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(54) **METHOD FOR PARTING LABELS FROM A WEB OF LABELLING MATERIAL**

(57) The invention refers to a method for parting labels (2), configured to be applied to articles (4) adapted to contain a pourable product, from a web (3) of labelling material; the method comprises the steps of:

- i) advancing the web (3) along a feeding path (Q);
- ii) sequentially weakening the web (3) at predetermined weakening areas (19) of the web (3);
- iii) sequentially spreading with glue at predetermined glu-

ing areas (23) of the web (3), each of which including a respective weakening area (19) subsequent to the step ii) of weakening; and
iv) sequentially putting the web (3) under tension, subsequently to the step iii) of spreading, to part consecutive individual labels (2) at the respective weakening areas (19).

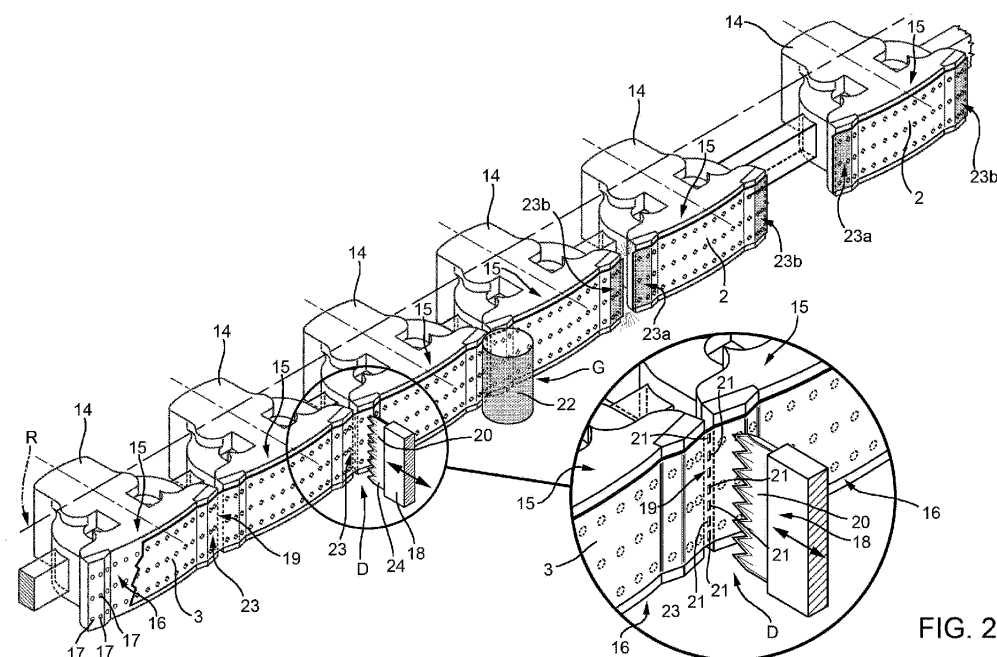


FIG. 2

Description

TECHNICAL FIELD

[0001] The present invention relates to a method for parting labels from a web of labelling material, in particular labels configured to be applied to articles adapted to contain a pourable product, preferably a pourable food product.

PRIOR ART

[0002] Labelling machines are known, configured to process a labelling material in an automated labelling process and commonly used for preparing, transporting and applying labels to articles, in particular bottles, containers, jars, flacons or the like, made of glass, plastic or metal, adapted to contain a pourable product, preferably a pourable food product.

[0003] The use of so-called "glued labels" is particularly widespread, obtained starting from a web of labelling material initially wound around one or more reels.

[0004] In detail, said web is cut into equal sized portions, to which the glue is applied. Glue is usually applied by gluing means, for example rollers, spray systems, injection systems, or the like. The labels thus obtained are then transferred and glued onto the outer side surface of the respective articles.

[0005] A labelling machine of the above-mentioned type typically comprises:

- a carousel rotatable around a vertical axis and configured to convey a plurality of successive articles along a horizontal path having the shape of an arc of a circle;
- an inlet station, in which the articles to be labelled are fed to the carousel;
- an outlet station, in which the labelled articles exit the carousel; and
- one or more labelling modules arranged peripherally relative to the carousel and configured to feed respective pluralities of labels to the carousel itself at relative application stations, in order to apply said labels to respective articles.

[0006] Generally, a labelling module of the known type comprises:

- one or more storage units, normally rotatable rollers, around which corresponding reels of labelling material, in the form of a continuous web, are wound;
- a plurality of unwinding rollers which support, in use, the web of labelling material unwound from the respective reel and guide it along a feeding path;
- a gluing device, for example a gluing roller, configured to apply a given amount of predetermined glue to predetermined gluing areas of the web, which typically define, once the parting has taken place, end

side portions of each label; and

- a transfer device for labels, for example a vacuum drum, configured to receive each label, hold it on its outer side surface by means of suction, and to feed said label to the carousel at the application station.

[0007] Generally, the labelling module comprises, furthermore, a label parting device configured to part, in particular to sequentially part, the labels from the respective web of labelling material which is unwound, in use, from the relative reel.

[0008] The parting device usually comprises a blade (or a cutting tool) configured to cut the web at its predetermined cutting portions.

[0009] The parting devices, commonly used in labelling modules of the type described above, are of the rotary type and comprise:

- a first rotary element, for example a roller or support cylinder, that supports the blade and conveys it, in use, along a cutting path; and
- a second rotary element, for example a roller or support cylinder that supports and advances the web of labelling material, is arranged tangentially to the first rotary element and is configured to sequentially act as an abutment counter-blade surface (or anvil) for the blade carried by the first support element, during the cutting.

[0010] In practice, the web is interposed, during the cutting, between the first and the second rotary elements.

[0011] Conveniently, the carousel, the transfer device, the gluing roller, the unwinding rollers and the rollers of the parting device are perfectly synchronised, so as to correctly carry out the entire labelling process.

[0012] Alternatively, the parting device can be of the reciprocating motion type, namely, having a fixed counter-blade surface and a mobile blade with reciprocating motion that goes into abutment against the counter-blade surface to sequentially cut the web.

