

Method for Establishing the Presence of Specified Characteristics of a
Container Product and Device for Performing Said Method

The invention relates to a method for establishing the presence of specified characteristics of a container product, which is made of a plastic material in particular. Furthermore, the invention relates to a device for performing this method.

Container products made of plastic materials are used in a wide variety of shapes, sizes and equipment as mass-produced products in wide distribution and for a wide variety of intended applications. In manufacturing, which for economic reasons must be conducted in a particularly economical manner in view of the large number of parts, it is essential that quality control be conducted in close association with the respective manufacturing process, making it possible to recognize deviations of specified properties of the product from the respective target value and thereby make it possible for corrective procedures to be performed in the manufacturing plant before large quantities of rejects have been produced.

It is considered to be state of the art in this regard to divert sample batches from the respective production line at predetermined intervals of time and test them for deviations

in specified important use properties from the target value. This has proven to be tedious and time-consuming, in particular when, to arrive at reliable test results, sample batches having a large number of containers must be tested, each being handled manually and inspected by trained inspection personnel for the presence of specified properties. The required time involved and the resulting personnel costs have a negative effect on the cost-effectiveness of production of these container products.

In this regard, the object of the invention is to make available a method which creates a prerequisite for an improved profitability in the manufacture of container products through an efficient design of the quality control.

According to the invention, this object is achieved by a method having the measures of patent claim 1 in its entirety.

Due to the fact that, according to the invention, the actual value of at least one predetermined property is determined automatically in an inspection station of a testing device and is compared with the target value of this property, this eliminates the need for having the corresponding test processes performed by inspection personnel, which leads to corresponding savings in time and personnel costs. In particular, with the container products to be manufactured in the large numbers in question here, this results in a significant improvement in profitability. In addition, the automation of inspection steps also achieves the result that subjective test areas, such as those which cannot be ruled out completely through the use of inspection personnel, have a negative effect on the measurement result. Since the test results can be compiled with a very high reliability, they can be forwarded directly to the manufacturing machine upstream in the process sequence in order to optimize its manufacturing process.

With a corresponding number of inspection stations to be used for testing, it is thus possible to efficiently establish various essential product properties, such as weights, basically as a measure of the filling quantity of container contents, the wall thickness of the container, the applied force which is necessary for handling and/or use of a container and the like.

Container products with plastic containers can advantageously be manufactured in large numbers according to the known bottelpack® method in such a way that the container product is created in the form of a container strip, with containers made of plastic, for example, as vials or ampoules, which are connected to one another so they can be separated at the connection points. In an advantageous exemplary embodiment of the method according to the invention, it is possible to proceed in such a way that, in a first inspection station of the testing device, the containers are separated by machine and the separation force required to separate the containers is determined. Knowledge of the magnitude of the separation force makes it possible to control the manufacturing process in such a way that the connection point forms a sufficiently secure connection for strip sections being supplied for packaging and shipping, on the one hand, but the end user is capable of easily separating the respective containers to be used from the strip.

In the case of especially advantageous exemplary embodiments of the invention, containers are separated from the container strip by twisting in the first inspection station for this purpose, and the torque required for twist-off is detected automatically.

It is possible to proceed, with particular advantage, in such a way that, in the case of containers filled with container contents, the separated containers are moved by machine into a second inspection station, where they are weighed for an automatic

determination of their total weight, after which the weighed containers are moved by machine into a third inspection station, where they are emptied.

To determine the weight of the container contents, the emptied containers may be taken by machine to another inspection station and weighed there again to determine their tare weight, wherein the total weight detected is automatically compared with the tare weight detected to determine the weight of the container contents.

In the case of containers having an end part associated with a removal area on a neck part, said end part being removable from the main part of the container by a twisting movement, the containers may be moved by machine to an inspection station, where the end part is twisted off by machine and the torque required for twist-off is detected automatically. In the case of containers of the ampoule type, the end part on the neck is often a twist toggle, which can be removed from the neck part at an intended breaking point. Detecting the torque here provides information about whether the intended breaking point is designed suitably, so that the user can conveniently remove the end part. Similarly, with different types of containers such as vials, which have a removal area with screw closures on the neck part, a corresponding torque determination may signal the existence of use properties.

The containers may advantageously be moved by machine to an inspection station, where an incision, which exposes the cross section of at least a part of the container wall, is formed by machine. This opens up the possibility of detecting the thickness of at least one cut container wall automatically after the cut containers have been moved by machine to another inspection station.

