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(54) **Unit and method for contact or contactless filling an article with pourable food product**

## Description

**[0001]** The present invention relates to a unit and a method for contact or contactless filling of an article with pourable product.

**[0002]** In greater detail, the filling unit is adapted either to fill the article with a carbonated food product, i.e. a food product containing carbon dioxide, according to a contact modality or to fill the article with a still pourable product according to a contactless modality.

**[0003]** A known filling unit substantially comprises:

- a carousel conveyor rotating about a rotation axis;
- a tank containing the pourable food product;
- a plurality of filling devices supported by the carousel conveyor in a position radially external with respect to the rotation axis of the carousel conveyor;
- a plurality of holding devices, which are supported by the carousel conveyor underneath respective filling device, move along the path integrally with respective filling devices, and are adapted to convey respective articles along an arc-shaped trajectory extending about the rotation axis; and
- a fixed cam which interacts with cam followers of holding devices, so as to displace the latter with respect to the relative filling devices and parallel to a direction, which is spaced and parallel to the rotation axis.

**[0004]** In greater detail, as it rotates about the rotation axis, each holding device moves with respect to relative filling device between a lowered rest position and a raised operative position parallel to the rotation axis.

**[0005]** Still more precisely, each holding device receives the relative article to be filled at an inlet station of the path and outputs the relative filled article at the outlet station of the path.

**[0006]** Furthermore, each holding device is arranged in the relative lowered position at the inlet station and in the output station, and moves towards and back from the relative raised operative position between the inlet station and the outlet station.

**[0007]** In case of contact filling of carbonated products, a mouth of each article is tight-fluidly pressed against a body of the respective filling device, when the holding device is in the relative raised operative position. In this way, the carbon dioxide contained in the food product is prevented from escaping from the article in the environment, when the holding device in the respective raised operative position.

**[0008]** Differently, in case of contactless filling of still products, the body of each filling device is arranged at a given distance from the mouth of the relative article to be filled, when the respective holding device in the respective raised operative position.

**[0009]** Furthermore, in the case of contact filling with carbonated food products, each filling device is required to carry out a plurality of additional operations on the

respective articles, in addition to the filling with the pourable food product, when the relative holding devices are in the raised operative position.

**[0010]** In greater detail, the articles undergo a pressurization operation before the filling thereof with the pourable food product. Still more precisely, the empty articles are filled with a pressurized gas before the filling thereof, so as to render the pressure inside the articles equal to the pressure of the pourable product, during the filling operation.

**[0011]** Furthermore, the pressure inside the filled articles is reduced to the environment value, after the completion of the filling of the same articles.

**[0012]** Each holding device substantially comprises:

- the relative cam follower;
- a gripping device for gripping relative article as the latter moves along the arc-shaped trajectory; and
- an actuator for actively displacing the gripping device parallel to the rotation axis of the carousel.

**[0013]** Furthermore, the cam extends about the rotation axis of the carousel for an arch smaller than 360 degrees.

**[0014]** As a result, the cam follower of each holding device interacts with the cam only along a first portion of the path, whereas it is detached from the cam along a second portion of the path.

**[0015]** The interaction of the cam with each cam follower along the first portion of the path:

- displaces the relative holding device between the relative raised operative position and the relative lowered rest position, upstream of the outlet station, according to the rotation direction of carousel;
- keeps the relative holding device in the relative lowered rest position from the outlet station and the inlet station; and
- displaces the relative holding device from the relative lowered rest position and a relative intermediate position, downstream of the inlet station.

**[0016]** The actuator of each holding device is controlled to exert an upward action on the relative gripping device, so as to:

- keep the relative cam follower in contact with the cam along the first portion of the path; and
- upwardly moving the relative article together with the second portion up to the raised operative position along the second portion of the path.

**[0017]** In the known solution, the actuator is pneumatically operated and substantially exerts a constant value upwards action on the gripping device, along the whole path.

**[0018]** Furthermore, a considerable action is required to keep the relative article in the relative raised position

along the second portion of the path. That action is even greater in case of contact filling, because it is required to contrast the pressure of the gas inside the articles.

**[0019]** Accordingly, the cam follower of each holding device exerts that considerable action also against the cam, which therefore undergoes substantial mechanical stress and is subjected to considerable wear with a corresponding reduction of the lifetime thereof.

**[0020]** A need is felt within the sector to reduce the mechanical stress on and/or the wear of the cam and of the cam follower, while preserving the flexibility of the unit of both contact and contactless filling the articles.

**[0021]** It is an object of the present invention to provide a unit for contact or contactless filling an article with a pourable product, which allows to easily and cost-effectively meet at least the above identified need.

**[0022]** The aforementioned object is achieved by the present invention as it relates to a unit for contact or contactless filling an article with a pourable product, as defined in claim 1.

**[0023]** The present invention also relates to a method for contact or contactless filling an article with a pourable product, as defined in claim 13.

**[0024]** One preferred embodiment is hereinafter disclosed for a better understanding of the present invention, by way of non-limitative example and with reference to the accompanying drawings, in which:

- Figure 1 shows a schematic view of a filling unit according to the present invention, with parts removed for clarity;
- Figure 2 is an enlarged scale section along line II-II of Figure 1 of one holding device and one filling head of the unit of Figure 1 showing the unit in a first configuration and in case of contact filling, with parts removed for clarity;
- Figures 3 and 4 show in a further enlarged view the components of Figure 2, with parts removed for clarity;
- Figure 5 is an enlarged scale section along line II-II of Figure 1 of one holding device and one filling head of the unit of Figure 1 showing the unit in the first configuration and in case of contactless filling, with parts removed for clarity;
- Figures 6 and 7 show in a further enlarged view the components of Figure 5, with parts removed for clarity;
- Figure 8 is an enlarged scale section along line II-II of Figure 1 of one holding device and one filling head of the unit of Figure 1 showing the unit in a second configuration and in case of contact filling, with parts removed for clarity;
- Figures 9 and 10 show in a further enlarged view the components of Figure 8, with parts removed for clarity;
- Figure 11 is an enlarged scale section along line II-II of Figure 1 of one holding device and one filling head of the unit of Figure 1 showing the unit in a idle

configuration, with parts removed for clarity;

- Figures 12 and 13 show in a further enlarged view the components of Figure 11, with parts removed for clarity;
- Figure 14 is a schematic top view of the filling unit of Figure 1, showing the operation steps in case of contact filling;
- Figure 15 is a schematic top view of the filling unit of Figure 1, showing the operation steps in case of contactless filling;
- Figure 16 is a schematic view of a component of the filling unit of Figures 1 to 15; and
- Figure 17 is a top view of the filling unit of Figures 1 to 16, with parts removed for clarity.

**[0025]** With reference to Figures 1 and 14 to 17, numeral 100 indicates a filling station for contact or contactless filling articles, containers 2 in the embodiment shown, with a pourable product.

**[0026]** In greater detail, filling station 100 substantially comprises (Figures 14 and 15):

- an in-feed star-wheel 6 which advances containers 2 to be filled;
- a filling unit 1, which receives containers 2 from star-wheel 6 at an input station I, conveys containers 2 along an arch-shaped trajectory and outputs filled containers 2 at an output station O;
- an out-feed star-wheel 7, which receives filled containers 2 from filling unit 1 at output station O.

**[0027]** Filling unit 1 substantially comprises (Figures 1 and 14 to 17):

- a carousel 3 rotating about an axis A, which is vertical in the case shown, along a path P;
- a frame 4 (shown in Figure 17 only), with respect to which carousel 3 is rotatable about axis A; and
- a plurality of filling devices 10 adapted to fill respective containers 2 with the pourable food product along path P and supported by a peripheral edge external to axis A of carousel 3.

**[0028]** Carousel 3 also includes a tank (not-shown) common to all filling devices 10 and which is filled with the pourable food product.

**[0029]** Each container 2 comprises (Figure 2):

- a mouth 11 adapted to allow the filling of container 2 by means of filling unit 1 and the following pouring of the food product from container 2;
- a neck 12 arranged immediately below mouth 11; and
- a bottom wall 13 opposite to mouth 11.

**[0030]** Filling unit 1 further comprises:

- a stationary cam 49; and

- a plurality of holding devices 17 carried by carousel 3, associated to respective filling devices 10, and adapted to move relative containers 2 with respect to relative filling devices 10 along respective axes B.

**[0031]** For simplicity, the following description will refer to only one filling device 10 and to relative holding devices 17 and container 2, as devices 10 are identical to one another.

**[0032]** Filling device 10 substantially comprises (Figures 1 to 13):

- a frame 15 fitted to carousel 3;
- a hollow body 19 which is defined by frame 15 and which extends about an axis B parallel to and staggered from axis A; and
- a shutter 16 movable along axis B inside body 19. Body 19 comprises, in turn, proceeding along axis B: an opening 20, which is fluidly connected with tank; and
- an opening 21, which is opposite to opening 20, which faces mouth 11 of container 2 and through which the food product passes during the filling of container 2.

**[0033]** In the embodiment shown, shutter 16 comprises (Figures 4, 7, 10 and 13):

- a stem 23 which receives a force along axis B; and
- a plunger 25, which is arranged at an end of stem 23 arranged on the side of opening 21.

**[0034]** Plunger 25 is conical of axis B and comprises a conical end on the side of opening 21 shaped correspondingly to the shape of opening 21.

**[0035]** Shutter 16 is movable relative to body 19 and along axis B between:

- an open configuration, in which it allows the fluidic connection between openings 20, 21, thus allowing the filling of container 2 with the food product (Figure 5); and
- a closed configuration, in which it prevents the fluidic connection between opening 20 and opening 21 (Figure 2).

**[0036]** Holding devices 17 move synchronously and together with relative filling devices 10 along path P and about axis A.

**[0037]** Holding device 17 further comprises (Figures 4, 7, 10 and 13):

- a cam follower 48 rotatable about an axis E;
- a gripping device 18, which is operatively connected to cam follower 48 and is adapted to grip neck 12 of container 2; and
- an actuator 51 adapted to exert an action directed along axis B on gripping device 18 and, therefore,

container 2.

**[0038]** Furthermore, gripping device 18 is movable parallel to axis B between:

- a lowered rest position (shown in Figures 2 to 4 in case of contact filling); and
- a raised operative position (shown in Figures 5 to 7 in case of contactless filling and in Figures 8 to 10 in case of contact filling), in which container 2 undergoes a filling operation.

**[0039]** In the embodiment shown, when gripping device 18 is in the raised operative position,:

- mouth 11 of container 2 is in tight-fluid contact with opening 21 of filling unit 10, in case of contact filling with a carbonated product; or
- mouth 11 of container 2 is spaced along axis B from opening 21 of filling device 10, in case of contactless filling with a still product.

**[0040]** Cam 49 extends along a portion P1, which is smaller than 360 degrees, of path P (Figure 17).

**[0041]** Path P further comprises a portion P2, extending about axis A and complementary with respect to portion P1.

**[0042]** As it will be clearer from the foregoing of the present description, actuator 51 can be selectively arranged in a first configuration, in which it exerts a first value of the action on cam follower 48 and gripping device 18 parallel to axis B. In particular, the first action is exerted by actuator 51 in the first sense, upward in the embodiment shown.

