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(54) Method and divice for filling plastic bottles

(57) Method and device for filling plastic bottles whereby a dispensing/suction nozzle (1) is inserted into the mouth (2) at the top of a bottle. The nozzle (1) dispenses a liquid to fill the bottle and at the same time sucks out the air contained inside the said bottle. As the bottle is filled, the nozzle (1) has a frustoconical surface (6), which is made of steel, that fits tightly against an edge of the mouth (2), forming an air-tight seal around the said mouth by virtue of which seal the pressure inside the bottle can be less than the pressure in the external environment.

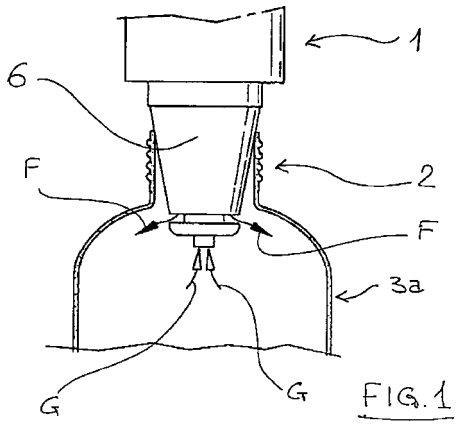

FIG. 1

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Description

[0001] The subject of the present invention is a method for filling plastic bottles.
More specifically, but not exclusively, the method can be usefully applied to aseptic bottling processes.

[0002] Reference is made in particular to a method whereby a dispensing/suction nozzle is inserted into the mouth at the top of each bottle in order to dispense a liquid to fill the bottle and suck out the air contained inside the bottle; the method also involves forming an air-tight seal around the mouth so that, as the bottle is filled, the pressure inside it is less than the pressure in the external environment.

[0003] Various methods of this type are already known: for example, this category includes the forced-suction constant-pressure filling method and, more generally, any method in which the pressure inside the bottle during the filling stage is different to the pressure of the environment outside the bottle.

[0004] In these known methods, the seal around the mouth of the bottle is produced using a sealing ring made of an elastic material which is fitted in a seat formed in the filling member.
The front of the sealing ring is designed to come into sealing contact with the top edge of the bottle mouth. As is known, the required seal tightness is achieved as a result of the deformation to which the sealing ring is subjected as it is pressed against the edge of the mouth.

[0005] However, these known methods have certain limitations and drawbacks. Firstly, the sealing ring is prone to rapid wear, both because of the type of material from which it is made - which is necessarily soft and porous - and because of the high number of operational cycles to which it is subjected. In a filling machine, this involves frequent replacement of the sealing rings with the result that the said machine has to be stopped.

[0006] This problem is further compounded in aseptic filling machines on account of the heat treatments carried out during the washing and sterilization stages, and as a result of which the sealing rings experience thermal expansion which may even cause them to come out of their seats. Secondly, the use of a sealing ring can lead to serious problems in terms of the bottled product becoming contaminated with bacteria.

[0007] This is because the product with which the bottles are tilled can easily get into the gap between the sealing ring and its seat and become trapped therein. Given that this gap could easily be missed by the washing and sterilizing action, it is possible for the product to stagnate, resulting in the growth of bacteria. The mechanical action and thermal expansion to which the sealing ring is subject could cause the contaminating material trapped within the gap to be dislodged, thereby contaminating the bottled product.

[0008] The object of the present invention is to overcome the above limitations and drawbacks of the known art by means of a method for filling plastic bottles under sealed conditions, whereby the seal is produced by the mouth of the bottle fitting tightly against a frustoconical surface that is integral with the nozzle and is less deformable than the said mouth.

[0009] One advantage of the invention in question is that it allows a considerable number of bottles to be filled under sealed conditions without having to stop the filling plant and while always ensuring a perfect seal.

[0010] A further advantage is that a perfect seal is ensured even when the filling plant is subjected to washing and sterilization operations which involve sudden temperature changes and consequent expansions.

[0011] An additional advantage is that it allows filling under completely aseptic sealed conditions in all circumstances.

[0012] A further object of the invention is to make available a device that is simple and cheap to construct and that enables the method in question to be implemented.

[0013] A further advantage of the invention is that it provides a device which, during its operation, can remain perfectly clean and free from contaminating deposits.

