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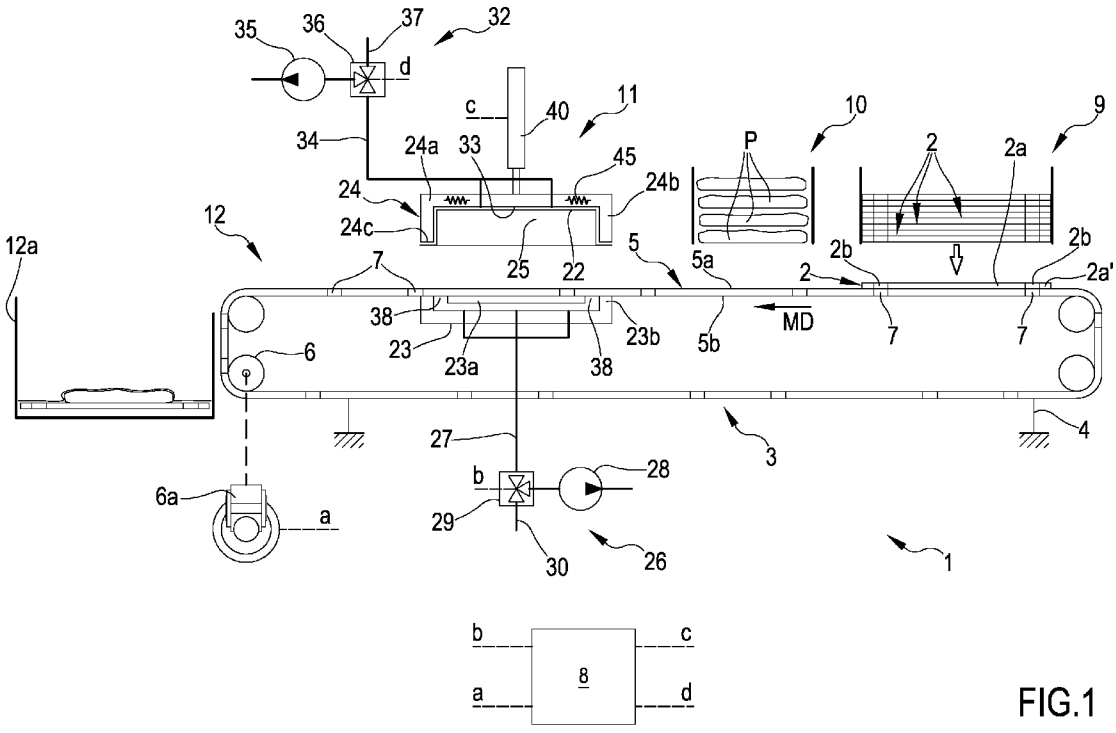

FIG.1

(57) Abstract: An apparatus and process for packaging a product (P) arranged on a support (2) or on a support portion (2') of a continuous support using a packaging assembly (11) configured for tightly fixing a film portion (22) of a plastic film to said support or support portion; a conveyor (3) extends through or in correspondence of the packaging assembly (11) and is configured to move the supports (2) or the support portions (2') inside the packaging assembly (11); a vacuum arrangement (26) is controlled to extract - through the conveyor (3) and through holes in the support or support portion - gas present in the packaging assembly (11) between the film portion (22) and the underlying support or support portion for then forming a vacuum skin packaged product (P).

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TITLE

Apparatus and process for packaging a product.

DESCRIPTION

Technical field

The present invention relates to an apparatus and to a process for packaging of a product. In accordance with certain aspects, the invention relates to an apparatus and process for packaging a product under vacuum. In accordance with further aspects, the invention relates to an apparatus and process for vacuum skin packaging of a product. The apparatus and process of the invention find a convenient application for packaging perishable products, such as for example food products, which would lose one or more of their properties if left in ambient atmosphere.

Background art

In order to package products, in particular food products, vacuum packaging has been developed in the past.

Among the known vacuum packaging processes, vacuum skin packaging is commonly employed for packaging food products such as fresh and frozen meat and fish, cheese, processed meat, ready meals and the like. Vacuum skin packaging is described for instance in FR 1 258 357, FR 1 286 018, AU 3 491 504, US RE 30 009, US 3 574 642, US 3 681 092, US 3 713 849, US 4 055 672, and US 5 346 735.

Vacuum skin packaging is basically a thermoforming process. In particular, the product is typically placed on a rigid or semi-rigid support (such as a plate, a tray, a bowl or a cup). The support with the product placed thereon is put in a vacuum chamber, where a film of thermoplastic material, held by vacuum in a position above the product placed on the support, is heated to soften it. The space between the support and the film is then evacuated and finally vacuum above the film is released to cause the film to drape down all around the product and seal to the surface of the support not covered by the product, thus forming a tight skin around the product and on the support.

US 2007/0022717 and US 2005/0257501 disclose a machine for packaging a product arranged in a tray. The machine has a packaging assembly with a lower tool for supporting the tray and an upper tool for applying the plastic film. In the machines disclosed in US 2007/0022717 and US 2005/0257501, the film is cut to the size of the tray within the packaging chamber formed by the upper tool and the lower tool, by means of the cutting devices provided on the upper tool; furthermore, appropriate mechanisms are provided to confer the required mobility to the upper and lower tools.

In the above machines, relatively complex system are required to handle the trays and in particular to move the trays from the loading area into the packaging chamber and, after the packaging cycle, from the packaging chamber to an exit of the machine. Moreover, given the presence of cutting devices inside the packaging chamber and given the mobility of the upper and lower tools, also the structure of the packaging chamber is complex.

Besides the above machines other packaging apparatus have been developed, which adopt a support in the form of a continuous web. In particular, US3481101 discloses a method for packaging small items on a continuous web support provided with holes: a plastic film is fed from a roll and positioned above the web support carrying the small items. The web support has holes through which air is withdrawn to form a packaging. US3533212A shows a continuous web

support receiving products to be packaged and an extruder of a continuous film applied above the continuous support web. A vacuum device acts below the support web, which is provided with passages to allow extraction of air and formation of a package. GB1552299A discloses a conveyor belt provided with gas evacuation holes supporting a continuous and narrow support receiving items to be packaged. The conveyor passes through a packaging station which applies a film onto the support. Means are used to serve a film to the upper dome of the packaging station. These second group of packaging of products evidenced a number of limitation such as limited level of vacuum and abundant generation of waste material.

Thus, it is an object of the invention conceiving a process and an apparatus suitable for vacuum skin packaging of products capable of reducing as much as possible generation of waste material.

An auxiliary object is that of offering a packaging process and apparatus characterized by an extremely reduced consumption of the plastic material used for the covering film and of material used for the support.

It is a further aim of the invention that of conceiving a process and an apparatus for packaging products which sensibly reduces the complexity in the design of the key components of the apparatus, namely the packaging assembly, and the systems used for moving the supports and the covering film to be applied to the supports.

Another object is that of offering a process and an apparatus capable of increasing productivity and of avoiding as possible problems of incorrect positioning of the plastic film onto the support or tray.

Summary of the invention

One or more of the objects specified above are substantially achieved by a process and by an apparatus according to any one of the appended claims

Aspects of the invention are described herein below.

A 1st aspect concerns an apparatus for packaging a product (P) arranged on a support, comprising:

a conveyor having an operative tract configured for receiving a plurality of distinct supports positioned at a distance the one from the other, the conveyor being configured for displacing supports along a predetermined path and to allow passage of gas through a conveyor thickness between a superior side and an inferior side of the operative tract of the conveyor;

a film supply assembly configured for supplying a plastic film;

a packaging assembly configured for tightly fixing a film portion of said plastic film to at least one respective of said supports, wherein the operative tract of the conveyor extends through the packaging assembly.

In a 2nd aspect according to the 1st aspect the packaging assembly includes:

a lower tool operative below the inferior side of said operative tract;

an upper tool operative above the superior side of the operative tract.

In a 3rd aspect according to the preceding aspect, the packaging assembly is configured to operate at least in:
a first operating condition, where the upper tool is spaced from the superior side of said operative tract allowing positioning of one or more of said supports and of said film portion inside the packaging assembly, and
a second operating condition, where the upper tool is approached towards the operative tract of the conveyor and is configured to sealingly apply the film portion to the at least one underlying support present in the packaging assembly.

In a 4th aspect according to any one of the preceding aspects, the apparatus includes:
a vacuum arrangement configured to extract gas from the packaging assembly;
a control unit configured for controlling the packaging assembly and the conveyor, wherein the control unit is configured to execute the following cycle:

- with the packaging assembly in the first operating condition, cause the conveyor to position one or more of said supports, with a respective product thereon, inside the packaging assembly,
- with the packaging assembly in the second operating condition, command the vacuum arrangement to extract - through the conveyor - gas present between the film portion and the underlying support forming a vacuum skin packaged product.

In a 5th aspect according to any one of the preceding two aspects, the apparatus is configured such that with the packaging assembly in the first operating condition the control unit is configured to

- cause the conveyor to move in order to position the one or more of said supports, with a respective product thereon, inside the packaging assembly, and then
- cause the conveyor to stop,

and then – with the conveyor stopped – cause the packaging assembly to move to the second operating condition and seal the film portion to the underlying at least one support.

In a 6th aspect according to any one of the preceding three aspects, the packaging assembly – in the second operating condition – causes the film portion to seal in correspondence of a peripheral border of the underlying at least one support.

In a 7th aspect according to any one of the preceding two aspects, the apparatus further comprises means for positioning the supports on the operative tract according to a predetermined distribution pattern whereby each support is located at a pre-determined distance from an adjacent support.

In a 8th aspect according to the preceding aspect the means for positioning comprises seats defined on the superior side of the operative tract, each one of the seats being located at a pre-defined distance from an adjacent seat and being shaped to receive and keep a respective support in a position fixed relative to the conveyor.

In a 9th aspect according to the 7th aspect the means for positioning include at least one sensor, for instance a position

sensor, connected to the control unit and configured for detecting the position of said one or more supports on the operative tract or of holes present in said one or more supports relative to the conveyor.

In a 10th aspect according to the preceding aspect wherein the means for positioning include a positioner also connected to the control unit, the control unit being configured to receive from said sensor a signal related to a detected position of a support on the conveyor or related to a position of said holes relative to the conveyor, compare said signal with a reference indicative of a proper position of the support on the conveyor, and issue a control signal for the positioner to reposition the support if said comparison indicates that the detected position does not match the proper position of the support. For instance the sensor may be an optical sensor or a mechanical sensor or an electromagnetic sensor and the positioner may simply be a stopper configured to stop the supports until when they are in the proper position.

In an 11th aspect according to any one of the preceding aspects the conveyor comprises a plurality of discrete apertures extending through the entire conveyor thickness and positioned along the conveyor.

In an 12th aspect according to any one of the preceding aspects the conveyor comprises at least a permeable portion extensive through the conveyor thickness and made from gas permeable material.

In an 13th aspect according to any one of the preceding aspects the packaging assembly – in correspondence of said second operating condition – defines a chamber housing the product or products positioned on the one or more supports.

In an 14th aspect according to any one of the preceding aspects the upper tool comprises a central portion and a peripheral portion together defining an upper tool active surface located above the superior side of the operative tract.

In an 15th aspect according to any one of the preceding aspects, the peripheral portion of the upper tool is configured to – directly, or indirectly via interposition of said film portion – abut against one of:

- the superior side of the operative tract of the conveyor encircling one or more supports,
- a top surface of a peripheral band of said one or more supports.

In an 16th aspect according to any one of the preceding two aspects the peripheral portion extends peripherally with respect to the central portion of the upper tool, optionally to define an upper tool having a dome shape.

In an 17th aspect according to any one of the preceding aspects the upper tool comprises holding means configured for attracting the film portion in adhesion of the active surface of the upper tool.

In an 18th aspect according to any one of the preceding four aspects, the control unit is configured for executing a film

deformation procedure comprising the steps of:

- controlling the upper tool to position above a film portion, with the film portion being in a substantially flat configuration,
- causing the holding means to hold the film portion and bring the film portion to substantially adhere to said active surface.

In an 19th aspect according to any one of the five preceding aspects the peripheral portion of the upper tool is fixed to the central portion of the upper tool to define a fixed active surface, optionally a dome shaped active surface; or the peripheral portion of the upper tool is mounted for relative motion relative to the central portion for defining a variable volume cavity, optionally wherein the control unit is configured for commanding the relative motion of the peripheral portion with respect to the central portion in order to define the volume said cavity.

In an 20th aspect according to any one of the preceding seven aspects the lower tool – in correspondence of said second operating condition – is configured to abut against the inferior side of the operative tract below said chamber, and wherein the conveyor is configured such that a number of the conveyor apertures and/or at least a part of the conveyor permeable portion are/is located in correspondence of said chamber when the packaging assembly is in the second operating condition.

In an 21st aspect according to any one of the preceding aspects the apparatus comprise a support loading station configured for storing one or more supports each provided with respective one or more through holes, and for supplying said one or more supports to the conveyor operative tract.

In a 22nd aspect according to the preceding aspect – when the means for positioning comprises said seats defined on the superior side of the operative tract – the supports received in the respective seats do not occlude the conveyor apertures and/or the conveyor permeable portion.

In a 23rd aspect according to any one of the preceding two aspects – when the means for positioning comprises said seats defined on the superior side of the operative tract – the supports received in the respective seats have the one or more through holes in the supports placed in alignment with the conveyor apertures and/or the conveyor permeable portion.

In a 24th aspect according to any one of the preceding three aspects – when the means for positioning comprises the position sensor connected to the control unit – in correspondence of said proper position the support is not occluding the conveyor apertures and/or the conveyor permeable portion.

In a 25th aspect according to any one of the preceding four aspects – when the means for positioning comprises the position sensor connected to the control unit – in correspondence of said proper position the support has its holes

placed in alignment with the conveyor apertures and/or the conveyor permeable portion.

In an 26th aspect according to any one of the preceding aspects packaging assembly lower tool comprises a number of suction apertures located on an active surface of the lower tool facing the inferior side of the conveyor.

In an 27th aspect according to the preceding aspect the vacuum arrangement is connected to the suction apertures and capable to extract gas from said chamber, through the conveyor thickness, when the packaging assembly is in the second operating condition.

In a 28th aspect according to any one of the preceding two aspects, with the packaging assembly in the second operating condition, the control unit is configured to command the vacuum arrangement to cause air extraction from the chamber via the apertures and/or permeable portion of the conveyor and, optionally via the holes present in the support.

In a 29th aspect according to any one of the preceding aspects, packaging assembly lower tool comprises a fixed support structure having active surface in sliding contact with the inferior side of the operative tract of the conveyor.

In a 30th aspect according to any one of the preceding aspects, packaging assembly lower tool comprises a fixed support structure in the shape of a fixed plate body.

In a 31st aspect according to any one of the preceding aspects, packaging assembly upper tool – in correspondence of said second operating condition of the packaging assembly – is configured to bring a peripheral band of each one of said one or more film portions in sealing abutment against a respective one of:

- a corresponding band defined on the superior side of the operative tract encircling one or more supports,
- a corresponding peripheral band of a top surface of said one or more supports.

In a 32nd aspect according to the preceding aspect, when the packaging assembly is in the second operating condition, the upper tool and the lower tool are configured to tightly sandwich between them the peripheral band of the film portion, the peripheral band of the respective support and a band portion of the conveyor underlying said peripheral band of the support.

In a 33rd aspect according to any one of the preceding aspects, the apparatus includes:

- a support loading station configured for allowing loading of the one or more supports on the operative tract of the conveyor,
- a product loading station located between the support loading station and the packaging assembly and allowing positioning of one or more products onto the one or more supports,
- a discharge station allowing unloading of packaged products from the apparatus.

In a 34th aspect according to the preceding aspect the conveyor operative tract extends all the way through the support loading station, the product loading station, the packaging assembly and the discharge station.

In a 35th aspect according to any one of the preceding aspects the conveyor is an endless conveyor belt.

In a 36th aspect according to any one of the preceding aspects the film supply assembly is configured for supplying a continuous film and wherein the apparatus includes:

- a film cutting assembly active on the continuous film and configured for cutting film sheets of prefixed length from said continuous film, the film cutting assembly being located outside said packaging assembly;
- at least one transfer device configured for positioning the cut film sheets inside the packaging assembly and above the respective support.

In a 37th aspect according to the preceding aspect the transfer device includes:

- a backing structure having a flat holding surface adapted for receiving the at least one or more film sheets cut by the cutting assembly, and
- a mechanism active on the packaging assembly and configured for displacing the upper tool between a first position, where the upper tool is positioned in correspondence of the backing structure and configured to pick up from the backing structure the one or more cut film sheets, and at least a second position, where the upper tool is aligned to the lower tool and configured to position at least one film sheet above said support.

In a 38th aspect according to the 36th aspect the transfer device includes:

- a backing structure having a flat holding surface adapted for receiving the at least one or more film sheets cut by the cutting assembly, and
- a mechanism active on the backing structure and configured for relative movement of the backing structure with respect to the packaging assembly between a first position, where the baking structure is positioned at the cutting assembly and at least a second position, where the backing structure is positioned inside said packaging assembly and configured to place at least one film sheet above said support.

In a 39th aspect according to the preceding aspect the mechanism includes a transfer actuator active on the backing structure and configured for pushing and pulling the backing structure along a path suitable for achieving the displacement between said first and second positions.

In a 40th aspect according to the preceding aspect the control unit is configured for:

- activating the film cutting assembly for cutting, outside the packaging assembly, the continuous film into the cut film sheet(s);
- activating the transfer device for positioning the cut film sheet(s) inside the packaging assembly and above the respective support;

- synchronizing activation of the transfer device with passage of the packaging assembly from the second to the first operating condition, leaving the packaging assembly in the first operating condition a time sufficient for the backing structure of transfer device to:
    - position inside the packaging assembly and above the respective support the cut film sheet(s) which have/has been cut outside the packaging assembly, and then
    - exit from the packaging assembly.

In a 41st aspect according to any one of the preceding aspects the control unit is configured to cause motion of the conveyor when the packaging assembly is in the second operating condition and to cause stop of the conveyor when the packaging assembly is in the first operating condition thereby conferring an overall step-by-step motion to the conveyor.

In a 42nd aspect according to any one of the preceding aspects the apparatus has heating means at least associated to the upper tool and configured to at least heat a film portion received in the packaging assembly.

A 43rd aspect concerns a process of packaging a product (P) arranged on a support.

In a 44th aspect according to the preceding aspect, the process uses the apparatus of any one of the preceding aspect from the 1st to the 42nd.

In a 45th aspect according to any one of the preceding two aspects, the process comprises the following steps:

- positioning a plurality of distinct supports at a distance the one from the other on the operative tract of the conveyor;
- placing at least one product to be packaged on each respective support;
- supplying a plastic film from the film supply assembly;
- with the packaging assembly in the first operating condition,
    - displacing the supports positioned on the operative tract along a predetermined path and into the packaging assembly;
    - receiving and holding at least one film portion of said plastic film above at least one respective support located in the packaging assembly;
- bringing packaging assembly from first operating condition to second operating condition and tightly sealing the film portion of said plastic film to the least one respective of said supports,
- extracting gas present between the film portion and the underlying support forming a vacuum skin packaged product, during gas extraction at least part of said extracted gas passing through the conveyor.

In a 46th aspect according to the preceding aspect the process provides that, with bringing of the packaging assembly to the second operating condition, the film portion be sealed in correspondence of a peripheral border of the support.

In a 47th aspect according to any one of the preceding two aspects the process comprises a step of releasing the film portion from the upper tool, which takes place either during or after the step of extracting the gas, the film portion draping down and adhering to an exposed surface e of the product and to an upper surface of the support not occupied by the product.

In a 48th aspect according to the preceding aspect wherein the step of releasing the film portion from the upper tool is achieved by venting the apertures present on the upper tool active surface (i.e. by connecting said apertures to the external atmosphere such us to let air at atmospheric pressure in the packaging assembly and above the film portion).

In a 49th aspect according to any one of the preceding four aspects, the process comprises a step of venting the suction apertures in the lower tool before or after starting to move the packaging assembly back to the first operating condition.

In a 50th aspect according to any one of aspects from the 43rd to the 49th the supports are flat, optionally plastic or paperboard, supports.

In a 51st aspect according to any one of aspects from the 43rd to the 50th the supports the supports are each provided with respective one or more through holes and the product is placed on each respective support leaving the one or more through holes open for passage of gas.

In a 52th aspect according to the preceding aspect, the process provides that - while extracting gas present between the film portion and the underlying support - part of said gas passes through the one or more through holes present in the support and through the thickness of the conveyor.

In a 53rd aspect according to any one of aspects from the 43rd to the 52nd positioning the supports on the operative tract comprises positioning each support at a pre-determined distance from an adjacent support by placing each support in a corresponding one of seats defined on the superior side of the operative tract.

In a 54th aspect according to any one of aspects from the 43rd to the 53rd positioning the supports on the operative tract comprises detecting the position of said one or more supports on the operative tract, comparing said detected position with a proper position of the support, and reposition the support if said comparison indicates that the detected position does not match the proper position of the support.

In a 55th aspect according to any one of aspects from the 43rd to the 54th, the process provides that, in correspondence of said second operating condition of the packaging assembly, this latter defines a chamber housing the product or products positioned on the one or more supports located in the same packaging assembly.

In a 56th aspect according to any one of aspects from the 43rd to the 55th , the process provides that in correspondence of second operating condition of packaging assembly the upper tool peripheral portion directly abuts in a gas tight manner against one of:

- the superior side of the operative tract encircling one or more supports,
- a top surface of a peripheral band of said one or more supports,

In a 57th aspect according to any one of aspects from the 43rd to the 55th , the process provides that in correspondence of second operating condition of packaging assembly or the upper tool peripheral portion indirectly abut in a gas tight manner – via interposition of said film portion – against one of:

- the superior side of the operative tract encircling one or more supports,
- a top surface of a peripheral band of said one or more supports.

In a 58th aspect according to any one of the preceding three aspects, the process provides that, in correspondence of said second operating condition of the packaging assembly, the lower tool abut against the inferior side of the operative tract below said chamber.

In a 59th aspect according to any one of the preceding four aspects - when the packaging assembly is in the second operating condition - a number of the conveyor apertures and/or at least a part of the conveyor permeable portion are/is located in correspondence of said chamber and gas is permitted to pass through the conveyor apertures and/or through at least a part of the conveyor permeable portion.

In a 60th aspect according to any one of the preceding five aspects wherein extracting gas comprises extracting gas from said chamber via the apertures and/or permeable portion of the conveyor.

In a 61st aspect according to any one of the preceding six aspects wherein extracting gas comprises extracting gas from said chamber via the apertures and/or permeable portion of the conveyor, and via the holes present in the support.

In a 62nd aspect according to any one of the preceding aspects from 43rd to 61st, comprising aligning conveyor apertures and/or conveyor permeable portion with holes present in the support wherein - while extracting gas present between the film portion and the underlying support - part of said gas passes through the one or more through holes present in the support and through conveyor apertures and/or the conveyor permeable portion.

In a 63rd aspect according to any one of the preceding aspects from 43rd to 62nd, supplying a plastic film to the packaging assembly comprises:

- supplying a continuous plastic film from the film supply assembly;
- cutting the continuous film at film cutting assembly forming a film sheet of a prefixed size which defines said film portion.

In a 64th aspect according to the preceding aspect, the process includes transferring the cut film sheet inside the packaging assembly and above the respective support.

In a 65th aspect according to any one of the preceding two aspects, the cut film sheet is shaped and sized as the top surface of the support.

In a 66th aspect according to the preceding aspect tightly sealing the film portion to the least one respective of said supports comprises fixing a peripheral band of the cut film sheet to a corresponding peripheral band of the underlying support leaving zero or minimal film material protruding radially outside a peripheral edge of the support.

In a 67th aspect according to any one of the preceding four aspects transferring the cut film sheet inside the packaging assembly comprises:

- receiving the cut film sheet on flat holding surface of backing structure, and
- moving the backing structure with respect to the packaging assembly from its first position, where the backing structure is positioned at the cutting assembly, to its second position, where the backing structure is positioned inside said packaging assembly placing the at least one film sheet above said support.

In a 68th aspect according to the preceding aspect, the packaging assembly is kept in its first operating condition a time sufficient for the backing structure of transfer device to:

- position inside the packaging assembly and above the respective support the cut film sheet(s) which have/has been cut outside the packaging assembly, and then
- exit from the packaging assembly.

In a 69th aspect according to any one of the preceding aspects from 43rd to 68th, tightly sealing the film portion of said plastic film to the least one respective of said supports comprises heating the film portion and heat sealing at least a peripheral band of the film portion to a corresponding peripheral band of the top surface of the support.

In a 70th aspect according to the preceding aspect - during heat sealing - the peripheral band of said film portion is brought in abutment against the corresponding peripheral band of top surface of said one or more supports, the upper tool and the lower tool tightly sandwiching between them the peripheral band of the film portion, the peripheral band of the respective support and a corresponding band of the conveyor surrounding the products in the packaging assembly.

