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**Wan**(10) **Pub. No.: US 2019/0380520 A1**(43) **Pub. Date: Dec. 19, 2019**(54) **DISPOSABLE COATED PAPER STRAW**(71) Applicant: **Chi Wing Don Wan**, Kowloon (HK)(72) Inventor: **Chi Wing Don Wan**, Kowloon (HK)(21) Appl. No.: **16/434,820**(22) Filed: **Jun. 7, 2019**(30) **Foreign Application Priority Data**

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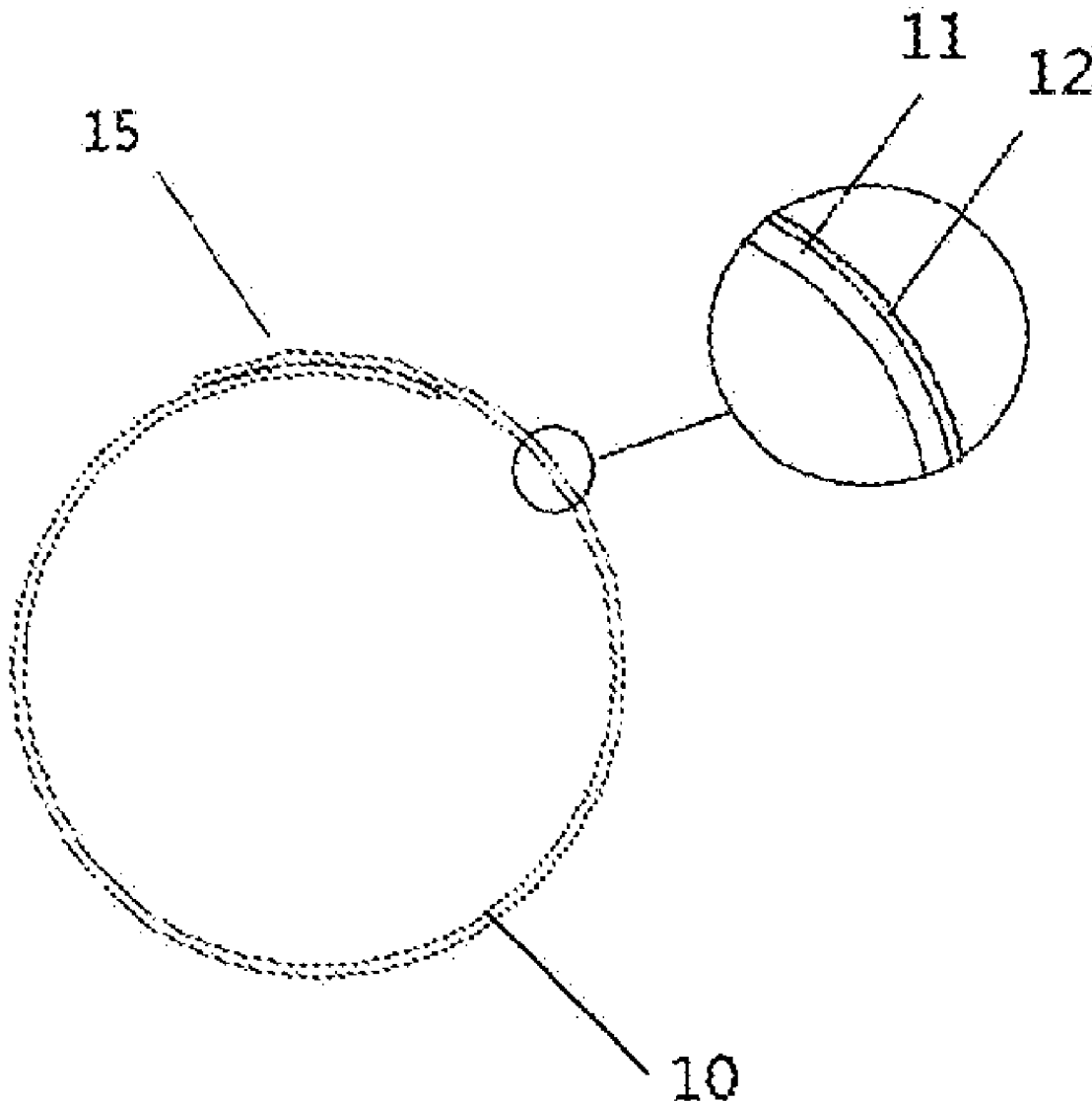
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**ABSTRACT**

The invention provides a disposable coated paper straw formed by rolling one or more sheets. In the straw each one of the one or more sheets is a coated paper strip made of a coated paper which comprises a first paper-base layer and a first coating layer. The first coating layer is located at least at an exterior side of the first paper-base layer. The straw further contains an interface edge which is joined by overlapping portions of the one or more sheets in the longitudinal direction. The first coating layer is made from degradable resin. The straw provided by the present invention is not only degradable, which is environmentally friendly, but also it can maintain the strength of the straw over a long period of time.