[0013] The configurations of the type described above require an increased precision in the setting and adjusting of the components, since they require a perfect mutual synchronisation during the cutting. Furthermore, both the blade and the counter-blade surface are subjected to high wear, and therefore the useful life of said components is limited.

[0014] In some applications, the use of a weakening, in particular perforation, device is known instead of the blade and the counter-blade surface, in order to create a weakening in predetermined weakening areas of the web, which substitute, in this case, the above-mentioned cutting portions.

[0015] In practice, the weakening device is configured to carry out the perforations on each predetermined weakening area of the web, along a direction substantially orthogonal to the longitudinal direction of the web.

[0016] Subsequently, the web is sequentially pulled so

as to cause breakage of the various weakening portions and the parting of each label from the web itself at the relative perforations.

[0017] Although the known parting devices of the type described above are functionally valid, they are susceptible to further improvements.

[0018] In particular, the need is felt in the sector to ensure cleaning and efficiency of the cutting process.

OBJECT AND SUMMARY OF THE INVENTION

[0019] The aim of the present invention is to achieve a method for parting labels from a web of labelling material having increased reliability and limited cost, and which enables to meet at least some of the needs specified above in a simple and economic manner.

[0020] According to the invention, this aim is achieved by a method to part labels from a web of material to be labelled as claimed in claim 1.

BRIEF DESCRIPTION OF THE DRAWINGS

[0021] For a better understanding of the present invention, some preferred non-limiting embodiments will be described in the following, purely by way of example and with the aid of the attached drawings, wherein:

- Figure 1 is a schematic top view, with parts removed for the sake of clarity, of a labelling machine configured to carry out a method for parting labels from a web of labelling material according to a first embodiment of the present invention;
- Figure 2 is a perspective view, on an enlarged scale and with parts removed for the sake of clarity, of a detail of the labelling machine of figure 1;
- Figure 3 is a schematic top view, with parts removed for the sake of clarity, of a labelling machine configured to carry out a method for parting labels from a web of labelling material according to a further embodiment of the present invention;
- Figure 4 is a schematic top view, with parts removed for the sake of clarity, of a labelling machine configured to carry out a method for parting labels from a web of labelling material according to an alternative embodiment of the present invention;
- Figures 5a to 5c schematically illustrate, on an enlarged scale and with parts removed for the sake of clarity, a component of the labelling machine of figure 1; and
- Figure 5d shows an alternative of the component of figure 5a.

DETAILED DESCRIPTION

[0022] With reference to the attached figures, 1 designates, as a whole, a labelling machine configured to process a labelling material in an automated labelling process.

[0023] In particular, the machine 1 is configured to apply labels 2, obtained from a web 3 of labelling material, to articles 4 designed to (adapted to) contain a pourable product, preferably of the food type.

[0024] More in particular, the articles 4 are defined by bottles, flacons, cans, jars, small jars, or the like, each of which is adapted to receive, during the above-mentioned labelling process, a respective label 2 on the relative outer side surface.

[0025] The labels 2 are of the type known as "glued labels", namely, labels 2 obtained starting from the web 3, which is initially wound around one or more reels 5 (only one of which is shown in figure 1) and is subsequently parted into equal sized portions defining the labels 2.

[0026] The labels 2 thus obtained are then transferred and applied, by means of glue, onto the outer side surface of the respective articles 4, according to a mode that will be described in the following.

[0027] As can be seen in figure 1, the machine 1 basically comprises:

- a carousel 6 rotatable around an axis X, preferably vertical, configured to convey a plurality of successive articles 4 along a conveying path P, preferably horizontal and shaped as an arc of a circle; and
- at least a labelling module 7 arranged peripherally with respect to the carousel 6 and configured to prepare, transport and feed a plurality of labels 2 to the carousel 6 itself, in order to apply them to the respective articles 4 at an application station A.

[0028] In an embodiment not illustrated, the machine 1 comprises two or more labelling modules 7 arranged peripherally with respect to the carousel 6 and configured to apply respective pluralities of labels 2 to relative articles 4 at respective application stations A.

[0029] In detail, the labelling module 7 comprises:

- at least a support shaft 8 fixed to a base (not illustrated) of the labelling module 7 and supporting in a rotatable manner, in use, at least an above-mentioned reel 5;
- a distribution system 10, for example a plurality of unwinding rollers mounted on the base of the module 7, configured to unwind the web 3 from the reel 5, and to support, guide and/or advance it along a preferably horizontal feeding path Q; and
- a transfer device configured to receive the web 3 from the distribution system 10 and to advance it along the feeding path Q.

[0030] The transfer device is configured, furthermore, to feed labels 2, obtained from the web 3 according to a mode that will be described in the following, along the feeding path Q and feed said labels 2 to the carousel 6 at the application station A, so that they can be applied to respective articles 4.

[0031] According to this preferred and non-limiting embodiment, the transfer device is defined by a conveyor 12 arranged peripherally to a carousel 6, at the application station A, and comprising:

- a closed-loop annular endless track 13 and defining a closed-loop advancing path R; and
- a plurality of mobile elements, in particular carts 14, coupled in a movable manner to the track 13 and configured to slide along the track 13 along the advancing path R, in order to sequentially pass at the application station A.

[0032] In particular, the carts 14 are slidable along the track 13 independently from one another.

[0033] For this purpose, the conveyor 12 comprises an electromagnetic linear motor, of the known type, configured to enable the independent control of the carts 14 along the track 13, according to a known mode and not described in detail.

[0034] In one embodiment, the track 13 is provided with electrically excitable elements and generators with an electromagnetic field, for example a solenoidal coil, and each cart 14 is provided with a permanent magnet (not illustrated).

[0035] Each permanent magnet is configured to be magnetically coupled to the above-mentioned coils, according to a known mode typical of linear motors.

[0036] As can be seen in figures 1 and 2, each cart 14 comprises a support portion 15 configured to cooperate in contact with the web 3.

