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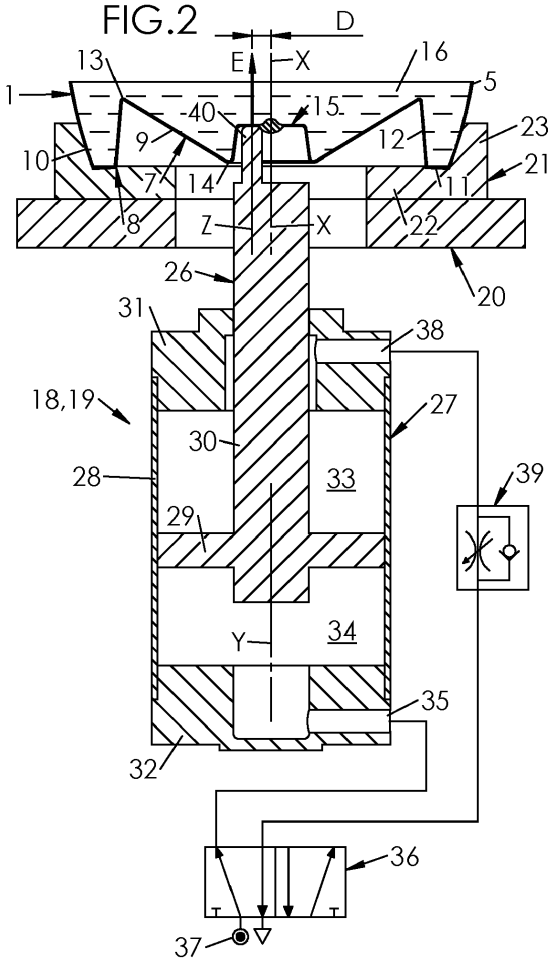
## (54) Method for processing filled containers having an invertible diaphragm

(57) Method for processing a container (1) provided with a sidewall and a base (7) including a standing ring (8) and a central invertible diaphragm (9), said diaphragm (9) having a symmetry around a main axis (X) and being deformable with respect to the sidewall (5) between a lower position wherein said diaphragm (9) projects outwardly with respect to the container (1) and an upper position wherein said diaphragm (9) projects inwardly with respect to the container (1), said method including the step of exerting on the diaphragm (9), by means of a movable pusher (26), an inversion effort (E) along an effort axis (Z) to invert the diaphragm (9) from its lower position to its upper position, wherein the effort axis (Z) is distinct from the main axis (X).

FIG.2

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## Description

### FIELD OF THE INVENTION

**[0001]** The invention generally relates to the processing of containers, such as bottles, which are produced by blow molding or stretch-blow molding from preforms made of plastic (mostly thermoplastic, e.g. PET) material. More specifically but not exclusively, the invention relates to the processing of hot-fill containers, i.e. containers filled with a hot pourable product (typically a liquid), the term "hot" meaning that the temperature of the product is higher than the glass transition temperature of the material, in which the container is made. Typically, hot filling of PET containers (the glass transition temperature of which is of about 80°C) is conducted with products at a temperature comprised between about 85°C and about 100°C, typically at 88°C.

### BACKGROUND OF THE INVENTION

**[0002]** U.S. Pat. Appl. No. 2008/0047964 (Denner et al, assigned to CO2PAC) discloses a container comprising a pressure panel located in the bottom portion of the container.

**[0003]** According to Denner, the pressure panel is movable between an outwardly-inclined position and an inwardly-inclined position to compensate for a change of pressure inside the container. In order to alleviate all or a portion of the vacuum forces within the container, the pressure panel is moved from the outwardly-inclined position by a mechanical pusher after the container has been capped and cooled, in order to force the pressure panel into the inwardly-inclined position.

**[0004]** Tests conducted on such a container revealed that the effort to be applied on the container bottom to achieve inversion of the diaphragm is important and therefore requires a large mechanical pusher to be mounted along the container manufacturing line.

### SUMMARY OF THE INVENTION

**[0005]** It is a purpose of the invention to provide a solution to facilitate inversion of the diaphragm.

**[0006]** It is another purpose of the invention to provide a method for processing containers, permitting diaphragm inversion with less effort.

**[0007]** It is yet another purpose of the invention to provide a machine for processing containers, including a movable pusher of smaller dimensions and/or requiring less power to permit diaphragm inversion.

**[0008]** It is therefore provided, in a first aspect, a method for processing a container provided with:

- a sidewall,
- a neck defining an opening,
- and a base including a standing ring and a central invertible diaphragm, said diaphragm having a symmetry around a main axis and being deformable with respect to the sidewall between a lower position, wherein said diaphragm projects outwardly with respect to the container, and an upper position wherein said diaphragm projects inwardly with respect to the container,

said method including the step of exerting on the diaphragm, by means of a movable pusher, an inversion effort along an effort axis to invert the diaphragm from its lower position to its upper position, wherein the effort axis is distinct from the main axis.

**[0009]** Accordingly, the diaphragm is distorted asymmetrically, the distortion starting with an initiator portion and spreading around the container main axis, whereby the effort required to achieve inversion is lower than in the known techniques.

**[0010]** In one embodiment, the effort axis is spaced from the main axis.

**[0011]** The effort axis is for example substantially parallel to the main axis and spaced therefrom of a distance comprised between 2 mm and 10 mm.

**[0012]** In an alternate embodiment, the effort axis is tilted with respect to the main axis.

**[0013]** The effort axis is for example tilted with respect to the main axis of an angle comprised between 3° and 15°.

**[0014]** The method may further comprise the steps of:

- filling the container through said opening with a pourable product, the diaphragm being in its lower position;
- closing the container at its neck with a cap.

**[0015]** The steps of filling and closing the container preferably precede the step of inverting the diaphragm.

**[0016]** It is provided, in a second aspect, a machine for processing containers each including:

- a sidewall,
- a neck defining an opening,
- and a base including a standing ring and a central invertible diaphragm, said diaphragm having a symmetry around a main axis and being deformable with respect to the sidewall between a lower position, wherein said diaphragm projects outwardly with respect to the container, and an upper position wherein said diaphragm projects inwardly with respect to the container,

this machine including:

- a container supporting frame including a hollow support ring for engaging a container base;
- a pusher movable with respect to the container supporting frame, capable of coming into abutment with the container base through the supporting frame, said pusher being capable of exerting an inversion

effort along an effort axis onto the container base, distinct from the main axis;

- an actuator for slidingly moving the pusher frontwards towards the container base through the supporting frame, and backwards,

**[0017]** The actuator is e.g. an electric or magnetic actuator, including an electric or magnetic motor, or a hydraulic or pneumatic cylinder including a cylinder housing, a piston and a rod fixed to the piston, and the pusher is mounted onto the rod.