**[0043]** In greater detail, cam 49 (shown projected on a plane in Figure 16) comprises a profile 50 formed by, proceeding according to the advancing direction of carousel 3 along portion P1 of path P:

- a first descending portion 60;
- a second portion 61, which lies on a plane orthogonal to axis A; and
- a third ascending portion 62.

**[0044]** The movement of gripping device 18 and, therefore, of container 2 parallel to axis B is determined by the interaction of cam 49 with cam follower 48 along portion P1 of path P. Furthermore, actuator 51 thrusts cam follower 48 against cam 49 along portion P1 of path P in the first sense, upwards in the embodiment shown.

**[0045]** Differently, cam follower 48 no longer contacts cam 49 along portion P2 of path P, and actuator 51 displaces cam follower 48 and, therefore, gripping device 18 along portion P2 of path P.

**[0046]** With reference to Figure 14 and in case of contact filling, path P comprises, proceeding according to the advancing direction of carousel 3 about axis A,:

- an arch  $\alpha$ , which is arranged downstream of station I and along which cam follower 48 interacts with portion 62 of cam 49 so as to cause the movement in the first sense, upwards in the embodiment shown, of gripping device 18 together with container 2 to be filled;
- an arch  $\beta$ , along which actuator 51 causes the movement of gripping device 18 together with container 2 to be filled in the first sense, upwards in the embodiment shown,;
- an arch  $\gamma$ , along which actuator 51 keeps mouth 11 in tight-fluid contact with opening 21, and a pressurization step is carried out onto container 2 to be filled;
- an arch  $\varepsilon$ , along which actuator 51 keeps mouth 11 in tight-fluid contact with opening 21, and filling device 10 is controlled to fill container 2 with the pourable product;
- an arch  $\zeta$ , along which actuator 51 keeps mouth 11 in tight-fluid contact with opening 21, and a depressurization step is carried out onto filled container 2;
- an arch  $\eta$ , along which actuator 51 causes the movement of gripping device 18 together with filled container 2 in the second sense, downwards in the embodiment shown;
- an arch  $\theta$ , along which cam follower 48 interacts with portion 60 of cam 49, so as to cause the movement of gripping device 18 together with container 2 to be filled in the second sense, downwards in the embodiment shown, up to the lowered rest position; and
- an arch  $\vartheta$ , along which cam follower 48 interacts with portion 61 of cam 49, so as to keep gripping device 18 in the lowered rest position.

**[0047]** Stations I, O are arranged along arch  $\vartheta$ .

**[0048]** Portion P1 coincides with arches  $\theta$ ,  $\vartheta$ ,  $\alpha$  while portion P2 coincides with arches  $\beta$ ,  $\gamma$ ,  $\varepsilon$ ,  $\zeta$  and  $\eta$ , in case of contact filling (Figure 14).

**[0049]** With reference to Figure 15 and in case of contactless filling, path P comprises, proceeding according to the advancing direction of carousel 3 about axis A,:

- arch  $\alpha$ ;
- an arch  $\tau$ , along which actuator 51 keeps mouth 11 at a certain distance along axis B from opening 21, and filling device 10 is controlled to contactless fill container 2 with the pourable product;
- arc  $\theta$ ; and
- arch  $\vartheta$ .

**[0050]** Portion P1 coincides with arches  $\theta$ ,  $\vartheta$ ,  $\alpha$  while portion P2 coincides with arch  $\tau$ , in case of contactless filling (Figure 15).

**[0051]** Gripping device 18 comprises, in turn, (Figures 4, 7, 10 and 13):

- a frame; and
- a pair of jaws 30 which are hinged about an axis parallel to axis B to the frame.

**[0052]** Jaws 30 can be moved between:

- a rest configuration in which they are free from neck 12 of container 2; and
- a gripping configuration, in which they grip neck 12 of container 2 (Figures 4, 7, 10 and 13).

**[0053]** In particular, jaws 30 move from the open configuration to the closed configuration at station I, remain in the closed configuration from station I to station O, and move from the closed configuration to the open configuration at station O.

**[0054]** Holding device 17 further comprises (Figures 3, 6, 9 and 12):

- a pair of rods 52 which extend along respective axes C, are operatively connected to cam follower 48, and are operatively connected to gripping device 18;
- a pair of housings 54, which surround respective rods 52 and through which rods 52 may slide parallel to respective axes C; and
- a pair of bellows 53.

**[0055]** Housings 54 are stationary with respect to relative axes C, are shaped as hollow cylinder, and slidably house relative rods 52.

**[0056]** Each rod 52 comprises:

- an end 55 (Figures 3, 6, 9 and 12), which is arranged on the side of cam follower 48;
- an end 56 (Figures 3, 6, 9 and 12), opposite to end 55, and arranged on the side of respective bellows 53; and
- a portion 57 interposed between ends 55, 56.

**[0057]** End 55 is fitted, on one side, to a fixed pin 47, which extends along an axis E and with respect to which cam follower 48 is rotatable about axis E.

**[0058]** End 55 is also fitted, on the opposite side with respect to pin 47, to a crossbar 58 which extends parallel to axis E.

**[0059]** In the embodiment shown, crossbar 58 and pin 47 are made in one piece.

**[0060]** Axis E is, in the embodiment shown, orthogonal to axes A, B, C and horizontal.

**[0061]** In particular, holding device 17 further comprises (Figures 4, 7, 10 and 13):

- a plate 40 lying on plane orthogonal to axes D and protruding from end 56; and
- a pair of columns 41, which extend between plate 40 and the frame of gripping device 18.

**[0062]** In detail, columns 41 extend parallel to axes C.

**[0063]** Plate 40 and columns 41 connect rods 52 with gripping device 18.

**[0064]** Accordingly, when rods 52 are arranged in the uppermost position, gripping device 18 is in the operative

raised position and bellows 53 assume their minimum length.

**[0065]** When rods 52 are arranged in the lowermost position, gripping device 18 is in the rest lowered position and bellows 53 assume their maximum length.

**[0066]** Bellows 53 are arranged on the opposite side of gripping device 18 with respect to opening 21 of filling device 10 (Figures 2 to 13).

**[0067]** Bellows 53 are arranged below gripping device 18 and below mouth 11 of container 2.

**[0068]** Each bellow 53 comprises (Figures 4, 7, 10 and 13):

- an end 65 fixed to housing 54 of respective rod 52; and
- an end 66, opposite to end 65 and fixed to plate 40.

**[0069]** End 66 is furthermore sandwiched between end 56 of respective rod 52 and plate 40.

**[0070]** End 65 is, in the embodiment shown, arranged above end 66.

**[0071]** Advantageously, actuator 51 can be selectively set in a second configuration, in which it exerts an action with a second value, greater than the first value, along portion P2 of path P and in the first sense, upwards in the embodiment shown (Figures 8 to 10).

**[0072]** In this way, the second value of action is not exerted on cam 49 and on cam follower 48.

**[0073]** In the following of the present description, only one actuator 51 will be described in detail, being all actuators 51 identical to one another.

**[0074]** Actuator 51 extends along to an axis D, which is parallel and distinct from axes A, B and C and is radially interposed between axis A and relative axis B.

**[0075]** In greater detail, actuator 51 comprises (Figures 3, 6, 9 and 12):

- a housing 70;
- a piston 71 which is operatively connected to cam follower 48 and, therefore, to rod 52 and gripping element 13; and
- an element 72, which is fixed to housings 54.

**[0076]** Housing 70 and piston 71 are mounted slidably with respect to one another along axis D.

**[0077]** Furthermore, housing 70 defines (Figures 2, 5, 8 and 11):

- a cavity 73, which is partly engaged by piston 71; and
- a cavity 74, which is partly engaged by element 72.

**[0078]** Piston 71 and element 72 are mounted slidably with respect to one another along axis D.

**[0079]** Piston 71 is arranged on the side of cam follower 48 while element 72 is arranged on the side of gripping device 18 along axis D.

**[0080]** In the embodiment shown, piston 71 is arranged over element 72.

**[0081]** Piston 71 comprises, in turn,:

- a stem 75 elongated along axis D and fixed to cross-bar 58; and
- a skirt 76 having diameter greater than stem 75 and which slides in tight-fluid contact with housing 70 inside cavity 73.

**[0082]** Skirt 76 is bounded, proceeding parallel to axis D, by:

- a surface 77 having a area A0 and from which stem 75 extends; and
- a surface 78, opposite to surface 77 and having an area A1, which is greater than area A0.

**[0083]** Surface 77 is arranged on the side of cam follower 48 and surface 78 is arranged on the side of gripping device 18, proceeding along axis D.

**[0084]** Stem 75 is arranged, in the embodiment shown, above skirt 76 along axis D.

**[0085]** Piston 71 is slidable along axis D with respect to housing 70 between:

- a completely lowered position (shown in Figures 2 to 4), in which surface 78 abuts against a surface 96 of housing 70; and
- a completely raised position (not shown), in which surface 77 abuts against a surface 95 of housing 70.

**[0086]** Element 72 comprises, in turn,:

- a stem 79 elongated along axis D and fixed to housings 54; and
- a skirt 80 having diameter greater than stem 79 and which is arranged in a fixed position along axis D inside cavity 74.

**[0087]** Skirt 80 is bounded, proceeding parallel to axis D, by:

- a surface 81 having a area A0 and from which stem 75 extends; and
- a surface 82, opposite to surface 81 and having a area A1, greater than area A0.

**[0088]** Surface 82 is arranged on the side of cam follower 48 and surface 81 is arranged on the side of gripping device 18, proceeding along axis D.

**[0089]** Stem 79 is arranged, in the embodiment shown, below skirt 80 along axis D.

**[0090]** Housing 70 is slidable along axis D with respect to fixed element 72 between:

- a completely raised position (shown in Figure 6), in which a surface 97 of housing 70 abuts against surface 81 of element 72; and
- a completely lowered position, in which surface 97

is spaced along axis D from surface 81.

**[0091]** Actuator 51 further comprises (Figures 2, 5, 8 and 11) :

- a chamber 90, which is arranged inside cavity 73 and axially extends between surface 77 of skirt 76 and surface 95; and
- a chamber 91, which is arranged inside cavity 73 and axially extends between surface 78 of skirt 76 and surface 96.

**[0092]** Furthermore, actuator 51 comprises a chamber 92 (Figures 2, 5, 8 and 11), which is defined between surface 74 of housing 70 and surface 82 of skirt 80.

**[0093]** Actuator 51 further comprises (Figures 3, 6, 9 and 12) an electronic control unit 94 programmed for controlling the pressures inside chambers 90, 91, 92, thus controlling the position of piston 71 and, therefore, of gripping device 18 along axis D.

**[0094]** Control unit 94 is, in the embodiment shown, programmed for adducing a fluid at adjustable respective pressure values  $p_2$ ,  $p_1$ ,  $p_2$  values in chambers 90, 91, 92 respectively.

**[0095]** In the embodiment shown, pressure value  $p_2$  is fixed while pressure value  $p_1$  can be switched between two different values.

**[0096]** In the following of the present description, pressure values  $p_2$ ,  $p_1$  are representative of relative pressure values.

**[0097]** With reference to Figures 11 to 13, it is shown a rest configuration of actuator 51, in which both pressure  $p_1$ ,  $p_2$  are null. It is important to clarify that this rest configuration is not assumed by actuator 51 during the normal operation of filling unit 1, but it is discussed only to better explain the operation of actuator 51.