[0037] In detail, each support portion 15 comprises a side surface 16 configured to receive, hold and advance the web 3 along the feeding path Q, and to hold, advance and release the relative label 2 obtained from the web 3 according to the mode that will be described in the following.

[0038] In greater detail, each side surface 16 is provided with a series of holes 17 distributed on the side surface 16 itself and fluidically connected to a vacuum source known and not described in detail.

[0039] In use, the vacuum source creates a negative pressure, and therefore a suction (or vacuum), at the holes 17, which allows to suck-up and hold the web 3.

[0040] Therefore, each cart 14 holds, in use, a relative portion of the web 3, having a size substantially corresponding to the size of the side surface 16, by means of suction through the relative holes 17.

[0041] More precisely, each cart 14 is configured to hold a relative portion of the web 3 that will constitute an individual label 2.

[0042] In particular, the side surface 16 of each cart 14 has respective opposite side end portions configured to respectively hold portions of the web 3 that will constitute the front edge and the rear edge of each label 2, according to the feeding direction of the label 2 along the feeding path Q.

[0043] In light of the above, the feeding path Q is par-

allel to the advancing path R at least for the segment in which the web 3 is conveyed by means of the conveyor 12.

[0044] As can be seen in figures 1 and 2, the labelling module 7 comprises, furthermore, a weakening device 18 arranged peripherally to the conveyor 12, in particular peripherally to the track 13 at a weakening station D, and configured to sequentially weaken the web 3 at predetermined weakening areas 19 of the web 3 itself.

[0045] In detail, the weakening device 18 comprises a blade 20, in particular a serrated blade, configured to move with reciprocating motion transversally relative to the feeding path Q, and therefore transversally relative to the web 3, and to sequentially cooperate in contact with the web 3 at the weakening station D.

[0046] In greater detail, the blade 20 is configured to sequentially perforate each weakening area 19 so as to obtain a series of perforations 21, preferably aligned on the web 3 along a direction transverse to the web 3 itself.

[0047] In this manner weakened portions are obtained, which pass through the web 3 transversally from one side to the other, substantially corresponding to the weakening areas 19 and configured to break under tension.

[0048] The labelling module 7 comprises, furthermore, a gluing device, in particular a gluing roller 22, arranged peripherally to the conveyor 12, in particular peripherally to the track 13 at a gluing station G, and configured to sequentially spread glue onto the web 3 at predetermined gluing areas 23 of the web 3 itself.

[0049] In particular, each gluing area 23 has a substantially rectangular shape, extends transversally along the entire width of the web 3 and comprises, within its own delimiting perimeter, the respective weakening area 19.

[0050] In other words, each weakening area 19 is included in the corresponding gluing area 23.

[0051] It follows that also the weakening areas 19 are spread with glue, one after the other, at the gluing station G.

[0052] Conveniently, each weakening area 19 is arranged, in use, between two adjacent carts 14, as shown in particular in figure 2.

[0053] More precisely, considering a pair of adjacent carts 14 and supporting two respective portions of the web 3 that will constitute as many labels 2, the relative weakening area 19 is comprised between the above-mentioned rear edge of the label 2 which leads (leading label) and the above-mentioned front edge of the label 2 that follows (trailing label).

[0054] In this manner, each weakening area 19 defines a transition area interposed between two consecutive labels 2.

[0055] More in particular, each weakening area 19 is not supported at the rear by any side surface 16, but is instead "hanging" between the two side surfaces 16 of the pair of adjacent carts 14 and is kept tensioned by the relative movement of said carts 14, so as to be able to be effectively perforated by the blade 20 at the weakening

station D.

[0056] According to an aspect of the present invention, the gluing station G is arranged downstream of the weakening station D, according to the advancing direction of the carts 14 along the advancing path R and according to the advancing direction of the web 3 along the feeding path Q.

[0057] Consequently, the gluing roller 22 is arranged downstream of the weakening device 18, namely the blade 20, relative to the above-mentioned advancing directions.

[0058] Therefore, in use, the web 3 is firstly weakened and then spread with glue.

[0059] It follows that the perforations 21 are made prior to the application of the glue by means of the roller 22.

[0060] This enables to prevent residues of glue from contaminating the blade 20.

[0061] Furthermore, due to this configuration an increased precision during application of the glue to the web 3 is not required, since it is not necessary to prevent spreading of the glue onto the weakening areas 19, which have already been perforated by the blade 20 at the moment of the application of the glue.

[0062] In addition, the above-described configuration is particularly advantageous in the case where a mismatch of the various components of the labelling module 7 occurs, due to which, the gluing areas 23 are not perfectly arranged in the predetermined nominal position at the gluing station G, since the blade 20 has the web 3 already weakened at the moment of the application of the glue.

[0063] According to this preferred and non-limiting embodiment, the web 3 is configured to be sequentially put under tension, after the application of the glue by means of the roller 22, for parting successive individual labels 2 at the respective weakening areas 19.

[0064] In this regard, the carts 14 are controllable to be distanced away from one other along said advancing path R at a parting station S arranged downstream of the gluing station G, according to the above-mentioned advancing directions.

[0065] In detail, considering a pair of adjacent carts 14, the cart 14 that leads (leading cart) is controllable, in particular controlled, in use, to move away from the cart 14 that follows (trailing cart), along the advancing path R.

[0066] This distancing, puts the web 3 under tension, which breaks at the weakening area 19 interposed between the two above-mentioned adjacent carts 14.

[0067] In this manner, a relative label 2 is parted from the web 3, at the parting station S.

[0068] Such label 2 is held by the relative cart 14 which is now distanced and is conveyed up to the application station A, at which it is applied to the respective article 4 simultaneously conveyed by the carousel 6.

[0069] In light of what has been described above, each gluing area 23 splits, at the parting station S, into:

- a first gluing subarea 23a, arranged at the rear edge

of the label 2 that leads and that has just been parted from the web 3; and into

- a second gluing subarea 23b, arranged at the front edge of the label 2 that follows and that is still joined to the web 3.

