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(54) **SEALING APPARATUS FOR CREATING MOISTURE-RESISTANT BARRIER AROUND FILAMENTS, AND CORRESPONDING METHODS**

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(57) **ABSTRACT**

Disclosed herein is a sealing apparatus comprising a moisture barrier that engages with a filament spool to create a moisture-resistant enclosure for housing a filament on said spool, and a passageway in said sealing apparatus so that the remaining filament can exit sad sealing apparatus during use. Also disclosed is a method for preparing and packaging the filament and sealing apparatus.

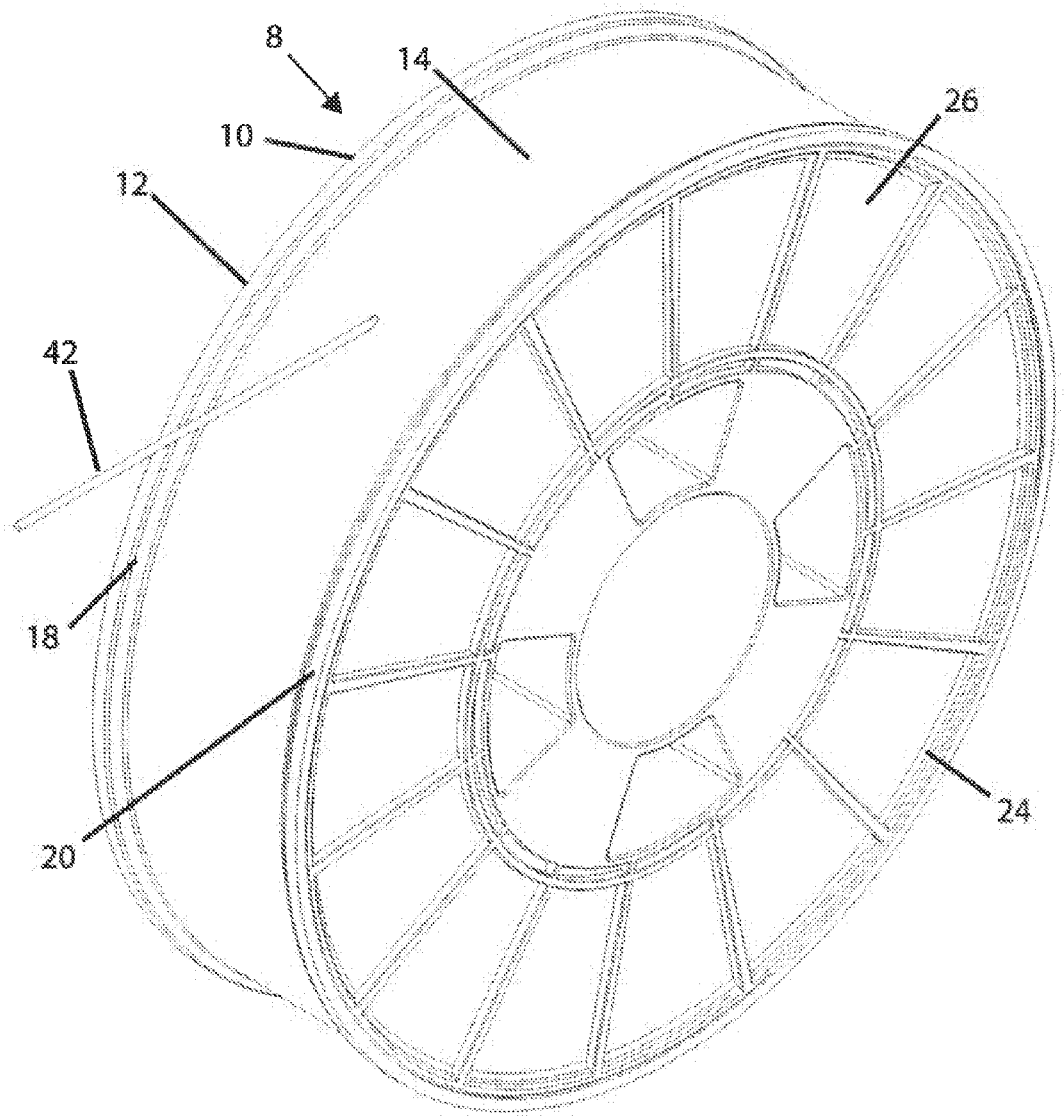


Fig. 1

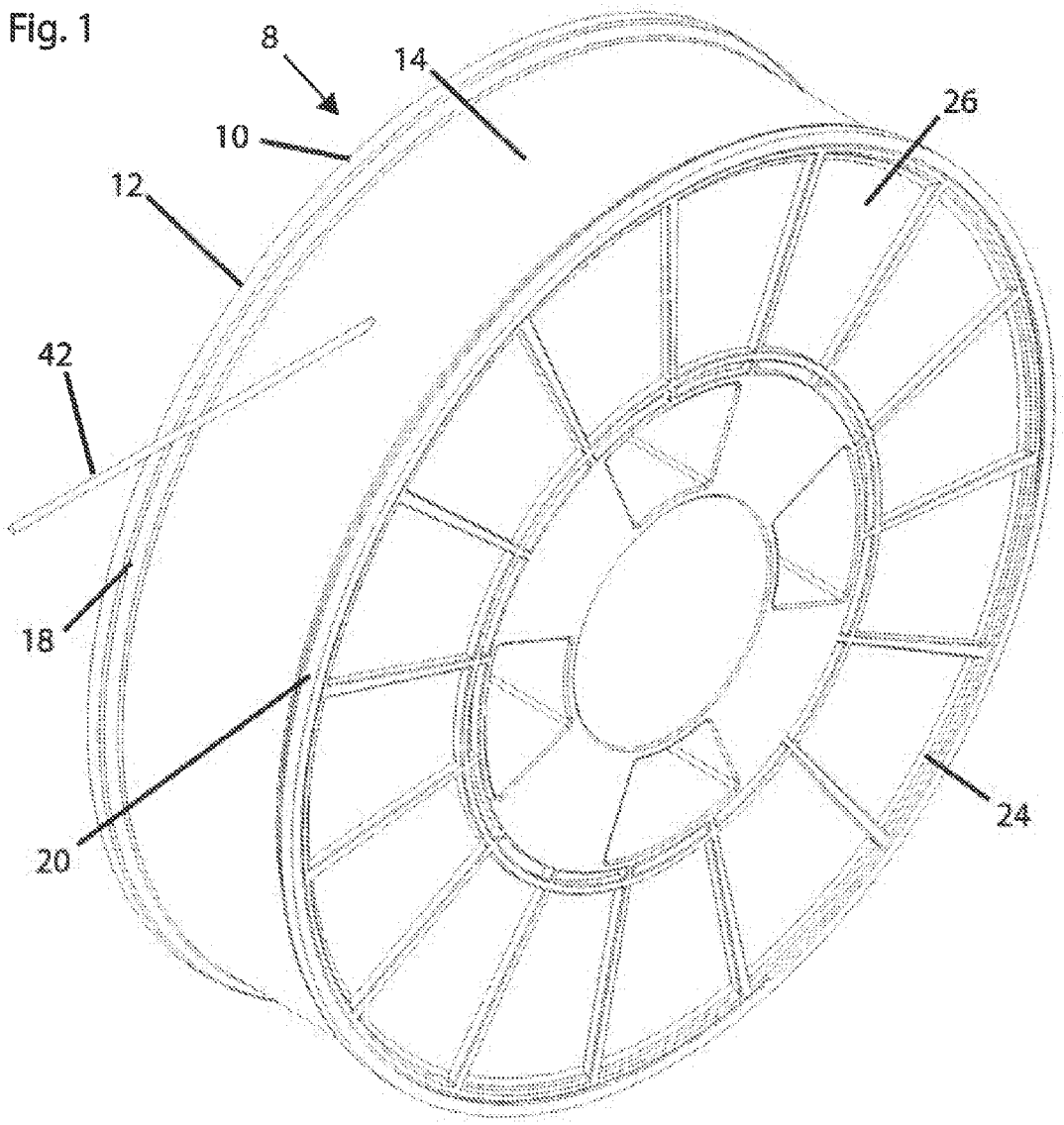


Fig. 2

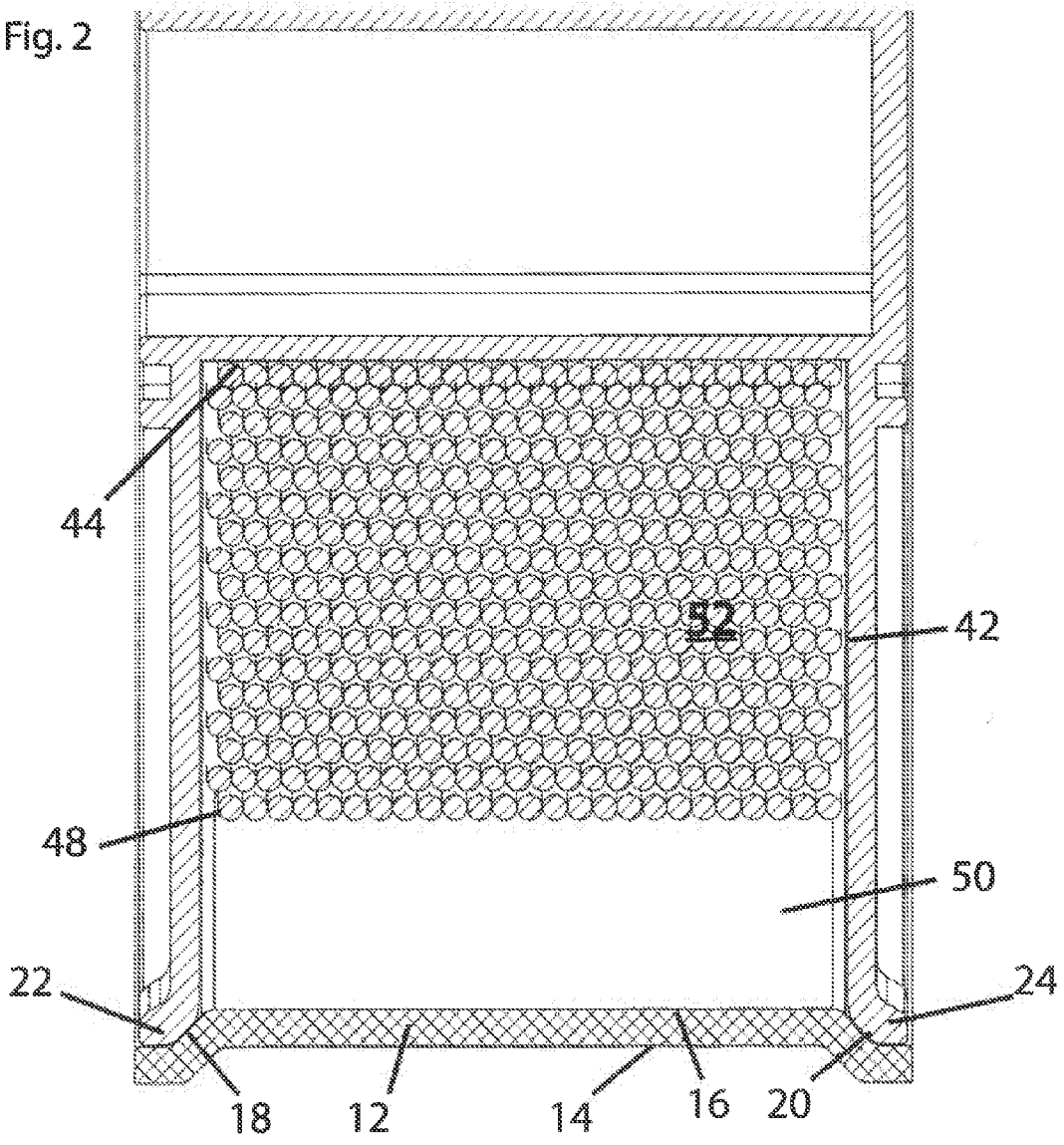


Fig. 3

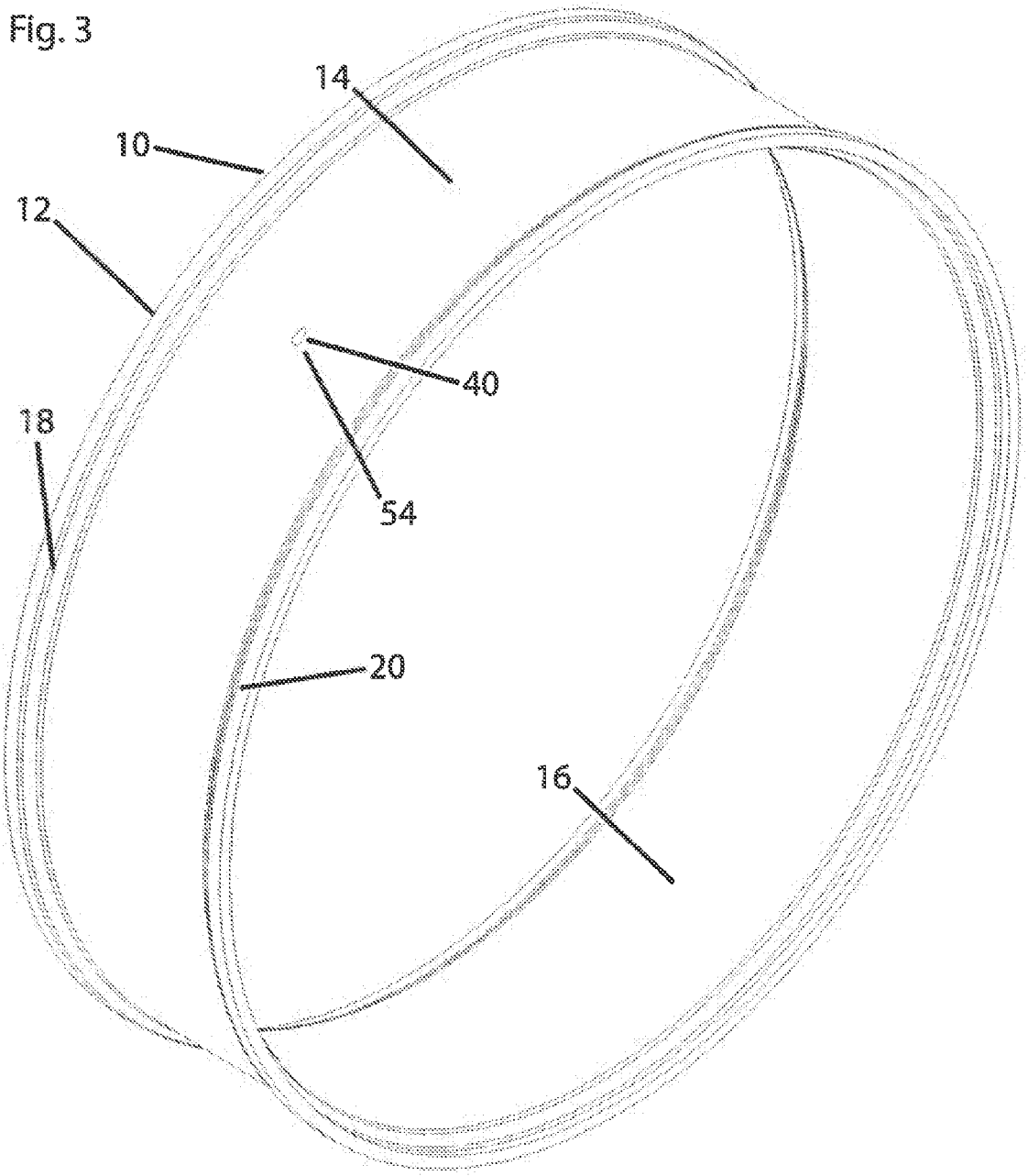


Fig. 4

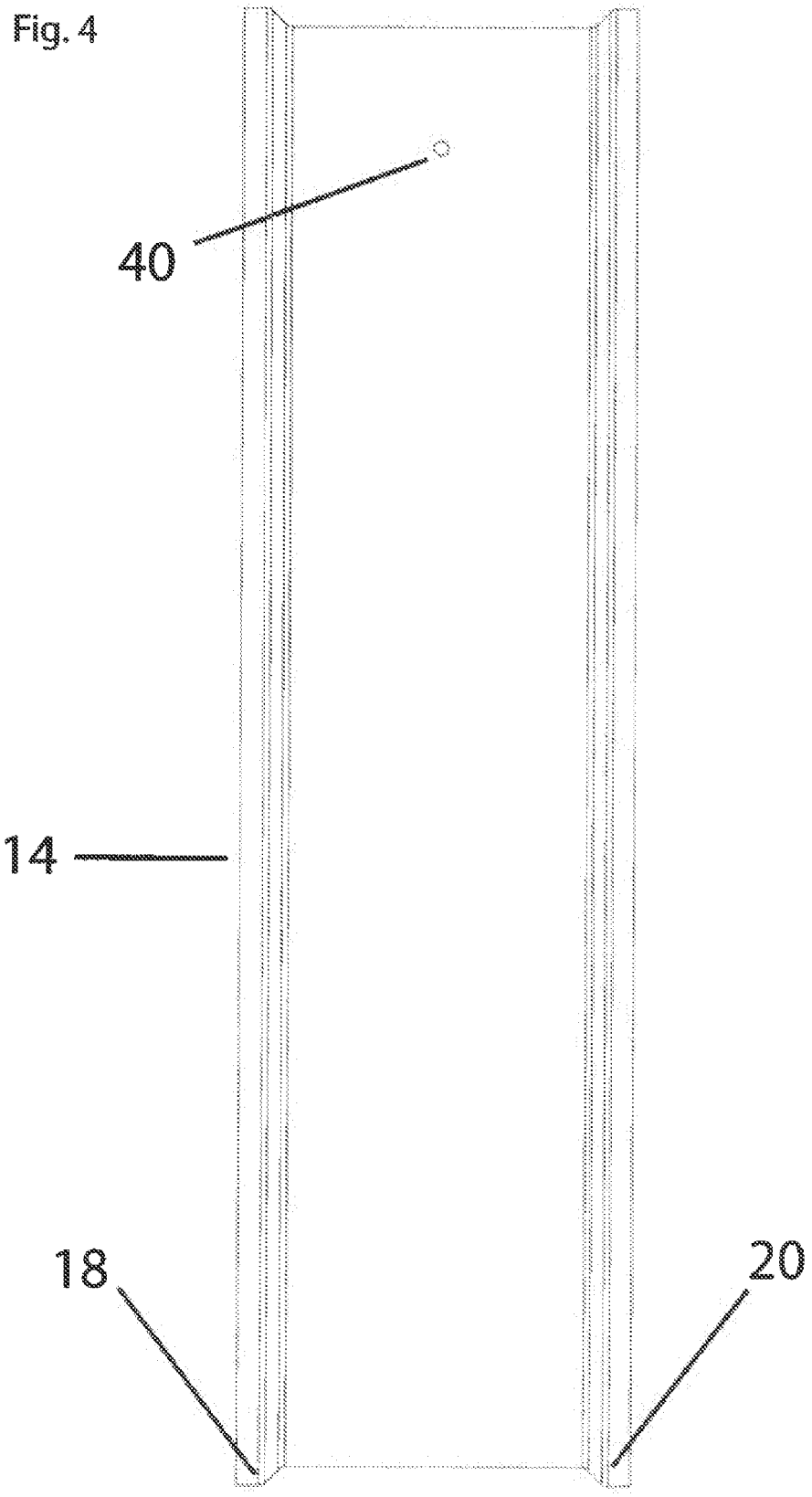


Fig. 5

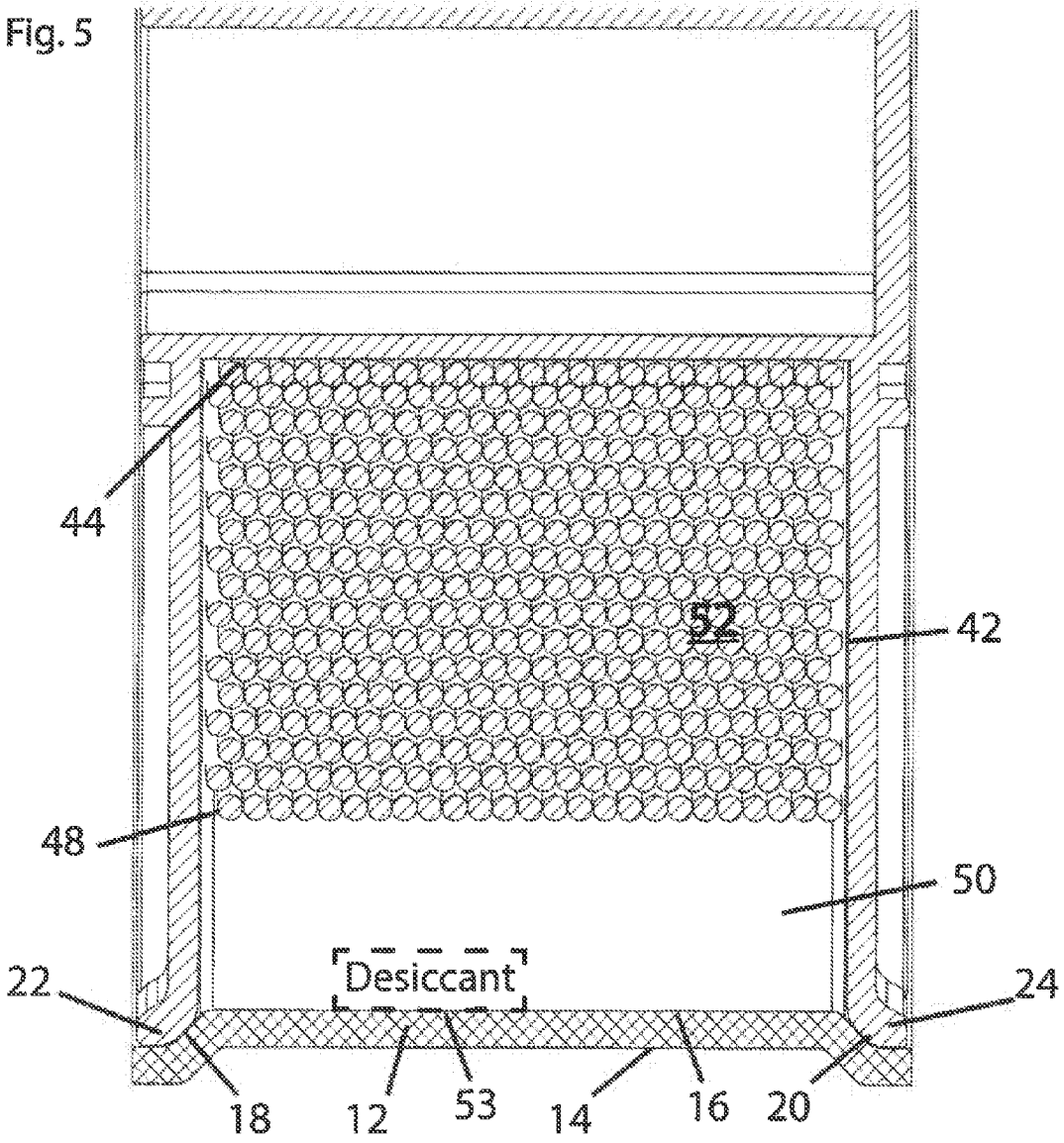


Fig. 6

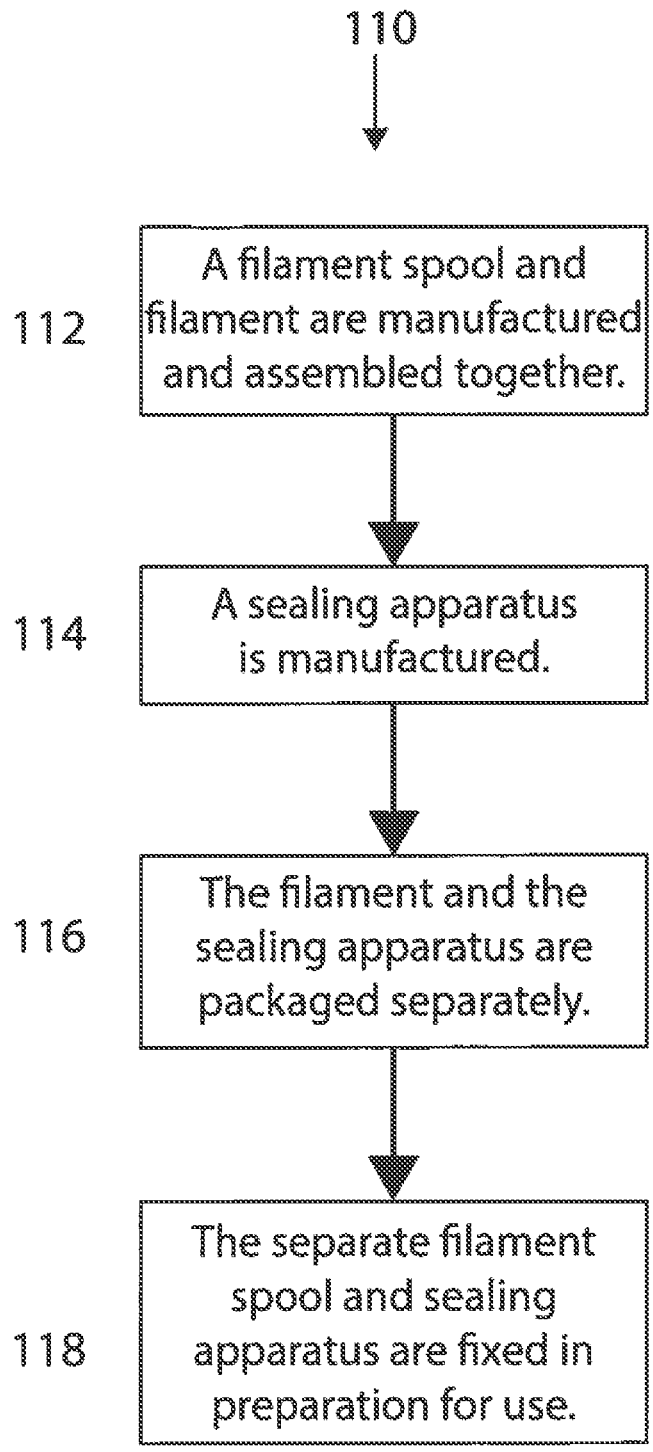
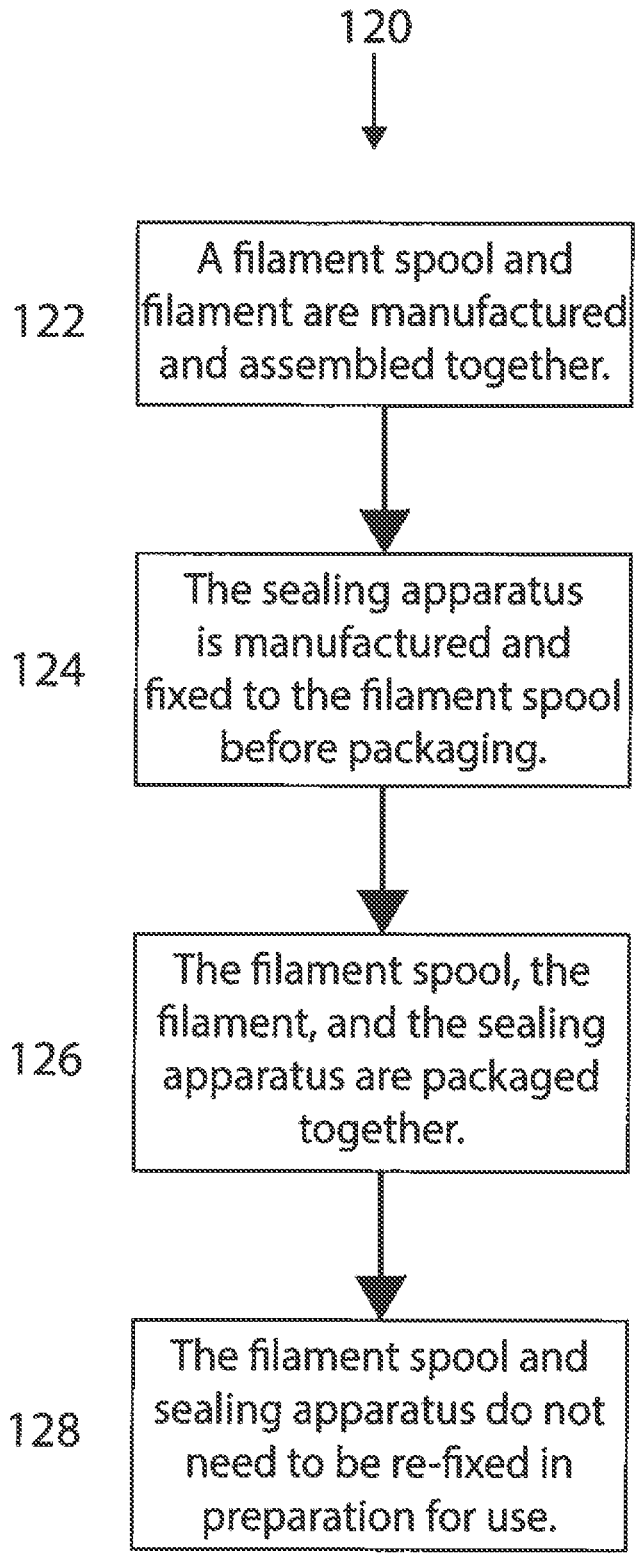

110
112
A filament spool and filament are manufactured and assembled together.
114
A sealing apparatus is manufactured.
116
The filament and the sealing apparatus are packaged separately.
118
