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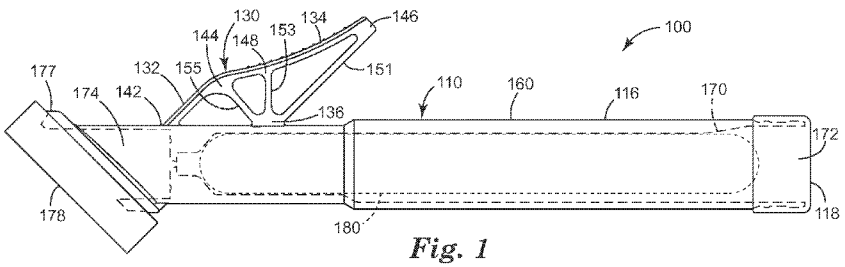

Fig. 1

(57) Abstract: Liquid applicators are described. The applicators include a lever having a hinge, grip and foot integrally formed with a hollow body suitable for receiving a liquid-filled ampoule. The foot is positioned adjacent the ampoule and crushes the ampoule when the lever is depressed. Applicators including a pad with an undulating surface are also disclosed.

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LIQUID APPLICATOR

FIELD

[0001] The present disclosure relates to a liquid applicator for applying a liquid to a surface, e.g., a surgical prep applicator. In particular, the present disclosure relates to a liquid applicator having a lever suitable for crushing an ampoule and releasing liquid within the applicator.

SUMMARY

[0002] Briefly, in one aspect, the present disclosure provides a liquid applicator for applying a liquid to a surface. Generally, the applicator comprises an elongated hollow body comprising a wall defining an internal chamber having a closed end and an open end; wherein the wall comprises a handle region and a crush region and wherein the ratio of thickness of the wall in the crush region over the thickness of the wall in the handle region is less than 1. A first ampoule formed of a frangible material is located in the internal chamber proximate the crush region and containing the liquid. A lever is integral with the hollow body and comprises a hinge projecting from a first location attached to the hollow body to a second location, a grip extending from the second location to a third location, and a foot integral to the wall adjacent the crush region. The lever comprises a first truss extending from the third location to the foot; a third truss extending from the second location to the foot, and a second truss between the first and third trusses and extending from the foot to a fourth location, between the second and third location. The width of the first truss is tapered from a first width proximate the third location and a second width proximate foot; wherein the ratio of the second width over the first width is less than 1.

[0003] In some embodiments, the width of the third truss is tapered from a third width proximate the second location to a fourth width proximate the foot; wherein the ratio of the fourth width over the third width is less than 1. In some embodiments, the second truss projects substantially perpendicular to the major axis of the elongated hollow body.

[0004] In some embodiments, the liquid applicator further comprises a pad connected to the open end of the hollow body. In some embodiments, the pad comprises a series of alternating peaks and troughs repeating across the exposed surface of the pad.

[0005] The above summary of the present disclosure is not intended to describe each embodiment of the present invention. The details of one or more embodiments of the invention are also set forth in the description below. Other features, objects, and advantages of the invention will be apparent from the description and from the claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] **FIG. 1** illustrates a side view of one exemplary liquid applicator according to some embodiments of the present disclosure.

[0007] **FIG. 2** illustrates a cross section of the exemplary liquid applicator of **FIG. 1**.

[0008] **FIG. 3** illustrates a side view of one exemplary lever corresponding to the lever of the exemplary liquid applicator of **FIG. 1**.

[0009] **FIG. 4a** illustrates a cross section of the exemplary lever of **FIG. 3**, before crushing.

[0010] **FIG. 4b** illustrates a cross section of the exemplary lever of **FIG. 3**, after crushing.

[0011] **FIG. 5** illustrates an end view of the exemplary lever of **FIG. 3**.

[0012] **FIG. 6a** is an image of an exemplary pad according to some embodiments of the present disclosure.

[0013] **FIG. 6b** illustrates a side view of the exemplary pad of **FIG. 6a**.

DETAILED DESCRIPTION

[0014] Antiseptic preparation of patient's skin for surgery conventionally includes a 3-10 minute scrubbing of the affected area with an antiseptic soap solution followed by the application of a water-soluble antiseptic paint solution. These solutions have been applied with saturated sponges that are attached to a blade or held with forceps. These sponges are often saturated by soaking them in open pans of solution. Sometimes, sponges with attached handles are provided in a plastic or aluminum foil laminate pouch containing enough liquid to saturate the sponges. In some products the sponges are supplied dry in a sterile "kit" with the antiseptic solutions provided in relatively thin walled 4 oz. polyethylene bottles. These bottles generally have wall thickness less than about 500 microns. While inexpensive, these techniques are messy and offer little control over inadvertent dripping of the solution into areas where it is undesired.

[0015] Alternatively, devices have been developed in an attempt to prevent solution dripping associated with these techniques, and to reduce the time required for application of the antiseptic solution. For example, liquid applicators that hold the liquid in a frangible ampoule and require additional elements to crush the ampoule and release the liquid have been developed. However, existing applicators are often complex to construct and may be difficult or cumbersome to use.

[0016] For example, some liquid applicators use a multipart design. Such liquid applicators include an elongated hollow body containing frangible ampoule that holds a liquid. A hinge is integrally formed with and projects from the outer wall of the hollow body. A separately formed part having a grip and a foot is attached to the hinge. If properly designed, when the grip is pressed, it will rotate about the hinge,

causing the foot to compress the hollow body and fracture the ampoule releasing the liquid. Generally, the liquid then flows from the chamber to be applied to the desired surface.

