ABSTRACT

In producing and filling packages made from a web of packaging material, the web is sterilized and folded lengthwise in a sterilizing station, a filling hose is introduced which extends to the filling station, the margins of the folded web are sealed together longitudinally and at desired intervals with partial transverse seals from side of the tube to the filling hose and after the filling station bridging the transverse seals to complete the transverse seals.

13 Claims, 6 Drawing Figures
METHOD AND APPARATUS FOR THE STERILE PACKAGING OF SUBSTANCES

The present invention refers to a process and apparatus for the sterile packaging of substances, especially fluid substances.

The invention particularly refers to those types of machines for the sterile packaging of fluid or semifluid substances, wherein a plastic web or a plastic coated paper web is unwound by a drive mechanism from a roll, is sterilized during a first portion of its path in a sterilizing station, thereafter doubled up lengthwise to bring together its two margins, led into a filling station, formed into a tube by sealing together longitudinally these margins at a level slightly above the level of the liquid substance introduced into said tube, subsequently the interior of said tube, with its contents, is separated into closed compartments by transverse seals applied to said tube at desired intervals and finally the tube is cut into individual containers corresponding to said seals. One of the main shortcomings of these types of packaging machines is that during its travel from the sterilizing station to the filling station, the folded web must remain open and therefore exposed to the penetration of unsterile outer air between its folds till just under the filling pipe or spout which introduces the liquid substance intended to form the contents of the packages. The other main drawback of these machines is that because of the above described arrangement of the filling pipe, the transverse seals must entirely be applied to the web, after it has been formed into a tube, at a point below the level of the liquid in it. This means that the seals must be applied under unfavorable conditions, against the pressure head of the overlying liquid, which tends to open these transverse seams before they have time to consolidate. In fact, the containers produced by said machines have a tendency to present faulty seals through which their contents may leak.

Therefore the main object of the present invention is the elimination of these and other inconveniences of the known packaging machines. The invention provides means for permitting the filling pipe to be placed between the doubled up web and the latter to be longitudinally sealed into a tube immediately after the termination of the sterilizing station, so that during its further path it is no more exposed to contamination by the external air. According to the invention, the filling pipe extends within the tube till the filling station, and partial transverse seals are applied to it at desired intervals while the tube interior is still dry and empty, so that these seals are not subjected to any liquid pressure and have time to consolidate prior to coming into contact with said liquid. Thanks to the provision of such partial seams, the transverse seams which complete the closure of the compartment, after the liquid has been introduced into the tube at the filling station, by bridging the gap left by the partial seams, are much shorter and therefore they can be applied more efficiently, because the pressure and the heat the sealing jaws have to produce for such shorter transverse seals can be concentrated upon a much smaller area.

In a strict interrelationship with these features, the invention provides new means to produce the longitudinal, the partial and the complementary transverse seams, and provides additionally novel web transport and guide means adapted to this novel packaging system.

Two embodiments of the invention will now be described with reference to the attached drawings, it being understood that their description and illustration is given for a purely illustrative and in no way limiting purpose.

In the drawings:

FIG. 1 is a schematical view of the first part of the first embodiment, taken along the broken line I—I of FIG. 3;

FIG. 2 is a schematic sectional view taken along line II—II of FIG. 1;

FIG. 3 is a schematic general lateral elevation of the apparatus;

FIG. 4 is a schematic view of the development of the packaging material, showing the various operating steps to which it is subjected in the apparatus according to the invention;

FIG. 5 is a schematic lateral elevation of the second embodiment;

FIG. 6 is a schematic front view of the packaging material, illustrating the various operating steps to which it is subjected in the apparatus according to FIG. 5.

With reference to FIG. 1, the web 1 of packaging material is unwound from a feed cylinder 2 and, after having passed over a guide roll 3, it passes under a small tank 4, which, through suitable feed means, is kept filled with a sterilizing liquid (hydrogen peroxide, eventually with the addition of a wetting agent). By means of a porous pad 5, said sterilizing liquid is transferred by capillary diffusion upon that surface of the web which will become the internal surface of the finished container and therefore will come into contact with the liquid.

