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(54) **A DEVICE AND A METHOD FOR DRYING A VENEER, AND A METHOD FOR ADAPTING A DRYER TO FORM A DEVICE FOR DRYING A VENEER**

(57) A device (100) for drying a veneer (111). The device (100) comprises a first primary roller (211) and a first secondary roller (212) together forming a first pair (210) of rollers configured to move the veneer (111) through a first gap (215) of the first pair (210). The device comprises a second primary roller (221) and a second secondary roller (222) together forming a second pair of rollers (220) rollers configured to move the veneer (111) through a second gap (225) of the second pair (220). At least a part of a first primary jet box (311) arranged in between the primary rollers (211, 221) and has a primary support surface (313). The gaps (215, 225) define a planar design trajectory (T). A primary imaginary plane (P1) that is defined by the first gap (215) and the primary sup-

port surface (313) in such way that (i) the primary imaginary plane (P1) makes a contact with the primary support surface (313) and (ii) an angle (β_1) between the primary imaginary plane (P1) and the planar design trajectory (T) is minimized intersects a surface of the second primary roller (221) at such a first primary intersection line (I11) that a primary angle (α_1), which is left in between the primary imaginary plane (P1) and a tangent plane (TP1) of the second primary roller (221) at the first primary intersection line (I11) is at least 115 degrees. Alternatively, the primary imaginary plane (P1) does not intersect the surface of the second primary roller (221). A method for adapting a dryer to form such a device (100). A method for drying a veneer with such a device (100).

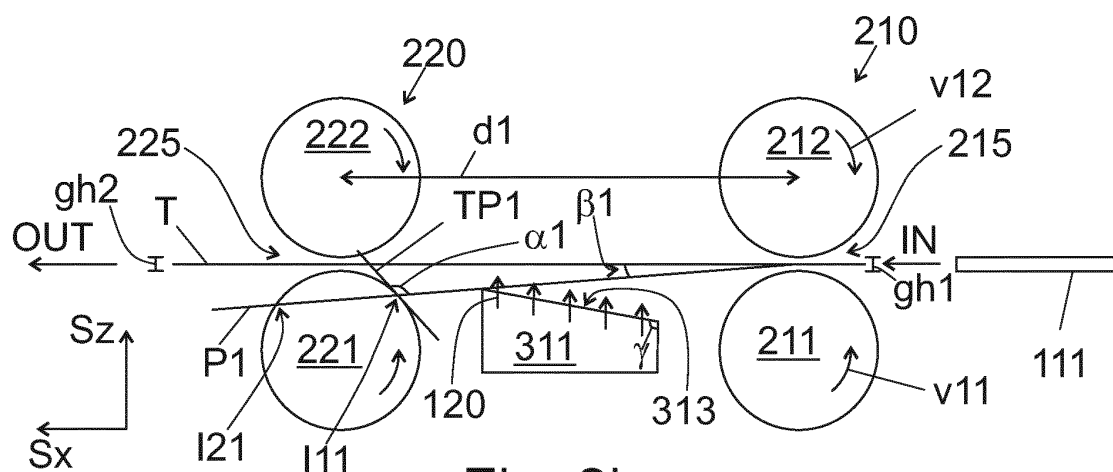


Fig. 2b

DescriptionTechnical field

5 **[0001]** The invention relates to devices and methods for drying veneers. The invention relates to a method for adapting a dryer to form a device for drying a veneer.

Background

10 **[0002]** To manufacture plywood, a wooden veneer mat is cut from wood, and the veneer mat is dried and cut to veneers. The veneers are stacked on top of each other and attached to each other with some adhesive. The veneer mat may be first dried and thereafter cut to veneers, or the veneer mat may be first cut to veneers and thereafter the veneers may be dried.

15 **[0003]** Veneers may be dried in various types of dryers. By far the most common veneer dryer is the direct-fired or steam- or hot water-heated roller conveyor type. In a roller dryer the rollers are generally tubes that transport veneers or form roller pairs that transport veneers between the pairs. However, in the field also wire-mesh conveyors are used, as well as progressive kilns, progressive platen dryers, and perforated drums, with a partial vacuum inside the drums. The present invention relates to a veneer dryer of a roller conveyor type, a method for adapting an existing veneer dryer of a roller conveyor type, and a method for drying a veneer.

20 **[0004]** A roller conveyor type dryer 900 of prior art is depicted, in a side view, in Fig. 1a. The dryer 900 includes multiple pairs of rollers that convey the veneers. In between the pairs of rollers, the veneers are heated in order to dry them. Pairs of rollers may be arranged in multiple different height levels, for example in four levels in Fig. 1a, in order to dry multiple veneers simultaneously. During drying, the veneers move in a longitudinal direction S_x of the dryer 900. The part 1b of Fig. 1a is depicted in more detail in Fig. 1b.

25 **[0005]** It has been found that in a roller conveyor type veneer dryer 900, the veneers may occasionally tend to propagate to a wrong side of a roller. Referring to Fig. 1b, the veneers are designed to propagate through a first gap 215 in between a first pair 210 of rollers 211, 212 and a second gap 225 in between a second pair 220 of rollers 221, 222; i.e. from "IN" to "OUT". However, occasionally, instead of going through the second gap 225, the veneer propagates in between a jet box 311 and a roller 221 forming the second gap 225, as indicated by a dotted arrow in Fig. 1b. This phenomenon causes jamming of the veneer dryer 900. When jamming occurs, at least a level of the dryer may be stopped, and the problem solved by clearing the jam. Thereafter, a subsequent jamming may occur. As a result, in operation, veneer dryer jamming occur at some jamming frequency.

Summary

35 **[0006]** It has been found that by a proper design of a supportive surface of the jet box, the jamming frequency can be significantly reduced. The supportive surface is configured to guide the veneer towards a gap in between the rollers. A corresponding device is described in more specific terms in the independent claim 1. Such a device can be manufactured from an existing dryer by applying thereto a suitable guide element, as indicated in independent claim 8. A veneer can be dried by using the device, as indicated in independent method claim 11. Dependent claims disclose most preferable embodiments. The description and figures support the invention and the most preferable embodiments, and disclose further embodiments.

Brief description of the drawings

45 **[0007]** The embodiments are explained with the figures, in which the direction S_x denotes a longitudinal direction of the device 100, in which the veneers are conveyed during drying, S_y denotes a transversal direction, which is perpendicular to S_x and substantially parallel to rotational axes of the rollers of the roller-conveyor, and S_z is perpendicular to both S_x and S_y . In typical use, S_z is vertical and reverse to gravitational force. As for the figures:

50 Fig. 1a shows, in a side view, a dryer of prior art,
 Fig. 1b shows, in a side view, the part 1b of Fig. 1a in detail,
 Fig. 2a shows, in a side view, a device for drying a veneer,
 Fig. 2b shows, in a side view, the part IIb of the device of Fig. 2a with some measures,
 55 Fig. 2c shows, in a side view, the part IIb of the device of Fig. 2a with some measures,
 Fig. 2d shows, in a side view, the part IIb of the device of Fig. 2a with some measures,
 Fig. 2e shows, in a side view, a part of a device for drying a veneer with some measures,
 Fig. 2f shows, in a side view, a part of a device for drying a veneer with some measures,

Fig. 2g	shows, in a side view, a larger part of a device for drying a veneer,
Fig. 2h	shows, in a side view, a larger part of a device for drying a veneer,
Fig. 3a	shows, in a side view, another device for drying a veneer,
Fig. 3b	shows, in a side view, the part IIIb of the device of Fig. 3a with some measures,
5 Fig. 3c	shows, in a side view, the part IIIb of the device of Fig. 3a with some measures,
Fig. 3d	shows, in a side view, a part of a device for drying a veneer with some measures,
Fig. 3e	shows, in a side view, a part of a device for drying a veneer with some measures,
Fig. 4a	shows, in a side view, another device for drying a veneer,
Fig. 4b	shows, in a side view, the part IVb of the device of Fig. 4a with some measures,
10 Fig. 5	shows, in a rear view as indicated in Fig. 2f, a jet box, a pair of rollers, a gap between the rollers of the pair of rollers, and heating and circulating medium,
Fig. 6a	shows, in a top view, a first primary roller, a second primary roller, and a jet box having a support surface in between these rollers,
Fig. 6b	shows, in a top view, a first primary roller, a second primary roller, and a jet box having a different support surface in between these rollers,
15 Figs. 7a to 7c	show, in a side view, a method for adapting an existing dryer using a guide element,
Fig. 7d	shows, in a side view, an adapted dryer, i.e. a device, the dryer having been adapted using a different guide element,
Fig. 7e	shows, in a side view, an adapted dryer, i.e. a device, the dryer having been adapted using a different guide element fixed to a side of a jet box,
20 Fig. 7f	shows, in a from view as indicated in Fig. 7e, the jet box and guide element of Fig. 7e, and a pair of rollers,
Fig. 7g	shows, in a side view, a device having a holder for a guide element,
Figs. 8a and 8b	show, in a side view, a method for adapting another existing dryer using a another similar guide element,
25 Fig. 9	shows, in a top view, a first veneer and feeding the first veneer to a gap of a pair of rollers,
Figs. 10a and 10b	show, in a side view, arranging two veneer is a partial overlap and feeding the two veneers in between a pair of rollers, and
Figs. 11a and 11b	show, in a side view, a method for adapting a dryer using a different type of a guide element.

Detailed description

[0008] As indicated in the background, it has been found that in a roller conveyor type veneer dryer 900, the veneers may occasionally tend to propagate to a wrong side of a roller, in particular a veneer may propagate in between a jet box 311 and the roller 221 as indicated by a dotted arrow in Fig. 1b. This phenomenon may be referred to veneer diving, since due to the phenomenon, a veneer propagates (i.e. dives) to a lower level of the roller conveyor type dryer. As a result, the diving causes jams. Jams are caused in not only the level from which the veneer starts to dive, but also in a level or levels beneath that level. Thus, this phenomenon causes jamming of at least two levels of a dryer 900. Even if this phenomenon is not common, e.g. only a few permilles (a few out of thousand) of the veneers may dive, this phenomenon slows production or temporarily forces to shut down the production to clear the jam.

[0009] Without going too much into details, it seems that warping of the veneer is a factor affecting the diving. The more warping in the veneers, the more likely diving occurs. Warping of the veneers during drying results from at least two factors: uneven drying of the veneers and anisotropic moisture expansion coefficient of the veneers, which are typically made of wood. Typically, the drying process is relatively homogeneous, whereby the former aspect may play a less significant role in drying. Typically a moisture content of a veneer will be decreased from a 70% - 160% level to a 2% - 15% level, whereby it is evident that a lot of drying induced contraction takes place. In case of wooden veneers, typically the veneers contract about 7 % at least in the two orientations that are perpendicular to the grain orientation of the wood. In contrast, in the grain orientation, the moisture induced swelling (or drying induced contraction) is much less. In addition, different parts of the veneers may absorb different amounts of water, e.g. the annual rings may absorb different amounts of water than the regions in between the rings. Therefore, uneven contraction occurs in the veneers, which also results in warping.

[0010] Veneer diving being a result of drying has been evidenced in dryers 900 of prior art, in which the diving occurs most often near such roller that the veneers have been dried a lot before the problem occurs. Typically, the most critical places are located near the halfway in between an inlet of the device 900 and an outlet of the device 900. As moist veneer dries more rapidly than a dry veneer, typically much more than a half of the moisture of a veneer has been evaporated at the most critical point of the dryer 900. However, the still remaining moisture implies that the veneer is relatively easily bendable. The term critical refers here to such locations in which the risk of veneers diving is the highest. Thus, the problem is more prominent when drying wooden veneers than when drying other sheet like material.

[0011] A dryer 900 typically comprises jet boxes both above and below the veneer, as the veneer passes in between the jet boxes. The air blown out of the jet boxes may also grab the veneer in such a manner that the risk of a veneer diving in the aforementioned manner increases.

[0012] In general it seems that the thickness of the veneer affect also the risk for diving. Thin veneers bend more easily than thick veneers. Moreover, a thin veneer is more easily bent by the air flows from the jet boxes than a thick veneers. Thus, the problem is more prominent when drying thin veneers than when drying thick veneers.

[0013] Figures 2a, 3a, and 4a show devices 100 for drying a veneer or veneers. Figures 2b, 3b, and 4b shows, respectively, in detail the parts IIb, IIIb, and IVb of the figures 2a, 3a, and 4a. Referring to these figure, a device 100 for drying a veneer 111 comprises a first pair 210 of rollers 211, 212. The first pair of rollers 210 is configured to move the veneer 111 in a longitudinal direction S_x . In typical use, the direction S_x is horizontal. The embodiments are primarily explained with reference to such a use, wherein the direction S_z is vertical and upwards, whereby primary rollers 211, 221 are arranged below secondary rollers 212, 222. This is because it has been found that the problem of prior art devices, as indicated above, is that the veneers propagate along the wrong side of lower one of the rollers. However, similar solution may be applied only on the top side of the pairs of rollers, in which case the embodiments explain such a use, wherein the direction S_z is vertical and downwards. Preferably, however, the solution is applied on both a top side and a bottom sides of the pairs of rollers.

[0014] The first pair of rollers 210 comprises a first primary roller 211 extending in a direction that is substantially parallel to a transversal direction S_y . Thus, the first primary roller 211 has a circular profile that extends in a longitudinal direction of the roller 211. The first primary roller 211 is configured to rotate about an axis that is parallel to the longitudinal direction of the roller 211. Moreover, the longitudinal direction of the roller 211 is substantially parallel to a transversal direction S_y , which is perpendicular to the longitudinal direction S_x . An angle between the rotational axis of the roller 211 and the transversal direction S_y may be e.g. at most 1 degrees. Typically the angle is much less, such as at most 0.1 degrees, but at least zero. However, a non-zero angle may be used to guide the veneer 111.

[0015] The first pair of rollers 210 further comprises a first secondary roller 212 that is substantially parallel to the first primary roller 211. Thus, an angle between the rotational axis of the first secondary roller 212 and the rotational axis of the first primary roller 211 may be e.g. at most 0.1 degrees. Moreover, an angle between the rotational axis of the roller 212 and the transversal direction S_y may be e.g. at most 0.1 degrees. Typically the angle(s) is/are much less, but at least zero. However, a non-zero angle may be used to guide the veneer 111. A first gap 215 is left in between the rollers 211, 212 of the first pair 210 of rollers.

[0016] The device 100 further comprises a second pair 220 of rollers 221, 222. The second pair 220 of rollers is arranged a first distance d_1 apart from the first pair 210 of rollers in the longitudinal direction S_x . The first distance d_1 may refer e.g. to the distance between the first gap 215 and a second gap 225.

[0017] The second pair of rollers 220 comprises a second primary roller 221 extending in a direction that is substantially parallel to a transversal direction S_y . Thus, the second primary roller has a circular profile that extends in a longitudinal direction of the roller 221. The roller 221 is configured to rotate about an axis, which is parallel to the longitudinal direction of the roller 221. What has been said about the direction of the first primary roller 211 relative to the transversal direction S_y applies to the second primary roller 221 *mutatis mutandis*.

[0018] The second pair of rollers 220 further comprises a second secondary roller 222 substantially parallel to the second primary roller 221. What has been said about the direction of the first primary roller 211 relative to the first secondary roller 212 applies to the mutual orientation of the second primary roller 221 and second secondary roller 222 *mutatis mutandis*. A second gap 225 is left in between the rollers 221, 222 of the second pair 220 of rollers.

[0019] The gaps 215, 225 extend in a direction that is substantially parallel to the transversal direction S_y and are separated from each other in the longitudinal direction S_x . In this way, the first gap 215 and the second gap 225 define a planar design trajectory T for the veneer 111. Thus, in use, a veneer 111 is designed to propagate along the planar design trajectory T from the first gap 215 to the second gap 225. The planar design trajectory T comprises a central line of the first gap 215, and further comprises a central line of the second gap 225. As indicated above, the central lines of the gaps 215, 225 propagate in substantially the transversal direction S_y .

[0020] Referring to Figs. 2b - 4c in the embodiments, the first primary roller 211 and the second primary roller 221 are left on a primary side of the planar design trajectory T. Correspondingly, the first secondary roller 212 and the second secondary roller 222 are left on a secondary side, different side, of the planar design trajectory T.

[0021] Referring to Figs. 2b, 3b, and 4b, in order to heat and dry the veneer 111, the device 100 comprises a first primary jet box 311. At least a part of the first primary jet box 311 is arranged in between the first primary roller 211 and the second primary roller 221. At least a part of the first primary jet box 311 is arranged on the primary side of the of the planar design trajectory T. Preferably the whole first primary jet box 311 is arranged on the primary side of the of the planar design trajectory T. The first primary jet box 311 has a primary support surface 313. The primary support surface 313 is configured to support the veneer 111 in use of the device 100; i.e. it is configured to guide the veneer 111 in the use. The primary support surface 313 is configured to support the veneer 111 (i.e. configured to guide the veneer 111) in such a way that the probability of the veneer 111 diving to a wrong side of the second primary roller 221 (i.e. in between

the first primary jet box 311 and the second primary roller 221) is reduced. Correspondingly, the primary support surface 313 is configured to guide the veneer 111 towards the second gap 225. In this way, the primary support surface 313 of the first primary jet box 313 is configured to prevent the penetration of the veneer 111 in between the first primary jet box 313 and the second primary roller 221. Technical details of the solution will follow.

[0022] In order to dry the veneer 111, the first primary jet box 311 is configured to feed gaseous drying medium 120 through the primary support surface 313 towards the planar design trajectory T. In an embodiment, in order to assure a continuous propagation of the veneer 111, neither the primary support surface 313 nor the first primary jet box 311 intersects with the planar design trajectory T. Thus, in such an embodiment, the whole primary support surface 313 is arranged on the primary side of the of the planar design trajectory T. However, in particular, if a secondary jet box is not used, or it is reasonably far away from the trajectory T, the primary support surface 313 may intersect with the planar design trajectory T. Thus, at least a part of the primary support surface 313 is arranged on the primary side of the planar design trajectory T. Heated air is typically used as the gaseous drying medium 120. The gaseous drying medium may comprise humidity and some volatile compounds evaporated from veneers.

