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(54) **VACUUM PACKAGE**

(57) The invention relates to a perishable goods package indicated as a whole with 20. The package according to the invention comprises a plurality of ribs 22 and a gas-tight cover 24, wherein the gas-tight cover comprises a tubular portion 26 which univocally defines an *X* axis, the ribs surround an inner useful space 28 developing along the *X* axis and the cover encloses the ribs and the useful space.

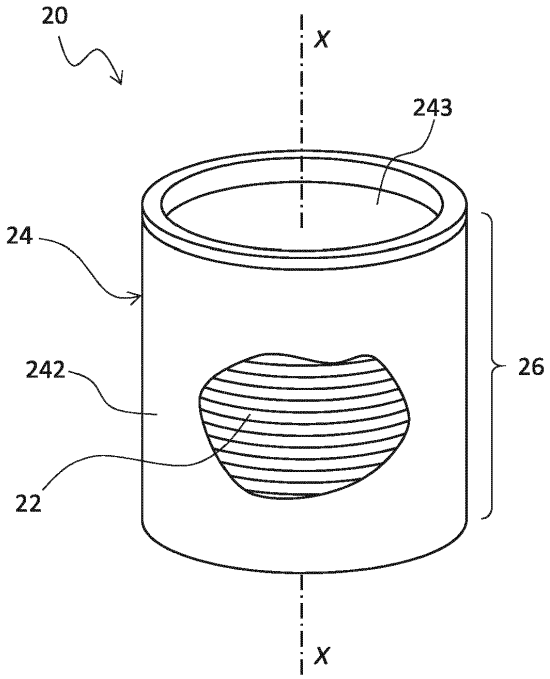

Fig. 1

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Description

[0001] The present invention relates to a vacuum-sealed package, in particular a low-cost vacuum-sealed package for perishable goods.

[0002] In a known way, large-scale distribution and trade of perishable goods require them to be packaged in such a way as to keep them desirable and/or to preserve their organoleptic properties.

[0003] In the following discussion, extensive reference will be made to perishable goods, meaning first of all goods which, due to their chemical nature, tend to undergo deterioration in the presence of atmospheric oxygen (for example due to oxidative processes and/or proliferation of aerobic bacteria). Furthermore, some of these goods can be easily damaged by even relatively modest external mechanical stresses. Consider, for example, food such as wild berries or fresh salads but also other non-food items such as flowers or the like.

[0004] It has long been known packaging certain food in rigid jars, typically made of glass, inside which the vacuum is created, thus removing atmospheric oxygen. The removal of oxygen from inside the jar allows the food to remain unchanged for the time necessary for distribution and sale until the time of use by the consumer. Such rigid jars are not without disadvantages. First of all, the glass jars have a relatively high unit cost and therefore their use is justified only for food of a suitable specific value. In practice, therefore, the vacuum-sealed glass jars are used only for preserves, marmalades, jams, sauces and the like. Furthermore, glass is a fragile and heavy material and both these features penalize the large-scale distribution phase.

[0005] Still in a manner known per se, some perishable food is packaged and distributed in special flexible vacuum-sealed bags. Such packages may also comprise a semi-rigid tray and/or a secondary wrapping but consist essentially of a flexible bag made of a gas-tight material. In the food packaging phase, the air is sucked from the inside of the bag and the bag is sealed. However, this type of package, although lighter and cheaper than the glass jar, does not represent a definitive solution since it cannot be used with all types of perishable goods. In fact, the vacuum bag adheres to the surface of the food transferring all the pressure exerted by the atmosphere. For this reason, the vacuum-sealed bag can only be used for food having an adequate consistency, such as hard cheese, cured meats, meat pieces and the like.

[0006] To solve the problems left unresolved by glass jars and vacuum-sealed bags, the use of light and gas-impermeable packages has spread, within which the so-called modified atmosphere is arranged. This atmosphere is called modified because inside it oxygen is replaced by other less reactive gases. Typically, the modified atmosphere comprises nitrogen and/or carbon dioxide and/or argon, in percentages that vary depending on the application. This low-cost solution therefore allows the packaging and distribution of foods with a low specific value and low mechanical resistance. As an example, bags in modified atmosphere are used for fresh salads, wild berries, sliced cured meats, hand-made pasta and the like. Even this last solution, although much appreciated, is not without disadvantages. In fact, although the gases used are decisively less reactive than oxygen, they still cause a slight alteration of taste and organoleptic properties of food with which they remain in contact for a long time. Typically, food distributed in a modified atmosphere is slightly acidified.

[0007] Therefore, the object of the present invention is to overcome the drawbacks underlined above with respect to the prior art.

[0008] In particular, an object of the present invention is to provide a package suitable for long-term preservation of food without altering the taste and organoleptic properties thereof.

[0009] Moreover, an object of the present invention is to provide a vacuum-sealed package that is light and low-cost.

[0010] This aim and these tasks are achieved by means of a vacuum-sealed package according to claim 1.

[0011] To better understand the invention and appreciate its advantages, some of its exemplifying and non-limiting embodiments are described below with reference to the accompanying drawings, wherein:

- Figure 1 schematically shows a perspective view of an embodiment of a vacuum-sealed package according to the invention, partially in transparency;
- Figure 2 schematically shows a perspective view of an embodiment of a vacuum-sealed package according to the invention;
- Figure 3 schematically shows a perspective view of an embodiment of a vacuum-sealed package according to the invention;
- Figure 4 schematically shows a perspective view of an embodiment of a vacuum-sealed package according to the invention;
- Figure 5 schematically shows in section a first step of packaging a perishable good in a vacuum-sealed package according to the invention;
- Figure 6 schematically shows in section a second step of packaging a perishable good in a vacuum-sealed package according to the invention;
- Figure 7 schematically shows in section a third step of packaging a perishable good in a vacuum-sealed package according to the invention;
- Figure 8 schematically shows in section a fourth step of packaging a perishable good in a vacuum-sealed package according to the invention;
- Figure 9 schematically shows in section a fifth step of packaging a perishable good in a vacuum-sealed package according to the invention;
- Figure 10 schematically shows in section a sixth step of packaging a perishable good in a vacuum-sealed package according to the invention;
- Figure 11 schematically shows a perspective view

of a detail of a vacuum-sealed package according to the invention;

- Figure 12 schematically shows a perspective view of a detail of a vacuum-sealed package according to the invention, similar and alternative to the detail of Figure 11;
- Figure 13 schematically shows a perspective view of a detail of a vacuum-sealed package according to the invention, similar and alternative to the detail of Figure 11;
- Figure 14 schematically shows in section a step of packaging a perishable good in a vacuum-sealed package according to the invention, similar and alternative to the step of Figure 6;
- Figure 15 schematically shows in section a step of packaging a perishable good in a vacuum-sealed package according to the invention;
- Figure 16 schematically shows in section a step of packaging following that of Figure 15;
- Figure 17 schematically shows a detail of a vacuum-sealed package according to the invention;
- Figure 18 schematically shows a plan view of a detail of a vacuum-sealed package according to the invention; and
- Figure 19 schematically shows a perspective view of a stack of details of the type showed in Figure 18.

[0012] In the context of the present discussion, some conventions have been adopted in order to make reading easier and smoother. Some terminological conventions refer to the attached figures. In particular, it is intended that the position in which the invention is depicted univocally defines the term "upper" and the like, with respect to the term "lower" and the like. As the skilled person can well understand, nothing would change if a different convention, for example the opposite, were adopted.

[0013] The invention relates to a perishable goods package indicated as a whole with 20. The package 20 according to the invention comprises a plurality of ribs 22 and a gas-tight cover 24, wherein the gas-tight cover 24 comprises a tubular portion 26 which univocally defines an *X* axis, the ribs 22 surround an inner useful space 28 developing along the *X* axis and the cover 24 encloses the ribs 22 and the useful space 28.

