



(12)

EUROPEAN PATENT APPLICATION

- (43)

Date of publication:
11.12.2024 Bulletin 2024/50
- (21)

Application number: 24175723.6
- (22)

Date of filing: 14.05.2024
- (51)

International Patent Classification (IPC):
B65H 23/038 (2006.01) B65H 27/00 (2006.01)
B65B 9/20 (2012.01) H02N 13/00 (2006.01)
B25J 15/00 (2006.01)
- (52)

Cooperative Patent Classification (CPC):
B65H 23/038; B65B 9/20; B65H 27/00;
H02N 13/00; B65H 2404/186; B65H 2404/193;
B65H 2553/23; B65H 2801/69

(84) Designated Contracting States: AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC ME MK MT NL NO PL PT RO RS SE SI SK SM TR Designated Extension States: BA Designated Validation States: GE KH MA MD TN (30) Priority: 05.06.2023 IT 202300011340 (71) Applicant: Tetra Laval Holdings & Finance S.A. 1009 Pully (CH) (72) Inventors: • BORELLI, Gabriele 41123 Modena (IT)	• PICCININI, Giorgio 41123 Modena (IT) • VERTECHY, Rocco 41123 Modena (IT) • AGOSTINI, Lorenzo 41123 Modena (IT) • BERTOLUCCI, Federico 41123 Modena (IT) • CARLONI, Amedeo 41123 Modena (IT) • MONARI, Eugenio 4112 Modena (IT) (74) Representative: Tetra Pak - Patent Attorneys SE AB Tetra Pak Patent Department Ruben Rausing's gata 221 86 Lund (SE)
---	--

(54)

CONVEYING DEVICE FOR A WEB OF PACKAGING MATERIAL AND PACKAGING MACHINE FOR PRODUCING SEALED PACKAGES PROVIDED WITH SAID CONVEYING DEVICE

- (57)

It is described a conveying device (15) for a web (4) of packaging material fed along a conveying path (P), in particular for a packaging machine (1) for producing sealed packages, with a number of electroadhesive ele-
- ments (18) having an outer electroadhesive gripping surface (19) configured to adhere to the web (4) of packaging material.

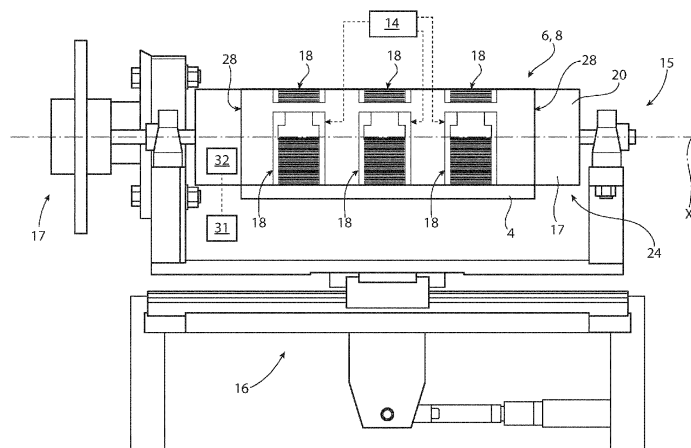


FIG. 3

Description

TECHNICAL FIELD

[0001] The present invention relates to a conveying device for conveying a web of packaging material and to a packaging machine for producing sealed packages provided with said conveying device.

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 tube forming unit arranged downstream of the sterilizing unit, extending substantially vertically and designed to fold the web of packaging material for producing a continuous tube. Inside the tube forming 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 a 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 tube forming unit is preferably arranged within a fixed structure in which the web of packaging material is maintained in a sterile-air environment. The tube forming unit further comprises a number of folding devices placed in succession (one after the other): by interacting with the folding devices, opposite lateral portions (or edges) of the web of packaging material are placed one on top of the one another so as to form the tube and so as to define an overlapping area and finally sealed to obtain a fluid-tight longitudinal seal in the tube.

[0005] In the above-described packaging machines, in order to ensure a good quality of the sealing of the tube of packaging material, the web of packaging material must be fed having a predetermined position. Therefore, the need is felt to control the position of the web of wrapping material on the known guiding elements and/or to control the friction between the web of wrapping material the known guiding elements to avoid slippery of packaging material.

DISCLOSURE OF INVENTION

[0006] The object of the invention is to provide a con-

veying device for conveying a web of packaging material not suffering from the drawbacks described above and, in particular, being easy and economic to be manufactured.

[0007] A further object of the invention is to provide a packaging machine for producing sealed packages not suffering from the drawbacks described above and, in particular, being easy and economic to be manufactured.

[0008] According to the invention, there are provided a conveying device for a web of packaging material and a packaging machine for producing sealed packages provided with said conveying device according to the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] 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 the packaging machine of Figure 1;
- Figure 3 is a schematic front view of an electroadhesive device of the packaging machine of Figure 1;
- Figures 4A and 4B are respectively a plan view and a side view of a portion of the electroadhesive device of figure 3.

BEST MODE FOR CARRYING OUT THE INVENTION

[0010] 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 a packaging material unwound from a reel 3 and fed along a conveying path P. When unwound from the reel 3, the packaging material has the shape of a continuous planar web 4 of packaging material.

[0011] Typically, the packaging material has a multi-layer structure. More specifically, the packaging material may comprise at least a layer of fibrous material, such as for example a paper or cardboard layer, and at least two layers of heat-seal plastic material, e.g. polyethylene, with the layer of fibrous material interposed between them. One of these two layers of heat-seal plastic material may define the inner face of the packages eventually contacting the pourable product.

[0012] 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, which, in particular, is arranged between one of the layers of heat-seal plastic material and the layer of fibrous material. Preferably, the

packaging material may also comprise a further layer of heat-seal plastic material interposed between the layer of gas- and light-barrier material and the layer of fibrous material.

