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(71) Applicant: **Sidel Participations**
76930 Octeville-sur-Mer (FR)

(72) Inventor: **D'ERRICO, Stefano**
43126 Parma (IT)

(74) Representative: **Sidel Group**
c/o Sidel Participations
Avenue de la Patrouille de France
76930 Octeville-sur-mer (FR)

(54) AN APPARATUS AND A METHOD FOR FILLING A CONTAINER

(57) An apparatus (1) for filling a container (2) includes a shutter (8) movable along an axis (A) for closing or opening, in a variable manner, an outflow passage of the valve (5) itself, designed to control the filling of the container (2) with a pourable product under pressure, a position sensor for measuring the position of the shutter (8) along the axis (A), a pressure sensor (28) for measuring the pressure of the pourable product, and a control unit (27) having a memory holding a predetermined dataset, which contains flowrate values as a function of the pressure of the pourable product and the position of the shutter (8), and estimating flowrate from the dataset as a function of the measured position of the shutter (8) and the measured pressure of the pourable product to control the position of the shutter (8).

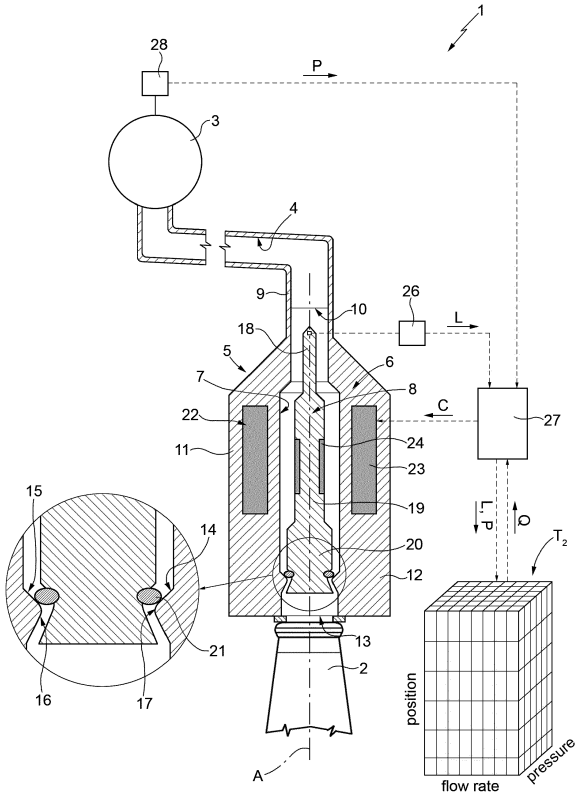

FIG. 1

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Description

[0001] The present invention relates to an apparatus and a method for filling containers, for example bottles or the like, with a pourable product at a pressure greater than the atmospheric pressure.

[0002] Filling machines are known, essentially comprising a carousel rotating around a vertical axis, a tank containing the pourable product, and a plurality of filling apparatus peripherally carried by the carousel, connected to the tank by means of respective circuits or ducts and conveyed from the carousel itself along a circular transfer path.

[0003] Each filling apparatus essentially comprises:

- a support element adapted to receive and hold in a vertical position a respective container; and
- a modulating filling valve arranged above the support element and configured to feed a pre-set volume of pourable product to the container, while moving along the transfer path due to the rotary movement of the carousel.

[0004] Typically, modulating filling valves of the known type essentially comprise:

- a vertical tubular body fixed to a peripheral portion of the carousel and defining a vertical flow channel for feeding the pourable product to a respective container to be filled, arranged below the tubular body itself; and
- a shutter which slidingly engages the tubular body and is mobile inside the channel, in order to open or close in a variable manner, and outflow passage of the pourable product towards the respective container.

[0005] In particular, the tubular body has a longitudinal axis parallel to the axis of the carousel and ends at a lower end with an axial outlet opening fluidically communicating, in use, with an end opening defined by an upper edge of the respective container to be filled.

[0006] The channel defined by the tubular body comprises a stretch having a constant section, usually cylindrical, and a stretch with variable section, positioned above the outlet opening and narrowing in the direction of the latter, up to a minimum-diameter section.

[0007] In modulating filling valves of a known type, the shutter is movable within the channel of the tubular body in a plurality of positions ranging between a position of maximum closure, wherein the shutter closes in a sealed manner the minimum-diameter section, in order to interrupt the flow of the pourable product towards the outlet opening, and a position of maximum aperture, wherein the shutter delimits together with the minimum-diameter section, an annular outflow passage of maximum aperture fluidically communicating with the outlet opening, so as to allow the flow of the pourable product towards the end opening of the respective container.

