



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:  
**27.03.2024 Bulletin 2024/13**

(21) Application number: **23198469.1**

(22) Date of filing: **20.09.2023**

(51) International Patent Classification (IPC):  
**B65B 9/02** (2006.01) **B65B 9/04** (2006.01)  
**B65B 41/00** (2006.01) **B65B 41/12** (2006.01)  
**B65B 47/00** (2006.01) **B65B 47/02** (2006.01)  
**B65B 57/00** (2006.01) **B65B 57/02** (2006.01)

(52) Cooperative Patent Classification (CPC):  
**B65B 9/02; B65B 9/023; B65B 9/04; B65B 9/042;**  
**B65B 41/00; B65B 41/12; B65B 47/02; B65B 57/02**

(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:  
**KH MA MD TN**

(30) Priority: **20.09.2022 NL 2033078**

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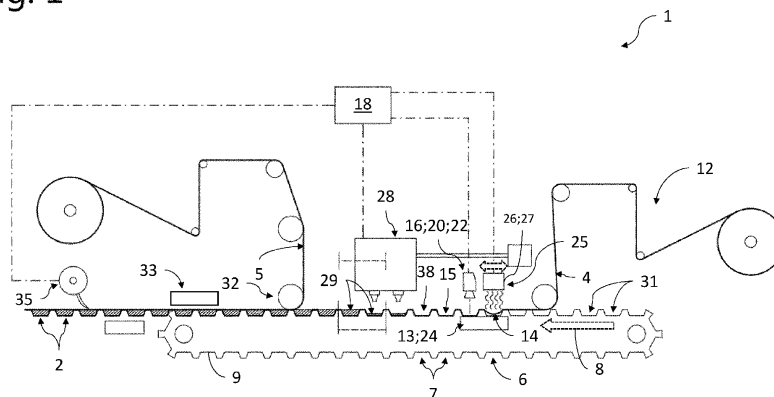
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(54) **PACKAGING SYSTEM AND METHOD FOR PRODUCING POUCHES**

(57) The present invention relates to a packaging system (1) for producing pouches (2) having at least one compartment (3) and made from a water-soluble first foil (4) and a water-soluble second foil (5), the packaging system (1) comprising a mould conveyor (6) configured to move multiple moulds (7) in a conveying direction (8) wherein each mould comprises at least one forming cavity (10); a first foil supplying device (12) configured to position the first foil on the support surface of the mould and over its at least one forming cavity; a forming device (13) configured to form a part of the first foil extending over the at least one forming cavity into the at least one

forming cavity of the moulds to form at least one open compartment (15) of the pouch; a sensor system (16) configured to acquire forming condition data (17) of the at least one open compartment, the sensor system being configured to be operatively coupled to a control system (18) configured for comparing the forming condition data to a desired forming condition, and for generating a control command corresponding to a predetermined forming condition, wherein the packaging system is configured to control the pouch production based on receipt of the control command.

Fig. 1



## Description

### FIELD OF THE INVENTION

**[0001]** The present invention relates to a packaging system and a method for producing pouches having at least one compartment and made from a water-soluble first foil and a water-soluble second foil.

**[0002]** The present invention further relates to a control system and a control method for controlling a pouch production of a packaging system.

### BACKGROUND OF THE INVENTION

**[0003]** Detergent pouches, or pods, have become increasingly popular over the last number of years, both for the laundry washing and for dishwashing. Detergent pouches are generally made from a water soluble material such as PVOH. This material forms the wall of the pouch and wraps the detergent, e.g. a powder, gel, and/or liquid.

**[0004]** Detergent pouches provide a number of advantages over other kinds of dosage methods, leading to increased convenience for the user. The dose is always controlled and the same. Also, in case of a detergent pouch having multiple chambers holding different substances, the ratio between the volumes is always controlled and the same. If handled properly, there is no or significantly less contact between the hands of the user and the detergent. This results in less skin irritation. There is also less spilling of detergent.

**[0005]** The production of detergent pouches is generally done with a packaging system, wherein a plurality of moulds are transported along a trajectory, and wherein different process steps are performed in order to produce a plurality of individualized pouches.

**[0006]** A problem during pouch production is the inefficiency due to downtime. Downtime for example occurs when the detergent is spilled. When the detergent is spilled on a part of a water-soluble foil outside a dedicated open compartment, the production needs to be halted until the spill has been cleaned.

**[0007]** Further, during pouch production the forming of the water soluble foil into open compartments, that are to be filled with detergent, is often not consistent. This often leads to problems in process steps downstream. There is a need for a more consistent forming of the open compartments.

### OBJECT OF THE INVENTION

**[0008]** It is an object of the invention to provide a packaging system and method for producing pouches with improved control.

**[0009]** It is an object of the invention to provide a packaging system and method for producing pouches that is more efficient.

**[0010]** It is an object of the invention to manufacture

with less material and consequently at less costs.

**[0011]** It is an object of the invention to reduce the percentage of defective pouches.

### SUMMARY OF THE INVENTION

**[0012]** In order to achieve at least one object, the invention provides a packaging system for producing pouches having at least one compartment and made from a water-soluble first foil and a water-soluble second foil, the packaging system comprising:

- a mould conveyor configured to move multiple moulds in a conveying direction along a trajectory, wherein each mould comprises at least one forming cavity, and a support surface adjoining the at least one forming cavity,
- a first foil supplying device configured to position the first foil on the support surface of the mould and over its at least one forming cavity,
- a forming device configured to form a part of the first foil extending over the at least one forming cavity into the at least one forming cavity of the moulds to form at least one open compartment of the pouch,
- a sensor system configured to acquire forming condition data of the at least one open compartment, the sensor system being configured to be operatively coupled to a control system configured for comparing the forming condition data to a desired forming condition, and for generating a control command corresponding to a predetermined forming condition,

wherein the packaging system is configured to control the pouch production based on receipt of the control command.

**[0013]** The packaging system provides an improved control of the pouch production. This is achieved by the sensor system which acquires forming condition data of the at least one open compartment. By determining the forming condition at an early stage of pouch production, i.e. forming of the first foil, the pouch production can be better controlled from an early stage as well. When the forming condition is not according to a desired forming condition, for example filling of the at least one open compartment can be prevented at a later stage. Also, the forming of the first foil into the open compartment itself can be influenced based on the acquired forming condition data by for example heating the first foil more and/or more locally.

**[0014]** In an embodiment of the packaging system, the sensor system comprises an imaging device configured to image the forming condition of the open compartments, wherein the control system is configured for comparing the forming condition of the open compartments based on the imaging of the imaging device.

**[0015]** With the imaging device the forming condition can be better determined and compared to the desired forming condition.

**[0016]** In an embodiment of the packaging system, the imaging device is a thermal imaging device configured to image a temperature distribution of the first foil downstream the first foil supplying device, wherein the control system is configured for comparing the forming condition of the open compartments based on the imaging of the temperature distribution of the first foil.

**[0017]** The temperature distribution image of the first foil allows for a more accurate and effective determination of the forming condition of the at least one open compartment. In the present invention it was recognized that the use of a thermal imaging device is beneficial, because a temperature of parts of the first foil is influenced when said parts come into contact with a surface of the forming cavity. The difference in temperature between parts of the first foil that have come in contact with the surface of the forming cavity and parts of the first foil that have not come in contact with the surface of the forming cavity can be effectively imaged by the thermal imaging device. Generally, parts that have not come into contact with the surface of the forming cavity are considered to be not formed properly. Based on the imaged temperature distribution, the control system can effectively compare the forming condition of the at least one compartment to the desired forming condition.

**[0018]** In an embodiment of the packaging system, the forming device comprises a suction device and/or a stamping device configured to respectively suck and/or stamp the part of the first foil extending over the at least one forming cavity into the at least one forming cavity.

**[0019]** In an embodiment the packaging system further comprises a foil heating device configured to heat the first foil prior and/or during the positioning of the first foil on the support surface and over its at least one forming cavity, and/or during the forming of the part of the first foil extending over the at least one forming cavity into the at least one forming cavity.

**[0020]** In an embodiment of the packaging system, the foil heating device is configured to heat the first foil to a first foil temperature that is higher than a mould temperature of the support surface of the mould.

**[0021]** Heating the first foil increases the temperature difference between the surface of the forming cavity and the first foil, such that the thermal imaging device can provide an improved image of the temperature distribution of the first foil during and/or after forming.

**[0022]** In an embodiment of the packaging system, the foil heating device comprises at least one heating unit, wherein a heat output of the at least one heating unit is adjustable.

**[0023]** In an embodiment of the packaging system, the at least one heating unit is movable in the conveying direction, the heating unit being configured to move along with the first foil during the forming thereof while heating the foil.

**[0024]** In an embodiment of the packaging system, the foil heating device comprises an infrared heating unit and/or a microwave heating unit.

**[0025]** In an embodiment of the packaging system, the packaging system further comprises a filling device configured to at least partially fill the at least one open compartment with a powder, a liquid, or a gel, wherein the filling device is configured to be operatively coupled to the control system for receiving the control command, the filling device being configured to, based on receipt of the control command, at least partially fill the at least one open compartment when the forming condition is according to the desired forming condition, and to not at least partially fill the at least one open compartment when the forming condition is not according to the desired forming condition.

**[0026]** By controlling the filling of the at least one open compartment based on the forming condition data acquired by the sensor system, a more efficient packaging system can be provided.

