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(54) disperser plate with grooved teeth

(57) A disperser plate segment for removing contaminants from fiber stock, the segment comprising: radially inner and outer edges, multiple radially concentric rows of teeth, each row of teeth having multiple teeth defining multiple channels disposed intermediate the teeth, each of the channels having a lower channel base surface and each of the teeth having a top surface, at least one face surface extending from the channel base surface to the top surface, and wherein at least one of the face surfaces comprises at least two grooves.

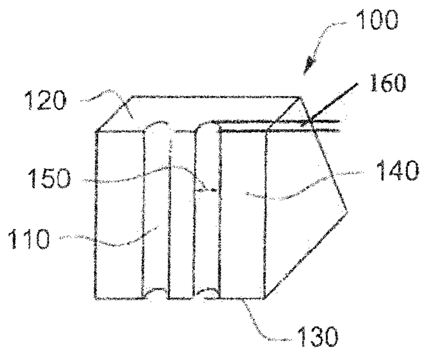

Fig. 2

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Description

TECHNICAL FIELD

[0001] This disclosure relates to disperser plate segments.

BACKGROUND OF THE INVENTION

[0002] Recovered paper and packaging materials are known as "fiber stock" to those skilled in the art. Fiber stock is generally subjected to several processes designed to remove ink and toner in the case of copy paper. Contaminants such as plastics generally referred to as "stickies" by those skilled in the art. The removal processes are not completely efficient and the residual ink, toner, and stickies are typically dispersed to avoid the stickies adhering to parts of the paper machine, which can cause holes or weak spots in new paper. The agglomeration and accumulation of stickies on the paper machine can cause idle time thereby increasing the cost of the manufacturing process itself. Residual ink particles typically appear as specs in the reconstituted paper, which can lower its value considerably.

[0003] A machine called a disperser (or a disperger) can be used to reduce the size of the ink and stickie particles so that in subsequent paper machine operations, paper qualities may be minimally impacted. Disperser machines generally have two circular discs facing each other. One disc, generally referred to as a rotor, can be rotated while the other disc, generally referred to as a stator, is generally stationary. Conical machines can also be used where a rotor cone can move while a stator cone generally remains stationary.

[0004] On the faces of the discs or cones may be mounted plate segments having pyramids or teeth mounted in tangential rows. The rows are at radii generally chosen to allow the rotor and stator teeth to intersect a plane between the discs or cones so that the fiber passing from the center of the stator to the periphery of the discs or cones generally receives impacts from the rotor teeth as they pass close to the stator teeth. The clearance between rotor and stator teeth is on the order of about 1 to about 12 mm so that the fibers are generally not cut but rather are typically severely and alternately flexed. This action usually breaks the ink and toner particles into smaller particles and also breaks down the stickie particles. It is also generally thought that the fresh smaller sticky surfaces collect fine fiber particles and may be further passivated as smaller particles. Increasing the number of flexures the fibers experience has generally been shown to improve the unwanted particle reduction process. Adding more teeth generally improves the efficiency of the dispersion process but the size of the teeth that can be manufactured at reasonable costs limits this number. A conventional disperser plate is described in US 7,172,148 where a single groove extends from the tooth top surface to a point intermediate the top surface and the channel base surface.

[0005] For conical dispersers, where the cones contain the pyramids or teeth, the same action usually occurs and the designs of the teeth are substantially the same as those for flat discs.

SUMMARY OF THE INVENTION

[0006] The efficiency of dispersion may be improved and the amount of ink, toner, and stickies entering a paper-making machine may be reduced by increasing the number of edges that contact the fiber stock. By configuring grooves into one or more sides of the teeth, the amount of contact edges may be increased while substantially maintaining the structural integrity of the teeth. The plane defined by sides of the teeth may be known as "face surfaces" throughout this disclosure.

[0007] A disperser plate segment for removing contaminants from fiber stock, the segment comprising: radially inner and radially outer edges, multiple radially concentric rows of teeth, each row of teeth having multiple teeth defining multiple channels disposed intermediate the teeth, each of the channels having a lower channel base surface and each of the teeth comprising: an top surface, at least one face surface extending from the channel base surface to the top surface, and wherein at least one of the face surfaces comprises at least two grooves.

[0008] At least one tooth may have multiple grooves on at least one of its surfaces. The additional grooves to the faces surfaces of the tooth may help to increase circumferential friction applied to the material in between the intermeshing row of teeth thereby improving separation of the contaminants from the desired material. By using a groove angled relative to the vertical axis of the face of the tooth surface, the angled groove may help to redirect material along the axis of the height of the teeth, as the teeth move material vertically between the channel base surface and the tooth top surface.

