

Apparatus for Producing at Least One Container, in Particular
in Ampule Form, Made of Thermoplastic Material

The invention relates to an apparatus for producing at least one container, in particular in ampule form, made of a thermoplastic material, said apparatus comprising a mold with mold components, which can be moved between an open position and a closed position in relation to one another and in which a synthetic plastic material can be placed against the wall of the mold by means of a pressure gradient, which acts on said plastic material in order to form the container; comprising a first and a second calibrating mandrel, which can be moved coaxially in relation to the longitudinal direction of the container and to one another, wherein the first calibrating mandrel and the second calibrating mandrel can move in relation to one another, so that the first calibrating mandrel can move through the container, which is located in the mold, and the second calibrating mandrel can move from the outside of the container, into a shaping position in which they calibrate a bottom area, which forms at least part of a container bottom, between their mandrel ends; and comprising a severing device, which has a movable cutting or punching surface in order to sever excess plastic material, which forms in interaction with a cutting or contact edge on the mold components assigned to the bottom region, during the shaping process.

In order to produce different types of plastic containers, in particular also containers that resemble ampules for pharmaceuticals, reagents, or the like, in an efficient and economical manner, the prior art uses to advantage apparatus that work according to the well-known bottelpack[®] process.

These apparatus enable the desired container shape to be expanded from the plastic material, which is extruded into a mold, by means of blow molding or by means of vacuum molding and, if it is desired, to fill the container in the mold. Since no handling outside the mold is necessary between the molding process of the container and its filling, the requirements for cleanliness and/or sterilization of the filling can be reliably fulfilled.

When the finished containers are used at a later date, for example, in the field of pharmaceuticals and medicine, the filling is usually extracted through the bottom of the container, for example, by inserting a canula or by tearing open a bottom area. In order to ensure a fail-safe extraction of the container content, it is prior art to perform a calibration at the bottom area relevant for the extraction process. Document DE 30 05 931 A1 discloses an apparatus of the type described in the foregoing. For this purpose, the prior art apparatus has movable calibrating mandrels, which can be moved coaxially in relation to one another from both sides of the container bottom of the container, which is located in the mold, into a shaping position, in which they calibrate the bottom area between their mandrel ends in such a way that a bottom-side wall region of defined shape and wall thickness is formed as a diaphragm. The excess plastic material, produced during the shaping process, is severed from the mold components, assigned to the bottom region, by means of a severing device, provided in the prior art apparatus in order to end the production process of the bottom region.

Proceeding from this prior art, the object of the present invention is to provide an apparatus in which higher accuracy and process reliability with respect to the calibrating and severing can be achieved in a simple and easy way.

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

According to the characterizing part of claim 1, an essential feature of the invention lies in the fact that the severing device has a cutting device, which is guided in an axially displaceable manner on the second calibrating mandrel, forms the cutting or punching surface, and can move between the retracted position and the punching position independently of the movement of the respective calibrating mandrel. Whereas in the aforementioned solution known from the prior art the second calibrating mandrel forms both the calibrating surface on the end of the mandrel and also forms the punching surface of the severing device with a step, which is set back from the end of the mandrel, at the transition to a larger diameter of the mandrel, in the case of the invention, the calibrating and severing functions are completely decoupled from one another. This means that the lifting motion of the mandrel for the calibrating process can be configured and controlled in such a way that the closing position is reached at exactly the point that is optimal for the position and wall thickness of the bottom area to be calibrated. In contrast to the invention, the prior art solution makes the movement of the calibrating mandrel a function of a percussion movement that is suitable for the punching process, so that, if suitably fine tolerances can be maintained, it can be guaranteed that this punching movement will bring the mandrel end into the closing position that is optimal for the calibrating process. In contrast to this prior art solution, the present invention provides that the punching movement takes place, independently of the calibrating process, with the percussion movement that is optimal for the severing process.

In this context, the cutting device can comprise in an especially advantageous way a cutting sleeve, which is guided in a displaceable manner on the second calibrating mandrel and which has a front edge, on which the cutting or punching surface is formed. Despite the advantageous decoupling of the punching and calibrating process, the result is a simple compact design, because, like the solution known from the prior art, the calibrating mandrel and the cutting device are combined into one structural unit that in the case of the present invention consists of two coaxial elements that can be moved relative to one another.