**[0018]** The above and other objects and advantages of the invention will become apparent from the detailed description of preferred embodiments, considered in conjunction with the accompanying drawings.

## BRIEF DESCRIPTION OF THE DRAWINGS

**[0019]**

**FIG.1** is a partial cut view showing a machine for processing containers, including a pusher for inverting a diaphragm provided on a container base, in a first embodiment.

**FIG.2** is an enlarged detailed view showing the machine of **FIG.1,** in a state preceding an inversion of the diaphragm.

**FIG.3** is a view similar to **FIG.2,** showing the machine during inversion of the diaphragm.

**FIG.4** is a view similar to **FIG.2** and **FIG.3,** showing the machine in a state where inversion of the diaphragm is complete.

**FIG.5** is a partial cut view showing a machine for processing containers, including a pusher for inverting a diaphragm provided on a container base, in a second embodiment.

**FIG.6** is an enlarged detailed view showing the machine of **FIG.5,** in a state preceding an inversion of the diaphragm.

**FIG.7** is a view similar to **FIG.6,** showing the machine during inversion of the diaphragm.

**FIG.8** is a view similar to **FIG.6** and **FIG.7,** showing the machine in a state where inversion of the diaphragm is complete.

## DETAILED DESCRIPTION

**[0020]** Shown on **FIG.1** is a container **1** made by blow molding or stretch blow molding from a preform made of plastic such as PET. In a preferred though not exclusive embodiment, the container **1** is a hot-fill container, i.e. it has undergone, during the blow molding process, a heat set phase in order to increase the resistance of the container **1** to thermal stresses undergone during a filling step with a hot product, "hot" meaning that the temperature of the product is higher than the glass transition temperature of the material. In the case of PET, which has a glass transition temperature of about 80°C, the hot pourable product has for example a filling temperature in a range of about 85-95°C. Examples of hot pourable liquid products include (but are not limited to) tea, fruit juices, sports drinks.

**[0021]** The container **1** includes an open cylindrical threaded upper portion or neck **2,** which terminates, at an upper end thereof, by an opening or mouth **3.** Below the neck **2,** the container **1** includes a shoulder **4** of increasing diameter in a direction opposite to the neck **2.**

**[0022]** Below the shoulder **4,** the container **1** has a sidewall **5,** which is substantially cylindrical around a container main axis **X.** The sidewall **5** may, as depicted in **FIG. 1,** include annular stiffening ribs **6** capable of resisting thermal and mechanical stresses undergone by the container **1** during filling, capping and subsequent handling.

**[0023]** At a lower end of the sidewall **5,** the container **1** has a base **7,** which closes the container **1** and allows it to be normally put on a planar surface such as a table when used by a final customer.

**[0024]** The container base **7** includes a standing ring **8,** which may be a high standing ring as it will be explained later, and a central invertible diaphragm **9,** which has a symmetry around the main axis **X** and is deformable with respect to the sidewall **5** between an outwardly-inclined (or lower) position shown on **FIG.1-2** and **FIG.5-6,** wherein the diaphragm **9** projects outwardly with respect to the container **1,** and an inwardly-inclined (or upper) position, shown on **FIG.4** and **FIG.8,** wherein the diaphragm **9** projects inwardly with respect to the container **1.**

**[0025]** The container **1** is blow molded with the diaphragm **9** in its lower position. As will be explained in further details below, the diaphragm **9** is capable of being mechanically forced upwards (i.e. inwards with respect to the container **1)** after the container **1** has been filled with a pourable product, capped and cooled down, in order to compensate for the vacuum generated by the cooling of the product and to increase the overall rigidity of the filled container **1,** for the benefits of container handling and customer quality perception.

**[0026]** The standing ring **8** connects to the sidewall **5** of the container at a lower end portion **10** thereof. The standing ring **8** has a support flange **11** adjacent and substantially perpendicular to the lower end portion **10** of the sidewall **5,** and a cylindrical or frustoconical inner portion **12** which connects the support flange **11** to the diaphragm **9.** The support flange **11** is also substantially perpendicular to the container main axis **X.**

**[0027]** In a preferred embodiment, the lower end portion **10** of the sidewall **5** has, when viewed in transversal section as shown on **FIG.2** and **FIG.3,** the shape of an arch with a concavity turned inward with respect to the container **1,** whereby the outer diameter of the support flange **11** is smaller than the overall diameter of the sidewall **5.**

**[0028]** As depicted, the inner portion **12** preferably has the shape of a frustum of a cone and, when viewed in transversal section as shown on **FIG.2,** inclines inwardly with respect to the container **1,** with a draft angle.

**[0029]** The cone shape of the inner portion **12** provides a vault stiffening and locking function to the diaphragm **9** in its inverted position (shown in **FIG.4** and **FIG.8**), whereby the restriction of diameter of the inner portion **12** at its junction with the diaphragm **9** prevents the latter to articulate back from its inverted position with respect to the inner portion **12.** As a result, re-inversion of the diaphragm **9** back to its initial outwardly-inclined position under the mere hydrostatic pressure of the poured product is prevented.

**[0030]** In the depicted example, the inner portion **12** has an axial extension, which is important with respect to the outer diameter of the support flange **11,** hence the expression "high standing ring" to name the standing ring **8.** More specifically, the axial extension (or height) of the inner portion **12** is greater than 1/10 of the outer diameter of the support flange **11,** and preferably comprised between 1/10 and 1/5 of the outer diameter of the support flange **11.**

**[0031]** In the blown (and filled) configuration of the container **1** depicted on **FIG.1, FIG.2, FIG.5** and **FIG.6,** the invertible diaphragm **9** extends outwards in a frusto-conical shape from an outer edge **13,** where the diaphragm **9** connects to an upper end of the inner portion **12,** to an inner edge **14,** where the diaphragm **9** connects to a central upwardly protruding recess **15.** The geometric center of the recess **15** is located on the container main axis **X.**

**[0032]** Also in the blown configuration of the container **1,** the axial extension, or height, of the diaphragm **9,** is such that the inner edge **14** of the diaphragm **9** extends slightly above a support plane defined at the junction between the support flange **11** and the lower end portion **10** of the sidewall **5.** In other words, the height of the diaphragm **9** is slightly lower than the height of the high standing ring **8.**

**[0033]** After the container **1** has been blow molded, it is filled through its opening **3** with a (possibly hot) pourable product **16** (shown by a dotted pattern in **FIG.1** to **FIG.8**), the diaphragm **9** remaining in its lower position.

**[0034]** Then the container **1** is closed at its neck **2** with a cap **17,** which is forced down and screwed onto the neck **2.**

**[0035]** The filled and capped container **1** may then undergo a cooling step for recovering an average atmospheric temperature, e.g. of about 20°C.

