wherein consumers would find a micro-drop adapter advantageous. Take for example the daily cleaning and conditioning of contact lenses. Contact lens solution can be used more efficiently when dispensed in micro drops. The consumer benefits from the increased economy, and the public benefits from less run-off solution entering the water system.

To address this problem a dropper bottle could be manufactured with a micro-dropper tip. However, since that may or may not occur, consumers desire the option to change the bottle as it is sold or otherwise convert their existing legacy bottles into micro drop dispensing bottles. There have been prior art attempts to achieve this, but those have various failings. Take for example, U.S. Patent No. 7,563,256 for a "Cannula Tip Eye Drop Dispenser" which sets out various dropper tips that are intended to replace or be substituted for the original tip that came with the bottle. In one embodiment, the replacement tip has a needle like portion that extends down into the bottle to penetrate the diaphragm barrier (the barrier is used to prevent contamination in certain medications). This is obviously not desirable because it damages and circumvents the purpose of the diaphragm barrier. Furthermore, the downward

extending needle prevents the bottle from being completely drained, which defeats the purpose of the more efficient micro-drops. In another embodiment of the same patent, a replacement tip is provided that does not have a needle. However, both this replacement tip and the previously discussed tip pre-suppose that either the bottle had
5 no existing dropper tip or the original tip of the bottle is removable. The modern reality is simply not so. Most liquids (including medicinal and non-medicinal) that are meant to be dispensed via drops are sold in a dropper bottle having a tip. And the tip of many modern-day dropper bottles is not removable because it is formed along with the bottle as a monolithic structure. Because of this, the prior art cannot be applied to the majority
10 of dropper bottles consumers experience in the market.

BRIEF SUMMARY

It is a goal of the present invention to provide an adapter that will work with the majority of existing dropper bottles that a consumer will experience in the market of drop
15 dispensable liquids. This adapter will convert a user's existing dropper bottle into a micro drop dispensing bottle. The present invention addresses the need in the form of an adapter that can be attached directly to the user's legacy or existing eye dropper bottle. To accomplish the goal of the present invention, the adapter comprises a coupler to attach to the original bottle, an internal sheath - referred to as the "inner tube"
20 - configured to at least partially surround and make a seal with the tip of the original bottle, a micro drop forming tip that is in fluid connection with the inner tube, and a removable new cap that can engage the adapter to protect the micro drop forming tip and thereby protect the bottle contents from external contamination.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

FIG. 1 shows an orthogonal front view of a typical prior art eye dropper bottle with the original lid secured in place.

FIG. 2 shows a partial cross-sectional view of a typical prior art eye dropper bottle with the original lid secured in place through the section 2 of FIG. 1.

FIG. 3 shows the partial cross-sectional view of FIG. 2 illustrating the typical prior art eye dropper bottle of FIG. 1 with the original lid removed.

FIG. 4 shows an orthogonal front view of a first implementation of a micro drop adapter for dropper bottles of the present disclosure secured to the typical prior art eye dropper bottle.

FIG. 5 shows a partial cross-sectional view of the micro drop adapter of FIG. 4 secured to the typical prior art eye dropper bottle through the section 5 of FIG. 4.

FIG. 6 shows an orthogonal front view of a second implementation of a micro drop adapter for dropper bottles of the present disclosure secured to the typical prior art eye dropper bottle.

FIG. 7 shows a partial cross-sectional view of the micro drop adapter of FIG. 6 secured to the typical prior art eye dropper bottle through the section 7 of FIG. 6.

FIG. 8 shows an orthogonal front view of a third implementation of a micro drop adapter for dropper bottles of the present disclosure secured to the typical prior art eye dropper bottle.

FIG. 9 shows a partial cross-sectional view of the micro drop adapter of FIG. 8 secured to the typical prior art eye dropper bottle through the section 9 of FIG. 8.

DETAILED DESCRIPTION

The micro drop adapter is described herein according to multiple implementations. As a convention for orientation, the descriptive directions of up, above, on top of, down, under, below, etc., may be used. One having ordinary skill in the art will understand that a bottle is typically oriented with the base or bottom of the bottle in the lowest position and the tip of the bottle will be positioned in the highest position. Therefore, terms such as up, above, on top of, etc., will refer to a relative position that is further from the base or bottom of the bottle. And similarly, terms such as down, under, below, etc., will refer to a relative position that is closer to the base or bottom of the bottle.

The typical prior art dropper bottle **100**, shortened to "the bottle **100**," is well understood in the art, but essentially consists of a circular or oval shaped base, a sidewall, and a top dispensing portion. See FIGS. 1-3. The bottle **100** is capable of dispensing drops having approximately 50 microliters in volume. The top dispensing portion of the bottle typically consists of an original drop dispensing tip **104** and a lid **105**. See FIG. 2. The original drop dispensing tip **104**, shortened to "original tip **104**," is typically comprised of a substantially cylindrical threaded portion **106** below a substantially frustoconical cone **107** having a base that tapers to an opening **108** in fluid connection with inside of the bottle **100**. The lid **105** engages the threaded portion **106** at the base of the original tip **104** to surround and enclose the original tip **104**, thereby creating a seal against the opening **108**. FIG. 3 shows a cross sectional view of the typical prior art eye dropper bottle **100** with the lid **105** removed.

The present disclosure describes various implementations of a micro drop adapter that is capable of dispensing micro drops. Some of the below described, implied, or understood implementations are capable of dispensing a micro drop of a particular pre-defined volume. However, certain implementations will dispense a micro drop having a pre-defined average volume in the range of 10-30 microliters.

The micro drop adapter **111**, shortened to "the adapter **111**," of the implementations of FIG. 4-7 is shown in orthogonal and cross-sectional views as positioned on the eye dropper bottle **100** of FIG. 1-3. The adapter **111** comprises a substantially cylindrical body section **112**, a substantially frustoconical cone section **113**, an inner tube **114**, and an adapter tip section **115**, such that the adapter tip section **115** is connected to the body section **112** via the cone section **113**.

