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(71) Applicant: **Sidel S.p.a. Con Socio Unico**
Parma (IT)

(72) Inventors:
- **Montanari, Michele**
43100 PARMA (IT)
- **Cocchi, Enrico**
43100 PARMA (IT)

(74) Representative: **Di Sciuva, Michele et al**
Studio Torta S.p.A.
Via Viotti, 9
10121 Torino (IT)

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(54) Method and device for contact filling an article with pourable product

(57) There is described a method for contact filling at least one article (2) with a pourable product, comprising the steps of: i) arranging a mouth (3) of article (2) in contact with a filling body (10, 11), which defines a first fluidic line (11) for pourable product; ii) filling article (2), by creating a fluidic connection between first fluidic line (11) and article (2); and iii) measuring a level (L) reached by pourable product inside article (2), during step ii); step iii) comprising the step iv) of measuring a first quantity (V1, V2) associated to the empty volume of article (2); step iv) being carried out during step ii).

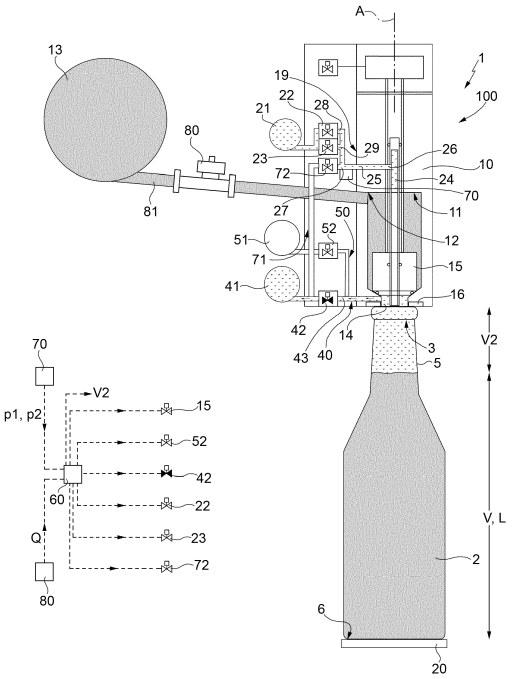


FIG. 7

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Description

[0001] The present invention relates to a method and filling device for contact filling of an article with pourable product, in particular a carbonated pourable food product such as beer or mineral water.

[0002] Filling machines are known comprising a filling station, which is fed at the input with empty articles, and supplies at the output articles filled with the pourable product.

[0003] The filling station substantially comprises a carousel conveyor rotating about an axis of rotation; a tank containing the pourable product; and a number of filling devices fluidly connected to the tank and fitted to the conveyor, radially outwards of the axis of rotation of the conveyor.

[0004] More specifically, the conveyor comprises a number of supports for positioning the mouths of the relative articles beneath the respective valves, and for moving the relative articles along an arc-shaped path about the axis of rotation and integrally with the respective valves.

[0005] Each support is also movable parallel to a respective second axis, which is parallel to and spaced from the axis of rotation of the carousel, between a lowered rest position and a raised operative position.

[0006] Each filling device substantially comprises a fastening body for attachment to the conveyor and defining a filling chamber connected fluidly to the tank; and a filling head fitted to the relative fastening body.

[0007] Each filling head comprises a shutter movable inside the chamber between a closed position cutting off flow of the pourable product to the mouth of the relative article, and an open position connecting the chamber fluidly to the mouth to allow flow of the pourable product into the article.

[0008] Each support receives the article to be filled at an inlet station of the arc-shaped path and discharges the filled articles at an outlet station of the arc-shaped path. Furthermore, each article is filled by relative filling head with the pourable product, as it is advanced by relative support along the arc-shaped path.

[0009] Furthermore, each support is arranged in the respective lowered rest position at the inlet station and the outlet station of the arc-shaped path. When each support is arranged in the relative lowered rest position, relative mouth is spaced along respective second axis from the body of the relative filling device.

[0010] Each support is arranged in the relative raised operative position along the arc-shaped path. Due to the fact that each article is contact filled by relative filling device, it is arranged in tight-fluid contact with the body of relative filling device along the arc-shaped path.

[0011] Still more precisely, when each support is in the relative raised operative position and the mouth of relative article tight-fluid contacts the corresponding filling body, the following operations are carried out:

- at first, each article is pressurized to the same pressure as the pourable product during the filling process, by feeding a fluid, e.g. carbon dioxide, into it, with the shutter in the closed position;
- then, each article is filled with the pourable product, with the shutter in the open position; and
- finally, each article is depressurized, so that pressure above the pourable product level equals atmospheric pressure, by discharging the aeriform contained in the article and with the shutter in the closed position.

[0012] According to a known technique, the filling device comprises a flow-meter for measuring the flow of the pourable product which fills the article and the shutter is moved back into the closed position when the flow-meter has detected that a desired volume of pourable product has filled the article.

[0013] However, especially when the pourable product is beer and the article is made of glass, the above-identified technique could lead to different levels in different filled articles, even if the desired volume of pourable product is the same.

[0014] This is due to the fact that the articles made in glass are generally re-cycled more times after the use and, therefore, are differently shaped.

[0015] In order to ensure, also in this case, that the level of the filled articles is constant, it is known to provide the filling device with a probe, e.g. an inductive probe, for determining the level of the pourable product, and which projects inside the relative article once the article is positioned beneath the relative filling valve.

[0016] According to this technique, when the level of the pourable product reaches a desired value corresponding to the height of the probe, the shutter is moved in the closed position.

[0017] A first drawback of the filling devices of the type described above is that, given the position of the probes projecting inside the relative articles, the explosion of or damage to the articles during the filling process may easily result in damage to the probe, thus resulting in stoppage of the filling machine.

[0018] For example, the glass of damaged articles can break the isolation of the probes and/or can remain between the corresponding probes and the corresponding filling bodies.

[0019] This situation is further exacerbated by the fact that the residues of glass tend to adhere to the probe.

[0020] A second drawback of the filling devices of the type described above is that they require a considerable stroke of the supports between the relative lowered rest position and the relative raised operative position.

[0021] This is due to that fact that the each probe protrudes downwardly into the relative container for a given height, associated to the desired level to be attained. As a result, the supports are required to move below the probe, when they are in the relative lowered rest position.

[0022] A third drawback of the filling devices of the type

described above is that they require a longer cleaning device, commonly known as "dummy bottle" for sterilizing the probe with a sterilizing agent, with respect to the filling devices normally used for contact filling pourable product inside plastic articles. This is due to the fact that each cleaning device must be shaped to accommodate also the relative probe, which protrudes from the relative filling head.

[0023] A fourth drawback of the filling devices of the type described above is that they require the whole replacement of the probe in order to vary the desired filling level to be attained.

[0024] A fifth drawback of the filling devices of the type described above is that they are quite different with respect to the filling devices normally used for contact filling pourable product inside plastic articles, mainly for comprising the probe.

[0025] As a result, they share a limited number of part numbers with the filling devices used for plastic articles, thus increasing the manufacturing and supplying cost.

[0026] It is an object of the present invention to provide a filling method designed to provide a cheap, easy solution to at least one of the above drawback typically associated with known filling device.

[0027] According to the present invention, there is provided a filling method for contact filling an article with a pourable product, as claimed in claim 1.

[0028] The present invention also relates to a filling for contact filling an article with a pourable product, as claimed in claim 9.

[0029] One preferred, non-limiting embodiments of the present invention will be described by way of example with reference to the accompanying drawings, in which:

- Figures 1 to 8 are schematic views of a filling device in accordance with the present invention, in different respective operative positions, with parts removed for clarity; and
- Figure 9 shows the variation of pressure inside articles, the position of a shutter and of a valve of the filling device of Figures 1 to 8.

[0030] With reference to Figures 1 to 8, number 1 indicates a filling device for contact filling an article, hereinafter referred to as container 2, with a pourable product, especially a carbonated food pourable product, beer in the embodiment shown.

[0031] Container 2 comprises, in a known manner,:

- a mouth 3, through which container 2 is filled by the filling machine, and the pourable product is subsequently poured from container 2;
- a bottom wall 6, which is opposite to mouth 3; and
- a neck 5, which is extends from mouth 3 towards bottom wall 6 and is detached by bottom wall 6.

[0032] Filling device 1 substantially comprises:

- a body 10 defining a cavity 11, which has an opening 12 fluidly connected with a tank 13 and defining, on the opposite side of opening 12, a filling opening 14;
- a shutter 15, which is movable parallel to an axis A inside cavity 11 between an open position in which it fluidly connects openings 12, 14 and a closed position in which it fluidly isolates openings 12, 14; and
- a support 20 which is adapted to contact wall 6 so as to arrange an axis of container 2 parallel to axis A and is movable between a rest position and an operative position along axis A.

[0033] Tank 13 is filled, in the embodiment shown, with the pourable product.

[0034] Support 20 is movable parallel to axis A between:

- a lowered rest position, in which mouth 3 is spaced along axis A by body 10 and opening 14 of filling device 1 (Figures 1 and 8); and
- a raised operative position, in which mouth 3 is in tight-fluid contact with body 10 and opening 14 of filling device 1, through the interposition of an annular gasket 16 (Figures 2 to 7).

