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(54) **DEVICE AND METHOD FOR FILLING RECEPTACLES WITH A POURABLE PRODUCT UNDER PRESSURE**

(57) The invention relates to a filling device (4) comprising: a filling valve (8) configured to be connected to a respective receptacle (2) to be filled and selectively movable between an opening configuration, wherein the filling valve (8) feeds a pourable product to the receptacle (2) at a pressure higher than the atmospheric pressure, and a closing configuration in which the filling valve (8) interrupts the flow of the pourable product to the receptacle (2) itself; and a decompression circuit (33) configured to depressurize the receptacle (2) after filling and comprising in turn a decompression chamber (35) kept at atmospheric pressure, a decompression duct (34) connected both to the receptacle (2) and to the decompression chamber (35), and a flow control valve (39) arranged in series on the decompression duct (34); the filling device (4) further comprises pressure detecting means (42) and a control unit (43) configured to receive a pressure signal (W) from the pressure detecting means (42) and control the flow control valve (39) according to said pressure signal (W).

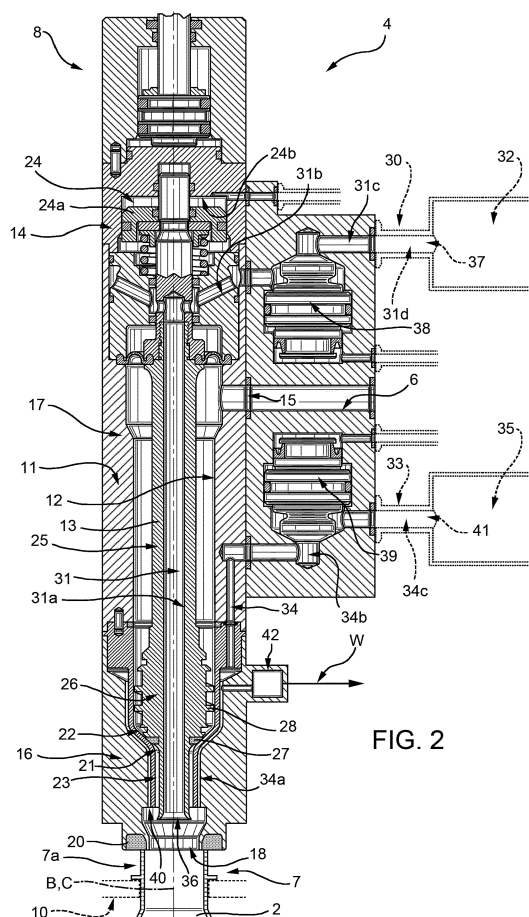


FIG. 2

Description

[0001] The present invention relates to a filling device for a filling machine configured for filling receptacles, in particular plastic receptacles, with a pourable product at a pressure higher than the atmospheric pressure, for example a pourable gasified product such as sparkling water, soft drinks or carbonated beverages, etc.

[0002] The present invention relates, furthermore, to a method for filling receptacles with a pourable product at a pressure higher than the atmospheric pressure.

[0003] Typically used filling machines in this field essentially comprise a carousel rotating around a vertical axis, a reservoir containing the pourable product, and a plurality of filling devices peripherally carried by the carousel, connected to the reservoir by means of respective circuits or ducts and conveyed by the carousel along a circular transfer path.

[0004] In particular, the carousel receives a succession of empty receptacles from an inlet star wheel and directs the full receptacles to an outlet star wheel.

[0005] Each filling device essentially comprises a support element apt to receive and hold a respective receptacle in a vertical position, and a filling valve configured to feed a predetermined volume of a pourable product into said receptacle, while the filling device moves along the transfer path due to the rotary motion imparted by the carousel.

[0006] An example of a filling valve of a known type is described in EP-B-1411023 and essentially comprises:

- a vertical tubular body fixed to a peripheral portion of the carousel and defining a vertical flow channel for feeding the pourable product into a respective receptacle to be filled arranged under the tubular body;
- a shutter which engages the tubular body in a sliding manner and movable inside the channel so that it can allow or prevent the outflow of the pourable product towards the respective receptacle; and
- an actuator configured for moving the shutter inside the channel defined by the tubular body.

[0007] In particular, the tubular body has a longitudinal axis parallel to the carousel axis and terminates at a lower end with an axial discharge opening configured to come into contact, in use, with a top end mouth of the respective receptacle to be filled.

[0008] The channel of the tubular body comprises a tapered-section portion located above the discharge opening and narrowing in the direction of the discharge opening itself, up to a section of minimum diameter.

[0009] The shutter is movable inside the channel of the tubular body between a lower closing position, in which the shutter sealingly closes the tapered-section portion of the channel itself and interrupts the flow of the pourable product towards the discharge opening, and an upper opening position in which the shutter delimits, together

with the tapered-section portion, an annular passage communicating with the discharge opening.

[0010] The filling valve comprises, furthermore, two circuits formed at least partially inside the tubular body:

- a pressurization/exhaust circuit used to pressurize the respective receptacle up to a predetermined pressure value higher than the atmospheric pressure value, before starting the actual filling of the receptacle itself, and also to exhaust the gas contained in the receptacle during the filling operation with the pourable product; and
- a decompression circuit configured to perform a decompression phase of the respective receptacle, at the end of the filling.

[0011] In particular, the decompression circuit has an end opening communicating, in use, with the receptacle located under the filling valve, and another end opening opposite to the first one and connected, by means of an on/off type valve, to a decompression chamber kept at atmospheric pressure.

[0012] The decompression phase is carried out by opening, for one or more pre-set time intervals, the on/off valve that controls the connection of the decompression circuit, and thus the internal environment of the filled receptacle, with the decompression chamber.

[0013] The duration of the above-mentioned time intervals is set to the same value for each filling valve of the filling machine, before the start of production, being part of the predetermined filling procedure.

[0014] It is known that the amount of foam contained in each receptacle at the end of the decompression phase depends on the method and speed at which the filling operation is performed, as well as by the method and the decompression rate during the decompression phase.

[0015] The need is felt in the industry to reduce the amount of foam contained in each receptacle at the completion of the filling operation and that could overflow from the receptacle itself when the latter is detached from the respective filling device at the completion of the decompression phase, so as to minimize product loss.

[0016] It is also felt, in the industry, the need to ensure that any product loss from each receptacle at the time of detachment of the latter from the respective filling device is the same for all receptacles that come out of the same filling machine, in order to ensure a constant filling volume of the receptacles with high precision.

[0017] The object of the present invention is to provide a filling device which is of high reliability and limited cost, and can satisfy at least one of the above-mentioned needs.

[0018] According to the invention, this object is achieved by a filling device as claimed in claim 1.

