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(54) **PACKAGING MACHINE AND METHOD FOR PRODUCING PACKAGES FROM A PACKAGING MATERIAL**

(57) A packaging machine and method for producing sealed packages from a packaging material fed along a conveying path (P) and having a plurality of patterns (12) of reference marks comprising at least two reference marks (14, 15; 14*, 15*), said machine comprises a control apparatus (8) with a sensing device (17) configured for measuring at least a first parameter (D_1; V) of the packaging material unit when the packaging material has a planar shape, an imaging device (9) configured for measuring at least a second parameter (D_2 ; D_4) of the packaging material when the packaging material has a substantially tubular shape, and a control unit (16) connected to both the sensing device (17) and the imaging device (11) and configured for calculating the width of an overlapping area (AO) of the tube (5) based on said first parameter (D_1; V) and said second parameter (D_2; D4) .

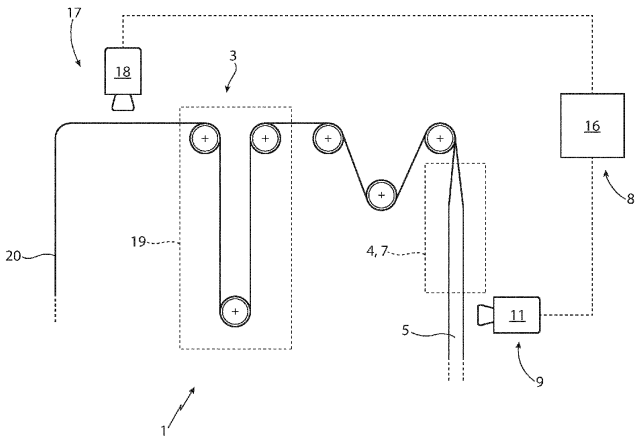

FIG. 2

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Description

TECHNICAL FIELD

[0001] The present invention relates to a packaging machine and a packaging method for producing packages from a packaging material. In particular, the invention relates to a packaging machine comprising a control apparatus for detecting parameters of a tube formed by folding the packaging material and filled with a product to be packaged. In particular, the invention also relates to a packaging method comprising the step of detecting parameters of a tube formed by folding the packaging material and filled with a product to be packaged.

BACKGROUND ART

[0002] As it is known, many liquid or pourable food products, such as for example pasteurized or long-life (UHT) milk, tomato sauce, wine, fruit juice are sold in packages made of sterilized packaging material.

[0003] Packages of this sort are normally produced with automatic packaging machines, which feed a web of packaging material through a sterilizing unit by means of known guiding elements (like for example rollers) for sterilizing the web of packaging material alternatively by means of chemical sterilization in a sterilizing bath (e.g. by applying a chemical sterilizing agent, such as a hydrogen peroxide solution) or by means of physical sterilization (e.g. by means of an electron beam).

[0004] The packaging machine further comprises a folding unit arranged downstream of the sterilizing unit and arranged for folding the web of packaging material for producing a continuous tube. Inside the folding unit, the web of packaging material is folded from a continuous planar shape to a continuous tubular shape with a vertical axis. The web of packaging material with planar shape is folded into a cylinder that is successively subdivided into a plurality of pillow packs which are subjected to successive mechanical folding operations to obtain the finished sealed packages. The folding unit is preferably arranged within a fixed structure in which the web of packaging material is maintained in a sterile-air environment. The folding unit further comprises a number of folding devices placed in succession (one after the other): by interacting with the folding devices, opposite lateral edge portions (or edge regions) of the web of packaging material are placed one on top of the other so as to form the tube and so as to define an overlapping area.

[0005] The packaging machine comprises a sealing unit arranged downstream of the folding unit for sealing the overlapping edge portions of the web of packaging material to obtain a fluid-tight longitudinal seal in the tube.

[0006] The tube is continuously filled with the pourable food product through a pour conduit, which partially extends inside the tube and is part of a filling circuit.

[0007] The tube is finally sent to a forming and transverse sealing unit, where the tube is gripped to transversely seal and cut the tube to form the pillow packs.

[0008] In the above-described packaging machines, to ensure a good quality of the transverse sealing of the tube of packaging material, the tube must be fed with the overlapping area having a predetermined angular position with respect to the vertical axis and with said overlapping area having a predetermined width.

[0009] Typically, the width of the overlapping area is simply measured manually by an operator through some randomly sampled sealed packages.

[0010] Therefore, the need to have a reliable automatic measure of the width of the overlapping area is strongly felt.

DISCLOSURE OF INVENTION

[0011] The object of the invention is to provide a packaging machine for producing packages from a packaging material, said machine not suffering from the drawbacks described above and, in particular, being easy and economical to be manufactured.

[0012] A further object of the invention is to provide a packaging method for producing packages from a packaging material, said method not suffering from the drawbacks described above and, in particular, being easy and economical to be implemented.

[0013] According to the invention, there are provided a packaging machine and a packaging method for producing packages from a packaging material according to the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] A non-limiting embodiment of the present invention will be described by way of example with reference to the accompanying drawings, in which:

- Figure 1 is a perspective view, with parts removed for clarity, of a packaging machine for producing packages from a packaging material, in accordance with the present invention;
- Figure 2 is a schematic side view of a first part of the packaging machine of Figure 1;
- Figure 3 is a perspective view of a second part of the packaging machine of Figure 1;
- Figure 4 shows a first embodiment of a planar portion of packaging material to obtain a package with the packaging machine of Figure 1;
- Figure 5 discloses a partial view of the portion of packaging material of Figure 4 once folded to obtain a tube;
- Figure 6 shows a second embodiment of a planar portion of packaging material to obtain a package with the packaging machine of Figure 1; and
- Figure 7 shows a partial view of the portion of packaging material of Figure 6 once folded to obtain a tube.

