

Method and Device for Producing and Filling Containers Made of
Thermoplastic Plastic and Containers Produced in Such a Way

The invention relates to a method for producing and filling containers made of thermoplastic plastic, in which an extruded plastic tube is inserted into an open mold having movable mold parts, the mold parts forming the container are closed, wherein the tube is expanded by a pressure gradient, acting on said tube, to the container, preferably in the form of a bellows, and is filled with a filling material, and the level of the filling material is raised by displacing the container volume in the direction of the container opening, wherein a container closure for the container opening is formed from the tube by closing the head jaws of the mold. Furthermore, the invention relates to a device for carrying out the method and to a container that is produced in such a way.

Methods of this type, such as the bottelpack[®] system, are widely used to produce containers of various shapes, sizes, and for different purposes. In this case, they can also be co-extruded containers. In particular, they can be transparent, flexible containers made of polyethylene or polypropylene. In many cases, the containers are both produced and also filled with a sterile filling material, such as pharmaceuticals, and sealed in an aseptic operation in one working step. Such a method is disclosed in document WO 2009/086864 A1.

When such containers are used in medicine, it is essential for the performance characteristics that the filling material can be removed in a suitable manner. If the filling material is, for example, a liquid that is to be infused, for example, an anesthetic, then it must be ensured that the container contains only a minimal residual volume of air, so that when the liquid is squeezed out by squeezing the flexible container, a highly accurate dosage of the liquid is delivered.

With respect to these requirements, the object of the present invention is to provide a method for producing containers which can be filled, with almost no air, in an economical and efficient way.

The invention achieves this object by means of a method having the features specified in claim 1 in its entirety.

Accordingly, one essential feature of the invention lies in the fact that the procedure for molding the container closure from the plastic tube is carried out in such a way that one section of the plastic tube remains unclosed and that a venting cannula is formed. In the same or in an additional displacement step, in which the level of the filling material is raised as required, the residual volume of air is displaced at this point from the container through the venting cannula; and thereafter the venting cannula and, with it, the container are closed by closing the head jaws or the auxiliary head jaws of the mold. When the liquid level is raised in this way, essentially no air or only a small volume of air remains inside the container after the venting cannula has been closed. Then the venting cannula itself or sections thereof can be removed along with the rest of the scraps. In one particular embodiment, the level could also be raised further or could be raised until the liquid is displaced through the respective venting cannula to the exterior; this would then result in a container having contents that are totally free of air.

If the venting cannula is formed at the upper end of the container closure, then any relevant residual volume of air can be removed without having to displace the contents as far as into the venting cannula.

Preferably, the venting cannula is closed directly at the wall of the container closure by means of the auxiliary head jaws, so that the venting cannula can be severed directly at the container closure; and, as a result, a larger, protruding remaining portion of the cannula does not remain at the container closure. This approach makes it possible to proceed in such an advantageous way that the venting cannula is not only closed by means of the auxiliary head jaws, but at the same time is also severed at the closing point or the welding spot. The auxiliary head jaws close the venting channel and, thus, create a thin section in the material, adjoining the container closure, by means of the cutting edges, so that there is also the possibility of removing with ease the so-called head flash together with the former venting channel in a stamping operation that takes place after the demolding process.

Preferably, the venting cannula is formed from a section of the plastic tube that is located outside the central region of the container closure. This arrangement allows, in an advantageous way, the central region of the container closure to remain without an attachment point or welding spot of the venting cannula, so that the applicability of the container closure as an infusion connecting head is not adversely affected.

The subject matter of the invention is also, according to claim 7, a device for carrying out the method. This device has movable mold parts for forming a container from an extruded plastic tube. In this case, the closing surfaces of the main head jaws of the mold that form the container closure have recesses that leave a section of the plastic tube unclosed in order to form a venting cannula; and the auxiliary head jaws, which can be moved relative to the main head jaws, can be moved into an active position that closes the venting cannula.

At the same time, the arrangement is configured preferably in such a way that the auxiliary head jaws are integrated into the main head jaws in such a way that these auxiliary head jaws, which penetrate the recesses, can be moved into the active position in the direction of the closing motions of the main head jaws.

