

Separating Device

The invention relates to a separating device for separating individual container products from a frame assemblage which consists of a plastic material, particularly polypropylene, with at least one punching device which at least partially separates the container product from the frame waste.

The prior art (DE 199 26 329 A1) discloses methods and devices for producing container products from plastic, how they are supplied to a generic separating device which is then used to separate these individual container products from a frame assemblage using a cutting or punching device.

To produce the respective container product, first a tube of plasticized plastic material is extruded into a molding device. One end of the tube is closed by heat sealing and by producing a pneumatic pressure which acts on the tube, the latter is expanded, and to form the container it is placed against the forming wall of the molding device consisting of two opposite molding tools. Then the plastic container is filled under sterile conditions within the molding device by way of a corresponding filling mandrel, and after removing the filling mandrel, it is then hermetically sealed with the formation of a definable head geometry. For the purpose of forming the actual plastic container, in which fluid is later stored, two container forming jaws are being moved by hydraulic driving means toward one another to obtain the closed position and are being moved in opposite directions away from one another into one of their open positions. In order to achieve very high

ejection rates of container products here, DE 103 23 335 A1 describes a multi-station arrangement, where the various molding steps are divided among different stations located in succession on an imaginary circular arc so as to form a type of carousel arrangement which enables very high cycle frequencies for the plastic material to be ejected in the form of container products.

Since the contents to be placed in the respective container product is often very susceptible to ambient media, especially if it is, for example, a highly sensitive pharmaceutical, the prior art focuses on, for example, covering the fill opening of the container tube by a sterile barrier under a sterile space at least from its formation to filling of the pertinent container, and very good results can be achieved here when, as shown in DE 10 2004 004 755 A1, by means of the indicated barrier a sterile medium is moved in the direction of the container fill opening using a media conveyance device in order to further improve the sterility. Another or an additional measure to increase sterility is to simply provide higher processing temperatures, for example, when producing the tube for the container product or during the filling process of the fill material, where an increased processing temperature finds its limits when the plastic material which is frequently used, such as polyethylene, is temperature-sensitive, but can otherwise be easily processed in the pertinent production devices and is preferred.

Otherwise, in addition to atmospheric oxygen, other gases can also diffuse later into the interior of the container through the thin polyethylene wall during storage and in distribution of the container product which has been produced under sterile conditions and in this way can damage the sensitive container contents or even make them unusable.

In order to eliminate this latter disadvantage, in the prior art production methods for these container products have been suggested (DE 103 47 907 A1 and DE 103 47 908 A1) which relate to so-called co-extrusion production methods in which the container is built up from several layers of plastic material, often at least one of the layers being used as a barrier layer. Here five and more

layers, for example, formed from polyethylene and low-density polyethylene as well as copolymers (ethylene-vinyl alcohol copolymers) can form the multi-layer container wall which in this case then forms an effective barrier layer; but these methods are cost-intensive in practical implementation. This makes the respective container product correspondingly more expensive.

If the individual container products arrive filled from the respective production machine, they emerge as ampule blocks in which several ampules or containers located next to one another in the manner of a block assemblage or frame assemblage have a common wall with one another. In order to detach the containers or ampules from the block or frame assemblage, they are cut out or punched out along edge zones, in this respect then a certain amount of frame waste being produced which can be recycled with modern techniques. DE-PS 38 31 957 discloses a method for producing hollow container products from plastics which initially emerge as an ampule block or a frame assemblage, in the edge zone of the frame waste a hollow body being additionally molded in; this increases the stability of the frame assemblage and also helps facilitate separation of the container product from the frame waste by means of the separating device used in each case.

Proceeding from this prior art, the object of the invention is to devise a separating device with which the container products, regardless of the plastic material comprising them, can be separated from the frame assemblage at high speed, and which in addition to a high degree of operating reliability also has relative low production costs. This object is achieved by a separating device with the features of claim 1 in its entirety.

In that, as specified in the characterizing part of claim 1, the punching device can be moved from an initial position into the punching position along a punching axis and vice versa by means of a ball screw which can be driven by a drive unit, especially in the form of an electric motor, separation can be done with a very high speed, dictated by the threaded spindle which can be driven by means of the electric motor, and additional mechanical components for applying a positive force

to the punching body in setting up the separation line can be omitted. The ball screw used makes it possible to reduce the energy used correspondingly; this benefits economical operation of the separating device.

