



- (51) International Patent Classification: Not classified
- (21) International Application Number: PCT/US2015/043228
- (22) International Filing Date: 31 July 2015 (31.07.2015)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data: 62/032,053 1 August 2014 (01.08.2014) US
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- (81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT,

[Continued on next page]

(54) Title: ABRASIVE ARTICLE INCLUDING Z-SHAPED ABRASIVE SEGMENTS

(57) Abstract: An abrasive article including a mounting body, a dampening member coupled to the mounting body, and a Z-shaped or other shaped abrasive segment coupled to the mounting body.

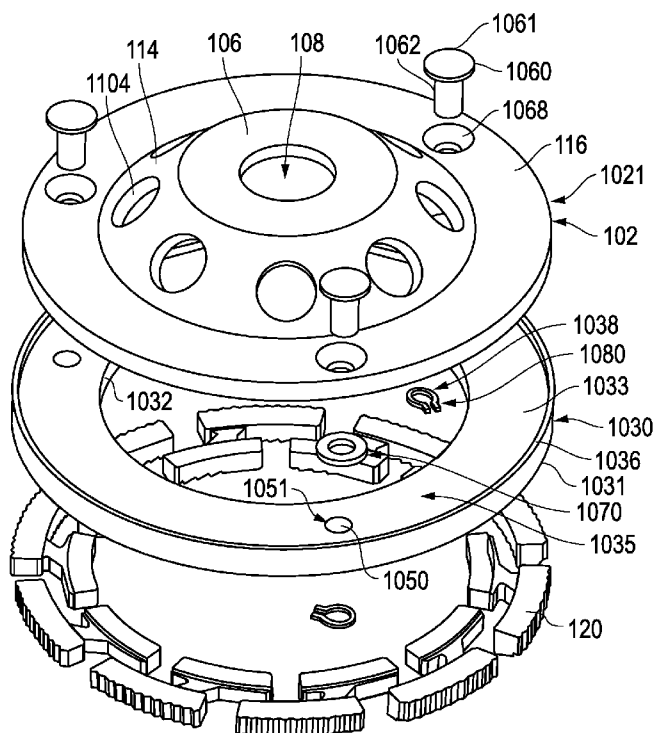


FIG. 10





HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

- (84) **Designated States** (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE,

SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

- as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))
- as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))

Published:

- without international search report and to be republished upon receipt of that report (Rule 48.2(g))
- with information concerning incorporation by reference of missing parts and/or elements (Rule 20.6)

ABRASIVE ARTICLE INCLUDING Z-SHAPED ABRASIVE SEGMENTS

BACKGROUND

Field of the Disclosure

[0001] The following is generally directed to abrasive tools and processes for forming same, and more particularly, to abrasive tools utilizing abrasive segments attached to a base and methods of assembling such tools.

Description of the Related Art

[0002] Tools necessary for furthering infrastructure improvements, such as building additional roads and buildings, are vital to the continued economic expansion of developing regions. Additionally, developed regions have a continuing need to replacing aging infrastructure with new and expanded roads and buildings.

[0003] The construction industry utilizes a variety of tools for cutting and grinding of construction materials. Cutting and grinding tools are required for to remove or refinish old sections of roads. Additionally, quarrying and preparing finishing materials, such as stone slabs used for floors and building facades, require tools for drilling, cutting, and polishing. Typically, these tools include abrasive segments bonded to a base element or core, such as a plate or a wheel. As with other industries, improvements to these abrasive tools are always sought.

SUMMARY

[0004] According to a first aspect, an abrasive article includes a mounting body, a dampening member coupled to the mounting body, and a Z-shaped abrasive segment coupled to the mounting body.

[0005] According to another aspect, an abrasive article includes a mounting body comprising a cup-shape contour, a dampening member coupled to the mounting body, and a Z-shaped abrasive segment coupled to the housing.

[0006] In yet another aspect, an abrasive article includes a mounting body, a dampening member coupled to the mounting body, a sealing member disposed between the mounting body and the dampening member, and a Z-shaped abrasive segment coupled to the housing.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] The present disclosure may be better understood, and its numerous features and advantages made apparent to those skilled in the art by referencing the accompanying drawings.

[0008] FIG. 1 includes a first plan view of an abrasive article in accordance with an embodiment.

[0009] FIG. 2 includes a second plan view of an abrasive article in accordance with an embodiment.

[0010] FIG. 3 includes a first plan view of a segment for an abrasive article in accordance with an embodiment.

[0011] FIG. 4 includes a second plan view of a segment for an abrasive article in accordance with an embodiment.

