



US011950591B2

(12) **United States Patent**
Ramsey et al.

(10) **Patent No.:** **US 11,950,591 B2**
(45) **Date of Patent:** **Apr. 9, 2024**

(54) **CONTAINER WITH BIOLOGICAL MATERIALS HAVING MULTIPLE SEALED PORTIONS**

(71) Applicant: **Instant Systems, Inc.**, Norfolk, VA (US)

(72) Inventors: **Tara C. Ramsey**, Norfolk, VA (US);
Uzair Rajput, Norfolk, VA (US)

(73) Assignee: **Instant Systems, Inc.**, Norfolk, VA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **18/014,470**

(22) PCT Filed: **Jun. 10, 2022**

(86) PCT No.: **PCT/US2022/032931**

§ 371 (c)(1),
(2) Date: **Jan. 4, 2023**

(87) PCT Pub. No.: **WO2022/261389**

PCT Pub. Date: **Dec. 15, 2022**

(65) **Prior Publication Data**

US 2023/0189793 A1 Jun. 22, 2023

Related U.S. Application Data

(60) Provisional application No. 63/209,712, filed on Jun. 11, 2021.

(51) **Int. Cl.**

A01N 1/02 (2006.01)
B65D 75/30 (2006.01)
B65D 75/52 (2006.01)

(52) **U.S. Cl.**

CPC **A01N 1/0273** (2013.01); **B65D 75/30** (2013.01); **B65D 75/527** (2013.01)

(58) **Field of Classification Search**

CPC B65D 75/5805; B65D 75/5855; B65D 75/58; B65D 25/08; B65D 81/3266;
(Continued)

(56) **References Cited**

U.S. PATENT DOCUMENTS

1,438,487 A * 12/1922 Greene B65D 75/5822
222/215

2,775,082 A 12/1956 Vog
(Continued)

FOREIGN PATENT DOCUMENTS

CN 202313465 U 7/2012
EP 1 031 341 11/2003

(Continued)

OTHER PUBLICATIONS

International Search Report and Written Opinion for PCT/US2022/032931, dated Nov. 30, 2022.

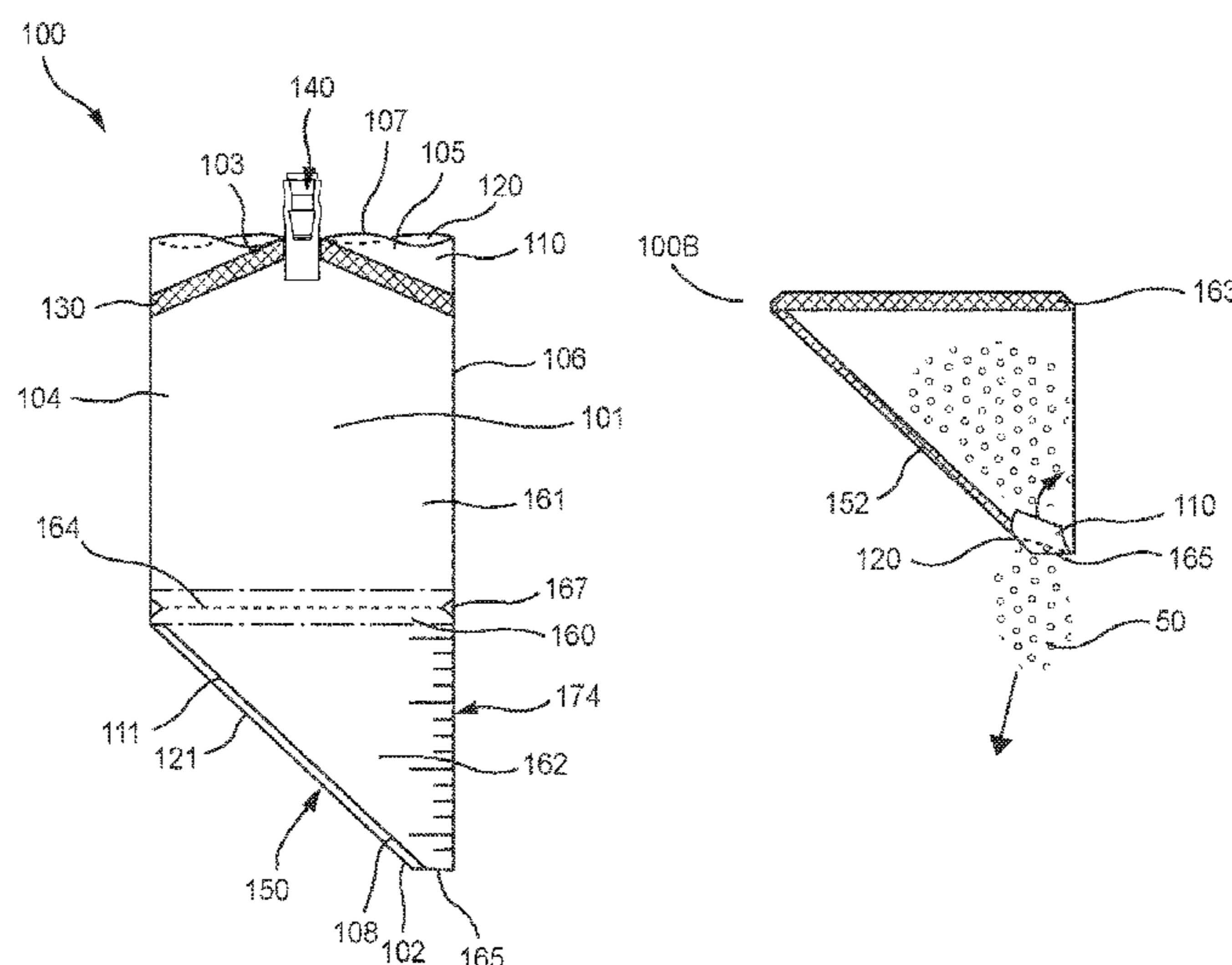
Primary Examiner — Chun Hoi Cheung

(74) *Attorney, Agent, or Firm* — Ambrose, Mills & Lazarow, PLLC

(57) **ABSTRACT**

An apparatus is disclosed having a first layer coupled to a second layer via a plurality of seals to define a storage volume that is separable by at least one intermediate seal into a first volume and a second volume. The intermediate seal is applicable after a material is introduced into the storage volume storage. The apparatus includes a first opening into the storage volume and a second opening into the storage volume. The first opening and the second opening are positioned near opposite edges. The apparatus also includes a first frangible region positioned along the intermediate seal and configured for separation of the first volume and the second volume.

17 Claims, 28 Drawing Sheets



(58)	Field of Classification Search							
	CPC	B65D 81/32; B65D 75/527; A61J 1/12; A61J 1/10		6,419,392 B1	7/2002	Baker		
	USPC	206/216, 823, 581, 730, 229, 484, 459.1, 206/459.5; 222/541.6		6,422,753 B1	7/2002	Thomas		
	See application file for complete search history.			6,523,698 B1	2/2003	Dennehey et al.		
				6,579,008 B2	6/2003	Price et al.		
				6,648,133 B1	11/2003	Blaschke et al.		
				6,730,071 B1	5/2004	Dassa		
				6,773,425 B1	8/2004	Tamari		
				6,945,695 B2	9/2005	Rabiea		
				7,051,879 B2*	5/2006	Ramet	B65D 35/22	
							206/823	
(56)	References Cited							
	U.S. PATENT DOCUMENTS							
	2,864,492 A	12/1958	Lappala	7,121,064 B2	10/2006	Ausnit		
	2,884,988 A	5/1959	D'Angelo	7,354,426 B2	4/2008	Young		
	3,254,828 A	6/1966	Hershey	D595,842 S	7/2009	Haga et al.		
	3,326,450 A	6/1967	Langdon	7,594,578 B2	9/2009	Smith et al.		
	3,339,826 A	9/1967	Beskind	7,670,384 B2	3/2010	Kumar et al.		
	3,548,723 A	12/1970	Sengewald	7,674,039 B2	3/2010	McMahon et al.		
	3,735,918 A	5/1973	Tundermann	7,770,611 B2	8/2010	Houwaert et al.		
	3,749,237 A	7/1973	Dorton	7,810,667 B2	10/2010	Douglas et al.		
	3,754,700 A	8/1973	Bonk	7,875,015 B2	1/2011	Pahlberg et al.		
	4,035,304 A	7/1977	Watanabe	8,038,348 B2	10/2011	Lerner et al.		
	4,140,162 A	2/1979	Gajewski et al.	8,136,330 B2	3/2012	Ostler et al.		
	4,152,184 A	5/1979	Bacehowski	8,267,912 B2	9/2012	Ferris		
	4,176,746 A	12/1979	Kooi	8,287,680 B2	10/2012	Foucaut et al.		
	4,181,069 A	1/1980	Porter	8,591,391 B2	11/2013	Chavarria et al.		
	4,305,503 A	12/1981	Membrino	8,597,223 B2	12/2013	D'Ayot et al.		
	4,335,770 A *	6/1982	Kulle	D705,443 S	5/2014	Ichimura et al.		
			A61J 1/10	9,095,499 B2	8/2015	Kugelman et al.		
			383/29	9,155,606 B2	10/2015	Benoit et al.		
	4,344,557 A	8/1982	Lerner	9,198,830 B2	12/2015	Kugelman et al.		
	4,479,989 A	10/1984	Mahal	9,796,166 B2	10/2017	Verri et al.		
	4,548,023 A	10/1985	Danby et al.	9,879,217 B2	1/2018	Coupier		
	4,550,831 A	11/1985	Whitford	9,926,524 B2	3/2018	Clark et al.		
	4,561,110 A	12/1985	Herbert	9,962,898 B1	5/2018	Russell et al.		
	4,581,007 A	4/1986	Kamp	9,974,528 B2	5/2018	Taylor et al.		
	4,616,760 A	10/1986	Kersten et al.	10,111,739 B2	10/2018	Benoit et al.		
	4,630,448 A	12/1986	Bilstad et al.	10,582,994 B2	3/2020	Kapec et al.		
	4,635,294 A	1/1987	Bentsen	11,058,530 B2	7/2021	Chen et al.		
	4,693,701 A	9/1987	deBin	11,065,095 B2	7/2021	Alden et al.		
	4,699,607 A	10/1987	Lambrecht	11,155,374 B2*	10/2021	Thesing	B65B 9/2056	
	4,714,595 A	12/1987	Anthony et al.	11,332,282 B2	5/2022	Murray		
	4,863,285 A	9/1989	Claxton	2002/0130093 A1	9/2002	Ferrara, Jr. et al.		
	4,887,715 A	12/1989	Spahn et al.	2003/0009989 A1*	1/2003	Knoerzer	B65B 9/2028	
	4,925,438 A	5/1990	Wagner				53/551	
	4,945,713 A	8/1990	Widenback	2003/0075474 A1*	4/2003	Moyer	A61B 50/33	
	4,998,671 A	3/1991	Leifheit				206/570	
	5,007,744 A	4/1991	Scarberry et al.	2003/0089084 A1	5/2003	Ausnit		
	5,031,762 A	7/1991	Heacox	2004/0134166 A1	7/2004	Ausnit		
	5,088,994 A	2/1992	Porat et al.	2004/0161167 A1	8/2004	Ausnit et al.		
	5,114,004 A	5/1992	Isono et al.	2005/0261659 A1	11/2005	Mizuo et al.		
	5,118,202 A	6/1992	Bruno	2005/0271307 A1	12/2005	Pawloski et al.		
	5,160,329 A	11/1992	Oxley	2006/0024818 A1	2/2006	Conconi		
	5,209,745 A	5/1993	Irr et al.	2007/0074980 A1	4/2007	Bankoski et al.		
	5,221,567 A	6/1993	Baker	2007/0092398 A1	4/2007	McDonald		
	D337,382 S	7/1993	Wallace	2007/0206888 A1	9/2007	Chang		
	5,226,858 A	7/1993	Snowdon	2008/0017543 A1	1/2008	Pahlberg et al.		
	5,236,088 A	8/1993	Dhority et al.	2008/0214998 A1	9/2008	Kurek et al.		
	5,253,754 A *	10/1993	Soodak	2008/0234654 A1	9/2008	McCarthy et al.		
			A01N 1/0268	2008/0254471 A1	10/2008	Bordano		
			493/189	2008/0285896 A1	11/2008	Taheri		
	5,266,140 A	11/1993	Kohno	2008/0304771 A1	12/2008	Harder et al.		
	5,309,698 A	5/1994	Huseman	2009/0030396 A1	1/2009	Ferris		
	5,360,413 A	11/1994	Leason et al.	2009/0034885 A1*	2/2009	McGruder	B65D 33/25	
	5,370,221 A	12/1994	Magnusson				383/38	
	5,728,086 A	3/1998	Niedospial	2009/0105684 A1	4/2009	Balteau et al.		
	5,804,265 A	9/1998	Saad et al.	2009/0238495 A1	9/2009	Anderson		
	RE36,132 E	3/1999	Heacox	2010/0040308 A1	2/2010	McLellan et al.		
	5,971,155 A	10/1999	Liang	2011/0308977 A1	12/2011	DiLiberto et al.		
	6,022,344 A	2/2000	Meijer et al.	2011/0308992 A1*	12/2011	Bahcall	B65D 75/566	
	6,045,546 A	4/2000	Drago et al.				206/812	
	6,089,541 A	7/2000	Weinheimer et al.	2012/0195533 A1	8/2012	Mead		
	6,127,009 A	10/2000	Strassmann	2013/0209000 A1	8/2013	Owensby et al.		
	6,149,302 A	11/2000	Taheri	2013/0281964 A1	10/2013	Kugelman et al.		
	6,176,371 B1	1/2001	Tyrrell	2015/0216763 A1	8/2015	Fearnot		
	6,238,090 B1	5/2001	Yuter	2016/0000062 A1	1/2016	Chen et al.		
	6,287,284 B1	9/2001	Warburton-Pitt	2016/0052690 A1	2/2016	Bolhous et al.		
	6,367,634 B1	4/2002	Lynn et al.	2016/0137354 A1	5/2016	Sargin		
	6,375,613 B1	4/2002	Brasile	2016/0177245 A1	6/2016	Johnson et al.		
	6,394,993 B1	5/2002	Chang et al.	2016/0228231 A1	8/2016	Southard et al.		
	6,398,771 B1	6/2002	Gustafsson et al.	2016/0305577 A1	10/2016	Huschke		

(56)

References Cited

U.S. PATENT DOCUMENTS

2017/0001782 A1 1/2017 Arent et al.
2017/0121061 A1 5/2017 Sprehe et al.
2017/0172847 A1 6/2017 Platenkamp et al.
2017/0181426 A1 6/2017 Wolf et al.
2017/0202740 A1 7/2017 Yoshida et al.
2018/0154289 A1 6/2018 Rhodes
2018/0249703 A1 9/2018 Llyin
2020/0008921 A1* 1/2020 Alden A01N 1/0273
2020/0061365 A1 2/2020 Alden et al.
2021/0298888 A1 9/2021 Alden et al.
2022/0273464 A1 9/2022 Rister et al.
2022/0305738 A1* 9/2022 Ramsey B65D 75/5855
2023/0233309 A1 7/2023 Alden et al.

