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(54) **SYSTEM AND METHOD OF IN-LINE SHAPING, FILLING AND ENCLOSING TO FORM PRODUCT PACKAGING**

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(57) **ABSTRACT**

Disclosed in the present invention is a system for forming a product package by online forming, filling and sealing, the system comprising: a sterilization apparatus, a forming apparatus, a conveyor belt, a filling apparatus and a first closing apparatus. Also disclosed is a method for forming a product package by online forming, filling and sealing. The method of the present invention integrates production and filling of large-volume packages, greatly shortening the supply chain and increasing production efficiency.

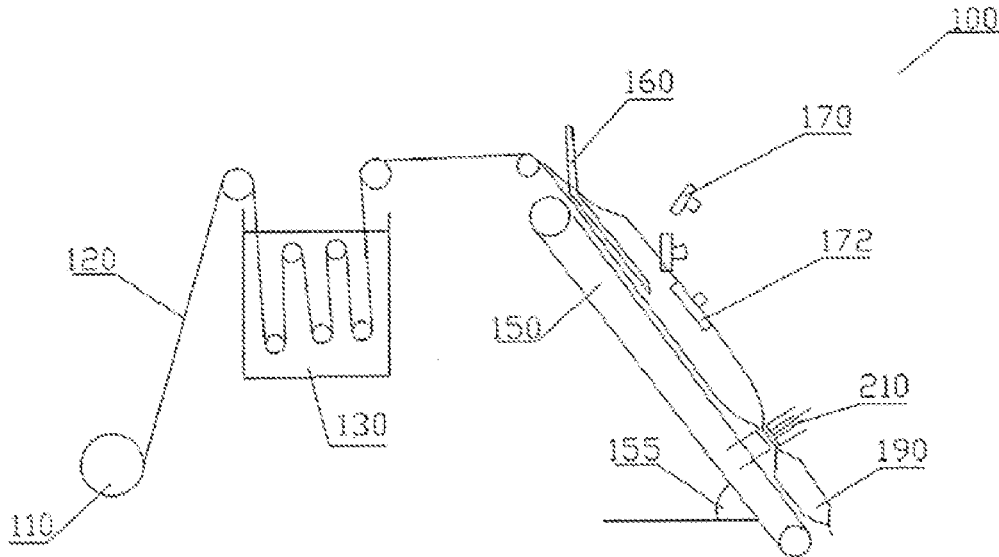
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(2) Date: **Nov. 15, 2017**



