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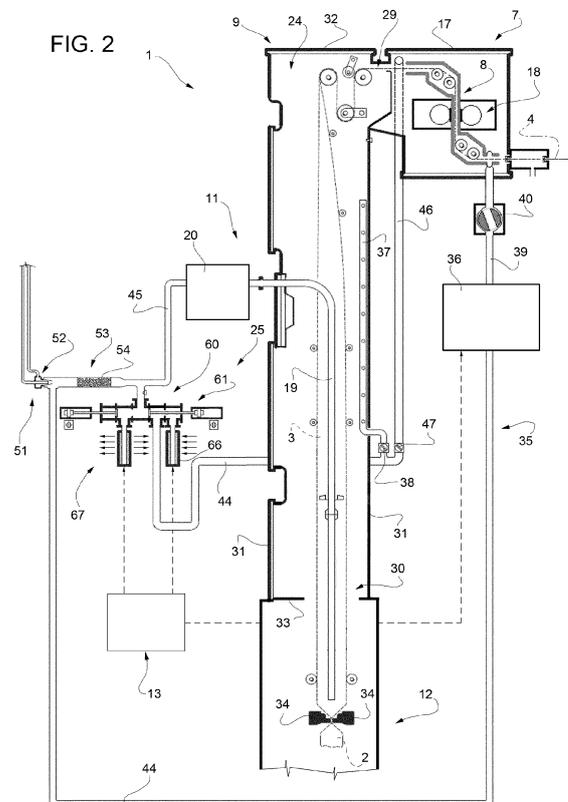
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(54) **PACKAGING MACHINE AND METHOD FOR PRODUCING SEALED PACKAGES**

(57) There is described a packaging machine (1) for producing sealed packages (2) of a pourable product from a web (4) of packaging material comprising a conveying device (5) for advancing a web (4) of packaging material along the web advancement path (P) at least to a tube forming station (6) at which the web (4) of packaging material is formed, in use, into a tube (3) and for advancing the tube (3) along a tube advancement path (Q), an isolation chamber (9), a tube forming and sealing device (10) at least partially arranged within the isolation chamber (9) and configured to form the tube (3) and to longitudinally seal the tube (3), and at least one inlet valve (61) selectively controllable between at least an open configuration in which the inlet valve (61) is configured to allow an inflow of a cooling gas into at least the isolation chamber (9) and a closed configuration in which the inlet valve (61) is in a closed position for impeding an inflow of the cooling gas into the isolation chamber (9).



DescriptionTECHNICAL FIELD

[0001] The present invention relates to a packaging machine for producing sealed packages of a pourable product, in particular a pourable food product.

[0002] The present invention also relates to a method for producing sealed packages of a pourable product, in particular a pourable food product.

BACKGROUND ART

[0003] 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.

[0004] 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 folding and sealing laminated strip packaging material. The packaging material has a multilayer structure comprising a base layer, e.g. of paper, covered on both sides with layers of heat-seal plastic material, e.g. polyethylene. In the case of aseptic packages for long-storage products, such as UHT milk, the packaging material also comprises a layer of oxygen-barrier material (an oxygen-barrier layer), e.g. an aluminum foil, which is superimposed on a layer of heat-seal plastic material, and is in turn covered with another layer of heat-seal plastic material forming the inner face of the package eventually contacting the food product.

[0005] Packages of this sort are normally produced on fully automatic packaging machines, which advance a web of packaging material from a magazine unit through a sterilization apparatus for sterilizing the web of packaging material and into an isolation chamber (a closed and at least in part sterile environment) in which the sterilized web of packaging material is maintained and advanced. During advancement of the web of packaging material through the isolation chamber, the web of packaging material is folded and sealed longitudinally to form a tube having a longitudinal seal, which is further fed along a vertical advancing direction through the isolation chamber and into a package forming unit of the packaging machine.

[0006] In order to complete the forming operations, the tube is filled with a sterilized or sterile-processed pourable product, in particular a pourable food product, and is subsequently formed for at least partially defining the final shape of the package, transversally sealed and subsequently cut along equally spaced transversal cross sections within the package forming unit during advancement along the vertical advancing direction.

[0007] Pillow packages are so obtained within the packaging machine, each pillow package having a longitudinal sealing band, a top transversal sealing band and a bottom transversal sealing band.

[0008] A typical packaging machine comprises a conveying device for advancing the web of packaging material along a web advancement path and a tube formed from the web of packaging material along a tube advancement path, a sterilizing apparatus for sterilizing the web of packaging material prior to its formation into the tube, a tube forming and sealing device at least partially arranged within an isolation chamber and being configured to form the tube from the advancing web of packaging material and to longitudinally seal the tube, a filling device for filling the tube with the pourable product and a package forming unit adapted to form, transversally seal and cut the single packages from the tube of packaging material.

[0009] A typical packaging machine also comprises a sterilization device configured to sterilize the isolation chamber and other critical components of the packaging machine prior to the activation of a production cycle of the packaging machine. Such a sterilization device allows to execute a so-called sterilization-in-place (SIP) cycle.

[0010] A commonly used sterilization device is based on the injection of vaporized hydrogen peroxide and the condensation of the hydrogen peroxide on the inner surfaces of the isolation chamber and the other components such as various flow conducts of the packaging machine to be sterilized.

[0011] A drawback of these packaging machines is that, in use, various components of the packaging machine, e.g. the isolation chamber, heat up. Therefore, during the termination of a production cycle, it is required to wait for a significant time interval before a technical operator may access the isolation chamber and other portions of the packaging machine.

[0012] Another drawback of these packaging machines resides in the fact that it may occur that the sterilization-in-place cycle needs to be repeated in order to obtain the desired sterility. However, immediately after the termination of one sterilization-in-place cycle the inner surfaces have temperatures, which are too high for allowing a reliable condensation of the hydrogen peroxide. This is why it becomes necessary to wait for a significant time interval before it becomes possible to execute a further sterilization-in-place cycle.

DISCLOSURE OF INVENTION

[0013] It is therefore an object of the present invention to provide a packaging machine to overcome, in a straightforward manner, at least one of the aforementioned drawbacks.

[0014] It is a further object of the present invention to provide a method for producing sealed packages to overcome, in a straightforward manner, at least one of the aforementioned drawbacks.

[0015] According to the present invention, there is provided a packaging machine and a method for producing sealed packages according to the independent claims.

[0016] Preferred embodiments are claimed in the dependent claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017] 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 machine according to the present invention, with parts removed for clarity;

Figure 2 is a schematic view of portions of the packaging machines of Figure 1, with parts removed for clarity;

Figure 3 is a schematic view of a detail of the packaging machine of Figures 1 and 2 in a first configuration, with parts removed for clarity; and

Figure 4 is a schematic view of the detail of Figure 3 in a second configuration, with parts removed for clarity.