[0035] When support 20 is in the raised operative position, container 2 preferably undergoes the following operations according the so-called contact filling modality:

- a vacuum generation step, during which vacuum is generated inside the inner volume of container 2 with the shutter 15 in the closed position, so as to prevent the risk of oxidation of the pourable product (Figure 2);
- a pressurization step, during which the inner volume of container 2 is pressurized to the same pressure as the pourable product during the filling process with shutter 15 in the closed position, for example by feeding a pressurizing fluid, e.g. carbon dioxide, into it (Figure 3) ;
- a filling step, during which shutter 15 moves to the open position, so as to fill container 2 with the pourable product, so as to fill container 2 according to the so-called "contact" modality, i.e. by isolating the inner volumes of cavity 11 and the inner volume of container 2 by the external environment during the filling of container 2 (Figures 4 to 6); and
- finally a de-pressurization step, during which the inner volume of neck 5 of container 2 is de-pressurized to the environment pressure with shutter 15 in the closed position, e.g. by connecting the inner volume of container 2 to a discharge (Figure 7).

[0036] It is important to stress that not all the above-identified operations are necessarily carried out before or after the filling of container 2, and that some operations, e.g. the vacuum generation step and the pressur-

ization step, can be repeated more than once.

[0037] Body 10 further comprises:

- a fluidic line 19, which extends between opening 14 and a collector 21 filled with the pressurizing gas - carbon dioxide - in the embodiment shown - and is adapted to allow the flow of the pressurizing fluid before the filling of container 2 or the return of the aeriform contained inside container 2 during the filling of container 2; and
- a pair of valves 22, 23 interposed along fluidic line 19.

[0038] In greater detail, fluidic line 19 comprises:

- a duct 24 extending parallel to axis A and coaxially with opening 14, cavity 11 and shutter 15; and
- a duct 25, which extends radially to axis A inside body 10, above cavity 11 and from a section 26 of duct 24 to a section 27;
- a pair of ducts 28, 29, which extend between section 27 and collector 21.

[0039] Valves 22, 23 are arranged along relative ducts 28, 29.

[0040] In greater detail, valves 22, 23 can be selectively set in:

- respective open positions, in which they fluidly connect section 27 with collector 21 along respective ducts 28, 29 (Figures 3, and 4 with reference to valve 22 only); or
- respective closed positions, in which they fluidly prevent the flow from between section 27 and collector 21 along respective ducts 28, 29 (Figures 1, 2, 4 with reference to valve 23, only and Figures 5 to 8);.

[0041] Valves 22, 23 are set in the respective open positions, during the pressurization step of container 2 (Figure 3), while they are set in the respective closed positions when the vacuum-generation step (Figure 2) and during the de-pressurization step (Figure 7).

[0042] Body 10 further comprises:

- a fluidic line 40, which extends between opening 14 and a discharge collector 41; and
- a valve 42, which is interposed along fluidic line 40 and can be selectively set in an open position (Figure 7) in which it fluidly connects vacuum collector 41 with opening 14, or in a closed position (Figures 1 to 6 and 8) in which it fluidly isolates collector 41 and opening 14.

[0043] Valve 42 is set in the open position, during the de-pressurization step of container 2, while is set in the closed position while the other operations are carried out on container 2.

[0044] Furthermore, body 10 comprises

- a fluidic line 50, which extends between a section 43 of fluidic line 40 and a vacuum collector 51;
- a valve 52, which is interposed along fluidic line 50 and can be selectively set in an open position (Figure 2) in which it fluidly connects vacuum collector 51 with opening 14 and a closed position (Figures 1 and 3 to 7) in which it fluidly isolates collector 51 and opening 14.

[0045] Section 43 is, in particular, interposed between valve 41 and opening 14 along fluidic line 40.

[0046] In other words, fluidic line 50 is formed as a derivation of fluidic line 40.

[0047] Section 43 is fluidly connected with opening 14 also when shutter 15 is in the closed position. In particular, fluidic line 40 opens into opening 14 below the position reached by shutter 15 in the closed position.

[0048] Valve 52 is set in the open position during the vacuum generation step of container 2 (Figure 2); and is set in the closed position (Figures 1 and 3 to 8) during the other operations on container 2.

[0049] Filling device 1 further comprises a control unit 60 (only schematically shown in Figures 1 to 8), which is programmed for measuring a quantity associated to the level reached by the pourable product that has been filled inside container 2.

[0050] Preferably, control unit 60 is programmed for detecting that the pourable product has reached a desired level L (Figures 6 to 8) inside container 2.

[0051] Advantageously, control unit 60 is programmed for measuring a quantity associated to the empty volume V1, V2 (Figure 5) of container 2, i.e. the volume not-filled with pourable product, during the filling of container 2.

[0052] Still more precisely, control unit 60 is programmed for associating to empty volume V1, V2, the level reached by the pourable product inside container 2, on the basis of the size of the diameter of neck 5 of container 2.

[0053] Furthermore, control unit 60 is programmed for associating empty volume V2 to the attainment of desired level L of pourable product inside container 2 (Figures 6 to 8).

[0054] In the following of the present description, V1 will indicate a general value of empty volume greater than value V2 and which is reached before that level of pourable product inside container 2 equals desired level L, i. e. when the level of the pourable product inside container 2 is smaller than desired level L.

[0055] Once the filling is completed, empty volume V2 defines a head-space in neck 5 of container 2 (Figures 6 to 8).

[0056] Furthermore, control unit 60 is programmed to set shutter 15 in the closed position when it has detected that the desired level L has been reached by the pourable product inside container 2.

[0057] Filling device 1 preferably comprises a flow-meter 80, which is arranged along a duct 81 extending between tank 13 and opening 12, and is adapted to measure

the flow Q - and, therefore, the quantity - of pourable product filled inside container 2, when shutter 15 is in the open position.

[0058] Preferably, when control unit 60 has set shutter 15 in the open position,:

- volume V of product filled inside container 2 is measured firstly by using flow-meter 80 (Figure 4) by simply multiplying Q and the time as of the opening of shutter 15, during a first step of the filling operation; and
- then, the level reached by the pourable product is measured by control unit 60 by measuring empty volume V2 (Figures 5 and 6), during a second step of the filling operation.

[0059] For example, volume V is measured by flow-meter 80 up to when it reaches 80% of desired volume and the level reached is then measured by control unit 60 by measuring empty volume V2, up to when desired level L is reached.

[0060] In particular, during the first step of filling operation shown in Figure 4, control unit 60 sets at least one (22 in the embodiment shown) in the open position, so as to allow the return of the aeriform - carbon dioxide in the embodiment shown - escaping from the inner volume of container 2 inside collector 21.

[0061] Differently, during the second step of filling, control unit 60 sets both valves 22, 23 in the respective closed position, so as to prevent the return of the aeriform - carbon dioxide in the embodiment shown - escaping from the inner volume of container 2 inside collector 21 (Figures 5 and 6).

[0062] Body 10 of filling device 1 comprises a sensor 70, which is configured to generate a signal associated to the pressure inside empty volume of container 2 and is functionally connected with control unit 60.

[0063] Preferably, body 10 comprises a fluidic line 71, which extends between section 27 and discharge collector 41.

[0064] Sensor 70 is arranged along fluidic line 71.

[0065] In this way, sensor 70 generates a signal associated to the pressure inside ducts 24, 25 - and, therefore, inside the empty volume V2 of container 2 -, when shutter 15 is in the closed position and valves 22, 23 are in respective closed positions.

[0066] In the embodiment shown, sensor 70 is, by a way of example, a piezo-electric sensor.

[0067] In the embodiment shown, filling device 1 comprise a single housing (not-shown) which houses sensor 70 and valve 72.

[0068] Furthermore, body 10 comprises a valve 72, which is arranged along fluidic line 71 and in a position interposed between sensor 70 and discharge collector 41.

[0069] During the second step of filling, control unit 60 is preferably programmed for selectively moving valve 72, when shutter 15 is in the open position and valves 22, 23 are in respective closed positions, between:

- an open position (Figures 6), in which it allows the aeriform to flow from the inner volume of container 2 towards discharge collector 41 along fluidic line 71; and
- a closed position (Figure 5), in which it prevents the aeriform from flowing the inner volume of container 2 towards discharge collector 41.

[0070] It is important to stress that fluidic line 71 and ducts 24, 25 define a single way for the aeriform contained in the empty volume of container 2, when valves 22, 23 are in respective closed positions.

[0071] As a result, the switch of valve 72 from the open position to the closed position causes an increase in the pressure of the aeriform in ducts 24, 25 and empty volume V2 of container 2, due to the fact that the pourable product filling container 2 is reducing the volume available for the aeriform.

[0072] Likewise, the switch of valve 72 from the closed position to the open position causes a decrease in the pressure of the aeriform in ducts 24, 25 and in empty volume V1, V2 of container 2, due to the fact that the switch increases the volume available for that aeriform.

[0073] It is important to point out that control unit 60 measures empty volume V1, V2 of container 2 by:

- at first measuring the sum of volume of empty volume V1, V2 and the fixed volume of ducts 24, 25; and
- then, by subtracting from that sum, the fixed volume of ducts 24, 25.

[0074] Preferably, control unit 60 is programmed for cyclically:

- setting valve 72 in the closed position;
- keeping valve 72 in the closed position for a time interval Δt necessary to register, by using sensor 70, a fixed increase p2-p1 in the pressure in ducts 24, 25 and in the inner volume of container 2; and
- setting valve 72 in the open position, at the end of time interval Δt.

[0075] Furthermore, control unit 94 is programmed for calculating the empty volume on the basis of time interval Δt necessary to register fixed increase p2-p1, where:

- pressure p1 corresponds to the minimum value of pressure detected by sensor 70 with valve 72 in the open position and immediately after valve 72 has been set in the closed position (Figure 9); and
- pressure p2, which corresponds to the maximum value of pressure detected by sensor 70 with valve 72 in the closed position (Figure 9).

[0076] In other words, when valve 72 is in the closed position, sensor 70 measures an increase from pressure

p1 to pressure p2 inside fluidic line 71.