[0009] The inner and outer surfaces of each tooth may extend at an acute angle from the channel base surface to the top surface, such that the tooth may have a truncated pyramid shape. With multi-grooved teeth, a segment of the top surface may separate the inner face and outer face surface grooves from each other when the grooves extend to the top surface of the tooth. Additionally, for multi-grooved teeth, a segment of the top surface may separate the grooves along a face surface; this face surface may be an inner face surface or outer face surface. In some example embodiments, the face surface may be the side surfaces of the teeth that define a channel between two teeth.

[0010] In some exemplary embodiments, the grooves on the inner face surface and outer face surface may be tapered. For example, for at least one of the grooves, the width of the groove may taper outward on the face surface from the top surface toward the channel base surface. In another example embodiment, the depth of the groove may taper from the face surface into or inward to the tooth mass as the groove extends from the top surface toward the channel base surface. In example embodiments involving a tapered groove, a segment of the top surface may separates the inner face and outer face surface grooves from each other.

[0011] In some embodiments the width of at least one of the grooves may change along its length. For example, at least one of the grooves may taper outwardly on the tooth face surface. In other exemplary embodiments, the depth of at least one of the grooves may change along its length. For example, the depth of at least one of the grooves may taper inward into the tooth face surface as the groove extends across the tooth face surface toward the channel base surface. In some exemplary embodiments, the grooves may not connect with each other through the teeth. In other exemplary embodiments, it is possible to have at least two of the grooves connect.

[0012] Each of the teeth may also have oppositely disposed leading and trailing edges. The grooves of the inner face surface of each tooth and the grooves of the outer face surface of each tooth may define additional leading edges and additional trailing edges.

[0013] In an exemplary embodiment of this disclosure, multiple grooves on the inner face or outer face surfaces of the teeth may extend the substantially similar lengths between the top surface and the channel base surface, that is from the top surface to a point intermediate the top surface and the channels base surface.

[0014] In another example embodiment of this disclosure, multiple grooves on the inner face surface or outer face surface of the teeth may extend the same lengths between the top surface and the channel base surface; for example, at least one of the grooves may extend from the tooth top surface to or substantially to the channel base surface.

[0015] In another example embodiment of the disclosure, multiple grooves on the inner face surface or outer face surface of the teeth may extend different lengths between the top surface and the channel base surface. For example, one or more grooves may extend from the top surface to the channel base surface, and one or more grooves may extend from the top surface to a groove lower most end point intermediate the top surface and the channel base surface, and one or more groves may extend from the channel base surface upward toward-but not to-the top surface, and one or more grooves can extend from below the top surface to a point intermediate the channel base surface.

[0016] In yet another embodiment, widths of the individual grooves on the inner face surface or outer face surface of teeth may vary. The widths of the individual grooves on the inner face surface or outer face surface may also vary among any individual tooth. For example, one groove may have a wider width than the remaining grooves on the face surface of the tooth. The lengths of each of the grooves, whether wide or narrow may be any of the previously identified lengths, e.g. the entire length from the top surface to the channel base surface or the length from the top surface to a point intermediate the top surface and the channel base surface or the length from the channel base surface to a point below the top surface. Moreover, one or more grooves can extend from below the top surface to a point intermediate the channel base surface.

[0017] In still another embodiment of the disclosure, the multiple tapered grooves of varying lengths (as described previously) may exist on the inner face surface or the outer face surface of the teeth.

[0018] In another embodiment of the disclosure, the grooves on the inner face surface or outer face surface may be angled relative to the vertical axis of the face of the tooth surface and each groove may be the same length or may be different lengths. The angled grooves may be the same width or different widths and may have tapering. Both the width and depth of the groove may be tapered. Conversely, either the width or depth of the groove may be tapered. The angle of the grooves may be about 5 degrees to about 60 degrees.

[0019] A disperser plate segment for removing contaminants from fiber stock has been conceived, the segment comprising: radially inner and outer edges and multiple of radially concentric rows of teeth; each row of teeth having multiple teeth defining multiple channels disposed intermediate the teeth; each of the channels having a lower channel base surface and each of the teeth comprising: a top surface, at least one face surface extending from the channel base surface to the top surface, the at least one face surface defining at least two grooves at an angle θ relative to the vertical axis of the face surface.

[0020] It is also possible to have the inner face surface with one embodiment of the disclosure and the outer face surface with a different embodiment or both the inner face and outer face surfaces may use the same embodiment of the disclosure. In yet another embodiment, any combination of previously described grooves on any of the surfaces of the teeth may be used.