**[0027]** Further, by not filling the at least one open compartment when it is not formed according to the desired forming condition, the chances of spills can be reduced. When an open compartment is not formed according to the desired forming condition, an inner volume of the open compartment is generally smaller than desired. As the filling device usually fills the open compartment with a predetermined amount of detergent, the predetermined amount may be too much for the smaller inner volume of an open compartment that is not formed according to the desired forming condition. Less spills lead to less downtime of the packaging system, and thereby to a more efficient packaging system.

**[0028]** Further, less material is used, because the powder, liquid and/or gel detergent is saved for another open compartment.

**[0029]** In an embodiment of the packaging system, the moulds are arranged in lanes and rows, wherein each mould is defined by a lane number and a row number, wherein the control command includes the lane number and row number of a mould corresponding to an open compartment having a forming condition not according to the desired forming condition, wherein the filling device is configured to not at least partially fill the open compartment in the mould corresponding to the lane number and row number based on the receipt of the control command.

**[0030]** By not filling the open compartment corresponding to mould with a specific lane number and row number, the pouch production can be further improved. When for example an entire row is not filled while said row comprises one or more open compartments that are formed according to the desired forming condition, the material of said well-formed open compartments is wasted.

**[0031]** In an embodiment the packaging system further comprises

- a second foil supplying device configured to position the second foil on at least a part of the first foil contacting the support surface of the mould and over the at least one open compartment, thereby closing

- the at least one open compartment,
- a sealing device for sealing the second foil to the first foil in order to form a pouch having at least one compartment.

**[0032]** In an embodiment of the packaging system, the packaging system further comprises a pouch rejection device configured to reject defective pouches, wherein the rejection device is configured to be operatively coupled to the control system for receiving the control command, the rejection device being configured to, based on receipt of the control command, reject pouches having at least one compartment with a forming condition that is not according to the desired forming condition.

**[0033]** By controlling the rejection process of the pouches based on the forming condition data acquired by the sensor system, a more efficient packaging system can be provided.

**[0034]** When the control command is received by both the filling device and the rejection device, a synergetic effect may occur in that the rejection device rejects empty pouches, or ghost pouches. Ghost pouches are pouches that are not filled with a detergent, and only consist of the water soluble first and second foil. Ghost pouches are beneficial compared to defective filled pouches, because it saves detergent and the water-soluble foil of the ghost pouches can be recycled more easily.

**[0035]** In an embodiment of the packaging system, the moulds are arranged in lanes and rows, wherein each mould is defined by a lane number and a row number, wherein the control command includes the lane number and row number of a mould corresponding to an open compartment having a forming condition that is not according to the desired forming condition, wherein the pouch rejection device is configured to reject a defective pouch in the mould corresponding to the lane number and row number based on the receipt of the control command.

**[0036]** By rejecting defective pouches that correspond to a mould with a specific lane number and row number, the pouch production can be further improved. When for example an entire row would be rejected while said row comprises one or more non-defective pouches, the material of said non-defective pouches is wasted.

**[0037]** In an embodiment of the packaging system, the foil heating device is configured to be operatively coupled to the control system for receiving the control command, wherein the control system further is configured for identifying one or more areas of the first foil that are not formed according to the desired forming condition based on the forming condition data provided by the sensor system, and for generating the control command if the one or more areas are identified, wherein the foil heating device is configured to heat one or more identified areas of the first foil based on receipt of the control command.

**[0038]** By heating the one or more identified areas the pouch production can be improved, because by heating the one or more identified areas said areas may become

formed. The heat allows the water soluble foil to stretch better. As a result the consistency of the forming of the open compartments can be improved.

**[0039]** In an embodiment of the packaging system, the foil heating device is configured to locally heat one or more areas of the first foil prior to the positioning thereof on the support surface of the mould and over its at least one forming cavity, wherein said one or more areas correspond to the one or more areas identified by the control system during the forming of a previous at least one open compartment.

**[0040]** By locally heating the one or more areas the pouch production can be improved, because by locally heating the one or more identified areas said areas may become formed, reducing the chance for open compartments that have a forming condition not according to the desired forming condition.

**[0041]** In an embodiment of the packaging system, during forming of the at least one open compartment, the foil heating device is configured to heat the one or more identified areas that are not formed according to the desired forming condition until the one or more identified areas are formed according to the desired forming condition with the forming device. This way there may be fewer open compartments with a forming condition not according to the desired forming condition. In the end leading to a higher percentage of correctly produced pouches.

**[0042]** In an embodiment of the packaging system, the mould conveyor is configured to move multiple moulds in a conveying direction along an endless trajectory.

**[0043]** The present invention further relates to a method for producing pouches having at least one compartment and made from a water-soluble first foil and a water-soluble second foil, the method comprising:

- a) moving multiple moulds in a conveying direction, wherein each mould comprises at least one forming cavity, and a support surface adjoining the at least one forming cavity,
- b) positioning a first foil on the support surface of the mould and over its at least one forming cavity,
- c) forming a part of the first foil extending over the at least one forming cavity into the at least one forming cavity of the moulds to form at least one open compartment of the pouch,
- d) acquiring forming condition data of the at least one open compartment with a sensor system, the sensor system being operatively coupled to a control system for comparing the forming condition data to a desired forming condition, and for generating a control command corresponding to a predetermined forming condition,

wherein the packaging system controls the pouch production based on receipt of the control command.

**[0044]** The method according to the present invention provides the same advantages as the packaging system

according to the invention.

**[0045]** In an embodiment the method comprises imaging the forming condition of the open compartments.

**[0046]** In an embodiment the method comprises imaging the temperature distribution of the first foil downstream of the supplying device.

**[0047]** In an embodiment the method comprises heating the first foil prior and/or during the positioning of the first foil on the support surface and over its at least one forming cavity, and/or during the forming of the first foil into the at least one forming cavity.

**[0048]** In an embodiment the method comprises heating the first foil prior to the positioning of the first foil on the support surface and over its at least one forming cavity to a first foil temperature that is higher than a mould temperature of the support surface of the moulds.

**[0049]** In an embodiment the method comprises at least partially filling the at least one open compartment with a powder or a liquid when the forming condition is according to the desired forming condition, and not at least partially filling the at least one open compartment when the forming condition is not according to the desired forming condition.

**[0050]** In an embodiment of the method, the moulds are arranged in lanes and rows, wherein each mould is defined by a lane number and a row number, wherein the control command includes the lane number and row number of a mould corresponding to an open compartment having a forming condition not according to the desired forming condition, wherein the method comprises not at least partially filling the open compartment in the mould corresponding to the lane number and row number based on the receipt of the control command.

**[0051]** In an embodiment the method further comprises

e) positioning a second foil on at least a part of the first foil contacting the support surface of the mould and over the at least one open compartment with a second foil supplying device in order to close the at least one open compartment,

f) sealing the second foil to the first foil with a sealing device in order to form a pouch having at least one compartment.

**[0052]** In an embodiment the method comprises rejecting defective pouches with a pouch rejection device, wherein the rejection device is operatively coupled to the control system for receiving the control command, wherein the rejection device, based on receipt of the control command, rejects pouches having at least one compartment with a forming condition that is not according to the desired forming condition.

**[0053]** In an embodiment of the method, the moulds are arranged in lanes and rows, wherein each mould is defined by a lane number and a row number, wherein the control command includes the lane number and row number of a mould corresponding to an open compart-

ment having a forming condition that is not according to the desired forming condition, wherein the method comprises rejecting a defective pouch in the mould corresponding to the lane number and row number based on the receipt of the control command.

**[0054]** In an embodiment the method comprises identifying one or more areas of the first foil that are not formed according to the desired forming condition based on the forming condition data provided by the sensor system, and heating one or more identified areas of the first foil based on receipt of the control command.

**[0055]** In an embodiment the method comprises locally heating one or more areas of the first foil prior to the positioning thereof on the support surface of the mould and over its at least one forming cavity, wherein said one or more areas correspond to the one or more areas identified during the forming of a previous at least one open compartment.

**[0056]** In an embodiment of the method, during the forming of the at least one open compartment the one or more identified areas that are not formed according to the desired forming condition are heated until the one or more identified areas are formed according to the desired forming condition.

**[0057]** The present invention further relates to a control system configured to be operatively coupled to a sensor system of a packaging system according to the invention, the sensor system being configured to acquire forming condition data of at least one open compartment of a pouch to be produced, wherein the control system is configured

- for receiving the forming condition data of the sensor system
- for comparing the forming condition data to a desired forming condition,
- for generating a control command corresponding to a predetermined forming condition, and
- for transmitting the control command to the packaging system for controlling the pouch production based on receipt of the control command.

**[0058]** The present invention further relates to a control method for controlling a pouch production of a packaging system, the method comprising:

- providing a control system operatively coupled to a sensor system of a packaging system,
- receiving forming condition data of the sensor system,
- comparing the forming condition data to a desired forming condition,
- generating a control command corresponding to a predetermined forming condition, and
- transmitting the control command to the packaging system for controlling the pouch production based on receipt of the control command.

**[0059]** These and other aspects of the invention will be more readily appreciated as the same becomes better understood by reference to the following detailed description and considered in connection with the accompanying drawings in which like reference symbols designate like parts.

## BRIEF DESCRIPTION OF THE FIGURES

### **[0060]**

Figure 1 schematically shows a side view of an embodiment of a packaging system according to the invention.

Figure 2 schematically shows a side view of another embodiment of a packaging system according to the invention.

Figure 3 schematically shows a perspective view of an embodiment of a plurality of moulds with at least one forming cavity, and a first foil.

Figure 4 schematically shows a top view of a mould with three forming cavities.

Figure 5A schematically shows the mould of figure 4 in cross-section along section A-A, wherein a first foil is positioned over the forming cavities.