BEST MODES FOR CARRYING OUT THE INVENTION

[0018] Number 1 indicates as a whole a packaging machine for producing sealed packages 2 of a pourable product, in particular a pourable food product such as pasteurized milk, fruit juice, wine, tomato sauce, etc., from a tube 3 of a web 4 of packaging material. In particular, in use, tube 3 extends along a longitudinal axis, preferentially having a vertical orientation.

[0019] Web 4 comprises at least a layer of fibrous material, in particular paper, covered on both sides with respective layers of heat-seal plastic material, e.g. polyethylene.

[0020] In a non-limiting embodiment, web 4 also comprises a layer of gas- and light-barrier material, e.g. aluminum foil or ethylene vinyl alcohol (EVOH) film, and at least a first layer and a second layer of heat-seal plastic material. The layer of gas- and light-barrier material is superimposed on the first layer of heat-seal plastic material, and is in turn covered with the second layer of heat-seal plastic material. The second layer of heat-seal plastic material forms the inner face of package 2 eventually contacting the filled pourable food product.

[0021] More specifically, web 4 comprises a first face and a second face, in particular the first face being the face of web 4 forming the inner face of the formed package 2 eventually contacting the filled pourable food product.

[0022] A typical package 2 obtained by packaging machine 1 comprises a longitudinal seam portion and a pair of transversal sealing bands, in particular a transversal top sealing band and a transversal bottom sealing band.

[0023] With particular reference to Figure 1, packaging machine 1 is configured to advance web 4 along a web advancement path P, preferably to sterilize web 4 during advancement along path P, to form and longitudinally

seal tube 3 from web 4, preferably to fill tube 3 with the pourable product and, preferentially to form single packages 2 from the filled tube 3.

[0024] With particular reference to Figures 1 and 2, preferably, packaging machine 1 comprises:

- a conveying device 5 configured to advance web 4 along a web advancement path P at least to a tube forming station 6 at which web 4 is formed, in use, into tube 3 and for advancing tube 3 along a tube advancement path Q;
- preferentially, a sterilization apparatus 7 for sterilizing at least a portion of web 4, preferentially at least the first face, even more preferentially the first face and the second face, at a sterilization station 8 arranged upstream of tube forming station 6 along web advancement path P;
- an isolation chamber 9 extending along a longitudinal axis A, preferentially having a vertical orientation;
- a tube forming and sealing device 10 at least partially arranged within isolation chamber 9 and being configured to form and longitudinally seal tube 3 at tube forming station 6, in particular within at least a portion of isolation chamber 9;
- preferably, a filling device 11 for filling tube 3 with the pourable product; and
- preferably, a package forming unit 12 adapted to at least form and transversally seal tube 3, preferentially to also transversally cut tube 3, between successive packages 2, in particular during advancement of tube 3 along tube advancement path Q.

[0025] In a preferred but non-limiting embodiment, packaging machine 1 also comprises a control unit 13 for controlling operation of packaging machine 1 itself.

[0026] In a preferred but non-limiting embodiment, packaging machine 1 also comprises a magazine unit adapted to host and to provide for web 4 at a host station.

[0027] In more detail, sterilization station 8 is arranged upstream of tube forming station 6 along web advancement path P. In other words, sterilization apparatus 7 is arranged upstream of isolation chamber 9 along path P. In particular, sterilization apparatus 7 is arranged such to sterilize web 4 prior to web 4 being, in use, formed into tube 3.

[0028] Preferentially, sterilization apparatus 7 is arranged downstream of the magazine unit along path P.

[0029] In particular, package forming unit 12 is arranged downstream of isolation chamber 9 and tube forming and sealing device 10 along path Q.

[0030] In more detail, conveying device 5 is adapted to advance tube 3 and any intermediate of tube 3 in a manner known as such along path Q, in particular from tube forming station 6 through isolation chamber 9, in particular towards and at least partially through package forming unit 12.

[0031] In particular, with intermediates of tube 3 any configuration of web 4 is meant prior to obtaining the tube

structure and after folding of web 4 by tube forming and sealing device 10 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 opposite lateral edges of web 4 with one another.

[0032] With particular reference to Figure 2, sterilization apparatus 7 is configured to sterilize web 4, in particular the first face, even more particular also the second face, by means of physical sterilization such as by means of a sterilization irradiation, in particular an electromagnetic irradiation, even more particular by electron beam irradiation.

[0033] Alternatively, sterilization apparatus 7 could be configured to sterilize web 4, in particular the first face, even more particular also the second face, by means of chemical sterilization, in particular by means of hydrogen peroxide.

[0034] In more detail, sterilization apparatus 7 comprises a, preferentially shielded, sterilization chamber 17 and is configured to sterilize at least the first face, preferentially also the second face, of web 4 during advancement of web 4 through sterilization chamber 17.

[0035] More specifically, sterilization apparatus 7 also comprises an irradiation device 18 configured to direct the sterilization irradiation, in particular the electromagnetic irradiation, even more particular the electron beam irradiation onto at least the first face, preferably onto the first face and the second face, of web 4.

[0036] Preferably, irradiation device 18 is arranged within sterilization chamber 17.

[0037] Preferentially, at least portions of sterilization chamber 17 comprise a shielding material adapted to shield the sterilization irradiation.

[0038] With particular reference to Figure 2, filling device 11 comprises at least a filling tube 19 being in fluid connection with a pourable product storage tank (not shown and known as such) and partially extending within isolation chamber 9. In particular, in use, filling tube 19 is partially placed within tube 3 for feeding the pourable product into the, in use, advancing tube 3.

[0039] Preferably, filling device 11 also comprises a conditioning unit 20 being in fluid connection with the pourable product storage tank and filling tube 19 and configured to condition the pourable product prior to directing the pourable product through filling tube 19 into tube 3. In particular, conditioning unit 20 is interposed between the pourable product storage tank and filling tube 19.

[0040] With particular reference to Figures 1 and 2, tube forming and sealing device 10 comprises at least a tube forming group 21 configured to form tube 3 from web 4, in particular by overlapping the respective lateral edges of web 4, and at least a sealing head 22 configured to longitudinally seal tube 3, in particular along the portion of tube 3 obtained by the overlapping of the lateral edges of web 4.

[0041] More specifically, tube forming group 21 and sealing head 22 are arranged within isolation chamber 9.

[0042] In more detail, tube forming group 21 comprises at least a plurality of forming ring assemblies 23, in the particular example shown two, being adapted to fold web 4 gradually into tube 3. In particular, forming ring assemblies 23 are arranged within parallel and spaced apart planes, in particular being orthogonal to axis A, even more specifically having a substantially horizontal orientation. Preferably, the forming ring assembly 23 arranged downstream of the other one is designed to also exert a mechanical force on tube 3, in particular for promoting the longitudinal sealing of tube 3.

[0043] With particular reference to Figures 1 and 2, isolation chamber 9 separates an, in particular aseptic, inner environment 24 from an outer environment 25. This allows to form tube 3 within a controlled atmosphere.