**[0036]** Then, the container **1** is submitted to a diaphragm inversion, whereby the diaphragm **9** is moved from its lower position to its upper position.

**[0037]** Diaphragm inversion is conducted by a container processing machine **18,** which may be a stand-alone machine but which, in a preferred embodiment, is part of a container labeling machine configured for applying a label on the sidewall **5** of each container **1.** As the present description is centered on the diaphragm inversion, the whole labeling machine will not be disclosed.

**[0038]** The processing machine **18** may comprise a carrousel rotatably mounted on a fixed support structure, such carrousel including a plurality of identical peripheral processing units **19** displaced along a circular path.

**[0039]** Since processing units **19** are identical, only one will be disclosed in detail hereinafter for the sake of clarity and simplicity.

**[0040]** The processing unit **19** comprises a container supporting frame **20** including a hollow support ring **21** for engaging a container base **7.** In the depicted example, the support ring **21** has an annular plate **22** and a tubular outer wall **23,** whereby plate **22** and outer wall **23** together form a counter print of at least the support flange **11** and the lower end portion **10** of the container sidewall **5.**

**[0041]** The supporting frame **20** (and more specifically the plate **22** and outer wall **23)** is (are) centered on a main axis, which, when a container **1** is located on the supporting frame **20,** merges with the container main axis **X.** In the following, **X** denotes both the container main axis and the supporting frame main axis.

**[0042]** The processing unit **19** further includes a container retaining member **24** for rigidly retaining the container **1** in vertical position with its base **7** located within the support ring **21** while the diaphragm **9** is being inverted.

**[0043]** In the depicted example, the retaining member **24** is provided with a conical head **25** suitable for vertically coming into abutment with the cap **17** along the main axis **X.**

**[0044]** The processing unit **19** further includes a mechanical pusher **26** movable with respect to the supporting frame **20,** capable of coming into abutment with the container base **7** through the supporting frame **20** for inverting the diaphragm **9.**

**[0045]** The processing unit **19** further includes an actuator **27** for slidingly moving the pusher **26** along a displacement axis **Y,** both frontwards (i.e. upwards) towards the container base **7** through the supporting frame **20** in order to achieve inversion of the diaphragm **9,** and backwards (i.e. downwards) thereafter, to be ready for another inversion cycle.

**[0046]** In the depicted example it can be seen that the actuator **27** is a hydraulic or pneumatic cylinder, preferably of the two-way type.

**[0047]** The actuator **27** has a cylinder housing **28,** a piston **29** and a rod **30** fixed to the piston **29,** with the pusher **26** mounted onto the rod **30.** In the depicted example, the pusher **26** is integral with the rod **30,** but in an alternate embodiment the pusher **26** may be fixed (e.g. screwed) to a distal end of the rod **30.**

**[0048]** In a known manner, the actuator **27** has a closure head **31** and a closure bottom **32.** The piston **29** defines within the actuator **27** a front chamber **33** around the rod **30** and a back chamber **34** opposite to the rod **30,** whereby the front chamber **33** is mainly defined between the piston **29** and the closure head **31** whereas the back chamber **34** is mainly defined between the piston **29** and the closure bottom **32.**

**[0049]** As depicted in **FIG.2** and **FIG.6,** the back chamber **34** is in fluidic connection, through a bottom fluid port **35** formed in the closure bottom **32,** with a directional

control valve (DCV) **36** linked to a source **37** of fluid (such as air or oil) under pressure.

**[0050]** In a preferred embodiment, the front chamber **33** is also in fluidic connection, through a front fluid port **38,** to the DCV **36** (which is here of the 5/2 type: 5 ports, 2 spool positions), preferably through a flow restrictor **39.** This allows for a speed regulation of the piston **29** (and hence of the pusher **26)** during actuation, i.e. during inversion of the diaphragm **9.**

**[0051]** To achieve inversion of the diaphragm **9** from its lower position to its upper position, the pusher **26** exerts on the diaphragm **9** an inwardly (or upwardly) oriented inversion effort **E** along an effort axis **Z,** which:

- passes through a contact point between the pusher **26** and the container base **7** (in case pusher **26** contacts the container base **7** in an area, the contact point is regarded as the geometric center of this contact area),
- is parallel to the displacement axis **Y,**
- is distinct from the main axis **X.**

**[0052]** In a first embodiment, depicted on **FIG.1** through **FIG.4,** the effort axis **Z** is spaced from the main axis **X.**

**[0053]** More specifically, in the depicted example, the actuator **27** is such mounted with respect to the container supporting frame **20** that the displacement axis **Y** and the main axis **X** are collinear, and the pusher **26** has a tip **40,** which protrudes from the rod **30** and which is shifted laterally with respect to the displacement axis **Y** (and hence with respect to the main axis **X)** by a distance **D.** In a preferred embodiment, distance **D** is of several millimeters, e.g. comprised between 2 mm and 10 mm.

**[0054]** In this first embodiment, the pusher **26** contacts the container base **7** at a contact point, which is shifted laterally with respect to the main axis **X** by the same distance **D.**

**[0055]** Accordingly, under the thus shifted inversion effort **E,** the central recess **15** is swiveled and the diaphragm **9** is first asymmetrically distorted at an initiator portion **41,** which bends inwards, see **FIG.3.** As inversion effort **E** is maintained, distortion spreads from the initiator portion **41** around the main axis **X,** whereby the whole diaphragm **9** inverts to its upper position, see **FIG.4.**

**[0056]** In a second embodiment, depicted on **FIG.5** through **FIG.8**, the effort axis **Z** is tilted with respect to the main axis **X** by an angle **A.** Angle **A** is preferably comprised between 3° and 15°. In the depicted example, angle **A** is of about 5°.

**[0057]** More specifically, in the depicted example, the actuator **27** is such mounted with respect to the container supporting frame **20** that the displacement axis **Y** is tilted with respect to the main axis **X,** and the pusher **26** has a tip **40',** which is aligned with the rod **30.**

**[0058]** In this second embodiment, the pusher **26** contacts the container base **7** at a contact point, which is substantially at the geometric center thereof. In an alternate embodiment, the pusher **26** may contact the container base **7** at a contact point, which is shifted laterally with respect to the main axis **X.**

**[0059]** When the pusher is applied against the container base **7,** it generates an inversion effort **E,** which is directed upwards along the tilted effort axis **Z** and hence swivels the central recess **15** as in the first embodiment. The diaphragm **9** is first asymmetrically distorted at an initiator portion **41,** which bends inwards, see **FIG.7.** As inversion effort **E** is maintained, distortion spreads from the initiator portion **41** around the main axis **X,** whereby the whole diaphragm **9** inverts to its upper position, see **FIG.8.**

**[0060]** Although the contact point may move during the inversion process, orientation of the effort axis **Z** remains substantially the same.