[0023] In order to guide the veneer 111 in such a way that the probability of the veneer 111 not following the planar design trajectory T is reduced, the first pair of rollers 210, the second pair of rollers 220, and the primary support surface 313 of the first primary jet box 311 are arranged relative to each other as follows:

Referring to Fig. 2b and 4b, the first gap 215 and the primary support surface 313 define a primary imaginary plane P1. The primary imaginary plane P1 is defined such that a central line of the first gap 215, which propagates in substantially the transversal direction S_y , belongs to the primary imaginary plane P1. Another point or line also defines the primary imaginary plane P1. The other point or line is selected such that (i) the primary imaginary plane P1 makes a contact with the primary support surface 313 and (ii) an angle β_1 between the primary imaginary plane P1 and the planar design trajectory T is minimized. In other words, (i) the primary imaginary plane P1 makes a contact with the primary support surface 313 and (ii) the primary imaginary plane P1 does not penetrate the primary support surface 313. Thus, other point or line is selected as an extreme point of the primary support surface 313, as indicated in Figs. 2b and 4b.

[0024] Referring to Figs. 2b and 4b, the primary imaginary plane P1 thus defined may

- not intersect a surface of the second primary roller 221 (Fig. 2f),
- intersect a surface of the second primary roller 221 at one intersection line 111 only (Fig. 2e), or
- intersect a surface of the second primary roller 221 at a first primary intersection line 111 and at a second primary intersection line 121 (Figs. 2b, 3b, and 4b).

[0025] The first and second options indicate that the veneer 111 is guided towards the second gap 225 as indicated in Figs. 2f and 2e. However, these alternatives involve the support surface 313 being so close to the planar design trajectory T that the support surface 313 may hinder the propagation of the veneers. This happens in particular, when both primary 313 and secondary 314 support surfaces are present, as they commonly are.

[0026] As for the third option, the two intersection 111 and 121 lines are defined such that the first primary intersection line 111 is closer to the first primary jet box 311 than the second primary intersection line 121, as indicated in the Figures, especially 2b and 4b. At the first primary intersection line 111 the surface of the second primary roller 221 has a tangent plane TP1. The primary imaginary plane P1 intersects the tangent plane TP1, whereby the intersection defines four angles: two angles on a first side of P1, separated from each other by TP1, and two angles on a second side of P1, separated from each other by TP1. Referring to Figs. 2b and 4b, only one of these four angles, a primary angle α_1 , opens towards the planar design trajectory T and the first pair 210 of rollers. In other words, the primary angle α_1 is arranged in between a primary side of the primary imaginary plane P1 and a primary side of the tangent plane TP1, wherein at least a part of the first secondary roller 212 is arranged on the primary side of the primary imaginary plane P1 and on the primary side of the tangent plane TP1.

[0027] It has been observed that in particular this primary angle α_1 is responsible for the underlying problem. In case the primary angle α_1 is small, e.g. 90 degrees or even less, the problem seems to likely occur. However, when the primary angle α_1 is larger, the probability of the veneer diving is significantly reduced. Therefore, the primary angle α_1 is at least 115 degrees. In some embodiments of the invention the primary angle α_1 is more than 120 degrees, more than 125 degrees, or at least 135 degrees. It has been observed that, the greater the primary angle α_1 , the less the jamming frequency.

[0028] Referring again to Fig. 2e, the primary imaginary plane P1 may intersect the surface of the second primary roller 221 in one intersection line 111 only. However, as evident from Fig. 2e, the jet box 311 should not be arranged at such a low position, that the secondary rollers 222 and 221 would be on a same side of the plane P1. Thus, in case the primary imaginary plane P1 intersects the surface of the second primary roller 221 in one intersection line 111 only, the second primary roller 221 is arranged on a first side of the primary imaginary plane P1 and the second secondary roller 222 is arranged on a second, opposite, side of the primary imaginary plane P1. In other words, the primary imaginary plane P1 is arranged in between the second primary roller 221 and the second secondary roller 222.

[0029] Referring to Fig. 2f, in an embodiment, the primary imaginary plane P1 does not intersect a surface of the second primary roller 221. However, in such a case, in order for the jet box 311 to allow for the veneer to move from the first gap 215 to the second gap, preferably, the second rollers 221, 222 are arranged on different sides of the plane P1. In other words, the primary imaginary plane P1 is arranged in between the second primary roller 221 and the second secondary roller 222. Therefore, in an embodiment, primary imaginary plane P1 does not intersect a surface of the second primary roller 221, the second primary roller 221 is arranged on a first side of the primary imaginary plane P1 and the second secondary roller 222 is arranged on a second, opposite, side of the primary imaginary plane P1.

[0030] In principle, it is possible, that the primary imaginary plane P1 does not intersect a surface of the second primary roller 221, but intersects a surface of the second secondary roller 222. E.g. by moving the jet box 313 of Fig. 2f in the direction Sz relative to the rollers 211, 212, 221, 222, such a situation would occur. In case the primary imaginary plane P1 does not intersect a surface of the second primary roller 221 and the primary imaginary plane P1 intersects a surface of the second secondary roller 222, preferably, a minority of the second secondary roller 222 is arranged on the same side of the primary imaginary plane P1 as the second primary roller 221. Thus, in an embodiment, the primary imaginary plane P1 does not intersect a surface of the second primary roller 221, the primary imaginary plane P1 intersects a surface of the second secondary roller 222, the second primary roller 221 is arranged on a first side of the primary imaginary plane P1, and at most 33%, at most 25 %, or at most 10 % of the second secondary roller 222 is arranged on the first side of the primary imaginary plane P1. Such situation is not shown in the figures. In terms of the angle β_1 (see Fig. 2b or 4b and definition above), the angle β_1 may be e.g. at least minus 5 degrees, at least minus 1 degree, or at least zero. The convention for the sign of the angle β_1 is discussed below.

[0031] As indicated above, the planar design trajectory T is defined by the first gap 215 and the second gap 225 such that the first primary roller 211 and the second primary roller 221 are arranged on a primary side of the planar design trajectory T; and the first secondary roller 212 and the second secondary roller 222 are arranged on a secondary side, different side, of the planar design trajectory T. Moreover, a line of the primary imaginary plane P1 is arranged in the first gap 215. Referring to Fig. 2b, the positive direction of the angle β_1 between the primary imaginary plane P1 and the planar design trajectory T, which angle β_1 is minimized, is selected such that if the primary imaginary plane P1 is turned about the first gap 215 at the location of the second gap 225 in a direction that is directed from the second secondary roller 222 towards the second primary roller 221, the angle β_1 increases. As indicated by the discussion above and by the definition of the positive direction given above, the angle β_1 between the primary imaginary plane P1 and the planar design trajectory may be negative. However, in a preferable embodiment, the angle β_1 between the primary imaginary plane P1 and the planar design trajectory T is at least zero. Furthermore, in case β_1 is positive, at least a part of the second primary roller 221 is arranged on a first side of the primary imaginary plane P1 and the whole second secondary roller 222 is arranged on a second, opposite, side of the primary imaginary plane P1.

[0032] Referring in particular to Figs. 3a and 3b, when the device 100 comprises a first secondary jet box 312, of which at least a part is arranged in between the first secondary roller 212 and the second secondary roller 222, preferably also a support surface 314 of the first secondary jet box 312 is configured to prevent the penetration of the veneer 111 in between the first secondary jet box 312 and the second secondary roller 222, i.e. configured to guide the veneer towards the second gap 225. When the device 100 comprises a first secondary jet box 312, at least a part of the first secondary jet box 312 is arranged on the secondary side of the planar design trajectory T. However, in such a case, preferably, the whole first secondary jet box 312, including the support surface 314, is arranged on the secondary side of the planar design trajectory T.

[0033] In the embodiment of Figs. 3a and 3b, the first secondary jet box 312 of device 100 comprises a secondary support surface 314 and is configured to feed gaseous drying medium 120 through the secondary support surface 314 towards the planar design trajectory T. At least a part of the secondary support surface 314 is arranged on the secondary side of the planar design trajectory T. Moreover, in an embodiment, the whole secondary support surface 314 is arranged on the secondary side of the planar design trajectory T. Thus, in an embodiment, neither the second support surface 314 nor the first secondary jet box 312 intersects with the planar design trajectory T.

[0034] For the reasons indicated above, in the embodiment, the first pair of rollers 210, the second pair of rollers 220, and the secondary support surface 314 of the first secondary jet box 312 are arranged as follows:

A secondary imaginary plane P2 is defined by the first gap 215 and the secondary support surface 314 in such way that (i) the secondary imaginary plane P2 makes a contact with the secondary support surface 314 and (ii) an angle β_2 between the secondary imaginary plane P2 and the planar design trajectory T is minimized. Here, the positive direction of the angle β_2 is reverse to the positive direction of the angle β_1 discussed in detail above. The secondary imaginary plane P2 thus defined (i) does not intersect a surface of the second secondary roller 222, as indicated in Fig. 3e, (ii) intersects the surface of the second secondary roller 222 at one secondary intersection line 112 only, as indicated in Fig. 3d, or (iii) intersects a surface of the second secondary roller 222 at a first secondary intersection line 112 and a second secondary intersection line 122, as indicated in Fig. 3b. In the third alternative, the first secondary intersection line 112 is closer to the first secondary jet box 312 than the second secondary intersection line 122. Moreover, a secondary angle α_2 , which is left in between the secondary imaginary plane P2 and a tangent plane TP2 of the second secondary

roller 222 at the first secondary intersection line 112 and opens towards the planar design trajectory T and the first pair 210 of rollers, is at least 115 degrees. The secondary angle α_2 may be more than 120 degrees, more than 125 degrees, or at least 135 degrees. Preferably, the secondary angle α_2 equals the primary angle α_1 .

[0035] Referring to Figs. 4a and 4b, in case the device 100 comprises both the first primary jet box 311 arranged in between the primary rollers 211 and 221 and the first secondary jet box 312 arranged in between the secondary rollers 212 and 222, it suffices that only the primary angle α_1 is large, as detailed above, while the secondary angle α_2 may be smaller and even smaller than the aforementioned 115 degrees. However, in such a solution diving is reduced only on the primary side of the planar design trajectory T. Preferably, in case the device 100 comprises both the first primary jet box 311 and the first secondary jet box 312, the arrangement of the rollers 211, 212, 221, 222 and jet boxes 311, 312 including the support surfaces 313, 314 is symmetric about the planar design trajectory T.

[0036] In use, the veneer 111 moves from the first gap 215 to the second gap 225 guided by the primary support surface 313. Therefore, the shape of the primary support surface 313 preferably does not comprise protrusions or similar, which could prevent the movement of the veneer. Thus, the shape of the primary support surface 313 (and also the secondary support surface 314, if applicable) is preferable such that it does not prevent free propagation of the veneer 111. Therefore, preferable, the primary support surface 313 does not comprise such a part that (i) a length of the part is more than 5 mm, (ii) a width of the part is more than 5 mm, and (iii) a normal of the part forms an angle of less than 10 degrees with the longitudinal direction S_x . Such a part (or parts) would constitute a step (or steps) in the primary support surface 313, which would prevent free propagation of the veneer 111. Thus, in an embodiment, primary support surface 313 is free from steps. Preferably also the secondary support surface 314, if present in the device 100, is free from steps as detailed above.

[0037] In a typical use the first primary roller 211 is arranged below the first secondary roller 212; and the second primary roller 221 is arranged below the second secondary roller 222.

[0038] Even if Figs. 2a to 2f show only two pairs of rollers, as indicated in Figs 2a, 3a, 4a, 2g, and 2h, the device 100 preferably comprises more than two pairs of rollers. Referring in particular to Fig. 2g or 2h, preferably the device 100 comprises a third pair 230 of rollers. The third pair 230 of rollers is arranged a third distance d_3 apart from the first pair 210 of rollers in the longitudinal direction S_x . The third distance d_3 may refer e.g. to the distance between the first gap 215 and a third gap 235 of the third pair 230 of rollers. In Fig. 2g, the first pair of rollers 210 is arranged in between the second pair of rollers 220 and the third pair of rollers 230. In Fig. 2h, the second pair of rollers 220 is arranged in between the first pair of rollers 210 and the third pair of rollers 230. In Fig. 2g, the third distance d_3 may be equal to the first distance d_1 , but need not be. In case the second pair of rollers 220 is arranged in between the first pair of rollers 210 and the third pair of rollers 230 (as shown in Fig. 2h), the distance d_3 is more than the distance d_1 , and is preferably twice the first distance d_1 .

[0039] The third pair of rollers 230 comprises a third primary roller 231 extending in a direction that is substantially parallel to a transversal direction S_y . Thus, the third primary roller 231 has a circular profile that extends in a longitudinal direction of the roller 231. The roller 231 is configured to rotate about an axis, which is parallel to the longitudinal direction of the roller 231. What has been said about the direction of the first primary roller 211 relative to the transversal direction S_y applies to the third primary roller 231 *mutatis mutandis*. The third pair of rollers 230 further comprises a third secondary roller 232 substantially parallel to the third primary roller 231. What has been said about the direction of the first primary roller 211 relative to the first secondary roller 212 applies to the mutual orientation of the third primary roller 231 and third secondary roller 232 *mutatis mutandis*. A third gap 235 is left in between the rollers 231, 232 of the third pair 230 of rollers. The third primary roller 231 is left on the primary side of the planar design trajectory T. The third secondary roller 232 is left on the secondary side of the planar design trajectory T. Moreover, the planar design trajectory T penetrates the third gap 235.

[0040] The embodiment of Fig. 2g or 2h further comprises a second primary jet box 321. At least a part of the second primary jet box 321 is arranged in between two neighbouring primary rollers, such as between the first primary roller 211 and the third primary roller 231 as in Fig. 2g, or between the second primary roller 221 and the third primary roller 231 as in Fig. 2h. At least a part of the second primary jet box 321 is arranged on the primary side of the of the planar design trajectory T. Preferably the whole second primary jet box 321 is arranged on the primary side of the of the planar design trajectory T. The second primary jet box 321 has a second primary support surface 323. Preferably, also the second primary support surface 323 is configured to support the veneer 111 (i.e. configured to guide the veneer 111) in such a way that the probability of the veneer diving to a wrong side of a primary roller is reduced. Correspondingly, the second primary support surface 323 may be configured to guide the veneer 111 towards a subsequent gap (e.g. the gap 215 in Fig. 2g). What has been and will be said about the shape and position of the primary support surface 313 relative to the first primary roller and the second primary roller preferably applies to the second primary support surface 323 *mutatis mutandis*.

[0041] Referring to Figs. 2g and 2h, if the device comprises the third pair of rollers 230, the third pair of rollers 230 may be arranged, in the longitudinal direction S_x , before the first pair of rollers 210, or after the second pair of rollers 220. However, the numbering of the pairs of rollers is such that in between the first pair 210 of rollers and the second

pair 220 of rollers, no other pair of rollers is arranged. More specifically, the device is free from such a pair (e.g. 230) of rollers that

- is configured to convey the veneer 111,
- comprises two such rollers (e.g. 321, 322) that the planar design trajectory T is arranged in between the rollers (321, 322) of the pair (e.g. 230) of rollers, and
- is arranged, in the longitudinal direction Sx, in between the first pair of rollers 210 and the second pair of rollers 220.

[0042] Thus, the first primary jet box 311 is next to the first primary roller 211 and the second primary roller 221. In an embodiment, no roller is arranged in between the first primary jet box 311 and the first primary roller 211. In an embodiment, no roller is arranged in between the first primary jet box 311 and the second primary roller 221.

[0043] Referring to Figs. 3a, 3b, 4a, and 4b, when the device comprises the third pair 230 of rollers, the device may comprise a second secondary jet box, of which at least a part arranged in between two neighbouring secondary rollers (e.g. 232 and 212; or 212 and 232), and of which least a part is arranged on the secondary side of the of the planar design trajectory T.

[0044] Referring now to Figs. 2c and 3c, a preferable shape of the primary support surface can further be defined in terms of distances. As indicated in Fig. 2c, the second gap 225 is arranged a first distance d1 apart from the first gap 215. The first distance d1 may be e.g. from 200 mm to 700 mm, such as from 300 mm to 600 mm.

[0045] As indicated in Fig. 2c, the primary support surface 313 is dividable to a front part 313f and a rear part 313r by a division plane DP. The division plane DP has a normal that is parallel to the longitudinal direction Sx; i.e. the normal of DP is to the direction Sx. Moreover, the division plane DP is arranged a second distance d2 apart from the first gap 215. The second distance d2 is at least one third (1/3) and at most two thirds (2/3) of the first distance d1, such as a half (1/2) of the first distance d1. As for the terms front and rear, the front part 313f of the primary support surface 313 is closer to the first pair 210 of rollers than to the second pair 220 of rollers. Correspondingly, the rear part 313r is closer to the second pair 220 of rollers than to the first pair 210 of rollers.

[0046] In a preferable embodiment, the primary support surface 313 is shaped such that a minimum distance dr1 between the rear part 313r of the primary support surface 313 and the planar design trajectory T is less than a minimum distance df1 between the front part 313f of the primary support surface 313 and the planar design trajectory T.

[0047] Preferably, the minimum distance dr1 between the rear part 313r of the primary support surface 313 and the planar design trajectory T is at least 3 mm, such as at least 5 mm or at least 10 mm smaller than the minimum distance df1 between the front part 313f of the primary support surface 313 and the planar design trajectory T. The minimum distance dr1 may be e.g. at least 0 mm. However, in order for the surface 313 not to prevent free propagation of the veneer 110, preferably the minimum distance dr1 is at least 5 mm, or at least 10 mm. Moreover, to guide the veneer 111 sufficiently towards the planar design trajectory, the minimum distance dr1 is, in an embodiment, at most 30 mm, such as at most 25 mm. The distance dr1 may be e.g. from 10 mm to 20 mm. As for the distance df1 (see Fig. 2c), df1 may be e.g. from 15 mm to 50 mm, preferably from 20 mm to 35 mm.