[0077] As a matter of fact, the greater is the volume of ducts 24, 25 and the empty volume, the lower is time interval Δt necessary to register fixed increase p2-p1, higher is the frequency of switching of valve 72 between the relative open position and closed position.

[0078] In the embodiment shown, control unit 60 is programmed for calculating V2, on the basis of:

- pressure p1 at the beginning of interval time Δt;
- pressure p2 at the end of interval time Δt; and
- Q is the flow of pourable product, detected by flow-meter 80.

[0079] Furthermore, control unit 60 is programmed for calculating V2, on the basis of the following equation (1):

$$V2 = \frac{p1 * Q * \Delta t}{p2 - p1}$$

[0080] Equation (1) can be justified in the following way, on the basis of the assumption that the aeriform contained in ducts 23, 24 and empty volume V2 behaves as a perfect gas, that the variation of temperature of that aeriform are neglectable during time interval Δt, and that both container 2 and pourable product are not compressible.

[0081] In the above identified conditions, the Boyle's law on gas perfect establishes that (2):

$$p2 * V2 = p1 * V1$$

where V1 is the volume of empty space of container 2 when valve 72 is in the open position and at the beginning of the interval time Δt.

[0082] Furthermore (3): $V2 = V1 - Q * \Delta t$.

[0083] By substituting (3) in (2), it follows that (4):

$$V2 = \frac{p1 * V1}{p2} = \frac{p1 * (Q * \Delta t + V2)}{p2}.$$

[0084] Equation (1) can be obtained by equation (4) in the following way:

$$V2 = \frac{\frac{p1}{p2} * Q * \Delta t}{1 - p1/p2} = \frac{p1 * Q * \Delta t}{p2 - p1}.$$

[0085] A software product is loaded on control unit 60 which, when executed implements equations (1) to (4).

[0086] With reference to Figure 9, it is shown the variation of pressure inside fluidic line 71 between values p1, p2, when valve 72 continually switches between respective open and closed position, with respect to time.

[0087] Figure 9 further shows the variation of time interval Δt, when the empty volume decreases, and the operation of shutter 15, which is the open position when line 101 assumes value 1 and is in the closed position when line 101 assume value 0.

[0088] Filling device 1 is preferably incorporated in a filling station 100, which substantially comprises:

- a carousel (not-shown), which is rotatable about an axis, which is in vertical, in use; and
- a plurality of filling devices 1, which are fitted to a periphery of the carousel.

[0089] Axes A of filling devices are spaced from and parallel axis of rotation of carousel.

[0090] Supports 20 are driven in rotation by carousel, receive relative empty containers 2 at an inlet station (not-shown), convey relative containers 2 along an arc-shaped trajectory, and output filled containers 2 at an outlet station (not-shown).

[0091] In particular, each support 20 is arranged in the relative rest position at inlet station and at the outlet station, and moves from the relative rest position to the lowered position and vice-versa along the arc-shaped trajectory.

[0092] Filling station 100 further defines a single tank 13, a single flow-meter 80 and duct 81, and single collectors 41, 51 for all filling devices 1.

[0093] The operation of the filling device 1 will be described as of the condition shown in Figure 1, with reference to only one filling device 1 and to relative container 2.

[0094] In this condition, support 20 is in the rest position and mouth 3 of empty container 2 is spaced along axis A from opening 14 and body 10.

[0095] Furthermore, control unit 60 sets shutter 15 and valves 22, 23, 42, 52, 72 in respective closed position.

[0096] At this stage, support 20 moves along axis A up to reach the operative position (Figure 2), in which mouth 3 of container 2 is pressed and in tight-fluid contact with opening 14 and body 10.

[0097] Control unit 60 sets valve 52 in the open position, so as to create a fluidic connection between vacuum collector 51 and opening 14 and, therefore, between vacuum collector 51 and the inner volume of container 2. As a result, the vacuum is generated inside the inner volume of container 2, so as to prevent the risk of oxidation of the pourable product.

[0098] Then, control unit 60 sets valve 52 in the closed position and sets valves 22, 23 in the respective open positions, while keeping shutter 15 in the closed position (Figure 3).

[0099] In this way, the pressurizing gas, carbon dioxide in the embodiment shown, flows from collector 21 towards ducts 28, 29, 23, 24, opening 14 and mouth 3, up to reach the inner volume of container 2. As a result, the

inner volume of container 2 is pressurized to the same pressure as the pourable product in tank 13.

[0100] Afterwards, control unit 60 sets shutter 15 in the open position (Figures 4 to 6), so as to fill container 2 with the pourable product.

[0101] The filling of container 2 comprises:

- the first step, during which volume V of product filled inside container 2 is measured by using flow-meter 80 (Figure 4); and
- the second step, during which the level of product filled inside container 2 is measured by control unit 60 (Figures 5 and 6).

[0102] During the first step, control unit 60 sets at least one (23) of valves 22, 23 in respective open position and sets shutter 15 in the open position (Figure 4).

[0103] In this way, the pourable product can flow from tank 13 to mouth 3 of container 2, thus filling the latter, while the aeriform - carbon dioxide in the embodiment shown - in container 2 escapes from container 2 through mouth 3 and ducts 24, 25 and returns inside collector 21 by one (or both) ducts 28, 29.

[0104] In particular, the pourable product flows along duct 81, cavity 11 and opening 14. Flow-meter 80 measures the amount of flow Q of the pourable product along duct 81.

[0105] By setting one or both valves 22, 23 in respective open positions, control unit 60 can adjust the filling speed of container 2.

[0106] During the second step, control unit 60 valves 22, 23 in respective open position, keeps shutter 15 in the open position, and cyclically move valve 72 between the open position (Figure 6) and the closed position (Figure 5).

[0107] In this way, the aeriform - carbon dioxide in the embodiment shown - escapes from container 2 through mouth 3 and ducts 24, 25 and is prevented from returning inside collector 21.

[0108] In the meanwhile, control unit 60 measures empty volume V1, V2 of container 2, and measures the level reached by the pourable product inside container 2 on the basis of the measure of the empty volume.

[0109] In greater detail, control unit 60 cyclically switches valve 72 between the open position (Figure 5) and the closed position (Figure 6).

[0110] As a result, sensor 70 detects an increase in the pressure inside ducts 24, 25 - and, therefore, inside empty volume V2 -, when valve 72 is in the closed position.

[0111] This is due to the fact that the pourable product entering container 2 is pressing aeriform in a narrower empty volume.

[0112] Differently, sensor 70 detects a sudden decrease in the pressure inside ducts 24, 25 - and, therefore, inside empty volume V1, V2, when control unit 60 sets valve 72 in the open position.

[0113] In particular, control unit 60 cyclically:

- sets valve 72 in the closed position;
- keeps valve 72 in the closed position for time interval Δt, necessary to increase pressure in ducts 24, 25
- and, therefore, inside empty volume - from value p1 to value p2; and
- sets valve 72 in the open position (Figure 5), at the end of time interval Δt, so as to connect ducts 23, 24 and empty volume V2 with discharge collector 41.

[0114] As empty volume V1, V2 decreases, time interval Δt correspondingly decreases and the commutation frequency of valve 72 correspondingly increases (Figure 9).

[0115] On the basis of time interval Δt, fixed value of pressures p1, p2, flow Q registered by flow-meter 80, control unit 60 measures empty volume V2 (or V1) with equation (1):

$$V2 = \frac{p1 * Q * \Delta t}{p2 - p1}.$$

[0116] Furthermore, control unit 60 measures that desired level L has been reached by pourable product inside container 2, on the basis of the attainment of empty volume V2 and of the size of the diameter of neck 5.

[0117] When control unit 60 detects that the level of pourable product that has filled container 2 equals desired value L, it sets shutter 15 in the closed position (Figure 6) .

[0118] Then, control unit 60 sets valve 42 in the open position, so as to fluidly connect discharge collector with opening 14 and the inner volume of container 2 through fluidic line 40. In this way, the aeriform in container 2 is discharge, up to when the pressure inside container 2 reaches the environment pressure (Figure 7).

[0119] Then, control unit 60 sets valve 42 in the closed position and support 20 moves from the operative position to the rest position, as shown in Figure 8.

[0120] Filled container 2 is now discharged from support 20.

[0121] The advantages of filling device 1 and the filling method according to the present invention will be clear from the above description.

[0122] In particular, control unit 60 is programmed for detecting that pourable product has reached desired level L of filling by measuring empty volume V1, V2 of container 2, during the filling of container 2.

[0123] In this way, filling device 1 can fill containers 2 with the desired level L of pourable product, by simply measuring that empty volume V2 has been reached therein, and without requiring the presence of an inductive probe, as in the known solutions discussed in the introductory part of the present description.

[0124] Furthermore, due to the fact that the inductive probe is no longer necessary to obtain desired level L, there is no risk that the residues of damaged/exploded container 2 can break the probe and/or remain between

probe and body 10, as in the known solution discussed in the introductory part of the present description.

[0125] Support 20 moved along a narrower stroke parallel to axis A between the rest position and the operative position, when compared with the known solutions described in the introductory part of the present description.

[0126] This is due to the fact that support 20 is no longer required to move away from the probe, when it is arranged in the rest position.

[0127] Due to the fact that it does not require any inductive probe, filling device 1 requires the same cleaning device as the filling device that fills plastic containers 2.

[0128] Filling device 1 can also be efficiently used for filling container 2 with a broader range of desired levels L than the known filling devices described in the introductory part of the present description.

[0129] As a matter of fact, in order to vary desired level L, it is enough to correspondingly varying the software loaded in control unit 60, without any need of changing the inductive probe as in the solutions described in the introductory part of the present description.

[0130] Filling device 1 is more similar to filling devices than the known filling devices described in introductory part of the present description and used for filling plastic containers 2 with carbonated products other.

