



(11)

EP 4 570 675 A1

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
18.06.2025 Bulletin 2025/25

(51) International Patent Classification (IPC):
B65B 9/20 (2012.01) B65B 55/10 (2006.01)

(21) Application number: **24215171.0**

(52) Cooperative Patent Classification (CPC):
B65B 55/103; B65B 9/20

(22) Date of filing: **25.11.2024**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC ME MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA
Designated Validation States:
GE KH MA MD TN

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(30) Priority: **07.12.2023 IT 202300026292**

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(54) **STERILIZATION APPARATUS FOR A PACKAGING MACHINE AND PACKAGING MACHINE FOR FORMING PACKAGES**

(57) There is described a sterilization apparatus (9) for a packaging machine (1); the sterilization apparatus (9) comprises a sterilization device configured to expose a web of packaging material (5) to a chemical sterilization agent during advancement along a sterilization portion (P1) of an advancement path (P), and a plurality of rollers (30, 31, 32) defining a drying portion (P2) of the advancement path (P) being arranged downstream of the sterilization portion (P1) so that the chemical sterilization agent is removed from the web of packaging material (5) during advancement along the drying portion (P2); the plurality of rollers (30, 31, 32) is arranged such that the drying portion (P2) comprises a first section (P2a) and a second section (P2b); the plurality of rollers (30, 31, 32) comprises a first deflection roller (30) arranged at a deflection station at which the drying portion (P2) changes from the first section (P2a) to the second section (P2b) and such that centrifugal forces (F1) act on the web of packaging material (5) at the deflection station for removing residuals of the chemical agent from cavities (10) of the a web of packaging material (5) .

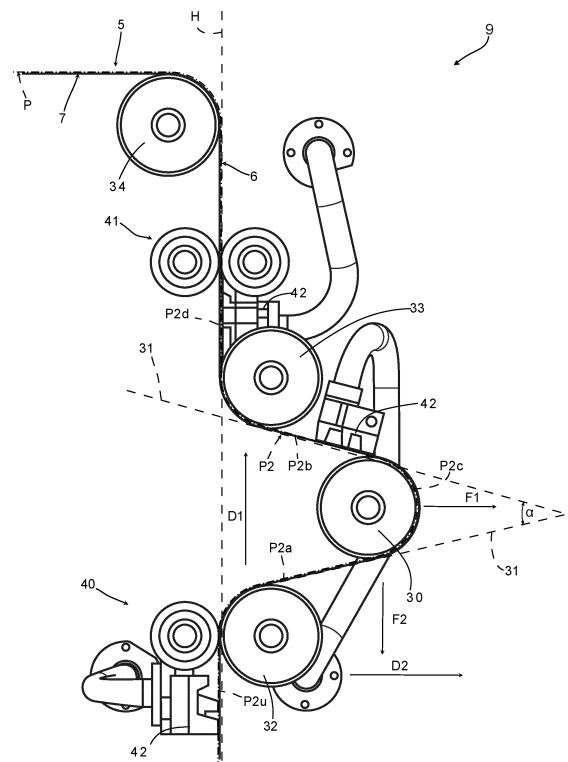


FIG.3

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Description

TECHNICAL FIELD

[0001] The present invention relates to a sterilization apparatus for a packaging machine for forming packages of a pourable product, more specifically of a pourable food product.

[0002] Advantageously, the present invention also relates to a packaging machine for forming packages of a pourable product, more specifically of 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 sealing and folding a laminated packaging material. The packaging material has a multilayer structure comprising a base layer, e.g. of paper or cardboard, 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 apparatuses, which advance and sterilize a web of packaging material, which is then formed into a tube and filled with the pourable pre/sterilized product under aseptic conditions before its formation into individual sealed packages.

[0006] It is known that some types of packages also comprise respective opening devices, which allow to be manipulated for accessing the pourable product.

[0007] In order to provide the packages with the opening devices, some automatic packaging apparatuses also comprise a molding apparatus for molding the opening devices or at least portions of the opening device onto the web of packaging material prior to the formation of the packages.

[0008] A typical automatic packaging apparatuses also comprise a sterilization apparatus operating by means of chemical sterilization and being arranged downstream of the molding apparatus so as to sterilize the packaging material.

[0009] The Applicant has found that, even though, the known sterilization apparatuses achieve excellent working results, a desire is felt in the sector to further improve the known sterilization apparatuses, in particular by

further improving the efficiency of removal of the chemical sterilization agent from the packaging material.

DISCLOSURE OF INVENTION

[0010] It is an object of the present invention to provide an improved sterilization apparatus for a packaging machine.

[0011] It is a further object of the present invention to provide an improved packaging machine having a sterilization apparatus.

[0012] According to the present invention, there is provided a sterilization apparatus as claimed in claim 1.

[0013] Preferred non-limiting embodiments of the sterilization apparatus are claimed in the respective dependent claims.

[0014] According to the present invention, there is also provided a packaging machine as claimed in claim 16.

BRIEF DESCRIPTION OF THE DRAWINGS

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

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

Figure 2 is a perspective view of a detail of the packaging machine of Figure 1, with parts removed for clarity;

Figure 3 is a side view of the detail of Figure 2, with parts removed for clarity; and

Figure 4 is a schematic view of a portion of an advancement path of a web of packaging material, with parts removed for clarity.

BEST MODES FOR CARRYING OUT THE INVENTION

[0016] Number 1 indicates as a whole a packaging machine for producing (sealed) packages 2 of a pourable product, more specifically of a pourable food product such as pasteurized milk, fruit juice, wine, tomato sauce, emulsions, beverages with pulp etc.

[0017] Each package 2 may comprise a main body 3 formed from a packaging material, more specifically a multilayer packaging material.

[0018] Additionally, each package 2 may comprise an opening device 4 connected to and/or protruding from main body 3. In particular, opening device 4 may be configured to allow for a controlled outpouring of the pourable product from package 2.