**[0061]** As already stated, starting from the raw blown container **1,** the whole processing of the container **1** comprises the following steps:

- filling the container **1** through its opening **3** with pourable product **16,** the diaphragm **9** being in its lower position;
- closing the container **1** at its neck **2** with cap **17,**
- and then, inverting the diaphragm **9** with the processing unit **19,** as disclosed hereinbefore by either embodiment.

**[0062]** In the filling step, the container **1** is normally not fully filled, so that an empty volume (also called headspace) **42** (of air or another gas such as nitrogen) remains between the product **16** and the cap **17.** Depending upon the reliability of the filling machine, the volume of poured product **16** may vary from one container **1** to another. As a consequence, the headspace **42** may also vary from one container **1** to another, although the headspace **42** should always be substantially equal in volume to a reference headspace left by the correct volume of dispensed product.

**[0063]** During inversion of the diaphragm **9,** the product **16,** which is virtually incompressible, is displaced upwardly, whereby the gas (generally air) enclosed in the headspace **42** is compressed by a volume substantially equal to the volume (so-called extraction volume) swept by the diaphragm **9** during its inversion, between its lower and upper positions.

**[0064]** Spacing or tilting the effort axis **Z** with respect to the main axis **X** facilitates inversion of the diaphragm **9,** since distortion of the latter is progressive, starting from a localized initiator portion **41** before spreading to the whole diaphragm **9.**

**[0065]** Accordingly, less effort is required to be applied onto the diaphragm **9.** This saves power and permits to use lighter and smaller actuator **27** and pusher **26** with respect to the known techniques.

**[0066]** Various alternate embodiments may be provided within the scope of the present disclosure.

**[0067]** For instance, the hydraulic or pneumatic actu-

ator **27** may be replaced by an electric or magnetic actuator, including an electric or magnetic motor.

**[0068]** In an alternate process, the step of inverting the diaphragm **9** is achieved before the filling and closing steps.

## Claims

**1.** Method for processing a container **(1)** provided with:

- a sidewall (**5**),
- a neck **(2)** defining an opening **(3),**
- and a base **(7)** including a standing ring **(8)** and a central invertible diaphragm **(9),** said diaphragm **(9)** having a symmetry around a main axis **(X)** and being deformable with respect to the sidewall **(5)** between a lower position wherein said diaphragm **(9)** projects outwardly with respect to the container **(1),** and an upper position wherein said diaphragm **(9)** projects inwardly with respect to the container **(1),**

said method including the step of exerting on the diaphragm **(9),** by means of a movable pusher **(26),** an inversion effort **(E)** along an effort axis **(Z)** to invert the diaphragm **(9)** from its lower position to its upper position, said method being **characterized in that** the effort axis **(Z)** is distinct from the main axis **(X).**

**2.** Method according to claim 1, wherein the effort axis **(Z)** is spaced from the main axis **(X).**

**3.** Method according to claim 2, wherein the effort axis **(Z)** is substantially parallel to the main axis **(X),** the distance **(D)** between the effort axis **(Z)** and the main axis **(X)** being comprised between 2 mm and 10 mm.

**4.** Method according to claim 1 or claim 2, wherein the effort axis **(Z)** is tilted with respect to the main axis **(X).**

**5.** Method according to claim 4, wherein the effort axis **(Z)** is tilted with respect to the main axis **(X)** of an angle **(A)** comprised between 3° and 15°.

**6.** Method according to any of the preceding claims, further comprising the steps of:

- filling the container **(1)** through said opening **(3)** with a pourable product, the diaphragm **(9)** being in its lower position;
- closing the container **(1)** at its neck **(2)** with a cap **(17).**

**7.** Method according to claim 6, wherein the steps of filling and closing the container **(1)** precede the step of inverting the diaphragm **(9).**

**8.** Machine **(18)** for processing containers **(1)** each including:

- a sidewall (**5**),
- a neck **(2)** defining an opening **(3),**
- and a base **(7)** including a standing ring **(8)** and a central invertible diaphragm **(9),** said diaphragm **(9)** having a symmetry around a main axis **(X)** and being deformable with respect to the sidewall **(5)** between a lower position, wherein said diaphragm **(9)** projects outwardly with respect to the container **(1),** and an upper position, wherein said diaphragm **(9)** projects inwardly with respect to the container **(1),**

this machine **(18)** including:

- a container supporting frame **(20)** including a hollow support ring **(21)** for engaging a container base **(7);**
- a pusher **(26)** movable with respect to the container supporting frame **(20),** capable of coming into abutment with the container base **(7)** through the supporting frame **(20),** said pusher **(26)** being capable of exerting an inversion effort **(E)** along an effort axis **(Z)** onto the container base **(7);**
- an actuator **(27)** for slidingly moving the pusher **(26)** frontwards towards the container base **(7)** through the supporting frame **(20),** and backwards;

**characterized in that** the effort axis **(Z)** is distinct from the main axis **(X).**

**9.** Machine **(18)** according to claim 8, wherein the effort axis **(Z)** is spaced from the main axis **(X).**

**10.** Machine **(18)** according to claim 9, wherein the effort axis **(Z)** is substantially parallel to the main axis **(X),** the distance **(D)** between the effort axis **(Z)** and the main axis **(X)** being comprised between 2 mm and 10 mm.

**11.** Machine **(18)** according to claim 8 or claim 9, wherein the effort axis **(Z)** is tilted with respect to the central axis **(X).**

**12.** Machine **(18)** according to claim 11, wherein the effort axis **(Z)** is tilted with respect to the main axis **(Z)** of an angle **(A)** comprised between 3° and 15°.

**13.** Machine **(18)** according to any of claims 8-12, wherein said actuator is an electric or magnetic actuator, including an electric or magnetic motor.

**14.** Machine **(18)** according to any of claims 8-12, wherein said actuator **(27)** is a hydraulic or pneumatic cylinder including a cylinder housing **(28),** a piston **(29)**

and a rod **(30)** fixed to the piston **(29),** and wherein said pusher **(26)** is mounted onto the rod **(30).**

**Amended claims in accordance with Rule 137(2) EPC.**

**1.** Method for processing a container **(1)** provided with:

- a sidewall **(5),**
- a neck **(2)** defining an opening **(3),**
- and a base **(7)** including a standing ring **(8)** and a central invertible diaphragm **(9),** said diaphragm **(9)** having a symmetry around a main axis **(X)** and being deformable with respect to the sidewall **(5)** between a lower position wherein said diaphragm **(9)** projects outwardly with respect to the container **(1),** and an upper position wherein said diaphragm **(9)** projects inwardly with respect to the container **(1),**

said method including the steps of

- filling the container (**1**) through said opening **(3)** with a pourable product, the diaphragm **(9)** being in its lower position ,
- closing the container (**1**) at its neck **(2)** with a cap **(17)**,
- exerting on the diaphragm **(9),** by means of a movable pusher **(26),** an inversion effort **(E)** along an effort axis **(Z)** to invert the diaphragm **(9)** from its lower position to its upper position, said method being **characterized in that** the effort axis **(Z)** is distinct from the main axis **(X).**

**2.** Method according to claim 1, wherein the effort axis **(Z)** is spaced from the main axis **(X).**

**3.** Method according to claim 2, wherein the effort axis **(Z)** is substantially parallel to the main axis **(X),** the distance **(D)** between the effort axis **(Z)** and the main axis **(X)** being comprised between 2 mm and 10 mm.