[0131] As a result, filling device 1 reduces the manufacturing and supplying cost, when compared with those known solution.

[0132] Finally, flow-meter 80 is efficiently used, during the first initial step of filling of container 2, for detecting that a given amount of pourable product has filled container 2 (Figure 4).

[0133] During this first step of filling, valve 72 is kept in the closed position and one (22) of valves (22, 23) is kept in the open position, so that the aeriform which escapes from the inner volume of container 2 returns inside collector 21.

[0134] Differently, during the second terminal step of the filling of container 2, control unit 60 sets valves 22, 23 in the closed position and switches valve 72 between the open position and closed position, so as to measure that value V2 of empty volume has been reached and, accordingly, detect that desired level L has been reached (Figures 5 and 6).

[0135] In this way, on one hand, valve 72 is required to switch between the open and the closed position only during the second step of filling, thus correspondingly increasing the life-time of valve 72.

[0136] On the other hand, the aeriform escapes from the inner volume of container 2 inside collector 41 - and is, therefore, not recovered in collector 21 - only during the second step of filling, thus reducing the consumption of carbon dioxide.

[0137] Finally, it is apparent that modifications and variants not departing from the scope of protection of the claims may be made to device 1 and method disclosed herein.

[0138] In particular, the first step of the filling cycle of container 2 could be not present.

[0139] Furthermore, filling device 1 could use a component other than flow-meter 80 to detect flow Q of pourable product.

[0140] Moreover, control unit 60 could use interval time Δt for measuring flow Q.

[0141] Finally, filling device 1 could not comprise valve 72. In that case, control unit 60 would be programmed for moving one of valves 22, 23 between the respective open position and the respective closed position and to leave the other valves 22, 23 in the respective open position, so that to cyclically increase and reduce the pressure inside ducts 24, 25 and empty volume V1, V2 of container 2.

Claims

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

   i) arranging a mouth (3) of said article (2) in contact with a filling body (10), which defines a first fluidic line (11) for said pourable product;
   ii) filling said article (2), by creating a fluidic connection between said first fluidic line (11) and said article (2); and
   iii) measuring a level (L) reached by said pourable product inside said article (2), during said step ii);

   characterized in that said step iii) comprises the step iv) of measuring a first quantity (V1, V2) associated to the empty volume of said article (2);
   said step iv) being carried out during step ii).

2. The method of claim 1, **characterized in that** said step iv) comprises the step v) of measuring a second quantity (p1, p2) associated to the pressure inside said empty volume.

3. The method of claim 2, **characterized in that** said step iv) comprises the step vi) of measuring a third quantity (p2-p1) associated to the temporal variation of the pressure inside said empty volume.

4. The method of claim 3, **characterized in that** said step vi) comprises the step vii) of measuring a fourth quantity (Δt) associated to time interval necessary to obtain a given increase (p2-p1) in the pressure inside said empty volume, during said step ii).

5. The method of any one of claim 2 to 4, **characterized by** comprising the steps of:

   viii) allowing the escape of an aeriform contained inside said article (2) along a second fluidic line (24, 25), during said step ii); and

ix) measuring said third quantity (p1, p2) along said second fluidic line (24, 25)

6. The method of claim 5, when depending on claim 3 or 4, **characterized in that** said step vi) comprises the step x) of cyclically interrupting the flow of said aeriform along said second fluid line (24, 25).

7. The method of claim 6, **characterized in that** said step vi) comprises the steps of:

xi) fluidly isolating said second line (24, 25) from a collector (21) of said aeriform; and
xii) cyclically connecting in a fluidic way said second line (24, 25) with a discharge (41).

8. The method of any one of the foregoing claims, **characterized by** comprising a step xiii) of measuring a fifth quantity (Q) associated to the volume of said pourable product that has filled said article (2), during a first part of said step ii);
said step iv) being carried out after said step xiii) and during a second part of said step ii).

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

- a body (10), which defines a first fluidic line (11) for said pourable product;
- a shutter (15), which can be selectively set in a first position in which it allows said pourable product to flow from said fluidic line (11) inside said article (2) so as to fill said article (2) with said pourable product, or in a second position, in which it prevents said pourable product from flowing from said fluidic line (11) inside said article (2); said article (2) being adapted to be arranged in contact with said body (10); and
- a control unit (60), which is programmed for measuring a level (L) reached by said pourable product inside said article (2), when said shutter (15) is in said first position;

characterized in that said control unit (60) is programmed for measuring a first quantity (V1, V2) associated to the empty volume of said article (2), when said shutter (15) is in said first position and for measuring said level (L) on the basis of said first quantity (V1, V2).

10. The filling device of claim 9, **characterized by** comprising a sensor (70), which is configured to generate a signal associated to a second quantity (p1, p2) associated to the pressure inside said empty volume;
said sensor (70) being functionally connected with said control unit (62);
said control unit (60) being programmed for measuring said first quantity (V1, V2) also on the basis of said second quantity (p1, p2).

11. The filling device of claim 9 or 10, **characterized by** comprising a second fluidic line (24, 25), which is fluidly connectable with the inner volume of said article (2) and is adapted to allow the escape of the aeriform, when said shutter (15) is in said first position;
said sensor (70) being arranged along said second fluidic line (24, 25).

12. The filling device of claim 11, **characterized by** comprising a first valve (72; 22, 23), which is interposed along said second line (24, 25) and is selectively movable between:

- a first position, in which it allows the flow of said aeriform along said second fluidic line (24, 25); or
- a second position, in which it prevents the flow of said aeriform along said second fluidic line (24, 25), so as to cyclically increase and reduce the pressure along said second fluidic line (24, 25) and said empty volume.

13. The filling device of claim 12, **characterized in that** said first valve (72; 22, 23) is controllable to interrupt the flow of said aeriform for a time interval (Δt) necessary to obtain a given increase (p1-p2) in the pressure inside said empty volume;
said control unit (60) being programmed for measuring said first quantity (V1, V2) also on the basis of said time interval (Δt).

14. The filling device of claim 12 or 13, **characterized by** comprising:

- a collector (21) for said aeriform;
- at least one second valve (22, 23), which can be selectively set in a first position in which it fluidly connects said collector (21) and said second fluidic line (24, 25), or in a second position in which it fluidly isolates said collector (21) and said second fluidic line (24, 25);
- a discharge (41), which is fluidly connectable to said article (2), when said shutter (15) is in said second position and when the said article (2) is, in use, in contact with said filling body;
- a third fluidic line (71), which extends between said discharge (41) and said second fluidic line (24, 25);

said control unit (60) being programmed to set:

- said first valve (72) in said first position;
- said at least one second valve (22, 23) in said second position; and
- said shutter (15) in said first position, so as to

convey said aeriform towards said discharge (41) along said third fluidic line (71), when said article (2) is, in use, filled with said pourable product.

15. The filling unit of any one of claims 11 to 14, **characterized by** comprising:

- a flow sensor (80) adapted to measure a third quantity (Q) associated to the amount of pourable product that has, in use, filled said article (2), when said shutter (15) is, in use, in said first position;

said control unit (60) being programmed for measuring the volume of said pourable product that has filled said article (2), during a first part of the time interval during which said shutter (15) is, in use, in said first position;
said control unit (60) being programmed for measuring said first quantity (V1, V2), during a second part, subsequent to said first part, of the time interval during which said shutter (15) is, in use, in said first position;
said control unit (60) being programmed for setting at least one second valve (22, 23) in said first position during first part and in said second position during said second part.

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

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

i) arranging a mouth (3) of said article (2) in contact with a filling body (10), which defines a first fluidic line (11) for said pourable product;
ii) filling said article (2), by creating a fluidic connection between said first fluidic line (11) and said article (2);
iii) measuring a level (L) reached by said pourable product inside said article (2), during said step ii);
iv) allowing the escape of an aeriform contained inside said article (2) along a second fluidic line (24, 25), during said step ii); and
v) discharging said aeriform from said filled article (2) towards a discharge (41);
said step iii) comprising the step vi) of measuring a first physical quantity (V1, V2) associated to the empty volume of said article (2);
said step vi) being carried out during step ii);
characterized by comprising a step vii) of measuring a fifth physical quantity (Q) associated to the volume of said pourable product that has filled said article (2), during a first part of said step ii);
said step vi) being carried out after said step vii) and during a second part of said step ii);
the method further comprising the steps of:
viii) fluidly connecting said collector (21) with said second fluidic line (24, 25) during said first part of said step ii) ;
ix) fluidly isolating said collector (21) and said second fluidic line (24, 25), and fluidly connecting said discharge (41) and said second fluidic line (24, 25) during said second part of said step ii).

2. The method of claim 1, **characterized in that** said step vi) comprises the step x) of measuring a second physical quantity (p1, p2) associated to the pressure inside said empty volume.

3. The method of claim 2, **characterized in that** said step vi) comprises the step xi) of measuring a third physical quantity (p2-p1) associated to the temporal variation of the pressure inside said empty volume.

4. The method of claim 3, **characterized in that** said step vi) comprises the step xii) of measuring a fourth physical quantity (Δt) associated to time interval necessary to obtain a given increase (p2-p1) in the pressure inside said empty volume, during said step ii).

5. The method of any one of claim 2 to 4, **characterized in that** said step vi) comprises the step xiii) of measuring said third physical quantity (p1, p2) along said second fluidic line (24, 25)

6. The method of claim 5, when depending on claim 3 or 4, **characterized in that** said step vi) comprises the step xiv) of cyclically interrupting the flow of said aeriform along said second fluid line (24, 25).

7. The method of claim 6, **characterized in that** said step vi) comprises the step of:

xv) cyclically connecting in a fluidic way said second line (24, 25) with a discharge (41).