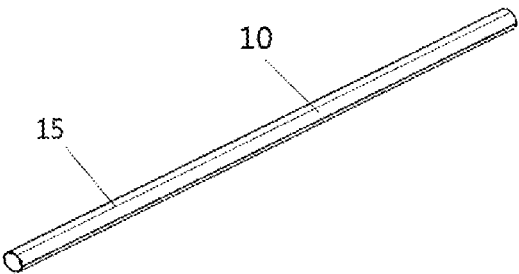


Fig.1

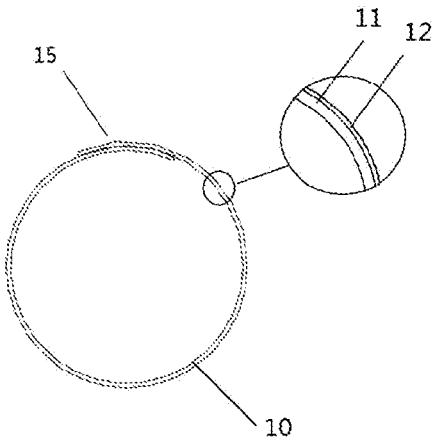


Fig.2

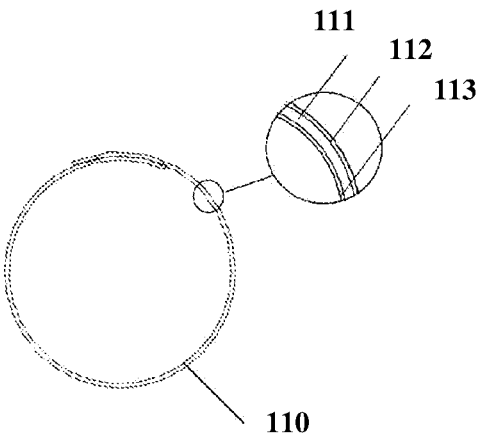


Fig.3

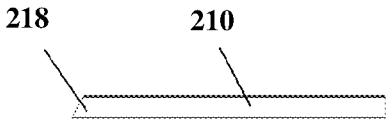


Fig.4

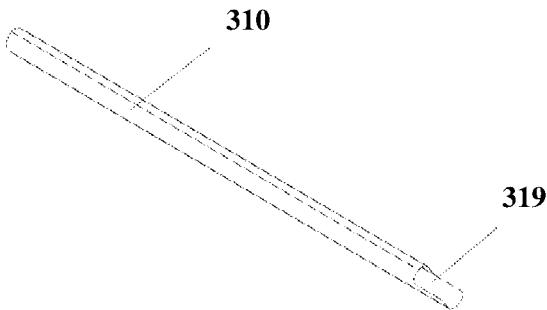


Fig.5A

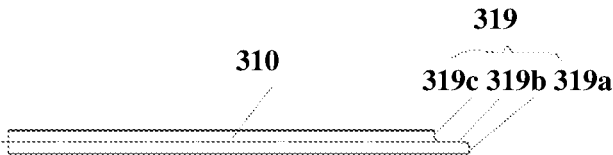


Fig.5B

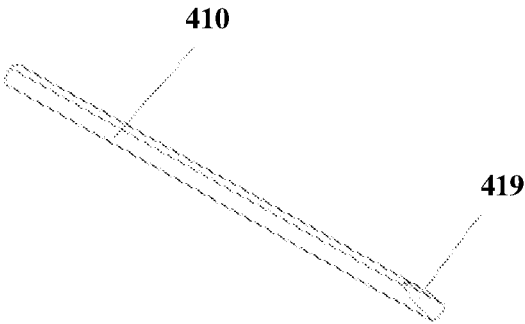


Fig.6A

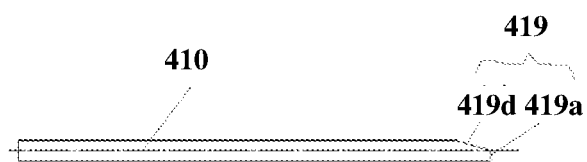


Fig.6B

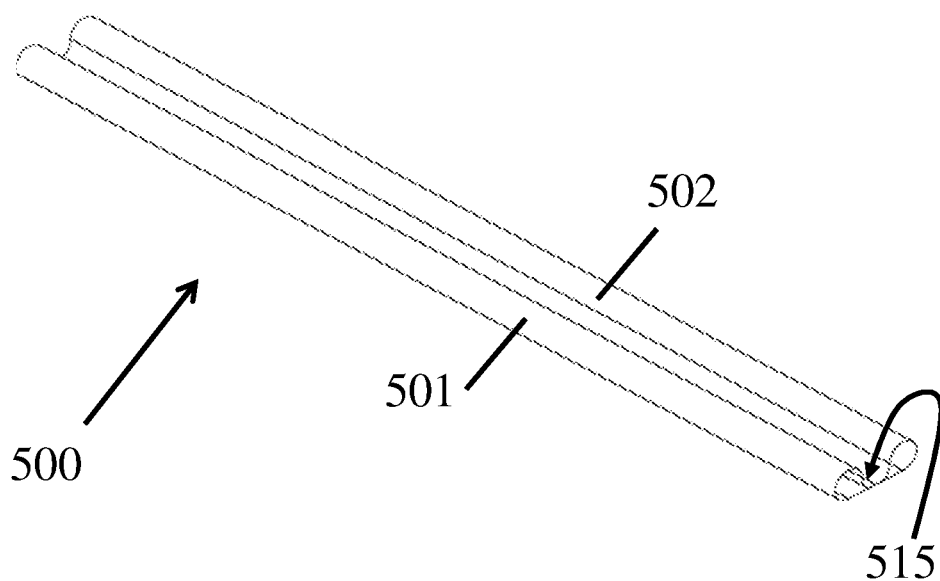


Fig.7

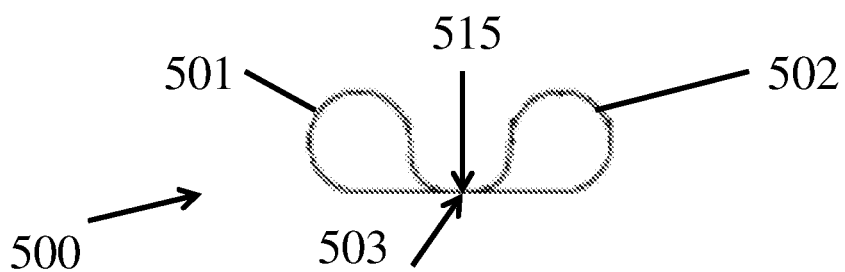


Fig.8

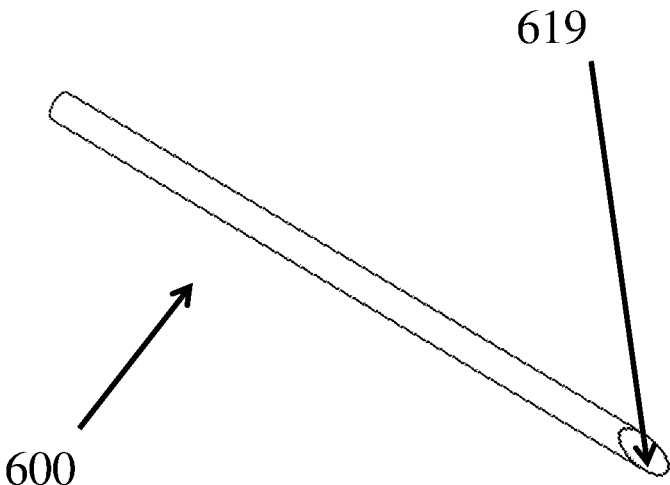


Fig.9

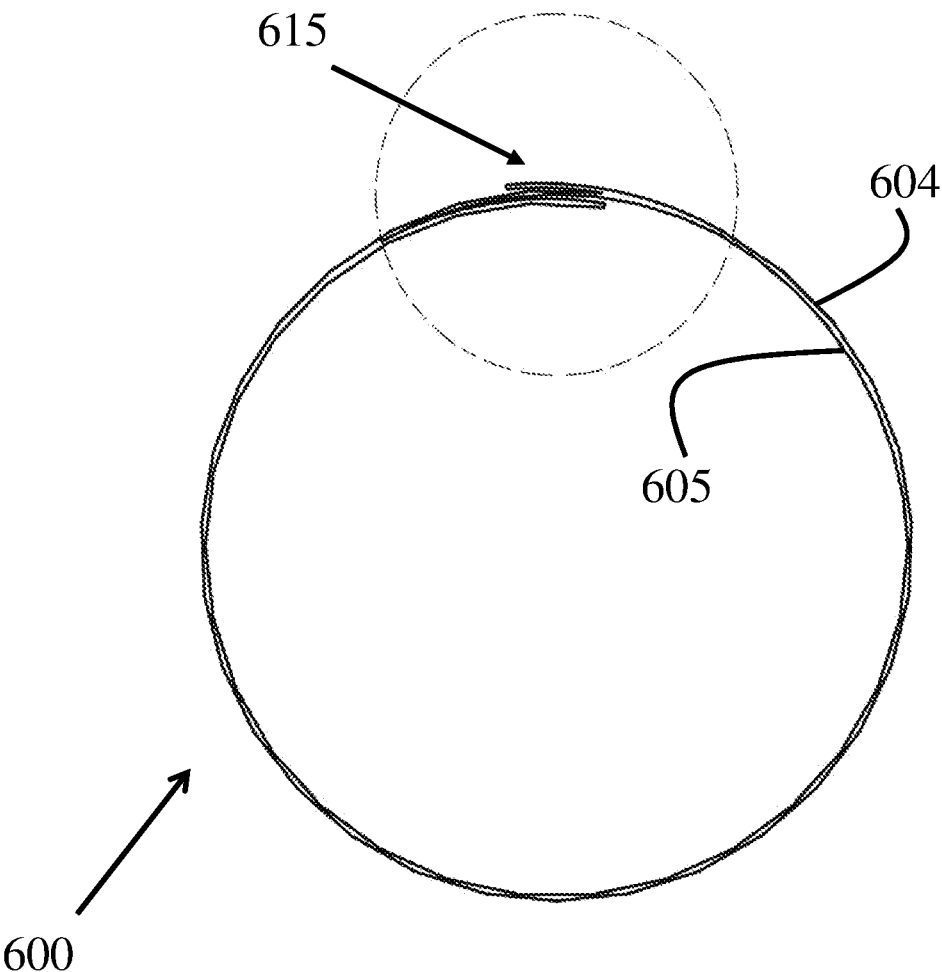


Fig.10a

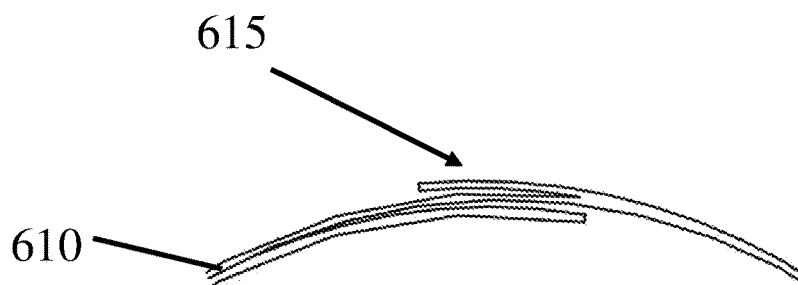


Fig.10b

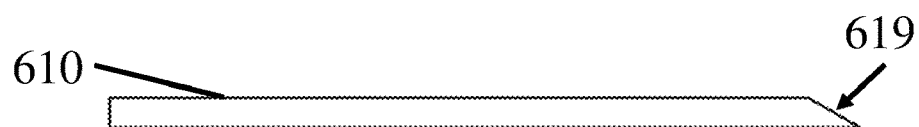


Fig.11

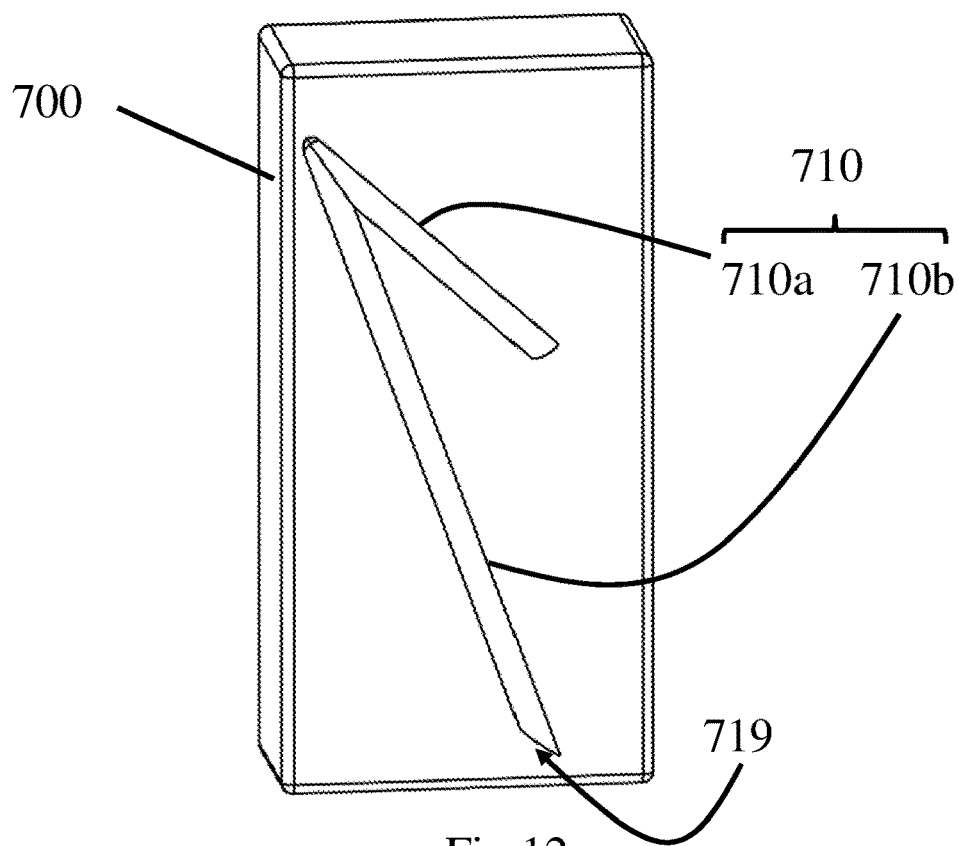


Fig.12

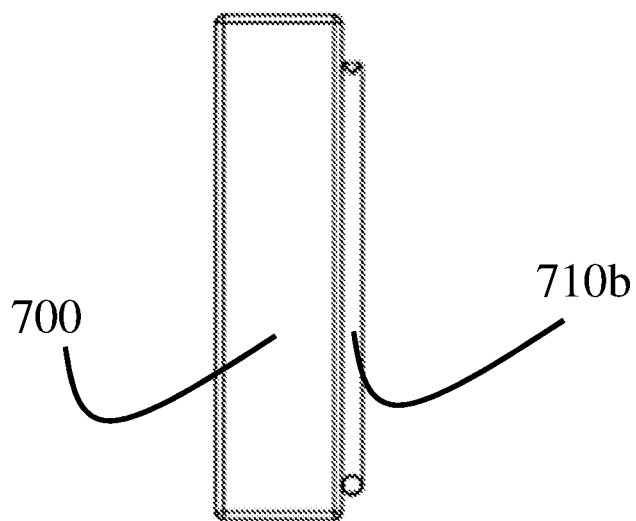


Fig. 13a

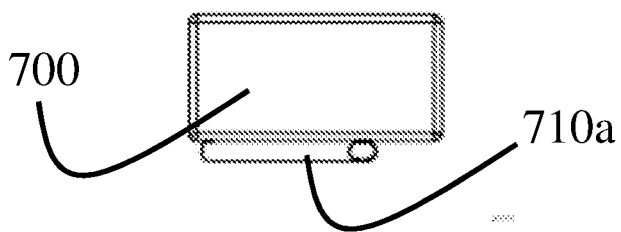


Fig. 13b

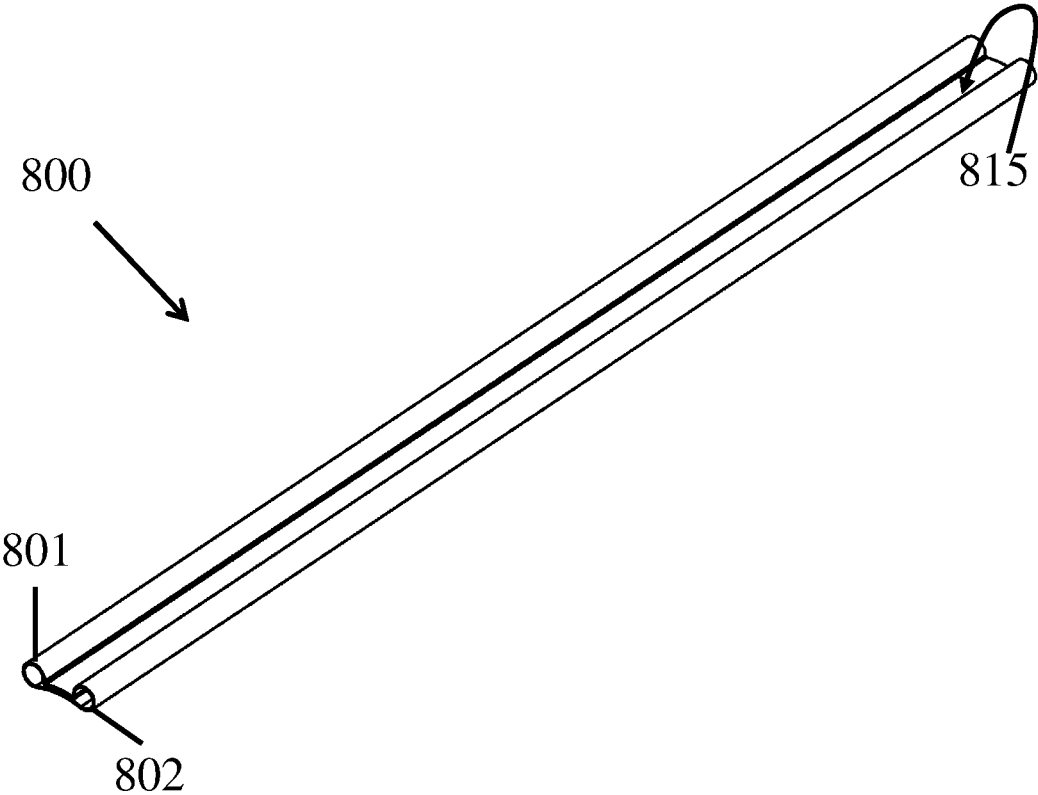


Fig.14a

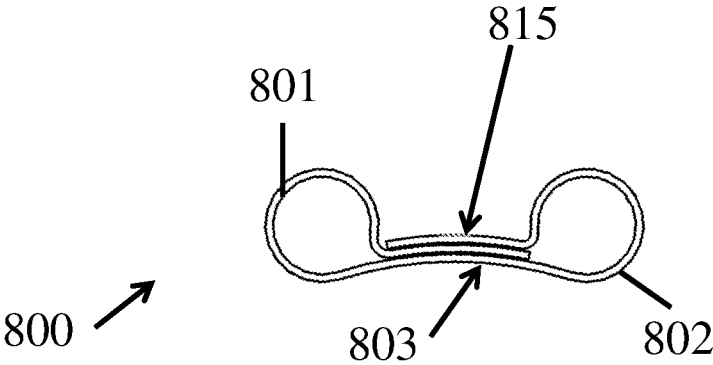


Fig.14b



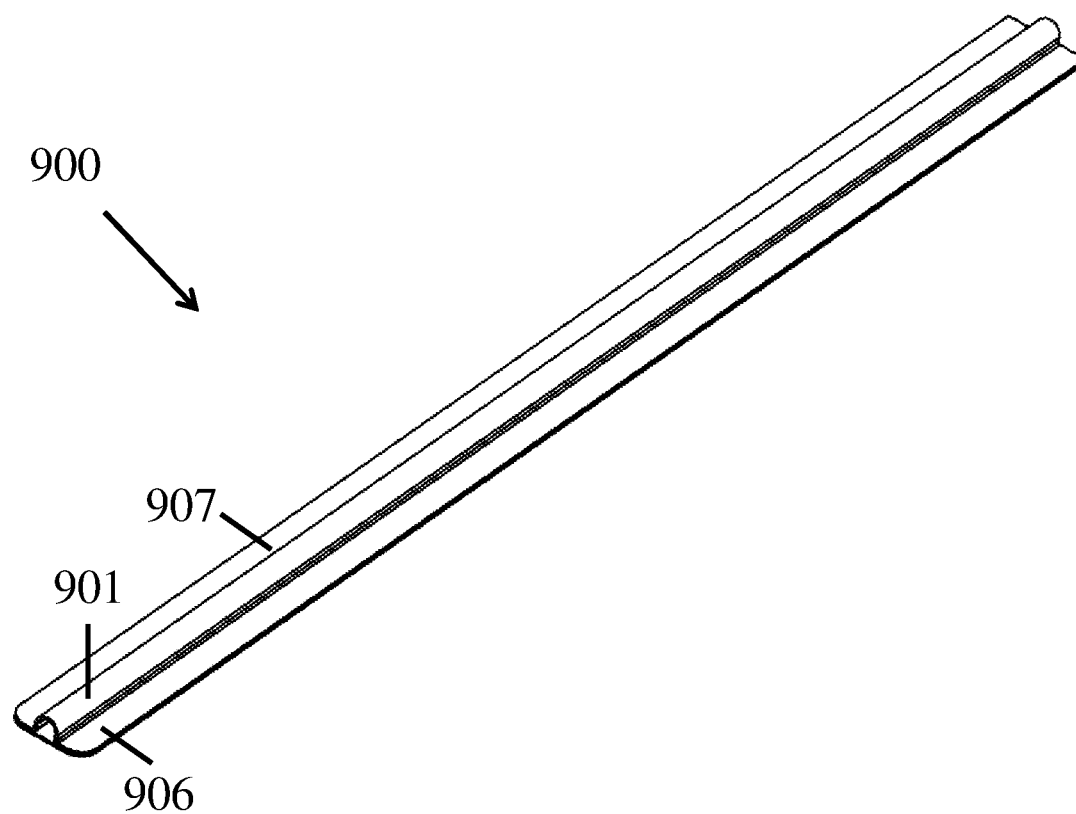


Fig.15a

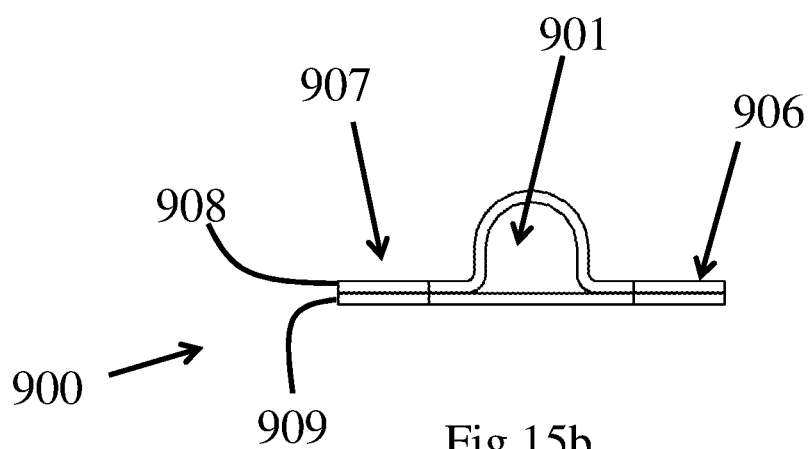


Fig.15b

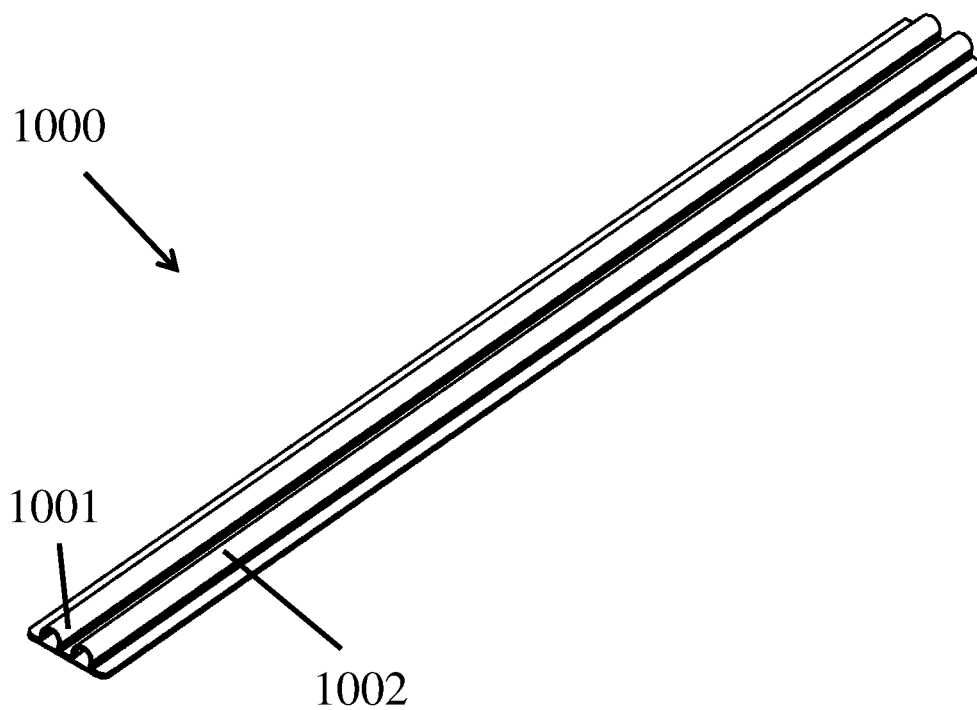


Fig. 16a

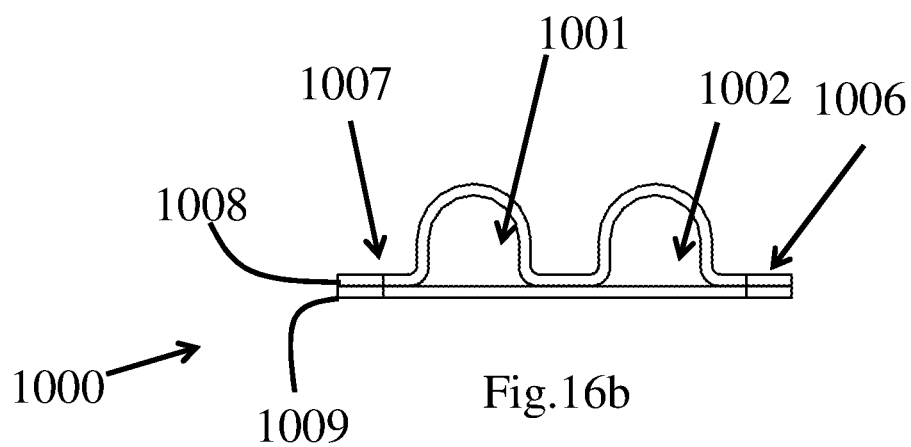


Fig. 16b

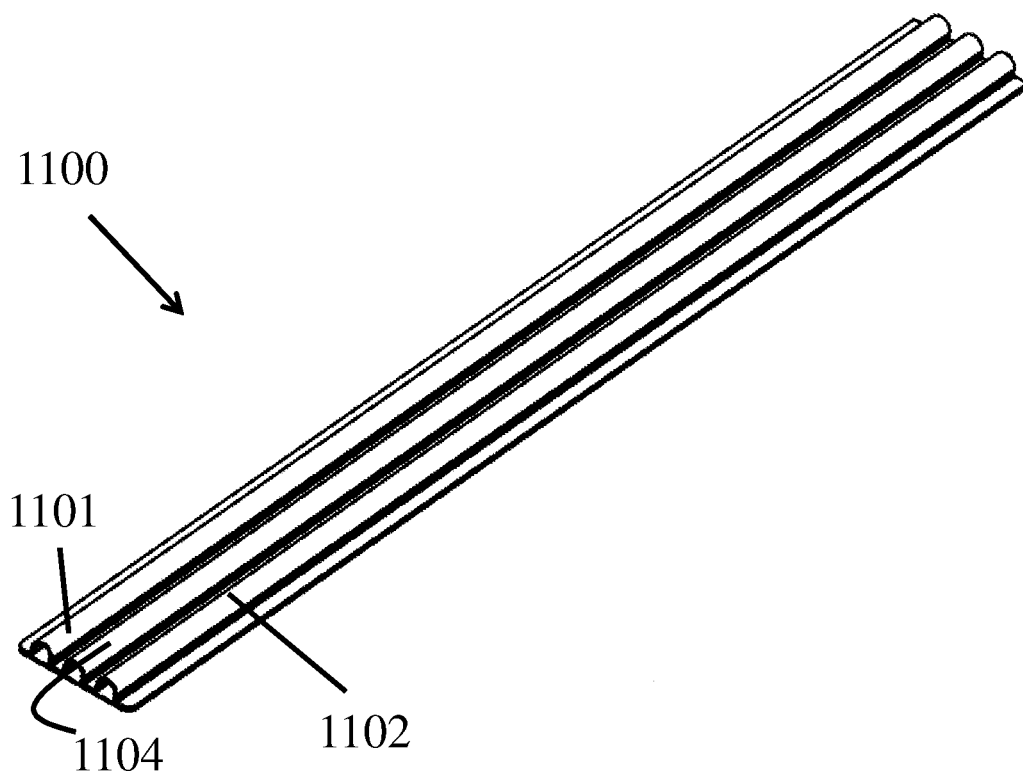


Fig.17a

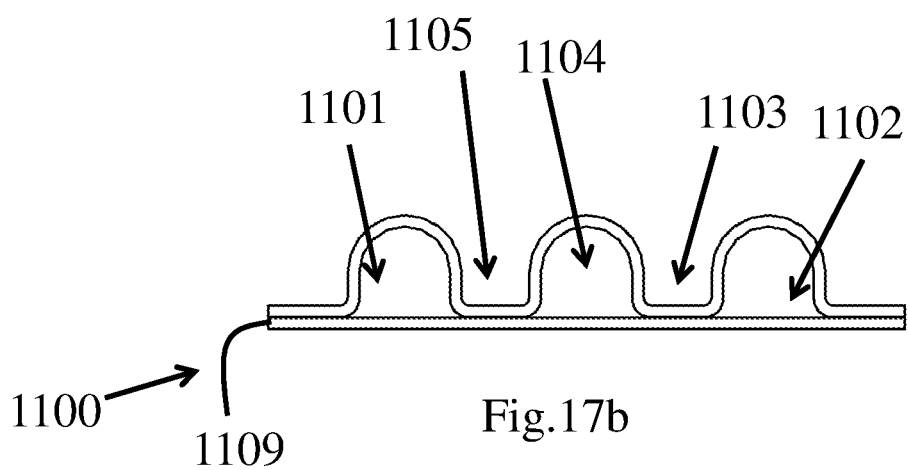


Fig.17b