In particular, it has been shown that with the separating device according to the invention, polypropylene as the wall material can be used for the container products, a plastic material which is brittle compared to a polyethylene material and which otherwise can be processed only with difficulty using conventional punching and cutting means for container separation. To the extent conventional separating devices are used, it has been shown that with respect to the very high processing temperatures of polypropylene it would be necessary to wait several minutes until the punching and cutting process is possible at all. But this would necessarily lead to very long retention sections and/or additional cooling means being necessary for the container products to be separated in order to be able to undertake separation at all without scrap. Due to the punching device which can be triggered by way of the ball screw, clean separation can take place without these waiting times or additional cooling means, simply by the respective container product being knocked out of the still warm or hot frame assemblage at high speed by means of the spindle drive along the intended punching lines. It is surprising to one with average skill in the art in the field of these separating devices that he will arrive at these clean separating punching lines with the cutting edges of the punching device which are kept relatively blunt and which need not be further reworked (ground) or otherwise maintained; this was not possible in the past with devices in the prior art.

The advantage of using polypropylene material instead of polyethylene or a coextruded multilayer composite consisting of LDPE/MDPE is that the polypropylene material at higher temperatures (121 °C) can be autoclaved, the polypropylene material being obtainable from only one extrusion head in a much more favorable manner than the described multilayer system. Thus, ultimately each individual layer to be produced in a multilayer system requires its own extrusion

head in the production machine; this increases production cost accordingly also from the control side.

Provided that the separating device according to the invention is used with the punching device which can be driven by the ball screw, this application is not limited thereto; rather, there are a host of possible applications, and the separating device according to the invention can also be used for other plastic materials such as polypropylene or multilayer plastic systems for separation of the container product as necessary.

In one preferred embodiment of the separating device according to the invention, a damping system prevents overloading of the ball screw in the punching process. The damping system has preferably at least one energy storage (compression spring) which decouples the punching device from the ball screw at least during the punching process. In this way the punching process can be initiated especially carefully and the ball screw is relieved; this increases its service life.

The separating device according to the invention is made in the form of a column structure with individual guide and adjustment plates which are spaced apart from one another, the column structure in addition to so-called adjustment columns also having guide columns which together with the assignable plates lead to a highly reinforced pedestal construction.

Other advantageous embodiments of the separating device according to the invention are the subject matter of the other dependent claims.

The separating device according to the invention is detailed below using one exemplary embodiment as shown in the drawings. Here the figures are schematic and not to scale.

- FIG. 1 shows a frame assemblage which is depicted in a face top view, consisting of the ampule block itself and the frame waste;
- FIG. 2 shows an ampule block from which the frame waste has been largely removed, and in which the individual container products are detachably connected to one another with intermediate wall webs as a commercial unit;
- FIG. 3 seen partially in a view, partially in a longitudinal section, shows a front view of the separating device as a whole;
- FIGS. 4 and 5 show a front view of the separating device corresponding to FIG. 3, shown without a punching device and die and a top view of the separating device as shown in FIGS. 3 and 4;
- FIGS. 6 and 7 show a side view seen in the direction of looking at the separating device along arrow X in FIG. 4 and a section along line A-A in FIG. 6;
- FIG. 8 shows a top view of the punching die as shown in FIG. 3 with a transport means for delivery of the container products which are to be separated from the frame assemblage.

In some of the figures, components of the overall device are omitted for purposes of clarity of the solution according to the invention.

The frame assemblage which is shown in FIG. 1 and designated as a whole as 10 consists of a plastic material, in this case of a polypropylene material. The frame assemblage 10 is composed essentially of the actual container products 12 and the so-called frame waste 14 which can be

separated from the actual container products 12. When the container products 12 are separated from the frame waste 14, an ampule block from which the frame waste 14 has been removed as shown in FIG. 2 results, the individual containers or individual ampules 12 being detachably connected to one another by way of the remaining intermediate wall webs 16 of the frame waste 14, the intermediate wall webs 16 making it possible for the respective container product 12 to be separated from the other containers 12 remaining in the block in a type of a twist-off motion.

The respective container product 12 is known in the prior art, and the above-described ampule block solution is shown, for example, in DE 38 31 957 C1. The basic form shown in FIGS. 1 and 2 constitutes only one type of one exemplary embodiment, and the container geometries in particular can be stipulated by the user within a widely drawn scope. To release the respective container contents, generally in the form of a fluid which has been added beforehand, a twist-off cap 18 is used which likewise can be separated via a corresponding scored site by a twist-off motion from the remaining container product 12 by way of a handle 20, with the result that the fluid can be removed via the cleared container opening. Other container opening solutions such as dropper caps, etc., can likewise be implemented.

