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(71) Applicant: **Tetra Laval Holdings & Finance S.A.**
1009 Pully (CH)

(72) Inventors:
• **FANGAREZZI, Gianni**
41012 Carpi (IT)

- **SANIBONDI, Paolo**
42124 Reggio Emilia (IT)
- **GARUTI, Nicola**
42019 Scandiano (IT)
- **BARBIERI, Andrea**
41126 Modena (IT)
- **KANEKO, Yutaka**
164-0011 Tokyo (JP)
- **FERRARINI, Filippo**
41126 Modena (IT)

(74) Representative: **Tetra Pak - Patent Attorneys SE**
AB Tetra Pak
Patent Department
Ruben Rausing's gata
221 86 Lund (SE)

(54) **PACKAGING APPARATUS FOR FORMING SEALED PACKAGES**

(57) There is described a packaging apparatus (1) comprising a tube forming and sealing device (5), a filling device (7), a product delivery device (8) configured to receive a pourable product from an external product supply (9) and to selectively feed the pourable product along a flow path to and into the filling device (7) and a package forming unit (10) configured to at least form and transversally seal the tube (3) for forming packages (2) filled with the pourable product. The product delivery device (8) comprises a main inlet valve (30) having a first inlet (31) and a first outlet (32) and a control valve (33) arranged downstream from the main inlet valve (30) and upstream from the filling device (7) along the flow path and having a second inlet (34) and a second outlet (35). The main inlet valve (30) comprises a first valve element (42) controllable into at least a closing position, an opening position and one or more intermediate positions. Additionally or alternatively, the control valve (33) comprises a second valve element (44) being controllable into a closed position and an open position.

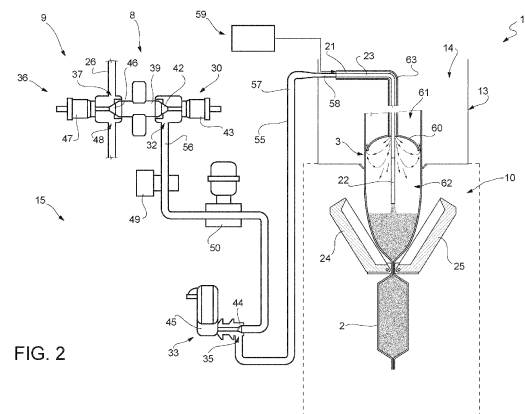


FIG. 2

Description

TECHNICAL FIELD

[0001] The present invention relates to a packaging apparatus for forming sealed packages, in particular for forming sealed packages filled with a pourable product.

BACKGROUND ART

[0002] As is known, many liquid or pourable food products, such as fruit juice, UHT (ultra-high-temperature treated) milk, wine, tomato sauce, etc., are sold in packages made of sterilized packaging material.

[0003] A typical example is the parallelepiped-shaped package for liquid or pourable food products known as Tetra Brik Aseptic (registered trademark), which is made by sealing and folding a multilayer packaging material. The multilayer packaging material comprises at least a layer of fibrous material, such as e.g. a paper or cardboard layer, and at least two layers of heat-seal plastic material, e.g. polyethylene, interposing the layer of fibrous material in between one another.

[0004] In the case of aseptic packages for long-term storage products, such as UHT milk, the packaging material also comprises a layer of gas- and light-barrier material, e.g. aluminum foil or ethylene vinyl alcohol (EVOH) film, in particular being arranged between one of the layers of the heat-seal plastic material and the layer of fibrous material. Typically, the web of packaging material also comprises a further layer of heat-seal plastic material being interposed between the layer of gas- and light-barrier material and the layer of fibrous material.

[0005] Packages of this sort are normally produced on fully automatic packaging apparatuses, which advance a web of packaging material through a sterilization unit of the packaging apparatus for sterilizing the web of packaging material, e.g. by means of chemical sterilization (e.g. by applying a chemical sterilizing agent, such as a hydrogen peroxide solution) or physical sterilization (e.g. by means of an electron beam). Then, the sterilized web of packaging material is maintained and advanced within an isolation chamber (a closed and sterile environment), and is folded and sealed longitudinally to form a tube, which is further fed along a vertical advancing direction.

[0006] Known packaging apparatuses also comprise a respective product delivery device configured to receive the pourable product from an external product supply and to selectively feed the pourable product along a flow path to and into the filling device, in particular the filling pipe.

[0007] A typical product delivery device comprises a plurality of valves of which a first valve and a second valve are on/off-valves and a third valve is a modulating valve. The first valve is connected to the external product supply and is controllable between a respective open position and a closed position in order to respectively allow and impede delivery of the pourable product to a second

valve. The second valve is moveable into a respective open position and a respective closed position for respectively allowing and impeding delivery of the pourable product to the third valve and the third valve is moveable into an endless position of open positions so as to modulate the flow rate of the pourable product to the filling device, in particular the filling pipe.

[0008] Typically the external product supply does not only deliver, in use, the pourable product to one single packaging apparatus, but to a plurality of independently operated packaging apparatuses, each of which has a respective product delivery device.

[0009] An inconvenience of these packaging apparatuses has been found to be that the change of the status of the respective first and second valves of one product delivery device may result in pressure fluctuations of the pourable product within the other packaging apparatuses.

[0010] Another inconvenience of these packaging apparatuses has been found to be that also the stop of supply of the pourable product within one respective packaging apparatus may create underpressure and/or pressure fluctuations of the pourable product within the respective packaging apparatuses.

[0011] Therefore, a need is felt in the sector to improve the packaging apparatuses in order to reduce any inconveniences resulting from possibly occurring pressure fluctuations of the pourable product within the packaging apparatus.

DISCLOSURE OF INVENTION

[0012] It is therefore an object of the present invention to provide in a straightforward and low-cost manner an improved packaging apparatus.

[0013] According to the present invention, there is provided a packaging apparatus as claimed in the independent claims.

[0014] Further advantageous embodiments of the packaging apparatus according to the invention are specified in the respective dependent claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] A non-limiting embodiment of the present invention will be described by way of example with reference to the accompanying drawings, in which:

Figure 1 is a schematic view of a packaging apparatus according to the present invention, with parts removed for clarity;

Figure 2 is an enlarged view of a detail of the packaging apparatus of Figure 1, with parts removed for clarity;

Figures 3a to 3c are schematic views of a detail of the packaging apparatus of Figures 1 and 2 being in three respective operational states; and

Figures 4a to 4c are schematic views of another de-

tail of the packaging apparatus of Figures 1 and 2 being in three respective operational states.

BEST MODES FOR CARRYING OUT THE INVENTION

[0016] Number 1 indicates as a whole a packaging apparatus for producing sealed packages 2 of a pourable food product, such as pasteurized milk or fruit juice, from a tube 3 of a web 4 of packaging material. In particular, in use, tube 3 extends along a longitudinal axis L, in particular having a vertical orientation.