Thus, this internal, plastic coated surface of the paper web receives continuously a film of a hydrogen peroxide solution. Web 1, while continuing its path, passes through a scoring station, represented by the scoring cylinders 6 and 7, which apply to the web the longitudinal, transverse and oblique scores, along which it is finally folded into containers. These scoring cylinders also act as drive cylinders, which operate stepwise and thereby bring about an intermittent movement of web 1. The latter passes thereafter over a guide roller, turns around an underlying compensating roll 9, rises thereafter to pass over another guide roll 10, mounted correspondingly to roll 8. Rolls 8 and 10 are mounted so as to resiliently compress the intervening web, whereby the liquid film of sterilizing substance is evenly distributed on said internal surface.

All the above described rolls are of course protected against contamination by dust and other foreign matter by a casing (not shown).

The positioning of the scoring rolls 6 and 7 successively to tank 4 and pad 5 is particularly advantageous since the scoring unit, which applies to the web scores of an appreciable depth, would press deeply into the web germs and other contaminating material, if the sterilizing agent were to be applied after the scoring unit, and such contaminants would not be reached by said agent.

According to the present invention, the sterilizing agent is applied only to the coated surface of the web, and not also to the opposite, external face, where it could discolor any lettering or figures printed on it.

During its further path, web 1, which issues flat from between rolls 8 and 10, is folded lengthwise along its center line 11 (see especially FIG. 2) into two halves,
so that its two longitudinal margins 12 and 13 approach and finally contact each other.

When web 1 reaches an upper guide roll 14, it is completely doubled up and in this condition it continues its travel beyond roll 14.

The approximate dihedral 15 formed by web 1 between rolls 8 and 10 and roll 14 is closed by any suitable means, such as by a triangular apron 16, whose base is located adjacent to the point of issuance of the web between rolls 8 and 10 and whose top is located adjacent to the point of contact of the web margins at the height of roll 14. Two sides of apron 16 are formed into flanges 17 and 18, which hug margins 12 and 13, while the central part 16' of the apron is bent inward, so that its walls practically parallel the two walls formed by web 1. The practically closed space formed by web 1 and apron 16 constitutes the sterilizing, drying and cooling chamber of the web. In fact, within said chamber the web receives, in counterflow to its movement, by means of an array of pipes 19 passing through said curved part 16' of the apron 16, jets of sterile and suitably heated air. In this manner the hydrogen peroxide film on the internal web face is dissociated into steam and nascent oxygen, thereby producing a sterilizing atmosphere which, together with the previous contact of the peroxide film on the coated web surface, ensures its complete sterilization. Advantageously the sterile air blown upon web 1 in the upper part of said chamber through tube 19' is cooler than the sterile air blown through the lower pipes, whereby in said chamber two zones of suitably differentiating thermal conditions are created, so as to obtain simultaneously a complete sterilization of the web as well as its complete drying and cooling to a temperature which is optimal for the successive steps of its treatment.

Means (not shown) are provided to withdraw the steam and oxygen charged air from the sterilization chamber and to subject it to a washing operation, so as to eliminate any disturbing effect this atmosphere may exert upon the machine personnel.

At the top of the sterilization chamber, slightly upstream of the point where the web is completely doubled up, a hose 20 of antifriction material, such as the one produced by Du Pont under the trade name "Teflon" is led through the apron 16 and between the folds of web 1.

With particular reference to FIGS. 1 and 3, the doubled up web passes from roll 14 between a pair of guide rolls 21 and 22, which also function as continuously acting drive rolls and impart a continuous uniform motion to the web, at a speed, which is slightly less than that which is imparted to said web by the scoring cylinders 6 and 7. The intermittent drive of the scoring rolls 6 and 7, the provision of the compensating roll 9 and the slower motion imparted by rolls 6 and 7 form altogether a safety feature of the device, so as to ensure the absorption of any accidental excessive stress to which the web could be subjected during its processing.

Rolls 14, 21 and 22 present a central annular groove 23, adapted to receive the bulge in the web produced by the hose 20 contained in it so that hose 20 may pass over roll 14 and between rolls 21 and 22 without being compressed and squeezed by the rolls. In other words, the provision of these grooves permits the web to be sealed longitudinally into a tube almost immediately after roll 14 and well ahead of the filling station.

The longitudinal sealing is effected by means of a pair of sealing rolls 24, 24' provided with suitable heating means, such as an annular electric resistor. Before reaching these sealing rolls, the margins of the web are preheated by sterile superheated steam, blown upon them through a pipe 25, whose opening is split so as to straddle said margins (see FIG. 1).