[0019] For example, each opening device 4 may be configured to allow to access and/or to outpour, in particular after a manipulation of the opening device, the pourable food product packaged within the respective package 2. For example, the manipulation of the opening

device can be reversible or irreversible.

[0020] In particular, packaging machine 1 may produce packages 2, in particular the respective main bodies 3, from a web of packaging material 5.

[0021] In more detail, the packaging material, more specifically web of packaging material 5, may have a multilayer structure and may comprise at least a layer of fibrous material, such as e.g. a paper or cardboard layer, and at least two layers of heat-seal plastic material, e.g. polyethylene, interposing the layer of fibrous material in between one another. One of these two layers of heat-seal plastic material defines the inner face of package 2 eventually contacting the pourable product.

[0022] Moreover, the packaging material, more specifically web of packaging material 5, may also comprise a layer of gas- and light-barrier material, e.g. aluminum foil or ethylene vinyl alcohol (EVOH) film, in particular being arranged between one of the layers of heat-seal plastic material and the layer of fibrous material.

[0023] Additionally, the packaging material, more specifically web of packaging material 5, may also comprise a further layer of heat-seal plastic material being interposed between the layer of gas- and light-barrier material and the layer of fibrous material.

[0024] The packaging material, more specifically web of packaging material 5, may comprise a first face 6 and a second face 7, in particular the first face 6 being the face of web of packaging material 5 defining the inner face of the formed package 2 eventually being in contact with the filled pourable food product.

[0025] In further detail, web of packaging material 5 may comprise a plurality of repeat units, more specifically successively arranged (and equally spaced) with respect to one another along web of packaging material 5.

[0026] In more detail, each repeat unit may form the basis of one respective package 2. In other words, packaging machine 1 may be configured to produce packages 2 from web of packaging material 5 such that each package 2 results from one respective repeat unit.

[0027] In further detail, each repeat unit may be defined by one respective pattern present on web of packaging material 5. For example, the pattern may be substantially identical for all repeat units and may also differ in minor details from the other patterns - minor differences may e.g. be the presence of information tags indicating a production day, a production lot, personalized information or similar.

[0028] With particular reference to Figure 1, packaging machine 1 may comprise:

- a conveying device 8 configured to advance web of packaging material 5 along a web advancement path P; and
- a sterilization apparatus 9 configured to sterilize web of packaging material 5.

[0029] Additionally, packaging machine 1 may comprise a molding apparatus arranged upstream of sterili-

zation apparatus 9 along web advancement path P and being configured to mold at least a portion of opening device 4 onto web of packaging material 5, more specifically onto each repeat unit.

[0030] Preferentially but not necessarily, the molding apparatus may be configured to mold each opening device 4 as a whole onto the respective repeat unit. Alternatively, the molding apparatus may mold only a portion of each opening device 4 onto the respective repeat unit.

[0031] Alternatively, packaging machine 1 may be void of a molding apparatus and web of packaging material 5 may be already fed into packaging machine 1 together with opening devices 4 and/or the portions of opening devices 4.

[0032] With reference to Figure 4, when, in use, entering sterilization apparatus 9, web of packaging material 5 comprises a plurality of cavities 10 resulting from the presence of opening device 4 and/or a portion of opening device 4.

[0033] It should be noted that after formation of the respective packages 2, each cavity 10 is part of an inner space of the respective package 2. Accordingly, sterilization apparatus 9 is configured to sterilize web of packaging material 5 together with cavities 10.

[0034] As will be discussed in more detail further below, sterilization apparatus 9 is provided with means for improving the sterilization of web of packaging material 5.

[0035] In further detail and as schematically shown in Figure 1, packaging machine 1 may also comprises:

- an isolation chamber 15 arranged downstream of sterilization apparatus 9 and having an inner environment 16, more specifically a sterile inner environment 16;
- a tube forming and sealing device 17 configured to form within inner environment 16 a tube 18 from the, in use, advancing web of packaging material 5 and to longitudinally seal tube 18 within inner environment 16;
- a filling device 20 configured to fill tube 18 with the pourable food product; and
- a package forming unit 21 configured to at least form and transversally seal tube 18, preferentially to also transversally cut tube 18, for forming (sealed) packages 2.

[0036] Advantageously, conveying device 6 may also be configured to advance tube 18 along a tube advancement path Q towards and at least partially through package forming unit 21.

[0037] In further detail, conveying device 6 may also be configured to advance tube 18 and any intermediate of tube 18 along tube advancement path Q. In particular, with intermediates of tube 18 any configuration of web of packaging material 5 is meant prior to obtaining the tube structure and after folding of web of packaging material 5 has been started. In other words, the intermediates of

tube 18 are a result of a gradual folding of web of packaging material 5 so as to obtain tube 18, in particular by overlapping opposite lateral edges of web of packaging material 5 with one another.

[0038] Preferentially, conveying device 6 may also be configured to advance web of packaging material 5 at and/or within sterilization apparatus 9.

[0039] With particular reference to Figure 1, isolation chamber 15 may be configured to protect inner environment 16 from an (hostile) outer environment.

[0040] Even more particular, isolation chamber 15 may be configured to allow for forming, longitudinally sealing and filling tube 18 in a sterile inner environment 16.

[0041] In further detail, sterilization apparatus 9 may comprise a sterilization device configured to expose web of packaging material 5 to a chemical sterilization agent such as hydrogen peroxide during advancement along a sterilization portion P1 of advancement path P.

[0042] In more detail, the sterilization device may comprise a bath configured to contain and/or containing the chemical sterilization agent and, in use, the web of packaging material 5 advances through the bath and the chemical sterilization agent when advancing along the sterilization portion P1.

[0043] In further detail, sterilization apparatus 9 may comprise a housing 22 having an inner space 23. Moreover, sterilization apparatus 9 may be configured to sterilize web of packaging material 5 within inner space 23.

[0044] More specifically, the sterilization device may be arranged within inner space 23.