[0019] The present invention further relates to a method for filling a receptacle with a pourable product as defined in claim 11.

[0020] For a better understanding of the present inven-

tion, a preferred non-limiting embodiment of the invention will be described in the following, by way of example and with the aid of the accompanying drawings, wherein:

Figure 1 is a schematic side view, partially sectioned and with parts removed for clarity, of a filling machine provided with a plurality of filling devices according to the teachings of the present invention;

Figure 2 is an axial section, in enlarged scale and with parts removed for clarity, of a filling device of Figure 1;

Figures 3a, 3b, 3c and 3d illustrate the filling device according to the invention in a reduced scale axial section similar to that of Figure 2 and during different and subsequent operating conditions, in which it co-operates with parts of the filling machine shown in a schematic manner; and

Figures 4a and 4b are two diagrams illustrating two different control methods of the pressure variation in the receptacle during the decompression phase.

[0021] With reference to Figure 1, number 1 denotes as a whole a filling machine configured for filling a plurality of receptacles 2 with a pourable product at a pressure value P_S higher than the atmospheric pressure. In particular, the receptacles 2 are preferably made of plastic material, and the pourable product is a liquid with the addition of gas under pressure, for example, sparkling water or a carbonated drink.

[0022] The machine 1 is fed with empty receptacles 2 and is configured for filling the latter with the pourable product.

[0023] For this purpose, the machine 1 comprises a rotary conveyor, preferably a carousel 3, configured to rotate about a vertical axis A, and a reservoir 5 containing the pourable product at pressure P_S and located peripherally with respect to the carousel 3.

[0024] The carousel 3 carries in a cantilevered manner at its own peripheral portion 3a a plurality of filling devices 4 configured for filling respective receptacles 2 up to a predetermined level during the rotation of the carousel 3 itself around the axis A.

[0025] The filling devices 4 are thus conveyed by the carousel 3 along a circular transfer path at respective radially spaced positions with respect to the axis A.

[0026] In particular, each filling device 4 is fluidly connected to the reservoir 5 by means of a circuit 6 configured to convey the pourable product from the reservoir 5 to the filling device 4 itself.

[0027] Preferably, the carousel 3 receives a succession of empty receptacles 2 from an inlet star wheel (not illustrated) and directs the filled receptacles 2 to an outlet star wheel (also not illustrated).

[0028] According to the preferred embodiment here described, each receptacle 2 is defined by a bottle having a longitudinal axis B and advanced in a vertical position by the carousel 3. In particular, each receptacle 2 is advanced by the carousel 3 with its own axis B parallel to

the axis A of the carousel 3.

[0029] More in detail, each receptacle 2 has a neck 7 coaxial with the axis B and defining a threaded surface 7a designed to allow the closure thereof by means of a screw cap (according to a known manner and not described in detail).

[0030] With reference to Figures 2 and 3a-3d, each filling device 4 comprises a filling valve 8 configured to control the outflow of the pourable product towards a respective receptacle 2 to be filled, and support means 10 adapted for supporting such receptacle 2 in a vertical position under the respective filling valve 8. In this configuration, the upper edge of the neck 7 of the receptacle 2 is placed in contact with the filling valve 8 so as to receive from the latter the pourable product in a fluid-tight condition.

[0031] The filling device 4 is thus configured to perform a so-called "contact filling operation", in which the receptacle 2 is supported in fluid-tight contact against the filling valve 8.

[0032] Such filling valve 8 essentially comprises:

- a vertical tubular body 11 fixed to the peripheral portion 3a of the carousel 3, having a longitudinal axis C parallel to the axis A of the carousel 3 itself, and defining a central flow channel 12 configured to feed the pourable product to the respective receptacle 2;
- a shutter 13 engaging the tubular body 11 in a sliding manner and movable inside the channel 12 so as to allow or prevent the outflow of the pourable product towards the respective receptacle 2 to be filled;
- an actuator 24 adapted to move the shutter 13 inside the channel 12; and
- an expansion 9 transversely protruding from one side of the tubular body 11 and interposed between the tubular body 11 itself and the carousel 3.

[0033] In particular, the tubular body 11 presents an upper end portion 14, an intermediate portion 17 provided with a transverse inlet opening 15 configured to receive the pourable product from the reservoir 5 through the circuit 6, and a lower end portion 16 ending with an axial outlet opening 18 configured to feed the pourable product to the respective receptacle 2.

[0034] The lower end portion 16 is adapted to come into contact, in use, with the neck 7 of the respective receptacle 2 to be filled so as to place the upper edge of the neck 7 itself in fluid connection with the outlet opening 18.

[0035] For this purpose, the end portion 16 comprises an annular gasket 20 defining, in use, an axial abutment for the neck 7 of the respective receptacle 2 and configured for sealing the latter to the filling valve 8 during the filling process. In this way, the inner volume of such receptacle 2 is kept in a fluid-tight condition during such process.

[0036] With reference to the preferred embodiment described herein, the channel 12 comprises, at the lower

end portion 16 of the tubular body 11, a tapered-section portion 21 defining the terminal part of the channel 12 itself.

[0037] In particular, the portion 21 comprises a first frustum-conical segment 22, with a section tapering towards the outlet opening 18, and a second substantially cylindrical segment 23, extending from the minimum section of segment 22 and ending, after a further final tapering, with the outlet opening 18. In practice, the segment 22 is located upstream of the segment 23 with respect to the flow direction of the pourable product inside the channel 12 and has a diameter gradually decreasing towards the diameter of the segment 23 itself.

[0038] As can be seen in Figure 2 and in Figures 3a-3, the shutter 13 is coaxially mounted inside the channel 12 of the tubular body 11.

[0039] In particular, the shutter 13 comprises an externally cylindrical upper portion 25, an intermediate portion 26 having a diameter larger than the diameter of the upper portion 25 and arranged below the latter, and a lower portion 29 extending axially from the intermediate portion 26 in the direction of the lower end portion 16 of the tubular body 11 and terminating in close proximity to the outlet opening 18 and above the latter.

[0040] Preferably, the intermediate portion 26 is provided with flow-stabilizing means for the pourable product, for example a swirler 28, configured to impart a rotating motion to the pourable product itself.

[0041] The shutter 13 is also provided, at the intermediate portion 26, with a sealing ring 27, preferably made of an elastomeric material and configured to selectively cooperate in a fluid-tight manner with the segment 22 of the channel 12 so as to prevent the outflow of the pourable product towards the outlet opening 18 and, therefore, inside the receptacle 2 to be filled.