On the bottom of the frame assemblage 10 as shown in FIG. 1 a type of blind holes 22 are made, and using the pins of a transport means (not shown) which engage the blind holes 22 on the lower edge of the frame waste 14, the frame assemblage 10, consisting of the container products 12 and the frame waste 14, is removed from the tool of a production machine which is not detailed, due to the higher stability of the frame waste in the form of an inherently closed waste edge zone, removal being easily and reliably possible when the plastic of the frame assemblage 10 has not yet completely cooled. This configuration is conventional and is shown, for example, in EP 0 359 971 A2 so that it will not be further detailed here.

Furthermore, it is also possible to arrange the blind holes 22 or other engagement option for a transport unit, viewed in the direction of looking at FIG. 1, laterally in a vertical alignment as part of the frame waste 14 on the latter, provided that, instead of the horizontally running transport direction which is shown in FIG. 1, a direction perpendicular thereto, i.e., in the direction of the longitudinal axes of the container, is desired. How the frame assemblage is suitably placed in the separating device as a cutting or punching device or is retrieved from it again is, for example, the subject matter of DE 38 32 566 C2 in which a moving transport hook engages the transport recesses in the frame waste of the frame assemblage 10.

For a separating or punching process, viewed in the direction of looking at FIG. 8, originating from a production machine which is not detailed, the respective frame assemblage 10 moves from right to left into a die 24, the die 24 shown in FIG. 8 constituting a receiving option for three frame assemblage arrangements 10 next to one another, with five connected container products 12 each. The respective container products 12 originating from the production machine are connected to one another by way of the frame waste 14, after the punching or separating process a container assemblage as shown in FIG. 2, viewed in the direction of looking at FIG. 8, having to leave the die 24 on the left side in order to be then packed into the corresponding packaging units for further transport. Moving the respective frame assemblage 10 with the container products 12 into and out of the die 24 by way of the transport means 26 is prior art so that it will not be further detailed here.

FIG. 3, viewed in the direction of looking at arrow Y of FIG. 8, shows a rear view of the die 24 again with three frame assemblage units 10 with five container products 12 each. As furthermore follows from the backward front view as shown in FIG. 3, the die 24 consisting of a solid metal block is moved upright via support columns 28 which extend between a die frame 30 for the die 24 and a lower base plate 32 which a slide 34 reaches through which is used to remove the plastic waste from the separating device. The lengths of the four support columns 28 are preferably

adjustable in order to enable alignment of the die 24 according to given production criteria. The rectangularly made lower base plate 32 allows a modular structure for the entire separating device so that a unit results which is easy to install and which can be easily integrated into the sequence of production machines which are already present.

The separating device shown in FIG. 3 has a punching device which is designated as a whole as 36 and which comparably to the die 24 consists of a solid metal frame block and can be made in several parts. To increase the punching or cutting pressure, a block-like charge weight 38 can be used, whose bottom is joined to individual upper dies 40 which in turn on their bottom have punching blades 42 which enable separation of the frame waste 14 from the container products 12 in order to move from a preliminary product as shown in FIG. 1 to the finished container product assemblage as shown in FIG. 2. In this respect the strip-like punching blades 42 travel into the intermediate intervals between the container products 12 held in the die 14 for each frame assemblage 10. This arrangement is only exemplary to the extent one or two units of the frame assemblage 10 or larger units of frame assemblage arrangements with a different number of container products 12 can also be processed. The respective arrangement is dictated by the machine operator and his requirements.

To move the block-like punching device 36 along a punching axis 44, a ball screw designated as a whole as 46 is used which can be actuated by an electric motor 48. The electric motor 48 can be especially a conventional servo motor with short operating times relative to the respective switchover direction. The ball screw 46 has a rod-like ball roller spindle 50 which, guided in a threaded bushing 52 viewed in the direction of looking at FIG. 3, can be moved down from the raised position shown in FIG. 3 into the punching or separating position along the punching axis 44. For this purpose, the electric motor 48 drives the threaded bushing 52 by means of an output pinion which is not shown, for example, by means of a toothed frame drive which is not detailed; the bushing is guided to be able to rotate in a rotary receiver 54. This belt drive runs

within an upper base plate 56 which terminates the separating device as a unit toward the top. The electric motor 48, the rotary receiver 54 with the threaded bushing 52, and part of the ball roller spindle 50 project with a definable excess length over the upper base plate 56, viewed in the direction of looking at FIG. 3.

