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(54) **DISPERSER**

(57) The disperser plate (3, 8) comprises, in a radial direction (RD) thereof, a feed zone (16), a mixing zone (17) and a refining zone (18). The refining zone (18) comprises elongated projecting parts (5c, 10c) extending in a non-radial direction relative to the radial direction (RD) of the disperser plate (3, 8), and cavities (24) extending between the elongated projecting parts (5c, 10c). A width (W_{24}) of the cavities (24) in the refining zone (18) are at least about twice of the width of the elongated projecting parts (5c, 10c). The disperser plate (3, 8) further comprises dams (25) extending between at least some neighbouring elongated projecting parts (5c, 10c) in a position deviating from a perpendicular position relative to the direction of the extension of the elongated projecting parts (5c, 10c).

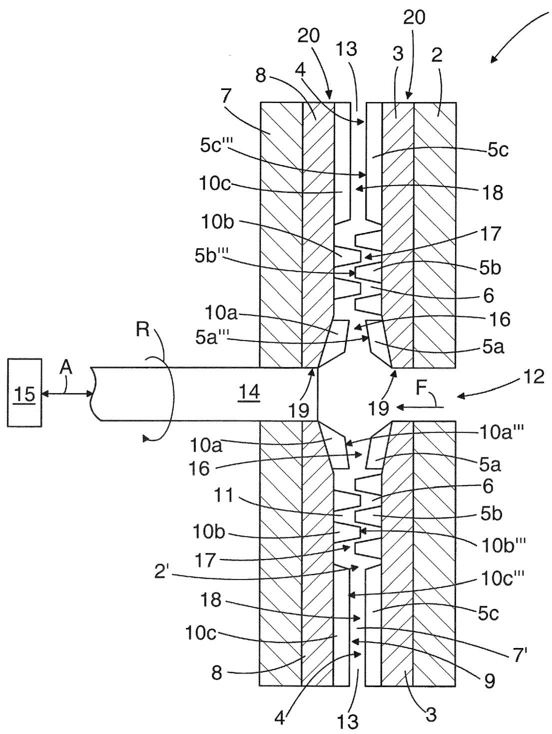

FIG. 1

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Description

FIELD OF THE INVENTION

[0001] The invention relates to a disperser for dispersing pulp, and more particularly to a disperser plate for the disperser for dispersing pulp.

BACKGROUND OF THE INVENTION

[0002] Recycling of waste paper and packaging material as a source of raw material to new fibre-based products has long traditions, however its importance has increased in these days in terms of environment, energy and sustainability. Several processes are used to remove ink, tone, plastics and stickies etc. which are present in the recovered paper.

[0003] When paper or paperboard is manufactured from pulp, and especially from pulp containing recycled fibres originating for example from wastepaper, chipboard or waste pulp, it is an intention to process different contaminants in the pulp before a formation of a paper web or a board web so that negative effects of the contaminants to the pulp as well as to a web forming in a paper or board machine are reduced. Said contaminants include for example printing inks and surface coating agents, such as different stickies, waxes, adhesives and pastes, remaining in the wastepaper, chipboard or waste pulp.

[0004] Dispersing of the pulp does not actually remove the contaminants from the pulp but in the dispersing the pulp is slushed or treated in order to diminish negative effects of the contaminants to a quality and a runnability of the pulp or to facilitate a removal of the contaminants in process stages following the dispersing. In the dispersing, among other things, contaminants such as printing ink particles attached to the fibres are detached from the fibres and made smaller so that they can be easily removed from the pulp in a flotation stage following the dispersing or, alternatively, to prevent them being visible in a finished paper or paperboard at least by visual examination. In the dispersing also sticky particles remaining in the pulp are broken up in order to prevent formation of different contaminant aggregates which may have negative effects on the runnability of the pulp during formation of the paper or board web and on the runnability of the formed paper or board web in an actual paper or board machine. Contrary to the refining, dispersing does not so much cut or break the fibres but helps to release fibres from the contaminants and to reduce particulate size of stickies.

[0005] A typical disperser comprises coaxial oppositely positioned disperser discs having either disc-like or conical forms and providing a stator and a rotor, the rotor being rotatable relative to the fixed stator. On the stator and the rotor there are disperser plates arranged in a removable way, the disperser plates providing dispersing surfaces of the stator and the rotor, whereby the dispersing surfaces of the stator and the rotor may consist of a single annular disperser plate extending over a whole perimeter of the stator/rotor but typically they consists of several pie-shaped disperser plates, i.e. segments, arranged adjacent to one another to form the complete annular dispersing surface both for the stator and rotor. The disperser plates comprise projecting parts, teeth or the like, and cavities which may be grooves but most often being planar areas between the projecting parts. The projecting parts and the cavities therebetween provide processing surfaces, i.e. dispersing surfaces, of the disperser plates. The dispersing surfaces of one or more disperser plates attached to the disc-like or conical stator/rotor thus provide the dispersing surface of the disc-like or conical stator/rotor.

[0006] The projecting parts in a typical disperser plate are pyramidal shaped discrete parts arranged in a number of concentric circularly extending rows at different radial distances in the disperser plate, the cavities thereby being concentric circularly extending open areas between the circularly extending rows of the projecting parts as well as open areas having a form of grooves between the individual projecting parts in the circularly extending rows of the projecting parts. In the disperser the projecting parts and the cavities in the oppositely positioned stator/rotor are then arranged to intermesh with each other such that the projecting parts in the concentric circularly extending rows in the stator extend into the concentric circularly extending open areas in the opposite rotor and vice versa as male-female elements. An example of this kind of disperser is disclosed in US 2005/0194482 A1.

[0007] When the rotor of the disperser is rotated relative to the stator, the pyramidal design of the discrete projecting parts cause impacts to the pulp to be processed, whereby effects of these impacts together with effects of internal friction in the pulp detach the contaminant particles from the pulp and break them up into smaller pieces.

[0008] A problem relating to the disperser of that kind is poor adjustability in view of the treatment effect to be directed to the pulp by the disperser.

[0009] EP-publication 2743397 A1 discloses a disperser assembly comprising annular dams between the concentric circularly extending rows of the projecting parts. Furthermore, in the disperser of EP2743397 grooves between the projecting parts in the concentric circularly extending rows are arranged to define, together with the annular dams, a serpentine passage extending radially between the opposing disperser discs. An intention of that solution is to enhance the flow of the pulp to be dispersed between the opposing disperser discs and thereby to increase the dispersing effect to be directed to the pulp by the disperser.

BRIEF DESCRIPTION OF THE INVENTION

[0010] An object of the present invention is to provide a novel disperser and a novel disperser plate for a disperser.

[0011] The disperser plate according to the invention is characterized by the features of claim 1.

[0012] The disperser according to the invention is characterized by the features of claim 11.

[0013] A disperser plate for a disperser comprises, in a radial direction thereof, an inner edge to be directed towards a feed of the pulp to be dispersed and an outer edge to be directed away from the feed of the pulp to be dispersed. Furthermore, the disperser plate comprises, in the radial direction thereof, a feed zone, a mixing zone and a refining zone. The feed zone comprises elongated projecting parts extending in a non-radial direction relative to the radial direction of the disperser plate and cavities extending between the elongated projecting parts. The refining zone comprises elongated projecting parts extending in a non-radial direction relative to the radial direction of the disperser plate and cavities extending between the elongated projecting parts. A width of the cavities in the refining zone is at least about twice of the width of the elongated projecting parts. Further the refining zone comprises dams extending between at least some neighbouring elongated projecting parts in a position deviating from a perpendicular position relative to the direction of the extension of the elongated projecting parts.