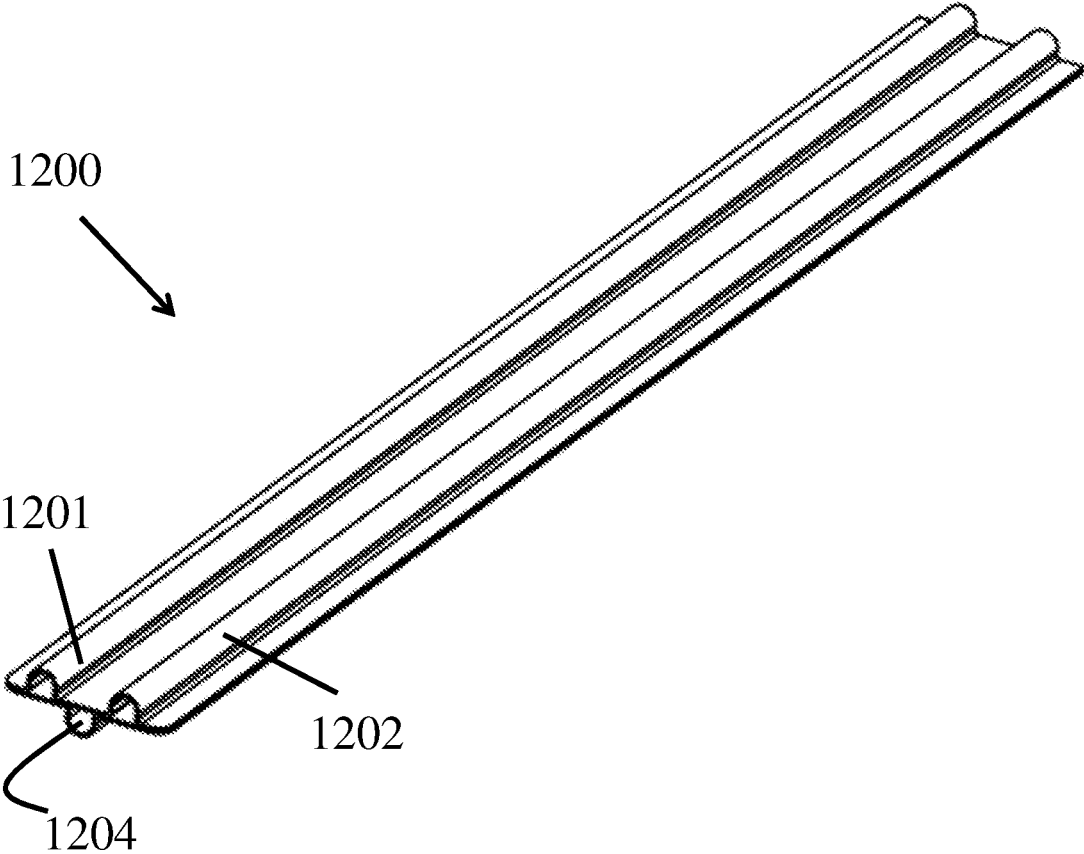


Fig.18a

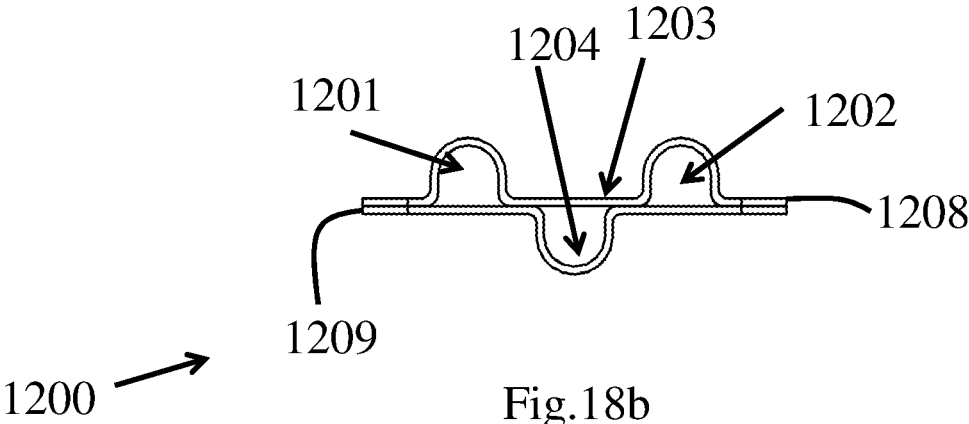


Fig.18b

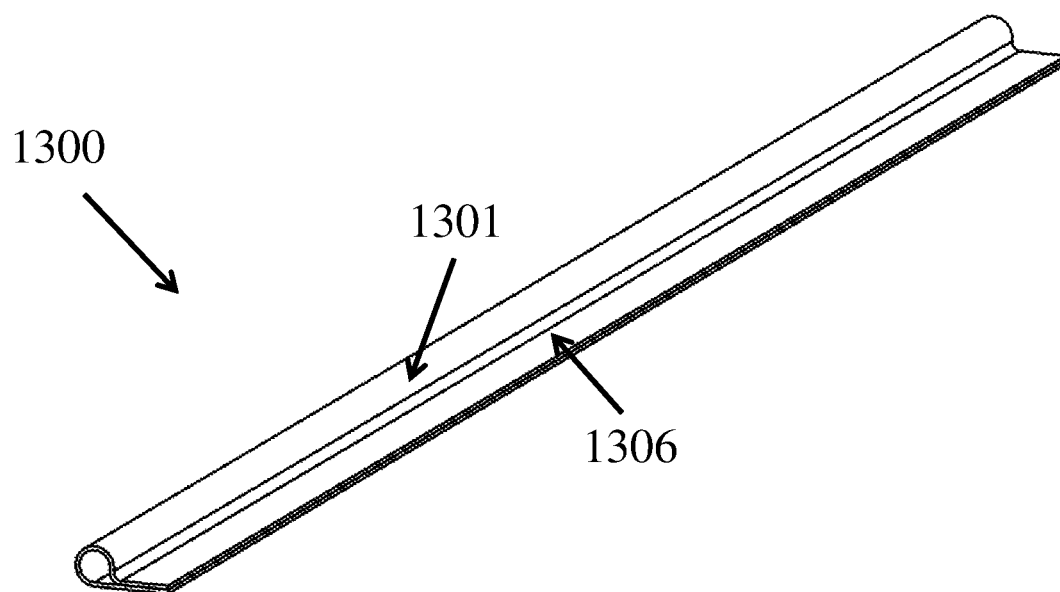


Fig.19a

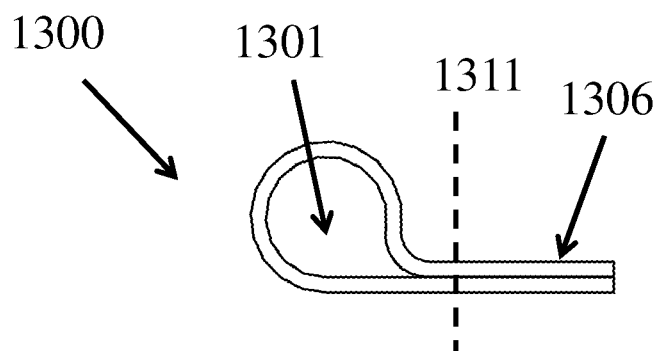


Fig.19b

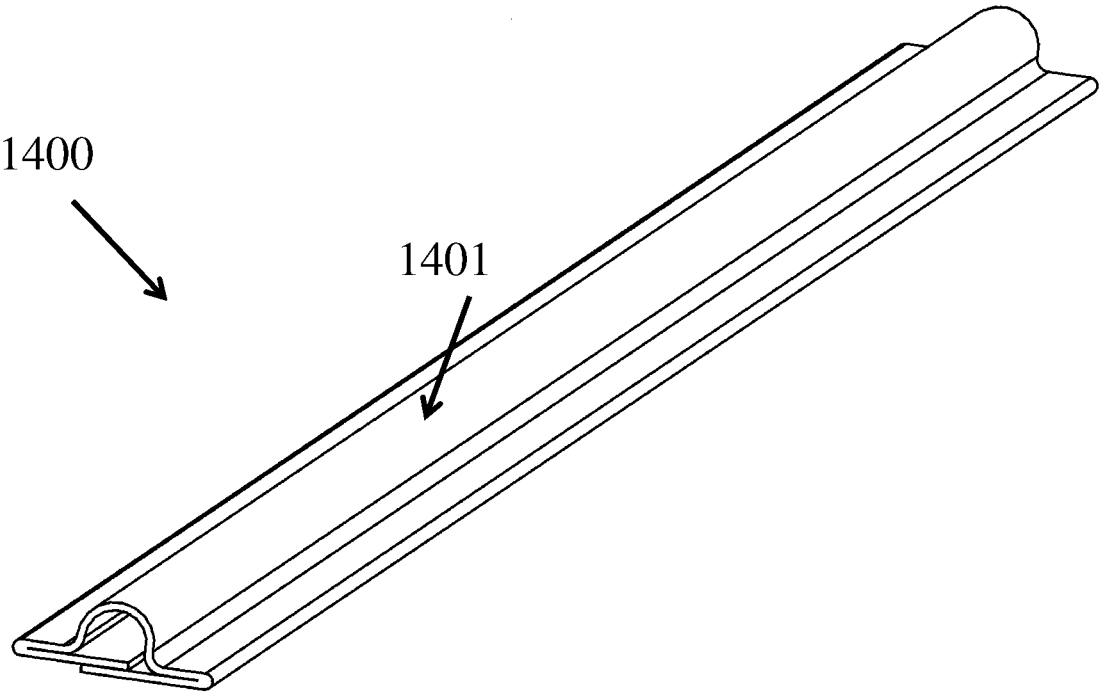


Fig.20a

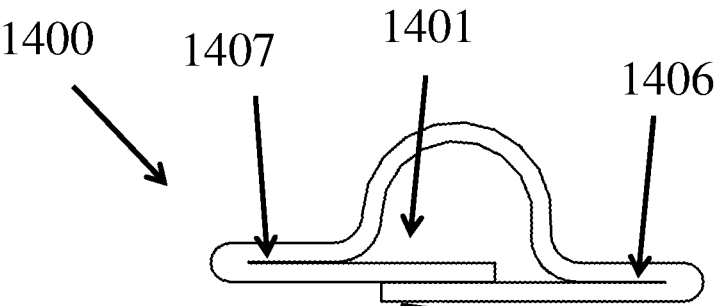


Fig.20b

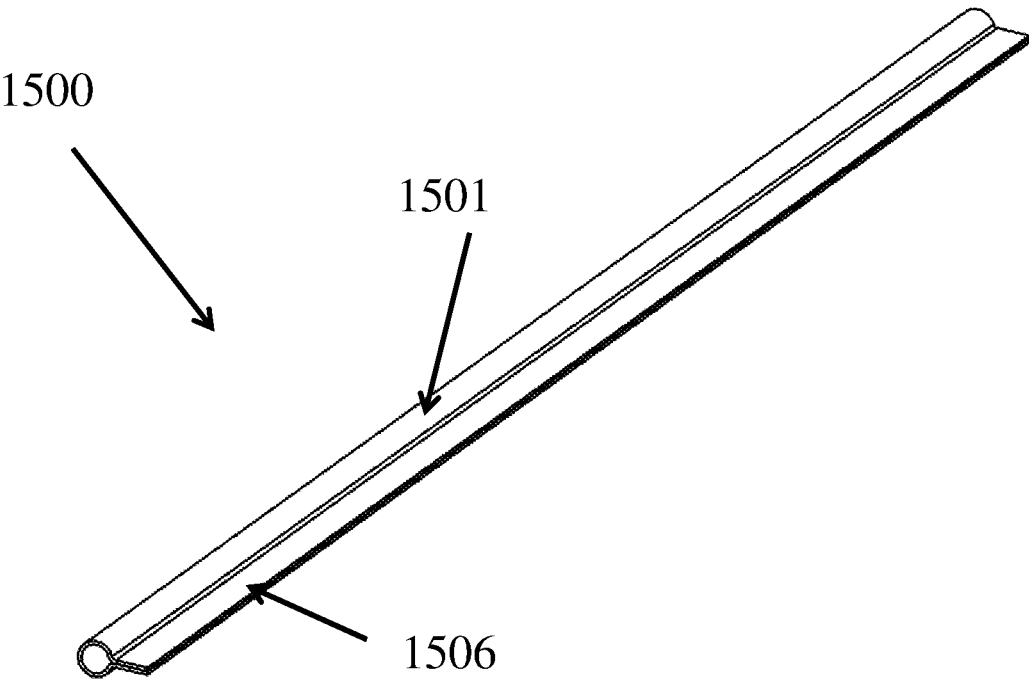


Fig.21a

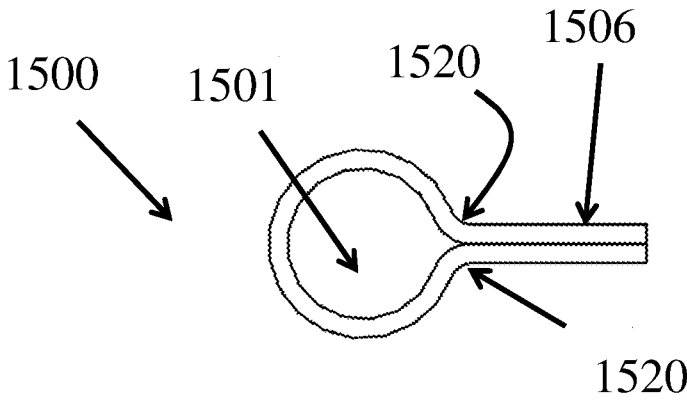


Fig.21b

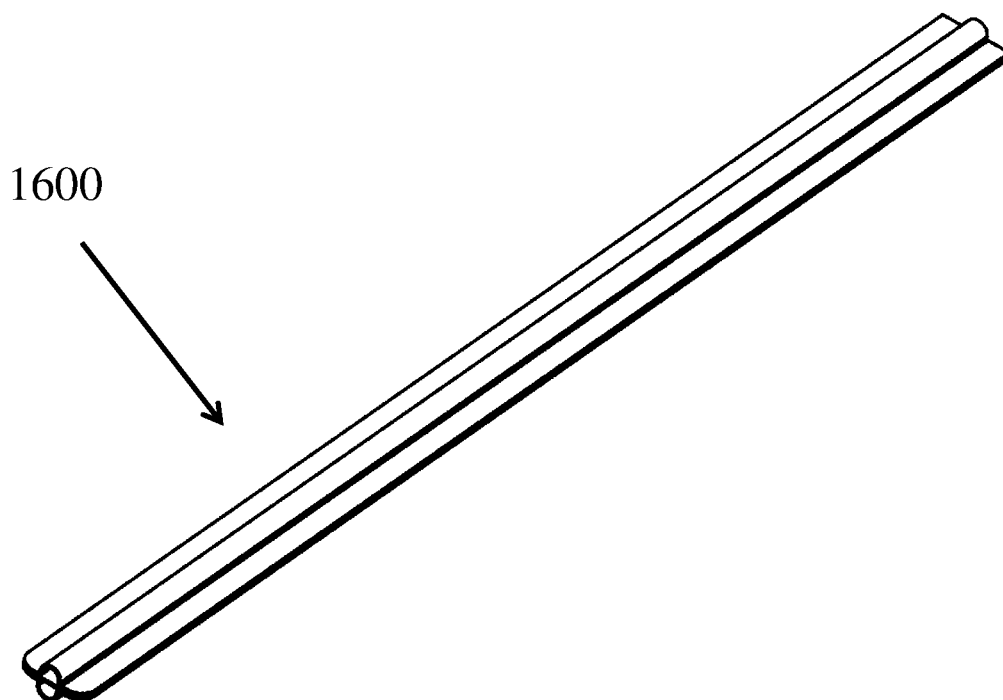


Fig.22a

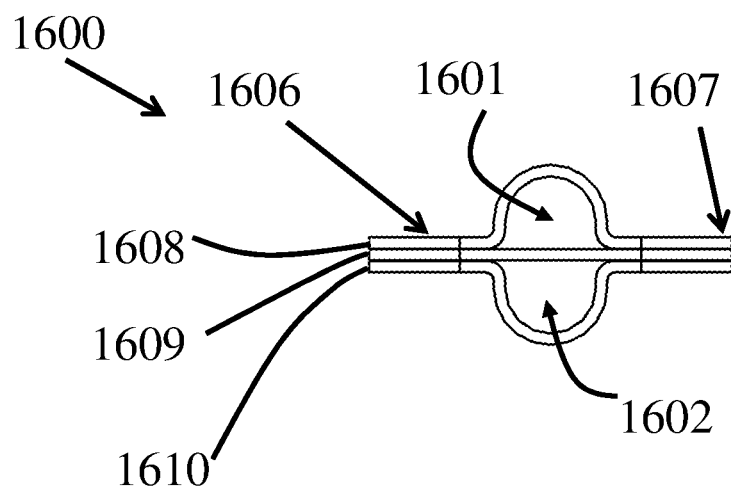


Fig.22b



## DISPOSABLE COATED PAPER STRAW

### FIELD OF INVENTION

**[0001]** The present invention relates to the field of beverage products, and in particular to a disposable coated paper straw.

### BACKGROUND OF INVENTION

**[0002]** Current drinking straws are typically plastic straws. Although plastic straws are convenient to use, the straw discarded after use is difficult to degrade in the natural environment, which is not environmentally friendly.

**[0003]** With the development of the society, environmental protection has been paid more and more attention. The industry has proposed more straw technologies which are environmentally friendly.