[0070] As described above, the blade 20 is defined by a serrated blade, in particular a serrated blade extending along a direction transverse to the web 3, preferably parallel to the axis X of the carousel 6, and having a plurality of teeth 24 with a triangular profile and arranged in a row along the above-mentioned transverse direction.

[0071] With reference to figures 5a, 5b and 5c, some constructive parameters of the serrated blade 20, identified by the applicant as optical parameters for carrying out the above-mentioned perforation in the most efficient manner possible, are listed hereinafter, without however affecting the generality of what has been described.

[0072] In particular, the serrated blade 20 according to the present invention can comprise all or any combination of said constructive parameters.

[0073] In detail:

- the distance B, (figure 5b) between the free vertexes of each pair of successive teeth 24, is comprised between 0.5mm and 2mm, preferably is 1mm; and/or
- the thickness H, (figure 5c) of the serrated blade 20, measured at the base of each tooth, is comprised between 0.75mm and 1.5mm, preferably is 1mm; and/or
- each tooth 24 comprises two side surfaces 25 (figure 5c) intersecting in the relative free vertex and inclined, with respect to an ideal plane K passing through the free vertexes of all the teeth 24, by an angle α of width equal to 60° ; i.e., the two side surfaces 25 identify between them an angle α of width equal to 60° ; and/or
- the adjacent side edges 26 (figure 5b) of each pair of successive teeth 24, the which edges 26 define the profile of the serrated blade 20, identifying between each other an angle β of width equal to 90° ; and/or
- the above-mentioned ideal plane K, passing through the free vertexes of all the teeth 24, is inclined with respect to the above-mentioned transverse direction with an inclination of $1/50$ (figure 5a); i.e., said ideal plane K identifies with the transverse direction an angle γ of width equal to 1.15°

[0074] According to an alternative embodiment illustrated in figure 5d, the weakening device 18 comprises a serrated blade 20' including sets of teeth 27, each set formed by a plurality of teeth 24 of the type described above.

[0075] In detail, the sets of teeth 27 have a substantially triangular profile and are arranged in a row along the above-mentioned transverse direction.

[0076] In greater detail:

- the half-distance D between the free vertexes of each pair of successive sets of teeth 27 is comprised between 5mm and 15mm, preferably is 10mm; and/or
- the side edges 28 of each set of teeth 27, defining the profile of the serrated blade 23', are inclined, with respect to an ideal plane, (not illustrated) passing through the free vertexes of all the sets of teeth 27, by an angle δ having a width comprised between 10° and 25°, preferably 15°.

[0077] According to this embodiment, the above-mentioned ideal plane is parallel to the transverse direction.

[0078] The operation of the labelling machine 1 according to the present invention will be described in the following, with particular reference to a pair of adjacent carts 14, to a single weakening area 19 and to a single gluing area 23, in a starting condition in which the weakening area 19 is at the weakening station D.

[0079] In this condition, the blade 20 is controlled so as to perforate, and thus weaken, the web 3 at the weakening area 19.

[0080] Subsequently, the roller 22 spreads the glue at the gluing area 23, including the entire weakening area 19, of the web 3, at the gluing station G.

[0081] After which, the cart 14 that leads is controlled to move away from the cart 14 that follows, so as to put the web 3 under tension and cause the breakage of the weakening area 19 and the parting of the label 2, at the parting station S.

[0082] The label 2 thus obtained is then fed from the cart 14 that leads, along the feeding path Q and up to the application station A.

[0083] What has been described above shall apply to each pair of adjacent carts 14 present in the conveyor 12 and to each label 2 to be applied.

[0084] With reference to figure 3, 1' designates, as a whole, a labelling machine configured to apply labels 2 to articles 4 designed to contain a pourable product made according to an alternative embodiment of the present invention.

[0085] Since the machine 1' is similar to the machine 1, only the different characteristics between the two machines will be highlighted in the following, by designating with the same reference numbers, where possible, the same or corresponding parts.

[0086] In particular, the machine 1' differs from the machine 1 due to the fact that the web 3 is sequentially put under tension by means of a rotation of the articles 4 on themselves, i.e. about their own axes.

[0087] More precisely, according to this embodiment, the web 3, after having been weakened and spread with glue, is conveyed, still as whole web, in use, up to the application station A.

[0088] At this point, the free end portion of the web 3, corresponding to a respective gluing subarea 23b, is

glued on the outer side surface of a relative article 4 simultaneously conveyed by the carousel 6 along the path P.

[0089] Such article 4 is, therefore, controlled to carry out a rotation on itself around its own axis, so as to favour the application of the web 3 on its side surface.

[0090] Said rotary movement puts the web 3 under tension, which breaks at the weakening area 19 closest to the article 4 in question, thus obtaining the relative label 2.

[0091] The rotary movement continues until the label 2 is completely applied to the article 4.

[0092] Conveniently, the labelling module 7 of the machine 1' comprises a transfer device defined by a vacuum drum 12', of a known type and not described in detail, arranged peripherally to the carousel 6, at the application station A, and configured to support the web 3 and to advance it along the feeding path G.

[0093] In an alternative embodiment not illustrated, the transfer device is defined by the conveyor 12 described above.

[0094] With reference to figure 4, 1'' designates, as a whole, a labelling machine, configured to apply labels 2 to articles 4 designed to contain a pourable product, made according to an alternative embodiment of the present invention.

[0095] Since the machine 1'' is similar to the machine 1, only the different characteristics between the two machines will be highlighted in the following, designating with the same reference numbers, where possible, the same or corresponding parts.

[0096] In particular, the machine 1'' differs from the machine 1 due to the fact that it comprises a breakage assist device 30, arranged downstream of the gluing station G along the feeding path Q and configured to sequentially stress each weakening area 19 so as to cause a breakage of the web 3 at each stressed weakening area 19.

[0097] More precisely, the device 30 is a presser configured to sequentially apply a pressure to the web 3 at the parting station S, so as to cause the breakage of the weakening areas 19 of the web 3, thus obtaining respective labels 2.