[0045] Advantageously, housing 22 may be connected to isolation chamber 15, in particular such that the sterilized web of packaging material 5 enters inner environment 16 directly from inner space 23 (so that web of packaging material 5 is not exposed to any possible contamination).

[0046] In further detail, housing 22 may comprise an inlet opening for receiving web of packaging material 5 to be sterilized (into inner space 23) and an outlet opening for discharging the sterilized web of packaging material 5 (out of inner space 23 and into inner environment 16).

[0047] Advantageously, the sterilization device may be arranged within housing 22, more specifically downstream of the inlet opening and upstream of the outlet opening along advancement path P.

[0048] With particular reference to Figures 1 to 4, sterilization apparatus 9 may further comprise a plurality of rollers defining a drying portion P2 of advancement path P being arranged downstream of sterilization portion P1.

[0049] As will be explained in more detail further below, advancement of web of packaging material 3 along drying portion P2 allows removal of the chemical sterilization agent from web of packaging material 5.

[0050] Preferentially but not necessarily, inner space 23 comprises a drying space. Drying space being defined as the portion of inner space 23 within which, in use, web of packaging material 5 advances when advancing along

drying portion P2.

[0051] Advantageously, sterilization apparatus 9 may further comprise heating means configured to control a temperature within the drying space ranging between 60°C to 90°C.

[0052] Preferentially, sterilization apparatus 9 is provided with means that efficiently allow for removal of the chemical sterilization agent not only from the planar portions of web of packaging material 5, but also from cavities 10.

[0053] Preferentially but not necessarily, the arrangement of the rollers of the plurality of rollers contributes to an efficient removal of the chemical sterilization agent.

[0054] Preferentially but not necessarily, the plurality of rollers is arranged such that drying portion P2 comprises a first section P2a and a second section P2b transversal and/or inclined with respect to first section P2a.

[0055] Moreover, the plurality of rollers comprises a first deflection roller 30 arranged at a deflection station at which drying portion P2 changes from first section P2a to second section P2b. Moreover, first deflection roller 30 is arranged such that the change from first section P2a to second section P2b results in centrifugal forces F1 acting on web of packaging material 5 at the deflection station, and, if present, on the chemical sterilization agent being placed within cavities 10, for removing residuals of the chemical agent from cavities 10.

[0056] This allows to render more efficient the removal of the chemical sterilization agent also from cavities 10.

[0057] Additionally, first section P2a may be defined by the plurality of rollers such that during advancement of web of packaging material 5 along first section P2a gravitational force F2 may act on the residues of the chemical sterilization agent being present within cavities 10. This furthermore improves the removal of the chemical sterilization agent from cavities 10.

[0058] In more detail and with particular reference to Figure 3, first deflection roller 30 may be arranged such that first section P2a and second section P2b and/or their respective imaginary linear extensions 31 define an acute angle α different from 90°.

[0059] With particular reference to Figures 2 and 3, the plurality of rollers, more specifically arranged within housing 22, even more specifically within inner space 23, further comprises a second deflection roller 32 arranged upstream of first deflection roller 30 along the advancement path P and a third deflection roller 33 arranged downstream of first deflection roller 30 along advancement path P.

[0060] In particular, the plurality of rollers is arranged downstream of the sterilization device along advancement path P.

[0061] For example, first section P2a may be defined between second deflection roller 32 and first deflection roller 30 and second section P2b may be defined between first deflection roller 30 and third deflection roller 33.

[0062] In further detail, first deflection roller 30 may

define an auxiliary portion P2c of drying portion P2, in particular interposed between first section P2a and second section P2b, and more specifically also connecting first section P2a and second section P2b with one another.

[0063] Preferentially but not necessarily, first section P2a, second section P2b and auxiliary portion P2c define a U-shape or a V-shape.

[0064] According to some possible non-limiting embodiments, second deflection roller 32 and third deflection roller 33 may be displaced from one another along at least a first direction D1.

[0065] Additionally, first deflection roller 30 may be displaced from at least one of second deflection roller 32 and third deflection roller 33, more specifically from second deflection roller 32 and third deflection roller 33, along a second direction D2 orthogonal to first direction D1.

[0066] Additionally, first deflection roller 30 may be displaced from at least one of second deflection roller 32 and third deflection roller 33 more specifically from second deflection roller 32 and third deflection roller 33, along first direction D1.

[0067] In further detail, each one of second deflection roller 32, third deflection roller 33 and first deflection roller 30 extend along respective longitudinal axes A. Advantageously, each longitudinal axis A defines also the respective rotation axis.

[0068] According to some preferred non-limiting embodiments, third deflection roller 33 may be arranged above second deflection roller 32 and/or third deflection roller 33 and second deflection roller 32 may be spaced apart from one another along first direction D1, but not about second direction D2.

[0069] Advantageously, longitudinal axes A may be parallel to one another.

[0070] Moreover, second direction D2 is orthogonal to longitudinal axes A or second direction D2 and first direction D1 are orthogonal to longitudinal axes A.

[0071] Additionally, none of first deflection roller 30, second deflection roller 32 and third deflection roller 33 is spaced apart from the other ones of first deflection roller 30, second deflection roller 32 and third deflection roller 33 along a direction parallel to longitudinal axes A.

[0072] According to some possible solutions, first section P2a and second section P2b may be inclined with respect to first direction D1. In particular, first direction D1 is not perpendicular to the respective portions of web of packaging material 5 advancing along respectively first section P2a and second section P2b.

[0073] In further detail, second deflection roller 32 may deflect, in use, the advancing web of packaging material 5 from an upstream section P2u of drying portion P2 to first section P2a and/or third deflection roller 33 may deflect, in use, the advancing web of packaging material 5 from second section P2b to a downstream section P2d of drying portion P2.

