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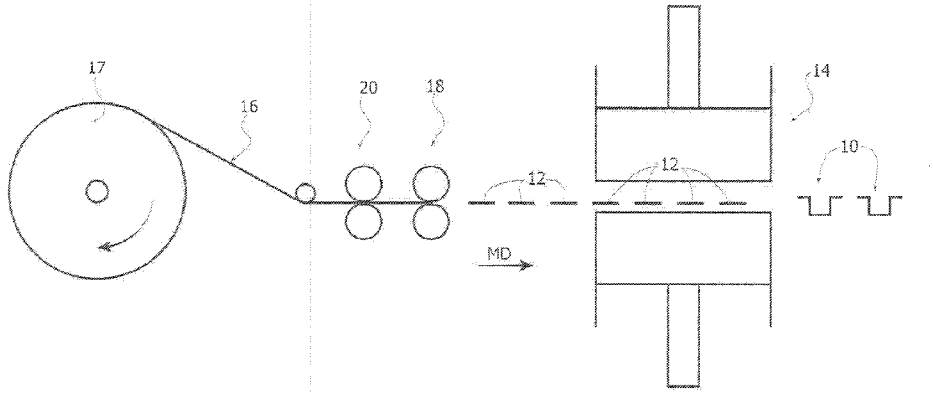
(54) Title: A METHOD FOR PRODUCING CELLULOSE PRODUCTS

FIG. 1



(57) Abstract: A method for producing cellulose products, comprising : - providing at least one row of discrete blanks (12) each including at least one layer of dry-formed cellulose fibers, - feeding said at least one row of discrete blanks (12) to a forming mold (14), - heating and pressing said discrete blanks (12) in the forming mold (14) to shape said discrete blanks (12) into two-dimensional or three-dimensional cellulose products (10).

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"A method for producing cellulose products"

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Field of the invention

The present invention relates to a method for producing cellulose products.

The invention was developed for producing a wide range of two-dimensional or three-dimensional products, for example containers, boxes, disposable plates, cups, packaging products for packaging liquids or solid goods, and other types of disposable articles.

Background of the invention

Many containers, packaging products and disposable articles are still made of plastic materials, which have a significant energy and environmental impact both for their production and their recycling.

Therefore, there is a strong need for sustainable articles that are recyclable in the paper chain.

Products formed of cellulose fibers can be used in many different situations where there is a need for producing sustainable products.

A low-price material commonly used for cellulose fiber products is wet molded pulp. Wet molded pulp has the advantage of being considered as a sustainable packaging material, since it is produced from biomaterials and can be recycled after use. Consequently, wet molded pulp has been quickly increasing in popularity for different applications. Wet molded pulp articles are generally formed by immersing a suction mold into a liquid or semi liquid pulp suspension or slurry, while suction is applied, whereby a body of pulp is formed with the shape of the desired product by fiber deposition. The suction mold is then

withdrawn from the suspension and the suction is generally continued to compact the deposited fibers while exhausting residual liquid.

With all wet-forming techniques, there is a need for drying the wet molded product and drying is a very time and energy consuming part of the manufacturing process.

In the wet-forming process it is difficult to control the mechanical properties and geometries of the products with the precision required to meet the increasing demands on aesthetical and mechanical properties of products. Furthermore, the production of aesthetically attractive wet-formed cellulose products, is time consuming and expensive.

There is thus a need for improved sustainable cellulose products where the cellulose products have improved mechanical properties, can be manufactured with high precision, and where the production is cost-efficient and rational. There is further a need for cellulose products, where the products are aesthetically attractive and where the process for manufacturing such products is accomplished with high production speeds in a cost-efficient way.

WO2021001276A1 and WO2019209160A1 disclose methods for producing a cellulose product from a cellulose blank structure. A known method comprises the steps of forming a multi-layer cellulose blank structure from at least a first layer of dry-formed cellulose fibers and a second layer of a cellulose fiber web structure arranged in a superimposed relationship in contact with each other; arranging the multi-layer cellulose blank structure in a forming mold; heating the multi-layer cellulose blank structure to a forming temperature in the range of 100°C to 300°C, and forming the cellulose product from the multi-layer cellulose blank structure in the forming

mold, by pressing the heated multi-layer cellulose blank structure with an isostatic forming pressure of at least 1 MPa, preferably 4-20 MPa, such that the multi-layer cellulose blank structure is shaped into a two-dimensional or three-dimensional fiber composite structure having a single-layer configuration.

WO2022/238484 and WO2022/238017 disclose a dry forming method for forming an essentially non-flat cellulose product from cellulose fibers. The method comprises: separating cellulose fibers from a dry cellulose material in a separating unit, providing the separated cellulose fibers onto a support structure for forming a blank of cellulose fibers, pressing the cellulose blank with a molding tool for forming the essentially non-flat cellulose product.

Object and summary of the invention

An object of the present invention is to provide improved methods for producing cellulose products, which increase manufacturing precision and improve mechanical properties, cost-efficiency, and quality of the products.

In accordance with the present invention, this object is achieved by a method according to claim 1.

The dependent claims contain further developments of the methods for producing cellulose products.

The claims are an integral part of the teachings provided in relation to the invention.

Brief description of the drawings

The present invention will now be described in detail with reference to the attached drawings, given purely by way of non-limiting example, wherein:

- Figure 1 is a schematic view of a possible embodiment of a method for producing cellulose products,

- Figures 2-5 are schematic plan views showing certain steps of possible embodiments of methods for producing cellulose products,
- Figures 6 and 7 are schematic views of possible embodiments of methods for producing cellulose products,
- Figures 8 and 9 are schematic plan views showing certain steps of possible embodiments of methods for producing cellulose products,
- Figures 10-13 are schematic views of possible embodiments of methods for producing cellulose products,
- Figures 14-17 are schematic views showing certain steps of possible embodiments of methods for producing cellulose products,
- Figure 18 is a schematic side view of another embodiment of a method for producing cellulose products,
- Figure 19 is a schematic plan view of the embodiment of Figure 18, and
- Figures 20 and 21 are schematic details of the part indicated by the arrow XX in Figure 18 in two operating positions.

It will be appreciated that in the drawings some components may not be illustrated to simplify the understanding of the figures, and that various figures may not be represented on the same scale.

Detailed description

Figure 1 schematically shows a possible embodiment of a method for producing cellulose products 10.

The method comprises:

- providing at least one row of discrete blanks 12 spaced from each other in a machine direction MD and each including at least one layer of cellulose fibers made from free cellulose fibers consolidated with each other or made by cutting a continuous cellulose web,
- advancing the at least one row of discrete blanks

12 in the machine direction MD,

- feeding the at least one row of discrete blanks 12 to a forming mold 14,

- heating and pressing the discrete blanks 12 in the forming mold 14 to shape the discrete blanks 12 into two-dimensional or three-dimensional cellulose products 10.

The layer of cellulose fiber may be dry-formed. With a layer of dry-formed cellulose fibers is meant a cellulose fiber layer that is formed in a dry-forming process in which cellulose fibers are air-laid to form the cellulose fiber layer. When forming the cellulose fiber layer in the air-laid process, the cellulose fibers are carried and formed to the fiber layer structure by air as carrying medium. This is different from a normal papermaking process or a traditional wet-forming process, where water is used as carrying medium for the cellulose fibers when forming the paper of fiber structure. In the air-laid process, small amounts of water or other substances may, if desired, be added to the cellulose fibers in order to change the properties of the cellulose product, but air is still used as carrying medium in the forming process. The layer of cellulose fibers may have a dryness that is mainly corresponding to the ambient humidity in the atmosphere surrounding the layer of cellulose fibers.

The discrete blanks 12 may be manufactured by forming an array of shapes of loose unbound fibers, wetting said shapes of loose unbound fibers and compressing said shapes of loose unbound fibers, as disclosed in IT 102022000012536.

The layer of cellulose fibers may have a fiber composition of 100% cellulose fibers. With cellulose fibers is meant any type of cellulose fibers, such as natural cellulose fibers or manufactured cellulose

fibers.

The layer of cellulose fibers may be free from thermoplastic fibers or other fibers that may negatively impact the formation of bonds between the cellulose fibers during forming of the cellulose products. Other substances may be added for changing the properties of the layer, such as suitable additives and water.

In a possible embodiment the discrete blanks 12 may be formed from a continuous web 16 comprising at least one layer of cellulose fibers. The continuous web 16 may be formed by a single layer of cellulose fibers. In possible embodiments, the continuous web 16 may be a multi-layer cellulose structure formed by a plurality of overlapped layers of cellulose fibers.

In possible embodiments, the continuous web 16 may be unwound from a reel 17. In possible embodiments, the continuous web 16 may be formed by overlapping several layers of cellulose fibers, each unwound from a respective reel.

In possible embodiments the discrete blanks 12 may be formed by cutting the continuous web 16 in a cutting unit 18 while advancing the continuous web 16 in the machine direction MD.

In possible embodiments the discrete blanks 12 may be formed by compacting loose cellulose fibers. The loose cellulose fibers may be obtained by defibrating a cellulose sheet.

The discrete blanks 12, either cut from the continuous web 16 or formed by compacting loose cellulose fibers, may be disc shaped.

In other possible embodiments the discrete blanks may have a three-dimensional structure. This would provide a raw material that is particularly suitable for forming packages with areas with different degrees of protection.