[0017] In particular, packaging apparatus 1 belongs to a production facility, which may comprise a plurality of packaging apparatuses 1 (the packaging apparatuses 1 being substantially identical in construction and operation to one another).

[0018] In more detail, web 4 may have a multilayer structure (not shown), and may comprise at least a layer of fibrous material, such as e.g. a paper or cardboard layer, and at least two layers of heat-seal plastic material, e.g. polyethylene interposing the layer of fibrous material in between one another. One of these two layers of heat-seal plastic material defines the inner face of package 2 eventually contacting the pourable product.

[0019] Moreover, web 4 may also comprise a layer of gas- and light-barrier material, e.g. aluminum foil or ethylene vinyl alcohol (EVOH) film, in particular being arranged between one of the layers of the heat-seal plastic material and the layer of fibrous material. Additionally, web 4 may also comprise a further layer of heat-seal plastic material interposed between the layer of gas- and light-barrier material and the layer of fibrous material.

[0020] With particular reference to Figure 1, packaging apparatus 1 comprises:

- a tube forming and sealing device 5 configured to form and longitudinally seal tube 3, in particular at a tube forming station 6, from web 4, in particular form the, in use, advancing web 4;
- a filling device 7 for continuously filling tube 3 with the pourable product;
- a product delivery device 8 configured to receive the pourable product from an external product supply 9 (only partially shown to the extent necessary for the understanding of the present invention) and to selectively feed the pourable product along a flow path to and into filling device 7; and
- a package forming unit 10 adapted to shape, transversally seal and, preferably but not necessarily, to transversally cut tube 3, in particular the, in use, advancing tube 3, for forming packages 2.

[0021] Additionally, packaging apparatus 1 may also comprise:

- a conveying device 11 configured to advance web 4 (in a manner known as such) along a web advancement path P from a delivery station 8 to tube forming

station 6, at which, in use, web 4 is formed into tube 3 and to advance tube 3 along a tube advancement path Q; and

- an isolation chamber 13 having an inner environment 14, in particular an inner sterile environment containing (comprising) a sterile gas such as sterile air, (at a given gas pressure and) being separated by isolation chamber 13 itself from an outer environment 15.

[0022] Moreover, packaging apparatus 1 may also comprise a sterilizing unit (not shown and known as such) configured to sterilize the, in use, advancing web 4 at a sterilization station, in particular the sterilization station being arranged upstream of forming station 6 along web advancement path P.

[0023] Preferably, tube forming and sealing device 5 may be at least partially arranged within inner environment 14 such that the tube forming and sealing device 5 is configured to form and longitudinally seal tube 3 within inner environment 13. Moreover, package forming unit 10 may be arranged outside of inner environment 14. In particular, packaging forming unit 10 is configured to shape and transversally seal, in particular also to transversally cut, tube 3 within an (not sterile) auxiliary space of packaging apparatus 1.

[0024] Preferentially, conveying device 11 may be configured to advance tube 3, and in particular also any intermediate of tube 3, in a manner known as such along tube advancement path Q, in particular from forming station 6 to and at least partially through package forming unit 10. In particular, by the wording "intermediates of tube 3" any configuration of web 4 is meant prior to obtaining the tube structure and after the folding of web 4 by tube forming and sealing device 5 has started. In other words, the intermediates of tube 3 are a result of the gradual folding of web 4 so as to obtain tube 3, in particular by overlapping with one another a first edge of web 4 and a second edge of web 4, opposite to the first edge.

[0025] In particular, at least a first portion of tube advancement path Q lies within isolation chamber 13 (in particular, within inner environment 14). Furthermore, a second portion of tube advancement path Q lies within the auxiliary space.

[0026] In more detail, tube forming and sealing device 5 may comprise a tube forming unit 5 at least partially, preferably fully, arranged within isolation chamber 13 and being configured to gradually fold the advancing web 4 into tube 3, in particular by overlapping the first edge and second edge with one another, for forming a longitudinal seam portion of tube 3. In particular, tube forming unit 5 extends along a longitudinal axis, in particular parallel to tube advancement path Q. In particular, the seam portion 23 extends from an initial level (not specifically shown) into a downward direction along tube advancement path Q. In other words, the initial level is at the position at which the first edge and the second edge start to overlap one another for forming the seam portion.

[0027] In further detail, tube forming and sealing device 5 may also comprise at least a sealing head 20 (at least partially) arranged within inner environment 13 and being configured to longitudinally seal tube 3 along the seam portion, in particular by transferring thermal heat to the seam portion. Sealing head 29 may be of any kind; e.g. sealing head 29 may be of the kind operating by means of induction heating and/or by a stream of a heated gas and/or by means of ultrasound and/or by laser heating and/or by any other means.

[0028] With particular reference to Figures 1 and 2, filling device 7 may comprise a filling pipe 21 configured to (continuously) direct, in use, the pourable product into tube 3 and extend at least partially within tube 3. In particular, filling pipe 21 is controllable to be in fluid connection with product delivery device 8 in order to selectively receive the pourable product from product delivery device 8.

[0029] More specifically, filling pipe 21 may comprise a (linear) main pipe portion 22 extending within and (substantially) parallel to tube 3. Additionally, filling pipe 21 may comprise an auxiliary pipe portion 23 transversal to main pipe portion 22 and connected to product delivery device 8.

[0030] According to a preferred non-limiting embodiment as shown in Figure 2, package forming unit 10 comprises a plurality of pairs of at least one respective operative assembly 24 (only one shown) and at least one counter-operative assembly 25 (only one shown); and

- in particular, a conveying device (not shown and known as such) adapted to advance the respective operative assemblies 24 and the respective counter-operative assemblies 25 of the pairs along respective conveying paths.

[0031] In more detail, each operative assembly 24 is adapted to cooperate, in use, with the respective counter-operative assembly 25 of the respective pair for forming a respective package 2 from tube 3. In particular, each operative assembly 24 and the respective counter-operative assembly 25 are configured to shape, transversally seal and, preferably but not necessarily also transversally cut tube 3 for forming the respective packages 2.

[0032] In further detail, each operative assembly 24 and the respective counter-operative assembly 25 are adapted to cooperate with one another for forming a respective package 2 from tube 3 when advancing along a respective operative portion of the respective conveying path. In particular, during advancement along the respective operative portion each operative assembly 24 and the respective counter-operative assembly 25 advance parallel to and in the same direction as tube 3. In even more detail, each operative assembly 24 and the respective counter-operative assembly 25 are configured to contact tube 3 when advancing along the respective operative portion of the respective conveying path.