[0048] Moreover, referring to Figs. 2b, 2d and 11b, preferably also a front edge of the primary support surface 313 is configured to guide the veneer. Thus, in an embodiment the front edge of the primary support surface 313 only comprises a inner angle γ (Figs. 2b and 2d) or inner angles γ (Fig. 11b) that are more than 90 degrees. The front edge refers to such an edge or edges of the front part 313f of primary support surface 313 that are arranged close to both the first pair of rollers 210 and close to the planar design trajectory T.

[0049] Therefore, and with reference to Fig. 2d, in an embodiment, a distance dfl between a leading edge of the front part 314f of the primary support surface 314 and the planar design trajectory T is greater than a distance dft between (i) the intersection of the division plane DP and the primary support surface 314 and (ii) the planar design trajectory T. Preferably, the distance dfl is at least 5 mm greater than the distance dft. As an example, the difference dfl-dft may be from 5 mm to 15 mm. What has been said about the front edge of the primary support surface 313 applies, in an embodiment, to the secondary support surface 314 (if present) *mutatis mutandis*.

[0050] The primary support surface 313 may be so shaped irrespective of there being a secondary support surface 314 and a shape thereof. However, referring to Fig. 3c, preferable, the device 100 comprises a first secondary jet box 312, of which at least a part is arranged in between the first secondary roller 212 and the second secondary roller 222, wherein the first secondary jet box 312 comprises the secondary support surface 314. Also the first secondary jet box 312 is configured to feed gaseous drying medium 120 through the secondary support surface 314 towards the planar design trajectory T. Moreover, in an embodiment, neither the second support surface 314 nor the first secondary jet box 312 intersects with the planar design trajectory T. In a manner similar to the primary support surface 313, also the secondary support surface 314 is dividable to a front part 314f and a rear part 314r by the division plane DP, such that the front part 314f of the secondary support surface 314 is closer to the first pair 210 of rollers than to the second pair 220 of rollers. Moreover, a minimum distance dr2 between the rear part 314r of the secondary support surface 314 and the planar design trajectory T is less than a minimum distance df2 between the front part 314f of the secondary support

surface 314 and the planar design trajectory T.

[0051] Preferably, the minimum distance $dr2$ between the rear part 314r of the secondary support surface 314 and the planar design trajectory T is at least 3 mm, such as at least 5 mm, or at least 10 mm smaller than the minimum distance $df2$ between the front part 314f of the secondary support surface 314 and the planar design trajectory T. The minimum distance $dr2$ may be e.g. at least 0 mm, at least 5 mm, or at least 10 mm. Moreover, the minimum distance $dr2$ is, in an embodiment, at most 30 mm, such as at most 25 mm.

[0052] The minimum distance $dr2$ may be e.g. from 10 mm to 20 mm. The distance $df2$ may be e.g. from 15 mm to 50 mm, preferably from 20 mm to 35 mm.

[0053] Figure 2d also indicates a distance ddv between the second primary roller 221 and the first primary jet box 311. The distance ddv is thus a length (e.g. in the direction S_x as in Fig. 2d or other direction as in Fig. 2e) of such a gap through which the (undesired) diving of the veneer occurs, if it occurs. In case the distance ddv is large, the diving becomes more probable, unless prevented by suitably large primary angle α_1 . Moreover, in case the distance ddv is too small, safety risks rise. For example if ddv is small, dust may accumulate in between the second primary roller 221 and the first primary jet box 311, and the friction between the rotating roller 221 and the dust may heat or even light the dust. Thus there is an increased risk of fire if ddv is too small. For these reasons, preferably, the distance ddv is from 5 mm to 30 mm, such as from 5 to 20 mm, or from 5 mm to 10 mm. Moreover, preferably, the distance ddv is from 5 mm to 30 mm and the primary angle α_1 is at least 115 degrees, more than 120 degrees, more than 125 degrees, or at least 135 degrees. More preferably, the distance ddv is from 5 mm to 20 mm and the primary angle α_1 at least 115 degrees, more than 120 degrees, more than 125 degrees, or at least 135 degrees. Even more preferably, the distance ddv is from 5 mm to 10 mm and the primary angle α_1 at least 115 degrees, more than 120 degrees, more than 125 degrees, or at least 135 degrees.

[0054] In the device 100 of the present invention, surfaces of the first primary roller 211, second primary roller 221, first secondary roller 212 and second secondary roller 222 are configured to contact the veneer 111 in use, in order to move the veneer 111 in the longitudinal direction S_x .

[0055] It has been found that the technical problem mentioned in background is more prominent when the veneers are thin. The inventors think that a thick veneer is more rigid, whereby it follows the planar design trajectory T more likely than a thin veneer. The problem has been found to occur in particular for veneers having a thickness of at most 3.5 mm or at most 2.0 mm. However, typically a thickness of the veneers is at least 0.5 mm. Therefore, in an embodiment, a minimum distance $gh1$ (see Fig. 2b) between the outer surfaces of the first primary roller 211 and the first secondary roller 212 is at most 3.5 mm, such as from 0.5 mm to 3.5 mm or from 0.5 mm to 2.0 mm.

[0056] The minimum distance $gh1$ refers also to a height of the first gap 215. In addition, in an embodiment, a minimum distance $gh2$ between the outer surfaces of the second primary roller 221 and the second secondary roller 222 is at most 3.5 mm, such as from 0.5 mm to 3.5 mm or from 0.5 mm to 2.0 mm. The minimum distance $gh2$ refers also to a height of the second gap 225 (see Fig. 2b).

[0057] Referring to Fig. 5, at least some of the gaseous drying medium 120 may be circulated in the device. However, air as such may, in the alternative, be used as the gaseous drying medium. Air may also be mixed with circulated gas. In a preferable embodiment, a moisture content of the gaseous drying medium 120 is at most 600 g/m³, wherein the moisture content is controlled by releasing gaseous drying medium and taking in air to compensate for the release of the gaseous drying medium. This is a sufficiently low humidity that dries the veneers, at least in the temperature range that will be presented below. Preferably, when the process is up and running, preferably, the moisture content of the gaseous drying medium 120 is at least 200 g/m³. A drier gas would result in only a small amount of the gas to be circulated, which would increase heating costs.

[0058] As indicated in Fig. 5, the device 100 comprises a heat exchanger arrangement 132 configured to heat the gaseous drying medium 120, such as gaseous drying medium 120 comprising air, using a heat exchange medium, such as steam. The heat exchanger arrangement 132 may be arranged in an upper part of the device 100. The heat exchange medium is not shown in Fig. 5. The steam (i.e. the heat exchange medium) may be pressurized and saturated. The pressure of the saturated steam may be e.g. from 10 bar to 20 bar, e.g. from 14 bar to 16 bar, to ensure a proper temperature for the gaseous drying medium 120. The heat exchanger arrangement 132 comprises at least one heat exchanger. The device 100 further comprises a blower arrangement 134 configured to drive the gaseous drying medium 120 through the heat exchanger arrangement 132 and at least the primary support surface 313. The gaseous drying medium may be conveyed in a channel 121. In case the first secondary jet box 312 is present, preferably, the blower arrangement 134 is configured to drive the gaseous drying medium 120 through the heat exchanger arrangement 132 and also through the secondary support surface 314 of the first secondary jet box 312. The blower arrangement 134 comprises at least one blower.

[0059] As detailed below, and indicated in Figs. 7a to 7c, the device 100 for drying a veneer may be made by adapting an existing dryer 900. In such an improvement, at least a primary guide element 315 is used to modify an existing surface, which may support a veneer. Therefore, in an embodiment of the device 100, at least a part of the primary support surface 313 is a surface of a primary guide element 315 that is made from a metal plate having a thickness of at least

1.5 mm. Preferably, a thickness of the primary guide element 315 is from 1.5 mm to 5 mm, such as from 1.5 mm to 3 mm.

[0060] Figures 6a and 6b show, as a top view, the primary rollers 211 and 221, and the primary jet box 311, of which primary guide surface 313 is shown in the top view. As indicated in Fig. 6a, the primary guide surface 313 may limit apertures 317 for feeding the gaseous drying medium 120 through the primary support surface 313. The primary support surface may be a top surface of a primary guide element 315. As indicated in Fig. 6b, the primary guide surface 313 may comprise fingers e.g. in the rear part 313r. In between the fingers, slots 318 are arranged for feeding the gaseous drying medium 120 through the primary support surface 313. The primary support surface may be a top surface of a primary guide element 315. The front part 313f may be e.g. welded to a jet box. Other possibilities for fixing a guide element 315 to the jet box 311 will be discussed below. What has been said about the apertures and slots of the primary support surface 313 applies to the secondary support surface 314 *mutatis mutandis*.

[0061] Referring to Figs. 2a, 3a, and 4a, in an embodiment, the device 100 comprises a first sensor 142 configured to determine a moisture content of a veneer that has not passed through the device 100. The veneer, of which moisture content is measured may be the veneer 111 that is later dried with the device. However, it need not be. A moisture content of a different veneer or different veneers may be considered to represent the moisture content of the veneer 111 to be dried. In addition or alternatively, in an embodiment the device comprises a second sensor 144 configured to determine a moisture content of a veneer that has been dried, i.e. has passed through the device 100. The veneer, of which moisture content is measured may be the veneer 111 that has been dried with the device. However, it need not be. A moisture content of a different veneer or different veneers may be considered to represent an estimate for the remaining moisture of the veneer 111 to be dried, if process parameters are not adjusted. The device may comprise the second sensor 144 even if it does not comprise the first sensor 142.

[0062] The information on one of the moisture contents or on both the moisture contents may be applied to control the drying process. For example, if the moisture content (after drying) is too high, or the moisture content (before drying) is higher than a design value, drying may be enhanced. Drying may be enhanced by slowing down the rollers, i.e. decreasing their angular velocity, whereby the veneers have more time to dry as they pass through the device 100. In addition or alternatively, a temperature of the gaseous drying medium 120 may be increased. This may be done e.g. by increasing the flow of the heat exchange medium through the heat exchanger 132. In addition or alternatively, the gas circulation within the device 100 may be increased. This may be done e.g. by increasing the flow of gas 120 by the blower arrangement 134.

[0063] Thus, in an embodiment, the device 100 comprises a control unit 146 that is configured control at least one of (i) a rotational speed of the first primary roller 211, (ii) a temperature of the drying medium 120, and (iii) a flow rate of the drying medium 120. Preferably the control is automated. Thus, in an embodiment, the control unit 146 is configured to receive a signal from at least one of the first sensor 142 and the second sensor 144 and to control, by using the signal(s), at least one of at least one of (i) a rotational speed of the first primary roller 211, (ii) a temperature of the drying medium 120, and (iii) a flow rate of the drying medium 120.

[0064] However, the temperature of the gaseous drying medium 120 should not be too high. In an embodiment, the device 100 comprises a temperature sensor 147 configured to measure a temperature in the device 100, in particular a temperature of the circulating gaseous drying medium 120. In an embodiment, the device 100 comprises a humidity sensor 148 configured to measure a humidity inside the device 100, in particular a humidity of the circulating gaseous drying medium 120. Also the signal/signals of at least one of these sensors (147, 148) can be used to control at least one of the aforementioned quantities. More specifically, in an embodiment, the control unit 146 is configured to receive a signal from at least one of the temperature sensor 147 and the humidity sensor 148 and to control, by using the signal(s), at least one of at least one of (i) a rotational speed of the first primary roller 211, (ii) a temperature of the drying medium 120, and (iii) a flow rate of the drying medium 120. The signals from the first 142 and/or second 144 sensor can be used in addition to the signal(s) from the temperature and/or humidity sensor (147, 148).

[0065] Furthermore, in an embodiment, a signal from the humidity sensor 148 is used to control the amount of gaseous drying medium released from the circulation, in order to maintain the moisture content at the level discussed above. In an embodiment, the control unit 146 is configured to receive a signal from the humidity sensor 148 and to control, by using the signal(s), to control the amount of gaseous drying medium released from the circulation.

[0066] As evident, the device 100 can be used to dry different veneers 111 subsequently and separately. Moreover, different levels of the device can be used to dry different veneers simultaneously.

[0067] Referring to Figs. 10a and 10b, in an embodiment, two veneers that are in partial overlap are fed simultaneously through the first gap 215. This improves the capacity of the device 100. Thus, an embodiment of the device 100 comprises a stopper-lifter arrangement 152 that is configured to arrange the first veneer 111 and another, second, veneer 112 in a partial overlap. The stopper-lifter arrangement 152 may be a single element that simultaneously stops the movement of the second veneer 112 and lifts a rear part of the first veneer 111. For example, in Fig. 10a, the stopper-lifter arrangement 152 is in the position to stop the second veneer 112 and lift a rear part of the first veneer 111. The stopper-lifter arrangement 152 may first rise the rear part of the first veneer 111, and thereafter allow the movement of the second veneer 112 to partial overlap with the first veneer 111. When the stopper-lifter arrangement 152 is lowered, also the second veneer

112 may continue to move in the longitudinal direction S_x . Preferably, the stopper-lifter arrangement 152 is configured to arrange the first veneer 111 and the second veneer 112 to overlap a length L_o of from 20 mm to 50 mm, wherein the length L_o is measured in the direction S_x of movement of the veneers.

[0068] The device 100 may be made by adapting a dryer 900 (i.e. an existing dryer 900). A dryer 900 is shown in Figs. 1a and 1b. Fig. 7b shows a part of a dryer in a manner similar to Fig. 1b. Referring to Figs. 1b and 7a, a dryer 900 comprises a first pair 210 of rollers configured to move the veneer in a longitudinal direction S_x . The first pair 210 of rollers comprises a first primary roller 211 extending in a direction that is substantially parallel to a transversal direction S_y and a first secondary roller 212 substantially parallel to the first primary roller 211, whereby a first gap 215 is left in between the a first primary roller 211 and the first secondary roller 212. As for the term substantially parallel, what has been said about the rollers of the device 100 of the invention applies for the existing dryer 900. The existing dryer 900 further comprises a second pair 220 of rollers arranged in the longitudinal direction S_x from the first pair 210 of rollers. The second pair 220 of rollers comprises a second primary roller 221 extending in a direction that is substantially parallel to the transversal direction S_y , and a second secondary roller 222 substantially parallel to the second primary roller 221, whereby a second gap 225 is left in between the second primary roller 221 and the second secondary roller 222. As for the term substantially parallel, what has been said about the rollers of the device 100 of the invention applies for the existing dryer 900.

[0069] The first gap 215 and the second gap 225 of the existing dryer 900 define a planar design trajectory T for the veneer 111 (not shown in Fig. 1b, but shown e.g. in Fig. 7a). A first distance d_1 is left in between the gaps 215, 225. The existing dryer 900 further comprises a first primary jet box 311 arranged in between the first primary roller 211 and the second primary roller 221, having an existing primary surface 313o (see Fig. 7a), and configured to feed gaseous drying medium 120 through the existing primary surface 313o towards the planar design trajectory T . The primary rollers 211, 221 and the first primary jet box 311, including the existing primary surface 313o, are arranged on a primary side of the planar design trajectory T . The secondary rollers 212, 222 are arranged on a secondary (different) side of the planar design trajectory T .

[0070] Typically, in an existing dryer 900, a minimum distance d_{o1} between the existing primary surface 313o and the planar design trajectory T is from 15 mm to 50 mm, more typically from 20 to 40 mm.

[0071] The method for adapting the existing dryer 900 comprises arranging available a primary guide element 315. What has been said about the materials and thicknesses of the guide element 315 in the context of the device 100 applies in the context of the method for adapting the existing dryer 900. An example of such a guide element is shown in Fig. 7b. Referring to Fig. 7c, the method comprises attaching the primary guide element 315 to the first primary jet box 311 in such a way that (i) a surface of the primary guide element 315 or (ii) a surface of the primary guide element 315 in combination with a part of the existing primary surface 313o forms such a primary support surface 313 of the adapted device that has the properties as described above for the primary support surface 313 of the device 100 for drying a veneer 111.

[0072] Thus, the first pair of rollers 210, the second pair of rollers 220, and the primary support surface 313 are arranged as follows:

A primary imaginary plane P_1 is defined by the first gap 215 and the primary support surface 313 in such way that (i) the primary imaginary plane P_1 makes a contact with the primary support surface 313 and (ii) an angle β_1 between the primary imaginary plane P_1 and the planar design trajectory T is minimized. Moreover, as indicated above, in an embodiment, the primary imaginary plane P_1 intersects the surface the second primary roller 221 at one intersection line 111 only. In another embodiment the primary imaginary plane does not intersect the surface the second primary roller 221. In a preferable embodiment, the primary imaginary plane P_1 intersects a surface the second primary roller 221 at a first primary intersection line 111 and at a second primary intersection line 121, wherein the first primary intersection line 111 is closer to the first primary jet box 311 than the second primary intersection line 121. A primary angle α_1 that is left in between the primary imaginary plane P_1 and a tangent plane TP_1 of the second primary roller 221 at the first primary intersection line 111 and opens towards the planar design trajectory T and the first pair 210 of rollers is at least 115 degrees, such as more than 120 degrees, more than 125 degrees, or at least 135 degrees. In an embodiment, at least a part of the primary support surface 313 is left on the primary side of the planar design trajectory T . In an embodiment, the whole primary support surface 313 is left on the primary side of the planar design trajectory T . Further details of the positive direction of the angle β_1 have been discussed above in the context of the device 100. Moreover, further details regarding the cases where the primary imaginary plane P_1 intersects the surface the second primary roller 221 at one intersection line 111 only or does not intersect the surface the second primary roller 221 have been discussed above in the context of the device 100.