[0014] When the disperser is equipped with a disperser plate comprising a refining zone, it may be provided at least some refining effect to the pulp to be dispersed for affecting the fibre properties of the pulp. Some dispersing effect may still be provided in the refining zone by a continuous back and forth flow of the pulp between the opposite disperser discs. The disperser disclosed may thus provide both the dispersing effect and the refining effect on the pulp to be processed, whereby a possible post-refining stage following a disperser in some traditional pulping processes may be left out.

[0015] Some embodiments of the invention are disclosed in the dependent claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016] In the following the invention will be described in greater detail by means of preferred embodiments with reference to the accompanying drawings, in which

Figure 1 is a schematic cross sectional side view of a disc-like disperser;

Figure 2 shows schematically a view of a disperser plate for a rotor of the disperser of Figure 1;

Figure 3 shows schematically a view of a conical disperser plate for a conical disperser, and

Figures 4a and 4b show schematically end views of some embodiments of longitudinal projecting parts in the disperser plate.

[0017] For the sake of clarity, the figures show some embodiments of the invention in a simplified manner. Like reference numerals identify like elements in the figures.

DETAILED DESCRIPTION OF THE INVENTION

[0018] Figure 1 is a schematic cross sectional side view of a disc-like disperser 1, which may be used for dispersing fibrous material, i.e. pulp, and especially pulp containing recycled fibres originating for example from wastepaper, chipboard or waste pulp. An intention of the dispersing is to treat the pulp so that contaminants are released from the fibres so that they can be easily removed from the pulp in a flotation stage following the dispersing or, alternatively, to prevent them being visible in a finished paper or paperboard at least by visual examination. Said contaminants include for example printing inks and surface coating agents, such as different stickies, waxes, adhesives and pastes, remaining in the wastepaper, chipboard or waste pulp.

[0019] The disperser 1 shown in Figure 1 comprises a stationary, fixed disperser disc 2, i.e. a stator 2, of the disperser 1. The stator 2 is typically supported on a fixed frame (not shown) of the disperser 1. The stator 2 comprises a number of, i.e. one or more, disperser plates 3 which form a dispersing surface 2' of the stator 2. The disperser plates 3 are typically pie-shaped segments, like for example that kind of shown in Figure 2, which are placed adjacent to each other to the stator 2 so as to form the dispersing surface 2' for the stator 2. The disperser plate 3 is detachable from the stator 2 in order to replace a worn or broken plate 3 with a new one.

[0020] The disperser plate 3 comprises a dispersing surface 4, whereby a complete dispersing surface 2' of the stator 2 is provided by the dispersing surfaces 4 of the one or more adjacent disperser plates 3 fastened to the stator 2. The dispersing surface 4 of the disperser plate 3 comprises projecting parts 5a, 5b, 5c and cavities 6 therebetween. The projecting parts 5a, 5b, 5c provide the parts of the dispersing surface of the stator 2 that direct a treatment effect to the pulp. The cavities 6, in turn, provide passages for the pulp in the dispersing surface of the stator 2.

[0021] The disperser 1 shown in Figure 1 further comprises a rotatable, i.e. movable, disperser disc 7, i.e. a rotor 7, of the disperser 1. The rotor 7 comprises a number of, i.e. one or more, disperser plates 8 which form a dispersing surface 7' of the rotor 7. Also the disperser plates 8 are typically pie-shaped segments, like for example that kind of shown in Figure 2, which are placed adjacent to each other to the rotor 7 so as to form the dispersing surface 7' in the rotor 7.The disperser plate 8 is detachable from the rotor 7 in order to replace a worn or broken disperser plate 8 with a new one.

[0022] The disperser plate 8 comprises a dispersing surface 9, whereby a complete dispersing surface 7' of the rotor 7 is provided by the dispersing surfaces 9 of the one or more adjacent disperser plates 8 fastened to the rotor 7. The dispersing surface 9 of the disperser plate 8 comprises projecting parts 10a, 10b, 10c and cavities 11 therebetween. The projecting parts 10a, 10b, 10c provide the parts of the dispersing surface of the rotor 7 that direct a treatment effect to the pulp by the rotor 7. The cavities 11, in turn, provide passages for the pulp in the dispersing surface 7' of the rotor 7.

[0023] The disperser 1 further comprises at a stator 2 side at least one feed opening 12 through which the pulp to be dispersed is supplied into a dispersing chamber 13 that is between the oppositely positioned stator 2 and rotor 7 along a feed or supply direction indicated schematically with an arrow F. Consistency of the pulp supplied into the disperser 1 may for example be 3 - 40%, preferably 10 - 30%. Together with the pulp also steam is supplied into the dispersing chamber 13 so as to improve the travel of the pulp in the dispersing chamber 13 along the dispersing surfaces of the stator 2 and the rotor 7.

[0024] The rotor 7 is connected to a motor (not shown) by a shaft 14 so that the rotor 7 may be rotated about the stator 2 by the motor in a direction of arrow R, for instance, the arrow R thus indicating an example of an intended rotation direction R of the rotor 7.

[0025] The disperser 1 shown in Figure 1 is an example of a disc disperser with plate-like disperser discs. However, the solutions presented herein may also be utilized in conical dispersers with conical disperser discs. Furthermore, in the disc disperser 1 as well as in the conical disperser the stator 2 may be replaced with another rotor that is arranged to be rotated into a direction opposite to the intended rotation direction R of the rotor 7.

[0026] The one or more disperser plates 3 in the stator 2 as well as the one or more disperser plates 8 in the rotor 7 are typically made by casting, meaning that the whole plate including its surface pattern is made by casting. As a consequence of that the dispersing surfaces 4, 9 of the disperser plates 3, 8 are originally very uneven comprising small bosses and recesses in an irregular manner. At least a part of the dispersing surfaces 4, 9 of the disperser plates 3, 8, especially at least a part of upper surfaces of at least some of the projecting parts 5a - 5c, 10a - 10c, may be machined for removing the irregularities originating from the casting at the upper surfaces of those projecting parts 5a - 5c, 10a - 10c. Further the projecting parts 5c, 10c may be manufactured by machining so as to provide different kind of prescribed profiles in the projecting parts 5c, 10c, such as even or plane surfaces, inclined surfaces, convex surfaces, concave surfaces or different combinations thereof etc. finer patterns which cannot be achieved by casting. Thereby it is possible to achieve the dispersing chamber 13 a size of which, i.e. a distance between the opposing stator 2 and the rotor 7 surfaces can be adjusted accurately in a predetermined manner without a risk of the dispersing surfaces thereof to impact to each other. The distance between the stator 2 and the rotor 7 can be adjusted by a loader device 15 which is connected to the shaft 14 of the rotor 7. The loader device 15 is able to move the shaft 14 and the rotor 7 back and forth as shown schematically with an arrow A for adjusting the distance between the stator 2 and the rotor 7. The size of the dispersing chamber 13 in Figure 1 is exaggerated relative to the sizes of the other parts of the disperser 1. At least a portion of a bottom surface of some cavities may also be a machined surface if that improves the flow of pulp to be dispersed along at least a portion of the dispersing surface 4, 9.