[0013] The web 4 of packaging material is fed to a sterilizing unit 5 by means of guiding elements 6, in particular by a number of rollers 6 (one of said rollers is illustrated in figure 2). The sterilizing unit 5 has a sterilizing bath 7, in which a chemical sterilizing agent, such as a hydrogen peroxide solution, is applied to the web 4 of packaging material. The web 4 of packaging material is fed through the sterilizing unit 5 by means of known guiding elements 8, like for example rollers 8 or similar elements.

[0014] The packaging machine 1 further comprises a tube forming unit 9 arranged downstream of the sterilizing unit 5 along the conveying path P. The tube forming unit 9 extends substantially vertically along the conveying path P for producing a continuous tube 10. In particular, inside the tube forming unit 9, the web 4 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.

[0015] The tube forming unit 9 is defined within a fixed structure 11 in which the web 4 of packaging material is maintained in a sterile-air environment. The tube forming unit 9 further comprises a number of folding devices 12 placed along the conveying path P in succession (one after the other), each of said folding devices 12 comprising a number of folding rollers cooperating to fold the web 4 of packaging material.

[0016] The packaging machine 1 comprises a sealing unit 30 (of the known type and not described in detail) for sealing overlapping lateral edges of the packaging material to obtain a fluid-tight longitudinal seal in the tube 10. The tube 10 is continuously filled with the pourable food product through a pour conduit 13, which partially extends inside the tube 10 and is part of a filling circuit.

[0017] The tube 10 is sent to a transverse forming sealing unit (not shown), in which the tube 10 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.

[0018] Figure 3 exemplifies a conveying device 15 according to a preferred embodiment, e.g. comprised in the packaging machine 1, for conveying the web 4 of packaging material fed along the conveying path P. The conveying device 15 may comprise a rotary device (like a drum or a roller).

[0019] It will be appreciated that, although depicted herein as a packaging machine producing packages from a tube 10, the conveying device 15 may be comprised in a packaging machine configured for producing packages from a web 4 of packaging material, that may be divided in blanks before being folded and filled.

[0020] In particular, the conveying device 15 may comprise an electroadhesive rollers guiding the web 4 of

packaging material through the packaging machine 1. According to a preferred embodiment, the conveying device 15 comprises at least one of the rollers 6 guiding the web 4 of packaging material to the sterilizing unit 5; in particular, the conveying device 15 comprises the roller 6 closest to an inlet of the sterilizing unit 5. Alternatively or in addition to what just described, the conveying device 15 comprises at least one of the rollers 8 guiding the web 4 of packaging material to the tube forming unit 9; in particular, the conveying device 15 comprises the roller 8 immediately upstream of the tube 10.

[0021] The conveying device 15 is illustrated in detail in figure 3 and comprises the roller 6,8 which is supported by a fixed structure 16 and is rotated about an axis X by dedicated driving means 17. The axis X is orthogonal to an advancing direction of the web 4 of packaging material.

[0022] The conveying device 15 comprises a number (which can be equal to 1 or greater than 1) of electroadhesive elements 18. The conveying device 15 may comprise a control unit 14 connected, e.g. wirelessly or cabled, to said electroadhesive elements 18 and configured for supervising and controlling said electroadhesive elements 18.

[0023] The conveying device 15 may comprise an energy receiver 32, connected to the number of electroadhesive elements 18, and an energy transmitter 31, e.g. positioned at a backing structure 24. The energy receiver 32 may be configured to receive, e.g. wirelessly, the energy from the energy transmitter 31, to power the electroadhesive elements 18. For example, the energy transmitter 32 and receiver 31 may exchange energy by means of a sliding contact or may comprise a transformer.

[0024] The electroadhesive elements 18 are substantially equal to each other, have a multilayered structure, are provided with an external electroadhesive gripping surface 19.

[0025] According to a preferred embodiment, the conveying device 15 may comprise the backing structure 24 for supporting the web of packaging material. The number of electroadhesive elements 18 may be positioned at an outer surface 20 of the backing structure 24 in contact, in use, with the web 4 of packaging material. For example, the electroadhesive elements 18 may be arranged to at least partially cover an external cylindrical surface 20 of the roller 6, 8.

[0026] The external electroadhesive gripping surface 19 is coaxial to axis X and, when in use, it is placed in contact with the web 4 of packaging material.

[0027] The number of electroadhesive elements 18 are arranged along the axis X; preferably the number of electroadhesive elements 18 are arranged side by side and/or evenly placed. The number of electroadhesive elements 18 arranged along the axis X may range from one to eight, preferably from two to six. In particular, the roller 6, 8 may comprise three electroadhesive elements 18 arranged side by side and evenly placed along the

axis X.

[0028] Advantageously, electroadhesive elements 18 are arranged along an axis parallel to the advancing direction of the web 4 of packaging material. Preferably, the number of electroadhesive elements 18 are arranged side by side and/or evenly placed.

[0029] According to a first embodiment, electroadhesive elements 18 are arranged one after the other along the circumference of the external cylindrical surface 20; in other words, the electroadhesive elements 18 are arranged in succession so as to uniformly cover a cylindrical surface portion.

[0030] According to a first embodiment, electroadhesive elements 18 are arranged with a chess-like configuration. The electroadhesive elements 18 cover as much available outer cylindrical surface 20 as possible; i.e. the electroadhesive elements 18 cover at least a majority of the outer cylindrical surface 20. The electroadhesive elements 18 cover from 50% to 90% of the outer cylindrical surface 20; preferably, the electroadhesive elements 18 cover from 60% to 80% of the outer cylindrical surface 20.

[0031] Only one electroadhesive element 18 will be described in detail below. The electroadhesive element 18 is illustrated in detail in figure 4.