To reinforce the overall system, four adjustable columns 58 extend between the lower base plate 32 and the upper base plate 56 and, relative to the punching axis 44, are arranged in pairs diametrically opposite one another (cf. FIG. 7). The four adjustable columns 58 as part of an adjustment means designated as a whole as 60 extend through a square adjustment plate 62 which is provided with four adjustable bushings 64 which extend around the respective adjustable column 58. Another part of the adjustment means 60 on the top of the upper base plate 56 comprises two working cylinders 66 (cf. FIG. 6) which, made in the manner of hydraulic or pneumatic cylinders, by means of adjustable rods 68 which are fixed with their lower end on the adjustment plate 62, induce its vertical adjustment along the adjustable columns 58. For the sake of visual simplicity, FIG. 3 does not show this cylinder arrangement 66 with adjustable rods 68. For the sake of simplicity FIGS. 4 and 6 have also omitted the punching device 36. With the indicated adjustment means 60, depending on the conditions of use on site, the punching plane for the punching device 36 can be adjusted, and viewed in the direction of looking at FIG. 4 the adjustment plane toward the bottom can be bordered by a stop body 70.

Furthermore, there is a damping system which is designated as a whole as 72, which is shown in FIG. 3, and which also contributes to helping prevent overloading of the ball screw 46 in operation, especially in a punching process itself. For this purpose the damping system 72 has an energy storage in the form of two compression springs 74 which the punching device 36 decouples from the ball screw 46. For this purpose, the two compression springs 74 with their top which is shown in the direction of looking at FIG. 3 are supported on a stop plate 76 which is permanently connected to the lower end of the ball roller spindle 50 by way of a fixing nut 78. The lower end of

the respective compression spring 74 is supported on a guide plate 80, whose bottom, permanently connected by way of retaining rods 82, is adjoined by the punching device 36. Instead of the indicated compression springs 74 as the energy storage, another solution can be used, for example, in the form of a disk spring or the like.

In the embodiment as shown in FIG. 3, however, the respective compression spring 74 encompasses a guide pin 84 which forms a guide for the stop plate 76 which in this respect can be moved back and forth between two end positions by means of the ball roller spindle 50. The lower possible end position is formed by way of lower buffer bushings 86 which can be made as an elastomer material and encompass the respective compression spring 74 in addition to the guide pin 84. In the other stop situation which is pointed upward, the top of the stop plate 76 has annular vibration compensators 88 which are supported on angled boundary strips 90, provided that the ball roller spindle 50 assumes its nonactuating position assumed in FIG. 3.

When the electric motor 48 is started and a punching process is to be undertaken, the ball roller spindle 50 is moved down along the punching axis 44, viewed in the direction of looking at FIG. 3, and the stop plate 76 is entrained against the action of the two compression springs 74 until it comes into contact with the top of the buffer bushings 86, and in the continuing downward motion then the punching process is induced by the punching device 36 for the respective frame assemblage 10. If the ball roller spindle 50 is moved up in the reverse sequence, the stop plate 76 is entrained upward until it engages, from underneath, the angular offsets of the two boundary strips 90 as shown in FIG. 3, this striking motion being cushioned by the vibration compensators 88.

The guide plate 80 is in turn guided along four guide columns 94 by way of the corresponding guide bushings 92. As FIG. 7 shows in particular, these guide column 94 are in turn located diametrically opposite one another to the punching axis 44 and lie within the outer peripheral plane with the four adjustable columns 58. In order to be able to ensure that the

individual components can move smoothly, the block-like punching device 36 as a whole extends through the corresponding rectangular recess in the adjustment plate 62. The four guide columns 94 are guided on the top of the upper base plate 56 in receivers 96 which are otherwise held on their lower opposite end (cf. FIG. 4) in guide receivers 98 on the bottom of the adjustment plate 62, which guide receivers allow movement for the guide columns 94 in the axial direction parallel to the punching axis 44, but transversely thereto they enable a defined position in the radial direction. In this way relative adjustment of the adjustment plate 62 to the guide plate 80 is possible.

The punching device 36 is furthermore at least partially encompassed by a hold-down device which is designated as a whole as 100 and which, made as a plate-like hold-down frame, can be raised and lowered by two working cylinders 102 (see FIG. 3). In the lowered position the hold-down device 100 is used to press down the frame waste 14 in the direction of the die frame 30 in order in this way to ensure clean contact of the respective frame assemblage 10 in the pertinent recess of the die 24. The required working cylinders 102 are preferably driven hydraulically, pneumatically, or servoelectrically, and are permanently connected with their housing parts to the adjustment plate 62 so that the hold-down device 100 can move relative to the adjustment plate 62. In order, however, to be able to ensure uninterrupted operation for the stop plate 76 in the sense that it can move up and down parallel to the punching axis 44, as follows especially from FIG. 7, the stop plate 76 is provided with two U-shaped recesses through which the housing parts of the respective working cylinder 102 extend.