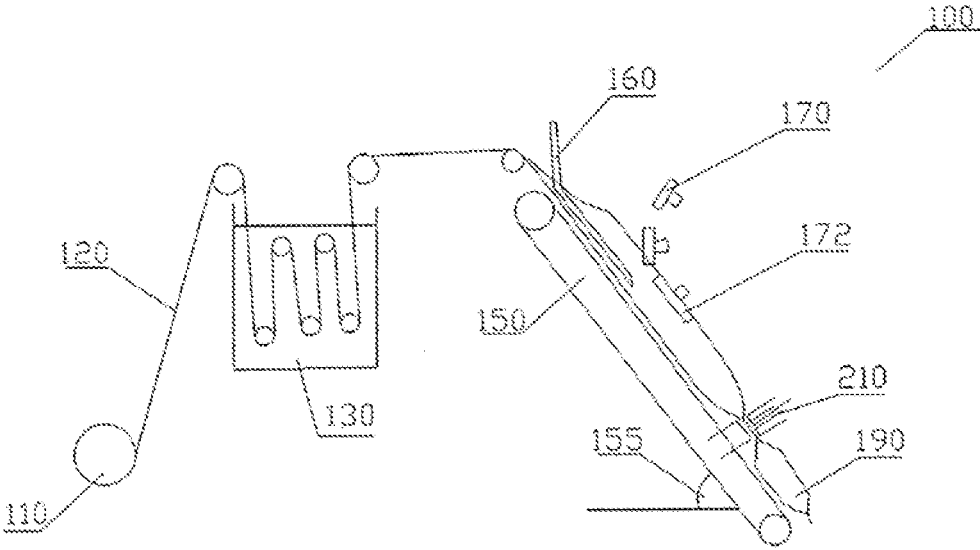


FIG. 1

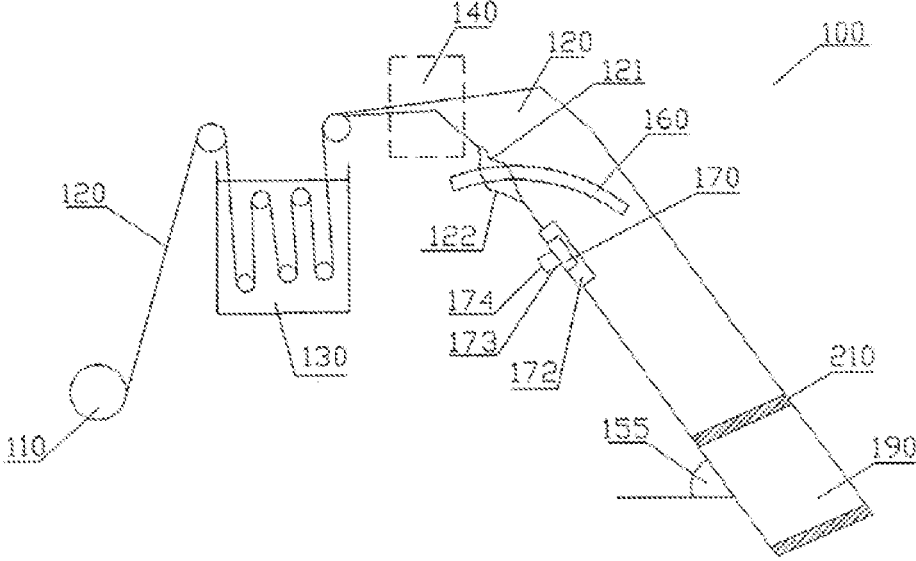


FIG. 2

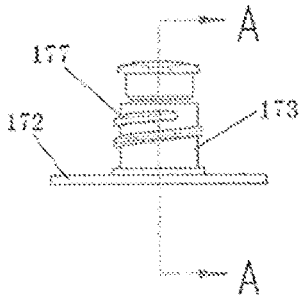


FIG. 3A

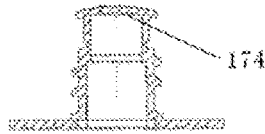


FIG. 3B

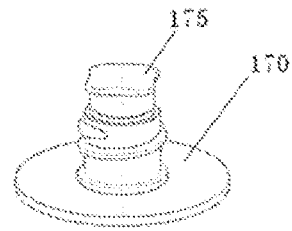


FIG. 3C

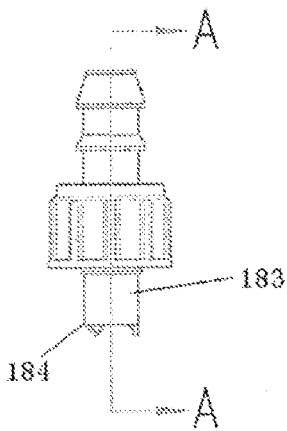


FIG. 4A

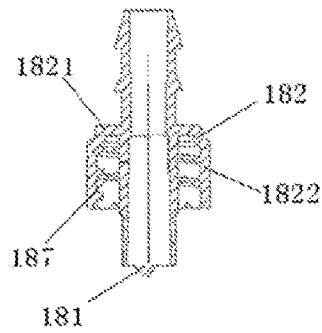


FIG. 4B

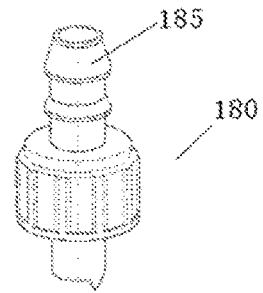


FIG. 4C

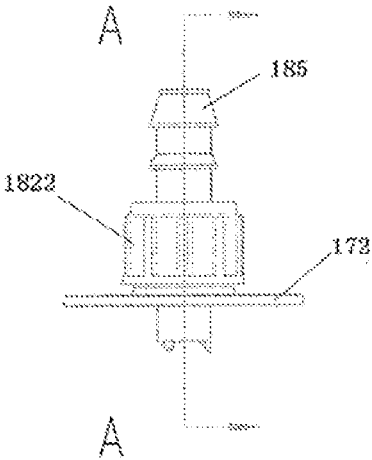


FIG. 5A

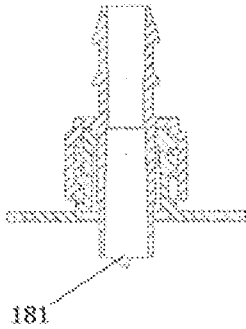


FIG. 5B

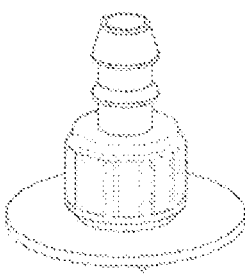


FIG. 5C

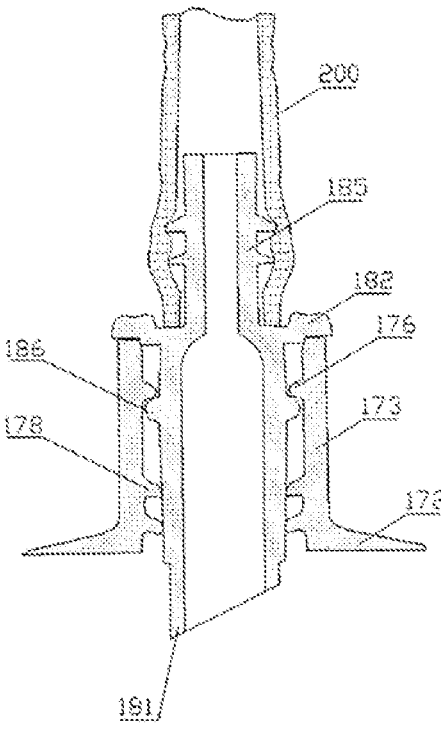


FIG. 6

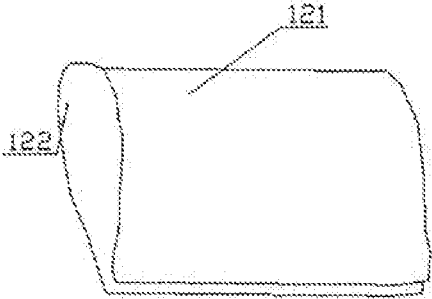


FIG. 7A

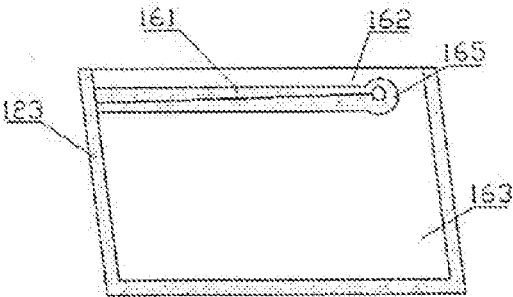


FIG. 7B

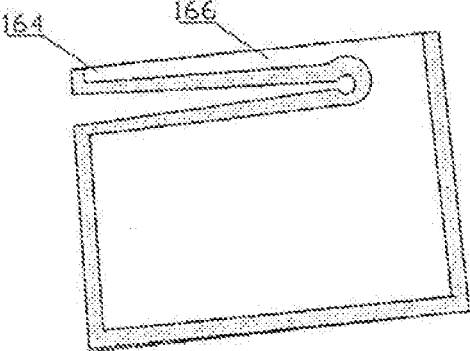


FIG. 7C

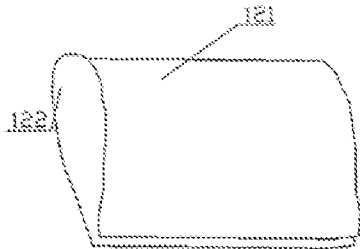


FIG. 8A

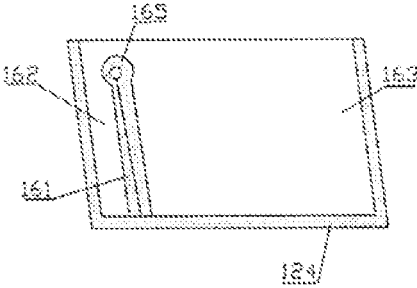


FIG. 8B

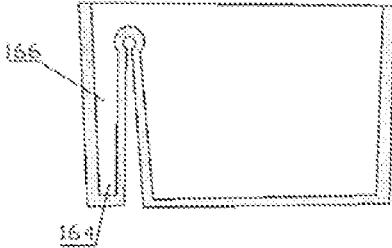


FIG. 8C

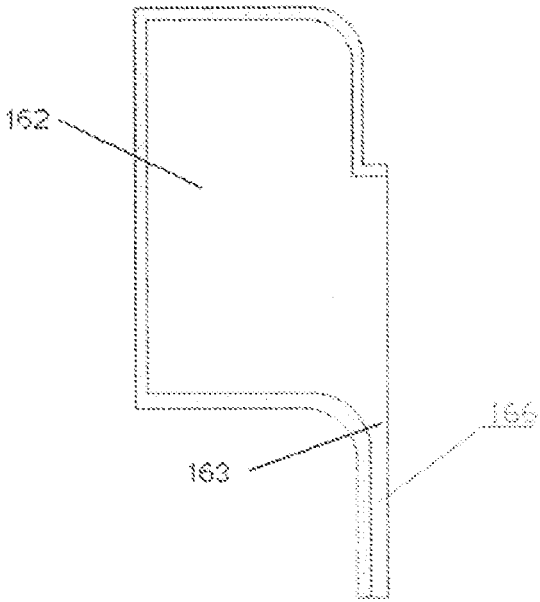


FIG. 9

**SYSTEM AND METHOD OF IN-LINE  
SHAPING, FILLING AND ENCLOSING TO  
FORM PRODUCT PACKAGING**

TECHNICAL FIELD

[0001] The present invention relates generally to the field of package manufacture. In particular, it relates to a system and method for forming a product package by online forming, filling and sealing.

BACKGROUND ART

[0002] Many consumable products, such as fruit juice, wine, tomato sauce, mixed beverage syrups, concentrates or similar substances are stored in packages made of flexible thin sheet material (e.g. a carton with a film and aluminium layer). Typically, a package for such a consumable product has a flexible shape. There are also certain packages which have a multi-ridged shape (e.g. a carton with a roof). Packages for large volumes are typically Bag In Box packages (abbreviated as BIB packages), which can be filled with ready-to-drink beverages or fluid concentrates.

[0003] Existing BIB packages are made of laminated film, with two interfaces; one interface is used for filling, the other interface is used for dispensing. The production flow thereof is as follows: first of all, a premade bag made from laminated film, lids, interfaces and a tube is purchased from a premade bag supplier, wherein the two interfaces are disposed on the premade bag in such a way as to be in communication with the interior of the premade bag, and the lids are used to cover the interfaces; secondly, the premade bag is packed, and transported to an irradiation plant to undergo sterilized by irradiation; next, the sterilized premade bag is transported to a filling plant under sterile storage conditions, and filled with product through the filling interface on a filling production line; finally, the premade bag is sealed and packed, then put into a box, to form a finished BIB package. Throughout the process, in order to ensure product quality, the logistical process must be kept as sterile as possible; consequently, the BIB package production cost is very high and product quality is very easily impaired. Furthermore, filling speed has an impact, so the interface used for filling must be sufficiently large.