In possible embodiments the discrete blanks 12 may have a same planar shape and different thickness and/or basis weight or different planar shape and different thickness and/or basis weight to form cellulose products with different characteristics. This provides higher manufacturing flexibility, possibility of customizing the finished product, and waste reduction.

In a possible embodiment the method may comprise embossing the continuous web 16 in an embossing unit 20 before cutting the continuous web 16 into a plurality of discrete blanks 12.

As shown in figure 2, in a possible embodiment the method may comprise forming on the continuous web 16 a plurality of embossing patterns 22 spaced from each other in the machine direction MD. As shown in figure 4, the embossing patterns 22 may have a regular shape such as a chessboard shape with at least one embossing line parallel to the machine direction MD and at least one embossing line transversal to the machine direction MD. The embossing patterns 22 may be formed in phase with the cutting unit 18, such that after the cut in the cutting unit 18 each of the discrete blanks 12 has a respective embossing pattern 22.

As shown in figure 3, in a possible embodiment the method may comprise forming on the continuous web 16 at least one continuous embossing pattern 23 extending continuously in the machine direction MD.

As shown in figure 5, in a possible embodiment the method may comprise embossing the individual discrete blanks 12 before feeding the discrete blanks 12 to the forming mold 14.

The discrete blanks 12 may be fed to the forming mold 14 in any suitable way, e.g. by a conveyor belt, an industrial robot, or any other suitable transport equipment.

The feeding of the discrete blanks 12 may be intermittent or continuous. If the cellulose products 10 are formed in an intermittent process, the discrete blanks 12 may be intermittently feed to the forming mold 14 and the feeding of the discrete blanks 12 may be stopped during the forming of the cellulose products 10 in the forming mold 14. If the cellulose products instead are formed in a continuous process, the forming mold 14 may be movable and the movement of the forming mold 14 may be reciprocating and synchronized with the feeding of the discrete blanks 12.

In the forming mold 14 the discrete blanks 12 may be heated to a forming temperature in the range of 100°C to 300°C and simultaneously pressed with an isostatic forming pressure of at least 1 MPa, preferably 4-20 MPa.

By heating and pressing the discrete blanks 12 in the forming mold 14, the discrete blanks 12 are shaped into two-dimensional or three-dimensional cellulose products 10.

The cellulose products 10 may have any desired two-dimensional or three-dimensional shape. The forming temperature, pressure, and time may be adapted to the shape and dimension of the cellulose products to be manufactured.

In a possible embodiment the discrete blanks 12 in the forming mold 14 may be formed into blister packaging units.

With reference to figure 6, in a possible embodiment the continuous web 16 may include at least one layer of cellulose fibers 22 and at least one thermally active layer 24. The thermally active layer 24 may be a thermally conductive or thermally insulating film or web. The layer of cellulose fibers 22 and the thermally active layer 24 may be unwound from respective reels 26, 28 and may be overlapped and fixed to each

other. The layer of cellulose fibers 22 and the thermally active layer 24 may be fixed to each other in a pressing unit 30. The pressing unit 30 may be heated.

The inclusion in the continuous web 16 of at least one thermally active layer 24 provides a raw material particularly suitable to produce thermally effective articles, for example thermally insulating or thermally conductive containers. Therefore, the finished product will not require further transformations to obtain the same properties. Specifically, thermally insulating containers (for example for food) capable to retain heat inside could be obtained. Conversely, it would be possible to obtain containers with effective heat transmission capacities, suitable for example for allowing a more homogeneous heating of the products contained therein.

In a possible embodiment the continuous web 16 may include at least one elastic element embedded in at least one layer of cellulose fibers 22. This would provide a raw material with a surprising elongation. The elastic element may be an elastic film. In possible embodiments, a plurality of parallel elastic wires may be embedded in at least one layer of cellulose fibers 22.

In a possible embodiment the discrete blanks 12 may include granular super-absorbent polymer (SAP) or super-absorbent fibers (SAF). This would provide a raw material suitable for the formation of articles with particular absorbent capacities, therefore the finished articles will not require further operations to obtain the same properties. Specifically, containers particularly suitable for storing and transporting oily food products could be made. The granular super-absorbent polymer (SAP) or super-absorbent fibers (SAF) may be applied on at least one layer of cellulose fibers 22 in a continuous or discrete pattern.

In a possible embodiment the continuous web 16 may include at least one water-soluble layer. This would allow the formation of a raw material with cavities or areas initially closed by the water-soluble layer and which can be opened by dissolving the water-soluble layer.

In a possible embodiment the method may comprise adding to the discrete blanks 12 at least one water-soluble layer.

In a possible embodiment the continuous web 16 may include at least one barrier film providing one or more of: vapor barrier, oxygen barrier, bacteria barrier.

In a possible embodiment the method may comprise adding to the discrete blanks 12 at least one barrier film providing a bacteria barrier.

This would provide a raw material that is particularly suitable for the formation of packages that are not permeable to vapor, oxygen, bacteria. Specifically, it is possible to provide a raw material suitable to make a finished articles with vapor barrier or other characteristics. Therefore, the finished articles will not need further operations to obtain the same properties. This allows to provide the functionalizing material which gives specific properties inside the body of the finished articles.

With reference to figures 7-9, in a possible embodiment the method may comprise the formation of holes into the discrete blanks 12. In a possible embodiment the holes may be formed into the continuous web 16 before cutting the continuous web 16 into a plurality of discrete blanks 12. The holes may be formed in a piercing unit 32 arranged upstream of the cutting unit 18. Alternatively, the holes may be formed on the discrete blanks 12.

As shown in figure 8, in a possible embodiment the

method may comprise forming on the continuous web 16 a plurality of piercing patterns 34 spaced from each other in the machine direction MD. The piercing patterns 34 may be formed in phase with the cutting unit 18, such that after the cut in the cutting unit 18 each of the discrete blanks 12 has a respective piercing pattern 34.

As shown in figure 9, in a possible embodiment the method may comprise forming on the continuous web 16 at least one continuous piercing pattern 36 extending continuously in the machine direction MD.

Forming on the continuous web 16 a plurality of piercing patterns 34, 26 provides a raw material suitable for the formation of articles with a significant degree of breathability, without the need of further operations on the finished articles to obtain the same properties. Specifically, breathable containers could be produced suitable for storing products, for example food products, particularly prone to the formation of mold and condensation.

With reference to figure 10, in a possible embodiment the method may comprise cutting the continuous web 16 along a continuous longitudinal cutting line in a longitudinal cutting unit 38 to form two continuous half-webs 16a, 16b. The two continuous half-webs 16a, 16b are then overlapped to each other in an overlapping unit 40 to form a second continuous web 42 formed by two overlapped cellulose layers.

With reference to figure 11, in a possible embodiment the method may comprise folding the continuous web 16 along a continuous longitudinal folding line in a longitudinal folding unit 44 to form a third continuous web 46 formed by two continuous cellulose flaps overlapped to each other.

This makes it possible to create a multilayer composite raw material while reducing the number of

unwinders (or more generally of raw material feeding equipment), thus reducing the overall dimensions of the entire manufacturing line.

With reference to figure 12, in a possible embodiment the discrete blanks 12 may be formed by laser cutting the continuous web 16 in a laser cutting unit 48 while the continuous web 16 advances in the machine direction MD.

With reference to figure 12, in a possible embodiment the continuous web 16 may include two outer layers 50 and one central layer 52 sandwiched between the two outer layers 50. The two outer layers 50 and the central layer 52 may be unwound from respective reels 54, 56. The two outer layers 50 and the central layer 52 may be overlapped to each other in a pressing unit 58.

As shown in figure 14, the central layer 52 may have a plurality of through holes 60 which may be formed in a piercing unit 62 (figure 13). The two outer layers 50 may be fixed to each other through the through holes 60 of the central layer 52.

This provides a multilayer composite raw material in which the central layer is not involved in the formation of the joints (application of adhesives, welding, etc.) thereby preventing alteration of its chemical and physical characteristics.

Figures 15 and 16 show a possible embodiment of the continuous web 16 in a plan view and in a cross-sectional view, respectively. In the embodiment shown in figures 15 and 16 the continuous web 16 may include areas with different basis weight. This provides higher manufacturing flexibility, possibility of customizing the finished product, and waste reduction.

For instance, the continuous web 16 may include a base layer 62 and longitudinal strips 64 applied on the base layer 62 to form a continuous web 16 with a three-

dimensional structure. This provides higher manufacturing flexibility, possibility of customizing the finished product, and waste reduction.

With reference to figure 17, in a possible embodiment the continuous web 16 may be shaped to form areas with different thickness 66, 68 alternating the machine direction MD, which may form discrete blanks 12 with a three-dimensional structure. The areas with different thickness 66, 68 may be joined by inclined sides which may facilitate insertion of the discrete blanks 12 in the forming mold 14.

In this way a suitably shaped raw material may be created to facilitate the subsequent molding process. This solution overcomes the problem of the formation of cracks, defects, breaking points in the finished product, which in EP4100245 is overcome by shaping the mold.

In a possible embodiment each of the discrete blanks 12 may include two half-shells joined to each other by a folding line. The discrete blanks 12 may be folded along said folding line to overlap the two half-shells, to each other. The two half-shells overlapped on each other may be joined to each other to form a hollow product such as a bottle or a box. Joining the two half-shells may be carried out by glue, hydro-bonding, thermo-mechanical or ultrasonic crimping or bonding.

Joining two half-shells to form a hollow product may be carried out on a rotating wheel having a plurality of welding heads spaced from each other along the periphery of the rotating wheel, which receive respective discrete blanks 12 from the forming mold 14.