A 71st aspect concerns an apparatus for packaging a product (P) arranged on a support, comprising:

- a conveyor (3) having an operative tract (5) configured for displacing along a predetermined path:
  either a plurality of distinct supports (2) positioned at a distance the one from the other, or consecutive support portions (2') of a continuous support (200);
- a film supply assembly (13) configured for supplying a plastic film;

- a packaging assembly (11) operative at said predetermined path and configured for tightly fixing at least one film portion (22) of said plastic film to at least one respective of said supports (2) or of said support portions (2'), wherein the packaging assembly (11) includes:
  - a lower tool (23);
  - an upper tool (24) operative above the lower tool, the packaging assembly (11) being configured to operate at least in:
    - a first operating condition, where the upper tool (24) is spaced from the lower tool (23) allowing positioning of one or more of said supports (2) or support portions (2') and of said film portion (22) inside the packaging assembly (11), and
    - a second operating condition, where the upper tool (24) is approached towards the lower tool (23) and is configured to sealingly apply the at least one film portion (22) to the at least one underlying support (2) or support portion (2') present in the packaging assembly (11);
- a vacuum arrangement (26).

In a 72nd aspect according to the 71st aspect the apparatus includes a support loading station (9) configured for allowing loading of the one or more supports (2) on the operative tract (5) of the conveyor (3), with each one of said supports (2) being provided with respective one or more through holes (2b).

In a 73rd aspect according to any one of aspects from the 71st to the 72nd the apparatus includes a continuous support supply (201) configured for supplying said continuous support (200) to the conveyor (3) operative tract (5), with a hole making device (202) configured for making one or more through holes (2b) in each one of said consecutive film portions (2') of said continuous support (200).

In a 74th aspect according to any one of aspects from the 71st to the 73rd the apparatus includes a control unit (8) configured for controlling the packaging assembly (11) and the conveyor (3), wherein the control unit (8) is configured to execute the following cycle:

- with the packaging assembly (11) in the first operating condition, causing the conveyor (3) to position one or more of said supports (2) or support portions (2'), with a respective product (P) thereon, inside the packaging assembly (11),
- with the packaging assembly (11) in the second operating condition, commanding the vacuum arrangement (26) to extract gas present between the at least one film portion (22) and the underlying support or support portion, forming a vacuum skin packaged product (P).

In a 75th aspect according to any one of aspects from the 71st to the 74th the control unit (8) is configured to control the conveyor (3) to position said one or more of said supports (2) or said support portions (2') inside the packaging assembly (11) and to control the packaging assembly (11) in the second operating condition, such that the extraction by the vacuum arrangement (26) of gas present between the at least one film portion (22) and the underlying support

or support portion takes place at least in part through the one or more through holes present in the one or more supports or support portions present inside the packaging assembly.

In a 76th aspect according to any one of aspects from the 71st to the 75th the apparatus comprises the support loading station (9), and the control unit is further connected to the support loading station (9) to control deposition of the one or more supports on the conveyor operative tract (5) and wherein the cycle, which the control unit is configured to execute, further includes commanding the support loading station to position the one or more supports on the operative tract such that each support is located at a pre-determined distance from an adjacent support (2) and each through hole of each support (2) is positioned at a known location relative to the conveyor operative tract (5).

In a 77th aspect according to the preceding aspect the cycle, which the control unit is configured to execute, further comprises:

- controlling the support loading station, the conveyor and the packaging assembly for bringing each one of said supports (2) inside the packaging assembly with its one or more through holes in fluid communication with the vacuum arrangement at least when the packaging assembly is in said second operating condition, wherein commanding the vacuum arrangement (26) to extract gas present between the at least one film portion (22) and the underlying support (2) includes extracting gas via said one or more through holes present in each respective support (2), or

In a 78th aspect according to any one of aspects from the 71st to the 75th the apparatus comprises the continuous support supply, and the control unit is connected to the hole making device to control formation of through holes in the continuous support, wherein the cycle further includes controlling the hole making device to form said holes into the continuous support according to a predetermined sequence such that each through hole practiced on the continuous support is positioned at a known location relative to the conveyor operative tract (5).

In a 79th aspect according to the preceding aspect the cycle, which the control unit is configured to execute, further comprises:

- controlling the hole making device, the conveyor and the packaging assembly for bringing each one of said support portions (2') inside the packaging assembly with its one or more through holes in fluid communication with the vacuum arrangement at least when the packaging assembly is in said second operating condition, wherein commanding the vacuum arrangement (26) to extract gas present between the at least one film portion (22) and the underlying support portion (2') includes extracting gas via said one or more through holes present in each respective support portion (2').

In a 80th aspect according to any one of aspects from the 71st to the 79th the apparatus has the support loading station (9) which is configured for storing a plurality of said one or more supports (2) and for supplying said one or more supports (2) to the conveyor (3) operative tract (5).

In a 81st aspect according to any one of aspects from the 71st to the 80th the apparatus has the continuous support

supply (201) with the hole making device (202) being positioned between the continuous support supply (201) and the packaging station (11), optionally in a position where the continuous support has not reached yet the operative tract (5).

In a 82nd aspect according to any one of aspects from the 71st to the 81st, the cycle which the control unit is configured to execute comprises the following:

with the packaging assembly (11) in the first operating condition

- first causing the conveyor (3) to move in order to position the one or more of said supports (2) or support portions (2'), with a respective product (P) thereon, inside the packaging assembly (11),
- then causing the conveyor (3) to stop,

thereafter, with the conveyor (3) stopped, causing the packaging assembly (11) to move to the second operating condition and seal the film portion (22) to the underlying at least one support (2) or support portion (2') at least in correspondence of a peripheral border of the same support or support portion.

In a 83rd aspect according to any one of aspects the apparatus further comprises heating means (45) at least associated to the upper tool (24) and configured to at least heat the at least one film portion (22) received in the packaging assembly (11).

In a 84th aspect according to any one of aspects from the 71st to the 83rd the conveyor (3) comprises a conveyor belt configured to define a resting surface for receiving the one or more supports or the one or more support portions and at the same time allow passage of gas through a conveyor thickness between a superior side and an inferior side of the operative tract (5) of the conveyor (3);

wherein the conveyor (3) extends through the packaging assembly (11) and comprises:

- a plurality of discrete apertures (7) extending through the entire conveyor thickness and positioned along the conveyor (3), and/or
- at least a permeable portion extensive through the entire conveyor thickness and made from gas permeable material.

In a 85th aspect according to the preceding aspect the lower tool (23) is operative below the inferior side of said operative tract (5) and the upper tool (24) operative above the superior side of the operative tract (5),

wherein the lower tool (23) – in correspondence of said second operating condition of the packaging assembly – is configured to position against the inferior side of the operative tract (5).

In a 86th aspect according to any one of the preceding two aspects the conveyor (3) is configured such that a number of the conveyor apertures (7) and/or at least a part of the conveyor (3) permeable portion are/is located inside the packaging assembly when the packaging assembly (11) is in the second operating condition.

In a 87th aspect according to the preceding aspect the cycle, which the control unit is configured to execute, further comprises:

- controlling the support loading station, the conveyor and the packaging assembly for bringing each one of said supports (2) inside the packaging assembly with its one or more through holes in alignment with at least one respective conveyor aperture (7) and/or conveyor (3) permeable portion and in fluid communication with the vacuum arrangement at least when the packaging assembly is in said second operating condition, wherein commanding the vacuum arrangement (26) to extract gas present between the at least one film portion (22) and the underlying support (2) includes extracting gas via said one or more through holes present in each respective support (2) and via said at least one respective conveyor aperture (7) and/or conveyor (3) permeable portion.

In a 88th aspect according to the 86th aspect the cycle, which the control unit is configured to execute, further comprises:

- controlling the hole making device, the conveyor and the packaging assembly for bringing each one of said support portions (2') inside the packaging assembly with its one or more through holes in alignment with at least one respective conveyor aperture (7) and/or conveyor (3) permeable portion and in fluid communication with the vacuum arrangement at least when the packaging assembly is in said second operating condition, wherein commanding the vacuum arrangement (26) to extract gas present between the at least one film portion (22) and the underlying support portion (2') includes extracting gas via said one or more through holes present in each respective support portion (2') and via said at least one respective conveyor aperture (7) and/or conveyor (3) permeable portion.

In a 89th aspect according to any one of aspects from the 71st to the 88th, further comprising means for positioning (15) the supports (2) on the operative tract (5), wherein the means for positioning (15) comprises one or more of:

- seats (16) defined on a superior side of the operative tract (5), each one of the seats (16) being located at a pre-defined distance from an adjacent seat and being shaped to receive and keep a respective support in a position fixed relative to the conveyor (3),
- a position sensor (17; 17a) connected to the control unit (8) and configured for detecting the position of said one or more supports (2) on the operative tract (5) or of holes (2b) present in said one or more supports (2), and a positioner also connected to the control unit (8), the control unit (8) being configured to receive from said position sensor (17; 17a) a signal related to a detected position of a support on the conveyor (3) or related to a position of said holes (2b) relative to the conveyor (3), compare said signal with a reference indicative of a proper position of the support on the conveyor (3), and issue a control signal for the positioner to reposition the support if said comparison indicates that the detected position does not match the proper position of the support (2).

In a 90th aspect according to any one of aspects from the 71st to the 89th, wherein the conveyor comprises parallel driving chains, each driving chain acting on a respective longitudinal side of the apparatus and carrying respective pincers configured to act on a respective lateral band of the supports or support portions to displace the supports or

support portions along said predetermined path,

wherein the lower tool (23) is operative below the inferior side of said operative tract (5) and the upper tool (24) operative above the superior side of the operative tract (5),

wherein the lower tool (23) – in correspondence of said second operating condition of the packaging assembly – is configured to position against the inferior side of the operative tract (5).

In a 90th aspect according to any one of aspects from the 71st to the 89th, the upper tool (24) comprises a central portion and a peripheral portion together defining an upper tool (24) active surface located above the superior side of the operative tract (5), and

- the peripheral portion of the upper tool (24) is configured to – directly, or indirectly via interposition of said film portion (22) – abut against one of:
    - a superior side of the operative tract (5) of the conveyor (3) encircling one or more supports (2),
    - a top surface of a peripheral band of said one or more supports (2),
    - a top surface of a peripheral band of said one or more support portions (2'),
    - a top surface of a portion of peripheral band of said one or more supports or support portions (2') and a superior side of the operative tract (5).

In a 91st aspect according to the preceding aspect the peripheral portion extends peripherally with respect to the central portion of the upper tool (24), optionally to define an upper tool (24) having a dome shape, and wherein the upper tool (24) comprises holding means (31) configured for attracting the film portion (22) in adhesion of the active surface of the upper tool (24),

wherein the control unit (8) is configured for executing a film deformation procedure comprising the steps of:

- controlling the upper tool (24) to position above a film portion (22), with the film portion (22) being in a substantially flat configuration,
- causing the holding means (31) to hold the film portion (22) and bring the film portion (22) to substantially adhere to said active surface.

In a 92nd aspect according to any one of the preceding two aspects:

- the peripheral portion of the upper tool (24) is fixed to the central portion of the upper tool (24) to define a fixed active surface, optionally a dome shaped active surface; or
- the peripheral portion of the upper tool (24) is mounted for relative motion relative to the central portion for defining a variable volume cavity, optionally wherein the control unit (8) is configured for commanding the relative motion of the peripheral portion with respect to the central portion in order to define the volume said cavity.

In a 93rd aspect according to any one of aspects from the 71st to the 92nd, the packaging assembly (11) in the second operating conditions, and particularly the upper tool, defines a chamber (25) extending above the operative tract (5)

and configured for housing the product (P) or products positioned on the one or more supports (2) or support portions (2').

In a 94th aspect according to the preceding aspect when the packaging assembly (11) is in the second operating condition, the vacuum arrangement is configured to extract gas from said chamber (25) through the holes of the support or support portions received in the packaging assembly.

In a 95th aspect according to the preceding aspect when the packaging assembly (11) is in the second operating condition, the vacuum arrangement is configured to extract gas from said chamber (25) through the holes of the support or support portions received in the packaging assembly and through the conveyor thickness via said at least one respective conveyor aperture (7) and/or conveyor (3) permeable portion.

In a 96th aspect according to any one of the preceding three aspects the lower tool (23) comprises a number of suction apertures (38) located on an active surface of the lower tool (23) facing the inferior side of the conveyor (3), and the vacuum arrangement (26) is connected to the suction apertures (38) and capable to extract gas from said chamber (25), through the holes of the support or support portions received in the packaging assembly.

In a 97th aspect according to any one of the preceding three aspects the lower tool (23) comprises a number of suction apertures (38) located on an active surface of the lower tool (23) facing the inferior side of the conveyor (3), and the vacuum arrangement (26) is connected to the suction apertures (38) and capable to extract gas from said chamber (25), through the holes of the support or support portions received in the packaging assembly and through the conveyor (3) thickness via said at least one respective conveyor aperture (7) and/or conveyor (3) permeable portion, when the packaging assembly (11) is in the second operating condition.

In a 98th aspect according to any one of the preceding four aspects, with the packaging assembly (11) in the second operating condition, the control unit (8) is configured to command the vacuum arrangement (26) to cause air extraction from the chamber (25) via the holes (2b) present in the support or support portions received in the packaging assembly, optionally via the apertures and/or permeable portion of the conveyor (3).

In a 99th aspect according to any one of aspects from the 71st to the 98th, the lower tool (23) comprises a fixed support structure, optionally in the shape of a fixed plate body, having active surface in sliding contact with the inferior side of the operative tract (5) of the conveyor (3).

In a 100th aspect according to any one of aspects from the 71st to the 99th, the upper tool (24) – in correspondence of said second operating condition of the packaging assembly (11) – is configured to bring a peripheral band of each one of said one or more film portions (22) in sealing abutment against a respective one of:

- a corresponding band defined on the superior side of the operative tract (5) encircling one or more supports

(2),

- a corresponding peripheral band of a top surface of said one or more supports (2) encircling the one or more through holes present in each support,
- a corresponding peripheral band of a top surface of said one or more support portions (2') encircling the one or more through holes present in each support portion.

In a 101st aspect according to the preceding aspect when the packaging assembly (11) is in the second operating condition, the upper tool (24) and the lower tool (23) are configured to tightly sandwich between them the peripheral band of the film portion (22), the peripheral band of the respective support or support portion and, optionally, a band portion of the conveyor (3) underlying said peripheral band of the support or support portion.

In a 102nd aspect according to any one of aspects from the 71st to the 101st the apparatus includes

- a product loading station (10) located between the support loading station (9) and the packaging assembly (11) or between the continuous support supply (201) and the packaging assembly (11), the product loading station being configured for allowing positioning of one or more products onto the one or more supports (2) or onto the one or more support portions (2'),
- a discharge station (12) allowing unloading of packaged products from the apparatus.

In a 103rd aspect according to the preceding aspect the conveyor (3) operative tract (5) extends all the way through the support loading station (9) if present, the product loading station (10), the packaging assembly (11) and the discharge station (12).

In a 104th aspect according to any one of the preceding aspects the film supply assembly (13) is configured for supplying a continuous film and wherein the apparatus includes:

- a film cutting assembly (21) active on the continuous film and configured for cutting film sheets of prefixed length from said continuous film, the film cutting assembly (21) being located outside said packaging assembly (11);
- at least one transfer device (41) configured for positioning the cut film sheets inside the packaging assembly (11) and above the respective support (2) or support portion (2'),

wherein the transfer device (41) includes:

- a backing structure having a holding surface, optionally a flat holding surface, adapted for receiving the at least one or more film sheets cut by the cutting assembly (21), and
- one of the following mechanisms:
  - a mechanism active on the packaging assembly (11) and configured for displacing the upper tool (24) between a first position, where the upper tool (24) is positioned in correspondence of the backing structure and configured to pick up from the backing structure (42) the one or more cut film sheets, and at least a second position, where the

upper tool (24) is aligned to the lower tool (23) and configured to position at least one film sheet above said support (2) or support portion (2'), or

- a mechanism active on the backing structure (42) and configured for relative movement of the backing structure (42) with respect to the packaging assembly (11) between a first position, where the baking structure is positioned at the cutting assembly (21) and at least a second position, where the backing structure (42) is positioned inside said packaging assembly (11) and configured to place at least one film sheet above said support or support portion (2').

In a 105th aspect according to the preceding aspect the transfer device (41) includes:

- the backing structure (42) adapted for receiving the at least one or more film sheets cut by the cutting assembly (21), and
- the mechanism active on the backing structure (42) and configured for relative movement of the backing structure (42) with respect to the packaging assembly (11) between a first position, where the baking structure is positioned at the cutting assembly (21) and at least a second position, where the backing structure (42) is positioned inside said packaging assembly (11) and configured to place at least one film sheet above said support (2) or support portion (2'), optionally wherein the mechanism includes a transfer actuator active on the backing structure (42) and configured for pushing and pulling the backing structure (42) along a path suitable for achieving the displacement between said first and second positions;

wherein the cycle which the control unit (8) is configured for executing comprises the following further steps:

- activating the film cutting assembly (21) for cutting, outside the packaging assembly (11), the continuous film into the cut film sheet(s);
- activating the transfer device (41) for positioning the cut film sheet(s) inside the packaging assembly (11) and above the respective support or support portion (2');
- synchronizing activation of the transfer device (41) with passage of the packaging assembly (11) from the second to the first operating condition, leaving the packaging assembly (11) in the first operating condition a time sufficient for the backing structure (42) of transfer device (41) to:
    - position inside the packaging assembly (11) and above the respective support or support portion the cut film sheet(s) which have/has been cut outside the packaging assembly (11), and then
    - exit from the packaging assembly (11).

wherein the control unit (8) is configured to cause motion of the conveyor (3) when the packaging assembly (11) is in the second operating condition and to cause stop of the conveyor (3) when the packaging assembly (11) is in the first operating condition thereby conferring an overall step-by-step motion to the conveyor (3).

A 106th aspect concerns a process of packaging a product (P) arranged on a support (2), comprising the following steps:

- displacing along a predetermined path and towards a packaging assembly (11):

either a plurality of distinct supports (2) located at a distance the one from the other, wherein each of the one or more supports (2) has a base wall provided with respective one or more through holes (2b);

or consecutive support portions (2') of a continuous support (200) each one of said consecutive film portions (2') presenting a base wall provided with one or more through holes;

wherein the packaging assembly (11) is configured for tightly fixing at least one film portion (22) of said plastic film to at least one respective of said supports (2) or of said support portions (2') and includes a lower tool (23) and an upper tool (24), operative above the lower tool, the packaging assembly (11) being configured to operate at least in a first operating condition, where the upper tool (24) is spaced from the lower tool (23) allowing positioning of one or more of said supports (2) or support portions (2') and of said film portion (22) inside the packaging assembly (11), and a second operating condition, where the upper tool (24) is approached towards the lower tool (23) and is configured to sealingly apply the at least one film portion (22) to the at least one underlying support (2) or support portion (2') present in the packaging assembly (11);

- placing at least one product to be packaged on each respective support (2) or on each respective support portion (2');
- supplying a plastic film from a film supply assembly (13) to the packaging assembly (11);
- with the packaging assembly (11) in the first operating condition,
  - moving at least one of the supports (2) or at least one of support portions (2') into the packaging assembly (11);
  - receiving and holding at least one film portion (22) of said plastic film above said at least one respective support or said at least one support portion located in the packaging assembly (11);
- bringing the packaging assembly (11) from said first operating condition to said second operating condition and tightly sealing the at least one film portion (22) of said plastic film to the at least one respective of said supports (2) or support portions (2'),
- extracting gas present between the at least one film portion (22) and the underlying support (2) or support portion (2') forming a vacuum skin packaged product, during gas extraction at least part of said extracted gas passing through the one or more through holes of the same support or support portion located in the packaging assembly.

In a 107th aspect according to the preceding aspect a support loading station (9) loads the one or more supports (2) on an operative tract (5) of a conveyor (3), which displaces the supports (2) along the predetermined path and towards the packaging assembly.

In a 108th aspect according to the 106th aspect a continuous support supply (201) supplies said continuous support (200) to a conveyor (3) operative tract (5) and a hole making device (202) makes the one or more through holes (2b) in each one of said consecutive film portions (2') of said continuous support (200).

In a 109th aspect according to any one of the preceding three aspects the conveyor (3) positions said one or more of said supports (2) or said support portions (2'), with a respective product (P) thereon, inside the packaging assembly (11).

In a 110th aspect according to the preceding aspect, with the packaging assembly (11) in the second operating condition, the extraction of by the vacuum arrangement (26) of gas present between the at least one film portion (22) and the underlying support or support portion takes place through the one or more through holes of the one or more supports or support portions present inside the packaging assembly.

In a 111th aspect according to the preceding aspect the support loading station positions the one or more supports (2) on the operative tract (5) such that each support is located at a pre-determined distance from an adjacent support (2) and each through hole of each support (2) is positioned at a known location relative to the conveyor operative tract (5).

In a 112th aspect according to the 110th aspect the hole making device forms through holes in the continuous support according to a predetermined sequence such that each through hole practiced on the continuous support is positioned at a known location relative to the conveyor operative tract (5).

In a 113th aspect according to any one of aspects from the 106th to the 112th the process provides that with bringing of the packaging assembly (11) to the second operating condition the film portion (22) is sealed, optionally heat-sealed, in correspondence of a peripheral border of the support (2) encircling the one or more through holes present in the same support or in correspondence of a peripheral border of the support portion (2') encircling the one or more through holes present in the same support portion (2').

In a 114th aspect according to any one of aspects from the 106th to the 113th a step of releasing the film portion (22) from the upper tool (24) takes place either during or after the step of extracting the gas, the film portion (22) draping down and adhering to an exposed surface e of the product (P) and to an upper surface of the support not occupied by the product (P).

In a 115th aspect according to the preceding aspect the process comprises a step of venting suction apertures (38) in the lower tool (23) before or after starting to move the packaging assembly (11) back to the first operating condition.

In a 116th aspect according to any one of the preceding aspects the supports (2) or the support portions (2') are flat, optionally plastic or paperboard supports (2) or support portions (2'), and wherein the supports (2) or support portions (2') are each provided with respective one or more through holes (2b) across the thickness of the base wall thereof and wherein the product (P) is placed on each respective support leaving the one or more through holes (2b) at least partially open for passage of gas such that, while extracting gas present between the film portion (22) and the

underlying support (2) or support portion (2'), at least part of said gas passes through the one or more through holes (2b) present in the support (2) or support portion and, optionally, and through the thickness of the conveyor (3).

In a 117th aspect according to any one of aspects from the 106th to the 116th displacing the supports includes positioning the supports (2) on the operative tract (5) of the conveyor and comprises:

- positioning each support (2) at a pre-determined distance from an adjacent support (2) by placing each support (2) in a corresponding one of seats (16) defined on the superior side of the operative tract (5), and/or
- detecting the position of said one or more supports (2) on the operative tract (5), comparing said detected position with a proper position of the support, and reposition the support if said comparison indicates that the detected position does not match the proper position of the support.

In a 118th aspect according to any one of aspects from the 106th to the 117th in correspondence of said second operating condition of the packaging assembly (11), this latter defines a chamber (25) housing the product (P) or products (P) positioned on the one or more supports (2) or support portions (2') located in the same packaging assembly (11), wherein:

either the upper tool (24) has a peripheral portion which directly abuts in a gas tight manner against one of:

- a superior side of the operative tract (5) of the conveyor (3) encircling one or more supports (2),
- a top surface of a peripheral band of said one or more supports (2),
- a top surface of a peripheral band of said one or more support portions (2'),
- a top surface of a portion of peripheral band of said one or more supports or support portions (2') and a superior side of the operative tract (5).

In a 119th aspect according to any one of aspects from the 106th to the 117th or the upper tool (24) has a peripheral portion which indirectly abuts in a gas tight manner – via interposition of said film portion (22) – against one of:

- a superior side of the operative tract (5) of the conveyor (3) encircling one or more supports (2),
- a top surface of a peripheral band of said one or more supports (2),
- a top surface of a peripheral band of said one or more support portions (2'),
- a top surface of a portion of peripheral band of said one or more supports or support portions (2') and a superior side of the operative tract (5).

In a 120th aspect according to any one of the preceding two aspects in correspondence of said second operating condition of the packaging assembly (11), the lower tool (23) positions against the inferior side of the operative tract (5) below said chamber (25).

In a 121st aspect according to any one of the preceding three aspects when the packaging assembly (11) is in the second operating condition, a number of the conveyor apertures (7) and/or at least a part of the conveyor permeable portion are/is located in correspondence of said chamber (25) and gas is permitted to pass through the conveyor

apertures (7) and/or through at least a part of the conveyor (3) permeable portion.

In a 122nd aspect according to any one of the preceding four aspects extracting gas comprises extracting gas from said chamber (25) via the apertures (7) and/or permeable portion of the conveyor and via the one or more holes (2b) present in the support (2) or support portion (2') present in the packaging assembly.