The lower end of tube 25 communicates with the sterilization chamber and the steam and the nascent oxygen passing through it serve to produce between the two folds of the web, which is not yet sealed at this point, a sterile atmosphere of a pressure which is higher than that of the surrounding air, thereby preventing this surrounding air from penetrating between said folds.

The web 1, which is now transformed into the tube 1', descends, after its passage through the guide rolls 21 and 22, vertically downward and passes through a pre-sealing station formed by the rolls 26 and 26', where partial transverse seals 37 (FIG. 4) are applied to it. These seals extend to the right and left of hose 20 to the side of tube 1'. It must be noted that these seals are applied while the tube 1' is still empty and dry, above the liquid level, which is marked with 31 in FIG. 3. Rolls 26 and 26' are equipped with radially extending sealing arms 27, which consist of units which transduce a suitable form of sealing power. Rolls 26 and 26' rotate intermittently so that the partial transverse seals are applied to it at regular pre-established intervals, corresponding to the height of the filled and finished containers.

After said pre-sealing station, tube 1' is passed between two heating units 28 and 28', which prepare it for the successive application of the complementary or bridging seals and thereby reduce the time necessary for the latter.

Slightly below the lower end of hose 20, marked at 32 in FIG. 3, these bridging seals are applied in a further station formed by rolls 29 and 29', each being fitted with sealing arms 30. The operation of this pair of rolls is similar to the already described operation of rolls 26 and 26'.

The width of these bridging seals is slightly larger than the diameter of hose 20. These bridging seals are the only ones applied to the tube after it has been filled, and due to their reduced area they permit a more uniform distribution and a greater concentration of the sealing heat and pressure. The width of these bridging seals is slightly larger than the gap between the partial seams, so that they overlap at both ends the latter, as shown in FIG. 4.

The transverse seals resulting from the combination of the partial seals with the bridging seals ensures containers which are perfectly tight and not liable to leaks.

The tube, which is now divided into liquid filled compartments by the transverse seals, is cut, corresponding to these seals, in the cutting station formed by rolls 34 and 34', fitted with radial cutting arms 35 and operating with the same rhythm as the transverse sealing rolls. The finished containers 33 may thereafter be conveyed to further stations, which impart to them their final shapes.

The development of the web is shown in FIG. 4, illustrating the continuous longitudinal seal 36 applied by rolls 24, 24', the partial transversal seals 37, applied by rolls 26 and 26', the bridging seal 38, whose ends overlap the internal ends of the partial seals 37, and finally
the transverse cut 39 along a center line of the transverse seals made by rolls 34 and 34'.

The second embodiment, as represented in FIG. 5, differs from the first one merely in the stations for the application of the partial and the bridging seals, and in the drive and timing of these stations. Therefore only this portion of the embodiment will be described and illustrated.

While the stations of the first embodiment permitted the packaging machine to operate with an intermittent motion, the transverse sealing station shown in FIG. 5 permits the machine to function with a continuous motion, thereby imparting to it a higher productivity.

With reference to FIG. 5, the transverse sealing station essentially comprises a pre-sealing or partial seal station generally indicated at 103 and a station, generally indicated at 104, for the application of the complementary or bridging seals to the tube 101. Station 103 consists of two vertically reciprocating frames 103a and 103b, each supporting a pair of sealing jaws 105, 106 and 107, 108 respectively, actuated in a horizontal reciprocating movement by means of pneumatic cylinders 110, 111, 112. During the descending motion of the frames 103a, 103b, the sealing jaws are in their operative, closed position. FIG. 5 shows frame 103a at the beginning of its descending motion, and frame 103b at the end of its descending motion. During this motion, the jaws of each frame apply the partial transverse seals 132 and 133 respectively and simultaneously engage the tube in their downward movement, while during their upward motion they are open and exert no influence on the tube. The movement of the frames 103a, 103b is timed so that the beginning of the operative step of one frame coincides with the end of the operative step of the other frame, this arrangement resulting in a practically continuous operation of the machine and in a practically continuous motion of tube 101.