[0012] FIG. 5 includes a third plan view of a segment for an abrasive article in accordance with an embodiment.

[0013] FIG. 6 includes a fourth plan view of a segment for an abrasive article in accordance with an embodiment.

[0014] FIG. 7 includes a fifth plan view of a segment for an abrasive article in accordance with an embodiment.

[0015] FIG. 8 includes a sixth plan view of a segment for an abrasive article in accordance with an embodiment.

[0016] FIG. 9 includes a seventh plan view of a segment for an abrasive article in accordance with an embodiment.

[0017] FIG. 10 includes a perspective view of an abrasive article according to an embodiment.

[0018] FIG. 11 includes a perspective view of an abrasive article according to an embodiment.

[0019] FIG. 12 includes a cross-sectional view of a portion of a dampening member according to an embodiment.

[0020] FIG. 13 includes a perspective view of a dampening member according to an embodiment.

[0021] FIG. 14 includes a perspective view of a fastener engaged with a mounting body according to an embodiment.

[0022] The use of the same reference symbols in different drawings indicates similar or identical items.

DETAILED DESCRIPTION

[0023] According to an embodiment, the abrasive article herein can include a core and a plurality of abrasive segments affixed to the core. The abrasive articles of the embodiments herein may be used to remove material from various workpieces by relative movement of the abrasive article relative to the workpiece. The abrasive article can be a grinding tool for grinding metal, concrete, or natural stone. The abrasive articles of embodiments herein can be a cutting tool for cutting construction materials, such as a saw for cutting concrete. Alternatively, the abrasive articles of the embodiments herein can be used for grinding concrete or fired clay or removing asphalt.

[0024] In general, the abrasive article can include multiple Z-shaped segments affixed to a core. FIG. 1 and FIG. 2 illustrate an exemplary abrasive article designated 100. FIG. 1 includes a front plan view of the abrasive article 100. FIG. 2 includes a rear plan view of the abrasive article 100. FIG. 3 through FIG. 8 include various views of a Z-shaped abrasive segment according to an embodiment.

[0025] FIGs. 1, 2, 10, and 11 include illustrations of an exemplary abrasive articles according to embodiments. As depicted, the abrasive article 100 can include a mounting body 102. The mounting body 102 can include various portions, which will be described in more detail herein. Moreover, certain elements of the abrasive articles of the embodiments herein may be represented in certain figures and exempt from other figures, however, it will be appreciated that any of the features of the

embodiments herein can be combined with any other features, even if such features are not necessarily depicted in the same figure.

[0026] Notably, the mounting body 102 can have a generally cup-shaped contour, which may appear as a cup-shaped body or bowl-shaped body. The mounting body 102 can include an arbor portion 106 coupled to an intermediate portion 112 of the mounting body. The arbor portion 106 can include a central opening 108 configured to engage an arbor of a grinding tool and facilitate rotary motion of the abrasive article 100 about a center 110 of the mounting body 102. The center 110 of the mounting body 102 can be the center 110 of the abrasive article 100.

[0027] As illustrated, and according to an embodiment, the mounting body 102 can include an intermediate portion 112 extending from the arbor portion 106. In certain instances, the annular rim portion 116 can be coupled to the intermediate portion 112 and extend radially from the intermediate portion 112. The annular rim portion 116 may define a flange on the periphery of the mounting body 102. According to one embodiment, the annular rim portion 116 can include an outer peripheral surface 1001, an inner peripheral surface 1002, and an annular rim surface 1003 extending between the outer peripheral surface 1001 and the inner peripheral surface 1002.

[0028] According to one embodiment, the intermediate portion 112 can have a surface 114 that extends in a direction and defines a plane different than a plane defined by the annular rim surface 1003 of the annular rim portion 116. For at least one embodiment, the intermediate portion 112 can have a surface that is tapered relative to the annular rim portion 116. The surface 114 of the intermediate portion 112 can define an arcuate surface with respect to the plane of the annular rim portion 116 and relative to a plane perpendicular to the plane defined by the annular rim portion 116. As illustrated, the intermediate portion 112 can define a bowl-shape. Moreover, in certain instances, such as illustrated in FIGs. 1 and 2, the intermediate portion 112 can have at least one opening, and more particularly, may include a plurality of openings extending around a circumference of the intermediate portion 112. In at least one embodiment, the intermediate portion 112 can have a frusto-conical shape, which can extend radially outward and axially from the arbor portion 106.

[0029] The mounting body 102 may include an inorganic material, including for example, but not limited to a metal. More particularly, in certain instances, the mounting body can include iron, and even more particularly, can include steel.