FOREIGN PATENT DOCUMENTS

WO WO 1997/042897 11/1997
WO WO 2002/041824 5/2002
WO WO 2017/026131 2/2017
WO WO 2020/014162 1/2020

* cited by examiner

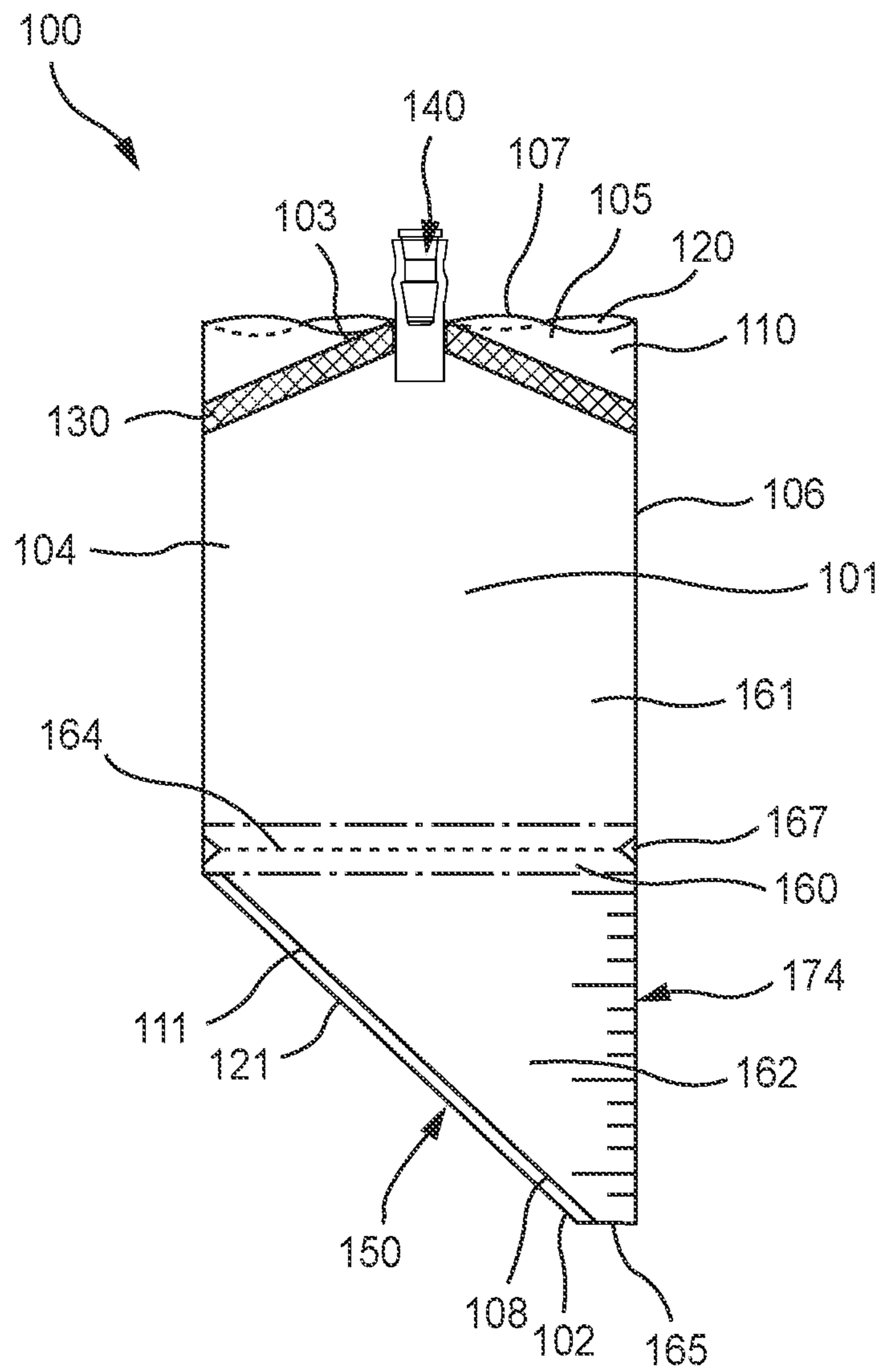


FIG. 1A

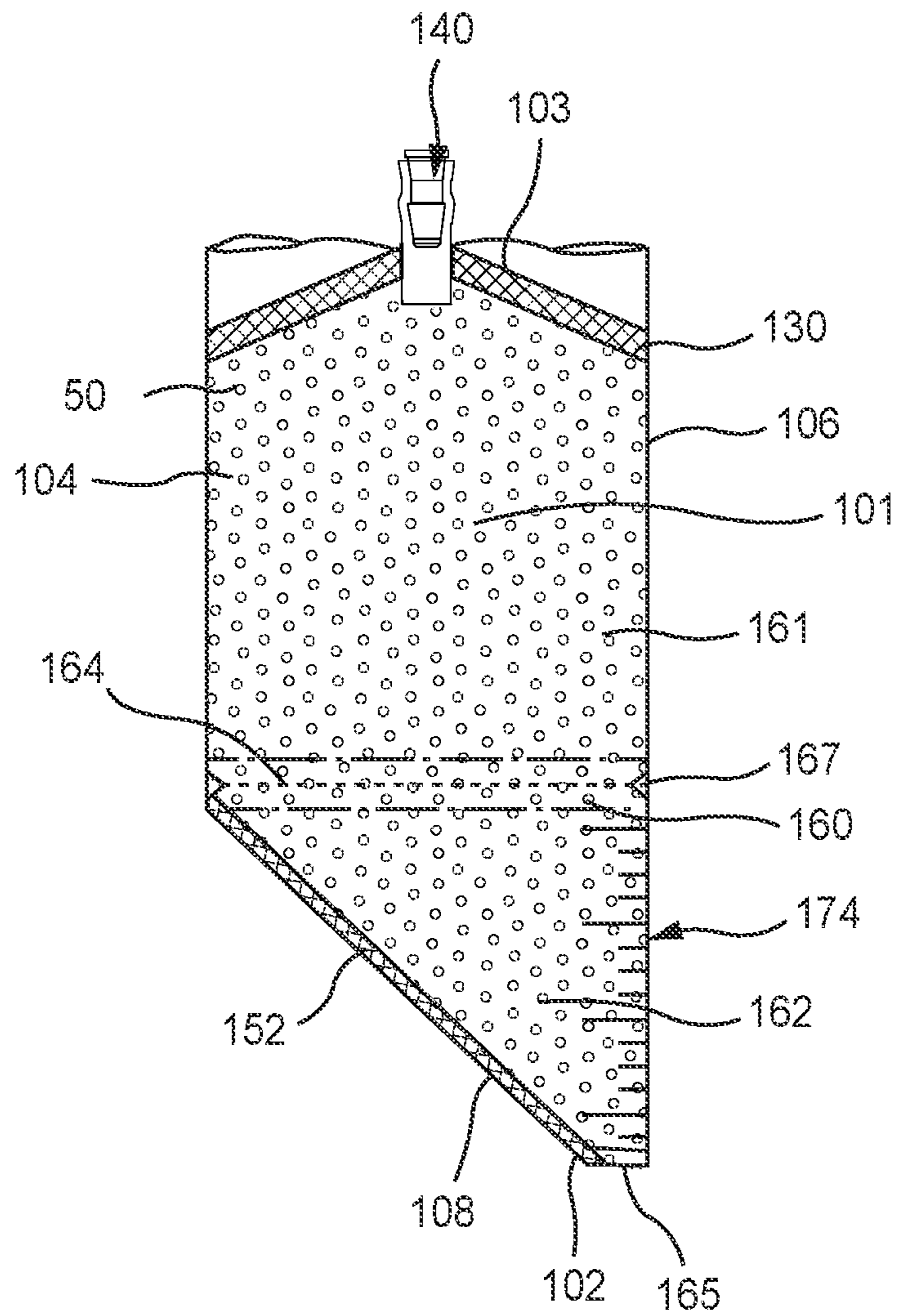


FIG. 1B

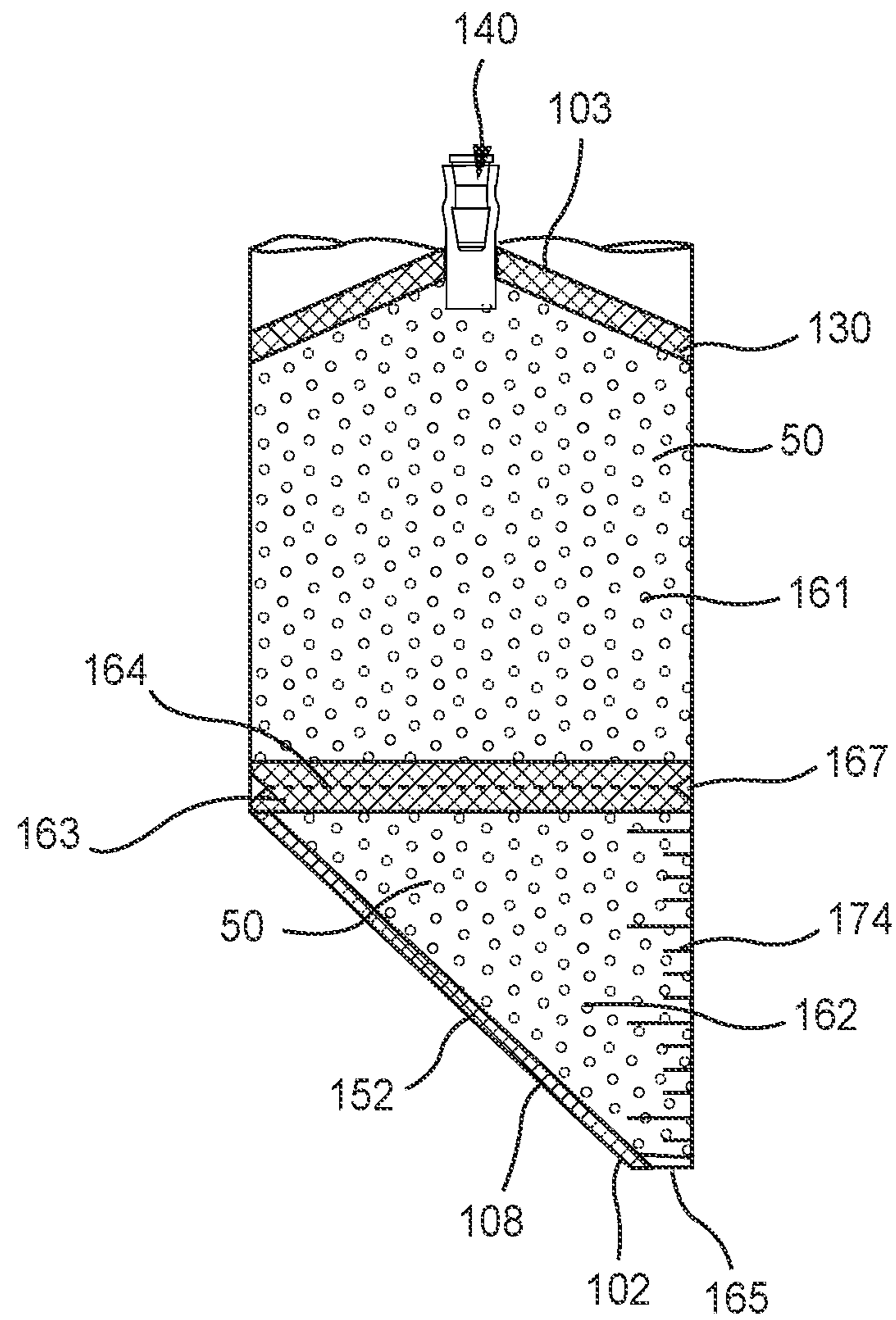


FIG. 1C

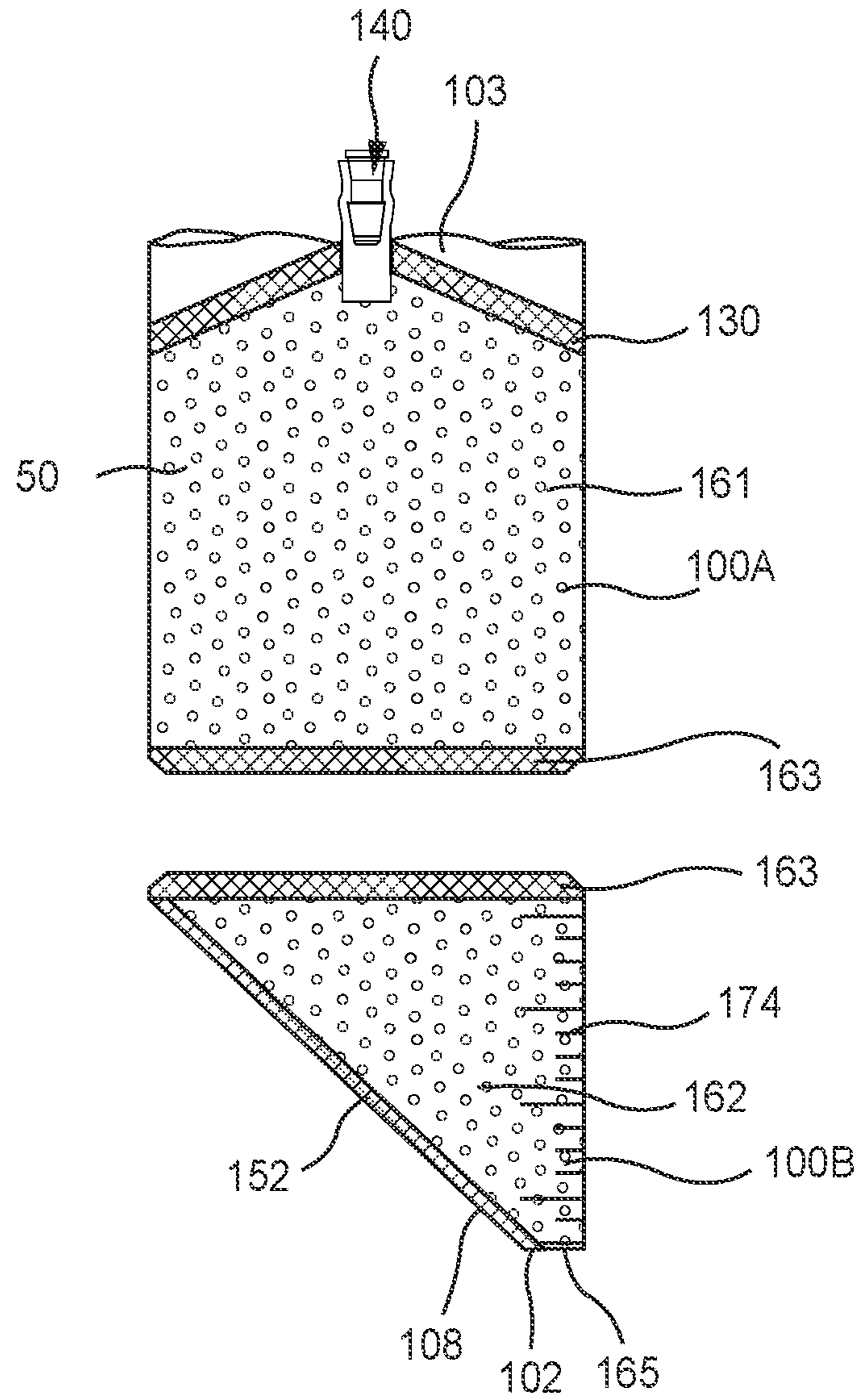


FIG. 1D

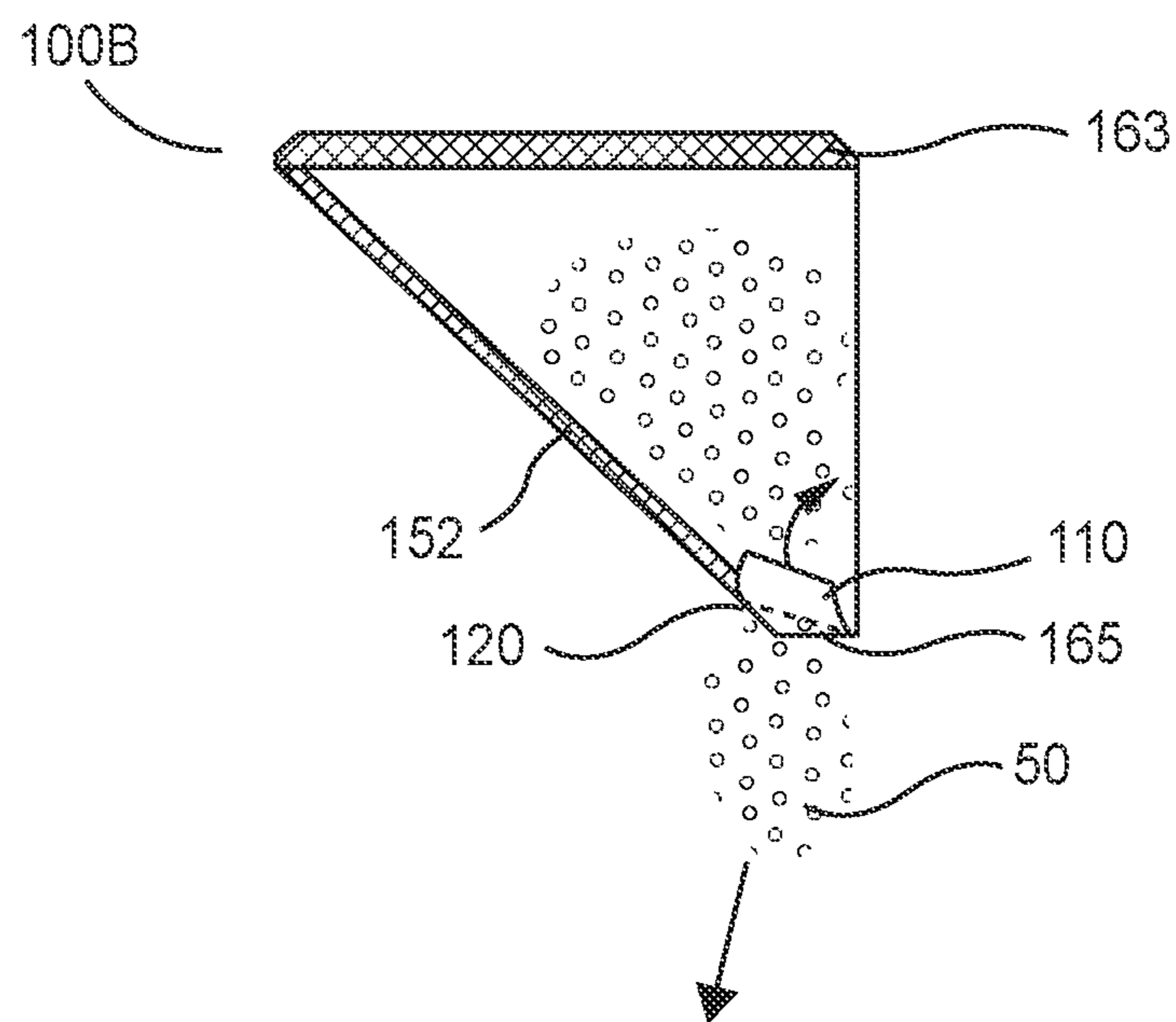


FIG. 1E

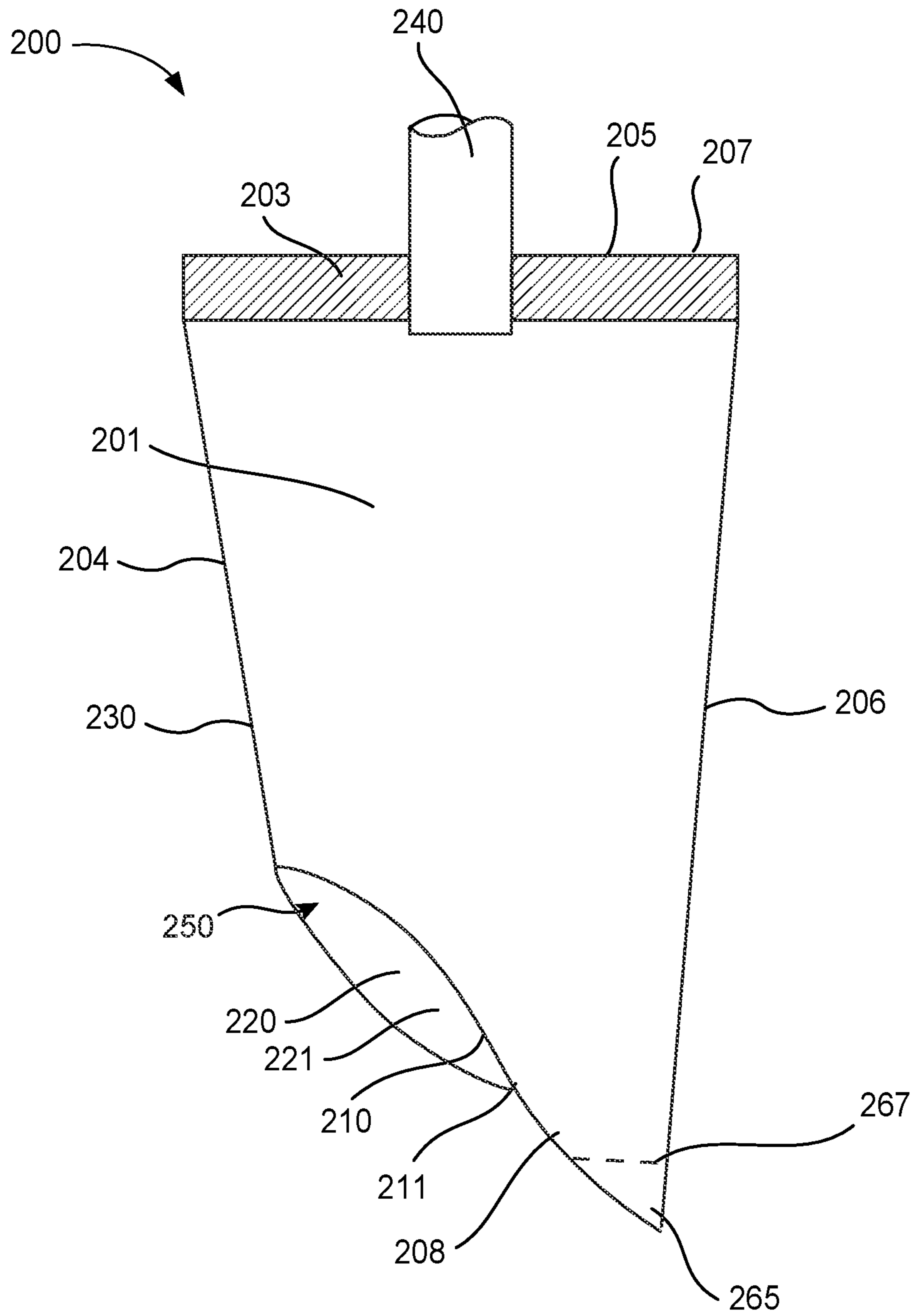


FIG. 2A

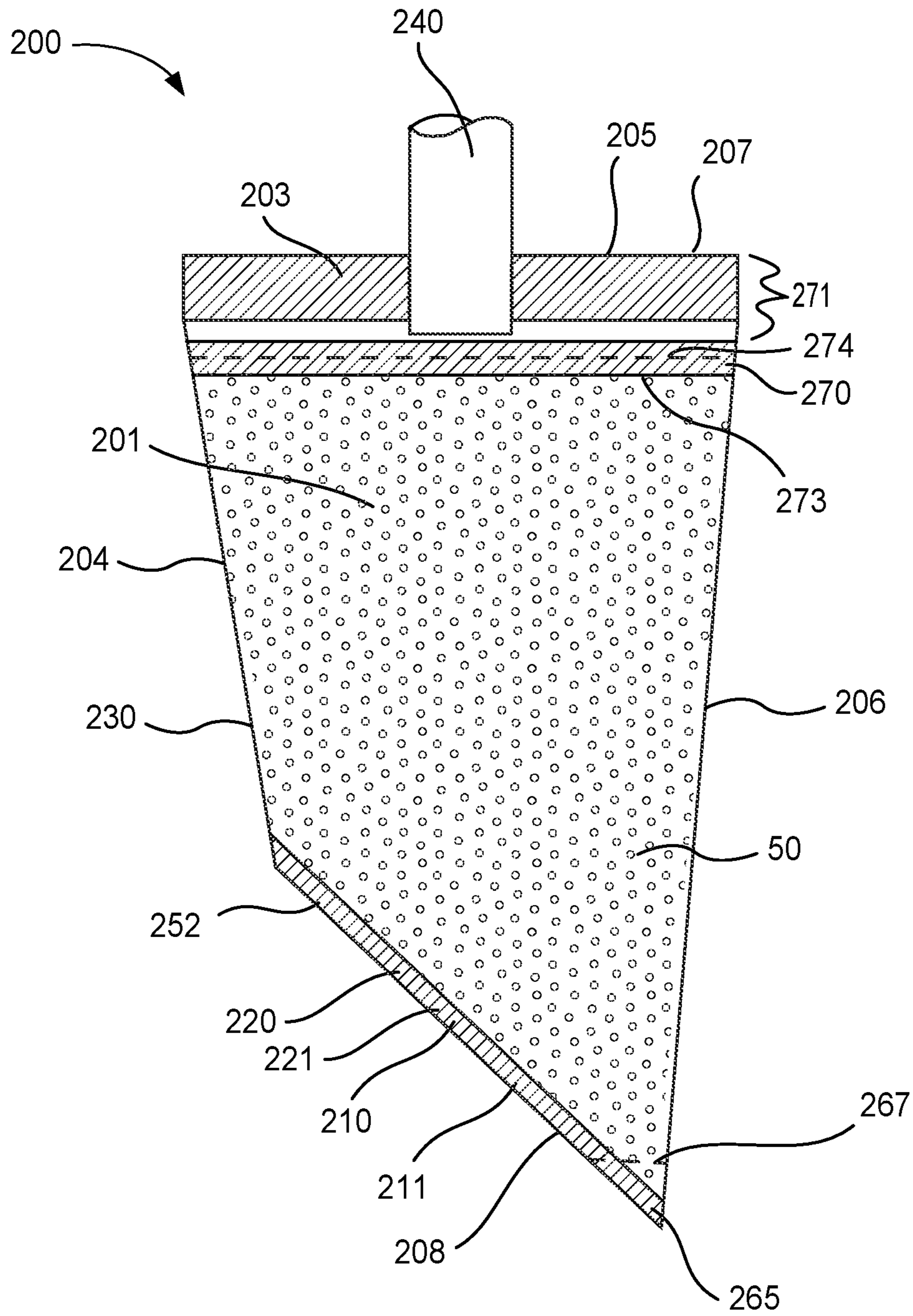


FIG. 2B

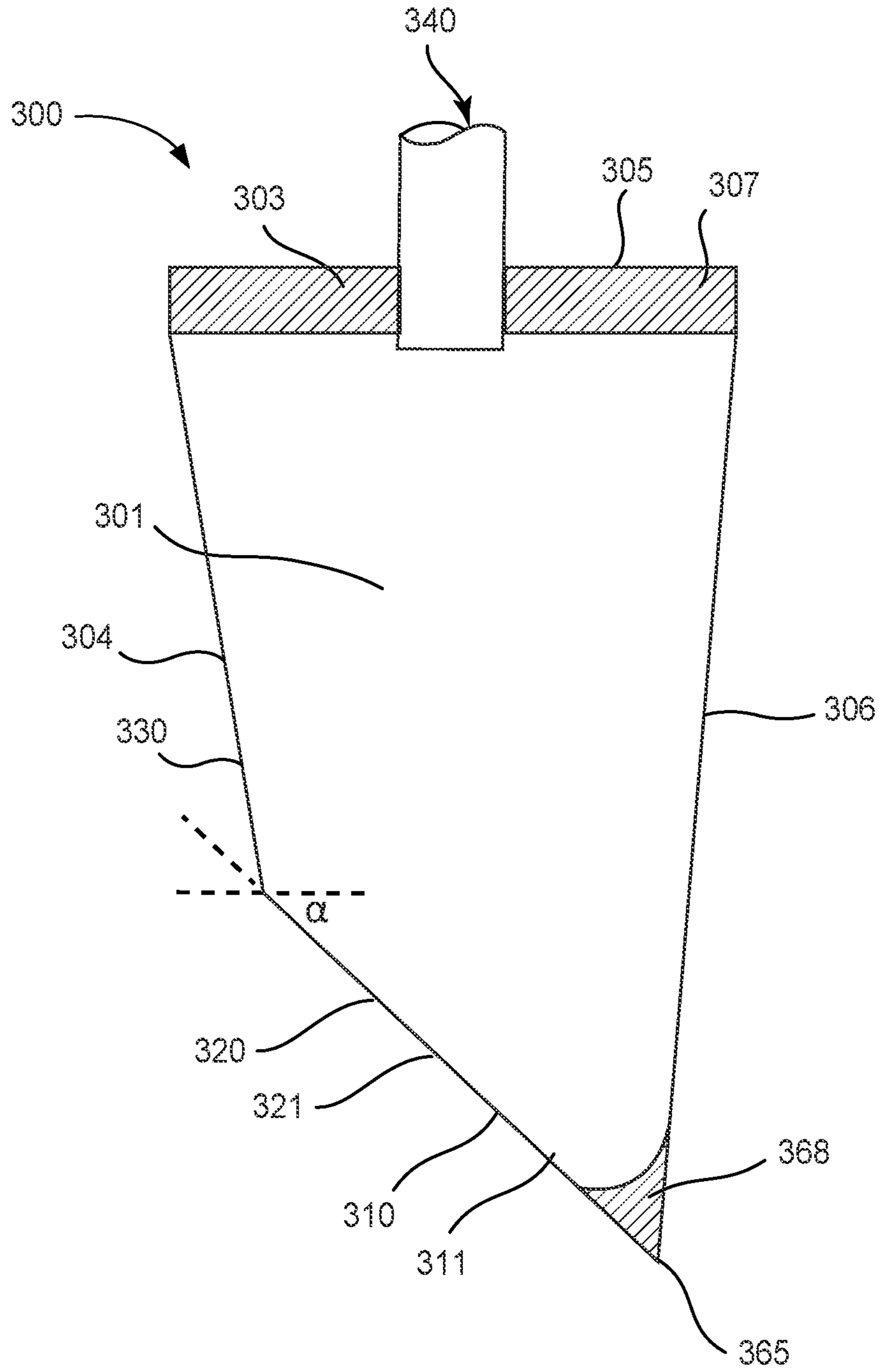


FIG. 3A

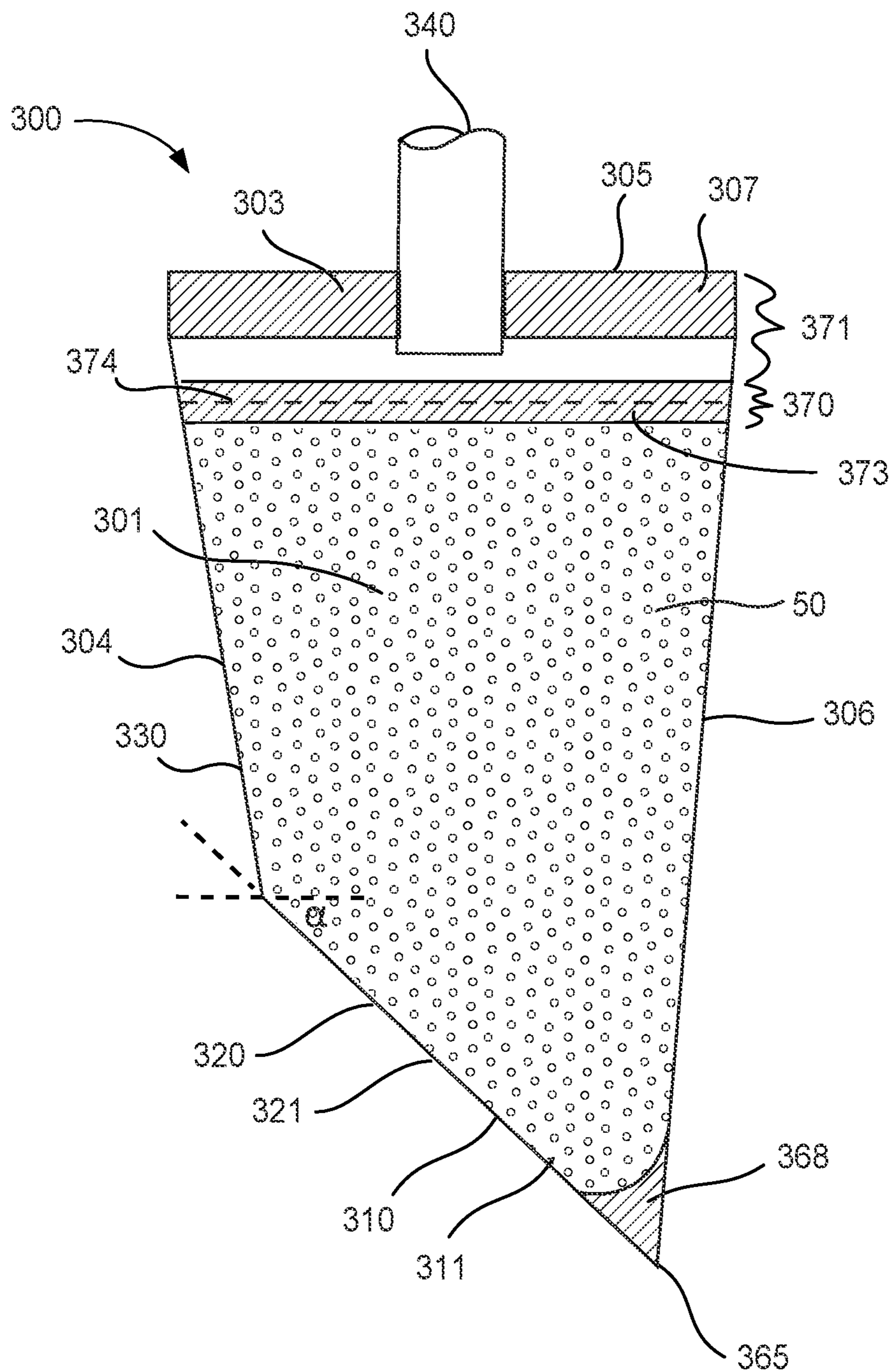


FIG. 3B

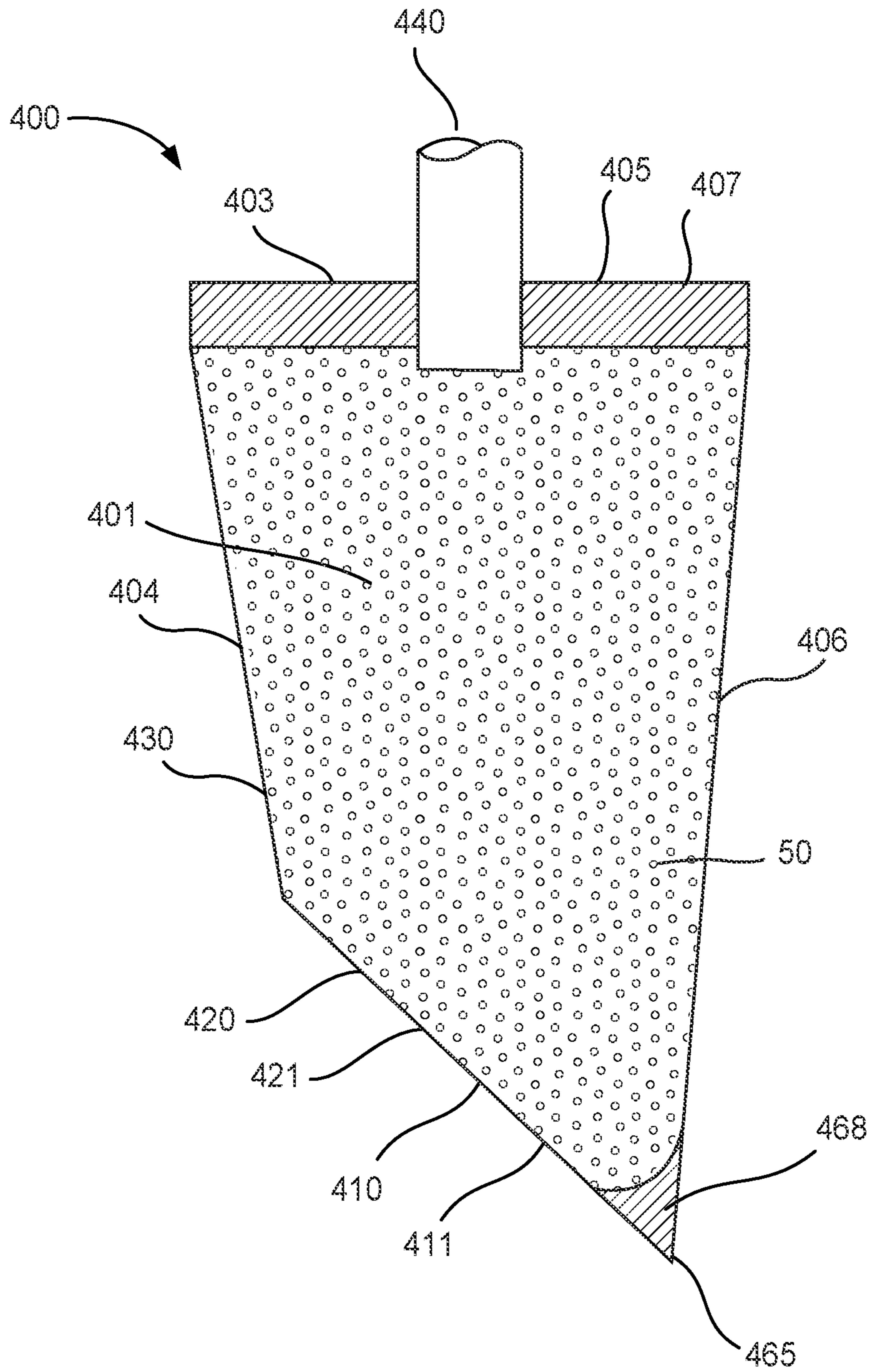


FIG. 4

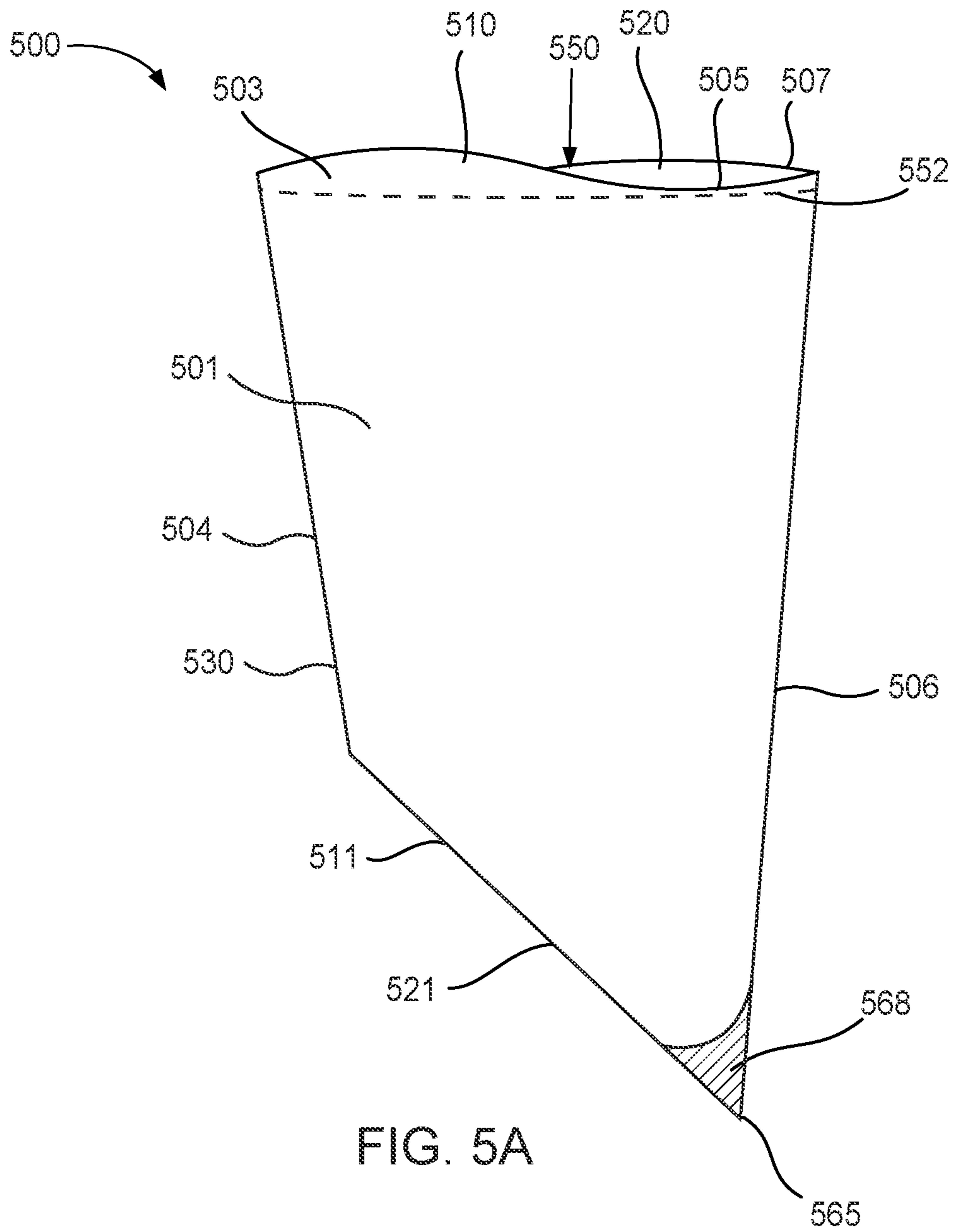
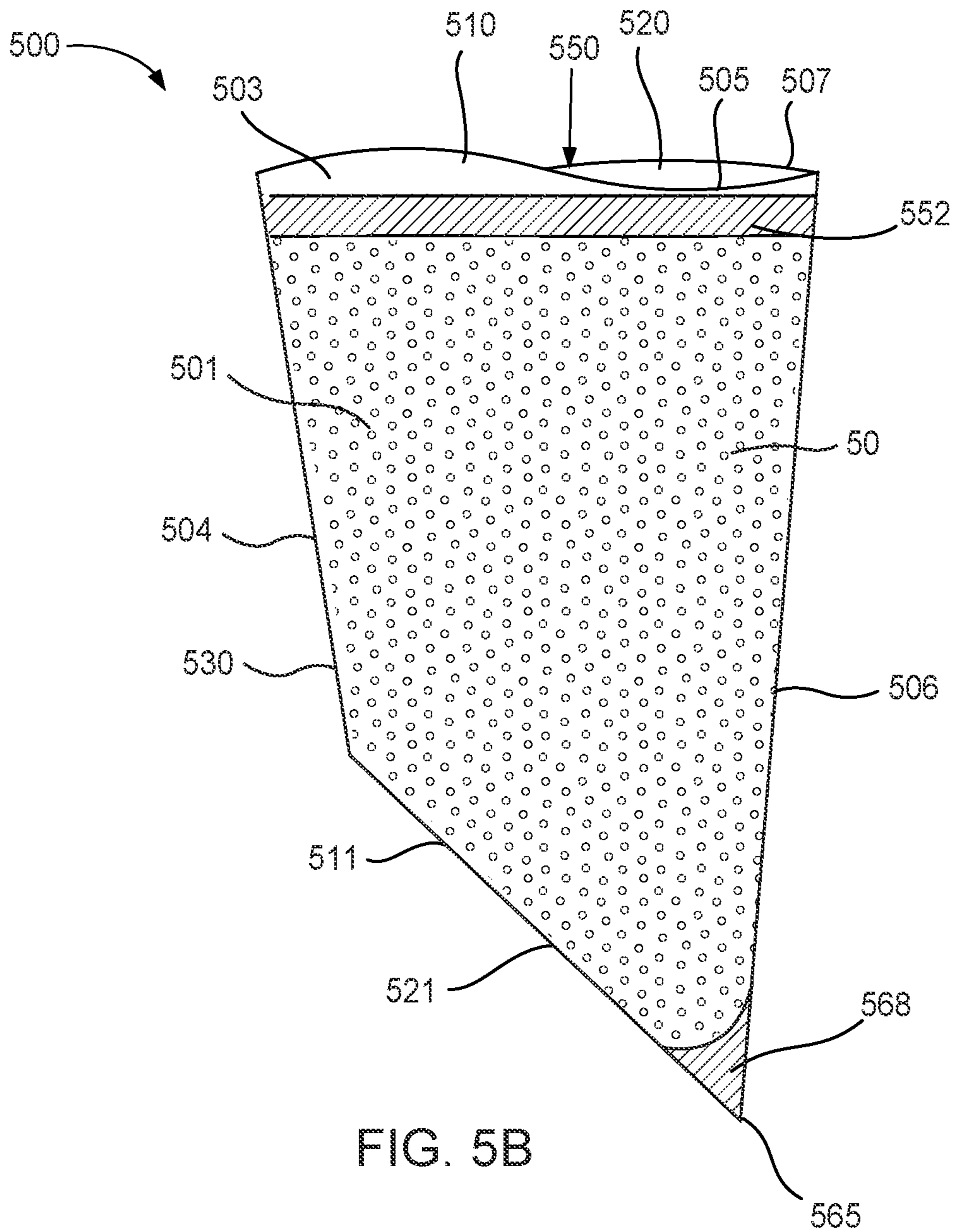