The welding heads may include ultrasonic welding units having respective sonotrodes which extend along the periphery of the products. A multi-head wheel for welding products in a tracking process may be formed as

disclosed in US10479022.

Before carrying out ultrasonic welding the products may be slightly wetted. In this case, the ultrasonic welding not only gives energy for welding, but allows evaporation of water and stabilization of the shape.

Figures 18 and 19 show a possible embodiment of a method for forming discrete blanks 12 made of loose unbound cellulose fibers.

In this embodiment, the discrete blanks 12 may be formed on a forming wheel 72 rotating about a vertical axis 74.

The forming wheel 72 has a horizontal upper surface 76 and a plurality of seats 78 open on the horizontal upper surface 76. The seats 78 have respective centers located on a circumference centered on the vertical axis 74.

Loose unbound cellulose fibers are deposited into the seats 78 of the forming wheel 72 to form discrete blanks 12. The seats 78 may be connected to a vacuum source 80 such that the loose unbound cellulose fibers deposited into the seats 78 are compacted by vacuum.

Loose unbound cellulose fibers may be supplied to the forming wheel 72 via a supply duct 82 having an outlet end facing the horizontal upper surface 76 of the forming wheel 72. The supply duct 82 may receive loose unbound cellulose fibers from a defibrator mill 84 which may be supplied by a continuous paper sheet 86 unwound from a reel 88.

The forming wheel 72 may comprise a plurality of extractor elements 90 associated to respective seats 78 and movable individually with respect to the forming wheel 72 between a lowered position (Figure 20) and a raised position (Figure 21). In the raised position the extractor elements 90 extract the discrete blanks 12 from the respective seat 78 and move the discrete blanks

12 above the horizontal upper surface 76.

The discrete blanks 12 once extracted from the respective seats 78 may be picked up by a transfer wheel 92 rotating about a second vertical axis 94. The transfer wheel 92 may have a lower surface 96 connected to a vacuum source 98 to pick up the discrete blanks 12 by vacuum.

The transfer wheel 92 may transfer the discrete blanks 12 to a conveyor 100 that feeds the discrete blanks 12 to the forming mold 14.

The formation of the discrete blanks 12 on a forming wheel rotating about a vertical axis keeps the discrete blanks 12 with the same orientation with respect to a vertical axis both during the formation and during the transfer to the forming mold 14. This arrangement allows for a flat detachment of the discrete blanks 12 from the forming wheel.

Of course, without prejudice to the principle of the invention, the details of construction and the embodiments can be widely varied with respect to those described and illustrated, without thereby departing from the scope of the invention as defined by the claims that follow.

CLAIMS

1. A method for producing cellulose products, comprising:

- providing at least one row of discrete blanks (12) each including at least one layer of cellulose fibers made from free cellulose fibers consolidated with each other or made by cutting a continuous web (16), wherein the discrete blanks (12) are spaced from each other in a machine direction (MD),
- advancing said at least one row of discrete blanks (12) in said machine direction (MD),
- feeding said at least one row of discrete blanks (12) to a forming mold (14),
- heating and pressing said discrete blanks (12) in said forming mold (14) to shape said discrete blanks (12) into two-dimensional or three-dimensional cellulose products (10),

wherein said discrete blanks (12) have different thickness and/or basis weight.

2. The method of claim 1, wherein said discrete blanks (12) having different thickness and/or basis weight have a same planar shape.

3. The method of claim 1, wherein said discrete blanks (12) having different thickness and/or basis weight have different planar shape.

4. The method of claim 1, comprising adding to the discrete blanks (12) at least one water-soluble layer.

5. The method of any of the preceding claims, comprising providing embossing patterns (22, 24) on said discrete blanks (12) before feeding said at least one

row of discrete blanks (12) to said forming mold (14).

6. The method of claim 1, comprising forming on said continuous web (16) at least one row of embossing patterns (22) wherein in each row said embossing patterns (22) are spaced from each other in said machine direction (MD).

7. The method of claim 1, comprising forming on said continuous web (16) at least one continuous row of embossing patterns (23) extending continuously in said machine direction (MD).

8. The method of claim 1, comprising embossing said discrete blanks (12) after cutting the continuous web (16) to form said at least one row of discrete blanks (12).

9. The method of any of the preceding claims, comprising providing a piercing pattern (34, 36) on said discrete blanks (12).

10. The method of any of the preceding claims, wherein said continuous web (16) includes at least one elastic element embedded in said at least one layer of cellulose fibers.

11. The method of any of the preceding claims, wherein said discrete blanks (12) include granular super-absorbent polymer (SAP) or super-absorbent fibers (SAF).

12. The method of claim 11, wherein said granular super-absorbent polymer (SAP) or super-absorbent fibers (SAF) is applied on said at least one layer of cellulose

fibers in a continuous or discrete pattern.

13. The method of any of the preceding claims, comprising cutting said continuous web (16) along a continuous longitudinal cutting line to form two continuous half-webs (16a, 16b), and overlapping to each other said continuous half-webs (16a, 16b).

14. The method of any of the preceding claims, comprising folding said continuous web (16) along a continuous longitudinal folding line to form two continuous flaps, and overlapping to each other said continuous flaps.

15. The method of any of the preceding claims, comprising laser cutting the continuous web (16) while advancing in the machine direction (MD) to form said plurality of discrete blanks (12).

16. The method of any of the preceding claims, wherein the continuous web (16) includes two outer layers (50) and one central layer (52) sandwiched between the two outer layers (50), wherein the central layer (52) has a plurality of through holes (60) and wherein the two outer layers (50) are fixed to each other through said through holes (60).

17. The method of any of the preceding claims, wherein the continuous web (16) includes at least one water-soluble layer.

18. The method of any of the preceding claims, wherein the discrete blanks (12) are disc shaped.

19. The method of any of the preceding claims,

wherein the continuous web (16) includes at least one barrier film providing a bacteria barrier.