Furthermore, the separating device according to the invention has an ejector means (FIG. 7) which is designated as a whole as 104 and which ejects the plastic waste of the assemblage 10 which may remain, for example, in the punching device 36 via the slide 34. For this purpose the ejector means 104 preferably has two hydraulically, pneumatically, or servoelectrically actuatable working cylinders 106 which actuate two ejector pins 108 which, viewed in the direction of looking

at FIG. 6, project underneath the adjustment plate 62; conversely, the working cylinders 106 are located above the adjustment plate 62.

For the sake of better understanding, a sequence for a punching process will be described below. The strip of ampules with the three frame assemblage units 10 is transported into the separating device in the manner of a punch by way of a definable cycle advance. When the respective frame assemblage 10 has advanced to above the die 24, the block-like punching device 36 is moved into the punching position by vertical lowering within the scope of the cycle advance. Afterwards, the hold-down device 100, actuated pneumatically, presses from overhead on the strip of ampules and clamps it between the hold-down device 100 and the die 24. Afterwards, the actual punching stroke is triggered, the electric motor 48 actuating the ball screw 46 in the connected position. The described damping system 72 prevents overly large impacts from being transmitted to the threaded spindle during the punching process, for example, in the form of the ball roller spindle 50. When the punching stroke has ended, pneumatically actuated ejector pins 108 press the ampules 12 which may have become caught in the punch of the punching device 36 onto a support (slide 34). One cycle behind the punching position of the ampules 12, shortly after punching of the ampules, the waste strip in the form of the frame waste 14 is crushed by pneumatic punching (not shown).

After the punching processes, ejector pins 108, the punch in the form of a punching device 36 with the punching blades, and the hold-down device 100 and support for the cycle advance move up again and the next cycle can begin. For better accessibility in installation and maintenance a so-called maintenance stroke can be executed in which the upper structure and therefore the adjustment plate 62 are moved away toward the top. The ball screw 46 with the triggerable threaded spindle allows very prompt feed processes and delivery of very high punching forces via the punching device 36; this had not been achieved in this way to date with conventional means. So that the punching device 36 does not collide with the lower die 24, there can be stops, detection sensors, and/or monitoring electronics for the electric motor 48.

C l a i m s

1. A separating device for separating individual container products (12) from a frame assemblage (14) which consists of a plastic material, particularly polypropylene, with at least one punching device (36) which at least partially separates the container product (12) from the frame waste (14), characterized in that the punching device (36) can be moved from an initial position into the punching position along a punching axis (44) and vice versa by means of a ball screw (46) which can be driven by a drive unit, especially in the form of an electric motor (48).
2. The separating device according to claim 1, characterized in that a damping system (72) prevents overloading of the ball screw (46) in the punching process.
3. The separating device according to claim 2, characterized in that the damping system (72) has at least one energy storage, preferably in the form of a compression spring (74) which decouples the punching device (36) from the ball screw (46).
4. The separating device according to claim 3, characterized in that the energy storage of the damping system (72) extends between a stop plate (76) which is connected to the ball roller spindle (50) of the ball screw (46), and a guide plate (80) with the punching device (36).
5. The separating device according to claim 4, characterized in that the stop plate (76) in the raised position of the punching device (36) strikes a stop (90) of the guide plate (80) and that the guide plate (80) is guided along at least one guide column (94).
6. The separating device according to one of claims 1 to 5, characterized in that to adjust the punching plane of the punching device (36) an adjustment means (60) is used which has an

adjustment plate (62) which can be vertically adjusted by means of at least one adjustable column (58).

7. The separating device according to claim 6, characterized in that the respective guide column (94) of the guide plate (80) extends through the adjustment plate (62) and is at least partially fixed on it, and that the respective adjustable column (58) is farther away from the punching axis (44) than the respective guide column (94).
8. The separating device according to claim 6 or 7, characterized in that the punching device (36) is at least partially encompassed by a hold-down device (100) which can be raised and lowered by means of at least one working cylinder (102) which is connected to the adjustment plate (62).
9. The separating device according to claim 8, characterized in that the hold-down device (100) presses the frame assemblage (10) with the container products (12) for a punching process against a die (24) which has recesses for at least partially accommodating the container products (12).
10. The separating device according to one of claims 6 to 9, characterized in that in the adjustment plate (62) there is an ejector means (104) which ejects container products (12) of the assemblage (10) which may have remained in the punching device (36).