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

- a body (10), which defines a first fluidic line (11) for said pourable product;
- a shutter (15), which can be selectively set in a first position in which it allows said pourable product to flow from said first fluidic line (11) inside said article (2) so as to fill said article (2) with said pourable product, or in a second position, in which it prevents said pourable product from flowing from said first fluidic line (11) inside said article (2); said article (2) being adapted to

be arranged in contact with said body (10);
- a second fluidic line (24, 25), which is fluidly connectable with the inner volume of said article (2) and is adapted to allow the escape of the aeriform, when said shutter (15) is in said first position;
- a discharge (41), which is fluidly connectable to said article (2), when said shutter (15) is in said second position and when the said article (2) is, in use, in contact with said filling body (10), so as to discharge said aeriform from said filled article (2); and
- a control unit (60), which is programmed for measuring a level (L) reached by said pourable product inside said article (2), when said shutter (15) is in said first position;

said control unit (60) being programmed for measuring a first physical quantity (V1, V2) associated to the empty volume of said article (2), when said shutter (15) is in said first position and for measuring said level (L) on the basis of said first physical quantity (V1, V2);
characterized by comprising:

- a collector (21) for said aeriform;
- a flow sensor (80) adapted to measure a third physical quantity (Q) associated to the amount of pourable product that has, in use, filled said article (2), when said shutter (15) is, in use, in said first position;
- at least one first valve (22, 23), which is interposed along said second fluidic line (24, 25), and which can be selectively set in a first position in which it fluidly connects said collector (21) and said second fluidic line (24, 25), or in a second position in which it fluidly isolates said collector (21) and said second fluidic line (24, 25);
- a third fluidic line (71), which extends between said discharge (41) and is selectively connectable with said second fluidic line (24, 25);
said control unit (60) being programmed for measuring the volume of said pourable product that has filled said article (2), during a first part of the time interval during which said shutter (15) is, in use, in said first position;
said control unit (60) being programmed for measuring said first physical quantity (V1, V2), during a second part, subsequent to said first part, of the time interval during which said shutter (15) is, in use, in said first position;
said control unit (60) being programmed for setting said first valve (22, 23) in said first position during first part and in said second position during said second part, so as to convey said aeriform towards said collector (21) during said first part and towards said discharge (41) during said second part.

9. The filling device of claim 8, **characterized by** comprising a sensor (70), which is configured to generate a signal associated to a second physical quantity (p1, p2) associated to the pressure inside said empty volume;
said sensor (70) being functionally connected with said control unit (62);
said control unit (60) being programmed for measuring said first physical quantity (V1, V2) also on the basis of said second physical quantity (p1, p2).

10. The filling device of claim 8 or 9, **characterized in that** said sensor (70) being arranged along said second fluidic line (24, 25).

11. The filling device of claim 10, **characterized by** comprising a second valve (72), which is interposed along said second line (24, 25) and is selectively movable between:

- a first position, in which it allows the flow of said aeriform along said second fluidic line (24, 25); or
- a second position, in which it prevents the flow of said aeriform along said second fluidic line (24, 25), so as to cyclically increase and reduce the pressure along said second fluidic line (24, 25) and said empty volume.

12. The filling device of claim 11, **characterized in that** said second valve (72) is controllable to interrupt the flow of said aeriform for a time interval (Δt) necessary to obtain a given increase (p1-p2) in the pressure inside said empty volume;
said control unit (60) being programmed for measuring said first physical quantity (V1, V2) also on the basis of said time interval (Δt).