BEST MODE FOR CARRYING OUT THE INVENTION

[0015] Figures 1 and 2 disclose, as a whole, a packaging machine 1 for continuously producing sealed packages, containing a pourable food product, such as for example pasteurized or long-life (UHT) milk, tomato sauce, wine, fruit juice. The sealed packages are obtained from packaging material unwound off a reel 21 and fed along a conveying path P. When unwound off the reel 21, the packaging material has the shape of a continuous planar web 20 of packaging material.

[0016] Typically, the packaging material has a multilayer structure. More specifically, the packaging material may comprise at least a layer of fibrous material, such as e.g. a paper or cardboard layer, and at least two layers of heat-seal plastic material, e.g. polyethylene, interposing the layer of fibrous material in between one another. One of these two layers of heat-seal plastic material may define the inner face of the packages eventually contacting the pourable product.

[0017] According to some possible non-limiting embodiments, the packaging material may also comprise a layer of gas- and light-barrier material, e.g. aluminum foil or ethylene vinyl alcohol (EVOH) film, in particular being arranged between one of the layers of the heat-seal plastic material and the layer of fibrous material. Preferentially, the packaging material may also comprise a further layer of heat-seal plastic material being interposed between the layer of gas- and light-barrier material and the layer of fibrous material.

[0018] The packaging machine 1 comprises a sterilizing unit 3 having a sterilizing bath 19, in which a chemical sterilizing agent, such as a hydrogen peroxide solution, is applied to the web 20 of packaging material. The web 20 of packaging material is fed through the sterilizing unit 3 by means of known guiding elements (like for example rollers or similar elements).

[0019] The packaging machine 1 further comprises a folding unit 4 arranged downstream of the sterilizing unit 3 along the conveying path P. The folding unit 4 extends, preferably substantially vertically, along the conveying path P for producing a continuous tube 5. In particular, inside the folding unit 4, the web 20 of packaging material is folded from a continuous planar shape to a continuous tubular shape with a longitudinal axis Y. In particular, the longitudinal axis Y is arranged along a vertical direction.

[0020] The folding unit 4 is defined within a fixed structure 6 in which the web 20 of packaging material is maintained in a sterile-air environment. The folding unit 4 further comprises a number of folding devices 100 placed along the conveying path P in succession (one after the other), each of said folding devices 100 comprising a number of folding rollers cooperating to fold the web 20 of packaging material.

[0021] The packaging machine 1 comprises a sealing unit 7 (of the known type and not described in detail) for sealing overlapping lateral edges 13A, 13B of the packaging material to obtain a fluid-tight longitudinal seal in the tube 5.

[0022] The tube 5 is continuously filled with the pourable food product through a pour conduit 101, which partially extends inside the tube 5 and is part of a filling circuit.

[0023] The tube 5 is sent to a forming and transverse sealing unit (not shown), in which the tube 5 is gripped to transversely seal the tube and form pillow packs 2. Finally, the pillow packs 2 are subjected to successive mechanical folding operations to obtain the finished sealed packages.

[0024] The packaging machine 1 comprises a control apparatus 8 configured for measuring and controlling the angular position T of the edge 13B with respect to the longitudinal axis Y (i.e. the rotation or twisting of the tube 5 around the longitudinal axis Y) and/or a width of an overlapping area AO defined by the portions of the packaging material edge 13A and the packaging material edge 13B that overlap each other.

[0025] The web 20 of packaging material comprises a plurality of patterns 12 of reference marks, which are arranged one after the other along the longitudinal dimension of the web 20 of packaging material (and of the tube 5) to provide information on the position of the packaging material.

[0026] Each pattern 12 of reference marks defines, or is part of, a packaging material unit 13 intended to form a respective sealed package.

[0027] Figure 4 discloses a first embodiment of a pattern 12 of reference marks. The pattern 12 of reference marks comprises at least two reference marks 14, 15. In the embodiment shown, the reference marks 14, 15 are dedicated marks, with a substantially square shape. Alternatively, the reference marks 14, 15 could be already existing marks (such as, for example, splice marks or barcodes or similar).

[0028] The reference mark 14 is arranged in proximity of the packaging material edge 13A. The reference mark 14 has a reference zone 14A, for example an edge zone, facing edge 13A.

[0029] A distance D_1 is defined between the packaging material edge 13A and the reference zone 14A. Said distance D_1 is different from zero.

[0030] The reference mark 15 is arranged in proximity of a packaging material edge 13B. In particular, reference mark 15 has a reference zone 15B, preferably corresponding to the packaging material edge 13B.

[0031] The second edge 13A may comprise a portion of the packaging material between the border of the second edge 13A and the reference mark 14.

[0032] The first edge 13B of the packaging material may be at least partially placed on top of the second edge 13A, i.e. an (outer) border of the edge 13B of the packaging material may be placed on top of the second edge 13A.

[0033] The control apparatus 8 comprises a sensing device 17 having at least a sensor 18. According to a first embodiment, the sensor 18 is adapted to frame a longitudinal portion of the web 20 of packaging material. Pref-

erably, the longitudinal portion of the web 20 of packaging material framed by sensor 18 comprises a packaging material unit 13. Even more preferably, the longitudinal portion of the web 20 of packaging material framed by sensor 18 corresponds to a packaging material unit 13. In one embodiment, the sensor 18 is preferably a camera 18A.