Figure 5B shows an image of a temperature distribution of the first foil during positioning thereof on a plurality of moulds corresponding to figure 5A.

Figure 6A schematically shows the mould of figure 4 in cross-section along section A-A, wherein a first foil is formed into a plurality of open compartments, wherein the open compartments have a forming condition according to a desired forming condition.

Figure 6B schematically shows an image of a temperature distribution of formed open compartments.

Figure 7A schematically shows the mould of figure 4 in cross-section along section A-A, wherein a first foil is formed into a plurality of open compartments, wherein the open compartments have a forming condition not according to a desired forming condition.

Figure 7B schematically shows an image of a temperature distribution of formed open compartments, wherein a plurality of open compartments have a forming condition not according to a desired forming condition.

Figure 8 schematically shows a perspective view of an embodiment of a pouch produced with a packaging system according to the invention.

## DETAILED DESCRIPTION OF THE FIGURES

**[0061]** Turning to figures 1 and 2, two embodiments are shown of a packaging system 1 according to the invention for producing pouches 2 having at least one compartment 3 and made from a water-soluble first foil 4 and a water-soluble second foil 5.

**[0062]** The packaging system 1 comprises a mould conveyor 6 configured to move multiple moulds 7 in a

conveying direction 8 along a trajectory 9. In the embodiment as shown in figure 1 the mould conveyor 6 has an oblong shape, wherein the moulds 7 follow an endless trajectory 9 with a substantial horizontal component. The machine direction of the mould conveyor 6 in figure 1 is from right to left, or counter-clockwise.

**[0063]** The mould conveyor 6 as shown in figure 2 is of the rotary drum type, having an endless trajectory 9 that is circular. The machine direction of the mould conveyor 6 in figure 2 is counter-clockwise.

**[0064]** Each mould 7 comprises at least one forming cavity 10, and a support surface 11 adjoining the at least one forming cavity 10, see figures 3 and 4. In the shown embodiments each mould 7 comprises three forming cavities 10. The moulds 7 may also have a different number of forming cavities 10, as well as other shapes thereof.

**[0065]** The packaging system 1 comprises a first foil supplying device 12 configured to position the first foil 4 on the support surface 11 of the mould 7 and over its at least one forming cavity 10, thereby closing the at least one forming cavity 10.

**[0066]** The packaging system 1 comprises a forming device 13 that is configured to form a part 14 of the first foil 4 extending over the at least one forming cavity 10 into the at least one forming cavity 10 of the moulds 7 to form at least one open compartment 15 of the pouch.

**[0067]** In the shown embodiment the forming device 13 comprises a suction device 24 configured to suck the part of the first foil 4 extending over the at least one forming cavity 10 into the at least one forming cavity 10. The suction device 24 typically comprises a vacuum system which is connected via passages to the forming cavities 10.

**[0068]** The forming device 13 may also, or instead, comprise a stamping device configured to stamp the part of the first foil 4 extending over the at least one forming cavity 10 into the at least one forming cavity 10.

**[0069]** To improve the forming of the first foil 4 into the at least one forming cavity 10, the packaging system 1 further comprises a foil heating device 25. The foil heating device 25 can heat the first foil 4 prior and/or during the positioning of the first foil 4 on the support surface 11 and over its at least one forming cavity 10. The foil heating device 25 may also be configured to heat the first foil 4 during the forming of the part of the first foil 4 extending over the at least one forming cavity 10 into the at least one forming cavity 10.

**[0070]** The foil heating device 25 is configured to heat the first foil 4 to a first foil temperature that is higher than a mould temperature of the support surface 11 of the mould 7.

**[0071]** The foil heating device 25 comprises at least one heating unit 26. The heat output of the at least one heating unit 26 may be adjustable.

**[0072]** The at least one heating unit 26 may be movable in the conveying direction 8, such that the heating unit 26 moves along with the first foil 4 during the forming

thereof while heating the foil.

**[0073]** The foil heating device 25 may comprise an infrared heating unit 27 and/or a microwave heating unit.

**[0074]** Downstream of the forming device 13 a filling device 28 is provided for at least partially filling the formed open compartments 15 with a powder, a liquid, and/or a gel 29.

**[0075]** Subsequently, downstream of the filling device 28 a second foil supplying device 32 is provided. The second foil supplying device 32 positions the second foil 5 on at least a part of the first foil 4 contacting the support surface 11 of the mould 7 and over the at least one open compartment 15, thereby closing the at least one open compartment 15.

**[0076]** In order to seal the second foil 5 to the first foil 4 a sealing device 33 is provided. Sealing the second foil 5 to the first foil 4 forms a pouch 2 having at least one compartment 3.

**[0077]** After sealing the formed pouches 2 are moved to a cutting device that cuts, or individualises the pouches 2.

**[0078]** A pouch rejection device 35 is located downstream of the cutting device. The pouch rejection device 35 is configured to reject defective pouches 2.

**[0079]** The packaging system 1 comprises a sensor system 16 configured to acquire forming condition data 17 of the at least one open compartment 15.

**[0080]** The sensor system 16 may comprise an imaging device 20, like a camera, for imaging the forming condition of the open compartments 15.

**[0081]** The sensor system 16 may in particular comprise a thermal imaging device 22 configured to image a temperature distribution 23 of the first foil 4 downstream the first foil supplying device 12.

**[0082]** The imaging device, here a thermal imaging device 22, is positioned above the mould conveyor 6, such that it can image the first foil when it moves past the imaging device.

**[0083]** The sensor system 16 is configured to be operatively coupled to a control system 18 that is configured for comparing the forming condition data 17 to a desired forming condition 19. The control system 18 can be provided on the packaging system 1, but may also be located at a remote server, or in the cloud.

**[0084]** The control system 18 is further configured for generating a control command corresponding to a predetermined forming condition. For example, when the forming condition of the at least one compartment 3 is not according to the desired forming condition 19, the control system 18 generates a corresponding control command. Or, when the forming condition of the at least one compartment 3 is according to the desired forming condition 19, the control system 18 generates a corresponding control command. The packaging system 1 is configured to control the pouch production based on receipt of the control command.

**[0085]** In case the sensor system 16 comprises the imaging device 20, the control system 18 is configured

for comparing the forming condition of the open compartments 15 based on the imaging of the imaging device 20.

**[0086]** In case the imaging device 20 is a thermal imaging device 22 configured to image a temperature distribution 23 of the first foil 4 downstream the first foil supplying device 12, the control system 18 is configured for comparing the forming condition of the open compartments 15 based on the imaging of the temperature distribution 23 of the first foil 4.

**[0087]** The control command can for example be received by the filling device 28 when the filling device 28 is operatively coupled to the control system 18. Based on receipt of the control command, the filling device 28 at least partially fills the at least one open compartment 15 when the forming condition is according to the desired forming condition 19, and not at least partially fills the at least one open compartment 15 when the forming condition is not according to the desired forming condition 19.

**[0088]** The control command may also be received by the pouch rejection device 35 when the pouch rejection device 35 is operatively coupled to the control system 18. Based on receipt of the control command, the pouch rejection device 35 rejects pouches 2 having at least one compartment 3 with a forming condition that is not according to the desired forming condition 19.

**[0089]** The control command may also be received by the foil heating device 25 when the foil heating device 25 is operatively coupled to the control system 18. The control system 18 may then be configured for identifying one or more areas 37 of the first foil 4 that are not formed according to the desired forming condition 19 based on the forming condition data 17 provided by the sensor system 16. If one or more areas 37 are identified the control system 18 generates the control command, wherein the foil heating device 25 is configured to heat one or more identified areas 37 of the first foil 4 based on receipt of the control command.

**[0090]** The foil heating device 25 may be configured to locally heat one or more areas 37 of the first foil 4 prior to the positioning thereof on the support surface 11 of the mould 7 and over its at least one forming cavity 10. Local heating can for example be done by an infrared heating unit 27 which is able to accurately aim heat radiation to specific areas 37 of the first foil 4. Said one or more areas 37 may correspond to the one or more areas 37 identified by the control system 18 during the forming of a previous at least one open compartment 38. This way an effective feedback loop can be created, thereby improving the forming of the open compartments 15 during operation of the packaging system 1.

**[0091]** During forming of the at least one open compartment 15, the foil heating device 25 may be configured to heat the one or more identified areas 37 that are not formed according to the desired forming condition 19 until the one or more identified areas 37 are formed according to the desired forming condition 19 with the forming device 13. For example, the control system 18 may be configured to send a control command to the foil heating

device 25 when an open compartment 15 is formed according to the desired forming condition 19 upon which the foil heating device 25 stops heating the identified areas 37.

**[0092]** As the moulds 7 are arranged in lanes 30 and rows 31, each mould 7 is defined by a lane number and a row number. The control command may include the lane number and row number of a mould 7 corresponding to an open compartment 15 having a forming condition not according to the desired forming condition 19. In that case the filling device 28 is configured to not at least partially fill the open compartment 15 in the mould 7 corresponding to the lane number and row number based on the receipt of the control command.

**[0093]** This also applies to the pouch rejection device 35, which can be configured to reject a defective pouch 2 in the mould 7 corresponding to the lane number and row number based on the receipt of the control command.