The separate filament spool and sealing apparatus are fixed in preparation for use.

Fig. 7


120
122
A filament spool and filament are manufactured and assembled together.
124
The sealing apparatus is manufactured and fixed to the filament spool before packaging.
126
The filament spool, the filament, and the sealing apparatus are packaged together.
128
The filament spool and sealing apparatus do not need to be re-fixed in preparation for use.

SEALING APPARATUS FOR CREATING MOISTURE-RESISTANT BARRIER AROUND FILAMENTS, AND CORRESPONDING METHODS

BACKGROUND

[0001] This disclosure relates generally to the degradation of filaments over time, and more particularly to the property of filaments to slowly absorb moisture from the air around them and become unusable due to the change in properties that occurs as a cause of this absorbed moisture. When a consumer purchases certain filaments for their specific properties, especially in the case of 3D printing, the consumer must either use the filament up incredibly quickly or constantly store and remove the filament from a moisture-resistant enclosure each and every time that the filament is used, which can become a time-consuming process.

[0002] It would be useful to develop a technique for preventing moisture from absorbing into filaments over time and degrading the quality of the filaments.

SUMMARY

[0003] One embodiment described herein is A sealing apparatus comprising a moisture barrier that engages with a filament spool to create a moisture-resistant enclosure for housing a filament on said spool, and a passageway in said sealing apparatus so that the remaining filament can exit said sealing apparatus during use.

[0004] A method of manufacturing and selling is described herein where the filament spool, the filament, and the sealing apparatus are manufactured individually, fixed together, and then sold in a single filament unit.

[0005] Another method of manufacturing and selling is described herein where the filament spool, the filament, and the sealing apparatus are manufactured individually, only the filament spool and the filament are fixed, and the two are sold as separate units to be later fixed by the customer.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] This embodiment is an enclosure that attaches to 3D printing filament spools to create a moisture-resistant environment for the filament. This enclosure keeps the filament from absorbing moisture from the air and allows the spool to still be placed on printers and storage racks.