FIG. 1

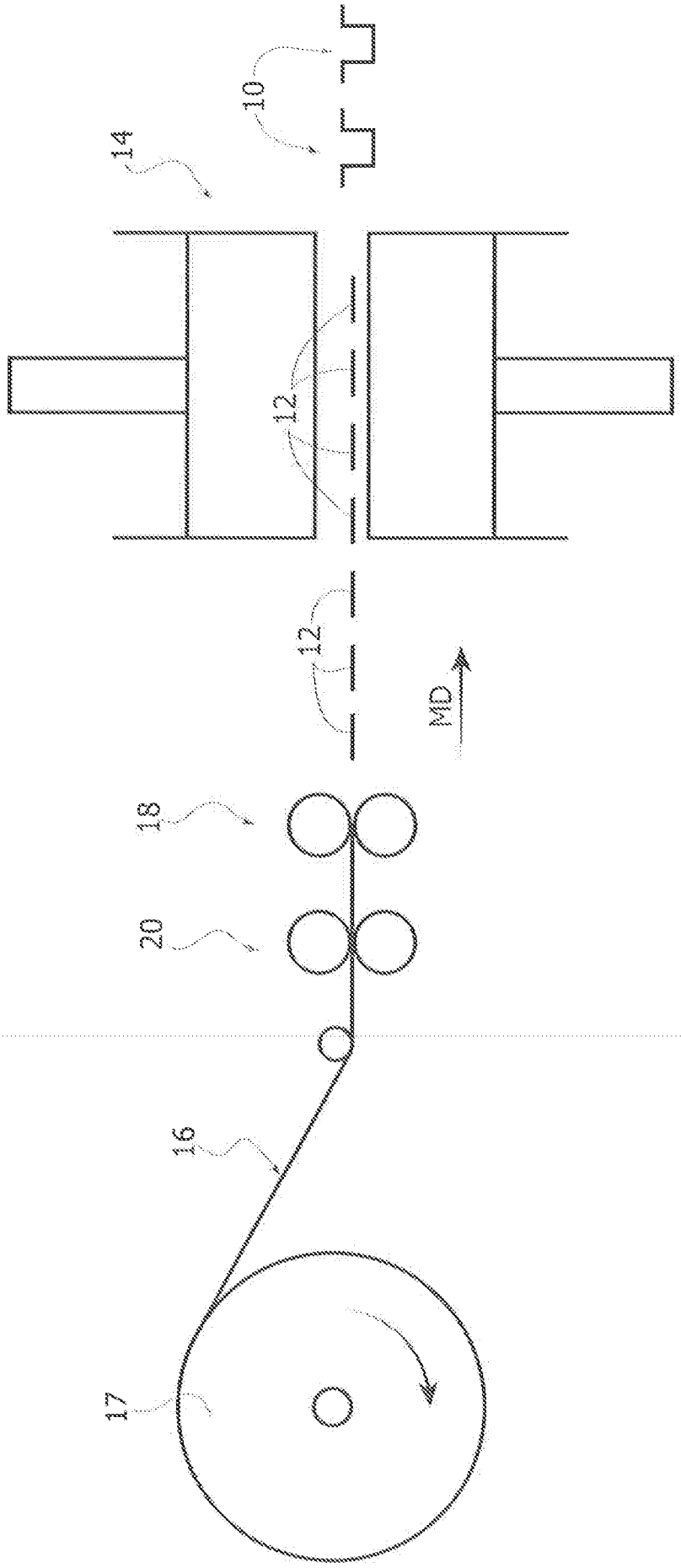


FIG. 2

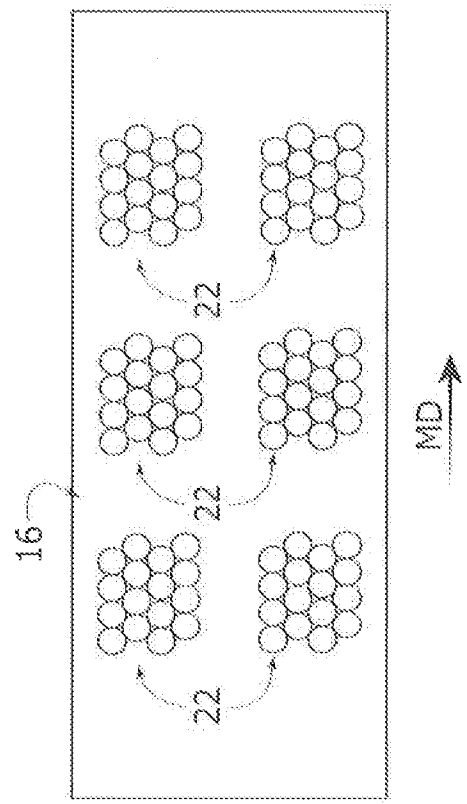


FIG. 3

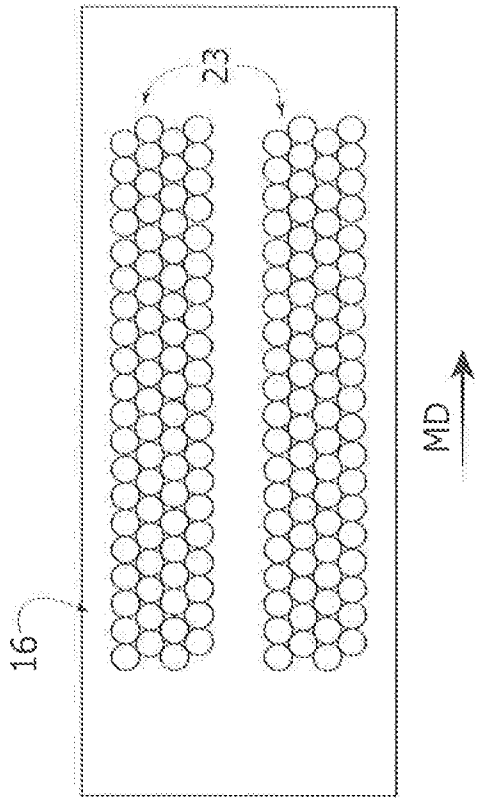


FIG. 4

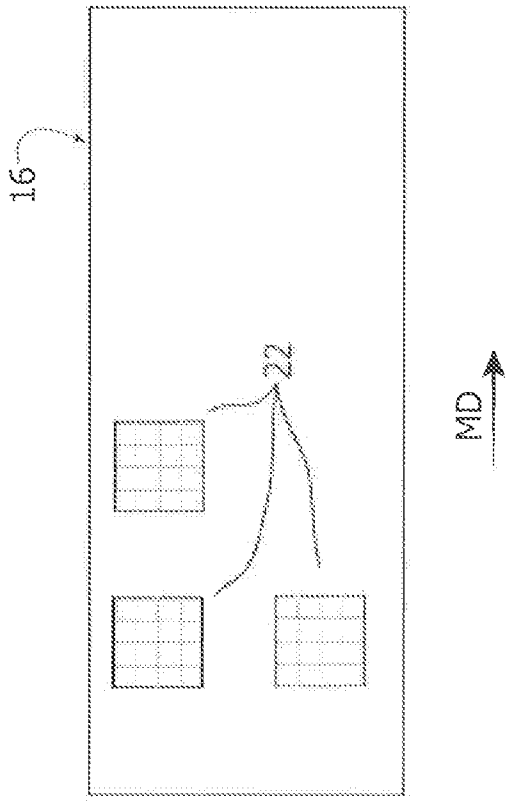


FIG. 5

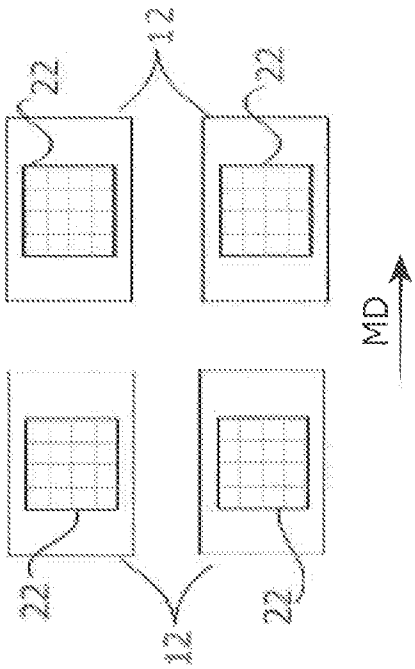