[0033] In more detail, external product supply 9 may

comprise a pourable product conditioning and/or storage device (not shown and known as such) configured to store/provide for and/or condition the pourable product to be packaged and at least one delivery pipe 26 connecting the pourable product storage tank to product delivery device(s) 8.

[0034] With particular reference to Figures 1 and 2, product delivery device 8 may comprise at least:

- a main inlet valve 30 having a first inlet 31 and a first outlet 32; and
- a control valve 33 arranged downstream from main inlet valve 30 and upstream from filling device 7, in particular 21, along the flow path and having a second inlet 34 and a second outlet 35.

[0035] Additionally, product delivery device 8 may comprise an auxiliary valve 36 connectable and/or connected to external pourable product supply 9 and having at least a third inlet 37 and a third outlet 38. In particular, third outlet 38 is in fluid connection with first inlet 31.

[0036] Additionally, product delivery device 8 may comprise a connection conduit 39 arranged between third outlet 38 and first inlet 31 for establishing the fluid connection between third outlet 38 and first inlet 31. In particular, connection conduit 39 is also configured to be filled with a gas (if the operational states of main inlet valve 30 and auxiliary valve 36 require so) for acting (if needed) as a gas barrier.

[0037] With particular reference to Figures 3a to 3c, main inlet valve 30 may also comprise a first valve element 42 configured to control a fluid connection between first inlet 31 and first outlet 32. In particular, first valve element 42 is controllable into at least:

- a closing position (see Figure 3a) at which first valve element 42 is designed to close the fluid connection between first inlet 31 and first outlet 32, in particular defining a respective minimum flow rate equaling zero;
- an opening position (see Figure 3c) at which first valve element 42 is designed to open the fluid connection between the first inlet 31 and first outlet 32 and allowing a respective maximum flow rate (of the pourable product between first inlet 31 and first outlet 32); and
- one or more intermediate positions (see Figure 3b), at each of which first valve element 42 is configured to allow a respective intermediate flow rate being lower than the respective maximum flow rate (and higher than the respective minimum flow rate).

[0038] More specifically, first valve element 42 is configured to modulate the flow rate of the pourable product flowing, in use, from first inlet 31 to first outlet 32.

[0039] Preferentially, each intermediate position may determine one respective intermediate flow rate being distinct from the others.

[0040] It should be noted that within the scope of the present description an intermediate position of first valve element 42 is a position which can be kept for a defined (and prolonged) time and is not solely a transitory position.

[0041] In more detail, main inlet valve 30 comprises an actuator 43, such as a pneumatic actuator, an electrical motor or similar, coupled to first valve element 42 and configured to linearly move first valve element 42, in particular within a respective space of main inlet valve 30, so as to position first valve element 42 in one of the opening position, closing position and intermediate positions.

[0042] Additionally, main inlet valve 30 may comprise a position sensor configured to determine a position of first valve element 42.

[0043] Advantageously, main inlet valve 30 may also comprise a pressure sensor for measuring the pressure of the pourable product flowing within main inlet valve 30 from first inlet 31 to first outlet 32.

[0044] With particular reference to Figures 4a to 4c, control valve 33 comprises a second valve element 44 configured to control a fluid connection between second inlet 34 and second outlet 35 and being controllable at least into:

- a closed position (see Figure 4a) at which second valve element 44 is configured to interrupt the fluid connection between second inlet 34 and second outlet 35, in particular defining a respective minimum flow rate equaling zero; and
- an open position (see Figure 4c) at which second valve element 44 is configured to open the fluid connection between second inlet 34 and second outlet 35, in particular allowing for a respective maximum flow rate.

[0045] Moreover and with particular reference to Figure 4b, second valve element 44 may also be controllable into one or more intermediate positions at each of which second valve element 42 is configured to allow a respective interim flow rate being lower than the maximum flow rate (and higher than the minimum flow rate).

[0046] More specifically, second valve element 44 is configured to modulate the flow rate of the pourable product flowing, in use, from second inlet 34 to second outlet 35, in particular also allowing to interrupt the flow of the pourable product.

[0047] Preferably, each interim position may determine one respective interim flow rate to be distinct from the others.

[0048] In more detail, control valve 33 may comprise an actuator 45, such as a pneumatic actuator, an electrical motor or similar, coupled to second valve element 44 and configured to linearly move second valve element 44, in particular within a respective space of control valve 33, in order to position second valve element 44 in one of the opened position, the closed position and the interim positions.

[0049] With particular reference to Figure 2, auxiliary valve 36 comprises a third valve element 46 configured to control a fluidic connection between third inlet 37 and third outlet 38.

5 **[0050]** More specifically, third valve element 46 is movable into a respective open position (see e.g. Figures 3a to 3c) and a respective shut position (see Figure 2) so as to respectively allow and impede the fluidic connection between third inlet 37 and third outlet 38.

10 **[0051]** Additionally, auxiliary valve 36 may comprise an actuator 36 configured to move third valve element 46 between the open position and the shut position.

[0052] Moreover, auxiliary valve 36 may further comprise an additional outlet 48 in fluid connection with third inlet 37 and configured to connect in collaboration with third inlet 37 auxiliary valve 36 to delivery pipe 26 (and to define a flow-through passage).

15 **[0053]** With particular reference to Figure 2, product delivery device 8 may further comprise a pressure sensor 49 arranged downstream from main inlet valve 30 along the flow path for measuring a pressure of the pourable product and/or a flow meter 50 arranged downstream from main inlet valve 30, and in particular also downstream from pressure sensor 49, along the flow path and configured to measure a flow rate of the pourable product.

20 **[0054]** Moreover, pressure sensor 49 and/or flow meter 50 may be placed upstream from control valve 33 along the flow path.

25 **[0055]** Advantageously, main inlet valve 30, in particular the position of first valve element 42, and/or control valve 33, in particular the position of second valve element 44, are configured to be controlled in function of the pressure measured, in use, by pressure sensor 49 and/or the flow rate measured, in use, by flow meter 50.

30 **[0056]** With particular reference to Figure 2, product delivery device 8 may also comprise a flow tube 55 connected to control valve 33, in particular second outlet 35, and to filling pipe 21.

35 **[0057]** Furthermore, product delivery device 8 may also comprise a flow conduit 56 connecting main inlet valve 30, in particular first outlet 32, and control valve 33, in particular second inlet 34, with one another. Preferentially, pressure sensor 49 and flow meter 50 are operatively coupled to flow conduit 56.

40 **[0058]** With particular reference to Figure 2, main portions of product delivery device 8 are arranged within outer environment 15. In particular, only a portion of flow tube 55 is arranged within inner environment 14.

45 **[0059]** More specifically, at least main inlet valve 30 and control valve 33 are arranged within outer environment 33.

