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(71) Applicant: **IPI S.r.l.**
06132 Perugia (PG) (IT)

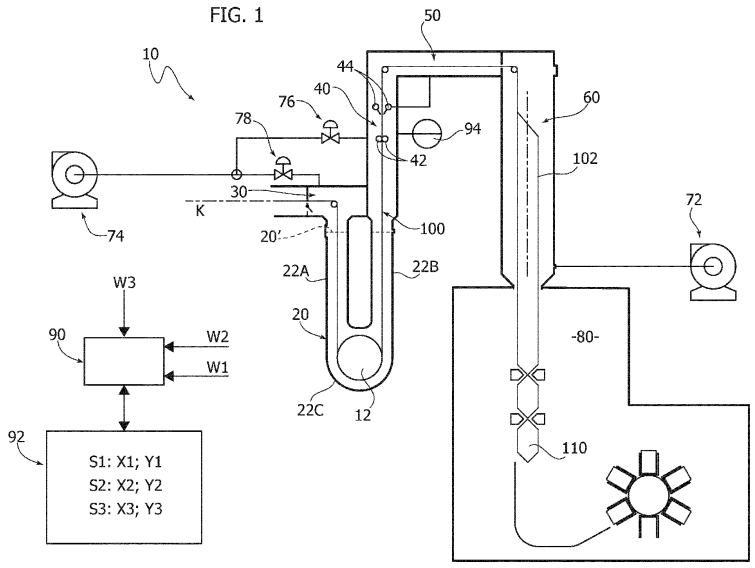
(72) Inventors:
- **BERNARDI, Enrico**
  I-40133 Bologna (IT)
- **BIRELLO, Fabio**
  I-40133 Bologna (IT)
- **CRISTOFORI, Alessandro**
  I-40133 Bologna (IT)
- **LIMONGELLI, Federico**
  I-40133 Bologna (IT)
- **SORICELLI, Giovanni**
  I-40133 Bologna (IT)
- **VERSARI, Enrico**
  I-40133 Bologna (IT)

(74) Representative: **Frontoni, Stefano**
Buzzi, Notaro & Antonielli d'Oulx S.p.A.
Corso Vittorio Emanuele II, 6
10123 Torino (IT)

(54) MACHINE AND METHOD FOR PRODUCING CONTAINERS FILLED WITH A PRODUCT AND SEALED

(57) A machine (10) for producing containers (110) filled and sealed, comprising: a feed system for feeding a web (100) of packaging material along a work path (K); a tank (20), which contains a bath (20') immersed in which is the web (100) that advances along the work path (K); a drying chamber (40), set downstream of and in fluid communication with the tank (20), for drying the web (100) that advances along the work path (K); and a forming chamber (60), set downstream of and in fluid communication with the drying chamber (40), and equipped with a forming device for forming the web (100) and obtaining the containers (110). A calibration step is provided for identifying automatically an optimal set-up of the machine.

FIG. 1



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Description

Field of the invention

[0001] The present invention regards a machine for producing containers filled with a product and sealed, starting from a web of packaging material.

[0002] In particular, the present invention regards a machine of the type comprising:

- a system for supplying the web of packaging material for feeding the latter along a work path;
- a tank, set along said work path, for containing a bath immersed in which is the web of packaging material that advances along the work path;
- a drying chamber, which is set downstream of the tank along the work path, is in fluid communication with said tank, and is equipped with at least one drying device for drying the web of packaging material that advances along the work path;
- a forming chamber, which is set downstream of the drying chamber along the work path, is in fluid communication with said drying chamber, and is equipped with a forming device for forming the web so as to obtain the containers;
- a compression unit for supplying pressurized air into the forming chamber; and
- an air-suction unit, which is connected to the drying chamber and to the tank.

[0003] In a machine of the type referred to above, the bath may contain a sterilizing and/or sanitizing liquid for performing an action of sterilization and/or sanitization of the web of packaging material.

[0004] The air that is introduced into the forming chamber is designed to bring about a controlled atmosphere both in the forming chamber and in the drying chamber, which is at a pressure higher than the pressure of the external environment so as to guarantee isolation of said chambers from the environment itself.

[0005] The present applicant has noted that, even though the aforesaid machines for producing containers operate according to operating parameters identified during testing, they may produce containers that do not meet the requisites envisaged as regards the state of sterilization/sanitization, and/or the state of drying, of the web of packaging material.

[0006] In this connection, the present applicant has noted that, once installed in the plant in which they are to operate, the above machines are unable to reproduce the working conditions previously defined during testing. For example, the pressures within the two chambers, namely, the forming chamber and the drying chamber, may be lower or else higher than the reference ones, this leading to a different development of the actions of maintenance of the sterility/sanitation and drying of the web of packaging material.

[0007] The present applicant has hence understood that the more or less important adaptations that are carried out on the machines during their installation in the plant, as well as the possible different conditions of the external environment, have a negative effect on operation of the machine, the actual working conditions of which, whether constant or variable, depart from the preset working conditions.

[0008] It consequently becomes necessary for the operator to intervene to set again the operating parameters of the machine, with a consequent increase in time to get the system up and running.