[0074] Advantageously, second deflection roller 32

and third deflection roller 33 may be arranged such that the respective portion of web of packaging material 5 advancing, in use, along upstream section P2u and the respective portion of web of packaging material 5 advancing, in use, along downstream section P2d lie within a common plane H.

[0075] According to the example shown in Figures 1 to 4, sterilization apparatus 9 may also comprise a fourth deflection roller 34, preferentially arranged within housing 22, more specifically within inner space 23.

[0076] More specifically, fourth deflection roller 34 may be arranged downstream of third deflection roller 33 along advancement path P.

[0077] In further detail, fourth deflection roller 34 may be displaced from second deflection roller 32 and third deflection roller 33 along first direction D1, and advantageously also along second direction D2.

[0078] According to some preferred non-limiting embodiments, fourth deflection roller 34 may be arranged adjacent to the outlet opening of housing 22.

[0079] Moreover, fourth deflection roller 34 may be configured to deflect the, in use, advancing web of packaging material 5 prior to feeding web of packaging material 5 out of inner space 23, and preferentially into inner environment 16.

[0080] According to some preferred non-limiting embodiments, fourth deflection roller 34 may be configured to deflect web of packaging material 5 at an angle of substantially 90°.

[0081] Additionally or alternatively, the plurality of rollers may comprise at least a first pair 40 of upstream squeegee rollers and a second pair 41 of downstream squeegee rollers arranged downstream of first pair 40 along drying portion P2. Each one of first pair 40 and second pair 41 may be configured to remove liquid, in particular parts of the chemical sterilization agent, from web of packaging material 5. More specifically, in use, web of packaging material 5 advances between the respective upstream squeegee rollers of first pair 40 and the respective downstream squeegee rollers of second pair 41 resulting thereby in a removal of at least parts of the chemical sterilization agent associated with web of packaging material 5. By relying on first pair 40 and second pair 41 it is possible to further improve the removal of the chemical sterilization agent.

[0082] According to some preferred non-limiting embodiments, first pair 40 and second pair 41 may be displaced from one another along first direction D1, but advantageously not along second direction D2 and even more advantageously even not along a direction parallel to longitudinal axes A.

[0083] In particular, in use, the respective portions of web of packaging material 5 being interposed between the upstream squeegee rollers of first pair 40 and the downstream squeegee rollers of second pair 41 may lie within common plane H.

[0084] According to some preferred non-limiting embodiments, first deflection roller 30 and third deflection

roller 33 may be interposed between first pair 40 and second pair 41.

[0085] More specifically, first deflection roller 30 may be arranged downstream of first pair 40 along advancement path P and third deflection roller 33 may be arranged upstream of second pair 41 along advancement path P.

[0086] According to the embodiment shown, second deflection roller 32 may define one of the upstream squeegee rollers of first pair 40.

[0087] According to some preferred non-limiting embodiments, the plurality of rollers and/or first deflection roller 30 and/or second deflection roller 32 and/or third deflection roller 33 and/or fourth deflection roller 34 and/or one or more of the upstream squeegee rollers and/or one or more of the downstream squeegee rollers may comprises respective grooves defining respective spaces within which opening devices 4 and/or portions of opening devices may move.

[0088] With particular reference to Figures 2 and 3, sterilization apparatus 9 may also comprise one or more gas nozzles 42, each one arranged at one respective blowing station along drying portion P2 and being configured to direct a stream of gas, such as a stream of a sterile gas or a stream of sterile air, against web of packaging material 5. Some or all of gas nozzles 42 may be placed such that the respective stream of gas may be directed into cavities 10.

[0089] Gas nozzles 42 further contribute to a more efficient removal of the chemical sterilization agent from web of packaging material 5 and/or cavities 10.

[0090] According to the specific example shown, one gas nozzle 42 may be positioned upstream of first pair 40 and/or second deflection roller 32 and/or one, more specifically two, even more specifically exactly two, gas nozzle 42 may be interposed between first pair 40 and/or second deflection roller 32 and second pair 41.

[0091] Additionally or alternatively, one gas nozzle 42 may be interposed between third deflection roller 33 and second pair 41 and/or one gas nozzle 42 may be interposed between first deflection roller 30 and third deflection roller 33, in particular this gas nozzle 42 and/or these gas nozzles 42 being configured to direct the respective stream of gas into cavities 10.

[0092] Preferentially but not necessarily, sterilization apparatus 9 may also comprise one or more air blades, i.e. gas nozzles having an elongated opening area through which a substantially linear stream of gas is ejected. For example at least one air blade may be arranged downstream of second pair 41.

[0093] Additionally, packaging machine 1 may also comprise a conditioning unit configured to define and control the atmosphere and conditions within inner environment 16 and/or inner space 23. In particular, the conditioning unit may be configured to maintain and control sterility of inner environment 16 and/or inner space 23. Additionally, the conditioning unit may also be configured to control temperature and/or humidity

and/or pressure.

[0094] Preferentially but not necessarily, the conditioning unit may comprise the heating means.

[0095] Moreover, the conditioning unit may also be configured to maintain sterility within inner environment 16 and/or inner space 23.

[0096] According to some preferred non-limiting embodiments, the conditioning unit may also be configured to control:

- a first pressure within inner environment 16; and
- a second pressure within inner space 23.

[0097] Advantageously, the conditioning unit may be configured to control the first pressure to be larger than the second pressure.

[0098] Moreover, the conditioning unit may be configured to control the first pressure and the second pressure to be larger than ambient pressure.

[0099] In use, packaging machine 1 produces packages 2 of a pourable food product. In particular, packaging machine 1 forms tube 18 from web of packaging material 5, longitudinally seals tube 18, fills tube 18 with the pourable product and forms, transversally seals and transversally cuts tube 18 so as to obtain packages 2.

[0100] Prior to the formation of tube 18 from web of packaging material 5, web of packaging material 5 is sterilized by sterilization apparatus 9.

[0101] During advancement of web of packaging material 5 along sterilization portion P1, web of packaging material 5 is sterilized, in particular by passing through the bath containing the chemical sterilization agent.