[0032] The electroadhesive element 18 comprises a set 21 of electrodes, in particular each set 21 comprises two electrodes 22, 23 of opposite polarity. A dielectric layer 25 may be interposed between the electrodes 22, 23. Optionally, the dielectric layer 25 may be part of the backing structure 24, i.e. the backing structure 24 may be made of a dielectric material. In alternative, as exemplified in the figures, the dielectric layer 25 may be interposed between the electrodes 22, 23 and the backing structure 24.

[0033] As exemplified, the backing structure 24 is coaxial to axis X, has a cylindrical shape and is aimed at supporting the electroadhesive elements 18.

[0034] The dielectric layer 25 preferably extends outward from the electrodes 22, 23, and/or is interposed between adjacent electrodes 22, 23 and/or is designed to isolate the electrodes 22, 23 from the backing structure 24. The dielectric layer 25 is made of insulating material; advantageously, the dielectric layer 25 is made of silicone material. The dielectric layer 25 has a thickness k comprised between $2\text{ }\mu\text{m}$ and $30\text{ }\mu\text{m}$; preferably, the thickness k is comprised between $10\text{ }\mu\text{m}$ and $20\text{ }\mu\text{m}$.

[0035] According to a preferred embodiment, the dielectric layer 25 has a cylindrical shape, is coaxial to the axis X and is arranged to uniformly cover the backing structure 24.

[0036] The electroadhesive element 18 comprises a further dielectric layer 26 covering the electrodes 22, 23 and optionally the dielectric layer 25. The electrodes 22, 23 are encapsulated within two dielectric layers 25, 26. The dielectric layer 26 has a uniform thickness h . The thickness h is comprised between $2\text{ }\mu\text{m}$ and $30\text{ }\mu\text{m}$; preferably, the thickness h is comprised between $4\text{ }\mu\text{m}$ and $16\text{ }\mu\text{m}$.

[0037] The dielectric layer 26 uniformly covers the electrodes 22, 23. The dielectric layer 26 may uniformly covers the dielectric layer 25 (or directly the backing structure 24) to which it is bonded with an inner surface.

The dielectric layer 26 is made in an insulating material, preferably chosen among the following ones: polyether ether ketone (also called PEEK), polyimide (also called PI), polyethylene terephthalate (also called PET), polyethylene naphthalate (also called PEN).

[0038] In use, an outer surface 27 of the dielectric layer 26 is in contact with the web 4 of packaging material and defines the outer electroadhesive gripping surface 19.

[0039] According to a preferred embodiment, the dielectric layer 26 has a cylindrical shape and is coaxial to the axis X. The dielectric layer 26 may be arranged to uniformly cover the dielectric layer 25 (e.g the backing structure 24 or a dielectric layer covering the backing structure 24).

[0040] More in detail, each set 21 includes an array of linear patterned negative teeth 22A, each of which is electrically coupled to a common negative bar 22B. The common negative bar 22B is substantially orthogonal to negative teeth 22A.

[0041] Each set 21 further includes an array of linear patterned positive teeth 23A, each of which is electrically coupled to a common positive bar 23B. The common positive bar 23B is substantially orthogonal to positive teeth 23A. The common negative bar 22B and the common positive bar 23B are connected to a power supply using respective known electrical connections (not shown).

[0042] The positive and negative teeth 22A, 23A are interdigitated on a common plane, e.g. on the same surface of the dielectric layer 25. In other words, the teeth 22A, 23A of opposite polarity are arranged extending in a comb-shaped interdigital array. The dielectric layer 25 or 26 is interposed between two adjacent teeth 22A, 23A. In particular, the negative and positive teeth 22A, 23A are manufactured so as to have the shapes of bars or stripes, each of which is interposed (not in contact) between two respective teeth 22A, 23A of opposite polarity. The negative and positive teeth 22A, 23A are substantially parallel one to another and have uniform dimensions.

[0043] A gap g is defined, which represents the distance between two adjacent teeth 22A, 23A. In other words, the gap g is the width of the stripe of dielectric layer 25 interposed between two adjacent teeth 22A, 23A. The gap g is comprised between $300\text{ }\mu\text{m}$ and $600\text{ }\mu\text{m}$; preferably, the gap g is comprised between $350\text{ }\mu\text{m}$ and $450\text{ }\mu\text{m}$; advantageously, the gap g is equal to $400\text{ }\mu\text{m}$.

[0044] A width w of each tooth 22A, 23A is also defined. The width w is comprised between $5000\text{ }\mu\text{m}$ and $9000\text{ }\mu\text{m}$; preferably, the width w is comprised between $6000\text{ }\mu\text{m}$ and $8000\text{ }\mu\text{m}$; advantageously, the width w is equal to $7300\text{ }\mu\text{m}$.

[0045] The teeth 22A, 23A of opposite polarity inter-

digitated on the dielectric layer 25 extend over an area having dimensions indicated with H and L; dimensions H and L are equal to 15 mm and 24 mm, respectively.

[0046] The active area (i.e. the area of the teeth 22A, 23A of opposite polarity that forms an electric field and interacts with the portion of web 4 of packaging material) of each electroadhesive element 18 is comprised between 320 mm² and 400 mm², preferably the active area of each electroadhesive element 18 is comprised between 365 mm² and 380 mm².

[0047] It is important to highlight that a standard roller 6, 8 of the known type acts as the backing structure 24.

[0048] In use, the web 4 of packaging material is conveyed upon the roller 6, 8, in particular the web 4 of packaging material is placed against the electroadhesive gripping surface 19.

[0049] The control unit 14 is coupled to the electroadhesive elements 18 and is aimed at applying an electrostatic adhesion voltage to each set 21 of electrodes 22, 23. In particular, the electrostatic adhesion voltage alternates positive and negative charges on adjacent electrodes 22, 23.