Jaws 105, 106 apply, as already stated, to tube 101, the partial seals indicated at 132, while jaws 107, 108 are dimensioned and placed (FIG. 6) with respect of the tube so that they apply to it the partial seals 133, said partial seals 132 and 133 extending from the right and from the left side of the tube to the vicinity of the filling hole 134, which corresponds to the filling hole 20 in the first embodiment. The level of the liquid in the tube is indicated at 135, and it is situated below the lower dead center of the motion of frames 103a and 103b, so that these partial seals are applied to the still dry and empty tube.

The bridging or complementary seals (of which only the one completing seal 132 is shown at 150) are applied in station 104 by the frames 104a and 104b, which support the pairs of sealing jaws 136, 137 and 138, 139 respectively, which jaws are reciprocated by their respective pneumatic cylinders 140, 141 and 142, 143. Frame 103a is synchronised with frame 104a, while frame 103b is synchronised with frame 104b. Frames 103a and 103b are linked to the machine frame 119 by pairs of parallel cranks 113, 114 and 115, 116 respectively, the first pair being pivoted with one end to frame 103a at points 120 and 121, the second pair to frame 103b at points 122 and 123, both pairs of cranks being pivoted with their opposite ends to the machine frame 119 at points 117 and 118 respectively.

Frames 104a and 104b are connected in an identical manner by pairs of parallel cranks 144, 145 and 146, 147 respectively to the machine frame 119. Frames 103a and 104a are reciprocated by a common vertical control rod 124 linked to crank 114 at joint 126 and to crank 145 at joint 148, said control rod 124 receiving its motion from an eccentric 128. Similarly frames 103b and 104b are reciprocated by a common vertical control rod 125 linked to cranks 116 and 147 at joints 127 and 149 respectively, and driven by an eccentric 129. Both eccentrics are keyed to a common shaft and actuated by a motor 130 through the intermediary of a reduction gear 131. As already stated, the complementary transverse seals 150 bridge the gap left by the partial seals and slightly overlap the latter, so as to ensure complete transverse seals extending throughout the width of the tube 101.

Ultrasoundics have proved a very convenient form of energy for the bridging seals, although of course any other suitable form of energy may be employed for this purpose.

After the completion of the transverse seals, the tube is divided into individual liquid filled containers in a cutting station generally indicated at 151, formed by rotating blades 152, which separate the containers correspondingly to the center line of the transverse seals.

It is obvious that many variants and changes may be applied to both forms of embodiment of the invention. Thus, in the first embodiment, the partial sealing operation could be combined with the longitudinal sealing of the web, so as to obtain simultaneously, during its passage between roll 14 and rolls 21, 22, the longitudinal as well as the partial sealing. For this purpose rolls 24, 24' could be additionally fitted with electric resistors placed along their mantle in positions parallel to their axes and suitably spaced apart, so that this pair of rolls would simultaneously effect the longitudinal and the partial transverse sealing on one side of the two folds of web 1, while a similar pair of rolls would apply the partial transverse seals on the other fold. Similarly, in the sealing stations shown in FIG. 5, the position and the size of the single sections of the single portions of the transverse seals could vary. For instance, the partial seals 132 and 133 could all be applied to the same side of the tube, instead of on alternate sides, as shown in this figure. Similarly, their length could be greater than one half of the width of tube 1. It also possible to obtain the partial seals on two or more simultaneously applied stretches, these seals being aligned in a transverse sense of the tube. Obviously, a free stretch must remain interposed between those successive stretches, for the passage of the filling hole. The location and the length of the bridging seals will of course be adapted in this case to the already applied partial seals.

It is obvious that these and other variants and changes do not depart from the scope of the present invention.

What is claimed is:

1. A process for producing packages made from a web of packaging material and filling the packages with filling material, comprising the steps of:

   i. passing the web through a sterilizing station;
   ii. creating a sterilizing atmosphere within said sterilizing station;
   iii. folding said web lengthwise within said sterilizing station;
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7. Apparatus in accordance with claim 3, wherein said second sealing means, mounted before the open end of said tube, comprises: frames, reciprocable in the direction of travel of the web, each frame comprising two sealing jaw means, reciprocable in a direction perpendicular to the direction of travel of the web, for gripping the tube and imparting thereto partial transverse seals at the beginning and releasing the tube at the end of the forward motion of said frames and remaining open till the end of the backward motion thereof, the operations of said frames and jaw means being timed so as to also impart by their operation a continuous forward motion to said tube.