**4.** Method according to claim 1 or claim 2, wherein the effort axis (Z) is tilted with respect to the main axis **(X).**

**5.** Method according to claim 4, wherein the effort axis **(Z)** is tilted with respect to the main axis **(X)** of an angle **(A)** comprised between 3° and 15°.

**6.** Method according to claim 1-5, wherein the steps of filling and closing the container (**1**) precede the step of inverting the diaphragm **(9).**

**7.** Machine **(18)** for processing containers (**1**) each including:

- a sidewall **(5),**
- a neck **(2)** defining an opening **(3),**
- and a base **(7)** including a standing ring **(8)** and a central invertible diaphragm **(9),** said diaphragm **(9)** having a symmetry around a main axis **(X)** and being deformable with respect to the sidewall **(5)** between a lower position, wherein said diaphragm **(9)** projects outwardly with respect to the container (**1**), and an upper position, wherein said diaphragm **(9)** projects inwardly with respect to the container **(1),**
- each container (**1**) being filled through said opening **(3)** with a pourable product, the diaphragm **(9)** being in its lower position, each container (**1**) being then closed at its neck **(2)** with a cap **(17)**,

this machine **(18)** including:

- a container supporting frame **(20)** including a hollow support ring **(21)** for engaging a container base **(7);**
- a pusher **(26)** movable with respect to the container supporting frame **(20),** capable of coming into abutment with the container base **(7)** through the supporting frame **(20),** said pusher **(26)** being capable of exerting an inversion effort **(E)** along an effort axis **(Z)** onto the container base **(7);**
- an actuator **(27)** for slidingly moving the pusher **(26)** frontwards towards the container base **(7)** through the supporting frame **(20),** and backwards;

**characterized in that** the effort axis **(Z)** is distinct from the main axis **(X).**

**8.** Machine **(18)** according to claim 7, wherein the effort axis **(Z)** is spaced from the main axis **(X).**

**9.** Machine **(18)** according to claim 7, wherein the effort axis **(Z)** is substantially parallel to the main axis **(X),** the distance **(D)** between the effort axis **(Z)** and the main axis **(X)** being comprised between 2 mm and 10 mm.

**10.** Machine **(18)** according to claim 8 or claim 9, wherein the effort axis **(Z)** is tilted with respect to the main axis **(X).**

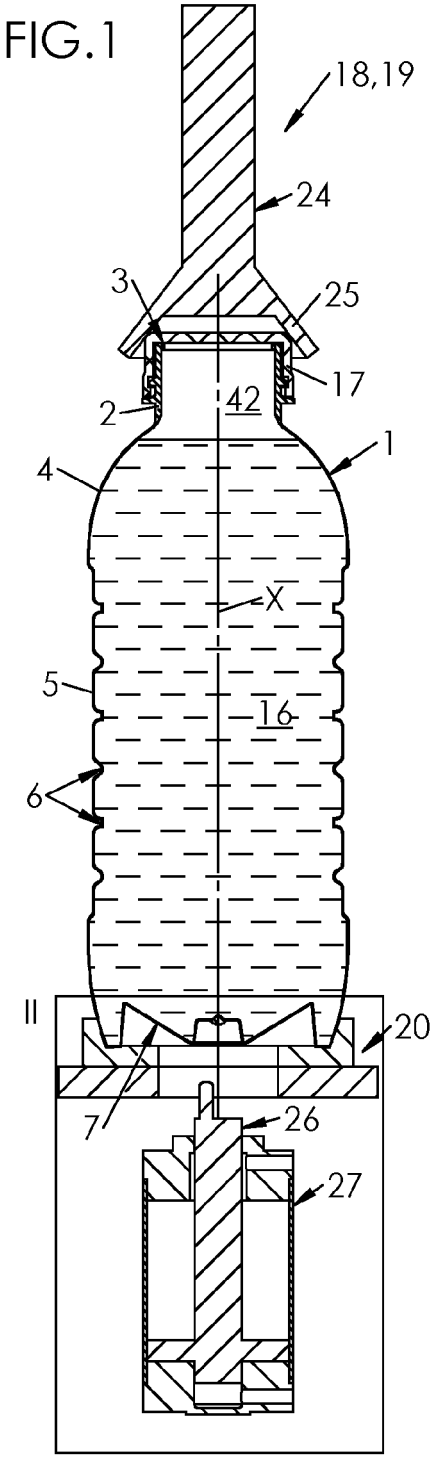
**11.** Machine **(18)** according to claim 10, wherein the effort axis **(Z)** is tilted with respect to the main axis **(X)** of an angle **(A)** comprised between 3° and 15°.

**12.** Machine **(18)** according to any of claims 7-11, wherein said actuator is an electric or magnetic actuator, including an electric or magnetic motor.

**13.** Machine **(18)** according to any of claims 7-11, where-

in said actuator **(27)** is a hydraulic or pneumatic cylinder including a cylinder housing **(28),** a piston **(29)** and a rod **(30)** fixed to the piston **(29),** and wherein said pusher **(26)** is mounted onto the rod **(30).**