[0044] Preferably, isolation chamber 9 comprises an inlet passage 29 configured to enable entrance of the, in use, advancing web 4 into isolation chamber 9 and an outlet passage 30 configured to enable exit of the, in use, advancing tube 3.

[0045] In a preferred non-limiting embodiment, isolation chamber 9 is in fluid connection with sterilization apparatus 7, in particular sterilization chamber 17, and is configured to receive the, in use, advancing web 4, in particular through inlet passage 29, from sterilization apparatus 7.

[0046] Preferably, isolation chamber 9 is also in fluid connection with package forming unit 12 and is configured to direct the, in use, advancing tube 3, from isolation chamber 9 itself, in particular through outlet passage 30, into package forming unit 12. Preferentially, isolation chamber 9 and/or package forming unit 12 is or are configured and/or conditioned such to impede any gas flow from package forming unit 12 into isolation chamber 9.

[0047] In more detail, isolation chamber 9 comprises a plurality of lateral walls 31, in particular extending substantially parallel to axis A, and at least one upstream wall 32 and at least one downstream wall 33 for delimiting inner environment 24. Preferentially, upstream wall 32 and downstream wall 33 are separated from one another and are transversal to lateral walls 31.

[0048] With particular reference to Figure 2, package forming unit 12 comprises a plurality of complementary pairs of operative units 34 (only one pair being partially shown) configured to at least shape and transversally seal, in particular also to transversally cut, packages 2, in particular between successive packages 2.

[0049] Advantageously but not necessarily, packaging machine 1 also comprises a flow circuit 35 configured to at least allow the introduction and the extraction of gas respectively into and out of isolation chamber 9.

[0050] Preferably, packaging machine 1 also comprises a gas control unit 36 being, in particular fluidically, connected to flow circuit 35 and being configured to at least control a flow of gas within flow circuit 35, preferentially for controlling an inflow into isolation chamber 9 and, preferentially, also an outflow from isolation chamber 9.

[0051] Preferentially but not necessarily, gas control unit 36 is also configured to condition, in particular to control the temperature of, even more particular to heat, the gases of the flow of gas.

[0052] Even more preferentially but not necessarily, gas control unit 36 comprises a heating device for heating the gases. In particular, gas control unit 36, in particular the heating device, is configured to heat the gases during a sterilization of at least isolation chamber 9 and/or flow circuit 35 and/or gas control unit 36 itself.

[0053] In more detail, flow circuit 35 comprises at least an inlet conduct 37 configured to inject, in particular in a controlled manner, gas into isolation chamber 9 and, preferentially being in or being controllable to be in fluidic connection with gas control unit 36.

[0054] More specifically, inlet conduct 37 comprises a portion being arranged within isolation chamber 9, in particular extending parallel to axis A, and preferentially being provided with a plurality of injection nozzles.

[0055] Preferentially, flow circuit 35 also comprises a control valve 38 configured to control a flow of gas into, through and out of inlet conduct 37.

[0056] In a preferred but non-limiting embodiment, flow circuit 35 also comprises an outlet conduct 39 configured to enable a (controlled) extraction of gas from isolation chamber 9. Preferably, outlet conduct 39 is or can be in fluidic communication with gas control unit 36.

[0057] Preferentially, flow circuit 35 also comprises a flow regulating valve 40, in particular being arranged within outlet conduct 39, for controlling the outflow of gas through outlet conduct 39.

[0058] In the specific non-limiting embodiment disclosed, outlet conduct 39 is fluidically connected or connectable to sterilization apparatus 7, in particular sterilization chamber 17, for enabling a flow of gas from isolation chamber 9 through sterilization apparatus 7, in particular sterilization chamber 17, into outlet conduct 39.

[0059] In a preferred but non-limiting embodiment, flow circuit 35 comprises also an intermediate flow conduct 44 being interposed between and being fluidically connected or connectable to gas control unit 36 and inlet conduct 37. In other words, intermediate flow conduct 44 fluidically connects inlet conduct 37 with gas control unit 36.

[0060] In a preferred but non-limiting embodiment, flow circuit 35 also comprises a coupling conduct 45 for fluidically connecting to at least a portion of filling device 11, in particular to at least conditioning unit 20.

[0061] In a preferred but non-limiting embodiment, flow circuit 35 also comprises a further injection tube 46 configured to inject gas into sterilization apparatus 7, in particular into sterilization chamber 17. Preferentially, injection tube 46 is configured to inject the gas in the area of an interface between sterilization apparatus 7 and isolation chamber 9. Preferably, flow circuit 35 also comprises a further control valve 47 configured to control the flow of gas through injection tube 46.

[0062] In a preferred non-limiting embodiment, gas

control unit 36 is also configured to pressurize and, preferentially also to sterilize, a gas, in particular while packaging machine 1 is controlled into a production configuration in which packaging machine 1 produces packages 2, for injecting a pressurized (and sterile) gas into isolation chamber 9.

[0063] With particular reference to Figure 2, packaging machine 1 also comprises a sterilization device 51 configured to sterilize, in particular at least by means of a chemical sterilizing agent, at least portions of packaging machine 1 itself. Preferentially, sterilization device 51 is configured to at least sterilize isolation chamber 9 and, preferably also the components of packaging machine 1 arranged within isolation chamber 9, such as e.g. sealing head 22 and tube forming group 21.

[0064] In a preferred but non-limiting embodiment, sterilization device 51 is also configured to sterilize at least portions of flow circuit 35, in particular at least inlet conduct 37, preferentially also outlet conduct 39, even more preferentially also intermediate flow conduct 44.

[0065] Preferably, sterilization device 51 is also configured to sterilize at least portions of gas control unit 36.

[0066] In a most preferred but non-limiting embodiment, sterilization device 51 is also configured to sterilize injection tube 46 and, preferably also coupling conduct 45.

[0067] Preferably, sterilization device 51 is also configured to sterilize at least portions of filling device 11, in particular filling tube 19, even more particular also conditioning unit 20.

[0068] In more detail, sterilization device 51 comprises at least an injection unit 52 configured to inject a chemical sterilization agent, in particular hydrogen peroxide, and a vaporizing unit 53 configured to vaporize the chemical sterilization agent.

[0069] Preferentially, injection unit 52 and vaporizing unit 53 are in fluid communication with flow circuit 35, in particular so that, in use, the vaporized chemical agent becomes distributed within at least isolation chamber 9, preferentially within isolation chamber 9 and flow circuit 35, even more preferentially also within sterilization chamber 17.

[0070] In a preferred but non-limiting embodiment, vaporizing unit 53 comprises a heating group 54 arranged within flow circuit 35, in particular within intermediate flow conduct 44, and injection unit 52 is configured to inject the chemical agent into flow circuit 35, in particular into intermediate flow conduct 44, so that the chemical agent gets, in use, into contact with heating group 54 for vaporizing upon contact with heating group 54.

