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(54) **DISC, SPACER AND TRANSPORTATION ASSEMBLY**

(57) A disc arranged for cooperating with a spacer for transporting materials on a feeding machine. The disc comprising a main body and a wear resistant portion. The main body has a centrally arranged opening defined around a central axis, wherein when looking from the direction of the central axis, the circumference of the main body has radius variation from the central axis. The wear resistant portion is arranged around the main body and comprises a first material. The main body comprises a second material, and the wear resistance of the first material is higher than that of the second material. The wear resistant portion comprises at least one protrusion projecting from the inner side of the wear resistant portion towards the main body, and the main body comprises at least one indentation to receive the protrusion.

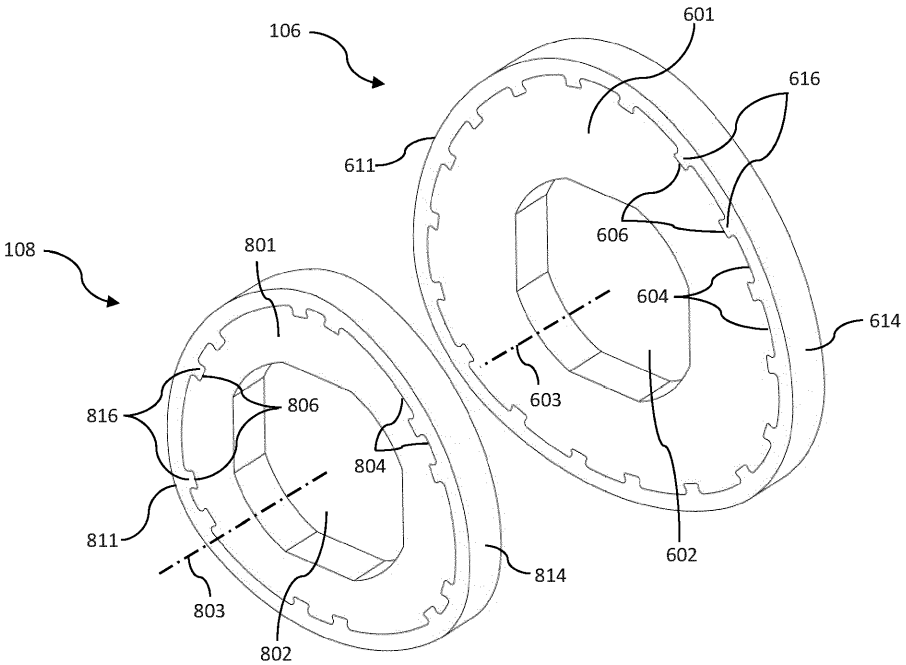

FIG. 2

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Description

Field of invention

[0001] The present invention relates to a disc, and a transportation assembly arranged for transporting materials on a feeding machine and in particular, although not exclusively, to a disc having wear resistant areas to contact the materials for transportation.

Background art

[0002] A feeding machine is a type of heavy machinery equipment for screening/sorting feed materials, e.g., coal. Roller screens and wobbler feeders are widely used heavy machines for feeding and screening. A transportation system of the feeding machine is highly exposed to the feed materials, because the transportation system contacts the feed materials and transports the materials in a rotating way. Such machines are known from patent publications US20140202933, WO9420227A1, FR2494140, JP4402218 and EP0861696.

[0003] In the U.S. patent publication US20140202933, a sorting screen comprising a row of rotatable, driven shafts mutually spaced in a conveying direction is described. Each of the shaft carries a row of radially extending rotor bodies for intermittently urging material on the sorting screen upward and in a conveying direction. The rotor bodies of each of the rows are mutually spaced in a longitudinal direction of the respective shaft by spacers, and each spacer is a tubular spacer and each rotor body is provided with a number of projections retaining a respective end face of a respective tubular spacer. In the International patent publication WO9420227A1, a roller screen with a plurality of parallel shafts, each having a plurality of circular discs that are separated by spacers is described. The discs are eccentrically mounted on the respective shafts, and the discs on each shaft have an eccentricity that is circumferentially offset from disc to disc. The spacers are made of rubber and are concentric with respective shafts. Since discs and the spacers are wear parts, after having been used for a certain period of time, wore out discs or spacers need to be replaced with a new one. In the French patent publication FR2494140A1, a screening transport gate is disclosed with rotating discs disposed one behind the other having convex contour formed from peripheral segments. The discs are further separated by an air gap, which remains substantially constant irrespective of the angular position of the discs. In the Japanese patent JP4405218B2, a roller type sieving apparatus is disclosed with integrally assembled wear resistant processed pieces exposed in the surface for contact, the pieces have L- or T-shaped extended parts for fixation and a plate-like shape and are preferably made of a cemented carbide or a hard ceramic. In the European patent publication EP0861696B 1, a disc sieve is disclosed with discs that has polygonal circumference with an even number of corners, on each second corner a stripping device is provided, and on the other second corner recesses are provided, into which there are inserted hard metal plate elements, so as to maintain the corner over a long service life.

[0004] As set forth above, after some operation time, worn out discs or spacers need to be replaced with new ones. Therefore, frequently worn-out pieces largely reduce cost efficiency of such feeding machines.

Summary of the Invention

[0005] It is an objective of the present invention to provide a disc that cooperates with a spacer for transporting materials on a feeding machine. The disc is wear-resistant against the feed materials and have increased wear resistant properties at the high wear zone. It is a further objective to provide a disc that is optimised to be an integrated piece, to particularly increase the service lifetime of the disc.

[0006] The objectives are achieved by providing a disc having a main body and a wear resistant portion arranged around the main body. The wear resistant portion comprises a material having higher wear resistance than the material of the main body, and the two materials are bonded together to form an integrated disc. Furthermore, the wear resistant portion comprises at least one protrusion projecting from the inner side of the wear resistant portion towards the main body, and the main body further comprises at least one indentation to receive the protrusion. Such a configuration optimises connection and casting of the wear resistant portion and the main body, and further improves the performance of the disc.