[0034] The sensing device 17 is configured for measuring the distance D_1 of each packaging material unit 13 when the packaging material has a planar shape. The sensing device 17 is arranged along the conveying path P. Preferably, the sensing device 17 is arranged upstream of the sterilizing unit 3.

[0035] The control apparatus 8 further comprises an imaging device 9, disclosed in Figure 3. Preferably the control apparatus 8 further comprises a fixed frame having a movable bracket (not shown) supporting the imaging device 9. The movable bracket is rotatable around an axis between a working position, in which the imaging device 9 faces the tube 5 and is arranged in proximity of the tube 5, and a rest position, in which the imaging device 9 does not faces the tube 5 and is arranged at a distance from the tube 5.

[0036] The imaging device 9 comprises at least a sensor 11, adapted to frame at least a longitudinal portion of the tube 5. Sensor 11 is preferably a camera 11A. The imaging device 9 is arranged downstream of the sealing unit 7. In particular, the sensor 11, i.e. the camera 11A, is adapted to frame a longitudinal portion of the tube 5. Preferably, the longitudinal portion of the tube 5 framed by sensor 11 comprises a packaging material unit 13. Even more preferably, the longitudinal portion of the web 20 of packaging material framed by sensor 18 corresponds to a packaging material unit 13.

[0037] When the web 20 of packaging material is folded from the planar shape to the (e.g. substantially) tubular shape, the packaging material edge 13B at least partially overlaps the packaging material edge 13A defining the overlapping area AO formed by overlapping lateral portions of the packaging material. In a preliminary set-up and design phase of a working cycle of the packaging machine 1, a reference value of a width of the overlapping area AO is defined. In other words, the reference value is a preferred value, or an optimal value, corresponding to a correct working condition of the packaging machine 1. It is important to notice that the distance D_1 has to be chosen (when printing the mark 14 on the packaging material) so that it is greater than said reference value. Furthermore, a distance D_2 is defined between the reference zone 15B (that, in the embodiment shown, corresponds to the packaging material edge 13B), and the reference zone 14A. The distance D_2 is measured when the web 20 of packaging material has the (e.g. substantially) tubular shape, as disclosed in Figure 5. The distance D_2 is measured by the imaging device 9, particularly for each packaging material unit 13.

[0038] Finally, the control apparatus 8 comprises a control unit 16 which is connected to both the imaging device 9 and the sensing device 17. In particular, the imaging device 9 is designed for generating and transmitting to the control unit 16 a signal indicating the distance D_2 of each packaging material unit 13. The sensing device 17 is instead designed for generating and transmitting to the control unit 16 a signal indicating the distance D_1 of each packaging material unit 13. The control unit 16 calculates an actual value of the overlapping area AO through the difference between the distance D_1 and the distance D_2 of each packaging material unit 13.

[0039] The control unit 16 further compares the actual value of the overlapping area AO with the reference value. In case the difference between the actual value of the overlapping area AO and the reference value exceeds a predefined threshold the control unit 16 is designed to generate a warning signal for informing of an undesired and significant deviation from the reference value.

[0040] According to a preferred embodiment, the control unit 16 is realized for controlling the folding unit 4 and the sealing unit 7 based on the actual value of the overlapping area AO.

[0041] According to a further embodiment not shown, the pattern 12 of reference mark comprises the reference mark 14 as described above and the reference mark 15 is the packaging material edge 13B. In other word, the pattern 12 of reference mark does not comprise a dedicated reference mark 15 but the reference mark 15 is defined by the packaging material edge 13B. The distance D_2 measured by the imaging device 9 is defined between the packaging material edge 13B and the reference zone 14A.

[0042] Figures 6 and 7 disclose a second embodiment of a pattern 12 of reference marks.

[0043] The pattern 12 of reference marks comprises at least two reference marks 14*, 15*. In the embodiment shown, the reference marks 14*, 15* are already existing marks (such as, for example, splice marks or barcodes or similar). Alternatively, the reference marks 14*, 15* could be dedicated marks.

[0044] The reference mark 14* is arranged in proximity of the packaging material edge 13A and the reference mark 15* is arranged in proximity of the packaging material edge 13B.

[0045] The first edge 13B may comprise the portion of the packaging material between the border of the first edge 13B and the reference mark 15*. The second edge 13A may comprise the portion of the packaging material between the border of the second edge 13A and the reference mark 14*.

[0046] For example, the (outer) border of the edge 13B of the packaging material may be placed on top of the second edge 13A.

[0047] According to the embodiment disclosed in figures 6 and 7, the sensor 18 is a camera 18A or alternatively a through-beam sensor 18, preferably a through-beam laser sensor 18.

[0048] The sensing device 17 is configured for measuring the width V of each packaging material unit 13 when

the packaging material has a planar shape, i.e. the width from the packaging material edge 13A to the packaging material edge 13B of the web 20 of packaging material.

[0049] Moreover, the producer of the web 20 of packaging material provides information about the packaging material, such as for example a distance D_3 between the reference marks 14*, 15*. More in detail, the producer of the web 20 of packaging material provides the distance D_3 defined between a reference point 14A* of the reference mark 14* and a reference point 15A*, in particular an edge, of the reference mark 15*. The distance D_3 has, therefore, a pre-defined value that is stored in the control unit 16.