In a 123rd aspect according to any one of aspects from the 106th to the 122nd the process comprises aligning conveyor apertures (7) and/or conveyor (3) permeable portion with holes (2b) present in the support wherein - while extracting gas present between the film portion (22) and the underlying support - part of said gas passes through the one or more through holes (2b) present in the support and through conveyor (3) apertures (7) and/or the conveyor (3) permeable portion.

In a 124th aspect according to any one of aspects from the 106th to the 123rd tightly sealing the film portion (22) of said plastic film to the least one respective of said supports (2) or to at least one respective of said support portions (2') comprises heating the film portion (22) and heat sealing at least a peripheral band of the film portion (22) to a corresponding peripheral band of the top surface of the support or support portion present in the packaging assembly.

In a 125th aspect according to the preceding aspect during heat sealing, the peripheral band of said film portion (22) is brought in abutment against the corresponding peripheral band of top surface of said one or more supports (2) or of said one or more support portions (2'), the upper tool (24) and the lower tool (23) tightly sandwiching between them the peripheral band of the film portion (22), the peripheral band of the respective support or support portion and optionally a corresponding band of the conveyor (3) surrounding the products (P) in the packaging assembly (11).

In a 126th aspect according to any one of aspects from the 106th to the 125th, the process uses the apparatus of any one of the preceding apparatus aspects.

In a 127th aspect according to the preceding aspect, after the step of extracting gas present between the at least one film portion (22) and the underlying support (2) or support portion (2') and forming a vacuum skin packaged product, the packaging assembly is brought back to the first operating condition and the packaged product or products is or are moved outside the packaging assembly.

In a 128th aspect according to any one of aspects from the 106th to the 127th the process provides that, after the packaged product or products is or are moved outside the packaging assembly, consecutive film portions of packaged products are severed from one another.

In a 129th aspect according to any one of aspects from the 106th to the 128th once the film portion is sealed to the respective support or support portion, each film portion entirely covers the product positioned on the support or support

portion and has a size which matches the size of the top surface of the respective support or support portion, the peripheral band of the film portion having a radially external perimeter coincident with that of the underlying support or support portion.

In a 130th aspect according to any one of aspects from the 106th to the 128th once the film portion is sealed to the respective support or support portion, each film portion entirely covers the product positioned on the support or support portion and has a size smaller than the size of the top surface of the respective support or support portion, the peripheral band of the film portion having a radially external perimeter which is placed at a radial distance from the external perimeter of the underlying support or support portion, whereby a part of the upper surface of the support or support portion is not covered by the film portion.

Brief description of the drawings

The present invention will become clearer by reading the following detailed description, given by way of example and not of limitation, to be read with reference to the accompanying drawings, wherein:

Figure 1 is a schematic side view layout of a first packaging apparatus according to aspects of the invention which uses pre-formed supports of discrete size (note that figure 1 does not show how the film has reached the upper tool as this aspect is detailed in figures 7 and 8);

Figures 2-6 are schematic side views relating to the apparatus of figure 1 in various consecutive phases of a packaging process to form a vacuum skin package, in accordance with certain aspects of the invention;

Figure 7 is a schematic side view layout of a the packaging apparatus of figure 1 where a film supply assembly configured to supply a continuous film to the packaging assembly has been added, according to further aspects of the invention;

Figure 8 is a schematic side view layout of a the packaging apparatus of figure 1 where a film supply assembly followed by a film cutting assembly and a transfer device have been inserted, according to yet further aspects of the invention;

Figure 9 is a schematic side view layout of a possible variant of the packaging assembly, which may be used in any one of the apparatus of the preceding figures 1-9;

Figure 10 is a longitudinal section of a portion of conveyor usable in the apparatus of any one of figures 1-9 characterized by having means for properly positioning the supports defined by seats for receiving said supports to be displaced inside the packaging assembly;

Figure 11 is a side view of a portion of conveyor usable in the apparatus of any one of figures 1-9 characterized by having alternative means for properly positioning on the conveyor the supports to be displaced inside the packaging assembly;

Figure 12 is an enlarged view representing the detail of the packaging assembly of the apparatus of figures 1 to 9 after the film portion has been applied to the support and product housed in the packaging assembly;

Figure 13 is a schematic side view layout of a second packaging apparatus according to aspects of the invention, wherein instead of preformed discrete supports 2 a continuous support 200 is used where consecutive support portions 2' are defined; in the packaging apparatus of figure 13 a hole making device 202 is operative in correspondence of the

conveyor 3 and configured to make through holes on the support portions after the continuous support has already contacted the conveyor surface;

Figure 14 is a schematic side view layout of a variant of the second packaging apparatus of figure 13: compared to the apparatus of figure 13 in the apparatus of figure 14 the hole making device 202 is operative upstream the conveyor 3 and configured to make through holes on the support portions before the continuous support has contacted the conveyor surface;

Figure 15 is a schematic side view layout of a further variant of the second packaging apparatus of figure 13: compared to the apparatus of figure 13 in the apparatus of figure 14 the conveyor 3 comprises side chains carrying pincers designed to clamp longitudinal side borders of the continuous support 200;

Figures 16 and 17 are schematic side views relating to the apparatus of any one of figures 13 to 15 in various consecutive phases of a packaging process to form a vacuum skin package, in accordance with certain aspects of the invention;

Figure 18 is an enlarged view representing the detail of the packaging assembly of the apparatus of any one of figures 13 to 15 after the film portion has been applied to the support and product housed in the packaging assembly;

Figure 19 shows a first variant of the final severing phase applicable to the apparatus of any one of figures 13 to 15 during which the support portions of the common support are separated from one another; and

Figure 20 shows a second variant of the final severing phase applicable to the apparatus of any one of figures 13 to 15 during which the support portions of the common support are separated from one another.

Definitions and conventions

It should be noted that in the present detailed description corresponding parts shown in the various figures are indicated with the same reference numeral through the figures. Note that the figures are not in scale and thus the parts and components shown therein are schematic representations.

In the following description and claims the apparatus and process refer to packaging of a product on a support or on a support portion: the product may be a food product or not.

As used herein support means a rigid or semi-rigid or flexible structure, such as for example a plate or a dish, designed for holding the product to be packaged which may have a rectangular shape or any other suitable shape, such as round, square, elliptical etcetera. In a specific form, the support is a discrete element and may be flat and have uniform thickness. Support portion means a portion, such as a longitudinal tract, of a continuous support in the form of a continuous film having a rigid or semi-rigid or flexible structure. Each support portion of the continuous support film is designed for holding the product to be packaged and may be flat and have uniform thickness.

With 'vacuum skin packaging' it is intended any packaging process where a product is placed on a rigid or semi-rigid or flexible support or support portion and a film of plastic material is applied above the product and the support, with air between the support and the plastic film being evacuated to cause the plastic film to drape down on the product

and seal to the surface of the support, thus forming a tight skin on the product and on the support.

The supports

The discrete support or the continuous support onto which the support portions are defined may be made in materials such as plastic material, paperboard, paper, wood or in combinations of the mentioned materials. The discrete supports or the continuous support may be single layer or multi-layer supports.

Plastic discrete or continuous supports may be manufactured by thermoforming or injection molding or cutting from foil material. Paper or paper board discrete or continuous supports may be obtained by cutting or die cutting from foil material.

The discrete supports or the support portions of the continuous support may include through holes: through holes may be obtained during manufacture of the discrete support or in a second phase, e.g., using an appropriate perforating tool part of the packaging apparatus. The through holes in the continuous support are preferably made using a hole making device which is part of the packaging apparatus or which operates upstream the packaging apparatus.

The support portions of the continuous support or the discrete supports present a base wall having a dimension, namely the thickness, which is significantly smaller than the other two dimensions: the through holes form through passages all through the thickness of the base wall of the supports or support portions.

The film or film material applied to the support or support portions

The film or film material heat sealed to the support or support portions in vacuum skin applications may be made of a flexible multi-layer material comprising at least a first outer heat-sealable layer, an optional gas barrier layer and a second outer heat-resistant layer. The outer heat-sealable layer may comprise a polymer capable of welding to the inner surface of the supports or support portions carrying the products to be packaged, such as for instance ethylene homo- or co-polymers, like LDPE, ethylene/alpha-olefin copolymers, ethylene/acrylic acid copolymers, ethylene/methacrylic acid copolymers, and ethylene/vinyl acetate copolymers, ionomers, co-polyesters, e.g. PETG. The optional gas barrier layer preferably comprises oxygen impermeable resins like PVDC, EVOH, polyamides and blends of EVOH and polyamides. The outer heat-resistant layer may be made of ethylene homo- or copolymers, ethylene/cyclic-olefin copolymers, such as ethylene/norbornene copolymers, propylene homo- or co-polymers, ionomers, (co)polyesters, (co)polyamides. The film may also comprise other layers such as adhesive layers or bulk layers to increase thickness of the film and improve its abuse and deep drawn properties. Particularly used bulk layers are ionomers, ethylene/vinyl acetate copolymers, polyamides and polyesters. In all the film layers, the polymer components may contain appropriate amounts of additives normally included in such compositions. Some of these additives are preferably included in the outer layers or in one of the outer layers, while some others are preferably added to inner layers. These additives include slip and anti- block agents such as talc, waxes, silica, and the like, antioxidants, stabilizers, plasticizers, fillers, pigments and dyes, cross-linking inhibitors, cross-linking enhancers, UV

absorbers, odor absorbers, oxygen scavengers, bactericides, antistatic agents and the like additives known to those skilled in the art of packaging films.

One or more layers of the film can be cross- linked to improve the strength of the film and/or its heat resistance. Cross-linking may be achieved by using chemical additives or by subjecting the film layers to an energetic radiation treatment.

The films for skin packaging are typically manufactured in order to show low shrink when heated during the packaging cycle. Those films usually shrink less than 15% at 160°C, more frequently lower than 10%, even more frequently lower than 8% in both the longitudinal and transversal direction (ASTM D2732). The films usually have a thickness comprised between 20 microns and 200 microns, more frequently between 40 and 180 microns and even more frequently between 50 microns and 150 microns.

Definitions and conventions concerning materials

PVDC is any vinylidene chloride copolymers wherein a major amount of the copolymer comprises vinylidene chloride and a minor amount of the copolymer comprises one or more unsaturated monomers copolymerisable therewith, typically vinyl chloride, and alkyl acrylates or methacrylates (e.g. methyl acrylate or methacrylate) and the blends thereof in different proportions. Generally a PVDC barrier layer will contain plasticisers and/or stabilizers as known in the art.

As used herein, the term EVOH includes saponified or hydrolyzed ethylene-vinyl acetate copolymers, and refers to ethylene/vinyl alcohol copolymers having an ethylene comonomer content preferably comprised from about 28 to about 48 mole %, more preferably, from about 32 to about 44 mole % ethylene, and even more preferably, and a saponification degree of at least 85%, preferably at least 90%.

The term “polyamides” as used herein is intended to refer to both homo- and co- or ter-polyamides. This term specifically includes aliphatic polyamides or co-polyamides, e.g., polyamide 6, polyamide 11, polyamide 12, polyamide 66, polyamide 69, polyamide 610, polyamide 612, copolyamide 6/9, copolyamide 6/10, copolyamide 6/12, copolyamide 6/66, copolyamide 6/69, aromatic and partially aromatic polyamides or co-polyamides, such as polyamide 6I, polyamide 6I/6T, polyamide MXD6, polyamide MXD6/MXDI, and blends thereof.

As used herein, the term “copolymer” refers to a polymer derived from two or more types of monomers, and includes terpolymers. Ethylene homopolymers include high density polyethylene (HDPE) and low density polyethylene (LDPE). Ethylene copolymers include ethylene/alpha-olefin copolymers and ethylene/unsaturated ester copolymers. Ethylene/alpha-olefin copolymers generally include copolymers of ethylene and one or more comonomers selected from alpha-olefins having from 3 to 20 carbon atoms, such as 1-butene, 1-pentene, 1-hexene, 1-octene, 4-methyl-1-pentene and the like.

Ethylene/alpha-olefin copolymers generally have a density in the range of from about 0.86 to about 0.94 g/cm3. The term linear low density polyethylene (LLDPE) is generally understood to include that group of ethylene/alpha-olefin

copolymers which fall into the density range of about 0.915 to about 0.94 g/cm3 and particularly about 0.915 to about 0.925 g/cm3. Sometimes linear polyethylene in the density range from about 0.926 to about 0.94 g/cm3 is referred to as linear medium density polyethylene (LMDPE). Lower density ethylene/alpha-olefin copolymers may be referred to as very low density polyethylene (VLDPE) and ultra-low density polyethylene (ULDPE). Ethylene/alpha-olefin copolymers may be obtained by either heterogeneous or homogeneous polymerization processes.

Another useful ethylene copolymer is an ethylene/unsaturated ester copolymer, which is the copolymer of ethylene and one or more unsaturated ester monomers. Useful unsaturated esters include vinyl esters of aliphatic carboxylic acids, where the esters have from 4 to 12 carbon atoms, such as vinyl acetate, and alkyl esters of acrylic or methacrylic acid, where the esters have from 4 to 12 carbon atoms.

Ionomers are copolymers of an ethylene and an unsaturated monocarboxylic acid having the carboxylic acid neutralized by a metal ion, such as zinc or, preferably, sodium.

Useful propylene copolymers include propylene/ethylene copolymers, which are copolymers of propylene and ethylene having a majority weight percent content of propylene, and propylene/ethylene/butene terpolymers, which are copolymers of propylene, ethylene and 1-butene.

As used herein, the term "polyolefin" refers to any polymerized olefin, which can be linear, branched, cyclic, aliphatic, aromatic, substituted, or unsubstituted. More specifically, included in the term polyolefin are homo-polymers of olefin, co-polymers of olefin, co-polymers of an olefin and an non-olefinic co-monomer co-polymerizable with the olefin, such as vinyl monomers, modified polymers thereof, and the like. Specific examples include polyethylene homo-polymer, polypropylene homo-polymer, polybutene homo-polymer, ethylene- alpha -olefin co-polymer, propylene- alpha -olefin co-polymer, butene- alpha -olefin co-polymer, ethylene-unsaturated ester co-polymer, ethylene-unsaturated acid co-polymer, (e.g. ethylene-ethyl acrylate co-polymer, ethylene-butyl acrylate co-polymer, ethylene-methyl acrylate co-polymer, ethylene-acrylic acid co-polymer, and ethylene-methacrylic acid co-polymer), ethylene-vinyl acetate copolymer, ionomer resin, polymethylpentene, etc.

The term " polyester" is used herein to refer to both homo-and co- polyesters, wherein homo-polyesters are defined as polymers obtained from the condensation of one dicarboxylic acid with one diol and co- polyesters are defined as polymers obtained from the condensation of one or more dicarboxylic acids with one or more diols. Suitable polyester resins are, for instance, polyesters of ethylene glycol and terephthalic acid, i.e. poly(ethylene terephthalate) (PET). Preference is given to polyesters which contain ethylene units and include, based on the dicarboxylate units, at least 90 mol %, more preferably at least 95 mol %, of terephthalate units. The remaining monomer units are selected from other dicarboxylic acids or diols. Suitable other aromatic dicarboxylic acids are preferably isophthalic acid, phthalic acid, 2,5-, 2,6- or 2,7-naphthalenedicarboxylic acid. Of the cycloaliphatic dicarboxylic acids, mention should be made of cyclohexanedicarboxylic acids (in particular cyclohexane-1 ,4-dicarboxylic acid). Of the aliphatic dicarboxylic acids, the (C3-Ci9)alkanedioic acids are particularly suitable, in particular succinic acid, sebacic acid, adipic acid, azelaic acid, suberic acid or pimelic acid. Suitable diols are, for example aliphatic diols such as ethylene glycol, diethylene glycol, triethylene glycol, propylene glycol, 1 ,3-butane diol, 1 ,4- butane diol, 1 ,5-pentane diol, 2,2-dimethyl-1 ,3-

propane diol, neopentyl glycol and 1 ,6-hexane diol, and cycloaliphatic diols such as 1 ,4- cyclohexanedimethanol and 1 ,4-cyclohexane diol, optionally heteroatom- containing diols having one or more rings.

Co-polyester resins derived from one or more dicarboxylic acid(s) or their lower alkyl (up to 14 carbon atoms) diesters with one or more glycol(s), particularly an aliphatic or cycloaliphatic glycol may also be used as the polyester resins for the base film. Suitable dicarboxylic acids include aromatic dicarboxylic acids such as terephthalic acid, isophthalic acid, phthalic acid, or 2,5-, 2,6- or 2,7-naphthalenedicarboxylic acid, and aliphatic dicarboxylic acids such as succinic acid, sebacic acid, adipic acid, azelaic acid, suberic acid or pimelic acid. Suitable glycol(s) include aliphatic diols such as ethylene glycol, diethylene glycol, triethylene glycol, propylene glycol, 1 ,3-butane diol, 1 ,4-butane diol, 1 ,5-pentane diol, 2,2- dimethyl-1 ,3-propane diol, neopentyl glycol and 1 ,6-hexane diol, and cycloaliphatic diols such as 1 ,4-cyclohexanedimethanol and 1 ,4- cyclohexane diol. Examples of such copolyesters are (i) copolyesters of azelaic acid and terephthalic acid with an aliphatic glycol, preferably ethylene glycol; (ii) copolyesters of adipic acid and terephthalic acid with an aliphatic glycol, preferably ethylene glycol; and (iii) copolyesters of sebacic acid and terephthalic acid with an aliphatic glycol, preferably butylene glycol; (iv) co-polyesters of ethylene glycol, terephthalic acid and isophthalic acid. Suitable amorphous co-polyesters are those derived from an aliphatic diol and a cycloaliphatic diol with one or more, dicarboxylic acid(s), preferably an aromatic dicarboxylic acid. Typical amorphous copolyesters include co-polyesters of terephthalic acid with an aliphatic diol and a cycloaliphatic diol, especially ethylene glycol and 1 ,4-cyclohexanedimethanol.

Detailed description of the apparatus and apparatus variants of figures 1-12

With reference to the enclosed figures, reference number 1 shows an apparatus for packaging a product P arranged on a support 2. As it is visible in the figures each support 2 is in this case a pre-formed support of discrete size physically separate from the other supports. The apparatus 1 is designed for packaging products, for instance perishable products, forming vacuum skin packages wherein a plastic film is heat sealed to an underlying support forming a skin above and around the product and on the support. The apparatus 1 comprises a conveyor 3: as shown in the attached figures, the conveyor is an endless conveyor belt positioned on an apparatus framework 4 according to a closed loop configuration. The conveyor 3 is for example driven by at least one driving roller 6 connected to a driving motor 6a, for instance a stepper electric motor, controlled by a control unit 8. According to one aspect, the conveyor 3 is designed to allow passage of gas through the thickness of the conveyor between a superior side 5a and an inferior side 5b of an operative tract 5 of the conveyor 3: in practice the conveyor has a body onto which the supports are laying and may either present one or more gas permeable portions, or the conveyor may have the entire conveyor body made in gas permeable material or the conveyor may have a plurality of discrete through apertures or holes 7 through the conveyor body (as in the examples of the attached figures 1-12). As mentioned, the conveyor 3 has an operative tract 5 configured for receiving a plurality of distinct supports 2 positioned at a distance D (please refer to figure 5) the one from the other. In particular, the apparatus includes a support loading station 9 configured for allowing loading of the one or more supports 2 on the operative tract 5 of the conveyor 3; each one of said supports 2 is provided with respective one or more through holes 2b which will be used for gas evacuation as further explained herein below.

The support loading station 9 is connected to the control unit 8 of the apparatus to control deposition of the one or

more supports on the conveyor operative tract 5: in practice the control unit is configured for commanding the support loading station to position the one or more supports on the operative tract such that each support is located at a pre-determined distance from an adjacent support 2 and each through hole of each support 2 is thereby positioned at a known location relative to the conveyor operative tract. As shown in figures 1-12 the support loading station 9 is configured for storing a plurality of said one or more supports 2 and for sequentially supplying, under the control of control unit 8, one or more supports 2 to the conveyor 3 operative tract 5.

In accordance with a further aspect, as schematically shown in figures 10 and 11, the apparatus 1 may include means 15 for positioning the supports 2 on the operative tract 5 according to a predetermined distribution pattern: in practice the means for positioning 15 may aid in properly positioning the discrete supports on the conveyor operative tract 5 so that it is guaranteed that each support be located at said pre-determined distance D from an adjacent support, and that when the conveyor is driven in motion the apparatus is capable to precisely position the supports in the packaging assembly and align the supports with the film portions to be fixed to each respective of said supports. The means 15 for positioning the support on the operative tract 5 may be of different types. For example, in a first alternative shown in figure 10, said means 15 may comprise seats 16 defined on the superior side 5a of the operative tract 5, i.e., on the exterior side of the conveyor: each one of the seats 16 is located at said pre-defined distance D from an adjacent seat and is shaped to receive and keep a respective support in a position fixed relative to the conveyor; in the example of figure 10 each one of the seats is an indent of constant depth practiced on superior side 5b having size and shape matching that of the support 2. The seats are positioned and shaped such that when the support is placed in the respective seat the conveyor through apertures 7 or the conveyor gas permeable portion is not occluded: for example, in case the support 2 has through holes 2b, as shown in the figures, then the seats and the supports would be configured to receive the respective supports in the seats with the through holes 2b in the supports placed in alignment with the conveyor apertures and/or the conveyor permeable portion. In a second alternative shown in figure 11 (which may also be combined with the first) the means for positioning 15 may include a position sensor 17 connected to the control unit 8 and configured for detecting the position of said one or more supports on the operative tract 5. In this second alternative the means for positioning 15 also include a positioner 18 connected to the control unit 8 and controlled by this latter: the control unit 8 may, in fact, be configured to receive from said position sensor 17 a signal related to a detected position of a support 2 on the operative tract 5 (for example the position sensor may detect the front edge of a support, or a mark on a support or one or more holes of the support), compare said signal with a reference indicative of a proper position of the support on the operative tract, and issue a control signal for the positioner 18 commanding the positioner to reposition the support if said comparison indicates that the detected position does not match the proper position of the support. The reference position may be know, or it may be detected by the position sensor 17 or by another appropriate auxiliary sensor 17a connected to control unit 8: for instance the position sensor or the auxiliary sensor may be used to detect the position of a fixed reference present on the conveyor; this fixed reference may be a marking or an indent or a protrusion or one of the through holes in the conveyor body; alternatively the position sensor or the auxiliary sensor may include an encoder associated with the motor of the conveyor and thus able to provide the control unit with an information related to the instantaneous conveyor position: then the control unit may be configured to correct the actual position of the support based on the knowledge of the reference position of the

fixed reference (as detected by the same position sensor or by the auxiliary sensor) and based on the knowledge of the detected position of the support relative to the operative tract. The proper position of the support is such that the through apertures 7 or the permeable portion of the conveyor are not occluded by the supports: for example, in case the support 2 has through holes 2b, as shown in the figures, then in correspondence of said proper position the support has its holes placed in alignment with the conveyor apertures and/or the conveyor permeable portion. In a possible embodiment of the second alternative of the means for positioning the support on the conveyor, the positioner may be constituted by a stopper configured to be moved relative to the conveyor between a first position – where the stopper is spaced apart from the operative tract – and a second position – where the stopper is in contact with or close to the superior side of the operative tract such as to stop the front edge of the support which is therefore unable to move with the conveyor and is instead compelled to slide on the conveyor superior side; the control unit 8 may be configured to move the stopper away from the second position and thus release the support when the holes present in the support are in the right position relative to the conveyor. Position of the holes on each support may be detected by the position sensor while the position of the conveyor may be detected by an encoder monitoring conveyor position, with no other sensor needed.

The positioner 18 may include an active organ 19, such as an arm or a bar, active on the supports under the action of a positioning actuator 20: the positioning actuator 20 may include a first positioning actuator 20a mounted on the frame 4 and configured for displacing up and down (arrow UD in figure 11) the active organ 19 and a second positioning actuator 20b mounted on the frame or on the first actuator and configured displacing back and forth (arrow BF in figure 11) in the machine direction MD the active organ in order to move the supports relative the surface of the operative tract 5. The positioning actuator 20 is controlled by the control unit 8 for positioning the supports in a proper position according to the predefined pattern (as explained above using the position sensor detections) onto the surface defined on the superior side of the conveyor operative tract 5. In case the positioner takes the form of a stopper, it may just include the active organ and the first positioning actuator for moving the active organ up and down. Under a constructional point of view the position sensor may be an optical sensor or an electromagnetic sensor, or an acoustic sensor or an electromechanical sensor or any other type of sensor capable of detecting position of a support or of a reference on a support positioned on the moving conveyor belt. The auxiliary sensor may be an optical sensor or an electromagnetic sensor, or an acoustic sensor or an electromechanical sensor or any other type of sensor capable of detecting the position of the conveyor or of a reference of the conveyor. The positioning actuator 20 may be formed by one or more pneumatic, hydraulic, electric or other type of actuators.

Going back now to the overall architecture of the apparatus 1 of figures 1-12, the conveyor 3 is configured for displacing the supports 2 along a predetermined path - which in the examples of the attached figures is a rectilinear path – in order to sequentially move the supports 2 from a support loading station 9, through a product loading station 10, then through a packaging assembly 11 and finally to a discharge station 12.