Instead of performing destructive testing of the container to detect the wall thickness in at least one measurement point on the container, this may be omitted and a nondestructive test of the container thickness may be performed in at least one location by testing the container with regard to its respective wall thickness, for example, by means of ultrasound or by means of optical measurement methods. Nondestructive testing also has the advantage that none of the separation dust or sawdust that is formed in destructive testing of a container is formed here; in this case, despite suitable suction exhaust, it is impossible to completely rule out the possibility that it will have a negative effect on the measurement precision of other inspection stations.

In a final method step, for example, after detection of the wall thickness, the containers are preferably brought by machine to an ejection station and removed there from the test apparatus, so that the overall sequence of the method can take place by machine without any procedures having to be performed by personnel. The individual process steps, taking into account the reference to the respective device inspection stations, may also be separated without interfering with the automatic character of the test processes. The test process steps may also be disposed in deviating constellations one after the other next to the devices.

The method according to the invention can also be expanded by additional test procedures. For example, any inscriptions on the top side of the container or in other regions can be detected by means of mechanical or optical scanning methods and then inspected with regard to the quality of the implementation and the thoroughness of the character information.

In addition to the methods described here, additional test methods may also be used in which, for example, by means of an ultrasound measurement

or a laser measurement in different regions of the container and its parts, their wall thickness can also be determined by using measurement methods in that regard, to ascertain the quantity of container content, while optionally incorporating acoustic measurement stations.

Based on the modular type of system pertaining to the individual test equipment with which the test methods described above can be performed, and which can also be easily adapted to different shapes of ampoules and container products, there is also the possibility of testing container or ampoule products that are joined together in a strip, as well as individual containers or individual ampoules, as described above.

In addition to the method according to the invention, the measured values for at least a portion of the containers can preferably be detected by means of electronic detection, storage, and evaluation media, in at least one of the measuring inspection stations, their measured values may be detected for at least some of the containers and stored for the purpose of obtaining a statistical analysis of the direction in which (trending), and the amount by which, the actual values of the inspection stations thereby determined can be removed from the target value specifications. The differential values obtained between the actual value specification and the target value specifications are relayed to a machine control unit of a manufacturing device, with the provision that the manufacturing parameters are to be optimized during or at the start or at the end of the manufacturing process such that the differential values approach zero, or the manufacturing material to be supplied to the manufacturing device is adjusted in its material properties.

Thus, if it is ascertained statistically that the container contents are in excess of or less than the target value specifications determined on the basis of the volume, then it is possible to instruct the manufacturing equipment to feed a greater or lesser filling

amount into the respective container on the basis of the statistical analysis. If the torque values in shearing off or twisting off in one direction or the other direction do not prove to be adequate based on the target value specifications, then by changing the plastic material used or by changing the wall thickness, the required values can also be achieved during the manufacturing process. If minor differential values between the actual value specified and the target value specified can be detected and the aforementioned statistical analysis reveals trends in the development of the manufacturing, then deviations can be effectively counteracted. In an expansion of the measures described above, the statistical analyses can also be filed and documented accordingly, so that the history of the manufacturing method can be disclosed at the time of customer acceptance of the manufacturing equipment and/or the container products.

The subject matter of the invention is also a device for performing the method having the features of claim 4. Advantageous embodiments of the device are defined in claims 15 through 29.

With such a device, it may be advantageous in particular to have a configuration, such that in the case of a container product in the form of a container strip, with containers made of plastic joined separably to one another at connecting points, a first inspection station has a separation device for mechanical separation of the containers by mechanical twist-off from the container strip.

In a particularly preferred exemplary embodiment, the first inspection station for the respective container to be separated from the container strip may have a holder, which encompasses this at least partially, this holder being rotatable by a rotary drive for

thereby twisting off the container, wherein the rotary drive has a torque sensor for detecting the twist-off torque.

In a particularly advantageous manner, the device may be designed such that a transport mechanism is provided, having receptacles which can be assembled with a respective container through the first inspection station, wherein the receptacles can be moved to additional inspection stations disposed along an inspection zone.

The transport device expediently has a motor-driven carousel which moves the receptacles along a circular test zone to additional inspection stations disposed along the test zone.

Alternatively, the configuration may be made in such a way that the inspection stations are disposed along a test zone extending in the longitudinal direction, wherein a transport device has a transport element which moves the containers from one inspection station to the next in succession.