[0073] What has been said above about the distance dd_v between (a) the primary support surface 313 of first primary jet box 311 or the first primary jet box 311 and (b) the second primary roller 221 applies also for the method.

[0074] As indicated above, a preferable embodiment comprises selecting the shape of the primary guide element 315 such that also the features discussed above for the minimum distances dr_1 and df_1 apply. In the alternative or in addition, an embodiment comprises attaching the primary guide element 315 to the primary jet box 311 in such a way that the

features discussed above for the minimum distances $dr1$ and $df1$ apply. Thus, an embodiment comprises selecting the shape of the primary guide element 315 such that, or attaching the primary guide element 315 to the primary jet box 311, in such a way that the primary support surface 313 is dividable to a front part 313f and a rear part 313r by a division plane DP that has a normal that is parallel to the longitudinal direction Sx and that is arranged a second distance $d2$ apart from the first gap 215, wherein the second distance $d2$ is at least one third and at most two thirds of the first distance $d1$, such as half of the first distance $d1$, and wherein the front part 313f of the primary support surface 313 is closer to the first pair 210 of rollers than to the second pair 220 of rollers. The guide element 315 is selected and/or attached in such a way that a minimum distance $dr1$ between the rear part 313r of the primary support surface 313 and the planar design trajectory T is less than a minimum distance $df1$ between the front part 313f of the primary support surface 313 and the planar design trajectory T. What has been said above about the difference between $dr1$ and $df1$ for the device 100 applies also in this case. Thus, in an embodiment, after the primary guide element 315 has been applied, the distance $dr1$ of the rear part (see Figs. 2a-2c and 7a-7c) is less than the distance $do1$ before applying the primary guide element. [0075] However, referring to Fig. 7d, it may suffice that a planar guide element 315 is used such that it is parallel to the planar design trajectory T. As indicated in Fig. 7d, it may suffice that a gap in between the second primary roller 221 and the primary jet box 311 is made narrower by the guide element 315 to increase the angle $\alpha 1$ to a sufficient level as discussed above. However, depending on the distance of the primary jet box 311 from the planar design trajectory 311 it is possible that a planar and parallel guide element 315 does not suffice.

[0076] It is also noted that the primary guide element 315, even if a planar guide element 315 as in Fig. 7d, makes the distance $dr1$ (see Fig. 2c) of the rear part of the primary support surface 313 to be less than the distance $do1$ (see Fig. 7a), which simultaneously increases the primary angle $\alpha 1$. Therefore, even if preferably values for the distance $dr1$ were presented in connection with there being also a smaller distance $df1$, it is noted that the preferable values for $dr1$ apply also in case the primary support surface 313 is planar and parallel to the design trajectory T.

[0077] The guide element 315 may be fixed on top of the jet box 311 of the existing dryer, as indicated in Fig. 7d. The guide element 315 may be fixed to a front side of the jet box 311 of the existing dryer, as indicated in Fig. 7c. Even if not shown, a guide element 315 may be fixed to a rear side of the jet box 311 of the existing dryer. Referring to Figs. 7e and 7f, a guide element may be fixed to an end of a the jet box 311 of the existing dryer. An end here refers to such a side of the jet box 311, of which normal is to the transversal direction Sy . As indicated in Fig. 7f, in such a case, the supportive surface 313 may be a surface of a plate, which plate may be separated from the existing primary surface 313o.

[0078] Referring to Fig. 7g, the device 100 may comprise a holder 316 for the guide element 315. In such a solution, the guide element 315 may be fixed to the jet box 311 in a detachable manner, i.e. such that the guide element 315 can be detached from the device without tools, or e.g. by opening at least a screw. Such a solution may help to clear a jam. In case of jamming, the guide element 315 could be detached from the device 100 for clearing the jam. As an example, in Fig. 7g, the jet box 311 and the holder 316, in combination, form a slot, to which the guide element can be slid in the transversal direction Sy . The solution of Fig. 7g can be used to adapt an existing dryer, or the solution may be applied when manufacturing a new device 100 for drying a veneer.

[0079] Referring to Figs. 8a and 8b, in case the existing dryer 900 comprises a secondary jet box 312 having an existing secondary surface 314o such that the planar design trajectory T is arranged in between the existing primary surface 313o of the primary jet box 311 and the existing secondary surface 314o of the secondary jet box 312, preferably a secondary guide element 315s (see Fig. 8b) is attached to the secondary jet box 312 as indicated in Fig. 8b. In this way, a secondary guide surface 314 of the adapted device is formed. What has been said above about the mutual configuration of the first pair of rollers 210, the second secondary roller 222 and the secondary guide surface 314 of the first secondary jet box 312 of the device 100 applies to the adapted device.

[0080] When the device 100 is used, a method for drying at least a first veneer 111 is performed. Such a method comprises arranging available a device 100 for drying a veneer 111 (i.e. a first veneer 111) as discussed above. The device 100 may be adapted from a dryer 900 using a guide element 315.

[0081] The method comprises (i) feeding the first veneer 111 through the first gap 215 of the first pair 210 of rollers in the longitudinal direction Sx , (ii) feeding gaseous drying medium 120 through the primary support surface 313 towards the planar design trajectory T and conveying the first veneer 111 alongside the first primary jet box 311 (i.e. alongside the primary support surface 313) in order to dry the first veneer 111, and (iii) conveying the first veneer 111 through the second gap 225 of the second pair 220 of rollers. When the first veneer 111 is being conveyed, the rollers 211, 212, 221, and 222 are rotated as indicated by the arrows e.g. in Figs. 2b, 3b, and 4b, in order to drive the first veneer 111.

[0082] The veneer 111 may be used in plywood manufacturing. As indicated above, the technical problem has been observed to be more prominent in case thin veneers are dried than in case thick veneers are dried. Therefore, preferably, the first veneer 111 comprises wood and a thickness of the first veneer 111 is at most 3.5 mm, such as from 0.5 mm to 3.5 mm, such as from 1.0 mm to 2.0 mm. This thickness corresponds to the heights $gh1$, $gh2$ of the gaps 215, 225 of the device 100; however, the height $gh1$, $gh2$ of the gap(s) may be somewhat less than the thickness of the veneer 111. More preferably, the first veneer is not coated at the time of drying. However, the first veneer and/or the log from which it has been turned may have been soaked with some liquid, such as water comprising impurities. In an embodiment

of the method, the first veneer consists of wood and has a thickness between 0.5 mm and 3.5 mm, such as from 1.0 mm to 2.0 mm.

[0083] It has been found that technical problem occurs more probable in case the first veneer 111 comprises hardwood than in case the first veneer 111 comprises softwood. Therefore, in an embodiment, the first veneer 111 comprises hardwood. The term hardwood refers to wood from angiosperms, such as ash, aspen, basswood, birch, cherry, hickory, mahogany, maple, oak, poplar, lauan, teak, rosewood, okume, and meranti; in particular birch. This may be due to different warping of softwood and hardwood during drying. In an embodiment, the first veneer 111 comprises hardwood, such as birch, and a thickness of the veneer 111 is from 0.5 mm to 2.0 mm. In an embodiment the first veneer 111 comprises birch. In an embodiment, the first veneer 111 consists of hardwood. In an embodiment the first veneer 111 consists of birch. However, the method can be used to dry softwood. The term softwood refers to wood from coniferous trees, such as spruce, pine, fir, and hemlock; in particular to spruce. In an embodiment the first veneer 111 comprises spruce. In an embodiment the first veneer 111 comprises spruce. In an embodiment the first veneer 111 comprises softwood, such as spruce, and a thickness of the veneer 111 is from 0.5 mm to 3.5 mm. In an embodiment the first veneer 111 comprises birch or spruce. In an embodiment the first veneer 111 comprises birch or spruce and a thickness of the veneer 111 is from 0.5 mm to 3.5 mm.

[0084] It may happen that the first veneer 111 is anisotropic. In particular, when the first veneer 111 comprises wood, the first veneer 111 is anisotropic. In case of wood, the bending stiffness of the first veneer 111 is less, when bent about an axis that is parallel (e.g. unidirectional) to a grain direction of the wood of the first veneer 111, than when bent about an axis that is perpendicular to the grain direction. Therefore, referring to Fig. 9 the first veneer 111 is preferably fed to the device 100 in such a way that the grain direction G is parallel (e.g. unidirectional) to the longitudinal direction Sx. In this way, the higher bending stiffness of the veneer, when bent about the transversal direction Sy than when bent about the longitudinal direction Sx, in its part reduces the probability of the veneer diving. The probability is reduced by orienting the veneer 111 such that the grains of the veneer 111 are to the longitudinal direction Sx. As evident, the grain direction G is perpendicular to the direction Sz of a line that is left in between the centres of the rollers 211, 212 of the first pair 210 of rollers.

[0085] Feeding the anisotropic first veneer 111 in such a direction to the device 100 decreases the probability of the veneer diving to a wrong side of a roller. This happens, because the, as indicated above, the first veneer 111 is relatively stiff, when fed into the device 100 in this orientation. In particular, when bent about the transversal direction Sy, the bending stiffness of the veneer is higher than when bent about the longitudinal direction Sx.

[0086] Therefore, and with reference to Fig. 9, in an embodiment, the first veneer 111 has a length L111 and a width W111. Herein the length L111 may be less than the width W111 or more than the width W111. Moreover, as indicated above, the first veneer 111 has (i) a first bending stiffness when bent about a first bending line that is parallel (e.g. unidirectional) to a direction of the length L111 and (ii) a second bending stiffness when bent about a second bending line that is parallel (e.g. unidirectional) to a direction of the width W111. When the first veneer 111 is anisotropic, as in an embodiment it is, the second bending stiffness is more than the first bending stiffness. In an embodiment of the method, the first veneer 111 is fed through the first gap 215 of the first pair 210 of rollers (211, 212) in the longitudinal direction Sx in such a way that the direction of the length L111 of the first veneer 111 is parallel (e.g. unidirectional) to the longitudinal direction Sx of the device. As motivated above, in an embodiment, the first veneer 111 comprises wood having a grain orientation G and the grain orientation G is parallel (e.g. unidirectional) to the direction of length L111 of the first veneer 111.

[0087] The gaseous drying medium 120 is preferably so hot that it enables the water of the first veneer 111 to boil. Moreover, gaseous drying medium 120 is preferably only so hot that, at that temperature, wood does not burn or change its colour by an observable amount. Therefore, an embodiment comprises heating the gaseous drying medium 120, such as air, to a temperature of from 120 °C to 210 °C, preferably from 140 °C to 205 °C. Moreover, the heated gaseous drying medium 120 is fed through the primary support surface 313 towards the planar design trajectory T. The heating may be done using a heat exchanger 132 (Fig. 5). Saturated and pressurized steam may be used as a heat exchange medium, as indicated above. A blower arrangement 134 (Fig. 5) may be used to feed the heated gaseous drying medium 120 through the primary support surface 313.

[0088] Referring to Figs. 2a, 3a, and 4a, a moisture content may be measured, and used to control the drying. Therefore, an embodiment of the method comprises (i) determining, before feeding the first veneer 111 through the first gap 215, a first moisture content of such a veneer that has not been passed through the device 100 and/or (ii) determining, before feeding the first veneer 111 through the first gap 215, a second moisture content of such a veneer that has been passed through the device. The first moisture content may be measured with the first sensor 142. The second moisture content may be measured with the second sensor 144 (see Figs. 2a and 3a).

[0089] Moreover, an embodiment comprises controlling, using the determined first moisture content and/or the determined second moisture content, at least one of (i) an angular velocity v_{11} , v_{12} of the first primary roller 211 and the first secondary roller 212, (ii) a temperature of the gaseous drying medium 120, and (iii) a flow rate of the gaseous drying medium 120. The controlling may be done using a control unit 146.

[0090] Moreover, moisture contents of multiple veneers, that have not been dried in the device 100 may be measured. Based on its moisture content, each veneer can be classified to a certain moisture class in such a way that multiple veneers belong to each moisture class. Thereafter, veneers from each moisture class may be dried such that the drying parameters vary from one moisture class to another. For example, the veneers can be classified before drying, to classes "more moist than average", "average moisture", and "less moist than average". Then the veneers from the class "more moist than average" can be dried using first drying parameters and the veneers from the class "average moisture" can be dried using second drying parameters, wherein the second drying parameters (or at least one of the drying second parameters) is different from the first drying parameters. The drying parameters include (i) a rotational speed of the first primary roller 211, (ii) a temperature of the drying medium 120, and (iii) a flow rate of the drying medium 120. For example, when veneers of the class "more moist than average" are dried, a smaller rotational speed of the first primary roller 211 can be used, that when drying veneers from the class "average moisture", to allow more time for the veneers to dry.

[0091] As indicated above, the temperature of the gaseous drying medium 120 should not be too high. Therefore, an embodiment of the method comprises determining at least one of a temperature and a humidity of the gaseous drying medium. The temperature and/or humidity sensor 147, 148 may be used for the purpose. An embodiment comprises controlling, using the determined temperature and/or humidity, at least one of (i) an angular velocity v_{11} , v_{12} of the first primary roller 211 and the first secondary roller 212, (ii) a temperature of the gaseous drying medium 120, and (iii) a flow rate of the gaseous drying medium 120. The controlling may be done using a control unit 146. Furthermore, an embodiment comprises determining at least one a humidity of the gaseous drying medium and controlling an amount of gaseous drying medium released from the circulation thereof.

[0092] In an embodiment of the method, the first veneer 111 is dried in such a way that when exiting the device 100, a moisture content of the first veneer 111 is from 2 % to 15 %, preferably from 3 % to 8 %. A moisture content (i.e. content of water in grams divided by dry mass in grams) of a first veneer 111 before drying may be e.g. from 100 % to 160 %, if the first veneer is not pre-dried. A moisture content of a first veneer 111 before drying may be e.g. from 70 % to 110 %, if the first veneer is pre-dried. The pre-drying may take place by compression after peeling the veneer from a log. Thus, in an embodiment, a moisture content of the first veneer 111, when entering the device 100, is from 70 % to 160 %. As indicated above, the moisture content is a weight percentage of water relative to dry mass, whereby it may be more than 100 %.

[0093] The device 100 is of roller conveyor type. Therefore, an embodiment comprises conveying the first veneer 111 through the device 100 by contacting the first veneer 111 with outer surfaces of the first primary roller 211, the second primary roller 221, the first secondary roller 212, and the second secondary roller 222.

[0094] As is evident, the device 100 may be used to dry multiple veneers, in particular the first veneer 111 and a second veneer 112. These veneers may be fed to the device 100 subsequently. However, to increase capacity, a space in between the first and second veneers 111, 112 should be small. It has been found that sufficient drying is achievable also when the subsequent veneers are in partial overlap. Referring to Figs. 10a and 10b, an embodiment comprises arranging available a second veneer 112. An embodiment comprises, before conveying the first veneer 111 through the second gap 225 of the device 100, arranging the first veneer 111 and the second veneer 112 in partial overlap (see Fig. 10a). Moreover, the embodiment comprises feeding the first veneer 111 and the second veneer 112 through the first gap 215 of the first pair 210 of rollers (221, 222) in the longitudinal direction S_x in such a way that the parts of the first 111 and second veneers 112 that are in partial overlap, are in partial overlap also as they pass through the first gap 215 of the device. It has been found that a suitable length for the overlapping part is some centimetres. Thus, in an embodiment, a length L_o of the overlapping parts in the longitudinal direction S_x is from 20 mm to 50 mm.

[0095] It has been found that the two veneers 111, 112 can be easily arranged in partial overlap using a stopper-lifter arrangement 152, as indicated above. When using the stopper-lifter arrangement 152 as indicated above and in Fig. 10a, the veneers 111, 112 become arranged in partial overlap in such a way that a trailing edge of the first veneer 111 is in partial overlap with the leading edge of the second veneer 112. Moreover, as indicated in Fig. 10b, when passing through the first gap 215, the leading edge of the second veneer 112 is left in between the first primary roller 211 and the trailing edge of the first veneer 111. The leading and trailing edges of the veneers are herein defined such that the leading edge is conveyed through the first gap 215 before the trailing edge (regarding both veneers 111, 112). However, it can not be excluded that this type of partial overlap increases the risk of the veneers going onto a wrong side of the second primary roller 221. In fact, at least when the length L_{111} of the first veneer is small, e.g. in comparison to the first distance d_1 , the second veneer 112 may tend to turn the first veneer 111 in such a way that the leading edge of the first veneer propagates to a wrong side of the second primary roller 221.

[0096] Fig. 11a shows a different type of a guide element 315, which can be used to adapt an existing dryer 900. Fig. 11b shows a part of a device 100 having the guide elements 315 of Fig. 11a to guide the veneer 111. A device 100 that is sold may already from the beginning have the guide surfaces 313, 314 of the type indicated in Fig. 11b. In the alternative the guide element 315 may have been retrofitted to an existing dryer 900.

[0097] As indicated in Figs. 2a, 3a, and 4a, a device 100 may have multiple pairs of rollers and a jet box arranged in between each two pairs of neighbouring rollers. For example, in each one of the figures 2a, 3a, and 4a, each drying line

includes eight pairs of jet boxes arranged in between pairs of neighbouring rollers. Thus each drying line includes nine pairs rollers. A drying line refers to a horizontal level of a roller conveyor type device 100. Moreover, the device 100 may comprise multiple parallel drying lines. The parallel drying lines are commonly arranged on top of each other. For example, the device of Figs. 2a, 3a, or 4a includes four drying lines on top of each other. A device 100 may comprise e.g. one, two, three, four, five, six, seven, eight, or more than eight drying lines. A drying line comprises at least two pairs of rollers. Typically, a drying line comprises at least four pairs of rollers, and a veneer is configured to pass through a gap of each one of the pairs of rollers. Each one of the jet boxes forms a support surface, and the support surface of each one of the jet boxes may be configured as indicated above relative to the neighbouring pairs of rollers. The device 100 may be operated in such a way that a temperature within the device 100 near the inlet (i.e. in the figures 2a, 3a, and 4a on the right hand side) is higher than a temperature within the device 100 near the outlet (i.e. in the figures 2a, 3a, and 4a on the left hand side).