**[0004]** For example, the Chinese patent for utility model CN204363641U proposes a paper straw, which is characterized in that a main body of the straw is formed by paper, and a plurality of loops are pressed at one end of the straw so that one end of the straw can be appropriately bent. Due to the use of a paper body, the straw is degradable and reduces environmental stress.

**[0005]** The Chinese patent for utility model CN202262782U also discloses a paper straw which adopts a paper tube body, and the tube body is flat in a folded manner to realize very small occupied space, and is unfolded and rounded from the folded manner at the time of use.

**[0006]** The above conventional art use paper tube body for the straw. However, the paper tube body leads to a quick damage to the strength of the tube body during operation due to immersion of the straw in the beverage, which causes inconvenience to the user.

**[0007]** The industry therefore requires a new straw that not only has a certain degree of degradability in the natural environment, but also maintains the strength of the straw over a long period of time.

### SUMMARY OF INVENTION

**[0008]** The embodiment of the invention provides a disposable coated paper straw, so that the straw does not only possess degradability, but also maintains the strength of the straw for a long period of time.

**[0009]** According to an aspect of an embodiment of the present invention, there is provided a disposable coated paper straw formed by rolling one or more sheets. In the straw each one of the one or more sheets is a coated paper strip made of a coated paper which comprises a first paper-base layer and a first coating layer. The first coating layer is located at least at an exterior side of the first paper-base layer. The straw further contains an interface edge which is joined by overlapping portions of the one or more sheets in the longitudinal direction. The first coating layer is made from degradable resin.

**[0010]** In one variation of the preferred embodiments, the coated paper further contains a second coating layer on an interior side of the first paper-base layer.

**[0011]** In another variation of the preferred embodiments, the coated paper further contains a second paper-base layer.

**[0012]** Preferably, the coated paper further contains a second coating layer at an exterior side of the second paper-base layer.

**[0013]** In a further variation of the preferred embodiments, the first coating layer is made of a biodegradable coated resin.

**[0014]** In a further variation of the preferred embodiments, the end surface of the straw is a cut surface, and the first paper-base layer is exposed on the end surface.