The auxiliary head jaws can be moved in an especially advantageous way by means of working cylinders, which are located in the main head jaws and can be actuated by means of pressurizing media. In addition or as an alternative, it is also possible for servo motors to replace the said working cylinders.

Furthermore, the subject matter of the invention is also, according to claim 10, an air-free container, which is produced according to the inventive method by means of the device according to the invention; and said container has a closed attachment point of a severed venting cannula.

The invention is explained in detail below with reference to the drawings. Referring to the drawings:

- FIG. 1 is a side view of one embodiment of a container that is drawn slightly smaller in size compared to a practical embodiment, with this container being produced according to the invention in the form of a bellows, which can be axially pressed together, before the venting cannula has been severed;
- FIG. 2 is a perspective oblique view of the container that is scaled down compared to the container shown in FIG. 1;
- FIG. 3 is an oblique view of the container that corresponds to the one in FIG. 2, after the venting cannula has been severed;
- FIG. 4 is a simplified drawing in schematic form of a partially closed blow mold with the container formed therein, wherein the operating state of filling the container with

- filling material is shown, and the head jaws of the mold that form the container closure are shown in the open position;
- FIG. 5 is a simplified top view in schematic form of the container from FIG. 4, where only the open head jaws of the mold parts are visible;
- FIG. 6 is a view similar to the one in FIG. 4, but the fill level of the filling material is raised in a first displacement step;
- FIG. 7 is a top view that corresponds to the view in FIG. 5 of the container from FIG. 6;
- FIG. 8 is a view similar to the one in FIG. 6, but the head jaws of the mold are closed, so that a container closure and a venting cannula are formed from the plastic tube;
- FIG. 9 is a top view of FIG. 8, but drawn to a larger scale;
- FIG. 10 is a view similar to the one in FIG. 8, but the fill level of the filling material is raised further in a second displacement step;
- FIG. 11 is a top view of FIG. 10 that corresponds to the view in FIG. 9;
- FIG. 12 is a view similar to the one in FIG. 10, where the auxiliary head jaws are shown closed; and the venting cannula is closed and severed by means of said auxiliary head jaws, and
- FIG. 13 is a top view of FIG. 12 that corresponds to the view in FIG. 11 and shows the auxiliary head jaws in the closed position.

The invention is explained below by means of the example of a container 1 that is configured as a bellows and that is shown in detail in FIGS. 1 to 3. It is clear that the invention can also be used just as advantageously for the production of containers with smooth walls. FIGS. 1 and 2 show the container 1 in an unfinished state, in which it is removed from a blow molding machine, so that the venting cannula 3 is not closed and not severed from the container closure 5. FIG. 3 shows the finished state, in which the venting cannula 3 has been severed from the container closure 5 at a welding spot or attachment point 7. It is clear from the drawing that the

venting cannula 3 and, thus, the attachment point 7 are located at a point that is moved outside the central region of the container closure 5.

FIG. 1 shows that the bottom of the container 1 is not formed flat, but rather exhibits a convexity 9 toward the inside. When the liquid is dispensed from the container 1, it is possible to displace the liquid from the container 1 by squeezing the bellows, so that no residual volume of liquid remains, because the convexity 9 forms a displacer body that compensates for the dead length that remains when the bellows is pressed completely together.

FIGS. 4 to 13 show the sequence of the method according to the invention, which is carried out on the basis of the known bottelpack[®] system. In this context, FIGS. 4 and 5 show the container 1, which is formed from a plastic tube 13 in a blow mold 11, while filling said container with liquid filling material 15. In this case, the movable head jaws 17 of the blow mold 11 are located in the open position, so that the container closure has not been formed yet by these head jaws 17 and, therefore, the container 1 is still open. FIGS. 6 and 7 show a first displacement step, wherein a displacer plunger 19 displaces the container volume starting from the direction of the bottom 21, so that the liquid level 23 of the filling material 15 rises to the mid-level height shown in FIG. 6. Once again, the head jaws 17 are located in the open position, so that the top view in FIG. 7 corresponds to the top view from FIG. 5.