The present invention is explained in detail below on the basis of exemplary embodiments illustrated in the drawings:

- Figure 1 shows a highly schematic and simplified view from above of a first exemplary embodiment of a device for performing the method according to the invention;
- Figure 2 shows a schematic and simplified, perspective oblique view of the device from Figure 1;
- Figure 3 shows a perspective oblique view on a larger scale of only a partial detail of a first inspection station of the device having a

separating mechanism;

Figure 4 shows a perspective oblique view of the first inspection station shown on a slightly smaller scale than Figure 3;

Figure 5 shows an enlarged partial detail from Figure 2 shown in a perspective oblique view, in which mainly the region of a second inspection station is shown, having a weighing stand;

Figure 6 shows an enlarged perspective oblique view of part of the weighing stand of the second inspection station;

Figure 7 shows a view of a third inspection station having an emptying device, this view being enlarged in comparison with Figures 1 and 2, while at the same time being simplified in a highly schematic manner;

Figure 8 shows a perspective oblique view of a fifth inspection station with a device for twisting off a container end part, this view being shown on a slightly larger scale in comparison with that of Figure 2;

Figure 9 shows a perspective oblique view which is shown on a slightly enlarged scale in comparison with Figure 2 and illustrates mainly the region of a sixth inspection station having a cutting device;

Figure 10 shows a side view of a partial region of a seventh inspection station, shown on an enlarged scale and having a device for measuring container wall thicknesses;

- Figure 11 shows a highly simplified and schematic perspective oblique view of a second exemplary embodiment of the device according to the invention;
- Figure 12 shows a perspective oblique view which is also highly simplified and schematic and is drawn on a larger scale than Figure 11, which shows, of the exemplary embodiment according to Figure 11, only the successive inspection stations with the associated transport device that are successive in the longitudinal direction;
- Figure 13 shows another perspective oblique view drawn an enlarged scale showing only the transport device of the second exemplary embodiment of the device;
- Figure 14 shows a perspective oblique view drawn on a larger scale showing only a partial detail of a first inspection station having a separation device according to the second exemplary embodiment of the invention;
- Figure 15 shows a perspective oblique view of the first inspection station according to the second exemplary embodiment of the invention;
- Figure 16 shows an enlarged perspective oblique view of the second and fourth inspection stations according to the second exemplary embodiment of the invention;
- Figure 17 shows a further enlarged perspective oblique view of a part of the weighing stand of the second and/or fourth inspection stations according to the second exemplary embodiment of the invention;

- Figure 18 shows a highly simplified and schematic view, enlarged in comparison with Figures 1 and 2, of a third inspection station having an emptying device according to the second embodiment of the invention;
- Figure 19 shows a perspective oblique view which is slightly enlarged in comparison with Figure 2, illustrating a fifth inspection station with a device for twisting off a container end part according to the second exemplary embodiment of the invention; and
- Figure 20 shows an oblique view, shown on an enlarged scale, of a partial region of a seventh inspection station with a device for measuring container wall thicknesses according to the second exemplary embodiment of the invention.

The method according to the invention and the device provided for carrying it out are explained below on the basis of two examples in which a container product in the form of a container strip made of plastic has a series of containers of an ampoule-type shape designed in one piece with the strip, such as those that can be produced, for example, according to the known bottelpack[®] system in a combined blow molding, filling and sealing process. It is self-evident that the method according to the invention can equally be performed with different types of containers.

In the first exemplary embodiment of the device, shown in Figures 1 and 2 in an overall diagram and in Figures 3 through 10 in partial diagrams, it has a plurality of stations into which a container 11, about whose properties a finding is to be made, is introduced by machine in succession. The stations are indicated in highly schematic and simplified diagrams in Figure 1 and not all of them are visible in Figure 2. These include (see

Figure 1) a first inspection station 1, a second inspection station 2, a third inspection station 3, a fourth inspection station 4, a fifth inspection station 5, a sixth inspection station 6, a seventh inspection station 7 and an ejection station 8. As already mentioned, in the present invention a carrier strip 9 has a series of ampoule-type containers 11 which are connected to one another at connection points 12, forming an intended breaking point for the separation of the containers 11 from the container strip 9.

As shown in Figures 1 to 3, the container strip 9 is moved by means of a conveyor 13 up to the first inspection station 1. The conveyor 13 is designed as a stepping conveyor which moves, with each advancing step, a container 11 into a separation position in which a separation device 14 separates the last container 11 in each case. The separation device 14 has a movable hold-down device 15 (see Figure 2 in particular), which secures the next to last container 11 of the strip 9 for a respective separation operation. To separate the last container 11 in the separation position, the separation device 14 has a holder for the container 11 that is to be separated, as shown best in Figures 3 and 4, having movable jaws 16 and 17, which surround the container 11 to be separated in the closed position shown in Figures 3 and 4.