### Operation

**[0094]** The present invention further provides a method for producing pouches 2 having at least one compartment 3 and made from a water-soluble first foil 4 and a water-soluble second foil 5. The method comprises:

- a) moving multiple moulds 7 in a conveying direction 8, wherein each mould 7 comprises at least one forming cavity 10, and a support surface 11 adjoining the at least one forming cavity 10,
- b) positioning a first foil 4 on the support surface 11 of the mould 7 and over its at least one forming cavity 10,
- c) forming a part 14 of the first foil 4 extending over the at least one forming cavity 10 into the at least one forming cavity 10 of the moulds 7 to form at least one open compartment 15 of the pouch,
- d) acquiring forming condition data 17 of the at least one open compartment 15 with a sensor system 16, the sensor system 16 being operatively coupled to a control system 18 for comparing the forming condition data 17 to a desired forming condition 19, and for generating a control command corresponding to a predetermined forming condition,

wherein the packaging system 1 controls the pouch production based on receipt of the control command.

**[0095]** The forming condition data 17 can be acquired in different ways. A possible way is by imaging the forming condition of the open compartments 15, in particular with an imaging device 20.

**[0096]** Figures 5B, 6B, and 7B show forming condition data 17 in the form of a temperature distribution 23 of the first foil 4.

**[0097]** An upper half of figure 5B corresponds to the positioning of the first foil 4 on the support surface 11 of the moulds 7 and over the forming cavities 10. The situation for a single mould 7 is schematically shown in figure

5A, wherein the first foil 4 is shown closing off the forming cavities 10 of the mould 7 as shown in figure 4 along section A-A. In the situation of figure 5A the part of the first foil 4 that extends over the forming cavities 10 has not been into contact with a surface of the mould 7. Said part of the first foil 4 therefore has a different, in particular a higher, temperature than the mould 7. This difference is shown in the temperature distribution 23 image of figure 5B as contrasting, wherein the lighter area of figure 5B shows the first foil 4, and wherein the darker area of figure 5B shows the moulds 7.

**[0098]** Turning to figures 6A and 6B another situation is shown, wherein the open compartments 15 are formed according to a desired forming condition 19. Figure 6A shows the first foil 4 being in contact with a surface of the forming cavities 10, i.e. a desired forming condition 19. Figure 6B shows an image of the temperature distribution 23 made by the thermal imaging device 22 corresponding to the situation of figure 6A. In figure 6B the first foil 4 is formed into all forming cavities 10 of all twelve moulds 7 shown, each mould 7 having three forming cavities 10. Figure 6B does show a few lighter, or brighter, areas 37. Those lighter areas 37 correspond to parts of the first foil 4 that are not in contact with the forming cavity 10 and are therefore not considered to be formed completely. However the forming condition does not have to correspond to a completely formed open compartment 15 in order to be formed according to a desired forming condition 19. In the case of figure 5B the forming condition still corresponds to a desired forming condition 19. The desired forming condition 19 may for example be a percentage of a completely formed open compartment 15, such as for example at least 80%, or preferably at least 90%.

**[0099]** Figures 7A and 7B show a situation in which open compartments 15 have a forming condition not according to a desired forming condition 19. Figure 7A schematically shows the first foil 4 being partly in contact with the surface of the forming cavities 10 after forming. The volume of the open compartments 15 is smaller than desired. When these smaller volume open compartments 15 would be filled with a detergent at the filling device 28, there is a greater likelihood for spills. Spills are detrimental for pouch production, because the spills need to be cleaned, leading to downtime. Based on the image of the temperature distribution 23 as shown in figure 7B, the control system 18 can identify which open compartments 15 are not formed properly, and generate a control command accordingly for the filling device 28, the foil heating device 25, and/or the pouch rejection device 35. The lighter, or brighter parts, indicate the badly formed open compartments 19.

**[0100]** The method further comprises

- e) positioning a second foil 5 on at least a part 14 of the first foil 4 contacting the support surface 11 of the mould 7 and over the at least one open compartment 15 with a second foil supplying device 32 in



order to close the at least one open compartment 15, f) sealing the second foil 5 to the first foil 4 with a sealing device 33 in order to form a pouch 2 having at least one compartment 3.

**[0101]** As the control system 18 has compared and identified which open compartments 15 are not formed according to the desired forming condition 19, a control command can be transmitted to the pouch rejection device 35. Based on the control command, the pouch 2 having an open compartment 15 with a non-desired forming condition 19, is rejected.

**[0102]** The invention further provides a control system 18 configured to be operatively coupled to a sensor system 16 of a packaging system 1 according to the invention, the sensor system 16 being configured to acquire forming condition data 17 of at least one open compartment 15 of a pouch 2 to be produced, wherein the control system 18 is configured

- for receiving the forming condition data 17 of the sensor system 16
- for comparing the forming condition data 17 to a desired forming condition 19,
- for generating a control command corresponding to a predetermined forming condition, and
- for transmitting the control command to the packaging system 1 for controlling the pouch production based on receipt of the control command.

**[0103]** The invention yet further provides a control method for controlling a pouch production of a packaging system 1, the method comprising:

- providing a control system 18 operatively coupled to a sensor system 16 of a packaging system 1,
- receiving forming condition data 17 of the sensor system 16,
- comparing the forming condition data 17 to a desired forming condition 19,
- generating a control command corresponding to a predetermined forming condition, and
- transmitting the control command to the packaging system 1 for controlling the pouch production based on receipt of the control command.

**[0104]** Lastly turning to figure 8, an embodiment of a pouch 2 is shown that is made with a packaging system 1 according to the invention. The pouch 2 comprises three compartments 3, wherein each compartment 3 is filled with a powder, a gel 29 or a liquid. The compartments 3 are enclosed by a water-soluble first foil 4 and a water-soluble second foil 5. It is noted that in the industry the word pod instead of pouch 2 is also used when referring to a detergent pouch. The words pod and pouch 2 are considered synonyms in this document.

**[0105]** As required, detailed embodiments of the present invention are disclosed herein; however, it is to

be understood that the disclosed embodiments are merely exemplary of the invention, which can be embodied in various forms. Therefore, specific structural and functional details disclosed herein are not to be interpreted as limiting, but merely as a basis for the claims and as a representative basis for teaching one skilled in the art to variously employ the present invention in virtually any appropriately detailed structure. Further, the terms and phrases used herein are not intended to be limiting, but rather, to provide an understandable description of the invention.

**[0106]** The terms "a" or "an", as used herein, are defined as one or more than one. The term plurality, as used herein, is defined as two or more than two. The term another, as used herein, is defined as at least a second or more. The terms including and/or having, as used herein, are defined as comprising (i.e., open language, not excluding other elements or steps). Any reference signs in the claims should not be construed as limiting the scope of the claims or the invention.

**[0107]** The mere fact that certain measures are recited in mutually different dependent claims does not indicate that a combination of these measures cannot be used to advantage.

**[0108]** The present invention further relates to the following numbered clauses:

1. Packaging system (1) for producing pouches (2) having at least one compartment (3) and made from a water-soluble first foil (4) and a water-soluble second foil (5), the packaging system comprising:

- a mould conveyor (6) configured to move multiple moulds (7) in a conveying direction (8) along a trajectory (9), wherein each mould comprises at least one forming cavity (10), and a support surface (11) adjoining the at least one forming cavity,
- a first foil supplying device (12) configured to position the first foil on the support surface of the mould and over its at least one forming cavity,
- a forming device (13) configured to form a part (14) of the first foil extending over the at least one forming cavity into the at least one forming cavity of the moulds to form at least one open compartment (15) of the pouch,
- a sensor system (16) configured to acquire forming condition data (17) of the at least one open compartment, the sensor system being configured to be operatively coupled to a control system (18) configured for comparing the forming condition data to a desired forming condition (19), and for generating a control command corresponding to a predetermined forming condition,

wherein the packaging system is configured to con-

trol the pouch production based on receipt of the control command.

2. Packaging system according to clause 1, wherein the sensor system comprises an imaging device (20) configured to image the forming condition of the open compartments, wherein the control system is configured for comparing the forming condition of the open compartments based on the imaging (21) of the imaging device.

3. Packaging system according to clause 2, wherein the imaging device is a thermal imaging device (22) configured to image a temperature distribution (23) of the first foil downstream the first foil supplying device, wherein the control system is configured for comparing the forming condition of the open compartments based on the imaging of the temperature distribution of the first foil.

4. Packaging system according to any one of the preceding clauses, wherein the forming device comprises a suction device (24) and/or a stamping device configured to respectively suck and/or stamp the part of the first foil extending over the at least one forming cavity into the at least one forming cavity.

5. Packaging system according to any one of the preceding clauses, further comprising a foil heating device (25) configured to heat the first foil prior and/or during the positioning of the first foil on the support surface and over its at least one forming cavity, and/or during the forming of the part of the first foil extending over the at least one forming cavity into the at least one forming cavity.

6. Packaging system according to the preceding clause, wherein the foil heating device is configured to heat the first foil to a first foil temperature that is higher than a mould temperature of the support surface of the mould.

7. Packaging system according to clause 5 or 6, wherein the foil heating device comprises at least one heating unit (26), wherein a heat output of the at least one heating unit is adjustable.

8. Packaging system according to any one of clauses 5-7, wherein the at least one heating unit is movable in the conveying direction, the heating unit being configured to move along with the first foil during the forming thereof while heating the foil.

9. Packaging system according to any one of clauses 5-8, wherein the foil heating device comprises an infrared heating unit (27) and/or a microwave heating unit.

10. Packaging system according to any one of the preceding clauses, wherein the packaging system further comprises a filling device (28) configured to at least partially fill the at least one open compartment with a powder, a liquid, and/or a gel (29), wherein the filling device is configured to be operatively coupled to the control system for receiving the control command, the filling device being configured to, based on receipt of the control command, at least partially fill the at least one open compartment when the forming condition is according to the desired forming condition, and to not at least partially fill the at least one open compartment when the forming condition is not according to the desired forming condition.