[0014] The axial, radial and circumferential directions are defined below with respect to the *X* axis.

[0015] Preferably the ribs 22 are structurally separated from the cover 24. In other words, although in use the ribs 22 are in contact with the cover 24, they are made separately from the cover 24 and are not constrained thereto.

[0016] The ribs 22 develop preferably around the *X* axis. Moreover, when the ribs 22 are correctly arranged for use in the package 20 according to the invention (see for example Figures 7 to 10), they take as a whole a preferably cylindrical or prismatic shape around the *X* axis.

[0017] The ribs 22 are preferably made of polymeric material suitable for use with food, such as for example polyethylene, polyester, polyamide, polyvinyl chloride, polyethylene terephthalate or bioplastic.

[0018] In some embodiments, the individual ribs 22 are independent and separated from one another. Advantageously, they take the form of a ring, preferably closed on itself, which develops in a plane perpendicular to the axis *X*. Individual ring-shaped ribs 22 of this type are illustrated in Figures 11, 12, 13 and 18. In the case of the independent and flat ring-shaped ribs 22, the plurality of ribs 22 takes the form of a stack in which the individual ribs 22 rest on one another in an axial direction. This arrangement of the ribs 22 is shown schematically in Figures 6-10, 15-16 and 19. In some figures, for greater clarity, the ribs 22 are shown slightly spaced one from the other in the axial direction, rather than in direct contact as in reality.

[0019] In accordance with some embodiments, the ring-shaped ribs 22 have a thickness s comprised between 0.5 mm and 3 mm.

[0020] In accordance with other embodiments, the ribs 22 take slightly different shapes even if substantially equivalent from the structural point of view. By way of example, the ribs 22 can take the form of coils of a helix, preferably cylindrical, constituting as a whole a single spring structure. This structure is completely similar to the one of the cylindrical helical spring widely used as a toy and called "Slinky" in English. In particular, it is preferable that in a condition without external loads and therefore not deformed, the pitch *p* of the helix is small with respect to the outer diameter *D* of the helix. See in this regard Figures 14 and 17. In this particular embodiment, due to the absence of external loads the coils of the spring are in contact with each other, the pitch *p* of the helix is substantially equal to the thickness *s* of the single coil. In accordance with some embodiments, the coiled ribs 22 have a thickness s comprised between 0.5 mm and 3 mm.

[0021] In accordance with some embodiments, such as for example the one schematically shown in Figure 12, the ribs 22 comprise axial spacers 30. These axial spacers 30 preferably have an axial extension comparable to the thickness of a single rib 22. For example, the axial spacers 30 may have an axial extension comprised between 0.5 mm and 3 mm. The presence of the spacers on the ribs 22, whether they are ring-shaped or coil-shaped, allows to reduce the number of ribs 22 necessary to obtain a certain axial extension of the stack and/or of the helix.

[0022] The structure of the ribs 22 is adapted to counteract the radial action exerted by the external atmospheric pressure when the vacuum is created inside the package 20. For this purpose, in a manner known per se, the circular shape of the ribs 22 (whether ring-shaped or coil-shaped) entails considerable advantages. These advantages are similar to those that in architecture are obtained from the use of arches and vaults and are referred to below with the term "shape resistance". In a

condition of hydrostatic pressure, that is equal in all directions, the optimal shape resistance is obtained with the structures of circular section such as circular cylinders, spheres and portions thereof. The embodiment of Figure 13 exploits the shape resistance in a non-optimal way, but it may be preferable for other reasons, for example of aesthetic nature or related to the ability of the polygonal shapes to effectively counteract an undesired rotation around the *X* axis. Another embodiment that exploits the shape resistance in a non-optimal manner is that in which the ribs 22 (whether they are ring-shaped or coil-shaped) have an elliptical or oval shape. Such embodiment, not shown in the figures, allows in some specific cases to optimize the bulk of the package 20 with respect to the volume and shape of the content. Still in other embodiments, not shown, the ribs 22 may have a star shape, a flower shape, a polygonal shape or still other shapes which satisfy specific needs.

[0023] According to some embodiments, the ribs 22 have an outer diameter *D* and an inner diameter *d*, where the difference between *D* and *d* is comprised between 8 mm and 20 mm.

[0024] The inner diameter *d* of the ribs 22 defines the radial extension of the useful space 28 which is destined to receive a perishable good 32 such as for example a fresh food product.

[0025] As already anticipated, the gas-tight cover 24 encloses the plurality of ribs 22 and, consequently, the useful space 28 and possibly the perishable good 32 received therein. The gas-tight cover 24 must be capable of defining a continuous and complete barrier so as to be able to maintain the desired vacuum degree within the package 20 for a predefined time for storing perishable goods 32. In the present discussion, the terms "vacuum" and "vacuum-sealed" refers to the level of vacuum typically employed in food packaging. Such level of vacuum, usually classified in the industrial field as a low vacuum (rough vacuum), is that obtained with vacuum packaging machines, of the bell-shaped or external suction type. According to some particular embodiments, this vacuum level is around 2 absolute mbars (200 Pa), while in other cases it can reach up to 0.5 absolute mbars (50 Pa).

[0026] Preferably, the cover 24 is made of a material suitable for food use. Advantageously, the cover 24 is made of an at least partially flexible material. By way of example, the cover 24 can be made of polymeric material (for example polyethylene, polyester, polyamide, polyvinyl chloride, polyethylene terephthalate or bioplastic), of expanded polystyrene, of a multilayer material, of aluminium, of steel.

[0027] In certain embodiments of the package 20 according to the invention, the cover 24 is constituted by a single piece, typically a flexible envelope 240 which, for certain aspects, is similar to those used for the vacuum-sealed packages of the prior art. In this case, the cover 24 also comprises a seal 241, obtained for example by welding or by gluing, in turn adapted to maintain the impermeability of the cover 24 with respect to the gas.

[0028] In accordance with other embodiments, the cover 24 comprises a container 242 and a cap 243 which can be sealingly coupled together. This allows to maintain the desired vacuum level inside the package 20. In accordance with other embodiments, the package 20 further comprises an inner vessel 38 housed in the useful space 28 surrounded by the ribs 22 and intended to receive perishable goods 32. Advantageously, the inner vessel 38 is suitable for defining a gap 50 between itself and the ribs 22. The inner vessel 38 advantageously has a maximum diameter r smaller than the inner diameter d of the ribs 22. Advantageously, the difference between the inner diameter d of the ribs and the diameter r of the inner vessel 38 is comprised between 2 mm and 6 mm.

[0029] The inner vessel 38 can be defined by a cup-shaped element or a stack of inner rings 380, each arranged inside a respective ring-shaped rib 22. Preferably the inner vessel 38 is permeable to gases, for example due to the presence of holes 40, in order to avoid creating pressure differences between different volumes inside the cover 24.

[0030] The inner vessel 38 is preferably made of polymeric material suitable for use with food, such as for example polyethylene, polyester, polyamide, polyvinyl chloride, polyethylene terephthalate or bioplastic.

[0031] Preferably, the inner vessel 38 is configured so as to maintain an almost uniform distance from the ribs 22 and from the cover 24. For example, the inner vessel 38 can advantageously comprise radial spacers 42 suitable for maintaining the inner vessel 38 centred with respect to the ribs 22 and to the useful space 28 defined therein. In some embodiments, the inner vessel 38 preferably comprises an axial abutment 44 adapted to provide a support in the axial direction of the inner vessel 38, for example on the ribs 22 or on the cover 24. In this way, even the bottom wall of the inner vessel 38 is kept spaced from the bottom wall of the cover 24.