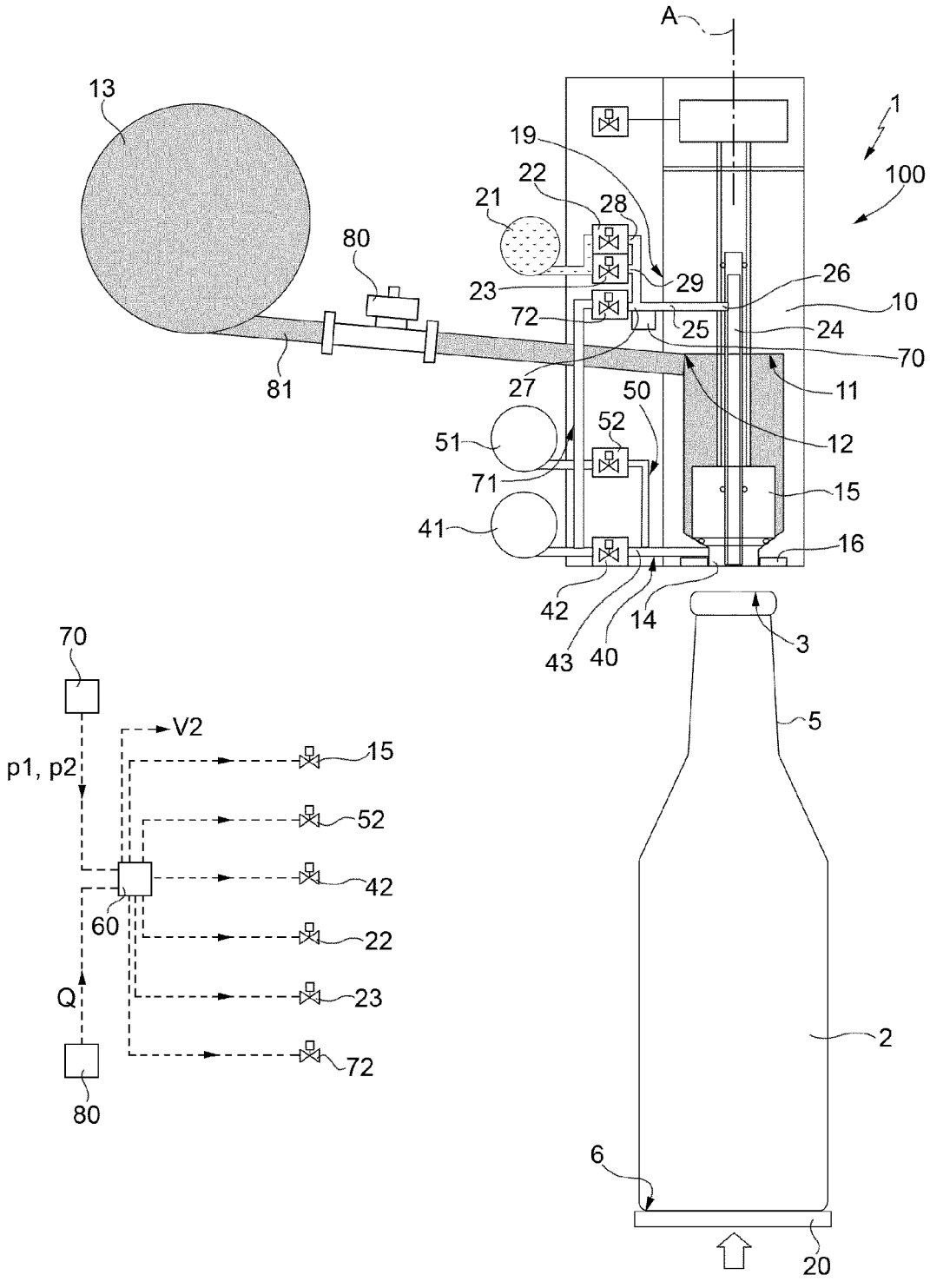

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FIG. 1

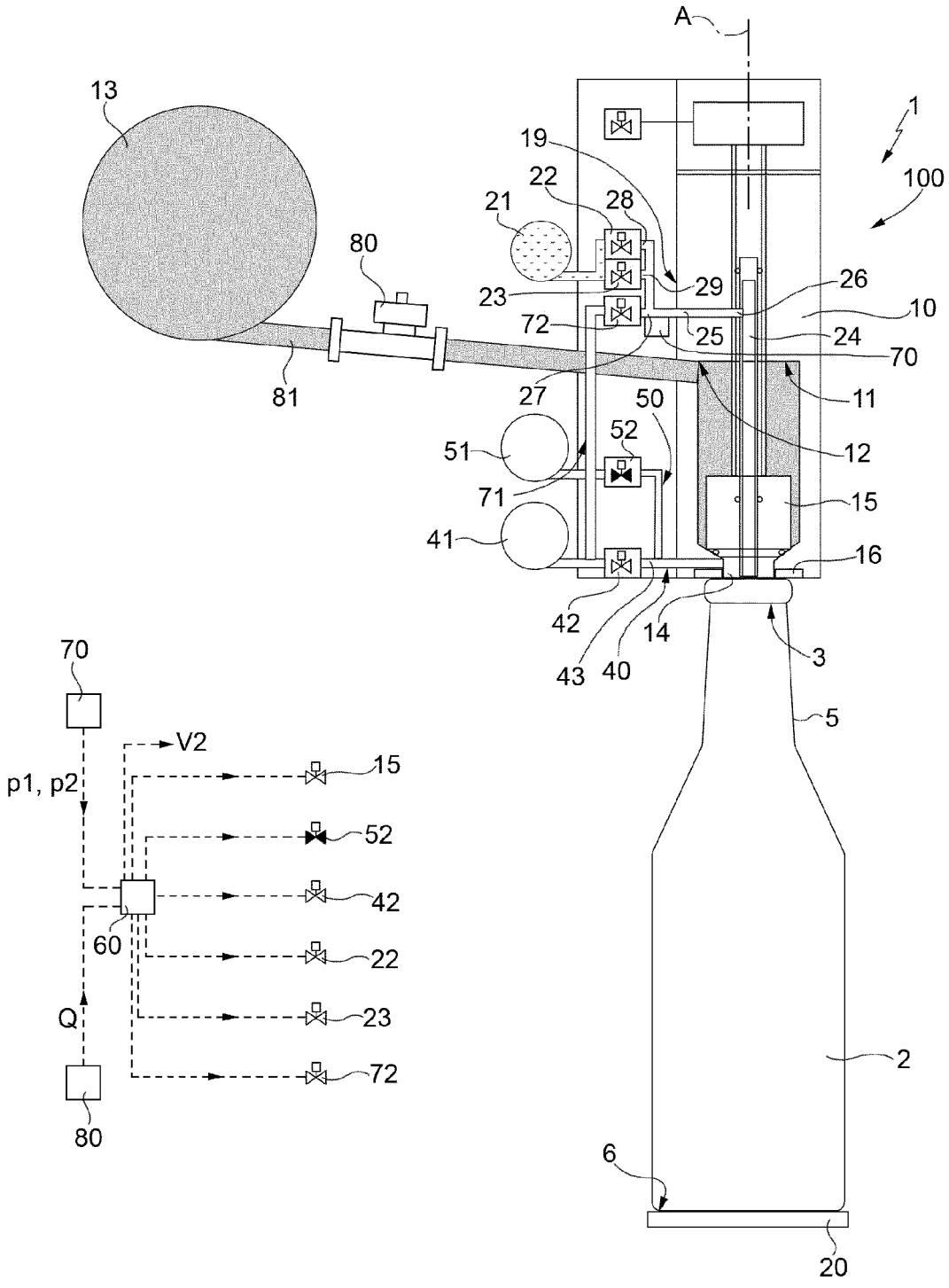

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FIG. 2

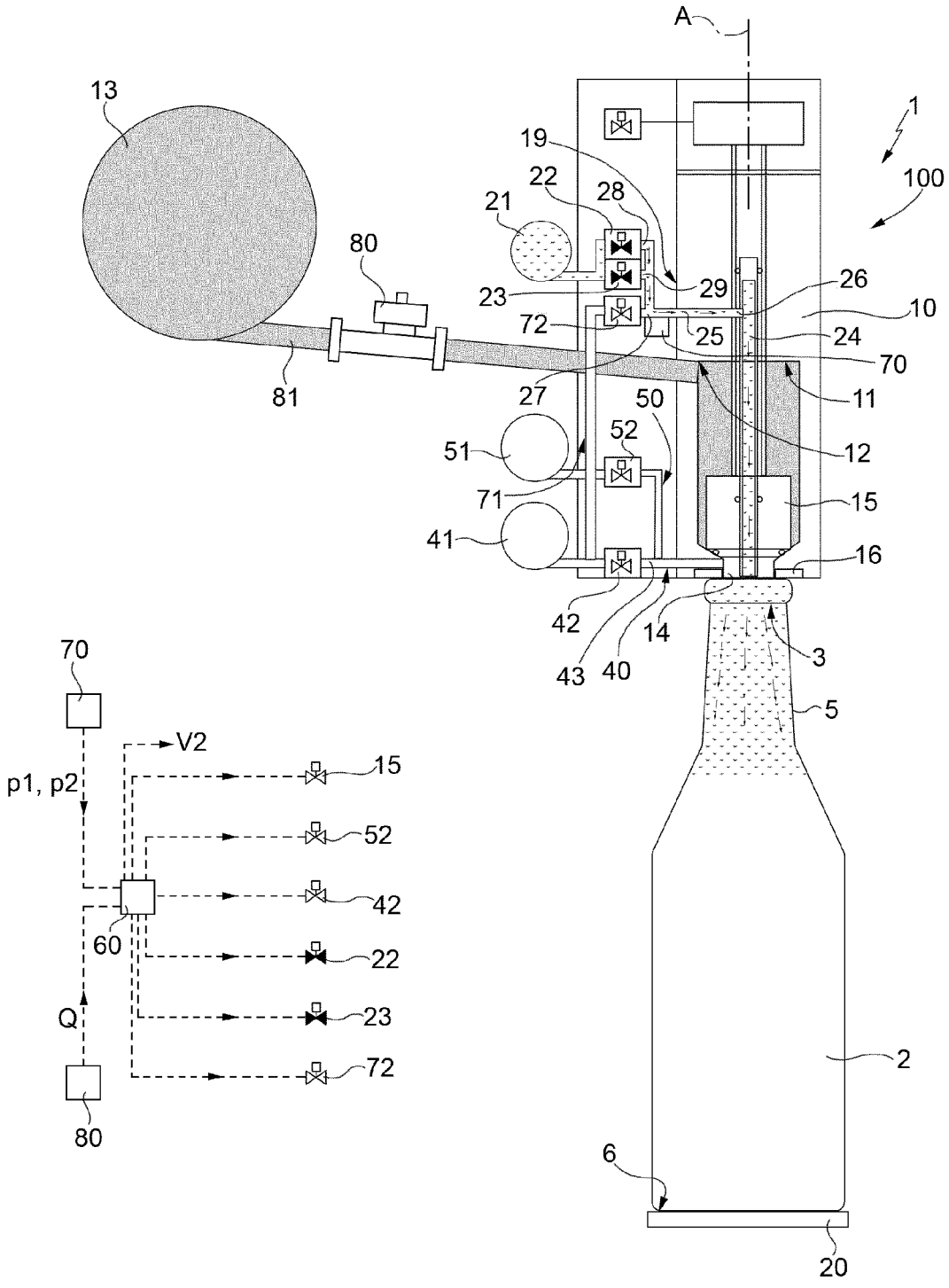

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FIG. 3

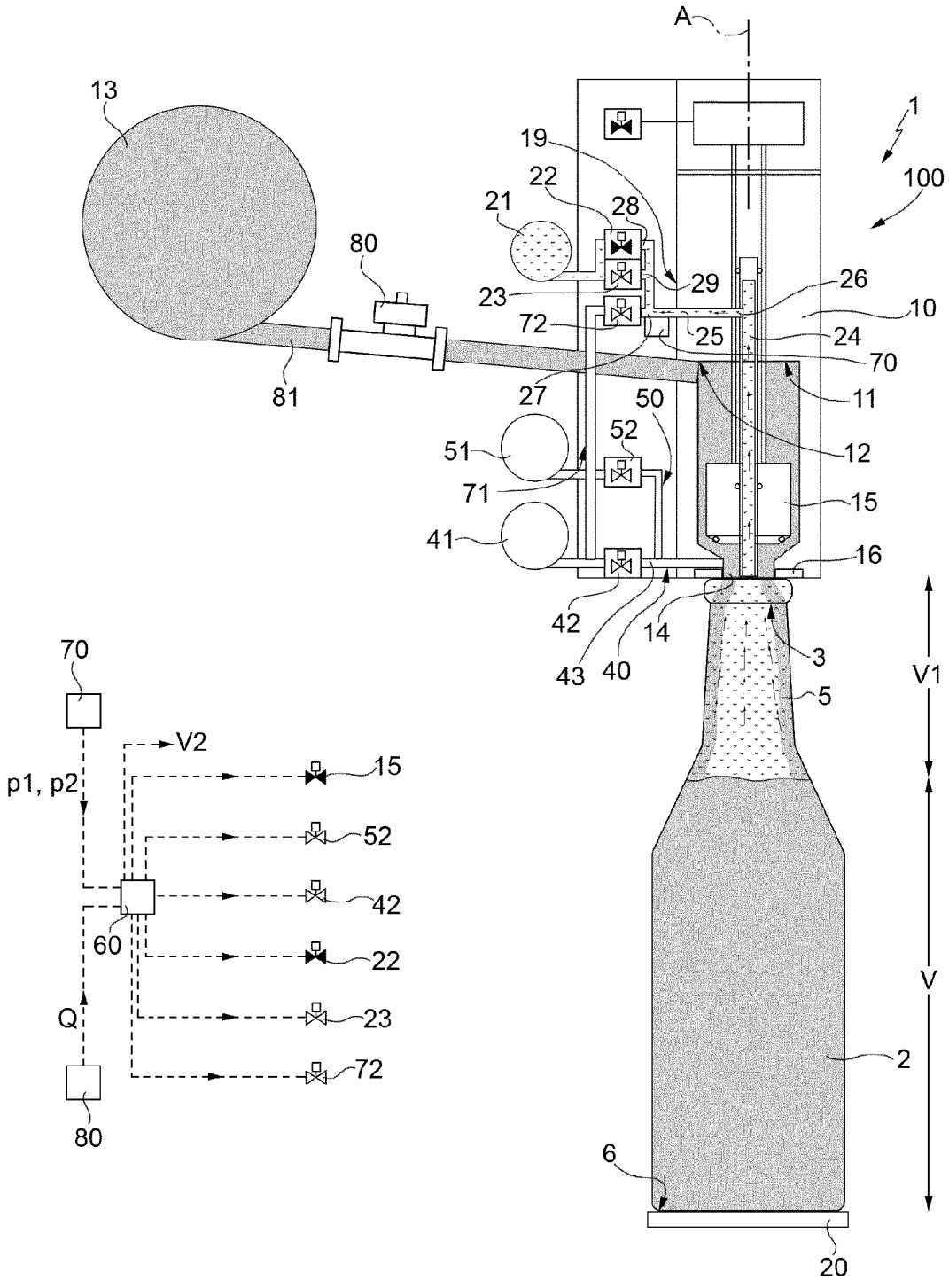

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FIG. 4