[0004] In existing flexible package production, the filling equipment used, including bag forming apparatus, filling apparatus and sealing apparatus, is all vertically distributed. Such a design has the result that the weight of the packed substance is almost completely borne by tension in the packaging material. In order to avoid splitting of the packaging material due to excessively high tension, all packages filled in this manner are not of large volume, but of small volume. However, since most small-volume packages are single-use, there is no need to take into account the problems of dispensing and long-term use, and existing filling equipment is capable of being used to produce small-volume packages. The production of large-volume packages can only be accomplished through the use of premade bags as described above, but this is a very complex process, with a long supply chain and high cost, and additional quality control is needed to ensure that package requirements are met.

[0005] In view of the above shortcomings, there is a demand for a system and method capable of online forming, filling and sealing.

CONTENT OF THE INVENTION

[0006] The present invention provides a system for forming a product package by online forming, filling and sealing, the system comprising:

[0007] a sterilization apparatus, for sterilizing a packaging material;

[0008] a forming apparatus, for forming the packaging material to have a space for holding a product to be dispensed;

[0009] a conveyor belt, for conveying the packaging material;

[0010] a filling apparatus, for filling the space for holding the product to be dispensed in the packaging material with the product to be dispensed; and

[0011] a first closing apparatus, for completely closing the packaging material filled with the product, to obtain the product package.

[0012] The system of the present invention may be used to form a large-volume product package.

[0013] Preferably, the conveyor belt forms an angle with a horizontal plane; or the system further comprises a bearing apparatus, for bearing the packaging material. The angle of inclination of the conveyor belt with respect to the horizontal plane may be adjusted, to suit different volumes and different product specifications. The bearing apparatus may be any apparatus capable of bearing, such as a mechanical hand. It is also possible to use an inclined conveyor belt in coordination with a bearing apparatus; the inclined conveyor belt conveys and partially supports the packaging material, the bearing apparatus provides additional partial support to the packaging material during filling with the product to be dispensed. The system of the present invention first uses the sterilization apparatus to sterilize the packaging material, then makes the packaging material into a shape having a space for holding the product to be dispensed, and finally uses the filling apparatus to fill the space with product, and at the same time, to avoid having the weight of the packed substance completely borne by tension in the packaging material, is provided with the conveyor belt and/or bearing apparatus to provide a certain amount of support to the packed substance, and can thus be used to produce large-volume packages. In this text, large-volume means a volume of 800 mL or more, preferably a volume of 1 L or more, more preferably a volume of 2 L or more, and generally 3 L-8 L. The system of the present invention integrates production and filling of large-volume packages, greatly shortening the supply chain and increasing production efficiency.

[0014] The sterilization apparatus may be an existing sterilization apparatus, including sterilization by irradiation, hydrogen peroxide sterilization, etc. For instance, when hydrogen peroxide is used, the packaging material is first washed by immersion in hydrogen peroxide ( $H_2O_2$ ), then rinsed in water, and finally dried in sterile hot air, to obtain sterilized packaging material. The packaging material can be transported to a hydrogen peroxide sterilization tank by means of a packaging material mounting and conveying apparatus, e.g. a feeding roller.

[0015] The packaging material is generally a coiled sheet material. Preferably, the forming apparatus further comprises a folding unit and a longitudinal closing unit. The folding unit is used for folding the packaging material, to form a first part and a second part facing each other; the longitudinal closing unit is used for longitudinally closing

edges of the folded packaging material, to form a tubular shape. The interior of the tubular shape is then the internal space for holding the product to be dispensed.

**[0016]** The filling apparatus comprises a filling tube. The filling tube is inserted into the space for holding the product to be dispensed in the packaging material through a part of the packaging material that has not yet been closed, and the space is filled with product to be dispensed, e.g. liquids such as beverages or beverage concentrates, or liquids containing solids. Therefore, when the system according to the present invention is used, there is no need to provide an additional interface for filling on a packaging bag.

**[0017]** In one embodiment of the present invention, it may be that when the packaging material is on the bearing apparatus, the packaging material is folded and closed longitudinally, and at the same time the filling tube is used for filling with the product to be dispensed. As an alternative, it may be that the packaging material is first folded and closed longitudinally, then received on the bearing apparatus and filled with the product to be dispensed using the filling apparatus.

**[0018]** A dividing apparatus may be used to separate a completely closed product package from the following product package, to form an independent product package.

**[0019]** In some embodiments, the system provides a sterile environment for each process after the packaging material has been sterilized, until the packaging material is completely closed. For instance, once the packaging material has been formed to have the space for holding the product to be dispensed, the interior of the space is filled with sterile hot air, which is used to resist air from the outside, and thereby ensure that the packaging material interior and the product are sterile.

**[0020]** In other embodiments, in the system, the filling apparatus uses a hot filling process. In this case, residual heat of the product is used to sterilize parts of the inner wall of the packaging material which might contact the product.

**[0021]** In some embodiments, the system also comprises an interface attaching apparatus, for attaching a dispensing interface to an outer surface of the packaging material; the dispensing interface comprises an interface base part, an interface connection mouth and an interface neck part located therebetween. Since the dispensing interface is attached to the outer surface of the packaging material, and is not in communication with the interior of the package, it will not damage the sealing of the packaging material, and thus will not cause any contamination of the product, and the attachment of the dispensing interface to the outside of the packaging material enables online forming and filling to obtain a product package having a dispensing interface. The interface base part of the dispensing interface is attached to the outer surface of the packaging material; it may be attached to a first part of the packaging material or a second part of the packaging material. Soldering, adhesive bonding or a similar method may for example be used to attach the dispensing interface to the packaging material. The dispensing interface may be attached to the packaging material in any step after sterilization of the packaging material, and may be attached to the packaging material after separating a closed package from the following package to form an independent package, but the dispensing interface is preferably attached to the packaging material before a closed product package is separated from the following product package to form an independent product package.

**[0022]** In some embodiments, the interface attaching apparatus may attach the dispensing interface to an outer surface of packaging material which has not been formed to have a space for holding a product to be dispensed. In such a situation, since microbes carried on the dispensing interface might contact the product and thereby impair product quality, in this case the system also comprises an interface sterilization apparatus, for sterilizing the dispensing interface, to ensure that the dispensing interface does not bring microbial contamination into a sterile space.

**[0023]** In other embodiments, the interface attaching apparatus may attach the dispensing interface to an outer surface of packaging material which has a space for holding a product to be dispensed. In this case, the dispensing interface need not be rigorously sterilized by the interface sterilization apparatus. This is because the dispensing interface will not contact the product, and the quantity of bacteria contained in the part which contacts the outer surface of the packaging material is very small; since the bacteria will only contact nutritional substance (i.e. the product in the product package) after product dispensing begins, and the period of time between the start of product dispensing and completion of dispensing is generally short, the effect of bacteria on product quality is very small, and can be neglected. Compared to the previous case, where the dispensing interface is attached to the outer surface of packaging material which has not been formed to have a space for holding a product to be dispensed, the requirements on process conditions are significantly reduced, which is more suitable for industrial production.

**[0024]** In other embodiments, the first closing apparatus is further used for dividing a package internal space into a first space and a tubular space in communication with each other.

**[0025]** In other embodiments, the system also comprises a second closing apparatus, for dividing a package internal space into a first space and a tubular space in communication with each other.