The body section **112** of the adapter **111** is tubular with a body outer wall **116**, a body inner wall **117**, a body top end **118**, and a body bottom end **119**, wherein the body bottom end **119** has a body opening **120** and the body top end **118** is connected to the widest portion of the cone section **113**. The inner wall **117** of the body section **112** is configured to receive and engage the threaded portion **106** of the bottle **100** (see FIG. 2-3). Therefore, the body section **112** of the adapter **111** comprises a bottle retainer **121** positioned on the body inner wall **117** towards the body bottom end **119**. In the implementation shown in FIG. 5, the bottle retainer **121** is comprised of a threaded section to engage with the threaded portion **106** of the bottle **100**. Having read the present disclosure, it will be readily apparent to one having ordinary skill in the art that in addition to threads that correspond to the threads of the bottle, there are many other forms and mechanisms implementing the bottle retainer **121**. For example, instead of threads, the bottle retainer **121** could utilize a multitude of fine filaments or bristles, or a deformable ring, or an elastically deformable ring - such that the threaded portion **106** of many different bottles **100** could be engaged without prior knowledge of the particular thread dimensions. In some implementations, the body section further comprises a grip enhancer **402** on the exterior surface. In some implementations the grip enhancer is a multitude of grooves formed into the body outer wall.

The substantially frustoconical cone section **113**, or simply the "cone section **113**," of the adapter **111** has a cone outer wall **122**, a cone inner wall **123**, a cone top end **124**, and a cone bottom end **125**. The cone bottom end **125** is connected to the body top end **118**. The cone inner wall **123** of the cone section **113** and the body inner wall **117** of the body section **112** together define a cavity **126**. The cavity **126** is capable of accommodating a diverse range of original tip **104** shapes.

In some implementations, the micro drop adapter does not have a cone section **113** but rather the body section **112** creates the cavity **126** with the adapter tip section **115**.

Still referring to FIG. 5, the inner tube **114** comprises an inner tube outer wall **127**, an inner tube inner wall **128**, an inner tube top end **129**, and an inner tube bottom end **130**. The inner tube top end **129** is connected to the cone inner wall **123** at the cone top end **124**. The inner tube **114** extends downward from the cone top end **124** into the cavity **126**. The inner tube bottom end **130** is adapted to contact the original tip **104** of bottle **100** such that at least part of the inner tube inner wall **128** forms a seal **131** against the exterior of original tip **104** of bottle **100** without obstructing opening **108** of bottle **100**. Thus, inner tube inner wall **128** forms a channel **132** in fluid connection with opening **108** of bottle **100** and its contents.

In some implementations, inner tube **114** is a cylindrical tube. In other implementations, inner tube **114** is a frustoconical tube. In some implementations, inner tube **114** is made of a material that is at least partially elastically deformable. In some implementations, inner tube **114** is made of one or more of the materials comprising the following group: rubber, rubberized silicone, silicone, and plastic.

Still referring to FIG. 5, the adapter tip section **115** comprises a tip section outer wall **133**, a tip section inner wall **134**, a tip section top end **135**, a tip section bottom end **136**, and an adapter tip opening **137**. The tip section bottom end **136** is connected to the cone top end **124** and the inner tube top end **129**, such that the tip section inner wall **134** continues channel **132** and is in fluid connection with the bottle **100**. The adapter tip section **115** extends upward from the cone top end **124**. Adapter tip opening **137** is positioned at the tip section top end **135**. The adapter tip section **115** is configured to dispense individual micro drops from adapter tip opening **137**.

In some implementations, adapter tip section **115** will comprise a narrow tube of cylindrical shape. In other implementations, adapter tip section **115** will comprise a tapered tube shape. Regardless of shape or dimension, the adapter tip section **115** is adapted to form and dispense micro drops.

Some implementations will further comprise a cap for the adapter to close off the dispensing channel. Adapter cap **139** (see, e.g., FIG. 7) will close channel **132** when fully engaged with adapter tip section **115**, thus preventing the contents of bottle **100** from being unintentionally dispensed. Referring to the implementation seen in FIG. 7, the tip section outer wall **133** will have a cap retainer **138** positioned towards tip section bottom end **136**. The cap retainer **138** will engage adapter cap **139**. In FIG. 5 and 7, the

cap retainer **138** is depicted as a threaded section that is engages with the corresponding threaded section of adapter cap **139**. However, having read the present disclosure it will be readily apparent to one having ordinary skill in the art that in addition to threads that correspond to the threads of the adapter cap **139**, there are many other forms and mechanisms the cap retainer **138** could be comprised of such as a simple lip and groove that retains the adapter cap **139** via an inwardly directed compressive force. Moreover, having read the present disclosure it will be readily apparent to one having ordinary skill in the art that cap retainer **138** could be positioned on the cone section **113** or body section **112** in alternative implementations. In some implementations, the adapter cap further comprises a grip enhancer **602** on the exterior surface. In some implementations the grip enhancer is a multitude of grooves formed into the cap adapter outer wall.

Turning now to FIG. 9 for reference, some implementations further comprise at least a second inner tube. Adapter **211**, shown in FIG. 9, is similar to adapter **111** in many respects. Indeed, adapter **211** comprises all of the features and described elements of adapter **111** unless otherwise specified. However, adapter **211** further comprises a second inner tube **240**. Second inner tube **240** comprises a second inner tube outer wall **241**, a second inner tube inner wall **242**, a second inner tube top end **243**, and a second inner tube bottom end **244**. The purpose of the second inner tube **240** is to create a second seal **245**. Second inner tube top end **243** is connected to the cone inner wall **123**. The second inner tube **240** extends down into cavity **126** such that the second inner tube bottom end **244** contacts the exterior of original tip **104**. The second seal **245** is created at the point of contact between bottom end **244** and original tip **104**. As with the inner tube **114**, second inner tube **240** is comprised of rigid materials of construction in some implementations and flexible - resiliently deformable - materials of construction in other implementations.

The adapter **211** seen in FIG. 9 features a second inner tube **240**. However, having read the present disclosure it will be understood by one having ordinary skill in the art that an alternative implementation of the presently disclosed adapter could be described as comprising at least one inner tube that creates at least one seal. In other words, some embodiments will feature a multitude of inner tubes creating a multitude of seals. The additional seals may be desired in certain adapter implementations for a variety of reasons such as greater resistance to leaking under the applied pressure while dispensing drops, or simply for the purpose of accommodating a larger range of bottle **100** original tip **104** shapes and sizes. The second inner tube **240** of the adapter

211 is also depicted in FIG. 9 as having a larger diameter but being concentric with inner tube **114**. This is true in some implementations but one having ordinary skill in the art will appreciate upon reading the present disclosure that this is not a limitation that will apply to all implementations of the present invention.

5 The adapter implementations have been described as connected sections and functional parts (such as a body section, a cone section, an inner tube section, etc.). That is strictly true of certain implementations. However, having read the present disclosure it will be understood by one having ordinary skill in the art that some implementations will be formed monolithically such that the sections and functional
10 elements are not separate parts that have been connected after the fact - but rather are elements forming a whole unit. In fact, FIG. 5, 7, and 9 show such implementations.