[0009] However, the present applicant has understood that is instead possible to overcome the aforesaid drawback via an automatic calibration step.

[0010] In the present description, as likewise in the claims annexed thereto, some terms and expressions are to be considered, except where otherwise explicitly indicated, as having the meaning given in the ensuing definitions.

[0011] In an apparatus or unit for processing an object that advances in a direction of feed along a work path, a first position is said to be "upstream" of a second position when the first position precedes the second position with reference to the direction of feed of the object; vice versa, the second position is said to be "downstream" of the first position in so far as it follows the first position once again with reference to the direction of feed of the object.

[0012] "Operation" of a machine comprises one or more cleaning cycles, referred to as cleaning-in-place (CIP) cycles, where the machine is cleaned of the product, in particular in the areas of contact, one or more sterilization cycles, referred to as sterilization-in-place (SIP) cycles, where the cleaned machine is further sterilized to remove bacteria and contaminating agents, one or more production cycles for the production proper of the end product, and one or more cycles of machine stoppage in which one or more parts of the machine are stopped for carrying out interventions of various types. The aforesaid cycles may alternate in any order, random or periodic, during operation of the machine. Two cycles having the same function may succeed one another or be separated by at least one cycle having a different function.

[0013] According to a first aspect, the present invention concerns a machine for producing containers filled with a product and sealed, starting from a web of packaging material.

[0014] The machine preferably comprises a system for supplying the web of packaging material. Preferably, the system for supplying the web is designed to feed the web of packaging material along a work path.

[0015] The machine preferably comprises a tank, set along the work path, for containing a bath, immersed in which is the web of packaging material that advances along said work path. Preferably, the bath contains at least one between a sterilizing liquid and a sanitizing liquid.

[0016] The machine preferably comprises a drying

chamber. Preferably, the drying chamber is set downstream of the tank along the work path. Preferably, the drying chamber is in fluid communication with the tank. Preferably, the drying chamber is equipped with at least one drying device, in particular for drying the web of packaging material that advances along the work path.

[0017] The machine preferably comprises a forming chamber. Preferably, the forming chamber is set downstream of the drying chamber along the work path. Preferably, the forming chamber is in fluid communication with the drying chamber. Preferably, the forming chamber is equipped with a forming device for forming the web so as to obtain the containers.

[0018] The machine preferably comprises an air-suction unit. Preferably, the air-suction unit is connected to the drying chamber. Preferably, the air-suction unit is connected to the tank.

[0019] The machine preferably comprises a sensor for detecting a pressure inside the drying chamber.

[0020] The machine preferably comprises a control unit. Preferably, the control unit is connected to the air-suction unit.

[0021] Preferably, the control unit is configured for starting a calibration step, preferably as a function of a state signal, which in particular indicates an operating state of the machine.

[0022] Preferably, the control unit is configured for varying, during the calibration step, at least one operating parameter of the air-suction unit, preferably as a function of a pressure signal, which in particular indicates the pressure inside the drying chamber, preferably to identify an effective value of said operating parameter. Preferably, the effective value of said operating parameter determines a desired pressure inside the drying chamber. Preferably, said effective value is contained within a range of optimal values of said operating parameter; preferably, said optimal values determine a pressure close to the desired pressure inside the drying chamber.

[0023] Preferably, the control unit is configured for operating the air-suction unit during operation of the machine. Preferably, the control unit is configured for setting the operating parameter substantially at said identified effective value, during operation of the machine. In an even more preferred way, the control unit is configured for setting the operating parameter substantially at said identified effective value, during a step of machine stoppage.

[0024] Thanks to the aforesaid characteristics, the machine is able to identify automatically an optimal set-up thereof that will take into account all the specificities of the installation layout of the machine and of the working environment in which it is installed, as well as the possible variations.

[0025] According to a second aspect, the present invention concerns a method for producing containers filled with a product and sealed, starting from a web of packaging material.

[0026] Preferably, the method comprises the step of feeding the web of packaging material along a work path.

[0027] Preferably, the method comprises the step of immersing the web of packaging material within a bath contained in a tank, which is preferably set along said work path.

[0028] Preferably, the method comprises the step of drying the web of packaging material inside a drying chamber, which is preferably set downstream of the tank along the work path and is preferably in fluid communication with said tank.

[0029] Preferably, the method comprises the step of forming the web to obtain said containers, preferably inside a forming chamber, preferably set downstream of the drying chamber along the work path and preferably in fluid communication with the drying chamber.

[0030] Preferably, the method comprises the step of drawing air from the drying chamber, preferably via an air-suction unit.

[0031] Preferably, the method comprises the step of drawing air from the tank, preferably via an air-suction unit.

[0032] Preferably, the method comprises the step of detecting a pressure inside the drying chamber.

[0033] Preferably, the method comprises the step of generating a pressure signal, which in particular indicates the pressure detected inside the drying chamber.

[0034] Preferably, the method comprises the step of starting a calibration step, preferably as a function of a state signal, which in particular indicates an operating state of the machine.

[0035] Preferably, the method comprises the step of varying, during the calibration step, at least one operating parameter of the air-suction unit, preferably as a function of the pressure signal, preferably to identify an effective value of the operating parameter, in particular said effective value determining a desired pressure inside the drying chamber.