[0032] In accordance with some embodiments, the spring-shaped ribs 22 are made in one piece with a lid 46 and/or with a base 48. This solution is schematically showed in Figure 17. The lid 46 and/or the base 48 are preferably transparent, in order to allow the visibility of the perishable goods 32 placed in the useful space 28 defined by the ribs 22. Moreover, the lid 46 and/or the base 48 are preferably dome-shaped; the advantages of this specific form are due to the aforementioned shape resistance.

[0033] In the following, the embodiments of the package 20 according to the invention schematically showed in the accompanying figures are described by way of non-limiting example.

[0034] Figure 1 shows a package 20 in which the gas-tight cover 24 comprises a container 242 and a cap 243. The container 242 in turn comprises a tubular portion 26 made of multilayer material closed at the lower end by a fixed cap (not visible). The container 242 is then closed by a removable upper cap 243. Similar covers 24 are

already used for atmospheric pressure packaging of chips and snacks. By definition, the multilayer material comprises a plurality of layers of different materials laminated together. Typically, the multilayer material can comprise a layer of cardboard suitable for giving a certain strength to the package 20 and suitable for supporting the printing of graphic elements and text which identify the product and its characteristics. Inside the cardboard layer can be provided an aluminium layer and/or a polymeric layer suitable for contacting food. These two layers, individually or in a combination thereof, make the multilayer material gas-tight. The two caps, the lower fixed one (not visible) and the upper one, can be made in turn with a multilayer material or with a polymeric material.

[0035] In the case in which a cap 243 is made of multilayer material, the latter should preferably be stiffer than the multilayer material used for the tubular portion 26. In fact, the curved shape and the inner ribs 22 help the material of the tubular portion 26 contrasting the radial force acting from the outside. Conversely, the flat cap 243 must have a significantly higher intrinsic stiffness to counteract the same external force.

[0036] In the case wherein a cap 243 is made of polymeric material, it can be made in such a way that its central part functions as a membrane. As known, the membrane structure is a flat and thin structure which is not suitable for generating significant reactions other than traction. When a membrane structure is subjected to a pressure difference, it exits from its plane assuming a concavity which allows it to react to the external action by internal traction stresses. The cap 243 made of polymeric material thus tends to assume a concave shape towards the inside of the package 20 and thus increases its resistance to the force acting from the outside.

[0037] In Figure 1 part of the multilayer cover 24 has been removed in order to show the ribs 22 placed inside the package 20. As can be seen, there is a minimum difference between the outer diameter D of the ribs 22 and the inner diameter of the tubular portion 26 of the cover 24. This minimum difference allows that, once the ribs 22 have been introduced into the cover 24, the subsequent application of the vacuum results in the cover 24 resting at least partially on the ribs 22 upon a minimum deformation in the radial direction.

[0038] Figure 2 shows a package 20 in which the gas-tight cover 24 is constituted by a flexible envelope 240 in polimeric material. Said cover 24 also comprises a seal 241, obtained for example by welding or by gluing. Inside the cover 24 it is arranged in turn an accessory tube 34, preferably closed at its ends by caps, for example similar to those described above for the embodiment of Figure 1. The presence of the accessory tube 34 is not necessary at all, but it may be useful to make the package 20 as a whole more manageable during the packaging phase, above all in the case wherein the plurality of ribs 22 is a stack of ring elements. Moreover, the accessory tube 34 can be advantageously used for printing graphic and text elements that identify the product and its characteristics. The difference between the tubular portion 26 of the cover 24 of Figure 1 and the accessory tube 34 of Figure 2 is that the latter must not necessarily be gas-tight, since this function is performed by the flexible envelope 240. Thus, the accessory tube 34 of Figure 2, which is not strictly necessary, can be made of simple cardboard, thus limiting the costs and the environmental impact. The flexible envelope 240, while adhering to the inner accessory tube 34, defines the tubular portion 26 of the cover 24. Similarly to Figure 1, also in Figure 2 part of the accessory tube 34 has been removed in order to show the ribs 22 placed inside the package 20. As can be seen, also in this case there is a minimum difference between the outer diameter D of the ribs 22 and the inner diameter of the accessory tube 34.

[0039] Figure 3 shows a package 20 in which the gas-tight cover 24 consists of a bell-shaped container 242 and a lower cap 243 similar to those already described above. The bell-shaped container 242 comprises a tubular portion 26 and an extroverted dome-shaped portion, and therefore largely exploits the advantages of the curved structures. In particular, the dome shape provides the material with high resistance. Although they are not visible, also in the embodiment of Figure 3, as well as in that of Figure 1, the ribs 22 suitable for contrasting the radial thrust acting from the outside are arranged inside the tubular part of the bell.

[0040] Figure 4 shows a package 20 wherein the gas-tight cover 24 consists of a tin container 242, typically of a metal material such as aluminium or steel. This type of package 20, which is widespread and studied per se, comprises a tubular portion 26, a monolithic bottom (not visible) and a removable cap 243, for example a tear-off cap. The tin container 242 is inherently impermeable to gases. Although they are not visible, also in the embodiment of Figure 4, as well as in that of Figure 1, the ribs 22 suitable for contrasting the radial thrust acting from the outside are arranged inside the tubular part of the tin container 242.

[0041] With reference to Figures 5 to 10, a method for the use of a further embodiment of the package 20 according to the invention is described below.

[0042] Figure 5 schematically shows the section of a container 242 which is part of the gas-tight cover 24. The container 242 comprises a tubular portion 26 and an introverted dome-shaped bottom. The upper part of the container 242 comprises a thread for applying a screw cap 243.

[0043] Figure 6 schematically shows the step of inserting the ribs 22 inside the container 242 of Figure 5. In this specific case, it is observed that the ribs 22 are of the ring type, flat and independent from each other. As the skilled person can see in Figure 6, it is required for the inner diameter of the upper opening of the container 242 to be at least slightly greater than the outer diameter D of the ribs 22. In the absence of this requirement, due to the stiffness of the ribs 22, the latter could not be introduced into the container 242. In Figure 6 and in the

subsequent figures up to Figure 10, for greater clarity, the ribs 22 are shown as slightly axially spaced one from the other, although in fact they rest axially on one another.

[0044] Figure 7 schematically shows the step of inserting perishable goods 32 inside the useful space 28 defined by the package 20 according to the invention.

[0045] Figure 8 schematically shows the step of preparing the screw cap 243 near the container 242. The assembly of the screw cap 243 and of the container 242 constitutes the gas-tight cover 24.

[0046] Figure 9 schematically shows the step of applying the screw cap 243 on the container 242, to form the gas-tight cover 24. It should be noted that the screw cap 243 is provided with sealing means 36 suitable for ensuring impermeability against the gas.

[0047] Figure 10 schematically shows the step of applying the vacuum to the package 20 according to the invention. It should be noted that in the schematic representation of Figure 10 the walls of the cover 24 are deformed upon the action of the external pressure. In particular, the wall of the tubular portion 26 is slightly deformed in a radial direction towards the inside, resting on the ribs 22 which effectively counteract the action of the external pressure. The bottom of the container 242, shaped like an introverted dome, and the screw cap 243 which works as a membrane, effectively counteract the action of the external pressure.

[0048] As the skilled person may well understand, the container 242 of Figures 5 to 10 is much lighter and cheaper than a glass jar of the known type. The container 242 intended to constitute the gas-tight cover 24 according to the invention can be made of a limited quantity of polymer, for example polyethylene terephthalate or the like. Moreover, the gas-tight cover 24 must be at least partially flexible to be able to cooperate effectively with the inner ribs 22. Thanks to this feature, the package 20 according to the invention solves the problems related to the fragility of the glass.

[0049] As already mentioned above, the plurality of ribs 22 can be arranged in the form of a stack (ring-shaped ribs 22, see Figures 6 to 10 and 19) or in the form of a cylindrical helix (coil-shaped ribs 22, see Figures 14 and 17). For some aspects these two embodiments of the ribs 22 are similar and interchangeable. For example, it is clear that a cylindrical helix can perfectly replace a stack of equal outer diameter *D* and of equal axial extension.