FIG.1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3
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17
2
42
1
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X
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II
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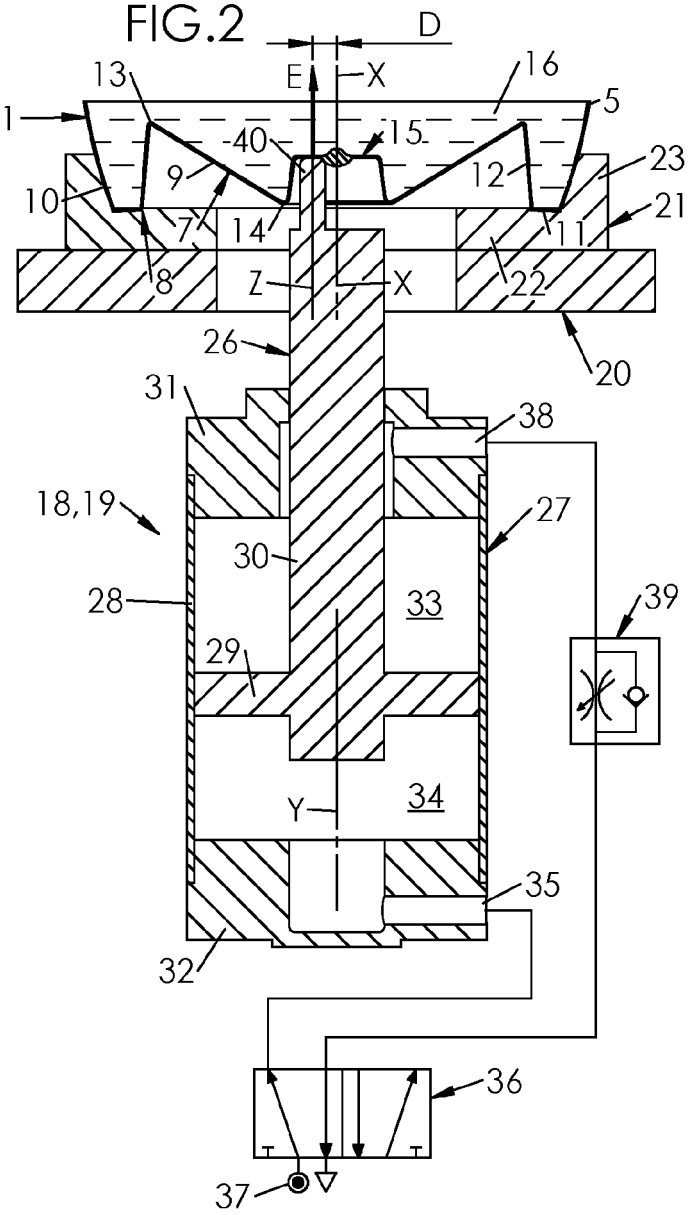
FIG.2


D
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Z
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FIG.4

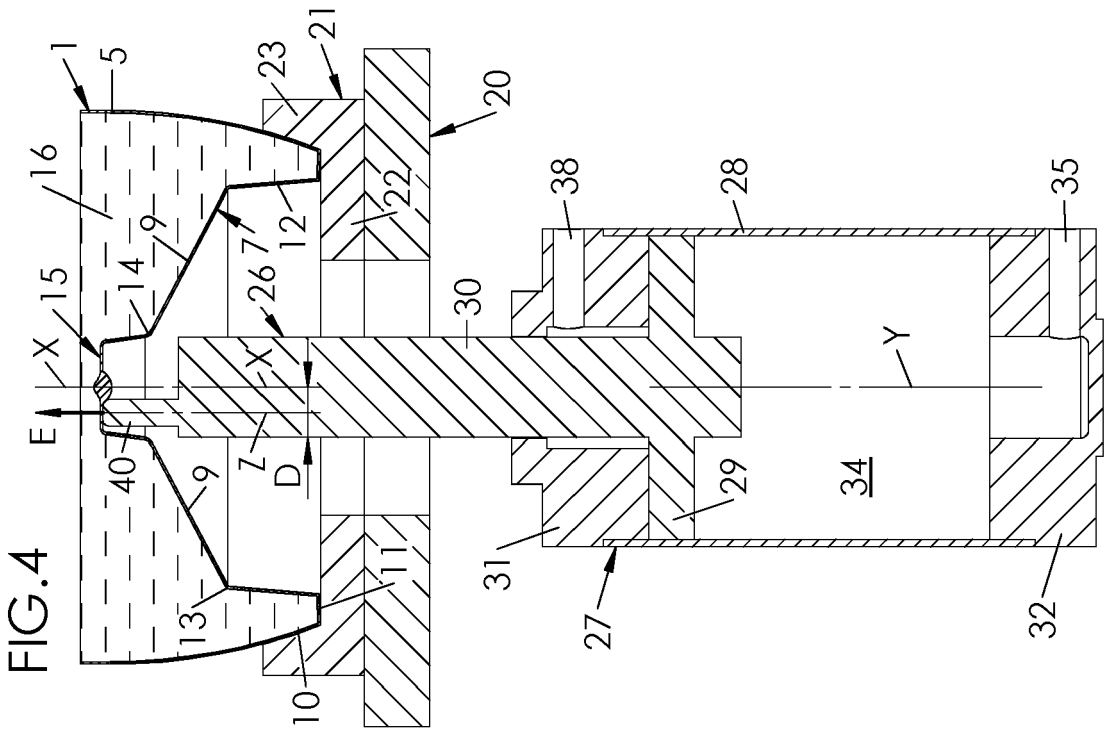
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FIG.3

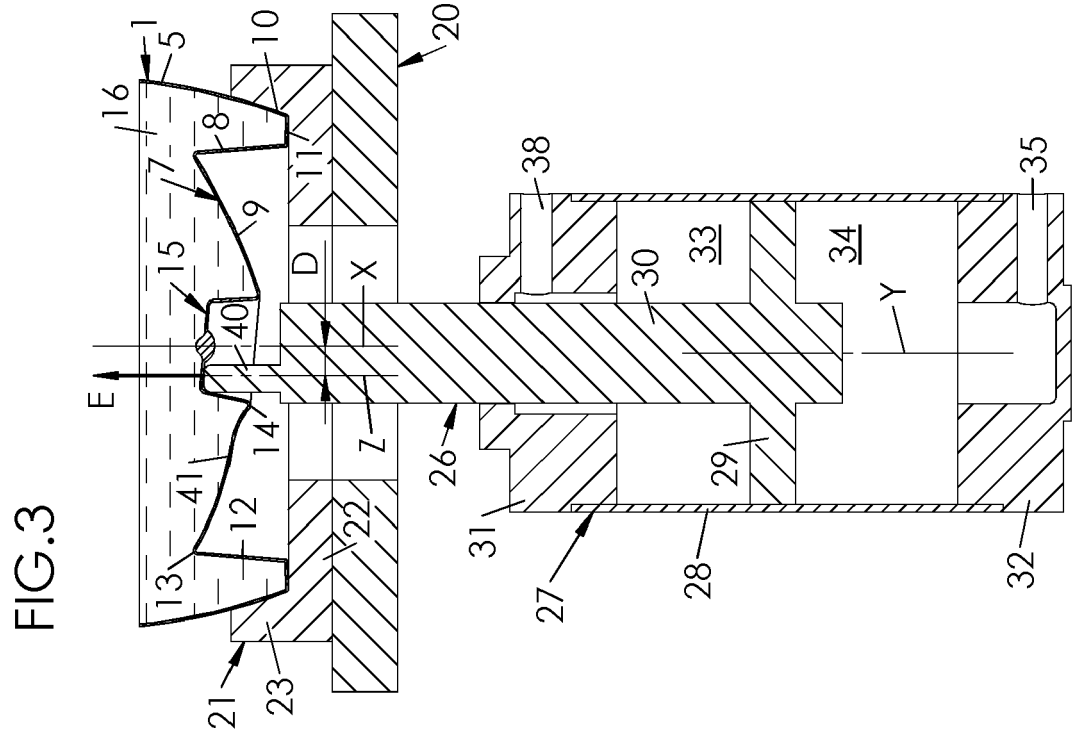
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FIG.5