50 **[0060]** Furthermore, also auxiliary valve 36 and/or pressure sensor 55 and/or flow meter 56 and/or flow conduit 56 may be arranged within outer environment 15.

55 **[0061]** Advantageously, flow tube 55 comprises a first portion 57 arranged within outer environment 15, and in particular a second portion 58 arranged within inner environment 14. In particular, first portion 57 is connected

to control valve 33, in particular second outlet 35, and second portion 58 and second portion 58 is connected to first portion 57 and filling pipe 21.

[0062] With reference to Figure 2, first portion 57 is realized as a single piece.

[0063] Alternatively, first portion 57 could comprise the most two distinct sections, in particular one being connected to control valve 33 and the other one to second portion 58, being connected to one another by a gasket element or a barrier element.

[0064] According to some possible non-limiting embodiments, packaging apparatus 1 may be controllable into at least:

- an operational configuration at which packaging apparatus 1 forms packages 2; and
- a stop configuration at which packaging apparatus 1 interrupts formation of packages 2.

[0065] Furthermore, product delivery device 8 is configured to be set into:

- an operational mode within which product delivery device 8 is designed to direct the pourable product to filling device 7; and
- a stop mode within which product delivery device 8 is designed to impede any flow of the pourable product to filling device 7.

[0066] In particular, product delivery device 8 is set in the operational mode and the stop mode with packaging apparatus 1 being controlled into respectively the operational configuration and the stop configuration.

[0067] In more detail, with product delivery device 8 being controlled into the stop mode, first valve element 42 and second valve element 44 are controlled into respectively the closing position and the closed position. Additionally, also third valve element 46 is arranged in the shut position.

[0068] Furthermore, with product delivery device 8 controlled into the operational mode, first valve element 42 is controlled into the opening position or one of the intermediate positions, in particular the position of first valve element 42 may be modified, in use, between the opening position and the intermediate positions.

[0069] As well, second valve element 44 may be controlled into the open position or one of the interim positions, in particular the position of second valve element 44 may be, in use, modified between the open position and the interim positions.

[0070] Furthermore, also third valve element 46 may be controlled into the respective open position.

[0071] According to some possible non-limiting embodiments, packaging apparatus 1 also comprises a conditioning device 59 configured to control the (condition) within inner environment 15. In particular conditioning device 59 is configured to feed the sterile gas, in particular the sterile air, into inner environment 14 may comprise

(i.e. contain) so as to establish a given pressure of the sterile gas. Preferably, the given pressure may be (slightly) above ambient pressure for reducing the risk of any contaminants and/or contaminations entering inner environment 14. In particular, the given pressure may be about 100 Pa to 500 Pa (0,001 bar to 0,005 bar) above ambient pressure.

[0072] According to the present invention and with particular reference to Figure 2, packaging apparatus 1 also comprises a delimiting element 60 placed, in use, within tube 3 and designed to divide tube 3, in use, into a first space 61 and a second space 62.

[0073] In more detail, first space 61 may be delimited by tube 3, in particular the walls of tube 3, and delimiting element 60. Furthermore, first space 61 opens up into inner environment 14. Even more particular, delimiting element 60 delimits first space 61 at a downstream portion (with respect to path Q), in particular a bottom portion, of first space 61 itself.

[0074] In more detail, second space 62 is delimited, in use, by tube 3, in particular the walls of tube 3, delimiting element 60 and a transversal seal portion of one respective package 2 (to be formed).

[0075] In other words, second space 62 extends in a direction parallel to path Q (i.e. parallel to axis L) from delimiting element 60 to the transversal seal portion.

[0076] In even other words, delimiting element 60 delimits second space 62 at an upstream portion (with respect to path Q), in particular an upper portion, of second space 62 itself; and the transversal seal portion delimits second space 62 at a downstream portion (with respect to path Q), in particular a bottom portion, of second space 62 itself.

[0077] In further detail, first space 61 is arranged upstream of second space 62 along tube advancement path Q. Even more particular, first space 61 is arranged upstream of delimiting element 60 along path Q and second space 62 is arranged downstream of delimiting element 60 along path Q. In the specific example shown, second space 62 is placed below first space 61.

[0078] Furthermore, in use, filling device 7, in particular filling pipe 21, may be configured to direct the pourable product into second space 62.

[0079] According to the preferred non-limiting embodiment disclosed, conditioning device 59 is also configured to direct a flow of sterile gas into second space 62 for obtaining a pressure within second space 62 that is higher than the gas pressure within first space 61.

[0080] Thus, in use, second space 62 may contain the pourable product and the pressurized sterile gas.

[0081] Advantageously, conditioning device 59 is configured to control a first pressure and a second pressure distinct from the first pressure within second space 62 with product delivery device 8 being controlled in respectively the operational mode and the stop mode.

[0082] Preferentially, conditioning device 59 is configured to control the first pressure to range between 5 kPa to 40 kPa, in particular between 10 kPa to 30 kPa, above

ambient pressure.

[0083] Furthermore, conditioning device 59 may be configured to vary, in use, the first pressure and the second pressure.

[0084] With particular reference to Figures 1 and 2, conditioning device 59 may comprise a gas feeding pipe 63 configured to direct the sterile gas into second space 62. At least a portion of gas feeding pipe 63 is parallel, in particular coaxial, to feeding pipe 21.

[0085] In use, packaging apparatus 1 forms packages 2 filled with a pourable product. In particular, packaging apparatus 1 forms packages 2 from tube 3 formed from web 4, tube 3 being continuously filled with the pourable product.

[0086] In more detail, operation of packaging apparatus 1 comprises to control packaging apparatus 1 into the operational configuration or the stop configuration. When being controlled in the operational configuration, packaging apparatus 1 forms the packages 2 and in the stop configuration packaging apparatus 1 interrupts the formation of packages 2.

[0087] When packaging apparatus 1 is controlled in the operational configuration, product delivery device 8 is set in the operational mode so as to deliver the pourable product to filling device 7, so that the latter direct the pourable product into tube 3, in particular second space 62.

[0088] In more detail, when product delivery device 8 is set in the operational mode, first valve element 42 is controlled into the opening position or one of the intermediate positions. In particular, first valve element 42 may also be controlled between the opening position and the intermediate positions. Furthermore, also second valve element 44 may be moved into the open position or one of the interim positions, in particular second valve element 44 may be moved between the open position and the interim positions.

[0089] Preferentially, the respective positions of first valve element 42 and second valve element 44 are set in dependence of the pressure measured by pressure sensor 49 and/or the flow rate measured by flow meter 50.