[0007] The objectives are further achieved by providing a transportation assembly for transportation of materials, the transportation assembly comprising a shaft and a plurality of discs and spacers, the discs and spacers being installed on the shaft wherein two adjacent discs are separated by at least one of the spacers. In particular, the spacer and the disc are arranged to cooperate to transport the feed materials on the transportation assembly. To be specific, a plurality of discs and a plurality of spacers are installed on each of a plurality of shafts in parallel on the transportation assembly, the discs and the spacers are further rotated together with the shafts being driven by a power unit, so as to roll the feed materials and further transport the material in a desired way.

[0008] According to a first aspect of the present invention there is provided a disc arranged for cooperating with a spacer for transporting materials on a feeding machine, the disc comprising: a main body having a centrally arranged opening being defined around a central axis, when looking from the direction of the central axis, the circumference of the main body has radius variation from the central axis; and a wear resistant portion arranged around the main body; the wear resistant portion comprises a first material, the main body comprises a second material, and the wear resistance of the first material is higher than that of the second material; characterised by:

the wear resistant portion comprises at least one protrusion projecting from the inner side of the wear resistant portion towards the main body, and the main body comprises at least one indentation to receive the protrusion. Optionally, the wear resistant portion further comprises a plurality of segments arranged end-to-end around the circumference of the main body. Advantageously, the cost efficiency of manufacturing segments of the wear resistant portion is largely increased compare to manufacturing a whole piece of wear resistant portion.

[0009] Optionally, two of the segments are identical, and interchangeably arranged on the main body. All of the segments can be identical, and interchangeably arranged on the main body. Such a configuration further increases the cost efficiency by manufacturing identical segments instead of segments with all different shapes.

[0010] Each of the segments comprises at least one of the protrusions projecting from the inner side of the segment, and a corresponding amount of indentations that receive the protrusions are arranged circumferentially along the periphery of the main body. Such a configuration optimizes the casting of the segments on the main body as the protrusions and indentations are matched, to lock the segments on the main body during casting, and it is further advantageous in increasing the contact area between the segments and the main body, to increase the bonding connection therebetween.

[0011] When looking from the direction of the central axis, the circumference of the main body is generally triangular shape with convex edges. Such a configuration of generally triangular disc optimized the transportation of materials due to the variation in radius of the triangular shape.

[0012] Optionally, the number of segments is six and the number of protrusions on each segment is two or three. Advantageously, six segments with each having two or three protrusions optimizes the cost efficiency by balancing the manufacturing of and casting of the discs.

[0013] Optionally, the first material is bonded with the second material so that the wear resistant portion and the main body form an integrated piece. Advantageously, the disc being an integrated piece having wear resistant portion, optimizes the wear resistant property of the disc.

[0014] Optionally, the second material comprises a matrix material, and the first material comprises cemented carbides metallurgically bonded to the matrix material. Advantageously, the metallurgical bonding between the matrix material and the cemented carbide enables an integrated part with strong wear resistance. More advantageously, the protrusions, being cemented carbides, are received by indentations, being matrix materials, such that the metallurgical bonding is further increased by the extra contact areas provided by the matched protrusions and indentations.

[0015] Optionally, the matrix material comprises iron. The iron can be spheroidal cast iron or high-chromium iron. The metallurgical bonding between the cemented carbides and spheroidal cast iron (or high-chromium iron) are known to be rather strong, and thus advantageously, the wear resistance of the disc is enhanced.

[0016] According to a second aspect of the present invention there is provided a transportation assembly for transportation of materials, comprising: a shaft having a rotational axis; a plurality of the discs, the discs are installed on the shaft through the openings of the discs, so that the central axis of the discs coincide with the rotational axis of the shaft; and a plurality of the spacers, the spacers are installed on the shaft through a central passages, wherein two adjacent discs are separated by at least one of the spacers. Advantageously, the axis of the discs, the axis of the spacers, and the rotational axis of the shaft are generally coincided, so that the discs and the spacers are located concentrically on the shaft. Such a configuration allows high efficiency for transporting the feed materials.

[0017] Optionally, the discs comprise at least one end disc and at least one intermediate disc, the end disc is positioned at either end of the shaft, and the intermediate disc is positioned away from the end of the shaft relative to the end disc. More optionally, the size of the end disc is scaled down with a certain proportion from the size of the intermediate disc. Such a configuration optimizes the transportation of materials, and further increases the operation efficiency of the feeding machine installed with the transportation assembly.

Brief description of drawings

[0018] A specific implementation of the present invention will now be described, by way of example only, and with reference to the accompanying drawings in which:

Figure 1 is a perspective view of transportation assembly of a feeding machine according to a specific implementation of the present invention;

Figure 2 is a perspective view of the intermediate disc and the end disc of Figure 1;

Figure 3A is a planar view of the intermediate disc of Figures 1 and 2 according to a specific implementation of the present invention;

Figure 3B is a planar view of the small disc of Figures 1 and 2 according to a specific implementation of the present invention;

Figure 4A is a planar view of a segment of the disc according to one specific implementation of the present invention;

Figure 4B is a planar view of a segment of the disc according to another specific implementation of the present invention;

Figure 4C is a planar view of a segment of the disc

according to yet another specific implementation of the present invention;

Figure 4D is a planar view of a segment of the disc according to yet another specific implementation of the present invention;

Figure 5 is a perspective view of a feeding machine according to a specific implementation of the present invention.

Detailed Description

[0019] In the present application, a disc, and a transportation assembly of which a plurality of the discs and spacers are installed on a shaft, are introduced for the purpose of material transportation of a feeding machine. Details of the disc, and the transportation assembly are introduced in the following paragraphs.