FIG. 5A



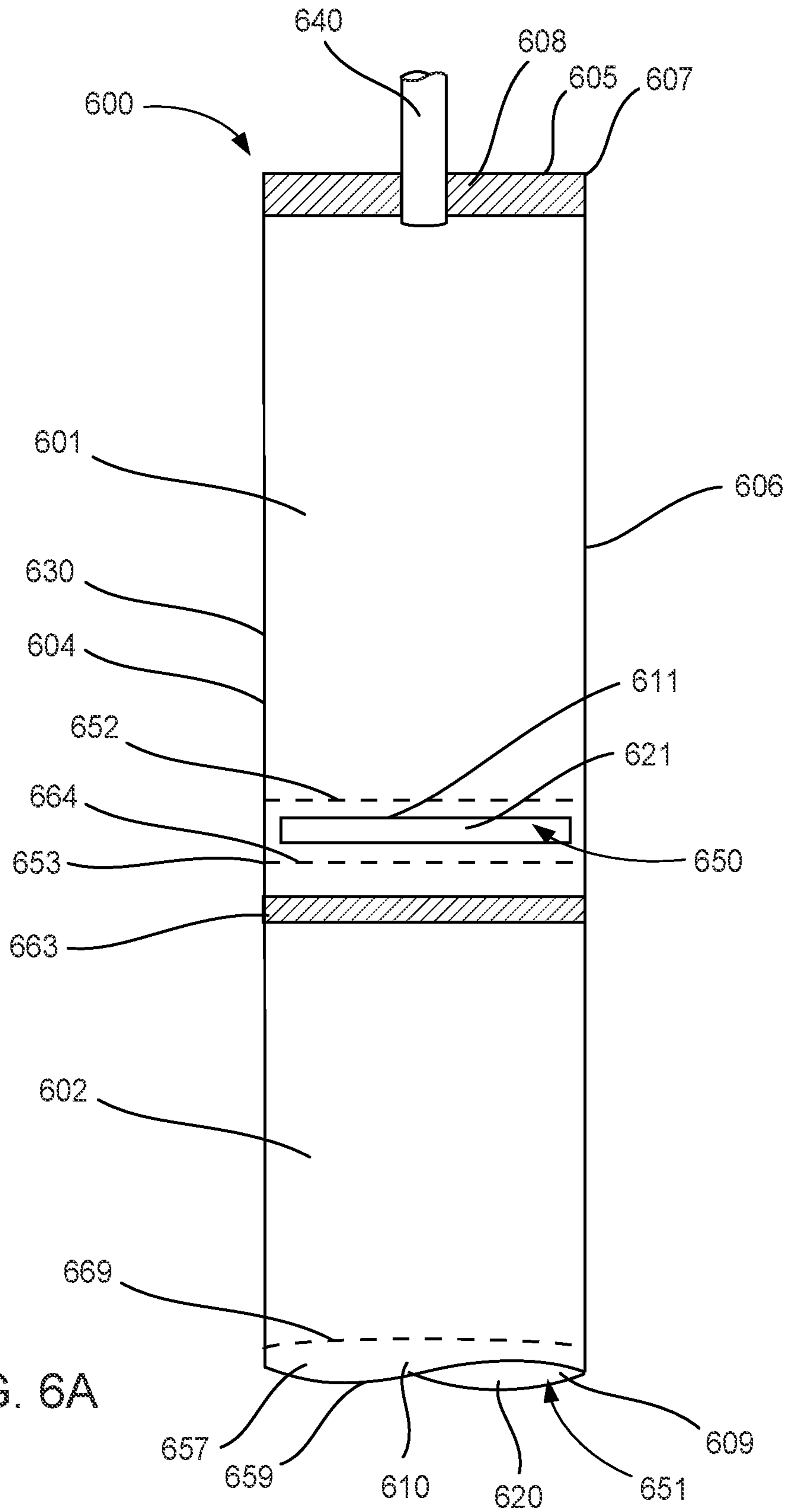


FIG. 6A

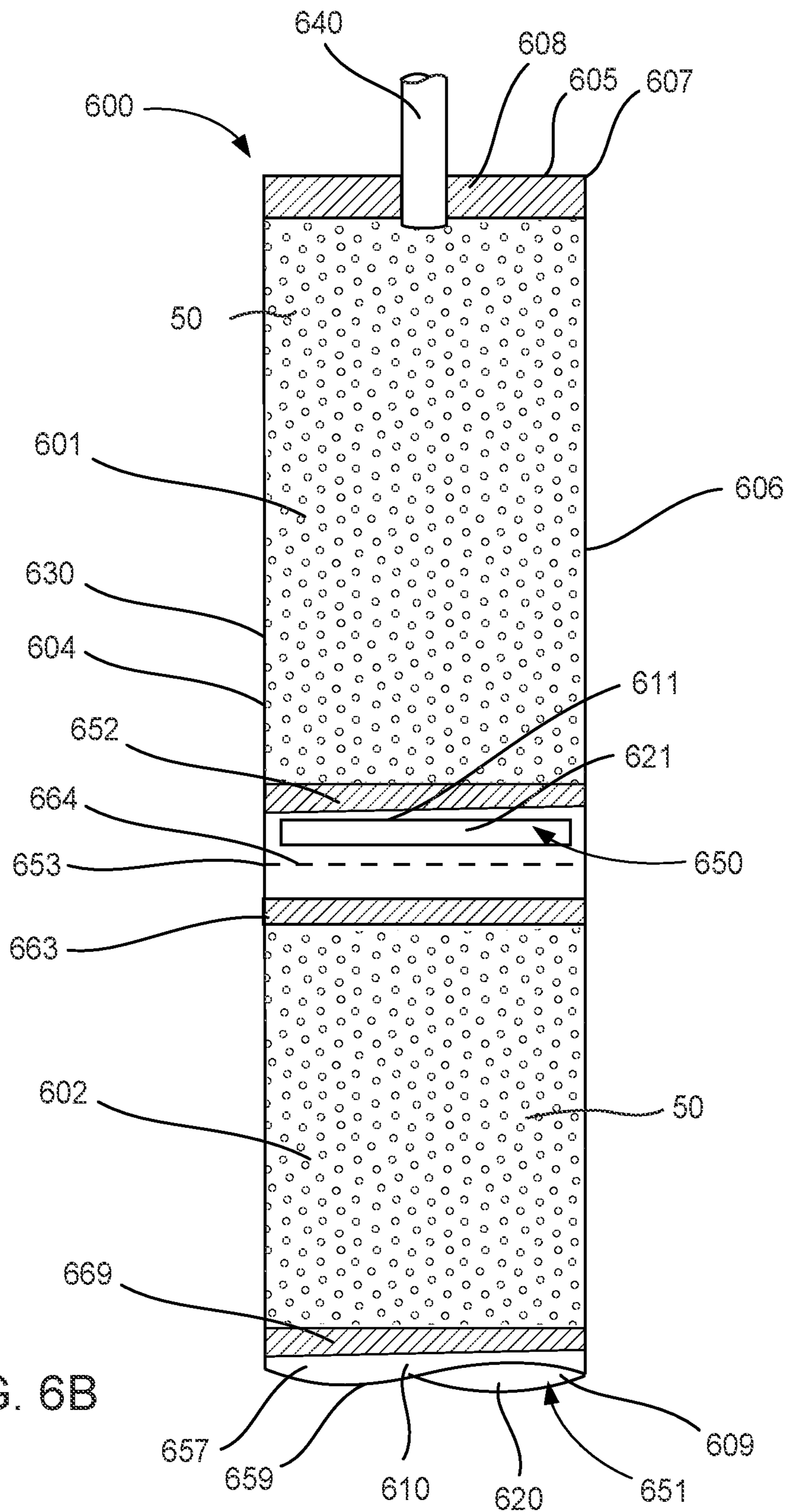


FIG. 6B

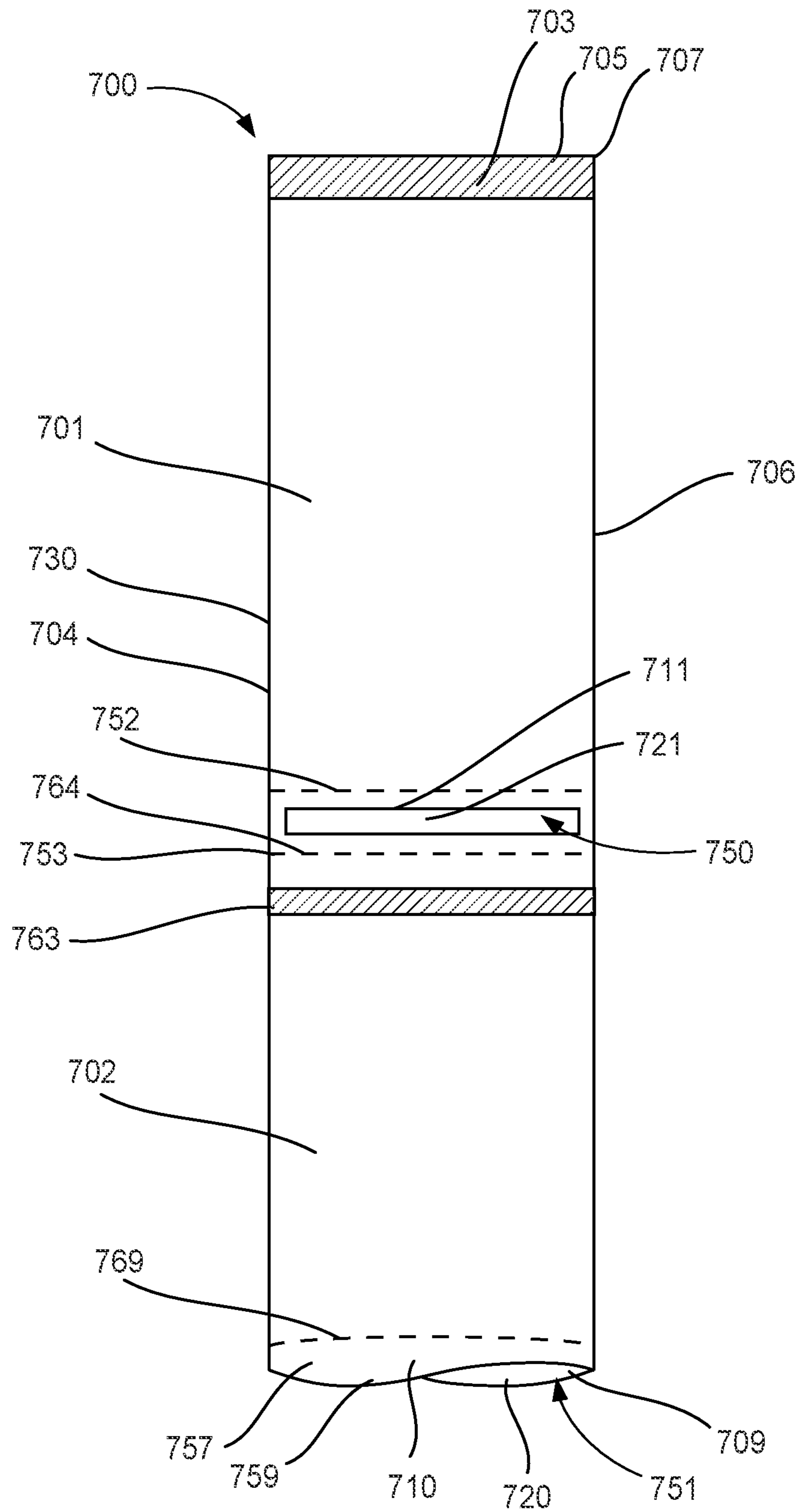


FIG. 7A

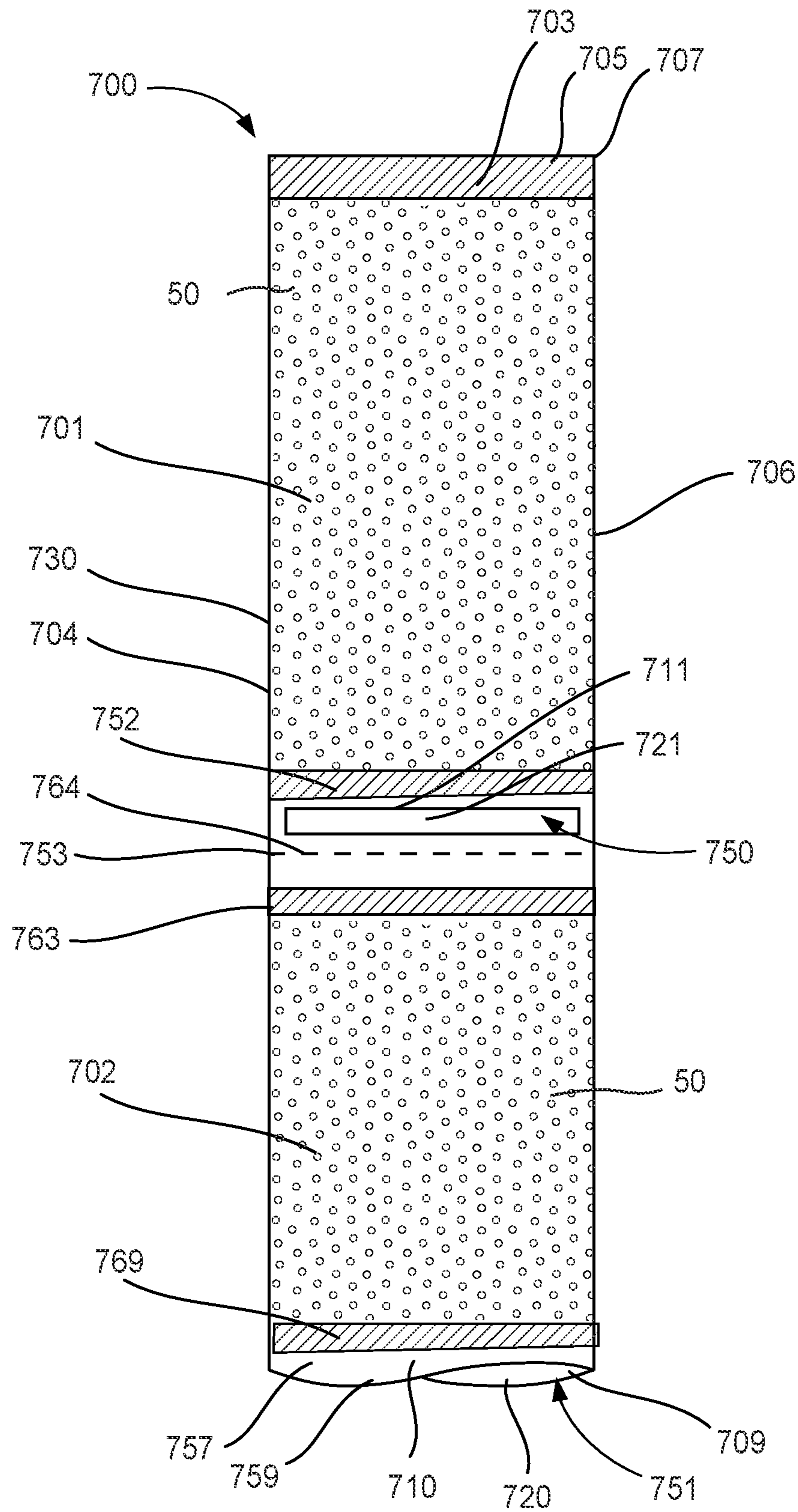


FIG. 7B

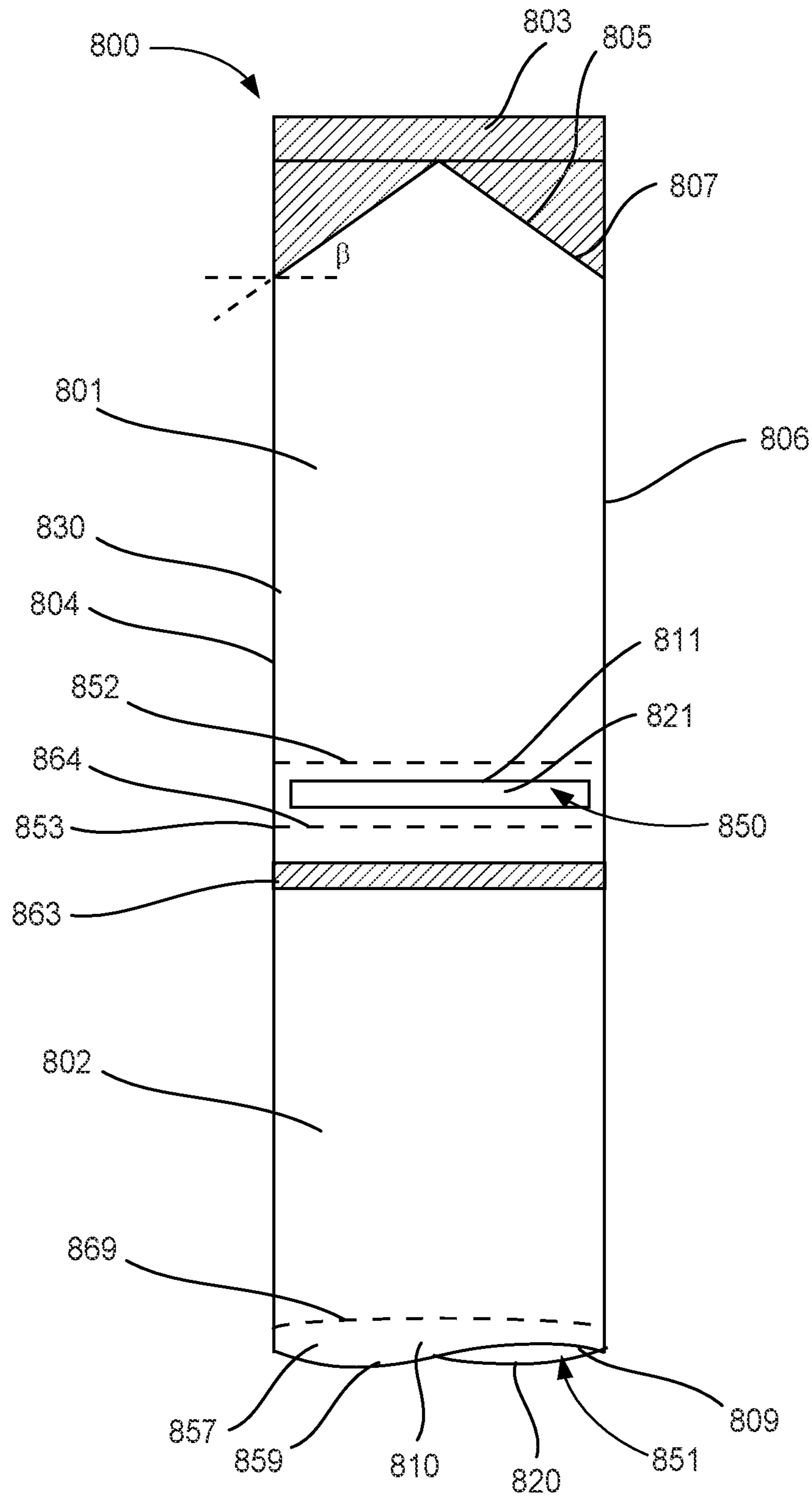


FIG. 8A

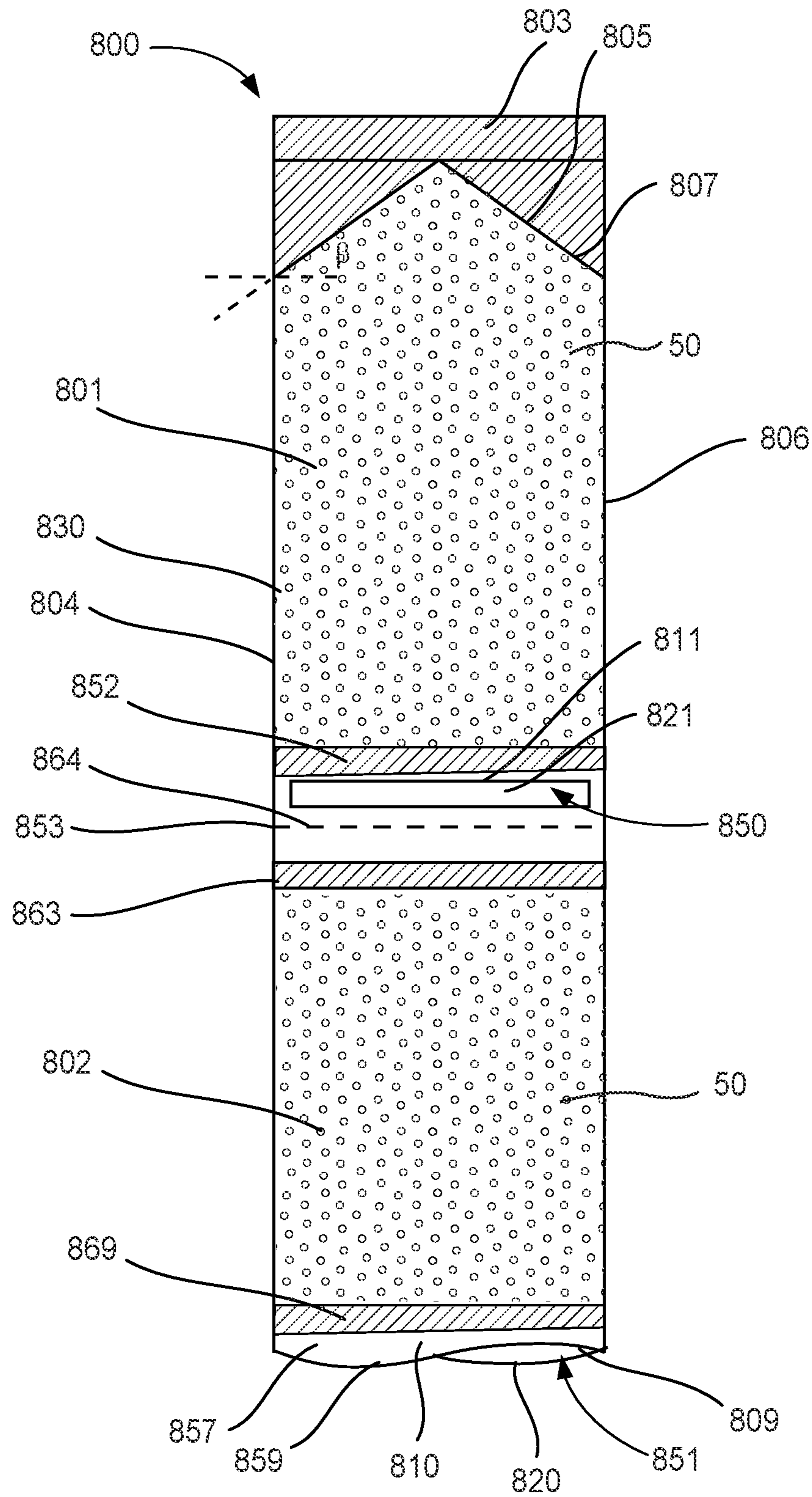


FIG. 8B

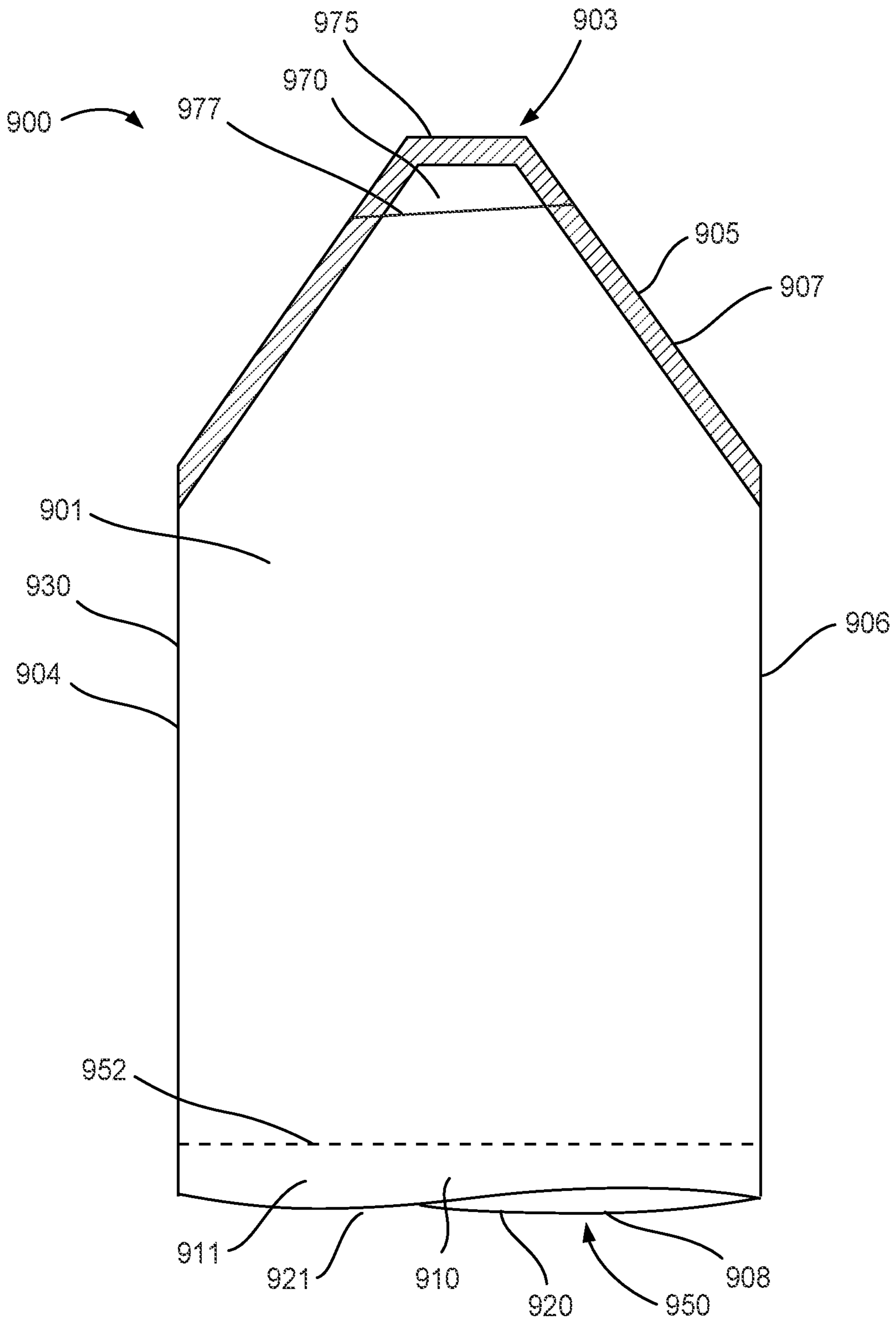


FIG. 9A

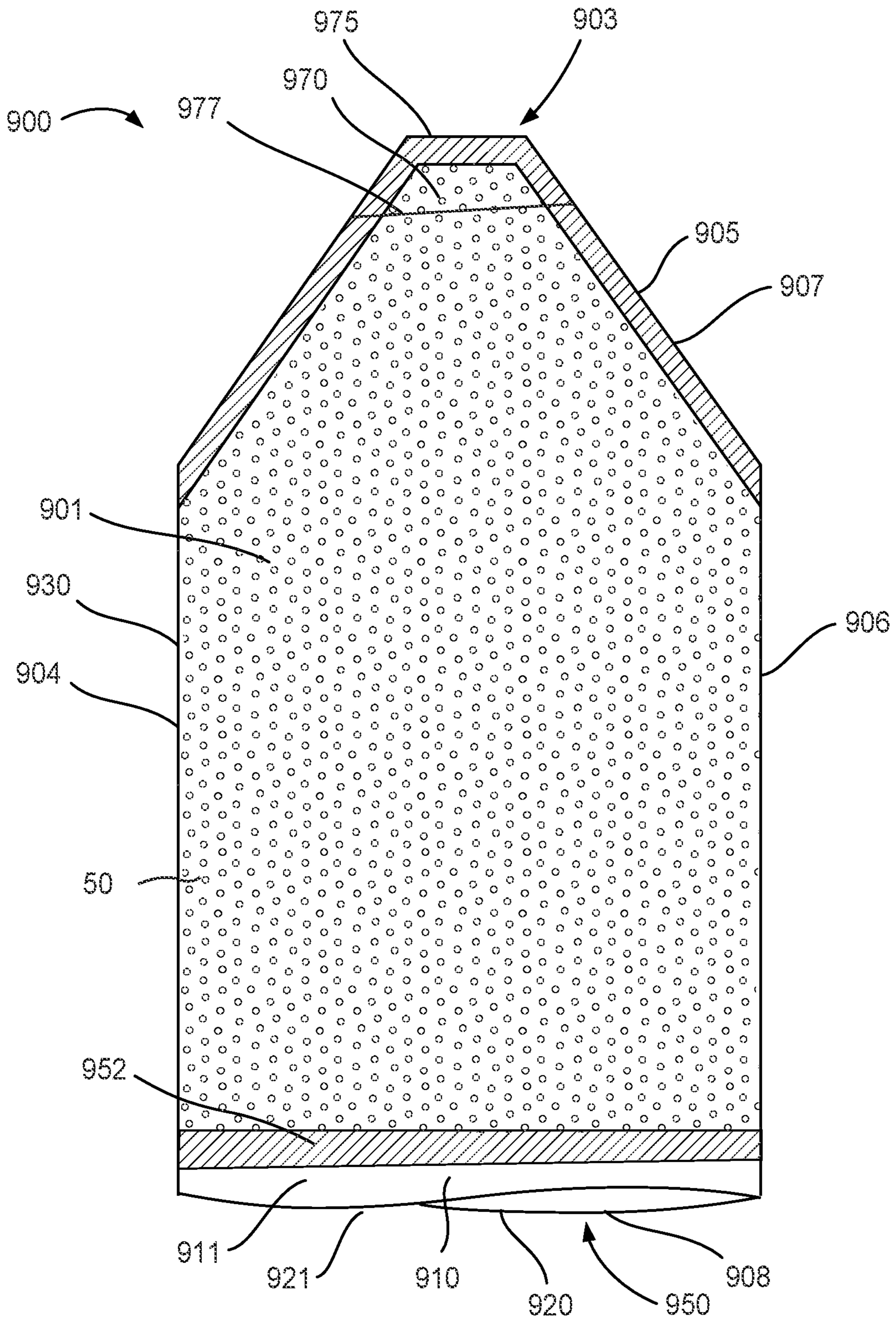


FIG. 9B

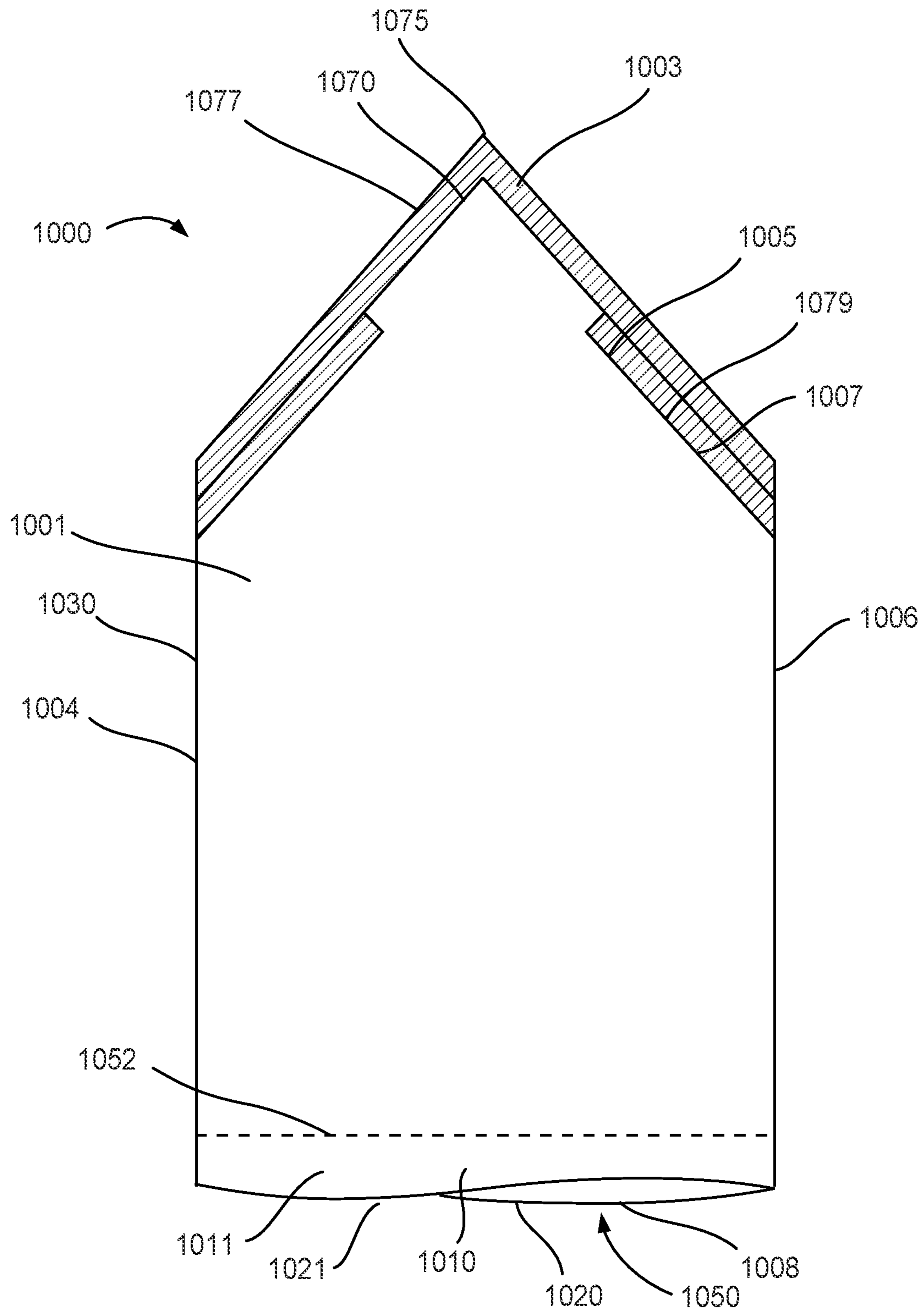


FIG. 10A

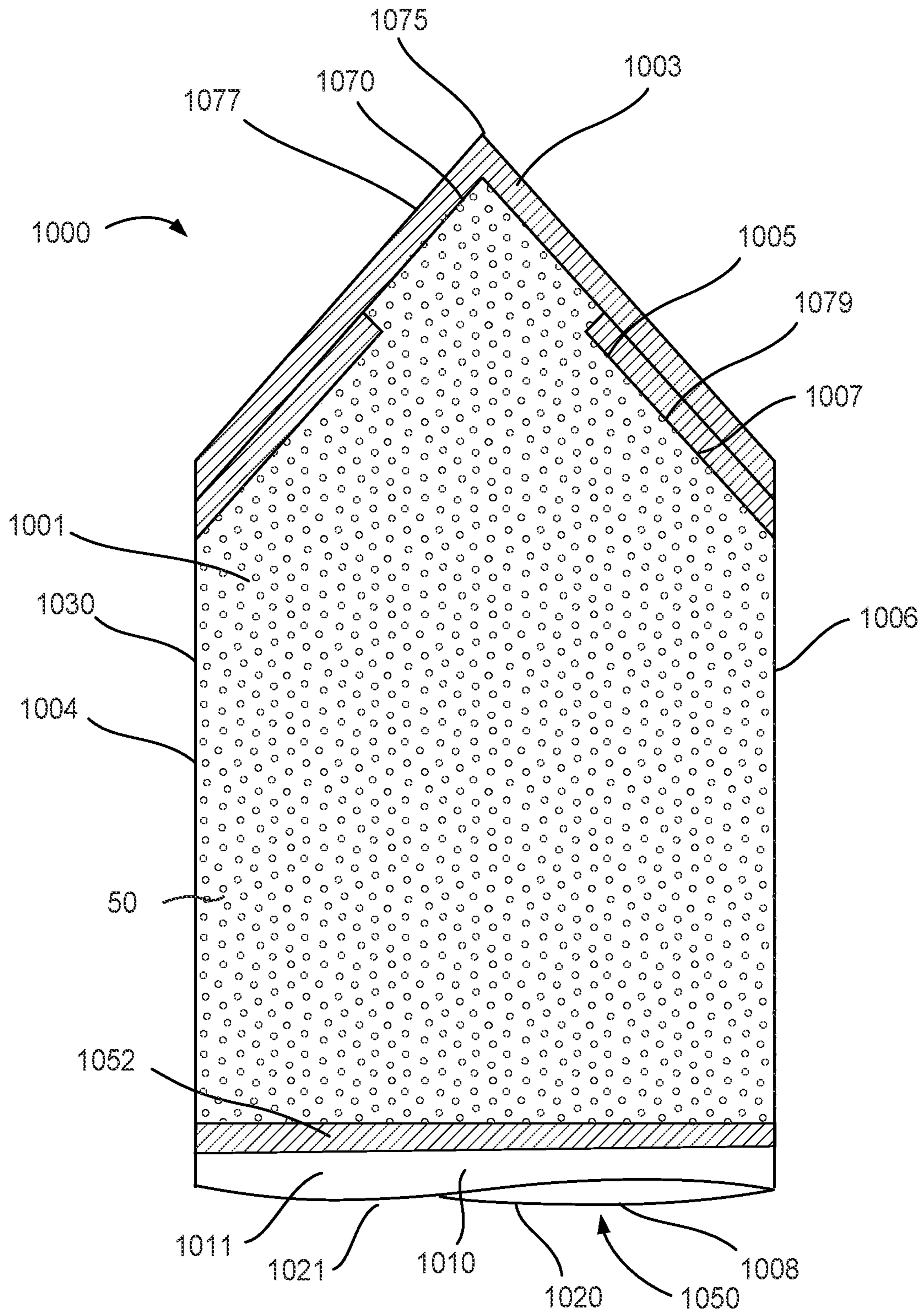


FIG. 10B

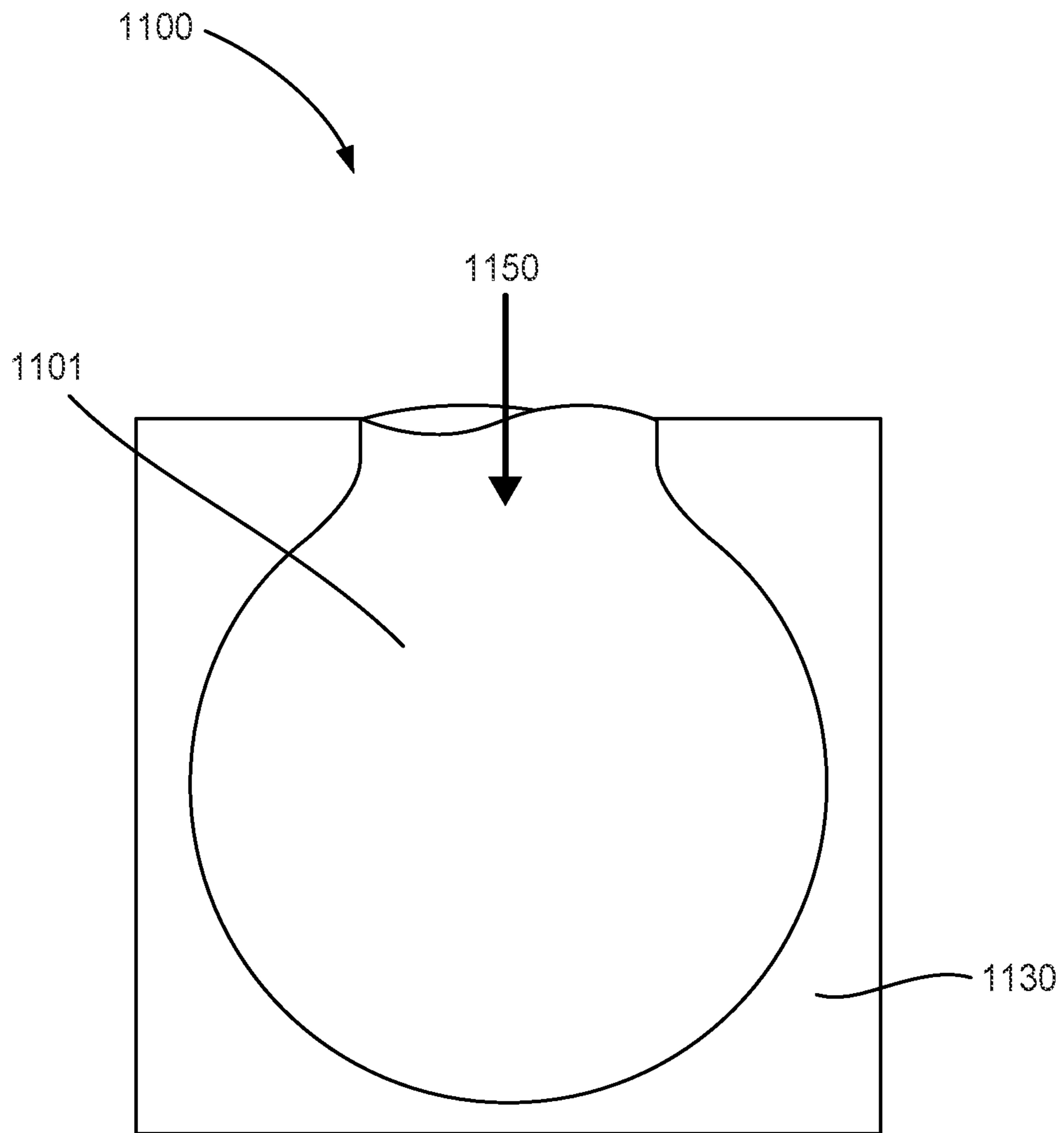
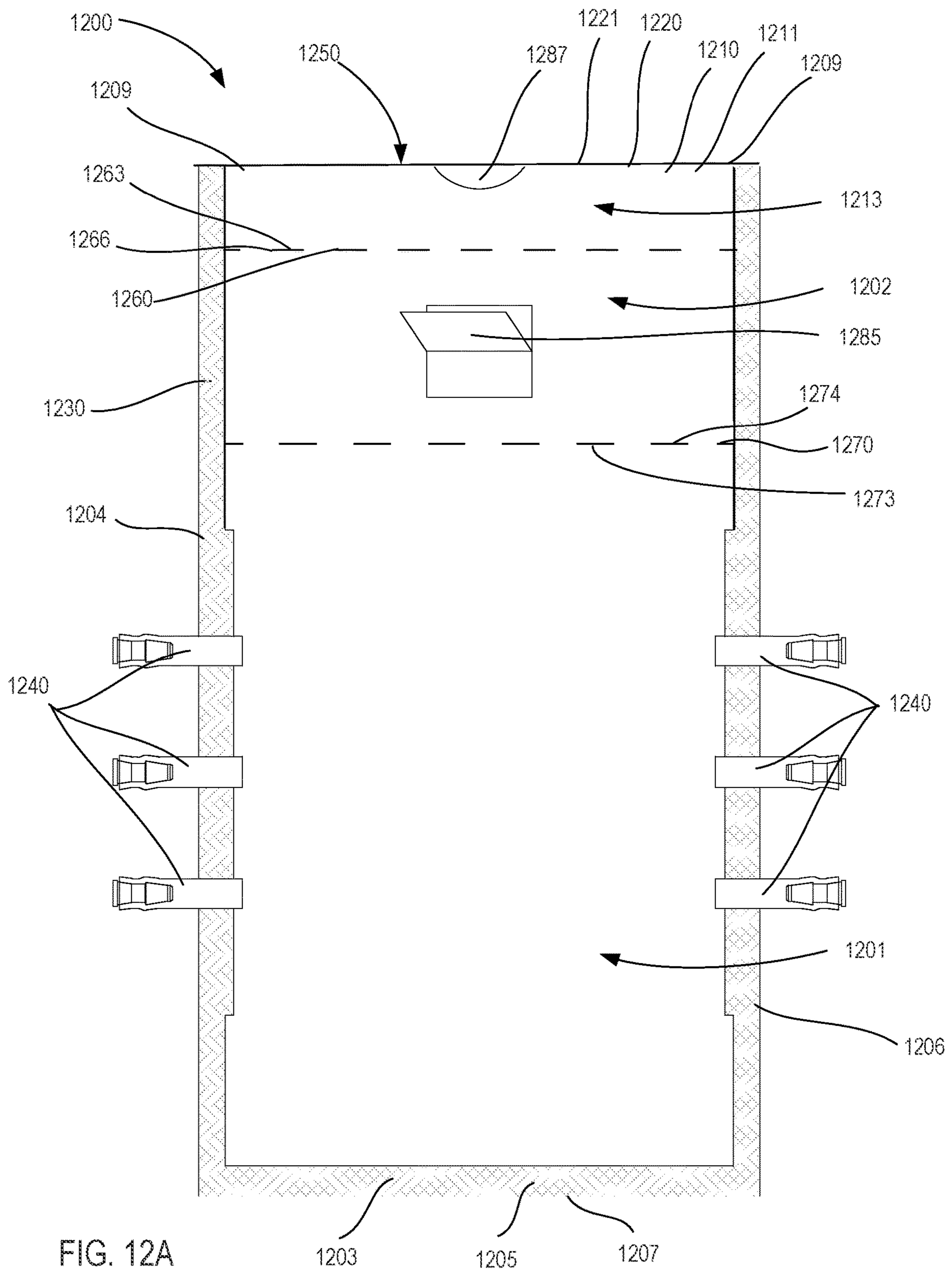


FIG. 11



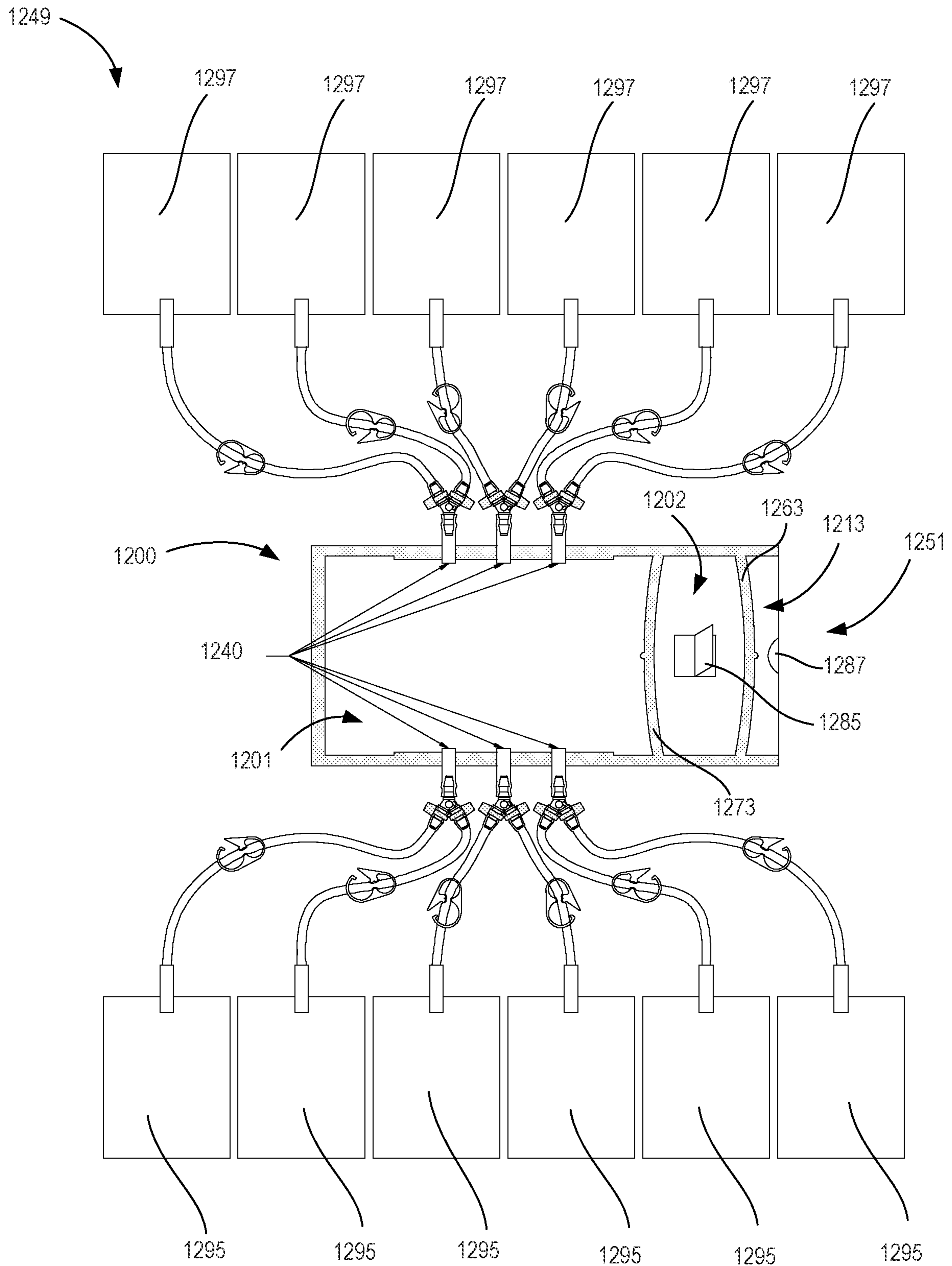


FIG. 12B

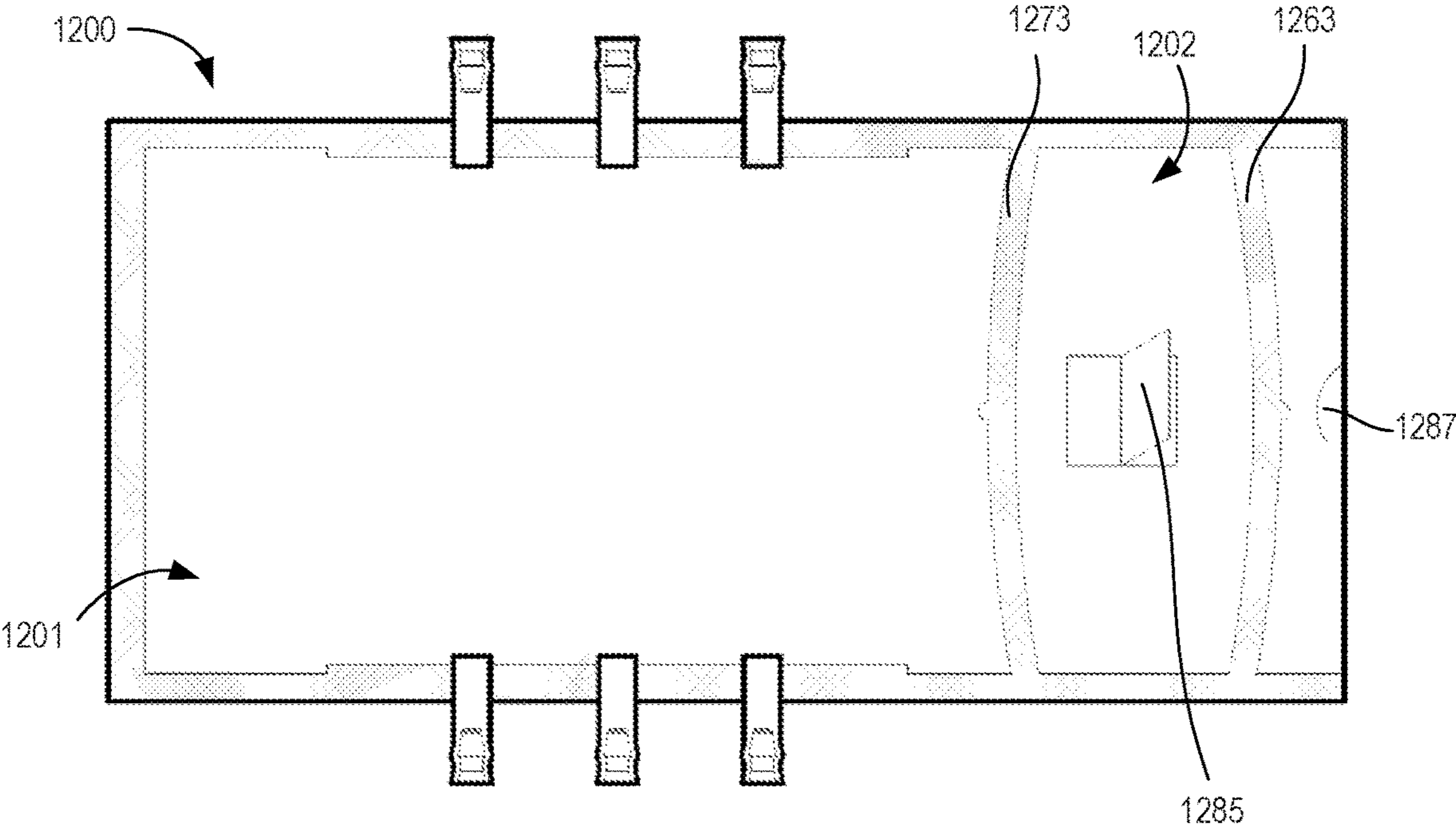


FIG. 12C

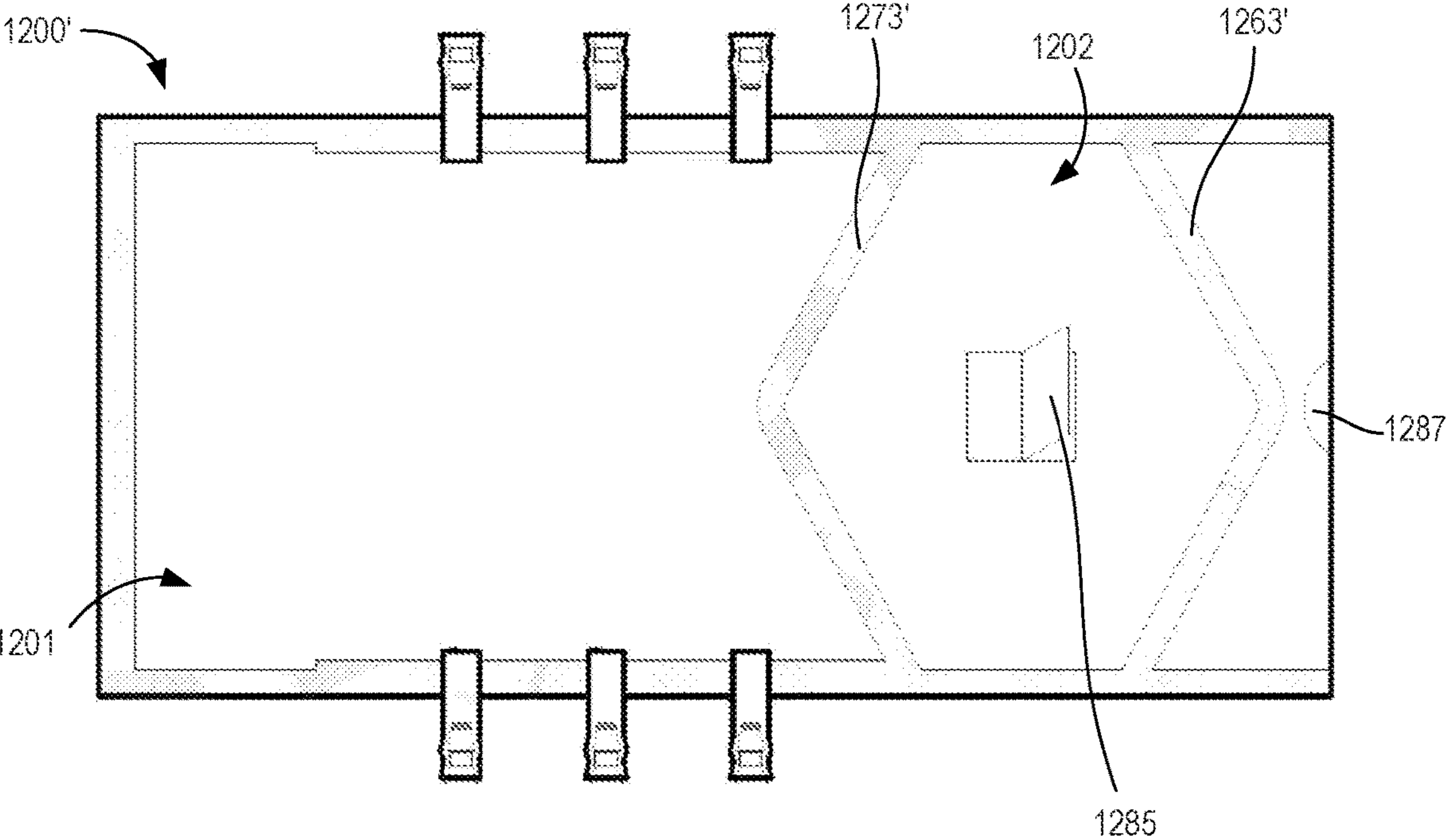


FIG. 12D

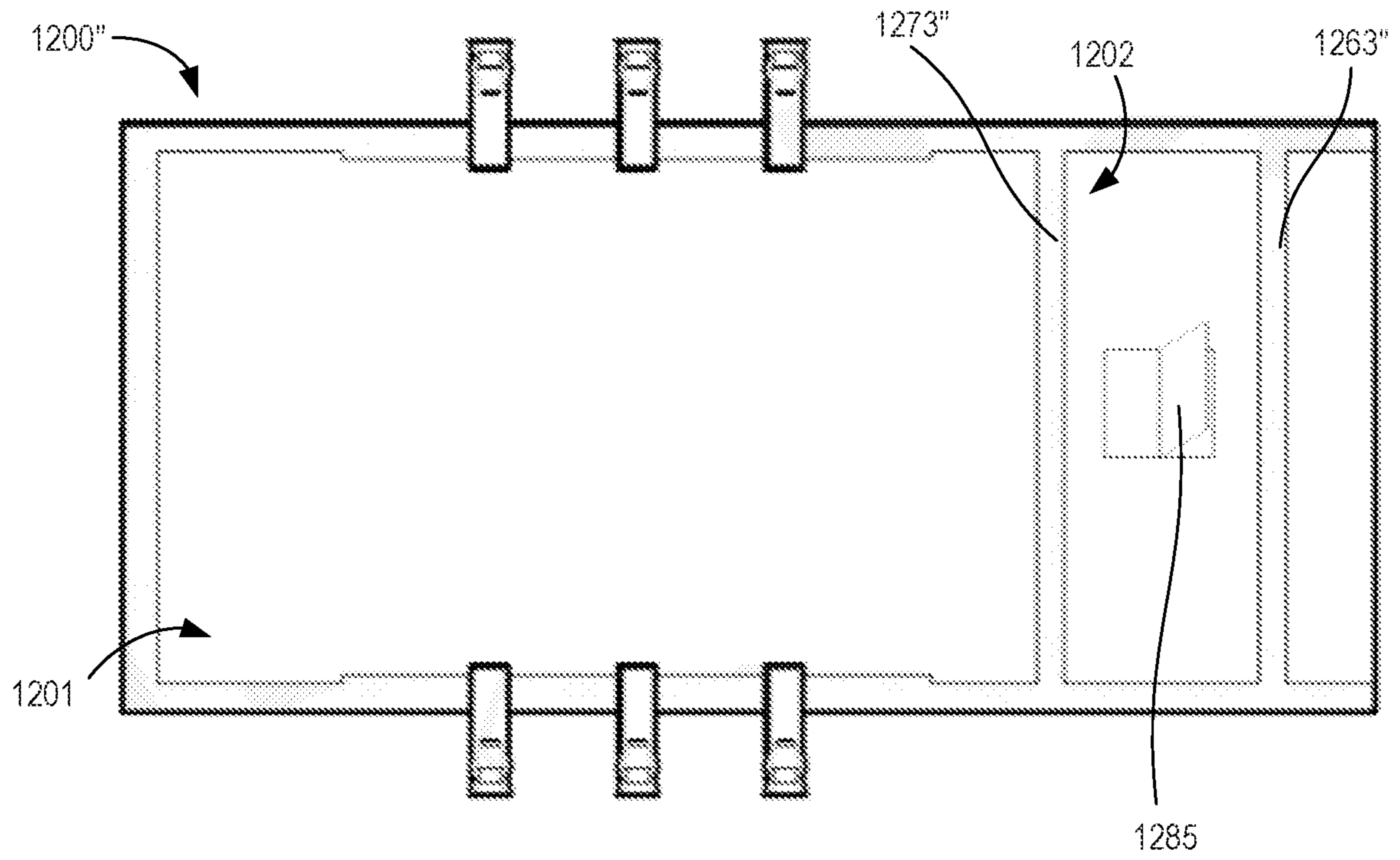


FIG. 12E

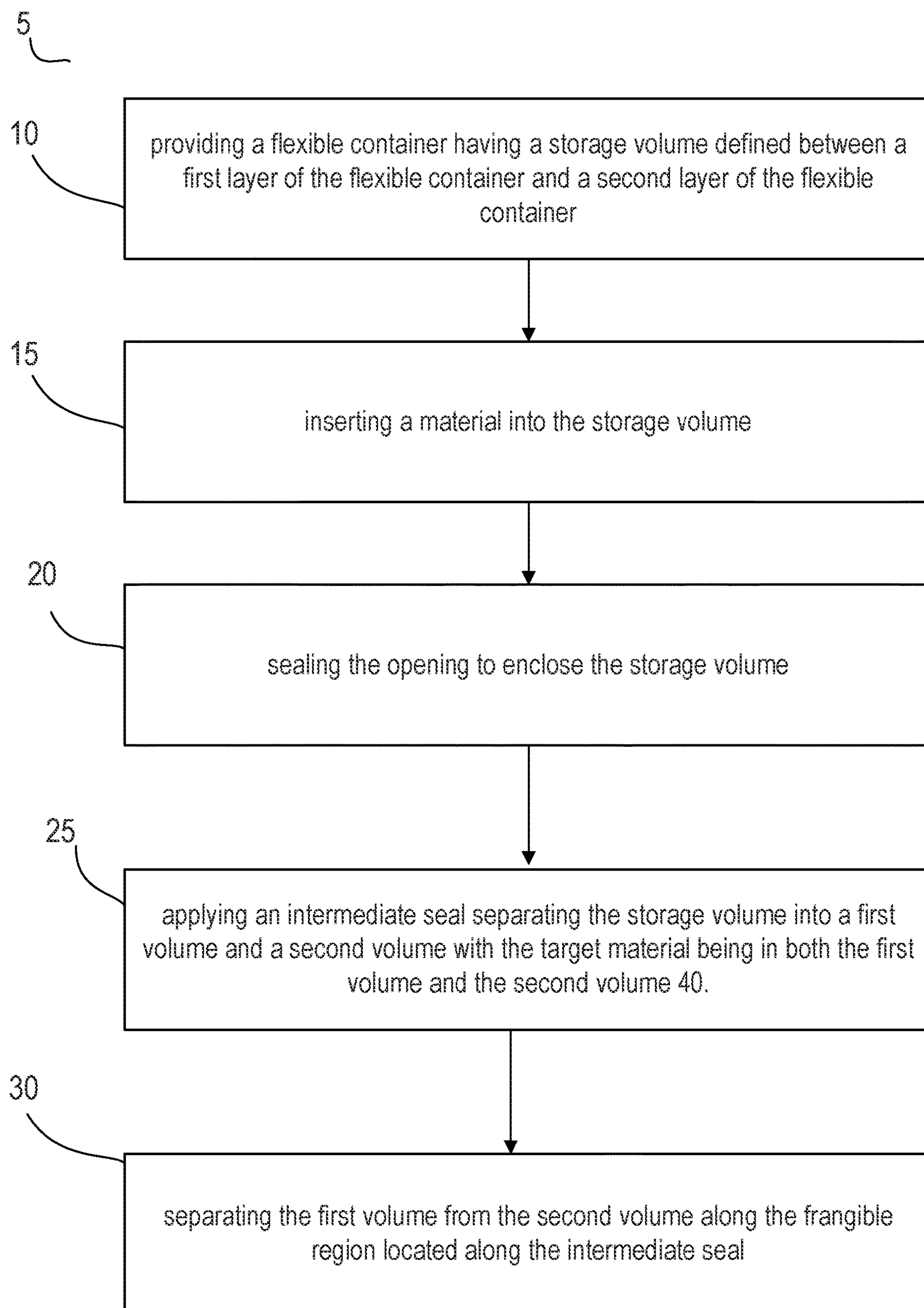


FIG. 13

1

CONTAINER WITH BIOLOGICAL MATERIALS HAVING MULTIPLE SEALED PORTIONS

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a U.S. national stage filing under 35 U.S.C. § 371 of International Application No. PCT/US2022/032931, filed Jun. 10, 2022, entitled “Container for Biological Materials Having Multiple Sealed Portions,” which claims priority to U.S. Provisional Application Ser. No. 63/209,712, entitled “Multi-Use Container for Biological Materials and Compounded Pharmaceuticals,” filed Jun. 11, 2021, each of which is incorporated herein by reference in its entirety.

BACKGROUND

The embodiments described herein relate to containers for storing, handling, packaging, and transporting material. Specifically, the embodiments described herein relate to containers for containing biological materials that have one or more seals that define multiple portions, some of which can be easily removed.

Known biological materials are used in a variety of procedures to perform medical procedures. Such procedures can include implanting bone or gum tissue to address dental or periodontal issues, bone grafting to repair fractures, and tendon grafting to repair damaged ligaments and/or tendons (e.g., repair of a torn anterior cruciate ligament), to name just a few. In many instances, the tissue implant is not taken from the patient’s body (i.e., is not an autograft), but rather is from another source, such as from a human cadaver (i.e., an allograft) or an animal (i.e., a xenograft). Known non-autologous grafts are often stored in a dried condition within a sterile package, and thus must be rehydrated or otherwise prepared prior to use.

Some known storage containers include a port that can be coupled to a tube set to allow fluids to be conveyed into or out of the container (e.g., to rehydrate the material stored within the container). In some instances, the port can also allow ingress or egress of flowable biological materials, such as bone chips, bone paste, blood, or cells (within a liquid medium). Many known ports include a tubular member that is sealed between opposing layers of material from which the container is constructed, and that extends from an end of the container. The inclusion of such ports increases the overall size of the container, thus such containers can require a greater volume for storage (e.g., for cold storage). This can reduce the storage capacity, which increases costs and decreases efficiency.

A port that extends from the end of the container, and which is often more rigid than the remainder of the container, can also contact surrounding structures during handling. For example, some known containers include ports that can catch on a shoulder or surface of storage containers or otherwise be subjected to external forces during handling. Accordingly, the port can be a point of failure for the container.

In addition to storing grafts, known containers are also used for storage, handling, and processing of blood, cells, and other liquid biological materials. Some cell processing and handling systems include multiple containers coupled together (e.g., via a tube set) so that desired amounts of the cells can be stored in separate locations. For example, some systems include different containers for holding harvested

2