[0008] Therefore, the shutter is movable between the position of maximum closure and the position of maximum aperture in a plurality of intermediate opening positions, defining with the minimum-diameter section respective intermediate annular outflow passages with increasing dimensions.

[0009] In order to control the movement of the shutter between the aforementioned positions, the modulating filling valves comprise an actuator, typically of the electromagnetic type.

[0010] In particular, the actuator comprises a coil arranged inside the tubular body and magnetically coupled to one or more permanent magnets appropriately included in the shutter.

[0011] Typically, the aforementioned filling apparatus further comprise a flowrate sensor, preferably a flowmeter, configured for measuring the flowrate of the pourable product passing through the channel of the tubular body and for generating a correlated flowrate signal, and a position sensor configured for measuring the position of the shutter inside the channel and for generating a correlated position signal. The filling apparatus of the known type furthermore comprise, a control unit configured for receiving the aforementioned flowrate and position signals and for controlling the movement of the shutter as a function of said flowrate and position signals.

[0012] In detail, the coil of the actuator receives, in use, a command signal from the control unit and produces, according to a known mode of operation typical of the coils, a corresponding magnetic field adapted to move the shutter by means of magnetic interaction with the permanent magnets included in the shutter itself.

[0013] In this manner, it is possible to control the opening of the modulating valve in correlation with the flowrate passing through the valve itself and the position of the shutter inside the channel measured by the respective sensors.

[0014] However, the applicant has observed that the measurement of the above-mentioned flowrate obtained by means of a flowmeter, is particularly inefficient for controlling the opening of the modulating valves currently in use in the field, since the output rates of the flowrate signals generated by the known flowmeters are at least an order of magnitude greater than process times of current control units. In fact, the known flowmeters output flowrate samples with time periods of approximately 50 milliseconds, whereas the control unit can update the command signal for the modulating valve with a rate of approximately 0.5 milliseconds. Therefore, an individual modulating filling valve receives the updated command signal from the control unit with a considerable delay, due to the slowness of the flowrate measurements.

[0015] The aim of the present invention is to provide an apparatus and a method for filling a container that allows overcoming the aforementioned drawbacks, related to the known apparatus, in a simple and economic manner.

[0016] According to the present invention, this aim is achieved by an apparatus and a method for filling a container, as defined in the appended set of claims.

[0017] For a better understanding of the present invention, a preferred non-limiting embodiment will now be described, purely by way of example and with the help of the attached drawings, wherein:

- Figure 1 schematically shows, with parts removed for clarity, an apparatus for filling a container, according to the invention; and
- Figure 2 schematically shows, with parts removed for clarity, a calibration apparatus for calibrating a modulating valve being part of the apparatus of Figure 1.

[0018] With reference to figure 1, number 1 indicates as a whole, an apparatus for filling, to a predetermined level, a respective container 2 with a pourable product at a pressure value greater than the atmospheric pressure, for example a carbonated beverage.

[0019] In particular, the apparatus 1 is connected, in a fluidic manner and by means of a duct 4, to a tank 3 (only partially illustrated) containing the pourable product.

[0020] As can be seen in figure 1, the apparatus 1 comprises a filling valve 5 of the modulating type, which can be selectively activated to control the outflow of the pourable product towards the container 2 to be filled. In this configuration, the container 2 is positioned below and in contact with the valve 5, in order to receive from the latter, the pourable product by the action of gravity and in a fluid-tight condition.

[0021] Therefore, the apparatus 1 is configured for carrying out a "contact filling operation", wherein the container 2 is supported in fluid tight contact against the corresponding valve 5.

[0022] Alternatively, the container 2 may be spaced from the valve 5, so that a "contactless filling operation" may be carried out.

[0023] The valve 5 essentially comprises:

- a tubular body 6, having a vertical axis A and defining a central flow channel 7 configured for feeding the pourable product into the container 2; and
- a shutter 8 slidingly engaging the tubular body 6 and movable inside the channel 7 in order to enable or prevent the outflow of the pourable product towards the respective container 2 to be filled.

[0024] In particular, the tubular body 6 has an upper end portion 9 provided with an inlet opening 10 axially configured to receive the pourable product from the tank 3 through the duct 4, an intermediate portion 11, and a lower end portion 12 ending with an outlet opening 13 axially configured for feeding the pourable product into the respective container2.