[0042] The shutter 13 is movable inside the channel 12 of the tubular body 11 between:

- a lower closing position (Figures 2, 3a, 3b and 3d), in which the shutter 13 closes in a fluid-tight manner, by means of the sealing ring 27, the segment 22 of the channel 12, thus interrupting the flow of the pourable product towards the respective receptacle 2; and
- an upper opening position (Figure 3c), in which the shutter 13 delimits, along with the segment 22 of the channel 12, an annular passage fluidly communicating with the outlet opening 18 so as to allow the outflow of the pourable product towards the respective receptacle 2 to be filled.

[0043] The movement of the shutter 13 from the closing position to the opening position is obtained by means of the actuator 24, preferably a fluid controlled actuator.

[0044] In particular, the actuator 24 comprises a plunger 24a housed inside a respective chamber 24b located at the upper end portion 14 of the filling device 4. The chamber 24b is adapted to receive a fluid under pressure

(e.g. air, water or oil) configured to exert a thrust on the plunger 24a. The shutter 13 is coupled to the plunger 24a, according to a known manner and not described in detail, and its movement between the closing and opening positions directly depends on the movement of the plunger 24a, as this is caused by the fluid under pressure on the inside of chamber 24b.

[0045] Alternatively, the actuation of the shutter 13 could be achieved by means of a mechanical or electromagnetic actuator.

[0046] The filling valve 8 further comprises:

- a pressurization-exhaust circuit 30 configured both to pressurize the respective receptacle 2 at a predetermined pressure value higher than the atmospheric pressure value before starting the actual filling, and to exhaust the gas contained in the receptacle 2 during the filling operation; and
- a decompression circuit 33 configured to perform a decompression phase of the respective receptacle 2 by means of gas outflow, once the filling is completed.

[0047] In particular, the pressurization-exhaust circuit 30 comprises a duct 31 which fluidly connects the internal environment of the respective receptacle 2 to an annular chamber 32 of the pressurization-exhaust circuit 30 itself, formed in the carousel 3 and containing a fluid under pressure, for example carbon dioxide.

[0048] In particular, the duct 31 has a lower opening 36 communicating, in use, with the receptacle 2 and an upper opening 37 communicating with the chamber 32.

[0049] As can be seen in Figure 2, the duct 31 of the pressurization-exhaust circuit 30 comprises, proceeding from the direction starting from the lower opening 36 to the upper opening 37:

- a first portion 31a formed within the shutter 13 and extending coaxially with the latter;
- a second portion 31b formed within the tubular body 11 at its upper end 14 and extending in a substantially transverse direction to the axis C;
- a third portion 31c extending within the expansion 9 in an orthogonal direction to the axis C and comprising a flow control valve 38, preferably of the pneumatic type, configured to allow or prevent the flow of fluid under pressure from or towards the chamber 32; and
- a fourth portion 31d extending through the carousel 3 on the extension of the portion 31c and fluidly connected with the chamber 32.

[0050] The decompression circuit 33 comprises a duct 34 which fluidly connects the internal environment of the respective receptacle 2 to an annular chamber 35 formed in the carousel 3; the chamber 35 is kept at a pressure lower than the pressure inside the receptacle 2 at the end of the filling and can be connected in turn to the

external environment at atmospheric pressure according to a known manner.

[0051] In particular, the duct 34 has a lower opening 40 communicating, in use, with the receptacle 2, and an upper opening 41 communicating with the chamber 35.

[0052] In more detail, the duct 34 of the decompression circuit 33 comprises, proceeding in the direction from the lower opening 40 to the upper opening 41:

- a first annular portion 34a extending through the tubular body 11 in a radially outermost position with respect to the portion 31a of the duct 31 and in a direction substantially parallel to the axis C;
- a second portion 34b extending within the expansion 9 in a direction orthogonal to the axis C and comprising a flow control valve preferably of the pneumatic type, configured to selectively open or close the fluid communication between the chamber 35 and the duct 34; and
- a third portion 34c extending through the carousel 3 on the extension of the portion 34b and fluidly connected with the chamber 35.

[0053] Advantageously, the filling device 4 comprises, furthermore, a pressure sensor 42, preferably a pressure gauge, configured to generate a pressure signal W correlated with the pressure inside the respective receptacle 2 connected to the filling valve 8; the filling device 4 further comprises a control unit 43 configured to receive the pressure signal W from the pressure sensor 42 and to control the valve 39 so as to cause a pressure drop in the respective receptacle 2 up to a predetermined final pressure value P_0 .

[0054] In practice, when the pressure detected by the pressure sensor 42 reaches the final value P_0 , the control unit 43 controls the closure of the valve 39 so as to terminate the decompression phase.

[0055] In other words, the decompression phase is dynamic.

[0056] Advantageously, the final pressure value P_0 is chosen to be higher than the atmospheric pressure; in particular, this final pressure value P_0 is preferably higher than the atmospheric pressure of an amount ranging between 0.1 and 0.5 bar, even more preferably between 0.2 and 0.3 bar.

[0057] The applicant observed that by selecting a final pressure value P_0 higher than the atmospheric pressure of the above mentioned quantity, it is possible to minimize the agitation of the pourable product inside the receptacle 2 at the time of detachment from the respective filling device 4, thereby limiting the formation of foam and the possible leakage of the pourable product itself.

[0058] Preferably, the decompression phase can be carried out in two or more successive cycles: in practice, one or more intermediate pressure values P_i can be selected and each time the pressure sensor 42 measures such pressure values P_i , the control unit 43 controls the pre-set time closure of the valve 39 for a pre-set time

interval.

[0059] The applicant observed that by operating in this way, it is possible to control the decompression rate, which plays an important role, together with the final pressure value P_0 , in foam formation.

[0060] The pressure sensor 42 is preferably fixed externally to the tubular body 11 and is connected to the portion 34a of the duct 34; the pressure detected at this point corresponds to that inside the underlying receptacle 2.

[0061] Preferably, the valve 39 of the decompression circuit 33 is of the on/off type, i.e. it is selectively movable between two opening and closing positions following the control signal received from the control unit 43.

[0062] The operation of the filling machine 1 according to the present invention will be described in the following, with particular reference to Figures from 3a to 3d and referring to a single filling device 4 carried by the carousel 3 and to a single receptacle 2 to be filled.

[0063] In particular, Figures from 3a to 3 show the operation of the filling machine 1 during four successive moments.

[0064] In detail, the receptacle 2 is fed by the carousel 3 in a position lower than the respective filling device 4 and is arranged by the support means 10 so as to be located with the upper end of the neck 7 in abutment against the annular gasket 20 of the tubular body 11 (Figure 3a).