[0021] A disperser plate comprising: multiple radially concentric rows of teeth, wherein each row may be configured to mesh between rows of teeth on an opposing plate; adjacent teeth of the radially concentric rows defining channels between the adjacent teeth, wherein the channels each are aligned with a respective row of teeth on the opposing plate, and multiple grooves on a face surface of each of the teeth in at least one of the concentric rows.

[0022] Additionally, the disperser plate may be segmented into disperser plate segments. In some embodiments, the disperser plate may have the teeth in at least one of the concentric rows each having an upper surface and the grooves extend from one of the channels to the top surface of the respective tooth. In at least some of the embodiments of the disperser plate, the depth of at least one of the grooves on each of the teeth may vary along the length of the groove. In some embodiments, the groove extends only partially along the height of the tooth and the grooves may be parallel. In other embodiments the grooves are oblique to a plane of rotation of the disperser plate. In at least some embodiments, the width of at least one of the grooves on each tooth differs from the width of another one of the grooves on the tooth.

BRIEF DESCRIPTION OF THE DRAWINGS

[0023] The foregoing will be apparent from the following more particular description of example embodiments of the disclosure, as illustrated in the accompanying drawings in which like reference characters refer to the same parts throughout the different views. The drawings are not necessarily to scale, with emphasis instead being placed upon illustrating embodiments of the disclosed device.

FIGS. 1a, 1b, and 1c show a conventional disperser with plate segments.

FIG. 2 shows an exemplary face view of a tooth with multiple grooves of similar length and width.

FIG. 3 shows an exemplary face view of a tooth with multiple grooves having differing lengths.

FIG. 4 shows an exemplary face view of a tooth with multiple grooves having differing widths.

FIG. 5 shows an exemplary face view of a tooth having a groove with a tapered width.

FIG. 6 shows an exemplary face view of a tooth having a groove with a tapered depth.

FIG. 7 shows an exemplary top view of the tooth having an asymmetrical shape to the depth tapering.

FIG. 8 is the mirror image of FIG. 6.

FIG. 9 shows an exemplary top view of the tooth with multiple grooves having different shapes.

FIG. 10 shows an exemplary face view of a tooth with angled grooves.

DETAILED DESCRIPTION OF THE INVENTION

[0024] Increasing the number of contact edges available for the material may improve the breaking down of the contaminants and stickies in the fiber stock and may improve the efficiency of a disperser machine.

[0025] A disperser plate segment according to any of the embodiments of the disclosure has at least one of the teeth of the inner face surface or outer face surface comprising at least two grooves. The teeth with at least two grooves can be any combination of groove lengths, groove widths, groove shape, tapered width grooves, tapered depth grooves, or angled grooves on the inner face surface or outer face surfaces.

[0026] Although the grooves are depicted as ovular, cylindrical, or conical in the figures, the grooves may have triangular, pyramidal, or quadrilateral shapes in other embodiments.

[0027] FIGS. 1a, 1b, and 1c show a conventional plate segment **10** for a disperser. In FIG. 1a, the conventional plate segment **10** is a stator plate segment **15.** Each conventional plate segment **10** is typically a molded metal piece formed as a pie-shape, such as an annularly truncated wedge-shape, having a generally planar substrate. However, the conventional plate segment **10** may be circular or semi-circular and the substrate may be conical or partially conical. Each conventional plate segment **10** has an inner edge **22** towards the common center axis **19** of the disc to which the conventional plate segment **10** may be attached (disc not shown). Each conventional plate segment 10 also has an outer edge **24** near the periphery of the disc to which the conventional plate segment **10** may be attached (disc not shown). Each conventional plate segment **10** has concentric rows **26** of teeth **28.** People skilled in the art may refer to the teeth **28** as pyramids. The concentric rows **26** of teeth **28** are each at a common radial distance (see radii **32)** from the common center axis **19.**

[0028] FIG. 1b is a cross-sectional view of one of the stator plate segment **15.** As the fiber stock (not shown) contacts the stator plate segment **15** near the inner edge **22** of the stator plate segment **15,** the fibrous material may flow over concentric rows **26** of teeth **28** towards the outer edge **24** of the stator plate segment **15.**

[0029] FIG. 1c is a cross-sectional view of a rotor disc **12** and a stator disc **13** arranged opposite to each other. The stator disc **13** has an annular array of the stator plate segments **15** and a rotor disc **12** has an annular array of rotor plate segments **14.**

[0030] The teeth **28** on rotor plate segments **14** intermesh with the rows of teeth on the array of stator plate segments **15,** as is shown in FIG. 1c. The intermeshing teeth **28** intersect a radially extending plane in the gap **30** between rotor disc **12** and stator disc **13.**

[0031] The array of rotor plate segments **14** on the rotor disc **12** and the array of stator plate segments **15** on the stator disc **13** generally rotate about a common center axis **19.**

[0032] As the rotor disc **12** rotates, fiber stock (not shown) generally moves through the serpentine gap **30** between the arrays of stator plate segments **15** and rotor plate segments **14** as a pad of fiber material. The flexing and bending of the fiber stock as the pad moves over and between the teeth **28** dislodges stickies from fibers in the fiber stock.