cells removed from a culture that need to be washed separate from cells that have been washed and are ready for storage. Because some biologic materials, such as blood and cells, require quality testing of samples (e.g., to ensure that the materials are appropriate for the desired use), some known systems include separate containers for holding quality control (“QC”) samples separately from the primary storage container. In use, the QC containers are often filled separately from the primary storage container by switching valves, tubes, or other fluid pathways during processing. Such known systems and methods, however, can be cumbersome and time consuming to properly separate the QC sample. Moreover, such known system can sometimes result in errors in ensuring that the QC sample is associated with the primary portion of the material (e.g., due to errors in valving, switching tubes, and the like).

Thus, a need exists for improved containers and methods for storing, transporting, and/or processing, units of biological material including improving quality control of the materials, improving the robustness of the storage of the materials, and dispersing the materials from the storage containers. Additionally, a need exists for better quality control of materials stored in containers and containers that facilitate that quality control.

SUMMARY

Material storage systems are described herein along with containers and methods for storing materials including tissue and other biological materials. In some embodiments, the system includes a first layer and a second layer. The first layer and second layer are coupled together to form a container having a first end portion, a second end portion, a first edge between the first end portion and the second end portion, and a second edge between the first end portion and the second end portion, the first edge opposite the second edge. The system includes a plurality of seals coupling the first layer and the second layer together along at least the first end portion, the second end portion, the first edge, or the second edge to define a storage volume between the first layer and the second layer. The system includes a first opening into the storage volume, with the first opening being positioned at the first end portion. The system includes at least one intermediate seal extending between the first edge and the second edge that separates the storage volume into a first volume and a second volume. The intermediate seal is applicable after a material is introduced into the storage volume such that the target material is stored within the first volume and the second volume. The system includes a frangible region extending along the intermediate seal that allows for physical separation of the container into a first container portion that includes the first volume and a second container portion that includes the second volume.

In some embodiments, the frangible region includes any of a perforation, a tear notch, or a stress concentration riser. In some embodiments, the frangible region includes a stress riser in the first layer and the second layer to initiate a tear along the frangible region. In some embodiments, the frangible region includes a first perforation defined in the first layer and a second perforation defined in the second layer, the first perforation aligned with the second perforation. In some embodiments, a width of the intermediate seal is greater than a width of the frangible region. The frangible region is proximal to the second end portion and is configured to allow removal of the second container portion by hand (i.e., without any external tools, such as a cutting blade or scissors).

In some embodiments, a first seal of the plurality of seals is located along the first edge and a second seal of the plurality of seals is located along the second edge. The system includes a port positioned along the first end portion that defines the opening. In some embodiments, the first end portion includes an end portion seal and an end portion frangible region that is configured such that in response to separation at the end portion frangible region, the port is removed from the storage volume.

In some embodiments, the second end portion includes an end portion seal that is applicable after the material is introduced to the storage volume. The end portion seal fluidically isolates the second opening from the storage volume.