[0065] Once the tight-seal contact between the receptacle 2 and the tubular body 11 is ensured, the valve 38 is opened to start the pressurization phase: the gas under pressure, typically carbon dioxide, contained in chamber 32 outflows along the pressurization-exhaust circuit 30, inside the receptacle 2, until the pressure on its inside reaches the pressure value of the reservoir 5 of the pourable product to be introduced into the receptacle 2 itself (Figure 3b).

[0066] At this point, the shutter 13 is moved, by means of the actuator 24 from the closing position to the opening position. The pourable product can therefore flow into the channel 12, through the outlet opening 18 and, then, inside the receptacle 2. At the same time, the gas contained in the receptacle 2 is released through the pressurization-exhaust circuit 30 (Figure 3c).

[0067] After the filling is completed, the shutter 13 is moved into the closing position by means of the actuator 24, and the valve 38 is closed (Figure 3d).

[0068] At this point, the valve 39 is opened to start the decompression phase: the receptacle 2 is depressurized by means of the outflow of the gas contained in the upper part of the neck 7, in the pressurization-exhaust circuit 30 up to the closed valve 38, and in the channel 12 up to the sealing ring 27 along the decompression circuit 33 towards the chamber 35. At the same time, the pressure sensor 42 measures the pressure value in the portion 34a of the duct 34 corresponding to that contained inside the filled receptacle 2; as soon as said value reaches the pre-set intermediate pressure value/s P_i , the control unit

controls the temporary closure of the valve 39 for a pre-set time interval thus allowing the pourable product contained in the receptacle 2 to reduce its "agitation" by settling to the new pressure value/s. When the final pressure value P_0 is reached, the control unit 43 controls the permanent closure of the valve 39, so as to end the decompression phase.

[0069] Figure 4a shows the pressure variation in the receptacle 2 during the decompression phase in the hypothesis where two decompression cycles are performed with a temporary closure of the valve 39 for a pre-set time for reaching a certain set pressure value P_i .

[0070] The receptacle 2 is then detached from the filling device 4 at the final pressure value P_0 to be conveyed by the carousel 3 to the outlet star wheel. During such phase, the pressure of the receptacle 2 will drop to the value of the atmospheric pressure P_a .

[0071] It is clear that the foregoing applies equally to each filling device 4 and to each receptacle 2 to be filled.

[0072] An examination of the characteristics of the filling device 4 and of the filling method, according to the present invention, clearly shows the advantages it allows to achieve.

[0073] In particular, the selective control of the valve 39 of the decompression circuit 33, correlated with the pressure value measured inside the receptacle 2 by the pressure sensor 42, allows the decompression phase to be carried out dynamically in multiple cycles and, therefore, to reach a certain determined final pressure value P_0 in the receptacle 2 at the end of the decompression phase itself. As a result, the amount of foam generated is always predictable and kept to a minimum, thus avoiding unforeseen and unwanted product loss.

[0074] It is clear that modifications and alternatives can be made to the filling device 4 and to the filling method described and illustrated without thereby departing from the protective scope defined by the claims.

[0075] In particular, the valve 39 of the decompression circuit 33 may be a modulating valve, i.e. capable of defining a plurality of opening positions with passage sections different from one another.

[0076] In this particular case, it may be possible to set one or more intermediate pressure values P_i and a final pressure value P_0 at which temporarily or permanently closing the valve 39 to control the decompression rate, but also a desired law of pressure variation in time could be directly set, which would define a decompression curve with consequent regulation, by way of the control unit 43, of the opening section of the valve 39 on the basis of the pressure values measured by the pressure sensor 42.

[0077] An example of a law of variation of this type is illustrated in Figure 4b.

Claims

1. A filling device (4) for a filling machine (1) configured

for filling receptacles (2) with a pourable product; said filling device (4) comprising:

- a filling valve (8) configured to be connected with a respective receptacle (2) to be filled and selectively movable between an opening configuration, in which said filling valve (8) feeds in use said pourable product to said receptacle (2) at a pressure higher than the atmospheric pressure, and a closing configuration, in which said filling valve (8) interrupts a flow of said pourable product towards the receptacle (2) itself; and
- a decompression circuit (33) configured to depressurize said receptacle (2) after filling;

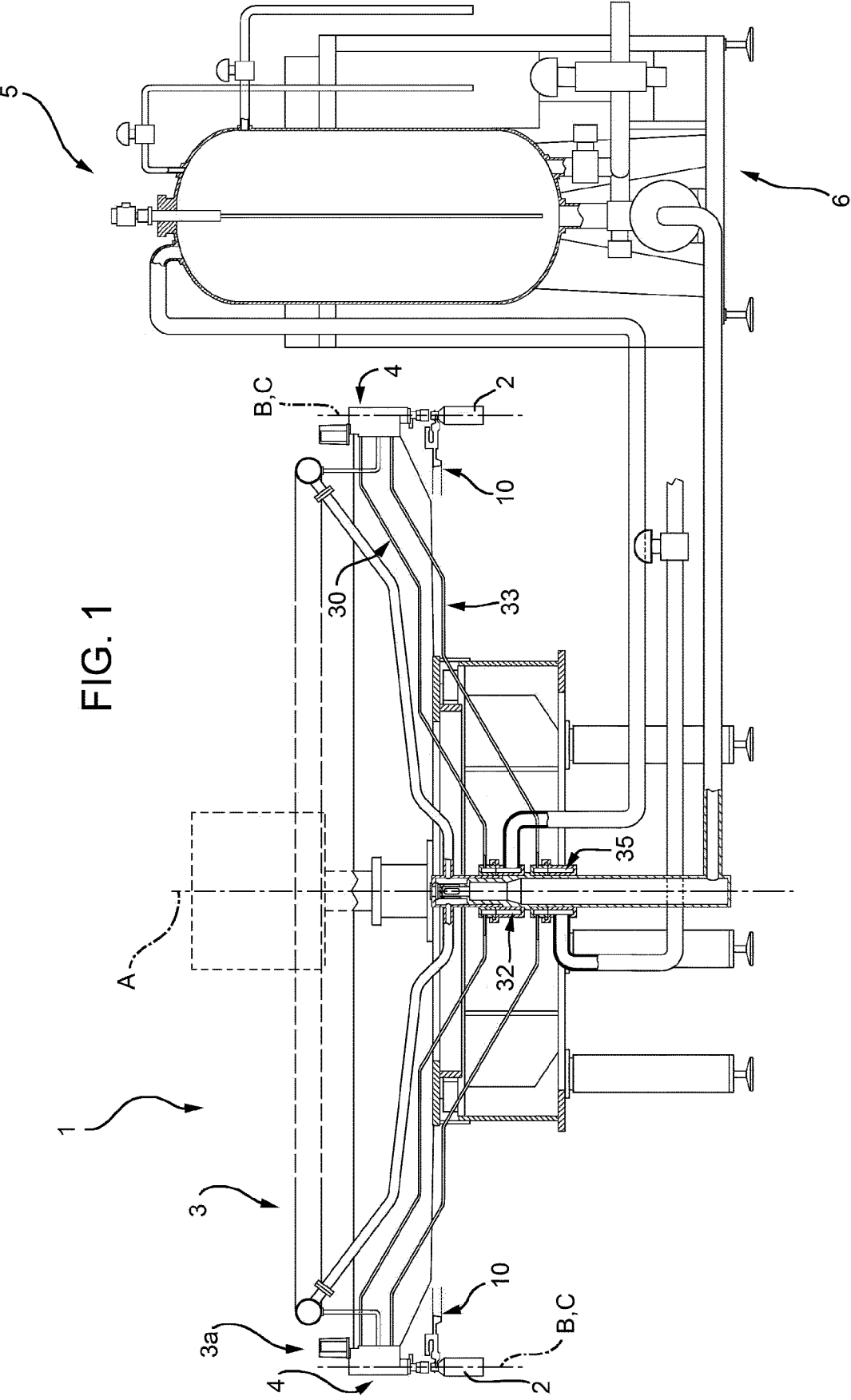
said decompression circuit (33) comprising:

- a decompression chamber (35) kept at a pressure lower than the pressure inside said receptacle (2) at the completion of the filling;
- a decompression duct (34) having a first end (40) communicating, in use, with said receptacle (2) and a second end (41) opposite to the first end (40) connected to said decompression chamber (35); and
- a flow control valve (39) configured to selectively open and close the fluid communication between said decompression chamber (35) and said decompression duct (34);

characterized in that it further comprises pressure detecting means (42) configured to generate a pressure signal (W) correlated with the pressure measured inside said receptacle (2), and a control unit (43) configured to receive said pressure signal (W) from said pressure detecting means (42) and control said flow control valve (39) in function of said pressure signal (W).

2. The device according to claim 1, wherein said control unit (43) is configured to control the closure of said flow control valve (39) when the pressure inside said receptacle (2) is equal to a final predetermined pressure value (P_0).
3. The device according to claim 2, wherein said final pressure value (P_0) is higher than the atmospheric pressure.
4. The device according to claim 3, wherein said final pressure value (P_0) is higher than the atmospheric pressure of an amount ranging between 0.1 bar and 0.5 bar.
5. The device according to claim 4, wherein said final pressure value (P_0) is higher than the atmospheric pressure of an amount ranging between 0.2 bar and 0.3 bar.

6. The device according to any one of the claims from 2 to 5, wherein said control unit (43) is configured to control a temporary closure, for a pre-set time, of said flow control valve (39) when the pressure inside said receptacle (2) is equal to at least one intermediate pressure value (P_i) higher than said final pressure value (P_0). 5
7. The device according to any one of the foregoing claims, wherein the pressure inside said decompression chamber (35) is equal to the atmospheric pressure. 10
8. The device according to any one of the foregoing claims, wherein said flow control valve (39) is an on/off type valve. 15
9. The device according to any one of claims from 1 to 7, wherein said flow control valve (39) is a modulating valve. 20
10. The device according to any one of the foregoing claims, wherein said filling valve (8) comprises:
- a tubular body (11) having a longitudinal axis (C) defining a central flow channel (12) for said pourable product and terminating at a lower end (16) with an axial outlet opening (18) configured for feeding said pourable product to said receptacle (2); 25
 - a shutter (13) movable inside said channel (12) between a closing position and an opening position defining, respectively, said closing and opening configurations, so as to prevent or allow the outflow of said pourable product towards said receptacle (2). 30 35
11. A method for filling a receptacle (2) with a pourable product comprising the steps of: 40
- i) feeding said pourable product to said receptacle (2) at a pressure higher than the atmospheric pressure so as to fill said receptacle (2) up to a predetermined level; and
 - ii) depressurizing said receptacle (2) after filling by selectively connecting, by means of a flow control valve (39), the internal environment of said receptacle (2) with a decompression chamber (35) kept at a pressure lower than the pressure inside the receptacle (2) itself; 45 50
- characterized in that** it further comprises the steps of:
- iii) measuring the pressure inside said receptacle (2); 55
 - iv) generating a pressure signal (W) correlated with said measured pressure; and
- v) controlling said flow control valve (39) in function of said pressure signal (W).
12. The method according to claim 11, wherein said step v) comprises the step of:
- vi) control the closure of said flow control valve (39) when the pressure measured inside said receptacle (2) is equal to a predetermined final pressure value (P_0). 10
13. The method according to claim 12, wherein said final pressure value (P_0) is higher than the atmospheric pressure (P_a). 15
14. The method according to claim 13, wherein said final pressure value (P_0) is higher than the atmospheric pressure (P_a) of an amount ranging between 0.1 bar and 0.5 bar. 20
15. The method according to claim 14, wherein said final pressure value (P_0) is higher than atmospheric pressure (P_a) of an amount ranging between 0.2 bar and 0.3 bar. 25
16. The method according to any one of the claims from 12 to 15, wherein said step v) further comprises the step of:
- vii) control the temporary closure for a pre-set time interval of said flow control valve (39) when the pressure measured inside said receptacle (2) is equal to at least one intermediate pressure value (P_i) higher than said final pressure value (P_0). 30 35
17. The method according to any one of the claims from 12 to 15, wherein said flow control valve (39) is a modulating valve, and wherein said step v) further comprises the steps of:
- viii) set a desired law of pressure variation in time inside said receptacle (2); and
 - ix) controlling said flow control valve (39) according to said law, until the pressure inside said receptacle (2) is equal to said final pressure value (P_0). 40 45 50