 The adapter of some implementations is constructed from a material that is suitable for sterilization procedures. Some sterilization procedures utilize intense ultraviolet light; therefore, a suitable material of construction will have the property of
15 being undamaged or highly resilient to exposure to intense ultraviolet light. In plastics, the term is "UV stabilized." Another common sterilization procedure is the use of an autoclave, which involves high pressure and heat. Therefore, other implementations will be constructed of a material that can withstand the pressure and heat of autoclave sterilization.

20 Although the invention has been described and illustrated with a certain degree of detail or with reference to one or more particular implementations, it is understood that the present disclosure has been made only by way of example. It should be understood that the invention is not intended to be limited to the particular forms disclosed. Furthermore, the invention is amenable to various modifications and
25 alternative forms. Obvious variations and other various changes in the composition, combination, and arrangement of parts can be utilized to by those skilled in the art without departing from the spirit and scope of the invention, as herein disclosed and claimed.

CLAIMS

What is claimed is:

1. A micro drop adapter for a dropper bottle having an original tip comprising:
a tubular body section having a body interior adapted to engage the
5 dropper bottle;
a dropper bottle retainer connected to the tubular body section;
a micro drop forming tip section connected to the tubular body section;
a cavity created by the body interior and the micro drop forming tip
section; and
10 an inner tube adapted to engage the original tip of the dropper bottle to
create a seal, the inner tube extending into the cavity and connected to the body
interior such that the inner tube and micro drop forming tip section create a
channel in fluid connection with the dropper bottle.
2. The micro drop adapter of claim 1 further comprising a cone section
15 connecting the tubular body section to the micro drop forming tip section.
3. The micro drop adapter of claim 1 further comprising a cap retainer and an
adapter cap that engages the cap retainer to close the channel.
4. The micro drop adapter of claim 3, the cap retainer positioned on the
micro drop forming tip section.
- 20 5. The micro drop adapter of claim 4, the cap retainer comprising a threaded
section that corresponds to a threaded section on the adapter cap.
6. The micro drop adapter of claim 1, the dropper bottle retainer comprising a
threaded section that corresponds to a threaded section on the dropper bottle.
7. The micro drop adapter of claim 1 further comprising a grip enhancer on
25 the tubular body section.

8. The micro drop adapter of claim 7, the grip enhancer comprising a multitude of grooves formed into the tubular body section.

9. The micro drop adapter of claim 3 further comprising a grip enhancer on the adapter cap.

5 10. The micro drop adapter of claim 9, the grip enhancer comprising a multitude of grooves formed into the adapter cap.

11. The micro drop adapter of claim 1 further comprising a second inner tube that surrounds the inner tube and is adapted to engage with the original tip of the dropper bottle to create a second seal.

10 12. The micro drop adapter of claim 1, the inner tube being at least partially elastically deformable.

13. The micro drop adapter of claim 1, the inner tube being frustoconical in shape.

14. The micro drop adapter of claim 1 comprising material of construction
15 suitable for sterilization.

15. A micro drop adapter for a dropper bottle having an original tip comprising:
a tubular body section having a body interior adapted to engage the dropper bottle;

a dropper bottle retainer connected to the tubular body section;

20 a cone section connected to the tubular body section;

a micro drop forming tip section connected to the cone section;

a cavity created by the body interior, the cone section, and the micro drop forming tip section;

25 an inner tube adapted to engage the original tip of the dropper bottle to create a seal, the inner tube extending into the cavity and is connected to the

body interior such that the inner tube and micro drop forming tip section create a channel in fluid connection with the dropper bottle;

a cap retainer; and

an adapter cap that engages the cap retainer to close the channel.

5 16. A micro drop adapter for a dropper bottle having an original tip comprising:

a tubular body section having a body interior adapted to engage the dropper bottle; a dropper bottle retainer connected to the tubular body section;

a cone section connected to the tubular body section;

10 a micro drop forming tip section connected to the cone section;

a cavity created by the body interior, the cone section, and the micro drop forming tip section;

an inner tube adapted to engage the original tip of the dropper bottle to create a seal, the inner tube extending into the cavity and is connected to the body interior such that the inner tube and micro drop forming tip section create a channel in fluid connection with the dropper bottle;

a second inner tube that surrounds the inner tube and is adapted to engage with the original tip of the dropper bottle to create a second seal;

a cap retainer; and

20 an adapter cap that engages the cap retainer to close the channel.

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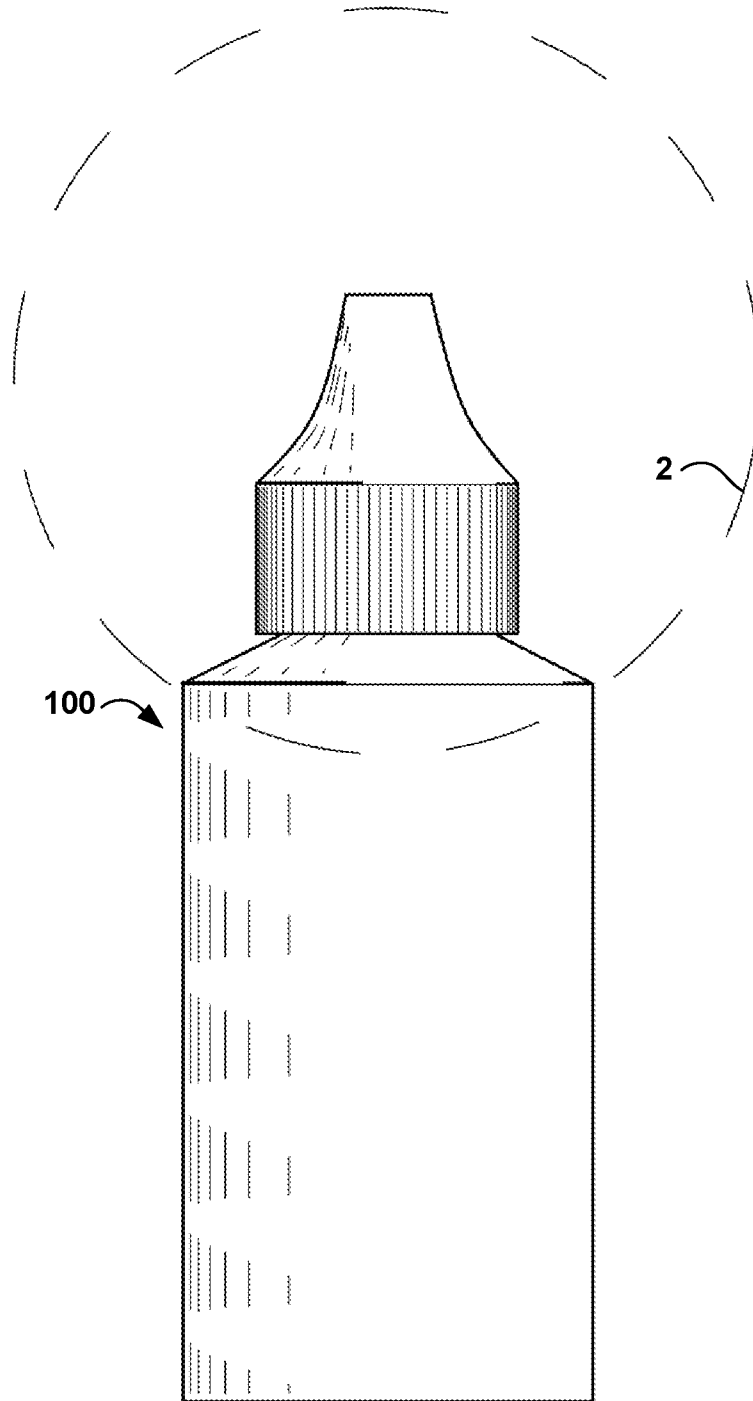