[0033] The rotation of the rotor disc **12** and the rotor plate segments **14** apply a centrifugal force that moves the fiber stock straight through the gap **30** between the opposing arrays of plate segments. As the fiber stock moves radially beyond the outer edges **24** of the rotor plate segments **14** and stator plate segments **15,** the fiber stock enters a casing **31** of the disperser.

[0034] For similar elements, similar reference numbers are used for the remaining figures. FIG. 2 shows a face surface **140** of a tooth **100** having grooves **110** of substantially the same length. The grooves **110** can extend from the top surface **120** of the tooth **100** to the channel base surface **130** The width **150** and depth **160** of each groove **110** may be similar or substantially the same.

[0035] FIG. 3 shows a face surface **240** of a tooth **200** having grooves **210** of differing lengths. The grooves **210** may extend from the top surface **220** to the channel base surface **230** or from the top surface **220** to a point **255** intermediate the top surface **220** and the channel base surface **230** or from the channel base surface **230** to a point below the top surface **220,** or one or more grooves **210** can extend from below the top surface **220** to a point intermediate the channel base surface **230,** or any combination with at least one of the grooves **210** being a different length from the other grooves **210,** with the width **250** and depth of all grooves **210** being the same or substantially the same.

[0036] FIG. 4 shows face surface **340** of a tooth **300** having grooves **310** of the same lengths. In other embodiments, the lengths of the grooves may be different. The grooves **310** may extend from the top surface **320** to the channel base surface **330** or from the top surface **320** to a point intermediate the top surface and the channel base surface **330** or from the channel base surface **330** to a point below the top surface **320,** or one or more grooves **310** can extend from below the top surface **320** to a point intermediate the channel base surface **330,** or any combination with at least one of the grooves being a different length from the other groove or grooves **310,** with at least one of the grooves **310** being a different width **350** from the other groove or grooves **310.** The depth **360** of the groove **310** into the tooth **300** may vary, e.g., linearly, in a direction towards the top of the tooth or in an opposite direction. Further, the depth **360** of the grooves **310** may vary from groove **310** to groove **310** on the same tooth **300.**

[0037] FIG. 5 shows face surface **440** of a tooth **400** having a single groove **410.** Groove **410** may have a width **450,** which tapers from narrowest point at or near the top surface **420** and widest at or near the channel base surface **430.** There may be grooves **410** that have widths **450** tapering along the face surface **440,** while the depth **460** and lengths of the grooves **410** may remain constant or the depths **460** of the grooves may remain constant while the lengths of the grooves may vary.

[0038] FIG. 6 shows face surface **540** of a tooth **500** having a single groove **510.** Groove **510** has a first depth **560** which tapers from the top surface **520** to a second depth **570** at the lowest point of the groove **510.** The first depth **560** may be measured as the distance between the face surface **540** and the top internal backside **580** of the groove **510** at the top surface **520.** The lowest point of the groove **510** may be the point closest to the channel base surface **530.** The second depth **570** may be measured as the distance from the face surface **540** and the lowermost internal backside **590** of the groove **510.** The tapering of the groove **510** may increase from the first depth **560** to the second depth **570** and can be for example about 1 mm to about 10 mm, or possibly about 2 mm to about 10 mm, or possibly about 1 mm to about 3 mm, or possibly about 2 mm to about 5 mm and any dimension in between. There may be grooves **510** with varying tapered depths where the first depth **560** and the second depth **570** can be the same for each groove **510** or can be different for each groove **510.** In addition to having different depths in the grooves **510,** the depth of each groove **510** may taper. Further, the length of the grooves **510** on the face surface **540** may vary as the first depth **560** and second depth **570** varies. There may be a lowest most point of the groove **510** at or near the channel base surface **530** while the upper end of the groove **510** may be located at any point between the channel surface base **530** and the top surface **520,** or the groove **510** may extend from the top surface **520** to a point intermediate the channel base surface **530,** or have the groove **510** located along the face surface **540** but not extend to either the top surface **520** or the channel base surface **530** while having at least one groove **510** with a first depth **560** and a second depth **570.** While not shown in FIG. 6, the depth of the groove may be greater in the top of a tooth **500** as compared to bottom of the tooth **500.**

[0039] FIGs. 5 and 6 depict exemplary groove embodiments that may be used on the claimed disperser plate segments. It should be noted that the claimed disperser plate segments would also feature at least one additional groove on the same face surface as the grooves depicted in FIGs. 5 and 6.