[0090] Additionally, while packaging apparatus 1 is controlled into the operational configuration web 4 is advanced along advancement path P (by conveying device 11), tube 3 is formed from web 4 and is longitudinally sealed (by tube forming and sealing device 5, tube 3 advances along tube advancement path Q and is filled (by filling device 7) with the pourable product and packages 2 are formed from tube 3 by shaping and at least transversally sealing, in particular also transversally cutting, tube 3.

[0091] According to some possible embodiments, while packaging apparatus 2 is controlled in the operational configuration conditioning device 59 introduces the sterile gas into second space 62 in order to determine the first pressure within second space 62.

[0092] Furthermore, when packaging apparatus 2 is

set in the stop configuration, e.g. in order to interrupt operation for resuming operation afterwards again or in order to execute a format change or to execute a sterilization-in-place or cleaning-in-place process, product delivery device 8 is set in the stop mode.

[0093] In particular, at least first valve element 42 and/or second valve element 44 are set in respectively the closing position and the closed position. Additionally, third valve element 46 may be set in the shutting position.

[0094] In this way, one guarantees that the delivery of the product to filling device 7 and therewith into tube 3, in particular second space 62 is interrupted.

[0095] Additionally, advancement of web 4 along advancement path P and of tube 3 along tube advancement path Q is interrupted. Furthermore, in particular after the stopping of advancement of web 4 and of tube 3, also web 4 is not formed into tube 3 anymore and not longitudinally sealing needs to be executed anymore. As well, no packages 2 are formed from tube 3.

[0096] According to some possible embodiments, when packaging apparatus 1 is controlled in the stop configuration, conditioning device 59 controls the pressure within second space 62 in order to compensate for the missing pourable product within tube 3 and filling pipe 21.

[0097] The advantages of packaging apparatus 1 according to the present invention will be clear from the foregoing description.

[0098] In particular, by providing for main inlet valve 30 having first valve element 42 to be also controllable into respective intermediate positions it is possible to compensate by controlling the position of first valve element 42 possible fluctuations of the pourable product pressure as originating from external product supply 9 (e.g. as may occur due to setting another packaging apparatus 1 into the stop configuration).

[0099] Another advantage resides in being able to position second valve element 44 in the closed position. In this way, it is substantially possible to avoid the occurrence of underpressure within the parts of product delivery device 8, which are arranged upstream from control valve 33.

[0100] A further advantage resides in that flow tube 55 may comprise at most two sections being connected to one another by means of a gasket element or a barrier element. In this manner, one reduces the risk of any possible suction of air from outer environment 15 into flow tube 55 in the case that underpressure develops within flow tube 55 with product delivery device 8 being in the stop mode.

[0101] Another advantage resides in controlling the pressure within second space 62 when controlling product delivery device 8 into the stop mode. In this way, it is possible to avoid the occurrence of any underpressure.

[0102] Clearly, changes may be made to packaging apparatus 1 as described herein without, however, departing from the scope of protection as defined in the accompanying claims.

Claims

1. A packaging apparatus (1) for forming a plurality of sealed packages (2) filled with a pourable product comprising:

- a tube forming and sealing device (5) configured to form and longitudinally seal a tube (3) from a web of packaging material (4);
- a filling device (7) adapted to direct, in use, a pourable product into the tube (3);
- a product delivery device (8) configured to receive the pourable product from an external product supply (9) and to selectively feed the pourable product along a flow path to and into the filling device (7); and
- a package forming unit (10) configured to at least form and transversally seal the packages (2) from the tube (3);

wherein the product delivery device (8) comprises:

- a main inlet valve (30) having a first inlet (31) and a first outlet (32); and
- a control valve (33) arranged downstream from the main inlet valve (30) and upstream from the filling device (7) along the flow path and having a second inlet (34) and a second outlet (35);

wherein the main inlet valve (30) comprises a first valve element (42) adapted to control a fluid connection between the first inlet (31) and the second outlet (32) and being controllable into at least a closing position at which the first valve element (42) is configured to close the fluidic connection between the first inlet (31) and the first outlet (32); an opening position at which the first valve element (42) is configured to open the fluidic connection between the first inlet (31) and the first outlet (32) and allowing a maximum flow rate of the pourable product; and one or more intermediate positions at each of which the first valve element (42) is configured to allow a respective intermediate flow rate being minor than the maximum flow rate;

and/or

wherein the control valve (33) comprises a second valve element (44) configured to control a fluid connection between the second inlet (34) and the second outlet (35) and being controllable at least into a closed position at which the second valve element (44) is configured to impede the fluidic connection between the second inlet (34) and the second outlet (35); and an open position at which the second valve element (44) is configured to open the fluidic connection between the second inlet (34) and the second outlet (35).

2. Packaging apparatus according to claim 1, further

comprising an auxiliary valve (36) being connectable to the external pourable product supply (9) and having at least a third inlet (37) and a third outlet (38) and the third outlet (38) being in fluidic connection with the first inlet (31); wherein the auxiliary valve (36) also comprises a third valve element (46) being configured to control a fluidic connection between the third inlet (37) and the third outlet (38).

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3. Packaging apparatus according to claim 1 or 2, wherein each intermediate position determines one respective intermediate flow rate being distinct from the others.

4. Packaging apparatus according to any one of the preceding claims, wherein the main inlet valve (30) comprises an actuator (43) coupled to the first valve element (42) and configured to linearly move the first valve element (42) in order to position the first valve element (42) in one of the opening position, the closing position and the intermediate positions.

5. Packaging apparatus according to any one of the preceding claims, further comprising a pressure sensor (49) arranged downstream from the main inlet valve (30) along the flow path for measuring a pressure of the pourable product and/or a flow meter (50) arranged downstream from the main inlet valve (33) along the flow path and configured to measure a flow rate of the pourable product; wherein the main inlet valve (30) and/or the control valve (33) are configured to be controlled as a function of the pressure measured by the pressure sensor (49) and/or the flow rate measured by the flow meter (50).

6. Packaging apparatus according to any one of the preceding claims, further comprising an isolation chamber (13) separating an inner environment (14) from an outer environment (15);

wherein the tube forming and sealing device (5) is configured to form and longitudinally seal the tube (3) within the inner environment (14); wherein the main inlet valve (30) and the control valve (33) are arranged within the outer environment (15).