**[0026]** Preferably, the package internal space is made to include a first space and a tubular space in communication with each other by partially bonding together opposing first and second parts of the packaging material, to form a long, narrow bonded part which divides the package internal space into a first space and a tubular space which can be used as a dispensing port, the first space and the tubular space being in communication with each other.

**[0027]** Preferably, the package internal space is made to include a first space and a tubular space in communication with each other by forming the package internal space to include a first space and a tubular space which extends outward from the first space and can be used as a dispensing port. The product package preferably has an external shape suited to close arrangement.

**[0028]** Once there is a tubular space inside the package, there is no need to mount a dispensing interface on the packaging material; a tubular structure of the tubular space need only be cut open to serve as a dispensing port in order to dispense the product. Moreover, compared with a product package to which a dispensing structure of a dispensing interface has been attached, the product package having a tubular space dispensing structure according to the present invention does not require the introduction of other structural components and materials, because it is formed completely by the packaging material itself, therefore material costs are reduced. The amount of packaging material need

only be increased by 5-8% to ensure that the volume of the package remains unchanged. Since there is no need for an additional dispensing interface and an interface sterilization step, the process flow and process costs are simplified. Moreover, the product only contacts the packaging material when being dispensed, further reducing the risk of contamination.

**[0029]** The present invention also provides a method for forming a product package by online forming, filling and sealing, comprising the following steps:

**[0030]** sterilizing a packaging material;

**[0031]** forming the sterilized packaging material to have a space for holding a product to be dispensed;

**[0032]** filling the space for holding the product to be dispensed in the packaging material with the product to be dispensed; and

**[0033]** completely closing the packaging material filled with the product, to obtain the product package;

**[0034]** wherein support is provided for the packaging material at least in the filling step.

**[0035]** In the method of the present invention, first of all the packaging material is sterilized, then the packaging material is made into a shape having a space for holding a product to be dispensed, and finally the space is filled with the product to be dispensed. At the same time, to prevent the weight of the packed substance from being completely borne by tension in the packaging material, the packaging material is provided with a certain amount of support, therefore the method may be used to produce large-volume packages. The method of the present invention integrates production and filling of large-volume packages, significantly shortening the supply chain and increasing production efficiency.

**[0036]** The sterilization may employ sterilization methods including sterilization by irradiation and hydrogen peroxide sterilization.

**[0037]** The provision of support for the packaging material may be accomplished using e.g. an inclined conveyor belt, a bearing apparatus, a vertical conveyor belt in coordination with a bearing apparatus, etc.

**[0038]** The packaging material is generally a coiled sheet material. The forming comprises: folding the packaging material, to form a first part and a second part facing each other; longitudinally closing edges of the folded packaging material, to form a tubular shape. The interior of the tubular shape is then the space for holding the product to be dispensed.

**[0039]** The filling consists of inserting a filling tube into the space for holding the product to be dispensed in the packaging material through a part of the packaging material which has not yet been closed longitudinally, filling the space with the product to be dispensed, such as beverage or beverage concentrate liquid, or liquid containing solids. Therefore, with the present method, there is no longer a need to specially provide an interface for filling on the packaging material.

**[0040]** In some embodiments, in the method, each process step after the packaging material has been sterilized is carried out in a sterile environment until the packaging material is completely closed to obtain the product package. For example, after the packaging material has been formed to have the space for holding the product to be dispensed, the interior of the packaging space is filled with sterile hot air, for resisting air from outside, thereby ensuring that the packaging material interior and the product are sterile.

**[0041]** In some embodiments, in the method, the filling employs a hot filling process. In this case, residual heat in the product is utilized to sterilize parts of the inner wall of the packaging material which might contact the product.

**[0042]** In some embodiments, the method also comprises attaching a dispensing interface to an outer surface of the packaging material; the dispensing interface comprises an interface base part, an interface connection mouth and an interface neck part located therebetween. Since the dispensing interface is attached to the outer surface of the packaging material, it will not damage the sealing of the packaging material, and thus will not cause any contamination of the product, and the attachment of the dispensing interface to the outside of the packaging material enables online forming and filling to obtain a package having a dispensing interface. The interface base part of the dispensing interface is attached to the packaging material; it may be attached to a first part of the packaging material or a second part of the packaging material. Soldering, adhesive bonding or a similar method may for example be used to attach the dispensing interface to the packaging material. The dispensing interface may be attached to the packaging material in any step after sterilization of the packaging material, and may be attached to the packaging material after separating a closed package from the following package to form an independent package, but the dispensing interface is preferably attached to the packaging material before a closed product package is separated from the following product package to form an independent product package.

**[0043]** Preferably, the method also comprises sterilizing the dispensing interface, to ensure that the dispensing interface does not carry microbial contamination into a sterile space.

**[0044]** In other embodiments, the method further comprises dividing a package internal space into a first space and a tubular space in communication with each other.

**[0045]** Preferably, by partially bonding together opposing first and second parts of the packaging material, the method forms a long, narrow bonded part such that the long, narrow bonded part divides the package internal space into a first space and a tubular space which can be used as a dispensing port, the first space and the tubular space being in communication with each other.

**[0046]** Preferably, the method further comprises forming the package internal space to include a first space and a tubular space in communication with each other by forming the package internal space to include a first space and a tubular space which extends outward from the first space and can be used as a dispensing port. The product package preferably has an external shape suited to close arrangement.

**[0047]** Once there is a tubular space inside the package, there is no need to mount a dispensing interface on the packaging material; a tubular structure of the tubular space need only be cut open to serve as a dispensing port in order to dispense the product. Moreover, compared with a product package to which a dispensing structure of a dispensing interface has been attached, the product package having a tubular space dispensing structure according to the present invention does not require the introduction of other structural components and materials, because it is formed completely by the packaging material itself, therefore material costs are reduced. The amount of packaging material need only be increased by 5-8% to ensure that the volume of the package remains unchanged. Since there is no need for an

additional dispensing interface and an interface sterilization step, the process flow and process costs are simplified. Moreover, the product only contacts the packaging material when being dispensed, further reducing the risk of contamination.

**[0048]** The present invention also provides a large-volume packaging bag having a dispensing interface, comprising: a packaging bag, and a dispensing interface attached to an outer surface of the packaging bag, the dispensing interface comprising an interface base part in contact with a packaging material, an interface connection mouth and an interface neck part located therebetween.

**[0049]** Preferably, a first sealing structure is provided at the interface connection mouth of the dispensing interface. The first sealing structure is used to ensure that before the product is dispensed, the interior of the dispensing interface is clean, and will not be contaminated.

**[0050]** Preferably, a pull-open structure is provided on the first sealing structure, for separating the first sealing structure from the interface connection mouth at least partially. The pull-open structure may be a pull-ring, a T-shaped pull-open structure, etc.

**[0051]** Preferably, the packaging bag also comprises a cap having a pointed structure; the cap comprises a cap base part, a cap head part having a pointed structure, and a cap neck part located therebetween; when the cap is fitted to the dispensing interface, the pointed structure is used to pierce the packaging material. During use, first of all the first sealing structure is taken out (e.g. pulled out), then the cap head part is screwed or pushed into the dispensing interface through the interface connection mouth, the pointed structure on the cap head part will then pierce the packaging material, the cap is removed and then the product in the package can be dispensed.

**[0052]** Preferably, the packaging bag also comprises a cap having a pointed structure; the cap comprises a cap base part, a cap head part having a pointed structure, and a cap neck part located therebetween; when the cap is fitted to the dispensing interface, the pointed structure is used to pierce the packaging material; the cap neck part is a hollow structure; an opening is provided on the cap base part, the opening being in communication with the hollow structure; an additional cap is provided on the cap base part, for closing the opening. During use, first of all the first sealing structure is taken out (e.g. pulled out), then the cap head part is screwed or pushed into the dispensing interface through the interface connection mouth, the pointed structure on the cap head part will then pierce the packaging material, and then the product in the package can be dispensed. Such a cap having a hollow structure need not be taken off after piercing the packaging material; the product can be dispensed immediately.