In advantageous exemplary embodiments, the first calibrating mandrel can have on the mandrel end a molded body with an end surface for the purpose of calibrating the bottom area and with a conical part, which is connected to the end surface and which widens away from the end surface in order to form a bottom cup of the container, with this bottom cup being adjacent to the bottom area. In addition to its calibrating function, the first calibrating mandrel acts as a movable mold component that imparts to the container a cup shape adjacent to the container bottom.

The second calibrating mandrel can have in an especially advantageous way a conical part on the mandrel end. This conical part is connected to that end surface of the calibrating mandrel that calibrates the bottom area; and this conical part widens away from the end surface in order to form an outward widening dispensing spout that has a shape resembling a shirt.

In view of actuating the second calibrating mandrel, the arrangement can be configured to advantage so that separately actuatable drive devices are provided in order to generate the back and forward movements of the second calibrating mandrel between the retracted position and the shaping position and in order to generate the movements of the cutting sleeve between the retracted position and the punching position.

Furthermore, two pairs of first and second calibrating mandrels that can be moved in parallel to one another can be provided for two containers that are to be formed by means of common mold components, with both second calibrating mandrels being mounted on a base body that can be moved by a mandrel drive.

In especially preferred exemplary embodiments, the arrangement is configured in such a way that the second calibrating mandrels penetrate a support plate, on which the respective cutting sleeves are mounted and that can be moved relative to the base body by means of a punch drive in order to move the cutting sleeves relative to the second calibrating mandrels between the retracted

position and the punching position. This arrangement allows a punch drive that is common for both cutting sleeves to be implemented in a very easy way.

The punch drive can comprise to great advantage at least one working cylinder, which is fitted between the base body and the support plate and is actuated with a pressure medium in order to generate the relative movements between the base body and the support plate. As an alternative, an electric linear drive, for example, in the form of a spindle drive or the like, could be provided. The same applies to the mandrel drive that generates the movements of the base body.

In especially preferred exemplary embodiments, the support plate has at least one ejector pin, which extends parallel to the respective cutting sleeve and which ejects the respective containers from the mold in the course of the severing process, i.e., during the punching movement that extends in the direction of the bottom region of the mold.

The invention is explained in detail below by means of one exemplary embodiment that is depicted in the drawings. Referring to the drawings:

- FIG. 1 is a longitudinal view of an exemplary embodiment of the apparatus according to the invention in a simplified schematic form, wherein the calibrating mandrels are shown in the shaping position, and the cutting sleeves are shown in the retracted position;
- FIG. 2 is a longitudinal view of a container, which is produced with the apparatus and has the shape of an ampule, with the container drawn about twice the size of a practical embodiment;
- FIG. 3 shows an enlarged portion of the area designated as III in FIG. 1, and
- FIG. 4 is a broken out section similar to the one shown in FIG. 3, where a cutting sleeve is shown prior to reaching its punching position; and where the punching surface of the cutting sleeve is still located at a distance from the assigned cutting edge.

The invention is explained below by means of one example, in which the apparatus is provided for producing containers in the form of an ampule, of which one is shown separately in FIG. 2 and is designated as 1. The container 1, which is shown in the closed state, but without the filling in FIG. 2, has a dispensing end 3 for subsequent use. At this dispensing end, the circularly cylindrical main part 5 of the container 1 undergoes transition into a bottom cup 7, which is defined by conical surfaces, which converge in the direction of the container bottom, which is formed by a bottom area 9, which forms the bottom-side closure of the container 1. In the present case, the bottom area 9 is designed as a diaphragm and is calibrated in such a way that it forms a closure element that is optimal for the subsequent use of the container 1. Connected to the bottom area 9 is a dispensing spout 11, which is defined by diverging side walls.

FIG. 1 shows those parts of the apparatus for producing the container 1 that are necessary for understanding the invention. Since the apparatus is based on the well-known bottelpack[®] system, only the movable mold components 15, 17 of the pertinent blow mold, which forms two mold cavities 13, which lie side by side in a tandem arrangement, for the simultaneous production of two containers 1, are indicated as the main jaw and the head jaw. The other components, such as the blowing mandrels, the filling mandrels, and the like, are not shown in FIG. 1, because they can be constructed according to the prior art. However, FIG. 1 shows very clearly in conjunction with FIGS. 3 and 4 those components that are relevant for forming the dispensing end 3 of the container 1 with the bottom cup 7, the calibrated bottom area 9, and the dispensing spout 11.