FIG. 6

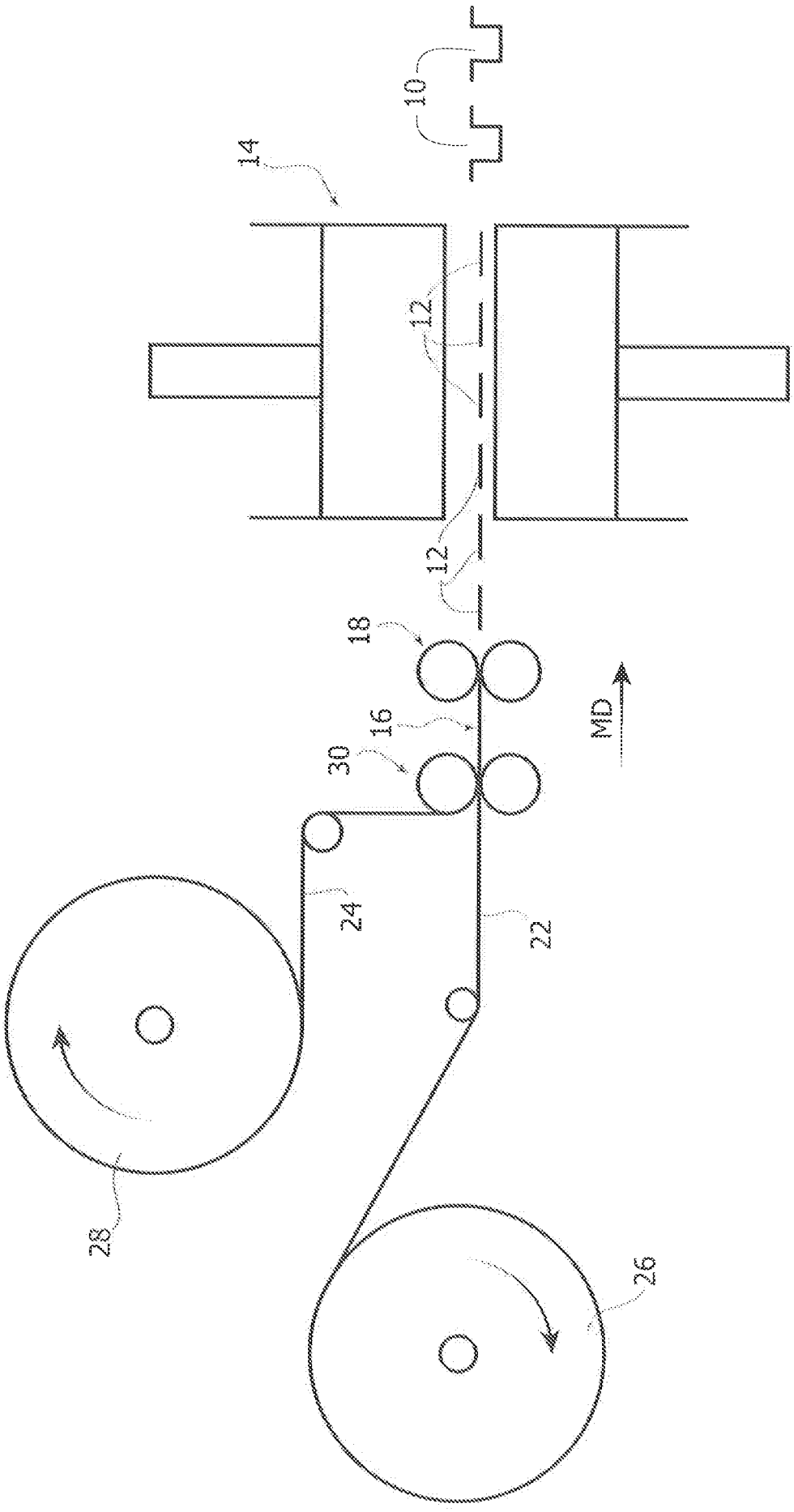


FIG. 7

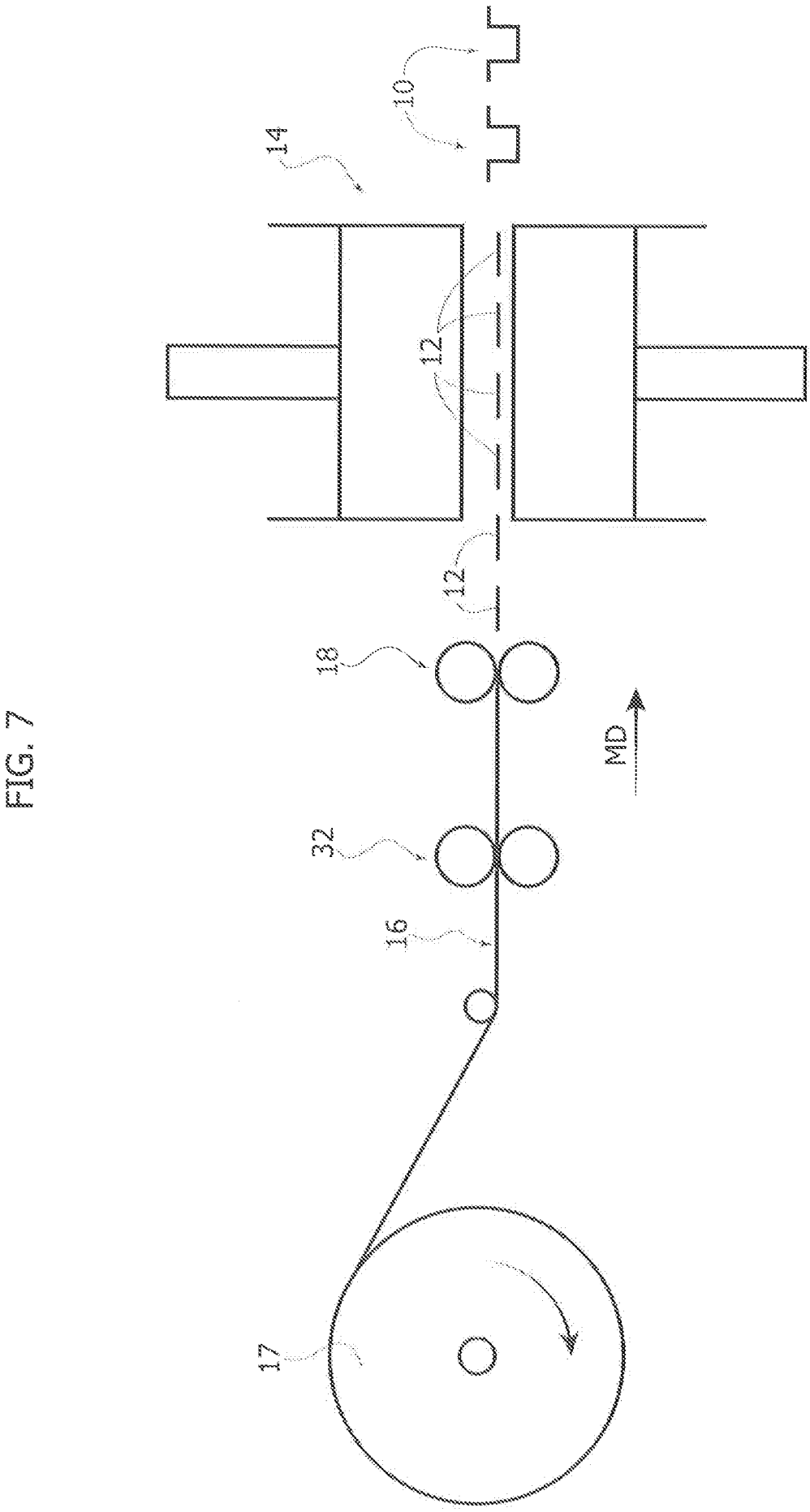


FIG. 8

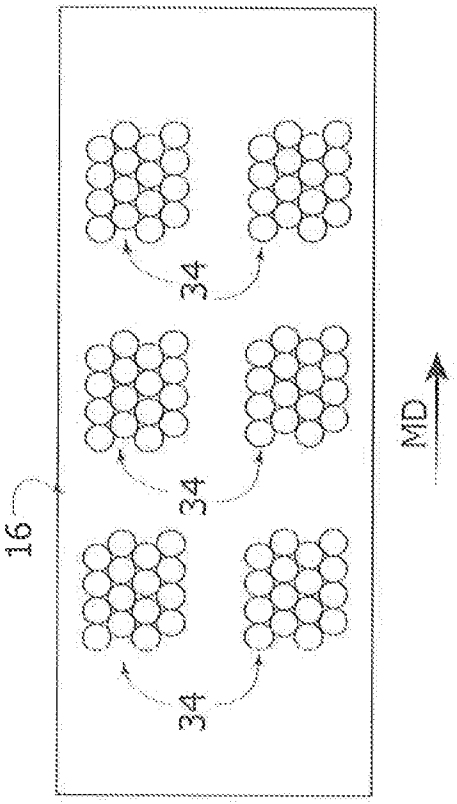


FIG. 9

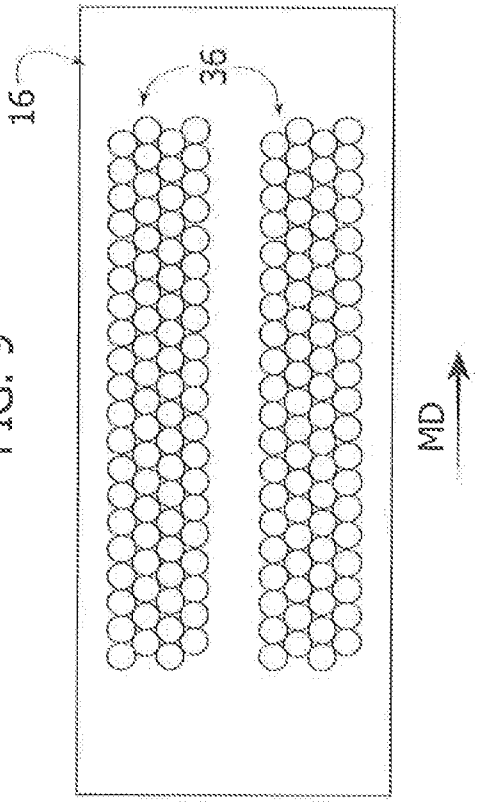


FIG. 10