As already mentioned, the support loading station 9 is configured for allowing loading of the one or more supports on the operative tract 5: for example the product loading station may include an automatic stock of supports controlled by control unit 8 to timely deliver one of more supports on the conveyor operative tract. Downstream the support loading

station 9 (with reference to the machine direction MD of movement of the operative tract 5 of the conveyor, as represented by arrow MD in figure 1), the apparatus presents the product loading station 10, which is in particular located between the support loading station 9 and packaging assembly 11 and which is configured for allowing positioning of one or more products onto respective one or more supports: the product loading station 10 may comprise an automatic dispenser of the products P controlled by control unit 8. The packaging assembly 11 is located downstream the product loading station and receives the support or supports to be packaged with the respective products thereon. Then, downstream the packaging assembly 11 the apparatus presents the discharge station 12 which is configured for allowing unloading of packaged products from the apparatus: the discharge station 12 may simply include an end of the operative tract 5 allowing to pick the packaged product by a user or it may include an automatic picker controlled by control unit 8 or it may include a collecting container or collecting area 12a for receiving the packaged products. As shown in the attached figures 1-12 of the first apparatus, the conveyor operative tract 5 may extend all the way through the support loading station 9, the product loading station 10, the packaging assembly 11 and the discharge station 12, such that by simply controlling movement of one single organ, namely the conveyor, the apparatus 1 may displace the supports through the entire operative path and stations, and thus through the whole process implemented by the apparatus.

It is also noted that the apparatus 1 includes a film supply assembly 13: the film supply assembly 13 may include a roller 14 configured for supplying a plastic film: depending upon the embodiments, the film supply assembly 13 may supply a continuous plastic film 15 directly to the packaging assembly 11 (see figure 7) or it may supply a continuous plastic film 15 to a cutting assembly 21 located outside the packaging assembly 11 and configured to cut the continuous film 15 into film portions 22 constituted by separate discrete film sheets. The cutting assembly 21 may be placed between the film supply assembly 13 and the packaging assembly 11, such that the cutting takes place before the film sheets reach the packaging assembly 11 (see figure 8), as it will be further described herein below.

Going now into a more detailed description of the packaging assembly 11, this latter is configured for tightly fixing a film portion 22 of said plastic film to at least one respective of said supports: the film portion 22 may be a portion of the continuous plastic film 15 (see figure 7) or one of said cut film sheets (see figure 8). The packaging assembly 11 includes a lower tool 23 operative below the inferior side 5b of the operative tract 5 and an upper tool 24 operative above the superior side 5a of the operative tract 5: the packaging assembly 11 is configured to operate at least in two operating conditions in order to allow access of the support(s) 2 and of the film portion(s) 22 into the packaging assembly 11 and in order to couple the film portion to the respective support carrying the product P and thereby form a packaged product. In greater detail, the packaging assembly 11 may operate between a first operating condition, where the upper tool 24 is spaced from the superior side 5a of said operative tract 5 allowing positioning of one or more of said supports 2 and of said film portion 22 inside the packaging assembly 11, and a second operating condition, where the upper tool 24 is approached towards the operative tract of the conveyor 3 and is configured to sealingly apply the film portion 22 to at least one underlying support 2 present in the packaging assembly 11. In practice, when the upper tool 24 is in the first operating condition, the packaging assembly 11 is open to receive the support or supports (more than one support may be positioned in the packaging assembly) and the respective film portions which need to

be sealingly applied to the support(s), while when the packaging assembly is in the second operative condition a chamber 25 is formed which allows extraction of air from the volume between the film portion and the support such as to form a package, in particular a vacuum skin package, under a predetermined level of vacuum.

At this purpose, the apparatus 1 includes a vacuum arrangement 26 active on the packaging assembly 11 and configured to extract gas from the packaging assembly 11 under the control of said control unit 8: the vacuum arrangement 26 may for instance include a suction line 27 connected to a vacuum pump 28 operated by the control unit 8 and one or more fluid intercept organs 29 (for example a number of valves) for selectively connecting the suction line 27 to the vacuum pump 28 or to a vent line 30.

As it is visible from figures 1-9, the upper tool 24 comprises a central portion 24a and a peripheral portion 24b. The peripheral portion 24b of the upper tool extends peripherally with respect to a central portion 24a of the same upper tool: in the examples shown the peripheral portion extends downwardly from the central portion 24a to provide the upper tool with a dome shape; depending upon the design of the upper tool 24, the peripheral portion 24b of the upper tool may be fixed to the central portion 24a of the upper tool 24 and define a fixed dome shape with a correspondingly dome shaped active surface or the peripheral portion 24b of the upper tool may be mounted for motion relative to the central portion 24a of the upper tool (see example of figure 9). In this last case, the upper tool 24 defines a variable volume cavity which volume may vary from a maximum volume, when central portion 24a is at a maximum distance from a lower border 24c of the peripheral portion, to a zero volume, when the central portion 24a of the upper tool 24 has lower surface 24a' aligned and flush relative to the lower border 24c of the peripheral portion. The control unit 8 may be configured for commanding the relative motion of the peripheral portion 24b with respect to the central portion 24a in order to define the volume said cavity; alternatively the relative position between peripheral portion and central portion may be adjusted by an operator in a manual manner, e.g., before operating the apparatus and starting a packaging process.

In correspondence of the second operating condition of the packaging assembly, the peripheral portion 24b of the upper tool 24 is configured either to act against the superior side of the portion of operative tract 5 of the conveyor present in the packaging assembly or to act against the top surface 2a of the one or more supports present in the packaging assembly. More in detail, the peripheral portion 24b of the upper tool 24 may present a lower border 24c of annular conformation which may directly abut against the superior side of said portion of operative tract 5 or which may directly abut against the top surface 2a of the support(s) 2; alternatively, the lower border 24c of the peripheral portion 24 may indirectly – i.e., via interposition of said film portion 22 – abut against said superior side of said portion of operative tract or against said top surface 2a of the support 2 (as shown in the examples of the attached figures. In both cases the lower active surface 24c of the peripheral portion 24b of annular shape is capable of forming (directly or indirectly) a gas tight abutment such as to encircle the one or more supports 2 present in the packaging assembly and define chamber 25 housing the product or products P positioned on said one or more supports located in the packaging assembly. In practice, the chamber operates as a vacuum chamber from which gas may be withdrawn via said suction line of the vacuum arrangement.

It should be noted that the upper tool 24 comprises holding means 31 associated to the active surface of the upper tool and configured for attracting the film portion 22 in adhesion of said active surface: the holding means 31 may be one

or more in the group of:

- a vacuum source 32 controlled by the control unit and connected to suction holes 33 located on the active surface of the upper tool 24, with the control unit which may be configured for activating the vacuum source and causing the active surface to receive and hold said film portion; this alternative is shown in the figures wherein the vacuum source includes a suction line 34 leading to the suction holes 33 and connected to a respective suction pump 35 operated by the control unit 8 and one or more fluid intercept organs 36 (for example a number of valves) for selectively connecting the suction line 34 to the suction pump 35 or to a vent line 37;
- mechanical holders associated to the active surface, with the control unit which may be configured for activating the mechanical holders and causing the active surface to receive and hold said film portion,
- adhesive portions associated to the active surface (in general adhesive active portion are passive and not controlled by the control unit),
- heatable portions associated to the active surface, with the control unit which may be configured for causing heating of the active surface and of the film portion located in the packaging assembly to increase stickiness of the film portion to the active surface,
- electric systems associated to the active surface, with the control unit being configured for charging the active surface with a predetermined polarity.

The control unit 8 is configured to act on the vacuum arrangement 26 to extract gas from the packaging assembly in order to form the vacuum skin package(s) and is also active on the holding means (e.g. on the vacuum source 32) in order to release the film portion once the desired level of vacuum has been reached inside the packaging assembly or after a desired time from activation of the vacuum arrangement 26.

Moving now to a more detailed description of the lower tool 23, this latter presents at least respective peripheral portion of its active surface 23a, or the entire active surface 23a, which – in correspondence of said second operating condition of the packaging assembly – is configured to abut against the inferior side of the operative tract 5 below said chamber 25. As shown e.g., in figures 7 and 8, the conveyor is configured such that a number of the conveyor apertures 7 and/or at least a part of the conveyor permeable portion are/is located in correspondence of said chamber 25 when the packaging assembly is in the second operating condition. The lower tool 23 comprises a number of suction apertures 38 located on said active surface 23a of the lower tool facing the inferior side of the conveyor, and the vacuum arrangement 26 described above is connected to the suction apertures 38 to extract gas from said chamber 25, from below the conveyor and through the conveyor thickness, when the packaging assembly is in the second operating condition. In practice, when the packaging assembly has formed the chamber 25, the vacuum arrangement withdraws air from the lower tool through the apertures or the permeable portion of the conveyor.

In the embodiments shown, the lower tool comprises a fixed support structure, optionally in the shape of a fixed plate body, having active surface 23a in sliding contact with the inferior side 5b of the operative tract 5: in practice the lower tool may be a simple plate with appropriately distributed suction apertures 38 and with a top active surface 23a matching the shape of the inferior side of the conveyor. When the conveyor is stopped, the active surface of the

conveyor is preferably in a gas tight contact with the surface of the inferior side of the lower tool in order to allow an efficient suction of gas from the packaging assembly by the vacuum arrangement 26.

In practice and as shown in figure 12 – in correspondence of said second operating condition of the packaging assembly – the upper tool 24 is configured to bring at least a peripheral band 22a of said film portion 22 in sealing abutment against one of:

- a corresponding band defined on the superior side of the operative tract encircling one or more supports,
- a corresponding peripheral band of top surface 2a of said one or more supports,

such as to define said chamber 25 which is basically delimited by the active surface of upper tool 24, by the top surface 2a of the support 2 and optionally also by the superior side of the operative tract 5 present in the packaging assembly.

As shown in figure 12, in accordance with one example, the upper tool and the lower tool 24, 23 are configured to tightly sandwich between them the peripheral band 22a of the film portion, the peripheral band 2a' of the respective support 2 and the annular band of the conveyor surrounding the products in the packaging assembly and underlying bands 22a and 2a'.

It has been mentioned that the control unit 8 is configured to command the overall operation of the apparatus. In further detail, the control unit 8 is configured for controlling the packaging assembly 11 and the conveyor 3 to execute the following cycle. At the beginning of the cycle and with the packaging assembly in the first operating condition, the control unit 8 commands the conveyor motor 6 to cause motion of the conveyor 3 for positioning one or more of said supports 2 with a respective product P thereon inside the packaging assembly 11; then, or at the same time with this initial positioning, the film portion 22 (or portions) is/are allowed to position in front of and below the upper tool 24; subsequently, the control unit 8 commands closure of the packaging assembly 11 commanding a main actuator 40 – for example acting on the upper tool – and causing the packaging assembly to move to the second operative condition; it should be noted that – when the film portion(s) 22 is/are received in correspondence of the upper tool 24 – the control unit 8 may be configured for executing a film deformation procedure (taking place before or after having positioned the packaging assembly in the second operating condition) comprising the steps of: controlling the upper tool 24 to position above the film portion 22, with the film portion being in a substantially flat configuration, activating the holding means 32 to hold the film portion and bring the film portion to substantially match the dome shape of the active surface of the upper tool 24: for instance the vacuum source 32 may be controlled to suck the film portion against the respective dome of the upper tool; when the support or supports are properly positioned in the packaging assembly below the upper tool 24, the control unit 8 commands the conveyor motor 6 to stop: with the conveyor 3 stopped and with the packaging assembly 11 in the second operating condition, the control unit commands the upper tool to seal the film portion to the underlying at least one support, and commands the vacuum arrangement 26 to extract - through the conveyor thickness - gas present between the film portion 22 and the underlying support 2 forming a vacuum skin packaged product. When the packaging assembly is in the second operating condition and once (or after) the film portion(s) have been sealed to the respective support, the control unit 8 releases the holding means (for example the vacuum source 32 is controlled so that the suction holes 33 are connected to line 37 and vented to the external atmosphere the suction holes present on the active surface of the upper tool), thereby allowing the film portion to detach from the upper tool, drape down on the product and on the support forming a plastic film skin on the support

and product.

Going in further detail – and referring again to the packaging assembly in the second operating condition – the control unit is configured to command the vacuum arrangement 26 to cause air extraction from the chamber 25 via the apertures and/or permeable portion 7 of the conveyor and/or via the holes 2b present in the support (see for example figures 5 and 8). When gas (air) is extracted via the holes in each support and via the apertures or permeable portions in the conveyor, then the apparatus makes sure that the holes in each support are aligned with apertures/permeable portions in the conveyor at least during gas extraction.

In accordance with further aspects, and as briefly mentioned herein above referring to figure 8, the film supply assembly may be configured for supplying continuous film 15 to a film cutting assembly 21 active on the continuous film and configured for cutting the film portions 22 in form of film sheets of prefixed length obtained from said continuous film. The film cutting assembly 21 of the example of figure 8 is located outside the packaging assembly 11 and at least one transfer device 41 is configured for positioning the cut film sheets 22 inside the packaging assembly 11 and above the respective support. In one example the transfer device 41 includes a backing structure 42 having a flat holding surface 42a adapted for receiving the at least one or more film sheets cut by the cutting assembly, and one of the following mechanisms:

- a mechanism (not shown) active on the packaging assembly and configured for displacing the upper tool between a first position, where the upper tool is positioned in correspondence of the backing structure and configured to pick up from the backing structure the one or more cut film sheets, and at least a second position, where the upper tool is aligned to the lower tool and configured to position at least one film sheet above said support, and
- a mechanism 43 active on the backing structure and configured for relative movement of the backing structure with respect to the packaging assembly between a first position, where the baking structure is positioned at the cutting assembly and at least a second position, where the backing structure is positioned inside said packaging assembly and configured to place at least one film sheet above said support.

In the enclosed figure 8, the transfer device 41 includes the backing structure 42 and the mechanism 43 active on the backing structure: in particular the mechanism includes a transfer actuator active on the backing structure and configured for pushing and pulling the backing structure along a path suitable for achieving the displacement between said first and second positions. In accordance with further aspects, the control unit may then be configured for:

- activating the film cutting assembly 21 for cutting, outside the packaging assembly, the continuous film into the cut film sheet(s);
- activating the transfer device 41 for positioning the cut film sheet(s) inside the packaging assembly and above the respective support;
- synchronizing activation of the transfer device 41 with passage of the packaging assembly 11 from the second to the first operating condition, leaving the packaging assembly in the first operating condition a time sufficient for the backing structure of transfer device to:
    - position inside the packaging assembly and above the respective support the cut film sheet(s) which have/has been cut outside the packaging assembly, and then

- exit from the packaging assembly.

The control unit 8 may also be configured to synchronize activation of the motion of the conveyor 3 with activation of the transfer device 41 and with passage of the packaging assembly 11 from the second to the first operating condition, such that the conveyor and the backing structure move when the packaging assembly is open to respectively position in the packaging assembly both the support(s) and the film portion or film sheet. In practice, the control unit 8 is configured to conferring an overall step-by-step motion to the conveyor 3 by causing motion of the conveyor 3 when the packaging assembly 11 is in the second operating condition and by causing the conveyor to stop when the packaging assembly 11 is in the first operating condition; correspondingly the transfer device 41 causes the backing structure to move back and forth in synchrony with the conditions of the packaging assembly to position the film portions (cut film sheets) inside the packaging assembly and to then exit from the packaging assembly, when this latter is open in the first operating condition.

Detailed description of the process using the apparatus and apparatus variants of figures 1-12

Aspect of the invention concern a process of packaging a product (P) arranged on a support. The process described below uses the apparatus or the apparatus variants disclosed above and/or in the attached figures 1-12 or the apparatus according to preceding aspects from the 1st to the 42nd.

The packaging process comprises positioning a plurality of distinct supports at a distance the one from the other on the operative tract of the conveyor and placing at least one product to be packaged on each respective support: the positioning of the supports may be done automatically under the control of control unit 8 action on the support loading station 9, while the products may be loaded by product loading station 10. At the same time the process contemplates supplying a plastic film from the film supply assembly 13 such that one or more film portions 22 reach the packaging assembly 11 while the packaging assembly is maintained open in the first operating condition. With the packaging assembly in the first operating condition, the process provides for displacing the supports positioned on the operative tract along a predetermined path and into the packaging assembly and receiving and holding one or more film portions of said plastic film above the respective support located in the packaging assembly. Then, once the at least one support and respective film portion have been properly positioned in the packaging assembly, the packaging assembly is brought from said first operating condition to said second operating condition in order to basically close the packaging assembly from uncontrolled inlet or outlet of gas to and from the chamber formed inside the packaging assembly itself; then, with the packaging assembly in the second operating condition, the process provides for tightly sealing the film portion or portions 22 of said plastic film to the at least one respective support 2, and for extracting gas present between the film portion and the underlying support forming a vacuum skin packaged product. While extracting gas from the volume between the film portion and the underlying support, or immediately after gas extraction has begun, the process also contemplates to release the film portion or portions from the upper tool (by e.g., acting on the vacuum source 32 and venting the apertures 33 as described above) such that the film portion or portions may be released by the upper tool and adhere to the support upper surface and to the exposed surface of the product above the support; according to one aspect, during gas extraction, at least part of said gas passes through the thickness of the conveyor and is then evacuated out of chamber 25 by the vacuum arrangement 26.

As it is shown in the attached figures, the supports used in the practical implementation are flat, optionally plastic or paperboard, supports each provided with respective one or more through holes 2b. For example the through holes 2b may be positioned in correspondence of a peripheral band of each support such that when the product is loaded at the center of the support top surface 2a none of the through holes gets occluded. More in general, the product is placed on each respective support leaving the one or more through holes open for passage of gas so that - while extracting gas present between the film portion and the underlying support - part of said gas passes through the one or more through holes present in the support and through the thickness of the conveyor.

As discussed in connection with the description of the apparatus 1, the supports are positioned on the operative tract for example by controlling the deposition timing and placing each support at a pre-determined distance from an adjacent support. Furthermore the positioning may be aided by locating each support in a corresponding one of seats defined on the superior side of the operative tract. Alternatively or in combination with the above positioning technique the process may provide for detecting the position of the one or more supports 2 on the operative tract 5, comparing said detected position with a proper position of the support, and reposition the support if said comparison indicates that the detected position does not match the proper position of the support. As discussed above, the repositioning may take place simply stopping the support until it takes the desired position relative to the operative tract of the conveyor. In the examples of the figures, when the supports are properly positioned relative to the operative tract, then the through holes in the support are aligned with the apertures or with the permeable portion of the conveyor. If a stopper is used to stop the support and release the support in the right moment when the conveyor has its holes in correspondence to the holes of the support, then there is no need to detect the position of the support, but it is possible to detect the alignment of the conveyor holes with the support holes using a single sensor.

It is noted that, when the packaging assembly 11 is in correspondence of said second operating condition, the packaging assembly defines the chamber 25 which is configured and positioned for housing the product or products P positioned on the one or more supports located in the same packaging assembly. In particular, the upper tool peripheral portion may directly abut (in a gas tight manner) against either one of the superior side of the operative tract encircling one or more supports, or a top surface of a peripheral band of said one or more supports thereby forming the chamber 25. Alternatively, the upper tool peripheral portion indirectly abuts either against the superior side of the operative tract encircling one or more supports, or against a top surface of a peripheral band of said one or more supports: by 'indirectly' it is meant that the peripheral portion abuts against said superior side or said top surface in a gas tight manner – via interposition of said film portion – as shown for example in figure 12.

When the packaging assembly is in the second operating condition also the lower tool presents at least a respective peripheral portion abutting against the inferior side of the operative tract below said chamber: in the examples shown the lower tool has an entire active surface (lower tool top surface) constantly in contact with the inferior side of the conveyor.

In practice, the upper and lower tools are coupled to the conveyor so as to create said chamber 25 above the conveyor operative tract 5 and so as to tightly evacuate air from the lower tool when the packaging assembly is in the second operating condition: in order to make this possible, a number of the conveyor apertures and/or at least a part of the conveyor permeable portion are/is located in correspondence of said chamber and gas is permitted to pass through

the conveyor apertures and/or through at least a part of the conveyor permeable portion during gas evacuation with vacuum arrangement 26. At this purpose, as mentioned above, the conveyor apertures and/or the conveyor permeable portion are aligned with the holes of the support while extracting gas present between the film portion and the underlying support, so that said gas passes through the one or more through holes present in the support and through conveyor apertures and/or the conveyor permeable portion.

Detailing now the way the film may be supplied to the packaging assembly 11, it is noted that the process may provide for supplying the plastic film to the packaging assembly as a continuous plastic film coming from the film supply assembly; alternatively the continuous film may be cut at film cutting assembly 21 forming a film sheet or a plurality of film sheets each of a prefixed size. Each film sheet defines a respective film portion 22: then the cut film sheet(s) is/are transferred inside the packaging assembly and above the respective support. Each film sheet is hold by the upper tool and is tightly applied to the underlying support. In this case of film sheets cut outside the packaging assembly, the cut film sheets are shaped and sized as the top surface of the respective supports: a peripheral band of each cut film sheet is tightly sealed to a corresponding peripheral band of the underlying support leaving zero or minimal film material protruding radially outside a peripheral edge of the support.

It is noted that the transfer of the film sheet(s) from the cutting assembly to the packaging assembly comprises:

- receiving the cut film sheet on the flat holding surface of backing structure, and
- moving the backing structure with respect to the packaging assembly from its first position, where the baking structure is positioned at the cutting assembly, to its second position, where the backing structure is positioned inside said packaging assembly placing the at least one film sheet above said support.

As discussed in connection with the apparatus 1, the packaging assembly is kept in its first operating condition a time sufficient for the backing structure of transfer device to position inside the packaging assembly and above the respective support the cut film sheet(s) which have/has been cut outside the packaging assembly, and then exit from the packaging assembly.

Alternatively the transfer of the cut film sheets may done as described in WO2011012652A1 where the upper tool is moved between a position where it is aligned with the lower tool and forms the packaging assembly and a pick-up position where the upper tool is not over the lower tool and is able to pick the cut film sheet or sheets from the cutting assembly and transfer them above the lower tool.

The step of tightly sealing the film portion of said plastic film to the at least one respective of said supports comprises heating the film portion and heat sealing at least a peripheral band of the film portion to a corresponding peripheral band of the top surface of the support. In practice, the film portion or film sheet 22 may be uniformly heated or at least heated in correspondence of a periphery thereof. This operation may take place using heating means 45 associated to the upper tool. The heating means may be electric heating means (for instance associated inside the material forming the upper tool) or ultrasonic or microwave based heaters comprising emitters carried by the upper tool or heating pipes with heating fluid contacting the upper tool.

In the examples shown in the drawings, during heat sealing, the peripheral band 22a of the film portion held by the upper tool 24 is brought in abutment against the corresponding peripheral band 2a' of top surface 2a of said one or more supports: in practice the upper tool 24 and the lower tool 23 tightly sandwich between them the peripheral band

22a of the film portion 22, the peripheral band 2a' of the respective support 2 and a corresponding band of the conveyor 3 surrounding the products in the packaging assembly and underlying bands 2a' and 22a. Once the bonding has been completed, the holding means are released (e.g. the apertures 33 are re-vented) so as to release the film portions from the upper tool so that the film portions may drape down and form a skin on the support and product. Once the vacuum skin package has been formed, the chamber may be opened by positioning the packaging assembly back in the first position, the vacuum skin packaged product(s) may be extracted and leave the packaging assembly by activating again the conveyor in motion, e.g. with the control unit commanding the electric motor to start again. At this point a new packaging cycle may start again along the lines described above.

Detailed description of the apparatus, apparatus variants and packaging processes of figures 13-20

Figures 13-20 show a second packaging apparatus and variants thereof according to aspects of the invention. The apparatus comprises a film supply assembly (not shown), a continuous support supply 201, a conveyor 3, a packaging assembly 11 and a discharge station 12. The film supply assembly in the apparatus of figures 13-20 is not shown for sake of simplicity, but of course a film supply assembly is present and it may be of the type shown in figure 7 or in figure 8 and described above in detail. The packaging assembly 11 of the apparatus of figures 13-20 may be of the same type described above in connection with figures 1-13 and same components are identified with same reference numbers and not described again. As to the conveyor 3, it may either be of the type described above in connection with figures 1-12 or of a different type: in particular in the variant of figures 13 and 14 the conveyor 3 is of the same type as the conveyor 3 of figures 1-12 and same components or parts are identified with same reference numbers, while in the variant of figure 15 the conveyor 3 comprises side chains carrying pincers designed to clamp longitudinal side borders of the continuous support 200. The discharge station 12 of the apparatus of figures 13-20 may be of the same type described above in connection with figures 1-13 and same components are identified with same reference numbers and not described again.