[0050] However, the cylindrical helix implies at least one considerable advantage which is described herein with particular reference to Figure 14. As stated above, the ring-shaped ribs 22 of outer diameter *D* can be introduced only into an opening having an inner diameter that is slightly larger than *D*. Conversely, the coil-shaped ribs 22 with an outer diameter *D* can also be introduced into an opening having an inner diameter smaller than *D*. As can be seen in Figure 14, this result can be obtained thanks to the helical structure of the ribs 22, which can be introduced into the opening by a screwing movement. Furthermore, the coil-shaped ribs 22 of outer diameter *D* can also be introduced into a container 242 which has an inner diameter that is slightly smaller than *D*. By forcing the coil-shaped ribs 22 by means of a screwing movement, a radial outward preload is obtained which, during the operating life, helps the package 20 effectively counteracting the radial actions towards the interior.

[0051] With reference to Figures 15-16 and 18-19, further embodiments of the package 20 according to the invention are described below wherein inside the useful space 28 is provided an inner vessel 38 which houses the perishable goods 32 and is permeable to gases. Advantageously, the inner vessel 38 is suitable for defining a gap 50 between itself and the ribs 22. In other words, the inner vessel 38 is kept almost completely separated from the ribs 22 and from the cover 24. The gap 50 is preferably between 1 mm and 3 mm thick.

[0052] As the skilled person can well understand, when vacuum is created inside the cover 24, the gap 50 provides an excellent thermal insulation, with the effect of preserving perishable goods 32 for a longer time in an absolutely natural way.

[0053] The embodiment of Figures 15 and 16 is similar to that of Figures 5 to 10. According to this embodiment, the package 20 comprises an inner vessel 38 shaped like a cup. This inner vessel 38 houses the perishable goods 32 and is permeable to gases. In the specific example, the inner vessel 38 is provided in a package 20 whose cover 24 comprises a container 242 and a cap 243. However, as the skilled person can easily understand, the inner vessel 38 can also be arranged in different packages 20, for example wherein the cover consists of a flexible envelope 240 similar to that shown in Figure 2. Furthermore, in the specific example, the inner vessel 38 is arranged in a package 20 whose ribs 22 are of the ring type, arranged in a stack. However, as the skilled person can easily understand, the inner vessel 38 can also be arranged in different packages 20, for example wherein the ribs 22 are of the coil type, arranged in a single spring structure similar to that shown in Figures 14 and 17.

[0054] As can be seen, the inner vessel 38 comprises radial spacers 42 to keep it centred with respect to the useful space 28 in order to form the gap 50. Moreover, the inner vessel 38 comprises an axial abutment 44 which rests in the axial direction on the ribs 22, so that the bottom wall of the inner vessel 38 remains spaced from the bottom wall of the cover 24.

[0055] Thanks to its particular configuration, the inner vessel 38 is kept almost completely separated from the ribs 22 and from the cover 24. In other words, the inner vessel 38 is almost completely surrounded by the gap 50. The only contact of the inner vessel 38 with the other components of the package is limited to the radial spacers 42 and to the axial abutment 44. As the skilled person can well understand, the gap 50, when vacuum-sealed, allows an excellent thermal insulation and the extremely limited contact provides a very low thermal bridge.

[0056] Figures 18 and 19 show another embodiment wherein the individual ribs 22 are independent and separated from one another. Advantageously, they take the form of a ring, preferably closed on itself, which develops in a plane perpendicular to the axis *X*. Unlike the ribs 22 of Figures 11-13, the ring-shaped ribs 22 of Figures 18-19 further comprise an inner ring 380. Therefore, even in this case, the plurality of ribs 22 takes the form of a stack wherein the individual ribs 22 rest on one another in an axial direction. However, in addition with respect to the other embodiments, the plurality of inner rings 380 of the ribs 22 resting on one another in the axial direction form the inner vessel 38. According to this embodiment, the package 20 comprises an inner vessel 38 shaped like a stack. This inner vessel 38 houses the perishable goods 32 and is permeable to gases. In the specific example of Figures 18-19 the stack of ribs 22 with the inner ring 380 is not placed in any specific cover 24. As the skilled person can easily understand, this type of ribs 22 with inner vessel 38 can be arranged in different packages 20, for example wherein the cover 24 consists of a flexible envelope 240 or wherein the cover 24 comprises a container 242 and a cap 243.

[0057] As can be seen, to form the gap 50, the inner ring 380 comprises at least one radial spacer 42 which keeps it centred with respect to the respective rib 22 and therefore centred with respect to the useful space 28.

[0058] Even in this case, thanks to its particular configuration, the inner vessel 38 is kept almost completely separated from the ribs 22 and from the cover 24, almost completely surrounded by the gap 50. The only contact of the inner vessel 38 with the other components of the package is limited to the radial spacers 42. As the skilled person can well understand, the gap 50 allows an excellent thermal insulation and the extremely limited contact provides a very low thermal bridge.

[0059] As described above, the inner vessel 38 is permeable to gases, for example thanks to holes 40. In this way two different advantages are obtained. First of all, the inner vessel 38 must not withstand any pressure difference and can therefore have a very light structure. Furthermore, if perishable goods 32 release moisture, it can freely pass outside of the inner vessel 38. Should the moisture condense forming drops of water on the inner walls of the cover 24 or of the ribs 22, such drops would remain separated from the perishable goods 32, further improving their conservation.

[0060] In other embodiments, not shown in the attached figures, the cover 24 can be made of expanded polystyrene. As it is known, this material is widely appreciated for its thermal insulation properties and is therefore particularly suitable for packaging goods that are particularly vulnerable to temperature changes.

[0061] In light of all the above, it will be clear to the skilled person how the present invention applies a distinction of functions between the different components of the package 20. In particular, the ribs 22 are responsible for counteracting the radial thrust that acts from the outside towards the inside due to the pressure difference. Instead, the function of creating a gas-tight barrier in order to keep the vacuum inside the package 20 is assigned to the cover 24. For the purpose of comparison, it should be considered that in some packages of a known type these functions are performed by the same component. For example, the glass wall of a known type of jar performs both functions. Still for the purpose of comparison, it should be considered that in some packages of the known type one of the two functions is not carried out at all by the package. For example, the flexible vacuum-sealed bags entrust the mechanical contrast function to the same goods contained therein.

[0062] The separation of the two functions and the efficient cooperation between the stiff ribs 22 and the deformable cover 24 allow the package 20 according to the invention to be altogether lighter and cheaper than the known packages providing similar performances.

[0063] It is worth noting here that a plurality of ribs 22 arranged axially side by side (stack or helix) are able to counteract the radial thrust of the external atmospheric pressure more efficiently than a monolithic tube of equal radial thickness. Tests conducted by the applicants have in fact shown that a monolithic tube is more subject to macroscopic deformations with respect to a stack or helix of ribs 22 such as those described above. According to the applicants, the explanation of this phenomenon can be the following. In a continuous wall such as that of a monolithic tube, a small deformation induced by external pressure and/or other stresses such as the hand of a user who grasps the package immediately propagates to the surrounding area due to the structural continuity of the tube wall. This phenomenon induces a deformation that locally limits the shape resistance of the tube wall. The deformed area is therefore weakened and, being constantly exposed to external pressure, is subject to further deformation. For this reason, the deformation propagates immediately to the entire structure of the monolithic tube.