[0036] Preferably, the method comprises, during operation of the machine, the step of operating the air-suction unit, preferably by setting the operating parameter substantially at said identified effective value. In an even more preferred way, the method comprises, during a step of machine stoppage, the step of operating the air-suction unit, preferably by setting the operating parameter substantially at said identified effective value.

[0037] Thanks to the aforesaid characteristics, the method described herein enables fast and automatic identification of an optimal set-up of the machine, which will take into account all the specificities of the installation layout of the machine itself and of the environment in which it is installed, i.e., of the working conditions (whether constant or variable) that affect operation of the machine.

[0038] According to one or more of the aforesaid aspects, the present invention may comprise one or more of the characteristics described in what follows.

[0039] In one or more embodiments, the machine comprises a compression unit. Preferably, the compression

unit is designed to supply pressurized air into the forming chamber.

[0040] In one or more embodiments, the machine comprises a first valve for controlling fluid communication between said drying chamber and said air-suction unit. In one or more embodiments, the machine comprises a second valve for controlling fluid communication between said tank and said air-suction unit.

[0041] In one or more embodiments, the machine comprises a memory unit. Preferably, stored in the memory unit are at least one first configuration set that comprises respective operating parameters of said first and second valves and a second configuration set that comprises respective operating parameters of said first and second valves.

[0042] In one or more embodiments, the control unit is configured for operating selectively said first and second valves according to the first configuration set and according to the second configuration set, preferably as a function of a filling signal, which in particular indicates a state of filling of said tank.

[0043] Thanks to the aforesaid characteristics, the machine described herein is able to guarantee stable conditions inside the two chambers, namely the drying chamber and the forming chamber, during the entire period of operation of the machine, in a simple and reliable way, without the need to provide a continuous feedback control based upon a direct measurement of the pressure inside the two chambers.

[0044] In one or more embodiments, stored in said memory unit is a third configuration set comprising respective operating parameters of said first and second valves.

[0045] In one or more embodiments, the control unit is configured for operating said first and second valves according to the third configuration set, preferably as a function of said filling signal.

[0046] In one or more embodiments, the machine comprises a drying tunnel, in particular for drying the web of packaging material. Preferably, the drying tunnel extends along the work path. Preferably, the drying tunnel connects together the drying chamber and the forming chamber.

[0047] Thanks to the aforesaid characteristics, the machine described herein is able to dry the packaging web in an effective way, at the same time maintaining large production volumes.

[0048] In one or more embodiments, the method comprises the step of supplying pressurized air into the forming chamber, preferably via a compression unit.

[0049] In one or more embodiments, the operating state of the machine corresponds to one between a state of starting of said machine and a state in which the bath is absent from the tank.

[0050] In one or more embodiments, the method comprises the step of controlling fluid communication between the drying chamber and the air-suction unit, preferably via a first valve.

[0051] In one or more embodiments, the method comprises the step of controlling fluid communication between the tank and the air-suction unit, preferably via a second valve.

[0052] In one or more embodiments, the step of controlling fluid communication between the drying chamber and the air-suction unit and between the tank and the air-suction unit includes extracting, for example from a memory unit, a configuration set comprising respective operating parameters of said first and second valves, preferably as a function of a filling signal, which in particular indicates a state of filling of the tank.

[0053] In one or more embodiments, the step of controlling fluid communication between the drying chamber and the air-suction unit and between the tank and the air-suction unit includes operating the first valve and the second valve according to the configuration set extracted from the memory unit.

[0054] Thanks to the aforesaid characteristics, the method described herein guarantees stable conditions inside the two chambers, namely the drying chamber and the forming chamber, during the entire period of operation of the machine, in a simple and reliable way, without the need to provide a continuous feedback control based upon a direct measurement of the pressure inside the two chambers.

[0055] In one or more embodiments, said configuration set comprises a respective first operating parameter, preferably for controlling a section of flow of the first valve. In one or more embodiments, said configuration set comprises a respective second operating parameter, preferably for controlling a section of flow of the second valve.

[0056] In one or more embodiments, extracting a configuration set includes selectively extracting one between a first configuration set and a second configuration set, preferably as a function of the filling signal.

[0057] In one or more embodiments, the first configuration set, preferably comprising respective operating parameters of the first and second valves, is extracted when the filling signal indicates a state of complete filling of the tank. In one or more embodiments, the second configuration set, preferably comprising respective operating parameters of the first and second valves, is extracted when the filling signal indicates a state of zero filling of the tank.

[0058] In one or more embodiments, a first operating parameter of the second configuration set controls a section of flow of the first valve so that it will be smaller than a section of flow of said first valve controlled by a first operating parameter of the first configuration set. In one or more embodiments, a second operating parameter of the second configuration set controls a section of flow of the second valve so that it will be larger than a section of flow of said second valve controlled by a second operating parameter of the first configuration set.

[0059] In one or more embodiments, extracting a configuration set includes extracting, for example from a memory unit, a third configuration set, preferably as a function of the filling signal, in an even more preferred

way when said filling signal indicates a state of incomplete filling of the tank. Preferably, the third configuration set comprises respective operating parameters of said first and second valves.