In some embodiments, either of the second edge or the second container portion includes a tapered portion. The tapered portion extends from the first end portion to the second end portion of the container. Alternatively, the tapered portion extends from an end of the second edge to a tip at the second end portion. The second container portion includes the length of the tapered portion. In some embodiments, the opening into the container is a first opening and the plurality of seals coupling the first layer and the second layer includes a peelable seal at the tip. The peelable seal is configured such that the first layer can be peeled away from the second layer to produce a second opening at the tip.

In some embodiments, the first volume or the second volume are partially defined by one or more of the plurality of seals and the intermediate seal completes a closure to fully isolate the first volume and the second volume from one another. The frangible region is proximal to the second end portion and is configured to remove the tapered portion while maintaining the plurality of seals of the first container portion and the second container portion keeping them enclosed.

In some embodiments, the first volume is larger than the second volume. The first volume is more than twice the size of the second volume. In some embodiments, both the first volume and the second volume include regions that are openable to remove the material from each of the first volume and the second volume. The first volume includes a port and the second volume include a peelable region. The second container portion includes a plurality of graduated markings that indicate quantity of the material stored therein. The second volume is larger than the first volume.

In some embodiments, the first container portion includes a first indicium associated with the target material and the second container portion includes a second indicium associated with at least one of the first indicium, the first container portion, or the target material.

In some embodiments, the second volume includes a plurality of ports extending to an exterior of the container. At least one of the first layer or the second layer includes a separation tab extending from an exterior portion of the first layer or the second layer and oriented such that a user can grip the tab and separate the first layer from the second layer.

In some embodiments, a storage container includes a first layer and a second layer. The first layer and second layer are coupled together to form a container having a first end portion, a second end portion, a first edge between the first end portion and the second end portion, and a second edge between the first end portion and the second end portion. The first edge is opposite the second edge. The storage container includes a plurality of seals coupling the first layer and the second layer together along at least the first end portion, the second end portion, the first edge, or the second edge to define a storage volume between the first layer and the

second layer. The storage container includes a port coupled to the first end portion of the container that defines an opening into the storage volume. The storage container includes an end portion seal at the first end portion of the container that fluidically isolates the port from the storage volume. The storage container includes an end portion frangible region extending between the first edge and the second edge along of the end portion seal. The end portion frangible region is configured for physically separating the port from the storage volume while keeping the storage volume isolated.

In some embodiments, the storage container includes an at least one intermediate seal extending between the first edge and the second edge, the storage volume being separable into a first volume and a second volume by the at least one intermediate seal. The intermediate seal is applicable after a material is introduced into the storage volume. The storage container includes an intermediate frangible region extending along the at least one intermediate seal that allows for physical separation between the first volume and the second volume defining a first container portion storing the material and a second container portion storing the material. The first volume or the second volume are partially defined by one or more of the plurality of seals and the at least one intermediate seal completes a closure to fully isolate the first volume and the second volume from one another. The intermediate frangible region includes a stress riser in the first layer and the second layer to initiate a tear along the intermediate frangible region.

In some embodiments, the second end portion includes an end portion seal that is applicable after the material is introduced to the storage volume. The end portion seal is a peelable seal. The storage container tapers along the second edge extending from the first end portion to the second end portion. The storage container tapers from an end of the second edge to the second end portion. The second container portion includes the length of the tapered portion of the storage container.

In some embodiments, the frangible region is proximal to the second end portion and is configured to remove the tapered portion forming an opening into the first container portion. The end portion frangible region is proximal to the second end portion and is configured to remove the tapered portion while maintaining the plurality of seals keeping the first container portion and the second container portion enclosed.

In some embodiments, the tapered region includes graduated markings that indicate quantity of a material stored therein. The second volume is larger than the first volume. The second volume includes a plurality of ports extending to an exterior of the container. At least one of the first layer or the second layer includes a separation tab extending from an exterior portion of the first layer or the second layer and oriented such that a user can grip the tab and separate the first layer from the second layer.

In some embodiments, a method of storing a material includes providing a storage container having a storage volume defined between a first layer of the storage container and a second layer of the storage container. The storage container includes an opening. The method includes inserting the material into the storage volume via the opening. The method includes sealing the opening to enclose the storage volume. The method includes applying an intermediate seal separating the storage volume into a first volume and a second volume with the material being in both the first volume and the second volume. In some embodiments, the storage container includes a frangible region along the

5

intermediate seal allowing the first volume and the second volume to be physically separated by hand along the frangible region. The method optionally includes separating the first volume from the second volume along the frangible region located along the intermediate seal. Additionally, or alternatively, the method can include separating and storing the second volume for future reference to the material stored therein. This allows ongoing testing and verification of the material to understand what material was used in the first volume. Additionally, or alternatively, the method can include dispensing the material from either the first volume or the second volume. The material can be used, tested, or stored. Since both volumes contain materials that match the other volume, one can serve as a reference material after the other volume is used.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1A is a schematic illustration of a storage container according to an embodiment.

FIG. 1B is a schematic illustration of the storage container according to FIG. 1A filled with a material.

FIG. 1C is a schematic illustration of the storage container according to FIG. 1A with an intermediate seal.

FIG. 1D is a schematic illustration of the storage container according to FIG. 1A showing a first volume and second volume separated.

FIG. 1E is a schematic illustration of the storage container according to FIG. 1A showing dispensing the material from the second volume.

FIG. 2A is a schematic illustration of a storage container according to another embodiment in a first configuration.

FIG. 2B is a schematic illustration of the storage container of FIG. 2A in a second configuration.

FIG. 3A is a schematic illustration of a storage container according to another embodiment in a first configuration.

FIG. 3B is a schematic illustration of the storage container of FIG. 3A in a second configuration.

FIG. 4 is a schematic illustration of a storage container according to another embodiment.

FIG. 5A is a schematic illustration of a storage container according to another embodiment in a first configuration.

FIG. 5B is a schematic illustration of the storage container of FIG. 5A in a second configuration.

FIG. 6A is a schematic illustration of a storage container according to another embodiment in a first configuration.

FIG. 6B is a schematic illustration of the storage container of FIG. 6A in a second configuration.

FIG. 7A is a schematic illustration of a storage container according to another embodiment in a first configuration.

FIG. 7B is a schematic illustration of the storage container of FIG. 7A in a second configuration.

FIG. 8A is a schematic illustration of a storage container according to another embodiment in a first configuration.

FIG. 8B is a schematic illustration of the storage container of FIG. 8A in a second configuration.

FIG. 9A is a schematic illustration of a storage container according to another embodiment in a first configuration.

FIG. 9B is a schematic illustration of the storage container of FIG. 9A in a second configuration.

FIG. 10A is a schematic illustration of a storage container according to another embodiment in a first configuration.

FIG. 10B is a schematic illustration of the storage container of FIG. 10A in a second configuration.

FIG. 11 is a schematic illustration of a storage container according to another embodiment.

6

FIG. 12A is a schematic illustration of a storage container according to another embodiment.

FIG. 12B is a schematic illustration of a material preparation system including the of the storage container of FIG. 12A in accordance with one embodiment.

FIG. 12C is a schematic illustration of a storage container according to another embodiment.

FIG. 12D is a schematic illustration of a storage container according to another embodiment.

FIG. 12E is a schematic illustration of a storage container according to another embodiment.

FIG. 13 is a flow chart illustrating a method of using a storage container system.

DETAILED DESCRIPTION

The embodiments described herein related to a storage container that can advantageously be used with a wide variety of materials for transportation, processing and/or implantation operations associated with the materials. In particular, the storage containers described herein can allow for material (e.g., a tissue specimen, biologic material, etc.) to be loaded and sealed at the point of loading (e.g., a tissue bank, a cell culturing system, or the like). The storage containers described herein can further facilitate efficient transportation and storage of the materials therein by allowing a port or other portions of the container to be removed while maintaining the stored material in a hermetically sealed (or fluidically isolated) condition. The storage containers described herein can further facilitate quality control ("QC") testing and record keeping of QC test results by allowing a predetermined volume of the storage container to be removed from the primary storage portion after the container has been filled with the material.

In some embodiments, multiple stored product can be stored within respective storage volumes of the storage container, transported together as part of the same storage container, and frozen together as part of the same storage container (e.g., cryogenically frozen down to about -200° C.). In some embodiments, the entire storage container is thawed. In some embodiments, one or more of the separable storage container portions of the storage container can be removed from the storage container and processed individually (e.g., thawed, subjected to QC testing, stored in a sample record keeping facility). In some embodiments, unused separable storage containers of the storage container can be re-frozen, transported to a different facility, or otherwise maintained for viable use. In some embodiments the storage container can be inserted into an overwrap or into one separable storage containers of a multi-chamber overwrap assembly.

In some embodiments, a method of rehydrating a tissue specimen includes conveying a rehydration fluid into a storage volume defined between a first layer of a storage container and a second layer of the storage container. The rehydration fluid is conveyed via a port coupled to the storage container. The storage volume contains a tissue specimen hermetically sealed therein, and, in some embodiments, the tissue specimen is supported by a support structure. A stiffness of the support structure is greater than each of a stiffness of the first layer and a stiffness of the second layer. The rehydration fluid is maintained within the storage volume to rehydrate the tissue specimen. The first layer is then peeled from the second layer to expose the storage volume. The method further includes removing the rehydrated tissue specimen from the storage volume after the first layer is peeled.

In some embodiments, a method of processing a biologic material (e.g., cells, blood, or the like) includes conveying the biologic material into a storage volume defined between a first layer of a storage container and a second layer of the storage container. The biologic material is conveyed via a port coupled to the storage container. After the biologic material is within the storage volume, an end portion seal is produced to fluidically isolate the storage volume from the port. The port (and any portions of an end portion of the storage container to which the port is coupled) is removed from the remainder of the storage container by separating the port (and any portions of an end portion of the storage container to which the port is coupled) via a frangible region along the end portion seal. The separation via the frangible region can be performed by hand (i.e., without the use of a cutting blade, machinery or equipment). In some embodiments, the frangible region can include a perforation, a tear notch, or a stress concentration riser.

As used herein, the term “about” when used in connection with a referenced numeric indication means the referenced numeric indication plus or minus up to 10% of that referenced numeric indication. For example, the language “about 50” covers the range of 45 to 55. Similarly, the language “about 5” covers the range of 4.5 to 5.5.

As used herein, the term “tissue specimen” or “tissue graft” refers to any material that can be used in a tissue repair procedure or other procedures which use tissue grafts (e.g., birth tissue used as patch for healing then removed). Thus, a tissue specimen or a tissue graft can include any of a skin graft, bone tissue, fiber tissue (e.g., tendon tissue, ligament tissue, or the like), ocular tissue (e.g., corneal implants), birth tissue (e.g., amnion graft), cardio vascular tissue (e.g., heart valve) or the like. A tissue specimen or a tissue graft can include a portion of tissue harvested from a donor or a structure component that includes both tissue and non-tissue material (e.g., a synthetic matrix that includes tissue therein). For example, a tissue specimen or a tissue graft can include bone tissue that also includes bone cement or other non-tissue components. As another example, a tissue specimen or tissue graft can include bone chips including cortical bone chips, cancellous bone chips, and corticocancellous bone chips, and/or bone chips with viable bone lineage committed cells.

used herein, the term “biologic material” refers to any material that is produced or derived from a living (or recently living) organism. Biologic materials can include, for example, tissues, cells, blood, or other bodily fluids. Biologic materials can also include plants, plant products, microorganisms, genetically modified organisms (including cells and cell lines). Biologic materials can also include DNA or RNA (including plasmids, oligonucleotides, cDNA) or viral vectors.

As used in this specification, specific words chosen to describe one or more embodiments and optional elements or features are not intended to limit the invention. For example, spatially relative terms—such as “beneath”, “below”, “lower”, “above”, “upper”, “proximal”, “distal”, and the like—may be used to describe the relationship of one element or feature to another element or feature as illustrated in the figures. These spatially relative terms are intended to encompass different positions (i.e., translational placements) and orientations (i.e., rotational placements) of a device in use or operation in addition to the position and orientation shown in the figures. For example, if a device in the figures is turned over, elements described as “below” or “beneath” other elements or features would then be “above” or “over” the other elements or features. Thus, the term “below” can

encompass both positions and orientations of above and below. A device may be otherwise oriented (e.g., rotated 90 degrees or at other orientations) and the spatially relative descriptors used herein interpreted accordingly. Likewise, descriptions of movement along (translation) and around (rotation) various axes include various spatial device positions and orientations.

Similarly, geometric terms, such as “parallel”, “perpendicular”, “round”, or “square”, are not intended to require absolute mathematical precision, unless the context indicates otherwise. Instead, such geometric terms allow for variations due to manufacturing or equivalent functions. For example, if an element is described as “round” or “generally round”, a component that is not precisely circular (e.g., one that is slightly oblong or is a many-sided polygon) is still encompassed by this description.

In addition, the singular forms “a”, “an”, and “the” are intended to include the plural forms as well, unless the context indicates otherwise. The terms “comprises”, “includes”, “has”, and the like specify the presence of stated features, steps, operations, elements, components, etc. but do not preclude the presence or addition of one or more other features, steps, operations, elements, components, or groups.

The storage containers discussed herein including any suitable package, pouch, bag, or container assemblies (e.g., storage containers **100, 200, 300, 400, 500, 600, 700, 800, 900, 1000**) includes internal volumes configured to suitably store one or more of the materials **50**. The storage containers (e.g., storage containers **100, 200, 300, 400, 500, 600, 700, 800, 900, 1000**) can include in some embodiments a flexible material defining a flexible container. In some embodiments, the storage containers can include one or more rigid components.

As used herein the materials **50** can include compounded and non-compounded pharmaceuticals, a tissue or tissues, cellular material, biological material (including but not limited to biological material **50**, as described herein), and/or related media (herein referred to together as stored product). In some embodiments, the container assemblies described herein can be used to store packages containing tissue, cellular material, biological material, or related media. In some embodiments, the stored product within internal volumes or within packages within internal volumes can include biologic materials, including but not limited to, human and animal tissues, human and animal cells or cellular materials, plant materials (tissue and cellular materials), organs, organoids, biologically sourced materials (e.g., printed tissues, cells, organs, or organoids), bacteria, viruses, viral vectors, fungi, medical devices, combination devices, material for homologous or non-homologous use, and/or materials for autologous or allogenic use. In some embodiments, the stored product can include cellular material, including but is not limited to, lineage committed and non-lineage committed cells (e.g., bone lineage committed cells, osteoblasts, osteocytes, etc.), differentiated cells or non-differentiated cells (e.g., muscle cells, endothelial cells, etc.), and/or genetically modified or non-genetically modified materials. Examples of human and animal tissues include, but is not limited to, birth tissues (e.g., amnion, cord, cord blood, chorion, placenta, etc.), bones and/or products made from bones (e.g., machined allografts, ground particles, etc.), bone sources (e.g., tibia, fibula, humerus, cranial flaps, radius, ulna, pelvic bones, and joints, etc.), brain tissue, cartilages (from all sources in bodies generally from knee joints, shoulders, etc.), fascia lata, heart valves, arteries, veins, nerves, organs (e.g., lungs, hearts, liver, kidneys, etc.), reproduction tissue (e.g., semen and

eggs), ribs, soft tissues (e.g., all tendons, Achilles, patellar, etc.), skin, and/or tumors. Examples of the human or animal cellular materials include, but is not limited to, B-cells, blood cells and blood derived cells, bone cells, CAR-T cells, egg cells, engineered T-Cells, fat cells, muscle, cells, natural killer cells, nerve cells, sperm cells, stem cells (modified and un-modified, differentiated, and non-differentiated), T-cells, tumor infiltrating lymphocytes (TIL), viral vectors, viruses and bacteria. The human or animal cellular material can be modified or non-modified (such as genetically modified). Examples of the plant materials include, but is not limited to, cellulose, hemicellulose, pectin, fruit, fungi, leaves, mitochondria, plant organelles, pollen, roots, seeds, shoots, and/or stems. In some embodiments, the stored product can include related media, including but not limited to, culture media, saline solution, cryoprotectant, preservation solution, etc. It will be appreciated that any suitable stored product can be stored within any of the container assemblies described herein.

An embodiment of a storage container **100** is shown in FIG. 1A. The storage container **100** (and any of the container assemblies described herein) includes a storage volume **101** that can be used to store the material **50** (e.g., e), and/or to perform any of the methods described herein and/or the methods of preparing the material **50** for use in a procedure. As described herein, the storage container **100** provides a container that can be used for cryogenically freezing, storage, transport, processing, defrosting and/or rehydration of the material **50**. The storage container **100** also includes a first layer **110**, a second layer **120** and one or more seals **130** connecting the first layer **110** and the second layer **120**. The one or more seals **130** form side edges **104**, **106** of the storage container **100**. While sealed edges can define the storage container **100**, it is also appreciated that in some embodiments, the two layers (e.g., **110**, **120**) can be provided as tubular material that is flattened forming two longitudinal connections between the layers on the flattened longitudinal edges of the tubular material (e.g., layflat tubular film). Said another way, the side edges **104**, **106** need not be formed by the one or more seals **130**.

As shown in FIG. 1, the storage container **100** includes one or more material ingresses and/or egresses. For example, the storage container **100** can include a first end portion **103** and a second end portion **102**. The storage container **100** can include a first opening **141**. The first opening can include any opening suitable to receive or expel the material **50** (or other fluids or flowable substances associated with the material **50**, such as a wash solution, buffer, or rehydration solution). For example, the first opening can be defined by a port **140**. In other examples the first opening **141** can include a capped opening, unattached layers, a resealable opening, or any other suitable passage for receiving or expelling the material **50**. The first opening is referred to herein as a port for simplicity. This should not be construed as limiting from other structural configurations for the opening. In some embodiments the port **140** is proximal to (extends from) the end portion **103**. The storage container **100** can also or alternatively include a second opening (not shown). The second opening can include any opening suitable to receive or expel the material **50**. For example, the second opening can include an edge opening defined by a portion where the layers defining the container are unattached.

In some embodiments, the first opening is defined by the port **140**. For example, as shown in FIG. 1A, the two layers (e.g., the first layer **110**, the second layer **120**) respectively are joined at a first end portion **103** with the port **140**

therebetween, and the two side edges **105**, **107** at the first end portion **103** are joined together. Thus, the port **140** is coupled to the first end portion **103** of the storage container **100** and is configured to allow fluid communication between the outside of the storage container **100** and the storage volume **101** that is defined between the first layer **110** and the second layer **120**. In this manner, the material can be inserted or additionally or alternatively treated (e.g., with a preservation fluid) after being conveyed into the storage container **100** via the port **140**. Additionally or alternatively, the port **140** can also be coupled to a vacuum source to evacuate the storage volume. Additionally or alternatively, when in use (e.g., during a surgical procedure), the port **140** can allow for cryogenically defrosting the material **50**. Additionally or alternatively, when in use (e.g., during a surgical procedure), the port **140** can allow for inflow of fluid for rehydration or other purposes. Additionally or alternatively, when in use, the port **140** can allow for removal of fluid.

The port **140** can be any suitable port that selectively provides fluid communication to the storage volume **101**. For example, the port **140** can include a tube, a valve, and/or a cap. In some embodiments, the port **140** can be a needle-free port. In some embodiments, the port **140** can be a swabable connector. Similarly stated in some embodiments, the port **140** can have external surfaces and can be devoid of recesses or crevices such that the port **140** can be easily wiped or "swabbed" to maintain sterility during use. In some embodiments, the port **140** can include any of the barbed, swabable valves produced by the Halkey-Roberts Corporation, such as the **2455** series of swabable valves. In other embodiments, the port **140** (and any of the ports described herein) need not be either a swabable connector or a needle-free port; any suitable port can be employed. In some embodiments, the port **140** can include a male or female luer fitting. In some embodiments, the port **140** can include a threaded connection for coupling with a syringe or a tubing set or a cap. In some embodiments, the port **140** can be sealed at the end for sterile docking or cutting.

Although the port **140** is shown as being coupled at the first end portion **103** of the storage container **100**. In other embodiments, the port **140** (and any of the ports described herein) can be coupled at any location and to any portion of the storage container **100**. For example, in some embodiments, the port **140** (and any of the ports described herein) need not be coupled to the first end portion **103** of the storage container **100**, the port can be on the surface or another edge portion of the storage container **100**. The port **140** (and any of the ports described herein) can be offset from a center line of the storage container **100**. For example, in some embodiments, the port can be located at a corner of the container. In some embodiments, the port (and any of the ports described herein) can be coupled around a central portion of the container.

In some embodiments, the port **140** can include a filter. In some embodiments, the port **140** can include a Y-connector. The base of Y-connector near port can contain the filter. One end of Y-connector can be sealed. The other end of the Y-connector can be threaded port for syringe connection. This allows for both hospital uses (e.g., syringe connection to port) and lab uses (e.g., a sterile dockable connection to the port). In some embodiments, the material **50** stored in the storage volume **101** does not or is limited in its ability to move through the port **140**. This may be due to size, viscosity, or other characteristics. In such embodiment, the

port can be filter-less allowing the material **50** to move into or out of the volume without regard to the material **50** stored therein.

In some embodiments, as illustrated in FIG. 1A, in a first (or opened) configuration, one or more edges (e.g., edge **111**) of the first layer **110** are spaced apart from one or more edges (e.g., edge **121**) of the second layer **120** to define a second opening **150** into the storage volume **101** of the storage container **100**. The opening **150** can be of any suitable size to facilitate loading of the material **50** (including e.g., tissue, biological material and/or treatment therapeutics) such that the volume **101** can receive the material **50**. In this manner, such embodiments of the storage container **100** can receive materials that cannot be conveyed into the storage volume **101** via the port **140** (or the first opening **141**). In some embodiments, the second opening **150** can extend across a portion of the length of an end or a side of the storage container **100**. In some embodiments, the opening **150** can extend across substantially all of the end or side of the storage container **100**. In the example shown in FIG. 1A, the second opening **150** can extend across the edge **108** of the storage container **100** defined by the separation between edges **111** and **121**. This opening can be larger than a ported opening, such as the port **140** discussed above. A larger opening can allow for input of a larger material (e.g., a tissue graft) into the storage volume **101**. Although it is appreciated that other materials as discussed herein can additionally or alternatively be introduced through opening **150**. After the material **50** is introduced into storage volume **101**, the opening **150** can be sealed by a seal **152** as shown in FIG. 1B. Sealing the second opening **150** by seal **152** encloses storage volume **101** isolating the material **50** therein. This allows for the loading of biologicals or other materials through the second opening **150** opposite the port **140**. Once loaded, the second opening **150** is sealed. The seal can be performed by a heat seal, an adhesive, or other suitable methods. In some embodiments, a laser line guides the sealing of the opening.

In some embodiments, the container is suitable for segregating the material **50** into multiple portions. For example, the storage container **100** can include a sealable region **160** (FIG. 1B), suitable to apply (or produce) an intermediate seal **163** (e.g., the intermediate seal **163** in FIG. 1C) to separate the storage volume **101** into a first volume **161** and a second volume **162**. In some embodiments, the intermediate seal **163** is applied after the material **50** has been introduced into the storage volume **101**. The intermediate seal **163** is applied or produced by any suitable procedure or mechanism, such as via a heat seal, a pressure seal, a laser weld, an adhesive seal, or any other suitable sealing procedures. The sealable region **160** can include indicia or other markings to indicate to the user loading the material **50** into the storage container **100** where to apply the intermediate seal **163**. When sealed at the indicia, the volume on a first side of the seal will have a first predetermined volume (e.g., volume **161**) and the volume on the other side of the seal has a second predetermined volume (e.g., volume **162**). In this way, one portion of the material **50** (e.g., the material in volume **161**) is usable for the intended process or operation while the other portion of the material **50** (e.g., the material contained in volume **162**) can be stored for subsequent use (e.g., quality control, testing, archiving, etc.) Separating the material **50** into two portions allows for second portion in volume **162** to be a known sample that is the same (i.e., that is from the same batch, that has been subjected to the same processing, and/or that is filled at the same time) as the first portion in volume **161** for exact match retention. In other

words, the material **50** within the volume **161** has substantially identical properties as the material **50** within the volume **162**. In various embodiments, second portion in the volume **162** is a quality control sample that is fully representative of the portion stored in volume **161**. In some embodiments, the volume **161** is the larger volume as shown in FIG. 1C-1E. Contrarily, in some embodiments, the volume **162** is the larger volume. In this alternative, the larger volume can be used for significant subsequent testing using more material than the actual procedure. The second portion can be stored and subsequently tested to show first portion meets certain criteria. In some embodiments, the second portion could be about 5 cubic centimeters to about 50 cubic centimeters in volume.

In some embodiments, the sealable region **160** includes a frangible region **164**. The frangible region can be suitable to facilitate or initiate separation of volume **161** from volume **162** as shown in FIG. 1D defining a first storage container **100A** and a second storage container **100B**. The frangible region **164** can include perforations, thinning of material, a tear notch **167** (that functions as a stress riser), or any other suitable mechanism for separating volumes **161** and **162** of the storage container **100** from one another. Specifically, in some embodiments, the frangible region **164** can facilitate separating the first storage container **100A** from the second storage container **100B** by hand (e.g., without a cutting blade, machinery, or other external equipment). For example, as shown in FIG. 1B, the frangible region **164** includes perforations and stress risers **167**. In some embodiments, the frangible region **164** can include one or more perforations lines positioned between the storage volume **161** and the storage volume **162**. When the frangible regions are separated volume **162** is removable from the volume **161** without compromising the sealed structure of either of the volumes defining the first storage container **100A** and the second storage container **100B**. Specifically, as shown the width of the intermediate seal **163** is greater than the width of the frangible region **164**. In some embodiments, the width of the intermediate seal **163** is at least two times than the width of the frangible region **164**. In this manner the intermediate seal **163** will be maintained on the ends of each of the first storage container **100A** and the second storage container **100B** after the containers are separated.

While shown in FIG. 1D as a triangular section and a rectangular section, it will be appreciated that other shapes of the volumes, seals, and frangible regions are applicable as well. In some embodiments, the first volume **161** (which functions as the first container portion) and the second volume **162** (which functions as the second container portion) can be different shapes. For example, as shown in FIGS. 1A-1D, the first volume **161** can be generally rectangular. The second volume **162** can be tapered from one-side having a similar width to volume **161** to a narrower width on the opposite end of volume **162** at a tip **165** as shown in FIG. 1E. In some embodiments, the narrower width can be a point. In some embodiments, the narrower width can be a truncated end suitable to dispense the material through an opening as a defined flow (see FIG. 1E). The tapered portion with its narrow end can be opened thereby allowing the material within the second volume **162** to be dispensed in a controlled manner as shown in FIG. 1E. Without a port attached to the second volume **162**, port leaking can be avoided, thus producing robust long-term storage. As shown in FIGS. 1A-1D, the first volume **161** can in some embodiments include the port **140**, which remains coupled thereto, after separation from the second volume **162** allowing for the introduction and removal of fluids. In

this manner, the first volume **161** (which functions as the first container portion **100A** after the separation from the second volume **162**) can function as a primary portion of the material. The first container portion **100A** can be stored, transported, and otherwise processed for desired use of the material **50** therein. The second volume **162** (and the container portion **100B**) can function as a secondary portion of the material. The second volume **162** can be dispensed by opening the tip **165**. In response to the tip **165** being opened (see also e.g., tip **265** in FIGS. 2A-2B) the material **50** can be released or dispensed in a controlled manner during dispensing of the material **50**, such as for example, in quality control operations. The tip **165** can be opened by tearing, peeling, cutting, or any other suitable manner to form an opening that allows for controlled dispensing of the material **50**.

In some embodiments, the tapered portion also defines a larger diagonal bottom opening that is defined by a longer edge (e.g., along edges **111**, **121**) compared to the width of the volume **161**, which would define the opening (e.g., if the opening was the same width as the sealable region **160**) in the absence of a tapered volume **162**. This configuration allows for a large opening for loading while retaining small footprint for both controlled freezing and space saving of the storage container **100** (including the second container portion **100B**).

In some embodiments, the container can include measurement indicia **174**. The measurement indicia **174** can include graduated markings located on the storage container **100**. In some embodiments, the measurement indicia **174** are located on the tapered volume (e.g., volume **162**). Measurement indicia allows for controlled filling into and/or dispensing of material **50** from the volume, thereby improving the quality control of testing and usage of the material in the volume.

In some embodiments, the first container portion **100A** includes a first indicium (not shown) associated with the material **50**. The first indicium can include a label or other marker associated with the material **50**. In some embodiments, the label can be a machine-readable (and/or machine writable) label, such as a bar code, RFID, QR code, or the like. In this manner, information such as the type of material (e.g., a specific type of cell), the material lot, the packaging date, the source of the material (e.g., a cell line), the target use (including the destination) can be incorporated into the first container portion **100A** to facilitate identification and tracking of the material therein. In some embodiments, the second container portion **100B** includes a second indicium (not shown) associated with the material **50** or the first indicium. The second indicium can include a label or other marker associated with the material **50** or the first indicium (on the first container portion **100A**). In some embodiments, the label can be a machine-readable (and/or machine writable) label, such as a bar code, RFID, QR code, or the like. In this manner, after the second container portion **100B** is separated from the first container portion **100A**, the two separate containers can be linked together to facilitate identification and tracking of the material therein. For example, QC test results performed on the materials from the second container portion **100B** can be saved on the second indicium and loaded into a cloud storage system. These results can be associated with the materials in the first container portion **100A** to ensure fast and accurate transmission of QC test results to the first container portion **100A**.

FIG. 13 is a flow chart showing a method **5** of storing a material **50** according to one embodiment. Although the method is described with reference to the container **100**, in

other embodiments, the method **5** can be performed on any of the containers described herein (e.g., container **200**, **300**, **400**, **500**, **600**, **700**, **800**, **900**, **1000**, **1100**, or **1200**.) The method **5** includes providing (at **10**) a storage container **100** (also referred to as a flexible container) having a storage volume **101** defined between a first layer **110** of the flexible container and a second layer **120** of the storage container **100**. The storage container includes a first opening (e.g., port **140**). The method **5** includes inserting (at **15**) the material **50** into the storage volume **101** via the first opening (e.g., port **140**). In some embodiments the container can optionally include, and material can be inserted via a second opening (e.g., edge opening **150**). The method **5** includes sealing (at **20**) the opening (e.g., closing the port **140**) to enclose the storage volume **101**. The method **5** includes applying (at **25**) an intermediate seal **163** separating the storage volume **101** into a first volume **161** and a second volume **162** with the material being in both the first volume **161** and the second volume **162**. In some embodiments, the storage container includes a frangible region **164** along the intermediate seal allowing the first volume and the second volume to be physically separated by hand along the frangible region **164**. The method **5** includes separating (at **30**) the first volume **161** from the second volume **162** along the frangible region **164** located along the intermediate seal **163**. Additionally, or alternatively, the method can include separating and storing the second volume for future reference to the material stored therein. This allows ongoing testing and verification of the material to qualify, confirm, and/or verify the material included in the first volume. Additionally, or alternatively, the method can include dispensing the material from either the first volume or the second volume. Since both volumes contain materials that match the other volume, one can serve as a reference material after the other volume is used.

An embodiment of a storage container **200** is shown in FIGS. 2A-2B. The storage container **200** (and any of the container assemblies described herein) includes a storage volume **201** that can be used to store any of the tissue and biological materials described herein, and/or to perform any of the methods described herein and/or the methods of preparing the material for use in a procedure. As described herein, the storage container **200** provides a container that can be used for cryogenically freezing, storage, transport, processing, defrosting and/or rehydration of the material. The storage container **200** also includes a first layer **210**, a second layer **220** and one or more seals **230** connecting the first layer **210** and the second layer **220**. The one or more seals **230** form side edges **204**, **206** of the storage container **200**. While sealed edges can define the container **200**, it is also appreciated that in some embodiments, the two layers (e.g., **210**, **220**) can be provided as tubular material that is flattened forming two longitudinal connections between the layers on the flattened longitudinal edges of the tubular material (e.g., layflat tubular film). Said another way, the side edges **204**, **206** need not be formed by the one or more seals **230**.