It is apparent from FIGS. 5 and 7 that the closing surfaces 24 of the head jaws 17 have semi-cylindrical recesses 25 that face each other. When the head jaws 17 are moved toward each other, as illustrated by the arrows in FIG. 8 and, as a result, a container closure 5 is formed from the plastic tube 13 (see FIGS. 8 and 9), that section of the plastic tube 13 that may be found in the recesses 25 remains unclosed, so that the venting cannula 3, shown in FIGS. 1 and 2, is formed. The recesses 25 are located outside the central region of the head jaws 17 (see FIGS. 5 and 7), so that the venting cannula 3 opens, as stated, eccentrically on the container closure 5.

FIGS. 10 and 11 illustrate a state in which a second displacement step is carried out by means of the displacer plunger 19 after the formation of the container closure 5 and the venting cannula 3 while the head jaws 17 are still closed, so that the liquid level 23 rises as far as up to the vicinity of the opening region of the venting cannula 3 inside the container closure 5, while the air flows out of the container 1 through the venting cannula 3. As a result, the container 1 is practically free of a residual air volume.

Having reached this state, the venting cannula 3 is closed, as shown in FIGS. 12 and 13. This closing is performed by means of the auxiliary head jaws 31, which are integrated into the head jaws 17. As shown with the motion arrows 33 in FIGS. 12 and 13, these auxiliary head jaws can be moved toward each other. The auxiliary head jaws 31 have welding edges 35, which perform a closing and severing action at the venting cannula 3, so that the venting cannula 3 is severed from the container closure 5 at the attachment point 7. The auxiliary head jaws 31 are actuated by means of actuating cylinders 37 (FIG. 13), which can be actuated by means of pressurized media.

C l a i m s

1. A method for producing and filling containers (1) made of thermoplastic plastic, in which an extruded plastic tube (13) is inserted into an open mold (11) having movable mold parts, the mold parts forming the container (1) are closed, wherein the tube is expanded by a pressure gradient, acting on said tube, to the container (1), preferably in the form of a bellows, and is filled with a filling material (15), and the level (23) of the filling material (15) is raised by displacing the container volume in the direction of the container opening, wherein a container closure (5) for the container opening is formed from the tube (13) by closing the head jaws (17) of the mold (11), **characterized in that** the container (1), preferably in the region of the container closure (5), is formed in such a way that at least one section of the plastic tube (13) initially remains unclosed in order to form a venting cannula (3) and that, when the container volume is displaced, the level (23) of the filling material (15) is raised in such a way that at least the air is displaced from the container (1) through the venting cannula (3), and the respective venting cannula (3) is closed by closing the head jaws (17) or the auxiliary head jaws (31).
2. The method according to claim 1, characterized in that the venting cannula (3) is formed in the region of the upper end of the container closure (5).
3. The method according to claim 2, characterized in that the venting cannula (3) is closed directly at the exterior of the container closure (5) by means of the auxiliary head jaws (31).
4. The method according to claim 3, characterized in that the venting cannula (3) is severed directly at the wall of the container closure (5) by means of the auxiliary head jaws (31).

5. The method according to one of claims 1 to 4, characterized in that the venting cannula (3) is formed from a section of the plastic tube (13) that is located outside the central region of the container closure (5).
6. The method according to one of claims 1 to 5, characterized in that the displacement of the container volume is carried out in such a way that a convexity (9) of the bottom (21) is produced, starting from the bottom (21) of the container into the interior of the container (1).
7. A device for carrying out the method according to one of claims 1 to 6, comprising movable mold parts for forming a container (1) from an extruded plastic tube (13), characterized in that the closing surfaces (24) of the main head jaws (17) of the mold (11) that form the container closure (5) have recesses (25) that leave a section of the plastic tube (13) unclosed in order to form at least one venting cannula (3), and that the auxiliary head jaws (31), which can be moved relative to the main head jaws (17), can be moved into an active position closing the venting cannula (3).
8. The device according to claim 7, characterized in that the auxiliary head jaws (31) are integrated into the main head jaws (17) in such a way that these auxiliary head jaws, which penetrate the recesses (25), can be moved into the active position in the direction of the closing motions of the main head jaws (17).
9. The device according to claim 7 or 8, characterized in that the auxiliary head jaws (31) can be moved by means of working cylinders (37), which are located in the main head jaws (17) and can be actuated by means of pressurized media.

10. An air-free container (1), which is produced according to the method according to one of claims 1 to 6, by means of the device according to one of claims 7 to 9, said container having a closed attachment point (7) of a severed venting cannula (3).