[0014] Yet another advantage is the provision of a self-centring type device, in other words one which is able automatically to correct any slight misalignments between the dispensing nozzle and the neck of the bottle to be filled.

[0015] These objects and advantages, together with others, are all achieved by the invention in question, as characterized by the claims set out below.

[0016] Further features and advantages of the present invention will become clear in the following detailed description of a preferred embodiment of the invention in question, illustrated by way of non-limiting example in the appended figures.

Figure 1 shows a diagrammatic section, taken on a vertical plane of section, of a detail of the device in question, comprising the filling nozzle during a stage of its operation.
Figure 2 shows the nozzle of Figure 1 inserted in the mouth of a different type of bottle from that illustrated in Figure 1.

[0017] With reference to the abovementioned figures, the numeral 1 denotes, as a whole, a nozzle for filling plastic bottles. The nozzle 1 is used especially in aseptic bottling machines for filling plastic bottles, each having a mouth at the top, under sterile conditions.

[0018] The bottling machine may comprise a filling carousel, known per se and not illustrated, that rotates on command about a vertical axis of rotation and carries a plurality of nozzles arranged circumferentially around the axis of rotation. The bottles are fed to the carousel by a feed line, also known per se and not illustrated, that can feed the bottles one by one to the various nozzles,

synchronously with the rotation of the filling carousel.

[0019] Each nozzle 1 has a lower end that can be inserted into the mouth 2 of a bottle 3a, 3b. The nozzle 1 can be used with a bottle 3a made of polyethylene, as in Figure 1, or with a bottle 3b made of PET, as in Figure 2, or with a bottle of another type, as long as it has a mouth at the top that can be deformed to a certain degree.

[0020] The nozzle 1 is of a type able to dispense a liquid to fill the bottle 3a or 3b and suck out the air contained inside the said bottle. The lower end of each nozzle 1 has at least one outlet for the filling liquid and one inlet for sucking the air out. In this particular example, the liquid flows out around 360° (in the direction denoted by the arrows F), while the suction inlet is located in the centre (the air being sucked out in the direction denoted by the arrows G)

[0021] Means, of a known type and not illustrated, are also provided for inserting the lower end of each nozzle 1 into the mouth 2 at the top of each bottle. The PET bottle 3b shown in Figure 2 has an outwardly-projecting annular collar 4 by means of which the mouth 2 can be grasped by an annular member 5 of known type in order to grip and handle the bottle 3b.

[0022] According to the invention, each nozzle 1 has a frustoconical external surface 6 that tapers downwards. The larger diameter of the surface 6 is greater than the internal diameter of the mouth 2. The frustoconical surface 6 is shaped so that it fits tightly against an upper edge of the mouth 2 of the bottle. The frustoconical surface 6 is more rigid than the mouth 2 of the container. The frustoconical surface 6 is in particular made of metal (stainless steel for example).

[0023] The frustoconical surface may, as in the examples illustrated, consist of the external surface of the body of the nozzle 1; it is, however, possible for the frustoconical surface 6 to be formed by attaching an applied material (by setting or by ceramicizing or in other similar ways) on to the external surface of the nozzle 1. All the same, it is preferable to avoid any gaps, cracks, recesses or the like - where particles of filling material may become trapped and stagnate - between the nozzle and any material that may be attached to it to form the frustoconical surface 6. The way in which the device in question works will be described below.

The bottles 3a or 3b are fed, one after the other and in a known manner, to the filling carousel which receives the bottles and advances them around a circumferential path, along which they are filled.

[0024] The mouth 2 of each bottle is moved upwards so that the corresponding dispensing/suction nozzle 1 can be inserted.

[0025] Any misalignment between the nozzle 1 and the mouth 2 is corrected automatically. During filling an air-tight seal is formed around the mouth 2 so that the pressure inside the bottle is, as a result of the suction, less than the pressure in the external environment.

[0026] The seal is produced by an upper edge of the mouth 2 fitting tightly against the frustoconical surface 6 that is integral with the nozzle 1. The edge of the mouth 2 is pressed with a given pressure against the external frustoconical surface 6 of the nozzle 1. The plastic material from which the mouth 2 is made is more deformable than the frustoconical surface 6. The slight elastic yielding of the mouth 2 of the bottle is sufficient to ensure an excellent seal around the edge of the said mouth. As a result of this seal, the air can be efficiently sucked out.