[0098] In an embodiment, the device 30 applies a pneumatic stress to the web 3 (for example, compressed air).

[0099] In another embodiment, the device 30 applies a mechanical stress to the web 3 (by means, for example, of a cutting tool or an anvil or an ultrasound device).

[0100] Once parted from the web 3, the labels 2 are applied to the articles 4, for example by means of rotation of the same as described above for the machine 1'.

[0101] From an examination of the characteristics of the labelling machines 1, 1', 1'' and of the method for parting labels 2, made according to the present invention, the advantages that they allow to obtain are clear.

[0102] In particular, the above described configuration enables preventing residues of glue from contaminating the blade 20.

[0103] Furthermore, an increased precision during the

application of the glue to the web 3 is not required, since it is not necessary to stay clear from the weakening areas 19, which have already been perforated by the blade 20 at the moment of the application of the glue.

[0104] In addition, the above-described configuration is particularly advantageous in the case where a mismatch of the various components of the labelling module 7 occurs, due to which the gluing areas 23 are not perfectly arranged in the predetermined nominal position at the gluing station G, since the blade 20 already has the web 3 already weakened at the moment of the application of the glue.

[0105] It is clear that modifications and variations can be made to the labelling machine 1, 1', 1'' and to the method to part labels described and illustrated herein, without thereby departing from the scope defined by the claims.

Claims

1. A method for parting labels (2), configured to be applied to articles (4) adapted to contain a pourable product, from a web (3) of labelling material; said method comprising the steps of:

- i) advancing said web (3) along a feeding path (Q);
- ii) sequentially weakening said web (3) at predetermined weakening areas (19) of said web (3);
- iii) sequentially spreading with glue predetermined gluing areas (23) of said web (3), each of which including a respective said weakening area (19), subsequent to the step ii) of weakening; and
- iv) sequentially putting said web (3) under tension, subsequently to the step iii) of spreading, for parting individual consecutive labels (2) at the respective weakening areas (19);

wherein the step i) of advancing comprises the steps of:

- vi) advancing said web (3) along said feeding path (Q) by means of a plurality of mobile elements (14) supporting said web (3); and
- vii) controlling a movement of said mobile elements (14) along an advancing path (R), independently from one another;

wherein each weakening area (19) is interposed, along said feeding path (Q), between two adjacent mobile elements (14);

and wherein said step iv) of putting under tension, comprises the step of:

viii) distancing said two adjacent mobile elements (14) away from one another along a direction parallel

to said feeding path (Q) .

2. The method as claimed in claim 1, wherein the step ii) of weakening comprises the step of:
v) perforating said web (3) at each weakening area (19), so as to obtain a series of perforations (21) transversal relative to said feeding path (Q).

3. The method as claimed in any of the previous claims, wherein the step viii) of distancing comprises the step of:
ix) distancing the leading mobile element (14), of said two adjacent mobile elements (14), from the trailing mobile element (14), of said two adjacent mobile elements (14), according to a feeding direction extending along said advancing path (R).

4. The method as claimed in any of the previous claims, further comprising the steps of:

- x) feeding at least an article (4) to be labelled along a conveying path (P);
- xi) gluing an end portion of said web (3), defining at least part (23b) of one said gluing area (23), to said article (4);

and wherein said step iv) of putting under tension comprises the step of:

xii) rotating said article (4) on itself, subsequently to the step xi) of gluing.

5. The method as claimed in claim 4, wherein the step i) of advancing comprises the step of:
xiii) advancing said web (3) along said feeding path (Q) by means of a vacuum drum (12').

6. The method as claimed in any one of the preceding claims, wherein the step iv) of putting under tension further comprises the step of:
xiv) sequentially stressing said weakening areas (19) so as to cause breakages of said web (3) at said stressed weakening areas (19).

7. The method as claimed in any one of the preceding claims, wherein said step ii) of weakening comprises the step of:
xv) sequentially perforating said web (3) at each weakening area (19), by means of a serrated blade (20; 20').

8. The method as claimed in claim 7, wherein said serrated blade (20) extends along a direction transverse to said feeding path (Q) and has a plurality of teeth (24) having a triangular profile arranged in a row along said transverse direction; and wherein:

- the distance between the free vertexes of each pair of consecutive teeth (24) is comprised be-

tween 0.5mm and 2mm, preferably is 1mm;
and/or

- the thickness of said serrated blade (20), measured at the base of each tooth (24), is comprised between 0.75mm and 1.5mm, preferably is 1mm; and/or

- each tooth (24) comprises two side surfaces (25) intersecting in said free vertex and inclined, with respect to an ideal plane (K) passing through the free vertexes of all the teeth (24), by an angle (α) of 60°; and/or

- the adjacent side edges (26) of each pair of successive teeth (24) identify between each other, an angle (β) of 90°; and/or

- the ideal plane (K), passing through the free vertexes of all the teeth (24), is inclined relative to said transverse direction with an inclination of 1/50, namely with an angle (γ) of 1.15°.

9. The method as claimed in claim 8, wherein said serrated blade (20') comprises a plurality of sets of teeth (27) arranged in a row along said transverse direction, each formed by a plurality of said teeth (24) and having a triangular profile; and wherein:

- the half-distance (D), between the free vertexes of each pair of successive set of teeth (27), is comprised between 5mm and 15mm, preferably is 10mm; and/or