FIG. 1

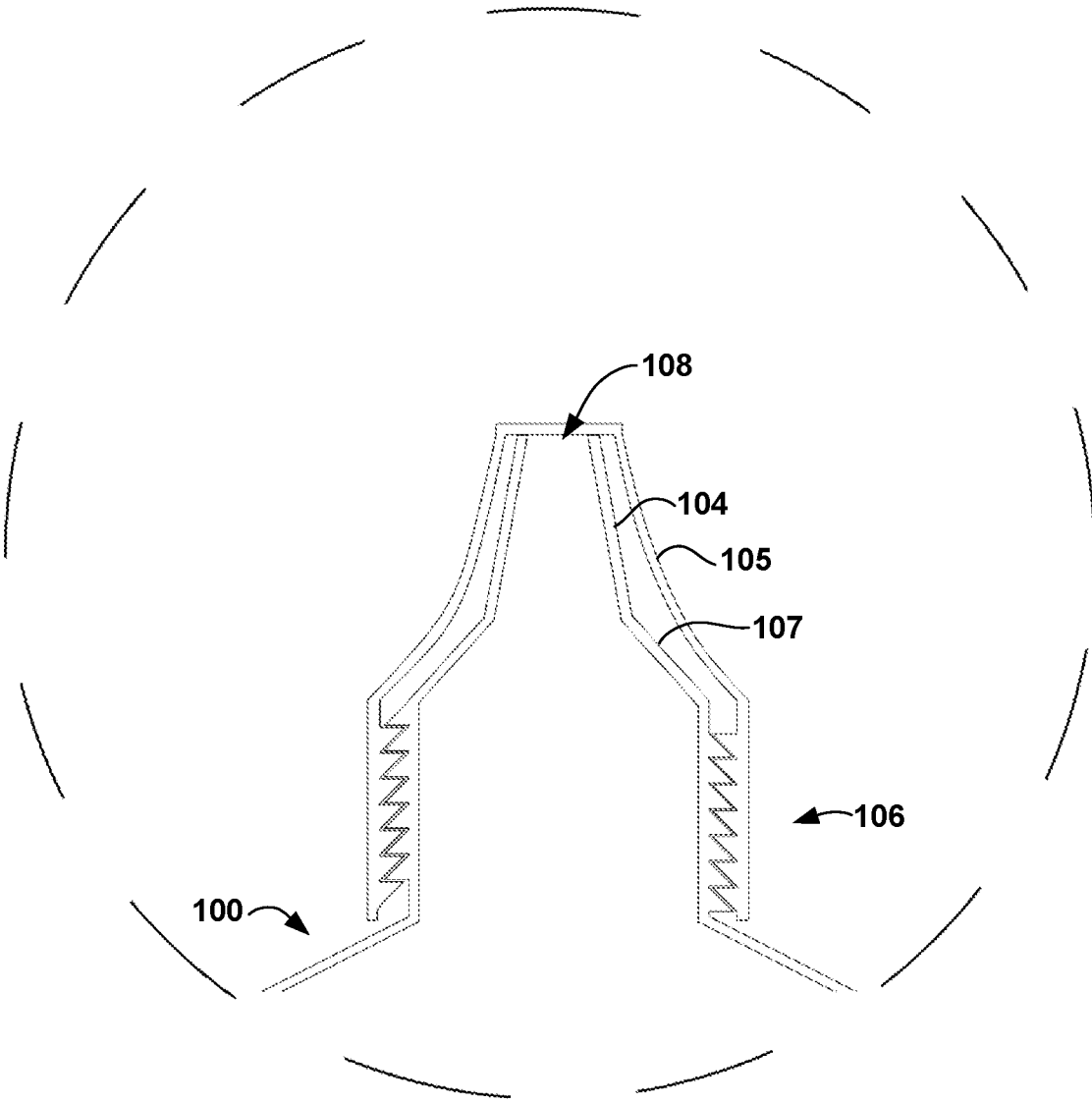


FIG. 2

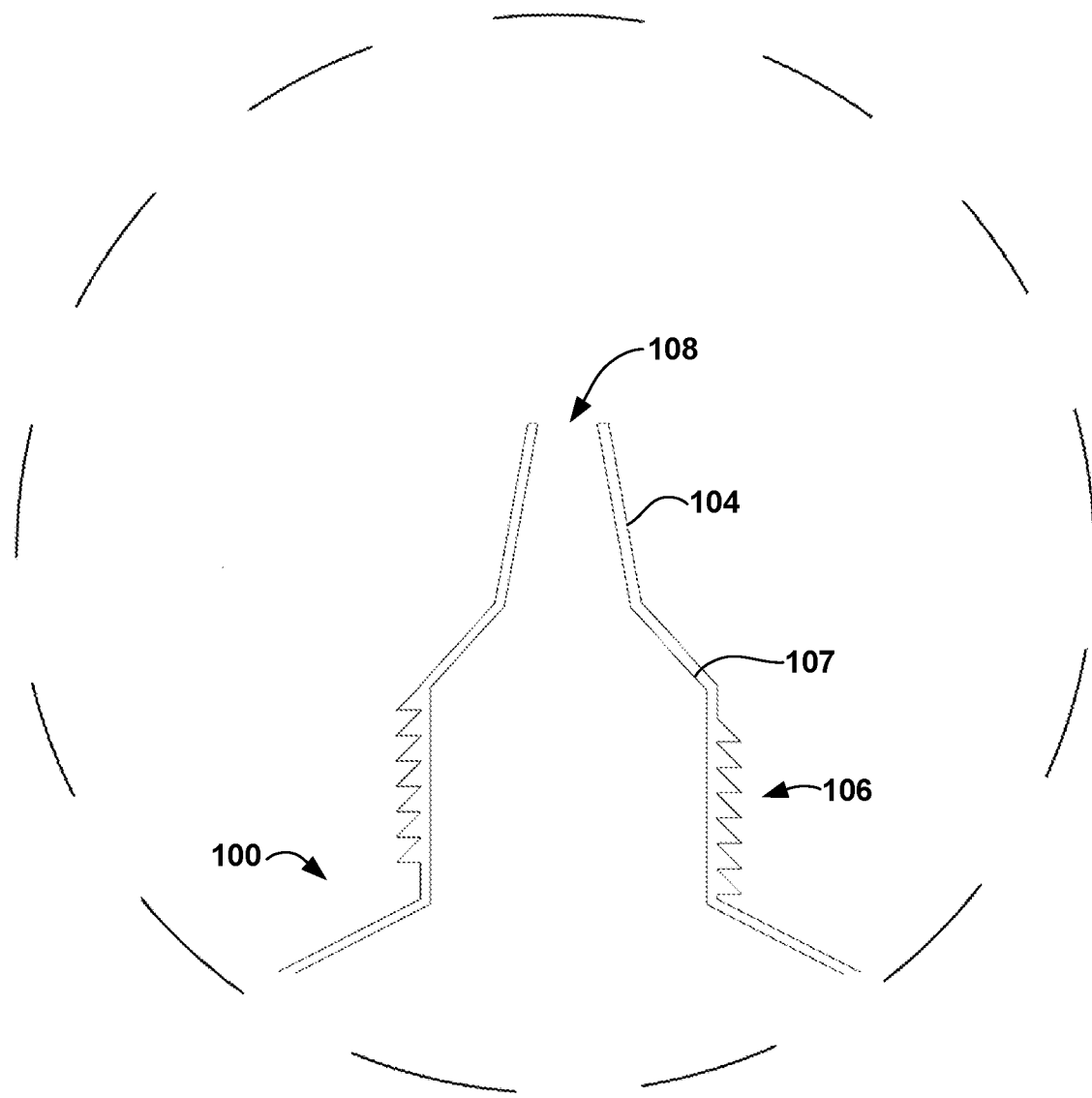