[0102] Moreover, during advancement along drying portion P2, the chemical sterilization agent is removed from web of packaging material 5, including cavities 10.

[0103] Removal of the chemical sterilization agent is efficiently obtained by having first deflection roller 30 guaranteeing centrifugal forces F1.

[0104] Removal of the chemical sterilization agent is also efficiently obtained by having first pair 40 and second pair 41 and/or by having gas nozzles 42.

[0105] The advantages of packaging machine 1 and/or sterilization apparatus 9 according to the present invention will be clear from the foregoing description.

[0106] In particular, sterilization apparatus 9 allows for an efficient removal of the chemical sterilization agent from web of packaging material 5, including cavities 10.

[0107] A further advantage resides in the use of first deflection roller 30 as guaranteeing the presence of centrifugal forces acting on the chemical sterilization agent, which results in removal of the chemical sterilization agent from web of packaging material 5 having particular advantages with regard to removal of the chemical sterilization agent from cavities 10.

[0108] Another advantage relies on the use of first pair 40 and second pair 41, in particular in combination with gas nozzles 42 as this allows for an efficient removal of the chemical sterilization agent.

[0109] An even other advantage resides in that gravitational force acts on the chemical sterilization agent being present within cavities 10, which allows draining of the chemical sterilization agent from cavities 10.

[0110] Clearly, changes may be made to packaging machine 1 and/or sterilization apparatus 9 as described herein without, however, departing from the scope of protection as defined in the accompanying claims.

Claims

1. Sterilization apparatus (9) for a packaging machine (1) for forming packages (2) filled with a pourable product from a web of packaging material (5) having a plurality of cavities (10);

wherein the sterilization apparatus (9) is configured to sterilize the web of packaging material (5) during advancement of the web of packaging material (5) along an advancement path (P); wherein the sterilization apparatus (9) comprises:

- a sterilization device configured to expose the web of packaging material (5) to a chemical sterilization agent during advancement along a sterilization portion (P1) of the advancement path (P); and
- a plurality of rollers (30, 31, 32) defining a drying portion (P2) of the advancement path (P) being arranged downstream of the sterilization portion (P1) so that the chemical sterilization agent is removed from the web of packaging material (5) during advancement along the drying portion (P2);

wherein the plurality of rollers (30, 31, 32) is arranged such that the drying portion (P2) comprises a first section (P2a) and a second section (P2b) transversal and/or inclined with respect to the first section (P2a);

wherein the plurality of rollers (30, 31, 32) comprises a first deflection roller (30) arranged at a deflection station at which the drying portion (P2) changes from the first section (P2a) to the second section (P2b) and such that centrifugal forces (F1) act on the web of packaging material (5) at the deflection station for removing residuals of the chemical agent from the cavities (10).

2. Sterilization apparatus according to claim 1, wherein the first deflection roller (30) is arranged such that the first section (P2a) and the second section (P2b) and/or their respective imaginary extensions (31) define an acute angle (α) different from 90°.

3. Sterilization apparatus according to claim 1 or 2, wherein the plurality of rollers (30, 31, 32) further comprises a second deflection roller (32) arranged upstream of the first deflection roller (30) along the advancement path (P) and a third deflection roller (33) arranged downstream of the first deflection roller (30) along the advancement path (P); wherein the second deflection roller (32) and the third deflection roller (33) are displaced from one another along at least a first direction (D1) and the first deflection roller (30) is displaced from at least one of the second deflection roller (32) and the third deflection roller (33) along a second direction (D2) orthogonal to the first direction (D1).

4. Sterilization apparatus according to claim 3, wherein each one of the first deflection roller (30), the second deflection roller (32) and the third deflection roller (33) and extends along a respective longitudinal axis (A);

wherein the longitudinal axes (A) are parallel to one another;

wherein the second direction (D2) is orthogonal to the longitudinal axes (A).

5. Sterilization apparatus according to claim 3 or 4, wherein the first deflection roller (30) is displaced from at least one of the second deflection roller (31) and the third deflection roller (33) along the first direction (D1).

6. Sterilization apparatus according to any one of claims 3 to 5, wherein the first deflection roller (30) defines an auxiliary section (P2c) of the drying portion (P2); wherein the first section (P2a), the second section (P2b) and the auxiliary section (P2c) define a U-shape or a V-shape.

7. Sterilization apparatus according to claim 6, wherein the second deflection roller (32) is configured to deflect, in use, the advancing web of packaging material (5) from an upstream section (P2u) of the drying portion (P2) to the first section (P2a) and the third deflection roller (33) is configured to deflect, in use, the advancing web of packaging material (5) from the second section (P2b) to a downstream section (P2d) of the drying portion (P2); wherein the second deflection roller (32) and the third deflection roller (33) are arranged such that the respective portion of the web of packaging material (5) advancing, in use, along the upstream section (P2u) and the respective portion of the web of packaging material (5) advancing, in use, along the downstream section (P2d) lie within a common plane (H).