**[0053]** Preferably, the packaging bag also comprises a cap having a pointed structure; the cap comprises a cap base part, a cap head part having a pointed structure, and a cap neck part located therebetween; when the cap is fitted to the dispensing interface, the pointed structure is used to pierce the packaging material; the cap neck part is a hollow structure; an opening is provided on the cap base part, the opening being in communication with the hollow structure; a connecting tube is provided on that side of the cap base part which is remote from the cap head part, the opening being in communication with the connecting tube. During use, first of all the first sealing structure is taken out (e.g.

pulled out), then the cap head part is screwed or pushed into the dispensing interface through the interface connection mouth, the pointed structure on the cap head part will then pierce the packaging material, and then the product in the package can be dispensed. A product dispensing tube may be mounted on the connecting tube. Such a cap, which includes not only a hollow structure but also a connecting tube, need not be taken off after piercing the packaging material, and can be directly connected to the product dispensing tube, to make dispensing of the product more convenient. The cap and the product dispensing tube can be assembled in advance, and packed together in a clean sealed packaging bag and included as an accessory. The other end of the product dispensing tube is preferably sealed. This can ensure that when the cap is connected to the product package, the entire internal product path is still in a clean, closed space. During use, the product package is placed on a product dispensing device and the product dispensing tube is fitted into a dispensing valve, then the sealed end of the product dispensing tube is cut off, and the product is dispensed for sale under the control of the dispensing valve.

**[0054]** The cap can be attached to a product package which has been completely closed and has a dispensing interface, to be sold and transported etc. as a single unit together with the product package, but may also be connected with the dispensing interface in a fitted manner, and may also be packaged independently as a unit to be sold and transported etc. Preferably, the cap is packaged independently, and thus can be used repeatedly.

**[0055]** In one embodiment where the cap is connected with the dispensing interface in a fitted manner, a layer of annular material which can be taken off is provided between the dispensing interface and the cap. When the cap is not being used, the pointed structure is separated from the packaging material by a certain distance due to the presence of the annular material; when the cap is being used, the annular material is taken off, the cap is rotated downwards or pressed down, and the pointed structure contacts the packaging material, piercing the packaging material.

**[0056]** More preferably, the cap and dispensing interface are provided with matching second sealing structures, for ensuring that when the cap is fitted to the dispensing interface, a seal has already been formed in the dispensing interface before the packaging material is pierced by the pointed structure of the cap head part, so the product can only flow out of the interior of the packaging material directly through the cap neck part. The second sealing structures produce an interference fit between the interface neck part and the cap neck part, thereby avoiding leakage of product to the outside of the sealed region and consequent contamination on the one hand, and keeping the region through which the product flows sterile on the other hand, further guaranteeing product quality. More preferably, the second sealing structure is a projection disposed on an inner wall of the interface neck part or a projection on an outer wall of the cap neck part. Most preferably, the second sealing structure is a sealing ring disposed on an inner wall of the interface neck part or on an outer wall of the cap neck part.

**[0057]** The fitting between the dispensing interface and the cap may be such that a first screw-thread is provided on an inner wall of the interface neck part, a second screw-thread is provided on an outer wall of the cap neck part, and the first screw-thread matches the second screw-thread; it may also

be such that the cap base part comprises a cap base part bottom and a cap base part sidewall; a third screw-thread is provided on an outer wall of the interface neck part, a fourth screw-thread is provided on an inner wall of the cap base part sidewall, and the third screw-thread matches the fourth screw-thread.

**[0058]** The present invention also provides a large-volume packaging bag having a tubular space, an internal space of the packaging bag comprising a first space and a tubular space in communication with each other.

**[0059]** Preferably, the packaging bag comprises a long, narrow bonded part which divides the internal space of the packaging bag into a first space and a tubular space which can be used as a dispensing port, the first space and the tubular space being in communication with each other.

**[0060]** Preferably, the internal space of the packaging bag comprises a first space and a tubular space which extends outward from the first space and can be used as a dispensing port. More preferably, the packaging bag has an external shape suited to close arrangement.

**[0061]** The present invention has the following beneficial effects:

**[0062]** 1. The cost of the BIB package produced according to the present invention is about 30-50% lower than that of an existing BIB package.

**[0063]** 2. The system of the present invention significantly shortens the supply chain, and increases production efficiency.

**[0064]** 3. The shelf life of the package produced by the system of the present invention is unchanged, being 6-9 months.

#### DESCRIPTION OF THE ACCOMPANYING DRAWINGS

**[0065]** Particular embodiments of the present invention are explained in further detail below in conjunction with the accompanying drawings.

**[0066]** FIG. 1 is a schematic diagram of the system in a first example.

**[0067]** FIG. 2 is another schematic diagram of the system in the first example.

**[0068]** FIG. 3 is a structural schematic diagram of the dispensing interface in the first example.

**[0069]** FIG. 4 is a structural schematic diagram of the cap in the first example.

**[0070]** FIG. 5 is a structural schematic diagram of the cap fitted to the dispensing interface in the first example.

**[0071]** FIG. 6 is another structural schematic diagram of the cap fitted to the dispensing interface in the first example.

**[0072]** FIG. 7 is a schematic diagram of the process of forming the product package obtained in a third example of the present invention.

**[0073]** FIG. 8 is a schematic diagram of the process of forming the product package obtained in a fourth example of the present invention.

**[0074]** FIG. 9 is a schematic diagram of the product package obtained in a fifth example of the present invention.

**[0075]** These drawings are not necessarily to scale; certain features may be exaggerated or minimized in order to show details of specific components. In some examples, well-known components, systems, materials or methods are explained in detail to avoid ambiguity in the present invention. Specific structural and functional details of the present invention must not be interpreted as being restrictive; they

merely serve as a basis for the claims and as a representative basis for guiding those skilled in the art to adopt the present invention in a multi-faceted way.

#### PARTICULAR EMBODIMENTS

**[0076]** Detailed embodiments of the present invention are disclosed herein as required. These disclosed embodiments are merely examples which can be implemented in different and alternative forms and combinations thereof. When used herein, “exemplary” for instance and similar terms indicate, by way of extension, embodiments that serve a displaying, illustrating, model or mode function.

**[0077]** The present invention is mainly explained in relation to fluid consumable products, for example but not limited to ready-to-drink products and mixed products (e.g. syrups). However, the concepts here can be used in various applications, for example used together with unsterilized product packaging, solid product packaging, and other packaging processes for assembly lines.

**[0078]** FIG. 1 is a schematic diagram of a system **100** for online forming, filling and sealing to form a product package **190** according to a first example of the present invention. FIG. 2 is another schematic diagram of a system **100** according to a first example of the present invention.

**[0079]** Feeding roller **110**—a coiled sheet packaging material **120** passes through a sterilization apparatus **130**, pulled by the feeding roller **110**, to undergo sterilization. The packaging material **120** may be made of film, paper, or a barrier material (e.g. aluminium (AL) or ethylene-vinyl alcohol copolymer (EVOH)), and film, paper and barrier material may be combined by coating or a laminating forming process according to different protection requirements. When paper is present, the packaging material **120** is a hard material that must be folded, and the package obtained is also hard. When no paper is present, the shape of the package obtained is bendable. In one example, the packaging material **120** is film.

**[0080]** Sterilization apparatus—a sterilization tank **130** is used to sterilize the packaging material **120**. Hydrogen peroxide ( $H_2O_2$ ) is put into the sterilization tank **130**, the packaging material **120** is washed by immersion therein, then rinsed in water, and finally dried with sterile hot air, to obtain sterilized packaging material **120**.