[0098] As for typical measures of such devices, a typical distance between the gaps 215, 225 has been indicated above (e.g. from 200 mm to 700 mm), and d1 may be from 300 mm to 550 mm. A diameter of the first primary roller 211 may be from 50 mm to 200 mm, preferably from 100 mm to 125 mm. This helps to control the feeding of the veneers through the gap 215. Preferably, a diameter of the first secondary roller 212 equals the diameter of the first primary roller 211. A diameter of the second primary roller 221 may be from 50 mm to 200 mm, preferably from 100 mm to 125 mm. Preferably, a diameter of the second secondary roller 222 equals the diameter of the second primary roller 221. Also preferably, a diameter of the second primary roller 221 equals the diameter of the first primary roller 211. This helps maintenance of the device 100.

[0099] Typically the gap 215 is formed such that at least a one of the rollers 211, 212 in between which the gap 215 is arranged, comprises an annular protrusion, and a surface or a protrusion of the other roller 212, 211, respectively, makes a contact with the protrusion of the first mentioned roller 211, 212, respectively. A height of the protrusion may be e.g. from 0.5 mm to 2 mm.

[0100] A length of the first primary roller, as measured along its axis of rotation, is preferably from 3 m to 9 m, such as from 4 m to 6 m. A width W111 of a veneer in this direction is preferably from 5 feet (i.e. 1.5 m) to 10 feet (i.e. 3 m with one significant number). A length L111 of a veneer is preferably from 5 feet (i.e. 1.5 m) to 10 feet (i.e. 3 m with one significant number).

Claims

1. A device (100) for drying a veneer (111), the device (100) comprising

- a first pair (210) of rollers configured to move the veneer (111) in a longitudinal direction (Sx), the first pair of rollers (210) comprising

- a first primary roller (211) extending in a direction that is substantially parallel to a transversal direction (Sy) and
- a first secondary roller (212) substantially parallel to the first primary roller (211), whereby
- a first gap (215) is left in between the first primary roller (211) and the first secondary roller (212),

- a second pair of rollers (220) arranged in the longitudinal direction (Sx) from the first pair (210) of rollers, the second pair (220) of rollers comprising

- a second primary roller (221) extending in a direction that is substantially parallel to the transversal direction (Sy) and
- a second secondary roller (222) substantially parallel to the second primary roller (221), whereby
- a second gap (225) is left in between the second primary roller (221) and the second secondary roller (222), and
- the first gap (215) and the second gap (225) define a planar design trajectory (T) for the veneer (111),

- a first primary jet box (311), of which at least a part is arranged in between the first primary roller (211) and the second primary roller (221), the first primary jet box (311) having a primary support surface (313) and being configured to feed gaseous drying medium (120) through the primary support surface (313) towards the planar design trajectory (T), wherein

- the first pair of rollers (210), the second pair of rollers (220), and the primary support surface (313) of the first primary jet box (311) are arranged such that
- a primary imaginary plane (P1) that is defined by the first gap (215) and the primary support surface (313) in

such way that (i) the primary imaginary plane (P1) makes a contact with the primary support surface (313) and (ii) an angle (β_1) between the primary imaginary plane (P1) and the planar design trajectory (T) is minimized:

[A]

- intersects a surface of the second primary roller (221) at a first primary intersection line (111) and at a second primary intersection line (121), wherein
- the first primary intersection line (111) is closer to the first primary jet box (311) than the second primary intersection line (121), and
- a primary angle (α_1), which is left in between the primary imaginary plane (P1) and a tangent plane (TP1) of the second primary roller (221) at the first primary intersection line (111) and opens towards the planar design trajectory (T) and the first pair (210) of rollers, is at least 115 degrees, or

[B]

- is arranged in between the second primary roller (221) and the second secondary roller (222), or

[C]

- intersects a surface of the second secondary roller (222).

2. The device of claim 1, wherein

- the second primary roller (221) is arranged a distance (ddv) apart from the first primary jet box (311), wherein
- the distance (ddv) is from 5 mm to 30 mm; preferably,
- the distance (ddv) is from 5 mm to 20 mm; more preferably from 5 mm to 10 mm.

3. The device of claim 1 or 2, wherein

- the primary angle (α_1) is more than 120 degrees, preferably more than 125 degrees, or at least 135 degrees.

4. The device of any of the claims 1 to 3, wherein

- the second gap (225) is arranged a first distance (d1) apart from the first gap (215) and
- the primary support surface (313) is dividable to a front part (313f) and a rear part (313r) by a division plane (DP) that has a normal that is parallel to the longitudinal direction (Sx) and that is arranged a second distance (d2) apart from the first gap (215), such that
- a minimum distance (dr1) between the rear part (313r) of the primary support surface (313) and the planar design trajectory (T) is less than a minimum distance (df1) between the front part (313f) of the primary support surface (313) and the planar design trajectory (T), wherein
- the front part (313f) of the primary support surface (313) is closer to the first pair (210) of rollers than to the second pair (220) of rollers, and
- the second distance (d2) is at least one third and at most two thirds of the first distance (d1).

5. The device of any of the claims 1 to 4, wherein

- surfaces of the first primary roller (211), second primary roller (221), first secondary roller (212) and second secondary roller (222) are configured to contact the veneer (111) in use in order to move the veneer (111) in the longitudinal direction (Sx); and/or
- a distance (gh1) between the outer surfaces of the first primary roller (211) and the first secondary roller (212) is at most 3.5 mm, such as from 0.5 mm to 3.5 mm; and/or
- a distance (gh2) between the outer surfaces of the second primary roller (221) and the second secondary roller (222) is at most 3.5 mm, such as from 0.5 mm to 3.5 mm.

6. The device of any of the claims 1 to 5, comprising

[A]

- a first secondary jet box (312) arranged in between the first secondary roller (212) and the second secondary roller (222), the first secondary jet box (312) comprising a secondary support surface (314), and configured to feed gaseous drying medium (120) through the secondary support surface (314) towards the planar design trajectory (T); and/or

[B]

- a heat exchanger arrangement (132) configured to heat the gaseous drying medium (120), such as air, using a heat exchange medium, such as steam, and
 - a blower arrangement (134) configured to drive at least some of the gaseous drying medium (120) through the heat exchanger arrangement (132) and at least the primary support surface (313); preferably
 - a blower arrangement (134) is configured to drive at least some of the gaseous drying medium (120) through the heat exchanger arrangement (132) and also through a/the secondary support surface (314).

7. The device of any of the claims 1 to 6, wherein

- at least a part of the primary support surface (313) is a surface of a guide element (315) that is made from a metal plate having a thickness of at least 1.5 mm.

8. A method for adapting a dryer (900) in order to produce a device (100) for drying a veneer (111), the dryer (900) comprising

- a first pair (210) of rollers configured to move the veneer (111) in a longitudinal direction (Sx), the first pair (210) of rollers comprising

- a first primary roller (211) extending in a direction that is substantially parallel to a transversal direction (Sy) and
- a first secondary roller (212) substantially parallel to the first primary roller (211), whereby
- a first gap (215) is left in between the a first primary roller (211) and the first secondary roller (212),

- a second pair (220) of rollers arranged in the longitudinal direction (Sx) from the first pair (210) of rollers, the second pair (220) of rollers comprising

- a second primary roller (221) extending in a direction that is substantially parallel to the transversal direction (Sy) and
- a second secondary roller (222) substantially parallel to the second primary roller (221), whereby
- a second gap (225) is left in between the second primary roller (221) and the second secondary roller (222), and
- the first gap (215) and the second gap (225) define a planar design trajectory (T) for the veneer,

- a first primary jet box (311) arranged in between the first primary roller (211) and the second primary roller (221), having a primary surface (313o), and configured to feed gaseous drying medium (120) through the primary surface (313o) towards the planar design trajectory (T); the method comprising

- arranging available a primary guide element (315),
- attaching the primary guide element (315) to the dryer (900) such that (i) a surface of the primary guide element (315) or (ii) a surface of the primary guide element (315) in combination with a part of the primary surface (313o) forms such a primary support surface (313) that
- the first pair of rollers (210), the second pair of rollers (220), and the primary support surface (313) are arranged such that
- a primary imaginary plane (P1) that is defined by the first gap (215) and the primary support surface (313) in such way that (i) the primary imaginary plane (P1) makes a contact with the primary support surface (313) and (ii) an angle (β_1) between the primary imaginary plane (P1) and the planar design trajectory (T) is minimized:

[A]

- intersects a surface the second primary roller (221) at a first primary intersection line (111) and at a second primary intersection line (121), wherein

- the first primary intersection line (111) is closer to the first primary jet box (311) than the second primary intersection line (121), and
- a primary angle (α_1) that is left in between the primary imaginary plane (P1) and a tangent plane (TP1) of the second primary roller (221) at the first primary intersection line (111) and opens towards the planar design trajectory (T) and the first pair (210) of rollers is at least 115 degrees or

[B]

- is arranged in between the second primary roller (221) and the second secondary roller (222), or

[C]

- intersects a surface of the second secondary roller (222);

to form the device (100) for drying a veneer (111).

9. The method of claim 8,

[A] wherein

- the second primary roller (221) is arranged a distance (ddv) apart from the first primary jet box (311), wherein
- the distance (ddv) is from 5 mm to 30 mm; such as from 5 mm to 20 mm or from 5 mm to 10 mm;
- or

[B] comprising

- attaching the primary guide element (315) to the dryer (900) such that the primary support surface (313) is arranged a distance (ddv) apart from the second primary roller (221), wherein
- the distance (ddv) is from 5 mm to 30 mm such as from 5 mm to 20 mm or from 5 mm to 10 mm.

10. The method of claim 8 or 9, wherein

- in the dryer (900), the second gap (225) is arranged a first distance (d1) apart from the first gap (215), the method comprising
- selecting the shape of the primary guide element (315) such that, or attaching the primary guide element (315) to the primary jet box (311) in such a way that,
- the primary support surface (313) is dividable to a front part (313f) and a rear part (313r) by a division plane (DP) that has a normal that is parallel to the longitudinal direction (Sx) and that is arranged a second distance (d2) apart from the first gap 215, wherein the second distance (d2) is at least one third and at most two thirds of the first distance (d1) and the front part (313f) of the primary support surface (313) is closer to the first pair (210) of rollers than to the second pair (220) of rollers, such that
- a minimum distance (dr1) between the rear part (313r) of the primary support surface (313) and the planar design trajectory (T) is less than a minimum distance (df1) between the front part (313f) of the primary support surface (313) and the planar design trajectory (T).

11. A method for drying a first veneer (111), the method comprising

- arranging available a device (100) of any of the claims 1 to 7 or the device (100) produced by the method of any of the claims 8 to 10,
- feeding the first veneer (111) through the first gap (215) of the first pair (210) of rollers (211, 212) in the longitudinal direction (Sx),
- feeding gaseous drying medium (120) through the primary support surface (313) towards the planar design trajectory (T) and conveying the first veneer (111) alongside the first primary jet box (311) in order to dry the first veneer (111), and
- conveying the first veneer (111) through the second gap (225) of the second pair (220) of rollers (221, 222).

12. The method of claim 11, wherein

- the first veneer (111) comprises wood and
- a thickness of the first veneer is at most 3.5 mm, such as from 0.5 mm to 3.5 mm preferably,
- the first veneer (111) comprises hardwood, such as birch, and has a thickness between 0.5 mm and 3.5 mm, such as from 1.0 mm to 2.0 mm.

13. The method of claim 11 or 12, wherein

- the first veneer (111) has a length (L111) and a width (W111), wherein the length (L111) may be less than, equal to, or greater than the width (W111),
- the first veneer (111) has
 - a first bending stiffness when bent about a first bending line that is parallel to a direction of the length (L111) and
 - a second bending stiffness when bent about a second bending line that is parallel to a direction of the width (W111), wherein
 - the second bending stiffness is more than the first bending stiffness, the method comprising
- feeding the first veneer (111) through the first gap (215) of the first pair (210) of rollers (211, 212) in the longitudinal direction (Sx) of the device (100) such that the direction of the length (L111) of the first veneer is parallel to the longitudinal direction (Sx); preferably,
- the first veneer (111) comprises wood having a grain orientation (G) and the grain orientation (G) is parallel to the direction of length (L111) of the first veneer (111).

14. The method of any of the claims 11 to 13, comprising

- heating the gaseous drying medium (120), such as air, to a temperature of from 120 °C to 210 °C and
- feeding heated gaseous drying medium (120) through the primary support surface (313) towards the planar design trajectory (T).

15. The method of any of the claims 11 to 14, comprising

[A]

- determining a first moisture content of such a veneer that has not been passed through the device before feeding the first veneer through the first gap and/or
- determining a second moisture content of such a veneer that has been passed through the device before feeding the first veneer through the first gap and/or
- determining a temperature of the gaseous drying medium (120) and/or
- determining a humidity of the gaseous drying medium (120); and

[B]

- controlling, using at least one of the determined first moisture content, the determined second moisture content, the temperature of the gaseous drying medium (120), and the humidity of the gaseous drying medium (120), at least one of
 - an angular velocity (v_{11} , v_{12}) of the first primary roller (211) and the first secondary roller (212),
 - a temperature of the gaseous drying medium (120), and
 - a flow rate of the gaseous drying medium (120).

16. The method of any of the claims 11 to 15, comprising

- drying the first veneer (111) in such a way that after the drying a moisture content of the first veneer (111) is from 2 % to 15 %; preferably
- a moisture content of the first veneer (111), when entering the device (100), is from 70 % to 160 %.

17. The method of any of the claims 11 to 16, comprising

- conveying the first veneer (111) through the device (100) by contacting the first veneer (111) with outer surfaces of the first primary roller (211), the second primary roller (221), the first secondary roller (212), and the second secondary roller (222).

18. The method of any of the claims 11 to 17, comprising

- arranging available a second veneer (112),
- before conveying the first veneer (111) through the second gap (225), arranging the first veneer (111) and the second veneer (112) in partial overlap, and
- feeding the first veneer (111) and the second veneer (112) through the first gap (215) of the first pair (210) of rollers (221, 222) in the longitudinal direction (Sx) such that
- the parts of the first and second veneers (111, 112) that are in partial overlap, are in partial overlap as they pass through the first gap (215); preferably,
- a length (Lo) of the overlapping parts in the longitudinal direction (Sx) is from 20 mm to 50 mm.