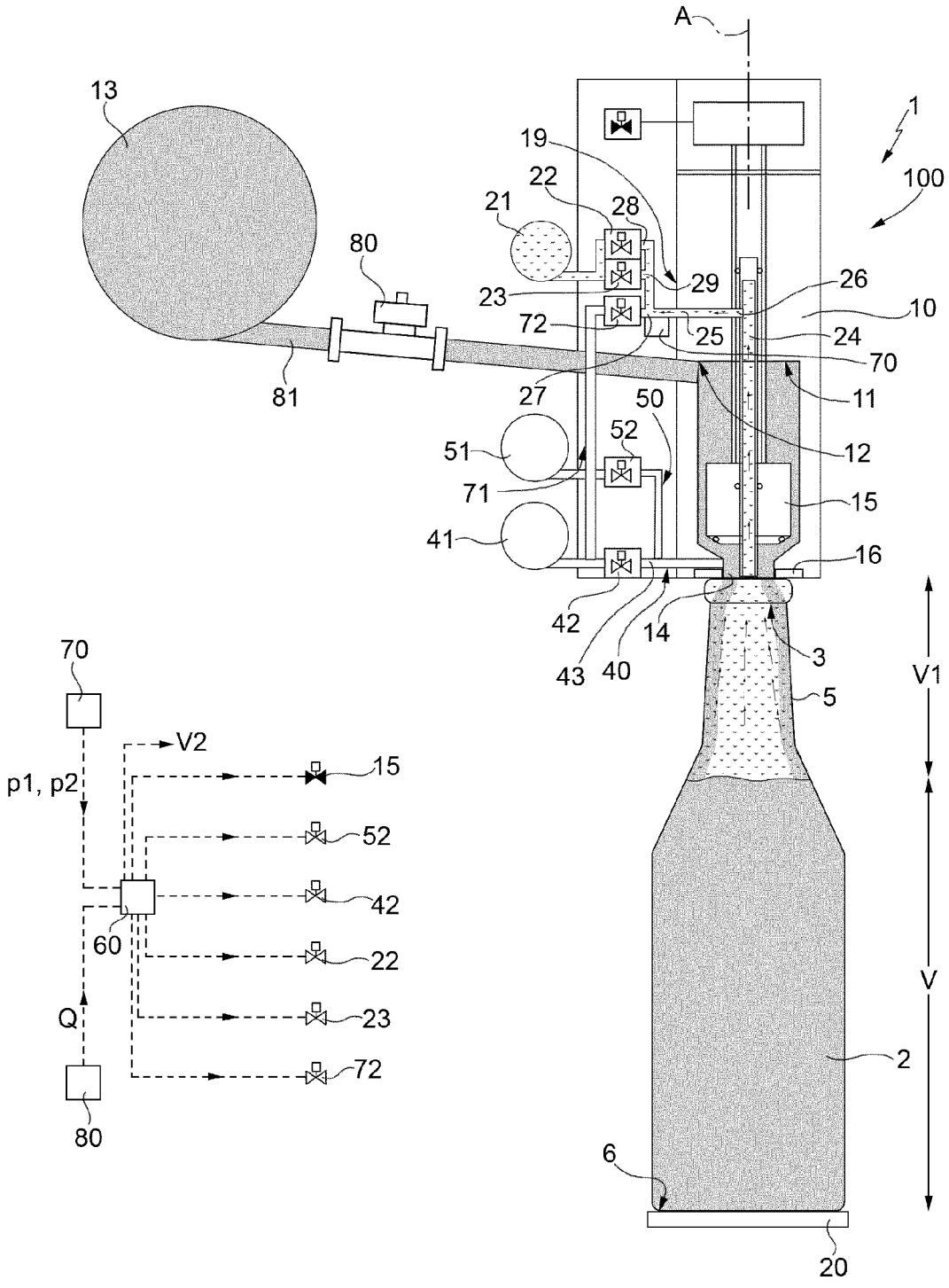

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FIG. 5

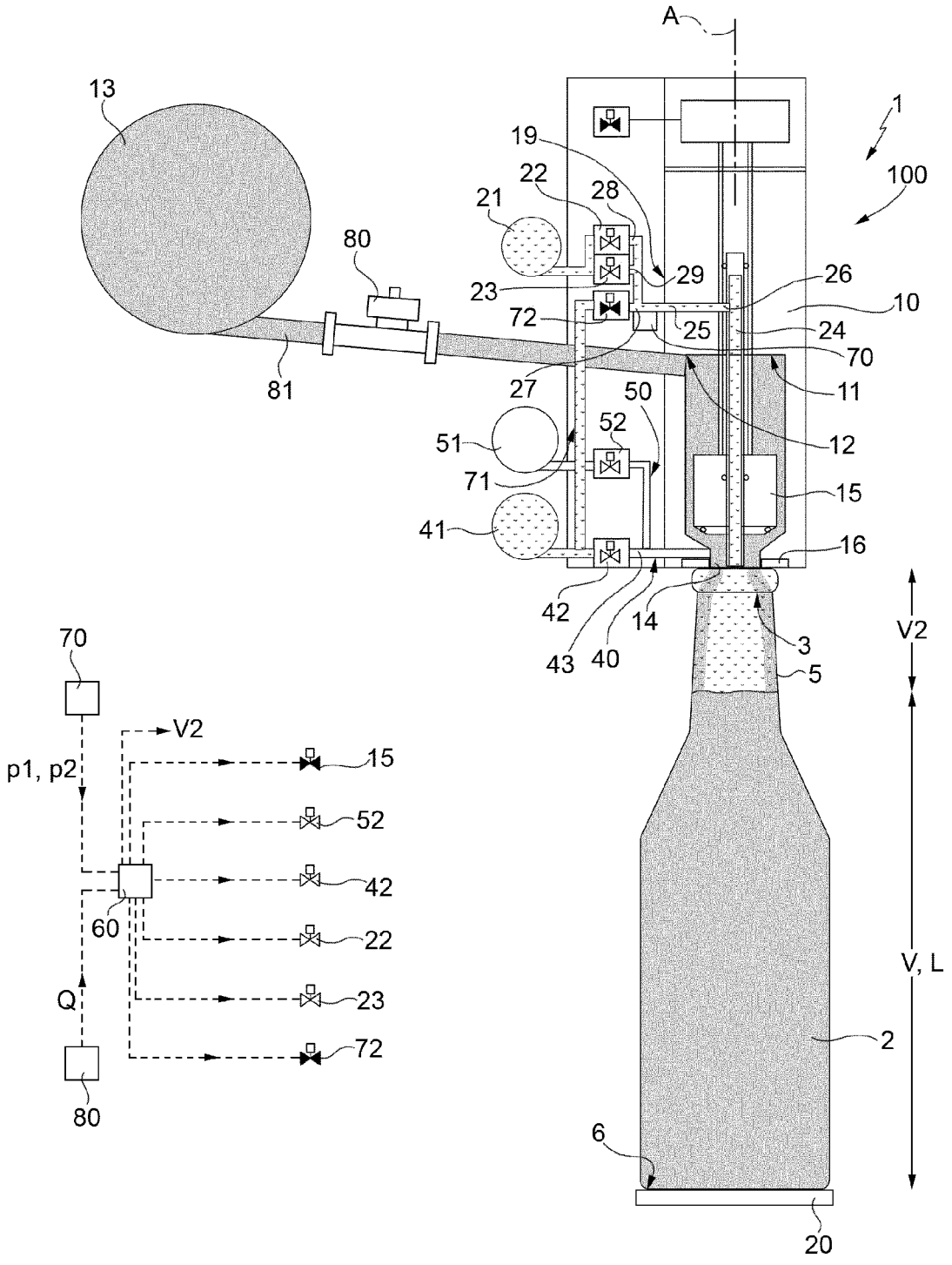

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FIG. 6

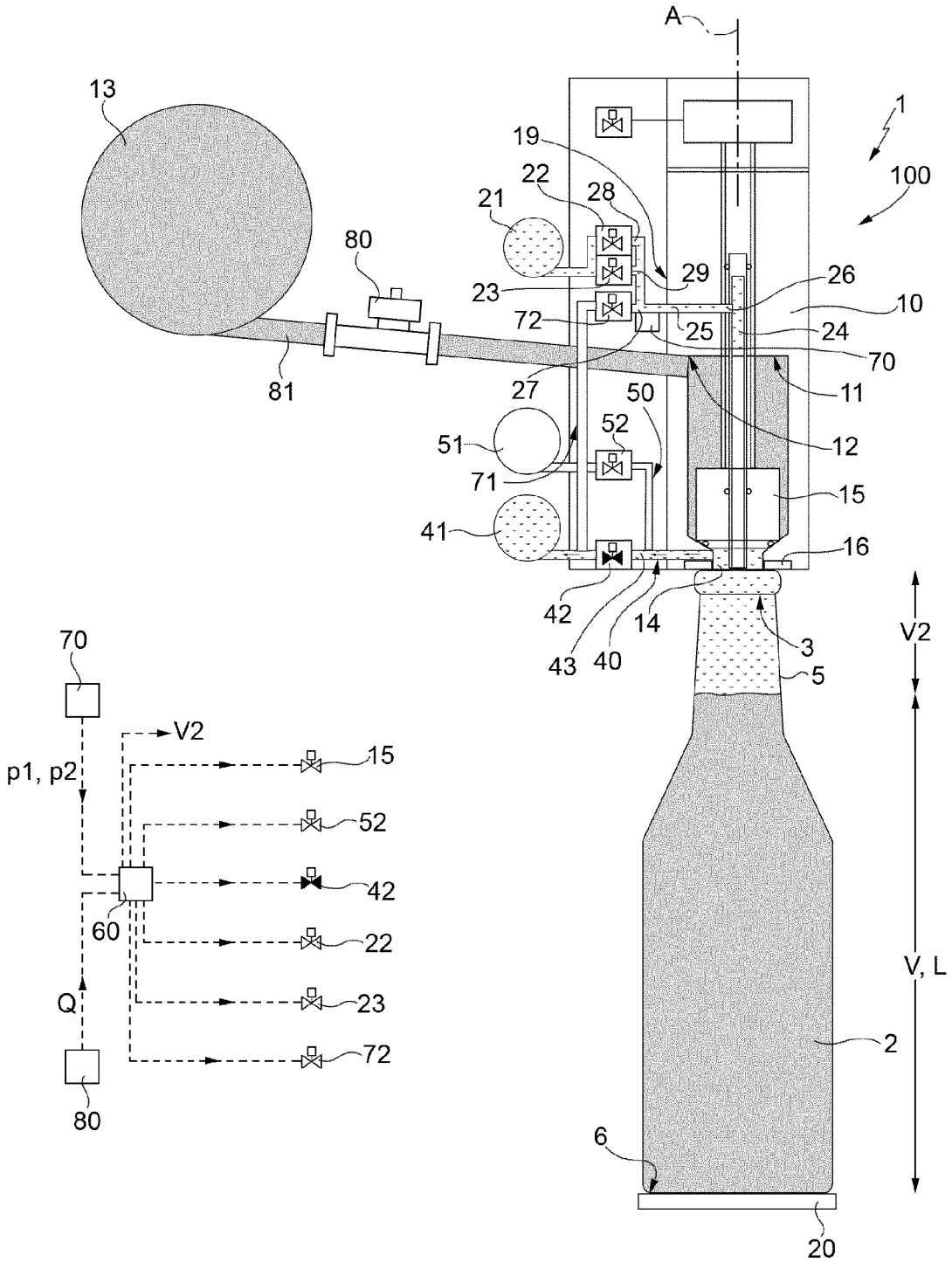

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FIG. 7

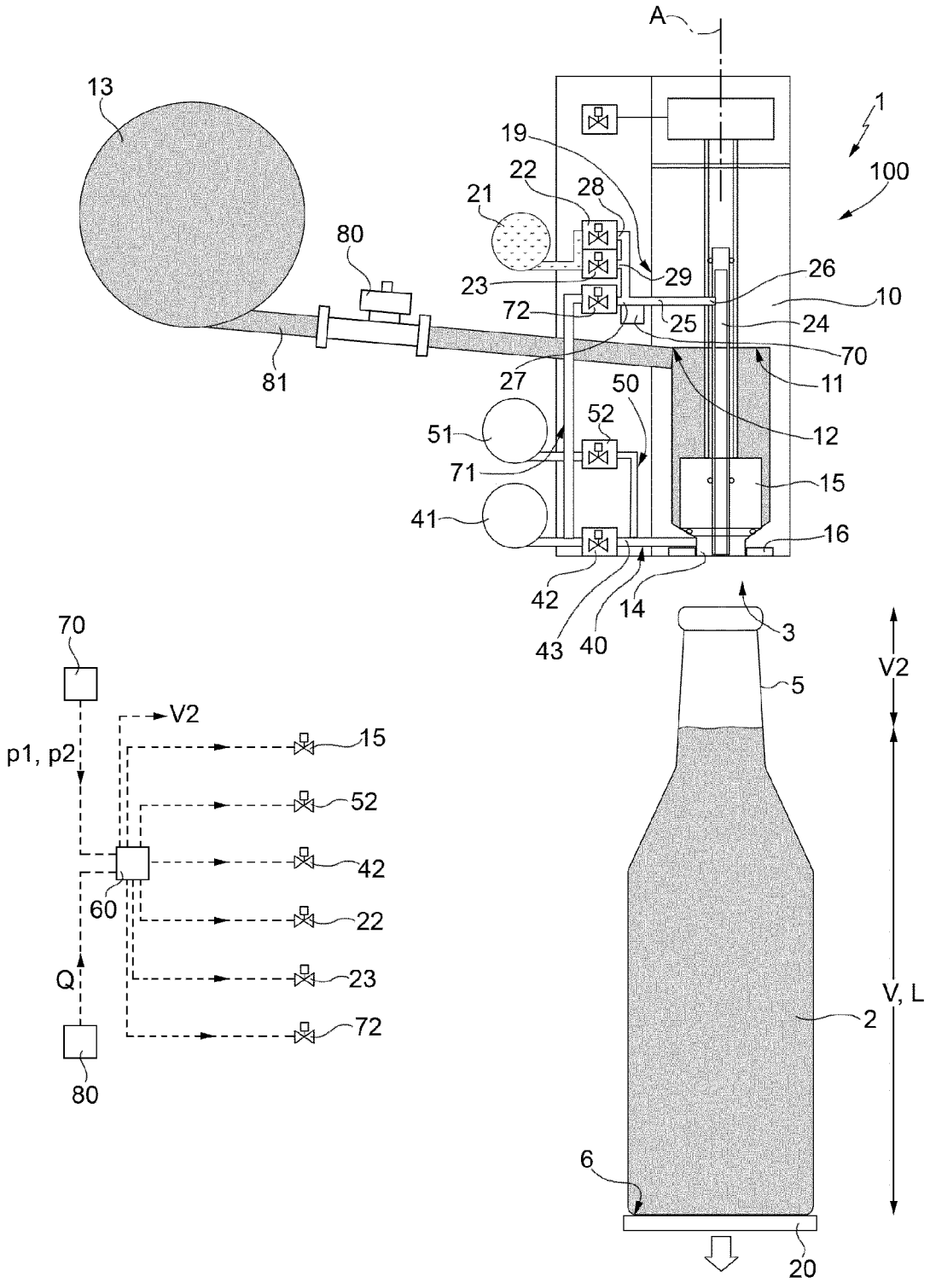

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FIG. 8