In practice, the conveyor 3 is configured for displacing the continuous support 200 and thus the support portions 2 along a predetermined path - which in the examples of the attached figures is a rectilinear path – in order to sequentially move the support portions 2 from the continuous supply 201 through a product loading station 10, then through the packaging assembly 11 and finally to the discharge station 12. The product loading station 10, which is in particular located in correspondence of the operative tract 5 of the conveyor 3 and upstream packaging assembly 11 is configured for allowing positioning of one or more products onto respective one or more support portions 2': the product loading station 10 may comprise an automatic dispenser of the products P controlled by control unit 8. The packaging assembly 11 is located downstream the product loading station 10 and receives the support portion or portions 2' to be packaged with the respective products thereon. Then, downstream the packaging assembly 11 the apparatus presents the discharge station 12 which is configured for allowing unloading of packaged products from the apparatus: the discharge station 12 may simply include an end of the operative tract 5 allowing to pick the packaged product by a user or it may include an automatic picker controlled by control unit 8 or it may include a collecting container or collecting area 12a for receiving the packaged products. As shown in the attached figures 13-

20 the conveyor operative tract 5 may extend all the way through the product loading station 10, the packaging assembly 11 and the discharge station 12, such that by simply controlling movement of one single organ, namely the conveyor, the apparatus 1 may displace the support portions through the entire operative path and stations, and thus through the whole process implemented by the apparatus.

Compared to the apparatus of figure 1, the apparatus of figures 13-20 uses instead of preformed discrete supports 2 a continuous support 200 supplied by the continuous support supply 201 which is for instance in the form of a supply roll. Consecutive support portions 2' are defined on the continuous support 200: the continuous support portions 201 are driven by the conveyor 3 towards the packaging assembly 11; in the packaging apparatus of figure 13, a hole making device 202 is operative in correspondence of the conveyor 3 and configured to make through holes 2b on the support portions after the continuous support has already contacted the conveyor surface while, in the variant of figure 14, the hole making device 202 is operative upstream the conveyor 3 and configured to make through holes 2b on the support portions before the continuous support has contacted the conveyor surface.

The control unit a control unit 8 controls the packaging assembly 11 and the conveyor 3 and executes the following cycle: with the packaging assembly (11) in the first operating condition, the control unit causes the conveyor (3) to position one or more of support portions (2'), with a respective product (P) thereon, inside the packaging assembly (11). Then the control unit commands the packaging assembly 11 to move to the second operating condition and, with the packaging assembly in the second operating condition, also controls the extraction by the vacuum arrangement 26 of gas present between the at least one film portion 22 and the underlying support portion takes place through the one or more through holes 2b present in the one or more support portions present inside the packaging assembly. The control unit 8 is also connected to the hole making device to control formation of through holes 2b in the continuous support and specifically to form said holes 2b into the continuous support 200 according to a predetermined sequence such that each through hole practiced on the continuous support is positioned at a known location relative to the conveyor operative tract 5. More in detail the control unit coordinates the hole making device, the conveyor and the packaging assembly for bringing each one of said support portions 2' inside the packaging assembly with its one or more through holes 2b in fluid communication with the vacuum arrangement at least when the packaging assembly is in said second operating condition; consequently when commanding the vacuum arrangement 26 to extract gas present between the at least one film portion 22 and the underlying support portion 2' the control unit causes the vacuum arrangement to extract gas via said one or more through holes 2b present in each respective support portion 2'.

In term of sequence of the steps controlled by the control unit, with the packaging assembly 11 in the first operating condition the control unit first causes the conveyor 3 to move in order to position the one or more of support portions 2', with a respective product P thereon, inside the packaging assembly 11, then causes the conveyor 3 to stop, and thereafter with the conveyor 3 stopped causes the packaging assembly 11 to move to the second operating condition and seal the film portion 22 to the underlying at least one support portion 2' in correspondence of a peripheral border

support portion; as in the apparatus of figures 1-12 the packaging assembly 11 includes heating means 45 at least associated to the upper tool 24 and configured to at least heat the at least one film portion 22 received in the packaging assembly 11.

When the conveyor 3 is a conveyor belt then a number of the conveyor apertures 7 and/or at least a part of the conveyor 3 permeable portion are/is located inside the packaging assembly when the packaging assembly 11 is in the second operating condition. In this case the control unit is configured for controlling the hole making device, the conveyor and the packaging assembly for bringing each one of said support portions 2' inside the packaging assembly with its one or more through holes 2b in alignment with at least one respective conveyor aperture 7 and/or conveyor 3 permeable portion and in fluid communication with the vacuum arrangement at least when the packaging assembly is in said second operating condition (see figures 13 and 14). When commanding the vacuum arrangement to extract gas present between the at least one film portion and the underlying support portion gas extraction thereby includes extracting gas via said one or more through holes present in each respective support portion 2' and via said at least one respective conveyor aperture 7 and/or conveyor 3 permeable portion.

In the apparatus of figures 13-20 the upper tool 24 comprises a central portion and a peripheral portion together defining an upper tool 24 active surface located above the superior side of the operative tract 5. The peripheral portion of the upper tool 24 is configured to – directly, or indirectly via interposition of said film portion 22 – abut against a top surface of a peripheral band 2a' of said one or more support portions 2'. In case the conveyor is a conveyor belt, then the peripheral portion of the upper tool 24 may also be configured to – directly, or indirectly via interposition of said film portion 22 – abut against a top surface of a portion of peripheral band of said one support portions 2' and a superior side of the operative tract 5.

To summarize, the packaging assembly 11 in the second operating conditions, and particularly the upper tool, defines a chamber 25 extending above the operative tract 5 and configured for housing the product P or products positioned on the one or more support portions 2'. When the packaging assembly 11 is in the second operating condition, the vacuum arrangement is configured to extract gas from said chamber 25, through the holes of the support portions received in the packaging assembly, optionally through the conveyor thickness via said at least one respective conveyor aperture 7 and/or conveyor 3 permeable portion.

After the step of extracting gas present between the at least one film portion 22 and the underlying support portion 2' and once formed a vacuum skin packaged product on the continuous support 200 and in correspondence of each support portion, the packaging assembly is brought back to the first operating condition and the packaged product or products is or are moved outside the packaging assembly. Then, after the packaged product or products is or are moved outside the packaging assembly, consecutive film portions of packaged products are severed from one another by a cutter 203 which may also be controlled by control unit 8 and which is operative at the end of the operative tract 5 and upstream the discharge station 12.

In the non-limiting variant shown in figure 20, once the film portion 22 is sealed to the respective support portion 2',

each film portion entirely covers the product positioned on the support portion and has a size which matches the size of the top surface of the respective support portion. In this case, the peripheral band 22a of the film portion 22 has a radially external perimeter coincident with that of the underlying support or support portion.

Alternatively, in the variant shown in figure 19, once the film portion is sealed to the respective support or support portion, each film portion entirely covers the product positioned on the support or support portion and has a size smaller than the size of the top surface of the respective support or support portion. In this other case, the peripheral band 22a of the film portion 22 has a radially external perimeter which is placed at a radial distance from the external perimeter of the underlying support or support portion, whereby a part of the upper surface of the support portion is not covered by the film portion.

Control unit

As already indicated the apparatus according to the invention makes use of at least one control unit. This control unit may comprise a digital processor (CPU) with memory (or memories), an analogical type circuit, or a combination of one or more digital processing units with one or more analogical processing circuits. In the present description and in the claims it is indicated that the control unit is "configured" or "programmed" to execute certain steps: this may be achieved in practice by any means which allow configuring or programming the control unit. For instance, in case of a control unit comprising one or more CPUs, one or more programs are stored in an appropriate memory: the program or programs containing instructions which, when executed by the control unit, cause the control unit to execute the steps described and/or claimed in connection with the control unit. Alternatively, if the control unit is of an analogical type, then the circuitry of the control unit is designed to include circuitry configured, in use, to process electric signals such as to execute the control unit steps herein disclosed.

While the invention has been described in connection with what is presently considered to be the most practical and preferred embodiments, it is to be understood that the invention is not to be limited to the disclosed embodiments, but on the contrary, is intended to cover various modifications and equivalent arrangements included within the spirit and the scope of the appended claims.

For instance, the specific nature of the actuators described is exemplificative and alternative types of actuators may be used provided the type of motion imposed to the mobile parts on which said actuators are operating is the same. Although the described embodiments show a single packaging assembly, multiple packaging assemblies may be used in parallel with a plurality of conveyors or with one conveyor wide enough to serve all packaging assemblies. In case of a plurality of packaging assemblies, then a plurality of cutting assemblies and corresponding transfer devices may also be provided.

Furthermore, although the above description and drawings mainly show a case where a single film portion and respective support or support portion per time is brought into the packaging assembly, it may be possible to move a plurality of film portions on respective supports or on respective support portions located in the lower tool.

Additionally, the plastic film may be cut outside the packaging assembly (as described above), or the plastic film may be cut into one or more film sheets inside the packaging assembly (which in this case would be provided with a cutting tool for instance associated to the upper tool), or the plastic film may be cut after formation of the vacuum skin packages downstream the packaging assembly.

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CLAIMS

1. An apparatus for packaging a product (P) arranged on a support, comprising:

- a conveyor (3) having an operative tract (5) configured for displacing along a predetermined path:
  either a plurality of distinct supports (2) positioned at a distance the one from the other, or consecutive support portions (2') of a continuous support (200);
- a film supply assembly (13) configured for supplying a plastic film;
- a packaging assembly (11) operative at said predetermined path and configured for tightly fixing at least one film portion (22) of said plastic film to at least one respective of said supports (2) or of said support portions (2'), wherein the packaging assembly (11) includes:
  - a lower tool (23);
  - an upper tool (24) operative above the lower tool, the packaging assembly (11) being configured to operate at least in:
    - a first operating condition, where the upper tool (24) is spaced from the lower tool (23) allowing positioning of one or more of said supports (2) or support portions (2') and of said film portion (22) inside the packaging assembly (11), and
    - a second operating condition, where the upper tool (24) is approached towards the lower tool (23) and is configured to sealingly apply the at least one film portion (22) to the at least one underlying support (2) or support portion (2') present in the packaging assembly (11);
- a vacuum arrangement (26);
- at least one of:
  - support loading station (9) configured for allowing loading of the one or more supports (2) on the operative tract (5) of the conveyor (3), with each one of said supports (2) being provided with respective one or more through holes (2b);
  - a continuous support supply (201) configured for supplying said continuous support (200) to the conveyor (3) operative tract (5), with a hole making device (202) configured for making one or more through holes (2b) in each one of said consecutive film portions (2') of said continuous support (200);
- a control unit (8) configured for controlling the packaging assembly (11) and the conveyor (3), wherein the control unit (8) is configured to execute the following cycle:
  - with the packaging assembly (11) in the first operating condition, causing the conveyor (3) to position one or more of said supports (2) or support portions (2'), with a respective product (P) thereon, inside the packaging assembly (11),
  - with the packaging assembly (11) in the second operating condition, commanding the vacuum arrangement (26) to extract gas present between the at least one film portion (22) and the underlying support or support portion, forming a vacuum skin packaged product (P).

2. Apparatus according to claim 1, wherein the control unit (8) is configured to control the conveyor (3) to position

said one or more of said supports (2) or said support portions (2') inside the packaging assembly (11) and to control the packaging assembly (11) in the second operating condition, such that the extraction by the vacuum arrangement (26) of gas present between the at least one film portion (22) and the underlying support or support portion takes place at least in part through the one or more through holes present in the one or more supports or support portions present inside the packaging assembly.

3. Apparatus according to any one of the preceding claims, wherein:
when the apparatus comprises the support loading station (9), the control unit is further connected to the support loading station (9) to control deposition of the one or more supports on the conveyor operative tract (5) and wherein the cycle, which the control unit is configured to execute, further includes commanding the support loading station to position the one or more supports on the operative tract such that each support is located at a pre-determined distance from an adjacent support (2) and each through hole of each support (2) is positioned at a known location relative to the conveyor operative tract (5); or
when the apparatus comprises the continuous support supply, the control unit is connected to the hole making device to control formation of through holes in the continuous support, wherein the cycle further includes controlling the hole making device to form said holes into the continuous support according to a predetermined sequence such that each through hole practiced on the continuous support is positioned at a known location relative to the conveyor operative tract (5).

4. Apparatus according to claim 3, wherein the cycle, which the control unit is configured to execute, further comprises:
- controlling the support loading station, the conveyor and the packaging assembly for bringing each one of said supports (2) inside the packaging assembly with its one or more through holes in fluid communication with the vacuum arrangement at least when the packaging assembly is in said second operating condition, wherein commanding the vacuum arrangement (26) to extract gas present between the at least one film portion (22) and the underlying support (2) includes extracting gas via said one or more through holes present in each respective support (2), or
- controlling the hole making device, the conveyor and the packaging assembly for bringing each one of said support portions (2') inside the packaging assembly with its one or more through holes in fluid communication with the vacuum arrangement at least when the packaging assembly is in said second operating condition, wherein commanding the vacuum arrangement (26) to extract gas present between the at least one film portion (22) and the underlying support portion (2') includes extracting gas via said one or more through holes present in each respective support portion (2').

5. Apparatus according to any one of the preceding claims comprising the support loading station (9) which is configured for storing a plurality of said one or more supports (2) and for supplying said one or more supports (2) to the conveyor (3) operative tract (5).

6. Apparatus according to any one of the preceding claims comprising the continuous support supply (201) with

the hole making device (202) being positioned between the continuous support supply (201) and the packaging station (11), optionally in a position where the continuous support has not reached yet the operative tract (5).

7. Apparatus according to any one of the preceding claims, wherein the cycle which the control unit is configured to execute comprises the following:

with the packaging assembly (11) in the first operating condition

- first causing the conveyor (3) to move in order to position the one or more of said supports (2) or support portions (2'), with a respective product (P) thereon, inside the packaging assembly (11),
- then causing the conveyor (3) to stop,

thereafter, with the conveyor (3) stopped, causing the packaging assembly (11) to move to the second operating condition and seal the film portion (22) to the underlying at least one support (2) or support portion (2') at least in correspondence of a peripheral border of the same support or support portion;

wherein the apparatus further comprises heating means (45) at least associated to the upper tool (24) and configured to at least heat the at least one film portion (22) received in the packaging assembly (11).

8. Apparatus according to any one of the preceding claims wherein the conveyor (3) comprises a conveyor belt configured to define a resting surface for receiving the one or more supports or the one or more support portions and at the same time allow passage of gas through a conveyor thickness between a superior side and an inferior side of the operative tract (5) of the conveyor (3);

wherein the conveyor (3) extends through the packaging assembly (11) and comprises:

- a plurality of discrete apertures (7) extending through the entire conveyor thickness and positioned along the conveyor (3), and/or
- at least a permeable portion extensive through the entire conveyor thickness and made from gas permeable material.

9. Apparatus according to claim 8, wherein the lower tool (23) is operative below the inferior side of said operative tract (5) and the upper tool (24) operative above the superior side of the operative tract (5),

wherein the lower tool (23) – in correspondence of said second operating condition of the packaging assembly – is configured to position against the inferior side of the operative tract (5).

10. Apparatus according to claim 8 or 9, wherein the conveyor (3) is configured such that a number of the conveyor apertures (7) and/or at least a part of the conveyor (3) permeable portion are/is located inside the packaging assembly when the packaging assembly (11) is in the second operating condition.

11. Apparatus according to claim 10, wherein the cycle, which the control unit is configured to execute, further comprises:

- controlling the support loading station, the conveyor and the packaging assembly for bringing each one of said

supports (2) inside the packaging assembly with its one or more through holes in alignment with at least one respective conveyor aperture (7) and/or conveyor (3) permeable portion and in fluid communication with the vacuum arrangement at least when the packaging assembly is in said second operating condition, wherein commanding the vacuum arrangement (26) to extract gas present between the at least one film portion (22) and the underlying support (2) includes extracting gas via said one or more through holes present in each respective support (2) and via said at least one respective conveyor aperture (7) and/or conveyor (3) permeable portion; or

- controlling the hole making device, the conveyor and the packaging assembly for bringing each one of said support portions (2') inside the packaging assembly with its one or more through holes in alignment with at least one respective conveyor aperture (7) and/or conveyor (3) permeable portion and in fluid communication with the vacuum arrangement at least when the packaging assembly is in said second operating condition, wherein commanding the vacuum arrangement (26) to extract gas present between the at least one film portion (22) and the underlying support portion (2') includes extracting gas via said one or more through holes present in each respective support portion (2') and via said at least one respective conveyor aperture (7) and/or conveyor (3) permeable portion.

12. Apparatus according to claim 5 and to any one of claims from 8 to 11, further comprising means for positioning (15) the supports (2) on the operative tract (5), wherein the means for positioning (15) comprises one or more of:

- seats (16) defined on a superior side of the operative tract (5), each one of the seats (16) being located at a pre-defined distance from an adjacent seat and being shaped to receive and keep a respective support in a position fixed relative to the conveyor (3),
- a position sensor (17; 17a) connected to the control unit (8) and configured for detecting the position of said one or more supports (2) on the operative tract (5) or of holes (2b) present in said one or more supports (2), and a positioner also connected to the control unit (8), the control unit (8) being configured to receive from said position sensor (17; 17a) a signal related to a detected position of a support on the conveyor (3) or related to a position of said holes (2b) relative to the conveyor (3), compare said signal with a reference indicative of a proper position of the support on the conveyor (3), and issue a control signal for the positioner to reposition the support if said comparison indicates that the detected position does not match the proper position of the support (2).

13. Apparatus according to any one of the preceding claims from 1 to 7, wherein the conveyor comprises parallel driving chains, each driving chain acting on a respective longitudinal side of the apparatus and carrying respective pincers configured to act on a respective lateral band of the supports or support portions to displace the supports or support portions along said predetermined path,

wherein the lower tool (23) is operative below the inferior side of said operative tract (5) and the upper tool (24) operative above the superior side of the operative tract (5),

wherein the lower tool (23) – in correspondence of said second operating condition of the packaging assembly – is configured to position against the inferior side of the operative tract (5).

14. Apparatus according to any one of the preceding claims, wherein:

- the upper tool (24) comprises a central portion and a peripheral portion together defining an upper tool (24) active surface located above the superior side of the operative tract (5), and
- the peripheral portion of the upper tool (24) is configured to – directly, or indirectly via interposition of said film portion (22) – abut against one of:
    - a superior side of the operative tract (5) of the conveyor (3) encircling one or more supports (2),
    - a top surface of a peripheral band of said one or more supports (2),
    - a top surface of a peripheral band of said one or more support portions (2'),
    - a top surface of a portion of peripheral band of said one or more supports or support portions (2') and a superior side of the operative tract (5).

15. Apparatus according to claim 14, wherein the peripheral portion extends peripherally with respect to the central portion of the upper tool (24), optionally to define an upper tool (24) having a dome shape, and wherein the upper tool (24) comprises holding means (31) configured for attracting the film portion (22) in adhesion of the active surface of the upper tool (24),

wherein the control unit (8) is configured for executing a film deformation procedure comprising the steps of:

- controlling the upper tool (24) to position above a film portion (22), with the film portion (22) being in a substantially flat configuration,
- causing the holding means (31) to hold the film portion (22) and bring the film portion (22) to substantially adhere to said active surface.

further wherein:

- the peripheral portion of the upper tool (24) is fixed to the central portion of the upper tool (24) to define a fixed active surface, optionally a dome shaped active surface; or
- the peripheral portion of the upper tool (24) is mounted for relative motion relative to the central portion for defining a variable volume cavity, optionally wherein the control unit (8) is configured for commanding the relative motion of the peripheral portion with respect to the central portion in order to define the volume said cavity.

16. Apparatus according to any one of the preceding claims, wherein the packaging assembly (11) in the second operating conditions, and particularly the upper tool, defines a chamber (25) extending above the operative tract (5) and configured for housing the product (P) or products positioned on the one or more supports (2) or support portions (2').

17. Apparatus according to claim 16 wherein, when the packaging assembly (11) is in the second operating condition, the vacuum arrangement is configured to extract gas from said chamber (25), through the holes of the support or support portions received in the packaging assembly, optionally through the conveyor thickness via said at least one respective conveyor aperture (7) and/or conveyor (3) permeable portion.

18. Apparatus according to claim 16 or 17, wherein:
the lower tool (23) comprises a number of suction apertures (38) located on an active surface of the lower tool (23) facing the inferior side of the conveyor (3), and
the vacuum arrangement (26) is connected to the suction apertures (38) and capable to extract gas from said chamber (25), through the holes of the support or support portions received in the packaging assembly, optionally through the conveyor (3) thickness via said at least one respective conveyor aperture (7) and/or conveyor (3) permeable portion, when the packaging assembly (11) is in the second operating condition.

19. Apparatus according to claim 17 or 18 further wherein, with the packaging assembly (11) in the second operating condition, the control unit (8) is configured to command the vacuum arrangement (26) to cause air extraction from the chamber (25) via the holes (2b) present in the support or support portions received in the packaging assembly, optionally via the apertures and/or permeable portion of the conveyor (3).

20. Apparatus according to any one of the preceding claims, wherein the lower tool (23) comprises a fixed support structure, optionally in the shape of a fixed plate body, having active surface in sliding contact with the inferior side of the operative tract (5) of the conveyor (3).

21. Apparatus according to any one of the preceding claims, wherein the upper tool (24) – in correspondence of said second operating condition of the packaging assembly (11) – is configured to bring a peripheral band of each one of said one or more film portions (22) in sealing abutment against a respective one of:
- a corresponding band defined on the superior side of the operative tract (5) encircling one or more supports (2),
- a corresponding peripheral band of a top surface of said one or more supports (2) encircling the one or more through holes present in each support,
- a corresponding peripheral band of a top surface of said one or more support portions (2') encircling the one or more through holes present in each support portion;
and wherein when the packaging assembly (11) is in the second operating condition, the upper tool (24) and the lower tool (23) are configured to tightly sandwich between them the peripheral band of the film portion (22), the peripheral band of the respective support or support portion and, optionally, a band portion of the conveyor (3) underlying said peripheral band of the support or support portion.

22. Apparatus according to any one of the preceding claims comprising:
- a product loading station (10) located between the support loading station (9) and the packaging assembly (11) or between the continuous support supply (201) and the packaging assembly (11), the product loading station being configured for allowing positioning of one or more products onto the one or more supports (2) or onto the one or more support portions (2'),

- a discharge station (12) allowing unloading of packaged products from the apparatus.

further wherein the conveyor (3) operative tract (5) extends all the way through the support loading station (9) if present, the product loading station (10), the packaging assembly (11) and the discharge station (12).

23. Apparatus according to any one of the preceding claims wherein the film supply assembly (13) is configured for supplying a continuous film and wherein the apparatus includes:

- a film cutting assembly (21) active on the continuous film and configured for cutting film sheets of prefixed length from said continuous film, the film cutting assembly (21) being located outside said packaging assembly (11);
- at least one transfer device (41) configured for positioning the cut film sheets inside the packaging assembly (11) and above the respective support (2) or support portion (2'),

  wherein the transfer device (41) includes:
  - a backing structure having a holding surface, optionally a flat holding surface, adapted for receiving the at least one or more film sheets cut by the cutting assembly (21), and
  - one of the following mechanisms:
    - a mechanism active on the packaging assembly (11) and configured for displacing the upper tool (24) between a first position, where the upper tool (24) is positioned in correspondence of the backing structure and configured to pick up from the backing structure (42) the one or more cut film sheets, and at least a second position, where the upper tool (24) is aligned to the lower tool (23) and configured to position at least one film sheet above said support (2) or support portion (2'), or
    - a mechanism active on the backing structure (42) and configured for relative movement of the backing structure (42) with respect to the packaging assembly (11) between a first position, where the baking structure is positioned at the cutting assembly (21) and at least a second position, where the backing structure (42) is positioned inside said packaging assembly (11) and configured to place at least one film sheet above said support or support portion (2').

24. A process of packaging a product (P) arranged on a support (2), comprising the following steps:

- displacing along a predetermined path and towards a packaging assembly (11):

  either a plurality of distinct supports (2) located at a distance the one from the other, wherein each of the one or more supports (2) has a base wall provided with respective one or more through holes (2b);

  or consecutive support portions (2') of a continuous support (200) each one of said consecutive film portions (2') presenting a base wall provided with one or more through holes;

  wherein the packaging assembly (11) is configured for tightly fixing at least one film portion (22) of said plastic film to at least one respective of said supports (2) or of said support portions (2') and includes a

lower tool (23) and an upper tool (24), operative above the lower tool, the packaging assembly (11) being configured to operate at least in a first operating condition, where the upper tool (24) is spaced from the lower tool (23) allowing positioning of one or more of said supports (2) or support portions (2') and of said film portion (22) inside the packaging assembly (11), and a second operating condition, where the upper tool (24) is approached towards the lower tool (23) and is configured to sealingly apply the at least one film portion (22) to the at least one underlying support (2) or support portion (2') present in the packaging assembly (11);

- placing at least one product to be packaged on each respective support (2) or on each respective support portion (2');
- supplying a plastic film from a film supply assembly (13) to the packaging assembly (11);
- with the packaging assembly (11) in the first operating condition,
  - moving at least one of the supports (2) or at least one of support portions (2') into the packaging assembly (11);
  - receiving and holding at least one film portion (22) of said plastic film above said at least one respective support or said at least one support portion located in the packaging assembly (11);
- bringing the packaging assembly (11) from said first operating condition to said second operating condition and tightly sealing the at least one film portion (22) of said plastic film to the at least one respective of said supports (2) or support portions (2');
- extracting gas present between the at least one film portion (22) and the underlying support (2) or support portion (2') forming a vacuum skin packaged product, during gas extraction at least part of said extracted gas passing through the one or more through holes of the same support or support portion located in the packaging assembly.