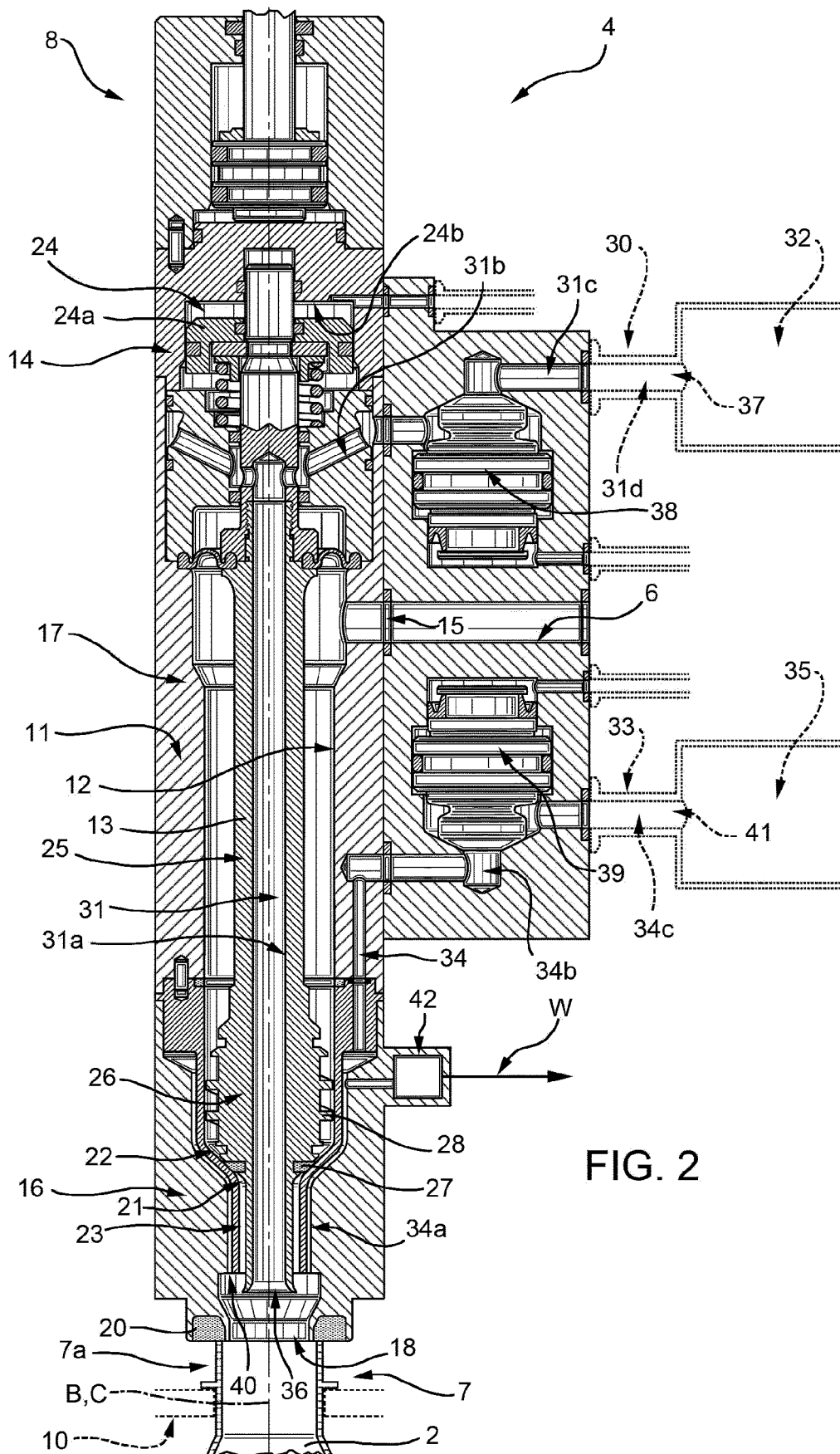
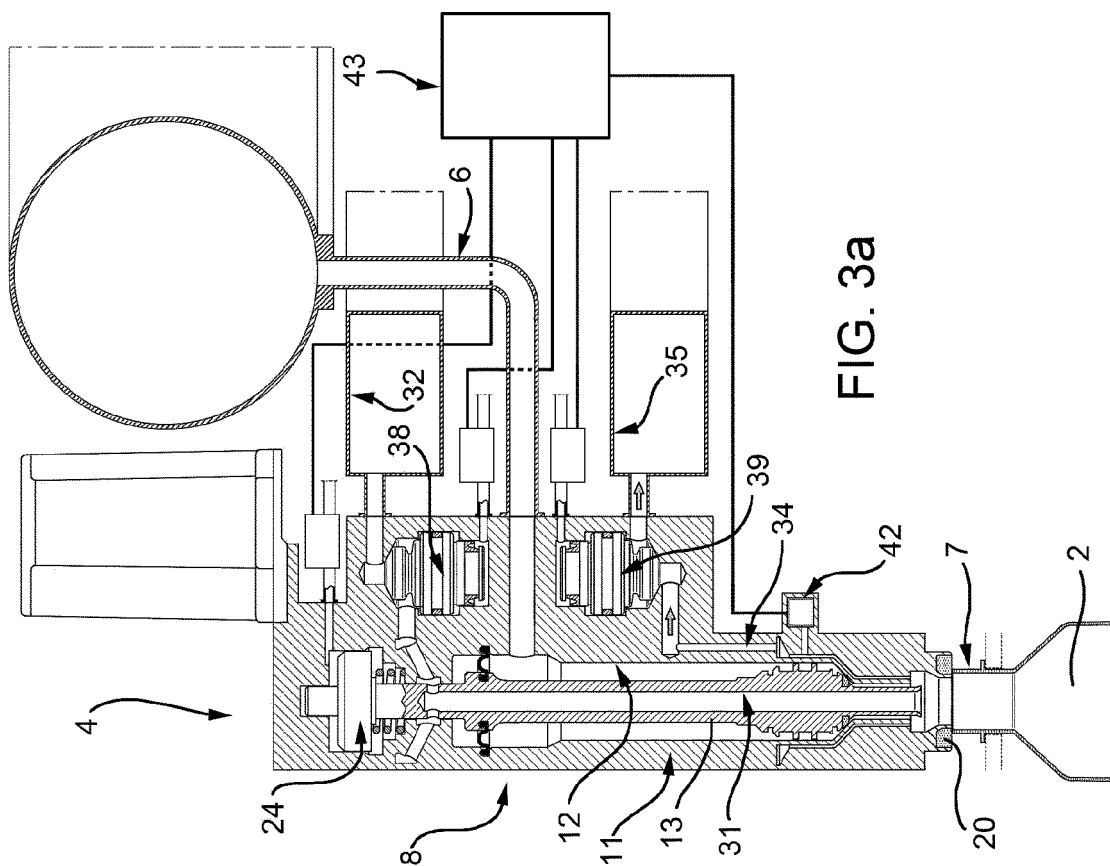
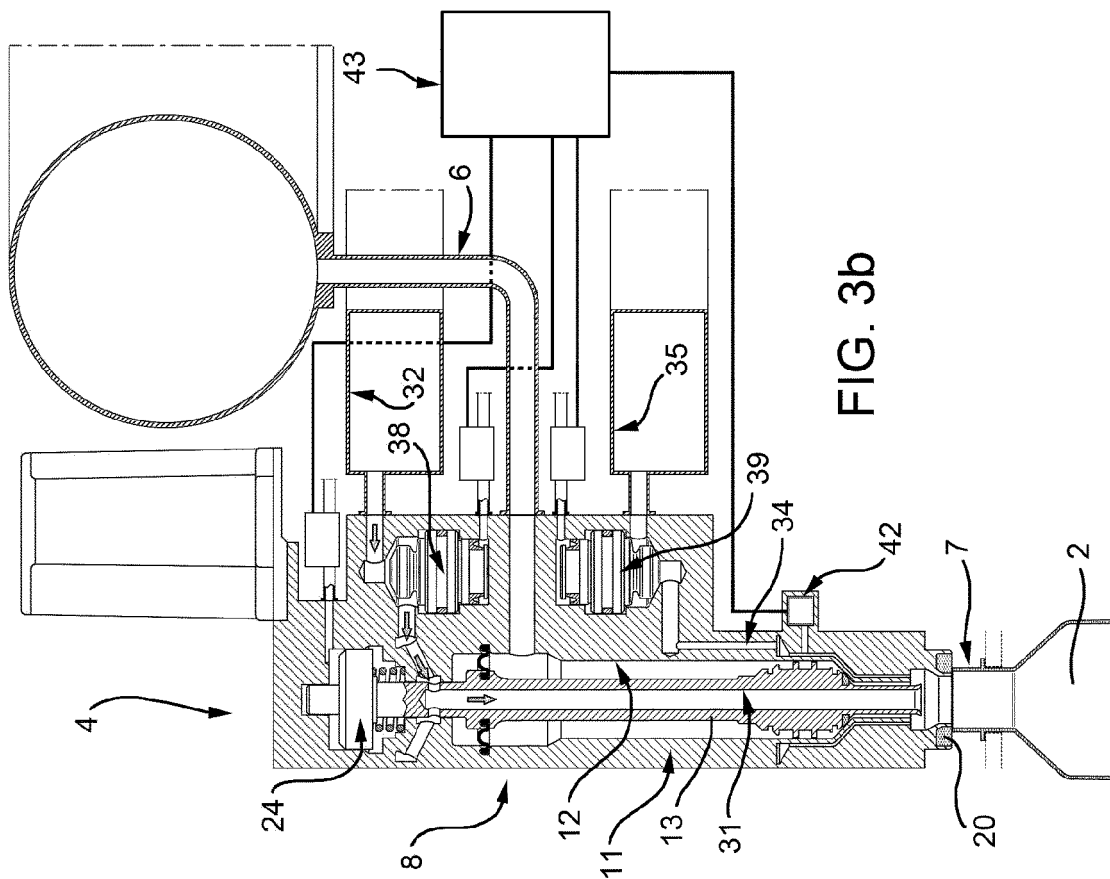