**[0081]** Forming apparatus—a forming apparatus **140** is used to form the packaging material so as to have a space for holding a product to be dispensed, and comprises: a folding unit, for folding the packaging material **120**, wherein after being folded, the packaging material **120** comprises a first part **121** and a second part **122** opposite the first part **121**; and a longitudinal closing unit, for closing edges of the folded packaging material **120** longitudinally, to form a tubular shape. After forming, the packaging material **120** has a space for holding a product to be dispensed.

**[0082]** Inclined conveyor belt **150**—the sterilized packaging material **120** is then borne and conveyed by an inclined conveyor belt **150**. The second part **122** of the packaging material **120** is adjacent to the conveyor belt **150**. Forming of the packaging material **120** may be completed before it is borne onto the conveyor belt **150**, or performed after it is borne onto the conveyor belt **150**.

**[0083]** The conveyor belt **150** may also comprise multiple structural components (not shown in the drawing), for supporting or distributing the weight of the packaging material **120** and the product with which it is filled. For

instance, the conveyor belt **150** may comprise a grid or a grid-like structure to distribute weight and reduce tension in the packaging material **120**.

[0084] The angle **155** of inclination of the conveyor belt **150** with respect to the horizontal can reduce the tension on the packaging material **120** caused by the product weight. Thus, such an inclined design enables the system to fill larger and heavier packages. Compared with the tension of packaging material **120** on a vertical conveyor belt, the size of the angle **155** is sufficient to reduce the tension of the packaging material **120**. The angle **155** is in the range 5°-85°. For instance, in the case of small-volume packages, the angle **155** may for example be approximately 45 degrees above the horizontal to approximately 90 degrees above the horizontal (i.e. approximately perpendicular to the horizontal), because the effect of the weight of such a product on the packaging material **120** is small. However, in the case of large-volume packages, the angle **155** may for example be approximately 0 degrees above the horizontal to approximately 75 degrees above the horizontal.

[0085] Filling apparatus—FIG. 1 shows part of a filling tube **160** of the filling apparatus. The filling tube **160** is inserted into the space for holding the product to be dispensed in the packaging material **120** through a part of the packaging material **120** that has not yet been closed longitudinally, and the space is filled with low-temperature or high-temperature product to be dispensed (e.g. fluid or a similar substance).

[0086] First closing apparatus (not shown in the drawing)—after filling the space for holding the product to be dispensed in the packaging material **120** with the required product, a first closing apparatus (not shown in the drawing) is used to close the packaging material completely. The first closing apparatus for example may be a transverse sealing device. The transverse sealing device is used to press the package filled with product.

[0087] After closing by the first closing apparatus, a completely closed product package **190** has been formed.

[0088] The product package **190** may also undergo further subsequent sterilization. For example, thermal sterilization. For instance, in the case of cold-filled products, the completed product package **190** might need thermal sterilization. In the case of hot-filled products, the completed product package **190** might not need subsequent sterilization. Although subsequent sterilization may not be needed in the case of hot-filled products, a subsequent cooling process may be needed.

[0089] Interface attaching apparatus—used for attaching a dispensing interface **170** to an outer surface of the packaging material **120**; the dispensing interface **170** comprises an interface base part **172**, an interface connection mouth **174** and an interface neck part **173** located therebetween.

[0090] The dispensing interface **170** may be integrally formed, or may be formed by attaching the interface neck part **173** having the interface connection mouth **174** to the interface base part **172**. In this case, the material of the interface base part **172** allows the interface neck part **173** to be attached to one side of the interface base part **172**, and allows the other side of the interface base part **172** to be attached to the exterior of the packaging material **120**; the material of the interface neck part **173** having the interface connection mouth **174** allows the interface neck part **173** to be attached to one side of the interface base part **172**. The dispensing interface **170** is formed in such a way as to allow

product to be poured out of the product package **190** (e.g. a typical dispensing interface). FIG. 3 is a structural schematic diagram of the dispensing interface **170** in a first example (FIG. 3a is a front view, FIG. 3b is a sectional view along A-A in FIG. 3a, and FIG. 3c is a perspective view).

[0091] A first sealing structure **175** is provided at the interface connection mouth **174** of the dispensing interface **170**. The first sealing structure is used to ensure that before the product is dispensed, the interior of the dispensing interface **170** is clean, and will not be contaminated. A pull-open structure (not shown in the drawing) is provided on the first sealing structure, for separating the first sealing structure from the interface connection mouth at least partially, and may be a pull-ring, a T-shaped pull-open structure, etc.

[0092] The present invention employs a cap **180** having a pointed structure for use in cooperation with the dispensing interface **170**. The cap **180** can contact and pierce the packaging material **120** through the dispensing interface **170** in order to dispense product.

[0093] FIG. 4 is a structural schematic diagram of the cap **180** in a first example (FIG. 4a is a front view, FIG. 4b is a sectional view along A-A in FIG. 4a, and FIG. 4c is a perspective view). FIG. 5 is a structural schematic diagram of the cap **180** fitted to the dispensing interface **170** in a first example (FIG. 5a is a front view, FIG. 5b is a sectional view along A-A in FIG. 5a, and FIG. 5c is a perspective view). FIG. 6 is another structural schematic diagram of the cap **180** fitted to the dispensing interface **170** in a first example.

[0094] The cap **180** comprises a cap base part **182**, a cap head part **184** having a pointed structure **181**, and a cap neck part **183** located therebetween; when the cap **180** is fitted to the dispensing interface **170**, the pointed structure **181** will pierce the packaging material **120**; the cap neck part **183** is a hollow structure; an opening is provided on the cap base part **182**, the opening being in communication with the hollow structure; a connecting tube **185** is provided on that side of the cap base part **182** which is remote from the cap head part **184**, the opening being in communication with the connecting tube **185**.

[0095] The cap **180** can be screwed into or pressed into the dispensing interface **170**; for instance, a first screw-thread **176** is provided on an inner wall of the interface neck part **173**, a second screw-thread **186** is provided on an outer wall of the cap neck part **183**, and the first screw-thread **176** matches the second screw-thread **186**. Alternatively, a third screw-thread **177** is provided on an outer wall of the interface neck part **173**, the cap base part **182** comprises a cap base part bottom **1821** and a cap base part sidewall **1822**; a fourth screw-thread **187** is provided on an inner wall of the cap base part sidewall **1822**, and the third screw-thread **177** matches the fourth screw-thread **187**.

[0096] During use, first of all the first sealing structure **175** is taken out (e.g. pulled out), then the cap head part **184** is screwed or pushed into the dispensing interface **170** through the interface connection mouth **174**, the pointed structure **181** on the cap head part **184** will then pierce the packaging material **120**, and then the product in the package can be dispensed.

[0097] A product dispensing tube **200** may be mounted on the connecting tube **185**. Such a cap, which includes not only a hollow structure but also a connecting tube, obviates the need to take off the cap after piercing the packaging material, and can be directly connected to the product dispensing tube,

to make dispensing of the product more convenient. The cap and the product dispensing tube can be assembled in advance, and packed together in a clean sealed packaging bag and included as an accessory. The other end of the product dispensing tube is preferably sealed. This can ensure that when the cap is connected to the product package, the entire internal product path is still in a clean, closed space. During use, the product package is placed on a product dispensing device and the product dispensing tube is fitted into a dispensing valve, then the sealed end of the product dispensing tube is cut off, and the product is dispensed for sale under the control of the dispensing valve.