[0017] By manufacturing the lever separate from the hollow body, different materials may be used to achieve the desired results. For example, typically the hollow body is formed of a flexible, low modulus material such as low density polyethylene. In contrast, the lever is typically formed of a more rigid, higher modulus material such as high density polyethylene or polycarbonate. With such selections, the force applied to lever will be sufficient to compress the hollow body and fracture the ampoule before the lever itself is significantly deformed. However, such a two-part structure is more complex to manufacture.

[0018] Other liquid applicators use a one-part design. Here, a lever is integrally formed with the hollow body. The lever includes a hinge, a grip, and a foot. If properly designed, when the grip is depressed, it will rotate about the hinge, causing the foot to compress the hollow body and fracture the ampoule releasing the liquid. The integral design of such applicators is simpler to construct; however, only a single material can be used for the entire construction. In such prior art applicators, rigid, high modulus materials have been chosen to ensure the force applied to lever will be sufficient to compress the hollow body and fracture the ampoule before the lever itself is significantly deformed. This requirement has led to designs that include the use of awkward and less efficient non-cylindrical hollow body designs. Even with such modifications, these applicators may be difficult to operate.

[0019] An exemplary liquid applicator according to one embodiment of the present disclosure is illustrated in **FIG. 1**. Liquid applicator **100** comprises elongated hollow body **110** comprising wall **160**. Wall **160** defines chamber **170** having closed end **172** and open end **174**. Closed end **172** may be sealed in any of a variety of known ways to inhibit or prevent fluid contained within the chamber from escaping through the closed end. For example, cap **118**, which may be press-fit, screwed or otherwise attached, may seal the chamber forming closed end **172**.

[0020] Open end **174** allows fluid to flow from the hollow body and be applied where desired. In some embodiments, pad **178** may be attached to the open end to control the flow rate and distribution of the fluid. Pad **178** may be formed of any suitable, porous substance including, e.g., sponge, woven and nonwoven materials, screens, meshes and combinations thereof. A wide variety of known materials can be used in the construction of the pad including, e.g., polyester polyurethane and polyester polyether open cell foams.

[0021] In some embodiments, such as the one shown in **FIG. 1**, open end **174** terminates in flange **177**, which provides a mating surface for pad **178**. In addition, flange **177** may include features such as ribs, holes, and channels to aid in the control and distribution of the flow. The pad can be attached to the flange by known means including, e.g., adhesives and ultrasonic welding.

[0022] Ampoule **180** is located within chamber **170**. Generally, the ampoule is formed of a frangible material, e.g., glass. Such materials are relatively brittle and will fracture when compressed. This is in contrast to relatively flexible materials that would deform when compressed but which must be punctured to release the liquid inside. In some embodiments, score lines or other features that provide local areas of weakness in the frangible material may be included to control breaking and/or reduce the force required to break the ampoule.

[0023] The size and shape of the ampoule is selected to be compatible with the dimensions of the internal chamber and the desired volume of liquid. For example, for use in preparation for a small surgical procedure, the amount of liquid in the ampoule should generally be sufficient to cover an area of, e.g., 10 square centimeters or more. For larger surgical procedures, the amount of liquid in the ampoule may need to be sufficient to cover at least the torso of a large person, e.g., at least about 500-600 square centimeters.

[0024] Ampoule **180** contains the liquid to be dispensed. Generally, any liquid can be contained within the ampoule, with the selection of the liquid influencing the selection of the materials used to construct the ampoule and other parts of the applicator, as understood by one of ordinary skill in the art. In some embodiments, the applicator may be particularly useful in dispensing liquids having viscosities at room temperature of less than about 10,000 cps, most preferably less than about 500 cps.

[0025] In some embodiments, the ampoule may contain an antiseptic preparation. Examples of suitable antiseptic preparations include those described in U.S. Pat. No. 4,584,192 and those described in U.S. Pat. No. 4,542,012. Other useful fluids include antiseptic preparations, e.g., iodophoric skin tinctures, such as "Duraprep™ Surgical Solution," commercially available from 3M. In some embodiments, the ampoule be filled with a composition that includes an antimicrobial agent such as iodine, an iodine complex (e.g., iodophors), chlorhexidine, chlorhexidine salts (e.g., chlorhexidine digluconate and chlorhexidine diacetate), or combinations thereof. Other exemplary antimicrobial agents include C2-C5 lower alkyl alcohols, fatty acid monoesters of glycerin and propylene glycol, polymers that include a (C12-C22) hydrophobe and a quaternary ammonium group, polyquaternary amines (e.g., polyhexamethylene biguanide), quaternary ammonium silanes, silver, silver salts (such as silver chloride), silver oxide and silver sulfadiazine, methyl, ethyl, propyl and butyl parabens, octenidene, peroxides (e.g., hydrogen peroxide and benzoyl peroxide), and the like, as well as combinations thereof.

[0026] Liquid applicator **100** also comprises lever **130** comprising hinge **132**, grip **134**, and foot **136**. Hinge **132** extends from first location **142**, which is integral to hollow body **110**, to second location **144**. Grip **134** continues the lever from second location **144** to third location **146**. Trusses **151**, **153**, and **155** connect hinge **132** and grip **134** to foot **136**. First truss **151** extends from third location **146** to foot **136**. Similarly, third truss **155** extends from second location **144** to foot **136**. Second truss **153** is located

between the first and third truss and extends from foot **136** to grip **134** at fourth location **148**, which is between the second and third locations.