[0020] Figure 1 is a perspective view of transportation assembly 100 of a feeding machine according to a specific implementation of the present invention. The feeding machine can be a roller screen, or a wobbler feeder, such as the feeding machine 500 in Figure 5, more details of the feeding machine 500 will be described later. The transportation assembly 100 is arranged for the transportation of materials and is installed on the feeding machine. The assembly 100 includes a shaft 101, and a plurality of discs 106, 108 and spacers 105.

[0021] The shaft 101 has a rotational axis 110 along which an elongate body 102 of the shaft 101 extends between two opposed ends 103, 104 of the shaft 101. Shaft 101 is installed with a plurality of the discs 106, 108 and a plurality of the spacers 105. The discs include at least one end disc 108 and at least one intermediate disc 106, where the end disc 108 is positioned at each end 103, 104 of the shaft 101, and the intermediate disc 106 is positioned away from the ends 103, 104 relative to the end disc 108. All of the discs 106, 108 and spacers 105 are installed on the shaft 101 through a central opening or a central passage, so that the discs and the spacers are rotated with the rotation of the shaft 101 by a power unit (not shown). Two adjacent discs 106, 108 are separated by at least one of the spacers 105, so that the discs 106, 108 and spacers 105 cooperate for transporting materials on the feeding machine. In one embodiment, the spacers 105 and the discs 106, 108 are installed one by one on the shaft 100, to optimize the transportation arrangement of the assembly 100.

[0022] In the embodiment of Figure 1, on the opposite ends 103, 104 of the shaft 101, one end disc 108 is installed adjacent to the last spacer 105. In this manner, the end discs 108 further helps in the transportation of feed materials around the ends 103, 104 of the shaft 101. In one embodiment, the size of the end disc 108 is scaled down with a certain proportion from the size of the intermediate disc 106. Using scaled down discs 106 as end discs guarantees the wear resistant requirement at the shaft end and at the same time reduces the cost of end discs. However, it should be appreciated that this is not to be used as a limitation of the present invention, as shown in another embodiment of the present invention, the end discs 108 can be the same as intermediate discs 106, and the assembly 100 of such will work as properly as the embodiment shown in Figure 1.

[0023] Figure 2 is a perspective view of the intermediate disc 106 and the end disc 108 of Figure 1. As mentioned above, the end disc 108 is a similar, but scaled down disc relative to the intermediate disc 106 in the present invention. The intermediate disc 106 surrounds a central axis 603 and the end disc 108 surrounds a central axis 803, where referring to Figure 1, the central axis 603 of each intermediate disc 106 and the central axis 803 of each end disc 108 coincide with the rotational axis 110 of the shaft 101, so that the discs 106, 108 and the spacers 105 are located concentrically around the shaft 101, and the rotation of the assembly 100 enables the transportation of feed materials on the feeding machine.

[0024] The intermediate disc 106 includes a main body 601 and a wear resistant portion 611 arranged around the main body 601, wherein the wear resistant portion 611 includes a first material, and the main body 604 includes a second material and the wear resistance of the first material is higher than that of the second material. The main body 601 has a centrally arranged opening 602 through which a centrally arranged imaginary axis 603 extends, and as shown in Figure 2, the main body 601 is generally of the same thickness as the wear resistant portion 611. In the embodiment of the present invention, the main body 601 includes at least one indentation 606 that indents from the main body 601, or to say, the main body 601 includes at least two teeth 604 projecting from the main body 601 to form the at least one indentation 606. The wear resistant portion 611 is arranged around the main body 601 and includes at least one protrusion 616 projecting from the inner side of the wear resistant portion 611 towards the main body 601, the at least one protrusion 616 is arranged circumferentially along the periphery of the wear resistant portion 611 and received by corresponding indentations 606 of the main body 601. The shape of the protrusion 616 and the indentation 606 are matched so as to lock the wear resistant portion 611 on the main body 601 in the radial direction. By radially locking the wear resistant portion 611 on the main body 601, it optimizes the casting process to have the two parts forming an integrated piece. In one embodiment, the protrusion 616 can be similar to the shapes of teeth, or similar to the shapes of square, triangle, trapezoid, semi-circle etc.. Moreover, the protrusion 616 can be either pointed shapes or non-pointed shapes, as long as the protrusion 616 of the wear resistant portion 611 matches with and is received by the corresponding indentation 606 of the main body 601.

[0025] Similarly, the end disc 108 includes a main body 801 and a wear resistant portion 811 arranged around the main body 801, wherein the wear resistant portion

811 includes the first material, and the main body 804 includes the second material. The main body 801 has a centrally arranged opening 802 through which a centrally arranged imaginary axis 803 extends, and as shown in Figure 2, the main body 801 is generally of the same thickness as the wear resistant portion 811. In the embodiment of the present invention, the main body 801 includes at least one indentation 806 that indents from the main body 801, or to say, the main body 801 includes at least two teeth 804 projecting from the main body 801 to form the at least one indentation 806. The wear resistant portion 811 is arranged around the main body 801 and includes at least one protrusion 816 projecting from the inner side of the wear resistant portion 811 towards the main body 801, the at least one protrusion 816 is arranged circumferentially along the periphery of the wear resistant portion 811 and received by corresponding indentations 806 of the main body 801. The shape of the protrusion 816 and the indentation 806 are matched so as to lock the wear resistant portion 811 on the main body 801 in the radial direction. By radially locking the wear resistant portion 611 on the main body 601, it optimizes the casting process to have the two parts forming an integrated piece. In one embodiment, the protrusion 816 can be similar to the shapes of teeth, or similar to the shapes of square, triangle, trapezoid, semi-circle etc. Moreover, the protrusion 816 can be either pointed shapes or non-pointed shapes, as long as the protrusion 816 of the wear resistant portion 811 matches with and is received by the corresponding indentation 806 of the main body 801.

[0026] According to a specific implementation, the wear resistance of the first material is higher than that of the second material, in a way that the wear resistant portion 611 (or 811) being more wear resistant than the main body 601 (or 801). Such a configuration is advantageous, as the wear resistant portion is a high wear zone on the disc. Additionally, according to a specific implementation, the first material is adjoined with the second material so that the wear resistant portion 611 (or 811) and the main body 601 (or 801) are integrated.