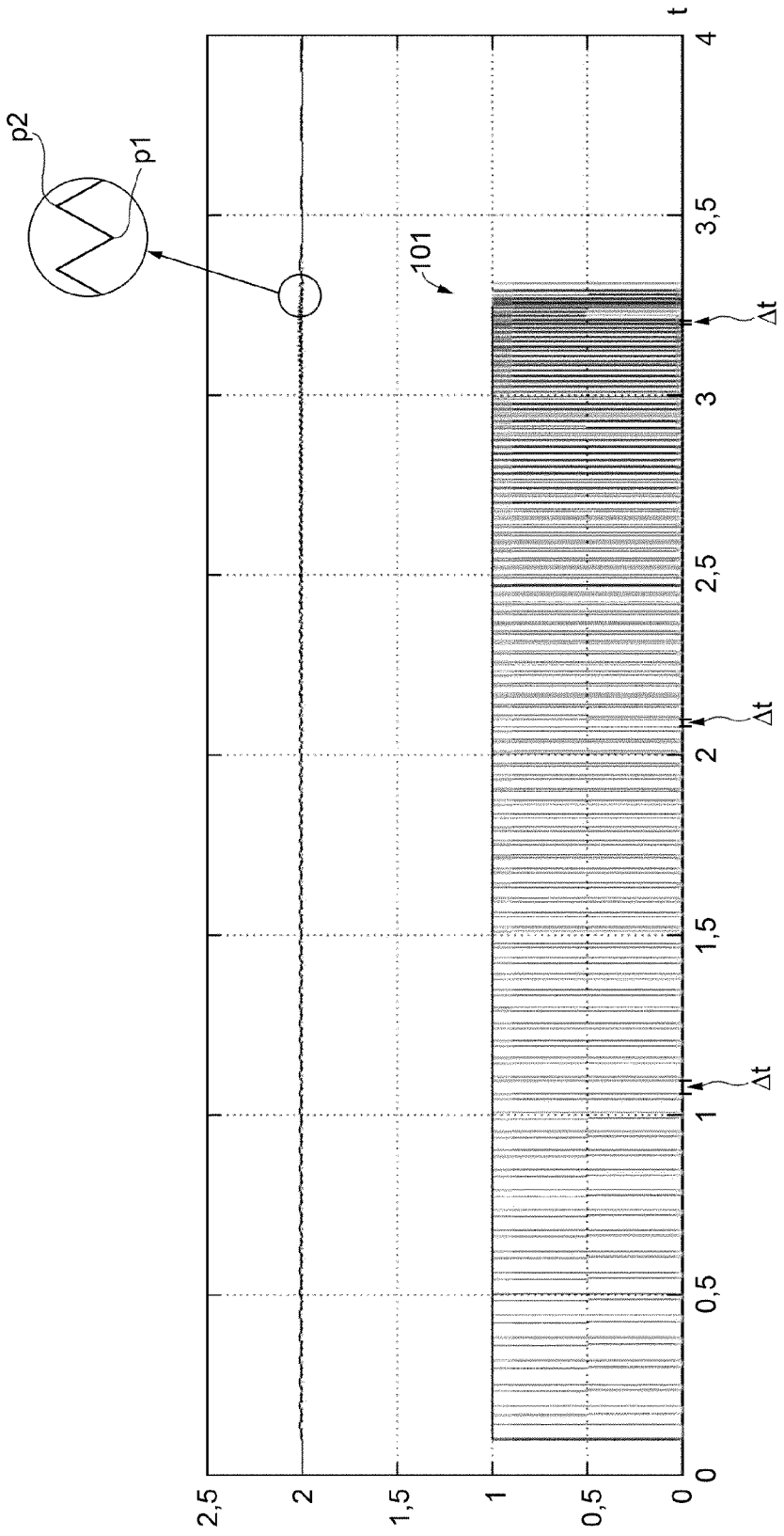


FIG. 9

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EUROPEAN SEARCH REPORT

Application Number
EP 14 17 0711

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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TECHNICAL FIELDS SEARCHED (IPC)

B67C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	4 December 2014	Luepke, Erik

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