**[0098]** More precisely, in case pressure  $p_1$ ,  $p_2$  are equal, piston 71 is in the completely lowered position with respect to housing 70, and housing 70 is the completely lowered position with respect to element 72.

**[0099]** With reference to Figures 2 to 4, it is shown actuator 51 in the first configuration, which is assumed along portion P1 of path P, i.e. when cam follower 48 abuts against cam 49, in case of contact filling of container 2 or in contactless filling of container 2.

**[0100]** When actuator 51 is arranged in the first configuration, piston 71 is in the completely lowered position and is, therefore, movable integrally with housing 70 in the first sense, upwards in the embodiment shown.

**[0101]** When actuator 51 is arranged in the first configuration, control unit 94 is programmed for rendering pressure  $p_2$  in chambers 90, 92 greater than pressure  $p_1$  in chamber 91.

**[0102]** In the embodiment shown, pressure  $p_2$  is 1 bar and pressure  $P_1$  is null.

**[0103]** Accordingly, pressure  $p_2$  in chamber 90 causes the integral upwards sliding of housing 70 and piston 71.

**[0104]** In this way, cam follower 48 is thrust with the

first action parallel to axis B against cam 49 along portion P1 of path P, and gripping device 18 remains in the lowered rest position.

**[0105]** When actuator 51 is arranged in the first configuration, the first value of action exerted on piston 71 parallel to axis D in the first sense - upward in the first embodiment - and, therefore, exerted by cam follower 48 on cam 49 equals:  $p_2 \cdot A_1 - p_1 \cdot A_0$ .

**[0106]** Furthermore, when actuator 51 is arranged in the first configuration, piston 71 and housing 70 and, therefore, container 2 - are movable together and with respect to element 72 for a first stroke having length  $s_1$  parallel to axis D.

**[0107]** In case of contact filling of container 2, control unit 94 sets actuator 51 in the second configuration along arches  $\beta$ ,  $\gamma$ ,  $\epsilon$ ,  $\zeta$  of portion P2 of path P.

**[0108]** In greater detail, control unit 94 renders pressure  $p_2$  in chambers 90, 92 lower than pressure  $p_1$  in chamber 91.

**[0109]** In the embodiment shown, pressure  $p_2$  is 1 bar and pressure  $p_1$  is 4 bar, when actuator 51 is set in the second configuration.

**[0110]** In this way, piston 71 upwards slides with respect to housing 70 from the completely lowered position to the raised position, thus causing also gripping device 18 and container 2 to move from the rest lowered position to the operative raised position (Figures 8 to 10).

**[0111]** Accordingly, the second value of action exerted in the first sense - upwards in the embodiment shown - on piston 71 and, therefore, on gripping device 18 is  $p_1 \cdot A_1 - p_2 \cdot A_0$ .

**[0112]** In the embodiment shown, pressure  $p_1$  is 4 bar and pressure  $p_2$  is 1 bar.

**[0113]** Due to the value of pressures  $p_1$ ,  $p_2$  and areas  $A_0$ ,  $A_1$ , the second value of the action is greater than the first action.

**[0114]** Furthermore, when actuator 51 is arranged in the second configuration, piston 71 - and, therefore, container 2 - is movable with respect to housing 70 in the first sense, upward in the embodiment shown, for a second stroke having length  $s_2$  parallel to axis D.

**[0115]** Length  $s_2$  of the second stroke is greater than length  $s_1$  of the first stroke.

**[0116]** Control unit 94 is also programmed, in case of contact filling of container, for arranging actuator 51 in a third configuration (not shown), along arch  $\eta$  of portion P2 of path P.

**[0117]** In greater detail, control unit 94 is programmed for rendering pressure  $p_2$  in chambers 90, 92 greater than pressure  $p_1$  in chamber 91.

**[0118]** Accordingly, the action exerted in the second sense - downwards in the embodiment shown - on piston 71 and, therefore, on gripping device 18 is  $p_2 \cdot A_0 - p_1 \cdot A_1$ .

**[0119]** Due to the value of pressures  $p_1$ ,  $p_2$  and areas  $A_0$ ,  $A_1$ , the action exerted by actuator 51 is directed in the second sense, downwards in the embodiment shown.

**[0120]** Due to the fact that, along arch  $\eta$  of portion P2, piston 71 is spaced along axis D from surface 96 of hous-

ing 70, actuator 51 exerts an action on piston 71 and, therefore, on gripping device 18 directed in the second sense - downwards and towards the opposite side of filling device 10 in the embodiment shown -.

**[0121]** As a result of this action, piston 71 slides with respect to housing 70 towards element 72 while gripping device 18 moves back from the raised operative position to the lowered position. That action equals, in the embodiment shown,  $p2 \cdot A0 - p1 \cdot A1$ .

**[0122]** In case of contactless filling of container 2, control unit 94 keeps actuator 51 in the first configuration for the whole path P, i.e. both along portion P1 and along portion P2.

**[0123]** The operation of filling unit 1 will be now described with reference to only one container 2, only one holding device 17 and only one gripping device 18.

**[0124]** Furthermore, the operation of filling unit 1 will be now described in a condition in which filling unit 1 has been set to contact fill containers 2 with a food product contained a gas therein, e.g. carbon dioxide, and in which shutter 16 of filling device 10 is in the closed configuration.

**[0125]** In-feed star wheel 6 advances container 2 at inlet station I, where gripping device 18 is arranged in the rest configuration and is set in the first rest position - lowered in the embodiment shown -.

**[0126]** At this stage, jaws 30 of gripping device 18 move in the gripping configuration, so as to firmly grip container 2.

**[0127]** Starting from station I and proceeding according to the advancing direction of carousel 3 about axis A, holding device 17 moves about axis A along (Figure 14):

- the portion of arch 9, which is arranged downstream of station I and along which cam follower 48 interacts with portion 61 of cam 49, so as to maintain gripping device 18 and container 2 to be filled in the first rest position;
- arch  $\alpha$ , which is arranged downstream of station I and along which cam follower 48 interacts with portion 62 of cam 49, so as to cause the movement in the first sense, upwards in the embodiment shown, of gripping device 18 together with container 2 to be filled;
- arch  $\beta$ , along which actuator 51 causes the movement of gripping device 18 together with container 2 to be filled in the first sense, upwards in the embodiment shown, up to reach the second operative position in which mouth 11 is in tight-fluid contact with opening 21 (Figures 8 to 10);
- arch  $\gamma$ , along which actuator 51 keeps mouth 11 in tight-fluid contact with opening 21 and gripping device 18 in the second operative position, and a pressurization step is carried out with gripping device 18 and container 2 to be filled in the second operative position (Figures 8 to 10);
- arch  $\epsilon$ , along which actuator 51 keeps mouth 11 in

tight-fluid contact with opening 21 and gripping device 18 in the second operative position, and filling device 10 is controlled to fill container 2 with the pourable product (Figures 8 to 10);

- 5 - arch  $\zeta$ , along which actuator 51 keeps mouth 11 in tight-fluid contact with opening 21 and gripping device 18 in the second operative position, and a depressurization step is carried out onto filled container 2, with the latter and the gripping device in the second operative position;
- 10 - arch  $\eta$ , along which actuator 51 causes the movement of gripping device 18 together with filled container 2 in the second sense, downwards in the embodiment shown;
- 15 - arch  $\theta$ , along which cam follower 48 interacts with portion 60 of cam 49, so as to cause the movement of gripping device 18 together with filled container 2 up to the first rest position and in the second sense, downwards in the embodiment shown; and
- 20 - the portion of arch 9 upstream of station O, along which cam follower 48 interacts with portion 61 of cam 49, so as to keep gripping device 18 in the first rest position.

25 **[0128]** Jaws 30 move in the rest configuration at station O, thus leaving free filled container 2, which is withdrawn by out-feed star-wheel 7 and conveyed in further operative stations, which are arranged downstream of filling station 100.

30 **[0129]** Holding device 17 moves along the portion of arch 9 interposed between stations I, O, and gripping device 18 is kept in the first rest position by portion 61 of cam 49.

35 **[0130]** Cam follower 48 is in contact with cam 49 along portion P1 of path P, which is formed by arches  $\theta$ ,  $\eta$  and  $\alpha$ .

**[0131]** Control unit 94 sets actuator 51:

- in the first configuration along portion P1 of path P, so as to keep cam follower 48 in contact with cam 49 along portion P1 and gripping device 18 in the first rest position (Figures 2 to 4);
- in the second configuration along arches  $\beta$ ,  $\gamma$ ,  $\epsilon$ ,  $\zeta$  of portion P2 of path P, where cam follower 48 no longer contacts cam 49, so as to at first move gripping device 18 in the first sense - upwards in the embodiment shown - and towards the second operative position, and then to keep gripping device 18 in that second operative position (Figures 8 to 10); and
- in the third configuration, along arches  $\eta$  of portion P2 of path P, where cam follower 48 no longer contacts cam 49, so as to move gripping device 18 in the second sense - downwards in the embodiment shown - and towards the first rest position.

55 **[0132]** When actuator 51 is arranged in the first configuration, control unit 94 renders pressure  $p2$  in chambers 90, 92 greater than pressure  $p1$  in chamber 91.

**[0133]** In this way, the action is exerted on piston 71

in the first sense, upwards in the embodiment shown, assumes the first value, and cam follower 48 is thrust against cam 49 with the first value.

**[0134]** In particular, when actuator 51 is arranged in the first configuration, piston 71 remains in the completely lowered position, in which surface 78 abuts against surface 96 of housing 70.

**[0135]** When holding device 17 moves along arch  $\alpha$ , gripping device 18 remains in the first rest position, while piston 71 and gripping device 18 slightly moves upwards along arch  $\alpha$ , due to the shape of portion 62 of cam 49.

**[0136]** When actuator 51 is arranged in the second configuration, control unit 94 renders pressure  $p_2$  in chambers 90, 92 smaller than pressure  $p_1$  in chamber 91.

**[0137]** In this way, the action is exerted on piston 71 in the first sense, upwards in the embodiment shown, assumes the second value, and both gripping device 18 and container 2 are thrust with the second value in the second operative position.

**[0138]** In particular, when actuator 51 is arranged in the second configuration, piston 71 moves with respect to housing 70 and element 72 in the first sense - upwards in the embodiment shown -, up to a position in which surface 78 is spaced along direction D from surface 95 of housing 70, i.e. up to a position, which is intermediate between the completely lowered position and the completely raised position.

**[0139]** When actuator 51 is arranged in the third configuration, control unit 94 renders pressure  $p_2$  in chambers 90, 92 greater than pressure  $p_1$  in chamber 91.

**[0140]** Due to the fact that piston 71 is detached from surface 96 of housing 70, i.e. is arranged either in the completely raised position or in the intermediate position along arch  $\zeta$ , piston 71 slides along direction D in the second sense, downwards in the embodiment shown, thus causing the movement of gripping element 18 in the same second sense along arch  $\zeta$ , i.e. towards the first rest position.

**[0141]** The operation of filling unit 1, in case the latter is set to contactless fill container 2 with a still food product is now described (Figure 15).