The upper jaws 16 in the drawing, as indicated with arrows 10, can be moved by means of an actuator 18 for the movement between the closed position illustrated here and an open feed position, in which the container 11 to be separated is accommodated between the jaws 16 and 17. Both jaws 16, 17 with the container 11 held between them, can be rotated by means of a rotary drive 19 for twisting off at the connection point 12. From this location, the driving torque is transferred to the jaws 16, 17 via a safety coupling 21 and a torque sensor 22. For determining whether the properties of the connecting point 12 correspond to the target state, the twist-off torque determined by the rotary torque sensor 22

is detected. After completing the separation, with the jaws 16, 17 moved back into the starting rotational position, the container 11 is pushed out of the jaws 16, 17 by means of a machine-operated slide 23 and reaches a position in which it is in a receptacle 24 of a transport carousel 25, as shown most clearly in Figure 1 (see Figure 1).

The motor-driven carousel 25 has eight of these receptacles 24 distributed uniformly on its circumference, and moves them along a circular test zone on which inspection stations 1 through 7, as well as ejection station 8, are disposed. The receptacles 24 each have a bearing part 26 for the respective container 11 as well as a movable cover part 27, the details of which can be seen most clearly in Figure 5. As shown there, the bearing part 26 has a seat 28 for the respective container 11. The cover part 27 is hinge-mounted on the bearing part 26 by a hinge 29 on whose articulated axis a rotary spring 31 is disposed, prestressing a cover part 27 into the open position illustrated in Figure 5. The cover part 27 has a bar journal 32 which, when the cover part 27 is pivoted into the closed position against the force of the rotary spring 31, engages with a bar slide 33, which is spring prestressed in the locked position. In the case of displacement of the bar slide 33 out of the bar position, the cover part 27 automatically moves back out of the closed position and into the open position illustrated in Figure 5. As shown in Figures 1 and 2, the cover parts 27 in the inspection stations 1 through 4 and at the ejection station 8 are each shown in the open position, and in test positions 5 through 7, each is in the closed position. In the closed position, the respective container 11 is secured with its container main part 41 in the seat 28 of the bearing part 26.

Since the twist-off torque in separating the container 11 from the container wall 9 was detectable in the first inspection station 1 and the separated

container 11 is moved into the respective receptacle 24 on the carousel part 25, this container 11 goes into the inspection station 2 through a rotational step of the carousel 25. These are a weighing station for automatic detection of the total weight of the filled container 11. Figures 5 and 6 show details of the weighing stand with a vertically movable weighing element 34 that functions as a type of weighing dish and can be displaced upward, out of the lowered position shown in Figure 5, to raise the container 11 up from the seat 28 of the bearing part 26 by acting on its forward end and on its rear end in order to determine the weight of the raised container 11. As shown in Figures 5 and 6, the cover part 27 is in the open position here.

After detecting the total weight, the weighed container 11 goes to the inspection station 3 which has a device for emptying the container contents. The important details of the emptying device can be obtained from Figure 7. As this shows, the inspection station 3 has a support 37 for the container 11, which is movable in the direction of an arrow 35 and brings the container into an oblique position in which the neck part 39 of the container 11 is at a higher level than the bottom end of the container main part 41. For emptying the container contents, a vent hole is formed by a movable puncturing needle 43 on the neck part 39 while a movable cannula 45 forms an emptying opening on the bottom part of the main part 11 of the container. The cannula 45 has a suction connection 47 for evacuating the container 11.

In the next transport step of the carousel 25, the emptied container 11 moves out of the inspection station 3 to the inspection station 4, which is a second weighing station corresponding in structure and function to the inspection station 2 already described with reference to Figures 5 and 6, apart from the fact that now the tare weight of the container 11, which was emptied previously, is detected. Thus the mass of the container contents is established as the test result by the total weight/tare weight comparison.

In the wake of the transport step to the following inspection station 5, the cover part 27, which is in the open position, as shown in Figures 1 and 2, comes into contact with a control unit having control rollers 49, which pivot the cover part 27 running thereon into the closed position where the twist lock 32 engages with the slide bar 33 so that the cover part 27 is secured in the closed position. In this position the container 11 is secured in the seat 28 of the bearing part 26; see Figure 8 showing further details of the respective inspection station 5, which has a twist-off device 53 that removes an end part in the form of a so-called twist toggle 51, which is integrally molded on the neck part 39 of the container 11, by twisting it off of the container 11, and thereby determines the torque required for this twist off. The twist-off device 53 therefore has a twist-off unit, which is displaceable on a carriage 55 and drives a controllable locking pliers 63 with a rotary drive 57 by means of a safety coupling 59 and a torque sensor 61. The locking pliers 63 grip the twist toggle 51 so that the latter can be twisted off by means of the drive 57. The twist-off torque thereby detected signals whether the connection of the twist toggle 51 to the container 11 corresponds to the target condition.

The next inspection station 6 along the test zone has a cutting device 65 with a circular saw 67 that forms a cut, in the form of a cross section through the container 11, severing the front part 71 from the remaining main part 41 of the container 11, within a cutting zone with a safety shell 69 made of plexiglass.