[0027] Additional features suitable for use in some embodiments are shown in **FIG. 2**, which illustrates a cross section of the exemplary applicator **100** of **FIG. 1**. For example, cap **118**, which is press-fit onto hollow body **110**, includes optional prongs **119** which conform to the end of ampoule **180** holding in place. Wall **160** includes optional ribs **161** projecting into chamber **170** aiding in the placement and retention of ampoule **180**. Hollow body **160** may also include optional stop **175**. In some embodiments, when an ampoule is inserted in the chamber, it is seated against the stop helping to position the ampoule relative to the lever. Although not shown, in some embodiments, a screen or other filtering means may be located near open end **174** preventing shards of the crushed ampoule from reaching pad **178**.

[0028] Hollow body **110** includes handle **116** which can be manually gripped during use. Here, wall **160** has first thickness, **T1**. In crush region **114**, located adjacent foot **136**, wall **160** has second thickness, **T2**, which is less than first thickness, **T1**. Hollow body **110** may include optional step **111** transitioning between handle **116** and crush region **114**.

[0029] Generally, first thickness, **T1**, is selected to provide the desired mechanical integrity and may depend on known factors such as the choice of material and the design of the applicator. For example, for a given material, the wall should be of sufficient thickness to prevent crushing the ampoule when the handle is gripped during normal use. In addition, the thickness should be sufficient to prevent shards of the broken ampoule from penetrating the wall. Generally, first thickness **T1** is at least 1 mm, e.g., at least 2 mm. In some embodiments, thickness **T1** is no greater than 5 mm, e.g., no greater than 4 mm.

[0030] Generally, second thickness, **T2**, is selected to reduce the force required to deform the wall in crush region **114**. As the applicator is often operated with a single hand, the grip is depressed by thumb. Given the wide range of thumb strength for potential operators, it can be desirable to minimize the force required to depress the grip, compress the wall, and fracture the ampoule. However, the second thickness should still be adequate to minimize or prevent unintended crushing and to retain any shards of broken ampoule. Generally, the ratio of **T2** over **T1** is less than 1. In some embodiments, the ratio of **T2** over **T1** is no greater than 0.9, no greater than 0.7, or even no greater than 0.5. In some embodiments, the ratio of **T2** over **T1** is at least 0.2, in some embodiments, at least 0.4.

[0031] Generally, the length of crush region **114** should be longer than the length of foot **136**. In some embodiments, crush region extends from handle **116** to a location near or at open end **172**. In some embodiments, crush region **114** may end at stop **175**.

[0032] In some embodiments, the crush region may extend throughout the circumference of the applicator. However, in some embodiments, the walls may not be thinned throughout the circumference of the hollow body. For example, in some embodiments, the wall in support region **115** may be thicker

than in crush region **114**. In some embodiments, the wall in support region **115** may have a third thickness, **T3**, which is greater than the fist thickness, **T1**. In some embodiments, the ratio of **T3** over **T1** is at least 1.1, e.g., at least 1.2, or even at least 1.3. Generally, the circumferential width of the crush region should be greater than the width of the foot. In some embodiments, the crush region extends at least +/- 30 degrees from the foot, in some embodiments, at least +/- 60 degrees, or even +/- 90 degrees. Generally the support region would encompass the remaining circumference of the hollow body.

[0033] A larger view of exemplary lever **130** is shown in **FIG. 3**. Hinge **132** connects to and is integral with hollow body **110** at first location **142**. The hinge extends from the hollow body at an angle terminating at second location **144** corresponding to the location of third truss **155**. Grip **134** continues the lever from second location **144** to third location **146** at a distance **H** from the hollow body. Foot **136** is connected to, and integral with hollow body **110**. First truss **151** extends from third location **146** to foot **136** forming angle **A** with wall **160**.

[0034] While there is some flexibility in the design of the lever, the present inventors have discovered certain dimensions which are important to ease of use and functionality. **FIG. 4a** illustrates a cross section of the lever of **FIG. 3**, showing its position before crushing ampoule **170**. **FIG. 4b** illustrates a cross section of the lever of **FIG. 3**, showing its position after crushing ampoule **170** producing shards **171**. Angle **A** and height **H** should be selected such that when grip **134** is depressed, the travel of foot **136** is sufficient to compress wall **160** in crushing region **114** and fracture ampoule **170** before grip **134** contacts wall **160** in handle region **116**. By increasing the angle **A**, sufficient distance **H** can be achieved without requiring a grip of unwieldy length. In some embodiments, angle **A** is greater than 30 degrees, e.g., greater than 40 degrees. If angle **A** is too steep, however, it may be difficult to actuate the lever. In some embodiments, angle **A** is no greater than 60 degrees, e.g., no greater than 50 degrees.

[0035] Distance, **H**, will be somewhat dependent on the diameter of the chamber and ampoule, as the foot, and therefore the grip, must be capable of travelling a sufficient distance in order to crush the ampoule. In some embodiments, **H** is greater than 0.5 times the diameter of the chamber, e.g., at least 1 times the diameter of the chamber, or even at least 1.5 times the diameter of the chamber. In some embodiments, height H is at least 10 mm, e.g., at least 20 mm. In some embodiments, height H is no greater than 40 mm, e.g., no greater than 30 mm.