FIG. 3

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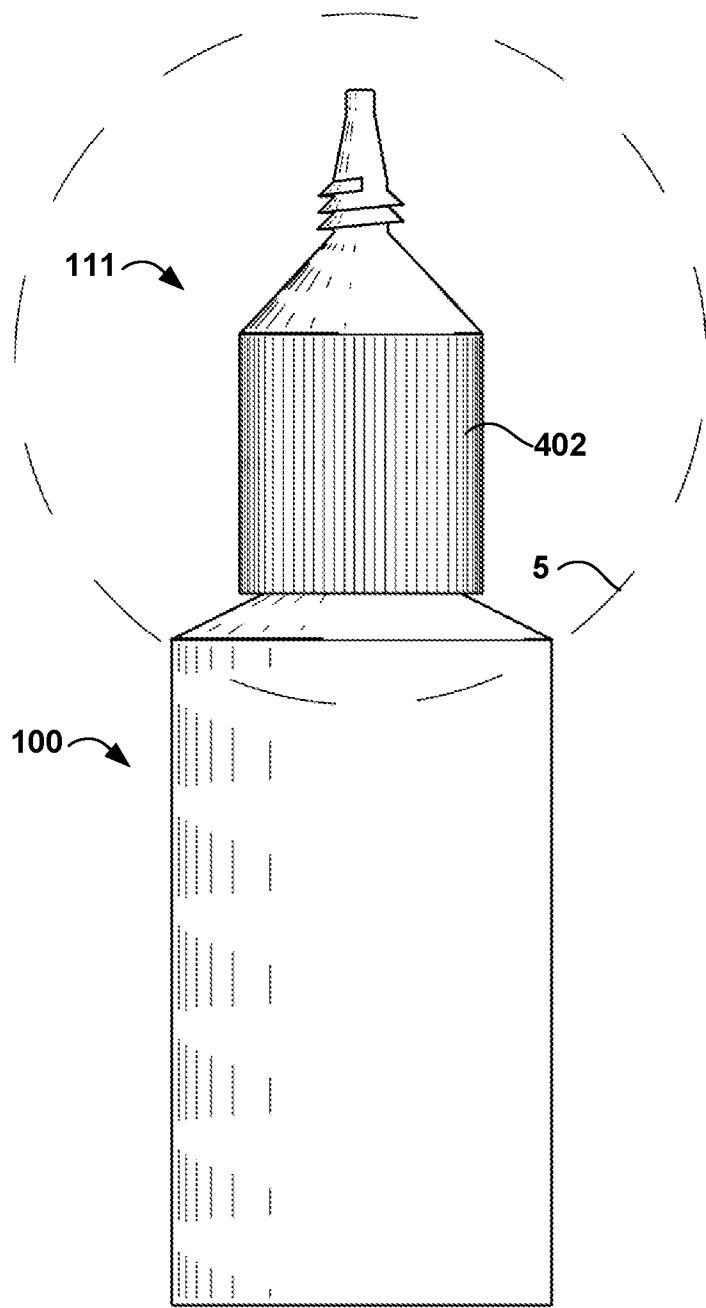