[0040] FIG. 7 shows a top view of a tooth **600** having an asymmetrical shape to the depth tapering. On the left side **612** of the opening **621,** the angle from the face surface **640** to the innermost point of the groove **655** may be shallow and sharp such as less than about 90 degrees. On the right side **613,** the angle from the face surface **640** to the innermost point of the groove **655** may be about 90 degrees. In some embodiments, the angles from the front surface **640** to the innermost point of the groove **655** may by symmetrical. In other embodiments, the angles from the front surface **640** to the innermost point of the groove **655** may be asymmetrical.

[0041] FIG. 8 shows a top view of a tooth **700** having an asymmetrical shape to the depth tapering a mirror image of FIG. 7. On the right side **712** of the opening **721,** the angle from the face surface **740** to the innermost point of the groove **755** may be shallow and sharp, such as less than about 90 degrees. On the left side **713,** the angle from the face surface **740** to the innermost point of the groove **755** may be about 90 degrees. In some embodiments, the angles from the front surface **740** to the innermost point of the groove **755** may by symmetrical. In other embodiments, the angles from the front surface **740** to the innermost point of the groove **755** may be asymmetrical.

[0042] FIG. 9 shows a top view of a tooth **800** when multiple grooves are used and may be any combination of the shapes shown in FIGS. 7 and 8. As shown in FIG. 9, opening **821** has the shape of the opening **621** (from FIG. 7). On the first shallow side **818,** the angle from the face surface **840** to the innermost point of the groove **855** may be shallow and sharp such as less than about 90 degrees. On the sharp side **813,** the angle from the face surface **840** to the innermost point of the groove **855** may be about 90 degrees. Opening **822** has the shape of opening **721** (from FIG. 8). On the second shallow side **812,** the angle from the face surface **840** to the innermost point of the groove **855** may be shallow and sharp such as less than about 90 degrees. On the sharp side **813,** the angle from the face surface **840** to the innermost point of the groove **855** may be about 90 degrees. In other embodiments, grooves using at least one of the configurations from FIGS. 7 or 8 may be used for at least one of the teeth.

[0043] FIG. 10 shows face surface **940** of a tooth **900** having a top surface **920,** a channel base surface **930,** and grooves **910.** The grooves **910** are positioned at an angle θ of between about 5 degrees and about 60 degrees. In other example embodiments, angle θ may be between about 10 degrees and about 60 degrees, or possibly about 30 degrees and about 60 degrees relative to the vertical axis of the face surface **940** of the tooth**900**. In some example embodiments, the angle θ may vary between at least one groove on the same tooth. In some example embodiments, the angle θ may vary among at least one groove on a different tooth on the disperser. The angle θ may allow edges of the grooves to engage fiber stock at different angles thereby increasing the number of edges that contact the fiber stock and altering the direction of the fiber stock in a manner that may improve dispersion. By contrast, the angle θ for conventional grooves in conventional disperser plate teeth is about zero degrees. Grooves **910** are shown as having differing lengths **965** and the same widths **950.** In some example embodiments, grooves **910** may also have the same depths (not shown). The grooves **910** may have differing widths **950** and the same lengths **965** and the same depths. In other example embodiments, the grooves **910** may have the same widths and differing heights. In another exemplary embodiment, the length of at least of the grooves may extend through the side face surface of at least one tooth. In some embodiments, the widths **950** of grooves **910** could taper from narrow to wide as grooves **910** move across the face surface **940.** In some embodiments, the depth may taper from shallow to deep as grooves **610** move across the face surface **940.** Combinations of the above embodiments are also possible.

[0044] While preferred embodiments have been shown and described, various modifications and substitutions may be made thereto without departing from the scope of the invention as defined by the claims. Accordingly, it is to be understood that the present invention has been described by way of illustration and not limitation.

Claims

1. A disperser plate segment for removing contaminants from fiber stock, the segment comprising:

radially inner and outer edges;
multiple radially concentric rows of teeth;
each row of teeth having multiple teeth defining multiple channels disposed intermediate the teeth;
each of the channels having a lower channel base surface and each of the teeth comprising:

a top surface,
at least one face surface extending from the channel base surface to the top surface; and

wherein at least one of the face surfaces comprises at least two grooves.

2. A disperser plate segment as in claim 1, wherein at least one of the grooves extends from the top surface of the respective tooth to or substantially to the lower channel base surface of a channel adjacent the tooth.