[0036] When grip **134** is depressed with applied force **F1**, lever **130** operates as a second degree lever applying a crushing force **F2** at foot **136**. Crushing force **F2** can be enhanced relative to applied force **F1** by appropriate selection of lengths **L1** and **L2**. **L1** is the distance between first location **142** where hinge **132** is connected the wall and the center of foot **136**. **L2** is the distance from first location **142** to third location **146** at the end of grip **134**. Generally, the ratio of **F2** over **F1** is proportional to the ratio of **L2** over **L1**. In some embodiments, the ratio of **L2** over **L1** is at least 1.5, e.g., at least 1.8. In some embodiments, the ratio of **L2** over **L1** is no greater than 3, e.g., no greater than 2.5.

[0037] In order to concentrate the crushing force and reduce the applied force required to break ampoule **170**, it may be desirable to decrease the size of foot **136**. However, if the area of foot **136** is too small, lever **130** may flex to the side when compressed hindering operation. This problem has been reduced in prior art constructions through the use of rigid, high modulus materials. However, alternative approaches are required when flexible, lower modulus materials are used. Referring to **FIG. 3**, second truss **153** assists in transferring force to foot **136**, and along with trusses **151** and **155** aides in stabilizing the lever. In some embodiments, second truss **143** extends substantially perpendicularly from wall **160**. For example, in some embodiments second truss **143** forms an angle of between 80 and 100 degrees, in some embodiments, between 85 and 95 degrees relative to wall **160**. In some embodiments, two or three of the trusses may merge at a common location at the foot. Alternatively, as shown in **FIG. 3**, in some embodiments, each of the trusses may connect to foot **136** at spaced-apart locations providing further stability to the lever.

[0038] An end view of lever **130** according to some embodiments of the present disclosure is shown in **FIG. 5**. The top of grip **134** has a first width **W1** where it terminates at third location **146**. Generally, the top surface of grip 134, including its width, is selected to provide a comfortable and stable base form the application of force to crush the ampoule. In general, the size may be selected to correspond to the expected range of widths of the human thumb. In some embodiments, width **W1** is at least 5 mm, e.g., at least 10 mm. In some embodiments, width W1 is no greater than 25 mm, e.g., no greater than 20 mm.

[0039] In some embodiments, in order to further concentrate the applied force onto foot **136**, first truss **151** may be tapered. That is, the width of first **truss151** may decrease from first width **W1** where the truss connects to the grip to second width **W2** where the truss connects to foot **136**. Generally, the ratio of **W2** over **W1** is less than 1, e.g., less than 0.8, less than 0.5 or even less than 0.4. The minimum desirable width at foot **136** will be influenced by the desirable stability of the lever, as the narrower the foot the more likely undesirable sidewise flexing may occur. In some embodiments, width **W2** is at least 2 mm, e.g., at least 3 mm. In some embodiments, width **W2** is no greater than 6 mm, e.g., no greater than 5 mm.

[0040] Along with its width, the length of foot 136 determines the pressure applied to crush the ampoule, with a smaller foot creating more pressure per unit force applied. However, as with the width, mechanical robustness and lever stability affect the minimum foot length. In some embodiments, the length of the foot is at least 3 mm, e.g., at least 5 mm. In some embodiments, the length of the foot is no greater than 12 mm, e.g., no greater than 10 mm, or even no greater than 8 mm.

[0041] A wide variety of pads are known, including sponges and fabrics. Generally, such pads have been cylindrical or rectangular in shape with substantially smooth surfaces, i.e., although the surface may have some small scale roughness associated with the material selected, no large scale variations in the thickness of the applicator are present. All such applicators are suitable for use in the various

embodiments of the present disclosure. However, in some embodiments, the present inventors have discovered that an undulating pad may provide additional benefits in the uniform application of liquids to surfaces.

[0042] An exemplary pad **200**, suitable for use in some embodiments of the present disclosure is shown in **FIGS. 6a** and **6b**. Pad **200** is formed of a sponge, although any material or combination of materials known for use in applicators may be used. Pad **200** generally has a rectangular perimeter with rounded corners. However, any suitable shape may be used, e.g., diamond, circular, oval or iron shaped. Pad **200** differs from pads commonly used with applicators in that exposed surface **210** includes a series of troughs **220** and peaks **230**. Thus, although the density of the foam is substantially uniform, the height and available fluid bearing volume of the foam varies across the surface of the pad.

[0043] The present inventors have discovered that such a combination of features provides greater control over the delivery and uniformity of the applied liquid. For example, as greater pressure is applied between the applicator and the surface, more of the applicator will contact the surface and the enhance pressure will deliver more fluid. As the application pressure is reduced, and the undulations are released from compression, fluid can be wicked into the sponge aiding in the prevention of pooling and over delivery of fluid. In addition, at lower pressures, the contact area between the applicator and the surface consists of discrete contact regions. Thus, as the applicator is repeated passed over a surface, the fluid is more readily spread rather than being removed or re-absorbed into the pad as can occur with a continuous contact surface.