As shown in the prior art document (DE 30 05 931 A1), the apparatus has a pair of first calibrating mandrels 19, which can be moved coaxially to the longitudinal axis 21 that corresponds to the longitudinal axis of the container 1 that is to be formed. The drive for the movements of the first calibrating mandrels 19, each of which may be found, as depicted in FIG. 1 as well as in FIGS. 3 and 4, in the shaping position, can be designed in the standard way according to the prior art. The first calibrating mandrels 19 extend through the mold cavities 13, i.e., through the interior of the respective container 1, so that, in the shaping position, these first calibrating mandrels can

perform, in interaction with a pair of second calibrating mandrels 23, the calibration of the bottom area 9 of the container 1. The second calibrating mandrels 23 extend coaxially to the longitudinal axis 21 and to the first calibrating mandrels 19. The first and second calibrating mandrels 19 and 23 form a calibrating surface 25 and 27, respectively, on their end. In the depicted exemplary embodiment, these two calibrating surfaces are flat surfaces, so that in the present case a bottom area 9, which has the shape of a flat diaphragm, can be calibrated.

It goes without saying that in order to calibrate a curved or contoured bottom area, corresponding shapes of the calibrating surfaces 25, 27 could be provided. In the figures, in which none of the synthetic plastic material, which may be found in the mold cavity 13, is shown for the sake of simplifying the drawings, the calibrating surfaces 25, 27 are shown as abutting one another. Under normal operating conditions, however, with the calibrating mandrels 25, 27 in the shaping position, there is a gap (not shown in the drawing) that corresponds to the wall thickness of the bottom area 9 that resembles a diaphragm.

The first calibrating mandrels 19 have on the mandrel end a molded body 29 with an end surface, which forms the calibrating surface 25, to which a conical part 31 is connected. This conical part widens away from the calibrating surface 25 in order to form the bottom cup 7 of the container 1, where said bottom cup is adjacent to the bottom area 9. Similarly, the respective second calibrating mandrel 23 has on the mandrel end a conical part 33 that is connected to the calibrating surface 27, which calibrates the bottom area 9 and that widens away from the calibrating surface 27 in order to form the outward widening, shirt-like dispensing spout 11 of the container 1.

The severing device of the apparatus is shown in greater detail in the FIGS. 1 and 4. It is very clear that a cutting sleeve 35 is guided with a sliding fit on each of the two calibrating mandrels 23 in such a way that said cutting sleeve can be moved in the axial direction. It is most easily discernible from FIG. 4 that the front edge of the cutting sleeve 35 has an inclined surface 37

that interacts with a cutting or contact edge 39 as the punching surface. This cutting or contact edge is formed by the end edge of the outlet opening of the mold component 17. When in operation, the cutting sleeve 35 is moved out of the position shown in FIG. 4 on the second calibrating mandrel 23 into the punching position, i.e., upward in FIG. 4; then the excess synthetic plastic material, which surrounds the end edge of the molded dispensing spout 11, is cut off.

FIG. 1 shows that both cutting sleeves 35 have ends that are opposite the inclined surface 37 and are supported on a common support plate 38 that is pierced by the second calibrating mandrels 23, but can be moved relative to these calibrating mandrels. The second calibrating mandrels 23 are fastened on a base body 41, with which a linear drive 43 engages. This linear drive forms the mandrel drive for the movements of the second calibrating mandrels 23. This drive 43 can be an electric, hydraulic, or pneumatic drive. Independently of the movements of the base body 41 and with it the calibrating mandrels 23, the support plate 38 and with it the cutting sleeves 35 can be moved relative to the second calibrating mandrels 23 by means of a punch drive. In the present exemplary embodiment, two working cylinders 45 are provided as the punch drive. On both sides of the calibrating mandrels 23, one of these two working cylinders is arranged between the base body 41 and the support plate 38; and both working cylinders can be hydraulically or pneumatically operated in order to generate the punching movement of the cutting sleeves 35. Instead of the working cylinders 45, other types of linear drives could also be used. Laterally next to each of the cutting sleeves 35, ejector pins 47 are mounted on the support plate 38; and these ejector pins extend parallel to the cutting sleeves next to the cutting sleeves 35; and the material that remains after the severing process, including the container 1, is ejected from the opened mold.