**[0015]** In a further variation of the preferred embodiments, the coated paper includes a printed pattern layer which is located on an exterior surface of the first coating layer or between the first coating layer and the first paper-based layer.

**[0016]** In a further variation of the preferred embodiments, the interface edge extends along a longitudinal axis of the straw.

**[0017]** In a further variation of the preferred embodiments, one end of the straw forms an angular portion or a spoon portion.

**[0018]** Preferably, the spoon portion comprises one of the following a straw end face and a spoon bevel connected to each other; or a straw end face, a spoon step plane and a spoon step end face connected to each other.

**[0019]** In a further variation of the preferred embodiments, the straw is formed by rolling a single said sheet. The straw further contains two tubular portions.

**[0020]** Preferably, the two tubular portions are separated from each other along a direction perpendicular to the longitudinal direction of the straw, but are connected by the interface edge.

**[0021]** In a further variation of the preferred embodiments, the straw is formed by combining two said sheets which are otherwise separate from each other.

**[0022]** Preferably, wherein one of the two sheets is rolled to form an arc shape, and the other one of the two sheets is substantially flat.

**[0023]** Alternatively, both of the two sheets are rolled to form an arc shape respectively. The two arc shapes together form a tubular portion of the straw.

**[0024]** Alternatively, each of the two sheets has a first portion that is rolled to form an arc shape, and a second portion which is substantially flat. The first portion of one of the two sheets corresponds to a second portion of the other one of the two sheets to form a tubular portion.

**[0025]** In a further variation of the preferred embodiments, the straw is formed by rolling a single said sheet. The straw further contains a tubular portion and a flat portion; the tubular portion located off-center along the direction of a line connecting the tubular portion and the flat portion.

**[0026]** According to another variation of the preferred embodiments, the biodegradable coated resin is a petroleum-based coated resin or a bio-based coated resin.

**[0027]** In one specific implementation, the straw has a cylindrical cross section.

**[0028]** In another specific implantation, the first coating layer is implemented on the exterior side of the first paper-base layer by printing.

**[0029]** Preferably, the first coating layer is implemented on the exterior side of the first paper-base layer by flexographic printing.

**[0030]** Since the straw is made of coated paper which can slow the contact and soaking of the paper-base layer with the beverage during use, the paper-base layer does not soften prematurely. As a result, the straw is able to maintain sufficient use strength for a certain period of time. At the

same time, since the coated paper is mainly made of paper, the straw has good degradability and is environmentally friendly.

#### BRIEF DESCRIPTION OF THE DRAWINGS

[0031] Accompanying drawings are for providing further understanding of embodiments of the disclosure which form a part of the disclosure and are for illustrating the principle of the embodiments of the disclosure along with the literal description. Apparently, the drawings in the description below are merely some embodiments of the disclosure, a person skilled in the art can obtain other drawings according to these drawings without creative efforts. In the figures:

[0032] FIG. 1 is a perspective view showing a structure of a disposable coated paper straw according to a first embodiment of the present invention;

[0033] FIG. 2 is a schematic view showing a cross-sectional structure of the straw in FIG. 1.

[0034] FIG. 3 shows the schematic view of the cross-sectional structure of the straw according to another embodiment of the straw according to FIG. 1.

[0035] FIG. 4 is a schematic view showing the end face structure of a straw according to a third embodiment of the invention.

[0036] FIGS. 5A and 5B are respectively a schematic perspective view and a front view of a straw according to a fourth embodiment of the invention.

[0037] FIGS. 6A and 6B are respectively a schematic perspective view and a side view of a straw according to a fifth embodiment of the invention.

[0038] FIG. 7 is a perspective view of a two-holes disposable coated paper straw according to a sixth embodiment of the present invention.

[0039] FIG. 8 is a cross-sectional view of the two-holes straw of FIG. 7.

[0040] FIG. 9 is a perspective view of a double-layer disposable coated paper straw according to a seventh embodiment of the present invention.

[0041] FIG. 10a is a cross-sectional view of the double-layer straw of FIG. 9.

[0042] FIG. 10b is a partial enlarged view of the portion of the double-layer straw marked with dashed lines in FIG. 10a.

[0043] FIG. 11 is a side view of the double-layer straw of FIG. 9.

[0044] FIG. 12 is a perspective view of a drink carton with a disposable coated paper straw attached thereto, according to an eighth embodiment of the invention.

[0045] FIG. 13a is a left view of the drink carton with the disposable coated paper straw in FIG. 12.

[0046] FIG. 13b is a top view of the drink carton with the disposable coated paper straw in FIG. 12.

[0047] FIGS. 14a and 14b show respectively the perspective view and a cross-sectional view of a two-holes disposable coated paper straw according to a ninth embodiment of the present invention.

[0048] FIGS. 15a and 15b show respectively the perspective view and a cross-sectional view of a single-hole disposable coated paper straw according to a ninth embodiment of the present invention.

[0049] FIGS. 16a and 16b show respectively the perspective view and a cross-sectional view of a two-holes disposable coated paper straw according to a tenth embodiment of the present invention.

[0050] FIGS. 17a and 17b show respectively the perspective view and a cross-sectional view of a three-holes disposable coated paper straw according to an eleventh embodiment of the present invention.

[0051] FIGS. 18a and 18b show respectively the perspective view and a cross-sectional view of a three-holes disposable coated paper straw according to a twelfth embodiment of the present invention.

[0052] FIGS. 19a and 19b show respectively the perspective view and a cross-sectional view of a single-hole disposable coated paper straw according to a thirteen embodiment of the present invention.

[0053] FIGS. 20a and 20b show respectively the perspective view and a cross-sectional view of a single-hole disposable coated paper straw according to a fourteenth embodiment of the present invention.

[0054] FIGS. 21a and 21b show respectively the perspective view and a cross-sectional view of a single-hole disposable coated paper straw according to a fifteenth embodiment of the present invention.

[0055] FIGS. 22a and 22b show respectively the perspective view and a cross-sectional view of a dual-hole disposable coated paper straw according to a sixteenth embodiment of the present invention.

#### DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0056] In order to make the technical solution of the present invention better understandable by a person skilled in the art, technical solutions in the embodiments of the present invention are clearly and integrally described in the following with reference to the accompanying drawings in the embodiments of the present invention. Apparently, the described embodiments are merely part of the embodiments of the present invention, but not all of the embodiments. All other embodiments obtained by a person skilled in the art based on the embodiments of the present invention without departing from the inventive scope should fall within the scope of the present invention.

[0057] It should be noted that the terms “first”, “second”, and the like in the description, claims, and figures of the present invention are used to distinguish similar objects, and are not necessarily used to describe a particular order or precedence order. It is to be understood that the materials so used here are interchangeable where appropriate, so that the embodiments of the invention described herein can be implemented in a sequence other than those illustrated or described herein. Moreover, the terms “comprises” and “comprising” and any variations thereof are intended to cover a non-exclusive inclusion.

[0058] Similarly, when terms indicating directions like “length”, “width”, “upper”, “lower”, “horizontal”, and “vertical” are used in the detailed description, they are only used to better described the relative spatial relationships between different components of the product or between different portions of a component, in particular in certain views of the product such as in a cross-sectional view. None of these terms is intended to limit the invention in any absolute spatial dimensions in which the product is positioned.

[0059] FIG. 1 is a perspective view showing the structure of a disposable coated paper straw according to a first embodiment of the present invention. Referring to FIG. 1, the straw 10 is rolled from a coated paper strip (sheet) made of coated paper, and the straw 10 has an interface edge 15.

[0060] The coated paper of the straw in FIG. 1 is a paper-based substrate forming a paper-based layer 11, as shown in FIG. 2. At the same time, a coating layer 12 is formed on an exterior side of the paper-based layer 11. That is, the coated paper of the straw in FIGS. 1-2 is a single-sided coated paper. Since the straw 10 is made of coated paper, the coating layer 12 can slow the contacting and soaking processes of the paper-based layer 11 with the beverage during use, so that the paper-based layer 11 does not soften prematurely, and as a result the straw 10 can maintain a sufficient use-strength for a certain period of time. In other words, as the coating layer 12 is effectively waterproof, the straw 10 can be prevented from softening and collapsing in the beverage for a short time, and the rigidity of the straw 10 can be maintained, thereby facilitating the use and acceptance by the consumer. At the same time, since the coated paper is mainly made of paper, the straw 10 has good degradability and is environmentally friendly.

[0061] To achieve the waterproof effect, the coating layer 12 is made of a degradable resin. For example, biodegradable resin is one type of the degradation resins, and degradation resins will also include other resins such as compost resin.

[0062] In an exemplary implementation, the coating layer 12 is made of a biodegradable coated resin. The coating process of the approved biodegradable resin coated on papers (paper-based layer) can be made reference to a general coated paper production process. The coated resin that can be used includes but not limited to the following two types:

[0063] 1. petroleum-based coated resin: Polyethylene (PE)/Polypropylene (PP) containing photo-oxygen biodegradable additives. The photo-biodegradation additive (such as Reverte BD93835) is mixed into PE/PP to form a petroleum-based coated resin, which can be used for paper coating.

[0064] 2. bio-based coated resin: it can be for example poly(butylene succinate) (PBS), polylactic acid (PLA) and Polyhydroxyalkanoates (PHA) or the like, and these bio-based coated resin can be directly coated on papers.

[0065] It can be seen from FIGS. 1 and 2 that the straw 10 has a cylindrical cross section. This cylindrical design can effectively resist the pressure of the "+" type anti-leakage opening of the disposable cup cover, preventing the straw 10 from being flattened during use and impeding normal drinking. The cylindrical shape of the straw 10 can also be used to conveniently enjoy drinks with large particles (such as pearl milk tea and sand ice).

[0066] FIG. 3 is a schematic view showing the end face structure of a straw 110 according to a second embodiment where the straw 110 has an appearance similar to that shown in FIG. 1. One can see that in this embodiment, the coated paper is a double-sided coated paper, and the coated paper includes a first coating layer 112 at an exterior side of the paper-based layer 111 and a second coating layer 113 at an interior side of the paper-based layer 111. The straw 110 made of double-coated paper provides a better use strength than single-side coated paper with only one coating layer.

[0067] According to some further embodiments of the invention, one or both ends of the straw have an end face as a cut surface and the paper-based layer is exposed on the end face. Since the end of the straw are cut at the time of production, the cut portion does not have protection from the coating, and the water will slowly invade the body of the straw from the cutting portions at both ends. As a result, the

ends of the straw are softened after a period of use which is just beneficial to be blunt and soft after the discarded straw is thrown into waterbody, so that it cannot harm creatures inside the water, and is beneficial to the protection of the natural ecological environment such as the ocean.

[0068] For example, FIG. 4 is a front perspective view of a third embodiment of the straw according to FIG. 1, in which one end of the straw 210 is shown to form an acute angle portion 218.