[0027] In one embodiment, the second material includes a matrix material, and the first material includes cemented carbide metallurgically bonded to the matrix material. Advantageously, the metallurgical bonding between the matrix material and the cemented carbide enables an integrated part with stronger wear resistance. More specifically in the embodiment, the main body 601 (or 801) including the matrix material is bonded to the wear resistant portion 611 (or 811) on the outermost surface (not shown) of the main body 601 (or 801). In one embodiment, the peripheral outermost surface of the main body 601 (or 801), which is generally teeth shaped surfaces around the axis 603 (or 803), is the contact surface of the main body 601 (or 801) and the wear resistant portion 611 (or 811), and thus provides an area where the cemented carbide and the matrix material are metallurgically bonded. The metallurgical bonding between the main body 601 (or 801) and the wear resistant portion 611 (or 811) enables the disc 106 (or 108) to be respectively one integrated piece, and the increased area of contact between the matrix material and the cemented carbide provides stronger bonding in-between. Advantageously, the integrated disc 106 (or 108) has improved wear resistance property, and thus a prolonged service life.

[0028] In one embodiment of the present invention, the matrix material comprises iron. Additionally, the iron is spheroidal cast iron or high-chromium iron. The metallurgical bonding between iron and cemented carbide is extremely strong and as it is well known by the technical person skilled in the art, details of the metallurgical bonding will not be illustrated in detail in this application.

[0029] Figure 3A is a planar view of the intermediate disc 106 of Figures 1 and 2 according to a specific implementation of the present invention. Figure 3B is a planar view of the end disc 108 of Figures 1 and 2 according to a specific implementation of the present invention;

[0030] In the embodiment of Figures 3A and 3B, the wear resistant portion 611 (or 811) each includes multiple segments 614 (or 814) arranged on the radially outermost region of main body 601 (or 801), to contact with the feeding materials when the disc 106 (or 108) are assembled on the shaft 101 for the transportation of the materials. Providing segments instead of a complete piece of wear resistant portion is more cost efficient, however, such should not be considered a limitation of the present invention.

[0031] In one embodiment, the segments 614 (or 814) are arranged end-to-end around the circumference of the main body 601 (or 801), and each of the segments 614 (or 814) comprises at least one protrusion 616 (or 816) projecting from the inner side of the segment 614 (or 814). The main body 601 (or 801) has the same amount of indentations 606 (or 806) as the segments 614 (or 814). The indentations 606 (or 806) are arranged circumferentially along the periphery of the main body 601 (or 801), and each indentation 606 (or 806) matches to and receives a corresponding protrusion 616 (or 816), so that the segments 614 (or 814) are arranged end-to-end around the circumference of the main body 601 (or 801). In one embodiment, two of the segments 614 (or 814) are identical and interchangeably arranged on the main body 601 (or 801. All of the segments (614, 814) can be identical and interchangeably arranged on the main body 601 (or 801). This further increases the cost efficiency of manufacturing the segments, and also simplifies the casting process by positioning any segment 614 (or 814) onto the main body 601 (or 801) in an end-to-end way.

[0032] In the embodiment of Figures 3A and 3B, the circumference of the main body 601 (or 801) is generally triangular shape with convex edges when looking from the direction of the central axis 603 (or 803), and the radius of the periphery of the main body 601 (or 801) varies along the circumference. It should be appreciated that the circumference of the main body 601 (or 801) can

be other shapes, such as a generally circular shape and the shape should not be considered a limitation to the present invention.

[0033] In the embodiments of the main body 601 (or 801) being generally triangular shape, the number of segments 614 (or 814) can be six, and all segments 614 (or 814) are manufactured identically. Moreover, the number of protrusions 616 (or 816) on each segment 614 (or 814) can be two or three, so that the contact area between the protrusions 616 (or 816) and the indentations 606 (or 806) are increased to provide very strong metallurgically bonding inside the integrated piece, disc 106 (or 108).

[0034] The protrusions 616 (or 816) and the indentations 606 (or 806) can be in varied shapes as long as they are matched and received by each other. Referring to Figures 4A-4D, different embodiments of the segment with differently shaped protrusions will be described.

[0035] Figure 4A-4D are planar views of segments 414A-414D of the disc according to specific implementations of the present invention. Segments 414A and 414B have protrusions 416A, 416B without pointed edges, where the protrusion 416A of the segment 414A has a generally semi-circle shape, and the protrusion 416B of the segment 414B has an extended part with a generally semi-circle shaped end. Segments 414C and 414D have protrusions 416C, 416D with pointed edges, where the protrusion 416C of the segment 414C has a generally triangular shape, and the protrusion 416D of the segment 414D has an extended part with a generally triangular shaped end.

[0036] In other embodiments, the segments may have protrusions with different profiles, or protrusions with extended body having an end part of different profiles, or protrusions in combination of varies shapes. As long as the protrusion enables the positioning of segment around the main body, and further provides increased area of contact between the wear resistant portion and the main body, it would stay in the scope of protection of the present invention, and thus the profile of the protrusion on the wear resistant portion and/or indentation on the main body should not be considered a limitation of the present invention.

[0037] Figure 5 is a perspective view of a feeding machine 500 according to a specific implementation of the present invention. The feeding machine can be a wobbler feeder 500 having a plurality of transportation assemblies arranged in parallel, in which each of the transportation assemblies can be assembled in the same way as the transportation assembly 100 as shown in Figure 1. The transportation assemblies 100 being assembled on the wobbler feeder 500 in parallel, enables each and every transportation assembly 100 to be rotated in the same direction, such that the feeding materials (not shown) are screened and transported along the length of the wobbler feeder 500.