[0027] Once the filling stage is complete, the bottle and the nozzle are disengaged simply by moving the bottle vertically downwards.

The degree of taper of the frustoconical surface 6 is such as to allow the nozzle 1 easily to penetrate inside the mouth 2 of the bottle and also such as to allow the nozzle 1 to be subsequently removed from the mouth 2. It is also important that the engagement between the frustoconical surface 6 and the mouth 2 does not cause any permanent deformation of the latter. It has however been found that an effective seal can be produced without damaging the bottle mouth.

[0028] More specifically, the degree of taper is selected as a function of the deformability of the mouth 2: generally, the greater the deformability, the greater the angle of taper of the frustoconical surface 6, whereas in the case of very rigid mouths 2 it is advisable to use a relatively shallow taper.

[0029] According to the invention, the seal tightness required to generate a drop in pressure inside the bottle during filling is achieved as a result of the temporary deformation to which the mouth edge is subjected when it is pressed against the relatively hard and relatively non-deformable frustoconical surface.

There are therefore no soft, deformable elements that are subjected to a high number of fatigue cycles, such as for example the rubber sealing rings usually used in such cases, since in the example in question the deformable element - whose function it is to provide the seal - is deformed only once and in a non-permanent manner.

[0030] The invention may undergo numerous modifications of a practical nature to the constructional details, without thereby departing from the scope of protection of the inventive concept claimed below.

Claims

1. Method for filling plastic bottles, each having a mouth (2) at the top, comprising the following operations:

   - inserting a dispensing/suction nozzle (1) into the mouth (2) of each bottle in order to dispense a liquid to fill the bottle and suck out the air contained inside the said bottle;
   - forming an air-tight seal around the mouth (2) so that, as the bottle is filled, the pressure

inside it is less than the pressure in the external environment;
characterized in that the said seal is produced by an edge of the mouth (2) fitting tightly against an essentially frustoconical surface (6) that is integral with the nozzle (1), the said edge of the mouth (2) being more deformable than the frustoconical surface (6).

2. Method according to Claim 1, characterized in that the edge of the mouth (2) and the frustoconical surface (6) are pressed against each other with a given pressure.

3. Method according to Claim 1 or 2, characterized in that the said frustoconical surface (6) is the external surface of the nozzle (1)

4. Device for filling plastic bottles, each having a mouth (2) at the top, comprising:

- at least one dispensing/suction nozzle (1) able to dispense a liquid to fill the bottle and suck out the air contained inside the bottle, having a lower end that can be inserted into the mouth (2) at the top of a bottle, the said end having at least one outlet for the filling liquid and one inlet for sucking the air out;
- means for feeding the bottle to the nozzle (1) and for inserting the said lower end of the nozzle (1) into the mouth (2) at the top of the bottle;

characterized in that the nozzle (1) has a frustoconical external surface (6) that tapers downwards, the larger diameter of the said surface (6) being greater than the internal diameter of the mouth (2), the said surface (6) being shaped so that it fits tightly against an edge of the mouth (2) of the bottle and also being less deformable than the said edge.

5. Device according to Claim 4, characterized in that the said frustoconical external surface (6) of the nozzle (1) is made of metal.

6. Device according to Claim 4 or 5, characterized in that it comprises:

- a filling carousel that rotates on command about a vertical axis of rotation and carries a plurality of the said dispensing/suction nozzles (1) arranged circumferentially around the said axis of rotation;
- a bottle feed line that can feed the bottles one by one to the said nozzles, synchronously with the rotation of the filling carousel.

7. Method for filling plastic bottles according to the preceding claims and according to the description and illustration given with reference to the figures of the appended drawings, for the purposes set out above.