**[0142]** Starting from station I and proceeding according to the advancing direction of carousel 3 about axis A, holding device 17 moves about axis along:

- the portion of arch 9, which is arranged downstream of station I and along which cam follower 48 interacts with portion 61 of cam 49, so as to maintain gripping device 18 and container 2 to be filled in the first rest position (Figures 5 to 7);
- arch  $\alpha$ , which is arranged downstream of station I and along which cam follower 48 interacts with portion 62 of cam 49, so as to cause the movement in the first sense, upwards in the embodiment shown, of gripping device 18 together with container 2 to be filled;
- arch  $\tau$ , along which actuator 51 keeps gripping device 18 in the second operative position with mouth

11 at a certain distance along axis B from opening 21, and filling device 10 is controlled to contactless fill container 2 with the pourable product;

- 5 - arch  $\theta$ , along which cam follower 48 interacts with portion 60 of cam 49, thus moving back gripping device 18 with filled container 2 up to the first rest position and in the second sense, downwards in the embodiment shown; and
- 10 - the portion of arch 9 upstream of station O, along which cam follower 48 interacts with portion 61 of cam 49, so as to keep gripping device 18 in the first rest position.

15 **[0143]** Cam follower 48 is in contact with cam 49 along the whole portion P1, which is formed by arches  $\theta$ , 9 and  $\alpha$ .

**[0144]** Cam follower 48 is detached from cam 49 along the whole portion P2, which is formed by arch  $\tau$ .

20 **[0145]** In this case, control unit 94 is programmed to set actuator 51 in the first configuration along the whole path P, i.e. to keep actuator 51 in the first configuration both along portion P1 and along portion P2 of path P.

25 **[0146]** From an analysis of the features of unit 1 and of the method according to the present invention, the advantages it allows to obtain are apparent.

**[0147]** In particular, actuator 51 is set in the first configuration in which exerts the first action in the first sense along portion P1 of path P, i.e. where cam follower 48 contacts cam 49, and in the first sense, upwards in the embodiment shown (Figures 2 to 4).

30 **[0148]** Differently, actuator 51 may be selectively set in the second configuration, in which it exerts the second action greater than first action in the first sense, along arches  $\beta$ ,  $\gamma$ ,  $\varepsilon$ ,  $\zeta$  of portion P2 in case of contact filling, i.e. where cam follower 48 is detached from cam 49 (Figures 8 to 10).

35 **[0149]** Accordingly, cam 49, cam follower 48 and sliding components of actuator 51 undergo the lower first action while the higher second action is efficiently applied to move gripping device 18 and container 2 in the second operative position and to keep them in that second operative position.

40 **[0150]** As a result, cam 49, cam follower 48 and sliding component of actuator 51 undergo contained mechanical stresses and undergoes lower wear, when compared with the known solutions discussed in the introductory part of the present description where the same action was applied along whole path P.

45 **[0151]** In the light of above, on one hand, the size and the cost of cam 49 can be made reduced and the lifetime of cam 49 can be increased, when compared with the known solution discussed in the introductory part of the present description.

50 **[0152]** As a consequence, the life-time of cam follower 48 and of the sliding components of actuator 51 is increased, while the maintenance cost of cam follower 48 and of the sliding components of actuator 51 is reduced.

[0153] On the other hand, unit 1 ensures that containers 2 are pressed against relative filling device 10, when corresponding actuators 51 are set in the respective second position, in which they exert second value of action on relative gripping devices 18.

[0154] Furthermore, control unit 94 can be programmed to displace actuators 51 in the third configuration, in which an action in the second sense - downward in the embodiment shown - is exerted on relative gripping devices 18.

[0155] In this way, actuators 51 can be efficiently used for moving relative gripping devices 18 and filled containers 2 towards the second rest position and in the second sense.

[0156] Unit 1 can be easily switched between a modality in which it contact fills containers 2 with carbonated food product and a modality in which it contactless fills containers 2 with a still product, while containing the stress and/or the wear on cam 49.

[0157] As a matter of fact, when unit 1 is required to contact fill containers 2, actuators 51 are switched into the second configuration along arches  $\beta$ ,  $\gamma$ ,  $\varepsilon$ ,  $\zeta$  of portion P2 of path P and then to the third configuration along arch  $\eta$  of portion P2 of path P.

[0158] Differently, when unit 1 is required to contactless fill containers 2, actuators 51 are kept in the first configuration, along the whole path P.

[0159] Finally, it is apparent that modifications and variants not departing from the scope of protection of the claims may be made to unit 1 disclosed herein.

[0160] In particular, different values of pressures  $p_2$ ;  $p_1$  could be generated inside chambers 90, 92; 91, provided that:

- a first value of action is generated on gripping device 18 directed in the first sense, upwards in the embodiment shown, when actuator 51 is in the first configuration; and
- a second value, greater than the first value, of action is generated on gripping device 18 directed in the first sense, upwards in the embodiment shown, when actuator 51 is in the second configuration; and/or
- an action is generated in the second sense, downwards in the embodiment shown, on gripping device 18, when actuator 51 is in the third configuration.

## Claims

1. A unit (1) for contact or contactless filling at least one article (2) with a pourable product, comprising:
  - at least one filling device (10) movable along a path (P);
  - at least one holding device (17) movable together with said filling device (10) along said path (P), and adapted to hold said article (2) and to move it with respect to said filling device along

a direction (B) between a first rest position and a second operative position; and  
- a cam (49);

said holding device (17) comprising, in turn,:

- a gripping member (18) for gripping said article (2);
- a cam follower (48) adapted to interact, in use, with said cam (49) at least along a first portion (P1) of said path (P) and operatively connected to said gripping member (18); and
- an actuator (51) controllable to exert on said gripping member (18) an action directed along said direction (B) and in a first sense;

said actuator (51) being selectively arrangeable in a first configuration, in which it exerts said action and with a first value along said first portion (P1) of said path (P), so as to thrust said cam follower (48) against said cam (49) and to keep, in use, said article (2) in said first rest position;

**characterized in that** said actuator (51) can selectively be set in a second configuration, in which it exerts said action with a second value, greater than said first value, along at least one first region ( $\beta$ ,  $\gamma$ ,  $\varepsilon$ ,  $\zeta$ ) of a second portion (P2) of said path (P), so as to move, in use, said article (2) towards said second operative position.

2. The unit of claim 1, **characterized in that** said holding device (17) comprises:

- at least one rod (52) operatively connected with said cam follower (48) and said gripping member (18), and movable along said direction (B); and
- at least one first housing (54), which is stationary with respect to said direction (B) and within which said rod (52) may slide along said direction (B);

said actuator (51) comprising, in turn,:

- a second housing (70), which can slide parallel to said direction (B);
- a piston (71), which is operatively connected to said gripping member (18); said piston (71) and second housing (70) being free to slide with respect to one another parallel to said direction (B);
- a first chamber (90), which is defined between a first area (77, A0) of said piston (71) and said second housing (70); and
- a second chamber (91), which is defined between a second area (78, A1) of said piston (71) and said second housing (70); said second area (77, A0) being greater than said first area (77, A0);

said actuator (51) further comprising:

- an element (72) connected to said first housing (54); said element (72) and said second housing (70) being free to slide with respect to one another parallel to said direction (B);
  - a third chamber (92), which is defined between said element (72) and said second housing (70); and
  - a control unit (94) programmed for controlling the pressure inside said first chamber, second chamber and third chamber (90, 91, 92).
3. The unit of claim 2, **characterized in that** said control unit (94) is programmed for generating a first value (p1) of pressure inside said second chamber (91), and a second value (p2) of pressure inside said first and third chamber (90, 92); said first pressure value (p1) and said second pressure value (p2) being selectively adjustable.
  4. The unit of claim 2 or 3, **characterized in that**, when said actuator (51) is in said first configuration, said second area (78, A1) abuts against said second housing (70), so as to render said second housing (70) and said piston (71) integrally movable along said direction (B).
  5. The unit of claim 4, **characterized in that** said control unit (94) is programmed, when said actuator (51) is in said first configuration, for rendering said second pressure value (p2) greater than said first pressure value (p1); the difference between said second pressure value (p2) and said first pressure value (p1) generating said first action and being enough to thrust said piston (71) in said first sense together with said second housing (70) with respect to said element (72), and to keep said article (2), in use, in said first rest position.
  6. The unit of any one of the foregoing claims, **characterized in that** said cam follower (48) is detached from said cam (49) along said second portion (P2) of said path (P) in a direction parallel to said direction (B).
  7. The unit of any one of the foregoing claims, **characterized in that** said filling device (10) is adapted to fill, in use, said article (2) with said pourable product along said first region ( $\beta$ ,  $\gamma$ ,  $\varepsilon$ ,  $\zeta$ ;  $\tau$ ) of said path (P).
  8. The unit of any one of claims 2 to 7, **characterized in that** said control unit (94) is programmed, when said actuator (51) is in said second configuration, for rendering said first pressure value (p1) greater than said second pressure value (p2); the difference between said first pressure value (p1) and said second pressure value (p2) generating said second action and being enough to thrust in said first sense said piston (71) with respect to said second housing (70) and to move said article (2) towards the second operative position.
  9. The unit of any one of claims 2 to 8, **characterized in that** said second housing (70) is movable together with said piston (71) with respect to said element (72) along a first stroke (s1), when said actuator (51) is in said first configuration; said piston (71) being movable with respect to said second housing (70) along a second stroke (s2), when said actuator (51) is in said second configuration; said second stroke (s2) being longer than said first stroke (s1).
  10. The unit of any one of the foregoing claims, **characterized in that** said actuator (51) is selectively arrangeable, in case of contact filling of said article (2), in a third configuration, in which it exerts a third action on said gripping member (18) directed in a second sense, opposite to said first sense, so as to displace, in use, said article (2) from said second operative position to said first rest position; said control unit (94) being programmed for arranging said actuator (51) in said third configuration along a second region ( $\eta$ ) of said second portion (P2); said second region ( $\eta$ ) being arranged in use, downstream of said first region ( $\beta$ ,  $\gamma$ ,  $\varepsilon$ ,  $\zeta$ ), proceeding according to an advancing direction of said holding device (17) along said path (P).
  11. The unit of claim 10, when depending on any one of claims 2 to 9, **characterized in that**, when said actuator (51) is set in said third configuration, said first area (78, A1) of said piston (71) is spaced from said second housing (70); said control unit (94) being programmed, when said actuator (51) is in said third configuration, for rendering said first pressure value (p1) smaller than said second pressure value (p2); the difference between said second pressure value (p2) and said first pressure value (p1) being enough to thrust in said second sense said piston (71) with respect to said second housing (70) and move said article (2) towards said first rest position.
  12. The unit of any one of the foregoing claims, **characterized in that** said actuator (51) is set in said second configuration along said first region ( $\beta$ ,  $\gamma$ ,  $\varepsilon$ ,  $\zeta$ ) in case of contact filling, and is kept in said first configuration along said second portion (P2), in case of contactless filling.
  13. A method for contact or contactless filling at least one article (2) with a pourable product, comprising

the steps of:

- i) moving together along a path (P) a filling device (10) and at least one holding device (17), which is adapted to hold said article (2);
- ii) moving said holding device (17) with respect to said filling device (10) along a first portion (P1) of said path (P) and parallel to a direction (B) between a first rest position and a second operative position, as a result of the interaction between a cam (49) and a cam follower (48) carried by said holding device (17); and
- iii) exerting on a gripping member (18) of said holding device (17) an action directed along said direction (B) and in a first sense;

said step iii) comprising a step iv) of selectively arranging said actuator (51) in a first configuration, in which it exerts said action with a first value along said first portion (P1) of said path (P), so as to thrust said cam follower (48) against said cam (49) and to keep said article (2) in said first rest position;

**characterized in that** said step iii) comprises a step v) of selectively arranging said actuator (51) in a second configuration, in which it exerts said action with a second value, greater than said first value, along at least one first region ( $\beta$ ,  $\gamma$ ,  $\varepsilon$ ,  $\zeta$ ) of a second portion (P2) of said path (P), so as to move said article (2) towards said second operative position.