[0044] A side view of pad **200** is shown in **FIG. 6b**. Surface **210** includes a matrix of peaks **230** and troughs **220**. Generally, the height and spacing of the peaks can be varied. In some embodiments, the ratio of peak to trough height, **X**, over the total pad thickness **Y** is less than 0.6, e.g., less than 0.5. In some embodiments, the ratio of **X** over **Y** is at least 0.1, e.g., at least 0.2, or even at least 0.3. Generally, the peak to trough height **X** may be uniform or non-uniform and can vary across the surface of the pad. In some embodiments, the average peak to trough height is at least 1 mm, e.g., at least 2 mm. In some embodiments, the maximum average peak to trough height is less than 6 mm, e.g., less than 5 mm. In some embodiments, the average total pad thickness, **Y**, is at least 5 mm, e.g., at least 8 mm. In some embodiments, the average total pad thickness is no greater than 15 mm, e.g., no greater than 10 mm.

[0045] Generally, the spacing of the peaks can be uniform or non-uniform across the surface of the applicator. In some embodiments, the peak to peak spacing, **S**, is comparable to the peak to trough height **X**. For example, in some embodiments, the ratio of **S** over **H** is between 0.7 and 1.3, inclusive, e.g., between 0.8 and 1.2, or even between 0.9 and 1.1. In some embodiments, the peaking spacing is greater than the peak to trough height. For example, in some embodiments, the ratio of **S** over **H** is at least 2, e.g., at least 3, or even at least 4. In some embodiments, the ration of **S** over **H** is no greater than 6, e.g., no greater than 5.

[0046] In addition to applying a composition, in some embodiments, applicators of the present disclosure may be used to scrub the surface. Pads having a pattern of peaks and troughs across the surface of the pad, such as those illustrated in **FIGS. 6a** and **6b** may be advantageous for scrubbing. The peaks allow greater force concentration to deliver a scrubbing action, while the troughs minimize removal of the antiseptic during scrubbing. In addition, a uniform pattern of peaks and troughs allows consistent scrubbing regardless of the direction of linear scrubbing or even in scrubbing is performed with a circular motion. The density and firmness of the pad may be selected to achieve the desired level of scrubbing action without undue surface irritation.

[0047] Liquid applicators according to the present disclosure were molded from linear low density polyethylene and high density polyethylene. The required crush force of these unitary structures was compared to the crush force for three commercially available applicators.

[0048] Applicators were place in a V-shaped block and held at a 45 degree angle with the pad facing downward. In this orientation, the lever was in an approximately vertical position. A handheld force gauge was held horizontal, and perpendicular to the lever with its sensor contacting the outermost point on the grip. The force gauge was pressed forward to compress the lever and crush the ampoule.

[0049] The first commercial product tested was the 8635 DuraPrep™ applicator available from 3M Company, St. Paul Minnesota. This was a two part construction with the hollow body formed from linear low density polyethylene, and a separate lever formed of a rigid polycarbonate. Based on five tests, the average applied force for this commercial product was 50 +/- 2 Newtons. Commercial experience indicates that this is an acceptable force.

[0050] The second commercial product tested was a 10 mL ChloroPrep™ applicator available from CareFusion. This was a unitary structure formed of high density polyethylene and having two levers positioned on opposite sides of a hollow body. Based on four samples, the average applied force for this commercial product was 41 +/- 2 Newtons. Commercial experience indicates that this is an acceptable force.

[0051] The third commercial product tested was a 26 mL ChloroPrep™ applicator available from CareFusion. This was a unitary structure formed of high density polyethylene and having a single lever attached to the hollow body. The hollow body had an oval cross section housing two ampoules side-by-side such that the lever crushed both ampoules. Based on five samples, the average applied force for this commercial product was 69 +/- 16 Newtons. Commercial experience indicates that this is a noticeable increase in required force relative to the other commercial products.

[0052] Based on seven examples prepared using linear low density polyethylene (flexural modulus of 317 MPa), the average applied force was 45 +/-3 Newtons. Based on ten samples prepared using high density polyethylene (flexural modulus of 1070 MPa), the average applied force was 61 +/- 5 Newtons.

Thus, the present disclosure describes one-part applicator designs that, when prepared from low modulus materials, provide comparable performance to two-part designs.

[0053] Generally, the applicators of the present disclosure can be made by known methods. In some embodiments, injection molding may be used. A variety of materials may be used to form the applicators. In some embodiments, applicators formed of low flexural modulus materials such as low density polyethylene may be used. For example, in some embodiments, materials having a flexural modulus of no greater than 500 Mpa, e.g., no greater than 400 MPa, or even no greater than 350 MPa may be used.

[0054] Various modifications and alterations of this invention will become apparent to those skilled in the art without departing from the scope and spirit of this invention.

What is Claimed is:

1. A liquid applicator for applying a liquid to a surface, the applicator comprising:

an elongated hollow body comprising a wall defining an internal chamber having a closed end and an open end; wherein the wall comprises a handle region and a crush region and wherein the ratio of thickness of the wall in the crush region over the thickness of the wall in the handle region is less than 1;

a first ampoule formed of a frangible material located in the internal chamber proximate the crush region and containing the liquid;

a lever integral with the hollow body and comprising a hinge projecting from a first location attached to the hollow body to a second location, a grip extending from the second location to a third location, and a foot integral to the wall adjacent the crush region;

wherein the lever comprises a first truss extending from the third location to the foot; a third truss extending from the second location to the foot, and a second truss between the first and third trusses and extending from the foot to a fourth location, between the second and third location;

wherein the width of the first truss is tapered from a first width proximate the third location and a second width proximate foot; wherein the ratio of the second width over the first width is less than 1.