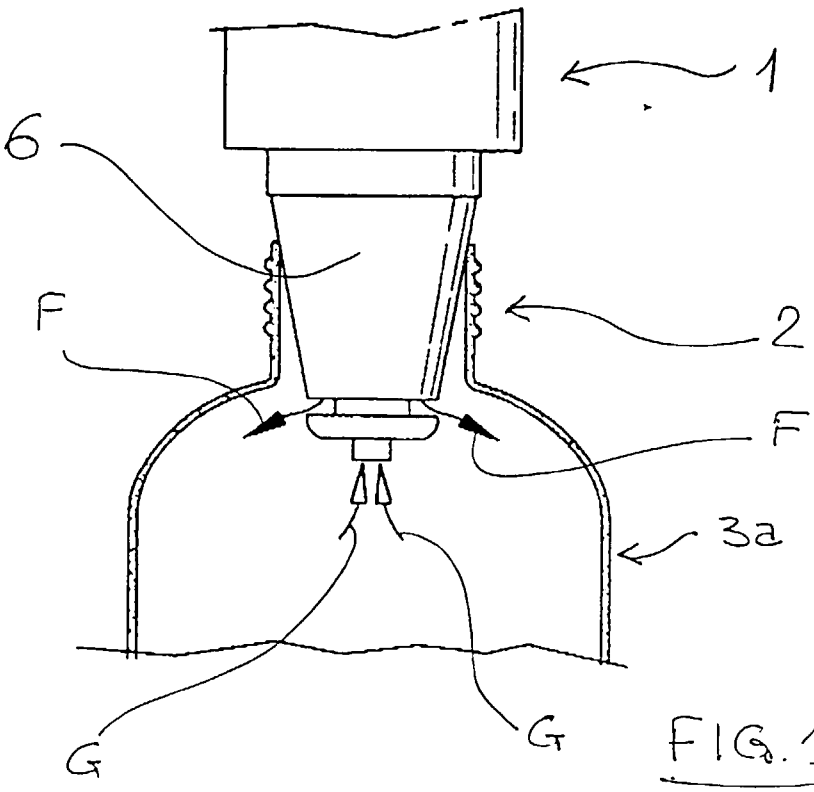

FIG. 1

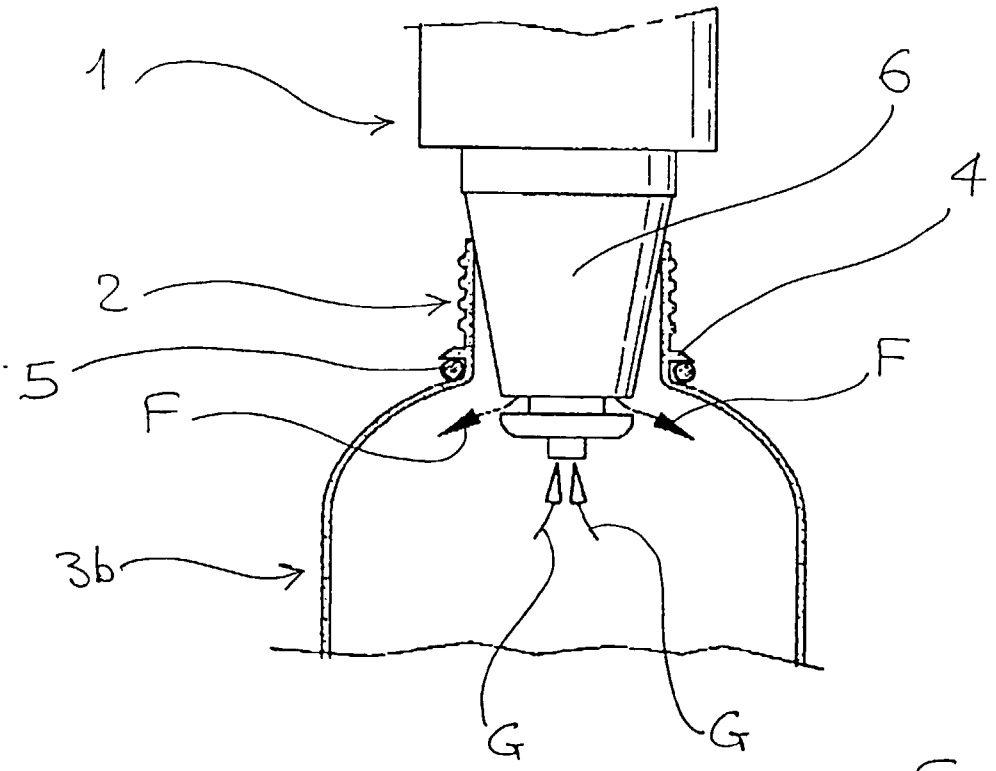

FIG. 2