[0050] The outer electroadhesive gripping surface 19 may be configured to adhere to the web 4 of packaging material by means of an electric field inducing electric charges in the web 4. In particular, the electrostatic adhesion voltage forms an electric field that interacts with the portion of web 4 of packaging material in contact with the electroadhesive gripping surface 19. The electric field may locally polarize the web 4 of packaging material and induce electric charges in the web 4 of packaging material that are opposite to the charge of the electrodes 22, 23. The opposite charges of the electrodes 22, 23 and the web 4 of packaging material attract, causing electroadhesion between the electrodes 22, 23 and the web 4 of packaging material. In other words, as a result of the electrostatic adhesion voltage applied to adjacent electrodes 22, 23, an electroadhesive force is generated, which acts so as to cause the web 4 of packaging material to adhere to the roller 6, 8.

[0051] The electroadhesive element 18 also works as a contact sensor of the web 4 of packaging material depending on the capacity of the electroadhesive element 18 itself. Control unit 14 is configured for determining a position of the web 4 of packaging material with respect to the electroadhesive elements 18 and/or the backing structure 24. In particular, control unit 14 is configured for determining the position of the edges 28 of the web 4 of packaging material, in particular with respect to the roller 6, 8 axial direction; i.e. control unit 14 is configured for determining if the electroadhesive elements 18 are at least partly or fully covered with the web 4 of packaging material. For example, the control unit 14 may be configured to receive a capacity from the number of electroadhesive elements 18, indicative of presence of the web. That is, a difference in capacity value exists in case of an electroadhesive element 18 covered by the web and an uncovered electroadhesive element 18.

[0052] Advantageously, control unit 14 is configured for determining a speed of the web 4 of packaging material (in particular, control unit 14 is configured for checking if the web 4 of packaging material slips).

[0053] The control unit 14 is configured for determining a difference between a speed of the conveying device 15 (e.g. an angular velocity of the roller) and a speed of the web 4 of packaging material. If the difference exceeds a predetermined threshold, a slip occurs.

[0054] The control unit 14 is designed to determine the capacity of each electroadhesive element 18; the capacity of each electroadhesive element 18 is variable as a function of the active area and of the dielectric permittivity of the material in contact with the electroadhesive gripping surface 19. The active area remains the same while dielectric permittivity has a different value in case the material in contact with the electroadhesive gripping surface 19 is air or, alternatively, the web 4 of packaging material or, alternatively, a combination of air and the web 4 of packaging material. Therefore, based on the capacity determined for each electroadhesive element 18, the control unit 14 can detect if the electroadhesive element 18 is at least partly or fully covered with the web 4 of packaging material and the position of the edges 28.

[0055] The conveying device 15 uses the electrical control of the electrostatic adhesion voltage to permit a temporary and detachable attachment between the web 4 of packaging material and the electroadhesive gripping surface 19.

[0056] More in detail, the electroadhesive gripping surface 19 is configured to selectively adhere to the web 4 of packaging material. In particular, the electroadhesive gripping surface 19 is configured for adhering to the web 4 when an electrostatic adhesion voltage is applied to the electroadhesive element 18. Removal of the electrostatic adhesion voltage ceases the adhesion.

[0057] In particular, the outer electroadhesive gripping surface (19) may be configured to selectively adhere to the web (4) of packaging material as a function of a number of parameters, e.g. comprising one or more of the tensioning of the web 4 of packaging material and/or the position of the web 4 of packaging material (in particular, with respect to the backing structure 24) and/or the speed of the web 4 of packaging material.

[0058] The electroadhesive elements 18 can be driven (operated) independently of each other; in particular, the control unit 14 is designed to apply an electrostatic adhesion voltage to each set 21 independently of the electrostatic adhesion voltage applied to the remaining sets 21. Thus, the friction between the electroadhesive gripping surface 19 and the web 4 of packaging material is variable along the axis X. In other words, the control unit 14 uses the electrical control of the electrostatic adhesion voltage to modify (i.e. increase or decrease) the friction between the web 4 of packaging material and the electroadhesive gripping surface 19 along the axis X.

[0059] The minimum electrostatic adhesion voltage needed to allow the web 4 of packaging material to ad-

here to the electroadhesive gripping surface 19 is variable according to a number of factors, such as: the size of the web 4 of packaging material, the material conductivity and spacing of the electroadhesive elements 18, the insulating material used for the dielectric layer 26, the presence of any disturbances to the electro-adhesion such as dust, other particulates or moisture. The electrostatic adhesion voltage can vary between 500 V and 10 kV; preferably, the electrostatic adhesion voltage can vary between 2 kV and 4 kV.

[0060] Removal of the electrostatic adhesion voltages from the electrodes 22, 23 ceases the electrostatic adhesion force between the web 4 of packaging material and the electroadhesive gripping surface 19. Thus, when there is no electrostatic adhesion voltage between electrodes 22, 23, the web 4 of packaging material can readily move relative to the outer cylindrical surface 20.