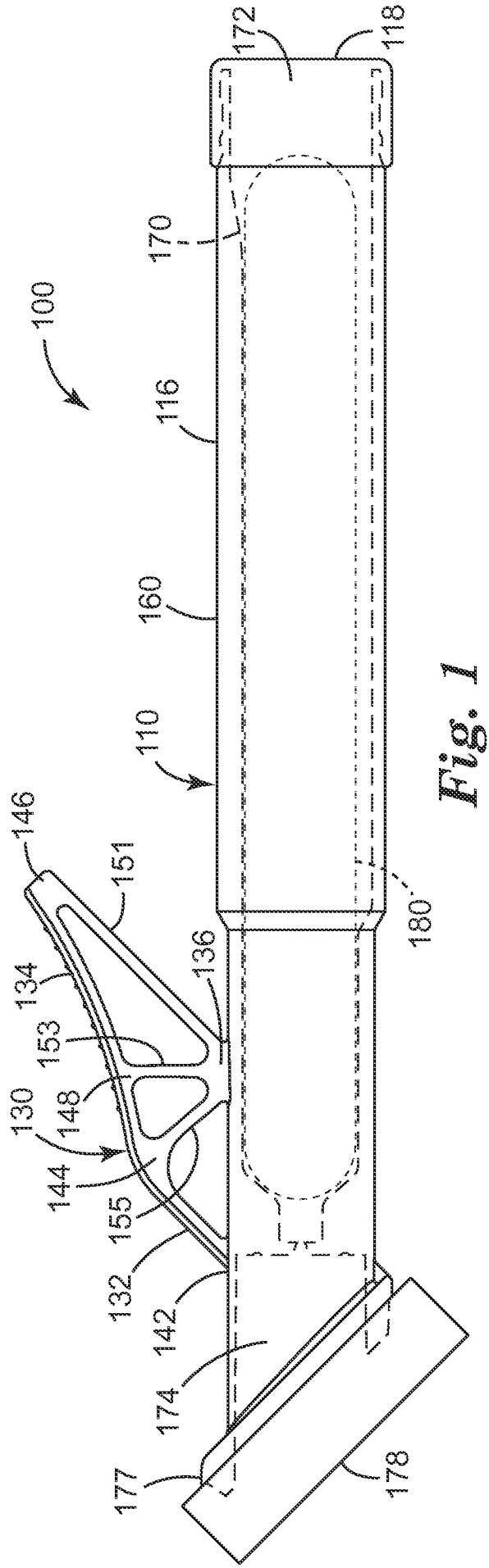
2. The liquid applicator of claim 1, wherein the width of the third truss is tapered from a third width proximate the second location to a fourth width proximate the foot; wherein the ratio of the fourth width over the third width is less than 1.

3. The liquid applicator of claim 1 or 2, wherein the second truss projects substantially perpendicular to the major axis of the elongated hollow body.

4. The liquid applicator according to any one of the preceding claims, wherein the applicator is formed of a material having a flexural modulus of no greater than 500 MPa.

5. The liquid applicator according to any one of the preceding claims, further comprising a pad connected to the open end of the hollow body.

6. The liquid applicator of claim 5, wherein the pad comprises a series of alternating peaks and troughs repeating across the exposed surface of the pad.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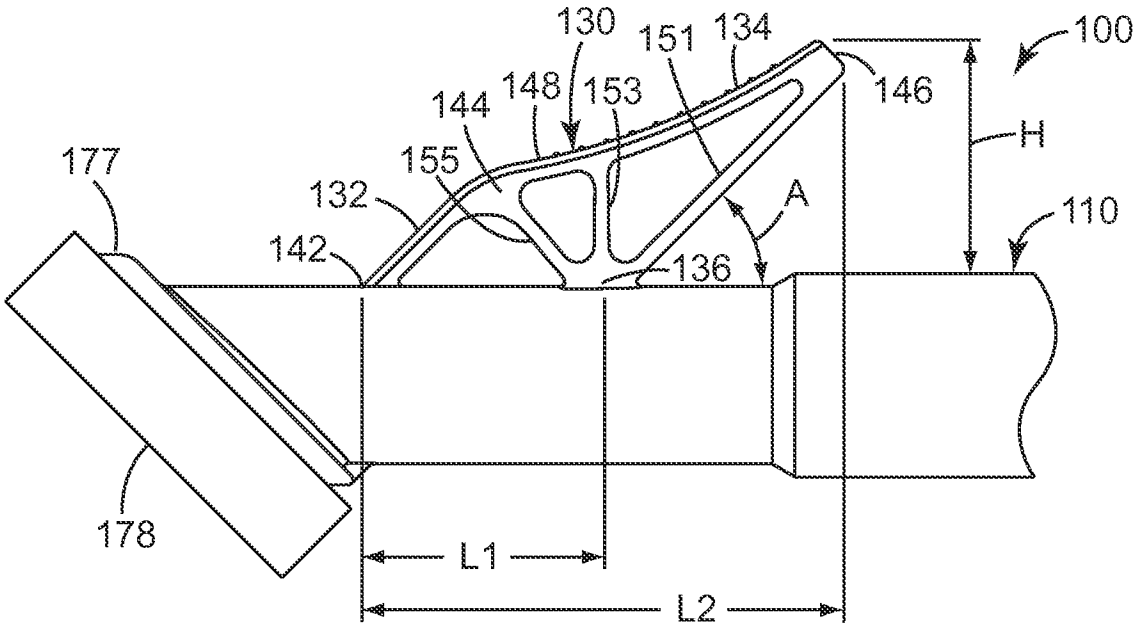
178
180
T1
T2
T3
111
114
115

