In the case of nested containers to be filled by a filling station, a gripping device picks up a row of empty containers and transfers it to a weighing station. Following weighing, the row of containers is simultaneously filled and subsequently re-weighed. The row of containers is then reinserted into the nest and sealed, without being refilled, which allows checking the operation of the filling station without wasting any of the product involved.
DEVICE AND METHOD FOR CONTROLLED FILLING

The invention relates to a device and a method for the controlled filling of nested containers, in particular, nested containers employed in the pharmaceutical field.

To be construed as “containers” are vessels that to be filled with, for example, liquids, in particular, pharmaceuticals. Included thereunder are syringes, vials, capsules, etc. To be construed as “nested containers” are containers that have been arranged in a nest or magazine for further processing. Preferably involved are disposable syringes that have been nested and stably packed in a box for further processing.

Filling stations must be checked for proper operation at regular intervals by measuring, or weighing, the content of a container. This type of checking is also termed “in-process control.” Such checking may take place at regular or irregular intervals, since it may be assumed that any changes in filling accuracy will occur gradually. However, every container may also be individually checked.

When filling individual containers, a known procedure is weighing containers prior to filling and reweighing them subsequent to filling. The reweighing must take place before containers are sealed, since the tolerances imposed on the weights of the plugs with which containers are sealed may be relatively large. This sort of checking will be adequate when filling individual containers, since it allows drawing conclusions regarding the operation of the filling station.

A device for weighing pharmaceutical containers, in particular, ampoules, is already known (cf. DE-U 29923418). However, in this case, the containers involved are conveyed sequentially, one after the other, using a rack conveyor, rather than nested. A gripper grips several containers and withdraws them sideward, from beneath the filling station. That sort of processing is impossible in the case of nested containers.

In the case of nested containers, however, several containers are filled simultaneously, in which case, weighing individual containers will not allow drawing any conclusions regarding whether a filling station is operating properly. Furthermore, in the pharmaceutical field, sealing containers as soon as possible after filling is either desirable or demanded by regulations.

To date, the standard practice for continuously monitoring the filling of nested containers has been manually withdrawing one or more filled containers and removing and measuring their contents, which requires considerable manual effort and yields only inaccurate results. Moreover, the products involved are wasted. If the products involved are pharmaceutical products, they might well be very expensive ones.

The problem addressed by the invention is creating a means for automatic in-process control of the filling of nested containers that will allow drawing conclusions regarding whether filling stations are operating properly.

In order to solve that problem, the invention proposes a device having those features stated under claim 1. The invention also proposes a method having those features stated in the claims. Elaborations thereon are covered by the respective dependent claims.
configured such that the gripping device is capable of setting a single container thereon for that purpose. The gripping device would then release the container during the actual weighing procedure. Several weighing cells could also be present in order that several containers could be weighed simultaneously. Of course, it would be best if the number of weighing cells were equal to the total number of containers in a row in order that they could all be simultaneously weighed.

0018. According to the invention, it may be provided that the gripping device has a multi-axis robot arm capable of executing all of the motions required, which would also allow installing a monitoring device on an existing filling device in the manner described.

0019. The controller could control the robot arm such that it would be able to pick up a row of containers to be checked from any position on the nest, or from a certain position on the nest only.

0020. The method proposed by the invention proceeds such that a row of containers residing on a nest is simultaneously filled and subsequently sealed. A row of empty containers is picked up from the nest at certain regular, or irregular, time intervals and weighed prior to filling. The row of containers is then simultaneously filled and reweighed. Following reweighing, the row is reinserted into the nest and then sealed. The results of these weighings are recorded by a controller and analyzed.

0021. According to the invention, in elaborating thereon, an entire row of containers may be simultaneously sealed and/or simultaneously weighed.

0022. Nests having several rows of containers are preferably cyclically advanced, where, in particular, the row of weighed containers is reinserted at the position thereon that is situated at the entrance to a filling station.

0023. Other features, details, and benefits of the invention will be evident from the claims and the abstract, whose wording is herewith made part of the contents of this description by way of reference thereto, the following description of a preferred embodiment of the invention, and the figures, where the figures depict:

0024. FIG. 1 a schematized view of the arrangement of a holder for a container at the entrance to a filling station:

0025. FIG. 2 a side view indicating the course of processing;

0026. FIG. 3 a top view of the arrangement shown in FIG. 2;

0027. FIG. 4 an end view of the holder for a container.

0028. In the case of nested containers, entire nests are fed in for processing, one at a time. The nests have a variable packing density, where their packing density depends upon the type of containers involved. Both the total number of rows and the total number of containers per row may be variable. Containers residing on a nest are usually processed row by row, where a row may be processed during a single cycle or during several cycles. The important thing in the pharmaceutical industry is that a row of containers that has just been filled be immediately sealed, i.e., sealed during the next cycle, whenever feasible.