7. Packaging apparatus according to claim 6, wherein the filling device (7) comprises a filling pipe (21), in use, being at least partially arranged within the tube (3);

wherein the product delivery device (8) comprises a flow tube (55) connected to the second outlet (35) of the control valve (33) and to the filling pipe (21); wherein the flow tube (55) comprises a first por-

- tion (57) being arranged within the outer environment (15);
 wherein the first portion (57) comprises the most two distinct sections connected to one another by a gasket element or a barrier element. 5
8. Packaging apparatus according to any one of the preceding claims, wherein the product delivery device (8) is configured to be set in at least: 10
- an operational mode within which the product delivery device (8) is designed to direct the pourable product to the filling device (7); and
 - a stop mode within which the product delivery device (8) is designed to impede any flow of the pourable product to the filling device (8); 15
- wherein when, in use, the product delivery device (8) is controlled into the stop mode, the first valve element (42) and/or the second valve element (44) are controlled into respectively the closing position and the closed position; and 20
- wherein when the product delivery device (8) is controlled into the operational mode, the first valve element (42) is controlled into the opening position or one of the intermediate positions and/or the second valve element (44) is controlled in the open position or a respective interim position. 25
9. Packaging apparatus according to any one of the preceding claims, further comprising: 30
- a conveying device (11) adapted to advance the web of packaging material (4) along an advancement path (P); 35
 - an isolation chamber (13) separating an inner environment (14) containing a sterile gas from an outer environment (15);
- wherein the tube forming and sealing device (5) is configured to form the tube (3) from the advancing web of packaging material (4) and to longitudinally seal the tube (3) within the inner environment (14). 40
10. Packaging apparatus for forming a plurality of sealed packages (2) filled with a pourable product comprising: 45
- a conveying device (11) adapted to advance a web of packaging material (4) along an advancement path (P); 50
 - an isolation chamber (13) separating an inner environment (14) containing a sterile gas from an outer environment (15);
 - a tube forming and sealing device (5) being at least partially arranged within the isolation chamber (13) and being adapted to form and longitudinally seal a tube (3) from the, in use, 55

advancing web of packaging material (4); wherein the conveying device (11) is also adapted to advance the tube (3) along a tube advancement path (Q);

- a delimiting element (60) arranged, in use, within the tube (3) and designed to divide the tube (3) in a first space (61) being in fluidic connection with the inner environment (11) and a second space (62) being arranged downstream of the first space (61) along the tube advancement path (Q);
- a filling device (7) adapted to direct, in use, a pourable product into the second space (62);
- a product delivery device (8) configured to receive the pourable product from an external product supply (9) and to selectively feed the pourable product along a flow path to and into the filling device (7);
- a conditioning device (59) configured to direct, in use, a flow of sterile gas into the second space (62) of the tube for obtaining a gas pressure within the second space (62) that is higher than the gas pressure within the first space (61); and
- a package forming unit (10) adapted to at least form and transversally seal the packages (2) from the, in use, advancing tube (3);

wherein the product delivery device (8) is configured to be set in at least:

- an operational mode within which the product delivery device (8) is designed to direct the pourable product to the filling device (7); and
- a stop mode within which the product delivery device (8) is designed to impede any flow of the pourable product to the filling device (7);

wherein the conditioning device (59) is configured to control a first pressure and a second pressure distinct from the first pressure within the second space with the product delivery device (8) being controlled in respectively the operational mode and the stop mode.

11. Packaging apparatus according to claim 10, wherein the second pressure is larger than the first pressure.
12. Packaging apparatus according to claim 10 or 11, wherein the pressurizing device (47) is configured to control the first pressure to range between 5 kPa to 40 kPa, in particular between 10 kPa to 30 kPa, above ambient pressure.
13. Packaging apparatus according to any one of claim 10 to 12, wherein the product delivery device (8) comprises:
- a main inlet valve (30) having a first inlet (31)

and a first outlet (32); and
 - a control valve (33) arranged downstream from
 the main inlet valve (30) and upstream from the
 filling device (7) along the flow path and having
 a second inlet (34) and a second outlet (35); 5

wherein the main inlet valve (30) comprises a first
 valve element (42) adapted to control a fluidic con-
 nection between the first inlet (31) and the second
 outlet (32) and being controllable into at least a clos- 10
 ing position at which the first valve element (42) is
 configured to close the fluidic connection between
 the first inlet (31) and the first outlet (32); an opening
 position at which the first valve element (42) is con- 15
 figured to open the fluidic connection between the
 first inlet (31) and the first outlet (32) and allowing a
 maximum flow rate of the pourable product; and one
 or more intermediate positions at each of which the
 first valve element (42) is configured to allow a re- 20
 spective intermediate flow rate being minor than the
 maximum flow rate;

and/or

wherein the control valve (33) comprises a second
 valve element (44) configured to control a fluidic con- 25
 nection between the second inlet (34) and the sec-
 ond outlet (35) and being controllable at least into a
 closed position at which the second valve element
 (44) is configured to impede the fluidic connection
 between the second inlet (34) and the second outlet 30
 (35); and an open position at which the second valve
 element (44) is configured to open the fluidic con-
 nection between the second inlet (34) and the sec-
 ond outlet (35).