[0098] The cap 180 and dispensing interface 170 are provided with matching second sealing structures. The second sealing structures produce an interference fit between the interface neck part 173 and the cap neck part 183, thereby ensuring that a sealed region has been formed already before the packaging material 120 attached to the dispensing interface 170 is pierced by the pointed structure 181 of the cap head part 184, and the product can only flow out of the interior of the packaging material 120 through the cap neck part 183; thus, on the one hand, leakage of product to the outside of the sealed region and consequent contamination are avoided, and on the other hand, the region through which the product flows is kept sterile, further guaranteeing product quality.

[0099] The second sealing structure may be a projection disposed on an inner wall of the interface neck part 173 or a projection on an outer wall of the cap neck part 183, and may also be a sealing ring 178 disposed on an inner wall of the interface neck part 173 or a sealing ring on an outer wall of the cap neck part 183.

[0100] The cap can be attached to a product package which has been completely closed and has a dispensing interface, to be sold and transported etc. as a single unit together with the product package, but may also be connected with the dispensing interface in a fitted manner, and may also be packaged independently as a unit to be sold and transported etc. Preferably, the cap is packaged independently, and thus can be used repeatedly.

[0101] In one embodiment where the cap is connected with the dispensing interface in a fitted manner, a layer of annular material which can be taken off is provided between the dispensing interface and the cap. When the cap is not being used, the pointed structure is separated from the packaging material by a certain distance due to the presence of the annular material; when the cap is being used, the annular material is taken off, the cap is rotated downwards or pressed down, and the pointed structure contacts the packaging material, piercing the packaging material.

[0102] Dividing apparatus—a dividing apparatus is used to separate a completely closed package from the following package. A completely closed product package 190 can be separated from the following package using a large number of cut-off apparatuses already known in the prior art. For example, a cutter 210 can be used to cut apart the completely closed product package 190 and the following package at a fixed interval (e.g. according to a predetermined size or predetermined time period), to obtain an independent product package 190. The independent product package 190 can then proceed to a subsequent process or be prepared for shipping.

[0103] Alternatively, the completely closed product package 190 and the following package can be connected in a

breakable fashion, and therefore need not be separated during production; the two can be separated at the time of use.

[0104] The dispensing interface 170 may be attached to the outside of the independent product package 190 after the independent product package 190 is obtained.

[0105] In some embodiments, where it is necessary to sterilize all package elements and products separately, sterile filling may be needed. These package elements will be assembled and filled with product in a clean environment, to ensure that the final sealed product will not be contaminated. In a first example, each process step after the packaging material 120 has been sterilized is carried out in a sterile environment until the packaging material is completely closed to obtain the product package 190. The sterile environment is equipped with multiple sterile air filters in order to cushion a sterile or sterilized product therein and maintain a clean environment during filling and sealing. It can be appreciated that in order to ensure a sterile environment in a sterile space, the sterile space is kept at normal pressure, to resist air from outside. The sterile space ensures that the package is filled and sealed in high-quality environmental conditions. In such an environment, the product, package and closing element (e.g. sealing element) all have a low biological load, so the microbe content of the product can be minimized.

[0106] The dispensing interface 170 can be attached by e.g. soldering, adhesive or a similar method to any position suitable for attaching the interface base part 172 on the outside of the first part 121 or second part 122 of the packaging material 120. For instance, the dispensing interface 170 may be attached to the outside of the first part 121 or second part 122 of the packaging material 120 when the packaging material 120 has not yet been closed longitudinally and formed to have a space for holding a product to be dispensed. The dispensing interface 170 may also be attached to the outside of the first part 121 or second part 122 of the packaging material 120 when the packaging material 120 is longitudinally closed and formed to have a space for holding a product to be dispensed. The dispensing interface 170 may also be attached to the outside of the first part 121 or second part 122 of the packaging material 120 when the space of the packaging material 120 is filled with product to be dispensed. The dispensing interface 170 may also be attached to the outside of the first part 121 or second part 122 of the packaging material 120 after the space of the packaging material 120 has been completely filled with product and the packaging material 120 is completely closed. In the case where the dispensing interface 170 is attached to the packaging material 120 when the packaging material 120 has not yet been closed longitudinally and formed to have a space for holding a product to be dispensed, the dispensing interface 170 must first be sterilized, for example by means of an interface sterilization apparatus, because the dispensing interface 170 might contact the product. In a preferred embodiment, the dispensing interface 170 is attached to an outer surface of the packaging material 120 at any time after the packaging material 120 has been closed longitudinally and formed to have a space for holding a product to be dispensed. In this case, since the dispensing interface 170 will not contact the product, the attachment thereof can be carried out in a non-sterile environment. If the product does

not require a sterilized environment (e.g. a product highly resistant to rotting), the dispensing interface 170 can be attached at any time.

[0107] In a second example, a hot filling process is used when the filling apparatus is used to fill the space for holding the product to be dispensed in the packaging material 120 with the product to be dispensed. In this case, residual heat of the product is used to sterilize parts of the inner wall of the packaging material which might contact the product.

[0108] Compared with the first example, in a third example, the first closing apparatus is further used to divide an internal space of the package into a first space and a tubular space in communication with each other. The feeding roller 110, sterilization apparatus, packaging material 120, forming apparatus, filling apparatus and dividing apparatus are similar to those in the first example, and will not be expounded again here.

[0109] A vertical conveyor belt is used to convey the packaging material 120. Forming of the packaging material 120 may be completed before it is borne onto the conveyor belt, or performed after it is borne onto the conveyor belt. A bearing apparatus, e.g. a mechanical hand, is used to provide support for the weight of the packaging material 120 and the product with which it is filled. It can be appreciated that an inclined conveyor belt 150 and the bearing apparatus could also be used at the same time to convey and support the packaging material 120.

[0110] In a third embodiment, the first closing apparatus is further used for partially bonding together the first part 121 and second part 122 of the packaging material 120 to form a long, narrow bonded part 161, which divides an internal space of the package into a first space 163 and a tubular space 162 which can be used as a dispensing port, the first space and the tubular space being in communication with each other. The first closing apparatus may employ e.g. fusion, pressing or a similar method.

[0111] FIG. 7 is a schematic diagram of the process of forming the product package obtained in a third example of the present invention. FIG. 7a shows a sheet packaging material being folded and formed to have a first part 121 and a second part 122. Subsequently, edges of the folded packaging material are closed longitudinally, so the packaging material forms a space for holding a product to be dispensed. FIG. 7b shows a schematic diagram of a completely closed product package having a tubular space. One end of a bonded part 161 extends to a short side edge 123 of the package, and the other end is located in a middle part of the package, dividing the internal space of the package into a tubular space 162 and a first space 163 in communication with each other. When the product package is used to dispense the product, the bonded part 161 is cut open and an end 164 of a tubular structure 166 formed by the tubular space 162 is cut open, enabling the product in the package to be dispensed. In FIG. 7c, the bonded part 161 is cut open, and the tubular structure 166 is clearly shown; after being cut open, the end 164 of the tubular structure 166 can be used to dispense product. Alternatively, the long, narrow bonded part 161 is designed to be able to be torn open; this is more convenient for showing the tubular structure 166.

[0112] Compared with the third example, in a fourth example, a second closing apparatus is used to divide a package internal space into a first space and a tubular space in communication with each other.

[0113] FIG. 8 is a schematic diagram of the process of forming the product package obtained in a fourth example of the present invention. FIG. 8a shows a sheet packaging material being folded and formed to have a first part 121 and a second part 122. Subsequently, edges of the folded packaging material are closed longitudinally, so the packaging material forms a space for holding a product to be dispensed. FIG. 8b shows a schematic diagram of a completely closed product package having a tubular space. One end of a bonded part 161 extends to a long side edge 124 of the package, and the other end is located in a middle part of the package, dividing the internal space of the package into a tubular space 162 and a first space 163 in communication with each other. In FIG. 8c, the bonded part 161 is cut open, and a tubular structure 166 formed by the tubular space 162 is clearly shown; after being cut open, the end 164 of the tubular structure 166 can be used to dispense product.