[0071] With particular reference to Figures 2 to 4, packaging machine 1 also comprises a ventilation device 60 configured to at least control the introduction of a cooling gas within at least isolation chamber 9, in particular within flow circuit 35 and isolation chamber 9. Preferentially, ventilation device 60 is also configured to control the evacuation of gases from at least isolation chamber 9, in particular from flow circuit 35 and isolation chamber 9.

[0072] In a preferred non-limiting embodiment, ventilation device 60 is also configured to evacuate hot gases from gas control unit 36.

[0073] In the following, a cooling gas is defined by a gas having a temperature of below 40 °C, preferentially having a temperature being equal or below room temperature.

[0074] In a preferred but non-limiting embodiment, the cooling gas (directly) originates from outer environment 25.

[0075] Furthermore, a hot gas is defined by a gas having a temperature above 40 °C.

[0076] It is to be noted that, in use, during a sterilization of isolation chamber 9, before sterilizing isolation chamber 9 by means of the chemical agent, the temperature of isolation chamber 9 should preferably be around 40 °C so as to increase the efficiency of the overall sterilization process of isolation chamber 9, in particular for improving the condensation of the vaporized chemical agent. Thus, the cooling gas should have a temperature below 40 °C in order to speed up the cooling time of isolation chamber 9.

[0077] Preferentially, ventilation device 60 is controlled by control unit 13, in particular in function of an operational mode of packaging machine 1.

[0078] Preferably, control unit 13 is configured to activate ventilation device 60 after a shutdown and/or an interruption of the production of packages 2 by packaging machine 1 and/or before or during an activation of sterilization device 51 for at least sterilizing isolation chamber 9. In this way, ventilation device 60 allows to speed up the cooling down of at least isolation chamber 9.

[0079] In more detail, packaging machine 1, in particular ventilation device 60 comprises an inlet valve 61 selectively controllable between at least:

- an open configuration (see Figures 2 and 3) in which inlet valve 61 is configured to allow an (controlled) inflow of the cooling gas into at least isolation chamber 9, in particular through inlet valve 61 itself; and
- a closed configuration (see Figure 4) in which inlet valve 61 is configured to impede an inflow of the cooling gas into isolation chamber 9, in particular through inlet valve 61 itself.

[0080] Preferentially, inlet valve 61 is configured to selectively establish a fluid connection between inner environment 24 and outer environment 25 for selectively allowing or impeding an inflow of gas from outer environment 25 as the cooling gas into at least inner environment 24. In other words, inlet valve 61 is configured to selectively establish or to impede a controlled fluid connection between inner environment 24 and outer environment 25.

[0081] Preferentially, inlet valve 61 is connected to flow circuit 35, in particular intermediate flow conduct 44, and is configured to direct the cooling gas into isolation chamber 9 through flow circuit 35, in particular through inlet conduct 37, even more particular through intermediate

flow conduct 44 and inlet conduct 37, when being controlled into the open configuration. Preferentially, when being controlled into the open configuration, inlet valve 61 establishes a fluid connection between flow circuit 35 and outer environment 25; and in particular when being controlled into the closed configuration, inlet valve 61 impedes a fluid connection between flow circuit 35 and outer environment 25.

[0082] In a preferred non-limiting embodiment, inlet valve 61 when being controlled into the open configuration is also configured to impede gas flowing from isolation chamber 9 back into isolation chamber 9 itself. In particular, when being controlled into the open configuration inlet valve 61 impedes a flow of gas from isolation chamber 9 through outlet conduct 39 and intermediate conduct 44 back into inlet conduct 37.

[0083] In more detail, inlet valve 61 comprises at least one shutter element 62 being controllable into at least an open position and a closed position in which shutter element 62 is configured to respectively allow and impede at least an outflow of gas from inlet valve 61.

[0084] In the preferred but non-limiting embodiment disclosed, inlet valve 61 also comprises an actuator 63 configured to move shutter element 62 between the respective open position and the respective closed position.

[0085] Preferentially, inlet valve 61 is in its open configuration and closed configuration with shutter element 62 being respectively in its open position and closed position.

[0086] In even more detail, inlet valve 61 also comprises at least an intake portion 64 for receiving the cooling gas, in particular the gas from outer environment 25, and at least an outlet portion 65 for allowing the outflow of the cooling gas from inlet valve 61, in particular (directly) into flow circuit 35. In particular, inlet valve 61 is connected to flow circuit 35 in the area of outlet portion 65.

[0087] In the preferred but non-limiting embodiment disclosed, shutter element 62 interacts with an engagement surface of outlet portion 65 when being in its closed position for impeding an outflow of gas from inlet valve 62.

[0088] In a preferred but non-limiting embodiment, inlet valve 61 comprises at least one filter element 66 configured to filter the cooling gas, in particular for removing contaminations, in particular macroscopic contaminations from the cooling gas. This allows to avoid the introduction of in particular macroscopic contaminations into isolation chamber 9 during the introduction of the cooling gas.

[0089] In a preferred but non-limiting embodiment, packaging machine 1, in particular ventilation device 60 also comprises an outlet valve 67 configured to be controlled between at least:

- an open configuration (see Figures 2 and 3) in which the outlet valve 67 is configured to allow gas to exit, in particular from at least isolation chamber 9 and/or flow circuit 35 and/or gas control unit 36, through

outlet valve 67, in particular into outer environment 25; and

- a closed configuration (see Figure 4) in which outlet valve 67 is configured to impede the outflow of gas, in particular from at least isolation chamber 9 and/or from flow circuit 35 and/or from gas control unit 36, through outlet valve 67.

[0090] In particular, by providing for outlet valve 67 it is possible to release hot gas from packaging machine 1, in particular the hot gas results from the gases circulating within isolation chamber 9 and/or flow circuit 35 and/or gas control unit 36, which allows to further increase the cooling down of at least isolation chamber 9.

[0091] Preferentially, outlet valve 67 is connected to flow circuit 35, in particular intermediate flow conduct 44, and is configured to allow the controlled outflow of gases out of at least isolation chamber 9 and/or flow circuit 35 and/or gas control unit 36.

[0092] As outlet valve 67 is similar to inlet valve 61, in the following outlet valve 67 is only described with respect to the differences to inlet valve 61, using the same references for similar or equivalent parts.

[0093] In particular, outlet valve 67 differs from inlet valve 61 in comprising intake portion 68 configured to receive gas from isolation chamber 9 and/or flow circuit 35 and/or gas control unit 36, in particular directly from flow circuit 35, and in further comprising outlet portion 69 configured to allow the exit of gas from outlet valve 67. In particular, outlet valve 67 is connected to flow circuit 35 in the area of intake portion 68.

[0094] In a preferred but non-limiting embodiment, control unit 13 is configured to control at least inlet valve 61, and preferentially also outlet valve 67, between the respective open configuration and the respective closed configuration.