14. The method of claim 13, **characterized by** comprising the step vi) of selectively arranging said actuator (51) in a third configuration, in case of contact filling of said article (2);
- said step vi) comprising the step of exerting a third action on said gripping member (18) directed in a second sense, opposite to said first sense, so as to displace said article (2) towards said first rest position;
- said step vi) being carried out along a second region ( $\eta$ ) of said second portion (P2);
- said second region ( $\eta$ ) being arranged downstream of said first region ( $\beta$ ,  $\gamma$ ,  $\varepsilon$ ,  $\zeta$ ), proceeding according to an advancing direction of said holding device (17) along said path (P).

15. The method of claim 13 or 14, **characterized by** comprising the step vii) of:

- carrying out said step iii) in case of contact filling; or
  - keeping said actuator (51) in said first configuration along said second portion (P2), in case of contactless filling;
- said cam follower (48) being detached from said cam (49) along said second portion (P2) of said path (P) in a direction parallel to said direction (B).

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

1. A unit (1) for contact or contactless filling at least one article (2) with a pourable product, comprising:

- at least one filling device (10) movable along a path (P);
- at least one holding device (17) movable together with said filling device (10) along said path (P), and adapted to hold said article (2) and to move it with respect to said filling device along a direction (B) between a first rest position and a second operative position; and
- a cam (49);

said holding device (17) comprising, in turn,:

- a gripping member (18) for gripping said article (2);
- a cam follower (48) adapted to interact, in use, with said cam (49) at least along a first portion (P1) of said path (P) and operatively connected to said gripping member (18); and
- an actuator (51) controllable to exert on said gripping member (18) a force directed along said direction (B) and in a first sense;

said actuator (51) being selectively arrangeable in a first configuration, in which it exerts said force and with a first value along said first portion (P1) of said path (P), so as to thrust said cam follower (48) against said cam (49) and to keep, in use, said article (2) in said first rest position;

wherein said actuator (51) can selectively be set in a second configuration, in which it exerts said force with a second value, greater than said first value, along at least one first region ( $\beta$ ,  $\gamma$ ,  $\varepsilon$ ,  $\zeta$ ) of a second portion (P2) of said path (P), so as to move, in use, said article (2) towards said second operative position;

said holding device (17) comprising:

- at least one rod (52) operatively connected with said cam follower (48) and said gripping member (18), and movable along said direction (B); and
- at least one first housing (54), which is stationary with respect to said direction (B) and within which said rod (52) may slide along said direction (B);

**characterized in that** said actuator (51) comprises, in turn,:

- a second housing (70), which can slide parallel to said direction (B);
- a piston (71), which is operatively connected to said gripping member (18); said piston (71)

and second housing (70) being free to slide with respect to one another parallel to said direction (B);

- a first chamber (90), which is defined between a first area (77, A0) of said piston (71) and said second housing (70); and

- a second chamber (91), which is defined between a second area (78, A1) of said of said piston (71) and said second housing (70); said second area (77, A0) being greater than said first area (77, A0);

said actuator (51) further comprising:

- an element (72) connected to said first housing (54); said element (72) and said second housing (70) being free to slide with respect to one another parallel to said direction (B);

- a third chamber (92), which is defined between said element (72) and said second housing (70); and

- a control unit (94) programmed for controlling the pressure inside said first chamber, second chamber and third chamber (90, 91, 92).

2. The unit of claim 1, **characterized in that** said control unit (94) is programmed for generating a first value (p1) of pressure inside said second chamber (91), and a second value (p2) of pressure inside said first and third chamber (90, 92); said first pressure value (p1) and said second pressure value (p2) being selectively adjustable.

3. The unit of claim 1 or 2, **characterized in that**, when said actuator (51) is in said first configuration, said second area (78, A1) abuts against said second housing (70), so as to render said second housing (70) and said piston (71) integrally movable along said direction (B).

4. The unit of claim 3, **characterized in that** said control unit (94) is programmed, when said actuator (51) is in said first configuration, for rendering said second pressure value (p2) greater than said first pressure value (p1); the difference between said second pressure value (p2) and said first pressure value (p1) generating said first force and being enough to thrust said piston (71) in said first sense together with said second housing (70) with respect to said element (72), and to keep said article (2), in use, in said first rest position.

5. The unit of any one of the foregoing claims, **characterized in that** said cam follower (48) is detached from said cam (49) along said second portion (P2) of said path (P) in a direction parallel to said direction (B).

6. The unit of any one of the foregoing claims, **characterized in that** said filling device (10) is adapted to fill, in use, said article (2) with said pourable product along said first region ( $\beta$ ,  $\gamma$ ,  $\varepsilon$ ,  $\zeta$ ;  $\tau$ ) of said path (P).

7. The unit of any one of the foregoing claims, **characterized in that** said control unit (94) is programmed, when said actuator (51) is in said second configuration, for rendering said first pressure value (p1) greater than said second pressure value (p2); the difference between said first pressure value (p1) and said second pressure value (p2) generating said second force and being enough to thrust in said first sense said piston (71) with respect to said second housing (70) and to move said article (2) towards the second operative position.

8. The unit of any one of the foregoing claims, **characterized in that** said second housing (70) is movable together with said piston (71) with respect to said element (72) along a first stroke (s1), when said actuator (51) is in said first configuration; said piston (71) being movable with respect to said second housing (70) along a second stroke (s2), when said actuator (51) is in said second configuration; said second stroke (s2) being longer than said first stroke (s1).

9. The unit of any one of the foregoing claims, **characterized in that** said actuator (51) is selectively arrangeable, in case of contact filling of said article (2), in a third configuration, in which it exerts a third force on said gripping member (18) directed in a second sense, opposite to said first sense, so as to displace, in use, said article (2) from said second operative position to said first rest position; said control unit (94) being programmed for arranging said actuator (51) in said third configuration along a second region ( $\eta$ ) of said second portion (P2); said second region ( $\eta$ ) being arranged, in use, downstream of said first region ( $\beta$ ,  $\gamma$ ,  $\varepsilon$ ,  $\zeta$ ), proceeding according to an advancing direction of said holding device (17) along said path (P).

10. The unit of claim 9, when depending on any one of claims 2 to 8, **characterized in that**, when said actuator (51) is set in said third configuration, said first area (78, A1) of said piston (71) is spaced from said second housing (70); said control unit (94) being programmed, when said actuator (51) is in said third configuration, for rendering said first pressure value (p1) smaller than said second pressure value (p2); the difference between said second pressure value (p2) and said first pressure value (p1) being enough to thrust in said second sense said piston (71) with respect to said second housing (70) and move said

article (2) towards said first rest position.

11. The unit of any one of the foregoing claims, **characterized in that** said actuator (51) is set in said second configuration along said first region ( $\beta$ ,  $\gamma$ ,  $\varepsilon$ ,  $\zeta$ ) in case of contact filling, and is kept in said first configuration along said second portion (P2), in case of contactless filling.

12. The unit of any one of the foregoing claims, **characterized in that** said holding device (17) comprises a bellow (53), which extends between said first housing (54) and a plate (40) connected to said gripping member (18), and is located, in use, below said gripping member (18).

13. A method for contact or contactless filling at least one article (2) with a pourable product, comprising the steps of:

- i) moving together along a path (P) a filling device (10) and at least one holding device (17), which is adapted to hold said article (2);
- ii) moving said holding device (17) with respect to said filling device (10) along a first portion (P1) of said path (P) and parallel to a direction (B) between a first rest position and a second operative position, as a result of the interaction between a cam (49) and a cam follower (48) carried by said holding device (17); and
- iii) exerting on a gripping member (18) of said holding device (17) a force directed along said direction (B) and in a first sense;

said step iii) comprising a step iv) of selectively arranging said actuator (51) in a first configuration, in which it exerts said force with a first value along said first portion (P1) of said path (P), so as to thrust said cam follower (48) against said cam (49) and to keep said article (2) in said first rest position;

said step iii) comprising a step v) of selectively arranging said actuator (51) in a second configuration, in which it exerts said force with a second value, greater than said first value, along at least one first region ( $\beta$ ,  $\gamma$ ,  $\varepsilon$ ,  $\zeta$ ) of a second portion (P2) of said path (P), so as to move said article (2) towards said second operative position;

said holding device (17) comprising:

- at least one rod (52) operatively connected with said cam follower (48) and said gripping member (18), and movable along said direction (B); and
- at least one first housing (54), which is stationary with respect to said direction (B) and within which said rod (52) may slide along said direction (B);

**characterized by** comprising the step vi) of pro-

gramming a control unit (94) for controlling the pressure inside a first chamber (90), a second chamber (91) and a third chamber (92);  
said actuator (51) comprising, in turn,:

- a second housing (70), which can slide parallel to said direction (B);
- a piston (71), which is operatively connected to said gripping member (18); said piston (71) and second housing (70) being free to slide with respect to one another parallel to said direction (B);
- said first chamber (90), which is defined between a first area (77, A0) of said piston (71) and said second housing (70); and
- said second chamber (91), which is defined between a second area (78, A1) of said piston (71) and said second housing (70); said second area (77, A0) being greater than said first area (77, A0);

said actuator (51) further comprising:

- an element (72) connected to said first housing (54); said element (72) and said second housing (70) being free to slide with respect to one another parallel to said direction (B);
- said third chamber (92), which is defined between said element (72) and said second housing (70); and
- said control unit (94).

14. The method of claim 13, **characterized by** comprising the step vii) of selectively arranging said actuator (51) in a third configuration, in case of contact filling of said article (2);  
said step vii) comprising the step of exerting a third force on said gripping member (18) directed in a second sense, opposite to said first sense, so as to displace said article (2) towards said first rest position; said step vii) being carried out along a second region ( $\eta$ ) of said second portion (P2);  
said second region ( $\eta$ ) being arranged downstream of said first region ( $\beta$ ,  $\gamma$ ,  $\varepsilon$ ,  $\zeta$ ), proceeding according to an advancing direction of said holding device (17) along said path (P).

15. The method of claim 13 or 14, **characterized by** comprising the step vii) of:

- carrying out said step iii) in case of contact filling; or
- keeping said actuator (51) in said first configuration along said second portion (P2), in case of contactless filling;

said cam follower (48) being detached from said cam (49) along said second portion (P2) of said path (P)

in a direction parallel to said direction (B).