11. Packaging system according to the preceding clause, wherein the moulds are arranged in lanes (30) and rows (31), wherein each mould is defined by a lane number and a row number, wherein the control command includes the lane number and row number of a mould corresponding to an open compartment having a forming condition not according to the desired forming condition, wherein the filling device is configured to not at least partially fill the open compartment in the mould corresponding to the lane number and row number based on the receipt of the control command.

12. Packaging system according to any one of the preceding clauses, further comprising

- a second foil supplying device (32) configured to position the second foil on at least a part of the first foil contacting the support surface of the mould and over the at least one open compartment, thereby closing the at least one open compartment,
- a sealing device (33) for sealing the second foil to the first foil in order to form a pouch having at least one compartment,

13. Packaging system according to any one of the preceding clauses, wherein the packaging system further comprises a pouch rejection device (35) configured to reject defective pouches, wherein the rejection device is configured to be operatively coupled to the control system for receiving the control command, the rejection device being configured to, based on receipt of the control command, reject pouches having at least one compartment with a forming condition that is not according to the desired forming condition.

14. Packaging system according to the preceding clause, wherein the moulds are arranged in lanes and rows, wherein each mould is defined by a lane number and a row number, wherein the control com-

mand includes the lane number and row number of a mould corresponding to an open compartment having a forming condition that is not according to the desired forming condition, wherein the pouch rejection device is configured to reject a defective pouch in the mould corresponding to the lane number and row number based on the receipt of the control command.

15. Packaging system according to any one of the preceding clauses 5-14, wherein the foil heating device is configured to be operatively coupled to the control system for receiving the control command, wherein the control system further is configured for identifying one or more areas (37) of the first foil that are not formed according to the desired forming condition based on the forming condition data provided by the sensor system, and for generating the control command if the one or more areas are identified, wherein the foil heating device is configured to heat one or more identified areas (37) of the first foil based on receipt of the control command.

16. Packaging system according to the preceding clause, wherein the foil heating device is configured to locally heat one or more areas of the first foil prior to the positioning thereof on the support surface of the mould and over its at least one forming cavity, wherein said one or more areas correspond to the one or more areas identified by the control system during the forming of a previous at least one open compartment (38).

17. Packaging system according to the preceding clauses 15 or 16, wherein, during forming of the at least one open compartment, the foil heating device is configured to heat the one or more identified areas that are not formed according to the desired forming condition until the one or more identified areas are formed according to the desired forming condition with the forming device.

18. Packaging system according to any one of the preceding clauses, wherein the mould conveyor is configured to move multiple moulds in a conveying direction along an endless trajectory.

19. Method for producing pouches (2) having at least one compartment (3) and made from a water-soluble first foil (4) and a water-soluble second foil (5), the method comprising:

- a) moving multiple moulds in a conveying direction, wherein each mould comprises at least one forming cavity, and a support surface adjoining the at least one forming cavity,
- b) positioning a first foil on the support surface of the mould and over its at least one forming

cavity,

c) forming a part of the first foil extending over the at least one forming cavity into the at least one forming cavity of the moulds to form at least one open compartment of the pouch,

d) acquiring forming condition data of the at least one open compartment with a sensor system, the sensor system being operatively coupled to a control system for comparing the forming condition data to a desired forming condition, and for generating a control command corresponding to a predetermined forming condition,

wherein the packaging system controls the pouch production based on receipt of the control command.

20. Method according to the preceding clause, wherein the method comprises imaging the forming condition of the open compartments.

21. Method according to the preceding clause, wherein the method comprises imaging the temperature distribution of the first foil downstream of the supplying device.

22. Method according to any one of clauses 19 - 21, comprising heating the first foil prior and/or during the positioning of the first foil on the support surface and over its at least one forming cavity, and/or during the forming of the first foil into the at least one forming cavity.

23. Method according to any one of clauses 19 - 22, comprising heating the first foil prior to the positioning of the first foil on the support surface and over its at least one forming cavity to a first foil temperature that is higher than a mould temperature of the support surface of the moulds.

24. Method according to any one of clauses 19 - 23, comprising at least partially filling the at least one open compartment with a powder, a liquid, and/or a gel when the forming condition is according to the desired forming condition, and not at least partially filling the at least one open compartment when the forming condition is not according to the desired forming condition.

25. Method according to the preceding clause, wherein the moulds are arranged in lanes and rows, wherein each mould is defined by a lane number and a row number, wherein the control command includes the lane number and row number of a mould corresponding to an open compartment having a forming condition not according to the desired forming condition, wherein the method comprises not at least partially filling the open compartment in the mould corresponding to the lane number and row

number based on the receipt of the control command.

26. Method according to any one of clauses 19-25, further comprising

- e) positioning a second foil on at least a part of the first foil contacting the support surface of the mould and over the at least one open compartment with a second foil supplying device in order to close the at least one open compartment,
- f) sealing the second foil to the first foil with a sealing device in order to form a pouch having at least one compartment.

27. Method according to any one of clauses 19 - 26, comprising rejecting defective pouches with a pouch rejection device, wherein the rejection device is operatively coupled to the control system for receiving the control command, wherein the rejection device, based on receipt of the control command, rejects pouches having at least one compartment with a forming condition that is not according to the desired forming condition.

28. Method according to the preceding clause, wherein the moulds are arranged in lanes and rows, wherein each mould is defined by a lane number and a row number, wherein the control command includes the lane number and row number of a mould corresponding to an open compartment having a forming condition that is not according to the desired forming condition, wherein the method comprises rejecting a defective pouch in the mould corresponding to the lane number and row number based on the receipt of the control command.

29. Method according to any one of clauses 19 - 28, comprising identifying one or more areas of the first foil that are not formed according to the desired forming condition based on the forming condition data provided by the sensor system, and heating one or more identified areas of the first foil based on receipt of the control command.

30. Method according to the preceding clause, comprising locally heating one or more areas of the first foil prior to the positioning thereof on the support surface of the mould and over its at least one forming cavity, wherein said one or more areas correspond to the one or more areas identified during the forming of a previous at least one open compartment.

31. Method according to clause 28 or 30, wherein during the forming of the at least one open compartment the one or more identified areas that are not formed according to the desired forming condition are heated until the one or more identified areas are

formed according to the desired forming condition.

32. A control system configured to be operatively coupled to a sensor system of a packaging system according to any one of clauses 1-18, the sensor system being configured to acquire forming condition data of at least one open compartment of a pouch to be produced, wherein the control system is configured

- for receiving the forming condition data of the sensor system
- for comparing the forming condition data to a desired forming condition,
- for generating a control command corresponding to a predetermined forming condition, and
- for transmitting the control command to the packaging system for controlling the pouch production based on receipt of the control command.

33. A control method for controlling a pouch production of a packaging system, the method comprising:

- providing a control system operatively coupled to a sensor system of a packaging system,
- receiving forming condition data of the sensor system,
- comparing the forming condition data to a desired forming condition,
- generating a control command corresponding to a predetermined forming condition, and
- transmitting the control command to the packaging system for controlling the pouch production based on receipt of the control command.

## Claims

1. Packaging system (1) for producing pouches (2) having at least one compartment (3) and made from a water-soluble first foil (4) and a water-soluble second foil (5), the packaging system comprising:

- a mould conveyor (6) configured to move multiple moulds (7) in a conveying direction (8) along a trajectory (9), wherein each mould comprises at least one forming cavity (10), and a support surface (11) adjoining the at least one forming cavity,
- a first foil supplying device (12) configured to position the first foil on the support surface of the mould and over its at least one forming cavity,
- a forming device (13) configured to form a part (14) of the first foil extending over the at least one forming cavity into the at least one forming cavity of the moulds to form at least one open

compartment (15) of the pouch,  
 - a sensor system (16) configured to acquire forming condition data (17) of the at least one open compartment, the sensor system being configured to be operatively coupled to a control system (18) configured for comparing the forming condition data to a desired forming condition (19), and for generating a control command corresponding to a predetermined forming condition,

wherein the packaging system is configured to control the pouch production based on receipt of the control command.

2. Packaging system according to claim 1, wherein the sensor system comprises an imaging device (20) configured to image the forming condition of the open compartments, wherein the control system is configured for comparing the forming condition of the open compartments based on the imaging (21) of the imaging device.
3. Packaging system according to claim 2, wherein the imaging device is a thermal imaging device (22) configured to image a temperature distribution (23) of the first foil downstream the first foil supplying device, wherein the control system is configured for comparing the forming condition of the open compartments based on the imaging of the temperature distribution of the first foil.
4. Packaging system according to any one of the preceding claims, further comprising a foil heating device (25) configured to heat the first foil prior and/or during the positioning of the first foil on the support surface and over its at least one forming cavity, and/or during the forming of the part of the first foil extending over the at least one forming cavity into the at least one forming cavity.
5. Packaging system according to the preceding claim, wherein the foil heating device is configured to heat the first foil to a first foil temperature that is higher than a mould temperature of the support surface of the mould.
6. Packaging system according to claim 4 or 5, wherein the foil heating device comprises at least one heating unit (26), wherein a heat output of the at least one heating unit is adjustable.
7. Packaging system according to any one of claims 4-6, wherein the at least one heating unit is movable in the conveying direction, the heating unit being configured to move along with the first foil during the forming thereof while heating the foil.