[0064] On the contrary, in a package 20 like the one of the invention, the possible deformation of a single rib 22 does not propagate at all to the adjacent ribs, since they can slide with respect to each other in a radial direction. Moreover, since the pressure acts first of all on the cover 24 and only indirectly on the ribs, the deformation in the radial direction towards the inside of a rib 22 immediately implies that the latter is partially discharged by the action of the pressure which, by means of the cover 24, is distributed on the adjacent ribs 22. In this way, the most deformed rib 22 tends to discharge and return to the undeformed state. On the contrary, the slightly more loaded ribs 22 are undeformed and continue to exploit at best their shape resistance. For these reasons, in the package 20 according to the invention a small deformation does not propagate and remains confined at a local level.

[0065] As the skilled person may well understand, the invention provides a package 20 suitable for optimally

preserving a wide variety of perishable goods. First of all, the package 20 according to the invention is particularly suitable for storing fresh foods, even when they are very delicate from the mechanical point of view. Moreover, the package 20 according to the invention is equally suitable for preserving other perishable goods such as flowers, herbal products, pharmaceutical products, tobacco, electronic components, archaeological finds and cultural assets of an organic nature, archival material such as papyrus, paper or photographic films or even organic finds of forensic interest.

[0066] As the skilled person can easily understand, the invention allows to overcome the drawbacks highlighted above with reference to the prior art. In particular, the present invention provides a package 20 suitable for preserving foods for a long time without altering their taste and organoleptic properties. In fact, the package 20 according to the invention allows to apply and maintain the vacuum for food preservation. The absence of oxygen and other gases such as nitrogen or carbon dioxide allows food to be preserved for a long time without altering its taste. Furthermore, the present invention provides a lightweight and low-cost vacuum-sealed package 20. In fact, the distinction of the functions allows, compared to the known solutions, to use lighter and cheaper materials and to limit their quantity.

[0067] It is clear that the specific features are described in relation to various embodiments of the invention with exemplifying and non-limiting intent. Obviously, a person skilled in the art may make further modifications and variations to this invention, in order to meet contingent and specific requirements. For example, the technical features described in connection with an embodiment of the invention may be extrapolated from it and applied to other embodiments of the invention. Furthermore, such modifications and variations are included within the scope of protection of the invention, as defined by the following claims.

Claims

1. Package (20) for perishable goods (32), comprising a plurality of ribs (22) and a gas-tight cover (24), wherein:

   - the gas-tight cover (24) comprises a tubular portion (26) which univocally defines an *X* axis;
   - the ribs (22) surround an inner useful space (28) that develops along the *X* axis; and
   - the cover (24) encloses the ribs (22) and the useful space (28).

2. Package (20) according to claim 1, wherein the ribs (22) are structurally separated from the cover (24).

3. Package (20) according to claim 1 or 2, further comprising an inner vessel (38) housed in the useful space (28) surrounded by the ribs (22) and intended to receive perishable goods (32).

4. Package (20) according to claim 3, wherein the inner vessel (38) has a maximum diameter *r* smaller than the inner diameter *d* of the ribs (22).

5. Package (20) according to claim 3 or 4, wherein the inner vessel (38) is gas-permeable.

6. Package (20) according to any one of claims 3 to 5, wherein the inner vessel (38) is configured so as to maintain an almost uniform distance from the ribs (22) and from the cover (24).

7. Package (20) according to one or more of the preceding claims, wherein the ribs (22) are independent and separated from each other.

8. Package (20) according with one or more of the preceding claims, wherein the ribs (22) have the shape of a ring extending in a plane perpendicular to the *X* axis.

9. Package (20) according to one or more of claims 1 to 6, wherein the ribs (22) have the form of coils of a cylindrical helix, constituting as a whole a single spring structure.

10. Package (20) according to one or more of the preceding claims, wherein the ribs (22) comprise axial spacers (30).

11. Package (20) according to one or more of the preceding claims, wherein the gas-tight cover (24) is able to define a continuous and complete barrier so as to maintain the desired vacuum degree inside the package (20) for a predefined period of time.

12. Package (20) according to one or more of the preceding claims, wherein the cover (24) is made of an at least partially flexible material.

13. Package (20) according to one or more of the preceding claims, wherein the cover (24) consists of a single piece.

14. Package (20) according to one or more of the preceding claims, wherein the cover (24) comprises a container (242) and a cap (243) which can be sealingly coupled.