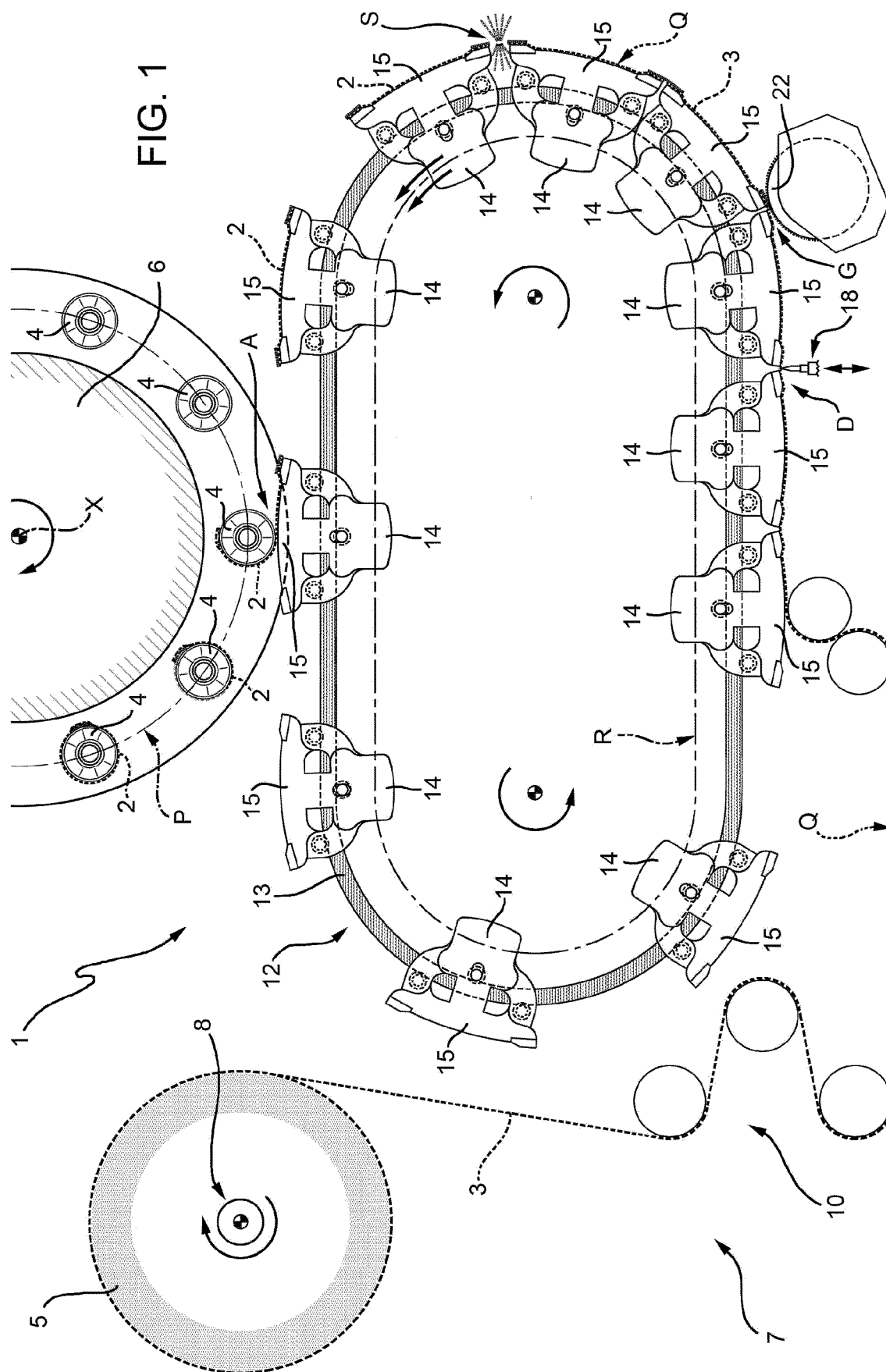
- the side edges (28), of each tooth of the set (27), defining the profile of said serrated blade (20'), are inclined, with respect to an ideal plane passing through the free vertexes of all the sets of teeth (27), by an angle (δ) the width of which is comprised between 10° and 25°, preferably 15°.

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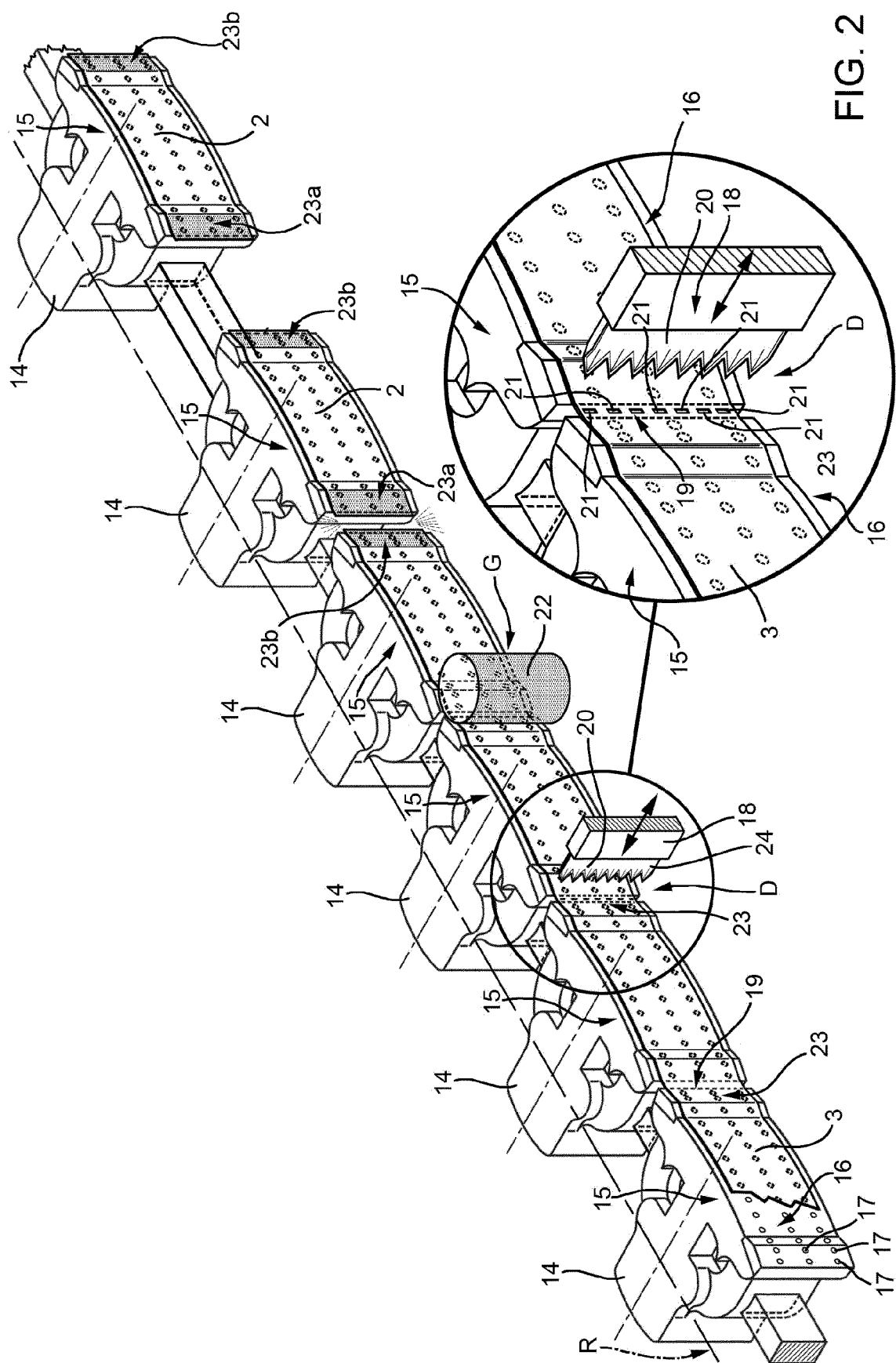