8. Packaging system according to any one of claims 4-7, wherein the foil heating device comprises an infrared heating unit (27) and/or a microwave heating unit.
9. Packaging system according to any one of the preceding claims, wherein the packaging system further comprises a filling device (28) configured to at least partially fill the at least one open compartment with a powder, a liquid, and/or a gel (29), wherein the filling device is configured to be operatively coupled to the control system for receiving the control command, the filling device being configured to, based on receipt of the control command, at least partially fill the at least one open compartment when the forming condition is according to the desired forming condition, and to not at least partially fill the at least one open compartment when the forming condition is not according to the desired forming condition and/or wherein the packaging system further comprises a pouch rejection device (35) configured to reject defective pouches, wherein the rejection device is configured to be operatively coupled to the control system for receiving the control command, the rejection device being configured to, based on receipt of the control command, reject pouches having at least one compartment with a forming condition that is not according to the desired forming condition.
10. Packaging system according to any one of the preceding claims 4-9, wherein the foil heating device is configured to be operatively coupled to the control system for receiving the control command, wherein the control system further is configured for identifying one or more areas (37) of the first foil that are not formed according to the desired forming condition based on the forming condition data provided by the sensor system, and for generating the control command if the one or more areas are identified, wherein the foil heating device is configured to heat one or more identified areas (37) of the first foil based on receipt of the control command.
11. Packaging system according to the preceding claim 10, wherein, during forming of the at least one open compartment, the foil heating device is configured to heat the one or more identified areas that are not formed according to the desired forming condition until the one or more identified areas are formed according to the desired forming condition with the forming device.
12. Method for producing pouches (2) having at least one compartment (3) and made from a water-soluble first foil (4) and a water-soluble second foil (5), the method comprising:
  - a) moving multiple moulds in a conveying direc-

a) moving multiple moulds in a conveying direc-

tion, wherein each mould comprises at least one forming cavity, and a support surface adjoining the at least one forming cavity,

b) positioning a first foil on the support surface of the mould and over its at least one forming cavity, 5

c) forming a part of the first foil extending over the at least one forming cavity into the at least one forming cavity of the moulds to form at least one open compartment of the pouch, 10

d) acquiring forming condition data of the at least one open compartment with a sensor system, the sensor system being operatively coupled to a control system for comparing the forming condition data to a desired forming condition, and 15  
for generating a control command corresponding to a predetermined forming condition,

wherein the packaging system controls the pouch production based on receipt of the control command. 20

13. Method according to the preceding claim, wherein the method comprises imaging the forming condition of the open compartments, wherein the method in particular comprises imaging the temperature distribution of the first foil downstream of the supplying device. 25

14. Method according to claim 12 or 13, comprising at least partially filling the at least one open compartment with a powder, a liquid, and/or a gel when the forming condition is according to the desired forming condition, and not at least partially filling the at least one open compartment when the forming condition is not according to the desired forming condition 30  
and/or comprising rejecting defective pouches with a pouch rejection device, wherein the rejection device is operatively coupled to the control system for receiving the control command, wherein the rejection device, based on receipt of the control command, rejects pouches having at least one compartment with a forming condition that is not according to the desired forming condition. 35  
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15. A control system configured to be operatively coupled to a sensor system of a packaging system according to any one of claims 1-11, the sensor system being configured to acquire forming condition data of at least one open compartment of a pouch to be produced, wherein the control system is configured 45  
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- for receiving the forming condition data of the sensor system
- for comparing the forming condition data to a desired forming condition, 55
- for generating a control command corresponding to a predetermined forming condition, and
- for transmitting the control command to the

packaging system for controlling the pouch production based on receipt of the control command.