FIG. 4

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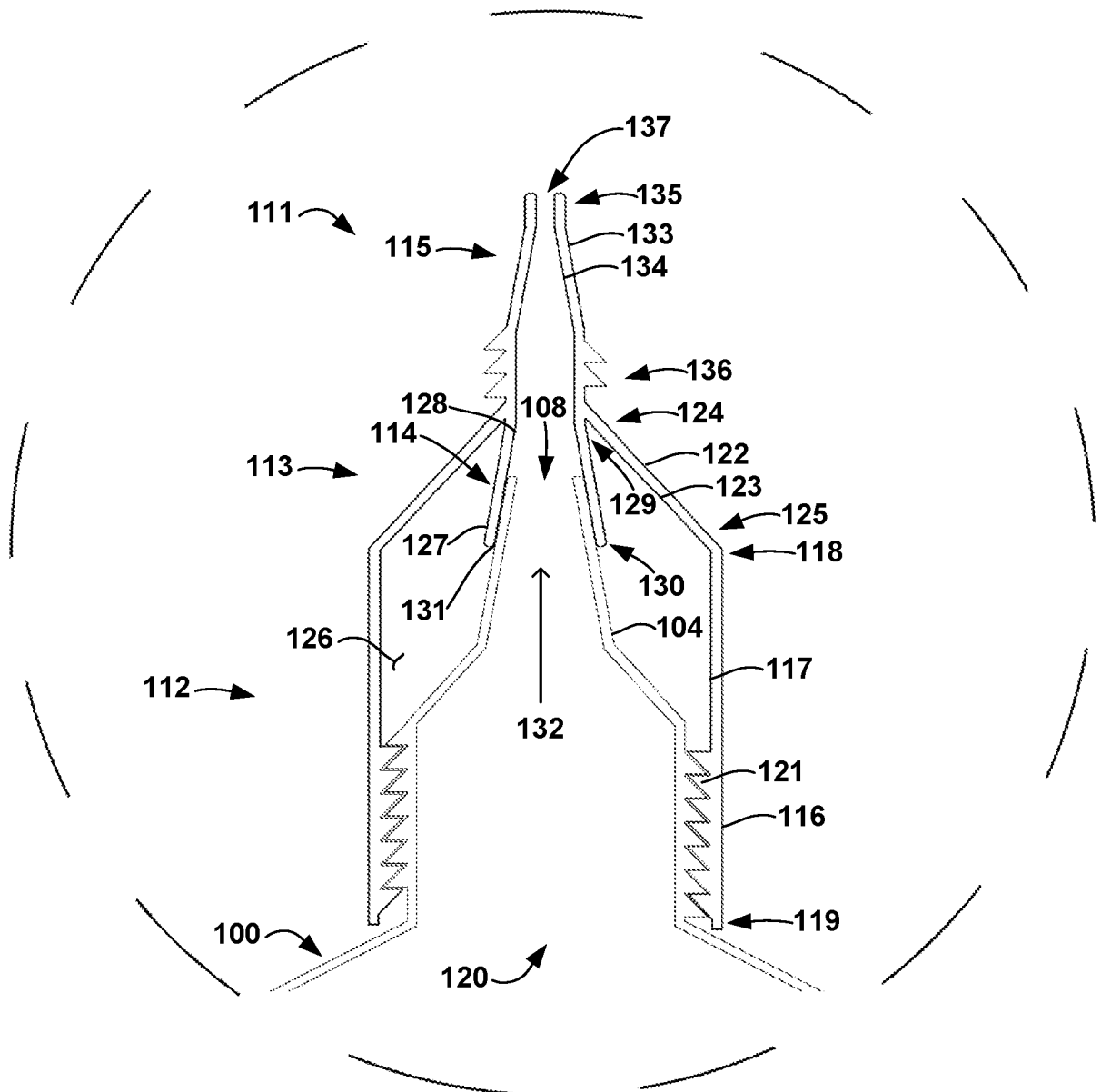


FIG. 5

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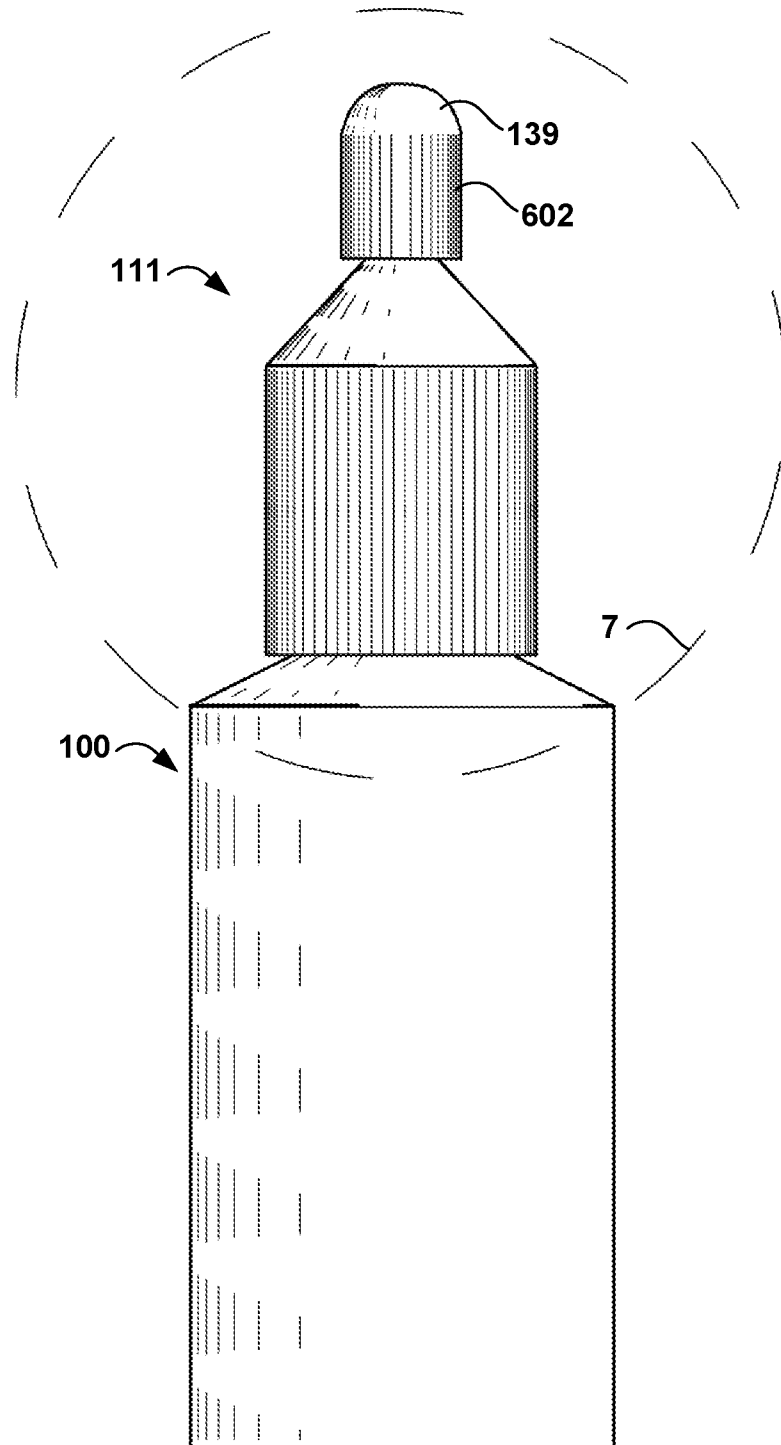