[0095] Preferentially, control unit 13 is configured to selectively control inlet valve 61 into the open configuration after a shutdown and/or an interruption of the production of packages 2 by packaging machine 1 and/or prior or during an activation of sterilization device 51 for at least sterilizing isolation chamber 9, even more preferentially also flow circuit 35 and gas control unit 36.

[0096] Preferably, control unit 13 is configured to control outlet valve 67 into the open configuration when controlling inlet valve 61 into the open configuration (see e.g. Figure 2 and Figure 3). In this way, it is possible to keep the overall volume of gas circulating within at least isolation chamber 9 and/or flow circuit 35 and/or gas control unit 36 substantially constant.

[0097] In a preferred but non-limiting embodiment, packaging machine 1, in particular gas control unit 36, comprises an aspiration device, e.g. a compressor, configured to generate a flow of cooling gas at least through inlet valve 61 into isolation chamber 9 and/or flow circuit 35 and/or gas control unit 36 itself (with inlet valve 61 being controlled into the open configuration). Preferentially, the aspiration device is also configured to generate

a flow of gas from isolation chamber 9 and/or flow circuit 35 and/or gas control unit 36 to outlet valve 67 (so that gas can exit through outlet valve 67 when being controlled into the respective open configuration).

[0098] More specifically, the aspiration device is configured to generate a depression within isolation chamber 9 for generating the flow of cooling gas through inlet valve 61 into isolation chamber 9.

[0099] Preferentially, the aspiration device is in fluid connection with flow circuit 35. In particular, the aspiration device is in fluid connection with and is interposed between outlet conduct 39 and intermediate flow conduct 44.

[0100] In use, packaging machine 1 forms packages 2 filled with the pourable product.

[0101] Operation of packaging machine 1 comprises at least a main production cycle during which packages 2 are produced and a ventilation cycle during which isolation chamber 9 becomes ventilated with the cooling gas.

[0102] Preferentially, operation of packaging machine 1 also comprises a step of sterilizing at least portions of isolation chamber 9 (for obtaining an aseptic inner environment 24), in particular also flow circuit 35, even more particular also portions of sterilization apparatus 7 (preferentially, at least portions of sterilization chamber 17).

[0103] In more detail, the main production cycle comprises at least the following steps:

- advancing web 4 along advancement path P;
- folding web 4 within an isolation chamber 9 into tube 3 at tube forming station 6;
- longitudinally sealing tube 3 within isolation chamber 9;
- filling tube 3 with the pourable product;
- advancing tube 3 along path Q, in particular towards and at least partially through package forming unit 12; and
- preferentially, obtaining single packages 2 from tube 3 by forming tube 3, transversally sealing tube 3 between successive packages 2 and, in particular transversally cutting tube 3 between successive packages 2 for obtaining single packages 2.

[0104] In a preferred non-limiting embodiment, the method also comprises a step of web sterilization, during which at least the first face, in particular also the second face, of web 4 is sterilized at sterilization station 8. In particular, the step of web sterilization is executed before the step of folding.

[0105] In more detail, the step of web sterilization comprises at least a sub-step of directing a sterilizing irradiation, in particular electromagnetic irradiation, even more particular electron beam irradiation, onto at least the first face, preferentially also onto the second face, of web 4 is executed.

[0106] During the step of folding tube 3, tube forming and sealing device 10 gradually overlaps the opposite

lateral edges of web 4 with one another so as to form a longitudinal seal.

[0107] During the step of longitudinally sealing tube 3, tube forming and sealing device 10 seals the longitudinal seal.

[0108] During the step of advancing tube 3, conveying device 5 advances tube 3 (and any intermediates of tube 3), in particular through isolation chamber 9, along path Q to package forming unit 12.

[0109] During the step of filling tube 3, filling device 11 fills the pourable product into the longitudinally sealed tube 3.

[0110] During the step of obtaining single packages 2, package forming unit 12 forms and transversally seals tube 3 between successive packages 2 and, preferentially, also transversally cuts tube 3 between successive packages 2.

[0111] In more detail, preferentially the step of sterilizing, is executed before the main production cycle.

[0112] More specifically, the step of sterilizing comprises at least a sub-step of injection during which a chemical agent, in particular a vaporized chemical agent, is injected at least into isolation chamber 9, in particular so as to sterilize inner environment 24 and at least the portions of tube forming and sealing device 10 being arranged within isolation chamber 9.

[0113] Preferentially, during the sub-step of injection the chemical agent is injected into flow circuit 35 and becomes distributed within at least flow circuit 35 and isolation chamber 9.

[0114] In more detail, during the sub-step of injection sterilization device 51 injects the chemical agent. In particular, injection unit 52 injects the chemical agent and upon interaction with vaporizing unit 53, in particular heating group 54, the vaporized chemical agent is generated.

[0115] In a preferred non-limiting embodiment, the step of sterilizing comprises also at least a sub-step of heating during which a heated gas is introduced into at least isolation chamber 9 and/or flow circuit 35 and/or gas control unit 36. Preferably, the sub-step of heating is executed before the sub-step of injection.

[0116] In a preferred non-limiting embodiment, during the sub-step of heating the heated gas is generated by gas control unit 36, in particular the heating device of gas control unit 36.

[0117] Preferably but not necessarily, during or after the sub-step of heating outlet valve 67 is controlled into its respective open configuration and is controlled back into its respective closed configuration before the sub-step of injection. In particular, during the step of sterilizing inlet valve 61 is controlled and/or is kept in its respective closed configuration.

[0118] In one preferred non-limiting embodiment, the ventilation cycle is executed if the step of sterilizing needs to be repeated. This may be necessary if during a first step of sterilizing the required sterility is not obtained. By activating the ventilation cycle, it is possible to speed up

the cooling down of at least isolation chamber 9 and/or flow circuit 35 and/or gas control unit 36. The cooling down is required so as to promote the condensation of the chemical agent onto the parts to be sterilized.

[0119] In an alternative preferred non-limiting embodiment, the ventilation cycle is executed before the step of sterilizing for controlling the temperature of at least the components of isolation chamber 9 to be sterilized.

[0120] In more detail, the ventilation cycle is executed before or after the main production cycle. In particular, the ventilation cycle is executed before the main production cycle if two successive steps of sterilization are required.

[0121] Preferentially, the ventilation cycle comprises at least a step of cooling, during which inlet valve 61 is controlled into the open configuration so that the cooling gas flows through the inlet valve 61 into at least isolation chamber 9, in particular also into flow circuit 35 and/or gas control unit 36.

[0122] More specifically, the cooling gas originates from outer environment 25 and flows from the outer environment 25 through the inlet valve 61 into isolation chamber 9 and/or flow circuit 35 and/or gas control unit 36 with inlet valve 61 being controlled into the respective open configuration.

[0123] Preferentially, the cooling gas flows through inlet valve 61 into flow circuit 35, in particular through intermediate flow conduct 44 and inlet conduct 37, into isolation chamber 9.