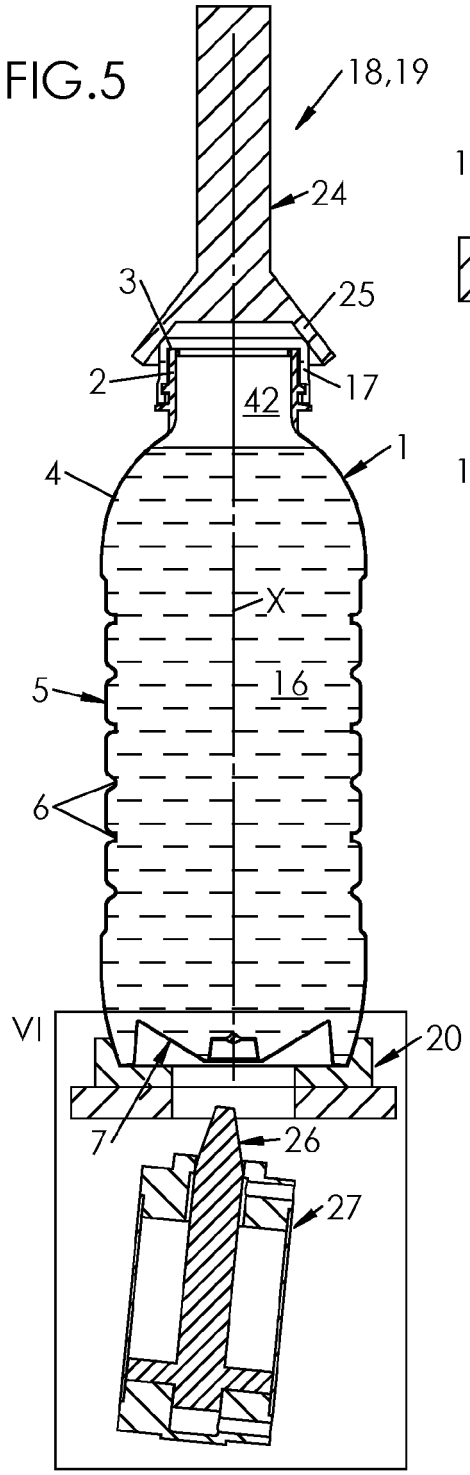
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FIG.6

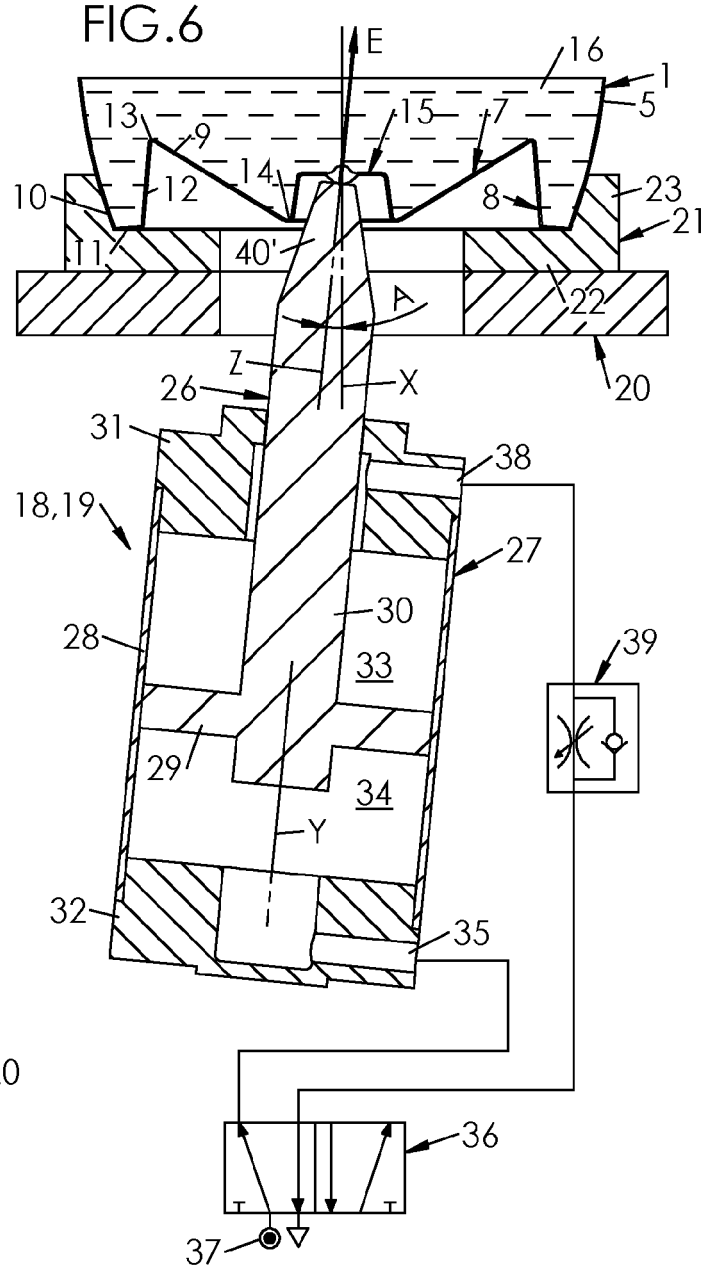
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FIG.8