FIG. 6

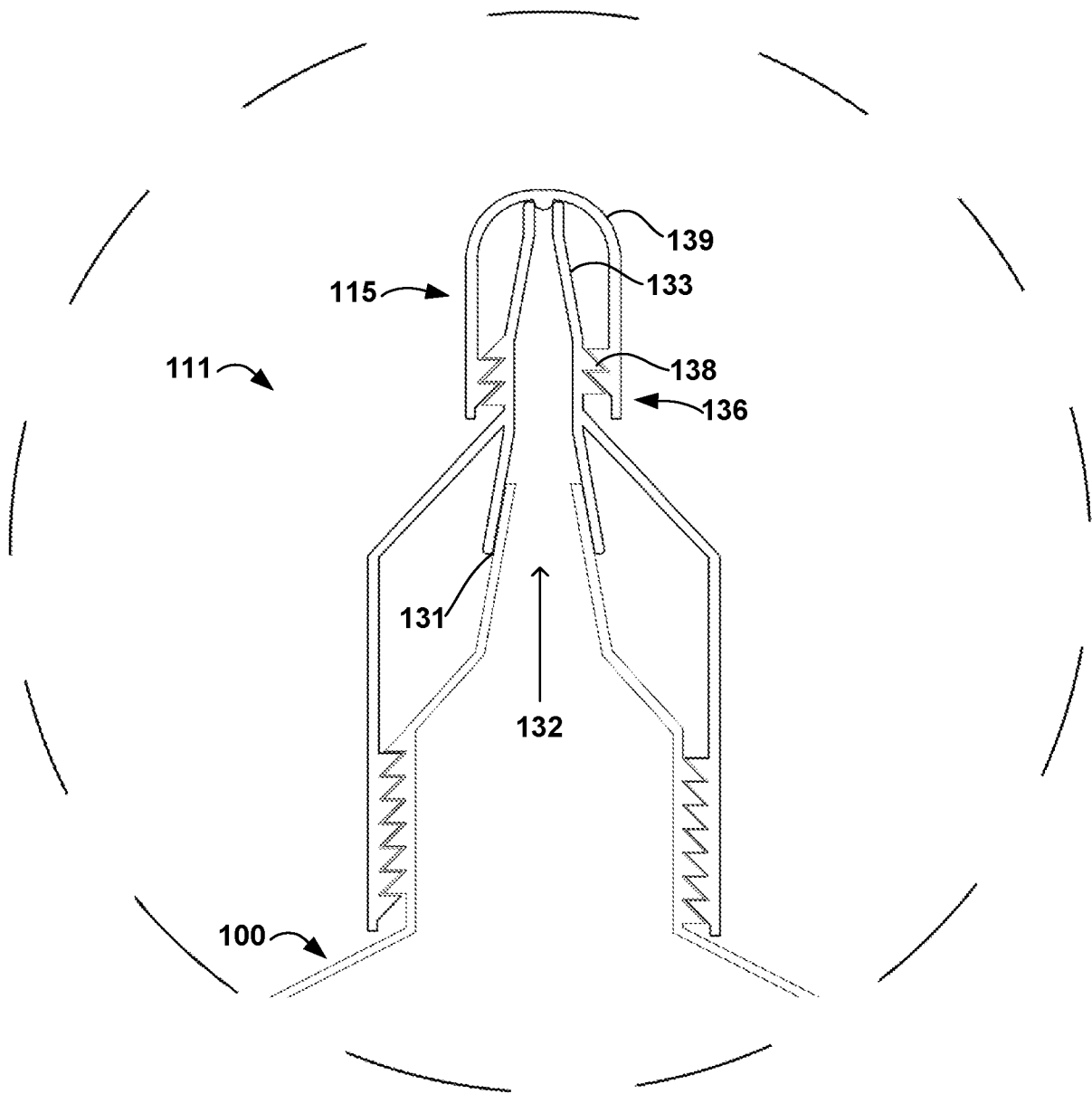


FIG. 7

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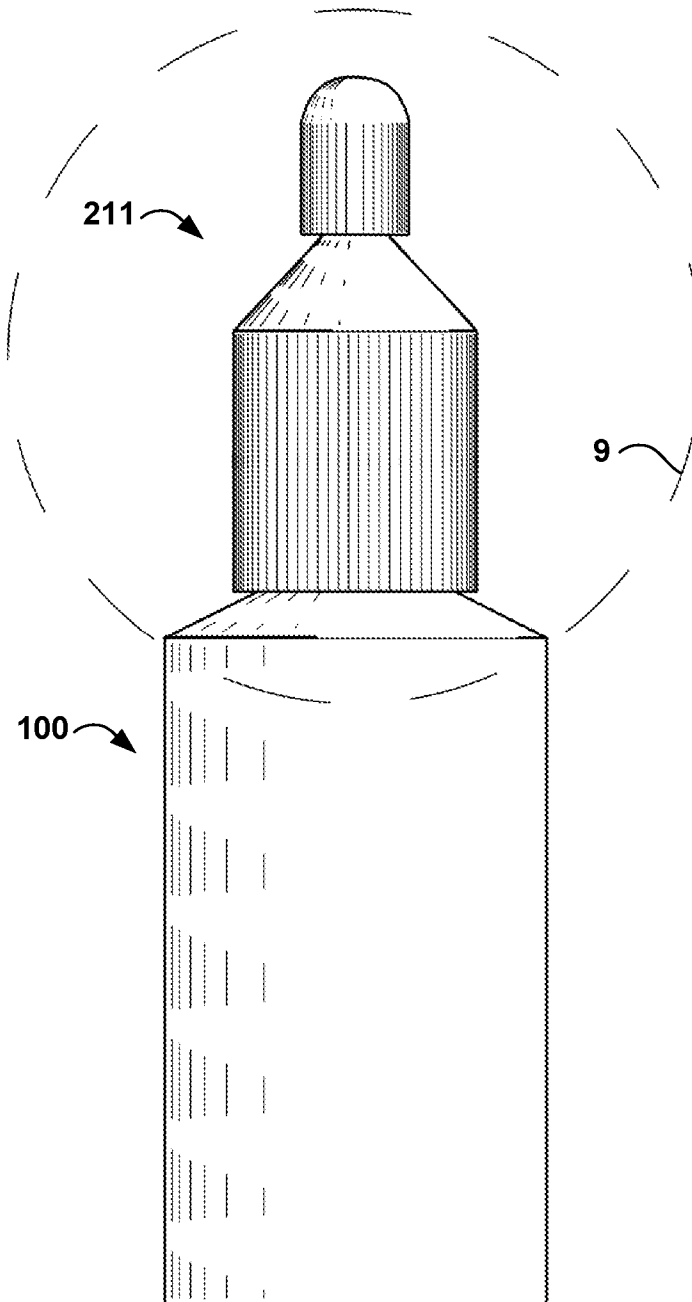