8. Sterilization apparatus according any one of claims 3 to 7, wherein the first deflection roller (30) is displaced from the second deflection roller (31) and the third deflection roller (33) along the first direction (D1) and the second direction (D2).
9. Sterilization apparatus according to any one of claims 3 to 8, wherein the third deflection roller (33) is arranged above the second deflection roller (32).
10. Sterilization apparatus according to any one of the preceding claims, and further comprising one or more gas nozzles (42), each gas nozzle (42) being arranged at one respective blowing station along the drying portion (P2) and being configured to direct a stream of gas against the web of packaging material (5).
11. Sterilization apparatus according to any one of the preceding claims, and further comprising an upstream pair (40) of upstream squeegee rollers arranged upstream of the first deflection roller (30) and/or a downstream pair (41) of downstream squeegee rollers arranged downstream of the first deflection roller (30).
12. Sterilization apparatus according to any one of the preceding claims, wherein the plurality of rollers (30, 31, 32) is arranged such that during advancement of web of packaging material (5) along a section (P2a) of drying portion (P2) gravitational force (F2) acting on the chemical sterilization agent present within the cavities (10) allows for draining of the chemical sterilization agent from the cavities (10).
13. Sterilization apparatus according to any one of the preceding claims, wherein the web of packaging material (5) advances within a drying space of the sterilization apparatus (9) during advancement along the drying portion (P2) ; wherein the sterilization apparatus (9) further comprises heating means configured to control a temperature within the drying space ranging between 60°C to 90°C.
14. Sterilization apparatus according to any one of the preceding claims, and further comprising a housing (22) having an inlet opening for receiving the web of packaging material (5) to be sterilized and an outlet opening for discharging the sterilized web of packaging material (5), wherein the sterilization device is arranged downstream of the inlet opening and/or upstream of the plurality of rollers (30, 31, 32).
15. Sterilization apparatus according to any one of the preceding claims, wherein the sterilization device comprises a bath configured to contain the chemical sterilization agent and, in use, the web of packaging material (5) advances through the bath and the chemical sterilization agent.
16. Packaging machine (1) for forming packages (2) filled with a pourable product, comprising:
- a conveying device (8) configured to advance the web of packaging material (5) along a web advancement path (P);
 - an isolation chamber (15) having an inner environment (16) ;
 - a tube forming and sealing device (17) configured to form a tube (18) from the, in use, advancing web of packaging material (5) within the inner environment (16) and to longitudinally seal the tube (18) within the inner environment (16);
 - a filling device (20) for filling the tube (18) with the pourable product;
 - a package forming unit (21) configured to form, to transversally seal and to transversally cut the, in use, advancing tube (18) for forming the packages (2); and
 - a sterilization apparatus (9) according to any one of the preceding claims, being configured to sterilize the web of packaging material (5) and being arranged upstream of the isolation chamber (15).