Fig. 1

Fig. 2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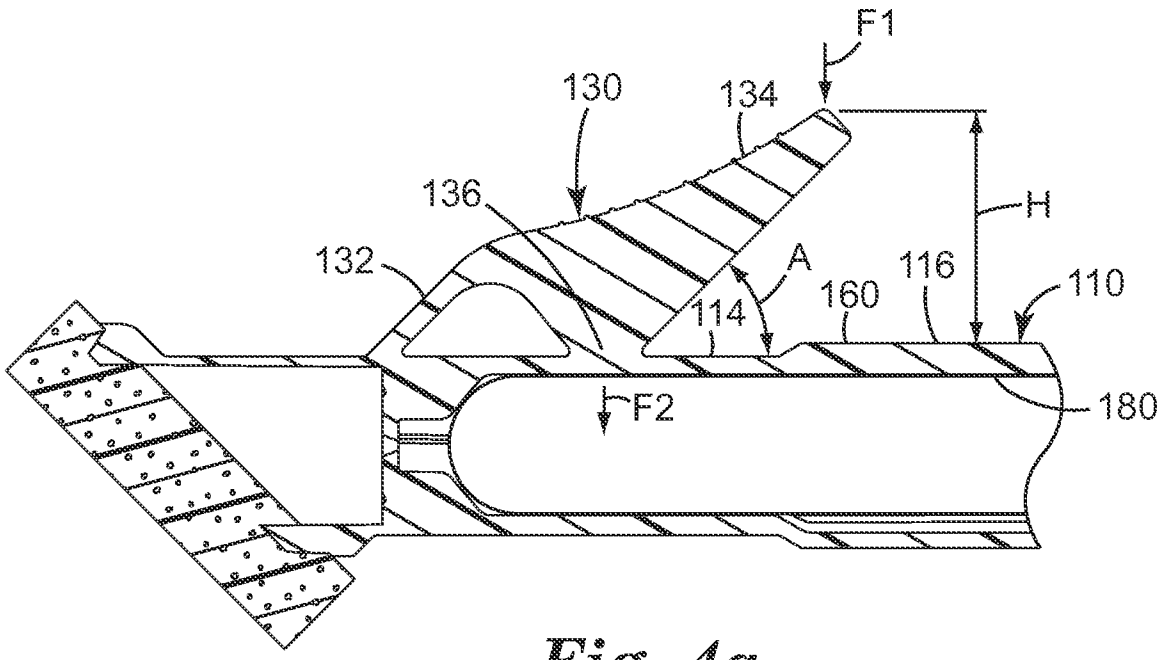
L2

Fig. 3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F2
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Fig. 4a