In the next step, the cut container 11 goes to the inspection station 7 which has a measuring device 73 for detecting the wall thickness of the container walls 77 exposed at the cut location 75. The measuring device 73 has movable measuring calipers 79 and 81 for this purpose, these calipers being movable for examining the upper wall 77 and

the lower wall 77 in Figure 10. Figure 10 shows the measuring operation of the upper wall 77 before the caliper 81 has come in contact with the inside of this wall 77.

After detecting the actual wall thickness value in inspection station 7, the container 11 then goes to the ejection station 8, which ejects the inspected container 11 into a waste collector 83.

The second exemplary embodiment of the device according to the invention, as shown in Figures 11 through 20 differs from the first exemplary embodiment fundamentally in that, instead of a test zone with inspection stations 1 through 7 disposed on a circular path, supplied with the containers 111 to be inspected by means of a transport device in the form of a carousel conveyor, an inspection zone extending in a longitudinal direction 220 is provided.

In the second exemplary embodiment of the device shown in Figures 11 and 12 in overall diagrams and in Figures 13 to 20 in partial diagrams, they have a plurality of stations into which a container 111, about whose properties a finding is to be made, are placed successively by machine. These stations are illustrated in simplified form in Figures 11 and 12, but not all the stations are visible in Figure 12.

As Figure 11 shows, the inspection zone is disposed on a frame 120 with a covering hood 142. A camera 186, situated above the inspection zone, permits monitoring of the operation from the outside, even with the cover hood 142 closed.

The individual stations include (see Figures 11 and 12) a first inspection station 101, a second inspection station 102, a third inspection station 103, a fourth inspection station 104, a fifth inspection station 105, a seventh

station 107 and an ejection station 108. The sixth inspection station, which is required in the first exemplary embodiment, has been eliminated in the second exemplary embodiment for reasons to be explained below.

As already mentioned, in the present example a carrier strip 109 has a series of ampoule-shaped containers 111, which are interconnected at connecting points 112, which form a type of intended breaking point for the separation of the containers 111 from the container strip 109. Container products 111 having a bulging shape are shown at the right in the direction of viewing in Figure 14, with a single container 111 formed as a flat product to the left of this at a distance. As shown in Figures 11, 12 and 14, the container strip 109 is supplied by machine to the first inspection station 101 by means of a conveyor 113. The conveyor 113 is designed as a stepping conveyor which moves one container 111 at a time into a separation position with each forward step. In this position a separation device 114 separates the last container 111 in the row. The separation device 114 has a movable hold-down device 115 (see Figure 14 in particular) which secures the next to last container 111 of the strip 109 for a respective separation operation. The hold-down device 115 is an L-shaped part which can be pivoted at its other end about a pivot axis 222. To achieve the forward advance, the pivot axis 222 is supported on a bearing block 223, which is movable in the forward direction 224 by an advancing mechanism 225.

To separate the last container 111 in the separation position, the separation device 114 has a holder with movable jaws 116 and 117 for the container 111 to be separated, as shown best in Figures 14 and 15. In the open position shown in Figures 14 and 15, these jaws grip the container 111 to be separated. For the movement between the open position shown here and a closed position, in which the container 111 to be separated is clamped between the jaws 116 and 117, the upper jaw 116 in the

drawing, as indicated with arrows 110, is movable by means of an actuator 118. The two jaws 116, 117, with the container 111 gripped between them, can be rotated about an axis of rotation 221, which runs parallel to the longitudinal direction 220, by means of a rotary drive 119 for twisting off the connection point 112. The rotary drive transfers the driving torque, via a safety coupling 121 and a torque sensor 122, to the jaws 116, 117. The twist-off torque determined by the torque sensor 122 is detected automatically for determining whether the properties of the connecting point 112 correspond to the ideal state.

A transport device 130, which moves the containers 111 from one inspection station to the next in succession, is provided for supplying containers to the inspection stations which are disposed, one after the other, in succession. As shown more clearly in Figure 13, the transport device 130 has a carrier 136, in the form of a bar, as the actual transport element extending above the inspection stations 101 to 105 and 107 along the inspection zone (see Figure 12). For the ampoules 111 to be transported, the carrier 136 has receptacles 138 at the bottom, disposed at intervals from one another, corresponding to the intervals between the inspection stations along the inspection zone. The receptacles 138 have vacuum holders, which can be controlled via suction lines 140, for holding ampoules 111 on the respective receptacle 138 and releasing the respective ampoule 111. The carrier 136 can be moved back and forth, and up and down, along the inspection zone, according to the principle of cycled feed, for its function as a conveyor, as indicated with the double arrows 188 in Figure 13. The carrier 136 with the outermost receptacle 138 at the left in Figure 13 picks up an ampoule 111 from the separation device 114 at the inspection station 101 and delivers it to the next inspection station 102 in the following transport step, while at the same time an ampoule 111 is removed from this inspection station by means of the receptacle 138, which is connected at the right and transfers this ampoule, in turn, to the following inspection station 103 and so forth. For