[0060] In one or more embodiments, a first operating parameter of the third configuration set controls a section of flow of the first valve so that it will be comprised between a section of flow of said first valve controlled by a first operating parameter of the first configuration set and a section of flow of said first valve controlled by a first operating parameter of the second configuration set. In one or more embodiments, a second operating parameter of the third configuration set controls a section of flow of the second valve so that it will be comprised between a section of flow of said second valve controlled by a second operating parameter of the first configuration set and a section of flow of said second valve controlled by a second operating parameter of the second configuration set.

[0061] In one or more embodiments, the first configuration set and the second configuration set are such that the first valve and the second valve operated according to the first configuration set determine inside the drying chamber a pressure that is preferably equal to or does not differ by more than 20% from the pressure inside said drying chamber determined by said first and second valves operated according to the second configuration set.

[0062] Thanks to the aforesaid characteristics, the method described herein is able to keep the two chambers, namely the drying chamber and the forming chamber, in stable conditions so as to guarantee proper operation of the machine.

[0063] In one or more embodiments, the third configuration set is such that the first valve and the second valve operated according to said third configuration set determine a pressure inside the drying chamber that is preferably equal to or does not differ by more than 20% from the pressure inside said drying chamber determined by said first and second valves operated according to one between the first configuration set and the second configuration set.

[0064] Thanks to the aforesaid characteristics, the method described herein is able to keep the two chambers, namely the drying chamber and the forming chamber, in stable conditions so as to guarantee proper operation of the machine.

[0065] In one or more embodiments, the method described herein includes controlling said compression unit as a function of a flow-rate signal indicating a reference flow rate of air.

[0066] It is pointed out that some steps of the method described above may be independent of the order of execution referred to, except where there is expressly indicated as necessary a sequentiality or simultaneity between two or more steps. Moreover, some steps may be optional. Moreover, some steps may be carried out in a repetitive way, or else may be carried out in series or in parallel with other steps of the method.

[0067] Further characteristics and advantages of the present invention will emerge clearly from the ensuing description, with reference to the annexed drawings, which are provided purely by way of non-limiting example and in which:

- Figure 1 is a schematic illustration of the machine described herein according to a preferred embodiment.

[0068] As indicated above, the machine described herein operates for producing containers filled with a product and sealed, starting from a web of packaging material.

[0069] The product may preferably be a liquid or else a granular material.

[0070] With reference to the preferred embodiment of Figure 1, the machine described herein - designated as a whole by the reference number 10 - comprises a feed system, for supplying a web 100 of packaging material and feeding the web 100 along a work path K. Preferably, the web 100 is supplied from a reel (not illustrated) and develops as a single continuous web along the entire work path K.

[0071] The machine 10 comprises a tank 20 that is set along the work path K and contains a bath 20' (represented in the figure with a dashed line) immersed in which is the web 100 that advances along the work path K.

[0072] The bath 20' may, for example, be constituted by a sterilizing and/or sanitizing liquid.

[0073] In one or more preferred embodiments, like the one illustrated, the tank 20 has a generic U shape, comprising a first branch 22A, upstream, a second branch 22B, downstream, and a bottom region 22C, which connects the two branches and housed within which is a deflector roller 12, belonging to the system for feeding the web 100 and configured to determine a reversal of the direction of advance of the web 100 (from a top-down direction to a bottom-up direction).

[0074] Provided above the first branch 22A is a chamber 30, which constitutes a top region of the tank 20, whereas extending above the second branch 22B is a drying chamber 40 for drying the web 100 after it has come out of the bath 20'.

[0075] It should be noted that the chamber 30 and the drying chamber 40 do not communicate directly with one another, but are instead connected to one another only through interposition of the tank 20. In operation, the presence of the bath 20' prevents any passage of air between the drying chamber 40 and the chamber 30.

[0076] In a way in itself known, the drying chamber 40 is equipped with a series of drying devices configured for drying two opposite faces 100A, 100B of the web 100 that advances inside the drying chamber 40 along the work path K. For instance, the drying chamber 40 may comprise a pair of opposed squeezing rollers 42, which operate for compressing the web 100, in a direction trans-

verse to the work path K, so as to expel the liquid absorbed by the web 100 in the bath 20'. Moreover, the drying chamber 40 may comprise a pair of heads 44 for delivery of air, preferably heated air, which are arranged on the two opposite sides of the web 100, to deliver a jet of air against the opposite faces 100A, 100B of the web 100.

[0077] Downstream of the drying chamber 40, along the work path K, the machine 10 comprises a forming chamber 60, within which the web 100 is formed to obtain the containers 101 filled with product and sealed.

[0078] In one or more preferred embodiments, like the one illustrated, the forming chamber 60 is provided with a forming device for curling the web 100 to form a tube about an axis I that extends in a direction parallel to the work path K inside the forming chamber 60 itself. Moreover, provided within the forming chamber 60 there are sealing means for fixing together the opposite longitudinal edges of the web 100 so as to close the web 100 and obtain a vertical tube 102 sealed laterally.