FIG. 8

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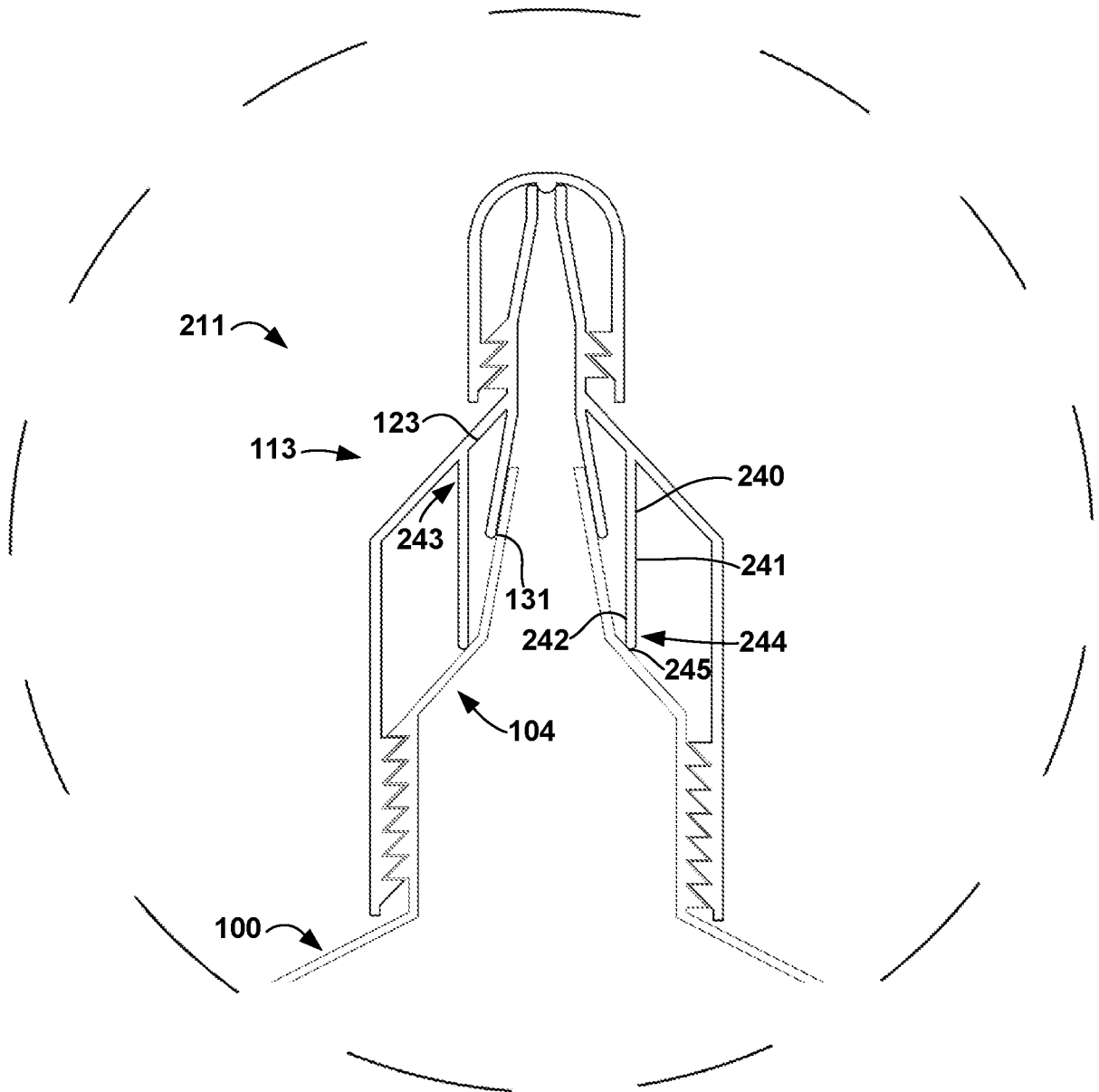


FIG. 9

A. CLASSIFICATION OF SUBJECT MATTER**B65D 47/18(2006.01)i, B65D 1/08(2006.01)i, B65D 43/02(2006.01)i**

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

B65D 47/18; A61J 1/05; A61J 1/14; B65D 88/54; B67D 3/02; B65D 1/08; B65D 43/02

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

Korean utility models and applications for utility models

Japanese utility models and applications for utility models

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

eKOMPASS(KIPO internal) & keywords: micro, drop, adapter, bottle, tip, nozzle, tube, thread

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	CN 104606048 B (HUANG, WENJIA) 11 November 2015 See paragraphs [0017]-[0018] and figures 1-3.	1-16
Y	JP 07-04812 Y2 (YOSHINO KOGYOSHO CO., LTD.) 08 February 1995 See claim 1 and figure 1.	1-16
Y	KR 10-1675989 B1 (HUONS CO., LTD.) 14 November 2016 See paragraphs [0028], [0044] and figures 1-5.	7-10
A	CN 202236291 U (TONGJI UNIVERSITY) 30 May 2012 See claims 1-2 and figures 1-2.	1-16
A	US 2013-0134186 A1 (DEFEMME et al.) 30 May 2013 See paragraph [0029] and figures 1-4.	1-16



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:

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

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

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

"&" document member of the same patent family

Date of the actual completion of the international search

27 June 2019 (27.06.2019)

Date of mailing of the international search report

02 July 2019 (02.07.2019)

Name and mailing address of the ISA/KR

International Application Division

Korean Intellectual Property Office

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

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