[0025] With reference to the preferred embodiment shown in Figure 1, the channel 7 comprises, at the lower end portion 12 of the tubular body 6, a portion with variable section 14 having two frustum conical stretches 15, 16. In particular, the stretch 15 is positioned upstream of the stretch 16 in respect to the feeding direction of the pourable product inside the channel 7, namely arranged superiorly with respect to the stretch 16 itself, and has a section tapering towards the latter; the stretch 16 instead has a diameter increasing from the stretch 15 up to the outlet opening 13. Therefore, the two stretches 15, 16 define between one another, a narrowed section 17, namely a minimum-diameter section.

[0026] As can be seen in figure 1, the shutter 8 is axially fitted within the channel 7 of the tubular body 6.

[0027] In particular, the shutter 8 comprises an upper end portion 18, an intermediate portion 19, having a diameter greater than the diameter of the upper portion 18 and axially extending therefrom in the direction of the outlet opening 13, and a shaped terminal portion 20, configured for cooperating with the portion of the tubular body 6 defining the portion with variable section 14 of the channel 7.

[0028] In particular, the terminal portion 20 is provided with a sealing ring 21, preferably an O-ring made in elastomeric material, configured for selectively cooperating in a fluid-tight manner with the narrowed section 17 of the channel 7, in order to prevent or enable the outflow of the pourable product towards the outlet opening 13 and, therefore, into the container2 to be filled.

[0029] For this purpose, the shutter 8 is movable within the channel 7 of the tubular body 6 in a plurality of positions ranging between:

- a position of closure, wherein the shutter 8 seals in a fluid tight manner, by means of the sealing ring 21, the narrowed section 17 of the channel 7, in order to prevent the outflow of the pourable product towards the outlet opening 13; and
- a position of maximum aperture, wherein the shutter 8 delimits together with the narrowed section 17 of the channel 7 an annular passage of maximum outflow fluidically communicating with the outlet opening 13, in order to allow the outflow of the pourable product towards the container 2.

[0030] Practically, the shutter 8 is movable, between the aforementioned positions of closure and maximum aperture, in a plurality of intermediate opening positions, which are virtually unlimited and define respective intermediate outflow annular passages with gradually increasing openings, as the shutter 8 proceeds from the position of closure to the position of maximum aperture.

[0031] In other words, during its movement from the position of closure along axis A, the shutter 8 delimits with the narrowed section 17 an outflow passage with variable dimension adapted to control the filling speed of the container 2.

[0032] In order to control the movement of the shutter 8 between the aforementioned positions, the valve 5

comprises an actuator 22, preferably of the electromagnetic type.

[0033] In particular, the actuator 22 comprises a coil 23 arranged around channel 7 at the intermediate portion 11 of the tubular body 6 and configured to be magnetically coupled to one or more permanent magnets 24 appropriately included in the intermediate portion 19 of the shutter 8.

[0034] As can be seen in figure 1, the apparatus 1 further comprises:

- a position sensor 26, preferably a Hall sensor, configured for measuring the position of the shutter 8 along the axis A within the channel 7 and for generating a position signal L correlated with the measured position;
- a pressure sensor 28 configured for measuring the pressure of the pourable product inside the tank 3 and for generating a pressure signal P correlated with the pressure measured; and
- a control unit 27 configured for receiving the position and pressure signals L, P, and for controlling the activation of the actuator 22 as a function of such signals L, P.

[0035] Preferably, the position sensor 26 is arranged at the upper portion 18 of the shutter 8.

[0036] Control unit 27 comprises a memory unit holding a three-dimensional table T2, which contains a plurality of flowrate values each associated to a corresponding couple of reference values defined by one position value and one pressure value measurable, respectively, by means of the position sensor 26 and the pressure sensor 28.

[0037] More precisely, at the start of a filling operation carried out, without any interruptions of productions, on a plurality of containers 2, the table T2 contains flowrate, position and pressure values that are relatively associated one to the others.

[0038] In other words, when the position of the shutter 8 and the pressure of the pourable product take respective reference values, the flowrate of pourable product flowing through the valve is expected, in view of the technical properties of the valve 5, to take a corresponding flowrate value included in table T2.

[0039] Table T2 represents a mathematical model of the modulating valve 5, i.e. defines a plurality of discrete estimates of the flowrate of the pourable product flowing through the valve 5, as a function of the position of shutter 8, i.e. the opening grade of modulating valve 5, and the pressure of the pourable product within tank 3.

[0040] Furthermore, by way of interpolation, table T2 represents an estimation tool during the filling operation for estimating the above flowrate as a function of signals L, P, which are generated by the position sensor 26 and the pressure sensor 28, respectively.

[0041] Table T2 is peculiar to modulating valve 5 and is predetermined, in the sense that it is present in the memory unit of control unit 27 before any filling operation has been started through filling apparatus 1.