[0069] FIGS. 5A and 5B are a schematic perspective view and a front view showing a straw 310 according to a fourth embodiment, wherein the spoon portion 319 includes a straw end face 319a, a spoon step plane 319b and a spoon step end face 319c which are connected to each other. The end face 319a of the straw 310 is perpendicular to a longitudinal axis of the straw 310. Also, the straw end face 319a is located in the lower half of the straw relative to the longitudinal axis of the straw 310. The spoon step plane 319b is located in the plane of the longitudinal axis of the straw 310, and the spoon step end face 319c is located in the upper half of the straw 310 relative to the longitudinal axis of the straw 310. In addition, a transitional rounded angle is formed between the straw end face 319a and the spoon step plane 319b, and a transitional rounded angle is formed between the spoon step plane 319b and the spoon step end face 319c. In a specific implementation, the radius of the arc of the aforementioned transitional round angle is 3-5 mm, preferably 4 mm.

[0070] FIGS. 6A and 6B are respectively a schematic perspective view and a side view of a straw 410 according to a fifth embodiment in which the spoon portion 419 includes a straw end face 419a and a spoon bevel 419d which are connected to each other. The straw end face 419a is perpendicular to the longitudinal axis of the straw. Also, the straw end face 419a is located in the lower half of the straw relative to the longitudinal axis of the straw, and the spoon bevel 419d is located in the upper half of the straw relative to the longitudinal axis of the straw.

[0071] According to some embodiments of the invention, an interface side formed in the straw may extend in the direction of extension of the longitudinal axis of the straw, i.e., in parallel with respect to the longitudinal axis (no matter if the longitudinal axis of the straw is straight or curved), or may extend in a spiral shape in the direction of extension of the longitudinal axis of the straw. This depends on the rolling equipment and the rolling process. The interface side is joined by overlapping portions of the two sides of the coated paper strip in the longitudinal direction.

[0072] Turning now to FIGS. 7 and 8, another embodiment of the present invention is a two-holes disposable coated paper straw 500 which contains two tubular portions 501, 502. The two tubular portions 501, 502 are configured to be parallel to each other along their longitudinal directions, but separated from each other along the direction of a line connecting the centers of the two tubular portions 501, 502 in a cross-sectional view. The two tubular portions 501, 502 are connected by a bridge portion 503 and on the bridge portion the interface side is formed. It should be noted that the straw 500 is formed by rolling a single piece of coated paper strip (sheet) made of coated paper. The coated paper could have similar composition/structure as those described in previous embodiments. The interface edge 515 of the straw 500 is joined by overlapping portions (not shown) of two sides of the coated paper strip along the longitudinal

direction, and as a result the interface edge **515** is formed at the bridge portion **503**. The two tubular portions **501**, **502** are symmetrical about the interface edge **515**. The straw **500** having the two tubular portions **501**, **502** is particularly suitable for hot drinks and can also be used as a stirrer.

[0073] Another embodiment of the invention is shown in FIGS. 9-11, which is a disposable coated paper straw **600** that has a similar overall appearance as the straw shown in FIG. 1. What is different from the embodiments shown in FIGS. 1-6B, however, is that the straw **600** contains a first layer **604** and a second layer **605**, with each of the first layer **604** and second layer **605** containing a paper-base layer (not shown) and a coating layer (not shown). The coating layer in each one of the first layer **604** and a second layer **605** may have a material/composition similar to those described in previous embodiments. Within each one of the first layer **604** and a second layer **605**, the coating layer is formed on an exterior side of the paper-base layer. The straw **600** is, similar to previous embodiments, formed by rolling a coated paper strip (sheet) made of coated paper. However, the coated paper in this embodiment has the first layer **604** and the second layer **605** permanently fixed to each other after the coated paper is manufactured. The coating layers of the first layer **604** and the second layer **605** are configured on the two surfaces of the coated paper which means that for the straw **600**, the coating layers are configured respectively at the outer most position and the inner most position along a radial direction of the straw **600**. As a result, when the straw **600** is soaked in liquid (not shown), the external circumference and the internal circumference of the straw **600** are both covered by the coating layers which protect underlying paper-base layers from being softened.

[0074] FIGS. 9 and 11 also show that one end of the straw **600** is formed with angle cut **619** such that the paper-based layers of the first layer **604** and the second layer **605** are exposed. Since the end with the angle cut **619** is cut at the time of production, the angle cut **619** does not have protection from the coating, and the water will slowly invade the body of the straw **610** from the angle cut **619**. As a result, the end of the straw **610** having the angle cut **619** is softened after a period of use which is just beneficial to be blunt and soft after the discarded straw **610** is thrown into the water, so that it cannot harm creatures inside the water, and is beneficial to the protection of the natural ecological environment such as the ocean.

[0075] For the embodiment shown in FIGS. 9-11, The straw **610** has an improved rigidity compared to straws having only one paper-based layer, and in other words the ability to maintain the cylindrical cross-sectional shape of the straw **610** (as shown in FIG. 10a) is significantly higher than that of straws of the same thickness but with only a single paper-based layer. For example, a straw with double paper-based layers, where each paper-based layer having a weight of 160 g/m<sup>2</sup>, has a much stronger stiffness than a straw with a single paper-based layer which has a weight of 320 g/m<sup>2</sup>. As a result, straws with double paper-based layers are particularly useful for pearl milk tea straws (e.g. with a 10-12 mm diameter) and paper bag drink straws, because otherwise conventional straws are easily crushed in these applications. In addition, straws with double paper-based layers which have improved rigidity are also beneficial for the making of angle cut on an end of the straw, which is convenient for piercing the beverage sealing protective film. It is also beneficial to manufacture the end of the straw into

a spoon shape. Last but not the least, the straws with double paper-based layers can be made into a smaller diameter one (for example, with 5 mm diameter) and is thus easier to be bent, as can be used for paper-pack beverages.

[0076] Turning to FIGS. 12-13b, which shows a straw **710** according to the present invention attached to a paper pack **700** like a normal plastic straw. The paper pack **700** for example can be used to contain beverages like milk, juice or soy milk. The straw **710** could contain one paper-based layer similar to those shown in FIGS. 1-6B, or double paper-based layers similar to that shown in FIGS. 9-11. It should be noted that the straw **710** are bent during the packaging process of the paper pack **700** into two parts, i.e. a first part **710a** and a second part **710b**. Different to conventional plastic straws, the first part **710a** and the second part **710b** can form a sharp bent angle between each other, because of the material characteristic of paper. In comparison, for plastic straws they are very difficult to be bent to acute angle, even with accordion pleat formed on the straws. The straw **710** therefore could have a very small form factor when it is bent and attached to the paper pack **700**. Preferably, the straw **710** is placed in a small plastic bag (not shown) for sanitary reasons.

[0077] FIGS. 14a and 14b show another embodiment of the invention, which is a two-holes disposable coated paper straw **800** that contains two tubular portions **801**, **802**. The paper straw **800** has an overall appearance similar to the straw shown in FIG. 7. However, what is different as compared to the straw in FIGS. 7-8 is that the straw **800** shown in FIGS. 14a-14b has a curved bridge portion **803** between the two parallel tubular portions **801**, **802**. The interface edge **815** of the straw **800** is joined by overlapping portions (not shown) of two sides of the coated paper strip along the longitudinal direction, and as a result the interface edge **815** is formed at the bridge portion **803**. As best shown in FIG. 14b, the bridge portion **803** consists of three layers of coated paper, and all these layers are actually different portions of a same coated paper strip. In other words, different portions of the coated paper strip are sandwiched to form the bridge portion **803**. Two of the three layers of coated paper strip are respectively two end edges of the coated paper, and the remaining layer is roughly the central portion of the coated paper strip, due to the symmetrical shape of the straw **800** in the cross-sectional view. One should understand the coated paper strip in this embodiment and all other embodiments hereinafter could have any composition/structure as those described in previous embodiments, for example having a single paper-base layer with a single coating layer, a single paper-base layer with two coating layers, or double paper-base layers each having a coating layer.

[0078] FIGS. 15a and 15b show another embodiment of the invention, which is a single-hole disposable coated paper straw **900** that contains only one tubular portion **901**. The tubular portion **901** is positioned at the middle part of the straw **900** along a width direction of the straw **900**. For the sake of easy description, throughout the specification the width direction of a straw means the direction along which the straw has the largest dimension in the cross-section. In the straw **900**, there are further two flat portions **906**, **907** which are also two interface edges of the straw **900**. Note that as shown in FIG. 15b, the straw **900** is formed by combining two separate coated paper strips **908**, **909**. The upper coated paper strip **908** is partially rolled to form a part

of the tubular portion **901** around its central part, with regions at two side edges of the coated paper strip **908** kept flat. The lower coated paper strip **908** is not rolled and has a generally flat shape. Together, the rolled part of the upper coated paper strip **908** and a portion of the lower coated paper strip **909** form the tubular portion **901**. Other corresponding portions of the coated paper strips **908**, **909** form the flat portions **906** and **907** by gluing these portions together or otherwise fixed together using means known to skilled persons in the art.

[0079] Another embodiment of the invention shown in FIGS. **16a** and **16b** is a two-hole straw **1000**. The straw **1000** has a structure largely similar to that of the straw shown in FIGS. **15a** and **15b**, and is also made of two separate coated paper strips **1008**, **1009**. The only difference is that there are two tubular portions **1001**, **1002** in the straw **1000**, and correspondingly a bridge portion **1003** between the two separated tubular portions **1001**, **1002**. The lower coated paper strip **1009** is substantially flat, and the upper coated paper strip **1008** is partially rolled at two locations to form a part of the tubular portion **1001** and also a part of the tubular portion **1002**. The bridge portion **1003** has a structure similar to that of the two flat portions **1006**, **1007** that contain combined portions of the two coated paper strips **1008**, **1009**. Both tubular portions **1001**, **1002** are located on a same side of the lower coated paper strip **1009**.

[0080] Another embodiment of the invention shown in FIGS. **17a** and **17b** is a three-hole straw **1100**. The straw **1100** has a structure largely similar to that of the straw shown in FIGS. **16a** and **16b** and similar structures will not be described again herein for the sake of simplicity. The only difference is that there are now three tubular portions **1101**, **1102**, **1104**, and two bridge portions **1103**, **1105** therebetween. All three tubular portions **1101**, **1102**, **1104** and two bridge portions **1103**, **1105** are aligned on a line, and the three tubular portions **1101**, **1102**, **1104** are located on a same side of a lower coated paper strip **1109**.

[0081] Another embodiment of the invention shown in FIGS. **18a** and **18b** is a three-holes straw **1200**. The straw **1200** has a structure largely similar to that of the straw shown in FIGS. **17a** and **17b** and similar structures will not be described again herein for the sake of simplicity. The only difference is that instead of three tubular portions formed on a same side in the cross-sectional view of the straw, two tubular portions **1201**, **1204** are located on a same side of a lower coated paper strip **1209**, but the other tubular portion **1202** between the two tubular portions **1201**, **1204** is formed on an opposite side of the straw as compared to the two tubular portions **1201**, **1204** in the cross-sectional view. In fact, the tubular portion **1202** has its rolled part formed by the lower coated paper strip **1209**, where the tubular portions **1201**, **1204** have their rolled part formed by the upper coated paper strip **1208**. There is only one bridge portion **1203** in the straw **1200** in this embodiment, which is between tubular portions **1201**, **1204**.