[0027] Figure 2 shows schematically a view of the rotor plate 8 of Figure 1 and the dispersing surface 9 thereof. The stator plate 3 of Figure 1 and the dispersing surface 4 thereof may be substantially similar to that shown in Figure 2 unless otherwise specifically expressed.

[0028] The rotor plate 8 of Figure 2 is a disc-like disperser plate comprising an inner edge 19 or an inner periphery 19 or a feed edge 19 directing towards a centre of the rotor 7, i.e. towards the feed opening 12 in the disperser 1. The pulp to be dispersed thus enters to the dispersing surface 9 of the rotor plate 8 over the inner edge 19. The rotor plate 8 further comprises an outer edge 20 or an outer periphery 20 or a discharge edge 20 directing towards an outer periphery of the rotor 7, i.e. away from the feed opening 12 of the disperser 1 and towards the discharge of the pulp dispersed. The rotor plate 8 further comprises side edges 21, 22 extending between the inner edge 19 and the outer edge 20, the first side edge 21 facing towards the intended rotation direction R of the rotor 7 and the second side edge 22 facing towards an opposite direction relative to the intended rotation direction R of the rotor 7. The rotor plate 8 provides a segment-like disperser plate providing a part of a complete dispersing surface 7' of the rotor 7, whereby the complete dispersing surface 7' of the rotor 7 is provided by setting a number of the segment-like rotor plates 8 adjacent to each other along a circumferential direction of the rotor 7.

[0029] The disperser plate 3, 8 comprises in a radial direction RD thereof at least three zones, i.e. a first zone 16, a second zone 17 and a third zone 18, having various effects on the pulp to be dispersed. The first zone 16, or an inner zone 16 or a feed zone 16, is at the inner periphery 19 of the disperser plates 3, 8 next to an inner periphery of the stator 2 and the rotor 7, and therefore next to the feed of the pulp to the dispersing chamber 13 of the disperser 1. The first zone 16 in the disperser plate 3, 8 comprises elongated projecting parts 5a, 10a, or ridge or bar shaped projecting parts 5a, 10a extending in a direction from the inner periphery 19 of the plate 3, 8 towards the outer periphery 20 of the plate 3, 8, and cavities 23 extending between the elongated projecting parts 5a, 10a.

[0030] To facilitate smooth and intensive pulp flow the projecting parts 10a in the rotor plate 8 are preferably positioned in an oblique position relative to the radial direction RD of the plate 8 in such a way that first ends 10a' of the projecting parts 10a facing towards the inner periphery 19 are leading ends in the intended rotation direction RD relative to the second ends 10a" of the projecting parts 10a facing towards the outer periphery 20. The proper angle is selected to match with the oblique design of the projecting parts 5c, 10c on the third zone 18, as explained later. Deviation from the radius RD or the oblique position of the projecting parts 5a, 10a in the feed zone 16 may vary between 15 and 45 degrees from the radial direction RD of the disperser plate 3, 8. Thereby, when the rotor 7 is rotated to the intended rotation direction RD, the projecting parts 10a in the rotor 7 provide to the pulp to be dispersed a resultant force promoting the flow of the pulp towards the outer edge 20. The corresponding projecting parts 5a in the stator plate 3 are positioned in an oblique position that may be a mirror image of that shown in Figure 2 relative to the radial direction RD, whereby the resultant force provided by the projecting parts 10a in the rotor 7 to the pulp is not hindered by the projecting parts 5a in the stator 2.

[0031] Furthermore at least a portion of upper surfaces 5a'", 10a'" of the projecting parts 5a, 10a may be machined to comprise a prescribed profile but it is not mandatory if the dimensioning of the projecting parts 5a, 10a does not allow contact between the projecting parts on counter plates during the adjustment of the size of the dispersing chamber 13.

[0032] The effect of the elongated projecting parts 5a, 10a is to intensify the feed of the pulp to be dispersed from the feed opening 12 forward along the dispersing surfaces 4, 9 of the disperser plates 3, 8 towards the second 17 and the third 18 zones but not substantially affect properties of the pulp to be dispersed.

[0033] The second zone 17, or a middle zone 17, is between the first zone 16 and the third zone 18, the second zone 17 thus succeeding the first zone 16 in a flow direction of the pulp to be dispersed along the dispersing surfaces 4, 9 of the disperser plates 3, 8. The second zones 17 in the disperser plates 3, 8 comprise pyramidal shaped projecting parts 5b, 10b. The projecting parts 5b, 10b are arranged in a number of concentric circularly extending rows at different radial distances in the disperser plates 3, 8, whereby there are concentric circularly extending open areas or cavities 6, 11 being between the circularly extending rows of the projecting parts 5b, 10b.

[0034] The projecting parts 5b in the stator plate 3 are arranged, in a height direction thereof, partly extend into cavities 11 which are between the projecting parts 10b in the rotor plate 8, and vice versa. In other words, the projecting parts 5b, 10b in one disperser plate 3, 8 may be arranged to extend into cavities 6, 11 which are between the projecting parts 5b, 10b in the opposite disperser plate 3, 8. At least upper surfaces 5b'", 10b'" of the projecting parts 5b, 10b may also be machined to comprise a prescribed profile.

[0035] The effect of these pyramidal shaped projecting parts 5b, 10b intermeshing with each other is to cause the pulp to flow along a continuously alternating course when the pulp to be dispersed flows back and forth between the cavities 6 on the dispersing surface 4 of the stator plate 3 and between the cavities 11 on the dispersing surface 9 of the rotor plate 8. The flow of the pulp then collides with bottoms of cavities 6, 11 and sides of the projecting parts 5b, 10b and the contaminant particles in the pulp are broken into smaller pieces by effects of the impacts and an internal friction in the pulp. At the same time the pulp to be dispersed is intermixed, the second zones 17 of the disperser plates 3, 8 thus providing mixing zones 17 in the disperser plates 3, 8.

[0036] Generally the mixing zone 17 is arranged to extend, in the radial direction RD of the disperser plate 3, 8, from a break point of the upper surface 5a'", 10a'" of the elongated projecting part 5a, 10a in the feed zone 16 up to a starting point of the upper surface 5b'", 5c'", 10b"', 10c'" of the projecting part 5b, 5c, 10b, 10c following the elongated projecting part 5a, 10a in the feed zone 16. The break point is thus on a last portion or at an end of the elongated projecting part 5a, 10a that faces towards the outer edge 20 of the disperser plate 3, 8, as seen in the radial direction RD of the disperser plate 3, 8. The starting point, in turn, is on a first portion or at a beginning of the projecting part 5b, 5c, 10b, 10c that faces towards the inner edge 19 of the disperser plate 3, 8, or towards the elongated projecting parts 5a, 10a in the feed zone 16, as seen in the radial direction RD of the disperser plate 3, 8.