[0042] Table T2, for example, may be obtained through a calibration procedure of the modulating valve 5, as it will be disclosed in the following with greater detail, or simply be provided by the producer of the modulating valve 5 based on a prior knowledge of the technical properties of the modulating valve 5.

[0043] Preferably, position values and pressure values that define the above couples of reference values span respective intervals in a uniform manner, such that the differences between consecutive position values and, respectively, pressure values in the corresponding intervals are all equal to one another and, for example, equal to 0.1 mm and $50 \cdot 10^{-3}$ bar. The bounds of the interval of position values coincide, in particular, with the position of closure and the position of maximum aperture.

[0044] During the filling of one container 2, control unit 27 is configured for extracting, according to a given sampling frequency, one position value and one pressure value, at each sample time, respectively from signals L, P received from the position sensor 26 and the pressure sensor 28.

[0045] Then, at each sample time, control unit 27 is configured for accessing table T2 with the extracted values and interpolating table T2 to extract therefrom an estimated flowrate value, associated to that sample time, in such a manner to generate with time a discrete flowrate signal Q.

[0046] According to the diagram illustrated in figure 1, the coil 23 receives, in use, a command signal C from the control unit 27, correlated with the flowrate signal Q, and consequently produces, according to a known mode of operation of the coils, an electromagnetic field adapted to magnetically interact with the permanent magnets 24 included in the shutter 8, so as to move the shutter 8 itself inside the channel 7.

[0047] In detail, based on the flowrate signal Q, control unit 27 determines a set position signal L_{set} that is sample-by-sample compared with the position signal L, which defines, therefore, a feedback signal for closed-loop controlling the actual position of the shutter.

[0048] In particular, the command signal C is proportional to the difference between the feedback position signal L and the set position signal L_{set} and, more in particular, to the integral and the derivative thereof; in other words, control unit 27 implements a so-called PID ("partial-integrative-derivative") control for controlling the position of the shutter 8.

[0049] Specifically, the set position signal L_{set} includes:

- a opening ramp with a predetermined slope from the position of closure to a reference position set between the position of closure and the position of maximum aperture;
- a constant portion at the reference position; and
- a closure ramp with a predetermined slope from the reference position to the position of closure.

[0050] Control unit 27 determines the end of the constant portion, which coincides with the beginning of the closure ramp, during filling by performing numerical integration of the flowrate signal Q until a filling threshold is reached. Here, the end of the constant portion occurs at the time sample when the filling threshold is reached.

[0051] The slopes of the opening and closure ramps are hold in the memory unit of control unit 27, whereas the end of the constant portion is determined during the filling.

[0052] For instance, the filling threshold coincides with the desired filling level for the container 2 and is hold in the memory unit of control unit 27; preferably, the filling threshold is updated after each filling by subtracting a filling lag to such desired filling level.

[0053] The filling lag is defined as the volume of pourable product supplied to the container 2 during the closure ramp and the same filling lag is computed by control unit 27 through a numerical integration of a portion of the flowrate signal Q, which corresponds to the closure ramp.

[0054] In this manner, it is possible to control the opening of the valve 5 in correlation with the position of the shutter 8 inside the channel 7 and the flowrate passing through the valve 5 itself, without providing apparatus 1 with any sensor for measuring such flowrate.

[0055] Advantageously, during the filling operation carried out, without any interruptions of production, on a plurality of containers 2, the control unit 27 commands the position of shutter 8 along the axis A as a function of the position signal L and the flowrate signal Q, the latter being generated from the predetermined table T2, which before the start of the filling operation contains flowrate values as a function of position values and pressure values; the flowrate signal Q is generated as a function of measured position and pressure values, which are extracted by control unit 27 from the received position and pressure signals L, P.

[0056] As it clearly appears from the above, there is no need of measuring the flowrate of the pourable product through the valve 5; therefore, apparatus 1 is devoid of any flowrate sensors.

[0057] Conveniently, the table T2 can be created during a calibration operation by means of a calibration apparatus 101, which allows the performance of a plurality of measurements of the flowrate of a calibration fluid through the valve 5, prior to the first filling and for a plurality of given positions of the shutter 8 and pressures of the calibration fluid.

[0058] Preferably, as shown in Figure 2, calibration apparatus 101 is defined by the apparatus 1 with the addition of a flowrate sensor, in particular a flowmeter 125 coupled to the apparatus 1, and the possible replacement of control unit 27 with a different control unit 127.

[0059] Calibration apparatus 101 is connected in a fluidic manner and by means of a duct 104, to a tank 103 (only partially illustrated) containing the calibration fluid.