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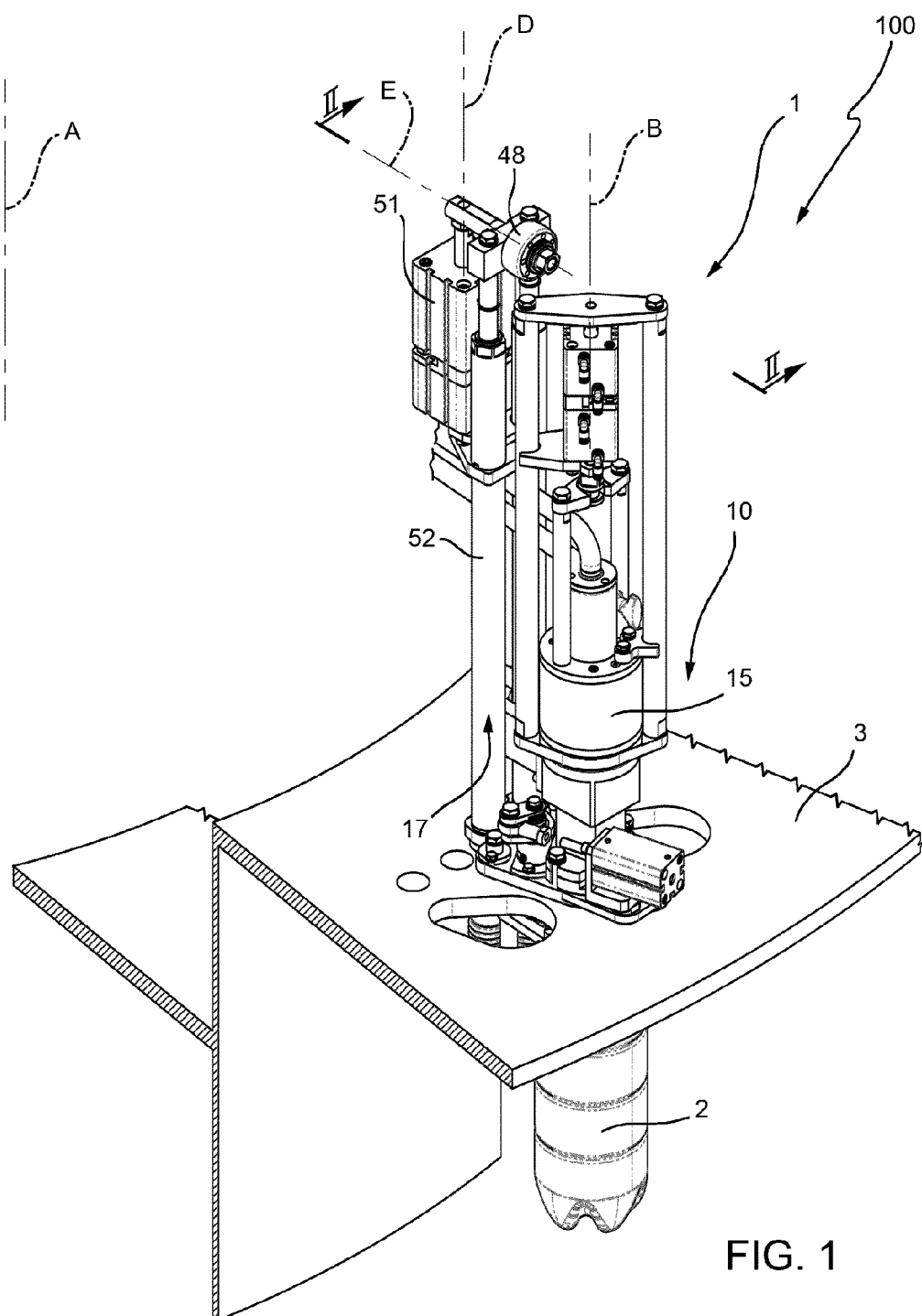
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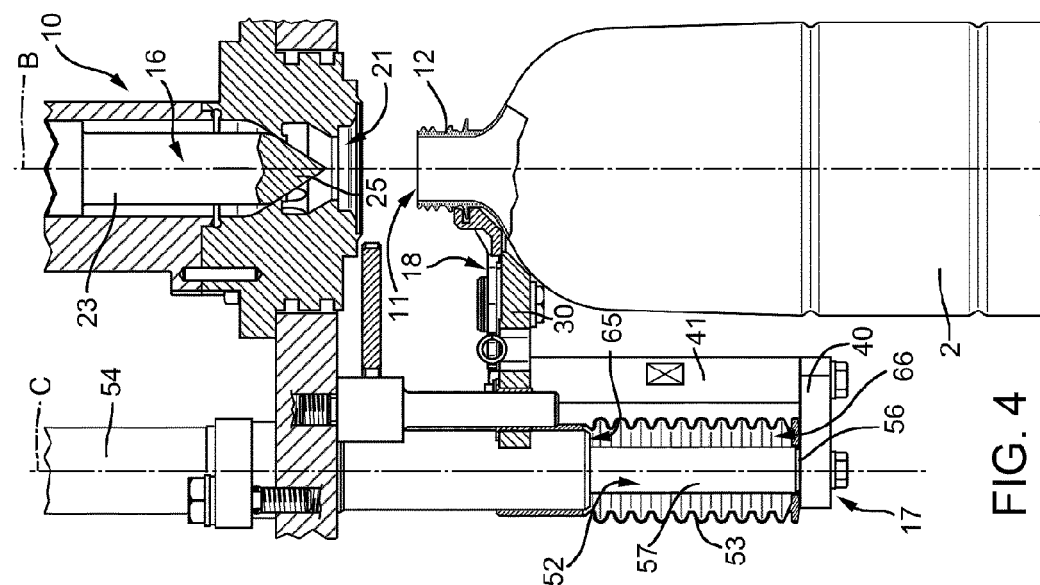


FIG. 4

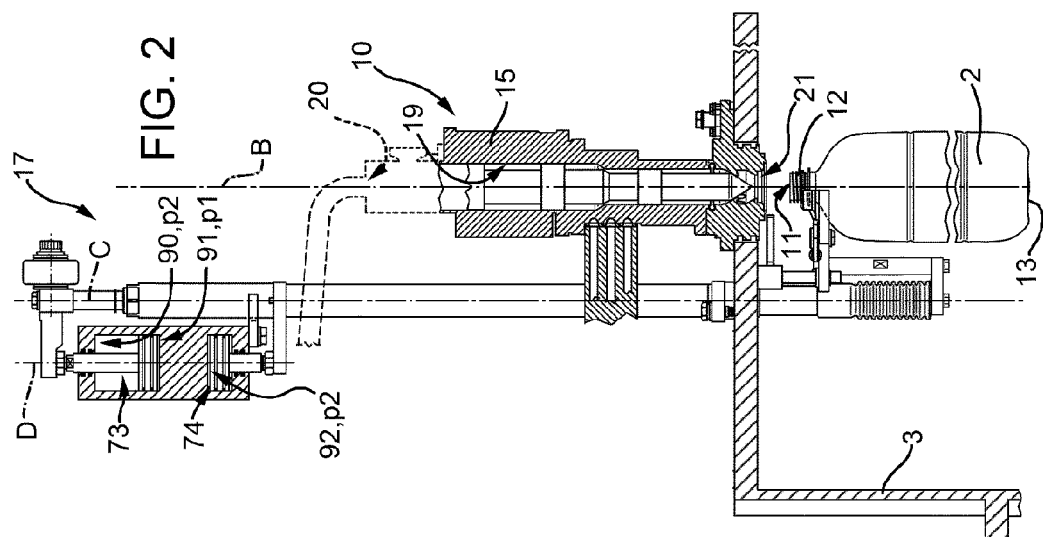


FIG. 2

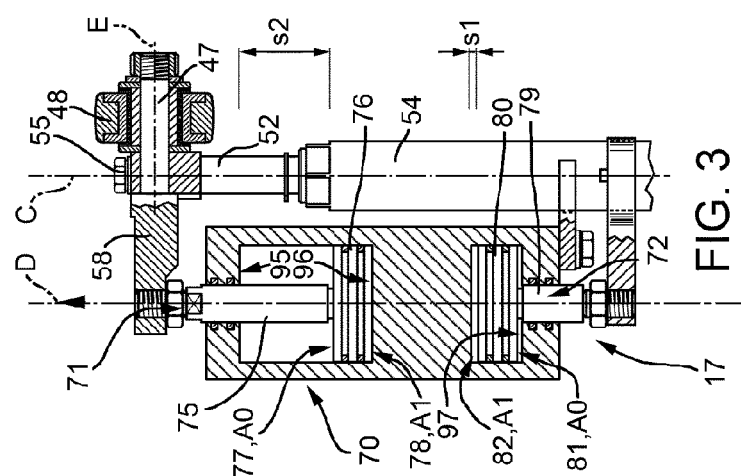
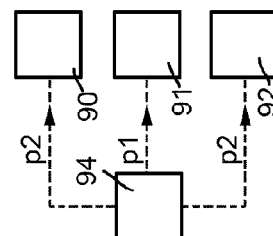