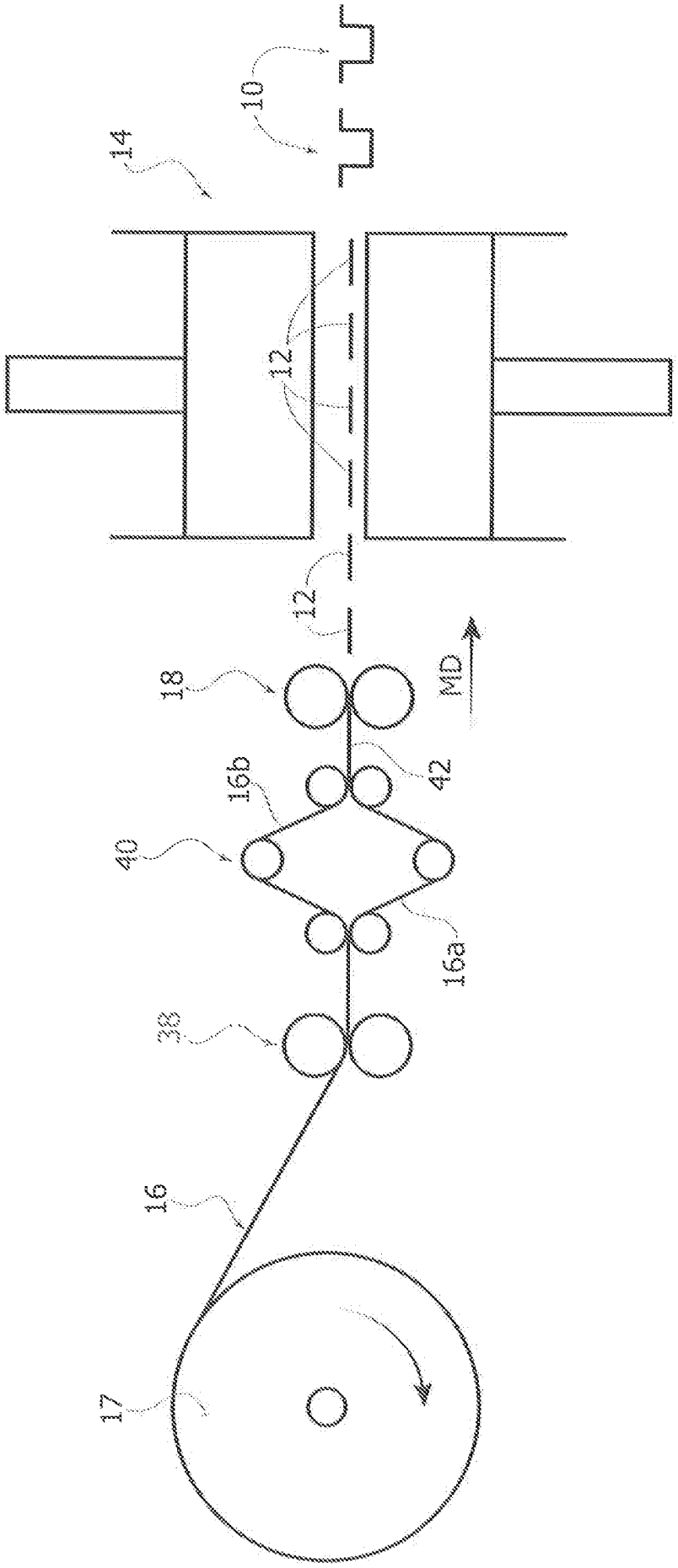


FIG. 11

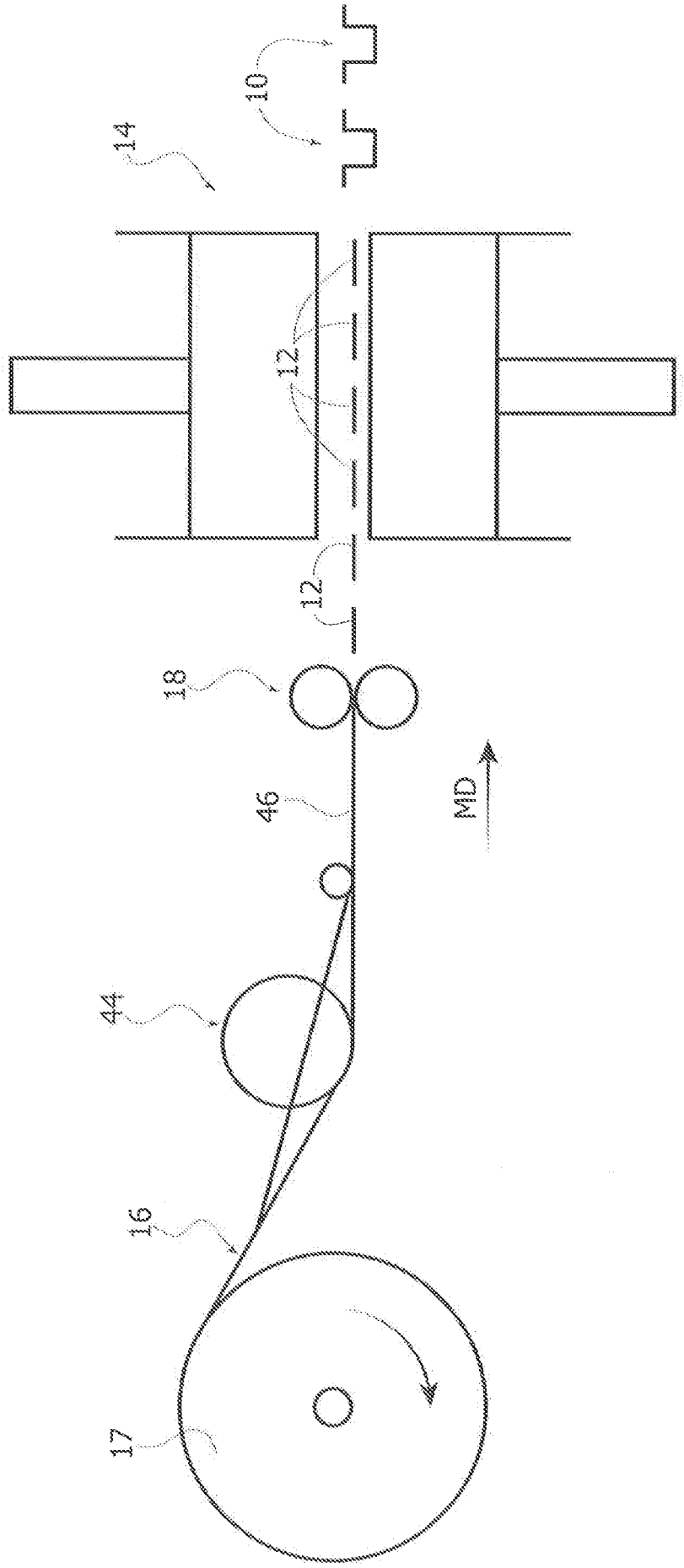


FIG. 12

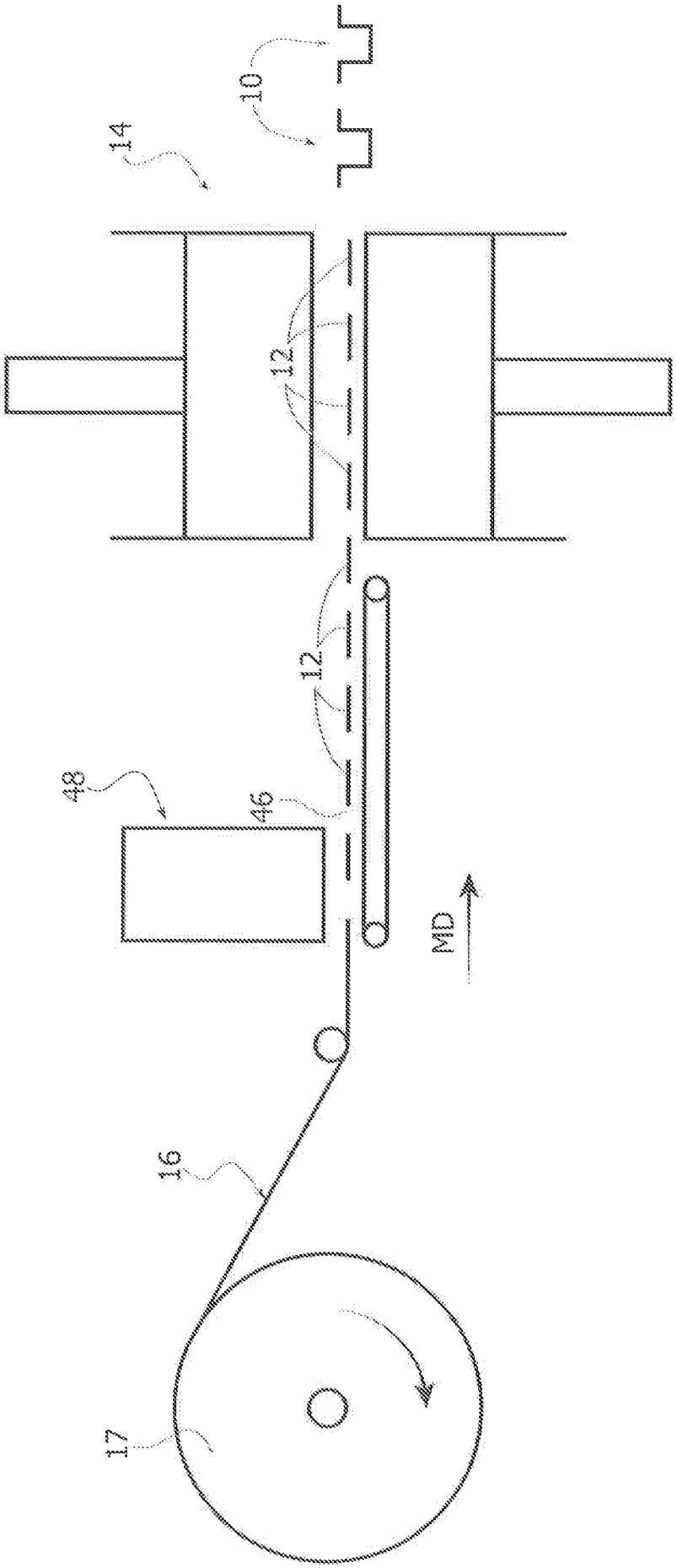


FIG. 13

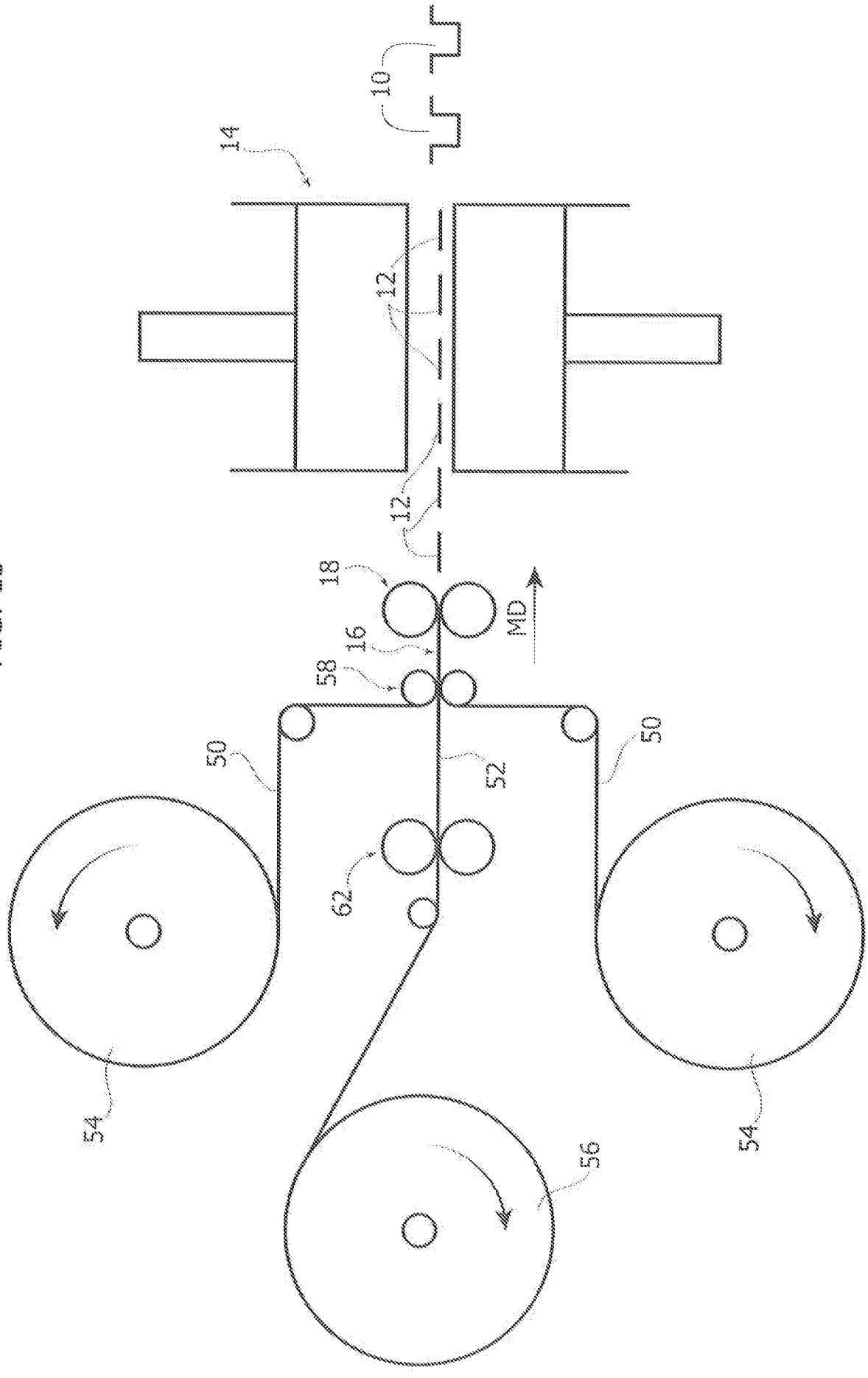
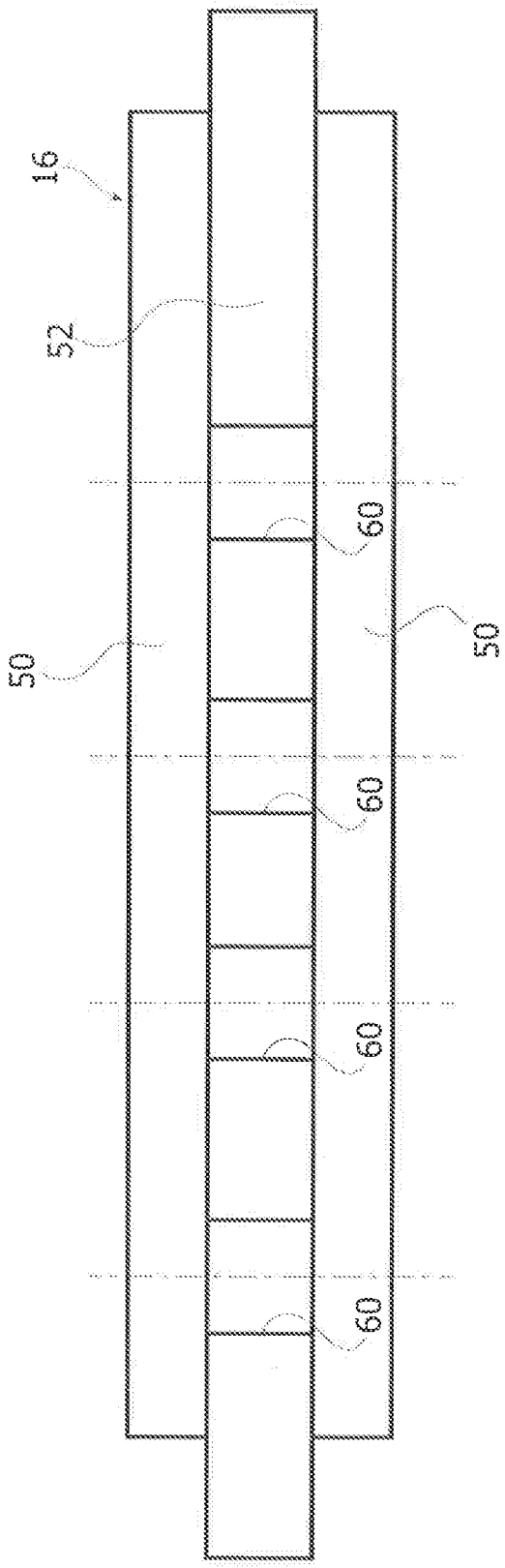


FIG. 14