[0079] The tube 102 is filled with the product to be packaged and extends downwards until it reaches a further chamber 80, set downstream of the forming chamber 60. In this further chamber, on the tube 102 filled with the product there are provided transverse sealing bands that identify, on the tube 102 itself, single containers 110, which are then cut off the tube 102.

[0080] The means to implement the steps described above of forming, sealing, and cutting may be of a known type, and consequently they will not be described in detail herein so as not to burden the present treatment.

[0081] In one or more preferred embodiments, like the one illustrated, the machine 10 further comprises a drying tunnel 50 for drying the web 100, which extends along the work path K and connects together the drying chamber 40, in particular an end downstream thereof, and the forming chamber 60, in particular an end upstream thereof.

[0082] In one or more preferred embodiments, like the one illustrated, the machine 10 comprises a compression unit 72 for supplying pressurized air into the forming chamber 60, and an air-suction unit 74, which is connected to the chamber 30 of the tank 20 and to the drying chamber 40.

[0083] Furthermore, the machine 10 comprises a first valve 76 for controlling fluid communication between the drying chamber 40 and the air-suction unit 74, and a second valve 78 for controlling fluid communication between the chamber 30 of the tank 20 and the air-suction unit 74.

[0084] The machine 10 comprises a control unit 90 for controlling operation of the compression unit 72, of the air-suction unit 74, of the first valve 76, and of the second valve 78.

[0085] The compression unit 72 and the air-suction unit 74 may both be constituted by a compressor of a conventional type. On the other hand, the two valves 76 and 78 may be ordinary valves for controlling a flow of gas, with variable section of flow.

[0086] The compression unit 72 is controlled, for example, as a function of a flow-rate signal indicating a flow rate, for generating a flow of air characterized by a reference flow rate.

[0087] As will be seen in what follows, the air-suction unit 74 is, instead, controlled on the basis of an operating parameter identified via an automatic calibration step carried out by the machine.

[0088] According to a preferred embodiment, the two valves 76 and 78 are operated according to an operating mode such that inside the drying chamber 40 there is guaranteed a desired pressure, irrespective of the state of filling of the tank 20.

[0089] In this connection, it should be noted that during operation of the machine 10 the tank 20 may be filled with the liquid constituting the bath 20', or else be completely empty, or else again be in the process of being filled.

[0090] The first state referred to, where the tank 20 is filled with the liquid of the bath 20', regards normal operation of the machine, where the machine is moving and produces the containers 110 that contain the product.

[0091] The second state referred to, where the tank 20 is empty, occurs, instead, during machine stoppages, which require, in fact, emptying of the tank in order to prevent the web 100 from remaining stationary immersed in the bath 20' and, in this condition, absorbing an excessive amount of water that might damage it.

[0092] The third state referred to, where the tank 20 is being filled, occurs, instead, during the process of filling of the tank 20 for the purpose of charging/recharging it with the liquid of the bath 20'.

[0093] For each of the aforesaid states, a configuration set is provided comprising a first operating parameter for controlling a section of flow of the first valve 76, and a second operating parameter for controlling a section of flow of the second valve 78. The two operating parameters are identified so as to determine the aforesaid desired pressure inside the drying chamber 40. With reference to Figure 1, in the solution illustrated therein, there are provided, merely by way of example, a first configuration set S1 (X1; Y1) regarding the state of complete filling of the tank, a second configuration set S2 (X2; Y2) regarding the state of zero filling of the tank, and a third configuration set S3 (X3; Y3) regarding the state of partial filling of the tank; X1 and Y1, X2 and Y2, X3 and Y3 are the operating parameters of the two valves 76 and 78 of the three different sets. In particular X1 and Y1 are, respectively, the first and second operating parameters of the first configuration set S1 or operating parameters with the tank full, X2 and Y2 are, respectively, the first and second operating parameters of the second configuration set S2, or operating parameters with the tank empty, and X3 and Y3 are, respectively, the first and second operating parameters of the third configuration set S3, or operating parameters with partial filling.

[0094] The first operating parameter X2 of the second configuration set S2, regarding the state of zero filling of

the tank, controls a section of flow of the first valve 76 so that it will be smaller than the section of flow of the first valve 76 itself controlled by the first operating parameter X1 of the first configuration set S1, regarding the state of complete filling of the tank 20. Conversely, the second operating parameter Y2 of the second configuration set S2 controls a section of flow of the second valve 78 so that it will be larger than the section of flow of the second valve 78 itself controlled by the second operating parameter Y1 of the first configuration set S 1.

[0095] It will be noted, in fact, that in the state of zero filling of the tank the drying chamber 40 is connected to the air-suction unit 74 both directly and through the empty tank 20, which is in turn connected to the air-suction unit 74 by way of its chamber 30. Consequently, in order to prevent an undesired drop in pressure in the drying chamber 40 and at the same time setting-up of an area of negative pressure in the tank 20, the section of flow of the second valve 78 is reduced and at the same time the section of flow of the first valve 76 is increased to generate a flow of air also through the tank 20.

[0096] It should again be noted that in the state of complete filling of the tank 20, the section of flow of the second valve 78 is not, however, zero so that the product of evaporation of the bath 20' and the air that is introduced into the chamber 30 as a result of the movement of advance of the web 100 can be emptied out from the chamber 30 itself and transmitted to the air-suction unit 74.