LIST OF REFERENCE NUMBERS

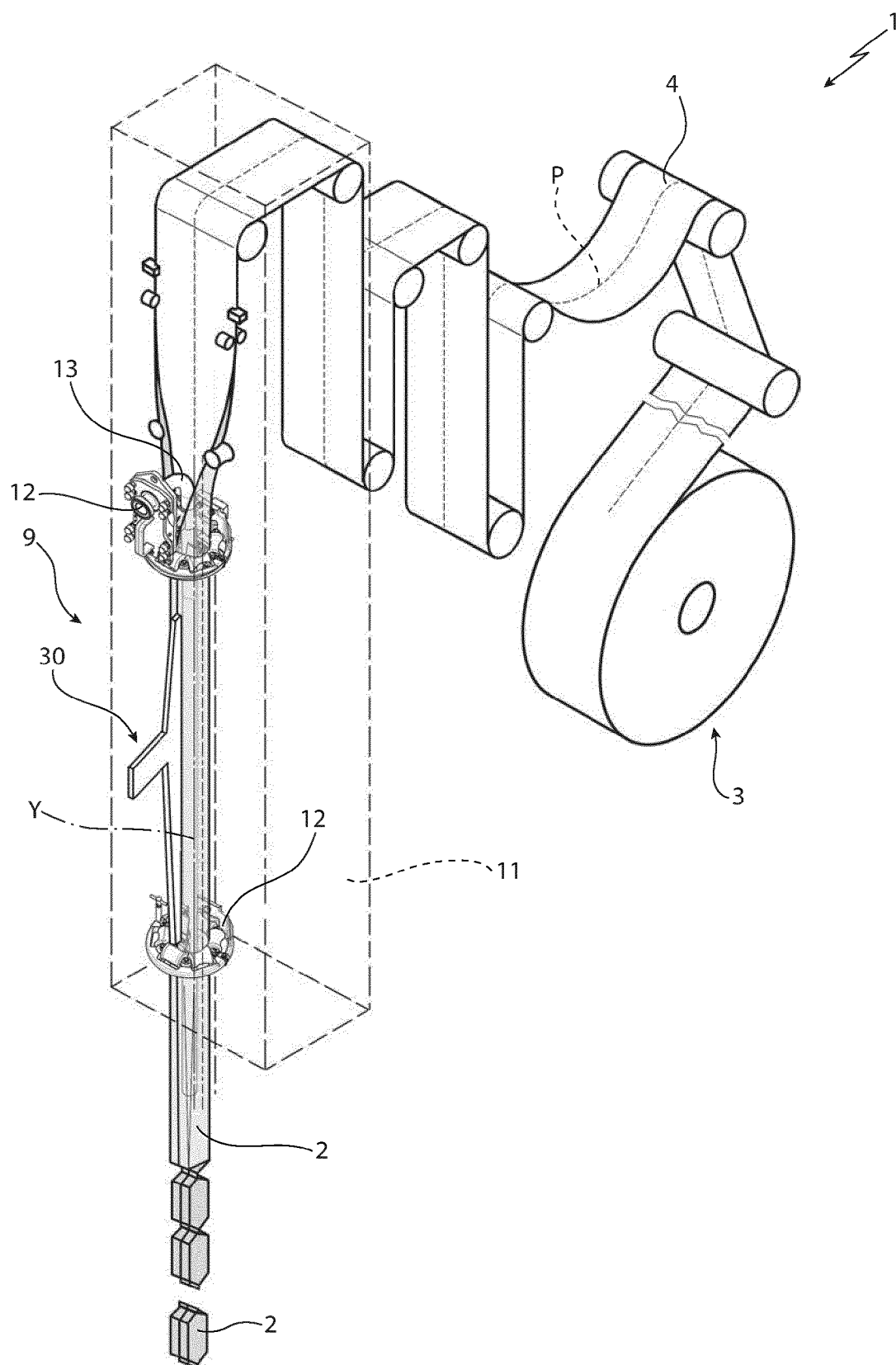
[0061]

1	packaging machine
2	packs
3	reel
4	web of packaging material
5	sterilizing unit
6	roller
7	sterilizing bath
8	roller
9	tube forming unit
10	continuous tube
11	structure
12	folding device
13	pour conduit
14	control unit
15	conveying device
16	structure
17	driving means
18	electroadhesive element
19	electroadhesive gripping surface
20	outer (cylindrical) surface
21	set
22	electrode
23	electrode
22A, 23A	positive/negative tooth
22B, 23B	common positive/negative bar
24	backing structure
25	dielectric layer
26	dielectric layer
27	outer surface
28	edge
30	sealing unit
31	energy transmitter
32	energy receiver
P	conveying path
Y	longitudinal axis
X	axis

Claims

1. A conveying device (15) for a web (4) of packaging material fed along a conveying path (P) comprising a number of electroadhesive elements (18) comprising an outer electroadhesive gripping surface (19) configured to adhere to the web (4) of packaging material.
2. The conveying device (15) according to claim 1, wherein said outer electroadhesive gripping surface (19) is configured to selectively adhere to the web (4) of packaging material.
3. The conveying device (15) according to claim 2, wherein said outer electroadhesive gripping surface (19) is configured to selectively adhere to the web (4) of packaging material as a function of the tensioning of the web (4) of packaging material and/or the position of the web (4) of packaging material with respect to the number of electroadhesive elements (18) and/or the speed of the web (4) of packaging material.
4. The conveying device (15) according to any previous claim and comprising a backing structure (24) for supporting the web of packaging material; wherein said number of electroadhesive elements (18) is positioned at an outer surface (20) of the backing structure (24) in contact, in use, with the web (4) of packaging material.
5. The conveying device (15) according to any previous claim and comprising a control unit (14) connected to the number of electroadhesive elements (18) and configured for determining as a function of the capacity of the number of electroadhesive elements (18):
 - a position of the web (4) of packaging material with respect to the number of electroadhesive elements (18); and/or
 - if the number of electroadhesive elements (18) is at least partly or fully covered with the web (4) of packaging material; and/or
 - a speed of the web (4) of packaging material.
6. The conveying device (15) according to any previous claim, wherein the number of electroadhesive elements (18) comprises a first dielectric layer (26), whose external surface (27) defines the outer electroadhesive gripping surface (19); the first dielectric layer (26) has a uniform thickness (h) comprised between 2 μm and 30 μm , preferably, the thickness (h) is comprised between 4 μm and 16 μm .
7. The conveying device (15) according to any of the previous claims, wherein the number of electroad-