0029. The nests are fed in for processing on a special conveyor system. Individual containers residing on nests will have already been laid out in the arrangement in which they will subsequently be conveyed and will thus have very high packing densities in order to save space, where their high packing densities are retained throughout the entire course of processing. An attempt to illustrate this has been made in FIG. 1. The containers are inserted into a holder 1 that has a plate 2. The plate 2 is mounted atop a rider 4 that runs on rails 3. The plate 2 has rows of holes 5 in which the containers are arranged. As may be seen from the simplified representation of FIG. 1, the rows of holes are staggered such that their holes are centered between those of the immediately adjacent row(s), which will allow achieving higher packing densities. But it is also possible not to stagger the holes. The holder 1 may be cyclically translated along the rails 3 by a drive, which has not been shown, that is controlled by a controller. The drive is configured such that short excursions of the holder 1 orthogonal to the transport axis may take place in order to allow bringing the holes of any row, including those having laterally offset holes, into coincidence with a set of parallel, straight lines.

0030. A filling station 6 having a row of filling needles 7 arranged on a holder 8 is situated above the holder 1. Every filling needle 7, only two of which have, for simplicity, been shown in FIG. 1, is connected to a device for dispensing the pharmaceutical to be filled by a hose 9. The holder 8 may be raised and lowered by the controller in order to provide that the filling needles 7 will at least extend down to the vicinities of the upper ends of the containers.

0031. A sealing station 10, represented by a single bar in FIG. 1, is arranged on the transport axis, which extends from the upper left to lower right in FIG. 1, behind the filling station. At the sealing station, plugs are inserted into the upper ends of the containers. This sealing station 10 may also be raised and lowered.

0032. As shown in FIG. 1, a weighing station 11 for weighing the containers, as mentioned above, is arranged at the entrance to the system.

0033. We now turn to considering FIG. 2, which schematically indicates the course of processing using the device proposed by the invention. A nest 12 of containers 13 arranged in rows is brought up. The nest may be a thin, plastic plate, into which the containers 13 have been inserted in the packing density to be involved. The purpose of the nest 12 is retaining and securing the containers 13, even while still in their shipping packages. For example, the containers 13 may be suspended in apertures in, or on cylindrical collars on, the nest such that they extend downward, with their free ends exposed. The containers 13 have a certain amount of free play in the holders in order to simplify their insertion into the nest 12. The holes in the plate thus have diameters that slightly exceed those of the containers.

0034. The nest 12 is cradled on the plate 2 shown in FIG. 1 using a device that has not been shown. As mentioned above, that plate 2 has apertures 5 at locations corresponding to the positions of the containers 13. The nest 12, or plastic plate, thus rests on the metal plate 2.

0035. The holder 1 is then cyclically advanced by a drive, which has been mentioned above but has not been shown,
where its advance will invariably be interrupted whenever a row of containers 13 is arranged immediately beneath the filling station 6. The filling needles 7 on the filling station 6 are then lowered and the containers 13 filled. The holder 1 is subsequently advanced one cycle, where the aforementioned excursion orthogonal to the plane of the paper simultaneously occurs. Shortly after filling, the containers are sealed by inserting a plug using the sealing station 10.

FIG. 3 depicts the top view of the arrangement shown in FIG. 2. The holder 1, complete with the plate 2 and the containers 13 inserted therein, is shown immediately preceding the entrance to the filling station 6. The weighing station 11, which has a row of weighing cells 14, is situated alongside the transport path. The total number of weighing cells 14 preferably equals the total number of positions within a row of containers 13. The total number of weighing cells may be increased in order to allow the device to also handle holders accommodating greater numbers of containers within a row. A single weighing cell for compensating for the air currents that are invariably present in clear rooms in which the device is arranged may also be present.

FIG. 4 depicts a, still schematized, side view of the holder 1, as viewed from the right in FIG. 1, drawn on a much larger scale. It may be seen that the plate 2 having raised edges 15 serves to support the packaging plate 12. Only several portions of this arrangement are shown. The packaging plate 12 has a hollow, cylindrical collar 16 whose inner diameter slightly exceeds the outer diameter of the container 13 for each container. The containers are inserted through the cylindrical collars 16 and remain suspended there, since the latter have a circumferential lip 17 on their upper end protruding beyond the outer walls of the collars 16.