[0097] The first and second operating parameters X3, Y3 of the third configuration set S3, regarding the state of partial filling of the tank 20, control sections of flow of the two valves 76, 78 intermediate between the ones obtained in the other two states.

[0098] In one or more preferred embodiments, the machine 10 comprises a memory unit 92, stored in which are the aforesaid configuration sets S1 (X1; Y1), S2 (X2, Y2) and S3 (X3, Y3), and the control unit 90 is configured for extracting from the memory unit 92 one of these sets as a function of the state of filling of the tank 20 and for operating the two valves 76 and 78 on the basis of the configuration set extracted. The control unit 90 receives a filling signal W1 indicating the state of filling of the tank 20, which may, for example, come from the means that are associated to the tank 20 itself and are configured for filling and emptying the latter, or else from a level sensor - not illustrated - located at the tank 20.

[0099] The control mode described above makes it possible to guarantee stable conditions inside the two chambers, the drying one 40 and the forming one 60, during the entire period of operation of the machine, in a simple and reliable way, without the need to provide a continuous feedback control based upon a direct measurement of the pressure inside the drying chamber 40 and the forming chamber 60 themselves.

[0100] The configuration sets referred to may be obtained empirically through tests conducted on the machine in the three states of the tank 20 discussed above.

[0101] Between one state and the other of the tank 20 the pressure generated in the drying chamber 40 does not necessarily have, in each case, to be precisely the same, but may vary within a range of tolerance of 20%.

[0102] It should be noted that the tests referred to above may be conducted during testing of the machine.

[0103] As discussed in the introductory part of the present treatment, the more or less important adaptations that are carried out on the machine during its installation in the plant, as likewise the possible different conditions of the external environment, may be responsible for deviations of operation of the machine from the preset working conditions.

[0104] To overcome the above drawback, according to an important characteristic of the solution described herein, the control unit 90 is configured for carrying out a calibration step, during which an operating parameter of the air-suction unit 74 is varied as a function of a pressure signal W3 indicating the pressure detected inside the drying chamber 40, until an effective value of said operating parameter that will determine a desired pressure inside the chamber 40 itself is identified.

[0105] The effective value identified is then used during operation of the machine 10; in particular, the operating parameter is set and kept at the above effective value for operating the air-suction unit 74.

[0106] The operating parameter in question may, for example, be a velocity of rotation of a rotor of the air-suction unit 74.

[0107] Preferably, the pressure signal W3 is obtained from a pressure sensor 94 configured for detecting the pressure inside the drying chamber 40.

[0108] The aforesaid calibration step is started automatically by the machine when it is in a given operating state. For this purpose, the control unit 90 receives a state signal W2 indicating the operating state of the machine 10, which may, for example, come from further control means thereof. Preferably, the calibration step is carried out during starting of the machine, for example when the machine is started for the first time after its installation or else after a prolonged machine stoppage.

[0109] The above calibration step enables the machine to identify automatically an optimal set-up thereof that will take into account all the specificities of the installation layout of the machine and of the working environment in which it is installed.

[0110] Of course, without prejudice to the principle of the invention, the details of construction and the embodiments may vary, even significantly, with respect to what has been illustrated herein purely by way of non-limiting example, without thereby departing from the scope of the invention, as defined by the annexed claims.

Claims

1. A machine (10) for producing containers (110) filled with a product and sealed, starting from a web (100) of packaging material, said machine (10) compris-

ing:

- a web-feed system for feeding said web (100) along a work path (K);
- a tank (20), set along said work path (K), for containing a bath (20') immersed in which is said web (100) that advances along said work path (K);
- a drying chamber (40), set downstream of said tank (20) along said work path (K) and in fluid communication with said tank (20), said drying chamber (40) being equipped with at least one drying device for drying said web (100) that advances along said work path (K);
- a forming chamber (60), set downstream of said drying chamber (40) along said work path (K) and in fluid communication with said drying chamber (40), said forming chamber (60) being equipped with a forming device for forming said web (100) so as to obtain said containers (110);
- an air-suction unit (74), connected to said drying chamber (40) and to said tank (20);
- a sensor (94) for detecting a pressure inside said drying chamber (40); and
- a control unit (90), connected to said air-suction unit (74) and configured for:

  - starting a calibration step as a function of a state signal (W2) indicating an operating state of said machine (10);
  - during said calibration step, varying at least one operating parameter of said air-suction unit (74) as a function of a pressure signal (W3) indicating said pressure detected inside said drying chamber (40) to identify an effective value of said operating parameter that determines a desired pressure inside said drying chamber (40); and
  - during operation of said machine (10), operating said air-suction unit (74), setting said operating parameter substantially at said identified effective value.

2. The machine according to claim 1, comprising a first valve (76) for controlling fluid communication between said drying chamber (40) and said air-suction unit (74), and a second valve (78) for controlling fluid communication between said tank (20) and said air-suction unit (74).