Claims

1. A disc (106, 108) arranged for cooperating with a spacer (105) for transporting materials on a feeding machine (500), the disc (106, 108) comprising:

   a main body (601, 801) having a centrally arranged opening (602, 802) being defined around a central axis (603, 803), wherein when looking from the direction of the central axis (603, 803), the circumference of the main body (601, 801) has radius variation from the central axis (603, 803); and
   a wear resistant portion (611, 811) arranged around the main body (601, 801);
   the wear resistant portion (611, 811) comprises a first material, the main body (601, 801) comprises a second material, and the wear resistance of the first material is higher than that of the second material;
   characterised by,
   the wear resistant portion (611, 811) comprises at least one protrusion (616, 816) projecting from the inner side of the wear resistant portion (611, 811) towards the main body (601, 801), and the main body (601, 801) comprises at least one indentation (606, 806) to receive the protrusion (616, 816).

2. The disc as claimed in claim 1, wherein the wear resistant portion (611, 811) further comprises a plurality of segments (614, 814) arranged end-to-end around the circumference of the main body (601, 801).

3. The disc as claimed in claim 2, wherein two of the segments (614, 814) are identical, and interchangeably arranged on the main body (601, 801).

4. The disc as claimed in any one of claims 2-3, wherein all of the segments (614, 814) are identical, and interchangeably arranged on the main body (601, 801).

5. The disc as claimed in any one of the previous claims, wherein each of the segments (614, 814) comprises at least one of the protrusions (616, 816) projecting from the inner side of the segment (614, 814), and a corresponding amount of indentations (606, 806) that receive the protrusions (616, 816) are arranged circumferentially along the periphery of the main body (601, 801).

6. The disc as claimed in any one of the previous claims, wherein when looking from the direction of the central axis (603, 803), the circumference of the main body (601, 801) is generally triangular shaped with convex edges.

7. The disc as claimed in any one of claims 2-6, wherein the number of segments (614, 814) is six.

8. The disc as claimed in any one of claims 2-7, wherein the number of protrusions (616, 816) on each segment (614, 814) is two or three.

9. The disc as claimed in any one of the previous claims, wherein the first material is bonded with the second material so that the wear resistant portion (611, 811) and the main body (601, 801) form one integrated piece.

10. The disc as claimed in any one of the previous claims, wherein the second material comprises a matrix material, and the first material comprises cemented carbides metallurgically bonded to the matrix material.

11. The disc as claimed in claim 10, wherein the matrix material comprises iron.

12. The disc as claimed in claim 7, wherein the iron is spheroidal cast iron or high-chromium iron.

13. A transportation assembly (100) for transportation of materials, comprising:

a shaft (101) having a rotational axis (110);
a plurality of discs (106, 108) as claimed in one of the claims 1-12, the discs (106, 108) are installed on the shaft (101) through the openings (602, 802) of the discs (106, 108), so that the central axis (603, 803) of the discs (106, 108) coincide with the rotational axis (110) of the shaft (101); and
a plurality of spacers (105), wherein the spacers (105) are installed on the shaft (101) through a central passage;
wherein two adjacent discs (106, 108) are separated by at least one of the spacers (105).

14. The transportation assembly (100) as claimed in claim 13, wherein the discs (106, 108) comprises at least one end disc (108) and at least one intermediate disc (106), the end disc (108) is positioned at either end (103, 104) of the shaft (101), and the intermediate disc (106) is positioned further away from the end (103, 104) of the shaft (101) relative to the end disc (108).

15. The transportation assembly (100) as claimed in claim 14, wherein the size of the end disc (108) is scaled down with a certain proportion from the size of the intermediate disc (106).