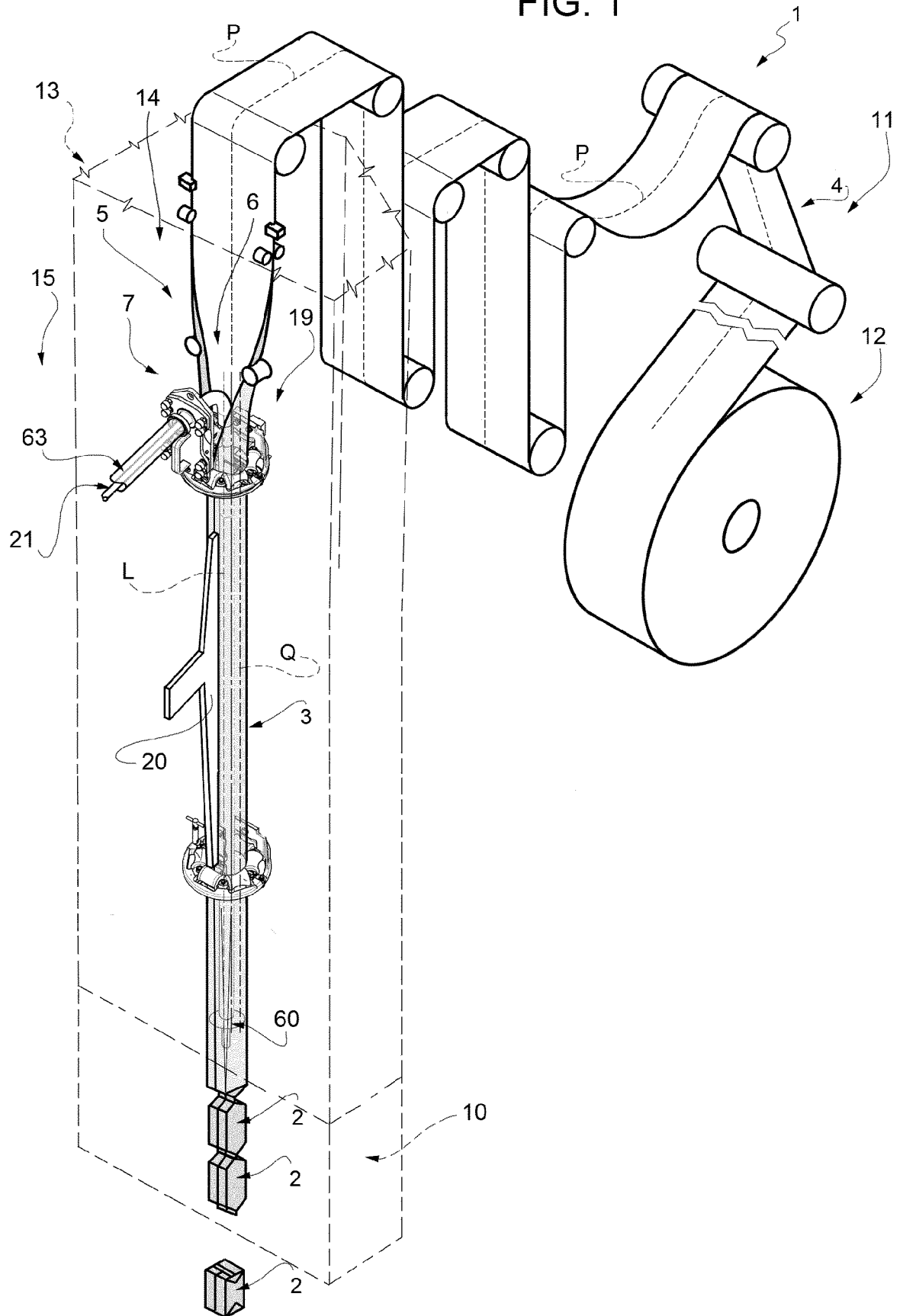
14. Packaging apparatus according to claim 13, further 35
 comprising an auxiliary valve (36) being connectable
 to the external pourable product supply (9) and hav-
 ing at least a third inlet (37) and a third outlet (38)
 and the third outlet (38) being in fluidic connection
 with the first inlet (31); wherein the auxiliary valve 40
 (36) also comprises a third valve element (46) con-
 figured to control a fluidic connection between the
 third inlet (37) and the third outlet (38).

15. Packaging apparatus according to claim 13 or 14, 45
 wherein each intermediate position determines one
 respective intermediate flow rate being distinct from
 the others.