As shown in FIG. 2A, the storage container **200** includes one or more material ingresses and/or egresses. For example, the storage container **200** can include a first opening (e.g., port **240**). The storage container **200** can also or alternatively include a second opening (e.g., edge opening **250**). In some embodiments, the first opening is defined by a port **240**. For example, as shown in FIG. 2A, the two layers **210**, **220** respectively are joined at a first end portion **203** with the port **240** therebetween, and the two side edges **205**, **207** at the first end portion are joined together. The port **240** is coupled to the first end portion **203** of the storage

container **200** and is configured to allow fluid communication between the outside of the storage container **200** and the storage volume **201**. In this manner, material can be inserted or additionally or alternatively treated (e.g., with a preservation fluid) after being conveyed into the storage container **200** via the port **140**. Additionally or alternatively, the port **240** can also be coupled to a vacuum source to evacuate the storage volume. Additionally or alternatively, when in use (e.g., during a surgical procedure), the port **240** can allow for cryogenically defrosting the material. Additionally or alternatively, when in use (e.g., during a surgical procedure), the port **240** can allow for inflow of fluid for rehydration or other purposes. Additionally or alternatively, when in use, the port **240** can allow for removal of fluid.

The port **240** can be any suitable port that selectively provides fluid communication to the storage volume **201**. For example, the port **240** can include a tube, a valve, and/or a cap. In some embodiments, the port **240** can be a needle-free port. In some embodiments, the port **240** can be a swabable connector. Similarly stated in some embodiments, the port **240** can have external surfaces and can be devoid of recesses or crevices such that the port **240** can be easily wiped or “swabbed” to maintain sterility during use. In some embodiments, the port **240** can include any of the barbed, swabable valves produced by the Halkey-Roberts Corporation, such as the **2455** series of swabable valves. In other embodiments, the port **240** (and any of the ports described herein) need not be either a swabable connector or a needle-free port; any suitable port can be employed. In some embodiments, the port **240** can include a male or female luer fitting. In some embodiments, the port **240** can include a threaded connection for coupling with a syringe or a tubing set. In some embodiments, the port **240** can be sealed at the end for sterile docking or cutting.

Although the port **240** is shown as being coupled at the first end portion **203** of the storage container **200**. In other embodiments, the port **240** (and any of the ports described herein) can be coupled at any location and to any portion of the storage container **200**. For example, in some embodiments, the port **240** (and any of the ports described herein) need not be coupled to the first end portion **203** of the container **200**, the port can be on the surface or another edge portion of the container **200**. The port **240** (and any of the ports described herein) can be offset from a center line of the storage container **200**. For example, in some embodiments, the port can be located at a corner of the container. In some embodiments, the port (and any of the ports described herein) can be coupled around a central portion of the container.

In some embodiments, the port **240** can include a filter. In some embodiments, the port **240** can include a Y-connector. The base of the Y-connector near port can contain the filter. One end of the Y-connector can be sealed. The other end of the Y-connector can be threaded port for syringe connection. This allows for both hospital uses (e.g., syringe connection to port) and lab uses (e.g., a sterile dockable connection to the port). In some embodiments, the material stored in the storage volume **201** does not or is limited in its ability to move through the port **240**. This may be due to size, viscosity, or other characteristics. In such embodiment, the port can be filterless allowing processing material to move into or out of the volume without regard to the material stored therein. In some embodiments, the port **240** allows material to be inserted into and removed from the storage volume **201** of each of the storage container **200**.

In some embodiments, the container **200** includes a seal **252** along the tapered second end portion that extends across

the edge **208** of container **200** to connect the separation between edges **211** and **221**. In some embodiments, seal **252** is a permanent seal. In some embodiments, seal **252** is a peelable seal. For example, the connection between the first layer **210** and the second layer **220** can be a peelable connection such that the opening **250** includes areas in which the first layer **210** and the second layer **220** can be peeled apart after connection. The container **200** can include features of the various the containers as disclosed in U.S. Pat. No. 11,065,095 (the '095 patent), titled “Sample Container with Peelable Seal and Access Port,” which is hereby incorporated by reference in its entirety. In light of the disclosure in the present application a person of ordinary skill in the art could adapt the features of the container in the '095 patent to be formed on as a storage container having peel reseal openings similar to those disclosed in the '095 patent.

In various examples, the connection between the first layer **210** and the second layer **220** can be a peelable connection such that the region includes areas in which the first layer and the second layer can be peeled apart after connection. For example, in some embodiments, the peelable seal **252** can be an adhesive-based seal in which an adhesive layer pulls back from one of the first layer **210** or the second layer **220** when the first layer **210** is peeled apart from the second layer **220**. In other embodiments, the peelable seal can be a cohesive seal in which an adhesive layer or intermediate layer fails within itself when the first layer **210** is peeled apart from the second layer **220**. The peelable seal **252** can be produced by any suitable methods and/or mechanism as described herein, such as, for example, by a heat-sealing operation. The seal and/or the layers **210**, **220**, whether peelable or permanent hermetically seals the storage volume **201**. The peelable seal **252** can be of any suitable geometry to facilitate the desired peel direction, peel strength, and the like. For example, in some embodiments, the peelable seal **252** can be an angled seal that provides for peel tabs that can be grasped by the user to peel the first layer **210** from the second layer **220**. In some embodiments, as illustrated in FIG. 2B, the seal **252** can extend across the length of the tapered edge **211**, **221**. However, in other embodiments, the seal **252** can extend across a portion of an edge. Because cutting and tearing can introduce foreign matter, the peelable opening allows for the contents inside to remain aseptic after opening the container **200**. Additionally, the peel strength can be adjusted based on the material selected. In some examples, the peel strength is between 0.25 pounds and 5 pounds. In other examples, the peel strength is between 0.5 pounds and 2 pounds. In one example, the peel strength is about 1 pound.

In some embodiments, the container **200** includes a seal **273** (which functions as an end portion seal). As illustrated in FIG. 2A, the container **200** can be empty and ready for use in the storage system. The material **50** (shown in FIG. 2B) can be inserted through port **240** or opening **250**. After the material has been inserted into the volume **201** of container **200**, the seal **273** can be applied as shown in FIG. 2B. For example, the storage container **200** can include a sealable region suitable to apply (or produce) the end portion seal **273** to fluidically isolate the storage volume **201** from the port **240**. Specifically, the end portion seal **273** is applied after the material **50** has been introduced into the storage volume **201**. The end portion seal **273** is applied or produced by any suitable procedure or mechanism, such as via a heat seal, a pressure seal, a laser weld, an adhesive seal, or any other suitable sealing procedures. In some embodiments, the sealable region can include indicia or other markings to indicate

to the user loading the material **50** into the storage container **200** where to apply the end portion seal **273**.

When sealed at the indicia, the seal **273** also allows for removal of the port **240**. Specifically, in some embodiments, the container **200** includes a frangible region **270**. The frangible region **270** can be suitable to facilitate or initiate separation of the port section **271** including the port **240** from storage volume **201**. The frangible region **270** can include perforations, thinning of material, stress risers suitable to directional tearing, adhesive attached otherwise detached containers or any other suitable mechanism for separating the port section **271** and storage volume **201** of the storage container **200** from one another. In some embodiments, the frangible region **270** can include one or more perforations lines **274** positioned between storage volume **201** and port section **271**. When the frangible regions are separated, port section **271** is removable from the storage volume **201** without compromising the sealed structure of storage volume **201**. However, it will be appreciated that other shapes of the volumes, seals, and frangible regions are applicable as well. In some embodiments, the port section can be different shapes suitable to allow removal of the port **240** from container **200**. In some embodiments, the width of the end portion seal **273** is greater than the width of the frangible region **270**. In some embodiments, the width of the end portion seal **273** is at least two times than the width of the frangible region **270**. In some embodiments, the frangible region can include a seal (e.g., **273**) and a frangible portion (e.g., perforations). Additionally or alternatively, the frangible portion may separate the storage volume **201** into separate volumes similar to the embodiments discussed with regards to FIG. 1C-1E above.

In some embodiments, the storage volume **201** can be tapered from a first end portion **203** to a narrower width on the opposite side at tip **265**. In some embodiments the narrower width tip **265** can be a point as shown in FIGS. 2A and 2B. The tapered portion with its narrow end can be opened thereby allowing material within the storage volume **201** to be dispensed in a controlled manner. Without a port on the storage volume **201**, port leaking can be avoided producing robust long-term storage. After removal of port **240**, the storage volume **201** can be dispensed by separating tip **265** along a frangible region **267**. When the tip **265** is removed the material can be released or dispensed in a controlled manner. The opening can control the amount of material dispensed. For example, the size of the opening adjusts the amount of material to be dispensed. The size can also be adjusted to the type of material being dispense. For example, a more viscous material can benefit from a larger opening. A less viscous material can benefit from a smaller opening.

In some embodiments, the tapered portion also defines a larger diagonal bottom opening that is defined by a longer edge (e.g., along edges **211**, **221**) compared to the width of the storage volume **201** at its widest region (e.g., above the tapered region). This configuration allows for a large opening for loading while retaining small footprint for both controlled freezing and space saving of the container **200**.

An embodiment of a storage container **300** is shown in FIG. 3A. The storage container **300** (and any of the container assemblies described herein) includes a storage volume **301** that can be used to store any of the tissue and biological materials described herein, and/or to perform any of the methods described herein and/or the methods of preparing the material for use in a procedure. As described herein, the storage container **300** provides a container that can be used for cryogenically freezing, storage, transport, processing,

defrosting and/or rehydration of the material. The storage container **300** also includes a first layer **310**, a second layer **320** and one or more seals **330** connecting the first layer **310** and the second layer **320**. The one or more seals **330** form side edges **304**, **306** of the storage container **300**. While sealed edges can define the container **300**, it is also appreciated that in some embodiments, the two layers (e.g., **310**, **320**) can be provided as tubular material that is flattened forming two longitudinal connections between the layers on the flattened longitudinal edges of the tubular material (e.g., layflat tubular film). Said another way, the side edges **304**, **306** need not be formed by the one or more seals **330**.

As shown in FIG. 3B, the storage container **300** includes one or more material ingresses and/or egresses. For example, the storage container **300** can include a first opening (e.g., defined by the port **340**). The storage container **300** can also or alternatively include a second opening (e.g., peelable region **368**). The first opening can include any opening suitable to receive or expel the material (or other fluids or flowable substances associated with the material, such as a wash solution, buffer, or rehydration solution). In some embodiments, the first opening is defined by a port **340**. For example, as shown in FIG. 3A, the two layers **310**, **320** respectively are joined at a first end portion **303** with the port **340** therebetween, and the two side edges **305**, **307** are joined together. The port **340** is coupled to the first end portion **303** of the storage container **300** and is configured to allow fluid communication between the outside of the storage container **300** and the storage volume **301**. In this manner, material can be inserted or additionally or alternatively treated (e.g., with a preservation fluid) after being conveyed into the storage container **300**. Additionally or alternatively, the port **340** can also be coupled to a vacuum source to evacuate the storage volume. Additionally or alternatively, when in use (e.g., during a surgical procedure), the port **340** can allow for cryogenically defrosting the material. Additionally or alternatively, when in use (e.g., during a surgical procedure), the port **340** can allow for inflow of fluid used in rehydration or other purposes. Additionally or alternatively, when in use, the port **340** can allow for removal of fluid.

The port **340** can be any suitable port that selectively provides fluid communication to the storage volume **301**. For example, the port **340** can include a tube, a valve, and/or a cap. In some embodiments, the port **340** can be a needle-free port. In some embodiments, the port **340** can be a swabable connector. Similarly stated in some embodiments, the port **340** can have external surfaces and can be devoid of recesses or crevices such that the port **340** can be easily wiped or "swabbed" to maintain sterility during use. In some embodiments, the port **340** can include any of the barbed, swabable valves produced by the Halkey-Roberts Corporation, such as the **3455** series of swabable valves. In other embodiments, the port **340** (and any of the ports described herein) need not be either a swabable connector or a needle-free port; any suitable port can be employed. In some embodiments, the port **340** can include a male or female luer fitting. In some embodiments, the port **340** can include a threaded connection for coupling with a syringe or a tubing set. In some embodiments, the port **340** can be sealed at the end for sterile docking or cutting.

Although the port **340** is shown as being coupled at the first end portion **303** of the storage container **300**. In other embodiments, the port **340** (and any of the ports described herein) can be coupled at any location and to any portion of the storage container **300**. For example, in some embodiments, the port **340** (and any of the ports described herein)

need not be coupled to the first end portion **303** of the container **300**, the port can be on the surface or another edge portion of the container **300**. The port **340** (and any of the ports described herein) can be offset from a center line of the storage container **300**. For example, in some embodiments, the port can be located at a corner of the container. In some embodiments, the port (and any of the ports described herein) can be coupled around a central portion of the container.

In some embodiments, the port **340** can include a filter. In some embodiments, the port **340** can include a Y-connector. The base of the Y-connector near port can contain the filter. One end of the Y-connector can be sealed. The other end of the Y-connector can be threaded port for syringe connection. This allows for both hospital uses (e.g., syringe connection to port) and lab uses (e.g., a sterile dockable connection to the port). In some embodiments, the material stored in the storage volume **301** does not or is limited in its ability to move through the port **340**. This may be due to size, viscosity, or other characteristics. In such embodiment, the port can be filterless allowing processing material to move into or out of the volume without regard to the material stored therein.

In some embodiments, the container **300** includes a seal **373** (which functions as an end portion seal). As illustrated in FIG. 3A, the container **300** can be empty and ready for use in the storage system. The material **50** (shown in FIG. 3B) can be inserted through port **340**. After the material has been inserted into the volume **301** of container **300**, the seal **373** can be applied as shown in FIG. 3B. For example, the storage container **300** can include a sealable region suitable to apply (or produce) the end portion seal **373** to fluidically isolate the storage volume **301** from the port **340**. Specifically, the end portion seal **373** is applied after the material **50** has been introduced into the storage volume **301**. The end portion seal **373** is applied or produced by any suitable procedure or mechanism, such as via a heat seal, a pressure seal, a laser weld, an adhesive seal, or any other suitable sealing procedures. In some embodiments, the sealable region can include indicia or other markings to indicate to the user loading the material **50** into the storage container **300** where to apply the end portion seal **373**.

The seal **373** also allows for removal of the port **340**. In some embodiments, the container **300** includes a frangible region **370**. The frangible region **370** can be suitable to facilitate or initiate separation of the port section **371** including the port **340** from the storage volume **301**. The frangible region **370** can include perforations, thinning of material, stress risers suitable to directional tearing, adhesive attached otherwise detached containers or any other suitable mechanism for separating the port section **371** and the storage volume **301** of the storage container **300** from one another. In some embodiments, the frangible region **370** can include one or more perforations lines **374** positioned between the storage volume **301** and port section **371**. When the frangible regions are separated port section **371** is removable from the storage volume **301** without compromising the sealed structure of the storage volume **301**. However, it will be appreciated that other shapes of the volumes, seals, and frangible regions are applicable as well. In some embodiments, the port section can be different shapes suitable to allow removal of the port **340** from container **300**. In some embodiments, the width of the end portion seal **373** is greater than the width of the frangible region **370**. In some embodiments, the width of the end portion seal **373** is at least two times than the width of the frangible region **370**.

In some embodiments, the frangible region can include a seal (e.g., **373**) and a frangible portion (e.g., perforations). Additionally or alternatively, the frangible portion may separate the storage volume **301** into separate volumes similar to the embodiments discussed with regards to FIG. 1A-1E above.

In some embodiments, the storage volume **301** can be tapered from end portion **303** to a narrower width on the opposite side end **365**. In some embodiments the narrower width end **365** can be a point or a tip as shown in FIG. 3A. The tapered portion with its narrow end can be opened thereby allowing the storage volume **301** to be dispensed in a controlled manner. Without a port attached to the storage volume **301**, port leaking can be avoided producing robust long-term storage. After removal of port **340**, the storage volume **301** can be dispensed by separating tip **365** along opening **367**. When the tip **365** is opened, the material can be released or dispensed in a controlled manner. In some embodiments, the opening is a peelable seal **368**. The connection between the first layer **310** and the second layer **320** can be a peelable connection such that the opening includes areas in which the first layer **310** and the second layer **320** can be peeled apart after connection. The container **300** can include features of the various the containers as disclosed in U.S. Pat. No. 11,065,095 (the '095 patent, titled "Sample Container with Peelable Seal and Access Port," which is hereby incorporated by reference in its entirety. In light of the disclosure in the present application a person of ordinary skill in the art could adapt the features of the container in the '095 patent to be formed on as a storage container having peel reseal openings similar to those disclosed in the '095 patent.

In various examples, the connection between the first layer **310** and the second layer **320** can be a peelable connection such that the region includes areas in which the first layer and the second layer can be peeled apart after connection. For example, in some embodiments, the peelable region **368** can be an adhesive-based seal in which an adhesive layer pulls back from one of the first layer **310** or the second layer **320** when the first layer **310** is peeled apart from the second layer **320**. In other embodiments, the peelable seal can be a cohesive seal in which an adhesive layer or intermediate layer fails within itself when the first layer **310** is peeled apart from the second layer **320**. The peelable region **368** can be produced by any suitable methods and/or mechanism as described herein. The seal and/or the layers **310**, **320**, whether peelable or permanent hermetically seals the storage volume **301**. The peelable region **368** can be of any suitable geometry to facilitate the desired peel direction, peel strength, and the like. For example, in some embodiments, the peelable region **368** can be an angled seal that provides for peel tabs that can be grasped by the user to peel the first layer **310** from the second layer **320**. In some embodiments, as illustrated in FIG. 3B, the peelable region **368** can extend across the length of the tapered edge **311**, **321**. However, in other embodiments, the peelable region **368** can extend across a portion of an edge. Because cutting and tearing can introduce foreign matter, the peelable opening allows for the contents inside to remain aseptic after opening the container **300**. Additionally, the peel strength can be adjusted based on the material selected. In some examples, the peel strength is between 0.25 pounds and 5 pounds. In other examples, the peel strength is between 0.5 pounds and 2 pounds. In one example, the peel strength is about 1 pound. The peel can also control the amount of material dispensed. For example, how far the layers are peeled adjusts the opening size allowing more material to be

dispensed relative to a smaller opening. The size can also be adjusted to the type of material being dispense. For example, a more viscous material can benefit from a larger opening. A less viscous material can benefit from a smaller opening. In some embodiments, the tapered edge **311**, **321** (or any other tapered edges described herein) extends at an angle (a) of between about degrees to about 75 degrees.

An embodiment of a storage container **400** is shown in FIG. **4**. The storage container **400** (and any of the container assemblies described herein) includes a storage volume **401** that can be used to store any of the tissue and biological materials described herein, and/or to perform any of the methods described herein and/or the methods of preparing the material for use in a procedure. As described herein, the storage container **400** provides a container that can be used for cryogenically freezing, storage, transport, processing, defrosting and/or rehydration of the material. The storage container **400** also includes a first layer **410**, a second layer **420** and one or more seals **430** connecting the first layer **410** and the second layer **420**. The one or more seals **430** form side edges **404**, **406** of the storage container **400**. While sealed edges can define the container **400**, it is also appreciated that in some embodiments, the two layers (e.g., **410**, **420**) can be provided as tubular material that is flattened forming two longitudinal connections between the layers on the flattened longitudinal edges of the tubular material (e.g., layflat tubular film).

As shown in FIG. **4**, the storage container **400** includes one or more material egresses. For example, the storage container **400** can include a first opening (e.g., port **440**). The storage container **400** can also or alternatively include a second opening suitable for dispensing the material **50** located at tip **465**. In some embodiments, the opening can include a peelable seal **468**. FIG. **4** is an alternative to FIG. **3B** in that the frangible region and upper seal proximal to the port are not applied.

In some embodiments, the first opening is a port **440**. For example, as shown in FIG. **4**, the two layers **410**, **420** respectively are joined at a first end portion **403** with the port **440** therebetween, and the two side edges **405**, **407** are joined together. The port **440** is coupled to the first end portion **403** of the storage container **400** and is configured to allow fluid communication between the outside of the storage container **400** and the storage volume **401**. In this manner, material can be inserted or additionally or alternatively treated (e.g., with a preservation fluid) after being sealed within the storage container **400**. Additionally or alternatively, the port **440** can also be coupled to a vacuum source to evacuate the storage volume. Additionally or alternatively, when in use (e.g., during a surgical procedure), the port **440** can allow for cryogenically defrosting the material. Additionally or alternatively, when in use (e.g., during a surgical procedure), the port **440** can allow for inflow of fluid used for rehydration or other uses. Additionally or alternatively, when in use, the port **440** can allow for removal of fluid.

The port **440** can be any suitable port that selectively provides fluid communication to the storage volume **401**. For example, the port **440** can include a tube, a valve, and/or a cap. In some embodiments, the port **440** can be a needle-free port. In some embodiments, the port **440** can be a swabable connector. Similarly stated in some embodiments, the port **440** can have external surfaces and can be devoid of recesses or crevices such that the port **440** can be easily wiped or "swabbed" to maintain sterility during use. In some embodiments, the port **440** can include any of the barbed, swabable valves produced by the Halkey-Roberts Corpora-

tion, such as the **3455** series of swabable valves. In other embodiments, the port **440** (and any of the ports described herein) need not be either a swabable connector or a needle-free port; any suitable port can be employed. In some embodiments, the port **440** can include a male or female luer fitting. In some embodiments, the port **440** can include a threaded connection for coupling with a syringe or a tubing set. In some embodiments, the port **440** can be sealed at the end for sterile docking or cutting.

Although the port **440** is shown as being coupled at the first end portion **403** of the storage container **400**. In other embodiments, the port **440** (and any of the ports described herein) can be coupled at any location and to any portion of the storage container **400**. For example, in some embodiments, the port **440** (and any of the ports described herein) need not be coupled to the first end portion **403** of the container **400**, the port can be on the surface or another edge portion of the container **400**. The port **440** (and any of the ports described herein) can be offset from a center line of the storage container **400**. For example, in some embodiments, the port can be located at a corner of the container. In some embodiments, the port (and any of the ports described herein) can be coupled around a central portion of the container.

In some embodiments, the port **440** can include a filter. In some embodiments, the port **440** can include a Y-connector. The base of the Y-connector near port can contain the filter. One end of the Y-connector can be sealed. The other end of the Y-connector can be threaded port for syringe connection. This allows for both hospital uses (e.g., syringe connection to port) and lab uses (e.g., a sterile dockable connection to the port). In some embodiments, the material stored in the storage volume **401** does not or is limited in its ability to move through the port **440**. This may be due to size, viscosity, or other characteristics. In such embodiment, the port **440** can be filterless allowing processing material to move into or out of the storage volume **401** without regard to the material stored therein.

In some embodiments, volume **401** can be tapered from end portion **403** to a narrower width on the opposite end portion near tip **465**. In some embodiments the narrower width portion of the container can be a point or tip **465** as shown in FIG. **4**. The tapered portion with its narrow end can be opened thereby allowing the storage volume **401** to be dispensed in a controlled manner. Without a port attached to the storage volume **401**, port leaking can be avoided producing robust long-term storage. After removal of port **440**, the storage volume **401** can be dispensed by separating tip **465** along opening **467**. When the tip **465** is opened, the material can be released or dispensed in a controlled manner.

In some embodiments, one opening is a peelable seal **468**. The connection between the first layer **410** and the second layer **420** can be a peelable connection such that the opening includes areas in which the first layer **410** and the second layer **420** can be peeled apart after connection defining the peelable seal **468**. The container **400** can include features of the various the containers as disclosed in U.S. Pat. No. 11,065,095 (the '095 patent, titled "Sample Container with Peelable Seal and Access Port," which is hereby incorporated by reference in its entirety. In light of the disclosure in the present application, a person of ordinary skill in the art could adapt the features of the container in the '095 patent to be formed on as a storage container having peel reseal openings similar to those disclosed in the '095 patent.

In various examples, the connection between the first layer **410** and the second layer **420** can be a peelable connection such that the region includes areas in which the

first layer and the second layer can be peeled apart after connection. For example, in some embodiments, the peelable seal 468 can be an adhesive-based seal in which an adhesive layer pulls back from one of the first layer 410 or the second layer 420 when the first layer 410 is peeled apart from the second layer 420. In other embodiments, the peelable seal can be a cohesive seal in which an adhesive layer or intermediate layer fails within itself when the first layer 410 is peeled apart from the second layer 420. The peelable seal 468 can be produced by any suitable methods and/or mechanism as described herein. The seal and/or the layers 410, 420, whether peelable or permanent hermetically seals the storage volume 401. The peelable seal 468 can be of any suitable geometry to facilitate the desired peel direction, peel strength, and the like. For example, in some embodiments, the peelable seal 468 can be an angled seal that provides for peel tabs that can be grasped by the user to peel the first layer 410 from the second layer 420. In some embodiments, as illustrated in FIG. 4, the peelable seal 468 can extend across the length of the tapered edge 411, 421. However, in other embodiments, the peelable seal 468 can extend across a portion of an edge. Because cutting and tearing can introduce foreign matter, the peelable opening allows for the contents inside to remain aseptic after opening the container 400. Additionally, the peel strength can be adjusted based on the material selected. In some examples, the peel strength is between 0.25 pounds and 5 pounds. In other examples, the peel strength is between 0.5 pounds and 2 pounds. In one example, the peel strength is about 1 pound. The peel can also control the amount of material dispensed. For example, how far the layers are peeled adjusts the opening size allowing more material to be dispensed relative to a smaller opening. The size can also be adjusted to the type of material being dispense. For example, a more viscous material can benefit from a larger opening. A less viscous material can benefit from a smaller opening.

An embodiment of a storage container 500 is shown in FIG. 5A. The storage container 500 (and any of the container assemblies described herein) includes a storage volume 501 that can be used to store any of the tissue and biological materials described herein, and/or to perform any of the methods described herein, and/or the methods of preparing the material for use in a procedure. As described herein, the storage container 500 provides a container that can be used for cryogenically freezing, storage, transport, processing, defrosting and/or rehydration of the material. The storage container 500 also includes a first layer 510, a second layer 520 and one or more seals 530 connecting the first layer 510 and the second layer 520. The one or more seals 530 form side edges 504, 506 of the storage container 500. While sealed edges can define the container 500, it is also appreciated that in some embodiments, the two layers (e.g., 510, 520) can be provided as tubular material that is flattened forming two longitudinal connections between the layers on the flattened longitudinal edges of the tubular material (e.g., layflat tubular film). Said another way, the side edges 504, 506 need not be formed by the one or more seals 530.

As shown in FIG. 5B, the storage container 500 includes one or more material ingresses and/or egresses. For example, the storage container 500 can include a first opening (e.g., opening 550). The storage container 500 can also or alternatively include a second opening (e.g., peelable region 568).

In some embodiments, in a first (or opened) configuration, one or more edges (e.g., edge 505) of the first layer 510 are spaced apart from one or more edges (e.g., edge 507) of the second layer 520 to define an opening 550 into the storage

volume 501 of each of the storage container 500. The opening 550 can be of any suitable size to facilitate loading of the material (e.g., a tissue graft), as described herein. In some embodiments, the opening 550 can extend across a portion of the length of an end or a side of the storage container 500. In some embodiments, the opening 550 can extend across substantially all of the end or side of the storage container 500. In the example shown in FIG. 5A, the opening can extend across the end portion 503 of container 500 defined by the separation between edges 505 and 507. This opening can be larger than a ported opening, such as those ports discussed above. A larger opening can allow for input of a larger material (e.g., a tissue graft) into the storage volume 501. Although it is appreciated that other materials as discussed herein can additionally or alternatively be introduced through opening 550. In some embodiments, the container 500 includes a seal 552. As illustrated in FIG. 5A, the container 500 can be empty and ready for use in the storage system. The material 50 (shown in FIG. 5B) can be inserted through opening 550. After the material is introduced into volume 501, the opening 550 can be sealed by seal 552 enclosing volume 501 as shown in FIG. 5B. This allows for the loading of biologicals or other materials through the opening 550. Once loaded, the opening 550 is sealed with seal 552 hermetically containing the material. The seal can be performed by a heat seal, an adhesive, or other suitable methods. In some embodiments, a laser line guides seal closing the opening 550.

In some embodiments, seal 552 is a peelable seal. The connection between the first layer 510 and the second layer 520 can be a peelable connection such that the opening 550 includes areas in which the first layer 510 and the second layer 520 can be peeled apart after connection. The container 500 can include features of the various the containers as disclosed in U.S. Pat. No. 11,065,095 (the '095 patent, titled "Sample Container with Peelable Seal and Access Port," which is hereby incorporated by reference in its entirety. In light of the disclosure in the present application a person of ordinary skill in the art could adapt the features of the container in the '095 patent to be formed on as a storage container having peel reseal openings similar to those disclosed in the '095 patent.

In various examples, the connection between the first layer 510 and the second layer 520 can be a peelable connection such that the region includes areas in which the first layer and the second layer can be peeled apart after connection. For example, in some embodiments, the peelable seal 552 can be an adhesive-based seal in which an adhesive layer pulls back from one of the first layer 510 or the second layer 520 when the first layer 510 is peeled apart from the second layer 520. In other embodiments, the peelable seal can be a cohesive seal in which an adhesive layer or intermediate layer fails within itself when the first layer 510 is peeled apart from the second layer 520. The peelable seal 552 can be produced by any suitable methods and/or mechanism as described herein. The seal and/or the layers 510, 520, whether peelable or permanent hermetically seals the storage volume 501. The peelable seal 552 can be of any suitable geometry to facilitate the desired peel direction, peel strength, and the like. For example, in some embodiments, the peelable seal 552 can be an angled seal that provides for peel tabs that can be grasped by the user to peel the first layer 510 from the second layer 520. In some embodiments, as illustrated in FIG. 5B, the seal 552 can extend across the width of the end portion 503. However, in other embodiments, the seal 552 can extend across a portion of an end portion 503. Because cutting and tearing can

introduce foreign matter, the peelable opening allows for the contents inside to remain aseptic after opening the container **500**. Additionally, the peel strength can be adjusted based on the material selected. In some examples, the peel strength is between 0.25 pounds and 5 pounds. In other examples, the peel strength is between 0.5 pounds and 2 pounds. In one example, the peel strength is about 1 pound.

In some embodiments, volume **501** can be tapered. As shown in FIG. **5B** the taper extends a portion of the way between end portion **503** and tip **565**. In some embodiments, the taper can extend from end portion **503** to a narrower width on the opposite side. The tapered portion with its narrow end can be opened thereby allowing the storage volume **501** to be dispensed in a controlled manner. Without a port attached to storage volume **501**, port leaking can be avoided producing robust long-term storage. After removal of port **540**, the storage volume **501** can be dispensed by separating tip **565** along opening **567**. When the tip **565** is opened, the material can be released or dispensed in a controlled manner. In some embodiments, the opening is a peelable seal **568**. The connection between the first layer **510** and the second layer **420** can be a peelable connection such that the peelable seal **568** includes areas in which the first layer **510** and the second layer **520** can be peeled apart after connection. The container **500** can include features of the various the containers as disclosed in U.S. Pat. No. 11,065,095 (the '095 patent, titled "Sample Container with Peelable Seal and Access Port," which is hereby incorporated by reference in its entirety. In light of the disclosure in the present application, a person of ordinary skill in the art could adapt the features of the container in the '095 patent to be formed on as a storage container having peel reseal openings similar to those disclosed in the '095 patent.

In various examples, the connection between the first layer **510** and the second layer **520** can be a peelable connection such that the region includes areas in which the first layer and the second layer can be peeled apart after connection. For example, in some embodiments, the peelable seal **568** can be an adhesive-based seal in which an adhesive layer pulls back from one of the first layer **510** or the second layer **520** when the first layer **510** is peeled apart from the second layer **520**. In other embodiments, the peelable seal can be a cohesive seal in which an adhesive layer or intermediate layer fails within itself when the first layer **510** is peeled apart from the second layer **520**. The peelable seal **568** can be produced by any suitable methods and/or mechanism as described herein. The seal and/or the layers **510**, **520**, whether peelable or permanent hermetically seals the storage volume **501**. The peelable seal **568** can be of any suitable geometry to facilitate the desired peel direction, peel strength, and the like. For example, in some embodiments, the peelable seal **568** can be an angled seal that provides for peel tabs **3560** that can be grasped by the user to peel the first layer **510** from the second layer **520**. In some embodiments, as illustrated in FIG. **5B**, the peelable seal **568** can extend across the length of the tapered edge **511**, **521**. However, in other embodiments, the peelable seal **568** can extend across a portion of an edge. Because cutting and tearing can introduce foreign matter, the peelable opening allows for the contents inside to remain aseptic after opening the container **500**. Additionally, the peel strength can be adjusted based on the material selected. In some examples, the peel strength is between 0.25 pounds and 5 pounds. In other examples, the peel strength is between 0.5 pounds and 2 pounds. In one example, the peel strength is about 1 pound. The peel can also control the amount of material dispensed. For example, how far the layers are

peeled adjusts the opening size allowing more material to be dispensed relative to a smaller opening. The size can also be adjusted to the type of material being dispense. For example, a more viscous material can benefit from a larger opening. A less viscous material can benefit from a smaller opening.