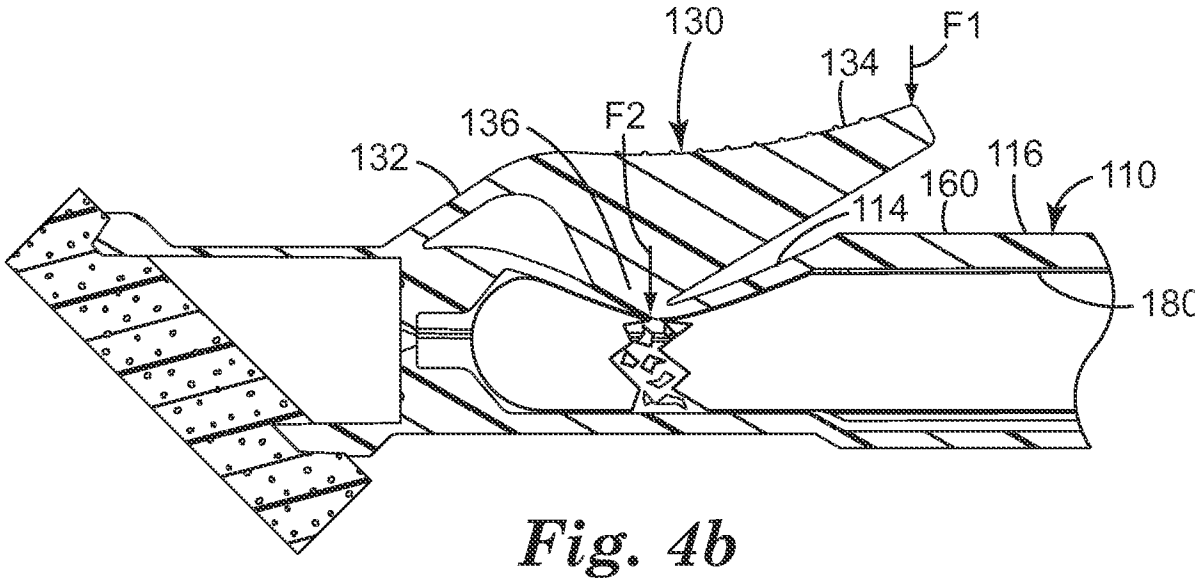

Fig. 4b

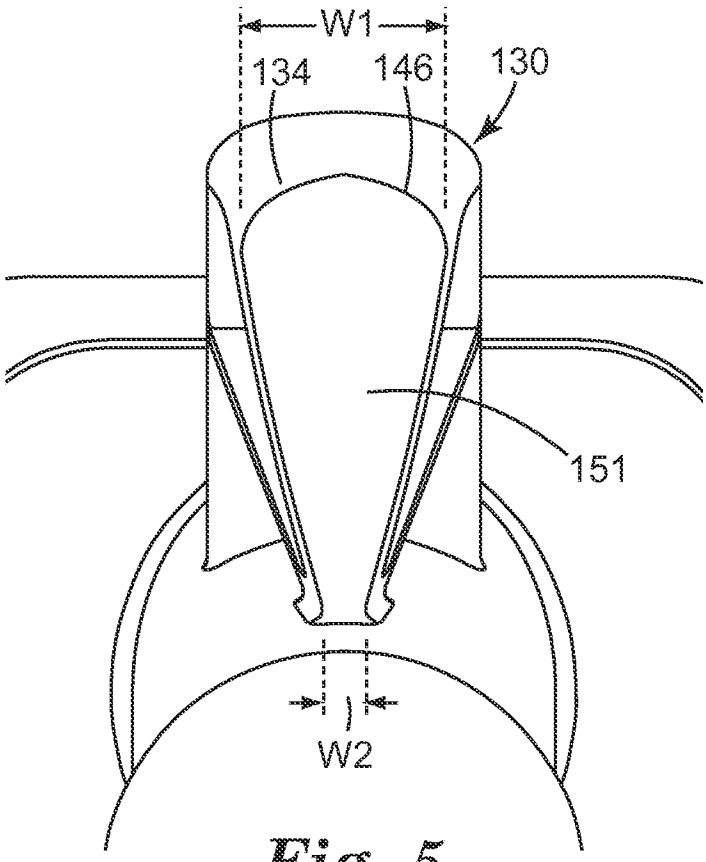

Fig. 5

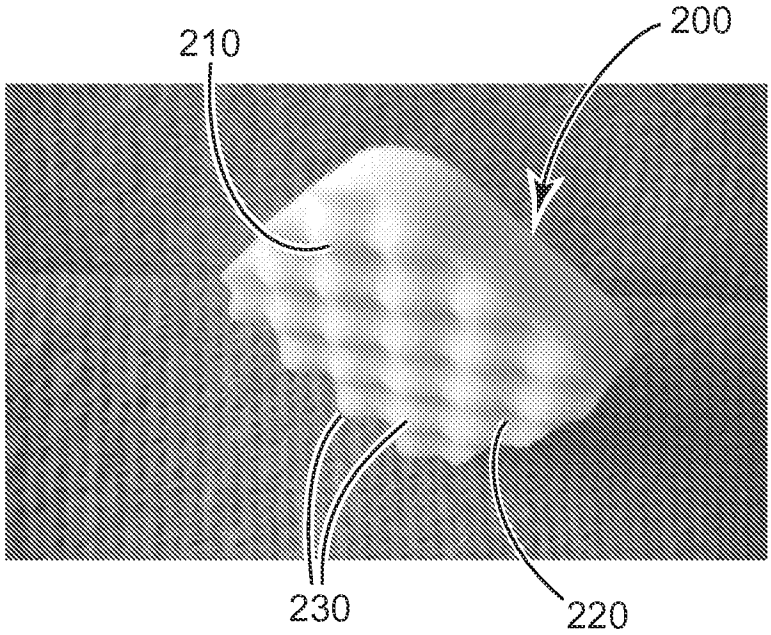

Fig. 6a

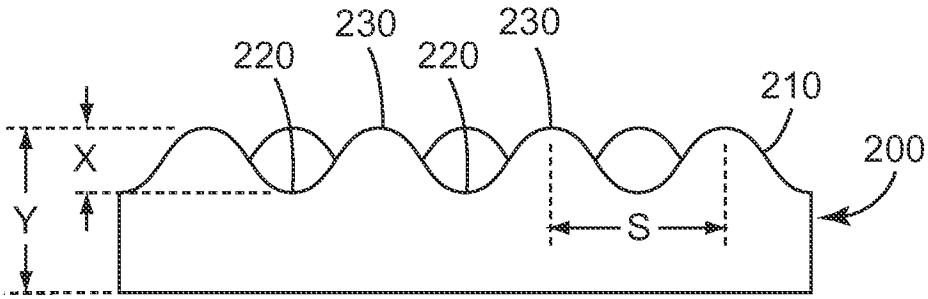

Fig. 6b

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2013/035881

A. CLASSIFICATION OF SUBJECT MATTER
INV. A61M35/00 A61F13/40
ADD.

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
A61M A61F

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

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 6 729 786 B1 (MEDIFLEX HOSPITAL PRODUCTS INC) 4 May 2004 (2004-05-04) column 7, line 46 - column 9, line 15; figure 6	1-6
A	WO 02/46089 A2 (MEDI FLEX HOSPITAL PRODUCTS INC) 13 June 2002 (2002-06-13) page 7, lines 16-25; figure 4	1-6
A	US 2004/254561 A1 (MEDLOGIC GLOBAL LTD) 16 December 2004 (2004-12-16) paragraphs [0022] - [0023]; figure 2	1-6

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

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

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

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
10 June 2013	19/06/2013

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Segerberg, Tomas

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
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