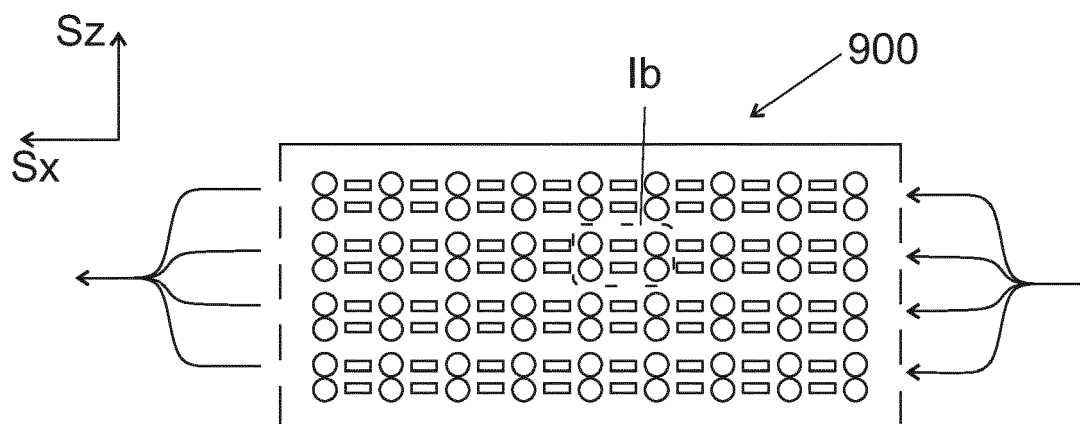


Fig. 1a
PRIOR ART

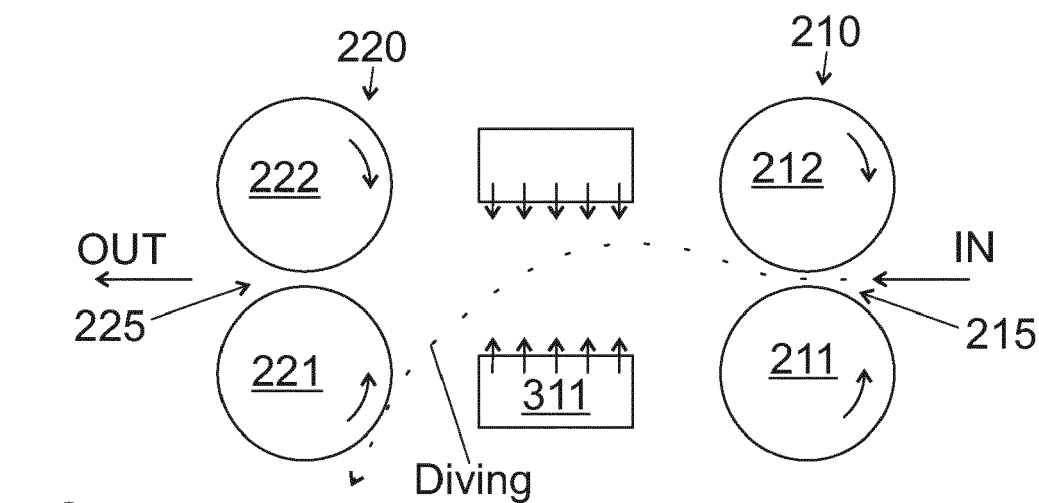


Fig. 1b
PRIOR ART

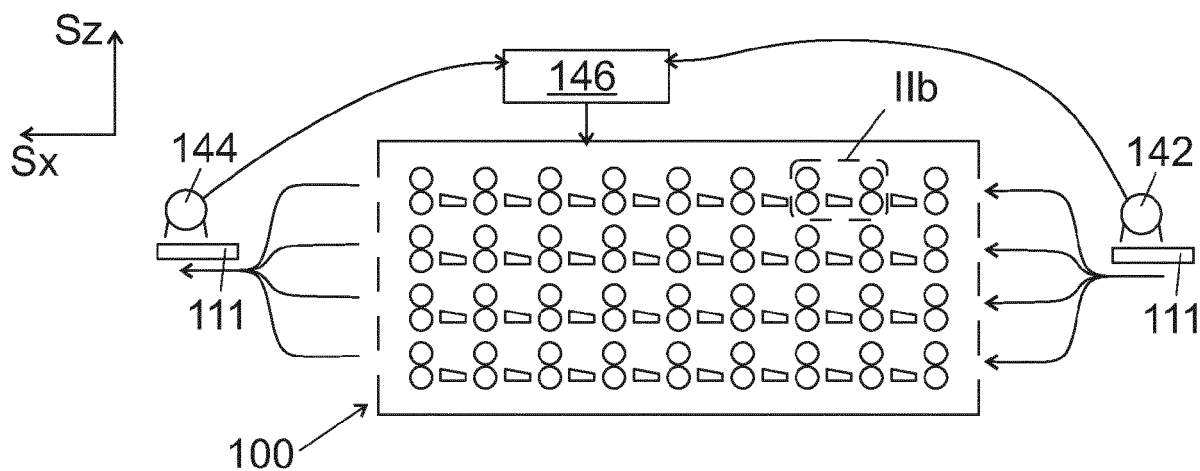


Fig. 2a

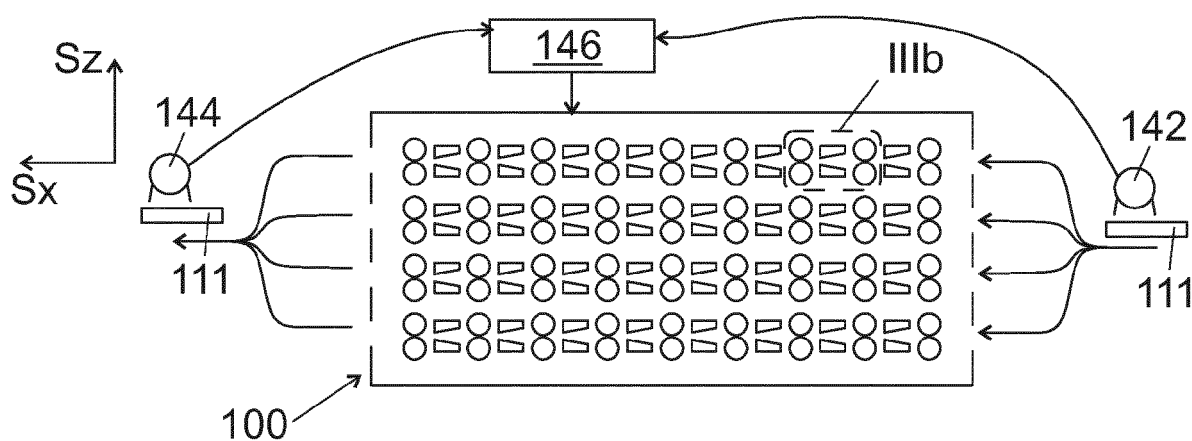


Fig. 3a

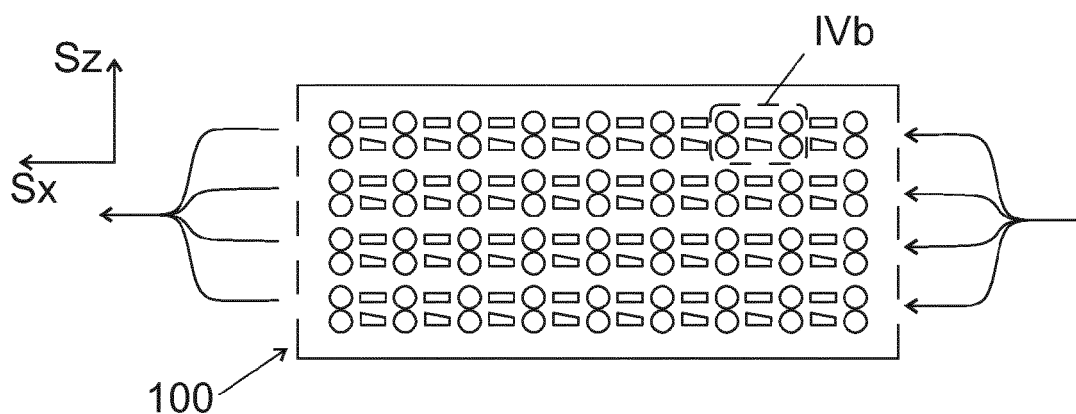


Fig. 4a

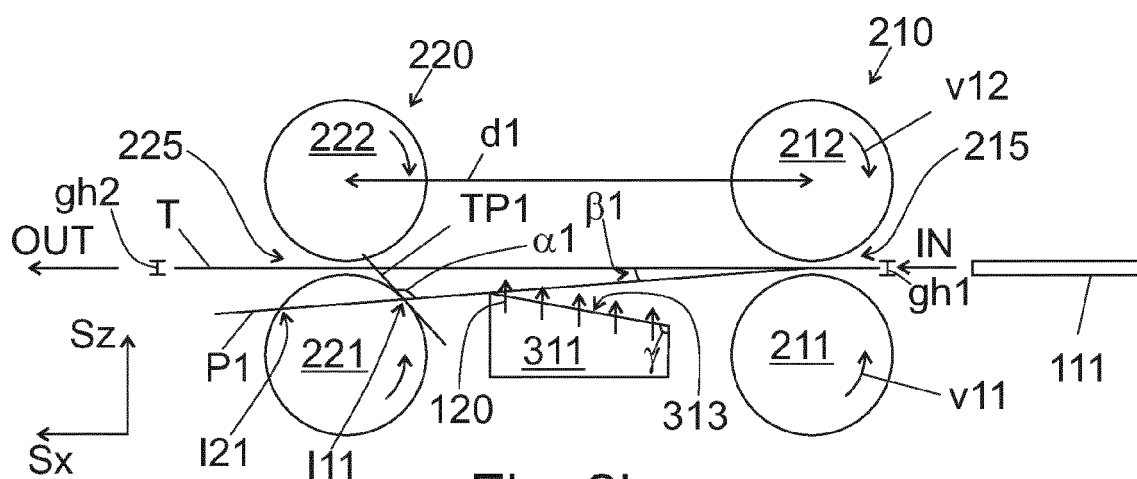


Fig. 2b

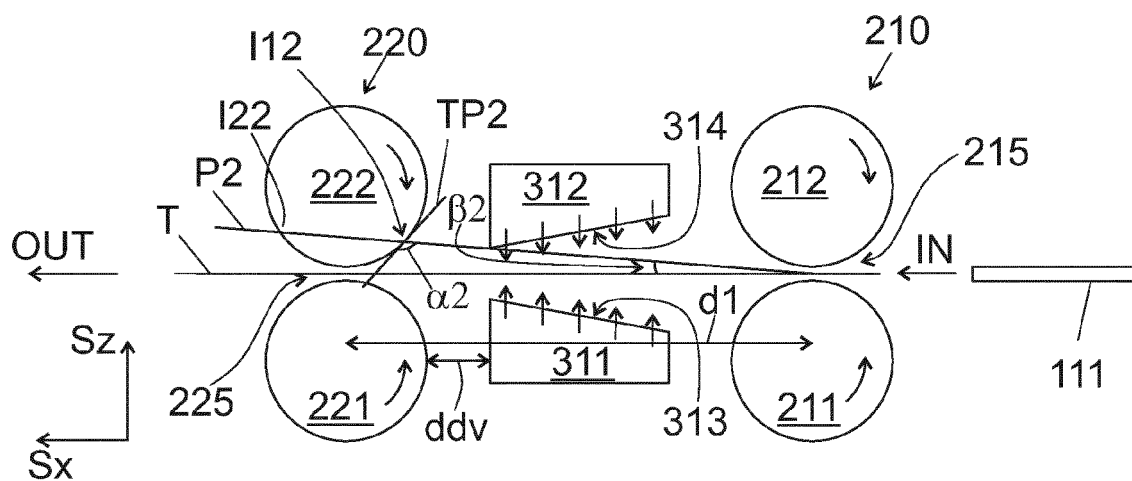


Fig. 3b

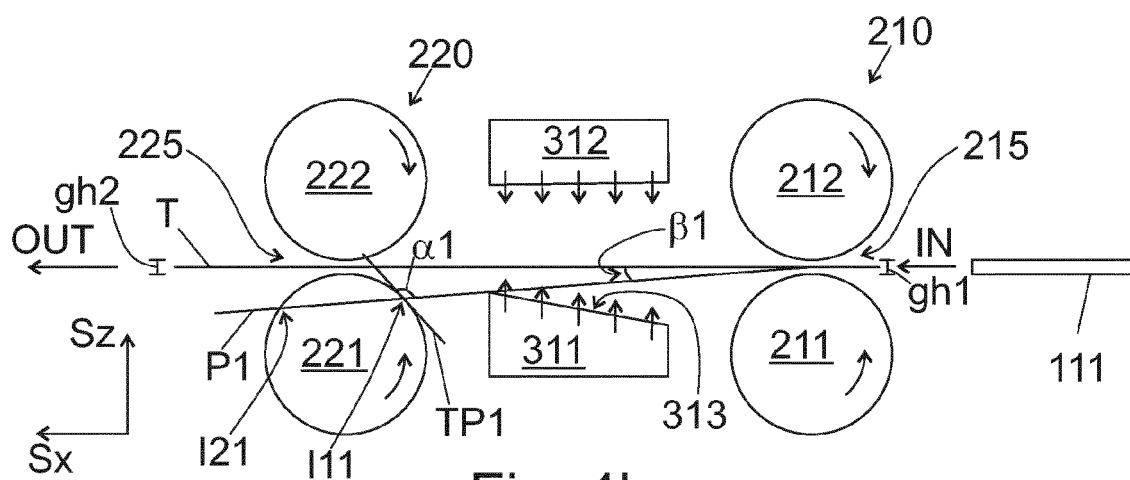


Fig. 4b

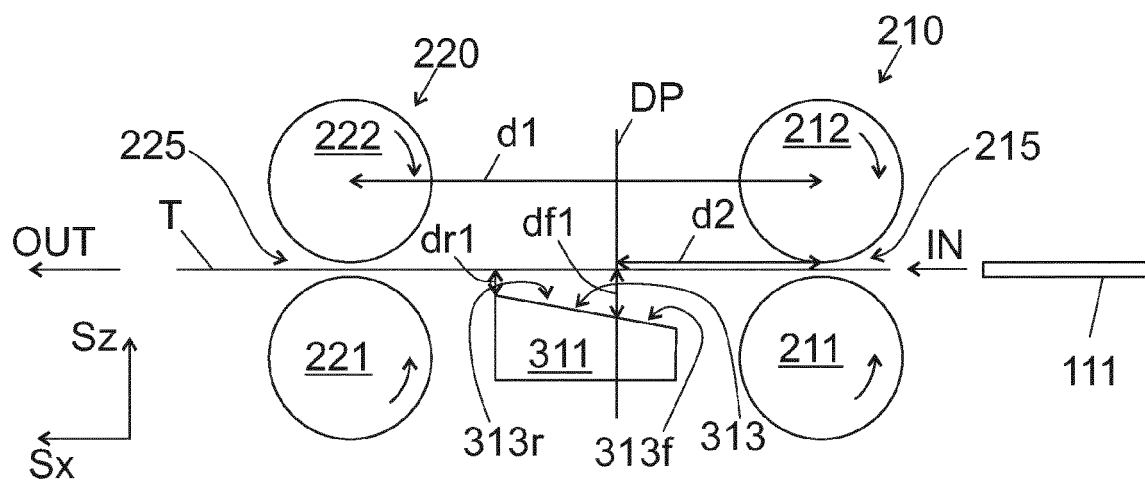


Fig. 2c

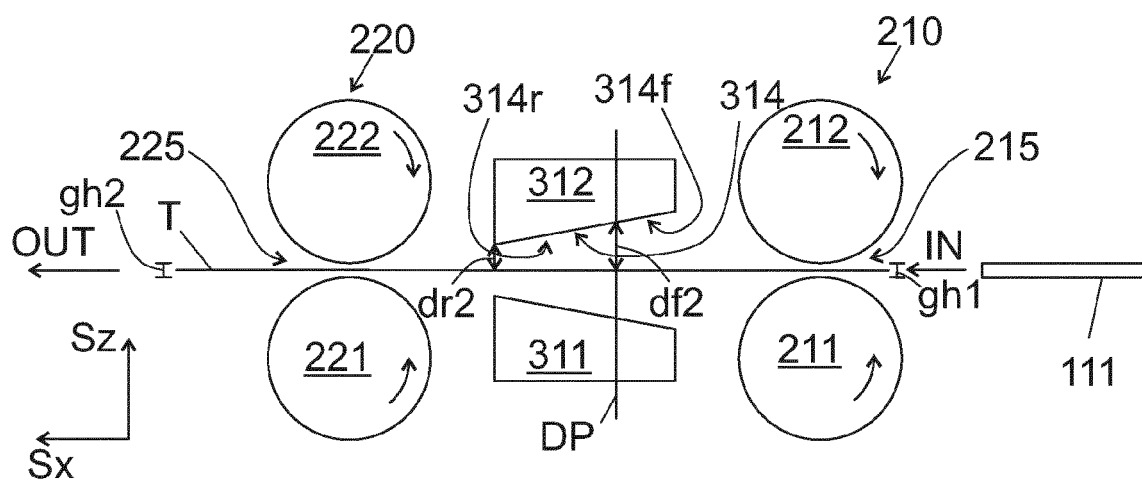


Fig. 3c

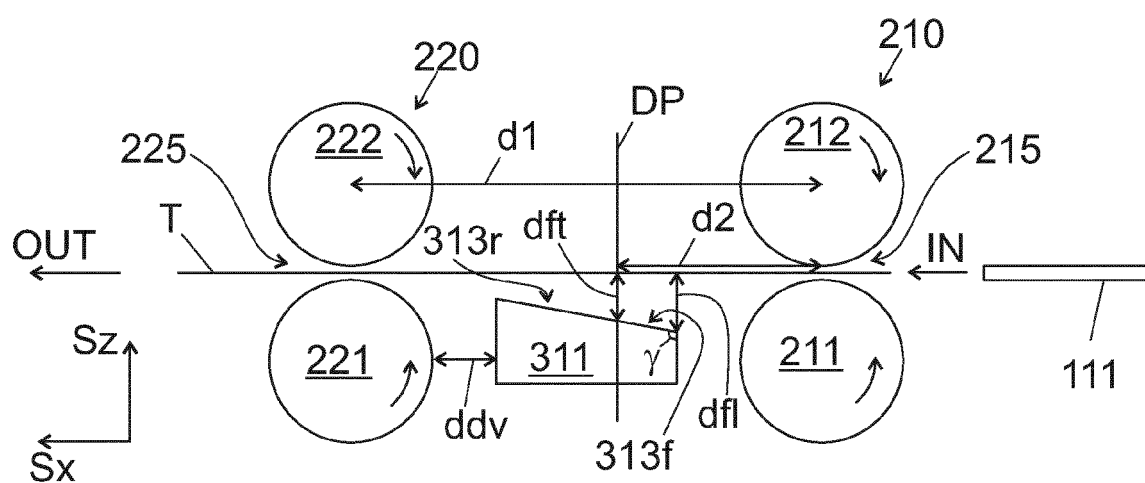


Fig. 2d

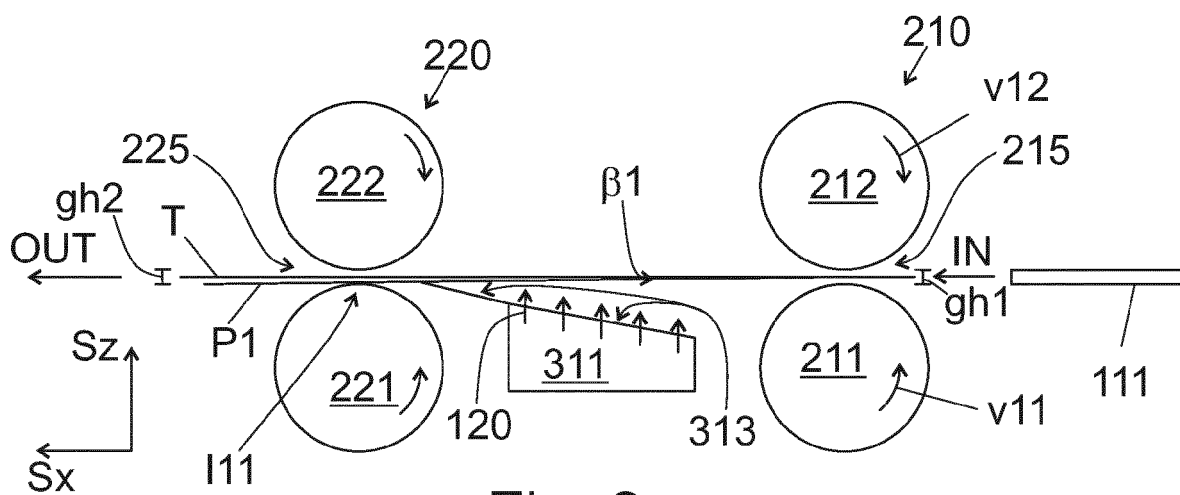


Fig. 2e