[0037] The break point of the upper surface 5a'", 10a'" of the elongated projecting part 5a, 10a in the feed zone 16, at which point the mixing zone 17 begins, is thus the point in the elongated projecting part 5a, 10a at which the elongated projecting part 5a, 10a is completely and abruptly interrupted or at which a bevel being at the end of the elongated projecting part 5a, 10a on the side of the outer edge 20 of the disperser plate 3, 8 and descending towards the outer edge 20 of the disperser plate 3, 8 begins. After this break point the pulp portions flowing in the grooves 23 neighbouring the elongated projecting parts 5a, 10a may begin directly to mix with each other, without being hindered by a complete or any elongated projecting parts 5a, 10a.

[0038] The starting point of the upper surface 5b'", 5c'", 10b"', 10c'" of the projecting part 5b, 5c, 10b, 10c, that follows the projecting part 5a, 10a in the radial direction RD of the disperser plate 3, 8, at which point the mixing zone 17 ends, is thus the point in the projecting part 5b, 5c, 10b, 10c at which the projecting part 5b, 5c, 10b, 10c is arranged to completely and abruptly start or at which a bevel being in the projecting part 5b, 5c, 10b, 10c on the side of the inner edge 19 of the disperser plate 3, 8 and ascending towards the outer edge 20 of the disperser plate 3, 8 ends. After this starting point the pulp portions flowing in the grooves 24 neighbouring the projecting parts 5b, 5c, 10a, 10c may not anymore directly mix with each other due to the projecting part 5b, 5c, 10b, 10c being therebetween.

[0039] In the embodiment of Figures 1 and 2 this means that the mixing zone 17 begins at the ends of the elongated projecting parts 5a, 10a which are on the side of the outer edge 20 of the disperser plate 3, 8, and extends up to a beginning of the upper surface 5b'", 10b'" of the projecting parts 5b, 10b, including the bevels being in the projecting parts 5b, 10b on the side of the inner edge 19 of the disperser plate 3, 8. An intermixing of the pulp to be dispersed becomes more intensive when a height of the projecting parts 10a starts to decrease or are completely interrupted, and, correspondingly, the intermixing of the pulp becomes weaker when the height of the projecting parts 10b starts to increase.

[0040] The third zone 18, or an outermost zone 18, is at an outer periphery 20 of the plates 3, 8 to be laid next to an outer periphery of the stator 2 and the rotor 7, i.e. next to a discharge of the pulp from the dispersing chamber 13 of the disperser 1. The third zone 18 thus succeeds the second zone 17 in the flow direction of the pulp to be dispersed along the processing surfaces 4, 9 of the disperser plates 3, 8, or in the radial direction RD of the disperser plates 3, 8. The third zones 18 in the plates 3, 8 comprise elongated projecting parts 5c, 10c, or ridge or bar shaped projecting parts 5c, 10c, extending from the direction of the inner periphery 19 of the plates 3, 8 towards the outer periphery 20 of the plates 3, 8, and substantially extending up to the outer periphery 20 of the plates 3, 8, as well as cavities 24 extending between the elongated projecting parts 5c, 10c.

[0041] For smooth pulp flow it is preferred that the projecting parts 10c in the rotor plate 8 are positioned in an oblique position relative to the radial direction RD of the plate 8 in such a way that first ends 10c' of the projecting parts 10c facing towards the inner periphery 19 are the leading ends in the intended rotation direction R relative to the second ends 10c" of the projecting parts 10c facing towards the outer periphery 20. Deviation from the radius RD, i.e. the oblique position may vary between 5 and 45 degrees, however, not more than the deviation of the projecting parts 10a on the feed zone 16. In other words the deviation angle of the projecting parts 10c on the third zone 18 is the same as or smaller than the deviation angle of the projecting parts 10a on the feed zone 16. This way pulp's dwell time in the disperser as well as its quality optimized. The projecting parts 10b on the mixing zone 17, when available, may also be similarly deviated from the radial direction RD, their deviation angle being the same as or smaller than that of the projecting parts 10a on the feed zone and the same as or bigger than the deviation angle of the projecting parts 10c on the third zone 18. However, the projecting parts 10b on the mixing zone 17 are preferably about radially oriented and fair short to intensify intermixing of the pulp. Thereby, when the rotor 7 is rotated to the intended rotation direction RD, the projecting parts 10c in the rotor 7 provide to the pulp to be dispersed a resultant force promoting the flow of the pulp towards the outer edge 20. The projecting parts 5c in the stator plate 3 are positioned in an oblique position that may be a mirror image of that shown in Figure 2 relative to the radial direction RD, whereby the resultant force provided by the projecting parts 10c is not hindered by the projecting parts 5c in the stator 2, unless that is not a specific intended effect to be provided by the projecting parts 5c in the stator 2.

[0042] The mutual distance between the projecting parts 10c in the circumferential direction of the rotor plate 8, i.e. a width W_{24} of an open area 24 or a groove 24 that is between the projecting parts 10c is selected such that the material to be dispersed does not clog the third zone 18. The clogging may be avoided for example by selecting the width of the groove 24 to be at least about twice of a width W_c of the projecting parts 10c. In the embodiment of Figures 1 and 2 the mutual distance between the neighbouring projecting parts 10c at the first ends 10c' thereof is about twice of the width W_c of the projecting parts 10c, the mutual distance increasing towards the outer periphery 20 of the rotor plate 8.

[0043] Preferably the upper surfaces 5c'", 10c'" of the projecting parts 5c, 10c are completely machined flat surfaces, whereby it is possible to achieve at the third zone 18 the dispersing chamber 13 a size of which, i.e. the distance between the dispersing surfaces of the opposing stator 2 and the rotor 7, can be adjusted accurately in a predetermined manner without a risk of the dispersing surfaces thereof to impact to each other. This means that the rotor 7 may be moved so close to the stator 2 that a refining effect may be provided to the pulp entered to the third zone 18 by shear forces provided by the opposed projecting parts 5c, 10c that move relative to each other and the distance of which can be accurately adjusted. This means that the third zone 18 provides a refining zone 18 in the disperser 1, the refining zone 18 thus providing at least some refining effect to the pulp to be dispersed for affecting the fibre properties of the pulp. Some dispersing effect may additionally be provided in the third zone 18 by the continuous back and forth flow of the pulp between the opposite dispersing surfaces 2', 7'.

[0044] The third zone 18 further comprises dams 25 between the projecting parts 10c, the dams 25 being arranged to interrupt the grooves 24 and to force the pulp flowing along the groove 24 to rise towards the dispersing chamber 13. As can be seen in Figure 2, the dams 25 are not exactly at a crosswise or transverse position relative to the direction of extension of the projecting parts 10c but at a position somewhat deviating from that crosswise or transverse position. This provides the effect that all the pulp that crosses over the dam 25 does not go over the neighbouring projecting parts 10c always at the same point thereof and thereby excessively wear the same points in the neighbouring projecting parts 10c. The same effect may also be provided by a dam that is curved in its longitudinal direction.

[0045] The disperser 1 disclosed may provide both the dispersing effect and the refining effect on the pulp to be processed, whereby a possible postrefining stage following a disperser in some traditional pulping processes may be left out.