FIG. 3



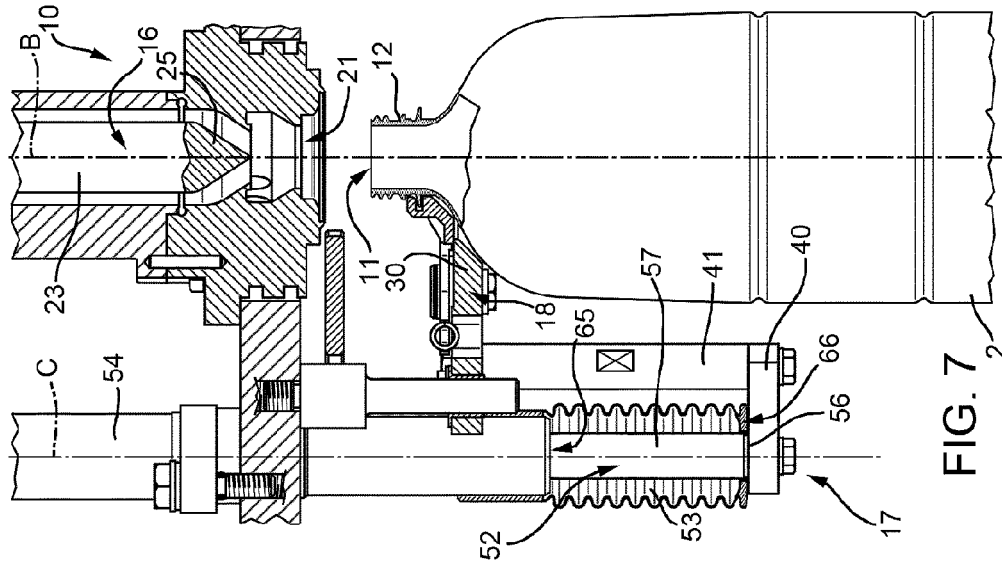


FIG. 7

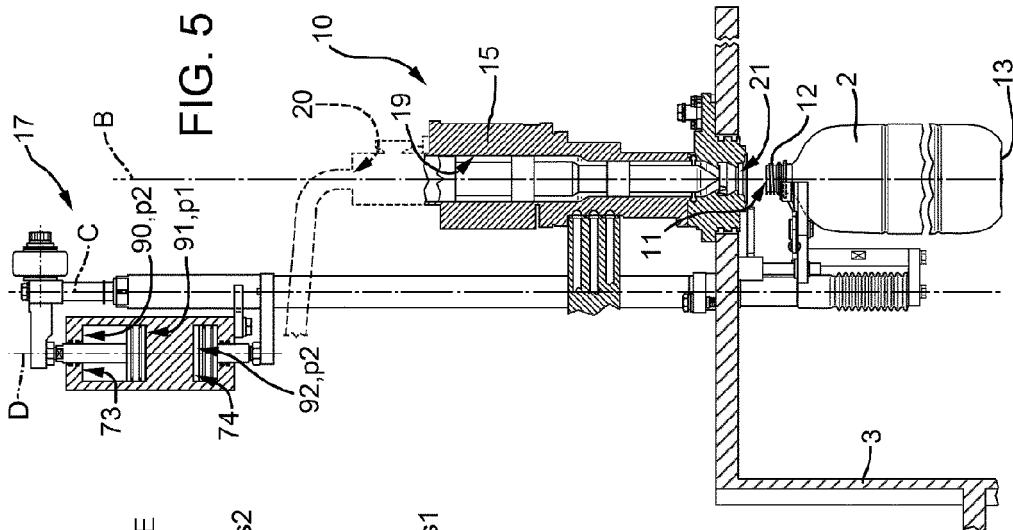


FIG. 5

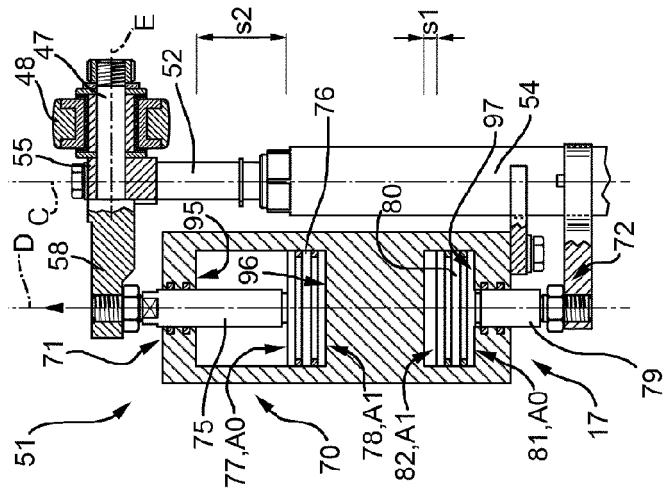
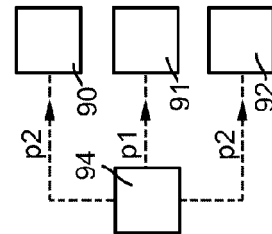
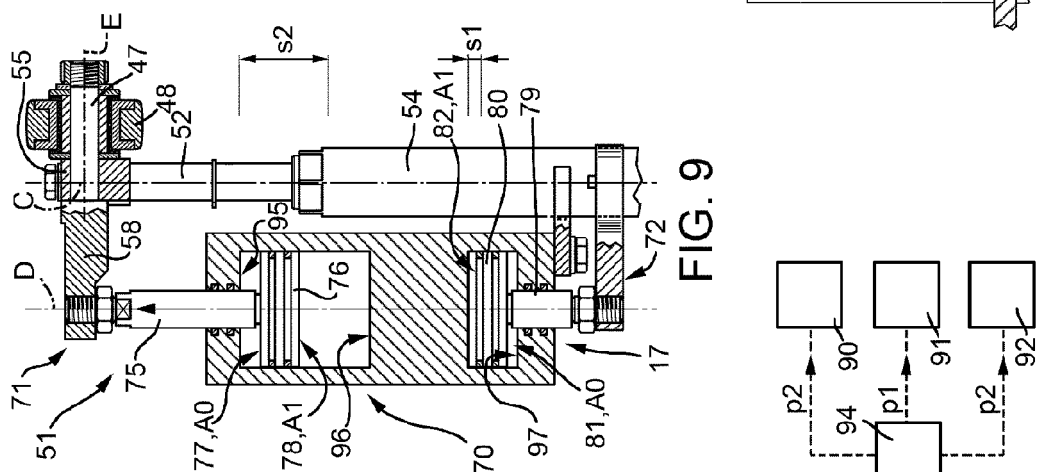
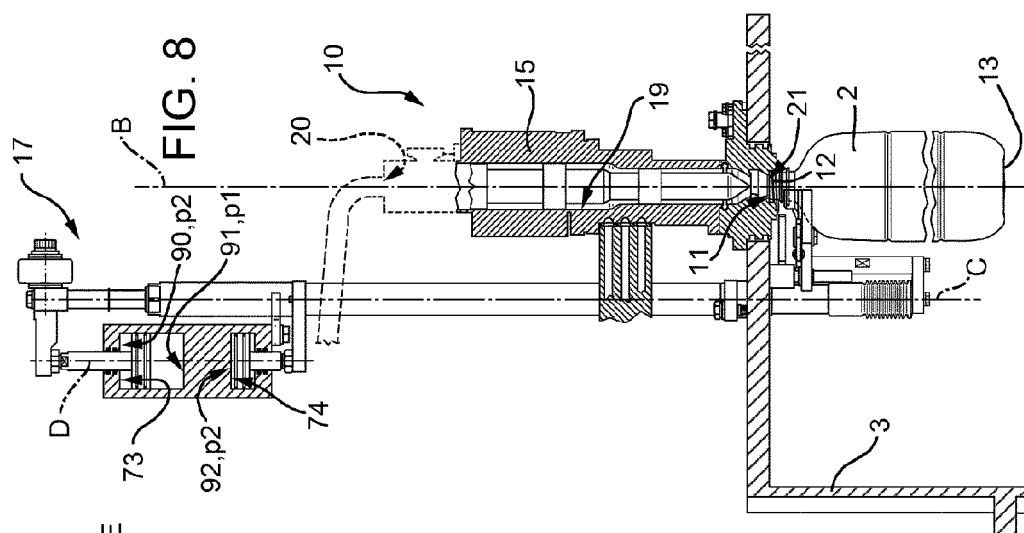
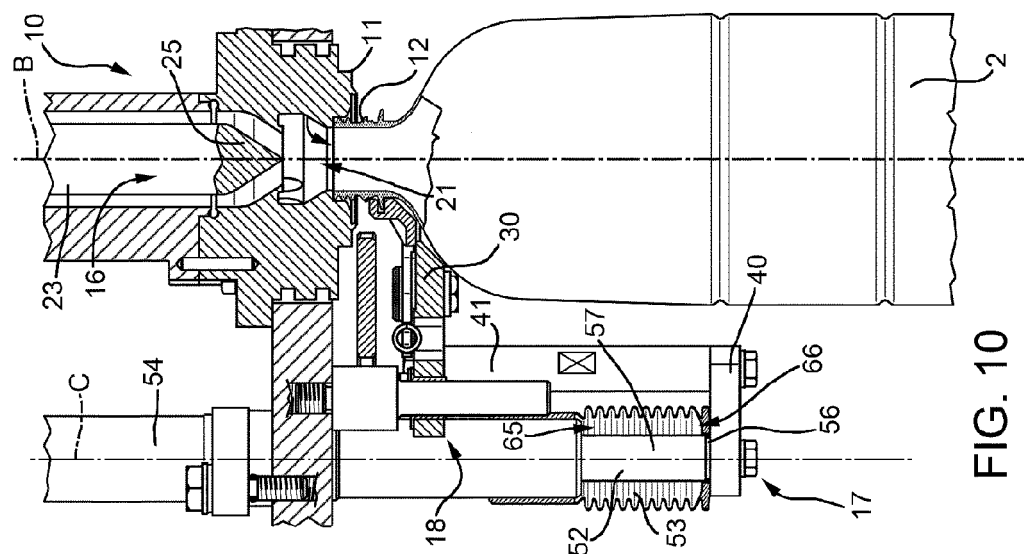