C l a i m s

1. An apparatus for producing at least one container (1), in particular in ampule form, made of a thermoplastic material, said apparatus comprising a mold (13) with mold components (15, 17), which can be moved between an open position and a closed position in relation to one another and in which a synthetic plastic material can be placed against the wall of the mold (13) by means of a pressure gradient, acting on said plastic material in order to form the container (1); comprising a first (19) and a second calibrating mandrel (23), which can be moved coaxially in relation to the longitudinal direction (21) of the container (1) and to one another, wherein the first calibrating mandrel (19) and the second calibrating mandrel (23) can move in relation to one another, so that the first calibrating mandrel (19) can move through the container (1), which is located in the mold (13), and the second calibrating mandrel (23) can move from the outside of the container (1), into a shaping position in which they calibrate a bottom area (9), which forms at least part of a container bottom, between their mandrel ends (25, 27); and comprising a severing device, which has a movable cutting or punching surface (37) in order to sever excess plastic material, which forms, in interaction with a cutting or contact edge (39), on the mold components (17) assigned to the bottom region, during the shaping process, **characterized in that** the severing device has a cutting device (35), which is guided in an axially displaceable manner on the second calibrating mandrel (23), forms the cutting or punching surface (37), and can move between the retracted position and the punching position independently of the movement of the respective calibrating mandrel (23).
2. The apparatus according to claim 1, characterized in that the cutting device has a cutting sleeve (35), which is guided in a displaceable manner on the second calibrating mandrel (23) and which forms the cutting or punching surface (37) on its front edge.

3. The apparatus according to claim 1 or 2, characterized in that the first calibrating mandrel (19) has on the mandrel end a molded body (29) with an end surface (25) for calibrating the bottom area (9) and with a conical part (31), which is connected to the end surface (25) and which widens away from the end surface (25) in order to form a bottom cup (7) of the container (1), with this bottom cup being adjacent to the bottom area (9).
4. The apparatus according to one of the preceding claims, characterized in that the second calibrating mandrel (23) has on the mandrel end a conical part (33) that is connected to the end surface (27) of the calibrating mandrel (23), said end surface calibrating the bottom area (9), and widens away from the end surface (27) in order to form an outward widening, shirt-like dispensing spout (11) of the container (1).
5. The apparatus according to one of the preceding claims, characterized in that said apparatus has separately actuatable drive devices (43, 45) for generating the back and forward movements of the second calibrating mandrel (23) between the retracted position and the shaping position and for generating the movements of the cutting sleeve (35) between the retracted position and the punching position.
6. The apparatus according to one of the preceding claims, characterized in that two pairs of first (19) and second calibrating mandrels (23), which can be moved in parallel to one another, are provided for two containers (1) that are to be formed by means of common mold components (15, 17); and that both second calibrating mandrels (23) are mounted on a base body (41) that can be moved by a mandrel drive (43).
7. The apparatus according to one of the preceding claims, characterized in that the second calibrating mandrels (23) penetrate a support plate (38), on which the respective cutting sleeves (35) are mounted and that can be moved relative to the base body (41) by means of

a punch drive (45) in order to move the cutting sleeves (35) relative to the second calibrating mandrels (23) between the retracted position and the punching position.

8. The apparatus according to one of the preceding claims, characterized in that the punch drive comprises at least one working cylinder (45), which is fitted between the base body (41) and the support plate (38) and is actuated with a pressure medium in order to generate the relative movements between the base body (41) and (38).
9. The apparatus according to one of the preceding claims, characterized in that the support plate (38) has at least one ejector pin (47), which extends parallel to the respective cutting sleeve (35), for an ejector activity that takes place in the course of the severing process.
10. The apparatus according to one of the preceding claims, characterized in that the mold components (15, 17) can be moved transversely to the longitudinal direction (21) of the container (1) between the open position and the closed position, with said longitudinal direction corresponding to the longitudinal axis of the respective container (1) to be formed.