[0046] The cast disperser plates 3, 8 with machined flat upper surfaces of the projecting parts at least on the third zone 18 provide low-cost solution to improve the effectivity of the disperser by incorporating refining of the pulp with the dispersing of the pulp. When at least upper surfaces 5c'", 10c'" of the projecting parts 5c, 10c in the third zones 18 of the disperser plates 3, 8 are machined to be flat, it is provided the dispersing chamber 13 the size of which can be adjusted accurately in a predetermined manner. This, in turn, provides that specific energy consumption [kWh/T] of the dispersing can be controlled and optimized and the dispersing result and the quality of the dispersed pulp can be controlled. It can thus be directed to the pulp to be dispersed an accurately adjustable treatment effect.

[0047] Figure 3 shows schematically a view of a disperser plate 8 intended for a rotor 7 of a conical disperser, the rotor plate 8 comprising a dispersing surface 9 provided with elongated projecting parts 10a, 10c and cavities 23, 24 extending between the elongated projecting parts 10a, 10c. At least upper surfaces 10a"', 10c'" of the projecting parts 10a, 10c may be machined. The disperser plate element for a stator of the conical disperser and a dispersing surface thereof may be substantially similar to that shown in Figure 3 unless otherwise specifically expressed.

[0048] The rotor plate 8 of Figure 3 is a conical-like plate comprising an inner edge 19 or an inner periphery 19 or a feed edge 19 intended to be directed towards a feed of the pulp into the disperser, the pulp to be dispersed thus entering to the dispersing surface 9 of the disperser plate 8 over the inner edge 19. The rotor plate 8 further comprises an outer edge 20 or an outer periphery 20 or a discharge edge 20 intended to be directed towards a discharge of the pulp out of the disperser, i.e. away from the feed of the pulp into the disperser, the pulp dispersed thus leaving the disperser over the outer edge 20 of the rotor plate 8. The rotor plate 8 further comprises side edges 21, 22 extending between the inner edge 19 and the outer edge 20. The rotor plate 8 provides a segment-like disperser plate intended to provide a part of a complete dispersing surface 7' of the rotor 7, whereby a complete dispersing surface of the rotor 7 is provided by setting a number of the segment-like disperser plates adjacent to each other.

[0049] The disperser plate 8 comprises in a radial direction RD thereof at least three zones, i.e. a first zone 16 forming a feed zone 16, a second zone 17 forming a mixing zone 17 and a third zone 18 forming a refining zone 18, each zone thus having various effects on the pulp to be dispersed. The effects of these zones to the pulp to be dispersed are similar to those described in Figures 1 and 2 and the related description above.

[0050] The first zone 16 is at the inner periphery 19 of the plate 8 next to an inner periphery of the rotor 7, and therefore next to the feed of the pulp to a dispersing chamber 13 of the disperser. The first zone 16 comprises elongated projecting parts 10a or ridge or bar shaped projecting parts 10a extending in a direction from the inner periphery 19 of the plate 8 at a distance towards the outer periphery 20 of the plate 8.

[0051] The projecting parts 10a in the rotor plate 8 are positioned in an oblique position, i.e. in a non-radial direction, relative to the radial direction RD of the plate 8 in such a way that first ends 10a' of the projecting parts 10a facing towards the inner periphery 19 are leading ends in the intended rotation direction RD relative to the second ends 10a" of the projecting parts 10a facing towards the outer periphery 20. In other words, there is an angle between an imaginary centre line of the projecting part 10a and the radial direction RD of the disperser plate 8. In the embodiment of Figure 3 the mutual distance between the neighbouring projecting parts 10a is substantially constant along the longitudinal extension of the projecting parts 10a. Furthermore at least a portion of upper surfaces 10a'" of the projecting parts 10a may be machined to comprise a prescribed profile but it is not mandatory if the dimensioning of the projecting parts 10a does not allow them to impact to the corresponding projecting parts in the stator during the adjustment of the size of the dispersing chamber 13. The corresponding projecting parts in the disperser plate for the stator may be positioned in an oblique position that may be a mirror image of that shown in Figure 3 relative to the radial direction RD,

[0052] The projecting parts 10a are in their longitudinal direction stepwise continuous or piecewise continuous, meaning that there are points in the projecting parts 10a at which there are lateral shifts or sideways towards an intended rotation direction R between two successive elongated portions of the projecting parts 10a.

[0053] First ends 10a' of the projecting parts 10a comprise guiding surfaces 26 ascending towards the outer edge 20 of the rotor plate 8 and up to the upper surfaces 10a'" of the projecting parts 10a. Second ends 10a" of the projecting parts 10a comprise also guiding surfaces 27 descending towards the outer edge 20 of the rotor plate 8 from the upper surfaces 10a'" of the projecting parts 10a and substantially up to the bottom of the cavity 23. At the points of the lateral shifts of the projecting parts 10a facing to the inner edge 19 of the disperser plate 8, or facing towards the intended rotation direction RD of the rotor 7, there may also be guiding surfaces 28 ascending towards the outer edge 20 of the rotor plate 8 and up to the upper surfaces 10a'" of the projecting parts 10a.

[0054] In the embodiment of Figure 3 the guiding surfaces 26, 27, 28 are bevelled surfaces but could also be convex or concave surfaces.

[0055] The third zone 18, or an outermost zone 18, is at an outer periphery 20 of the plate 8, i.e. next to an outer periphery of the stator 2 and the rotor 7, i.e. next to a discharge of the pulp from the dispersing chamber 13 of the disperser. The third zone 18 comprises elongated projecting parts 10c, or ridge or bar shaped projecting parts 10c, extending from the direction of the inner periphery 19 of the plate 8 towards the outer periphery

20 of the plate 8, and extending substantially up to the outer periphery 20 of the plate 8.

[0056] The projecting parts 10c in the rotor plate 8 are positioned in an oblique position or in a non-radial direction relative to the radial direction RD of the plate 8 in such a way that first ends 10c' of the projecting parts 10c facing towards the inner periphery 19 are leading ends in the intended rotation direction RD relative to the second ends 10c" of the projecting parts 10c facing towards the outer periphery 20. First ends 10c' of the projecting parts 10c facing to the inner edge 19 of the plate 8 may comprise ascending guiding surfaces 29 and second ends 10c" of the projecting parts 10c facing to the outer edge 20 of the plate 8 may comprise descending guiding surfaces 30.

[0057] The mutual distance between the projecting parts 10c in the circumferential direction of the rotor plate 8, i.e. a width W_{24} of an open area 24 or a groove 24 that is between the projecting parts 10c is selected to be at least about twice of a width W_c of the projecting parts 10c, whereby the clogging of the third zone 18 may be avoided. In the embodiment of Figure 3 the mutual distance between the neighbouring projecting parts 10c is substantially constant along the longitudinal extension of the projecting parts 10c. Furthermore the upper surfaces 10c'" of the projecting parts 10c are preferably machined to comprise a flat profile so as to allow accurate control of the size of the dispersing chamber 13 at least at the refining zone 18. The corresponding projecting parts in the disperser plate for the stator may be positioned in an oblique position that may be a mirror image of that shown in Figure 3 relative to the radial direction RD.