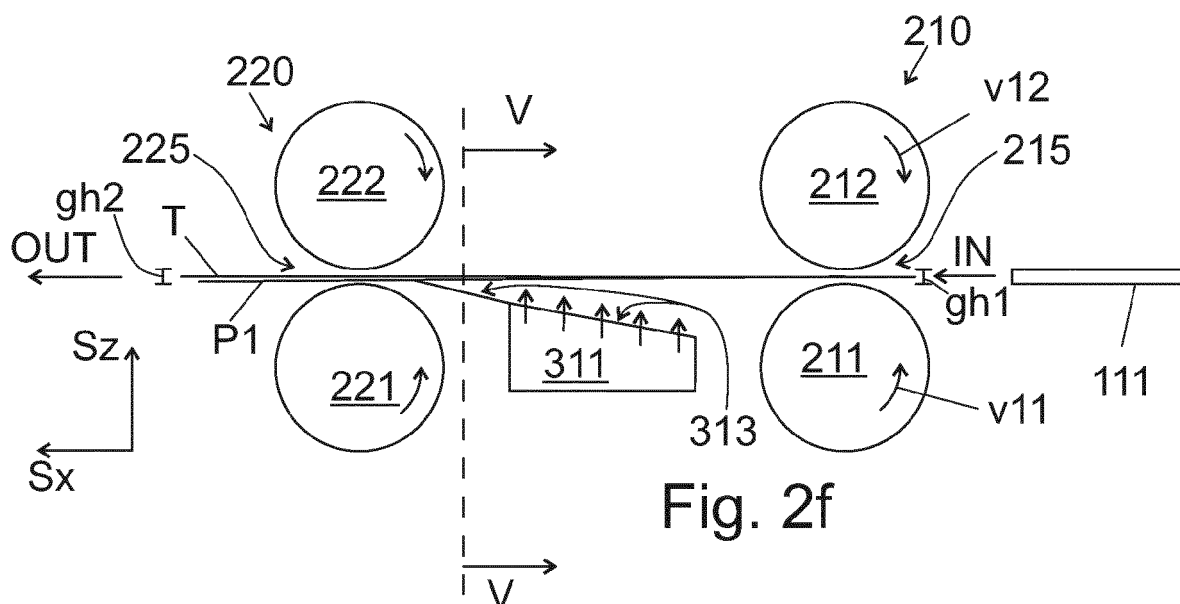


Fig. 2f

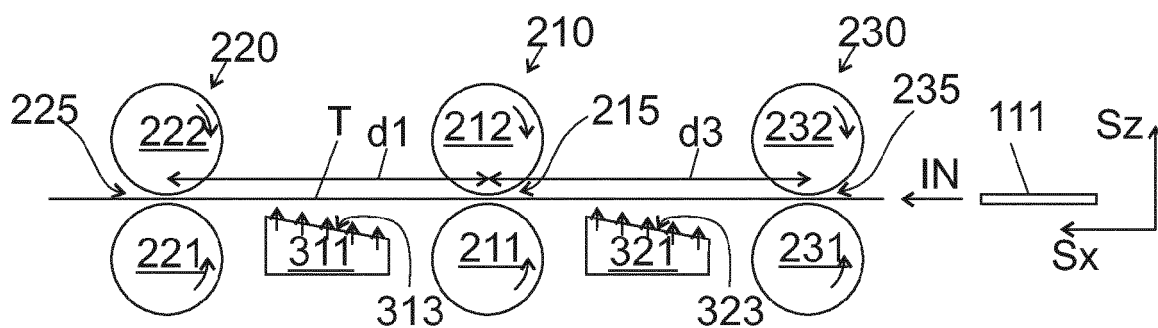


Fig. 2g

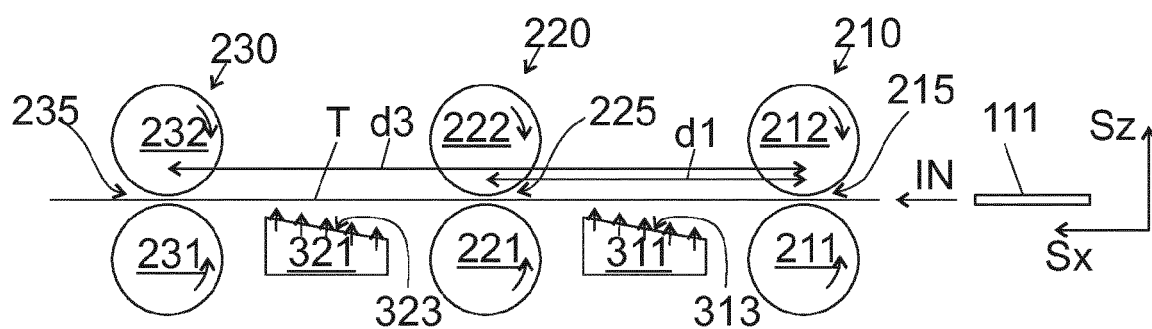


Fig. 2h

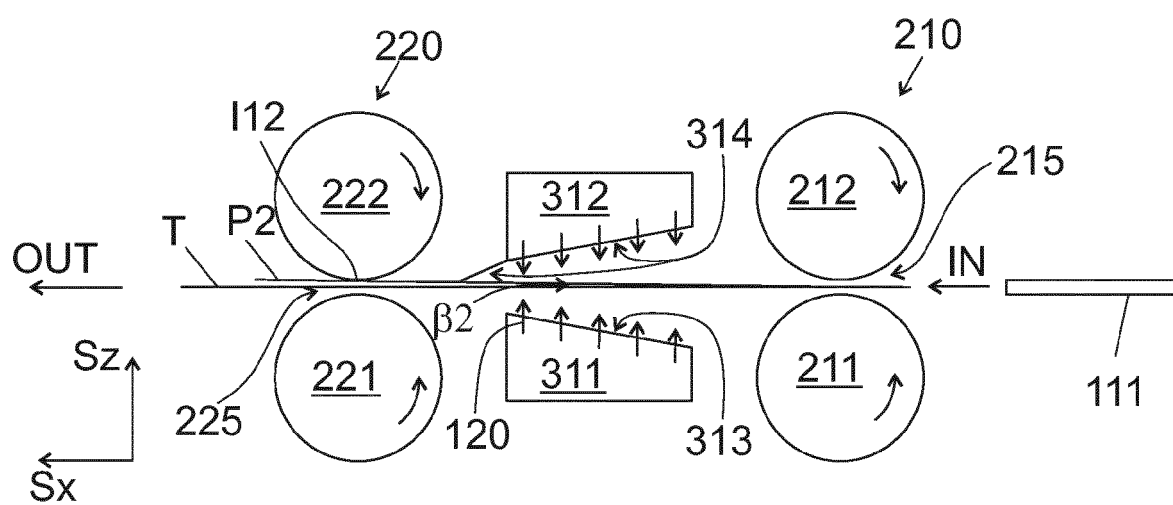


Fig. 3d

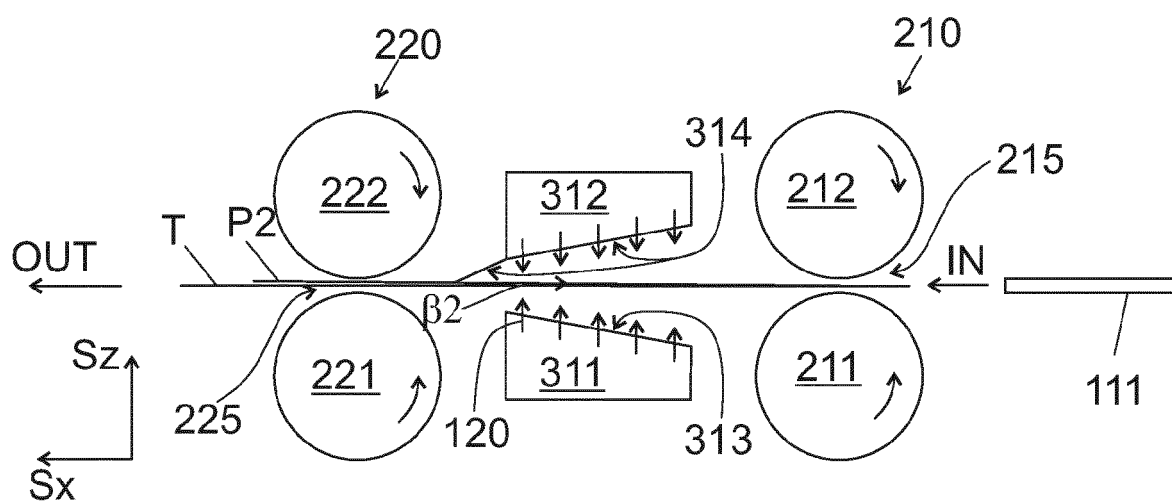


Fig. 3e

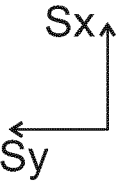
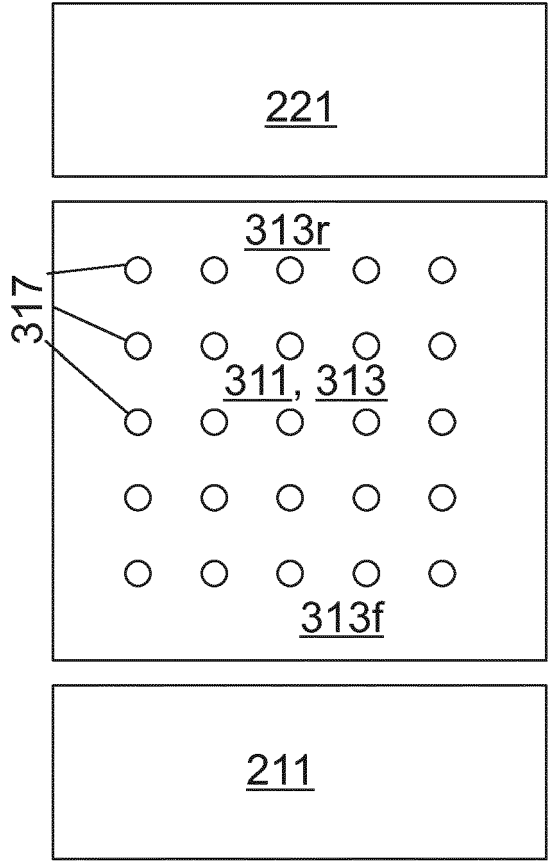


Fig. 6a

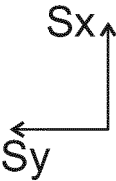
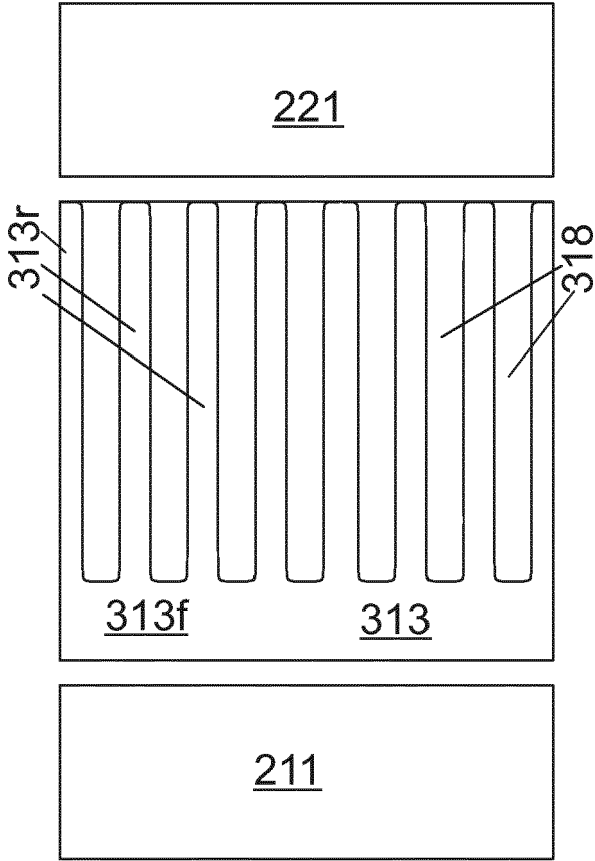


Fig. 6b

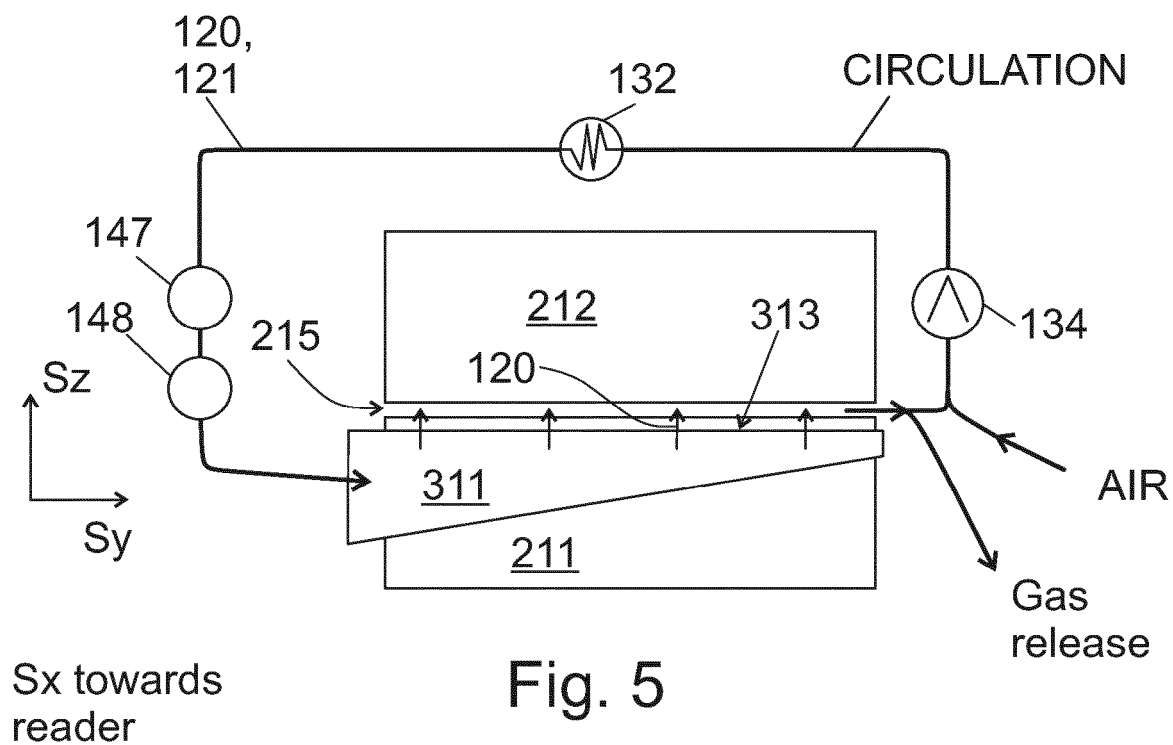


Fig. 5

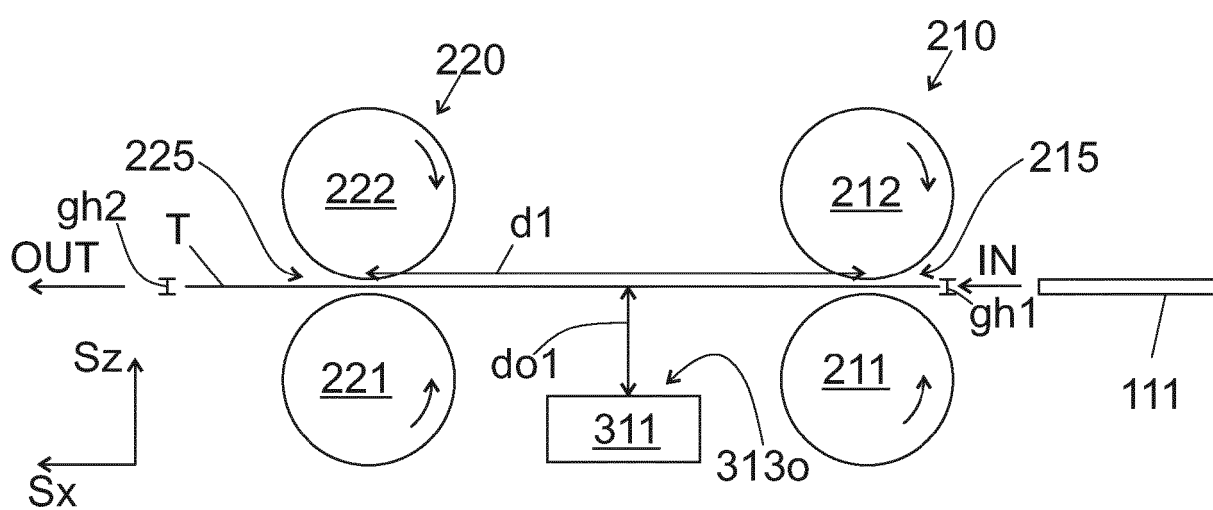


Fig. 7a

Fig. 7b

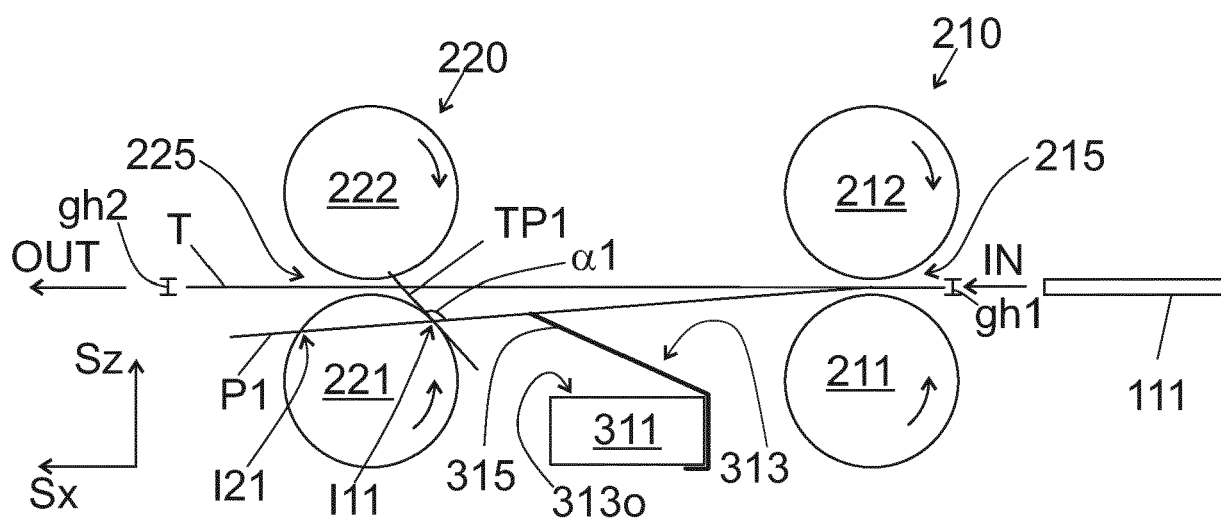
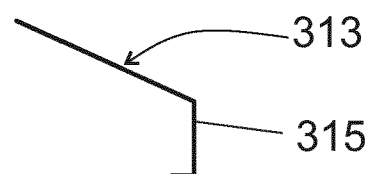