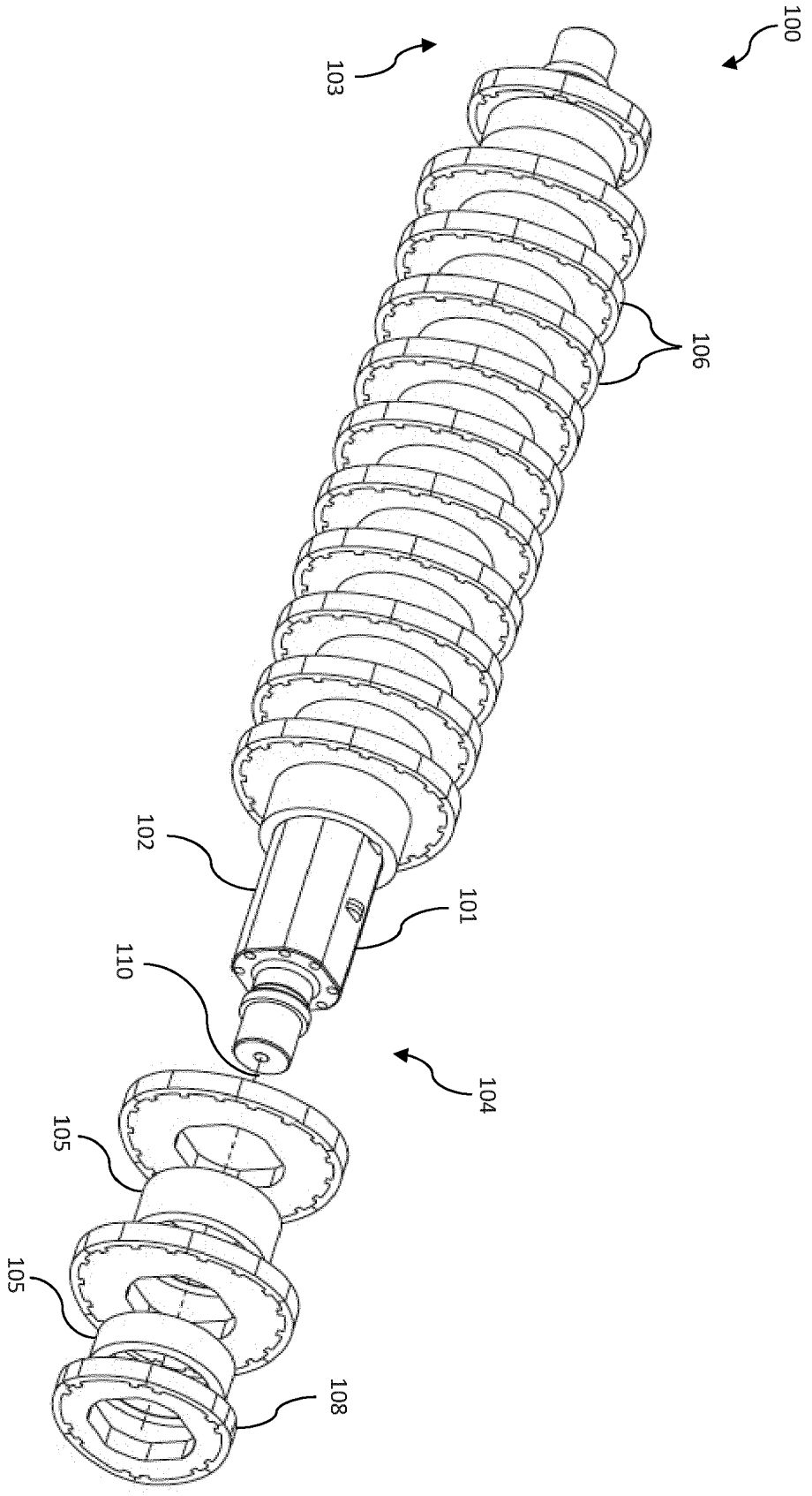
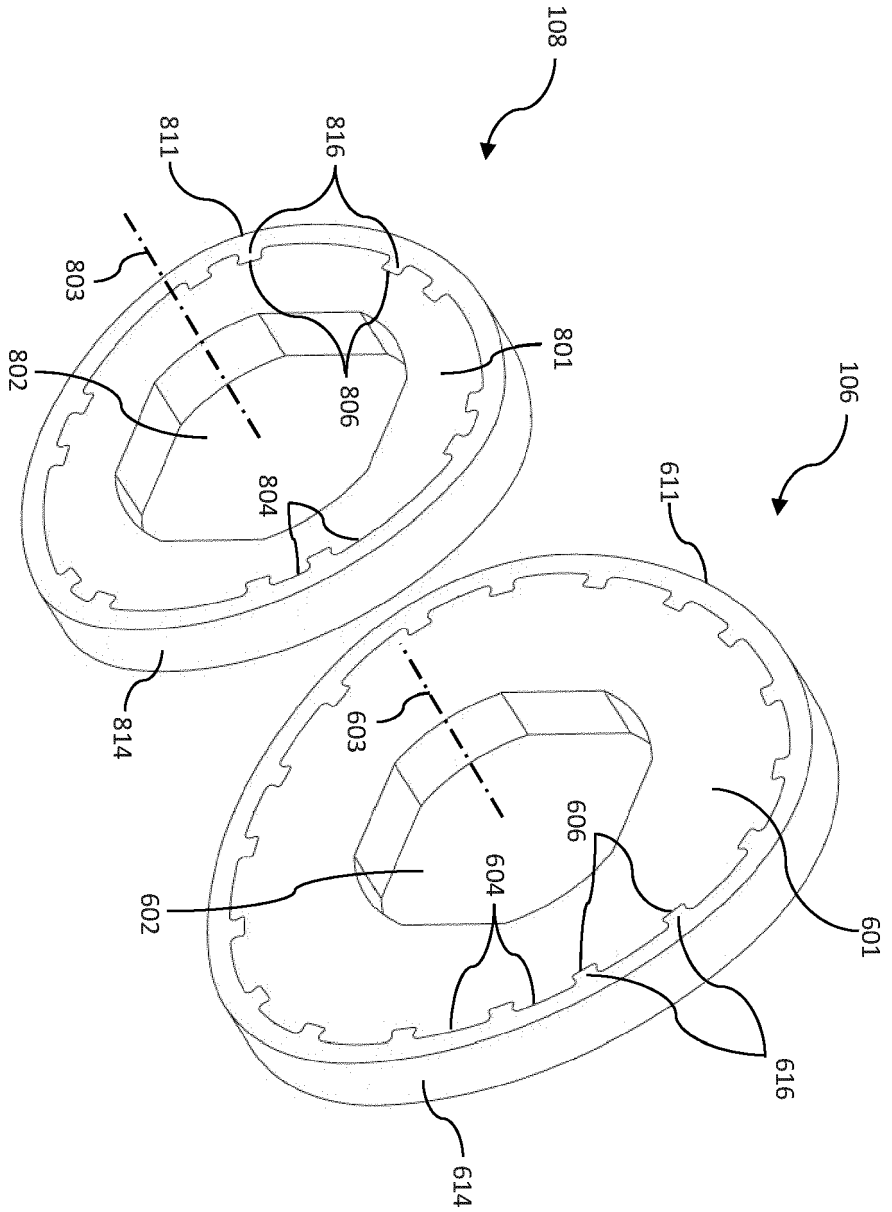