FIG. 6





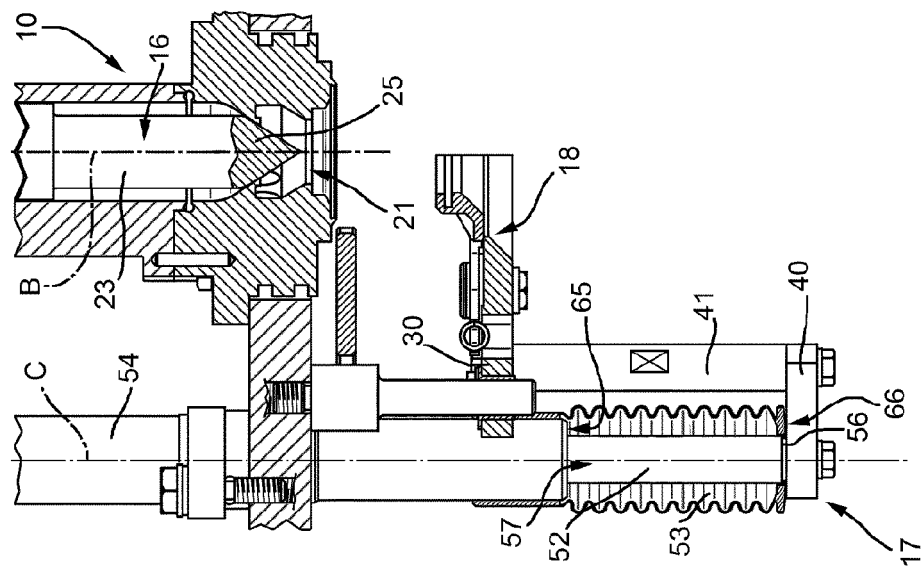


FIG. 13

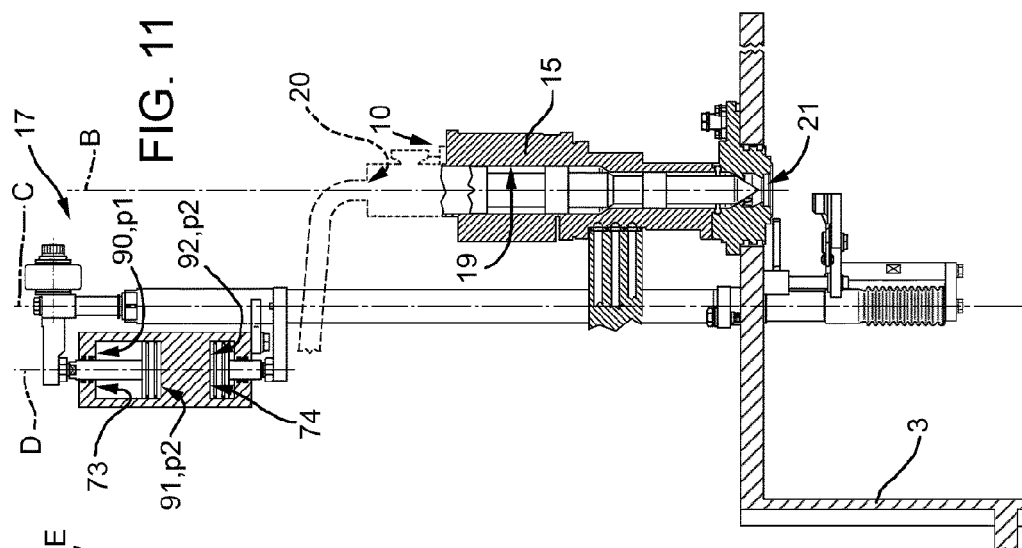


FIG. 11

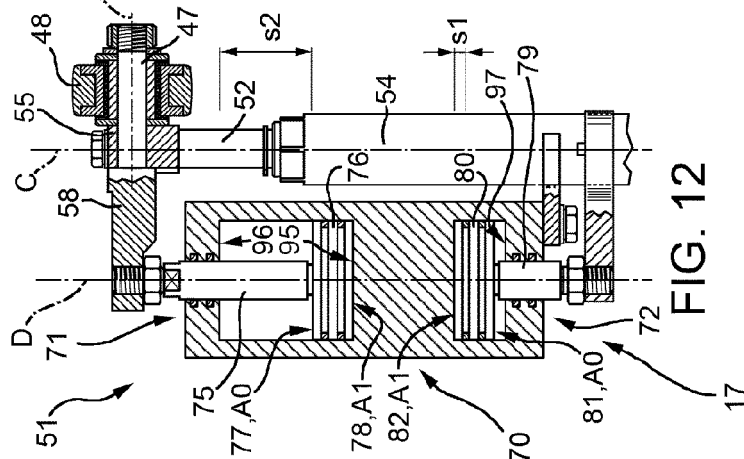
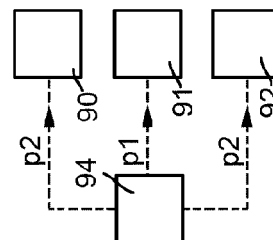
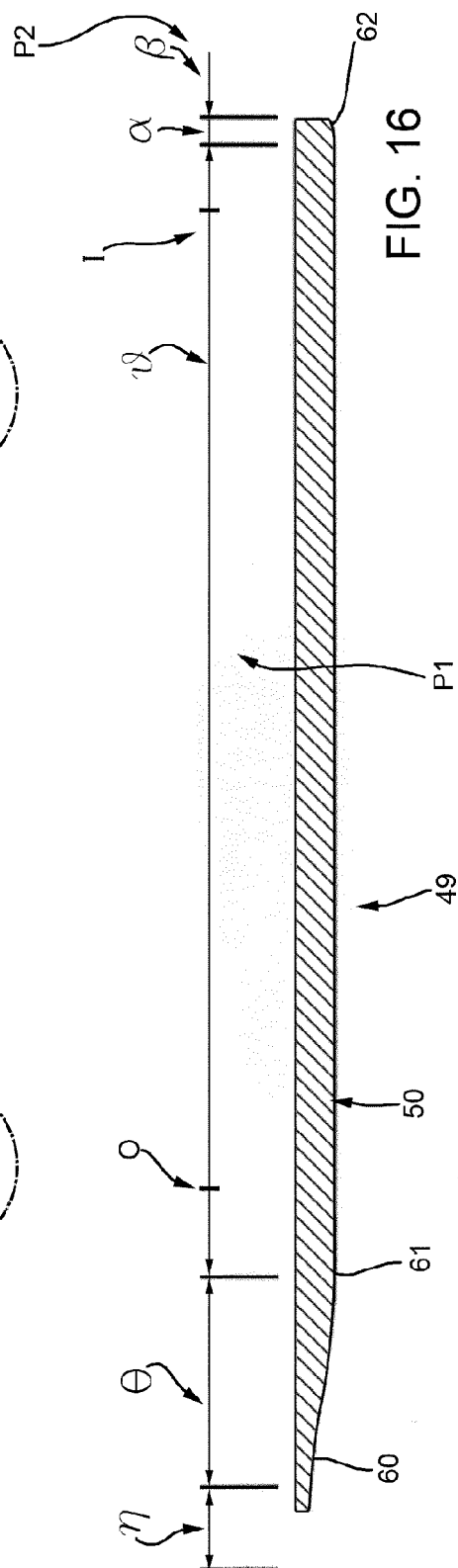
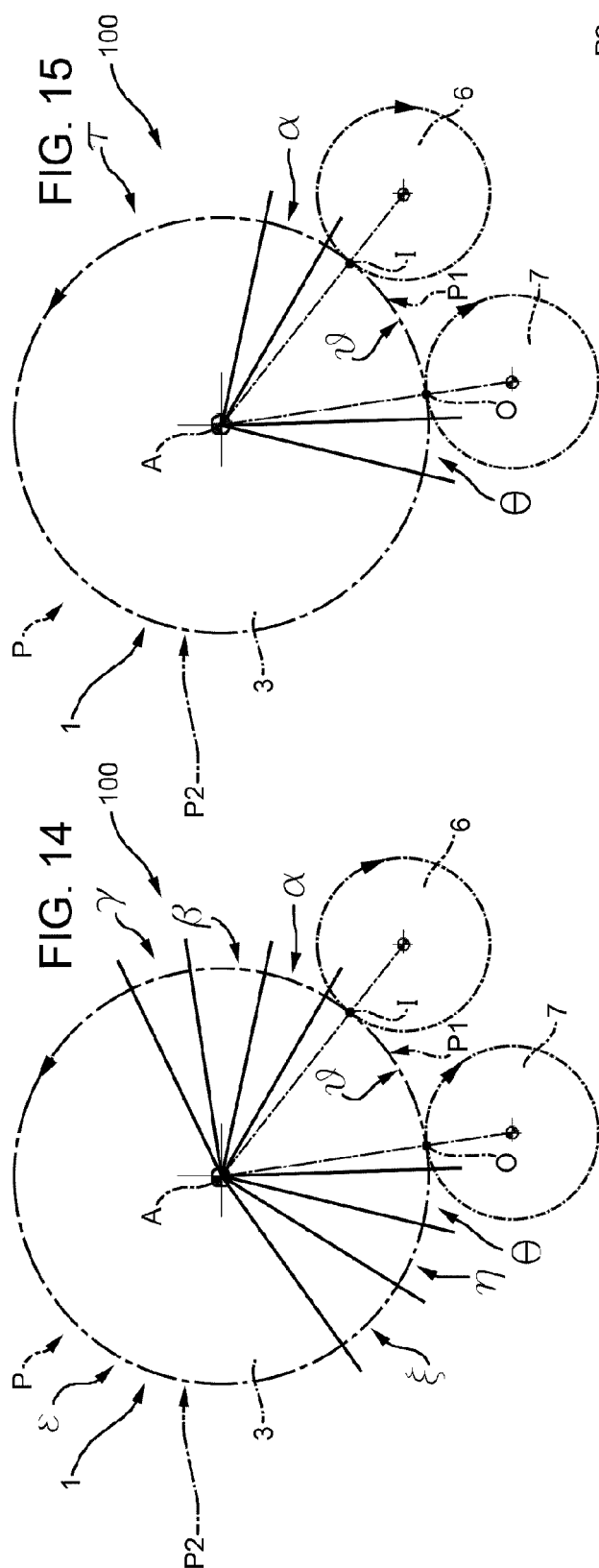


FIG. 12





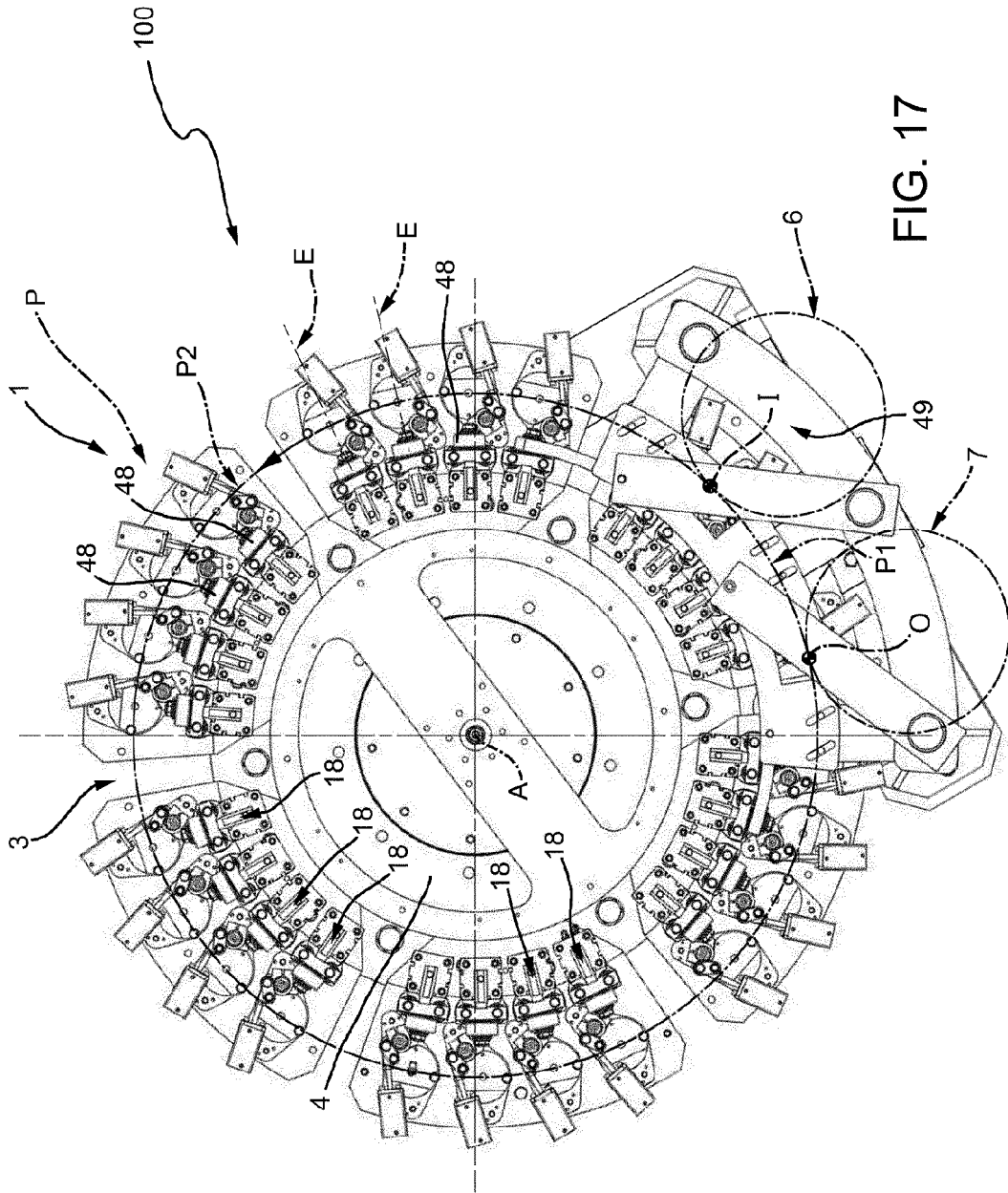


FIG. 17



## EUROPEAN SEARCH REPORT

Application Number  
EP 14 17 0712

| DOCUMENTS CONSIDERED TO BE RELEVANT                                                                                                                                                                                                                    |                                                                                                                                                        |                                                                                                                                                                                                                                                                              |                                         |
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|                                                                                                                                                                                                                                                        |                                                                                                                                                        |                                                                                                                                                                                                                                                                              | B67C                                    |
| The present search report has been drawn up for all claims                                                                                                                                                                                             |                                                                                                                                                        |                                                                                                                                                                                                                                                                              |                                         |
| Place of search<br>The Hague                                                                                                                                                                                                                           |                                                                                                                                                        | Date of completion of the search<br>4 December 2014                                                                                                                                                                                                                          | Examiner<br>Luepke, Erik                |
| CATEGORY OF CITED DOCUMENTS<br>X : particularly relevant if taken alone<br>Y : particularly relevant if combined with another document of the same category<br>A : technological background<br>O : non-written disclosure<br>P : intermediate document |                                                                                                                                                        | T : theory or principle underlying the invention<br>E : earlier patent document, but published on, or after the filing date<br>D : document cited in the application<br>L : document cited for other reasons<br>& : member of the same patent family, corresponding document |                                         |

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The members are as contained in the European Patent Office EDP file on  
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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82