these movement steps, the transport device 130 has a drive device 192, whose geared motor 194 moves a carriage 190 along a guide rail 196, horizontally and vertically, together with the latter, by means of crank drive, which is concealed in Figures 12 and 13 and therefore is not visible, so that the carrier 136 which is connected to the carriage 190 executes the combined transport movements, while the holding devices on the receptacle 138 are controlled via the suction lines 140 for pickup and release of the ampoules.

After the twist-off torque, in separating the container 111 from the container strip 109, is detected in the first inspection station 101, the container 111 is conveyed to the inspection station 102 by the transport device 130. This station is a weighing station for automatic determination of the total weight of the container 111 filled with container contents. Figures 16 and 17 show details of the weighing stand. As can be seen in particular in Figure 16, the weighing stands 193, 194 of the inspection stations 102 and 104 are disposed on their own frame 195, independently of the other inspection stations, to increase measurement precision by eliminating interfering influences from the other inspection stations. A plate 197, which is displaceable in a downward direction by a carriage 196, is disposed on the frame 195 and has two weighing stands 193, 194, one weighing stand 193 weighing the full container product and the subsequent weighing stand 194 weighing the empty container 111. A container 111 placed in a holder 199 can be lowered vertically onto a U-shaped weighing element 134 by a lowering device 198 at each inspection station 102, 104. A spacer 200 is provided between the weighing element 134 and the weighing stand 193, 194. Once the container 111 has been placed on the weighing stand 193, 194, it is decoupled from the holder 199 that can be allocated to it, so that the latter, with its own weight, cannot falsify the measurement result.

After detecting the weight, the weighed container 111, which is still filled, goes to inspection station 103, which has its own device for emptying the container contents. The important details of the emptying device can be seen in Figure 18. To empty the container contents, a vent opening is formed by a puncturing needle 143, which can be moved in the downward direction and vertically on the neck part 139, while a cannula 145 forms an emptying opening on the bottom part of the main part 141 of the container, the cannula also being movable vertically and in the downward direction. The cannula 145 has a suction connection 147 to empty the container 111 by suction. The puncturing needle 143 and the cannula 145 are therefore mounted on holders 201, 202 which are attached to carriages 203, 204, which are adjustable in their position, independently of one another, by means of hand wheels 205, 206. Position readings 207, 208 facilitate and accelerate the required adjustment operations. During emptying, the container 111 is held in a receptacle 209 between a holder 210 and a closable cover 211.

In the next transport step of the transport device 130, the empty container 111 moves from the inspection station 103 to the inspection station 104, which is the second weighing station, corresponding in design and function to the inspection station already described with reference to Figures 17 and 18, except that now the tare weight of the previously emptied container 111 is detected. Thus the mass of the preferably liquid container contents is ascertained precisely as the test result by comparing the total weight with the tare weight.

The next inspection station 105 (see Figure 19) has a twist-off device 153 which removes an end part that is integrally molded on the neck part 139 of the container 111, in the form of a so-called twist toggle 151, by twisting it off the container 111 as the torque required for this twist off is detected. The twist-off device 153 therefore has a twist-off unit, which is displaceable on a carriage 155 for this purpose, and drives a

controllable locking pliers 163 by means of a rotary drive 157 via a safety coupling 159 and a torque sensor 161, this locking pliers grips and securely clamps the toggle 151 by displacement of the carriage 155, so that the toggle can be twisted off by means of the drive 157. The twist-off torque detected thereby signals whether the connection of the toggle 151 to the container 111 corresponds to the target state.

In the next step, the container 111 moves to the inspection station 107 (see Figure 20), which has an optical measuring device 173 for detecting the wall thickness of the container walls 177. The measuring device 173 therefore has a movable laser measuring sensor 179, which can be moved into a suitable position on a carriage 226 with a hand wheel 227. To permit accurate positioning, a position sensor 228 is assigned to the carriage 226. The measuring sensor 179 is designed so that it can measure the thickness of opposing container walls 177 in one step. The container may therefore be gripped and rotated by a gripping device 229, which is disposed in such a way as to be movable on a carriage 230. The gripping device 229 comprises a servo motor 231 and a gripper 233, which has gripping fingers 234 and is rotatably mounted on a bearing block 232. By means of the laser measurement, any sawing that is still necessary in the first exemplary embodiment, or some other form of opening of the container 111, may be omitted.