[0050] The imaging device 9 is configured for measuring a distance D_4 between the reference mark 14* and the reference mark 15*, e.g. when the packaging material is folded into the (e.g. substantially) tubular shape. More in detail, the distance D_4 is defined between the reference point 15A* of the reference mark 15* and the reference point 14A* of the reference mark 14* of the tube 5.

[0051] The imaging device 9 is designed for generating and transmitting to the control unit 16 a signal indicating the distance D_4 of each packaging material unit 13. The control unit 16 then calculates the overall perimeter of each packaging material unit 13 by adding the distance D_3 to the distance D_4. Finally, the control unit 16 calculates the actual value of the overlapping area AO through the difference between the width V and the overall perimeter of each packaging material unit 13, obtained as explained above.

[0052] In this case, again, if the difference between the actual value of the overlapping area AO and the reference value exceeds a predefined threshold the control unit 16 is designed to generate a warning signal for informing of an undesired and significant deviation from the reference value. According to a preferred embodiment, the control unit 16 is realized for using the actual value of the overlapping area AO for a closed loop control of the folding unit 4 and/or the sealing unit 7.

[0053] The image of each packaging material unit 13 provided by the imaging device 9 is used for measuring the angular position T of the packaging material edge 13B being formed with respect to the longitudinal axis Y, which represents the rotation or twisting of the tube 5 around the longitudinal axis Y.

[0054] According to a first embodiment, the camera 11A is adapted to continuously acquire images of at least a longitudinal portion of the tube 5 and a reference marker (not shown). In particular, the camera 11A is adapted to frame a longitudinal portion of the tube 5 and the reference marker. The reference marker is connected to a frame of the packaging machine 1 and, therefore, is arranged in a fixed position with respect to the tube 5 advancing along the advancement path P. According to a possible embodiment, the reference marker is defined by a slit in a bracket connected to the frame of the packaging machine 1.

[0055] For each image acquired by camera 11A, the control unit 16 is configured for measuring the angular position T of the packaging material edge 13B with respect to the longitudinal axis Y based on the position of said packaging material edge 13B with respect to the reference marker. In particular, the control unit 16 is configured for measuring the angular position T of the packaging material edge 13B with respect to the longitudinal axis Y based on the distance of said packaging material edge 13B from the reference marker.

[0056] In one or more embodiments, the control unit 16 is configured for measuring the angular position T of the packaging material edge 13B with respect to the longitudinal axis Y based on the position of a (outer) border of said packaging material edge 13B with respect to the reference marker.

[0057] According to a further and preferred embodiment, the camera 11A is adapted to acquire a reference image in a preliminary set-up phase. The reference image comprises at least a longitudinal portion of the tube 5 and a movable reference marker. The reference marker is connected to a frame of the packaging machine 1. According to a possible embodiment, the reference marker is defined by a slit in a bracket connected in a removable manner to the frame of the packaging machine 1. After having acquired the reference image in the preliminary set-up phase, the movable reference marker is removed from the packaging machine 1 and the reference image is stored in the control unit 16.

[0058] The control unit 16 is configured for comparing the image provided by the imaging device 9 with the reference image. In particular, the control unit 16 is configured for measuring the angular position T of the packaging material edge 13B with respect to the longitudinal axis Y based on the displacement of the packaging material edge 13B with respect to a reference position of the packaging material edge 13B in the reference image.

[0059] In both embodiments, the evaluation of the correct positioning of the packaging material edge 13B allows the users to determine whether the tube 5 being formed is arranged in a correct position with respect to the longitudinal axis Y. According to a preferred embodiment, the control unit 16 is indeed realized for controlling the folding unit 4 and the sealing unit 7 based on the angular position T of the packaging material edge 13B.

[0060] In case the angular position T of the packaging material edge 13B being formed with respect to the longitudinal axis Y is greater than a pre-defined threshold, the control unit 16 is designed to generate a warning signal for informing of an undesired and significant deviation.

[0061] According to a preferred embodiment, the control unit 16 is configured for using the angular position T of the packaging material edge 13B for a closed loop control of the folding unit 4 and/or the sealing unit 7.

[0062] It is clear that, with the same image provided by the camera 11A for each packaging material unit 13, the control apparatus 8 can measure and control both the actual value of the overlapping area AO and the twist-

ing of the tube 5 around the longitudinal axis Y.

LIST OF REFERENCE NUMBERS

[0063]

1	packaging machine
2	packs
3	sterilizing unit
4	folding unit
5	tube
6	structure
7	sealing unit
8	control apparatus
9	imaging device
11	sensor
12	pattern of reference marks
13	packaging material unit
14, 14*	reference mark
14A*	reference point
15, 15*	reference mark
15A*	Reference point
16	control unit
17	sensing device
18	sensor
19	sterilizing bath
20	web of packaging material
21	reel
P	conveying path
Y	longitudinal axis
D_1	distance
D_2	distance
AO	overlapping area
V	width
D_3	distance
D_4	distance
T	angular position of the packaging material edge 13B

Claims

1. A packaging machine for producing sealed packages from a packaging material fed along a conveying path (P), said packaging material having a plurality of patterns (12) of reference marks which are arranged one after the other along the longitudinal dimension of the packaging material; each of said pattern (12) defines a packaging material unit (13) for a respective sealed package and comprises at least two reference marks (14, 15; 14*, 15*); the packaging (1) machine comprising a folding unit (4) arranged along said conveying path (P) for folding said packaging material from a planar shape into a tube (5) having a longitudinal axis (Y), in which a first edge (13B) of the packaging material is at least partially placed on top of a second edge (13A) of the packaging material defining an overlapping area (AO) of the packaging material; and a control apparatus (8) comprising:

- a sensing device (17) having at least a first sensor (18) arranged along said conveying path (P) upstream of the folding unit (4); the sensing device (17) being configured for measuring at least a first parameter (D_1; V) of the packaging material when the packaging material has a planar shape and generating a first signal indicating said first parameter (D_1; V);
- an imaging device (9) having at least a second sensor (11) arranged along said conveying path (P) downstream of the folding unit (4) and adapted to frame at least a longitudinal portion of the tube (5); the imaging device (11) is configured for measuring at least a second parameter (D_2; D_4) of the packaging material and generating a second signal indicating said second parameter (D_2; D_4); and

a control unit (16) connected to both the sensing device (17) and the imaging device (11) and configured for calculating a width of said overlapping area (AO) based on said first signal and second signal.

2. The packaging machine according to claim 1, and further comprising a sealing unit (7) arranged downstream of the folding unit (4) along the conveying path (P) to obtain a fluid-tight longitudinal seal in the tube (5), the imaging device (9) being placed downstream of the sealing unit (7).

3. The packaging machine according to claim 1 or 2 and comprising a sterilizing unit (3) for the packaging material arranged upstream of the folding unit (4) along the conveying path (P), the sensing device (17) being placed upstream of the sterilizing unit (3).

4. The packaging machine according to any one of the preceding claims, wherein the first sensor (18) is a first camera (18A) or a through-beam sensor (18), preferably a through-beam laser sensor (18).

5. The packaging machine according to any one of the preceding claims, in which the second sensor (11) is a second camera (11A).

6. A method for producing sealed packages from a packaging material fed along a conveying path (P), said packaging material having a plurality of patterns (12) of reference marks, which are arranged one after the other along the longitudinal dimension of the packaging material; each of said patterns (12) defines a packaging material unit (13) for a respective sealed package and comprises at least two reference marks (14, 15; 14*, 15*); the method comprises the steps of:

- acquiring an image of a longitudinal portion of the packaging material for measuring at least a first parameter (D_1; V) of a packaging material unit (13) when the packaging material has a planar shape;
- folding said packaging material from a planar shape into a tube (5) having a longitudinal axis (Y) such that a first edge (13B) of the packaging material at least partially overlaps a second edge (13A) of the packaging material so defining an overlapping area (AO) of the packaging material;
- acquiring an image of at least a longitudinal portion of the tube (5) for measuring at least a second parameter (D_2; D_4) of the packaging material unit (13); and
- calculating a width of said overlapping area (AO) based on said first parameter (D_1; V) and said second parameter (D_2; D_4).

7. The packaging method according to claim 6, wherein a first reference mark (14) is arranged in proximity of the second edge (13A) of the packaging material; and wherein the first parameter (D_1) is a distance of the second edge (13A) of the packaging material from the first reference mark (14).

8. The packaging method according to claim 7, wherein the second parameter (D_2) is a distance of the second reference mark (15) from the first reference mark (14); and wherein the method comprises the further step of calculating said width of the overlapping area (AO) through the difference between the first parameter (D_1) and the second parameter (D_2).

9. The packaging method according to claim 8, wherein the second reference mark (15) is the first edge (13B), preferably a border of the first edge (13B) of the packaging material.

10. The packaging method according to claim 8, wherein the second reference mark (15) has a reference portion (15B) that corresponds to the first edge (13B) of the packaging material, and wherein the second parameter (D_2) is a distance of the reference portion (15B) of the second reference mark (15) from a reference portion (14A) of the first reference mark (14).

11. The packaging method according to claim 10, wherein the reference potion (14A) is an edge of the first reference mark (14) facing the second edge (13A) of the packaging material.

12. The packaging method according to claim 6, wherein a first reference mark (14*) is arranged in proximity of the second edge (13A) of the packaging material and a second reference mark (15*) is arranged in proximity of the first edge (13B) of the packaging material; and wherein the first parameter (V) is a width of the packaging material from the first edge (13B) to the second edge (13A) when the packaging material has a planar shape.

13. The packaging method according to claim 12, wherein the second parameter (D_4) is a distance between the first reference mark (14*) and the second reference mark (15*) when the packaging material is folded; and wherein the method comprises the further steps of:

- acquiring a third parameter (D_3) indicating the distance between the first reference mark (14*) and the second reference mark (15*);
- calculating the perimeter of the tube (5) through the sum of the third parameter (D_3) and the second parameter (D_4); and
- calculating said width of the overlapping area (AO) through the difference between the first parameter (V) and said perimeter.

14. The packaging method according to any one of claims 6 to 12, wherein, in case the difference between said width of the overlapping area (AO) and a reference value exceeds a pre-set threshold, the method comprises the further step of generating a warning signal and/or the further step of closed loop controlling said step of folding.

15. The packaging method according to any one of claims 6 to 14, and comprising the further step of using the image of at least a longitudinal portion of the tube (5) for measuring the angular position (T) of the first edge (13B), preferably a border thereof, with respect to the longitudinal axis (Y).