25. The process of claim 24, wherein a support loading station (9) loads the one or more supports (2) on an operative tract (5) of a conveyor (3), which displaces the supports (2) along the predetermined path and towards the packaging assembly.

26. The process of claim 24, wherein a continuous support supply (201) supplies said continuous support (200) to a conveyor (3) operative tract (5) and a hole making device (202) makes the one or more through holes (2b) in each one of said consecutive film portions (2') of said continuous support (200).

27. The process according to claim 25 or 26, wherein the conveyor (3) positions said one or more of said supports (2) or said support portions (2'), with a respective product (P) thereon, inside the packaging assembly (11),
and wherein, with the packaging assembly (11) in the second operating condition, the extraction of by the vacuum arrangement (26) of gas present between the at least one film portion (22) and the underlying support or support portion takes place through the one or more through holes of the one or more supports or support portions present inside the packaging assembly.

28. The process according to claim 25 in combination with any one of the preceding claims 24, 26 and 27, wherein the support loading station positions the one or more supports (2) on the operative tract (5) such that each support is located at a pre-determined distance from an adjacent support (2) and each through hole of each support (2) is positioned at a known location relative to the conveyor operative tract (5).

29. The process according to claim 26 in combination with any one of the preceding claims 24, 26 and 27, wherein the hole making device forms through holes in the continuous support according to a predetermined sequence such that each through hole practiced on the continuous support is positioned at a known location relative to the conveyor operative tract (5).

30. The process according to any one of the preceding claims from 24 to 29, wherein with bringing of the packaging assembly (11) to the second operating condition the film portion (22) is sealed, optionally heat-sealed, in correspondence of a peripheral border of the support (2) encircling the one or more through holes present in the same support or in correspondence of a peripheral border of the support portion (2') encircling the one or more through holes present in the same support portion (2').

31. The process according to any one of the preceding claims from 24 to 30, wherein a step of releasing the film portion (22) from the upper tool (24) takes place either during or after the step of extracting the gas, the film portion (22) draping down and adhering to an exposed surface e of the product (P) and to an upper surface of the support not occupied by the product (P),
further wherein the process comprises a step of venting suction apertures (38) in the lower tool (23) before or after starting to move the packaging assembly (11) back to the first operating condition.

32. The process according to any one of the preceding process claims or the apparatus according to any one of the preceding apparatus claims, wherein the supports (2) or the support portions (2') are flat, optionally plastic or paperboard supports (2) or support portions (2'), and wherein the supports (2) or support portions (2') are each provided with respective one or more through holes (2b) across the thickness of the base wall thereof and wherein the product (P) is placed on each respective support leaving the one or more through holes (2b) at least partially open for passage of gas such that, while extracting gas present between the film portion (22) and the underlying support (2) or support portion (2'), at least part of said gas passes through the one or more through holes (2b) present in the support (2) or support portion and, optionally, and through the thickness of the conveyor (3).

33. The process according to any one of claims from 24 to 32, wherein displacing the supports includes positioning the supports (2) on the operative tract (5) of the conveyor and comprises:

- positioning each support (2) at a pre-determined distance from an adjacent support (2) by placing each support (2) in a corresponding one of seats (16) defined on the superior side of the operative tract (5), and/or

- detecting the position of said one or more supports (2) on the operative tract (5), comparing said detected position with a proper position of the support, and reposition the support if said comparison indicates that the detected position does not match the proper position of the support.

34. The process according to any one of claims from 24 to 33 wherein, in correspondence of said second operating condition of the packaging assembly (11), this latter defines a chamber (25) housing the product (P) or products (P) positioned on the one or more supports (2) or support portions (2') located in the same packaging assembly (11), wherein:
either the upper tool (24) has a peripheral portion which directly abuts in a gas tight manner against one of:

- a superior side of the operative tract (5) of the conveyor (3) encircling one or more supports (2),
- a top surface of a peripheral band of said one or more supports (2),
- a top surface of a peripheral band of said one or more support portions (2'),
- a top surface of a portion of peripheral band of said one or more supports or support portions (2') and a superior side of the operative tract (5);

or the upper tool (24) has a peripheral portion which indirectly abuts in a gas tight manner – via interposition of said film portion (22) – against one of:

- a superior side of the operative tract (5) of the conveyor (3) encircling one or more supports (2),
- a top surface of a peripheral band of said one or more supports (2),
- a top surface of a peripheral band of said one or more support portions (2'),
- a top surface of a portion of peripheral band of said one or more supports or support portions (2') and a superior side of the operative tract (5).

35. The process according to the preceding claim, wherein in correspondence of said second operating condition of the packaging assembly (11), the lower tool (23) positions against the inferior side of the operative tract (5) below said chamber (25); wherein when the packaging assembly (11) is in the second operating condition, a number of the conveyor apertures (7) and/or at least a part of the conveyor permeable portion are/is located in correspondence of said chamber (25) and gas is permitted to pass through the conveyor apertures (7) and/or through at least a part of the conveyor (3) permeable portion; and wherein extracting gas comprises extracting gas from said chamber (25) via the apertures (7) and/or permeable portion of the conveyor and via the one or more holes (2b) present in the support (2) or support portion (2') present in the packaging assembly.

36. The process according to any one of claims from 24 to 35, comprising aligning conveyor apertures (7) and/or conveyor (3) permeable portion with holes (2b) present in the support wherein - while extracting gas present between the film portion (22) and the underlying support - part of said gas passes through the one or more through holes (2b) present in the support and through conveyor (3) apertures (7) and/or the conveyor (3) permeable portion.

37. The process according to any one of claims from 24 to 35, wherein tightly sealing the film portion (22) of said

plastic film to the least one respective of said supports (2) or to at least one respective of said support portions (2') comprises heating the film portion (22) and heat sealing at least a peripheral band of the film portion (22) to a corresponding peripheral band of the top surface of the support or support portion present in the packaging assembly.

38. The process of claim 36, wherein, during heat sealing, the peripheral band of said film portion (22) is brought in abutment against the corresponding peripheral band of top surface of said one or more supports (2) or of said one or more support portions (2'), the upper tool (24) and the lower tool (23) tightly sandwiching between them the peripheral band of the film portion (22), the peripheral band of the respective support or support portion and optionally a corresponding band of the conveyor (3) surrounding the products (P) in the packaging assembly (11).

39. The process according to any one of claims from 24 to 38, wherein the process uses the apparatus of any one of claims from 1 to 23.

40. The process of the preceding claim wherein, after the step of extracting gas present between the at least one film portion (22) and the underlying support (2) or support portion (2') and forming a vacuum skin packaged product, the packaging assembly is brought back to the first operating condition and the packaged product or products is or are moved outside the packaging assembly.

41. The process of claims 26 and 40, wherein after the packaged product or products is or are moved outside the packaging assembly, consecutive film portions of packaged products are severed from one another.

42. The process of any one of claims 24 to 41 wherein, once the film portion is sealed to the respective support or support portion, each film portion entirely covers the product positioned on the support or support portion and has a size which matches the size of the top surface of the respective support or support portion, the peripheral band of the film portion having a radially external perimeter coincident with that of the underlying support or support portion.

43. The process of any one of claims 24 to 41 wherein, once the film portion is sealed to the respective support or support portion, each film portion entirely covers the product positioned on the support or support portion and has a size smaller than the size of the top surface of the respective support or support portion, the peripheral band of the film portion having a radially external perimeter which is placed at a radial distance from the external perimeter of the underlying support or support portion, whereby a part of the upper surface of the support or support portion is not covered by the film portion.

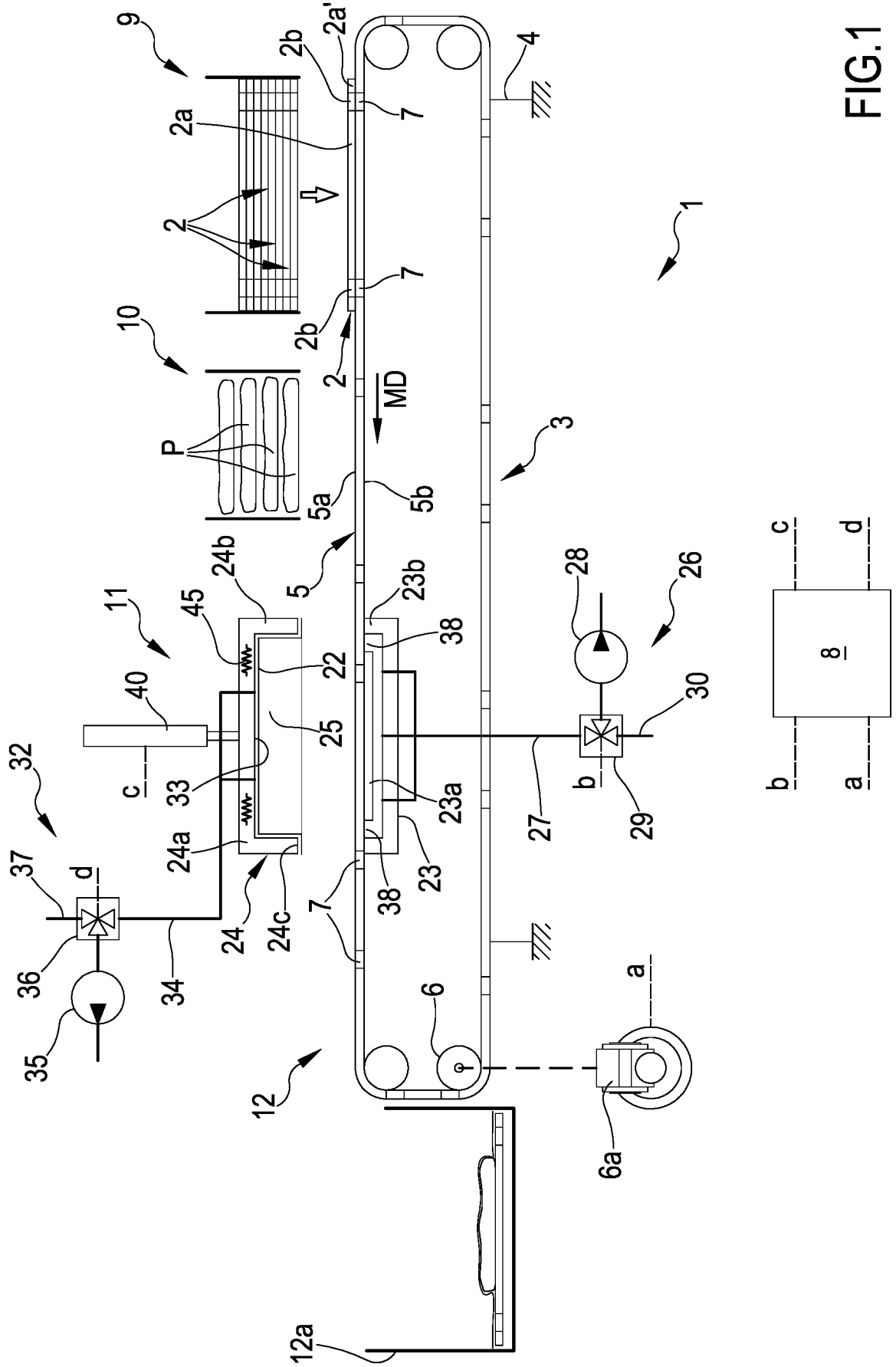
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FIG.1

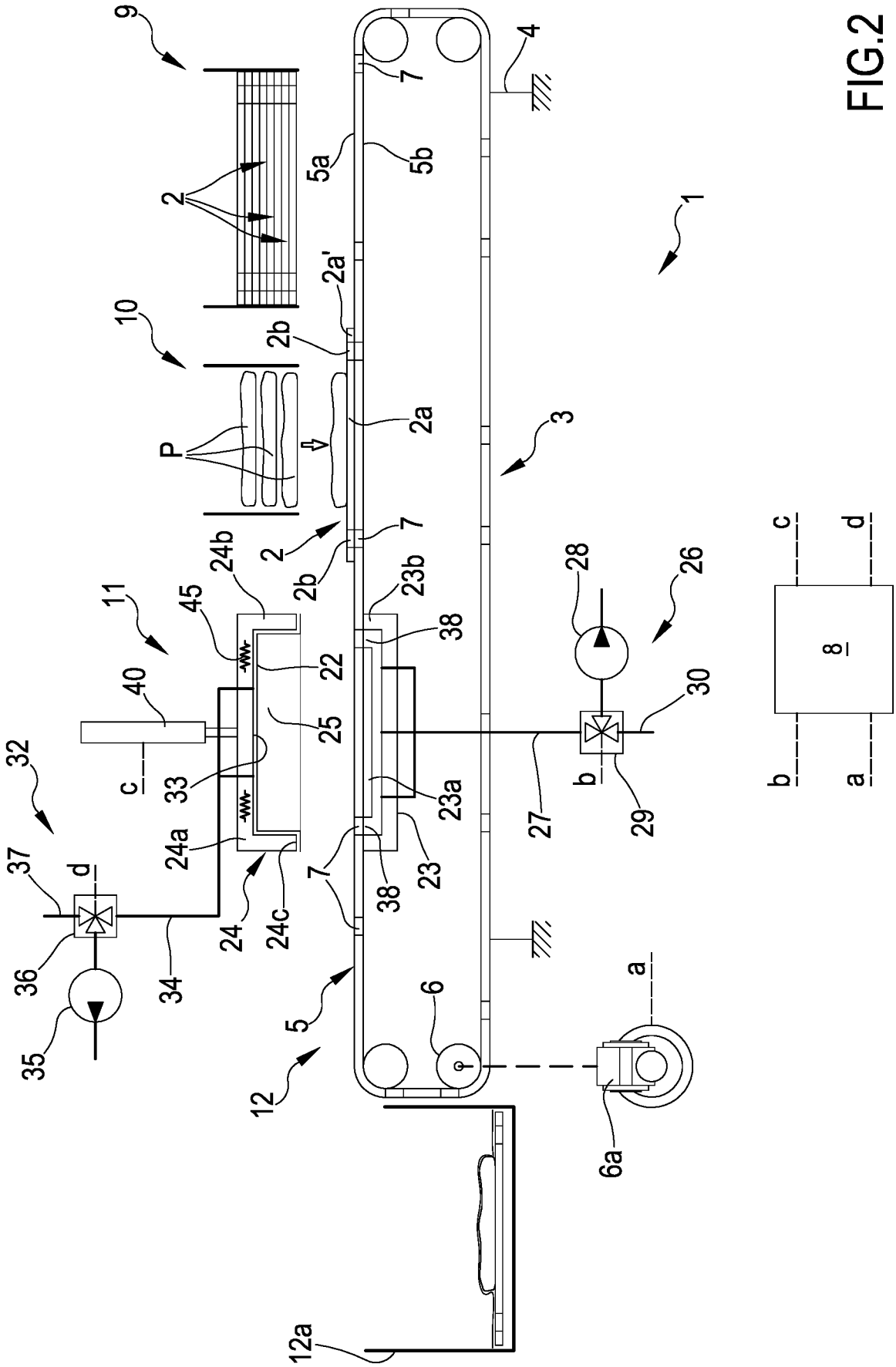
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FIG.2

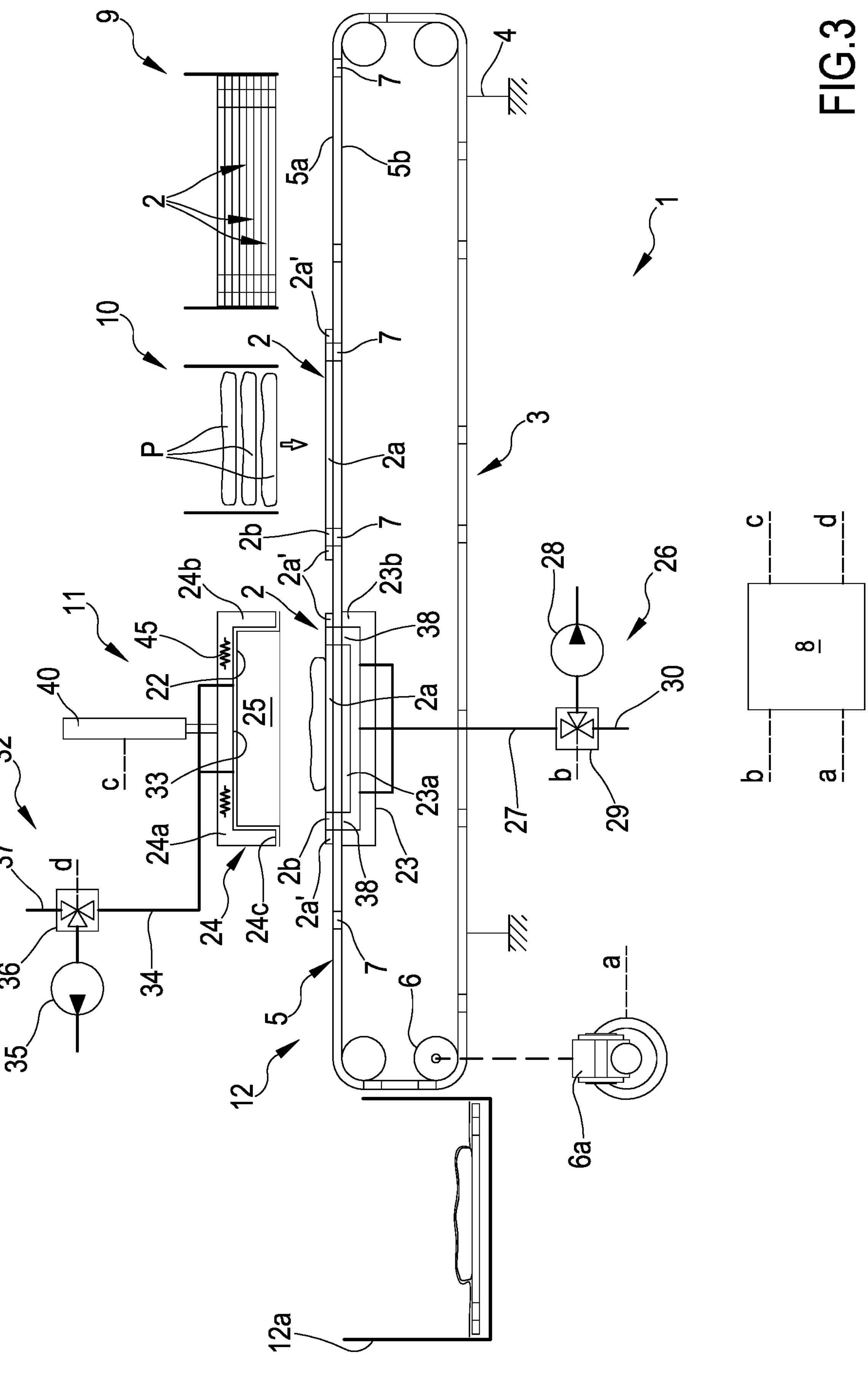
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FIG.3

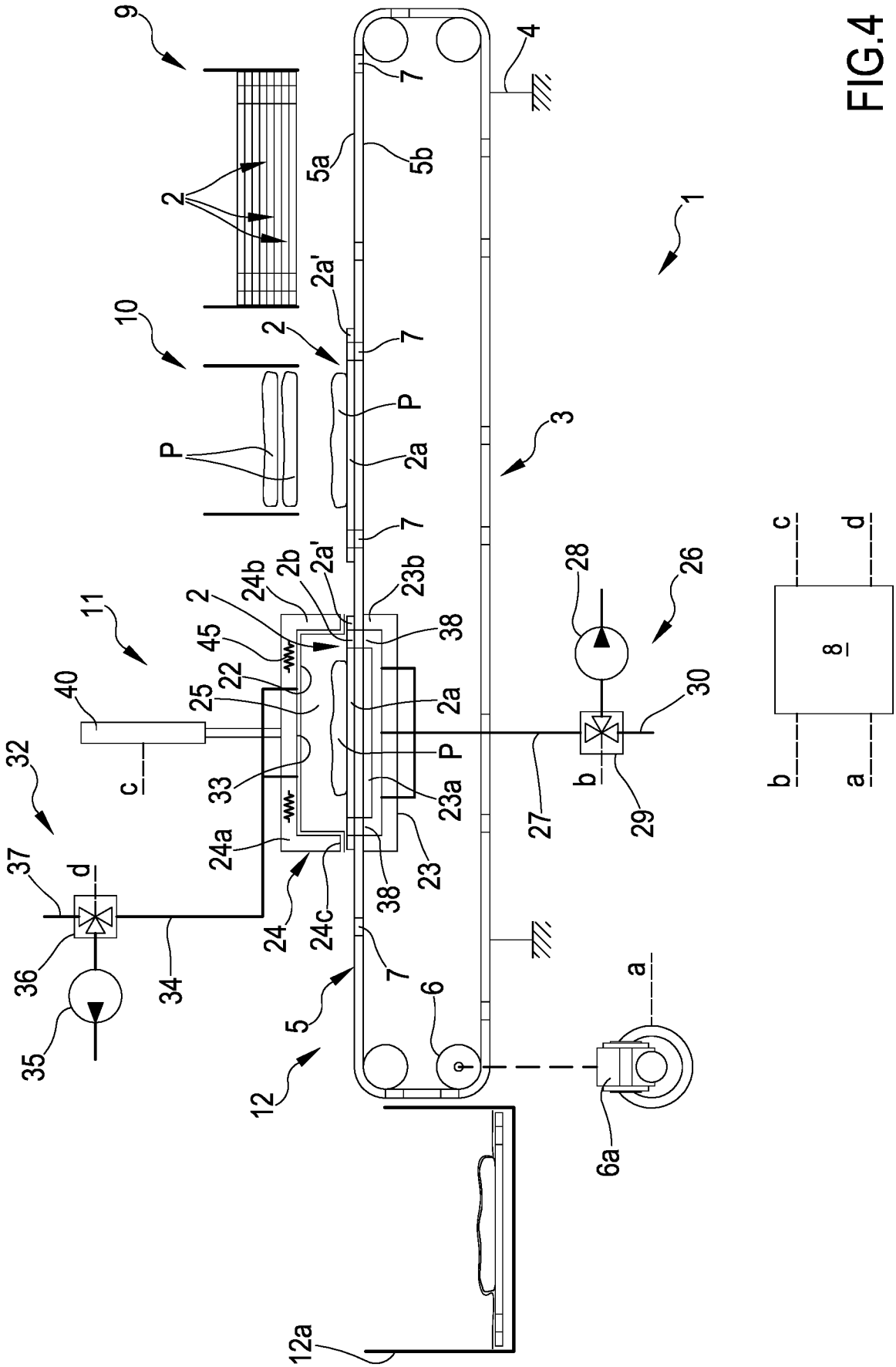
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FIG.4