[0124] In a preferred but non-limiting embodiment, the cooling gas flows through inlet conduct 37 into isolation chamber 9, preferably then into sterilization chamber 17, then through outlet conduct 39 into gas control unit 36.

[0125] Preferably, the ventilation cycle also comprises a step of extraction during which gas is directed through outlet valve 67, in particular out and away from at least isolation chamber 9 and/or flow circuit 35 and/or gas control unit 36.

[0126] During the step of extraction, outlet valve 67 is controlled into the open configuration so that the gas originating from at least isolation chamber 9 and/or flow circuit 35 and/or gas control unit 36 exits through outlet valve 67.

[0127] Preferentially, control unit 13 controls outlet valve 67 into the respective open configuration with inlet valve 61 being in the respective open configuration (see Figures 2 and 3). In this way, it is possible to remove the gases, which become heated up while being in contact with heated portions of e.g. isolation chamber 9 and/or flow circuit 35 and/or gas control unit 36, and to continue to introduce the cooling gas. In this way, it is also possible to retain the overall volume of gases circling within isolation chamber 9 and/or flow circulation 35 and/or gas control unit 36, constant.

[0128] Preferentially, the ventilation cycle also comprises a step of aspiration during which the aspiration device creates, in particular by creating a depression within isolation chamber 9, a flow of cooling gas through

inlet valve 61 and into isolation chamber 9. Preferentially, the aspiration device creates also a flow of gas from isolation chamber 9 to gas control unit 36, in particular through sterilization apparatus 7 (even more particular, through sterilization chamber 17) and outlet conduct 39.

[0129] In a preferred non-limiting embodiment, the ventilation cycle also comprises a step of closing, during which at least inlet valve 61, preferentially also outlet valve 67, is/are controlled into the respective closed configuration (see Figure 4).

[0130] Preferably, the step of closing is executed at least at the end of the ventilation cycle.

[0131] In one non-limiting embodiment, during operation of packaging machine 1 several ventilation cycles may be provided.

[0132] The advantages of packaging machine 1 according to the present invention will be clear from the foregoing description.

[0133] In particular, packaging machine 1 being provided with ventilation device 60 allows to speed up the cooling down of various components of packaging machine 1, in particular of isolation chamber 9 (and/or flow circuit 35 and/or gas control unit 36). This is in particular advantageous after shutdown and/or interruption of the process of production packages 2 so that a technical operator can access packaging machine 1, in particular at least isolation chamber 9, earlier with respect to the state-of-art packaging machines. Furthermore, this is also advantageous for reducing the time between two successive steps of sterilization of at least isolation chamber 9.

[0134] A further advantage, which was found by the applicant resides in that due to the introduction of the cooling gas within isolation chamber 9 it is possible to reduce the humidity within isolation chamber 9.

[0135] An even further advantage resides in that inlet valve 61 allows the introduction of a gas from outer environment 25 as the cooling gas. This simplifies the design of packaging machine 1 as no further machine components, which may provide for the cooling gas need to be provided.

[0136] Another advantage lies in the possibility of speeding up the cooling down of also flow circuit 35 and/or gas control unit 36. In particular, it should be noted that in use, the gases flow through isolation chamber 9 and/or flow circuit 35 and/or gas control unit 36 and, thereby, the gases heat up due to the interaction of the gases with the surfaces of isolation chamber 9 and/or flow circuit 35 and/or gas control unit 36. Even more particular, it is in particular gas control unit 36 having the heating device, which significantly contributes to the heating up of the gases. Thus, the introduction of the cooling gas into isolation chamber 9 and consequently into flow circuit 35 and gas control unit 36 allows to cool all these portions, in particular also control unit 36, which significantly contributes to the heating up of the gases.

[0137] Another advantage is to control outlet valve 67 into the open configuration when inlet valve 61 is controlled into the open configuration. In this manner it is

possible to further speed up the cooling of at least isolation chamber 9 and/or flow circuit 35 and/or gas control unit 36.

[0138] Clearly, changes may be made to packaging machine 1 as described herein without, however, departing from the scope of protection as defined in the accompanying claims.

10 Claims

1. A packaging machine (1) for producing sealed packages (2) of a pourable product from a web (4) of packaging material advancing along a web advancement path (P), the packaging machine (1) comprising:

- a conveying device (5) for advancing the web (4) of packaging material along the web advancement path (P) at least to a tube forming station (6) at which the web (4) of packaging material is formed, in use, into a tube (3) and for advancing the tube (3) along a tube advancement path (Q);

- an isolation chamber (9); and
- a tube forming and sealing device (10) at least partially arranged within the isolation chamber (9) and configured to form the tube (3) at the tube forming station (6) and to longitudinally seal the tube (3);

characterized in further comprising an inlet valve (61) selectively controllable between at least:

- an open configuration in which the inlet valve (61) is configured to allow an inflow of a cooling gas into at least the isolation chamber (9); and
- a closed configuration in which the inlet valve (61) is in a closed position for impeding an inflow of the cooling gas into the isolation chamber (9).

2. The packaging machine according to claim 1, wherein the isolation chamber (9) is configured to separate an inner environment (24) from an outer environment (25);

wherein the inlet valve (61) is configured to selectively establish a fluid connection between the inner environment (24) and the outer environment (25) for selectively allowing or impeding an inflow of gas from the outer environment (25) as the cooling gas into at least the inner environment (24).

3. The packaging machine according to any one of the preceding claims, wherein the inlet valve (61) comprises at least one filter element (66) configured to filter the cooling gas.