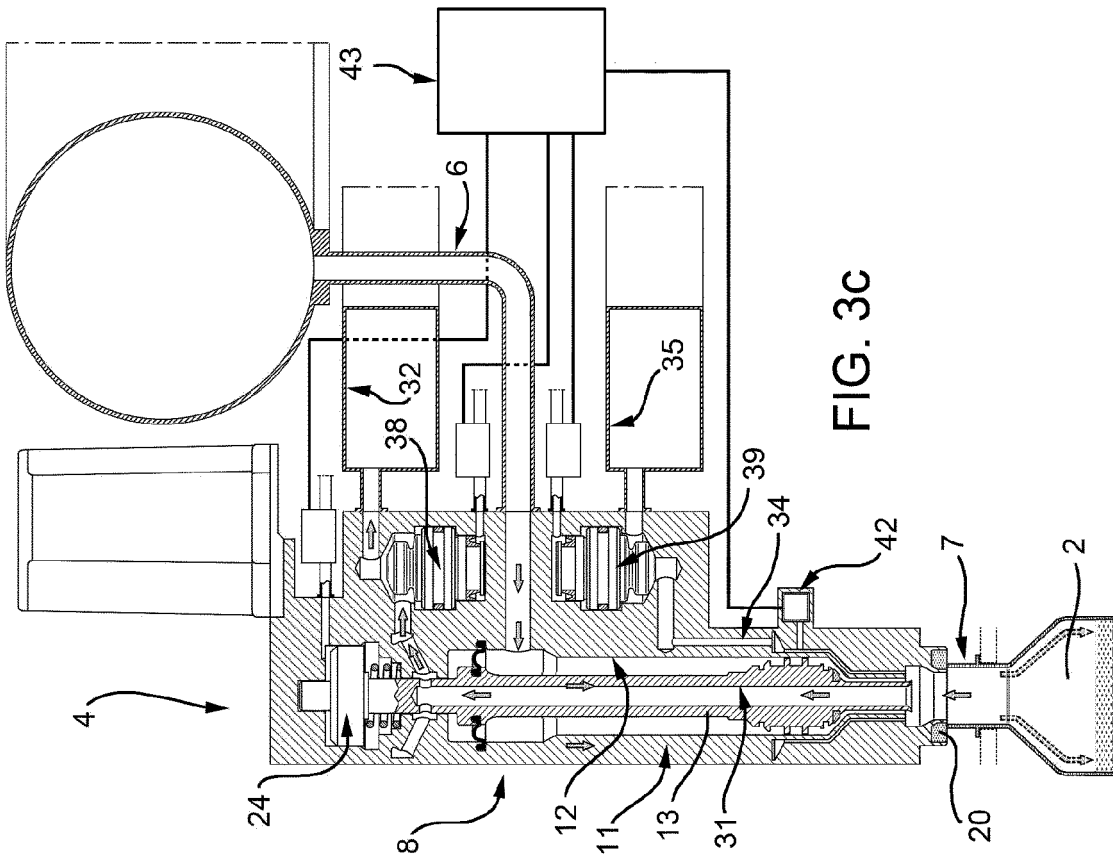
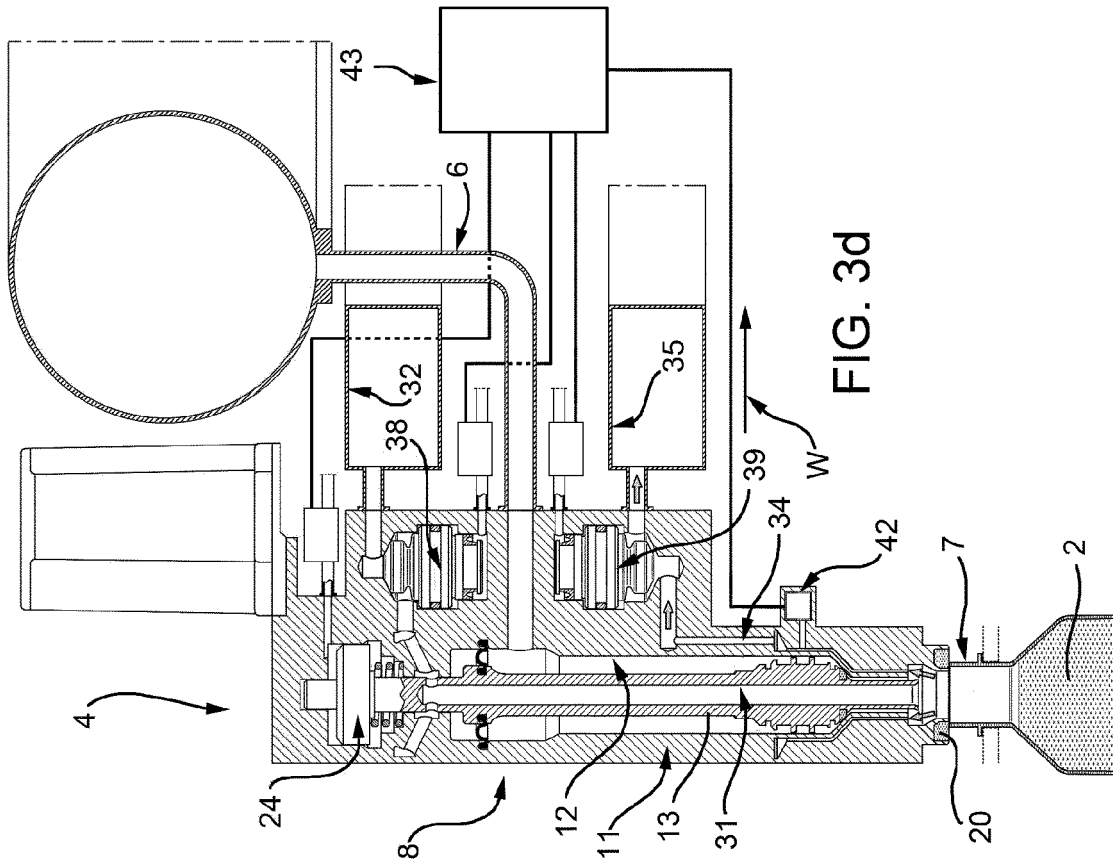