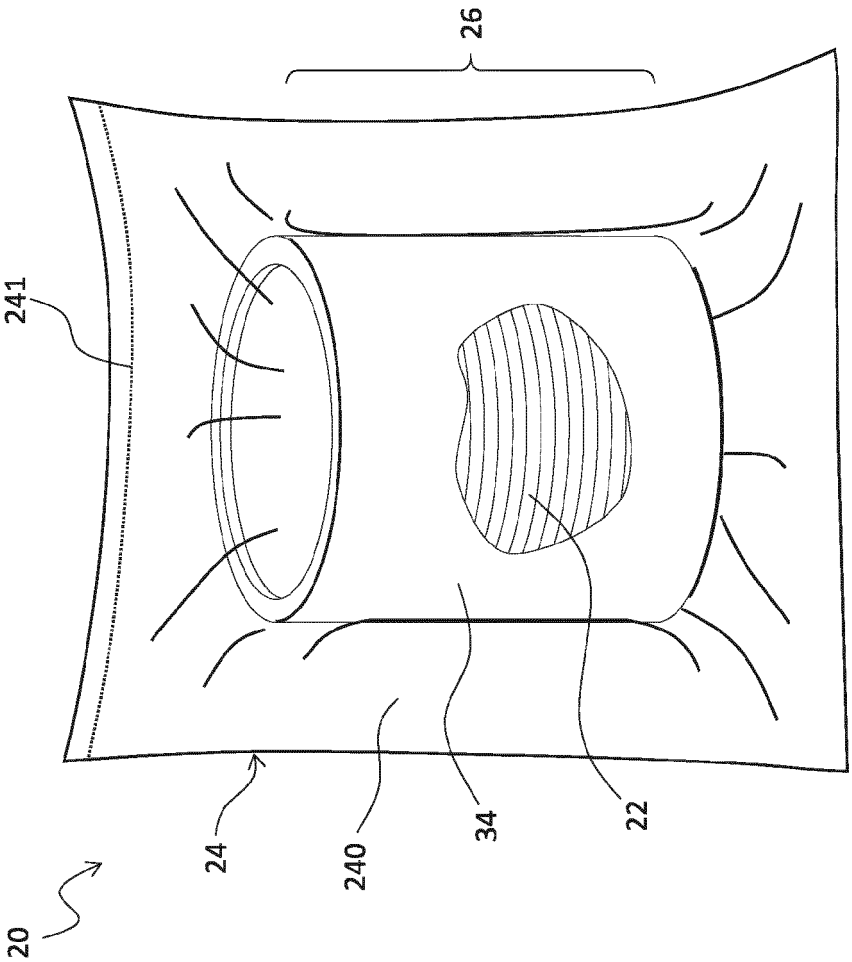

Fig. 2

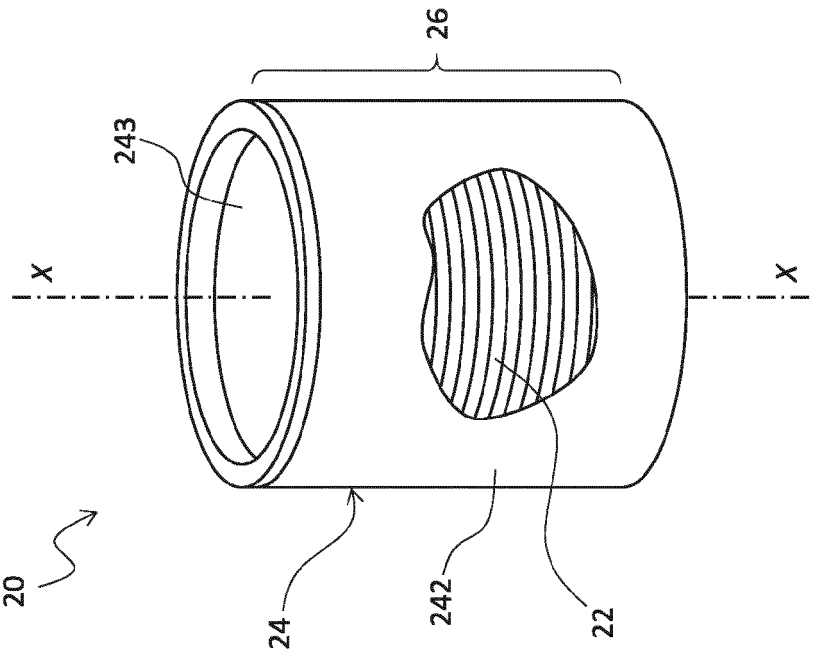

Fig. 1

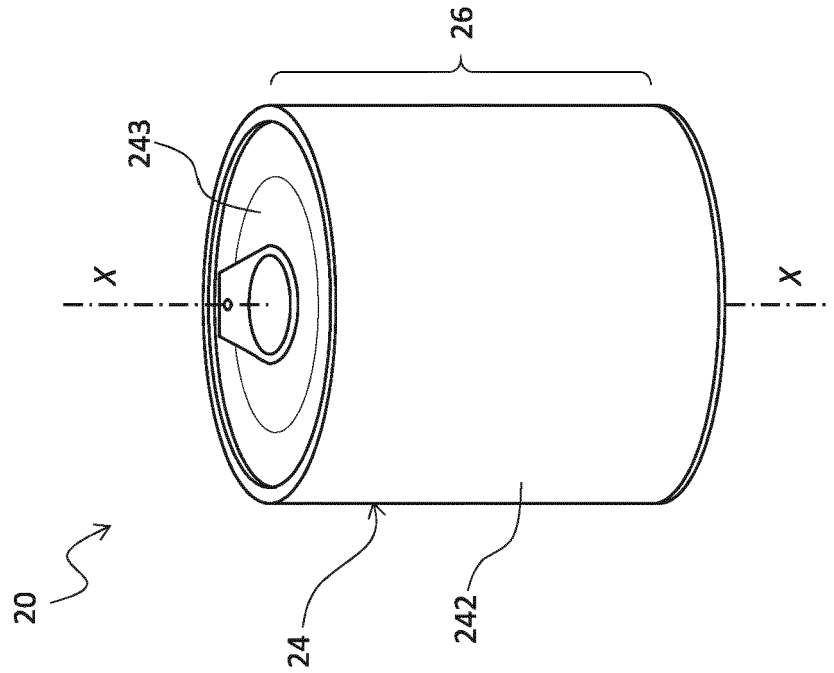

Fig. 4

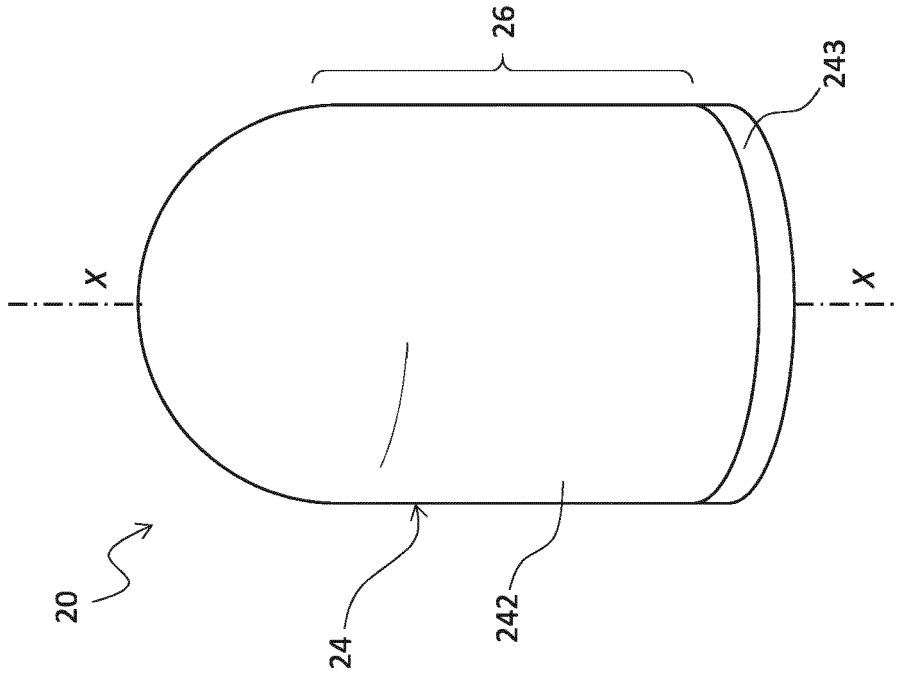

Fig. 3

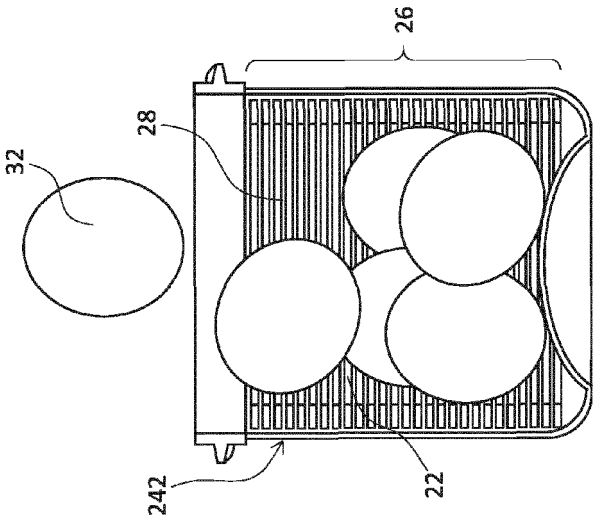

Fig. 7

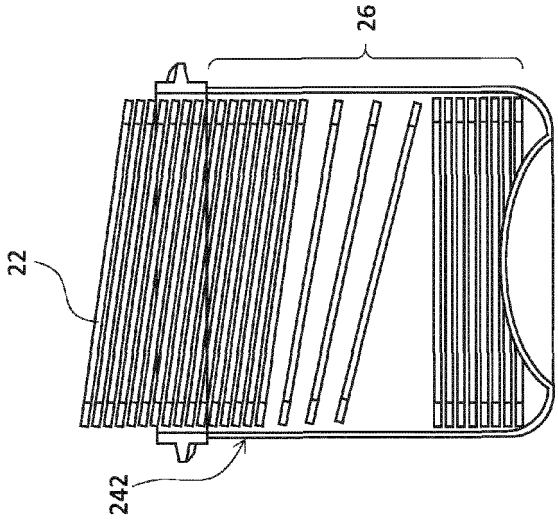

Fig. 6

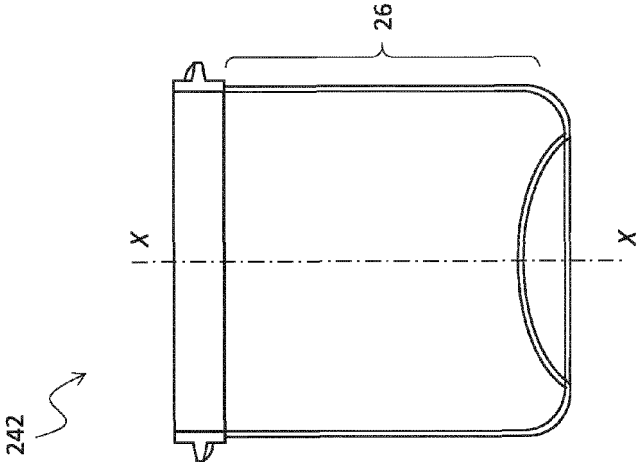

Fig. 5

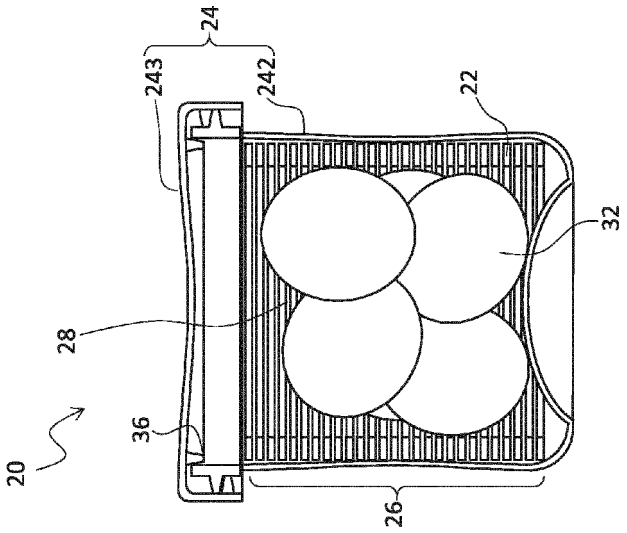

Fig. 10

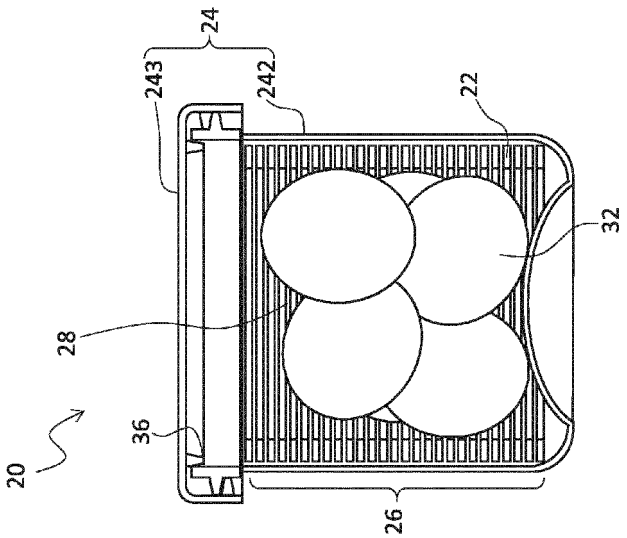

Fig. 9

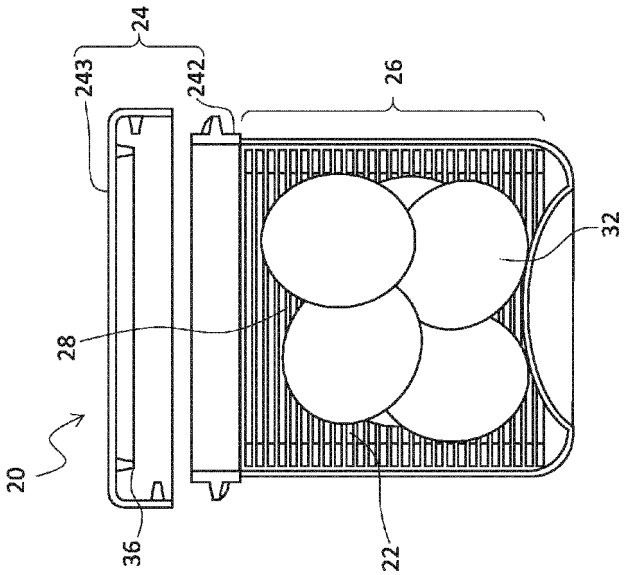

Fig. 8

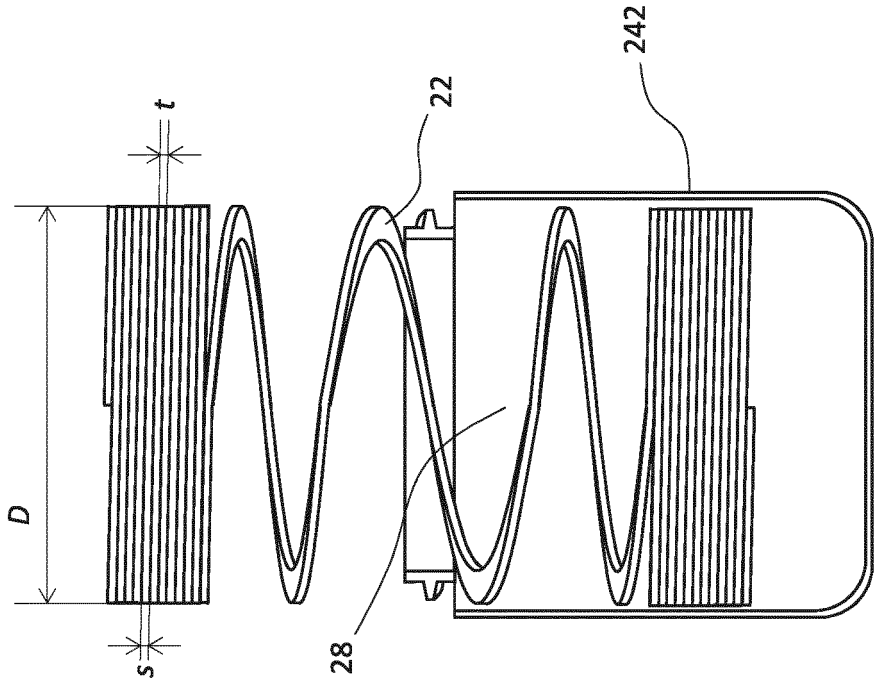

Fig. 14

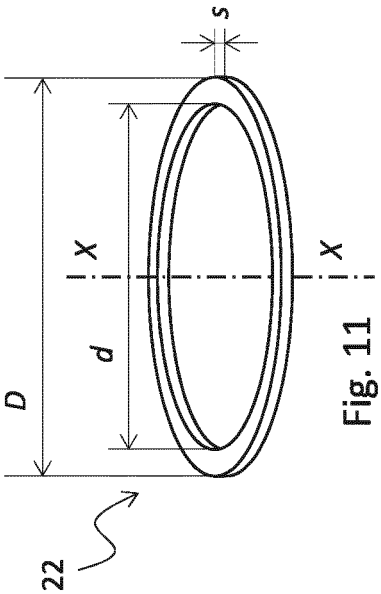

Fig. 11