4. The packaging machine according to any one of the

- preceding claims, and further comprising a flow circuit (35) configured to at least allow the introduction and the extraction of gas respectively into and out of the isolation chamber (9);
 wherein the inlet valve (61) is connected to the flow circuit (35) for directing the cooling gas into the isolation chamber (9) through the flow circuit (35) when being controlled into the open configuration.
- 5
5. The packaging machine according to any one of the preceding claims, further comprising an outlet valve (67) being controllable at least between:
- 10
- an open configuration in which the outlet valve (67) is configured to allow gas to exit through the outlet valve (67); and
 - a closed configuration in which the outlet valve (67) is configured to impede the outflow of gas through the outlet valve (67).
- 15
6. The packaging machine according to claim 5, further comprising a control unit (13) configured to control the inlet valve (61) and the outlet valve (67) into the respective open configuration and the respective closed configuration;
 wherein the control unit (13) is configured to control the outlet valve (67) into the open configuration when controlling the inlet valve (61) into the open configuration.
- 20
7. The packaging machine according to any one of the preceding claims, and further comprising an aspiration device configured to generate a flow of cooling gas through the inlet valve (61) into the isolation chamber (9).
- 25
8. The packaging machine according to any one of the preceding claims, and further comprising a control unit (13) configured to selectively control the inlet valve (61) into the open configuration after shutdown and/or interruption of the production of the packages (2) and/or before or during at least a sterilization of the isolation chamber (9).
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9. Method for producing sealed packages (2) of a pourable product comprising at least a main production cycle and a ventilation cycle:
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- wherein the main production cycle comprises at least the following steps of:
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- advancing a web (4) of packaging material along a web advancement path (P) at least to a tube forming station (6); and
 - folding the web (4) of packaging material within an isolation chamber (9) into a tube (3) at the tube forming station (6);
 - longitudinally sealing the tube (3) within
- 45
- the isolation chamber (9);
- advancing the tube (3) along a tube advancement path (Q); and
 - filling the formed tube (3) with the pourable product;
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- wherein the ventilation cycle comprises at least the step of cooling, during which an inlet valve (61) is controlled into an open configuration so that a cooling gas flows through the inlet valve (61) into at least the isolation chamber (9).
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10. The method according to claim 9, wherein the isolation chamber (9) separates an inner environment (24) from an outer environment (25);
 wherein during the step of cooling a gas flows as the cooling gas from the outer environment (25) through the inlet valve (61) into the isolation chamber (9).
11. The method according to claim 9 or 10, wherein the cooling gas has a temperature substantially equal to the room temperature.
12. The method according to any one of claims 9 to 11, wherein the ventilation cycle further comprises a step of extraction during which an outlet valve (67) is controlled into a respective open configuration so that a gas is directed through the outlet valve (67).
13. The method according to any one of claims 9 to 12, wherein the ventilation cycle further comprises a step of aspiration, during which an aspiration device creates the flow of cooling gas through the inlet valve (61) and into the isolation chamber (9).
14. The method according to claim 13, wherein during the step of aspiration, the aspiration device creates a depression within the isolation chamber (9) for creating the flow of cooling gas.
15. The method according to any one of claims 9 to 14, and further comprising the further step of sterilizing at least the isolation chamber (9); wherein the step of sterilizing is executed before the main production cycle; and wherein the ventilation cycle is executed in the case that the step of sterilizing is to be repeated.