[0030] At least one abrasive segment 120, and more particularly, a plurality of abrasive segments 120 can be coupled to the mounting body 102. In certain instances, which are provided herein, the abrasive segments 120 and the mounting body 102 may be indirectly coupled to each other, with at least one intervening component (e.g., a dampening member) disposed between the mounting body 102 and the abrasive segments 120.

[0031] The abrasive segments 120 can be formed separately from the mounting body 102, as described herein, and affixed to a component of the abrasive article via a brazing procedure, a welding

procedure, a mechanical coupling, etc. In a particular aspect, each adjacent pair of abrasive segments 120 can be separated by a gap 122.

[0032] FIG. 3 through FIG. 8 illustrate features of the abrasive segments 120 according to embodiments herein. As illustrated, the abrasive segment 120 can include a body 130 that can include a generally curved inner segment portion 132 and a generally curved outer segment portion 134 spaced a radial distance, d , from the inner segment portion 132, wherein “ d ” is a shortest distance between the curved inner segment portion 132 and curved outer segment portion 134 along the axis 200. The body 132 of the segment 130 can also include a central segment portion 136 connected to the inner segment portion 132 and the outer segment portion 134.

[0033] In a particular aspect, the inner segment portion 132 can include an inner circumferential wall 140 and an outer circumferential wall 142. The inner segment portion 132 can also include a leading radial sidewall 144 extending between the inner circumferential wall 140 and the outer circumferential wall 142 and a trailing radial sidewall 146 extending between the inner circumferential wall 140 and the outer circumferential wall 142 opposite the leading radial sidewall 144. The terms leading and trailing, as used herein, can be defined based on a direction of rotation of the abrasive article 100, which is counter-clockwise in the view illustrated in FIG. 1.

[0034] As illustrated, the inner segment portion 132 can further include a first grinding face 148 that can extend between the inner and outer circumferential walls 140, 142 and the leading and trailing radial sidewalls 144, 146. Moreover, a first serrated portion 150 can extend at least partially over the first grinding face 148. In a particular aspect, the first grinding face 148 can include an area, A_{GF1} , and the first serrated portion 150 can include an area, A_{SP1} . In at least one embodiment, A_{SP1} can be less than A_{GF1} . For example, A_{SP1} can be not greater than about 80% A_{GF1} , such as not greater than about 75% A_{GF1} , not greater than about 70% A_{GF1} , not greater than about 65% A_{GF1} , or even not greater than about 60% A_{GF1} . Further, in at least one embodiment, A_{SP1} can be at least about 30% A_{GF1} , such as at least about 35% A_{GF1} , at least about 40% A_{GF1} , at least about 45% A_{GF1} , or even at least about 50% A_{GF1} . In another aspect, A_{SP1} can be within a range between and including any of the maximum and minimum values of A_{SP1} described herein.

[0035] For example, A_{SP1} can be not greater than about 80% A_{GF1} and at least about 30% A_{GF1} , such as not greater than about 80% A_{GF1} and at least about 35% A_{GF1} , such as not greater than about 70% A_{GF1} and at least about 30% A_{GF1} . Further, A_{SP1} can be not greater than about 60% A_{GF1} and at least about 30% A_{GF1} .

[0036] In a particular aspect, the inner segment portion 132 can have a first radial width, W_1 , measured from the inner circumferential wall 140 to the outer circumferential wall 142. W_1 can be greater than or equal to d , which is a dimension described above. For example, W_1 can be at least about 105% d , such as at least about 110% d , or even at least about 125% d . In another aspect, W_1 can be not greater than about 200% d , such as not greater than about 175% d , or not greater than about

150% d. W_1 can also be within a range between and including any of the maximum and minimum values of W_1 described herein.

[0037] For example, W_1 can be at least about 105% d and not greater than about 200% d, such as at least about 125% d and not greater than about 200% d, or at least about 125% d and not greater than about 150% d.

[0038] As illustrated, the outer segment portion 134 can include an inner circumferential wall 160 and an outer circumferential wall 162. The outer segment portion 134 can also include a leading radial sidewall 164 extending between the inner circumferential wall 160 and the outer circumferential wall 162 and a trailing radial sidewall 166 extending between the inner circumferential wall 160 and the outer circumferential wall 162 opposite the leading radial sidewall 164.