[0060] Flowmeter 125 is connected to control unit 127 and is configured to measure the flowrate of the calibration fluid passing through the modulating valve 5, generate a flowrate signal Q_{meas} correlated with the measured flowrate, and send the signal Q_{meas} to the control unit 127.

[0061] Preferably, the flowmeter 125 is arranged in correspondence of the duct 104, in order to measure, during the calibration operation, the flow of the calibration fluid passing through the duct 104 itself and direct it towards the valve 5.

[0062] To perform a first set of flowrate measurements, the tank 103 is filled with a corresponding quantity of calibration fluid, e.g. water, having a given desired pressure value equal to one of the above-mentioned reference values.

[0063] Then, after the tank 103 is filled, control unit 127 progressively sends to coil 23 a plurality of commands C' correlated to a respective plurality of desired position values of the shutter 8, i.e. desired opening grades of the modulating valve 5, so that the shutter 8 moves accordingly inside the channel 7. Each of the desired position values corresponds to one of the above-mentioned reference values.

[0064] Each time the shutter 8 reaches one of those desired positions, control unit 127 associates to each other the pressure value measured by the pressure sensor 28, the position value measured by the position sensor 26 and the flowrate value measured by the flowmeter 125.

[0065] Accordingly, control unit 127 stores such pressure value, such position value, and such flowrate value in table T2.

[0066] Then, other sets of flowrate measurements are performed according to the just described scheme for the first set; to each set of flowrate measurements, the tank 103 is correspondingly re-filled with a respective quantity of calibration fluid at a distinct given pressure equal to one of the above-mentioned reference values.

[0067] Therefore, once table T2 is completely filled, the same table T2 is transferred to the memory unit of the control unit 27. Similarly, the flowmeter 125 is removed from calibration apparatus 101 to obtain the apparatus 1, which is connected in a fluidic manner to the tank 3 by means of the duct 4, so as to become ready for use.

[0068] It should be noted that table T2 may be occasionally updated by repeating the calibration operation after the performance of a filling operation, for example during a programmed or undesired machine downtime.

[0069] In the latter case, apparatus 1 is separated from tank 3 and connected to tank 103 via the duct 104, in which flowmeter 125 is arranged and fixed thereto.

[0070] In such a manner, the three-dimensional table T2 is adapted to actual technical properties of the valve 5 after intensive use thereof.

[0071] From the foregoing, the advantages of the apparatus 1 and of the method according to the invention are apparent.

[0072] Definitively, thanks to the absence of any flow-

rate sensor, which are efficiently substituted by table T2, the actuator 22 of the shutter 8 of the valve 5 receives the command signal C from the control unit 27 at a speed of many orders of magnitude greater in respect to the hypothetical case in which the command signal C would have been a function of flowrate values measured by a flowrate sensor, such as, for instance, flowmeter 125.

[0073] In fact, in this latter case, the control unit 27 should have waited to receive the flowrate signal Q directly from the flowmeter 125 before being able to control the movement of the shutter 8.

[0074] In addition, the possibility of obtaining different filling laws as a function of different pressures within the tank 103 allows a flexibility increase of the apparatus 1 when filling operations needs to be carried out at different pressure levels.

[0075] It is thus clear that modifications and variations can be made to the apparatus 1 and to the method described and illustrated herein, without departing from the scope of protection defined by the claims.

[0076] For example, table T2 may be replaced by a more general database containing flowrate estimates as a function of both the pressure of the pourable product and the position of the shutter 8.

[0077] The calibration operation may be performed through a calibration apparatus including a modulating valve, which is distinct from modulating valve 5 but has the same technical properties of the latter. Moreover, the calibration operation performed with the aid of the calibration apparatus 101 may include procedures different from those described above; in particular, the order of the flowrate measurements may be any appropriate order from the practical point of view.

[0078] Furthermore, the pressure sensor 28 may be used for measuring the pressure of the pourable product at the outlet opening 13 or anywhere else in the channel 7 or in the duct 4.

[0079] Eventually, control unit 12 may comprise control unit 127, so that no replacement of control units 12, 127 occurs.