3. The machine according to claim 2, comprising a memory unit (92) stored in which are at least a first configuration set (S1) comprising respective operating parameters (X1, Y1) of said first valve (76) and said second valve (78) and a second configuration set (S2) comprising respective operating parameters (X2, Y2) of said first valve (76) and said second valve (78), said control unit (90) being configured for operating selectively said first valve (76) and said second valve (78) according to said first configuration set (S1) and according to said second configuration set (S2), as a function of a filling signal (W1) indicating a state of filling of said tank (20).

4. The machine according to claim 3, wherein stored in said memory unit (92) is a third configuration set (S3) comprising respective operating parameters (X3, Y3) of said first valve (76) and said second valve (78), and wherein said control unit (90) is configured for operating said first valve (76) and said second valve (78) according to said third configuration set (S3) as a function of said filling signal (W1).

5. The machine according to any one of the preceding claims, comprising a drying tunnel (50) for drying said web (100), said drying tunnel (50) extending along said work path (K) and connecting together said drying chamber (40) and said forming chamber (60).

6. A method for producing containers (110) filled with a product and sealed, starting from a web (100) of packaging material, comprising the steps of:

- feeding said web (100) along a work path (K);
- immersing said web (100) in a bath (20') contained in a tank (20) set along said work path (K);
- drying said web (100) inside a drying chamber (40) set downstream of said tank (20) along said work path (K) and in fluid communication with said tank (20);
- forming said web (100) inside a forming chamber (60) set downstream of said drying chamber (40) along said work path (K) and in fluid communication with said drying chamber (40) to obtain said containers (110);
- drawing air from said drying chamber (40) and from said tank (20) via an air-suction unit (74);
- detecting a pressure inside said drying chamber (40);
- generating a pressure signal (W3) indicating said pressure detected inside said drying chamber (40);
- starting a calibration step as a function of a state signal (W2) indicating an operating state of said machine (10);
- during said calibration step, varying at least one operating parameter of said air-suction unit (74) as a function of said pressure signal (W3) to identify an effective value of said operating parameter that determines a desired pressure inside said drying chamber (40); and
- during operation of said machine (10), setting said operating parameter substantially at said identified effective value for operating said air-suction unit (74).

7. Method according to claim 6, wherein said operating state of said machine (10) corresponds to one between a state of starting of said machine (10) and a state in which said bath (20') is absent from said tank (20).

8. The method according to claim 6 or claim 7, comprising the steps of:

- controlling fluid communication between said drying chamber (40) and said air-suction unit (74) via a first valve (76); and
- controlling fluid communication between said tank (20) and said air-suction unit (74) via a second valve (78).

9. The method according to claim 8, wherein controlling fluid communication between said drying chamber (40) and said air-suction unit (74) and between said tank (20) and said air-suction unit (74) includes:

- as a function of a filling signal (W1) indicating a state of filling of said tank (20), extracting from a memory unit (92) a configuration set (S1; S2; S3) comprising respective operating parameters (X1, Y1; X2, Y2; X3, Y3) of said first valve (76) and said second valve (78); and
- operating said first valve (76) and said second valve (78) according to said configuration set extracted from said memory unit (92).

10. The method according to claim 9, wherein said configuration set (S1; S2; S3) comprises a respective first operating parameter (X1; X2; X3) for controlling a section of flow of said first valve (76) and a respective second operating parameter (Y1, Y2, Y3) for controlling a section of flow of said second valve (78).

11. The method according to claim 9 or claim 10, wherein extracting a configuration set (S1; S2; S3) includes selectively extracting, as a function of said filling signal (W1), one between a first configuration set (S1) and a second configuration set (S2).

12. The method according to claim 11, wherein:

- said first configuration set (S1) comprising respective operating parameters (X1, Y1) of said first valve (76) and said second valve (78) is extracted when said filling signal (W1) indicates a state of complete filling of said tank (20); and
- said second configuration set (S2) comprising respective operating parameters (X2, Y2) of said first valve (76) and said second valve (78) is extracted when said filling signal (W1) indicates a state of zero filling of said tank (20).

13. The method according to claim 11 or claim 12, wherein a first operating parameter (X2) of said second configuration set (S2) controls a section of flow of said first valve (76) so that it will be smaller than a section of flow of said first valve controlled by a first operating parameter (X1) of said first configuration set (S1), and wherein a second operating parameter (Y2) of said second configuration set (S2) controls a section of flow of said second valve (78) so that it will be larger than a section of flow of said second valve (78) controlled by a second operating parameter (Y1) of said first configuration set (S1).

14. The method according to any one of claims 11 to 13, wherein extracting a configuration set includes extracting from said memory unit (92), when said filling signal (W1) indicates a state of incomplete filling of said tank (20), a third configuration set (S3) comprising respective operating parameters (X3, Y3) of said first valve (76) and said second valve (78), and wherein a first operating parameter (X3) of said third configuration set (S3) controls a section of flow of said first valve (76) so that it will be comprised between a section of flow of said first valve (76) controlled by a first operating parameter (X1) of said first configuration set (S1) and a section of flow of said first valve (76) controlled by a first operating parameter (X2) of said second configuration set (S2), and wherein a second operating parameter (Y3) of said third configuration set (S3) controls a section of flow of said second valve (78) so that it will be comprised between a section of flow of said second valve (78) controlled by a second operating parameter (Y1) of said first configuration set (S1) and a section of flow of said second valve (78) controlled by a second operating parameter (Y2) of said second configuration set (S2).