FIG. 2

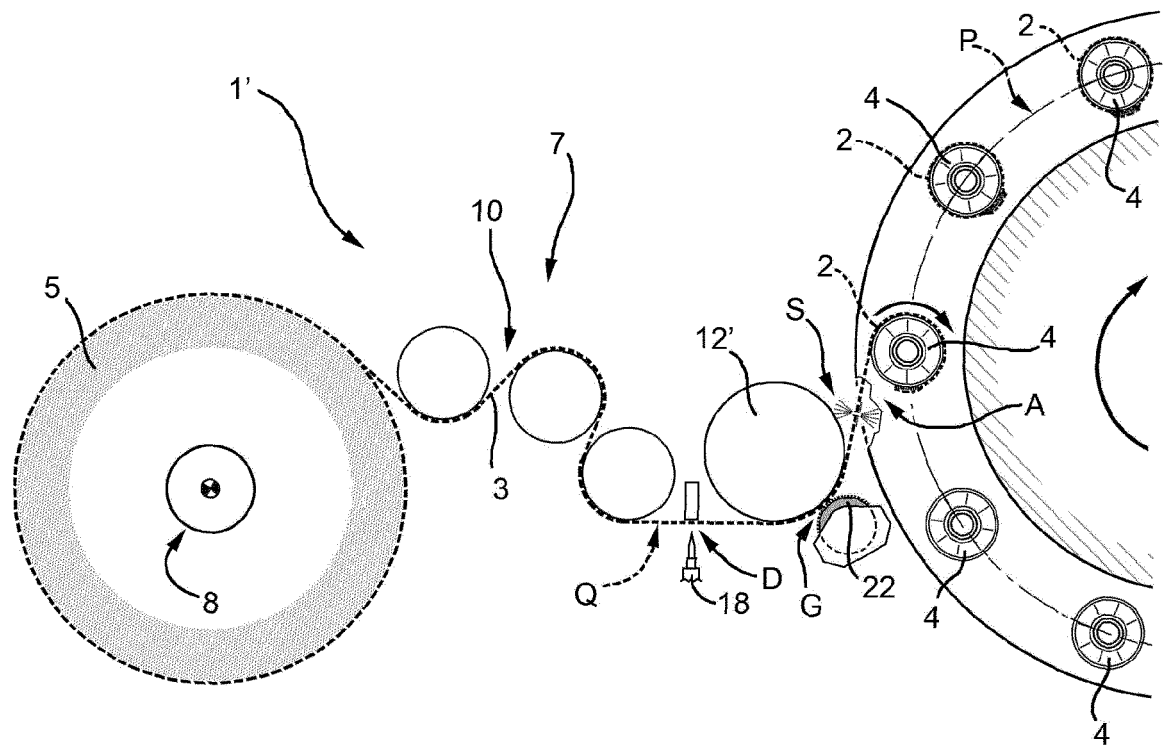


FIG. 3

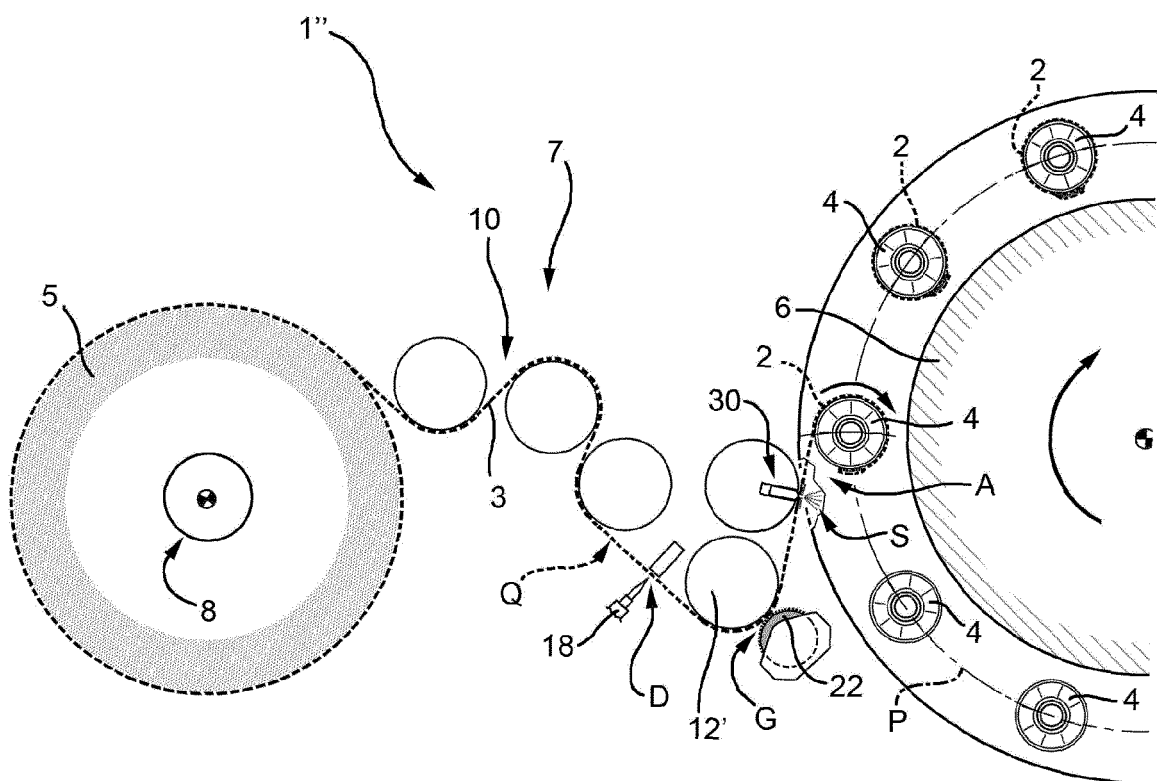
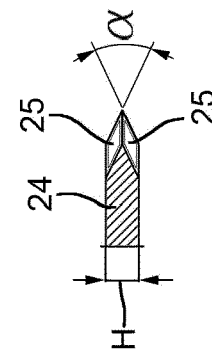
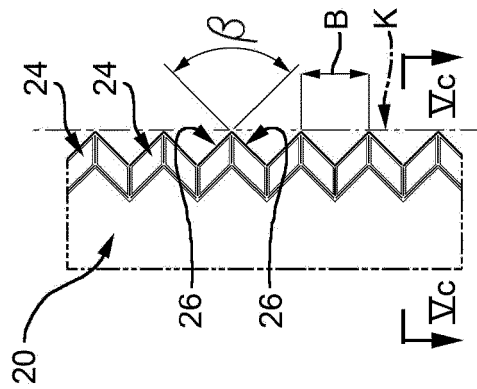
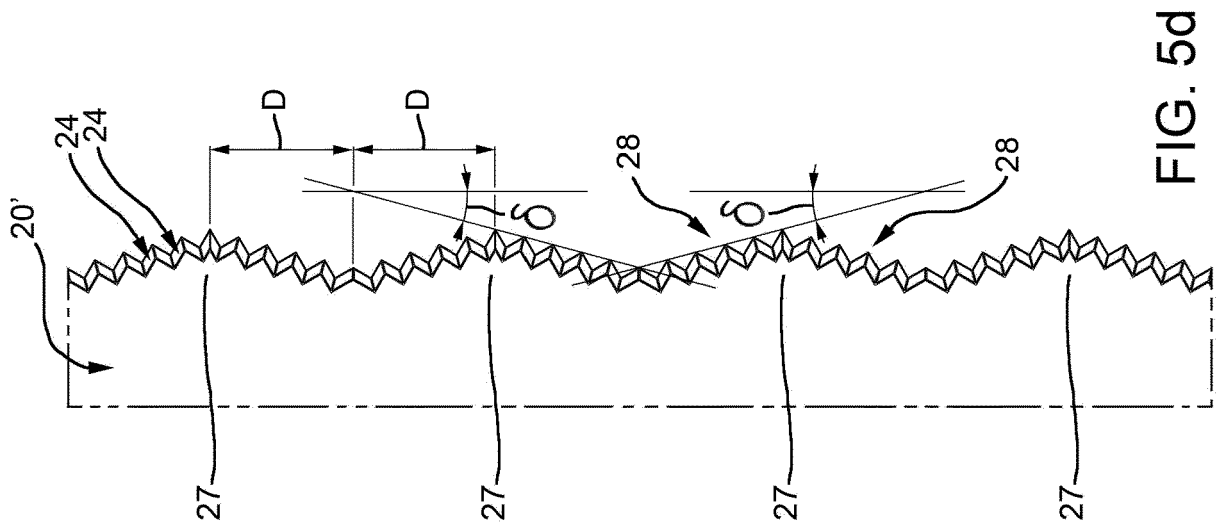