8. An apparatus in accordance with claim 3, wherein said third sealing means, mounted after the open end of said tube, comprises: frames, reciprocable in the direction of travel of the web, each frame comprising two sealing jaw means, reciprocable in a direction perpendicular to the direction of travel of the web, for gripping the tube and imparting thereto bridging transverse seals at the beginning and releasing the tube at the end of the forward motion of said frame, said jaw means remaining open till the end of the backward motion thereof, the operations of said frames and jaw means being synchronized with the motion and operation of said second sealing means.

9. An apparatus in accordance with claim 3, wherein said first sealing means comprises two continuously rotating sealing rolls gripping the margins of said web between them to impart to said tube a longitudinal seal along said margins and simultaneously impart thereto a continuous feed motion.

10. An apparatus in accordance with claim 3, further comprising: a pad means placed before the entrance to said sterilization housing for applying a film of sterilizing agent to the interior face of the web; scoring cylinder means located between said pad means and said housing for scoring the web corresponding to where it must successively be folded and imparting to said web an intermittent motion; a compensating roll located between said scoring cylinder means and said housing, the web being looped, with its interior face inward, around said compensating roll; distribution means, including a pair of guide rolls, for gripping the web at the end of the loop to press together the interior web faces to evenly distribute the film of sterilizing agent on the faces.

11. An apparatus in accordance with claim 10, wherein two walls of said sterilization housing are formed by the web, from the point at which it issues flat from between said pair of guide rolls to the point where it is completely folded, the third wall being formed by a triangular plate closing the approximate dihedral formed by said web.

12. An apparatus in accordance with claim 10, wherein said sterilization means includes pipes emitting hot sterile air to evaporate said film of sterilizing agent in said housing and pipes withdrawing said evaporated sterilizing agent from the interior of said housing.

13. An apparatus in accordance with claim 10, wherein said sterilizing agent in hydrogen peroxide.

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introducing into said folded web a flexible filling hose extending from said sterilizing station to a filling station; sealing together said folded web to form it into a tube at a sealing station downstream of said sterilizing station; applying to said tube between the sealing and filling stations, at predetermined intervals, partial transverse seals extending from at least one side of said tube to the vicinity of said filling hose; filling said tube at the filling station by passing the filling material through the filling hose into the tube; and applying bridging transverse seals to said tube to complete said partial seals therein at a bridging station downstream of said filling station.

2. A process in accordance with claim 1 further including the step of maintaining a sterile atmosphere in the interior of said web between the sterilizing station and the sealing station.

3. Apparatus for producing packages made from a web of packaging material and filling the packages with filling material, comprising: a sterilization housing having an entrance and an exit for the web passing therethrough; sterilization means connected to said housing for creating a sterilizing atmosphere therein; folding means within said housing for folding the web lengthwise along its centerline as it passes therethrough; a first sealing means located outside of said exit for joining together by a longitudinal seal the margins of the folded web to form it into a tube; a second sealing means located in the path of the web beyond said first sealing means for applying a partial transverse seal, at predetermined intervals, to the tube; a third sealing means located in the path of travel of the web beyond said second sealing means for applying bridging seals to said tube to complete its transverse seals; a filling hose, having an open end, passing into said sterilization housing and thence between the folds of the web and extending out of said housing with the web, the open end of said hose being positioned between said second and third sealing means; and drive means for causing the web to travel through said housing, then to said first sealing means, then to said second sealing means, past the open end of said hose and then to said third sealing means.

4. An apparatus in accordance with claim 3 wherein said drive means includes guide rolls interposed between said housing and the open end of said hose, said guide rolls having grooves therein corresponding to the position of said filling hose within the web to accommodate the bulge within the web caused by said hose.

5. An apparatus in accordance with claim 3 further including means for maintaining a hot sterile atmosphere of a pressure above that of the ambient atmosphere in the interior of the web between the exit of said housing and said first sealing means.

6. Apparatus according to claim 3 wherein said second sealing means comprise intermittently rotating rolls mounted at both sides of said tube before said filling station; sealing arms radially extending from said rolls, to grip and compress at pre-established intervals said still empty tube between them and to impart to it said partial transverse seals during said intermittent rotation of said rolls; and wherein said third sealing means similarly comprise rolls with radially extending arms, mounted at both sides of said tube after said tube filling station and provided with sealing arms to grip and compress said tube, after it has been filled, between them and to impart to it said bridging transverse seals.