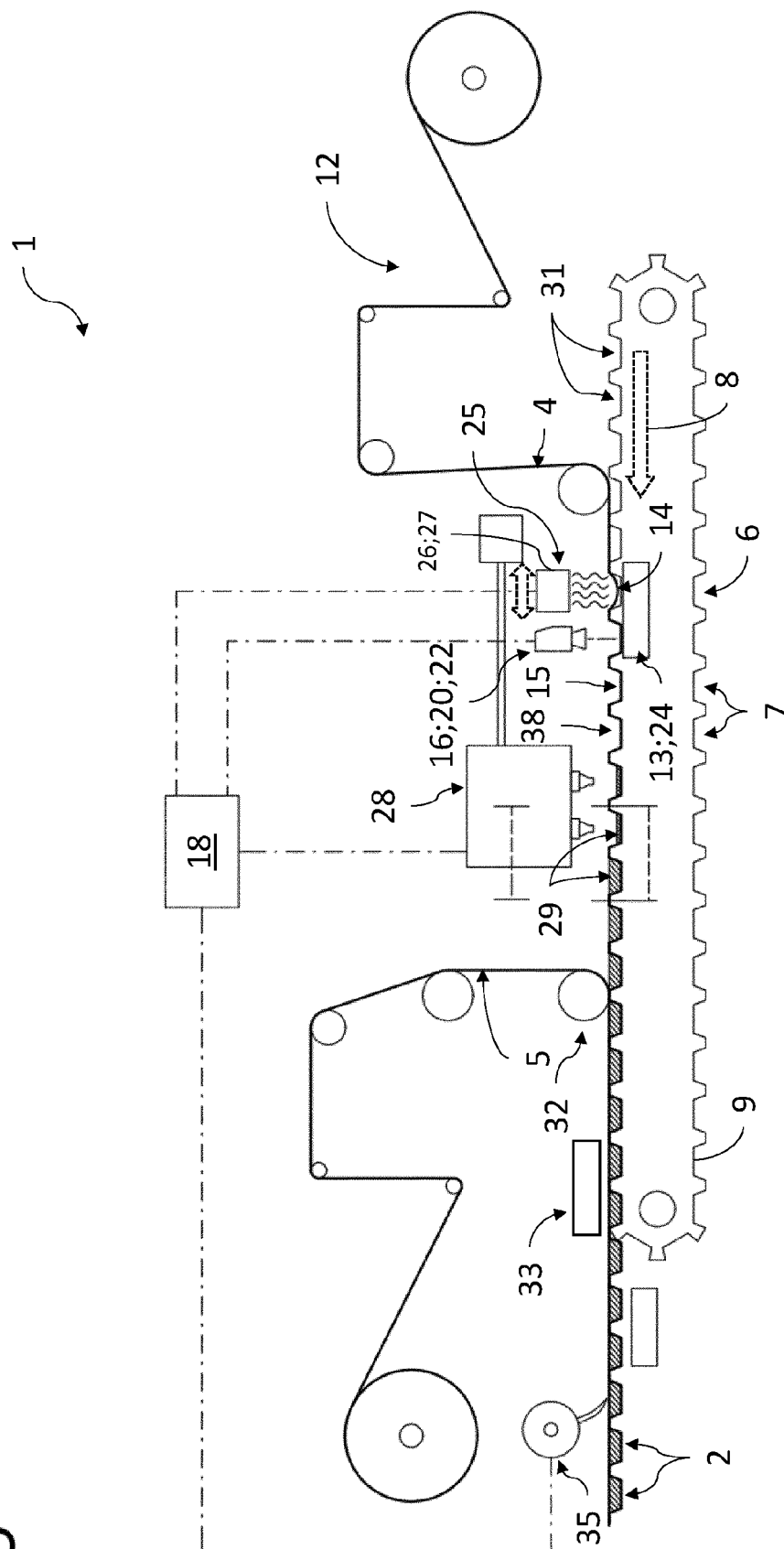


Fig. 1

Fig. 2

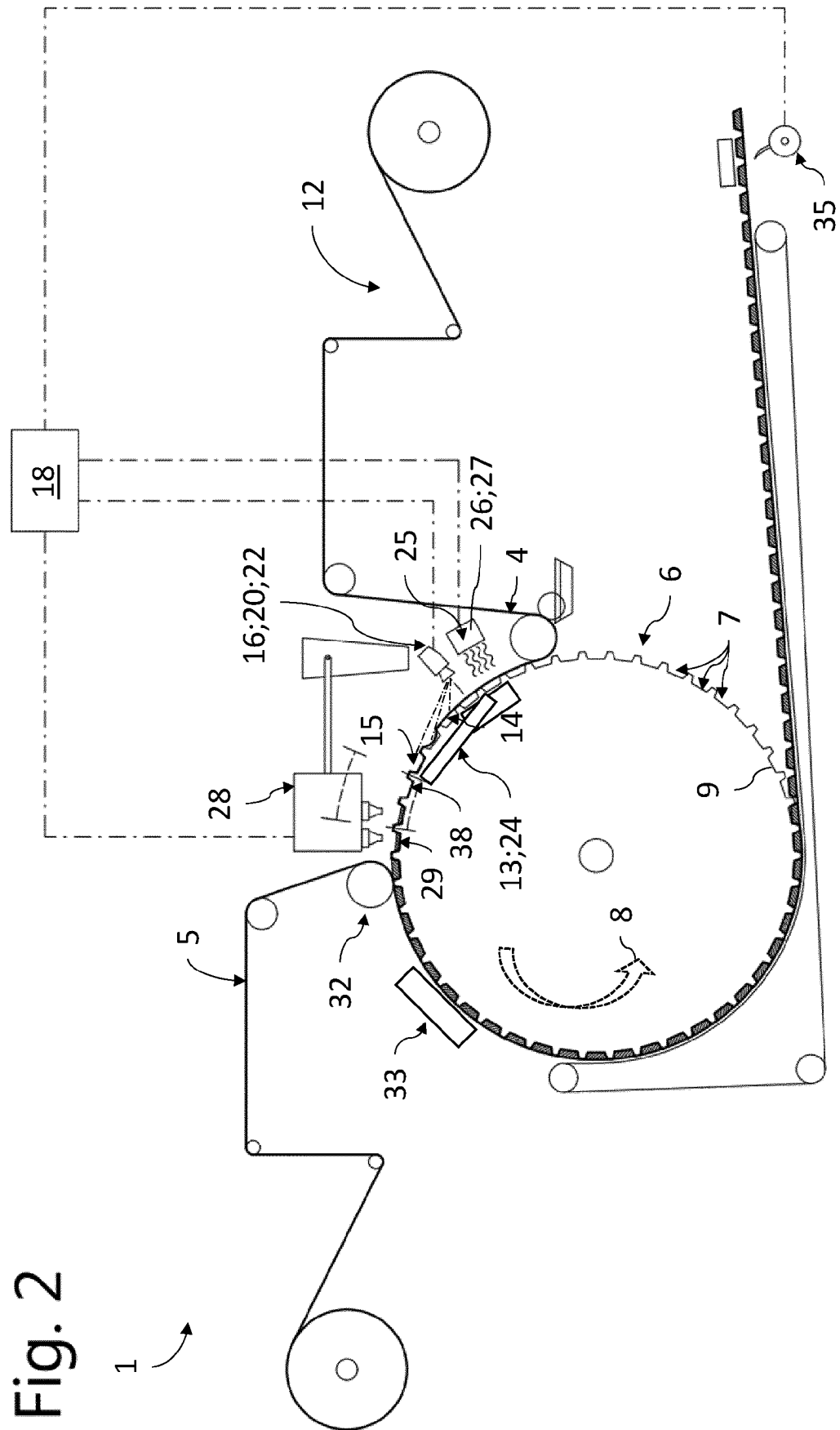




Fig. 3

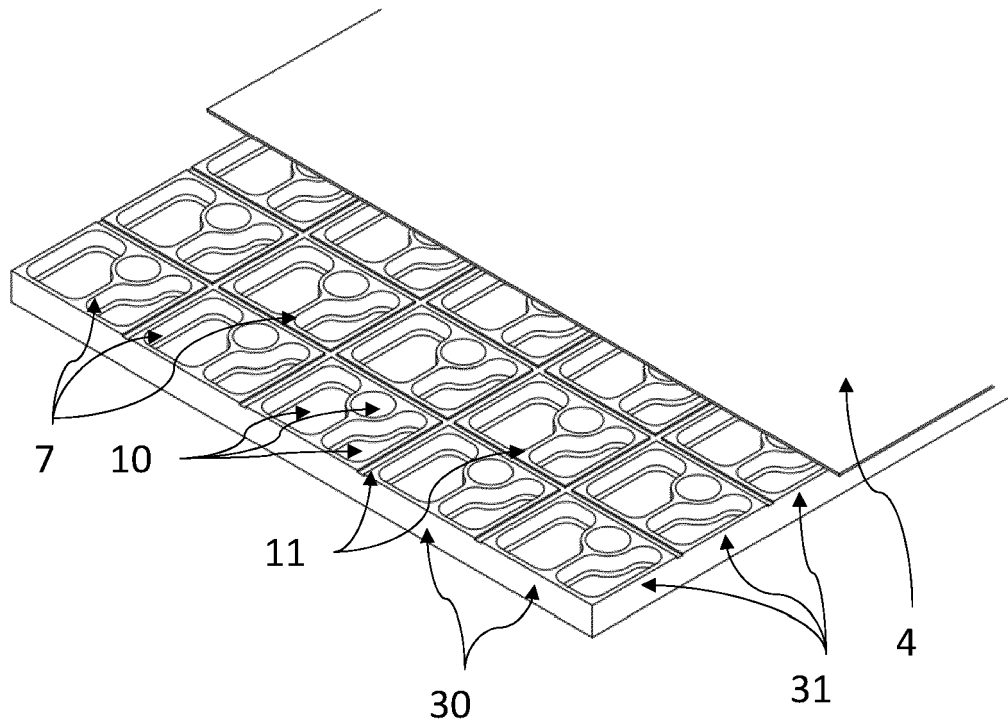


Fig. 4

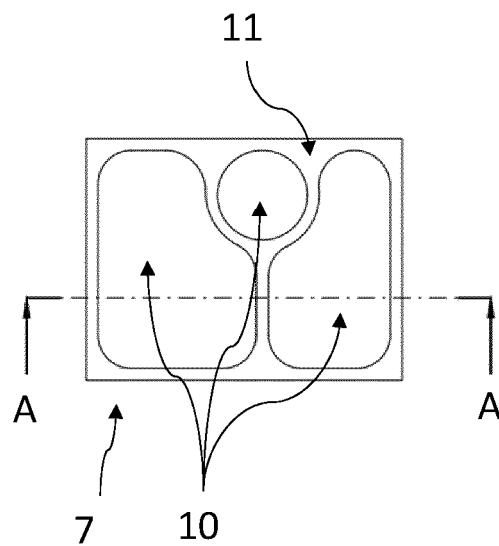


Fig. 5A

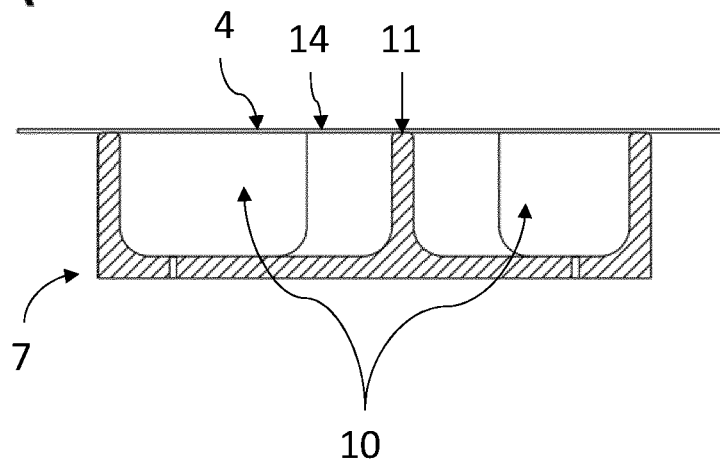


Fig. 5B

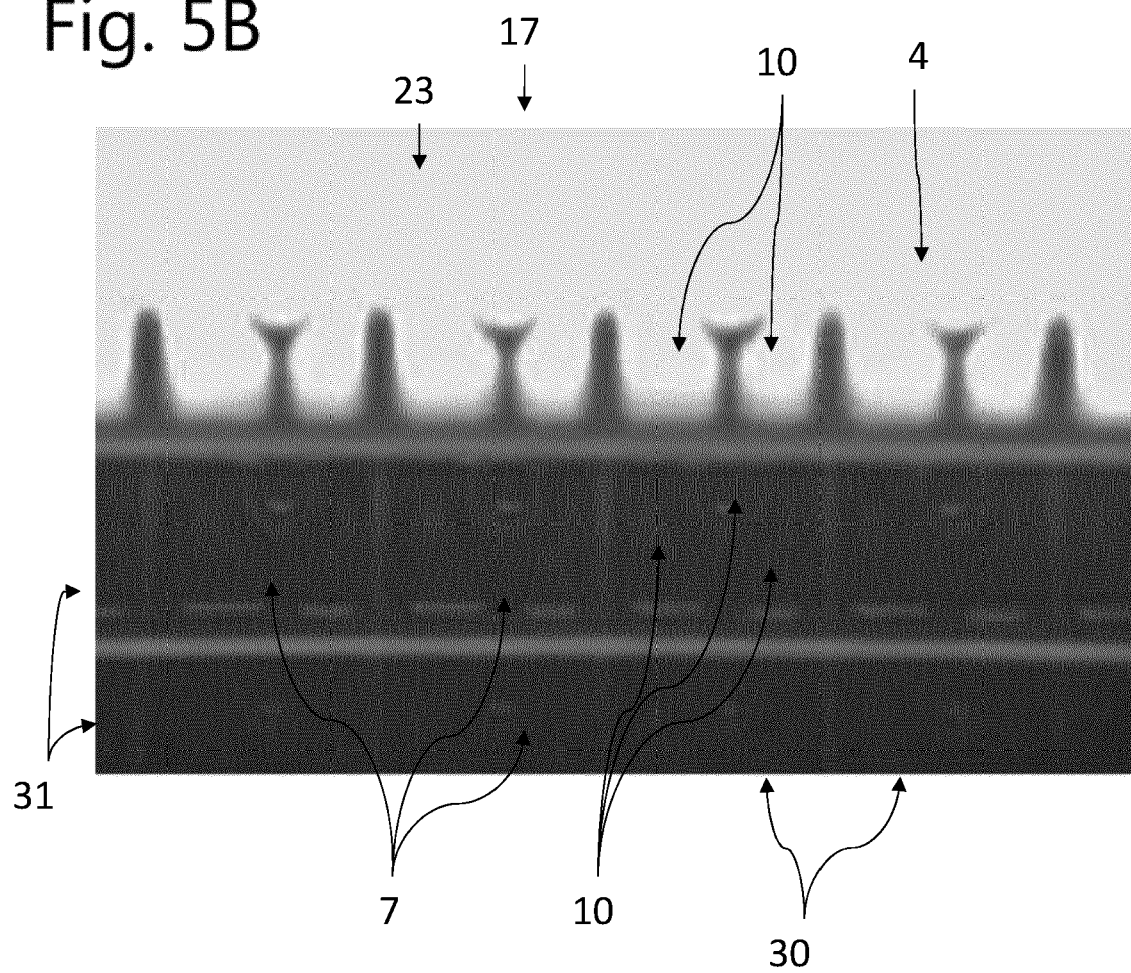




Fig. 7A

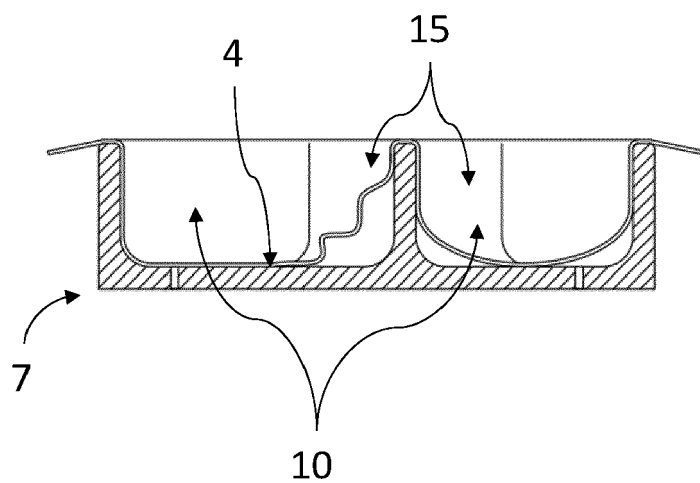


Fig. 7B

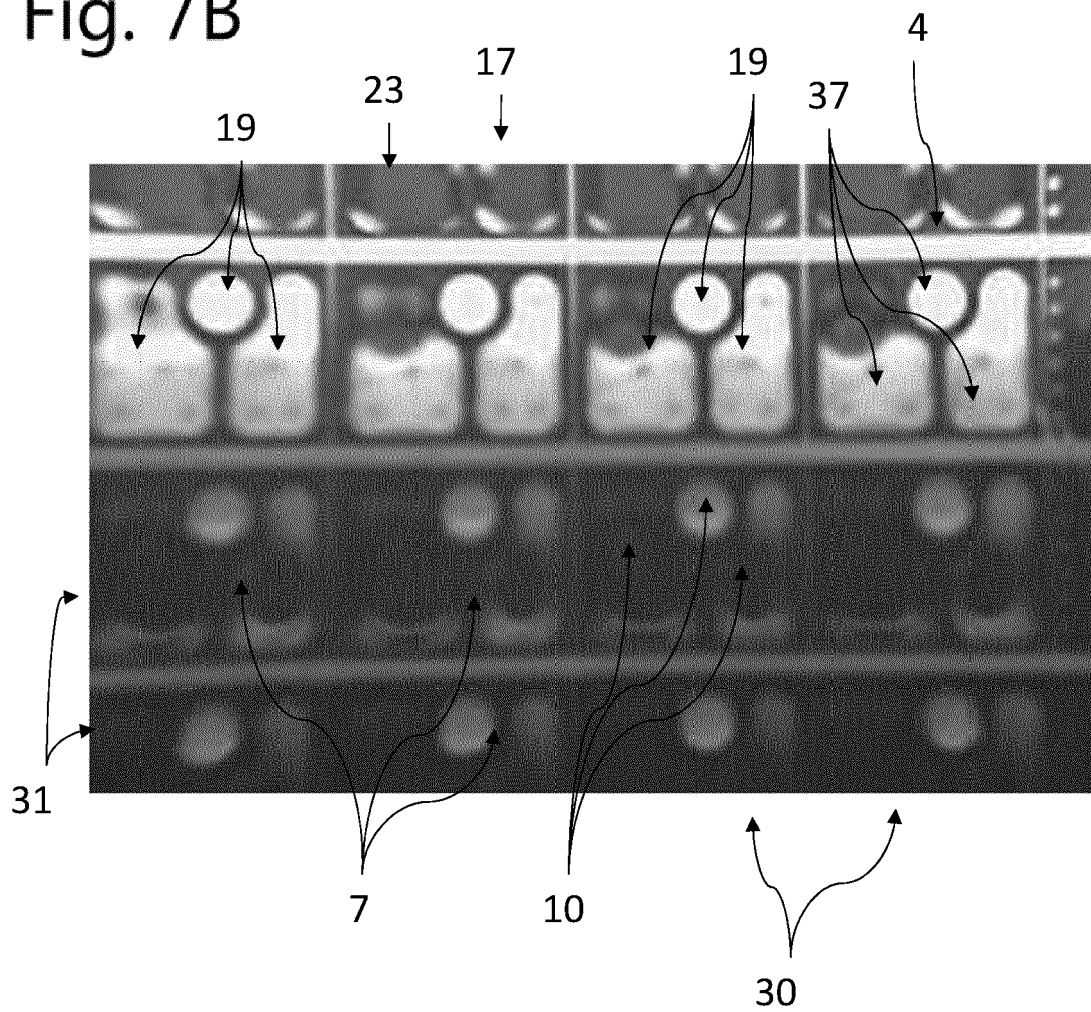
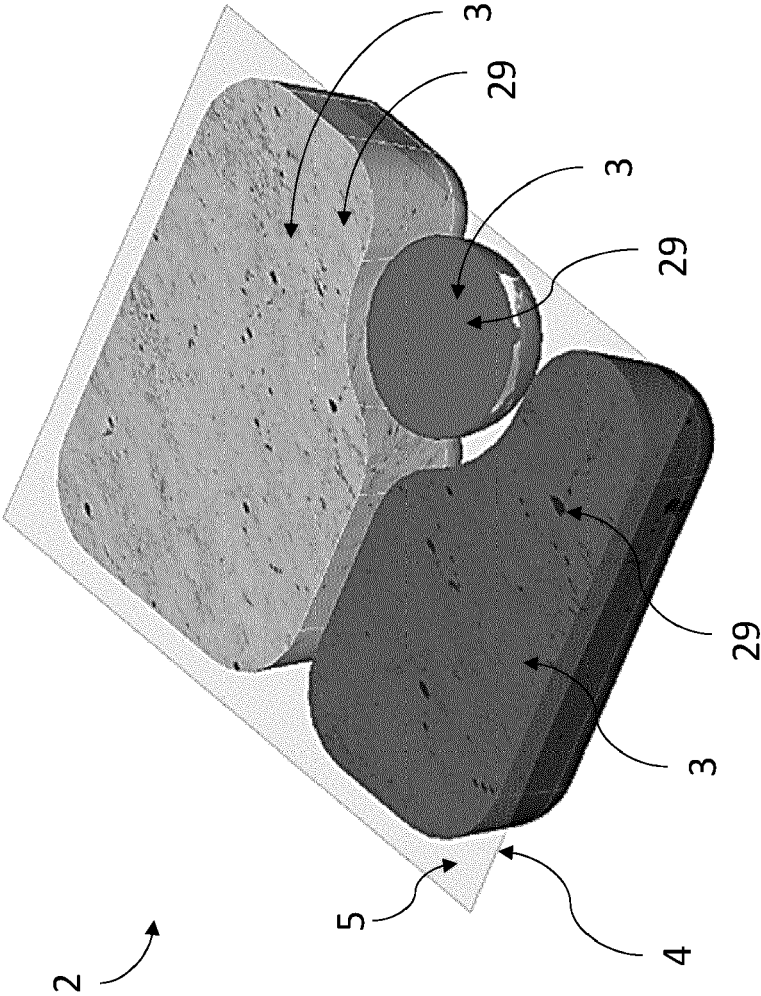


Fig. 8





## EUROPEAN SEARCH REPORT

Application Number

EP 23 19 8469

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EPO FORM 1503 03.82 (P04C01)

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
Y	US 11 273 943 B2 (CKD CORP [JP]) 15 March 2022 (2022-03-15) * the whole document *	1-15	INV. B65B9/02 B65B9/04 B65B41/00
Y	US 10 619 042 B2 (PROCTER & GAMBLE [US]) 14 April 2020 (2020-04-14) * column 29, last paragraph *	1-8	B65B41/12 B65B47/00 B65B47/02 B65B57/00 B65B57/02
Y	WO 2015/160741 A2 (PROCTER & GAMBLE [US]) 22 October 2015 (2015-10-22) * figure 1 *	1-15	
A	CA 2 983 452 C (PROCTER & GAMBLE [US]) 10 September 2019 (2019-09-10) * figure 5 *	1	
A	US 8 662 880 B2 (FOWLER JAMES [US]; MAKUTONIN BORIS [US]; RIDEAU MACHINERY INC [US]) 4 March 2014 (2014-03-04) * the whole document *	1	