An embodiment of a storage container **600** is shown in FIG. **6A-B**. The storage container **600** includes multiple storage volumes **601** and **602**. The storage container **600** (and any of the container assemblies described herein) includes a first storage volume **601** that can be used to store any of the tissue and biological materials described herein, and/or to perform any of the methods described herein, and/or the methods of preparing the material for use in a procedure. In some embodiments, the storage container **600** can include a second storage volume **602** that can be used similarly to the first storage volume **601** to store any of the tissue and biological materials described herein, and/or to perform any of the methods described herein. Alternatively, the second storage volume **602** can be used to store peripheral items such as labels (e.g., to identify the material in the storage volume **601**), tools (e.g., to perform procedures with the material in the storage volume **601**), therapeutic treatments (e.g., to supplement or use with the material in the storage volume **601**), etc.

As described herein, the storage container **600** can be used for cryogenically freezing, storage, transport, processing, defrosting and/or rehydration of the material. The storage container **600** also includes a first layer **610**, a second layer **620** and one or more seals **630** connecting the first layer **610** and the second layer **620**. The one or more seals **630** form side edges **604**, **606** of the storage container **600**. While sealed edges can define the container **600**, it is also appreciated that in some embodiments, the two layers (e.g., **610**, **620**) can be provided as tubular material that is flattened forming two longitudinal connections between the layers on the flattened longitudinal edges of the tubular material (e.g., layflat tubular film).

As shown in FIG. **6A**, the storage container **600** includes one or more material ingresses and/or egresses. For example, the storage container **600** can include a first opening (e.g., port **640**). The storage container **600** can also or alternatively include a second opening (e.g., opening **650**). In some embodiments, the first opening is a port **640**. For example, as shown in FIG. **6A**, the two layers **610**, **620** respectively are joined at a first end portion **603** with the port **640** therebetween, and the two side edges **605**, **607** are joined together. The port **640** is coupled to the first end portion **603** of the storage container **600** and is configured to allow fluid communication between the outside of the storage container **600** and the storage volume **601**. In this manner, material can be inserted or additionally or alternatively treated (e.g., with a preservation fluid) after being sealed within the storage container **600**. Additionally or alternatively, the port **640** can also be coupled to a vacuum source to evacuate the storage volume. Additionally or alternatively, when in use (e.g., during a surgical procedure), the port **640** can allow for cryogenically defrosting the material. Additionally or alternatively, when in use (e.g., during a surgical procedure), the port **640** can allow for inflow of fluid used in rehydration or other uses. Additionally or alternatively, when in use, the port **640** can allow for removal of fluid.

The port **640** can be any suitable port that selectively provides fluid communication to the storage volume **601**. For example, the port **640** can include a tube, a valve, and/or a cap. In some embodiments, the port **640** can be a needle-free port. In some embodiments, the port **640** can be a

swabable connector. Similarly stated in some embodiments, the port **640** can have external surfaces and can be devoid of recesses or crevices such that the port **640** can be easily wiped or “swabbed” to maintain sterility during use. In some embodiments, the port **640** can include any of the barbed, swabable valves produced by the Halkey-Roberts Corporation, such as the **2455** series of swabable valves. In other embodiments, the port **640** (and any of the ports described herein) need not be either a swabable connector or a needle-free port; any suitable port can be employed. In some embodiments, the port **640** can include a male or female luer fitting. In some embodiments, the port **640** can include a threaded connection for coupling with a syringe or a tubing set. In some embodiments, the port **640** can be sealed at the end for sterile docking or cutting.

Although the port **640** is shown as being coupled at the first end portion **603** of the storage container **600**. In other embodiments, the port **640** (and any of the ports described herein) can be coupled at any location and to any portion of the storage container **600**. For example, in some embodiments, the port **640** (and any of the ports described herein) need not be coupled to the first end portion **603** of the container **600**, the port can be on the surface or another edge portion of the container **600**. The port **640** (and any of the ports described herein) can be offset from a center line of the storage container **600**. For example, in some embodiments, the port can be located at a corner of the container. In some embodiments, the port (and any of the ports described herein) can be coupled around a central portion of the container.

In some embodiments, the port **640** can include a filter. In some embodiments, the port **640** can include a Y-connector. The base of Y-connector near port can contain the filter. One end of Y-connector can be sealed. The other end of the Y-connector can be threaded port for syringe connection. This allows for both hospital uses (e.g., syringe connection to port) and lab uses (e.g., a sterile dockable connection to the port). In some embodiments, the material stored in the storage volume **601** does not or is limited in its ability to move through the port **640**. This may be due to size, viscosity, or other characteristics. In such embodiment, the port can be filterless allowing processing material to move into or out of the storage volume **601** without regard to the material stored therein.

In some embodiments, in a first (or opened) configuration, one or more edges (e.g., edge **611**) of the first layer **610** are spaced apart from one or more edges (e.g., edge **621**) of the second layer **620** to define an opening **650** into the storage volume **601** of each of the storage container **600**. The opening **650** can be of any suitable size to facilitate loading of the tissue, biological material and/or treatment (e.g., a tissue graft), as described herein. In some embodiments, the opening **650** can extend across a portion of the length of an end or a side of the storage container **600**. In some embodiments, the opening **650** can extend across substantially all of the end or side of the storage container **600**.

In the example shown in FIG. **6A**, the opening **650** can extend across a face or layer **610** near the seal opposite port **640** (e.g., seal **663** or **653**) of container **600** defined by the separation between edges **611** and **621**. In one example, the opening **650** is defined by a slit in the first layer **610**. This opening **650** can be larger than a ported opening, such as the port **640** discussed above. A larger opening can allow for input of a larger material (e.g., a tissue graft) into the storage volume **601**. Although it is appreciated that other materials as discussed herein can additionally or alternatively be introduced through opening **650**. After the material is intro-

duced into volume **601**, the opening **650** can be sealed by seal **652** (e.g., a heat seal, adhesive seal, etc.), thereby enclosing the storage volume **601**. This allows for the loading of biologicals or other materials through the opening **650** opposite the port **640**. Once loaded, the opening **650** is sealed. The seal can be performed by a heat seal, an adhesive, or other suitable methods. In some embodiments, a laser line guides seal. In some embodiments, seal **653** can also be applied to fully separate opening **650** from the adjacent storage volumes.

In some embodiments, the container **600** is suitable for segregating a single material into multiple portions. For example, the storage container **600** can include a sealable region **660**, suitable to apply a seal **663** to separate the storage volume **601** into volume **601** and **602**. In some embodiments, the seal **663** can be applied before the material has been introduced into volume **601** thereby defining volume **601** and **602** separately before the material is introduced. In some embodiments, one or more edges (e.g., edge **611**) of the first layer **610** are spaced apart from one or more edges (e.g., edge **659**) of the second layer **620** to define an opening **651** into the storage volume **602** of each of the storage container **600**. The opening **651** can be of any suitable size to facilitate loading of the tissue, biological material and/or treatment (e.g., a tissue graft), as described herein. The opening **651** can be of any suitable size to facilitate loading of peripheral items such as labels, instruments, therapeutics, etc., as described herein. In some embodiments, the opening **651** can extend across a portion of the length of an end or a side of the storage container **600**.

In some embodiments, the opening **651** can extend across substantially all of the end or side of the storage container **600**. In some embodiments, the opening **651** can extend across a face or layer **610** near edge **609** of the container **600** defined by the separation between edges **657** and **659**. In another example, the opening **651** is defined by an unsealed portion of the layers **610** and **620** at edge **609**. In another example, the opening **651** is defined by a slit in the layer **610**. This opening can be larger than a ported opening, such as the port **640** discussed above. A larger opening can allow for input of a larger material (e.g., a tissue graft) into the storage volume **601**. Although it is appreciated that other materials as discussed herein can additionally or alternatively be introduced through opening **651**. After the material is introduced into volume **602**, the opening **651** can be sealed by seal **669** (e.g., a heat seal, adhesive seal, etc.) enclosing the storage volume **602**. This allows for the loading of materials through the opening **651** opposite the port **640**. Once loaded, the opening **651** is sealed. The seal can be performed by a heat seal, an adhesive, or other suitable methods. In some embodiments, a laser line guides seal.

In some embodiments, the seal **663** can be applied after the material has been introduced through opening **650** or alternatively opening **651**. In such embodiments, the storage volumes **601** and **602** would be defined after the material was introduced such that the two volumes could have identical material. The separation region **660** can include an indicia to tell operator loading material into container **600** where to apply the separation seal **663**. When sealed at the indicia, the volume on a first side of the seal will have a first predetermined volume (e.g., storage volume **601**) and the volume on the other side of the seal has a second predetermined volume (e.g., storage volume **602**). In this way, one portion of the material (e.g., the material in volume **601**) is usable for the intended process or operation while the other portion of the material (e.g., the material in volume **602**) can be stored for subsequent use (e.g., quality control, testing,

archiving, etc.) Separating the material into two portions allows for the second portion in volume to be a known sample that is the same as the first portion in volume **601** for exact match retention. In other words, the material within the storage volume **601** has identical properties as the material within the storage volume **602**. In various embodiments, the second portion in the storage volume **602** is a quality control sample that is fully representative of the portion stored in volume **601**. In some embodiments, the storage volume **601** is the larger volume as shown in FIG. **6B**. Contrarily, in some embodiments, the storage volume is the larger volume. In this alternative, the larger volume **602** can be used for significant subsequent testing using more material than the actual procedure. The second portion can be stored and subsequently tested to show first portion meets certain criteria. In some embodiments, the second portion could be about 5 cc to about 50 cc volume.

In some embodiments, the sealable region **660** can include a frangible region **664**. The frangible region **664** can be suitable to facilitate or initiate separation of volume **601** from volume **602**. The frangible region **664** can include perforations, thinning of material, stress risers suitable to directional tearing, adhesive attached otherwise detached containers or any other suitable mechanism for separating storage volumes **601** and **602** of the storage container **600** from one another. In some embodiments, the frangible region **664** can include one or more perforations lines positioned between container storage volumes **601** and **602**. For example, frangible region **664** can be located between seal **652** and **663**. When the frangible regions are separated volume **602** is removable from the storage volume **601** without compromising the sealed structure of either volume. However, it will be appreciated that other shapes of the volumes, seals, and frangible regions are applicable as well.

In some embodiments, the first storage volume **601** and the second storage volume **602** can be the same general shape, or in other embodiments, they can be different shapes. For example, as shown in FIG. **6B**, the storage volume **601** can be generally rectangular. The storage volume **602** can similarly be generally rectangular. As discussed, the storage volume **602** can be sealed after material or items have been added and without a port attached to the storage volume **602**, port leaking can be avoided producing robust long-term storage. As shown in FIG. **6B**, the first storage volume **601** can in some embodiments include the port **640** after separation from volume **662** allowing for the introduction and removal of fluids. The storage volume **602** can be dispensed by cutting.

An embodiment of a storage container **700** is shown in FIGS. **7A-7B**. The storage container **700** includes multiple storage volumes **701** and **702**. The storage container **700** (and any of the container assemblies described herein) can include the storage volume **701** that can be used to store any of the tissue and biological materials described herein, and/or to perform any of the methods described herein, and/or the methods of preparing the material for use in a procedure. In some embodiments, the storage container **700** can include a storage volume **702** that can be used similarly to storage volume **701** to store any of the tissue and biological materials described herein, and/or to perform any of the methods described herein. Alternatively, the storage volume **702** can be used to store peripheral items such as labels (e.g., to identify the material in the storage volume **701**), tools (e.g., to perform procedures with the material in the storage volume **701**), therapeutic treatments (e.g., to supplement or use with the material in the storage volume **701**), etc.

As described herein, the storage container **700** provides a container that can be used for cryogenically freezing, storage, transport, processing, cryogenically defrosting and/or rehydration of the material. The storage container **700** also includes a first layer **710**, a second layer **720** and one or more seals **730** connecting the first layer **710** and the second layer **720**. The one or more seals **730** form side edges **704**, **706** of the storage container **700**. While sealed edges can define the container **700**, it is also appreciated that in some embodiments, the two layers (e.g., **710**, **720**) can be provided as tubular material that is flattened forming two longitudinal connections between the layers on the flattened longitudinal edges of the tubular material (e.g., layflat tubular film).

As shown in FIG. **7A**, the storage container **700** includes one or more material ingresses and/or egresses. The storage container **700** can include a first opening (e.g., opening **750**). The storage container **700** can also or alternatively include a second opening (e.g., edge opening **751**). In some embodiments, such as the embodiment illustrated in FIG. **7A**, the container **700** does not include a port. In some embodiments, the port is removeable, via the mechanisms described herein (e.g., the end portion seal and associated frangible region).

The two layers **710**, **720** respectively are joined at a first end portion **703**. For example, the two side edges **705**, **707** are joined together. In such an embodiment, material can be inserted or additionally or alternatively treated (e.g., with a preservation fluid) via the opening **750** or **751**.

In some embodiments, in a first (or opened) configuration, one or more edges (e.g., edge **711**) of the first layer **710** are spaced apart from one or more edges (e.g., edge **721**) of the second layer **720** to define an opening **750** into the storage volume **701** of each of the storage container **700**. The opening **750** can be of any suitable size to facilitate loading of the tissue, biological material and/or treatment (e.g., a tissue graft), as described herein. In some embodiments, the opening **750** can extend across a portion of the length of an end or a side of the storage container **700**. In some embodiments, the opening **750** can extend across substantially all of the end or side of the storage container **700**.

In the example shown in FIG. **7A**, the opening **750** can extend across a face or layer **710** near a seal (e.g., seal **763**) of container **700** defined by the separation between edges **711** and **721**. In one example, the opening **750** is defined by a slit in the first layer **710**. A larger opening can allow for input of a larger material (e.g., a tissue graft) into the storage volume **701**. Although it is appreciated that other materials as discussed herein can additionally or alternatively be introduced through the opening **750**. After the material is introduced into the storage volume **701**, the opening **750** can be sealed by the seal **752** (e.g., a heat seal, adhesive seal, etc.), thereby enclosing the storage volume **701**. This allows for the loading of biologicals or other materials through the opening **750**. Once loaded, the opening **750** is sealed. The seal can be performed by a heat seal, an adhesive, or other suitable methods. In some embodiments, a laser line guides seal. In some embodiments, the seal **753** can also be applied to fully separate the opening **750** from the adjacent storage volumes.

In some embodiments, the container is suitable for segregating a single material into multiple portions. For example, the storage container **700** can include a sealable region **760**, suitable to apply a seal **763** to separate the storage volume **701** into volume **701** and **702**. In some embodiments, the seal **763** can be applied before the material has been introduced into volume **701** thereby defining volume **701** and **702** separately before the material is introduced. In some embodiments, such as this one, the

storage container 700 can include an opening 751 into volume 702. One or more edges (e.g., edge 757) of the first layer 710 are spaced apart from one or more edges (e.g., edge 759) of the second layer 720 to define an opening 751 into the storage volume 702 of each of the storage container 700. The opening 751 can be of any suitable size to facilitate loading of the tissue, biological material and/or treatment (e.g., a tissue graft), as described herein. The opening 751 can be of any suitable size to facilitate loading of peripheral items such as labels, instruments, therapeutics, etc., as described herein. In some embodiments, the opening 751 can extend across a portion of the length of an end or a side of the storage container 700. In some embodiments, the opening 751 can extend across substantially all of the end or side of the storage container 700. In some embodiments, the opening can extend across a face or layer 710 near edge 709 of container 700 defined by the separation between edges 757 and 759. In another example, the opening 751 is defined by an unsealed portion of the layers 710 and 720 at edge 709. In another example, the opening 751 is defined by a slit in the layer 710. A larger opening can allow for input of a larger material (e.g., a tissue graft) into the storage volume 701. Although it is appreciated that other materials as discussed herein can additionally or alternatively be introduced through opening 751. After the material is introduced into volume 702, the opening 751 can be sealed by seal 769 (e.g., a heat seal, adhesive seal, etc.) enclosing volume 702. This allows for the loading of materials through the opening 751. Once loaded, the opening 751 is sealed. The seal can be performed by a heat seal, an adhesive, or other suitable methods. In some embodiments, a laser line guides seal.

In some embodiments, the seal 763 can be applied after the material has been introduced through opening 750 or alternatively opening 751. In such embodiments, the storage volumes 701 and 702 would be defined after the material was introduced such that the two volumes could have identical material. The separation region 760 can include an indicia to tell operator loading material into container 700 where to apply the separation seal 763. When sealed at the indicia, the volume on a first side of the seal will have a first predetermined volume (e.g., storage volume 701) and volume on the other side of the seal has a second predetermined volume (e.g., storage volume 702). In this way, one portion of the material (e.g., the material in storage volume 701) is usable for the intended process or operation while the other portion of the material (e.g., the material in volume 702) can be stored for subsequent use (e.g., quality control, testing, archiving, etc.) Separating the material into two portions allows for second portion in volume 702 to be a known sample that is the same as the first portion in volume 701 for exact match retention. In other words, the material within the storage volume 701 has identical properties as the material within the volume 702. In various embodiments, second portion in the storage volume 702 is a quality control sample that is fully representative of the portion stored in volume 701. In some embodiments, the storage volume 701 is the larger volume as shown in FIG. 7B. Contrarily, in some embodiments, the storage volume 702 is the larger volume. In this alternative, the larger volume 702 can be used for significant subsequent testing using more material than the actual procedure. The second portion can be stored and subsequently tested to show first portion meets certain criteria. In some embodiments, the second portion could be about 5 cc to about 50 cc volume.

In some embodiments, the sealable region 760 can include a frangible region 764. The frangible region can be suitable to facilitate or initiate separation of volume 701

from volume 702. The frangible region 764 can include perforations, thinning of material, stress risers suitable to directional tearing, adhesive attached otherwise detached containers or any other suitable mechanism for separating storage volumes 701 and 702 of the storage container 700 from one another. In some embodiments, the frangible region 764 can include one or more perforations lines positioned between container storage volumes 701 and 702. For example, frangible region 764 can be located between seal 752 and 763. In another example, the frangible region can be located along one or more of seals 752, 753, or 763. When the frangible regions are separated volume 702 is removable from the storage volume 701 without compromising the sealed structure of either volume. However, it will be appreciated that other shapes of the volumes, seals, and frangible regions are applicable as well.

In some embodiments, the first volume 701 and the second volume 702 can be the same general shape, or in other embodiments, they can be different shapes. For example, as shown in FIG. 7B, volume 701 can be generally rectangular. Volume 702 can similarly be generally rectangular. As discussed, the storage volume 702 can be sealed after material or items have been added and without a port attached to the storage volume 702, port leaking can be avoided producing robust long-term storage. The storage volume 702 can be dispensed by cutting.

An embodiment of a storage container 800 is shown in FIGS. 8A-8B. The storage container 800 includes multiple storage volumes 801 and 802. The storage container 800 (and any of the container assemblies described herein) can include the storage volume 801 that can be used to store any of the tissue and biological materials described herein, and/or to perform any of the methods described herein, and/or the methods of preparing the material for use in a procedure. In some embodiments, the storage container 800 can include a storage volume 802 that can be used similarly to storage volume 801 to store any of the tissue and biological materials described herein, and/or to perform any of the methods described herein. Alternatively, storage volume 802 can be used to store peripheral items such as labels (e.g., to identify the material in 801), tools (e.g., to perform procedures with the material in 801), therapeutic treatments (e.g., to supplement or use with the material in 801), etc.

As described herein, the storage container 800 provides a container that can be used for cryogenically freezing, storage, transport, processing, defrosting and/or rehydration of the material. The storage container 800 also includes a first layer 810, a second layer 820 and one or more seals 830 connecting the first layer 810 and the second layer 820. The one or more seals 830 form side edges 804, 806 of the storage container 800. While sealed edges can define the container 800, it is also appreciated that in some embodiments, the two layers (e.g., 810, 820) can be provided as tubular material that is flattened forming two longitudinal connections between the layers on the flattened longitudinal edges of the tubular material (e.g., layflat tubular film).

As shown in FIG. 8A, the storage container 800 includes one or more material egresses. The storage container 800 can include a first opening (e.g., opening 850). The storage container 800 can also or alternatively include a second opening (e.g., edge opening 851). In some embodiments, such as the embodiment illustrated in FIG. 8A, the container 800 includes a peelable seal suitable for removing the contents from the container 800.

The two layers 810, 820 respectively are joined at a first end portion 803. For example, the two side edges 805, 807 are joined together. In such an embodiment, material can be

inserted or additionally or alternatively treated (e.g., with a preservation fluid) via the opening **850** or **851**.

In some embodiments, in a first (or opened) configuration, one or more edges (e.g., edge **811**) of the first layer **810** are spaced apart from one or more edges (e.g., edge **821**) of the second layer **820** to define an opening **850** into the storage volume **801** of each of the storage container **800**. The opening **850** can be of any suitable size to facilitate loading of the tissue, biological material and/or treatment (e.g., a tissue graft), as described herein. In some embodiments, the opening **850** can extend across a portion of the length of an end or a side of the storage container **800**. In some embodiments, the opening **850** can extend across substantially all of the end or side of the storage container **800**. In the example shown in FIG. **8A**, the opening can extend across a face or layer **810** near edge **808** of container **800** defined by the separation between edges **811** and **821**. In one example, the opening **850** is defined by a slit in the first layer **810**. A larger opening can allow for input of a larger material (e.g., a tissue graft) into the storage volume **801**. Although it is appreciated that other materials as discussed herein can additionally or alternatively be introduced through opening **850**. After the material is introduced into the storage volume **801**, opening **850** can be sealed by seal **852** (e.g., a heat seal, adhesive seal, etc.), thereby enclosing the storage volume **801**. This allows for the loading of biologicals or other materials through the opening **850**. Once loaded, the opening **850** is sealed. The seal can be performed by a heat seal, an adhesive, or other suitable methods. In some embodiments, a laser line guides seal. In some embodiments, seal **853** can also be applied to fully separate opening **850** from the adjacent storage volumes.

In some embodiments, the container is suitable for segregating a single material into multiple portions. For example, the storage container **800** can include a sealable region **860**, suitable to apply a seal **863** to separate the storage volume **801** into storage volumes **801** and **802**. In some embodiments, the seal **863** can be applied before the material has been introduced into volume **801** thereby defining storage volume **801** and **802** separately before the material is introduced. In some embodiments, such as this one, the storage container **800** can include an opening **851** into volume **802**. One or more edges (e.g., edge **857**) of the first layer **810** are spaced apart from one or more edges (e.g., edge **859**) of the second layer **820** to define an opening **851** into the storage volume **802** of each of the storage container **800**. The opening **851** can be of any suitable size to facilitate loading of the tissue, biological material and/or treatment (e.g., a tissue graft), as described herein. The opening **851** can be of any suitable size to facilitate loading of peripheral items such as labels, instruments, therapeutics, etc., as described herein. In some embodiments, the opening **851** can extend across a portion of the length of an end or a side of the storage container **800**. In some embodiments, the opening **851** can extend across substantially all of the end or side of the storage container **800**. In some embodiments, the opening can extend across a face or layer **810** near edge **809** of container **800** defined by the separation between edges **857** and **859**. In another example, the opening **851** is defined by an unsealed portion of the layers **810** and **820** at edge **809**. In another example, the opening **851** is defined by a slit in the layer **810**. A larger opening can allow for input of a larger material (e.g., a tissue graft) into the storage volume **801**. Although it is appreciated that other materials as discussed herein can additionally or alternatively be introduced through opening **851**. After the material is introduced into volume **802**, the opening **851** can be sealed by seal **869** (e.g.,

a heat seal, adhesive seal, etc.) enclosing volume **802**. This allows for the loading of materials through the open end **851**. Once loaded, the open end **851** is sealed. The seal can be performed by a heat seal, an adhesive, or other suitable methods. In some embodiments, a laser line guides seal.

In some embodiments, the seal **863** can be applied after the material has been introduced through opening **850** or alternatively opening **851**. In such embodiments, the storage volumes **801** and **802** would be defined after the material was introduced such that the two volumes could have identical material. The separation region **860** can include an indicium to tell operator loading material into container **800** where to apply the separation seal **863**. When sealed at the indicia, the volume on a first side of the seal will have a first predetermined volume (e.g., storage volume **801**) and volume on the other side of the seal has a second predetermined volume (e.g., storage volume **802**). In this way, one portion of the material (e.g., the material in volume **801**) is usable for the intended process or operation while the other portion of the material (e.g., the material in volume **802**) can be stored for subsequent use (e.g., quality control, testing, archiving, etc.) Separating the material into two portions allows for second portion in volume **802** to be a known sample that is the same as the first portion in volume **801** for exact match retention. In other words, the material within the volume **801** has identical properties as the material within the storage volume **802**. In various embodiments, second portion in the storage volume **802** is a quality control sample that is fully representative of the portion stored in the storage volume **801**. In some embodiments, the storage volume **801** is the larger volume as shown in FIG. **8B**. Contrarily, in some embodiments, the storage volume **802** is the larger volume. In this alternative, the larger volume **802** can be used for significant subsequent testing using more material than the actual procedure. The second portion can be stored and subsequently tested to show first portion meets certain criteria. In some embodiments, the second portion could be about 5 cc to about 50 cc volume.

In some embodiments, the sealable region **860** can include a frangible region **864**. The frangible region can be suitable to facilitate or initiate separation of the storage volume **801** from the storage volume **802**. The frangible region **864** can include perforations, thinning of material, stress risers suitable to directional tearing, adhesive attached otherwise detached containers or any other suitable mechanism for separating storage volumes **801** and **802** of the storage container **800** from one another. In some embodiments, the frangible region **864** can include one or more perforations lines positioned between container storage volumes **801** and **802**. For example, frangible region **864** can be located between seal **852** and **863**. In another example, the frangible region can be located along one or more of seals **852**, **853**, or **863**. When the frangible regions are separated volume **802** is removable from the storage volume **801** without compromising the sealed structure of either volume. However, it will be appreciated that other shapes of the volumes, seals, and frangible regions are applicable as well.

In some embodiments, the first storage volume **801** and the second storage volume **802** can be the same general shape, or in other embodiments, they can be different shapes. For example, as shown in FIG. **8B**, the storage volume **801** can be generally rectangular. The storage volume **802** can similarly be generally rectangular. As discussed, the storage volume **802** can be sealed after material or items have been added and without a port attached to storage volume **802**,

port leaking can be avoided producing robust long-term storage. The storage volume **802** can be dispensed by cutting.

As shown in FIG. **8B**, the storage container **800** includes one or more material egresses. For example, the storage container **800** can also or alternatively include opening (e.g., peelable seal **868**). In some embodiments, opening is a peelable seal **868**. A portion of connection between the first layer **810** and the second layer **820** can be a peelable connection such that the dispensing at the peelable seal **868** includes areas in which the first layer **810** and the second layer **820** can be peeled apart after connection. The container **800** can include features of the various the containers as disclosed in U.S. Pat. No. 11,065,095 (the '095 patent, titled "Sample Container with Peelable Seal and Access Port," which is hereby incorporated by reference in its entirety. In light of the disclosure in the present application, a person of ordinary skill in the art could adapt the features of the container in the '095 patent to be formed on as a storage container having peel reseal openings similar to those disclosed in the '095 patent.

In various examples, the connection between the first layer **810** and the second layer **820** can be a peelable connection such that the region includes areas in which the first layer and the second layer can be peeled apart after connection. For example, in some embodiments, the peelable seal **868** can be an adhesive-based seal in which an adhesive layer pulls back from one of the first layer **810** or the second layer **820** when the first layer **810** is peeled apart from the second layer **820**. In other embodiments, the peelable seal can be a cohesive seal in which an adhesive layer or intermediate layer fails within itself when the first layer **810** is peeled apart from the second layer **820**. The peelable seal **868** can be produced by any suitable methods and/or mechanism as described herein. The seal and/or the layers **810**, **820**, whether peelable or permanent hermetically seals the storage volume **801**. The peelable seal **868** can be of any suitable geometry to facilitate the desired peel direction, peel strength, and the like. For example, in some embodiments, the peelable seal **868** can be an angled seal that provides for peel tabs that can be grasped by the user to peel the first layer **810** from the second layer **820**. In some embodiments, as illustrated in FIG. **8B**, the peelable seal **868** can extend across the length and define the edge **805**, **807**. However, in other embodiments, the peelable seal **868** can extend across a portion of an edge. Because cutting and tearing can introduce foreign matter, the peelable opening allows for the contents inside to remain aseptic after opening the container **800**. Additionally, the peel strength can be adjusted based on the material selected. In some examples, the peel strength is between 0.25 pounds and 5 pounds. In other examples, the peel strength is between 0.5 pounds and 2 pounds. In one example, the peel strength is about 1 pound. The peel can also control the amount of material dispensed. For example, how far the layers are peeled adjusts the opening size allowing more material to be dispensed relative to a smaller opening. The size can also be adjusted to the type of material being dispense. For example, a more viscous material can benefit from a larger opening. A less viscous material can benefit from a smaller opening.

The storage container **800** can include a tapered portion. The tapered portion can define a narrow egress that can be opened thereby allowing the storage volume **801** to be dispensed in a controlled manner. Without a port attached to storage volume **801**, port leaking can be avoided producing robust long-term storage. The storage volume **801** can be dispensed by peeling the peelable seal **868**. When the

peelable seal **868** is peeled the material can be released or dispensed in a controlled manner during dispensing of the material in quality control operations. The peelable seal **868** can be defined by the region near the tapered portion. Edges **804** and **806** can extend in parallel until they taper together forming edges **803** and **805**. In some embodiments, the seals along end portions **803** and/or **805** (or any other sealed edges forming a funnel described herein) can extend at an angle (β) of between about 5 degrees to about 75 degrees. This configuration allows for a large opening for loading (e.g., opening **850**) and a controlled egress at the peelable seal **868** for dispensing.

An embodiment of a storage container **900** is shown in FIGS. **9A-B**. The storage container **900** includes a tapered end portion. The storage container **900** (and any of the container assemblies described herein) can include the storage volume **901** that can be used to store any of the tissue and biological materials described herein, and/or to perform any of the methods described herein and/or the methods of preparing the material for use in a procedure.

As described herein, the storage container **900** provides a container that can be used for cryogenically freezing, storage, transport, processing, defrosting and/or rehydration of the material. The storage container **900** also includes a first layer **910**, a second layer **920** and one or more seals **930** connecting the first layer **910** and the second layer **920**. The one or more seals **930** form side edges **904**, **906** of the storage container **900**. While sealed edges can define the container **900**, it is also appreciated that in some embodiments, the two layers (e.g., **910**, **920**) can be provided as tubular material that is flattened forming two longitudinal connections between the layers on the flattened longitudinal edges of the tubular material (e.g., layflat tubular film).

As shown in FIG. **9A**, the storage container **900** includes one or more material egresses. The storage container **900** can include a first opening (e.g., opening **950**). The two layers **910**, **920** respectively are joined at a first end portion **908**. In such an embodiment, material can be inserted or additionally or alternatively treated (e.g., with a preservation fluid) via the opening **950**.

In some embodiments, in a first (or opened) configuration, one or more edges (e.g., edge **911**) of the first layer **910** are spaced apart from one or more edges (e.g., edge **921**) of the second layer **920** to define an opening **950** into the storage volume **901** of each of the storage container **900**. The opening **950** can be of any suitable size to facilitate loading of the tissue, biological material and/or treatment (e.g., a tissue graft), as described herein. In some embodiments, the opening **950** can extend across a portion of the length of an end or a side of the storage container **900**. In the example shown in FIG. **9A**, the opening **950** can extend across substantially all of the end or side of the storage container **900**. In some embodiments, the opening can additionally or alternatively extend across a face or layer **910** near first end portion **908** of container **900** defined by the separation between edges **911** and **921**. In one example, the opening **950** is defined by a slit in the layer **910**. A larger opening can allow for input of a larger material (e.g., a tissue graft) into the storage volume **901**. Although it is appreciated that other materials as discussed herein can additionally or alternatively be introduced through opening **950**. After the material is introduced into the storage volume **901**, the opening **950** can be sealed by seal **952** (e.g., a heat seal, adhesive seal, etc.) enclosing the storage volume **901**. This allows for the loading of biologicals or other materials through the opening **950**. Once loaded, the opening **950** is sealed. The seal can be

performed by a heat seal, an adhesive, or other suitable methods. In some embodiments, a laser line guides seal.

The storage container **900** can include a tapered portion **903**. The tapered portion **903** can define a narrow egress **970** that can be opened thereby allowing the storage volume **901** to be dispensed in a controlled manner. Without a port attached to the storage volume **901**, port leaking can be avoided producing robust long-term storage. The storage volume **901** can be dispensed by egress **970**. In various examples the egress can include a V-shaped end or tip **975**. When the tip **975** is cut, the material can be released or dispensed in a controlled manner during dispensing of the material.