Claims

1. An apparatus (1) for filling a container (2), the apparatus comprising a modulating valve (5) having a shutter (8) movable along an axis (A) for closing or opening, in a variable manner, an outflow passage of the valve (5) itself, designed to control the filling of the container (2) with a pourable product under pressure;
said apparatus (1) further comprising:

- a position sensor (26) configured for measuring a position of said shutter (8) along said axis (A) and for generating a position signal (L) related with the measured position;
- a pressure sensor (28) configured for measuring a pressure of said pourable product and for generating a pressure signal (P) related to the measured pressure;
- a control unit (27) configured for receiving said position (L) and pressure (P) signals and for controlling the position of said shutter (8) along said axis (A) as a function of said position (L) signal and of a flowrate signal (Q) indicative of the flowrate of said pourable product flowing through said valve (5);

characterized in that said control unit (27) comprises a memory unit holding a predetermined dataset, which defines a flowrate model of said valve (5) by containing a plurality of flowrate values of said pourable product flowing through said valve (5), as a function of the pressure of said pourable product and the position of said shutter (8) along said axis (A); the control unit (27) being further configured to:

- extract measured position and pressure values from the received position (L) and pressure (P) signals, respectively; and
- generate said flowrate signal (Q) from said dataset, as a function of said measured position and pressure values.

2. The apparatus of claim 1, wherein said dataset is defined by a table (T2), which, at the start of a filling operation carried out, without interruptions of production, on a plurality of containers (2), contains the flowrate values, each associated to a corresponding couple of reference values respectively indicative of the pressure of said pourable product and the position of said shutter (8) along said axis (A).

3. The apparatus of claim 2, wherein the flowrate values are measured by a flowrate sensor (125) during a calibration operation of said valve (5) prior to a first filling of said containers (2) during the filling operation; said calibration operation comprising the steps of:

a) fluidly connecting said valve (5) with a source (103) of a calibration fluid;
b) setting the position of said shutter (8) along said axis (A) and the pressure of said calibration fluid to respective said reference values;
c) measuring the flowrate of said calibration fluid flowing through said valve (5) by means of said flowrate sensor (125) at said reference values;
d) storing in said table (T2) the flowrate values measured in step c) according to said reference values; and
e) repeating steps from a) to d) wherein at least one of said reference values is changed.

4. The apparatus of claim 2 or 3, wherein said control

unit (27) is configured to generate said flowrate signal (Q) by interpolating said table (T2).

5. The apparatus of any one of the foregoing claims, being devoid of any flowrate sensor (125) configured for measuring the flowrate of said pourable product flowing through said valve (5).

6. The apparatus of any one of the foregoing claims, wherein said valve (5) receives said pourable product from a tank (3) pressurised through a duct (4); said valve (5) comprising a hollow body (6) coaxial to said axis (A) and defining a flow channel (7) for said pourable product housing said shutter (8);
said position sensor (26) being arranged in correspondence with said shutter (8).

7. The apparatus of any one of the foregoing claims, further comprising an electromagnetic actuator (22) configured for receiving a command signal (C) from said control unit (27) correlated with said flowrate signal (Q) and for controlling the movement of said shutter (8) within said channel (7).

8. A method for filling a container (2) with a pourable product under pressure and by means of a modulating valve (5) having a shutter (8) movable along an axis (A) for closing or opening, in a variable manner, an outflow passage of the valve (5) itself, designed to control the filling of the container (2); said method comprising the steps of:

i) measuring a position of said shutter (8) along said axis (A) by means of a position sensor (26);
ii) measuring a pressure of said pourable product by means of a pressure sensor (28); and
iii) controlling the position of said shutter (8) along said axis (A) as a function of the position measured in step i) and of a flowrate of said pourable product flowing through said valve (5);

characterized by further comprising the steps of:

iv) providing a predetermined dataset, which defines a flowrate model of said valve (5) by containing a plurality of flowrate values of said pourable product flowing through said valve (5) as a function of the pressure of said pourable product and the position of said shutter (8) along said axis (A);
v) estimating said flowrate from said dataset, as a function of the position and pressure values measured in steps i) and ii).