3. The disperser plate of claim 2, wherein the teeth in at least one of the radially concentric rows each have their grooves extend from one of the channels to the top surface of the respective tooth.

4. The disperser plate in any one of claims 1 to 3, wherein at least one of the grooves extends partially along a height of the respective tooth.

5. A disperser plate segment as in claim 4, wherein at least one of the grooves has an upper most end which is below the top surface of the respective tooth.

6. A disperser plate segment as in claim 4 or 5, wherein at least one of the grooves has a lower most end which is intermediate the top surface of the respective tooth and the lower channel base surface of a channel adjacent the tooth.

7. A disperser plate segment as in any one of the preceding claims, wherein at least one tooth has at least two grooves which are parallel with each other.

8. A disperser plate segment as in any one of the preceding claims, wherein at least two grooves in at least one of the face surfaces are defined at an angle θ relative to the vertical axis of the face surface, wherein the angle θ is preferably between about 5 degrees and about 60 degrees.

9. A disperser plate segment as claimed in any one of the preceding claims, wherein a length of at least one of the grooves on the face surface of at least one tooth differs from length of at least one other groove on the said face surface.

10. A disperser plate segment as claimed in any one of the preceding claims, wherein a width of at least one of the grooves on the face surface of at least one tooth differs from the width of at least one other groove on the said face surface.

11. A disperser plate segment as claimed in claim 10, wherein a width of at least one of the grooves on each tooth differs from a width of another one of the grooves on the tooth.

12. A disperser plate segment as claimed in any one of the preceding claims, wherein a width of at least one of the grooves varies along a length of the groove.

13. A disperser plate segment as claimed in any one of the preceding claims, wherein a depth of at least one of the grooves varies along a length of the groove

14. A disperser plate for removing contaminants from fiber stock, the plate comprising:

radially inner and outer edges;
multiple radially concentric rows of teeth;
each row of teeth having multiple teeth defining multiple channels disposed intermediate the teeth;
each of the channels having a lower channel base surface and each of the teeth comprising:

a top surface,
at least one face surface extending from the channel base surface to the top surface; and

wherein at least one of the face surfaces comprises at least two grooves.

15. A disperser plate as claimed in claim 14, wherein each of the multiple radially concentric rows of teeth is configured to mesh between rows of teeth on an opposing plate;
the channels each are configured so as to be aligned with a respective row of teeth on the opposing plate, and
each of the teeth in at least one of the concentric rows has multiple grooves on a face surface thereof.

16. The disperser plate in claim 14 or 15, wherein the grooves are oblique to a plane of rotation of the plate.

17. The disperser plate of any one of claims 14 to 16, wherein the disperser plate is segmented into plate segments.

18. The disperser plate of any one of claims 14 to 17, wherein the grooves are configured as in any one of claims 1 to 13.