[0114] The closure, by the first closing apparatus, of the packaging material 120 filled with product may or may not take place at the same time as the partial bonding of the first part 121 and the second part 122 by the first closing apparatus or second closing apparatus. The bonded part 161 may be formed on the packaging material 120 before or during the filling process, or after filling and sealing. Since the product in the package will not be exposed to air when the bonded part 161 is being formed, the bonded part 161 need not be formed in a sterile space.

[0115] The bonded part 161 should have a certain width, to ensure that when the bonded part 161 is cut open, the package will still be sealed. A terminal end 165 of the bonded part 161 is preferably round in shape. This will result in less resistance being encountered during product dispensing or filling.

[0116] Compared with the fourth example, in a fifth example, a second closing apparatus is used to form a package internal space so as to include a first space and a tubular space which extends outward from the first space and can be used as a dispensing port. The second closing apparatus may employ e.g. fusion, pressing or a similar method.

[0117] FIG. 9 is a schematic diagram of a product package obtained in the fifth example of the present invention. The sheet packaging material is folded and formed to include a first part and a second part, then edges of the folded packaging material are closed longitudinally, so the packaging material forms a space for holding a product to be dispensed. A second closing apparatus is used to form the package internal space so as to include a first space 163 and a tubular space 162 which extends outward from the first space and can be used as a dispensing port. The tubular space 162 has a tubular structure 166, which can be formed on the packaging material before, during or after the filling process.

[0118] Another possibility is that a first closing apparatus is used to form the package internal space so as to include a first space and a tubular space which extends outward from the first space and can be used as a dispensing port, i.e. when filled packaging material is being finally completely closed, at least one edge of the packaging material is closed to form a tubular structure extending outwards; this is most favourable for actual operation.

[0119] The product package obtained preferably has an external shape suited to close arrangement. For example, an edge opposite that edge which forms the outwardly extend-

ing tubular structure is a gap shape matching the tubular shape. Such a matching arrangement of gap and tubular shape can reduce the amount of space occupied by the package during subsequent transportation, and helps to reduce costs.

**[0120]** The present invention can be used to produce a large-volume bag-in-box (BIB), filled with beverage or beverage concentrate.

**[0121]** Different examples of the present invention have been disclosed herein. These disclosed examples can be implemented in different and alternative forms, and in combination.

**[0122]** The above examples are merely exemplary demonstrations which expound embodiments for clearly understanding the principles of the present disclosure.

**[0123]** The above examples may be changed, amended and combined without departing from the scope of the claims. The scope of the present invention, and the claims, here include all such changes, amendments and combinations.

**[0124]** Clearly, the above examples of the present invention are merely examples cited for the purpose of clearly explaining the present invention, and do not limit the embodiments thereof. Those skilled in the art could make other changes or alterations in various forms on the basis of the explanation above. It is not possible to list all embodiments here exhaustively. All obvious changes or alterations derived from the technical solution of the present invention shall still fall within the scope of protection of the present invention.

1. A system for forming a product package by online forming, filling and sealing, characterized in that the system comprises:

- a sterilization apparatus configured to sterilize a packaging material;
- a forming apparatus configured to form the packaging material to have a space for holding a product to be dispensed;
- a conveyor belt configured to convey the packaging material;
- a filling apparatus configured to fill the space for holding the product to be dispensed in the packaging material with the product to be dispensed; and
- a first closing apparatus configured to completely close the packaging material filled with the product, to form the product package.

2. The system of claim 1, wherein the product package is a large-volume package.

3. The system of claim 1, wherein the conveyor belt forms an angle with a horizontal plane.

4. The system of claim 1, wherein the system further comprises a bearing apparatus configured to bear the packaging material.

5.-6. (canceled)

7. The system of claim 3, wherein the forming apparatus comprises:

- a folding unit configured to fold the packaging material; and
- a longitudinal closing unit configured to longitudinally close edges of the folded packaging material, to form a tubular shape.

8. The system of claim 3, wherein the system also comprises an interface attaching apparatus configured to attach a dispensing interface to an outer surface of the packaging material,

wherein the dispensing interface comprises an interface base part, an interface connection mouth and an interface neck part located therebetween.

9.-10. (canceled)

11. The system of claim 8, wherein the interface attaching apparatus attaches the dispensing interface to an outer surface of packaging material which has a space for holding a product to be dispensed.

12. (canceled)

13. The system of claim 3, wherein the system optionally further comprises a second closing apparatus, and wherein the first closing apparatus or the second closing apparatus is configured to form a package internal space comprising a first space and a tubular space in communication with each other.

14. (canceled)

15. The system of claim 13, wherein forming the package internal space comprises partially bonding together opposing first and second parts of the packaging material, to form a long, narrow bonded part which divides the package internal space into a first space and a tubular space which can be used as a dispensing port, the first space and the tubular space being in communication with each other.

16.-17. (canceled)

18. A method for forming a product package by online forming, filling and sealing, characterized by comprising:

- sterilizing a packaging material;
  - forming the sterilized packaging material to have a space for holding a product to be dispensed;
  - filling the space with the product to be dispensed; and
  - completely closing the formed packaging material filled with the product, to obtain the product package;
- wherein support is provided for the packaging material at least in the filling step.

19.-20. (canceled)

21. The method of claim 18, wherein the product package is a large-volume package.

22. The method wherein the product package is claim 18, wherein the packaging material forming step comprises:

- folding the packaging material; and
- longitudinally closing edges of the folded packaging material, to form a tubular shape.

23. The method of claim 19, wherein the method further comprises attaching a dispensing interface to an outer surface of the packaging material,

wherein the dispensing interface comprises an interface base part, an interface connection mouth and an interface neck part located therebetween.

24.-31. (canceled)

32. A large-volume packaging bag having a dispensing interface, comprising:

- a packaging bag; and
  - a dispensing interface attached to an outer surface of the packaging bag,
- wherein the dispensing interface comprises an interface base part in contact with a packaging material, an interface connection mouth and an interface neck part located therebetween.

**33.** The large-volume packaging bag of claim **32**, wherein a first sealing structure is provided at the interface connection mouth of the dispensing interface.

**34.** The large-volume packaging bag of claim **33**, wherein the first sealing structure comprises a pull-open structure configured to at least partially separate the first sealing structure from the interface connection mouth.

**35.** The large-volume packaging bag of claim **32**, wherein the packaging bag further comprises a cap comprising:

a cap base part, a cap head part having a pointed structure, and a cap neck part located therebetween;

wherein, when the cap is fitted to the dispensing interface, the pointed structure is used to pierce the packaging material.

**36.** The large-volume packaging bag of claim **35**, wherein the cap neck part is a hollow structure; an opening is provided on the cap base part, the opening being in communication with the hollow structure; and an additional cap is provided on the cap base part, configured to close the opening.

**37.** The large-volume packaging bag of claim **36**, wherein a connecting tube is provided on a side of the cap base part remote from opposite the cap head part, the opening being in communication with the connecting tube.

**38.** (canceled)

**39.** The large-volume packaging bag of claim **36**, wherein the cap and dispensing interface further comprise matching second sealing structures, for ensuring that when the cap is fitted to the dispensing interface, a seal has already been formed in the dispensing interface before the packaging material is pierced by the pointed structure of the cap head part,

wherein the second sealing structure is a projection or asealing ring disposed on an inner wall of the interface neck part or a projection on an outer wall of the cap neck part.

**40.-47.** (canceled)

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