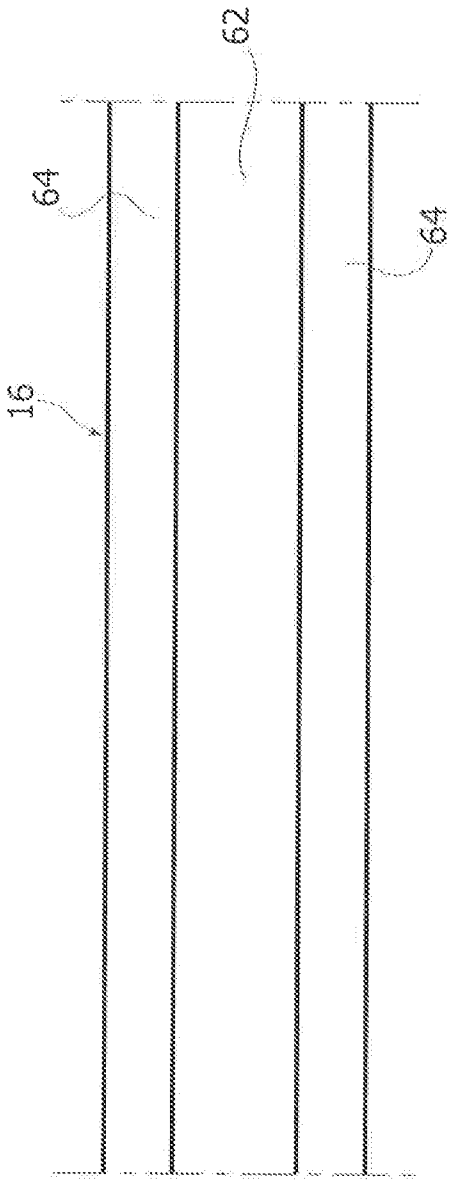


FIG. 15

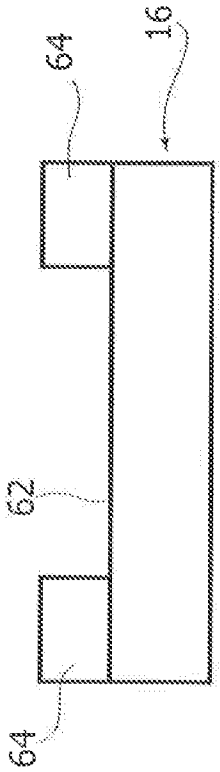


FIG. 16

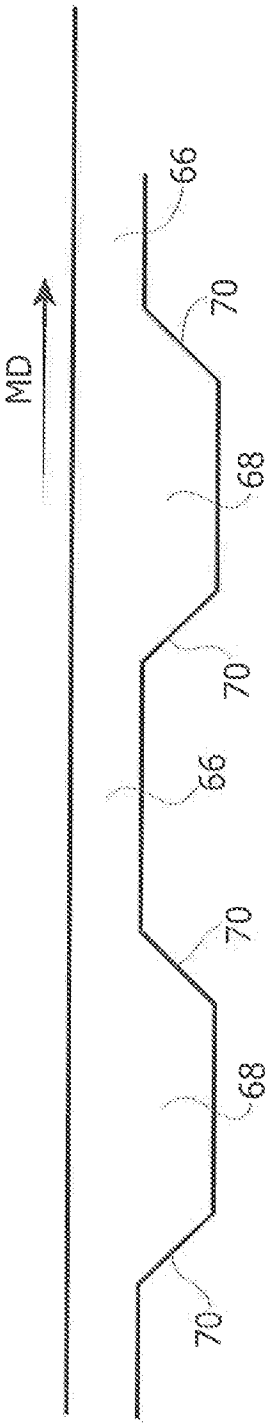


FIG. 17

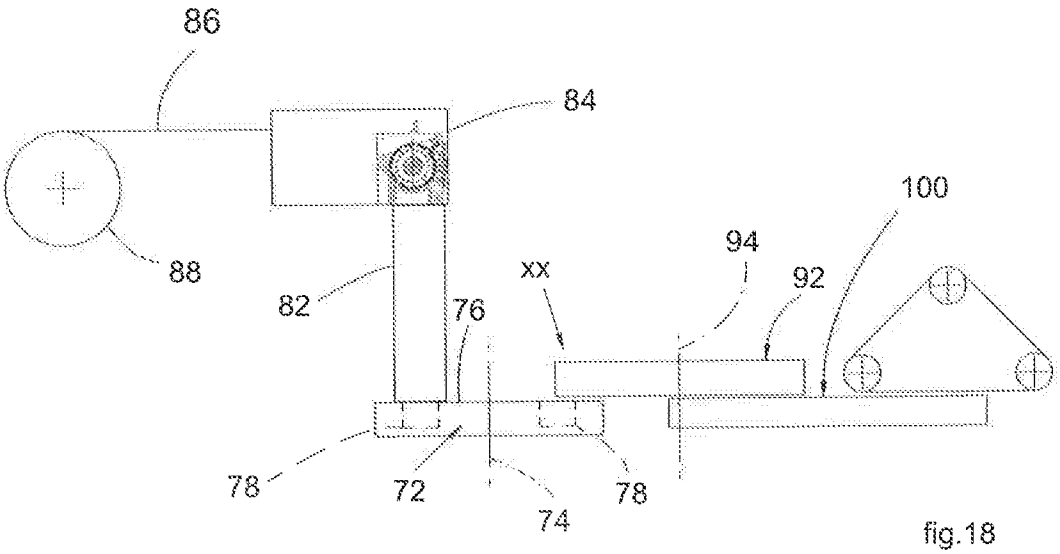
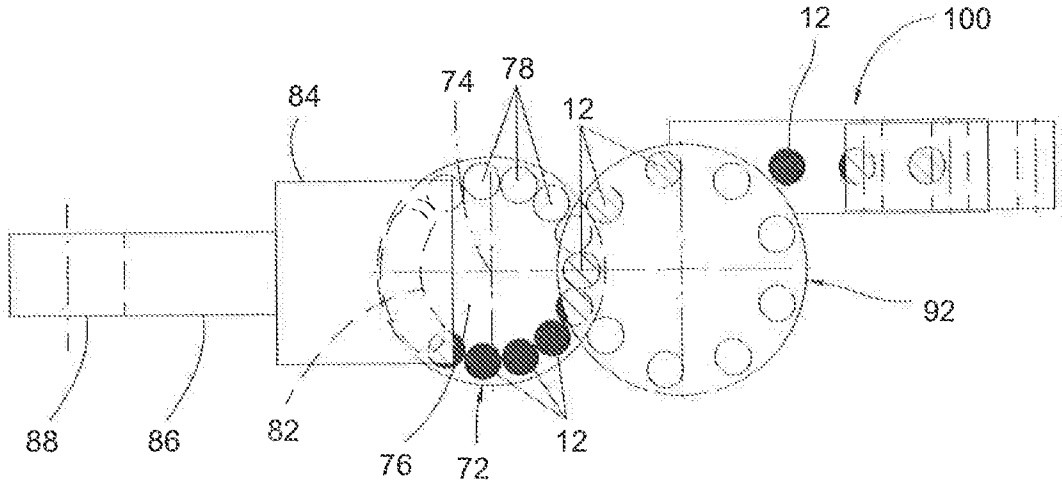