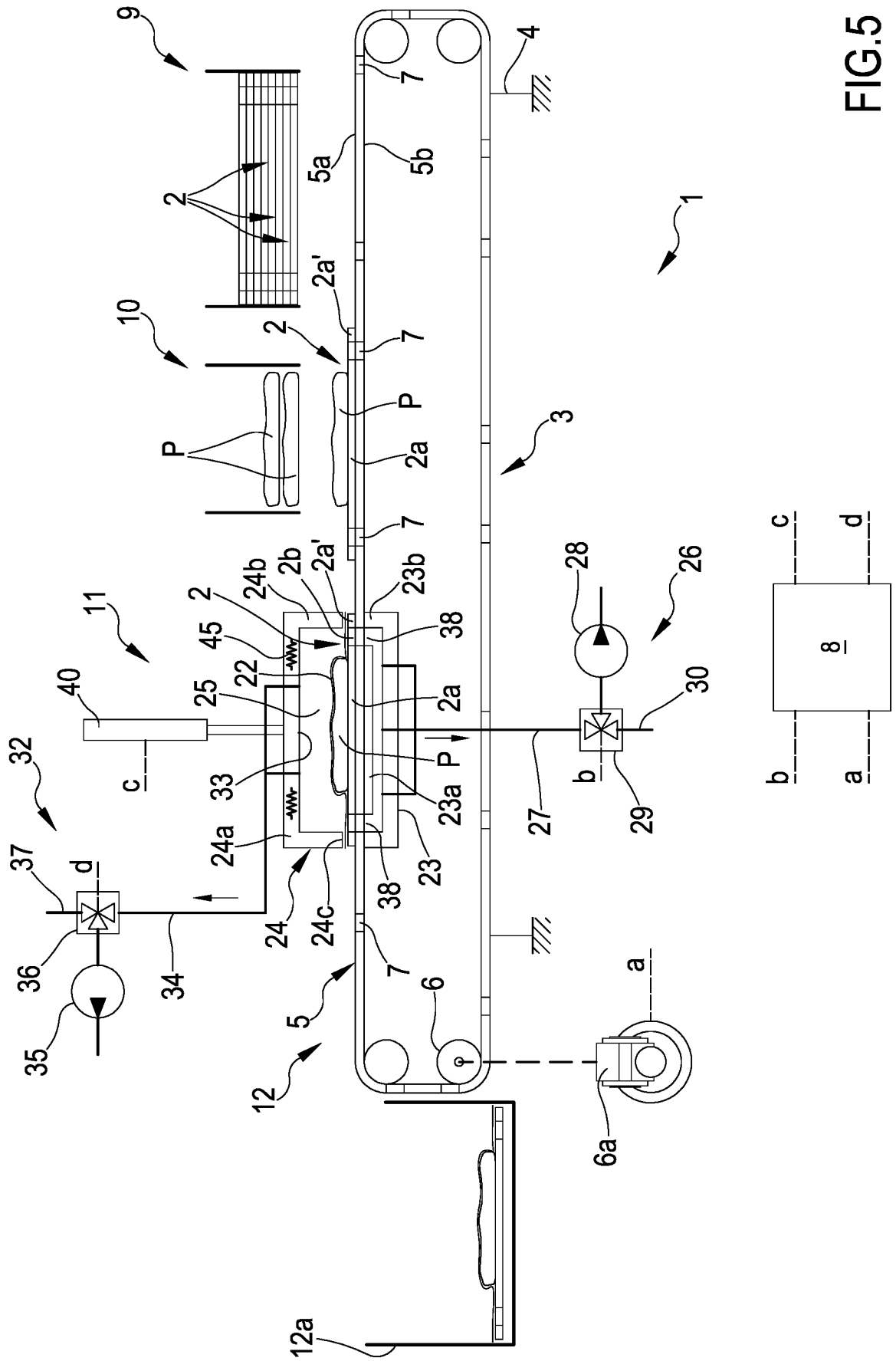
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FIG.5

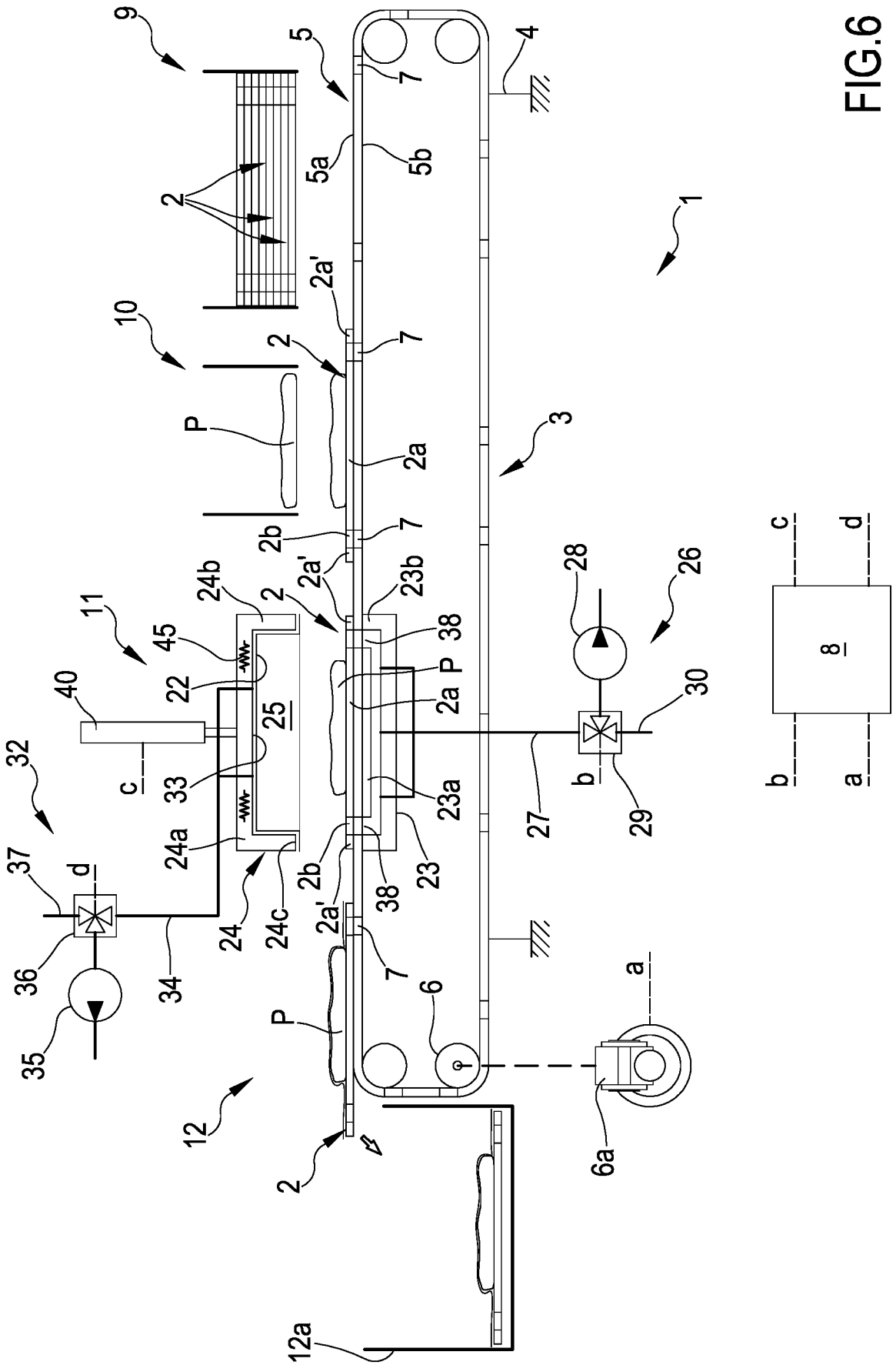
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FIG.6

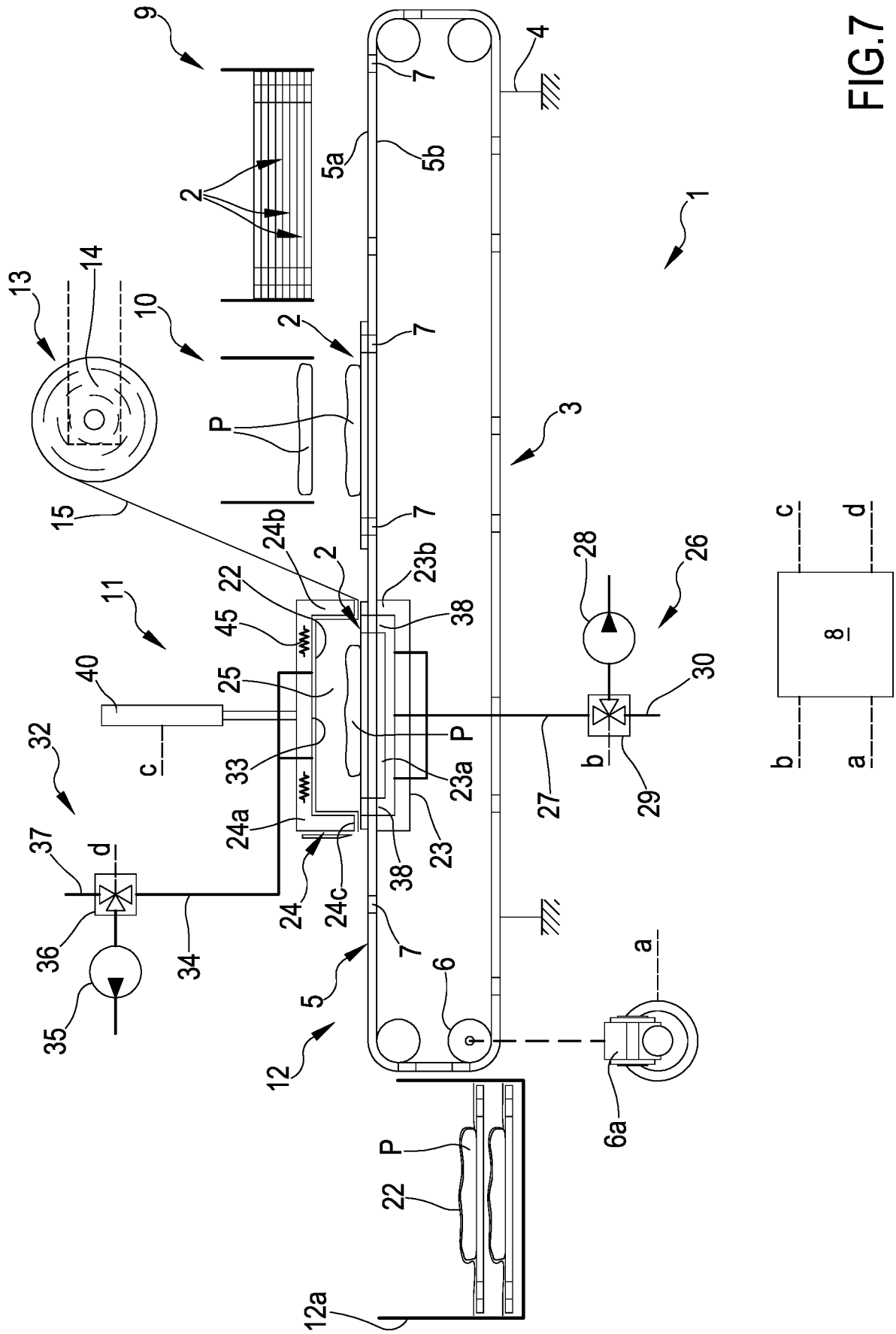
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FIG.7

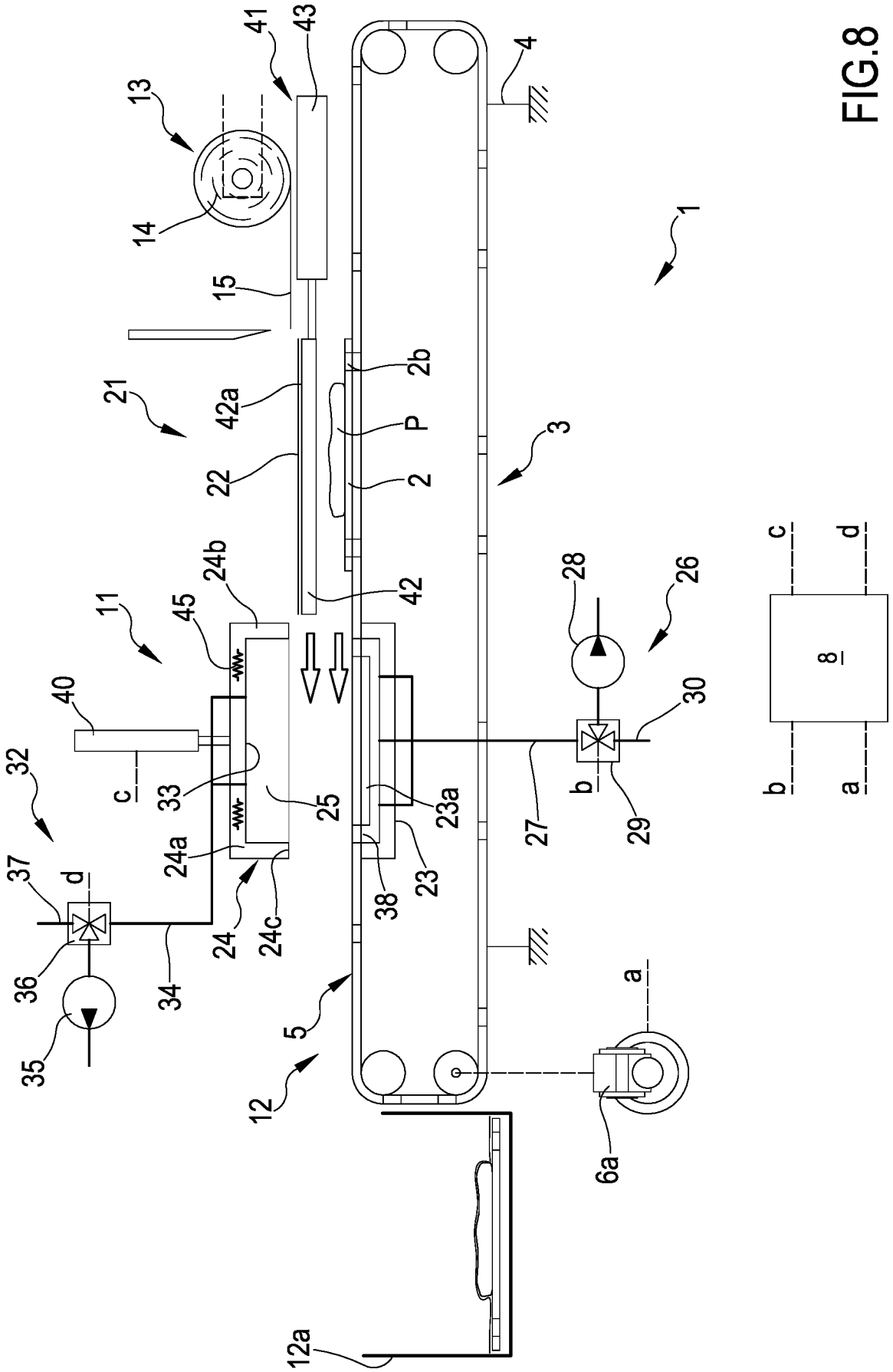
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FIG.8

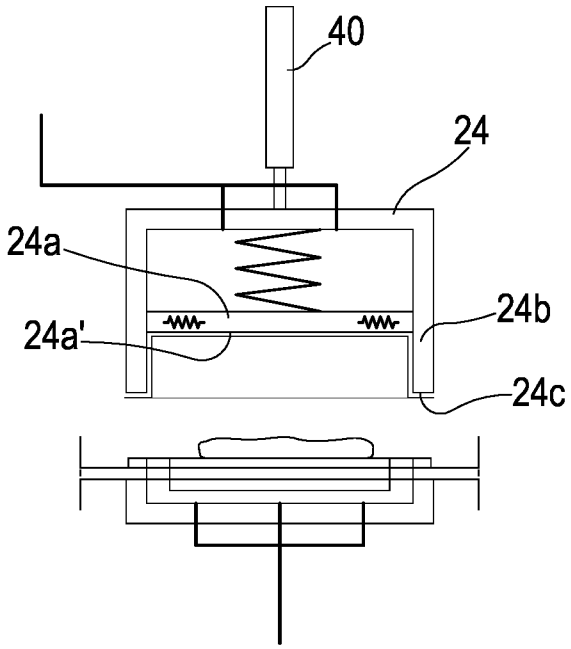


FIG.9

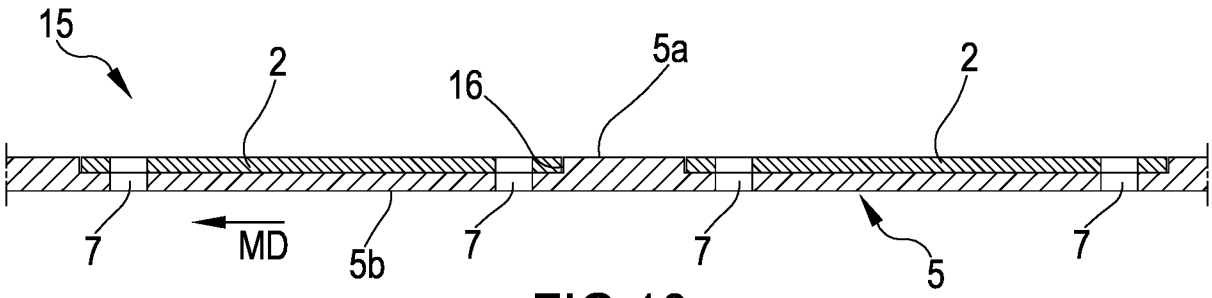


FIG.10

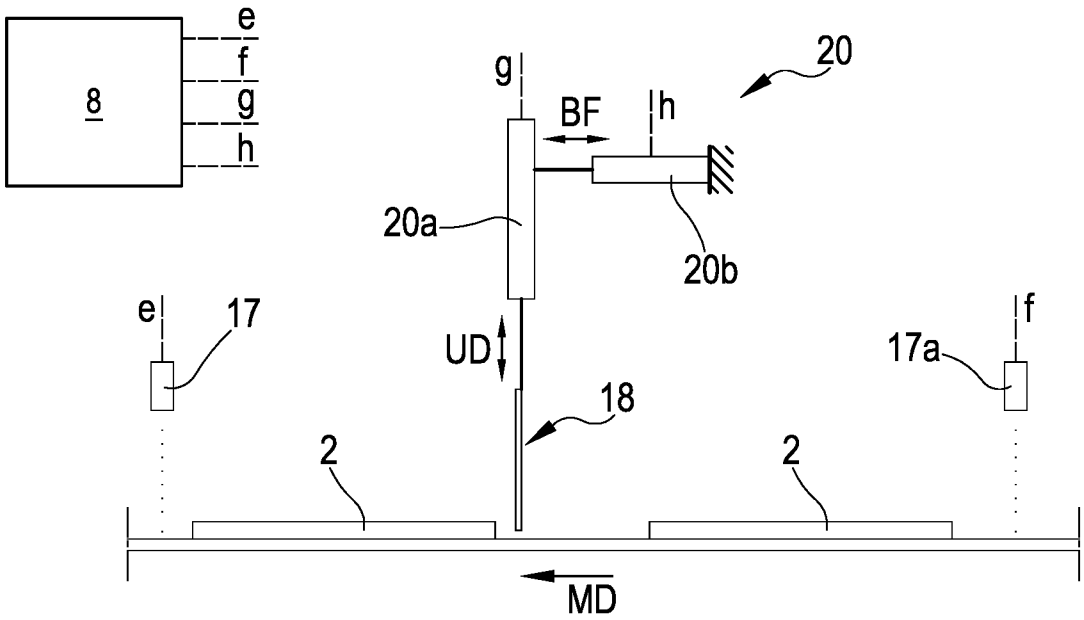


FIG.11

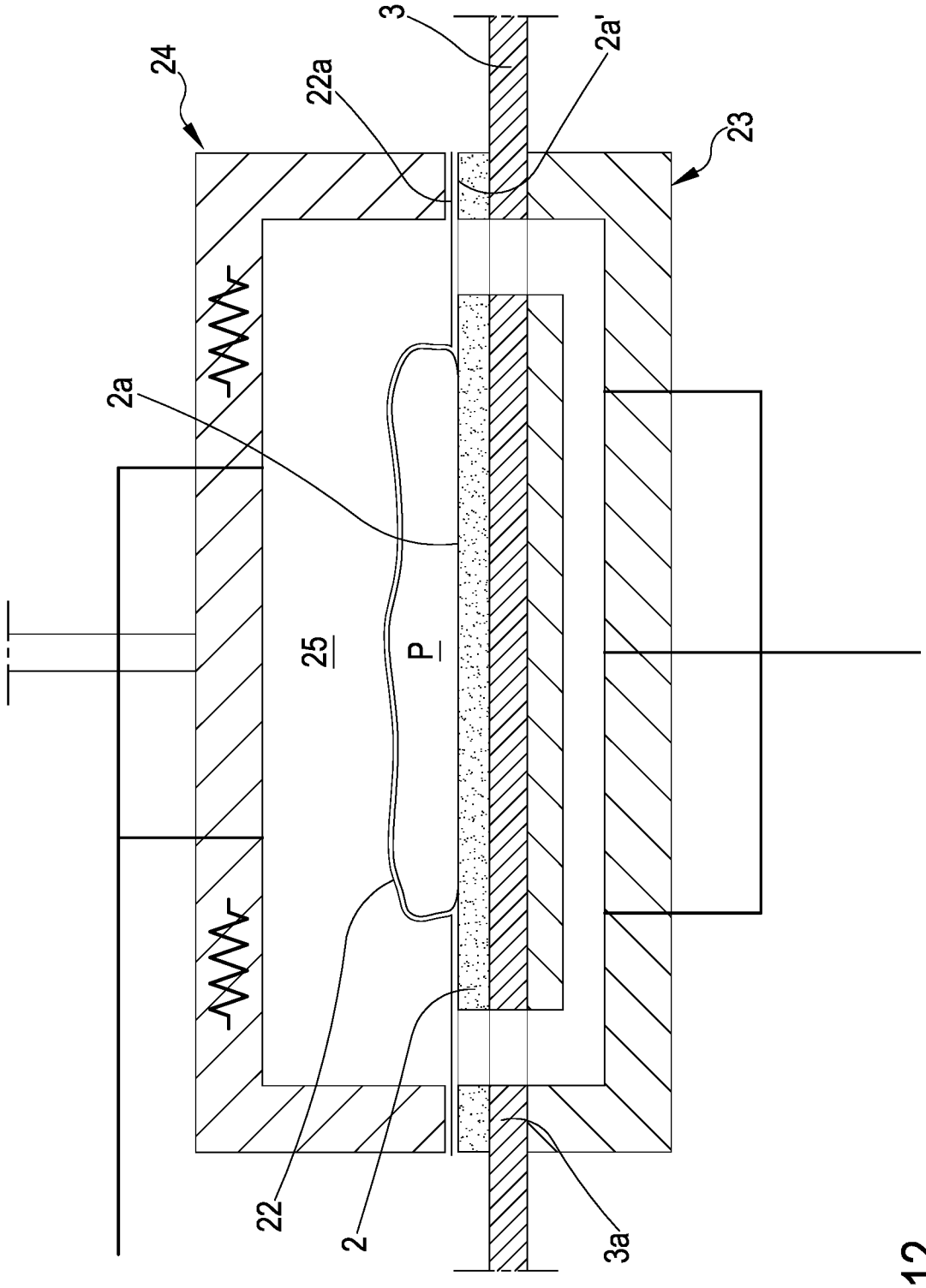
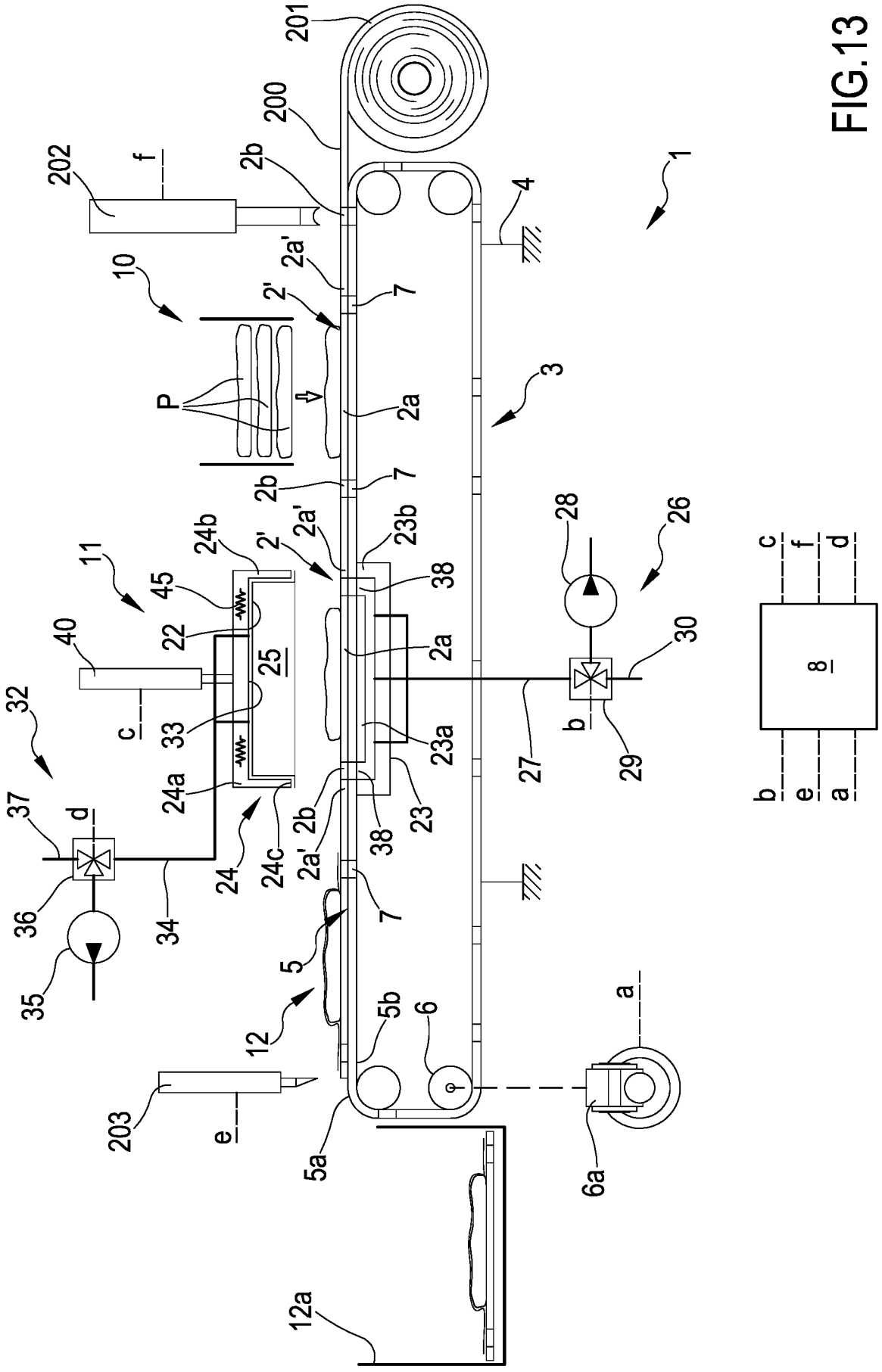