[0007] FIG. **1** shows an isometric view of the sealing apparatus fixed to a standard 3D printing filament spool. The sealing apparatus creates a moisture-resistant seal around the stored filament and allows a single strand to leave the enclosure without compromising the moisture-resistant barrier.

[0008] FIG. **2** is a section view of the bottom half of the sealing apparatus fixed to a 3D printing filament spool.

[0009] FIG. **3** is an isometric view of the standalone sealing apparatus.

[0010] FIG. **4** shows a front view of the standalone sealing apparatus.

[0011] FIG. **5** is a section view of an embodiment of the sealing apparatus with a desiccant within the sealing apparatus.

[0012] FIG. **6** depicts an embodiment of a method of manufacturing and selling the filament spool, the filament, and the sealing apparatus wherein the filament spool plus filament and the sealing apparatus are sold separately and fixed together by the customer after purchase.

[0013] FIG. **7** depicts an embodiment of a method of manufacturing and selling the filament spool, the filament, and the sealing apparatus wherein they are all sold together as a filament unit.

DETAILED DESCRIPTION

[0014] One embodiment is a flexible, tube-shaped, sealing apparatus that fits over 3D printing filament spools in order to provide a moisture-resistant enclosure for filaments without having to remove them from the enclosure in order to use them. The sealing apparatus slides onto current filament rolls and snaps into place to create a moisture-resistant seal.

[0015] As used herein, the term "frustocone" means a cone with the vertex cut off to make a new rounded face. The "remaining filament" refers to the filament still inside of the filament spool and sealing apparatus.

[0016] Referring to the drawings, FIG. **1** shows a sealing apparatus **10** that snap fits over a conventional 3D printing filament spool **26**. The sealing apparatus **10** has curves along its outer rim **18** and **20** that allow it to firmly fit over the standard filament spool, but also create a moisture-resistant seal. The sealing apparatus **10** has a passageway **40** on its surface that the feed portion **41** of the filament **42** can pass through, while still maintaining a moisture-resistant seal.

[0017] FIG. **2** illustrates the sealing apparatus **10**, which has a set of curves **18** and **20** on its inner surface **16** that allow it to be pressed over the filament spool **26**, while still creating a moisture-resistant seal for the filament **42** after it has been fully fixed. The filament spool **26** can contain varying amounts of filament **42** as more and more is used. The amount of filament **42** in the spool changes the distance between the floor **44** of the filament spool **26** and the filament **42** as well as the distance between the filament **42** and the inner surface **16** of the sealing apparatus. Because of this changing dimension, the passageway **40** must be shaped frusto conically or the feed portion **41** of the filament **42** would not be able to leave the sealing apparatus **10**.

[0018] FIG. **3** shows the sealing apparatus **10**, which, in embodiments, fits around a standard filament spool **26** with a diameter of approximately 8", but can be varied in size to fit multiple sizes of filament spools **26**. In embodiments, the sealing apparatus **10** can be configured to fit around spools **26** having diameters in the range of 1 to 20 inches, or 4 to 10 inches. The width of the band varies less between different filament spool **26** sizes, and is about 1 to 2 inches wide, but in additional embodiments can be configured to fit around spools having diameters in the range of 0.5 to 4 inches, or 0.75 to 2.5 inches. The passageway **40** for the feed portion **41** of the filament **42** creates a cone-shaped cutaway in towards where the filament **42** is stored. This conical cutaway allows the feed portion **41** of the filament **42** to exit through the passageway at multiple angles, while still creating a moisture-resistant seal for the filament **42**. The conical shape of the passageway **40** is also designed to reduce friction between the sealing apparatus **10** and the feed portion **41** of the filament **42** as the feed portion **41** of the filament **42** exits the sealing apparatus **10** through the passageway **40**.

[0019] FIG. **4** shows the front view of the sealing apparatus **10**. The hole seen here is the outer view of the passageway **40** for the feed portion **41** of the filament **42** to exit the sealing apparatus **10**. The circular shape of the

exterior view of the passageway **40** creates a full moisture-resistant seal for the remaining filament **42** inside of the sealing apparatus **10**, while still allowing the feed portion **41** of the filament **42** to leave through the passageway **40**.

[0020] FIG. **5** illustrates a front section view of an embodiment of the sealing apparatus **10** which contains a desiccant **53** within the filament gap **50**, which is the space between the outermost wrapped layer **48** of remaining filament **42** and the inner surface **16** of the sealing apparatus **10**. The desiccant **53** in this embodiment removes any small amounts of existing moisture within the sealing apparatus **10**.

[0021] FIG. **6** shows a method of preparing and packaging an embodiment of the sealing apparatus **10**. A filament spool and a filament are manufactured and assembled together **112**. A sealing apparatus is manufactured **114**. The filament and the sealing apparatus are packaged separately **116**. The separate filament spool and sealing apparatus are fixed in preparation for use **118**.

[0022] FIG. **7** shows a method of preparing and packaging an embodiment of the sealing apparatus **10**. A filament spool and filament are manufactured and assembled together **122**. The sealing apparatus is manufactured and fixed to the filament spool before packaging **124**. The filament spool, the filament, and the sealing apparatus are packaged together **126**. The filament spool and sealing apparatus do not need to be re-fixed in preparation for use **128**.

[0023] Referring to FIGS. **1** through **7**, a first embodiment of a sealing apparatus is shown and is designated as **10**. The sealing apparatus **10** includes a moisture resistant tube **12**, which has an outer surface **14** and an inner surface **16**. The sealing apparatus **10** includes ring-shaped seals **18** and **20** designed for a tight moisture-resistant fit over the outer rims **22** and **24** of the 3D printing filament spool **26**.