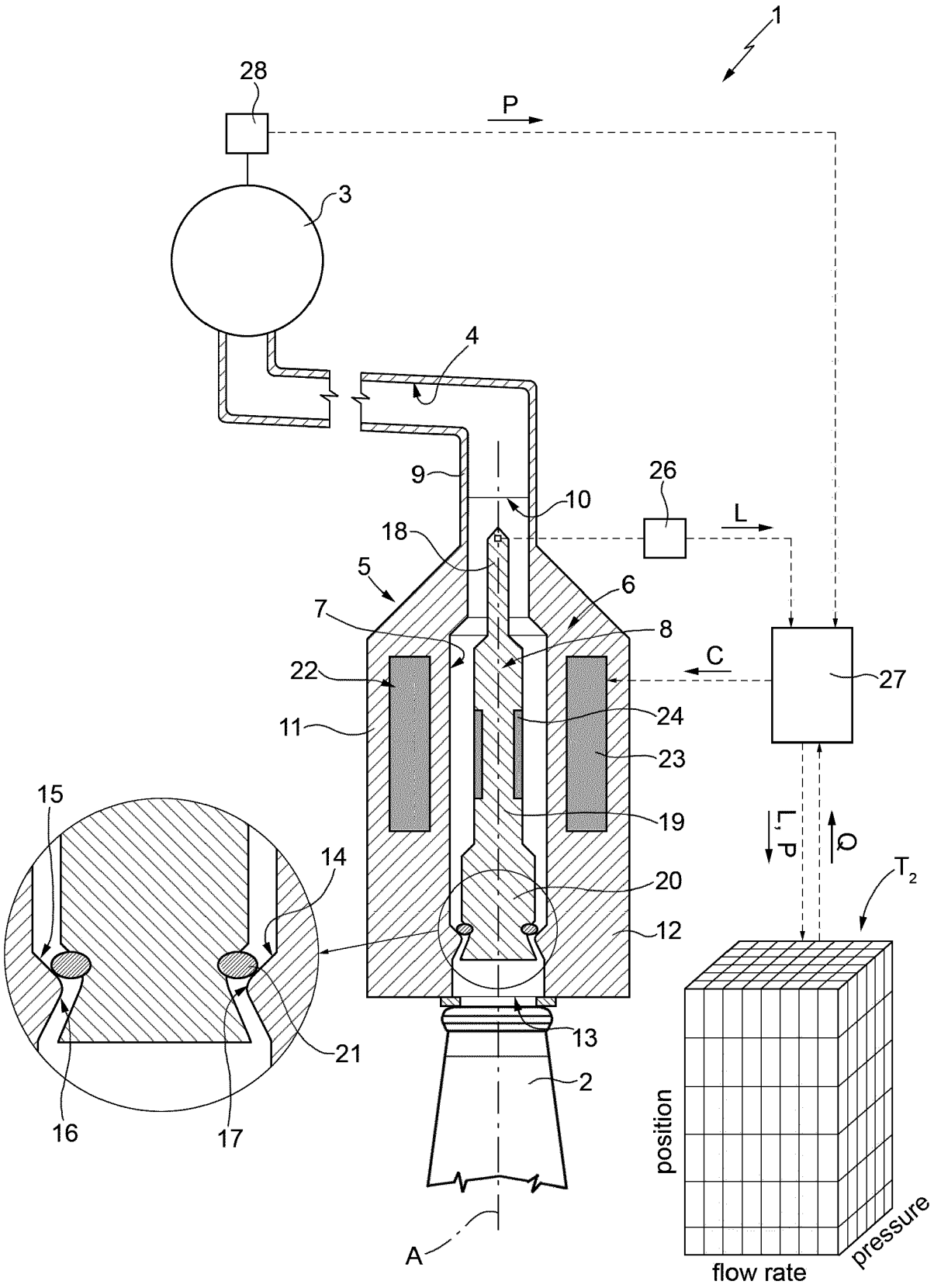
9. The method according to claim 8, wherein said dataset is defined by a table (T2), which, at the start of a filling operation carried out, without interruptions of production, on a plurality of containers (2), contains the flowrate values, each associated to a corresponding couple of reference values respectively indicative of the pressure of said pourable product and the position of said shutter (8) along said axis (A).

10. The method according to claim 9, wherein the step iv) comprises the steps of:
vi) measuring the flowrate values by means of a flowrate sensor (125) during a calibration operation of said valve (5) prior to a first filling of said containers (2) during the filling operation; said calibration operation comprising the steps of:

a) fluidly connecting said valve (5) with a source of a calibration fluid;
b) setting the position of said shutter (8) along said axis (A) and the pressure of said calibration fluid to respective reference values;
c) measuring the flowrate of said calibration fluid flowing through said valve (5) by means of said flowrate sensor (125) at said reference values;
d) storing in said table (T2) the flowrate values measured in step h) according to said reference values; and
e) repeating steps from a) to d) wherein at least one of said reference values is changed.