FIG.12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202
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2b
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1
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2a'
2'
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P
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3
2b
7
24b
2'
2a'
23b
28
26
11
45
38
22
2a
30
40
25
c
33
23a
27
b
29
32
24a
37
d
24
24c
2a'
2b
38
23
36
34
7
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35
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5a
6a
12a
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d
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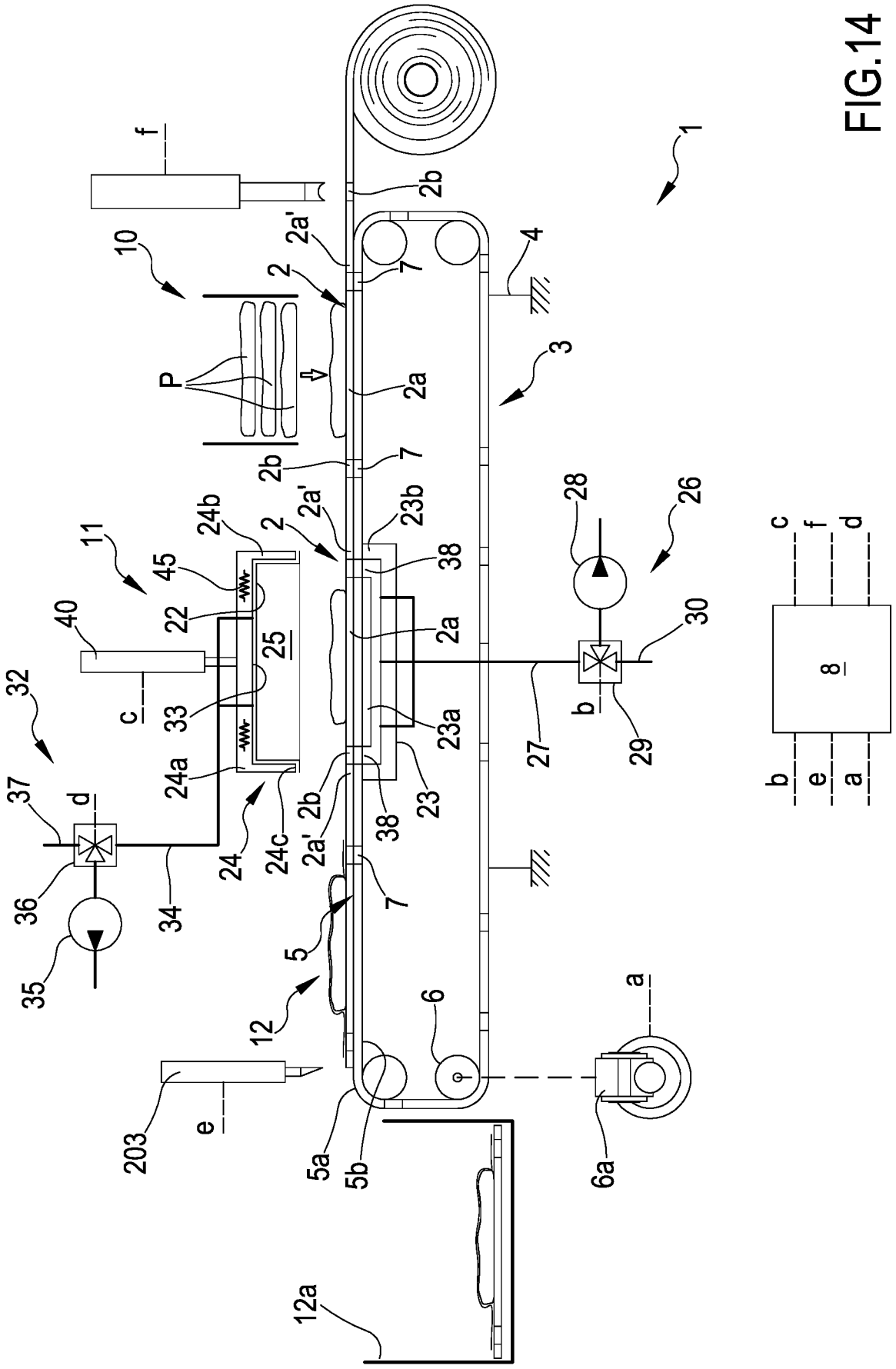
e
a

FIG.13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23a
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24a
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24c
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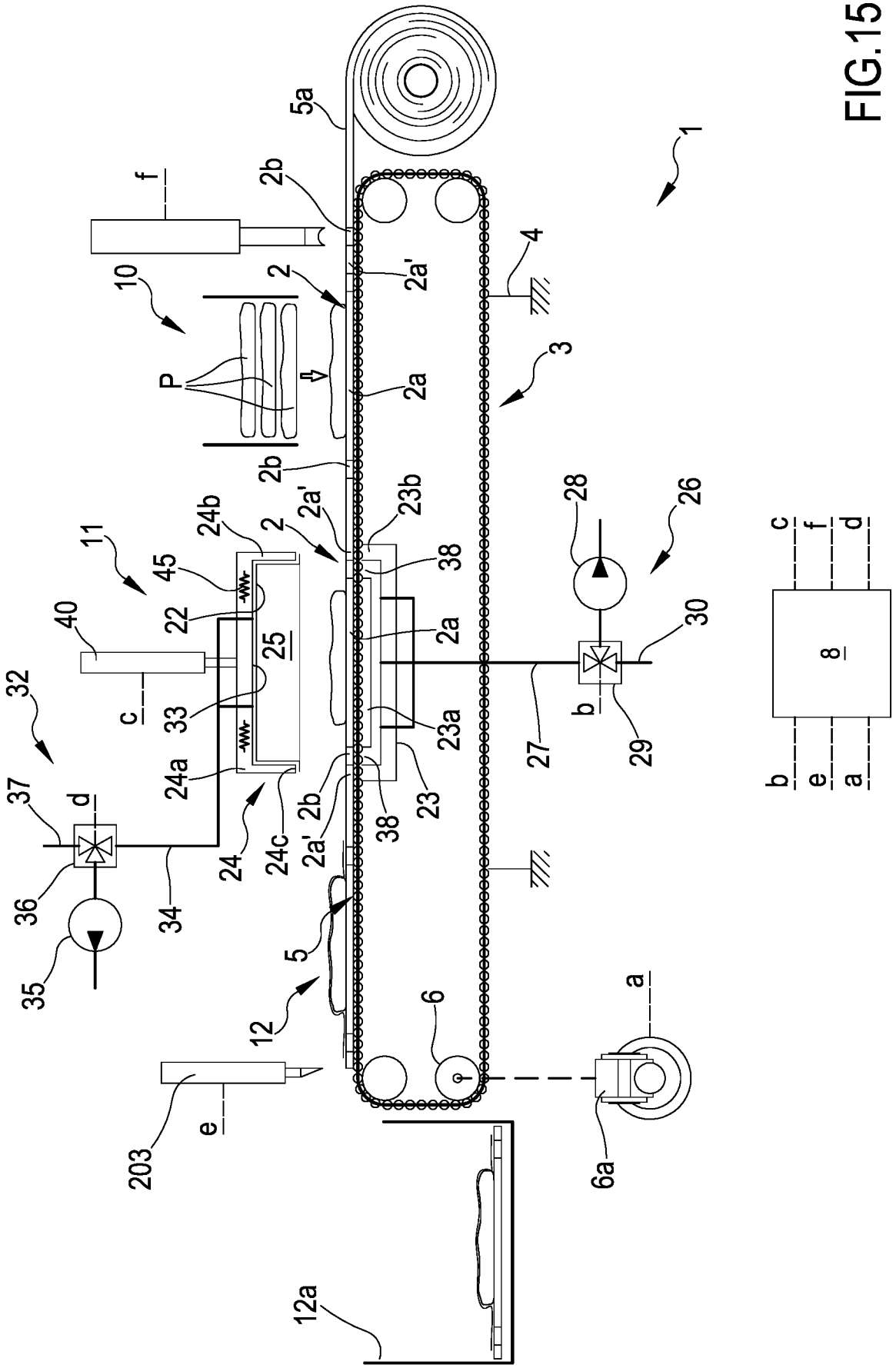
FIG.14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23b
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24a
24b
24c
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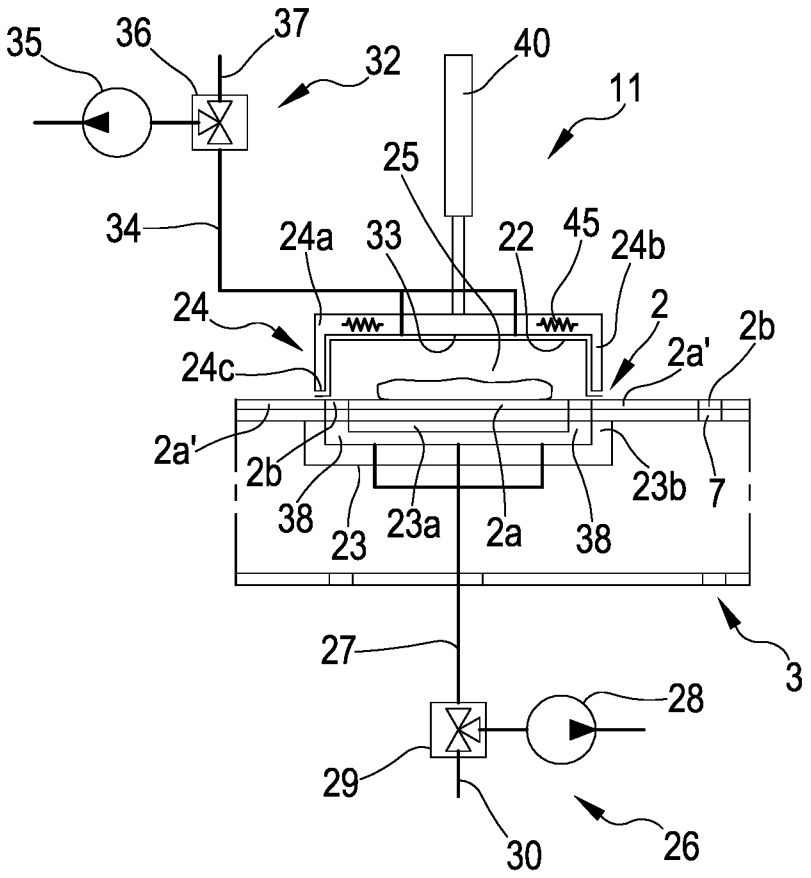
FIG.15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24b
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2b
24c
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FIG.16

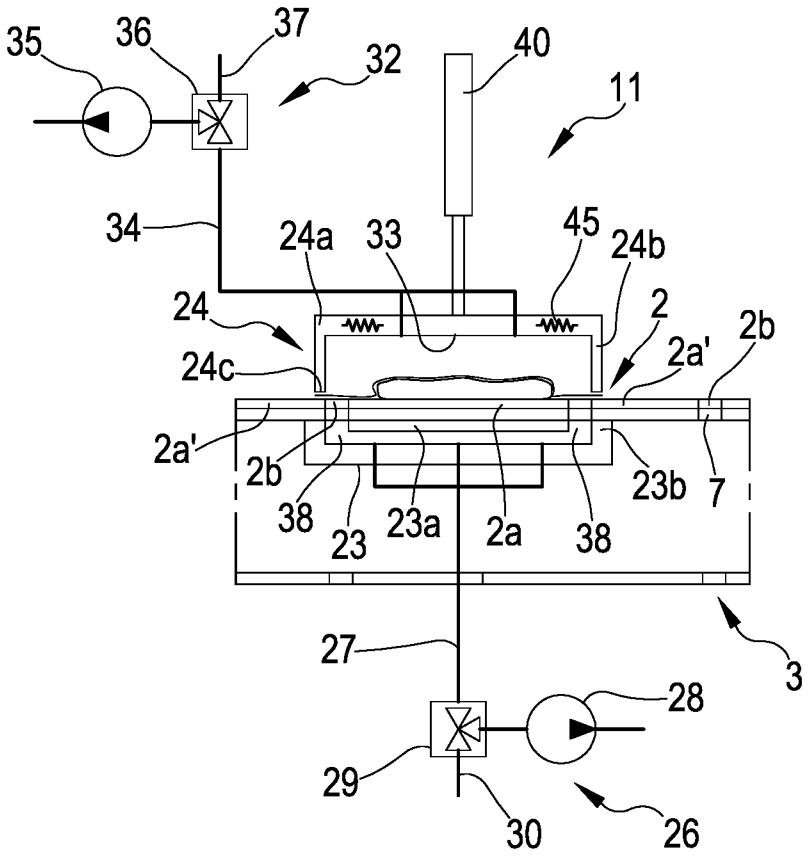
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FIG.17

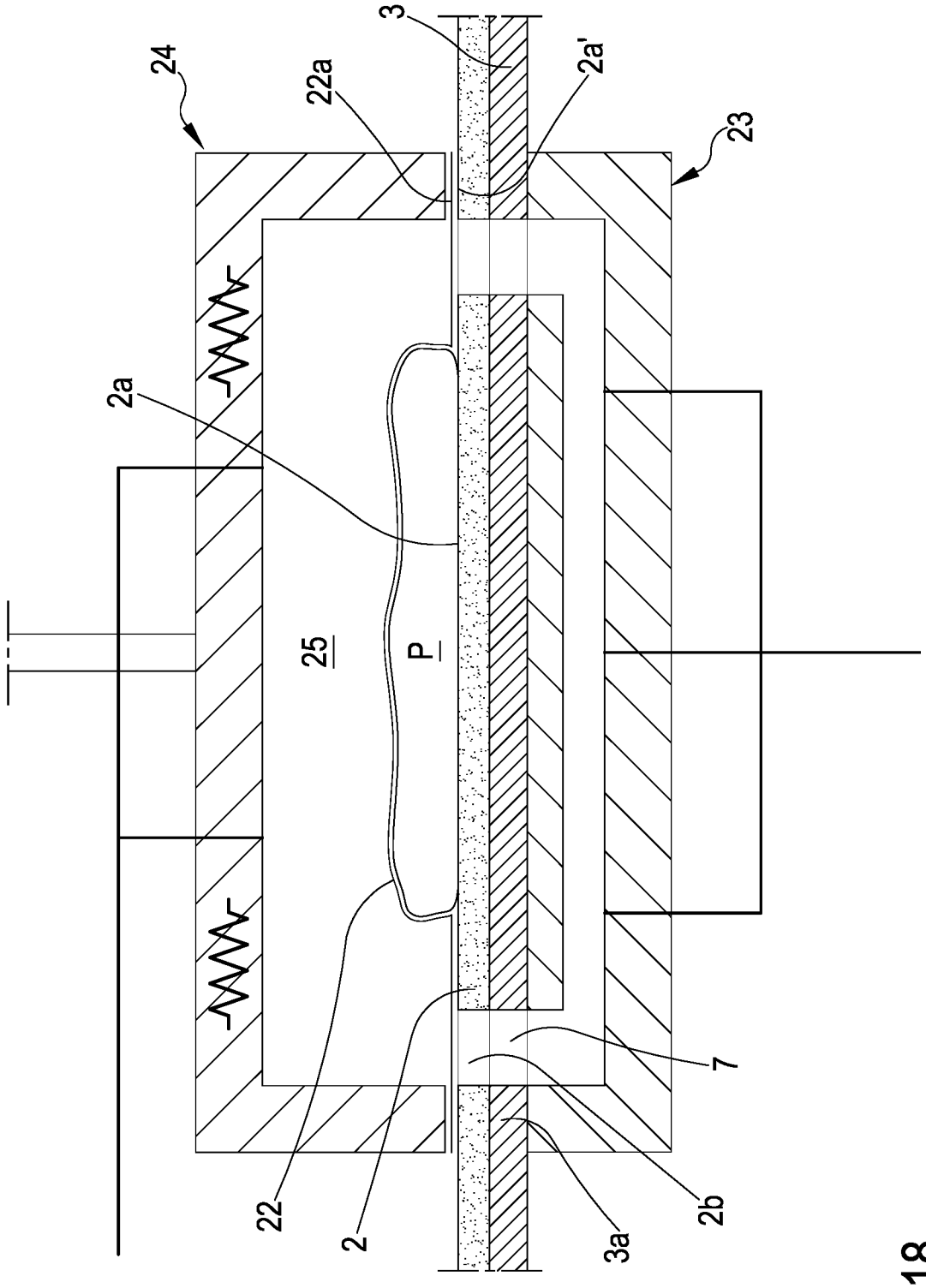
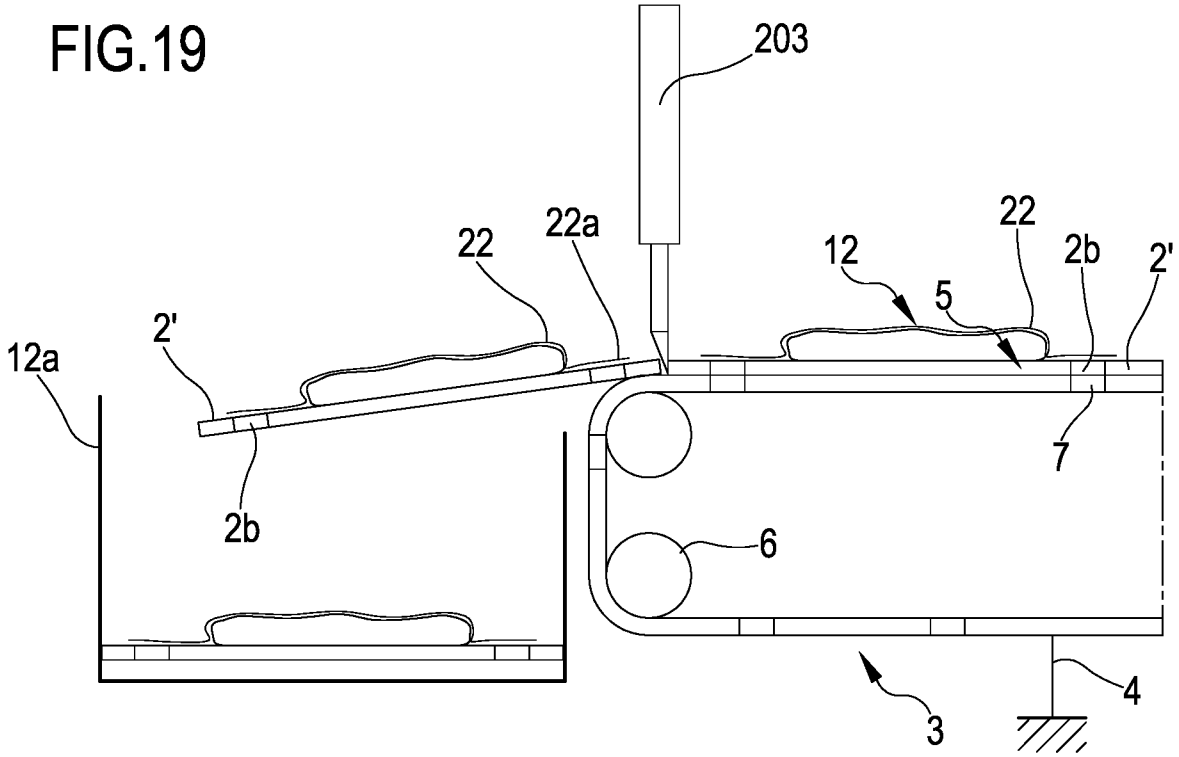


FIG.18

FIG.19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12a
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2b
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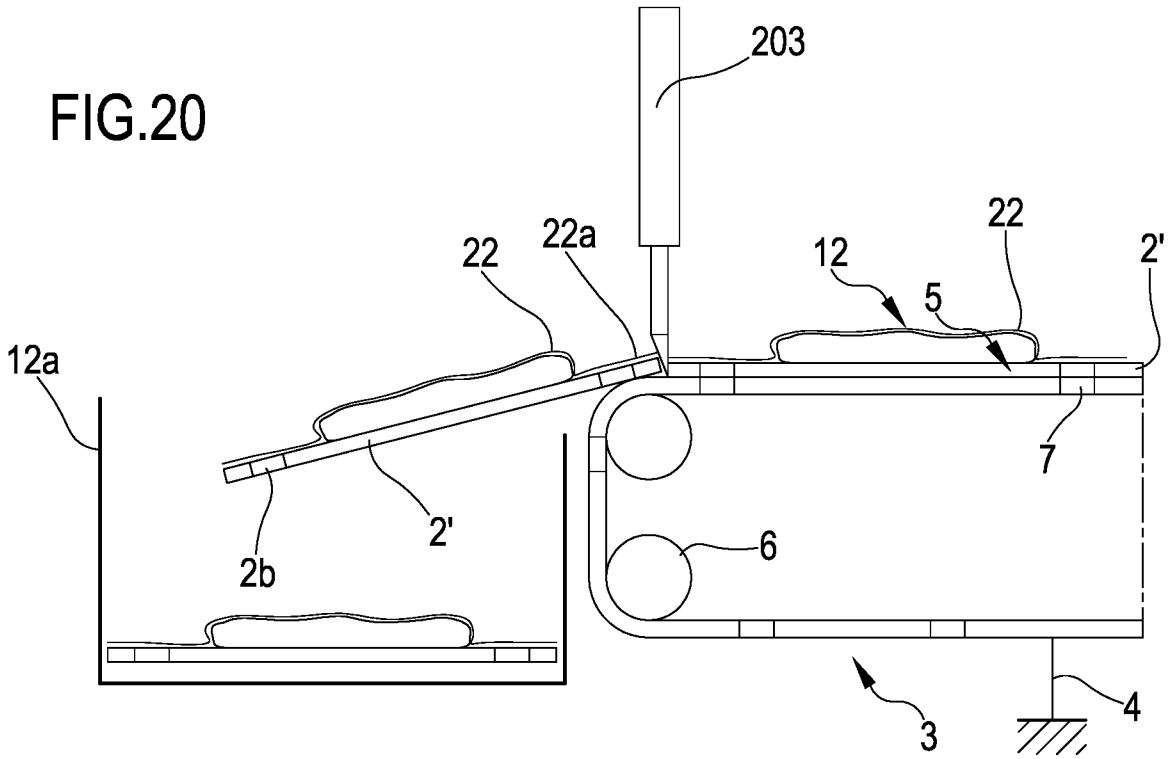
FIG.20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22a
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2'
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7
2'
2b
6
4
3

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2017/061808

A. CLASSIFICATION OF SUBJECT MATTER
INV. B65B41/02 B65B7/16 B65B7/28 B65B11/52 B65B31/02
B65B43/52 B65B43/54 B65B57/04 B65B61/28 B65B43/44
B65G47/28 B65G47/29 B65B35/12 B65B41/14 B65B41/18

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B65B B65G

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2014/060507 A1 (CRYOVAC INC [US]; PALUMBO RICCARDO [IT]) 24 April 2014 (2014-04-24)	1-7, 13-23
Y	figures 1, 3, 7, 5a-5k, 6a-6h	8-11
A	page 4, lines 12-16, 20-23, 28-30 page 5, lines 1-12 page 6, lines 4-9 page 10, line 35 - page 11, line 4 page 24, lines 15-34	12

Y	US 4 188 770 A (TABUR MARCEL J [FR]) 19 February 1980 (1980-02-19) figures 1-4 columns 1-2 column 3, lines 32-47 column 4, lines 9-43	1,8-11, 24-43

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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
7 June 2017	20/06/2017

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Schmitt, Michel

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INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2017/061808

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 93/24374 A1 (RASMUSSEN JOHANNES [DK]) 9 December 1993 (1993-12-09) figures 5-7 page 4, lines 1-2, 34-35 page 7, lines 3-5, 29-31 page 8, line 26 - page 9, line 34	1,8-11, 24-26, 28-43
Y	US 3 071 905 A (MORSE HUGH B) 8 January 1963 (1963-01-08) figures 1-2 columns 1-3	1,8-11, 25,26,37
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Y	US 3 848 393 A (MONOGHAN A) 19 November 1974 (1974-11-19) figure 1 column 1, lines 11-12 column 2, line 65 - column 3, line 2	1,8-11, 24,26, 27,29, 31-33, 35,39
Y	CN 204 937 574 U (CHONGQING CHENGSHUO TECH CO LTD) 6 January 2016 (2016-01-06) figures 1-2	40,41

1

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/EP2017/061808

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