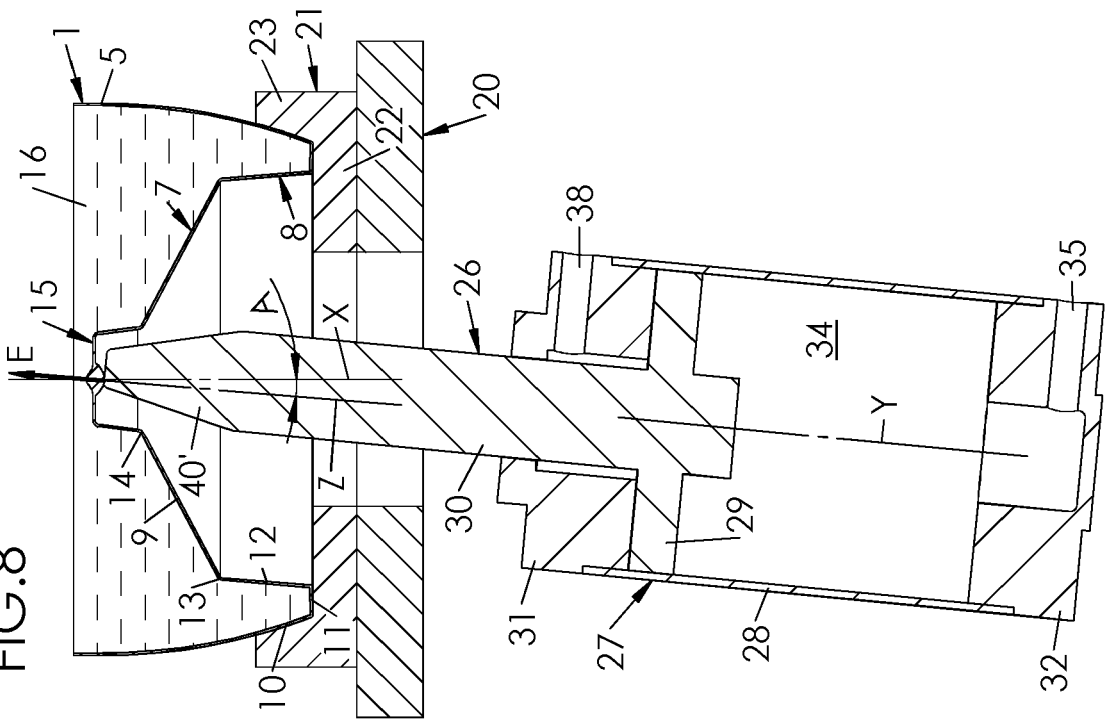
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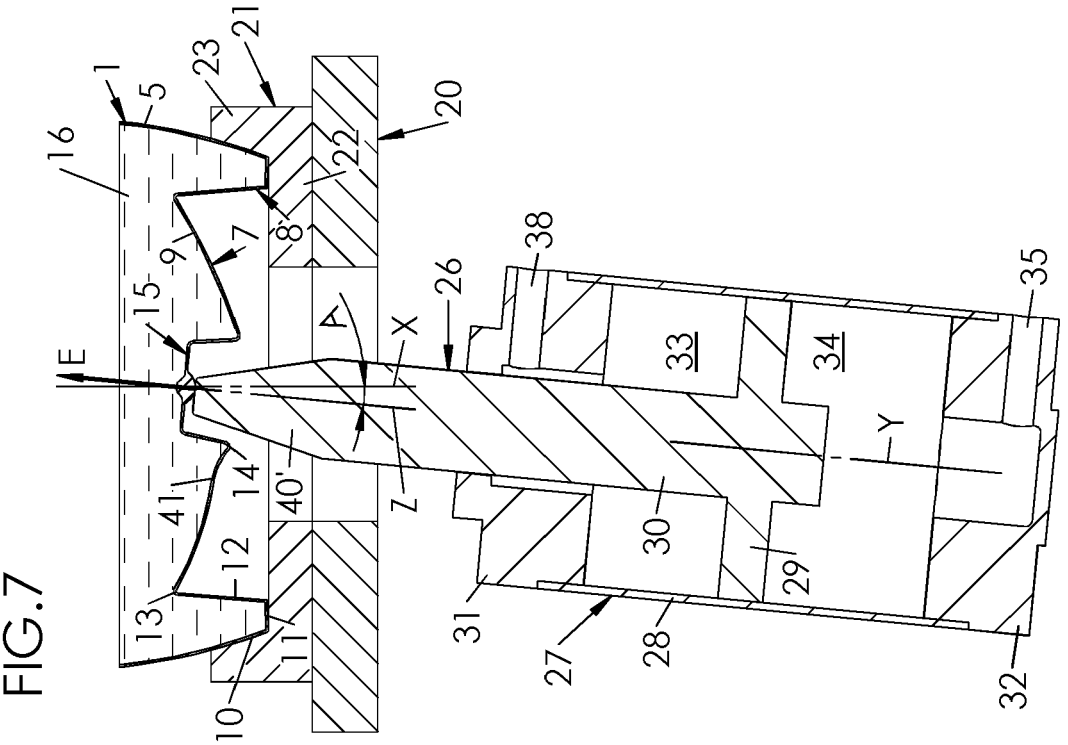
FIG.7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# EUROPEAN SEARCH REPORT

Application Number
EP 14 30 6647

## DOCUMENTS CONSIDERED TO BE RELEVANT

| Category | Citation of document with indication, where appropriate, of relevant passages | Relevant to claim | CLASSIFICATION OF THE APPLICATION (IPC) |
|---|---|---|---|
| X | JP 2008 100720 A (TOYO SEIKAN KAISHA LTD) 1 May 2008 (2008-05-01)<br>* figures 1-12 *<br>* abstract * | 1,4-8, 11-14 | INV. B67C3/24 |
| X | JP 2002 054100 A (KAO CORP) 19 February 2002 (2002-02-19)<br>* figures 1-4 *<br>* abstract *<br>* paragraphs [0014], [0015] * | 1-3, 6-10,13, 14 | |
| A,D | US 2008/047964 A1 (DENNER JOHN [US] ET AL MELROSE DAVID [NL] ET AL) 28 February 2008 (2008-02-28)<br>* figures 11A-11E * | 1,8 | |
| A | WO 2013/139874 A1 (SIDEL SPA CON SOCIO UNICO [IT]) 26 September 2013 (2013-09-26)<br>* figures 2-5 * | 1,8 | |

TECHNICAL FIELDS SEARCHED (IPC)

B67C
B65C

The present search report has been drawn up for all claims

| Place of search | Date of completion of the search | Examiner |
|---|---|---|
| The Hague | 23 March 2015 | Pardo Torre, Ignacio |

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23-03-2015

| Patent document cited in search report | Publication date | Patent family member(s) | Publication date |
|---|---|---|---|
| JP 2008100720 A | 01-05-2008 | JP 4858700 B2 | 18-01-2012 |
| | | JP 2008100720 A | 01-05-2008 |
| JP 2002054100 A | 19-02-2002 | NONE | |
| US 2008047964 A1 | 28-02-2008 | NONE | |
| WO 2013139874 A1 | 26-09-2013 | CN 104379456 A | 25-02-2015 |
| | | EP 2828170 A1 | 28-01-2015 |
| | | US 2015040515 A1 | 12-02-2015 |
| | | WO 2013139874 A1 | 26-09-2013 |

EPO FORM P0459

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### Patent documents cited in the description


- US 20080047964 A, Denner **[0002]**