A	US 2018/133919 A1 (WATERMAN ALEXANDER J [US] ET AL) 17 May 2018 (2018-05-17) * the whole document *	1	TECHNICAL FIELDS SEARCHED (IPC) B65B
A	US 2021/163160 A1 (BOOD ARIE [NL] ET AL) 3 June 2021 (2021-06-03) * the whole document *	1	
A	EP 1 375 351 A1 (PROCTER & GAMBLE [US]) 2 January 2004 (2004-01-02) * the whole document *	1	
A	US 7 253 378 B2 (UHLMANN PAC SYSTEME GMBH & CO [DE]) 7 August 2007 (2007-08-07) * the whole document *	1	
	----- --/--		
The present search report has been drawn up for all claims			
Place of search <b>Munich</b>		Date of completion of the search <b>8 December 2023</b>	Examiner <b>Ungureanu, Mirela</b>
CATEGORY OF CITED DOCUMENTS 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		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	



## EUROPEAN SEARCH REPORT

Application Number

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EPO FORM 1503 03.82 (P04C01)

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	<b>US 5 074 102 A (SIMPSON WALLINGTON M [US] ET AL) 24 December 1991 (1991-12-24)</b> <b>* the whole document *</b> -----	1-15	
			TECHNICAL FIELDS SEARCHED (IPC)
The present search report has been drawn up for all claims			
Place of search <b>Munich</b>		Date of completion of the search <b>8 December 2023</b>	Examiner <b>Ungureanu, Mirela</b>
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