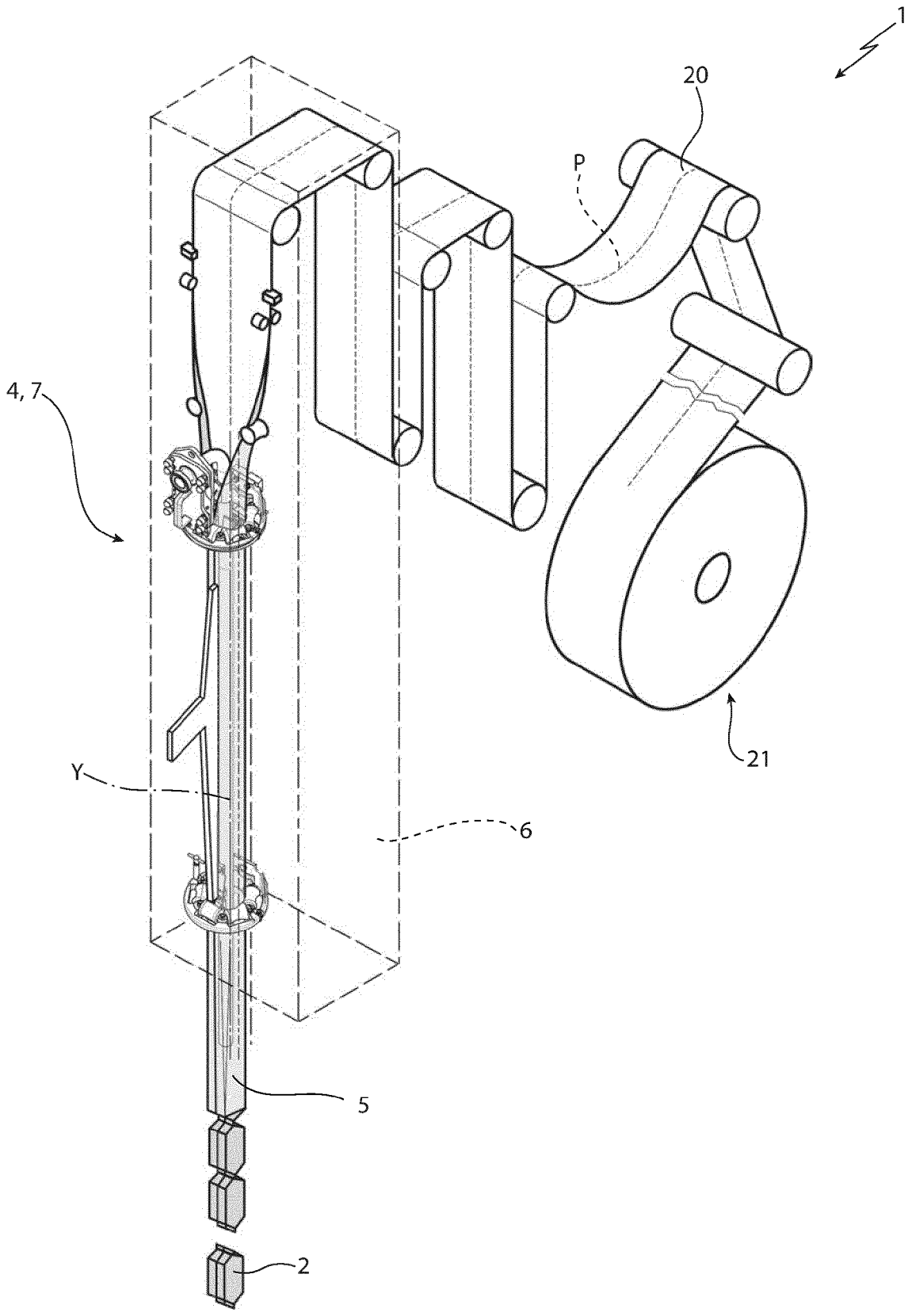

FIG. 1

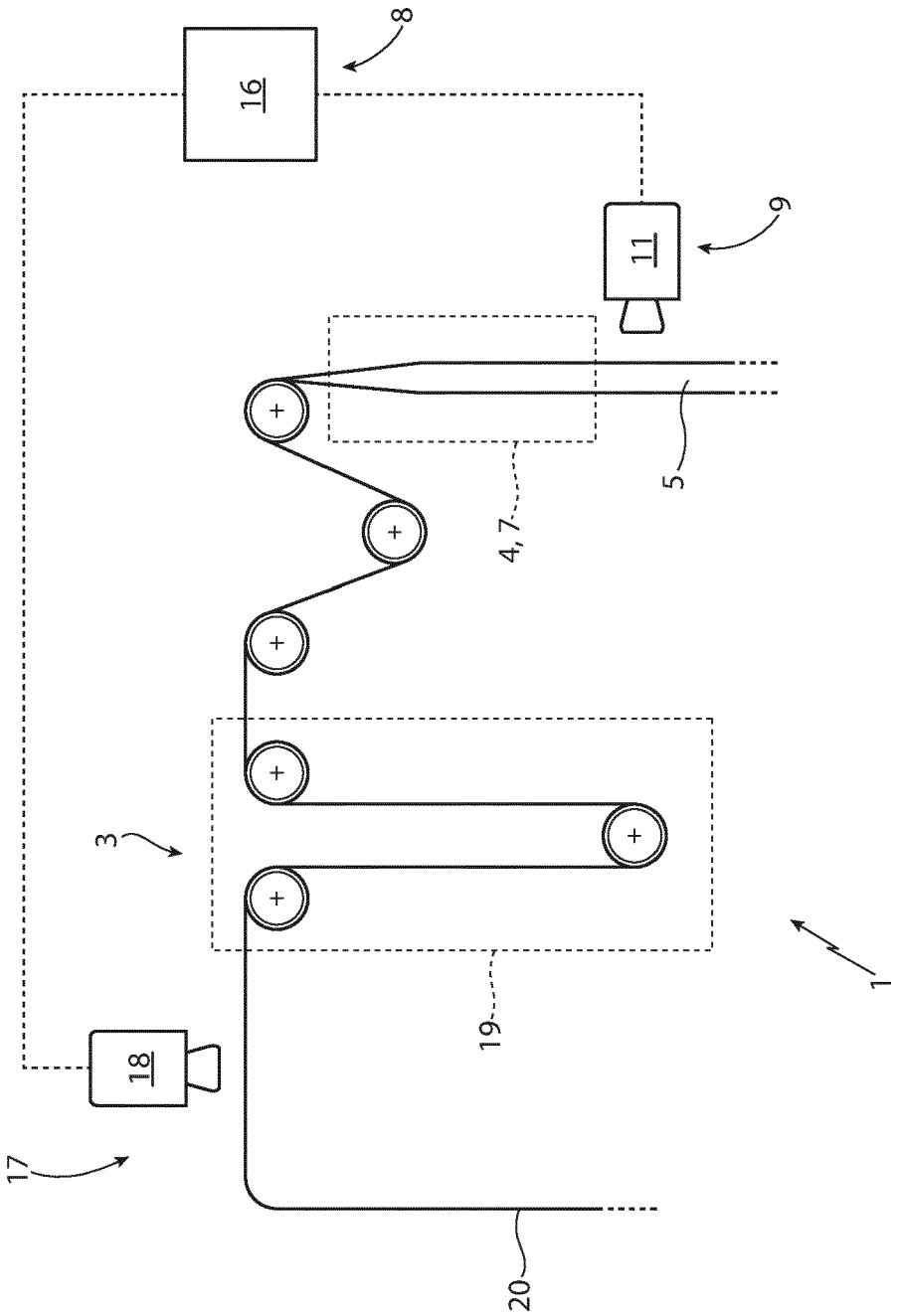

FIG. 2

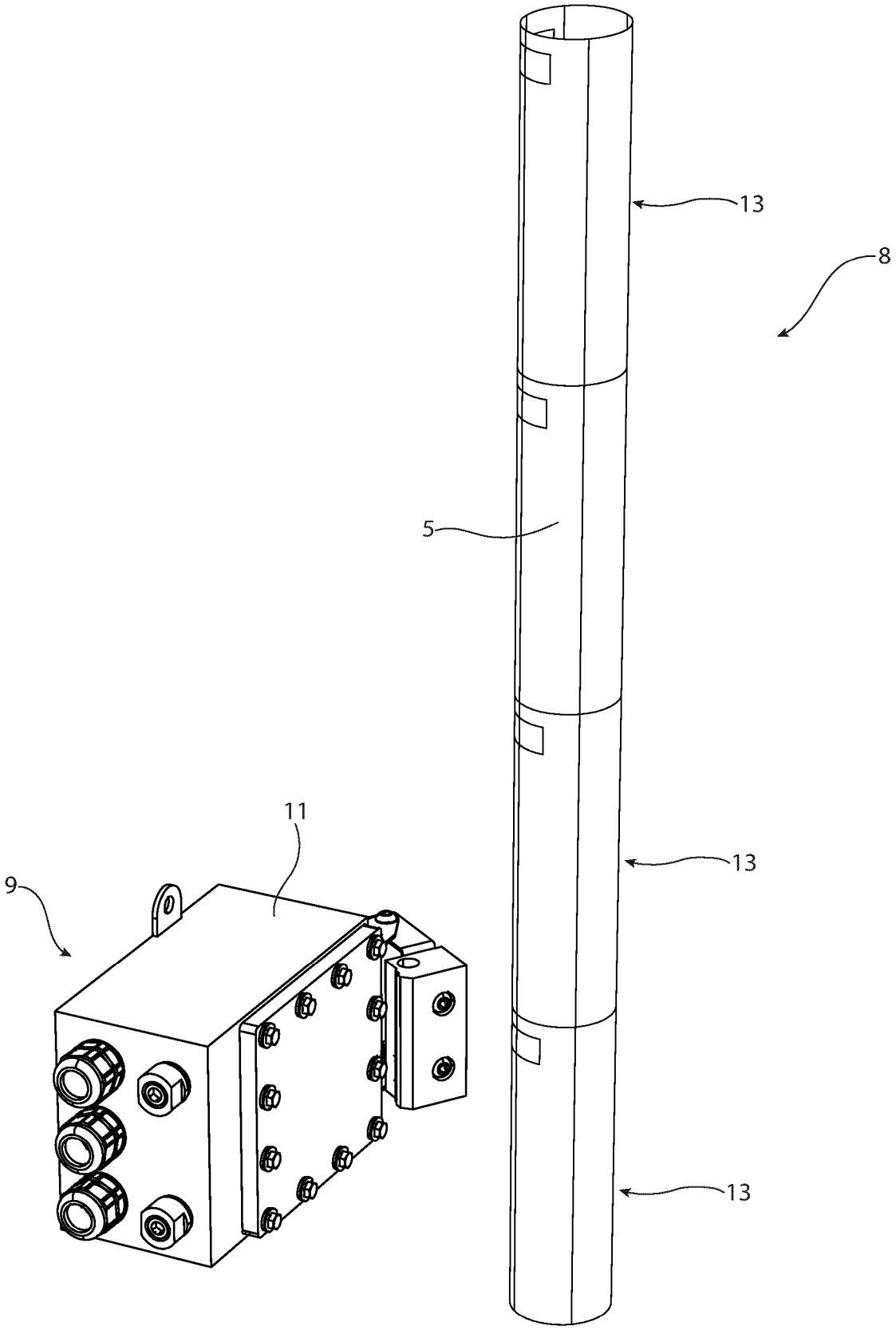

FIG. 3

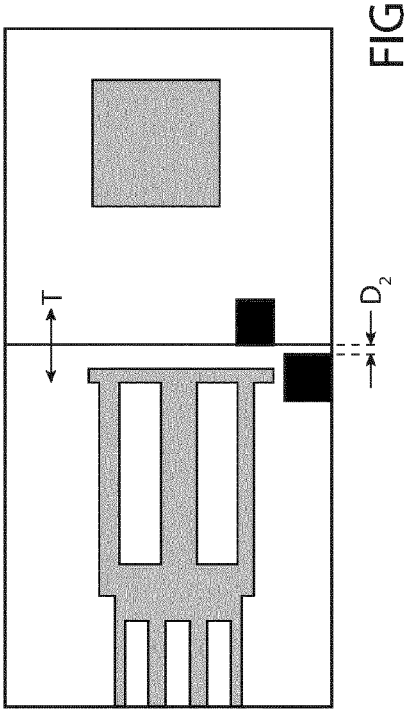

FIG. 5