After detecting the actual value for the wall thickness in the inspection station 107, the container 111 then moves to the ejection station 108 (see Figure 12), which ejects the finished and inspected container 111 into a product collector 183.

Based on the modular design of the components for the inspection devices, the retaining inserts for the container products or ampoule products may be varied in a wide range of applications, so that a wide variety of types of products can be inspected for specified properties, using only one inspection device. Thus, containers or ampoule products having cylindrical, oval or polygonal cross-sectional shapes can be inspected with

one inspection device with an appropriate adjustment of the receptacle modules. Individual ampoules or individual containers can also be inspected in just the same way as containers or ampoule products joined in a strip. It is self-evident that inspections will not be performed on the entire production output of one manufacturing machine, but only a statistically relevant random sample from ongoing production will be selected for inspection. In addition, a wide variety of driving means may also be used for activation of the inspection stations. In addition to hydraulic and pneumatic drives, electric drives, such as stepping motors and the like, may also be used.

The greatest advantage of the automatic inspection is that the inspection values thus obtained can be duplicated and are not subject to any subjective evaluation by inspection personnel. The test values, obtained automatically in this respect, are suitable for providing reliable information about the adjustment parameters of the upstream manufacturing machine in the sequence. Thus, for example, if the wall thickness is too small, more plastic material may be introduced into the shaping machine. If the quality of the plastic proves to be inferior, then the plastic material to be supplied can be changed and in particular a different blend of plastic material may be used. If the container or ampoule filling quantity is not correct, then the feed to the manufacturing machine can be controlled automatically. In particular, through long-term monitoring of the test results, it is possible to ascertain wear on the manufacturing machine, so that parts of the machine can be replaced upon reaching a preselectable wear level. For example, worn manufacturing molds may be replaced by new molds. A suitable machine control, along with memory programming, supports the adjustment processes between the test device and the respective manufacturing machine in this regard.

Claims

1. A method for establishing the presence of specified characteristics of a container product (9, 11, 109, 111), in particular made of plastic material, wherein the actual value of at least one specified characteristic is detected automatically in at least one inspection station (1-7, 101-107) of an inspection device, and is compared with the target value of this characteristic.
2. The method according to claim 1, characterized in that in the case of a container product in the form of a container strip (9, 109) with containers (11, 111) made of plastic, joined together separably at connecting points, the containers (11, 111) are separated by machine and the separation force required for this separation is determined.
3. The method according to claim 1 or 2, characterized in that containers are separated by twisting them off from the container strip (9, 109) in an independent, preferably the first, inspection station (1, 101) and the torque required for twist off is detected automatically.
4. The method according to any one of the preceding claims, characterized in that, in the case of containers (11, 111) filled with container contents, the separated containers (11, 111) are transferred by machine to an inspection station (2, 102) where they are weighed for an automatic determination of their total weight.
5. The method according to any one of the preceding claims, characterized in that the weighed containers (11, 111) are moved by machine into an inspection station (3, 103) and emptied there.

6. The method according to any one of the preceding claims, characterized in that the emptied containers (11, 111) are brought by machine to an inspection station (4, 104) where they are weighed to determine their tare weight and the total weight is automatically compared with the tare weight determined for ascertaining the weight of the container contents.
7. The method according to any one of the preceding claims, characterized in that, in the case of containers (11, 111) which have an end part (51, 151) assigned to a removal area on one neck part (39, 139), this end part being removable by a twisting movement from the main part (41, 141) of the container, the containers (11, 111) are brought by machine to an inspection station (5, 105) where the end part (51, 151) is twisted off mechanically, and the torque required for the twist off is determined automatically.
8. The method according to any one of the preceding claims, characterized in that the containers (11) are brought by machine to an inspection station (6) where an incision (75), which exposes the cross section of at least a portion of the container wall (77), is formed by machine.
9. The method according to any one of the preceding claims, characterized in that the cut containers (11, 111) are brought by machine into an inspection station (7, 107) where the thickness of at least one container wall (77, 177) is detected automatically.
10. The method according to any one of the preceding claims, characterized in that the containers (11, 111) are brought into

an ejection station (8, 108) by machine after the wall thickness has been detected, and are discharged from the testing device at this station.