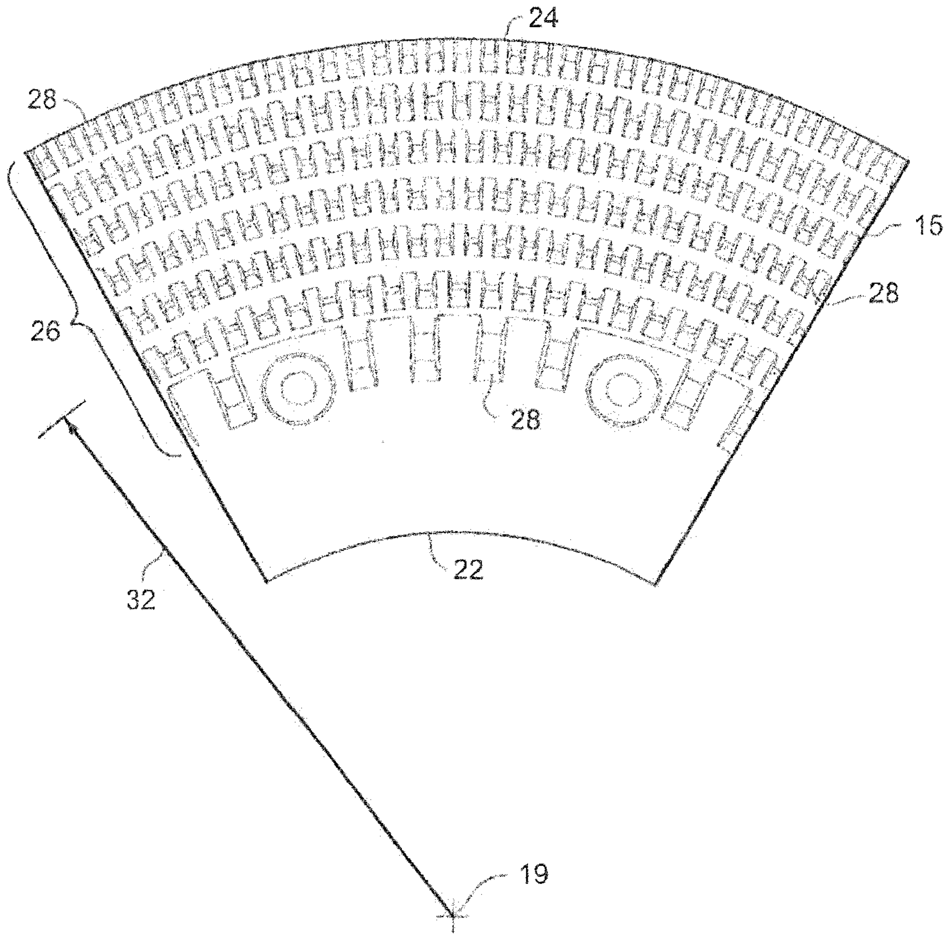

Fig. 1A
(PRIOR ART)

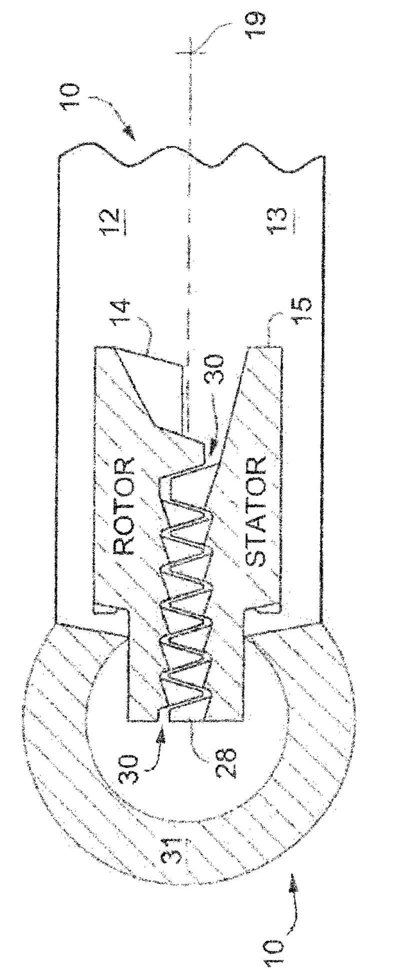

Fig. 1C
(PRIOR ART)

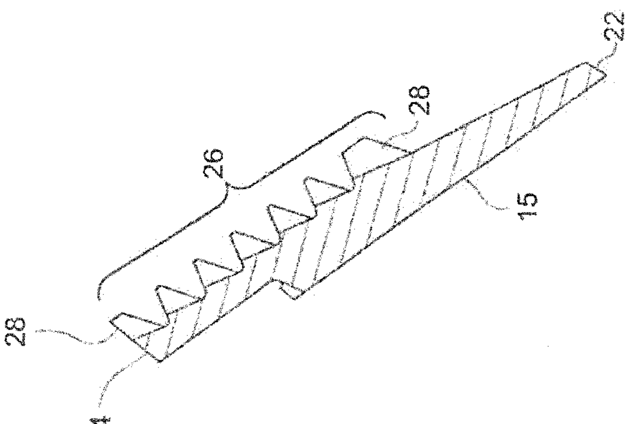

Fig. 1B
(PRIOR ART)