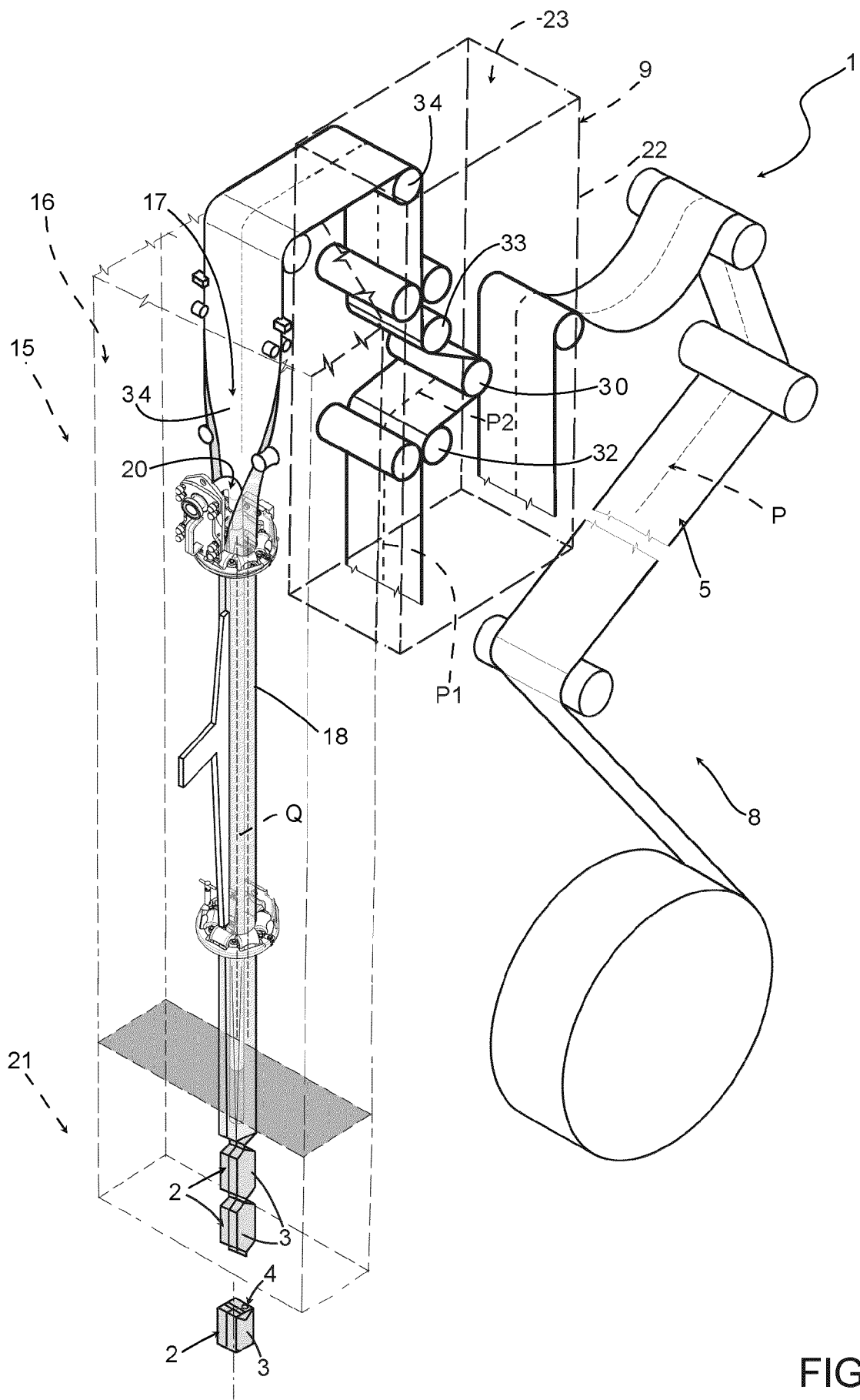


FIG.1

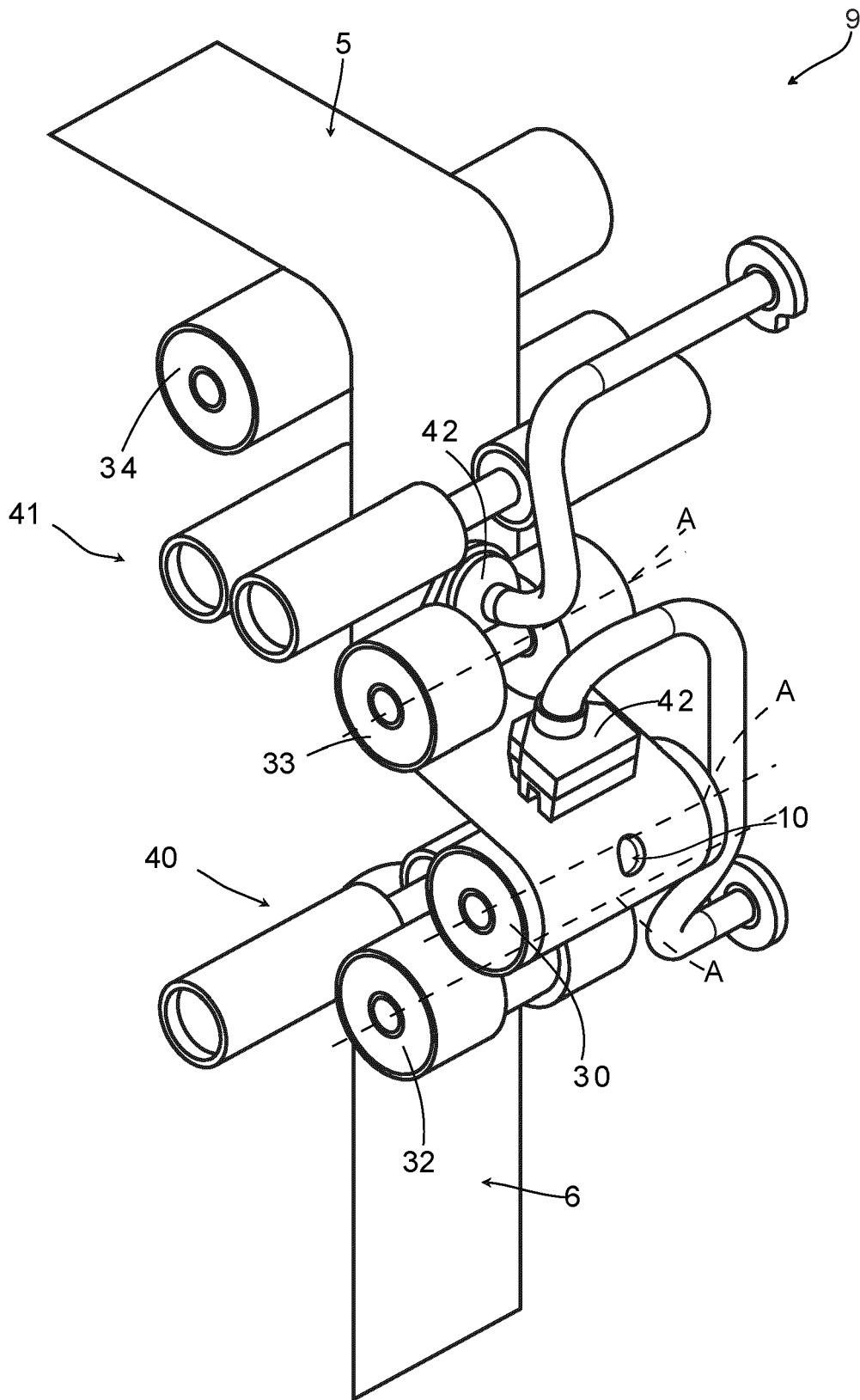


FIG.2

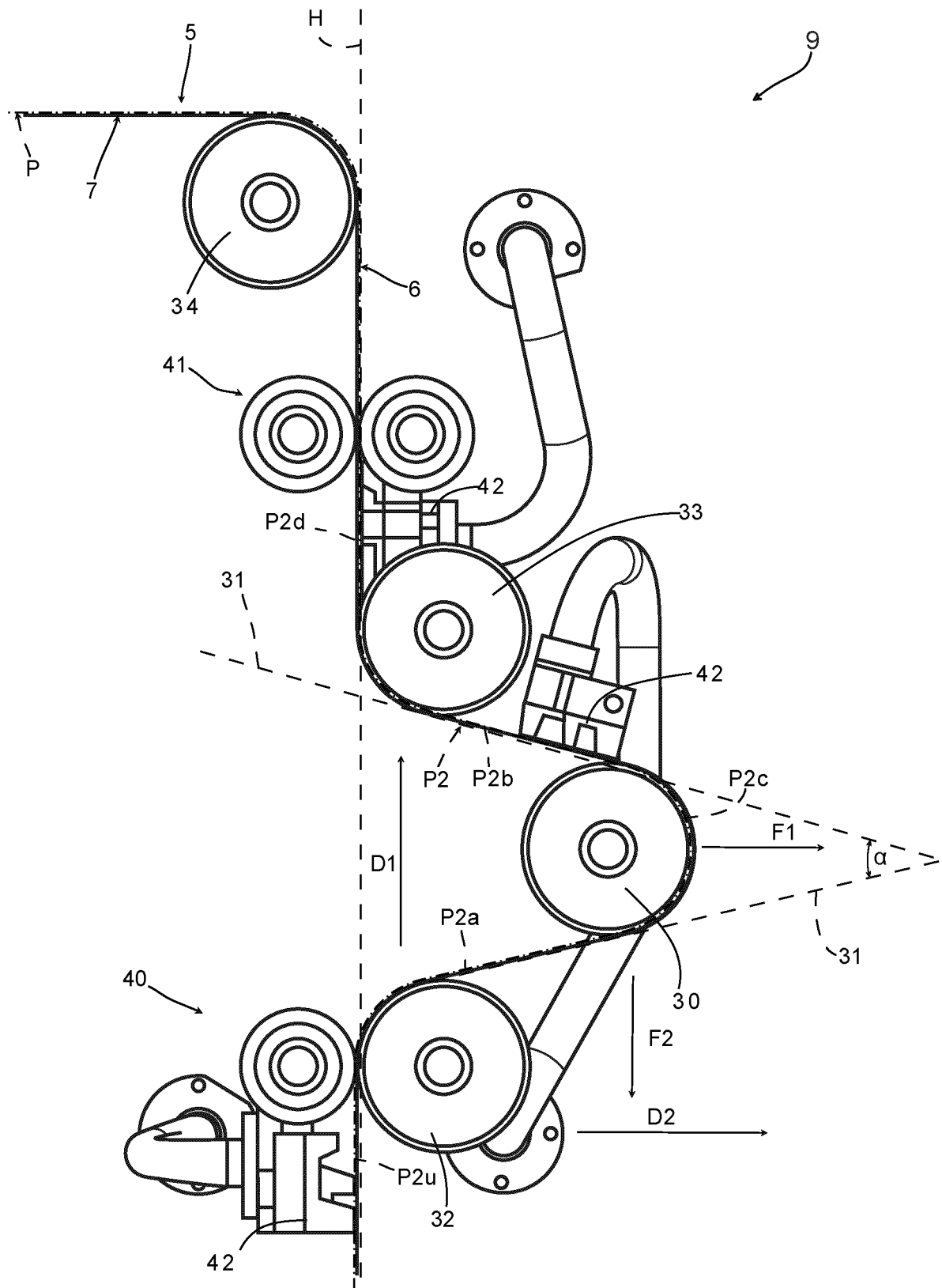


FIG.3

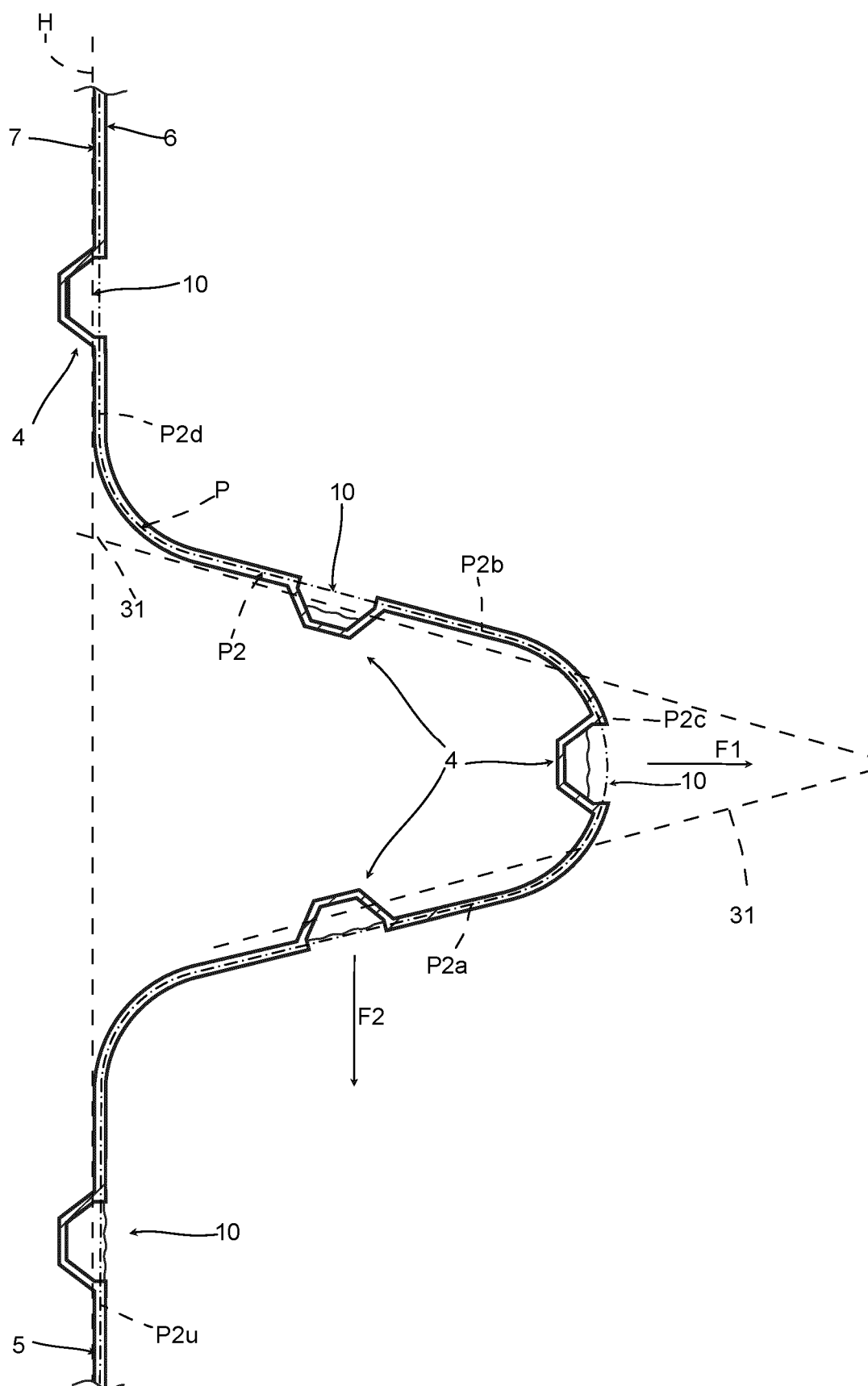


FIG.4



EUROPEAN SEARCH REPORT

Application Number

EP 24 21 5171

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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		30 April 2025	Dick, Birgit
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