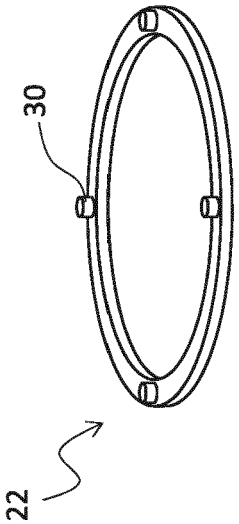

Fig. 12

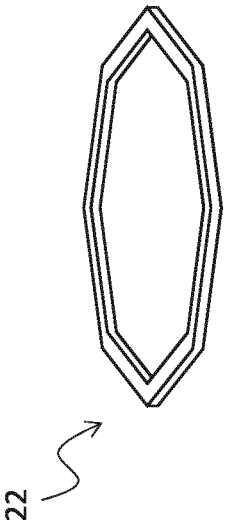

Fig. 13

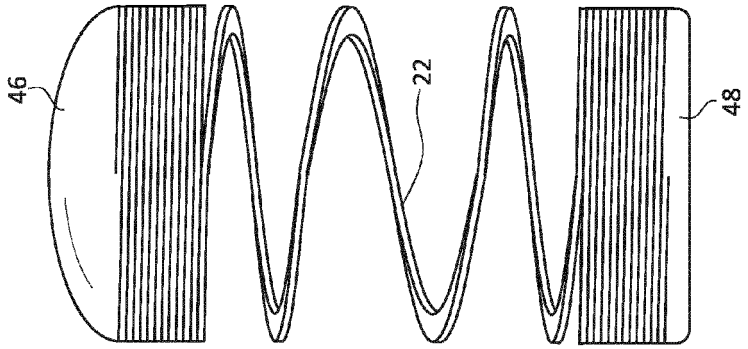

Fig. 17

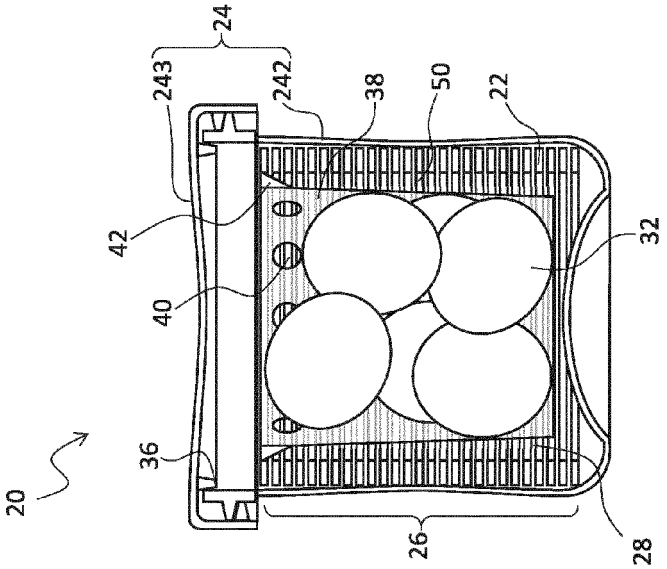

Fig. 16

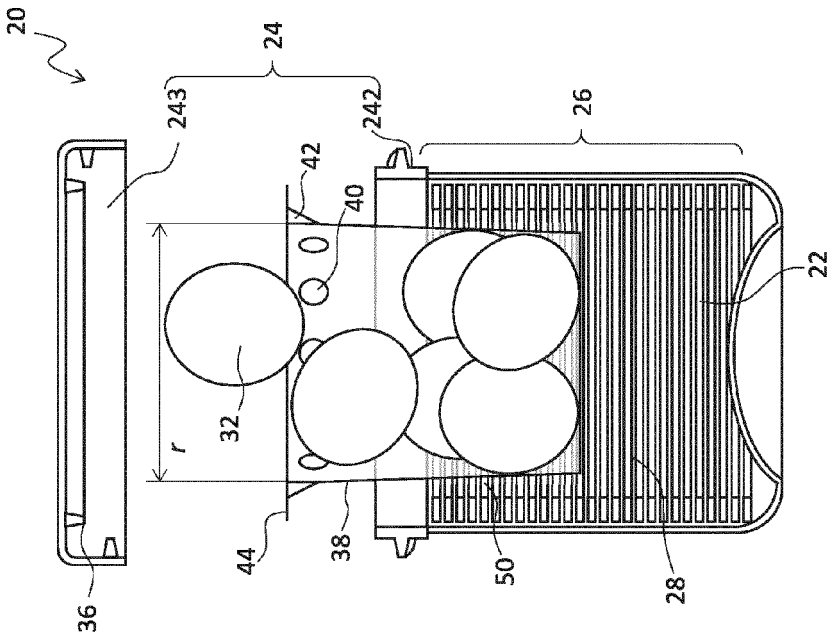

Fig. 15

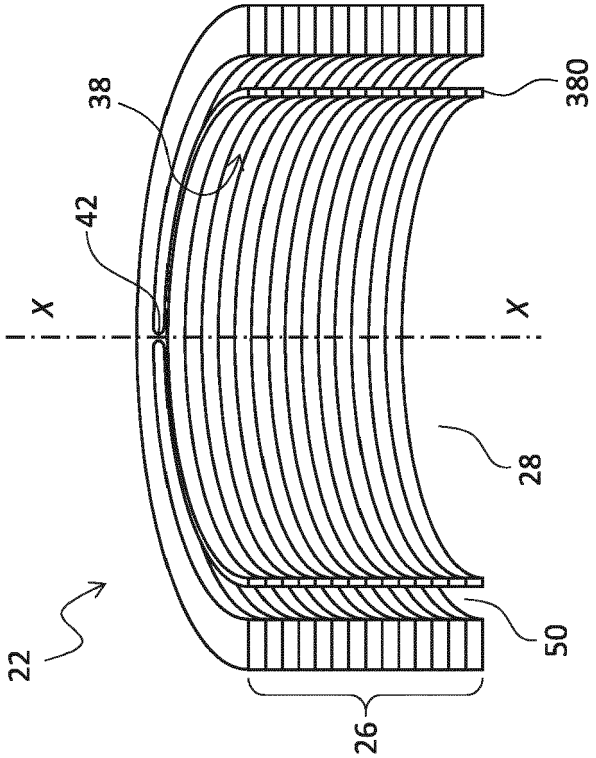

Fig. 19

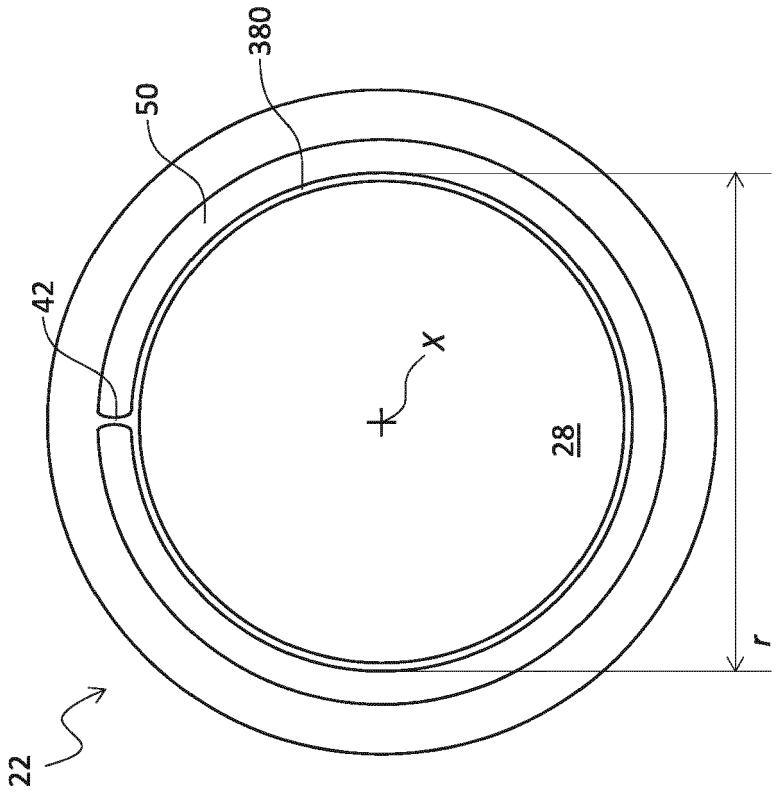

Fig. 18

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EUROPEAN SEARCH REPORT

Application Number
EP 19 18 4861

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 2009/230012 A1 (CHOY ANTHONY [US] ET AL) 17 September 2009 (2009-09-17) * paragraph [0019] - paragraph [0020] * * paragraph [0026] - paragraph [0028]; claims 1,11,12; figures 1,4,5 *	1-4,6, 8-12,14	INV. B65D81/20 B65D77/00 B65D77/04
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X	EP 1 502 874 A2 (TILIA INT INC [US]) 2 February 2005 (2005-02-02) * paragraphs [0001], [0005], [0009] * * paragraph [0016] - paragraph [0018] * * column 5, line 28 - line 31; figures 5,8 *	1,2,8, 11-13	
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B65D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	20 December 2019	Galli, Monia

CATEGORY OF CITED DOCUMENTS

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