- hesive elements (18) comprises a first dielectric layer (26), whose external surface (27) defines the outer electroadhesive gripping surface (19); wherein the first dielectric layer (26) is made of an insulating material chosen among the following ones: polyether ether ketone (PEEK), polyimide (PI), polyethylene terephthalate (PET), polyethylene naphthalate (PEN).
8. The conveying device (15) according to any previous claim and comprising a plurality of electroadhesive elements (18) arranged along an axis (X) orthogonal to an advancing direction of the web (4) of packaging material and/or along an axis parallel to the advancing direction of the web (4) of packaging material.
 9. The conveying device (15) according to any previous claim, wherein the backing structure (24) has an outer surface (20) and the number of electroadhesive elements (18) cover at least a majority of said outer surface (20); in particular, from 50% to 90% of said outer surface (20), preferably, from 60% to 80% of the outer surface (20).
 10. The conveying device (15) according to any previous claim, wherein each electroadhesive element (18) comprises a set (21) of electrodes comprising two electrodes (22, 23) of opposite polarity extending in a comb-shaped interdigital array.
 11. The conveying device (15) according to claim 10, wherein each of the two electrodes (22, 23) includes an array of linear patterned teeth (22A, 22B); wherein:
 - the distance (g) between two adjacent teeth (22A, 23A) of opposite polarity is comprised between 300 μm and 600 μm ; preferably, said distance (g) is comprised between 350 μm and 450 μm , and/or
 - a width (w) of each tooth (22A, 23A) is comprised between 5000 μm and 9000 μm ; preferably, said width (w) is comprised between 6000 μm and 8000 μm .
 12. The conveying device according to any previous claim, wherein the backing structure (24) is a roller rotatable around a first axis (X), preferably wherein each electroadhesive element (18) comprises a number of dielectric layers (25, 26) folded over an outer surface (20) of the roller.
 13. The conveying device (15) according to any previous claim, wherein the electrostatic adhesion voltage is variable between 500 V and 10 kV; preferably, the electrostatic adhesion voltage can vary between 2 kV and 4 kV.
 14. The conveying device (15) according to any previous claim, wherein each electroadhesive element (18) comprises a first dielectric layer (26) whose external surface (27) defines the outer electroadhesive gripping surface (19), a second dielectric layer (25), and a set (21) of electrodes comprising two electrodes (22, 23) of opposite polarity interposed within the two dielectric layers (25, 26); wherein an electrostatic adhesion voltage is applied to each set (21) such that an electroadhesive force is generated to allow the web (4) of packaging material to adhere to the electroadhesive gripping surface (19) and wherein the electrostatic adhesion voltage is applied independently in each set (21).
 15. A packaging machine (1) for producing sealed packages from a web of packaging material fed along a conveying path (P), the packaging (1) machine comprises a conveying device (15) for the web (4) of packaging material realized according to anyone of the claims 1 to 14.
 16. A packaging machine according to claim 15, comprising a sterilizing unit (5) for the web (4) of packaging material, wherein the conveying device (15) comprises at least one of the rollers (6) guiding the web (4) of packaging material to the sterilizing unit (5); preferably, the conveying device (15) comprises the roller (6) closest to an inlet of the sterilizing unit (5).
 17. A packaging machine according to claim 15 or 16, comprising a tube forming unit (9) arranged along said conveying path (P) for folding said web (4) of packaging material from a planar shape into a tube (10) having a longitudinal axis (Y), wherein the conveying device (15) comprises at least one of the rollers (8) guiding the web (4) of packaging material (7) to the tube forming unit (9); preferably the conveying device (15) comprises the roller (8) immediately upstream of the tube (10).