86
84
88
82
76
xx
94
92
100
78
72
74
78

fig.18


12
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86
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76
72
12

fig.19

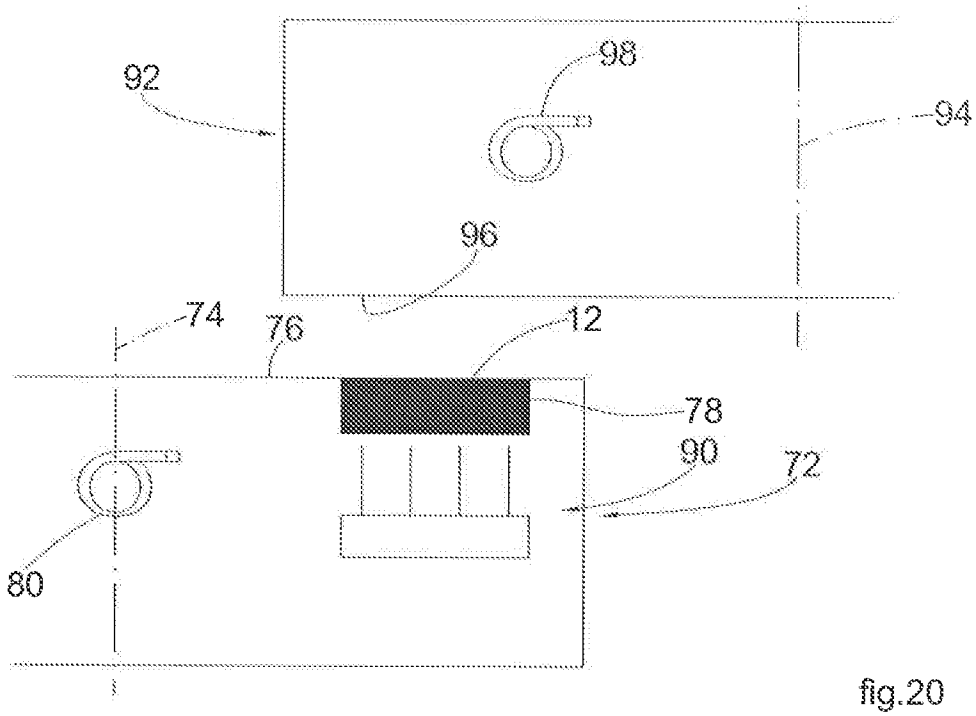

fig.20

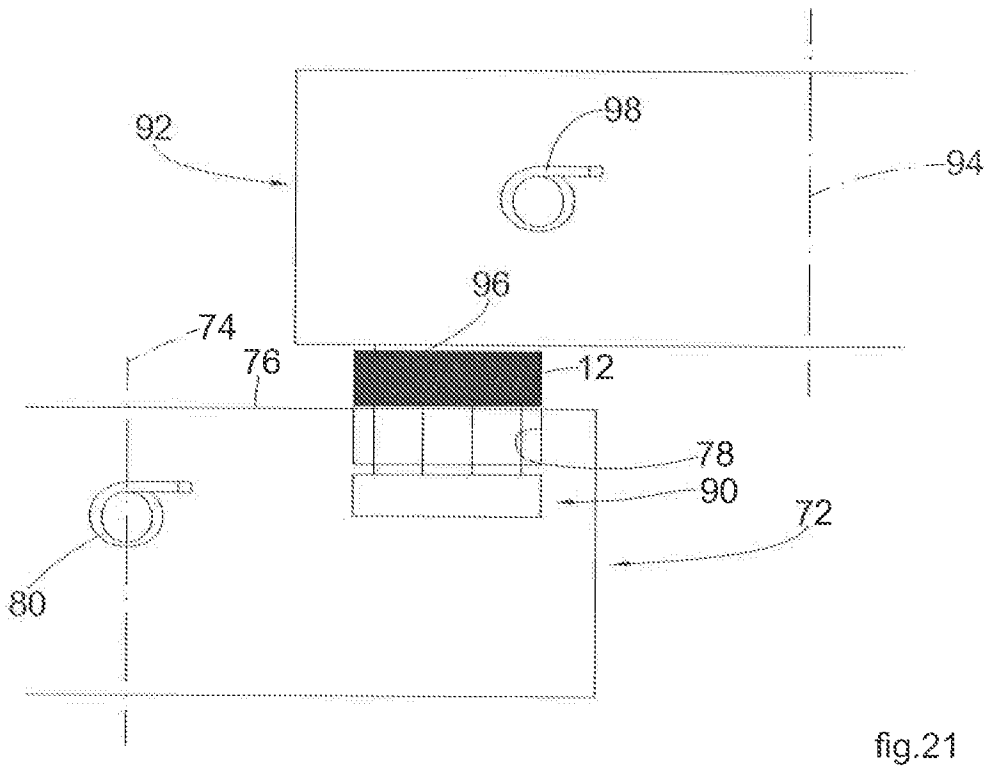

fig.21

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2023/056883

A. CLASSIFICATION OF SUBJECT MATTER
INV. B31B50/14 B31B50/16 B31B50/18 B31B50/36 B31B50/59
B31B50/74 B31B50/88 B31F1/12
ADD. B31B100/00 B31B120/00 B31B120/40 B31B120/50
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED
Minimum documentation searched (classification system followed by classification symbols)
B31B B31F B27N

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

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	SE 1 950 299 A1 (PULPAC AB [SE]) 9 September 2020 (2020-09-09)	1-3
Y	page 9, line 3 - line 8; figures 1-4	18
A	page 13, line 6 - line 29 page 17, line 22 - line 27 page 26, line 16 - line 20 page 27, line 27 - line 28	4,17
A	SE 2 151 359 A1 (PULPAC AB [SE]) 6 May 2023 (2023-05-06) page 28, line 11 - page 29, line 30; figures 5b,5c	1-4,17, 18
A	WO 2009/004660 A1 (CAVALLI S R L [IT]; CAVALLI LUIGI [IT]) 8 January 2009 (2009-01-08) page 6, line 22 - page 8, line 7; figures 4,5	4,17

-/--

[x] Further documents are listed in the continuation of Box C.
[x] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance;; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance;; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
24 January 2024	03/04/2024

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

Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IB2023/056883

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims;; it is covered by claims Nos.:

1-4, 17, 18

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2023/056883

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 2022/238017 A1 (YANGI AB [SE]) 17 November 2022 (2022-11-17) cited in the application page 14, line 5 - line 27; figures 3,4 -----	18

Form PCT/ISA/210 (continuation of second sheet) (April 2005)

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-4, 17, 18

adding to the discrete blanks at least one water-soluble layer

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2. claims: 5-8

providing an embossing pattern on the discrete blanks

---

3. claim: 9

providing a piercing pattern on the discrete blanks

---

4. claim: 10

continuous web including at least one elastic element embedded in the at least one layer of cellulose fibers

---

5. claims: 11, 12

discrete blanks including granular super-absorbent polymer (SAP) or super-absorbent fibers (SAF)

---

6. claims: 13, 14

overlapping to each other continuous half-webs or flaps

---

7. claim: 15

laser cutting the continuous web

---

8. claim: 16

the central layer of a three layer continuous web has a plurality of through holes

---

9. claim: 19

continuous web including at least one barrier film providing a bacteria barrier

---

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/IB2023/056883

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
SE 1950299 A1	09-09-2020	NONE	
SE 2151359 A1	06-05-2023	SE 2151359 A1	06-05-2023
		WO 2023078834 A2	11-05-2023
WO 2009004660 A1	08-01-2009	EP 2183147 A1	12-05-2010
		WO 2009004660 A1	08-01-2009
WO 2022238017 A1	17-11-2022	NONE	