15. The method according to any one of claims 11 to 14, wherein said first configuration set (S1) and said second configuration set (S2) are such that said first valve (76) and said second valve (78) operated according to said first configuration set (S1) determine inside said drying chamber (40) a pressure that is equal to or does not differ by more than 20% from the pressure inside said drying chamber (40) determined by said first and second valves (76, 78) operated according to said second configuration set (S2).

16. The method according to claim 14 or claim 15, wherein said third configuration set (S3) is such that said first valve (76) and said second valve (78) operated according to said third configuration set (S3) determine a pressure inside said drying chamber (40) that is equal to or does not differ by more than 20% from the pressure inside said drying chamber determined by said first and second valves (76, 78) operated according to one between said first configuration set (S1) and said second configuration set (S2).

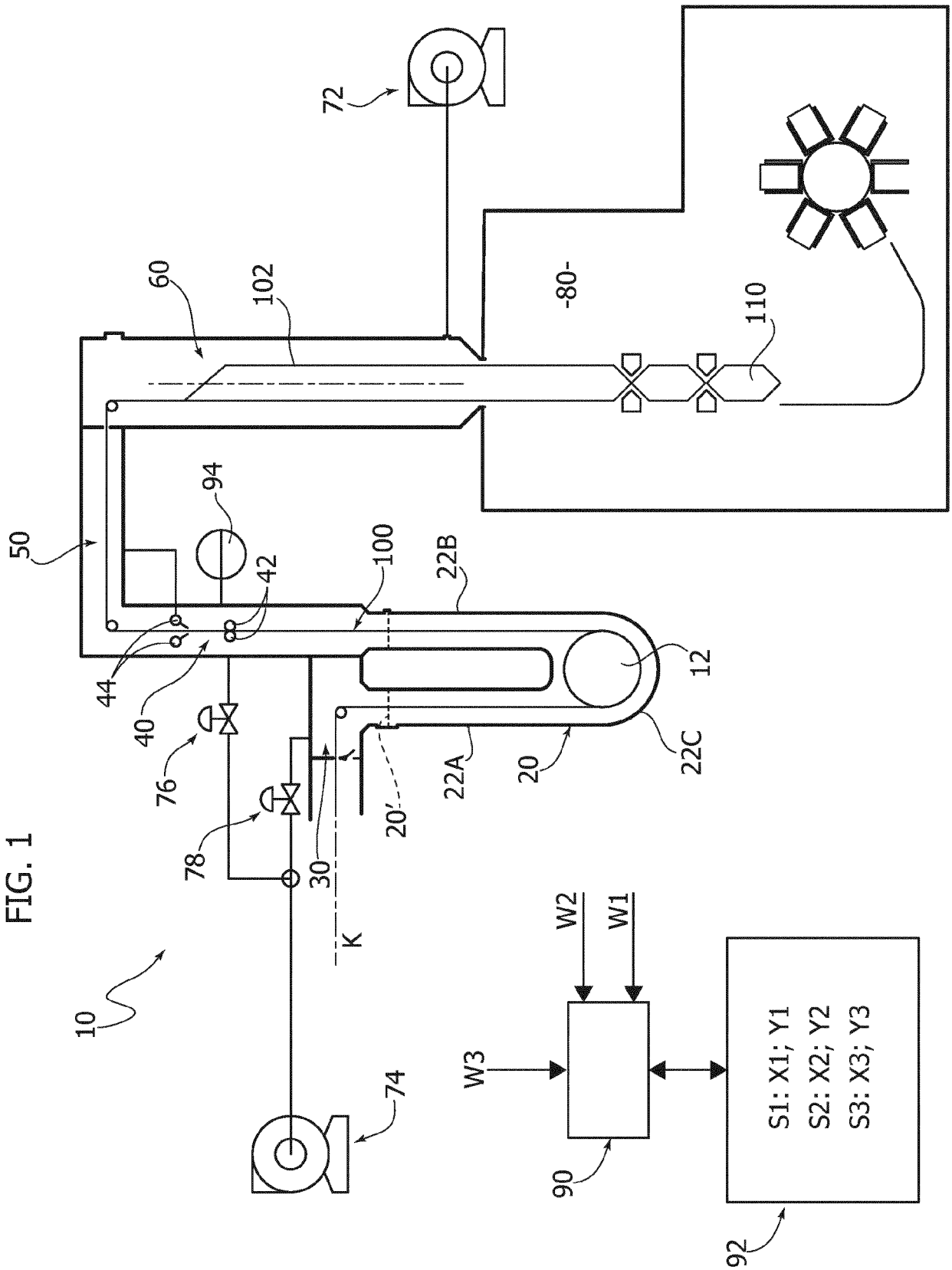
72
60
102
-80-
110
94
50
42
100
22B
44
40
12
76
22A
20
22C
78
20'
30
K
10
W2
W1
W3
74
90
92
S1: X1; Y1
S2: X2; Y2
S3: X3; Y3

FIG. 1

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EUROPEAN SEARCH REPORT

Application Number
EP 23 19 5676

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	19 February 2024	Yazici, Baris

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