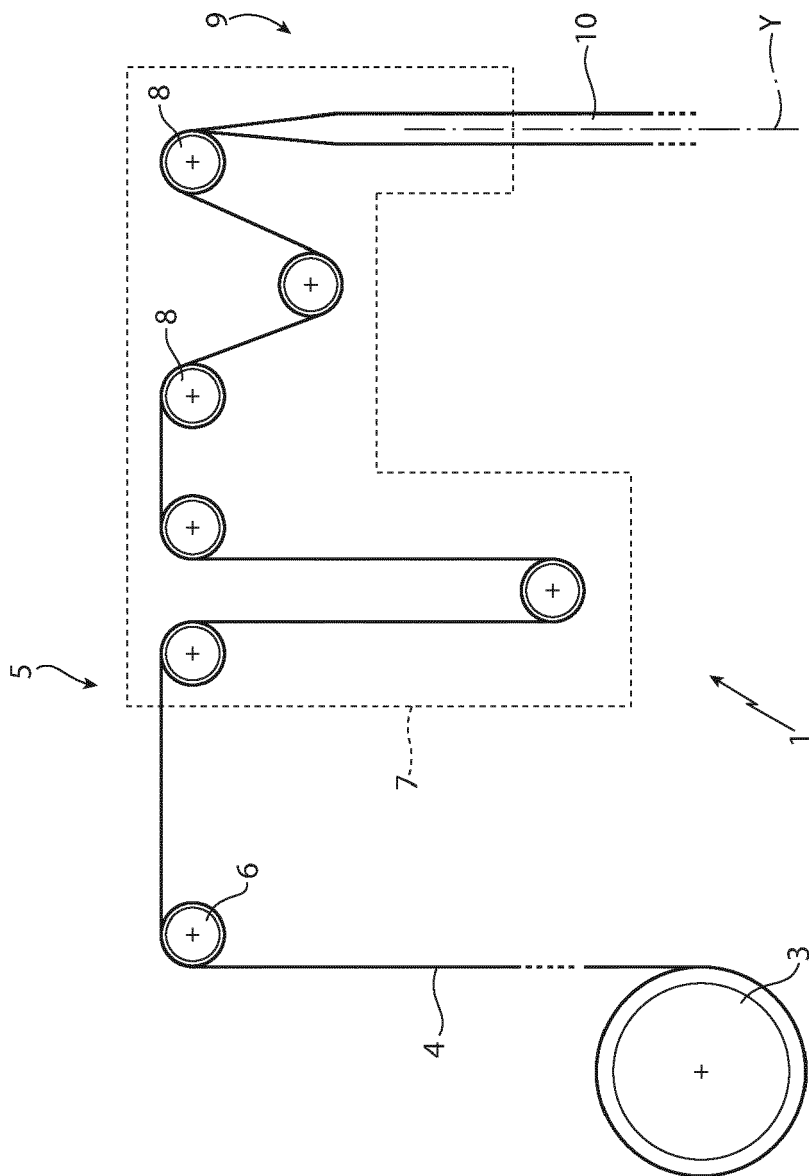


FIG. 2

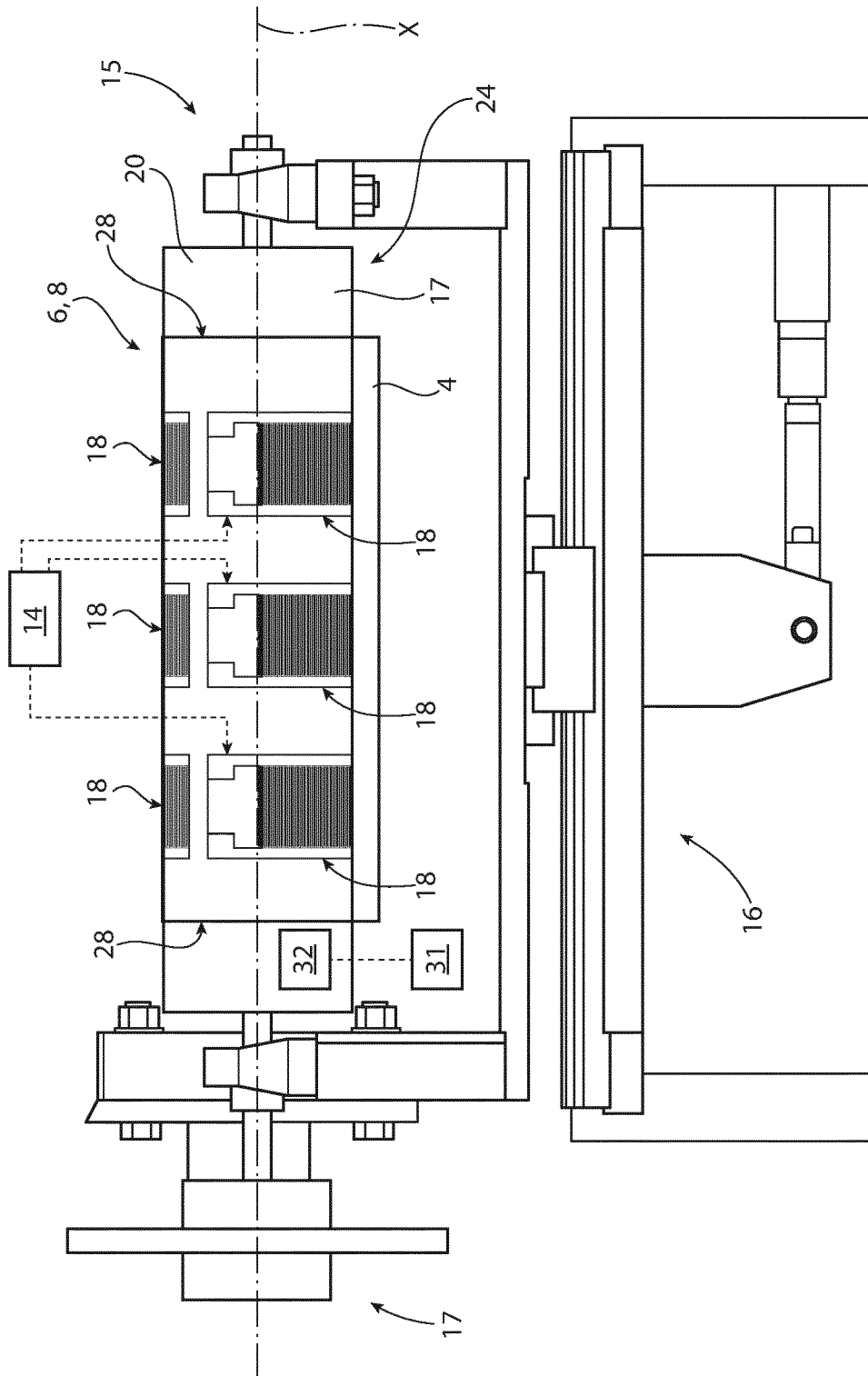


FIG. 3

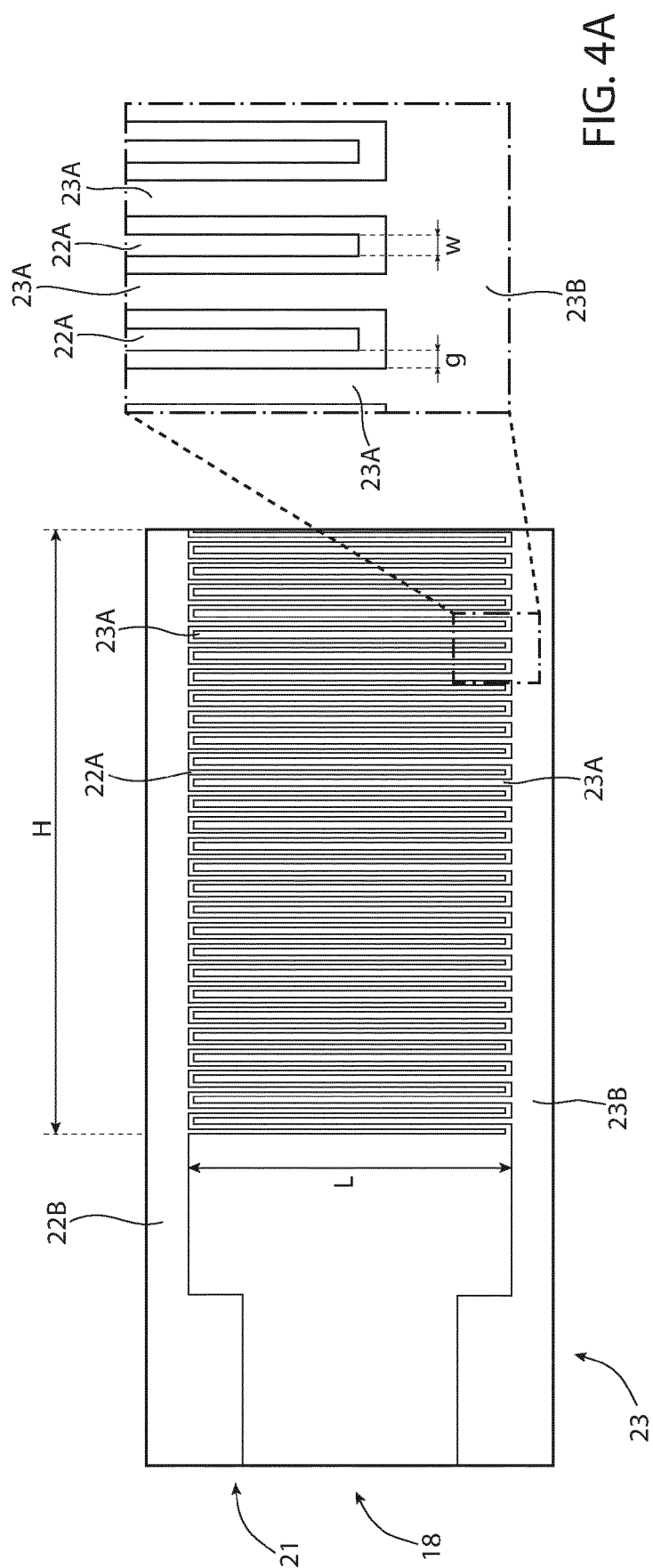


FIG. 4A

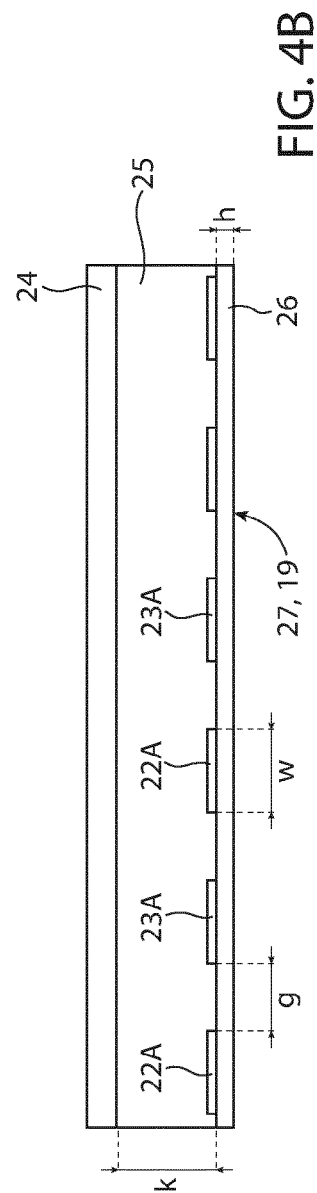


FIG. 4B



EUROPEAN SEARCH REPORT

Application Number

EP 24 17 5723

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	EP 0 479 594 A2 (ISHIDA SCALE MFG CO LTD [JP]) 8 April 1992 (1992-04-08) * column 1, lines 1-7 * * column 8, lines 3-25 * * figures 1,4,5 * -----	1-17	INV. B65H23/038 B65H27/00 B65B9/20 H02N13/00 B25J15/00
A	DE 195 16 871 A1 (ROVEMA GMBH [DE]) 14 November 1996 (1996-11-14) * column 1, lines 1-12, 39-46 * * column 4, lines 29-55 * * column 5, line 61 - column 6, line 9 * * figures 1, 4, 5 * -----	3	
A	EP 1 295 385 B1 (ALLISON HERMAN [ZA]; FRICKER RONALD KEVIN [ZA] ET AL.) 13 September 2006 (2006-09-13) * paragraphs [0002], [0006], [0032], [0033], [0044], [0053] * * figures 1, 5 * -----	6,7,14	
			TECHNICAL FIELDS SEARCHED (IPC)
			B65H B65B H02N B25J
The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
The Hague		10 October 2024	Cescutti, Gabriel
CATEGORY OF CITED DOCUMENTS			
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document			
T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

EPO FORM 1503 03/82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO.

EP 24 17 5723

5

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

10-10-2024

10

15

20

25

30

35

40

45

50

55

Patent document cited in search report		Publication date		Patent family member(s)		Publication date
EP 0479594	A2	08-04-1992	DE	69109992 T2		02-11-1995
			DE	69125728 T2		18-09-1997
			EP	0479594 A2		08-04-1992
			EP	0618136 A1		05-10-1994
			US	5174096 A		29-12-1992

DE 19516871	A1	14-11-1996	NONE			

EP 1295385	B1	13-09-2006	AT	E339801 T1		15-10-2006
			AU	7370001 A		24-12-2001
			AU	2001273700 B2		09-03-2006
			CN	1446395 A		01-10-2003
			DE	60123052 T2		15-03-2007
			EP	1295385 A2		26-03-2003
			ES	2272503 T3		01-05-2007
			JP	2004503450 A		05-02-2004
			PT	1295385 E		31-01-2007
			US	2003184731 A1		02-10-2003
			WO	0196219 A2		20-12-2001