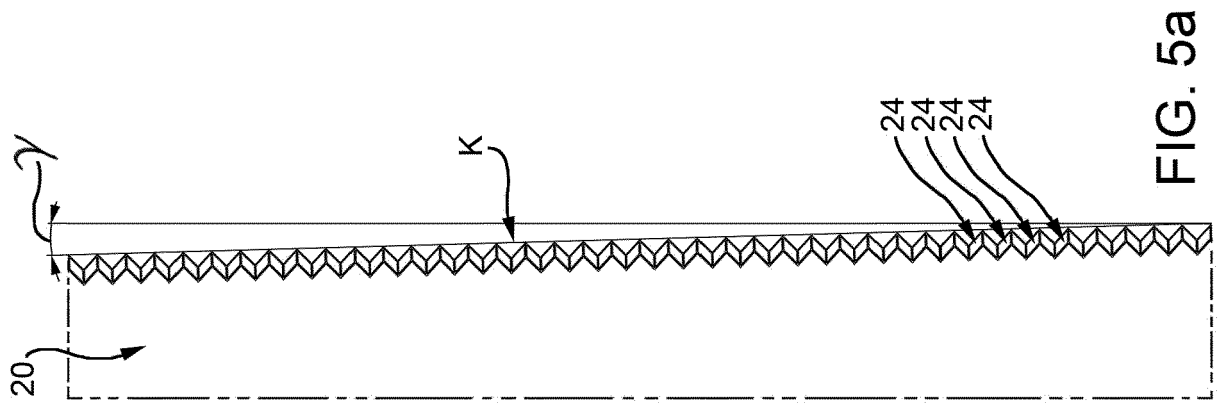


FIG. 4





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Place of search The Hague		Date of completion of the search 18 December 2020	Examiner Wartenhorst, Frank
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