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FIG. 1



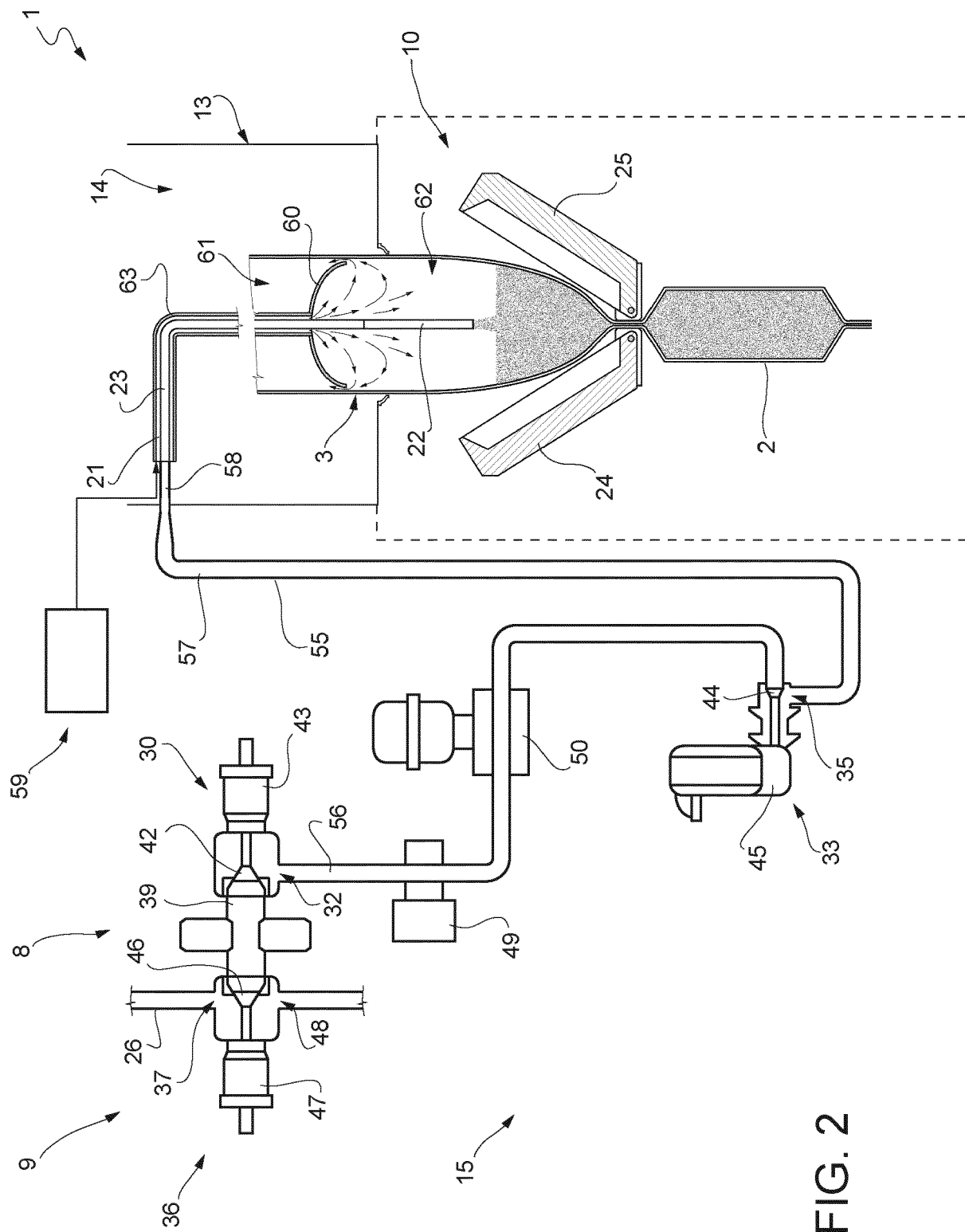


FIG. 3a

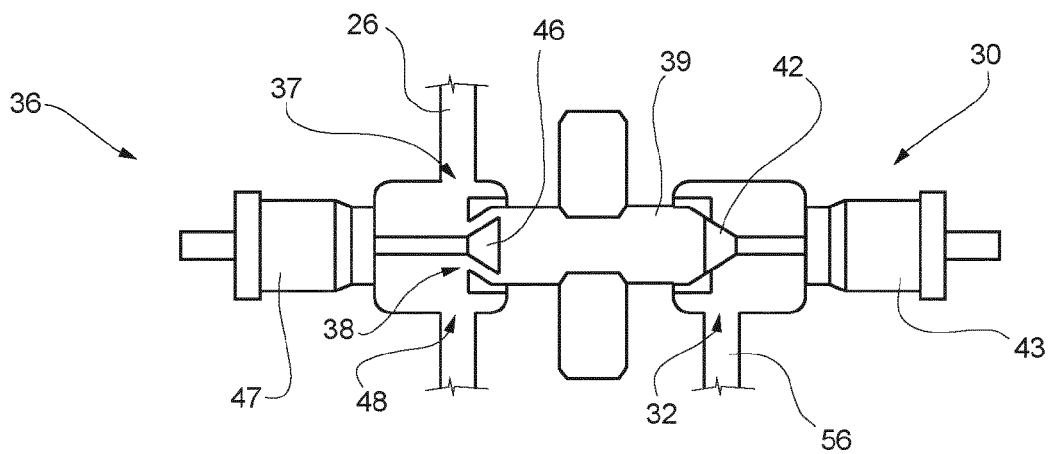


FIG. 3b

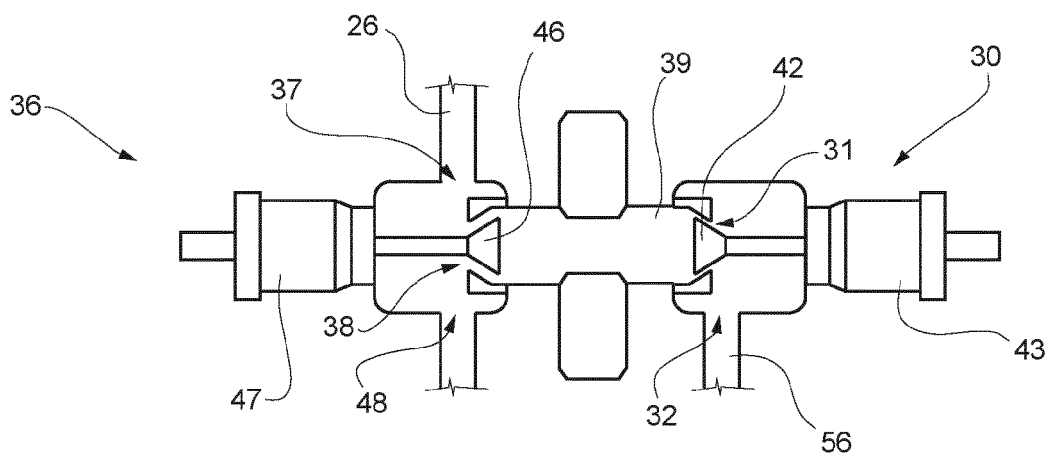


FIG. 3c

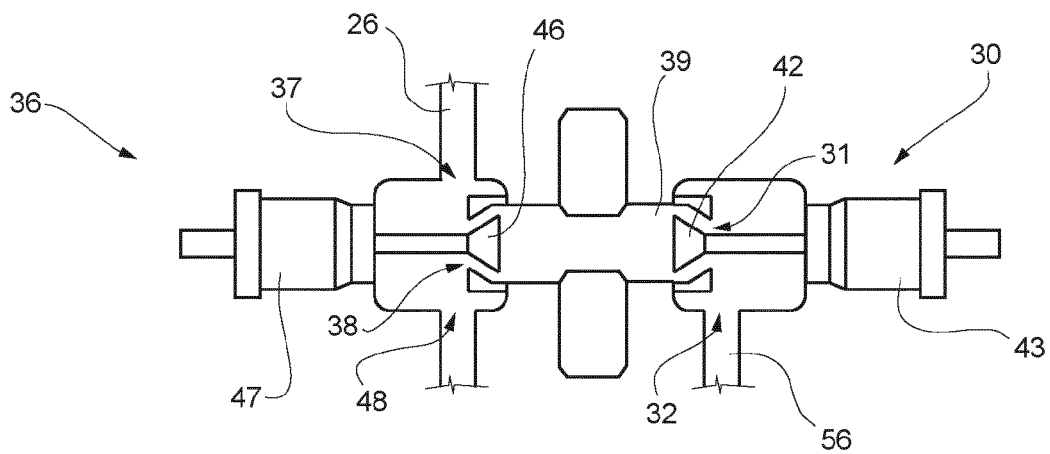


FIG. 4a

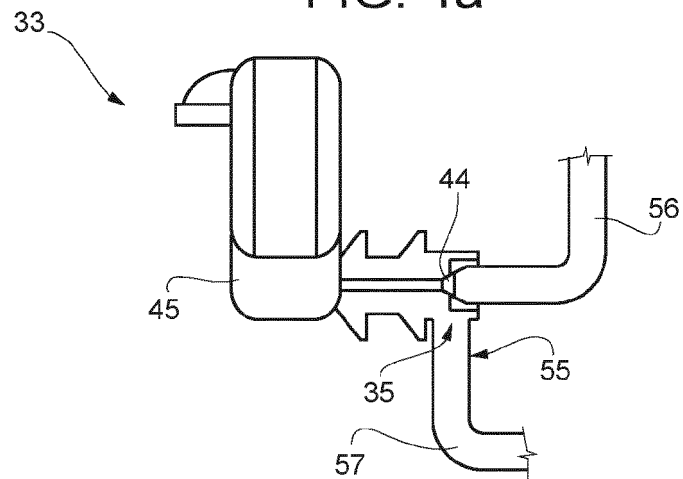


FIG. 4b

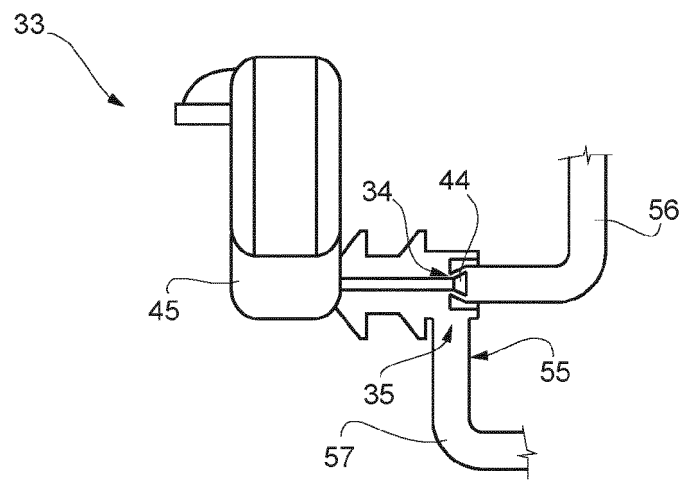


FIG. 4c