11. The method according to claim 9 or 10, wherein the step v) comprises the step of interpolating said table (T2) .

12. The method according to any of the claims from 8 to 11, wherein the flowrate of said pourable product through said valve (5) is not measured by means of a flowrate sensor (125) during the filling of the container.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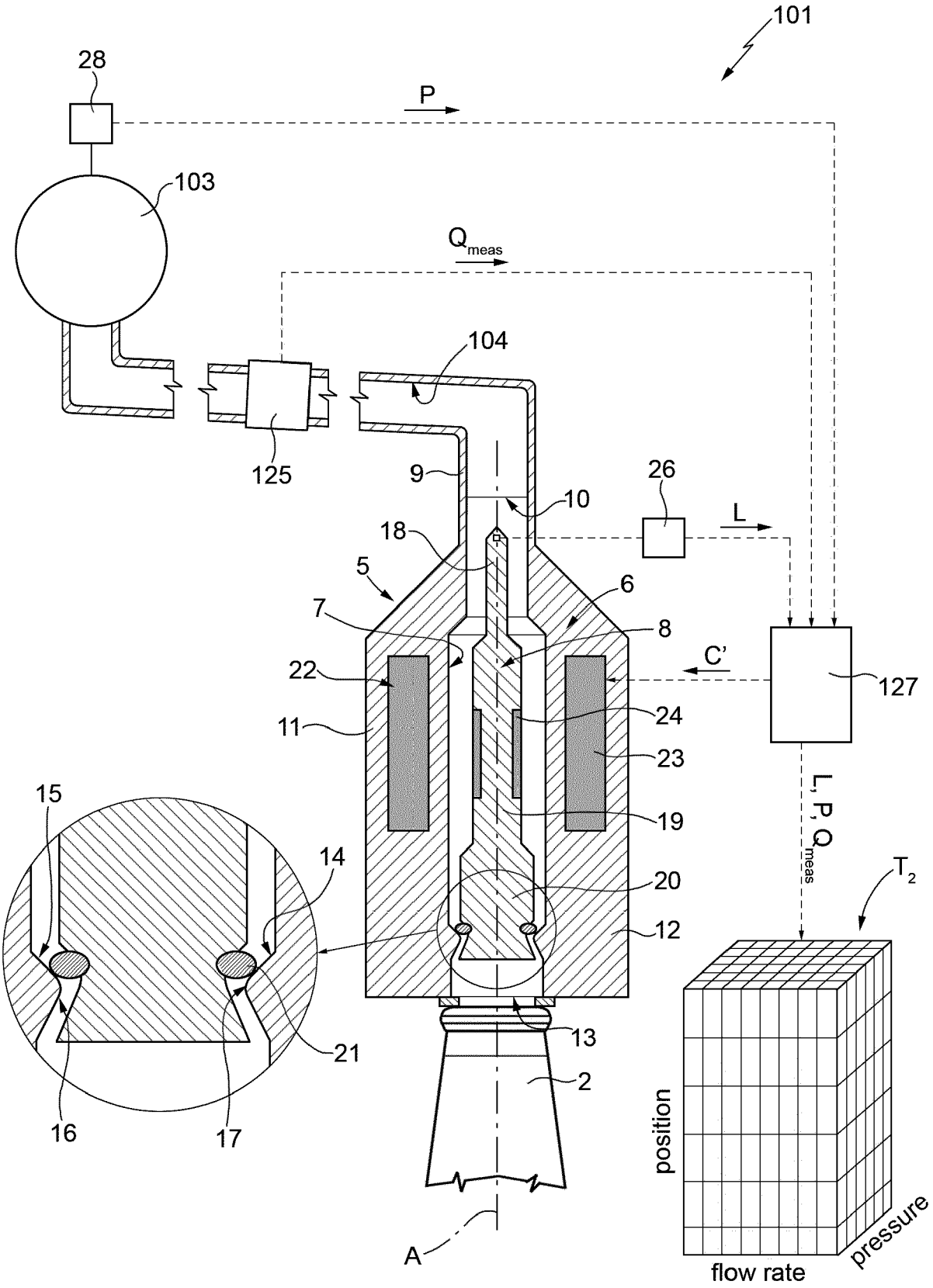
16
17
A
position
flow rate
pressure

FIG. 1


101
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Q_{meas}
104
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16
17
A
L, P, Q_{meas}
T_2
position
flow rate
pressure

FIG. 2

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EUROPEAN SEARCH REPORT

Application Number
EP 19 30 5271

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	EP 1 127 835 A1 (KHS MASCH & ANLAGENBAU AG [DE]) 29 August 2001 (2001-08-29) * abstract; figures 1-3 * * paragraphs [0010] - [0039] *	1-12	INV. B67C3/28 B67C3/00
A	WO 2015/055397 A1 (TETRA LAVAL HOLDINGS & FINANCE [CH]) 23 April 2015 (2015-04-23) * abstract; figures 1-6 * * page 4, line 18 - page 8, line 32 *	1-12	
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Place of search	Date of completion of the search	Examiner
The Hague	13 September 2019	Pardo Torre, Ignacio

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