[0058] The rotor plate 8 of Figure 3 further comprises between the projecting parts 10c dams 25 which are arranged to interrupt the grooves 24 and to force the pulp flowing in the grooves 24 to rise up towards the upper surfaces 10c'" of the projecting parts 10c and towards the dispersing chamber 13. As can be seen in Figure 3, the dams 25 are not exactly at a crosswise or perpendicular position relative to the projecting parts 10c but at a position somewhat deviating from the crosswise or perpendicular position relative to the direction of the projecting parts 10c.

[0059] The rotor plate 8 of Figure 3 further comprises the second zone 17, i.e. the mixing zone 17, that is between the feed zone 16 and the refining zone 18. The mixing zone 17 extends from the beginning of the descending guiding surfaces 27 at the second end 10a" of the projecting parts 10a up to the end of the ascending guiding surfaces 29 at the first end 10c' of the projecting parts 10c. An intermixing of the pulp to be dispersed becomes more intensive when a height of the projecting parts 10a starts to decrease and, correspondingly, the intermixing of the pulp becomes weaker when the height of the projecting parts 10c starts to increase.

[0060] An equalization groove 31 may be formed between a group of at least two projecting parts 10a in the inner zone 16 and a group of at least three projecting parts 10c in the outer zone 18. At the equalization groove 31 the second ends 10a" of the projecting parts 10a or their imaginary extensions towards the outer edge 20 of the disperser plate 8 are interlaced with the first ends 10c' of the projecting parts 10c or their imaginary extensions towards the inner edge 19 of the rotor plate 8. At the equalization groove 31 a width of the groove 23 between the projecting parts 10a corresponds at least a width of the projecting part 10c and a width of the groove 24 between the projecting parts 10c corresponds at least a width of the projecting part 10a. Furthermore, at the equalization groove 31 the second ends 10a" of the projecting parts 10a has a guiding surface 27 declining towards the outer edge 20 of the rotor plate 8 from the upper surfaces 10a'" of the projecting parts 10a substantially up to the bottom level of the grooves 24, and the first ends 10c' of the projecting parts 10c has a guiding surface 29 ascending towards the outer edge 20 of the plate 8 from the bottom level of the grooves 24 up to the upper surfaces 10c'" of the projecting parts 10c.

[0061] The equalization groove 31 is configured to buffer at the mixing zone 17 the flow of the pulp to be dispersed from the feed zone 16 and the grooves 23 therein and further to distribute the flow of the pulp to be dispersed to the refining zone 18 and into one or more grooves 24 therein.

[0062] According to an embodiment at least some of the elongated projecting parts 5a, 5b, 10a, 10b may be set to a tilted position in the disperser plate 3, 8 for the stator 2 and/or the rotor 7, as shown in the examples of Figures 4a, 4b as seen to the first end 10a' of the projecting part 10a in the rotor plate 8. In this embodiment, shown schematically in Figures 4a and 4b, an upper portion of the projecting part 10a is arranged to extend farther towards the intended rotation direction R relative to a bottom portion of the projecting part 10a (Fig. 4a), or farther towards the direction that is opposite to the intended rotation direction R relative to the bottom portion of the projecting part 10a (Fig. 4b). The embodiment of Figure 4a may be used to reduce the mixing of the pulp by preventing the pulp to move towards the dispersing chamber 13 and the embodiment of Figure 4b may be used to enhance the mixing of the pulp by directing the pulp to move more effectively towards the dispersing chamber 13.

[0063] It will be obvious to a person skilled in the art that, as the technology advances, the inventive concept can be implemented in various ways. The invention and its embodiments are not limited to the examples described above but may vary within the scope of the claims.

Claims

1. A disperser plate (3, 8) for a disperser (1) for dispersing pulp, the disperser plate (3, 8) comprising, in a radial direction (RD) thereof, an inner edge (19)

to be directed towards a feed of the pulp to be dispersed and an outer edge (20) to be directed away from the feed of the pulp to be dispersed, **characterized in that**
the disperser plate (3, 8) comprises, in the radial direction (RD) thereof, a feed zone (16), a mixing zone (17) and a refining zone (18), wherein
the feed zone (16) comprises elongated projecting parts (5a, 10a) extending in a non-radial direction relative to the radial direction (RD) of the disperser plate (3, 8) and cavities (23) extending between the elongated projecting parts (5a, 10a),
the refining zone (18) comprises elongated projecting parts (5c, 10c) extending in a non-radial direction relative to the radial direction (RD) of the disperser plate (3, 8) and cavities (24) extending between the elongated projecting parts (5c, 10c) in the refining zone (18), a width (W_{24}) of the cavities (24) in the refining zone (18) being at least about twice of the width of the elongated projecting parts (5c, 10c), and wherein
the refining zone (18) further comprises dams (25) extending between at least some neighbouring elongated projecting parts (5c, 10c) in a position deviating from a perpendicular position relative to the direction of the extension of the elongated projecting parts (5c, 10c).

2. A disperser plate as claimed in claim 1, **characterized in that**
the disperser plate (3, 8) is a cast plate and at least upper surfaces (5c"', 10c"') of the elongated projecting parts (5c, 10c) in the refining zone (18) are flat machined surfaces.

3. A disperser plate as claimed in claim 1 or 2, **characterized in that** the projecting parts (5a, 10a) in the feed zone (16) deviate from the radial direction (RD) 15 to 45 degrees and the projecting parts (5c, 10c) in the refining zone (18) deviate from the radial direction (RD) at least 5 degrees but not more than the projecting parts (5a, 10a) in the feed zone (16).

4. A disperser plate as claimed in any one of the preceding claims, **characterized in that** the elongated projecting parts (5a, 10a) in the feed zone (16) are arranged in the non-radial direction relative to the radial direction (RD) of the disperser plate (3, 8) promoting the flow of the pulp towards the outer edge (20) of the disperser plate (3, 8).

5. A disperser plate as claimed in any one of the preceding claims, **characterized in that**
the mixing zone (17) is arranged to extend, in the radial direction RD of the disperser plate (3, 8), from a break point of the upper surface (5a'", 10a'") of the projecting part (5a, 10a) in the feed zone (16) up to a starting point of the upper surface (5b"', 5c'", 10b"', 10c'") of the projecting part (5b, 5c, 10b, 10c) following the elongated projecting part (5a, 10a) locating in the feed zone (16).

6. A disperser plate as claimed in any one of the preceding claims, **characterized in that**
the mixing zone (17) comprises pyramidal shaped projecting parts (5b, 10b) arranged in a number of concentric circularly extending rows at different radial distances in the disperser plate (3, 8), whereby there are concentric circularly extending open areas (6, 11) which are between the circularly extending rows of the projecting parts (5b, 10b).

7. A disperser plate as claimed in any one of the preceding claims, **characterized in that**
the elongated projecting parts (5a, 10a) in the feed zone (16) comprises second ends (10a") facing to the outer edge (20) of the disperser plate (3, 8), the second ends (10a") of the elongated projecting parts (5a, 10a) in the feed zone (16) comprising guiding surfaces (27) descending towards the outer edge (20) of the disperser plate element (3, 8), and that
the elongated projecting parts (5c, 10c) in the refining zone (18) comprises first ends (10c') facing to the inner edge (19) of the disperser plate (3, 8), the first ends (10c') of the elongated projecting parts (5c, 10c) in the refining zone (18) comprising guiding surfaces (29) ascending towards the outer edge (20) of the disperser plate (3, 8), and that
the mixing zone (17) extends from the beginning of the descending guiding surfaces (27) at the second end (10a") of the projecting parts (5a, 10a) in the feed zone (16) up to the end of the ascending guiding surfaces (29) at the first end (10c') of the projecting parts (5c, 10c) in the refining zone (18).