The free ends of the containers 13 are exposed and protrude from the underside of the holder plate 2. In order that a gripper may now grasp the containers 13, a bar 18 that may be raised and lowered and will be raised whenever a row of containers 13 is to be removed from the plate 2 is arranged beneath the holder plate 2. The containers 13 will then protrude from the upper ends of the cylindrical collars 16. A gripper, which has not been shown, may then grasp the walls of the containers using a suction device or a mechanical gripping device and subsequently lift the entire row of containers 13 out of the holder. This gripper then brings the containers 13 to the weighing cells 14 on the weighing station and releases them there. They are then weighed. The gripper then grasps the containers 13 once again and holds them beneath the filling needles 7 on the filling station 6. The containers 13 of this row are then simultaneously filled. The gripper subsequently returns the containers 13 of this row to the weighing cells 14, releases them, and picks them up again after they have been reweighed. It then returns them to exactly the same row of cylindrical collars 16 or holes 5 from which it picked them up. The holder 1 remains stationary during these procedures and is not advanced. If the row of containers 13 that has just been weighed and filled should come under the filling station, the latter will be controlled by the controller such that no liquid will flow during that cycle. As soon as this row has been advanced further, it will be treated in the same manner as a normal row of containers, i.e., will be sealed using plugs when it reaches the sealing station.

1. A device for the controlled filling of nested containers (13) arranged in parallel rows in a nest (12), where the device has a filling station (6) for simultaneously filling a row of containers (13), a sealing station (10) for sealing the containers (13), a weighing station (11) for weighing at least one container (13), and a gripping device for picking up a row of containers (13) to be filled, transferring it to the weighing station (11), transferring the row of weighed containers (13) from the weighing station (11) to the filling station (6), transferring the row of filled containers (13) to the weighing station (11), and transferring the row of reweighed containers (13) to the nest before the latter enters the sealing station (10).

2. A device according to claim 1 having a drive controlled by a controller for cyclically conveying nests (12) transverse to the axes of the rows.

3. A device according to claim 2, wherein the controller is configured such that it records the row of weighed containers (13).

4. A device according to claim 2 or claim 3, wherein the controller is configured such that it triggers the motions involved cyclically and/or at random.

5. A device according to any of the foregoing claims, wherein the gripping device is configured such that it reinserts the row of containers (13) between the filling station (6) and the sealing station (10).

6. A device according to any of claims 1-4, wherein the gripping device is configured such that it reinserts the row of containers (13) into the nest (12) before the latter enters the filling station (6).

7. A device according to claim 6, wherein the operation of the filling station (6) is interrupted by the row of filled containers (13), controlled by the latter's recording by the controller.

8. A device according to any of the foregoing claims, wherein the sealing station (10) is arranged immediately following the filling station (6) and simultaneously seals the row of containers (13) that has just been filled.

9. A device according to any of the foregoing claims, wherein the weighing station (11) has at least one weighing cell (14) and the containers (13) are weighed one after the other, if necessary.

10. A device according to any of the foregoing claims, wherein the weighing station (11) has a row of weighing cells (14) and rows of containers (13) are simultaneously weighed.

11. A device according to any of the foregoing claims, wherein the gripping device has a multi-axis robot arm.

12. A device according to any of the foregoing claims, wherein the gripping device is configured such that it is capable of picking up a row of containers (13) from any of several positions, in particular, from any position, on the nest (12) and reinserting it at that position.

13. A method for controlling the filling of nested containers (13) arranged in parallel rows in nests (12) comprising the following stages:

   - simultaneously filling the containers (13) of a row of a nest,
   - subsequently sealing the filled containers (13),
   - periodically picking up a row of containers (13) from the nest (12) and weighing the empty containers (13),
simultaneously filling the weighed containers (13) of that row,

reweighing the weighed and filled containers (13) of that row, and

reinserting the row of reweighed containers (13) into the nest (12).

14. A method according to claim 13, wherein an entire row of containers (13) is simultaneously sealed.

15. A method according to claim 13 or claim 14, wherein an entire row of containers (13) is simultaneously weighed.

16. A method according to any of claims 13-15, wherein nests (12) having several rows of containers (13) are cyclically advanced transverse to the axes of the rows.

17. A method according to any of claims 13-16, wherein the row of weighed containers (13) is reinserted at the position situated at the entrance to a filling station (6).

18. A method according to any of claims 13-17, wherein the positions of the weighed containers (13) are recorded.