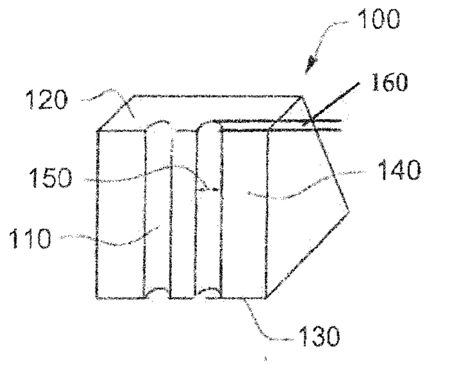

Fig. 2

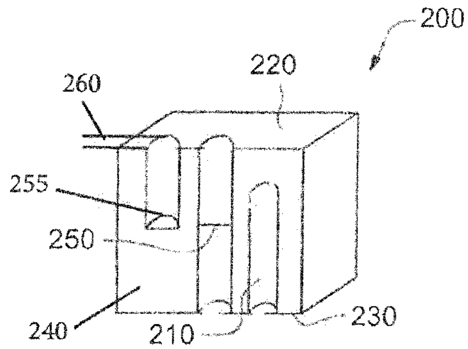

Fig. 3

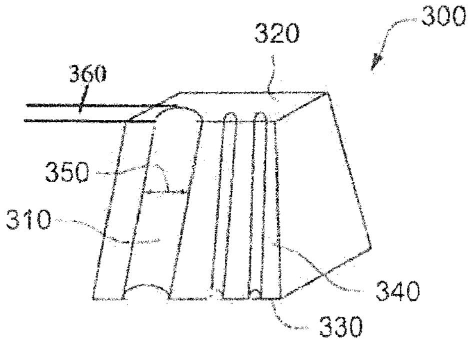

Fig. 4

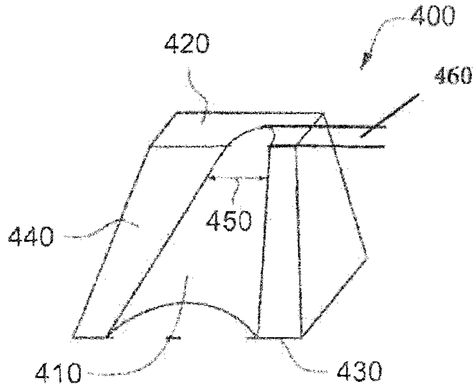

Fig. 5

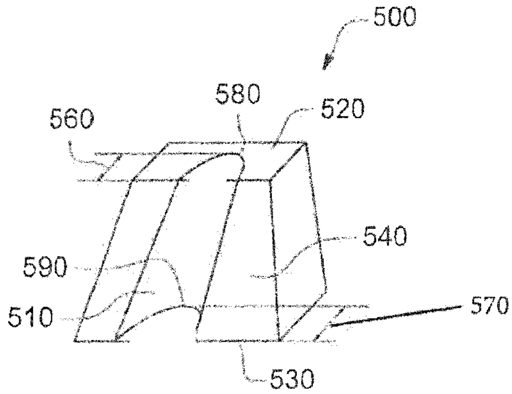

Fig. 6

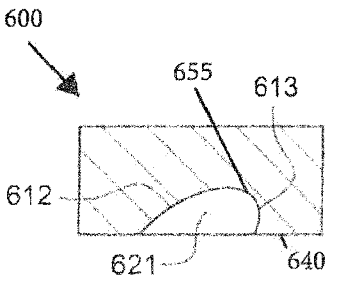

Fig. 7

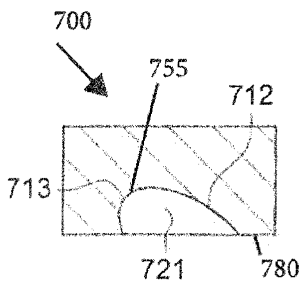

Fig. 8

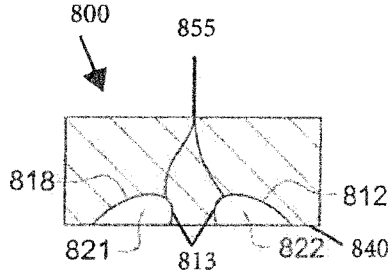

Fig. 9

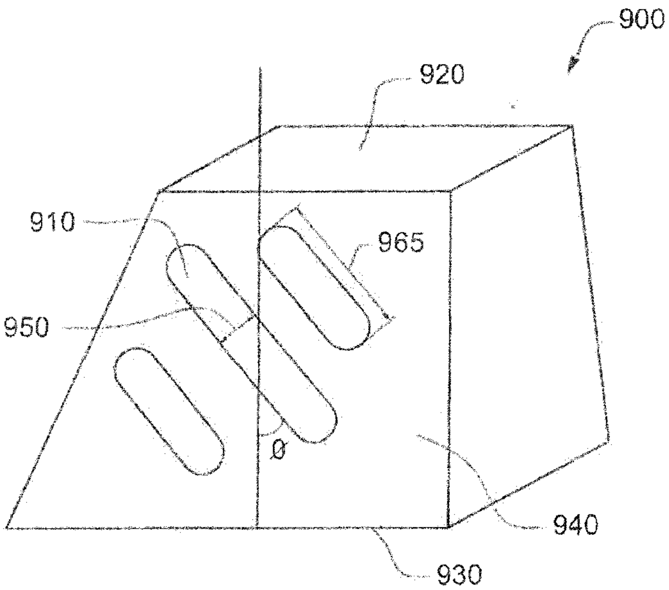

Fig. 10

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EUROPEAN SEARCH REPORT

Application Number
EP 13 19 9333

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The present search report has been drawn up for all claims

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Place of search	Date of completion of the search	Examiner
Munich	7 February 2014	Maisonnier, Claire

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