8. A disperser plate element as claimed in any one of the preceding claims, **characterized in that**
the disperser plate (3, 8) comprises at least one equalization groove (31) preceding the refining zone (18) in the radial direction of the disperser plate (3, 8) and configured to buffer and equalize the flow of the pulp before entering the refining zone (18).

9. A disperser plate element as claimed in any one of the preceding claims, **characterized in that**
at least some of the elongated projecting parts (5a, 5c, 10a, 10c) are set to a tilted position.

10. A disperser plate as claimed in any one of the preceding claims, **characterized in that**
the disperser plate element (3, 8) is a pie-shaped plate segment.

11. A disperser (1) for dispersing pulp, the disperser (1) comprising at least two oppositely positioned disperser discs (2, 7) at least one (7) of the disperser discs arranged to be rotated relative to the at least one other (2) disperser disc, each disperser disc (2, 7) comprising a dispersing surface (2', 7') provided by at least one disperser plate (3, 8) attached to the disperser disc (2, 7), **characterized in that** the at least one disperser plate (3, 8) is the disperser plate as claimed in any one of claims 1 to 10.

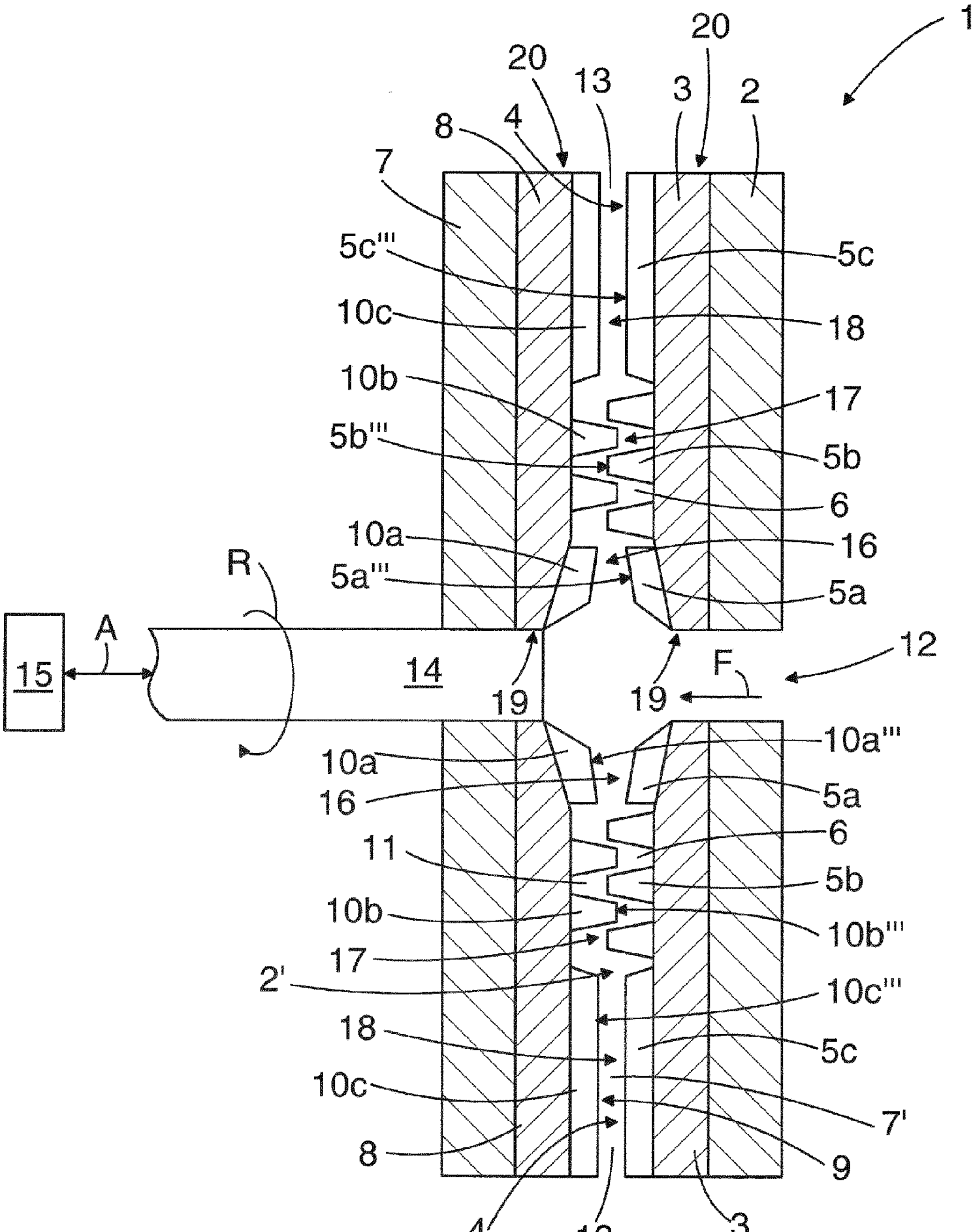

FIG. 1

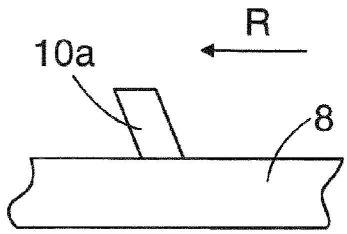

FIG. 4a

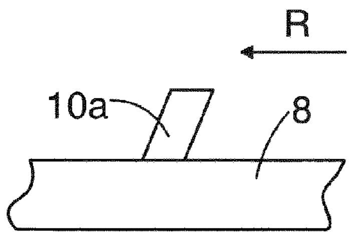

FIG. 4b

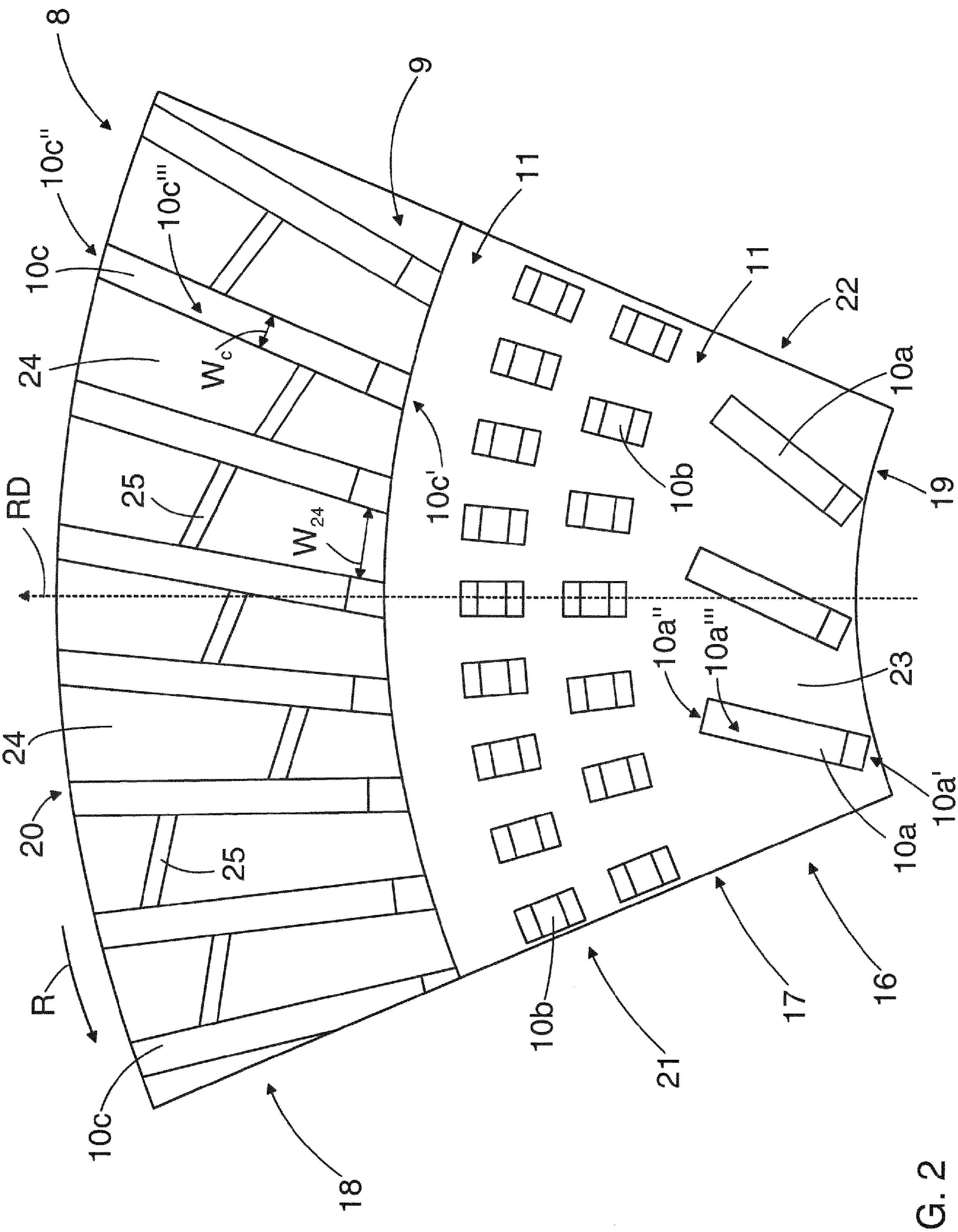
8
9
11
11
22
10a
19
10c''
10c'''
10c
24
W_c
10c'
10b
RD
25
W_{24}
10a''
10a'''
23
24
20
25
10a'
10a
R
10c
10b
21
17
16
18

FIG. 2

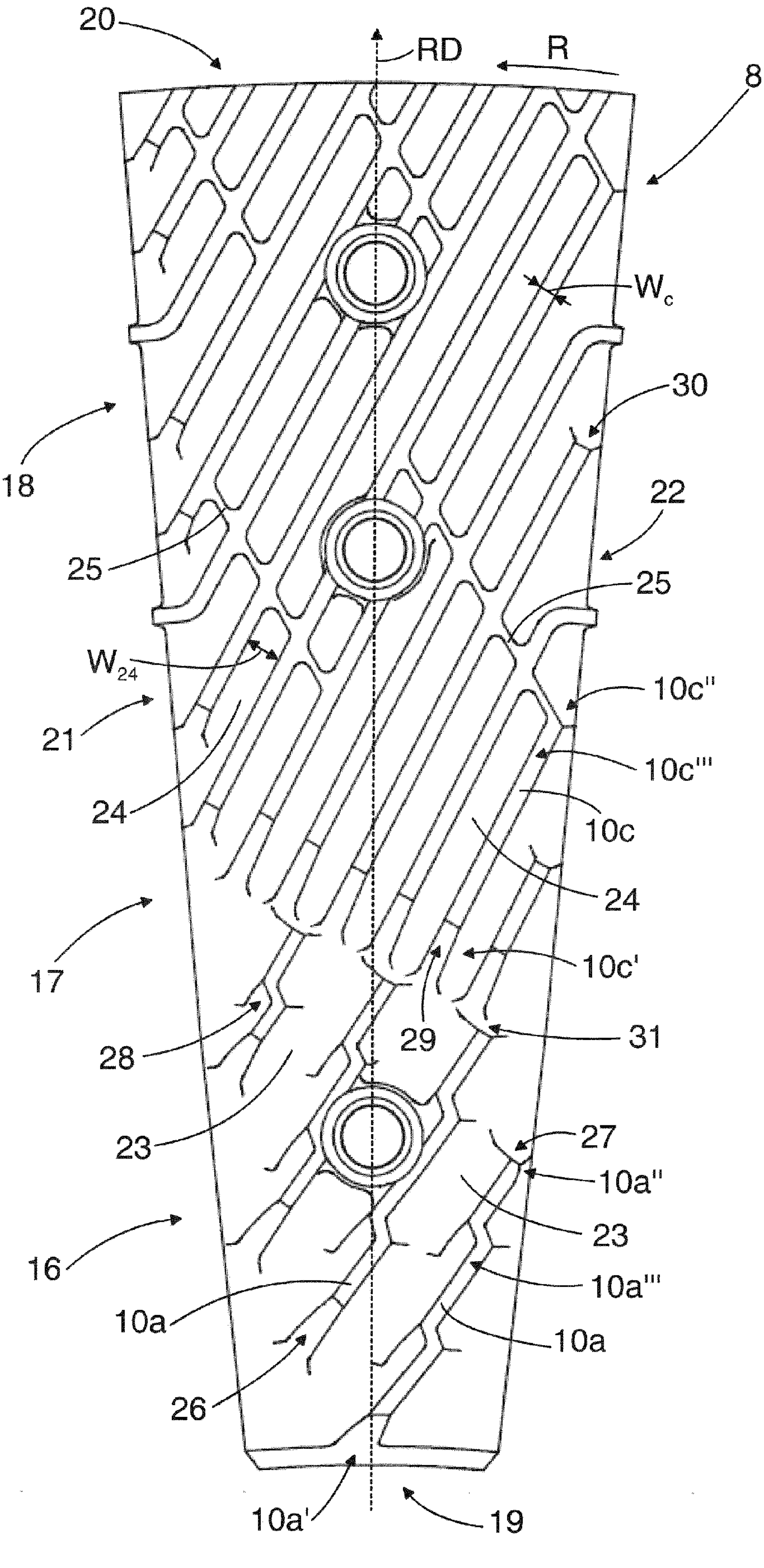
20
RD
R
8
W_c
30
18
22
25
25
W_{24}
10c''
21
10c'''
24
10c
24
17
10c'
28
29
31
23
27
10a''
16
23
10a'''
10a
10a
26
10a'
19

FIG. 3

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EUROPEAN SEARCH REPORT

Application Number
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The present search report has been drawn up for all claims

3

Place of search	Date of completion of the search	Examiner
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