[0082] Another embodiment of the invention shown in FIGS. **19a** and **19b** is a single-hole straw **1300**. The straw **1300** is formed by a single coated paper strip. The single hole is formed by a tubular portion **1301** resulted from a portion of the coated paper strip rolled. Besides the tubular portion **1301** in the cross-sectional view there is the flat portion **1306** which is formed by the combination of two side edges of the coated paper strip, using glues or other methods. In the cross-sectional view one can see that the

tubular portion **1301** is therefore off-center which means that the tubular portion **1301** is offset along a width direction from a hypothetical plane **1311** that is parallel to the longitudinal direction of the straw **1300**.

[0083] Another embodiment of the invention shown in FIGS. **20a** and **20b** is a three-holes straw **1400**. The straw **1400** has an overall appearance similar to that of the straw shown in FIGS. **15a** and **15b**. However, instead of being formed by two separate coated paper strips, the straw **1400** is formed by a single piece of coated paper strip. The only tubular portion **1401** is located at the center of the straw **1400** along its width direction, and on the two sides of the tubular portion **1401** there are two flat portions **1406**, **1407** where each one of the two flat portions **1406**, **1407** is formed by a portion of the coated paper strip folded 180 degrees. The tubular portion **1401** is formed by a rolled part of the coated paper strip, and two side edges of the coated paper strip which are combined using glues or other methods. In other words, while the flat side of the tubular portion of the straw in FIGS. **15a** and **15b** has only a single layer of coated paper, the flat side of the tubular portion **1401** has two layers of coated paper. The two side edges of the coated paper strip also become the interface edge **1415**.

[0084] Turning to FIGS. **21a** and **21b**, in which another type of single-hole straw **1500** according to a further embodiment of the invention is shown. The straw **1500** is generally similar to the straw shown in FIGS. **19a** and **19b**, and similar structures will not be described again herein for the sake of simplicity. The only difference is the flat portion **1506** in the straw **1500** has a hypothetical extension line (not shown) along the width direction that would pass through the center (not shown) of the tubular portion **1501** in the cross-sectional view, whereas in the straw in FIGS. **19a** and **19b** the flat portion is substantially tangential to the tubular portion. This is mainly because in the straw **1500** there are bent portions **1520** of the coated paper strip at both ends of the rolled part forming the tubular portion **1501**.

[0085] Another embodiment of the invention is shown in FIGS. **22a-22b**. The straw **1600** in this embodiment contains two tubular portions **1601**, **1602**. What is different in the straw **1600** as compared to those described in previously described embodiments is that the straw **1600** is formed by three coated paper strips **1608**, **1609** and **1610** configured in a substantially sandwiched manner. The coated paper strip **1609** is located between coated paper strips **1608** and **1610**, and the coated paper strip **1609** is substantially flat. On the other hand, each one of the coated paper strips **1608** and **1610** is partially rolled and forms the respective tubular portion **1601** and **1602** with the middle paper strip **1609**. The two tubular portions **1601**, **1602** are symmetrical about the middle paper strip **1609**. On two sides of the tubular portion **1601** or **1602**, there are two flat portions **1606** and **1607** each of which formed by all three coated paper strips **1608**, **1609** and **1610**. The straw **1600** also has a symmetrical shape about a hypothetical line (not shown) connecting the centers of the two tubular portions **1601** and **1602**.

[0086] The exemplary embodiments of the present invention are thus fully described. Although the description referred to particular embodiments, it will be clear to one skilled in the art that the present invention may be practiced with variation of these specific details. Hence this invention should not be construed as limited to the embodiments set forth herein.

**[0087]** While the invention has been illustrated and described in detail in the drawings and foregoing description, the same is to be considered as illustrative and not restrictive in character, it being understood that only exemplary embodiments have been shown and described and do not limit the scope of the invention in any manner. It can be appreciated that any of the features described herein may be used with any embodiment. The illustrative embodiments are not exclusive of each other or of other embodiments not recited herein. Accordingly, the invention also provides embodiments that comprise combinations of one or more of the illustrative embodiments described above. Modifications and variations of the invention as herein set forth can be made without departing from the spirit and scope thereof, and, therefore, only such limitations should be imposed as are indicated by the appended claims.

**[0088]** It is to be understood that, if any prior art publication is referred to herein, such reference does not constitute an admission that the publication forms a part of the common general knowledge in the art, in Australia or any other country.

**[0089]** Having introduced various embodiments of the invention above, in summary the technical effects of the embodiments of the present invention include, but not limited to the followings:

**[0090]** 1. The straws according to embodiments of the present invention can be produced with an appearance of a general conventional cylindrical plastic straw, but with a material replaced by a biodegradable single paper-base-layer coated paper or double-base-layer coated paper as the basic material.

**[0091]** 2. Since each straw is made of a piece of paper by crimping, different patterns can be printed with food-grade ink before the crimp molding.

**[0092]** 3. A cylindrical structure maintains the best geometric stability during use, and also facilitates the user drinking beverages containing large particles such as pearl milk tea.

**[0093]** 4. Biodegradable coated paper is used as the material. After the straw is discarded, in addition to being able to be recycled, the glue film (coating layer) can also be biodegraded together with the paper in case the straw is not recycled. The environmental pollution can be greatly reduced.

**[0094]** 5. Moreover, the coated paper is waterproof for a certain period of time, so that the straw can maintain its shape within a few hours without obvious softening, which effectively maintains the texture of use. However, after several hours of soaking, the two ends of the straw as well as other cutting portions, because of the lack of glue film for protection, will become soft and blunt, which is beneficial to the degradation of materials in the natural environment, and is also particularly beneficial to reduce the damage of the straw to aquatic organisms, thus contributing to ecological protection.

**[0095]** There could be many variations to the invention. For example, FIGS. 9-11 show a straw with two layers, each containing a paper-based layer. However, it is possible for the variations of the invention to have more than two layers with each such layer containing a paper-based layer. It could be expected that more layers of the coated paper forming the straw would mean a larger stiffness at the cost of increased thickness.

**[0096]** In some of the embodiments introduced above, an end of the straw may have a shape of angle cut/spoon. However, those skilled in the art would realize that the end of both ends of a straw may be cut in any other shape according to practical applications.

**[0097]** According to a variation of the invention, the coated paper may contain a printed pattern layer (not shown) which can be located at an exterior surface of the coating layer. As an alternative variation, the printed pattern layer may also be located between the coating layer and the paper-based layer.

**[0098]** Those skilled in the art would realize that the length of the straw can be cut according to different requirements, and in any event as mentioned above it can also be cut into an angle cut shape or a spoon shape to meet different requirements.

**[0099]** According to variations of the invention, the interface side of two edges of a rolled coated paper may extend in the direction of extension of the longitudinal axis of the straw, i.e., in parallel with respect to the longitudinal axis (no matter if the longitudinal axis of the straw is straight or curved), or may extend in a spiral shape in the direction of extension of the longitudinal axis of the straw. This depends on the rolling equipment and the rolling process.

**[0100]** For example, the width of the overlapping portion can be set to 2-7 mm, preferably 3-5 mm. After determining the width of the overlapping portion of the coated paper strip according to the diameter of the straw, the total width of the coated paper strip can be determined. Take a straw with a diameter of 7 mm and a length of 200 mm as an example, the width of the coated strip can be set to be about 26 mm.

**[0101]** As an example, the coated papers for straws according to embodiments of the invention can be manufactured by 1) melting PE/PP colloidal particles at a high temperature and 2) coating the colloidal material by a paper PE coating machine) on the surface of the paper. Such a process is also known as lamination and the coating machine is also referred to as a laminating machine.

**[0102]** Alternatively, the coating layer can be implemented on the paper-layer in the straws using different techniques. For example, the coating layer may be printed on the paper-base layer using flexographic printing. The material of the coating layer can be for example CH-Polymer® CHP BAR 3600 material, with which the suggested amount of the material to be printed is 9-20 grams each square meter, followed by a drying process under the temperature of 70-80 Celsius degrees. Those skilled in the art should understand that other types of printing methods, and/or other types of coating materials may be used as well for the purpose of making the straws in the present invention.

**[0103]** In fact, all types of degradable material which is water-resistant and which complies with relevant food contact compliance can be used for the purpose of the coating layer on the straws in the present invention. The coating layer can be implemented on the paper-base layer using various techniques including but not limited to the ones introduced above.

What is claimed is:

1. A disposable coated paper straw formed by rolling one or more sheets, the straw characterized in that:

each one of the one or more sheets is a coated paper strip made of a coated paper which comprises a first paper-

- base layer and a first coating layer; the first coating layer located at least at an exterior side of the first paper-base layer;
- the straw further comprising an interface edge which is joined by overlapping portions of the one or more sheets in the longitudinal direction;
- wherein the first coating layer is made from degradable resin.
2. The disposable coated paper straw of claim 1, characterized in that:
- the coated paper further comprises a second coating layer on an interior side of the first paper-base layer.
3. The disposable coated paper straw of claim 1, characterized in that:
- the coated paper further comprises a second paper-base layer.
4. The disposable coated paper straw of claim 3, characterized in that:
- the coated paper further comprises a second coating layer at an exterior side of the second paper-base layer.
5. The disposable coated paper straw of claim 1, which is characterized in that:
- the first coating layer is made of a biodegradable coated resin.
6. The disposable coated paper straw of claim 1, which is characterized in that: the end surface of the straw is a cut surface, and the first paper-base layer is exposed on the end surface.
7. The disposable coated paper straw of claim 1, which is characterized in that: the coated paper comprises a printed pattern layer which is located on an exterior surface of the first coating layer or between the first coating layer and the first paper-based layer.
8. The disposable coated paper straw of claim 1, which is characterized in that: the interface edge extends along a longitudinal axis of the straw.
9. The disposable coated paper straw of claim 1, which is characterized in that: one end of the straw forms an angular portion or a spoon portion.
10. The disposable coated paper straw according to claim 9, which is characterized in that: the spoon portion comprises one of the following:

a straw end face and a spoon bevel connected to each other; or

a straw end face, a spoon step plane and a spoon step end face connected to each other.

11. The disposable coated paper straw of claim 1, wherein the straw is formed by rolling a single said sheet; the straw further comprising two tubular portions.

12. The disposable coated paper straw of claim 11, wherein the two tubular portions are separated from each other along a direction perpendicular to the longitudinal direction of the straw, but are connected by the interface edge.

13. The disposable coated paper straw of claim 1, wherein the straw is formed by combining two said sheets which are otherwise separate from each other.

14. The disposable coated paper straw of claim 13, wherein one of the two sheets is rolled to form an arc shape, and the other one of the two sheets is substantially flat.

15. The disposable coated paper straw of claim 13, wherein both of the two sheets are rolled to form an arc shape respectively; the two arc shapes together forming a tubular portion of the straw.

16. The disposable coated paper straw of claim 13, wherein each of the two sheets has a first portion that is rolled to form an arc shape, and a second portion which is substantially flat; the first portion of one of the two sheets corresponds to a second portion of the other one of the two sheets to form a tubular portion.

17. The disposable coated paper straw of claim 1, wherein the straw is formed by rolling a single said sheet; the straw further comprises a tubular portion and a flat portion; the tubular portion located off-center along the direction of a line connecting the tubular portion and the flat portion.

18. The disposable coated paper straw of claim 1, wherein the first coating layer is implemented on the exterior side of the first paper-base layer by printing.

19. The disposable coated paper straw of claim 18, wherein the first coating layer is implemented on the exterior side of the first paper-base layer by flexographic printing.

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