Fig. 7c

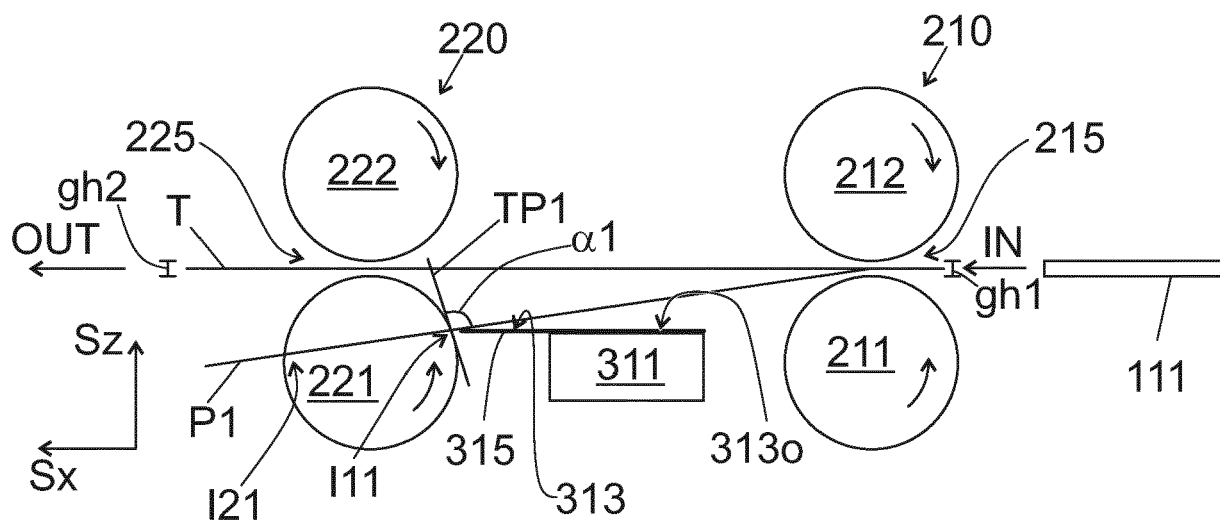


Fig. 7d

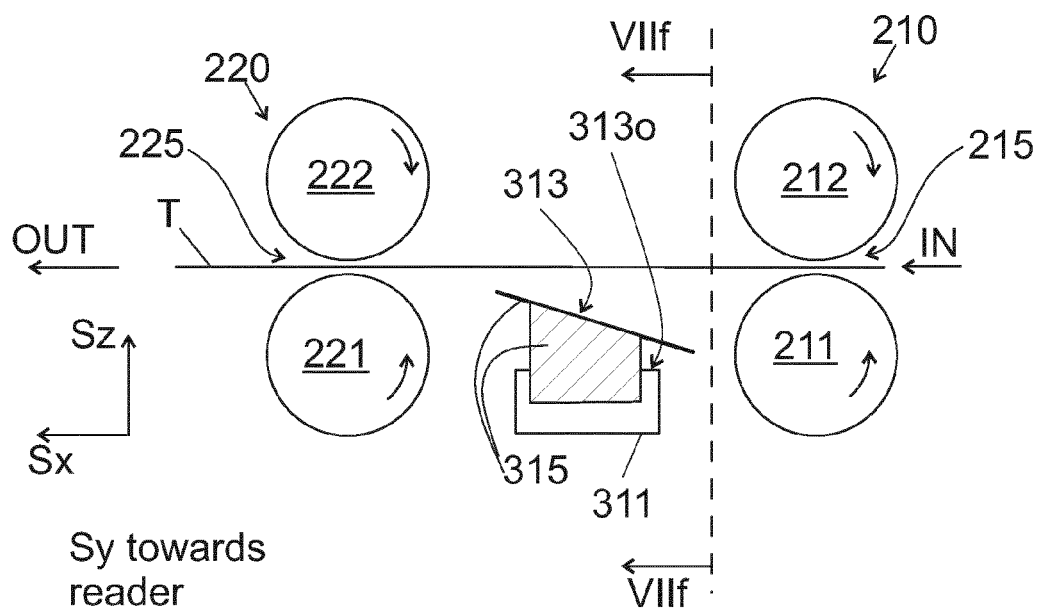


Fig. 7e

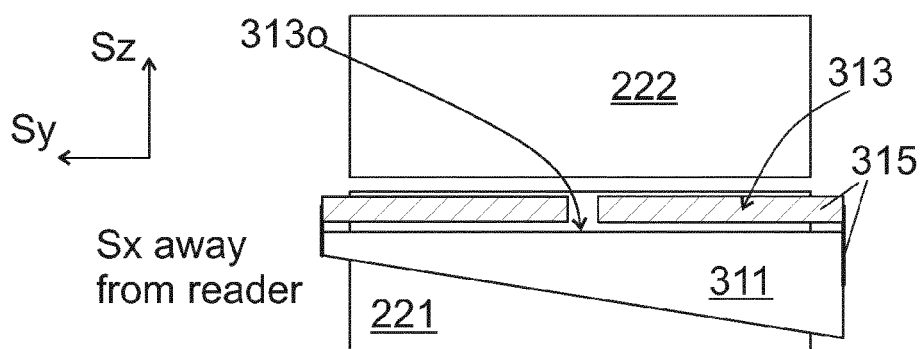


Fig. 7f

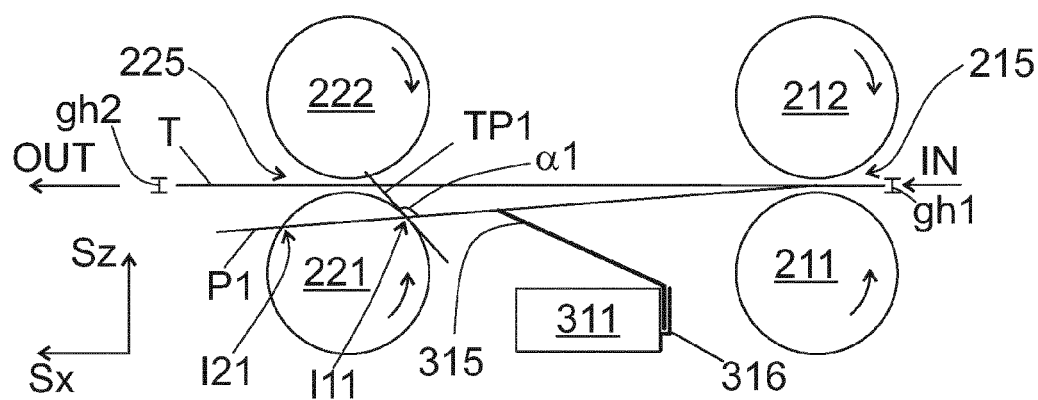
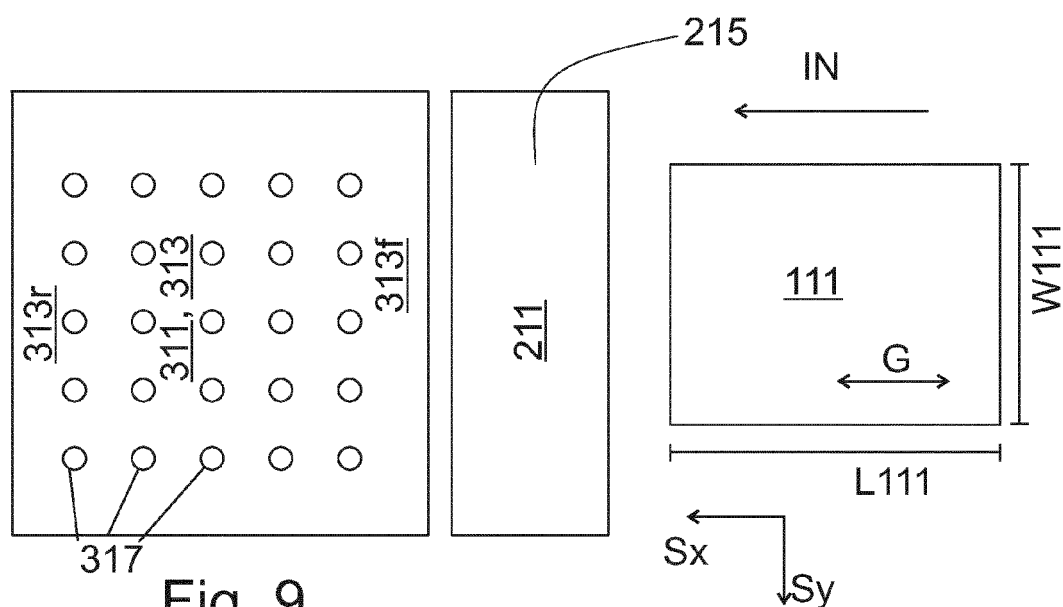
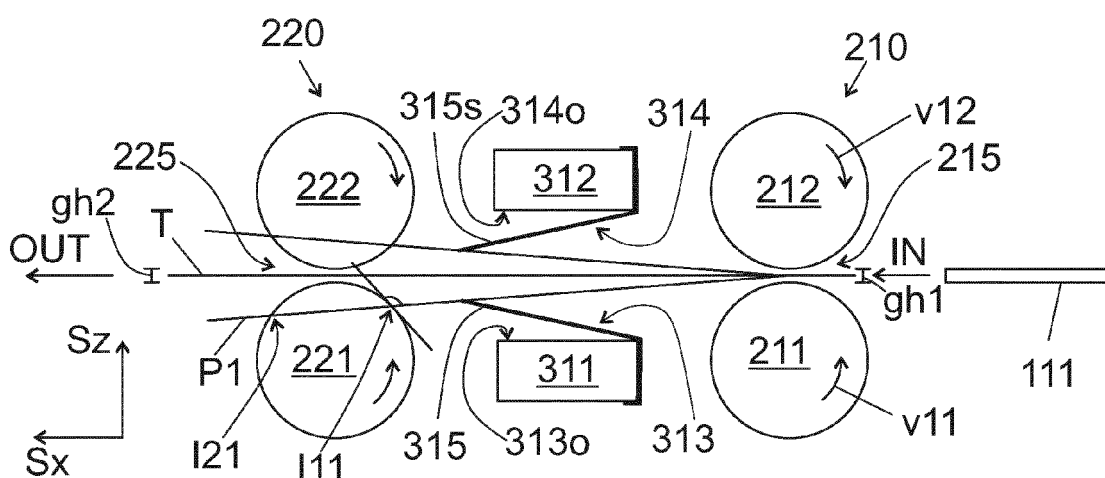
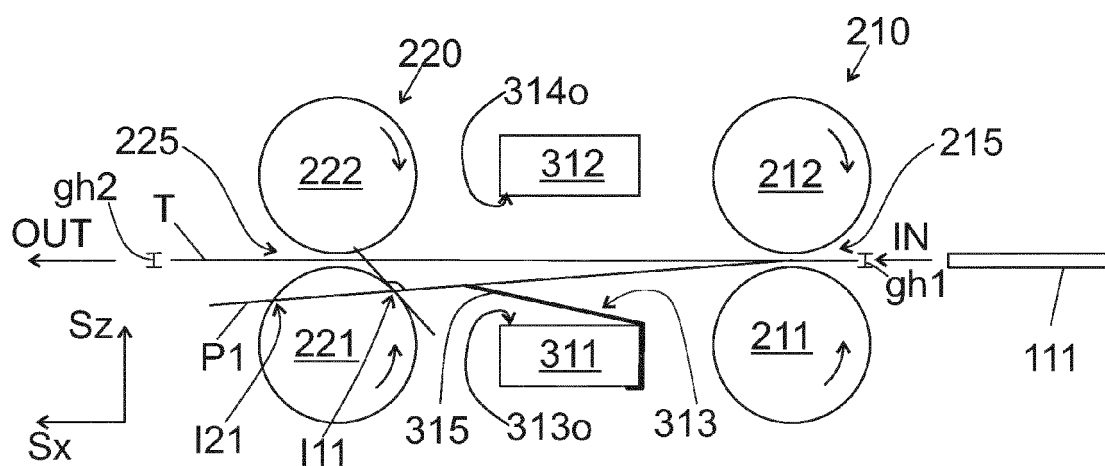


Fig. 7g



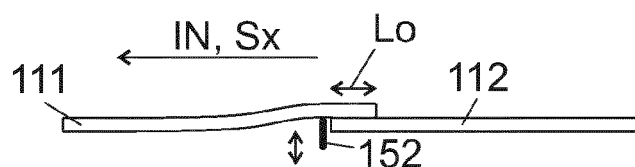


Fig. 10a

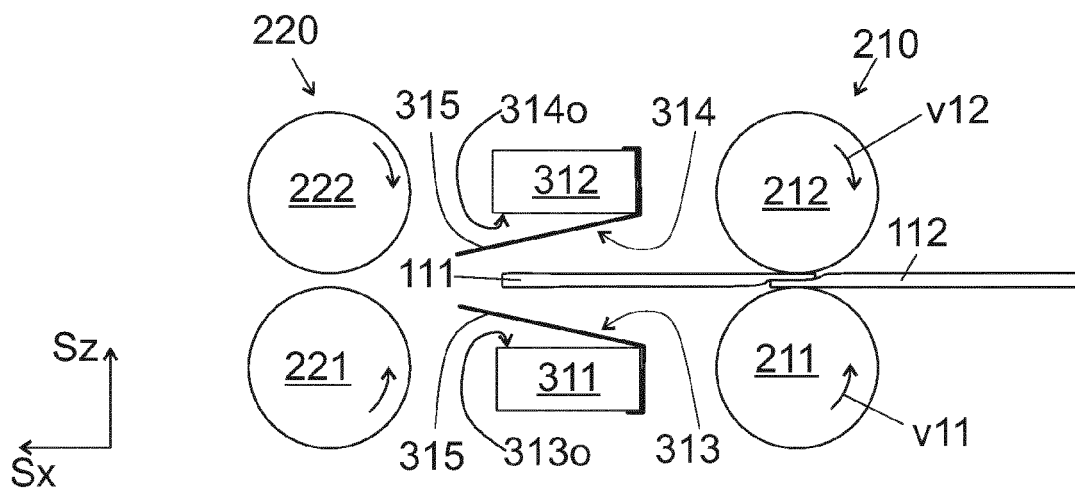


Fig. 10b

Fig. 11a

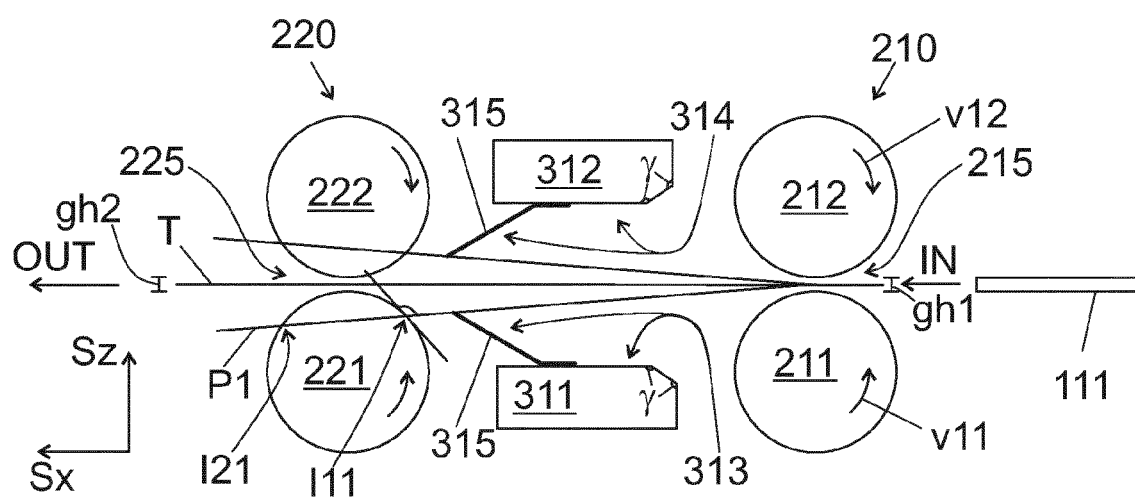
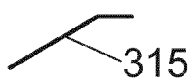


Fig. 11b



EUROPEAN SEARCH REPORT

 Application Number
 EP 18 39 7529

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X	WO 2008/122855 A2 (ANCORA SPA [IT]; CORRADINI FABIO [IT]) 16 October 2008 (2008-10-16) * figure 2 *	1,3,6,8, 11	
X	US 3 854 220 A (YAMAGUCHI M) 17 December 1974 (1974-12-17) * figure 1 *	1,3,8,11	
			TECHNICAL FIELDS SEARCHED (IPC)
			F26B
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 21 February 2019	Examiner Delval, Stéphane
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	

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The members are as contained in the European Patent Office EDP file on
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