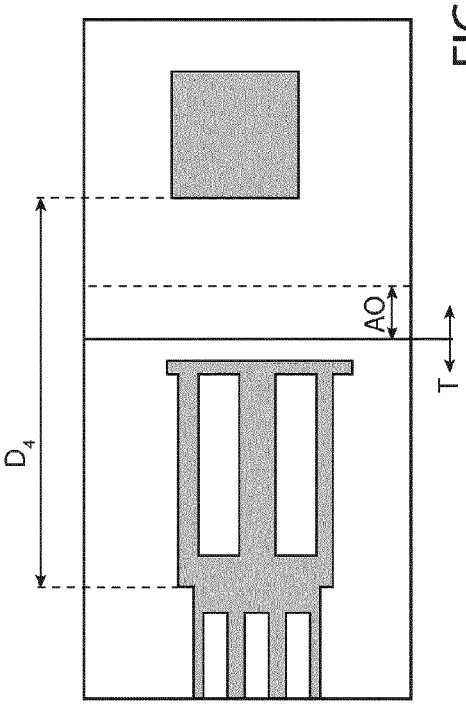

FIG. 7

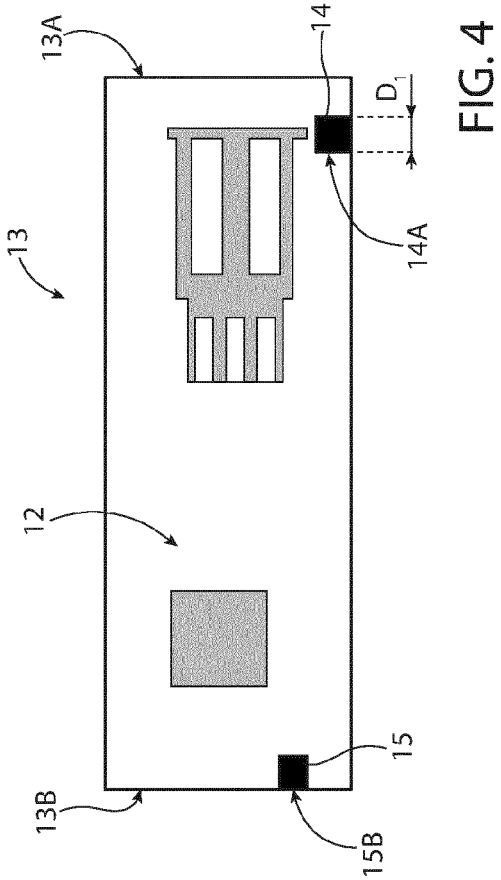

FIG. 4

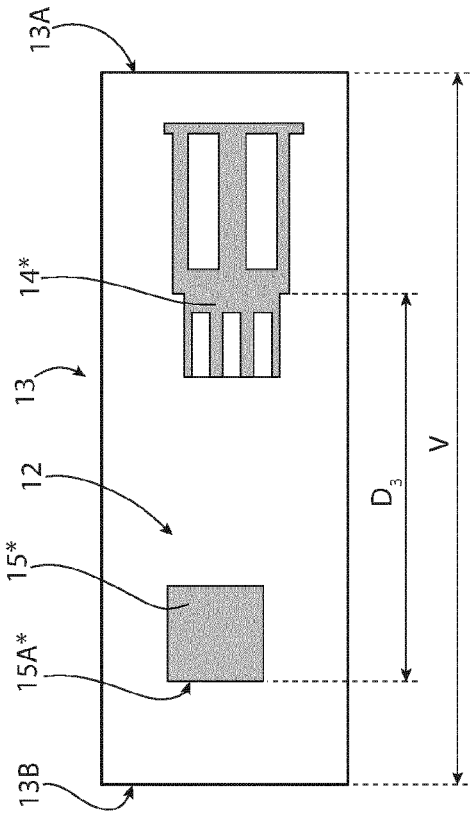

FIG. 6

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EUROPEAN SEARCH REPORT

Application Number
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B65B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	4 October 2023	Dick, Birgit

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