[0024] The sealing apparatus **10** includes a passageway **40** which has suitable size and shape to permit a feed portion **41** of the filament **42** to extend therethrough while maintaining a moisture-resistant barrier inside the filament spool between the filament spool floor **44** and the inner surface of the sealing apparatus **16**. The space between the inner surface **16** of the sealing apparatus **10** and the top wrapped layer **48** of filament **42** is the filament gap **50** and the space between the filament spool floor **44** and the top wrapped layer of filament **48** is the remaining filament **52**, ie the filament that is still inside the sealing apparatus **10**. A desiccant **53** is added to certain embodiments of the sealing apparatus **10** to further reduce the amount of moisture that comes in contact with the filament **42**. The desiccant **53** sits in the filament gap **50**.

[0025] In embodiments, the passageway **40** is frustoconical in shape with the frustocone's truncated circular end **54** on the outer surface **14** of the sealing apparatus **10** so that the feed portion **41** of the filament **42** can exit the sealing apparatus **10** independent of the size of the filament gap **50** and the amount of remaining filament **52**, while still keeping a moisture-resistant seal around the remaining filament **52**. The current sealing apparatus **10** has a passageway **40** with approximately a 2 mm diameter, but can be configured to have a passageway **40** that has diameters in the range of 0.5 mm to 4 mm, or 1.25 mm to 3.5 mm. An embodiment of the sealing apparatus **10** has a passageway **40** that is 20 mm in length, but can be configured to have a passageway **40** with a length in the range of 5 mm to 100 mm, or 10 mm to 50 mm.

[0026] One version of the sealing apparatus **10** fits the most common filament spool, which is approximately 8 inches in diameter and 2 inches wide, but in embodiments, the sealing apparatus can be configured to fit around spools having diameters in the range of 2 to 20 inches, or 4 to 10 inches and have widths hi the range of 0.5 to 8 inches, or 1 to 4 inches.

[0027] In one embodiment, the sealing apparatus **10** is mounted on the spool **26** at the time of the spoors **26** manufacturing. The manufacturer for this embodiment makes the filament spool **26**, makes the filament **42**, wraps the filament **42** around the spool **26**, makes the sealing apparatus **10**, and then fixes the sealing apparatus **10** to the filament spool **26** before any part is sold to a consumer. In another embodiment the sealing apparatus **10** is mounted after the manufacturing of the filament spool **26**. Here, the filament spool **26** and filament **42** are made and packaged and the sealing apparatus **10** is made and packaged separately from the spool **26** and filament **42**. The filament spool **26** and the sealing apparatus **10** would then be fixed before use by the end user. In one embodiment a user buys a 3D printing filament spool **26** from one source, buys the sealing apparatus **10** from another source, and fixes the two together directly before use. After long periods of not using the filament **42**, the feed portion **41** of the filament **42** absorbs moisture from the air and its properties degrade over time. The feed portion **41** can be trimmed in order to avoid using this deteriorated filament.

[0028] In embodiments, the filament is formed from a thermoplastic, thermoset, or other material that tends to absorb moisture. Non-limited examples of filaments include polylactic acid, acryionitrile butadiene styrene, and nylon. In embodiments, the filament is biodegradable.

[0029] In embodiments, the sealing apparatus is made from a rigid and transparent plastic that is able to hold its shape around a filament spool. Non-limited examples of sealing apparatuses are formed from an acrylic material or a polycarbonate material.

[0030] A number of alternatives, modifications, variations, or improvements therein may be subsequently made by those skilled in the art, which are also intended to be encompassed by the following claims.

What is claimed is:

1. A sealing apparatus comprising:

a moisture barrier configured to engage with a filament spool to create a moisture-resistant enclosure for housing a filament on said spool, and

a passageway in said sealing apparatus so that a feed portion of a filament can exit said sealing apparatus during use, said passageway being configured to rotate relative to said remaining filament.

2. The sealing apparatus of claim **1**, wherein the moisture barrier has two edges with seals that can be configured to be pressed to fix onto the filament spool.

3. The sealing apparatus of claim **1**, wherein the moisture barrier's edges can be pressed on one at a time so that the feed portion of the filament can be guided through the passageway before the sealing apparatus creates a seal around the remaining filament.

4. The sealing apparatus of claim **1**, wherein the passageway is a cutout in the surface of the moisture barrier with a frustocone shape.

5. The sealing apparatus of claim **1**, wherein the filament is formed from a biodegradable material.

6. The sealing apparatus of claim **1**, wherein the filament comprises at least one member selected from the group of polylactic acid, acrylonitrile butadiene styrene, and nylon.

7. A method of reducing moisture absorption by a filament configured for use in 3D printing comprising:

obtaining the filament on a spool,

obtaining a sealing apparatus comprising a moisture barrier configured to engage with said filament spool and a passageway in said sealing apparatus so that a feed portion of a filament can exit said sealing apparatus during use, said passageway being configured to rotate relative to said remaining filament, and

mounting the sealing apparatus on the spool.

8. The method of claim **7**, wherein the sealing apparatus is mounted on the spool soon after the filament is wound around the spool.

9. The method of claim **7**, wherein the filament spool is packaged without the sealing apparatus mounted thereon, and the sealing apparatus is mounted on the filament spool in preparation for use.

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