FIG. 1

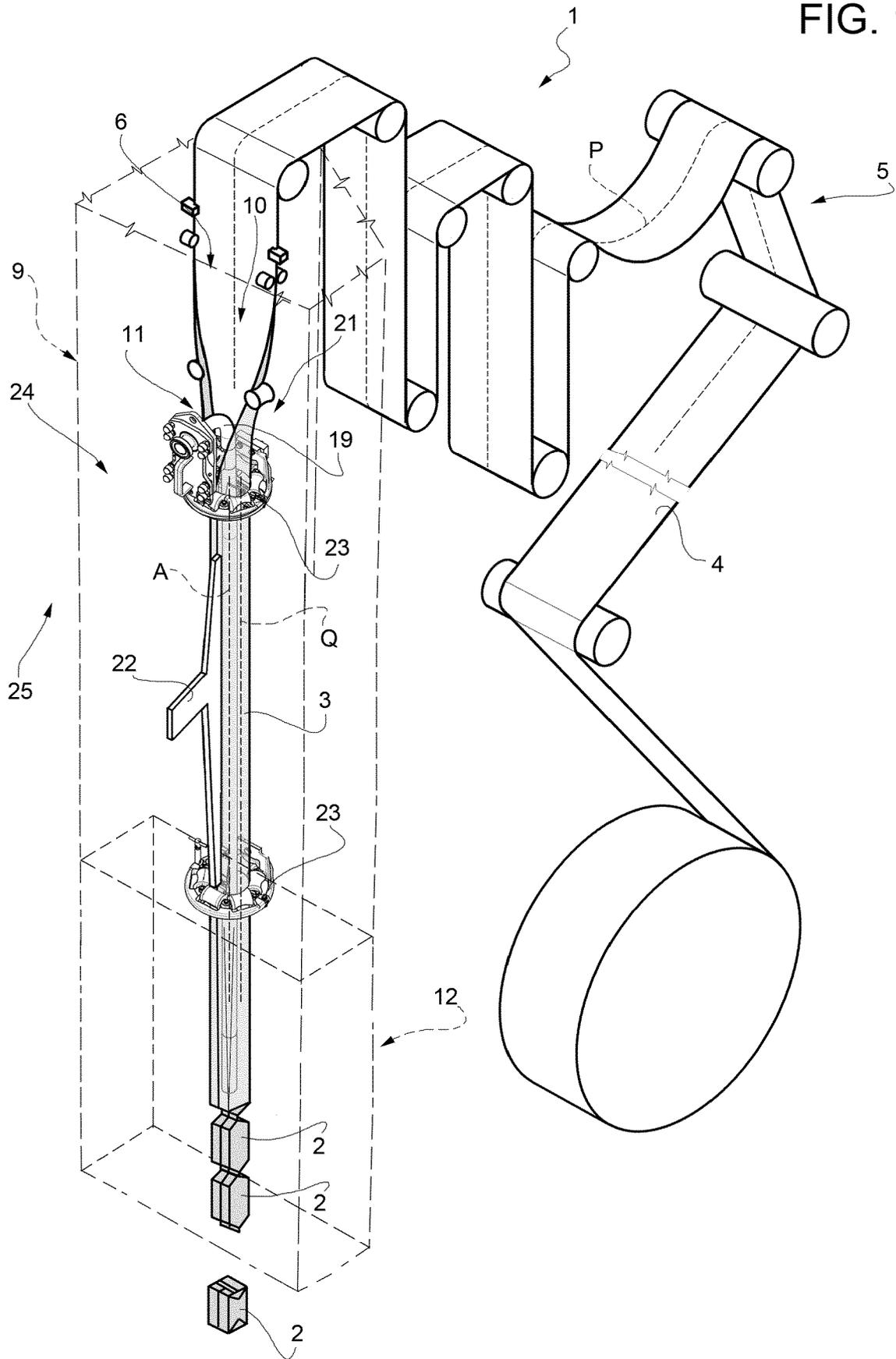


FIG. 2

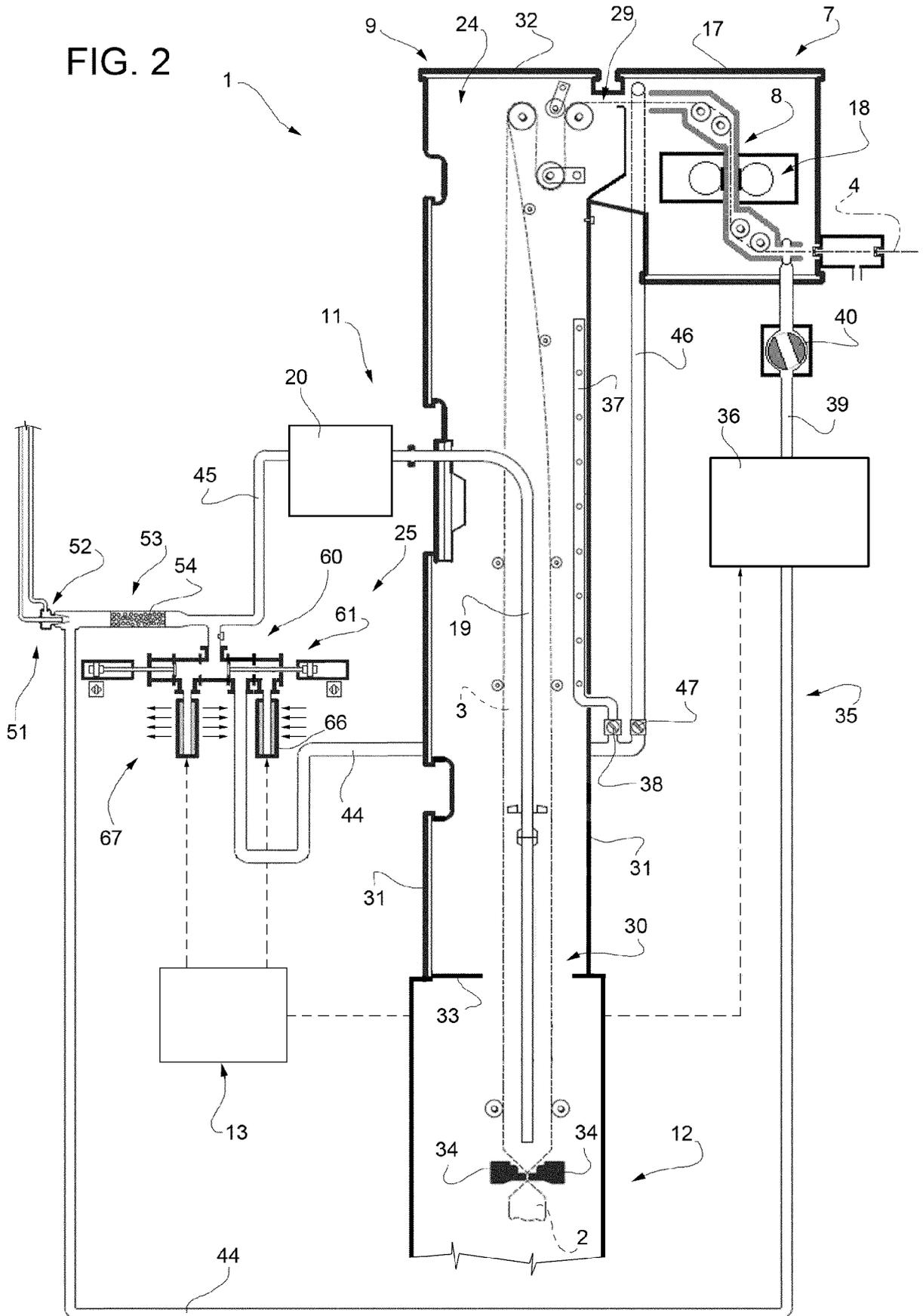


FIG. 3

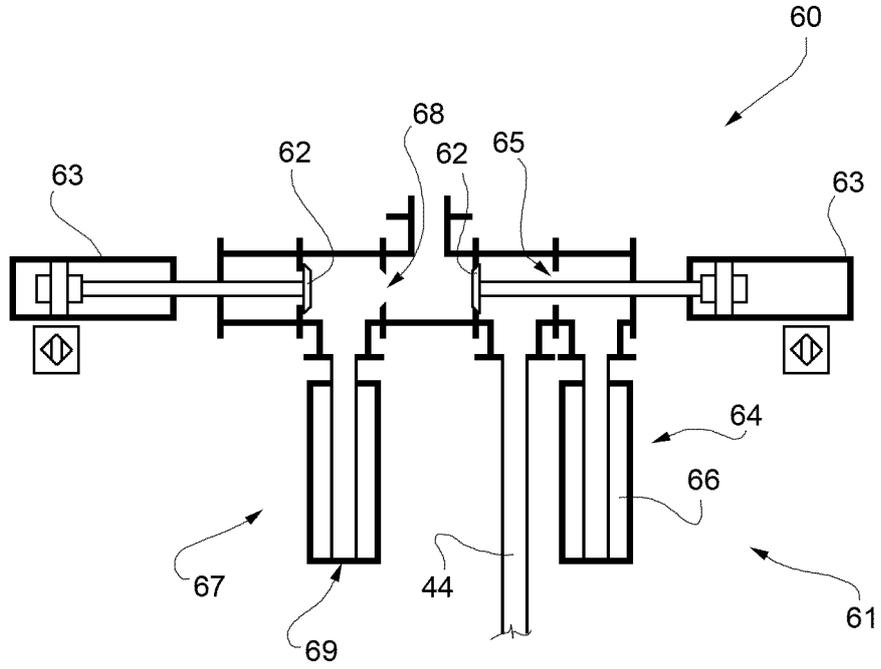
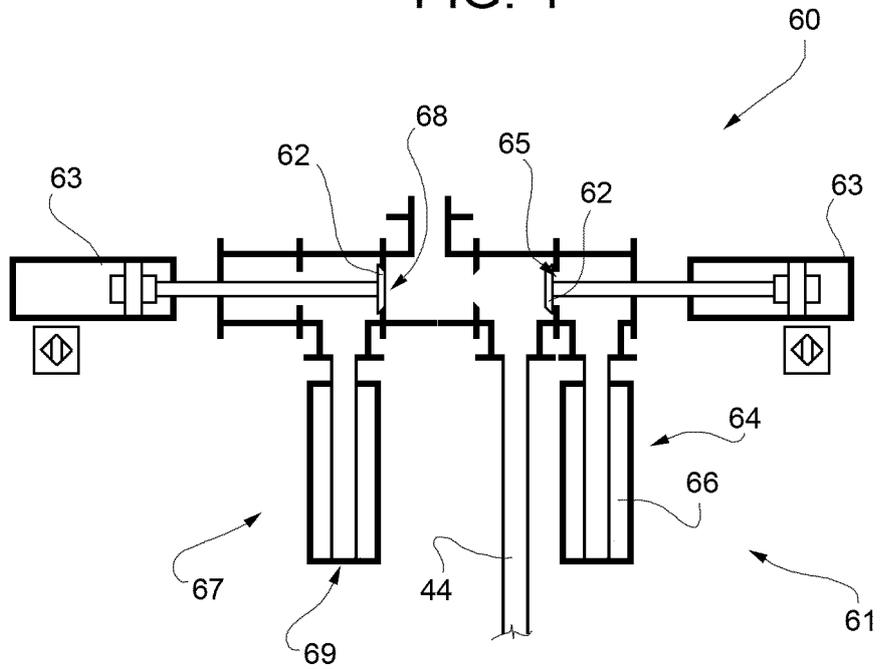


FIG. 4





EUROPEAN SEARCH REPORT

Application Number
EP 18 17 5450

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<p>CATEGORY OF CITED DOCUMENTS</p> <p>X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document</p> <p>T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document</p>			

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