The egress **970** can be of any suitable geometry to facilitate or form the designed egress opening. For example, in some embodiments, the egress **970** can be an angled seal that funnels the material in volume **901** toward the tip **975**. This taped end with angled seals along edges **905** and **907** allows for maximum material dispensing because there are limited regions for the material to get hung up on within the storage volume **901**. In some embodiments, as illustrated in FIG. **9B**, the egress **970** can extend across the width of the container **900** and define the edge **905**, **907**. However, in other embodiments, the egress **970** can extend across a portion of an edge. A cut indicia **977** can be provided on tip **975**. For example, the cut indicia **977** can include a laser mark in layer **910** and/or **920** can be provided to position the correct cut or tear of the material. In some embodiments, this indicia **977** can also be a weakened area allowing for a directed and easier tear along the desired position. For example, the material may be thinned along the weakened area.

An embodiment of a storage container **1000** is shown in FIGS. **10A-B**. The storage container **1000** includes a peelable tapered end portion. The storage container **1000** (and any of the container assemblies described herein) can include the storage volume **1001** that can be used to store any of the tissue and biological materials described herein, and/or to perform any of the methods described herein and/or the methods of preparing the material for use in a procedure.

As described herein, the storage container **1000** provides a container that can be used for cryogenically freezing, storage, transport, processing, cryogenically defrosting and/or rehydration of the material. The storage container **1000** also includes a first layer **1010**, a second layer **1020** and one or more seals **1030** connecting the first layer **1010** and the second layer **1020**. The one or more seals **1030** form side edges **1004**, **1006** of the storage container **1000**. While sealed edges can define the container **1000**, it is also appreciated that in some embodiments, the two layers (e.g., **1010**, **1020**) can be provided as tubular material that is flattened forming two longitudinal connections between the layers on the flattened longitudinal edges of the tubular material (e.g., layflat tubular film).

As shown in FIG. **10A**, the storage container **1000** includes one or more material egresses. The storage container **1000** can include a first opening (e.g., opening **1050**). In such an embodiment, material can be inserted or additionally or alternatively treated (e.g., with a preservation fluid) via the opening **1050**.

In some embodiments, in a first (or opened) configuration, one or more edges (e.g., edge **1011**) of the first layer **1010** are spaced apart from one or more edges (e.g., edge **1021**) of the second layer **1020** to define an opening **1050** into the storage volume **1001** of each of the storage container **1000**. The opening **1050** can be of any suitable size to facilitate

loading of the tissue, biological material and/or treatment (e.g., a tissue graft), as described herein. In some embodiments, the opening **1050** can extend across a portion of the length of an end or a side of the storage container **1000**. In the example shown in FIG. **10A**, the opening **1050** can extend across substantially all of the end or side of the storage container **1000**. In some embodiments, the opening can additionally or alternatively extend across a face or layer **1010** near edge **1008** of container **1000** defined by the separation between edges **1011** and **1021**. In one example, the opening **1050** is defined by a slit in the layer **1010**. A larger opening can allow for input of a larger material (e.g., a tissue graft) into the storage volume **1001**. Although it is appreciated that other materials as discussed herein can additionally or alternatively be introduced through opening **1050**. After the material is introduced into the storage volume **1001**, the opening **1050** can be sealed by seal **1052** (e.g., a heat seal, adhesive seal, etc.) enclosing volume **1001**. This allows for the loading of biologicals or other materials through the opening **1050**. Once loaded, the opening **1050** is sealed. The seal can be performed by a heat seal, an adhesive, or other suitable methods. In some embodiments, a laser line guides seal.

In some embodiments, the storage volume **1001** can be dispensed by egress **1070**. In various examples the egress can include a V-shaped end or tip **1075**. When the tip **1075** is opened, the material can be released or dispensed in a controlled manner during dispensing of the material. In some embodiments, the egress **1070** is a peelable seal. A portion of connection between the first layer **1010** and the second layer **1020** can be a peelable connection such that the egress **1070** includes areas **1078** in which the first layer **1010** and the second layer **1020** can be peeled apart after connection. The container **1000** can include features of the various the containers as disclosed in U.S. Pat. No. 11,065,095 (the '095 patent, titled "Sample Container with Peelable Seal and Access Port," which is already incorporated by reference in its entirety. In light of the disclosure in the present application, a person of ordinary skill in the art could adapt the features of the container in the '095 patent to be formed on as a storage container having peel reseal openings similar to those disclosed in the '095 patent.

In various examples, the connection between the first layer **1010** and the second layer **1020** can be a peelable connection such that the region includes areas in which the first layer and the second layer can be peeled apart after connection. For example, in some embodiments, the egress **1070** can include the peelable seal. The peelable seal can include an adhesive-based seal in which an adhesive layer pulls back from one of the first layer **1010** or the second layer **1020** when the first layer **1010** is peeled apart from the second layer **1020**. In other embodiments, the peelable seal can be a cohesive seal in which an adhesive layer or intermediate layer fails within itself when the first layer **1010** is peeled apart from the second layer **1020**. The egress **1070** can be produced by any suitable methods and/or mechanism as described herein. The seal and/or the layers **1010**, **1020**, whether peelable or permanent, hermetically seals the storage volume **1001**. The egress **1070** can include a peelable seal. The egress **1070** can be of any suitable geometry to facilitate the desired peel direction, peel strength, and the like. For example, in some embodiments, the egress **1070** can be an angled seal that provides for peel tabs that can be grasped by the user to peel the first layer **1010** from the second layer **1020**. In some embodiments, as illustrated in FIG. **10B**, the egress **1070** can extend across the length and define the edge **1005**, **1007**. However, in other

embodiments, the egress **1070** can extend across a portion of an edge. Because cutting and tearing can introduce foreign matter, the peelable opening allows for the contents inside to remain aseptic after opening the container **1000**. Additionally, the peel strength can be adjusted based on the material selected. In some examples, the peel strength is between 0.25 pounds and 5 pounds. In other examples, the peel strength is between 0.5 pounds and 2 pounds. In one example, the peel strength is about 1 pound. The peel can also control the amount of material dispensed. For example, how far the layers are peeled apart adjusts the opening size allowing more material to be dispensed relative to a smaller opening. The size can also be adjusted to the type of material being dispensed. For example, a more viscous material can benefit from a larger opening. A less viscous material can benefit from a smaller opening.

The container **1000** can include a tapered portion. The tapered portion can define a narrow egress that can be opened thereby allowing the storage volume **1001** to be dispensed in a controlled manner. Without a port attached to the storage volume **1001**, port leaking can be avoided producing robust long-term storage. The storage volume **1001** can be dispensed by egress **1070**. In various examples the egress can include a tip **1075**. When the tip **1075** is opened, the material can be released or dispensed in a controlled manner during dispensing of the material.

The egress **1070** can be of any suitable geometry to facilitate or form the egress opening. In some embodiments, container **1000** can include a tapered portion. For example, the egress **1070** can be an angled seal **1077** and **1079** that funnels the material in volume **1001** toward the tip **1075**. The angled seals **1077** and **1079** can be formed between edges **1005** and **1007** of layers **1010** and **1020**. This egress **1070** can include a tapered end that allows for maximum material dispensing because there are limited regions for the material to get hung up on within the storage volume **1001**. In some embodiments, as illustrated in FIG. **10B**, the egress **1070** can extend across the width of the container **1000** and define the edge **1005**, **1007**. However, in other embodiments, the egress **1070** can extend across a portion of the width of the container.

Although the volumes of the containers (e.g., any of the layers in storage containers **100**, **200**, **300**, **400**, **500**, **600**, **700**, **800**, **900**, and **1000**) shown and described herein are depicted with rectangular or trapezoidal shapes, it is appreciated that the volumes can be formed between the first and second layers with any other desirable shapes. For example, as shown in FIG. **11**, the volumes of the containers can include circular, oval, or U-shaped boundaries. The circular, oval, or U-shaped provides a rounded internal storage volume boundary that can provide a more compact storage area to keep stored material together, and/or prevent stored material from being trapped or retained in a corner portion while being removed from the storage volume. Additionally, the circular, oval, or U-shaped reduces stress risers by removing corners adding to the strength of the storage volume. The embodiment of a storage container **1100** is shown in FIG. **11**. The storage container **1100** (and any of the container assemblies described herein) can include the storage volume **1101** that can be used to store any of the tissue and biological materials described herein, and/or to perform any of the methods described herein and/or the methods of preparing the material for use in a procedure. The storage container **1100** includes a seal **1130** that is continuously curved on the interior of the storage volume **1101**. This curved profile limits stored material from being trapped or retained in any internal corner portions during

storage of the stored material or during removal of the stored material from the storage volume **1101**. Additionally, the circular, oval, or U-shaped reduces stress risers by omitting internal corner portions. While shown with an opening **1150** that tapers down to neck from the wider center portion of storage volume **1001**, it should be appreciated that other embodiments can have a wider opening. For example, the opening can be as wide as the widest portion of the volume **1101**.

An embodiment of a storage container **1200** is shown in FIG. **12A**. The storage container **1200** can be configured to have multiple storage volumes **1201**, **1202**, and **1213**. The storage container **1200** (and any of the container assemblies described herein) can include the storage volume **1201** that can be used to store any of the tissue and biological materials described herein, and/or to perform any of the methods described herein, and/or the methods of preparing the material for use in a procedure. In some embodiments, the storage container **1200** can include a storage volume **1202** that can be used similar to the storage volume **1201** to store any of the tissue and biological materials described herein, and/or to perform any of the methods described herein. Additionally or alternatively, the storage volume **1202** can be used as an interim material storage prior moving the material to the storage volume **1201**. For example, if multiple units or pieces of tissue and/or biological material is to be stored in the storage container **1200**, each unit or piece may be temporarily placed in the storage volume **1202** while the remaining units or pieces of material are retrieved. In this manner, the initial units and pieces of material placed within the storage volume **1202** are protected from external contaminants or debris while the remaining units or pieces are placed in the storage volume **1202**. Additionally, the storage volume **1201** is maintained in a sterile condition during the loading of all the units or pieces of material into the storage volume **1202**. Once all the units or pieces of material have been loaded into the storage volume **1202**, the storage container **1200**. In this way, the material can be sealed inside of the storage container **1200** before the storage volume **1201** is opened for moving the material into the storage volume **1201**.

In some embodiments, the first storage volume **1201** is used to store a first kind of tissue and biological materials, and the second storage volume **1202** is used to store a second kind of tissue and biological materials, different from the first kind. In some embodiment, the first kind of tissue and biological materials can be mixed together with the second kind of tissue and biological materials prior to use. Alternatively, in some embodiments, the storage volume **1202** can be used to store peripheral items such as labels (e.g., to identify the material in **1201**), tools (e.g., to perform procedures with the material in **1201**), therapeutic treatments (e.g., to supplement or use with the material in **1201**), etc. Alternatively, the storage volume **1213** can be used to store peripheral items such as labels (e.g., to identify the material in **1201**), tools (e.g., to perform procedures with the material in **1201**), therapeutic treatments (e.g., to supplement or use with the material in **1201**), etc. Alternatively, the storage volume **1213** can remain unsealed to the outer environment.

As described herein, the storage container **1200** provides a container that can be used for cryogenically freezing, storage, transport, processing, defrosting and/or rehydration of the material. The storage container **1200** also includes a first layer **1210**, a second layer **1220** and one or more seals **1230** connecting the first layer **1210** and the second layer **1220**. The one or more seals **1230** form side edges **1204**, **1206** of the storage container **1200**. While sealed edges can

define the storage container **1200**, it is also appreciated that in some embodiments, the two layers (e.g., **1210**, **1220**) can be provided as tubular material that is flattened forming two longitudinal connections between the layers on the flattened longitudinal edges of the tubular material (e.g., layflat tubular film).

As shown in FIG. **12A**, the storage container **1200** includes one or more material egresses. The storage container **1200** can include a first opening (e.g., opening **1250**). The two layers **1210**, **1220** respectively are joined at a first end portion **1203**. For example, the two side edges **1205**, **1207** are joined together. In such an embodiment, material can be inserted or additionally or alternatively treated (e.g., with a preservation fluid) via the opening **1250**.

In some embodiments, in a first (or opened) configuration, one or more edges (e.g., edge **1211**) of the first layer **1210** are spaced apart from one or more edges (e.g., edge **1221**) of the second layer **1220** to define an opening **1250** into one or more of the storage volumes **1213**, **1202**, and **1201** of the storage container **1200**. The opening **1250** can be of any suitable size to facilitate loading of the tissue, biological material and/or treatment (e.g., a tissue graft), as described herein. In some embodiments, the opening **1250** can extend across a portion of the length of an end or a side of the storage container **1200**. In some embodiments, the opening **1250** can extend across substantially all of the end or side of the storage container **1200**. A larger opening can allow for input of a larger material (e.g., a tissue graft) into the storage volume **1201**. It is appreciated that other materials as discussed herein can additionally or alternatively be introduced through opening **1250**. After the material is introduced into the storage volume **1202**, opening **1250** can be sealed by seal **1252** (e.g., a heat seal, adhesive seal, etc.), thereby enclosing the storage volume **1201**. This allows for the loading of biologicals or other materials through the opening **1250**. Once loaded, the opening **1250** is sealable. The sealing of the opening **1250** (and the application of any other seals described herein) can be performed by a heat seal, an adhesive, or other suitable methods. In some embodiments, a laser line guides seal. In some embodiments, a seal **1263** can also be applied to fully separate opening **1250** from the adjacent storage volumes.

As shown in FIG. **12A**, the storage container **1200** includes one or more material intermediate openings. For example, the storage container **1200** can include a first opening (e.g., port **1240**). For example, as shown in FIG. **12A**, the two layers **1210**, **1220** respectively are joined at a first end portion **1203** and along the edges **1204** and **1206**. In some embodiments, the one or more ports **1240** can be formed between the two layers **1210**, **1220**. In some embodiments, the ports **1240** can extend directly through a layer such as layer **1210** or **1220**. In some embodiments, the ports **1240** can be coupled to the first end portion **1203** of the storage container **1200**. The ports **1240** are configured to allow fluid communication between the outside of the storage container **1200** and the storage volume **1201**. In this manner, additional material can be inserted and/or the material within the storage volume **1201** can be treated (e.g., with a preservation fluid) after being sealed within the storage container **1200**. Additionally or alternatively, the port **1240** can also be coupled to a vacuum source to evacuate the storage volume. Additionally or alternatively, when in use (e.g., during a surgical procedure), the port **1240** can allow for cryogenically defrosting the material. Additionally or alternatively, when in use (e.g., during a surgical procedure), the port **1240** can allow for inflow of fluid used in rehydration or other uses. Additionally or alternatively, when in use,

the port **1240** can allow for removal of fluid. In some embodiments, one set of ports **1240**, such as those along edge **1206** can be used to convey a fluid into the storage volume **1201**, while another set of ports, such as those along edge **1204** can be used to remove the fluid from the storage volume **1201**.

The port **1240** can be any suitable port that selectively provides fluid communication to the storage volume **1201**. For example, the port **1240** can include a tube, a valve, and/or a cap. In some embodiments, the port **1240** can be a needle-free port. In some embodiments, the port **1240** can be a swabable connector. Similarly stated in some embodiments, the port **1240** can have external surfaces and can be devoid of recesses or crevices such that the port **1240** can be easily wiped or "swabbed" to maintain sterility during use. In some embodiments, the port **1240** can include any of the barbed, swabable valves produced by the Halkey-Roberts Corporation, such as the **2455** series of swabable valves. In other embodiments, the port **1240** (and any of the ports described herein) need not be either a swabable connector or a needle-free port; any suitable port can be employed. In some embodiments, the port **1240** can include a male or female luer fitting. In some embodiments, the port **1240** can include a threaded connection for coupling with a syringe or a tubing set. In some embodiments, the port **1240** can be sealed at the end for sterile docking or cutting.

Although the port **1240** is shown as being coupled along the side edges **1204** and **1206** of the storage container **1200**, the ports can be located in other locations. In other embodiments, the port **1240** (and any of the ports described herein) can be coupled at any location and to any portion of the storage container **1200**. For example, in some embodiments, the port **1240** (and any of the ports described herein) need not be coupled to the side edges **1204** and **1206** of the storage container **1200**, the port can be on the surface or another edge portion of the storage container **1200**. For example, in some embodiments, the port can be located at a corner of the storage container **1200**. In some embodiments, the port (and any of the ports described herein) can be coupled around a central portion of the storage container **1200**.

In some embodiments, the port **1240** can include a filter. In some embodiments, the port **1240** can include a Y-connector. The base of Y-connector near port can contain the filter. One end of Y-connector can be sealed. The other end of the Y-connector can be threaded port for syringe connection. This allows for both hospital uses (e.g., syringe connection to port) and lab uses (e.g., a sterile dockable connection to the port). In some embodiments, the material stored in the storage volume **1201** does not, or is limited in its ability to, move through the port **1240**. This may be due to size, viscosity, or other characteristics. In such embodiment, the port can be filterless allowing processing material to move into or out of the storage volume **1201** without regard to the material stored therein.

In some embodiments, the storage container **1200** is suitable for segregating a single material into multiple portions. For example, the storage container **1200** can include a sealable region **1260**, suitable to apply a seal **1263** to separate the storage volume **1201** and **1202** from volume **1213**. Additionally or alternatively, the sealable region can have a separable seal applied along seal **1266**. The seal **1266** can be separated, then the material can be inserted into the volumes **1201**, **1202** and then seal **1263** can be applied to sealable region **1260**. Formation of the seal **1263** seals off the volumes **1201**, **1202** from the exterior environment of the storage container **1200**.

In some embodiments, the storage container **1200** is suitable for segregating a single material into multiple portions. For example, the storage container **1200** can include a sealable region **1270**, suitable to apply a seal **1273** (also referred to as a separation seal) to separate the storage volume **1201** from volume **1202**. Additionally or alternatively, the sealable region can have a separable seal applied along seal **1276**. The seal **1276** can be separated allowing layers **1210** and **1220** to separate from one another opening volume **1201** to volume **1202**. Then, the material can be inserted into the volumes **1201**. Subsequently, the seal **1273** can be applied to sealable region **1270**. Formation of seal **1273** separates the volume **1201** from the volume **1202**.

In some embodiments, the seal **1273** can be applied after the material has been introduced into volume **1201**. In such embodiments, the storage volumes **1201** and **1202** would be defined after the material is introduced. In some embodiments, some material can be moved to volume **1201** while some material remains in volume **1202** such that the two volumes could have identical material. The separation region **1270** can include an indicia to tell operator loading material into container **1200** where to apply the separation seal **1273**. When sealed at the indicia, the volume on a first side of the seal will have a first predetermined volume (e.g., storage volume **1201**) and volume on the other side of the seal has a second predetermined volume (e.g., storage volume **1202**). In this way, one portion of the material (e.g., the material in volume **1201**) is usable for the intended process or operation while the other portion of the material (e.g., the material in volume **1202**) can be stored for subsequent use (e.g., quality control, testing, archiving, etc.) Separating the material into two portions allows for storage of the same material in both volume **1201** and volume **1202**. In other words, the material within the volume **1201** has identical properties as the material within the storage volume **1202**. In this manner, one portion of the material can be used or test without disturbing the second portion and therefore the second portion of material maintains sterility and can be used for a subsequent procedure or future testing. In various embodiments, second portion in the storage volume **1202** is a quality control sample that is fully representative of the portion stored in the storage volume **1201**. In some embodiments, the storage volume **1201** is the larger volume as shown in FIG. **12A**. Contrarily, in some embodiments, the storage volume **1202** is the larger volume. In this alternative, the larger volume **1202** can be used for significant subsequent testing using more material than the actual procedure. The second portion can be stored and subsequently tested to show first portion meets certain criteria. In some embodiments, the second portion could be about 5 cc to about 50 cc volume.

In some embodiments, the first storage volume **1201** and the second storage volume **1202** can be the same general shape, or in other embodiments, they can be different shapes. For example, as shown in FIG. **12A**, the storage volume **1201** can be generally rectangular. The storage volume **1202** can similarly be generally rectangular. As discussed, the storage volume **1202** can be sealed after material or items have been added and without a port attached to storage volume **1202**. Port leaking can be avoided producing robust long-term storage. The storage volume **1202** can be dispensed by cutting.

In some embodiments, the storage container **1200** includes a separation member **1285**. For example, one or both layers **210** and **220** can include the separation member **1285**. The separation member **1285** can be located in the same region as the storage volume **1202**. The separation

member is operable for applying an external force to the storage container **1200** to pull the layers **210** and **220** apart to more easily pass the material through the volume **1202** into the volume **1201**. In one example, as shown in FIGS. **12A** and **12B**, the separation member includes tabs that extend away from the external surface of layers **210** and **220**. The tabs can be grippable by the hand of a user or the figures or a user to apply the outward force. Utilization of the separation member **1285** reduces the intrusion of possibly non-sterile equipment, hands, figures, or other items into the storage container **1200** to cause the separation, thereby increasing the overall sterility of the inside of the storage container **1200**.

In some embodiments, the storage container **1200** includes an end separation member **1287**. The end separation member facilitates easier initial separation of layers **1210** and **1220**. In one example, the end separation member **1287** includes a notch extending through the surface of layer **1210**. The notch allows for a section of layer **1210** that does not overlap layer **1220** allowing for easy access to layer **1220** such that the layers can be separation proximal to their end termination.

FIG. **12B** is a schematic illustration of the storage container **1200** utilized in a material preparation system **1249** in accordance with some embodiments. The material preparation system **1249** can include one or more port injectable fluids **1295** connected to one or more of the ports **1240**. The port injectable related media can include any of a variety of substances such as culture media, saline solution, cryoprotectant, preservation solution, etc. Additionally or alternatively, the material preparation system **1249** can include one or more fluid egress containers **1297** connected to one or more of the ports **1240**. The media can be injected through a first set of ports **1240** and then evacuated through a second set of ports.

In some embodiments, seal **1273** can be applied after the material in volume **1201** has been exposed to the media via ports **1240**. In such an embodiment, a portion of the material can remain in volume **1202** after the exposure to the media. Once sealed off, the material in the volume **1202** functions as a quality control sample preserved apart from the media of the volume **1201**.

As described above, the storage container **1200** can be used to temporarily hold multiple units or pieces of materials (e.g., tissues and/or biological materials) during an extraction or loading process before the multiple units or pieces of materials are sealed within the storage container **1200** for storage. The temporarily holding volume promotes greater sterility within the storage container **1200**. In some embodiments, the storage container **1200** may be pre-formed with the seal **1263** and the seal **1273** to provide a sterility entry area between the seal **1263** and the seal **1273**. In such an embodiment, the seal **1263** is opened and one or more pieces of material is introduced into the volume **1202**. The seal **1263** is then replaced or re-applied at the same or similar location to close the sterility entry area. Seal **1273** is then separated opening volume **1202** up to volume **1201**. In some embodiments, an external force can be applied to separation members **1285** separating layers **1210** and **1220** from one another and breaking the seal **1273**. The material can then be moved from the sterility entry area and into the volume **1201**. In some embodiments, the seal **1273** is then replaced or re-applied at the same or similar location thereby sealing the material in the volume **1201** and separating it from the volume **1202**. In some embodiments, a portion of the material can be kept within the volume **1202** (prior to replacing or reapplying the seal **1273**) thereby allowing the

volume **1202** to serve as a quality control container and/or providing the storage container **1200** with two volumes **1201**, **1202** with the same material such that the two volumes of material can be used independent of one another without contaminating or affecting the sterility of the other volume of material.

FIG. **12C** shows the storage container **1200** with the seal **1263** and the seal **1273** applied. In some embodiments, one or more of the seals **1263**, **1273** form a concave inner wall bounding the volume **1202**. FIG. **12D** shows a storage container **1200'**, which is similar to the storage container **1200**, except that the volume **1202** is bounded by one or more V-shaped inner walls formed by the seals **1263'**, **1273'**. FIG. **12E** shows a storage container **1200''**, which is similar to the storage container **1200**, except that the volume **1202** is bounded by one or more linear inner walls formed by the seals **1263''**, **1273''**. Although the thickness of the seals (**1263**, **1263'**, **1263''**, **1273**, **1273'**, **1273''**) are shown as having a constant width (or having a constant wall thickness), it will be appreciated the seals (and therefore the thickness of the walls formed by the seals) can have a variable width. For example, seals (**1263**, **1263'**, **1263''**, **1273**, **1273'**, **1273''**, or any other seals described herein) can be provided with variable widths to promote separation (such as by using the separation member **1285**) and/or to provide additional structural support in certain areas of the storage container **1200**.

It should further be appreciated that any of the storage volumes described herein (including any of the storage volumes associated with storage containers **100**, **200**, **300**, **400**, **500**, **600**, **700**, **800**, **900**, **1000**, **1100** and **1200**) can include circular, oval, or U-shaped internal boundaries.

The first and second layers (e.g., any of the layers in storage containers **100**, **200**, **300**, **400**, **500**, **600**, **700**, **800**, **900**, **1000**, **1100**, and **1200**) can be constructed of any suitable material. The first layer can have a first stiffness and the second layer can have a second stiffness. In some embodiments, the stiffnesses of the first layer and the second layer are the same. In some embodiments the stiffnesses are different. In some embodiments the second stiffness is greater than the first stiffness. In some embodiments, the first stiffness is greater than the second stiffness. In some embodiments, the layers can be constructed from the same material. In some embodiments, the layers can be constructed from a different material. In some embodiments, the layers can have different stiffness. In some embodiments, the first layer can be a thin, peelable film. The first layer can have any suitable thickness to provide the desired strength, flexibility, and sealing characteristics. For example, in some embodiments, the first layer **1110** can be between about 10 microns (0.010 mm) and about 2000 microns (2.0 mm). In some embodiments, the first layer **1110** can be between about 50 microns (0.050 mm) and about 200 microns (0.200 mm). In some embodiments, the first layer can be between about microns (0.050 mm) and about 1000 microns (0.100 mm). The second layer can have any suitable thickness to provide the desired strength, flexibility, and sealing characteristics. For example, in some embodiments, the first layer can be between about 10 microns (0.010 mm) and about 2000 microns (2.0 mm). In some embodiments, the second layer **1120** can be between about 50 microns (0.050 mm) and about 200 microns (0.200 mm). In other embodiments, the second layer **1120** can be between about 50 microns (0.050 mm) and about 1000 microns (0.100 mm).

In some embodiments, the layers (e.g., any of the layers in storage containers **100**, **200**, **300**, **400**, **500**, **600**, **700**, **800**, **900**, **1000**, **1100**, and **1200**) can be produced out of any one

or more of the following materials: polyethylene (PE), low density polyethylene (LDPE), composites of LDPE, linear low-density polyethylene (LLDPE), high density polyethylene (HDPE), polychlorotrifluoroethylene (PCTFE), ethylene tetrafluoroethylene (ETFE), polytetrafluoroethylene (PTFE), fluorinated ethylene propylene (FEP), polyurethane, polyimides (coats or non-coated), polyvinyl chloride (PVC), perfluoroalkoxy alkane (PFA), ethylene-vinyl acetate (EVA), polyvinylidene fluoride or polyvinylidene difluoride (PVDF), THV (a polymer of tetrafluoroethylene, hexafluoropropylene and vinylidene fluoride), PFE (Poly (fluorenylene ethynylene)), nylon, and/or composite of nylon. In some embodiments, any of the packaging using the materials above can be co-extruded and/or laminated. In some embodiments, any of the multi-chamber packaging using the materials above can further include aluminum foil laminate, aluminum oxide laminate, or laminated or co-extruded with aluminum oxide. In some embodiments, any of the multi-chamber packaging can be laminated with a layer of alder or any other suitable adhesive. The materials from which the first layer and the second layer are selected to ensure that the two layers can be joined to hermetically seal the storage volume within which the material (or any other stored product described herein) is stored while also retaining the desired flexibility. The two layers can be joined together at the end portions and along the side edges by any suitable methods and/or mechanism, such as, for example, by heat bonding or by an adhesive.

In some embodiments, the closing seals of the containers (e.g., storage containers **100**, **200**, **300**, **400**, **500**, **600**, **700**, **800**, **900**, **1000**, **1100**, and **1200**) are a permanent seal that is openable by destroying the seal and/or the layers. In other embodiments, the closing seals are peelable seals that are openable by separating the first layer from the second layer with a force that is less than a force required to tear or rip a material of the first layer and/or the second layer apart when sealed. The peelable seal can be configured to have any suitable failure (or peel) mechanism and can be of any suitable peel strength. In some embodiments, any of the containers (e.g., any of storage containers **100**, **200**, **300**, **400**, **500**, **600**, **700**, **800**, **900**, **1000**, **1100**, and **1200**) described herein can be produced using a plasma treatment, and/or a corona treatment.

While some embodiments have been described above, it should be understood that they have been presented by way of example only, and not limitation. Where methods and/or schematics described above indicate certain events and/or flow patterns occurring in certain order, the ordering of certain events and/or operations may be modified. While the embodiments have been particularly shown and described, it will be understood that various changes in form and details may be made.

Although some embodiments have been described as having particular features and/or combinations of components, other embodiments are possible having a combination of any features and/or components from any of embodiments as discussed above. Aspects have been described in the general context of medical devices, and more specifically tissue packaging devices, but inventive aspects are not necessarily limited to use in medical devices and tissue packaging.

What is claimed is:

1. A system, comprising:
a first layer;

a second layer, the first layer and second layer being coupled together to form a container having a first end portion, a second end portion, a first edge between the

47

- first end portion and the second end portion, and a second edge between the first end portion and the second end portion, the first edge opposite the second edge;
- a plurality of seals coupling the first layer and the second layer together along at least the first end portion, the second end portion, the first edge, or the second edge to define a storage volume between the first layer and the second layer;
- a first opening into the storage volume, the first opening being positioned at the first end portion, the first opening being suitable to receive a material;
- at least one intermediate seal extending between the first edge and the second edge, the at least one intermediate seal separating the storage volume into a first volume and a second volume, the intermediate seal being applicable after a target material is introduced into the storage volume such that the target material is stored within the first volume and the second volume; and
- a frangible region extending along the at least one intermediate seal, the frangible region allowing for physical separation of the container into a first container portion and a second container portion, the first container portion including the first volume and the second container portion including the second volume, the second container portion including a tapered portion that extends from an end of the second edge to a tip at the second end portion,
- wherein the plurality of seals coupling the first layer and the second layer includes a peelable seal at the tip, the peelable seal is configured such that the first layer can be peeled away from the second layer to produce a second opening at the tip.
2. The system of claim 1, wherein the frangible region includes any of a perforation, a tear notch, or a stress concentration riser.
3. The system of claim 2, wherein the frangible region includes a first perforation defined in the first layer and a second perforation defined in the second layer, the first perforation aligned with the second perforation.
4. The system of claim 1, wherein a width of the intermediate seal is greater than a width of the frangible region.
5. The system of claim 1, wherein a first seal of the plurality of seals is along the first edge and a second seal of the plurality of seals is along the second edge.
6. The system of claim 1, further comprising a port positioned along the first end portion, the port defining the opening.

48

7. The system of claim 6, wherein:
- the first end portion includes an end portion seal that fluidically isolates the port from the storage volume; and
- an end portion frangible region extending along the end portion seal, the end portion frangible region allowing for physical separation of the port from the storage volume.
8. The system of claim 1, wherein the frangible region is configured to allow removal of the tapered portion while maintaining the plurality of seals of the first container portion and the second container portion.
9. The system of claim 1, wherein the first volume and the second volume are partially defined by at least one of the plurality of seals and the intermediate seal completes a closure across the one of the plurality of seals to fully isolate the first volume and the second volume from one another.
10. The system of claim 1, wherein the first volume is larger than the second volume.
11. The system of claim 1, wherein the first volume is more than twice a size of the second volume.
12. The system of claim 1, wherein both the first volume and the second volume include regions that are openable to remove the target material from each of the first volume and the second volume.
13. The system of claim 12, wherein the first volume includes a port and the second volume includes a peelable region.
14. The system of claim 1, wherein the second container portion includes a plurality of graduated markings that indicate a quantity of the target material stored therein.
15. The system of claim 1, wherein:
- the first container portion includes a first indicium associated with the target material; and
- the second container portion includes a second indicium associated with at least one of the first indicium, the first container portion, or the target material.
16. The system of claim 15, wherein the first indicium and the second indicium are each machine readable.
17. The system of claim 1, wherein at least one of the first layer or the second layer include a separation tab extending from an exterior portion of the first layer or the second layer and oriented such that a user can grip the separation tab and separate the first layer from the second layer.

* * * * *