FIG. 1


108
811
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616
614

FIG. 2

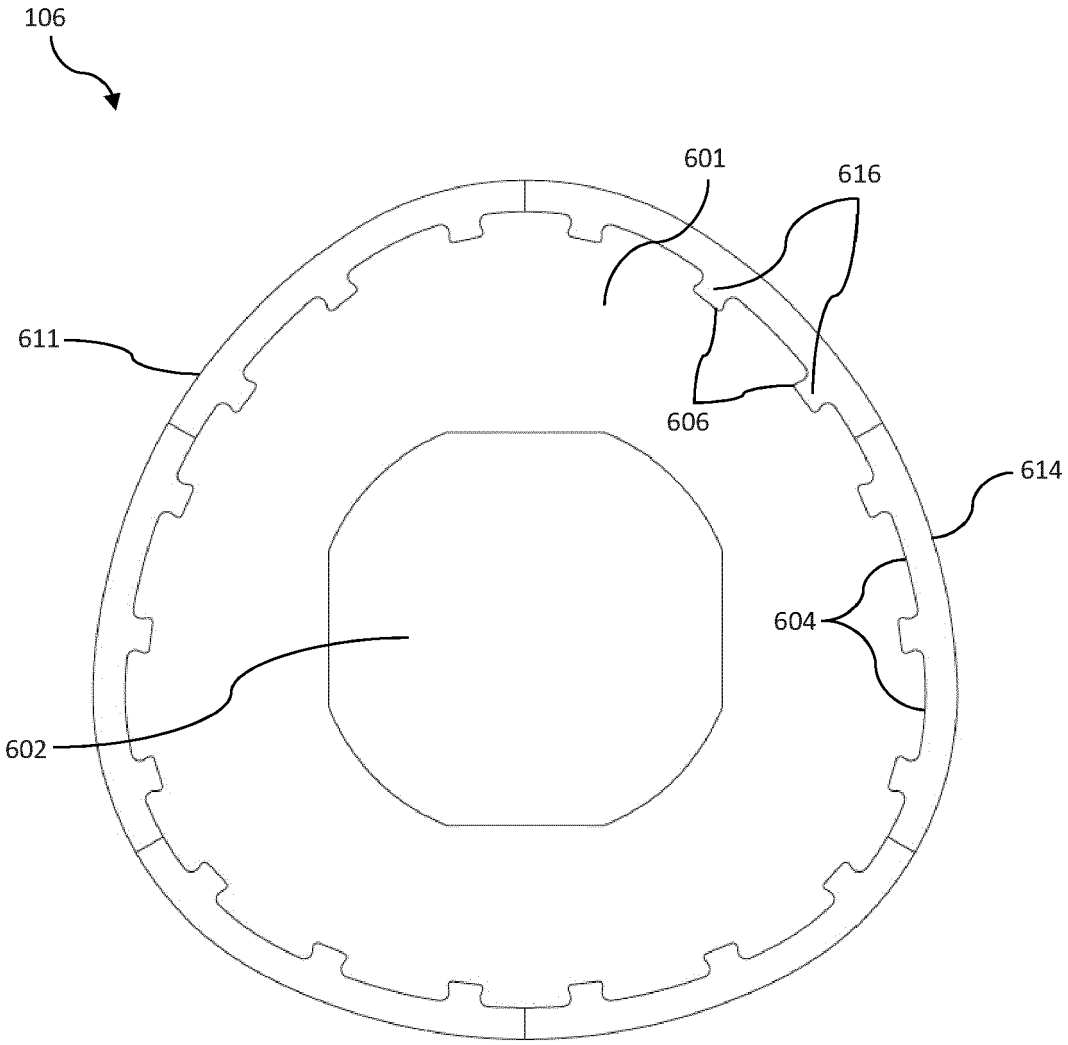

FIG. 3A

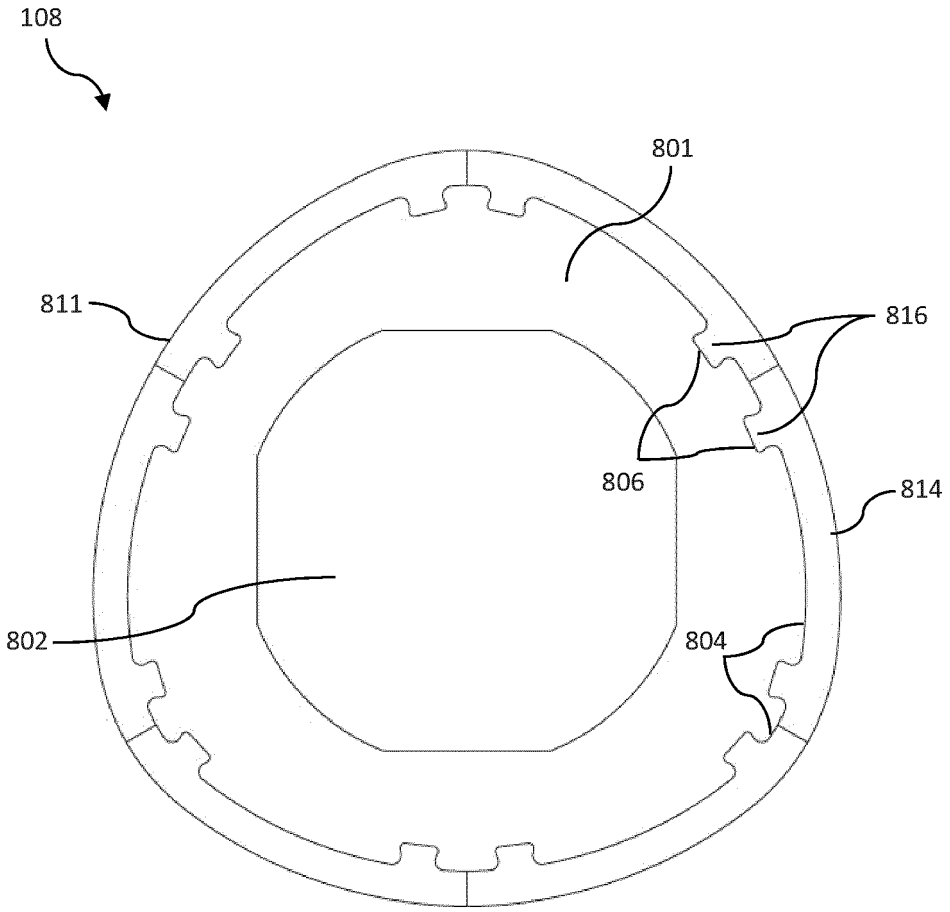

FIG. 3B

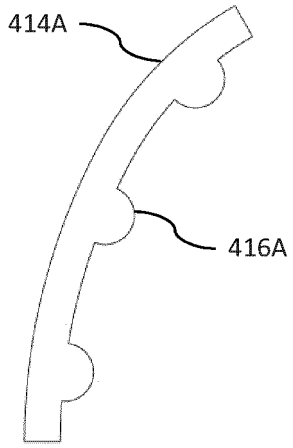

FIG. 4A

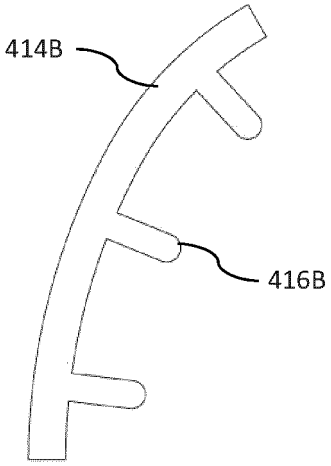

FIG. 4B

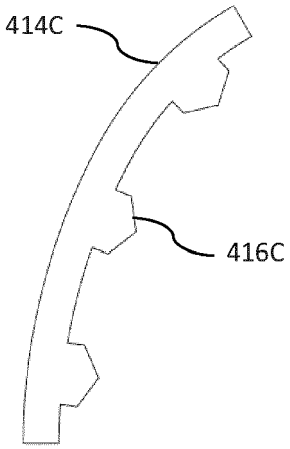

FIG. 4C

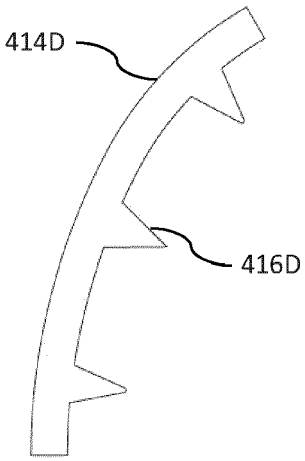

FIG. 4D

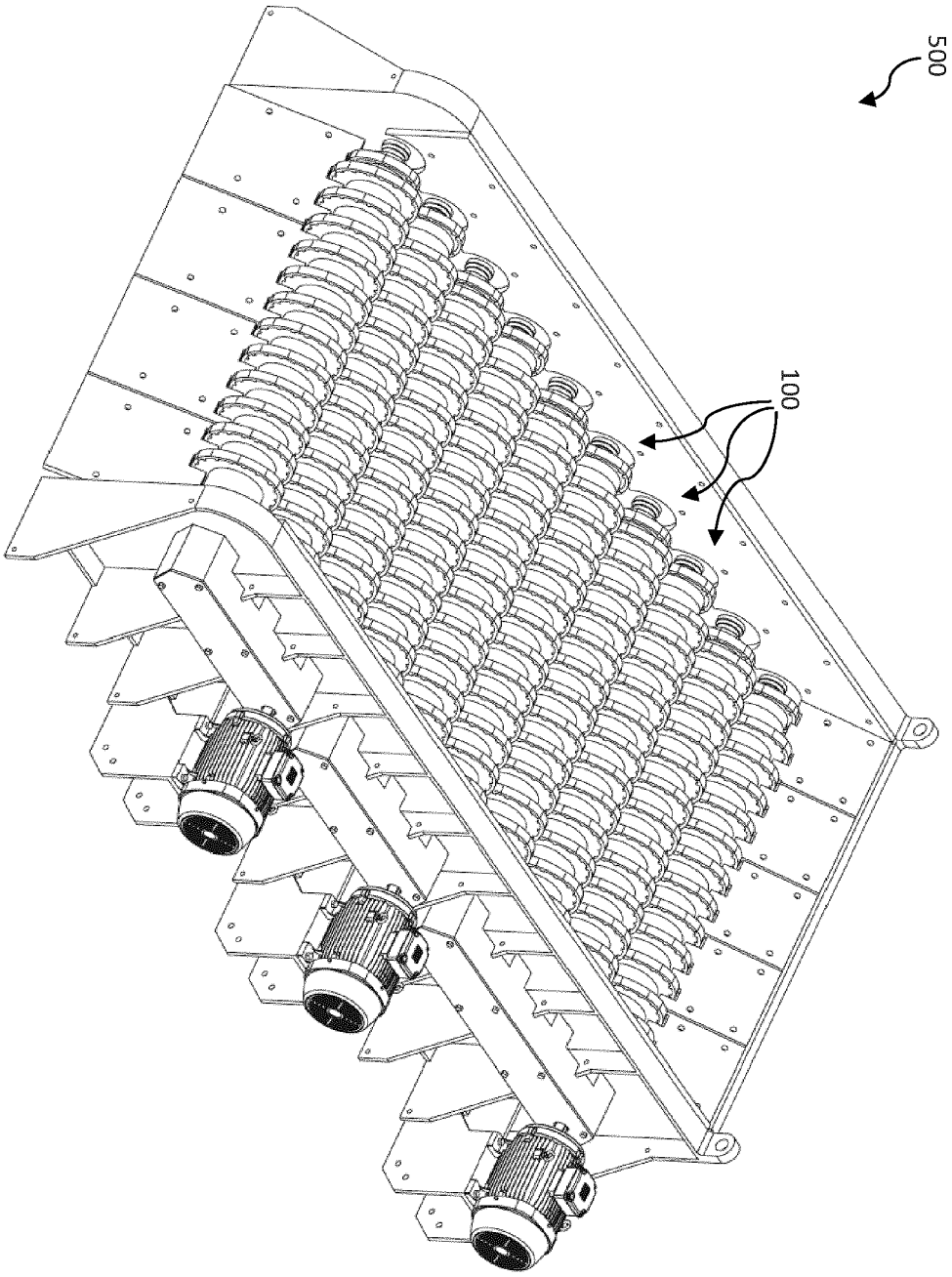

FIG. 5

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EUROPEAN SEARCH REPORT

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TECHNICAL FIELDS SEARCHED (IPC)

B07B
B65G
D21J
A01F
A01D
D21B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	30 May 2022	Delval, Stéphane

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30-05-2022

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