11. The method according to one of claims 1 through 7, characterized in that the container thickness is determined in a nondestructive manner on at least one location of the respective container (111) to be inspected, preferably by means of ultrasound or an optical measurement method, in at least one of the inspection stations (107) or one of the inspection stations following this one.
12. The method according to any one of the preceding claims, characterized in that, by means of electronic acquisition, storage and evaluation media on at least one of the inspection stations where a measurement is to be performed, their measured values for at least some of the containers (11, 111) are detected and stored for the purpose of obtaining a statistical analysis of, in which direction (trending), and by which amount, the actual values thereby determined differ from the target value specifications.
13. The method according to claim 12, characterized in that the difference in the values thereby obtained between actual specifications and target specifications, are forwarded to a machine control of a manufacturing device, with the provision to optimize the manufacturing parameters during, or at the beginning or end of, the manufacturing process, such that the difference in values approaches zero and/or the material properties of the manufacturing material to be supplied to the manufacturing device are adjusted to the specifications.
14. A device for performing the method according to any one of the preceding claims, having at least one inspection station (1-7, 101-107), which has a device

for automatic detection of the actual value of at least one specified property of the respective container product (9, 11, 109, 111).

15. The device according to claim 14, characterized in that, in the case of a container product in the form of a container strip (9, 109) having containers (11, 111) made of plastic that are held together with one another separably at connection points (12, 112), the device has a first inspection station (1, 101) having a separation device (14, 114) for machine separation of the containers (11, 111) from the container strip (9, 109) by a mechanical twist-off.
16. The device according to claim 14 or 15, characterized in that the first inspection station (1, 101) for the respective containers (11, 111) to be separated from the container strip (9, 109) has a holder (16, 17, 116, 117) which surrounds this container partially, the holder being rotatable by a rotary drive (19, 119) for twisting off the container so gripped (11, 111), and the rotary drive (19, 119) has a torque sensor (22, 122) for detecting the twist-off torque.
17. The device according to one of claims 14 to 16, characterized in that a transport device (25, 30, 125, 130) is provided, having receptacles (24, 38, 124, 138) in which a respective container (11, 111) can be placed in the first inspection station (1, 101) and can be moved toward additional inspection stations (2-7, 102-107) disposed along an inspection zone.
18. The device according to one of claims 14 to 17, characterized in that the transport device has a motor-driven carousel (25) which moves the receptacles (24)

along a circular inspection path to other inspection stations (2-7) disposed on the inspection path.

19. The device according to one of claims 14 to 18, characterized in that an ejection station (8) for machine ejection of the container (11) from the respective receptacle (24) of the transport device (25) is provided on the circular inspection path in front of the first inspection station (1).
20. The device according to one of claims 14 to 18, characterized in that the receptacles (24) have a bearing part (26) for containers (11), and a movable cover part (27), which can be moved between a closed position in which it surrounds a partial region of the supported container (11) and an open position that is raised from the bearing part (26), and the transport device (25) has a control unit (31, 49), by means of which the cover parts (27) can be moved into the closed position and into the open position.
21. The device according to claim 17, characterized in that the inspection stations (101, 107) are disposed along an inspection path extending in a longitudinal direction, and the transport device (130) has a transport element (136), which moves the containers (11) in succession from one inspection station to the next.
22. The device according to claim 21, characterized in that a carrier that can be moved back and forth and up and down along the inspection path is provided as the transport element (136), the receptacles (138) being disposed on this carrier at intervals which correspond to the intervals between the inspection stations, and the receptacles (138) have a device (140) for holding and releasing a respective container (111), which can be controlled in such a way that the containers (111)

can be picked up at an inspection station and released at a subsequent inspection station.

23. The device according to one of claims 14 to 22, characterized in that a second inspection station (2, 102) has a weighing stand (34, 134) for automatic detection of the weight of a container (11, 111) filled with container contents.
24. The device according to one of claims 14 to 23, characterized in that an inspection station (3, 103) has a device (43, 45, 143, 145) for emptying the container contents of the respective container (11, 111).
25. The device according to one of claims 14 to 24, characterized in that an inspection station (4, 104) has a weighing stand (34, 134) for automatically determining the weight of an emptied container (11, 111).
26. The device according to one of claims 14 to 25, characterized in that an inspection station (5, 105) is provided with a twist-off device (53, 153) which has a rotary drive (57, 157) and a torque sensor (61, 161) for detecting the torque required to remove the end part (51, 151) from containers (11, 111), which have an end part (51, 151) on a neck part (39, 139), said end part being removable from the main part (41, 141) of the container by a twist-off movement.
27. The device according to one of claims 14 to 26, characterized in that an inspection station (6) has a cutting device (65) for forming an incision (75), which exposes the cross section of at least one wall part (77) of the respective container (11).

28. The device according to one of claims 14 to 27, characterized in that an inspection station (7, 107) has a measuring device (79, 81, 179) for automatic detection of the wall thickness of a cut container wall (77, 177).
29. The device according to one of claims 14 to 27, characterized in that, in at least one of the inspection stations (1-5, 101-107), or an inspection station following these, the container thickness is determined nondestructively in at least one location on the respective container (111) to be inspected, preferably by means of ultrasound or by means of an optical measurement method.