FIG. 2





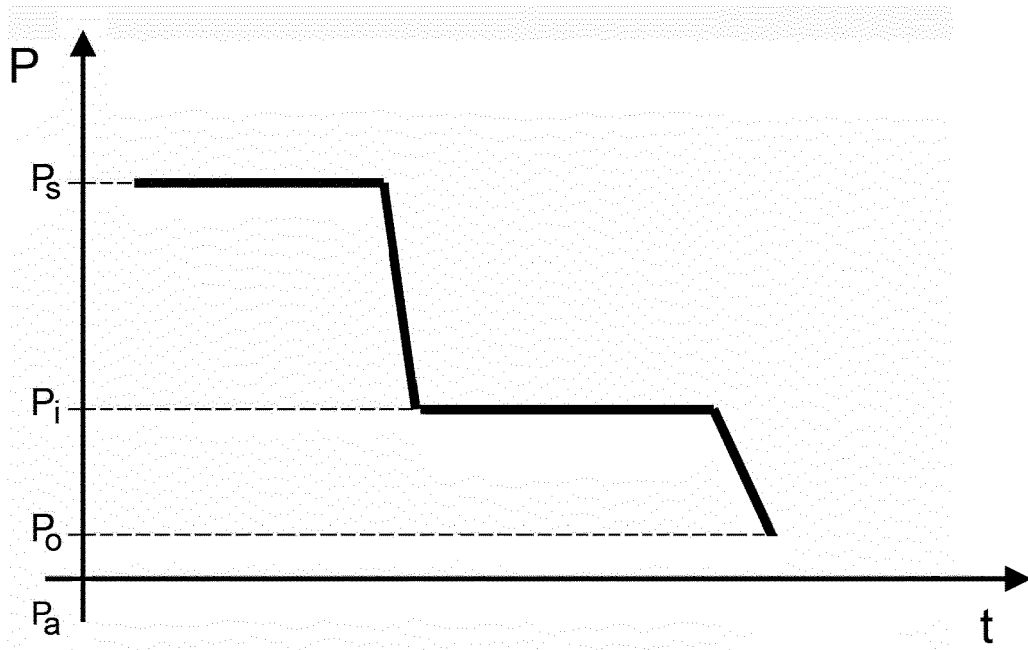


FIG. 4a

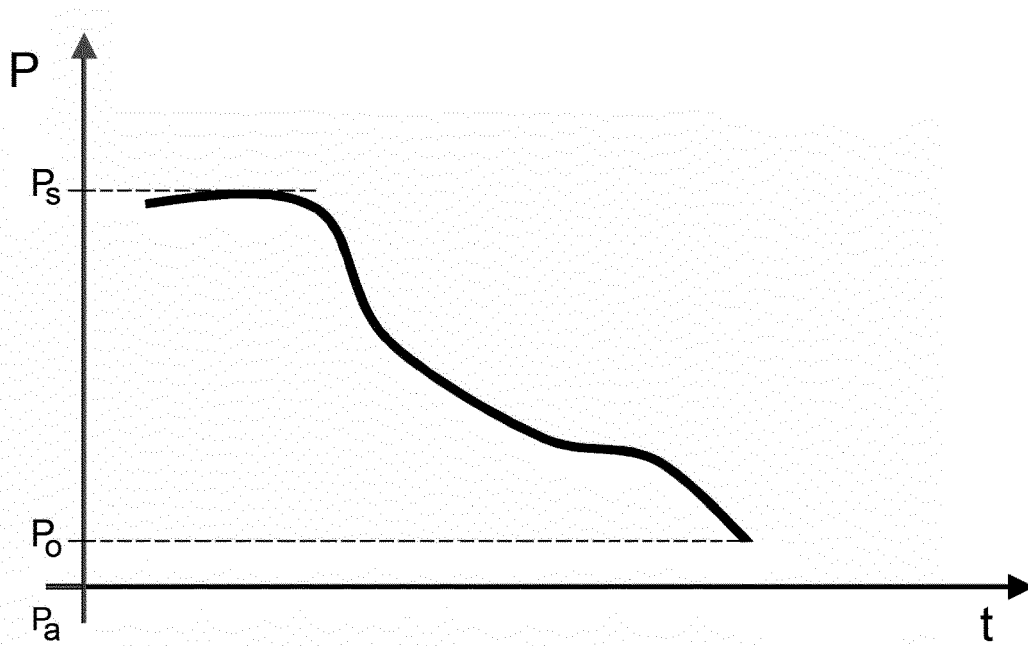


FIG. 4b



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Application Number
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