[0039] As illustrated, the outer segment portion 134 can further include a second grinding face 168 that can extend between the inner and outer circumferential walls 160, 162 and the leading and trailing radial sidewalls 164, 166. Moreover, a second serrated portion 170 can extend at least partially over the second grinding face 168. In a particular aspect, the second grinding face 168 can include an area, A_{GF2} , and the second serrated portion 170 can include an area, A_{SP2} . According to one embodiment, A_{SP2} can be less than A_{GF2} . For example, A_{SP2} can be not greater than about 80% A_{GF2} , such as not greater than about 75% A_{GF2} , not greater than about 70% A_{GF2} , not greater than about 65% A_{GF2} , or even not greater than about 60% A_{GF2} . Further, A_{SP2} can be at least about 30% A_{GF2} , such as at least about 35% A_{GF2} , at least about 40% A_{GF2} , at least about 45% A_{GF2} , or even at least about 50% A_{GF2} .

[0040] In another aspect, A_{SP2} can be within a range between and including any of the maximum and minimum values of A_{SP2} described herein. For example, A_{SP2} can be not greater than about 80% A_{GF2} and at least about 30% A_{GF2} . Further, A_{SP2} can be not greater than about 70% A_{GF2} and at least about 40% A_{GF2} . Still further, A_{SP2} not greater than about 60% A_{GF2} and at least about 50% A_{GF2} .

[0041] In a particular aspect, the outer segment portion 134 can have a second radial width, W_2 , measured from the inner circumferential wall 160 to the outer circumferential wall 162. W_2 can be equal to or greater than d, which is a dimension described above. For example, W_2 can be at least about 105% d, such as at least about 110% d, or even at least about 125% d. In another aspect, W_2 can be not greater than about 200% d, such as not greater than about 175% d, or not greater than about 150% d. W_2 can also be within a range between and including any of the maximum and minimum values of W_2 described herein.

[0042] For example, W_2 can be at least about 105% d and not greater than about 200% d, such as at least about 105% d and not greater than about 175% d, or at least about 105% d and not greater than about 150% d. Further, W_2 can be at least about 110% d and not greater than about 200% d, such as at least about 110% d and not greater than about 175% d, or at least about 110% d and not greater than about 150% d. Still further, W_2 can be at least about 125% d and not greater than about 200% d,

such as at least about 125% d and not greater than about 175% d, or at least about 125% d and not greater than about 150% d.

[0043] In another aspect, A_{SP1} can be not greater than about A_{SP2} . For example, A_{SP1} can be not greater than about 95% A_{SP2} , such as not greater than about 90% A_{SP2} , not greater than about 85% A_{SP2} , or not greater than about 80% A_{SP2} . Further, A_{SP1} at least about 50% A_{SP2} , such as at least about 55% A_{SP2} , or at least about 60% A_{SP2} . In another aspect, A_{SP1} can be within a range between and including any of the maximum and minimum values of A_{SP1} described herein.

[0044] For example, A_{SP1} can be not greater than about 95% A_{SP2} and at least about 50% A_{SP2} , such as not greater than about 95% A_{SP2} and at least about 55% A_{SP2} , or not greater than about 95% A_{SP2} and at least about 60% A_{SP2} . A_{SP1} can be not greater than about 90% A_{SP2} and at least about 50% A_{SP2} , such as not greater than about 90% A_{SP2} and at least about 55% A_{SP2} , or not greater than about 90% A_{SP2} and at least about 60% A_{SP2} . Further, A_{SP1} can be not greater than about 85% A_{SP2} and at least about 50% A_{SP2} , such as not greater than about 85% A_{SP2} and at least about 55% A_{SP2} , or not greater than about 85% A_{SP2} and at least about 60% A_{SP2} . Moreover, A_{SP1} can be not greater than about 80% A_{SP2} and at least about 50% A_{SP2} , such as not greater than about 80% A_{SP2} and at least about 55% A_{SP2} , or not greater than about 80% A_{SP2} and at least about 60% A_{SP2} .

[0045] As further depicted in FIG. 3, the outer segment portion 134 can further include a plurality of outer peripheral serrations 172 formed in the outer circumferential wall 162 of the outer segment portion 134. The outer peripheral serrations 172 can extend along the entire outer circumferential wall 162 from the leading radial sidewall 164 to the trailing radial sidewall 166 of the outer segment portion 134. Moreover, the outer peripheral serrations 172 can form a sinusoidal wave structure along the outer circumferential wall 162.

[0046] In a particular aspect, the outer circumferential wall 162 have a circumferential length, L_{OCW} , and the sinusoidal wave structure can includes a wavelength, WL_{SWS} . WL_{SWS} can be not greater than about 0.2 L_{OCW} , such as not greater than about 0.175 L_{OCW} , not greater than about 0.15 L_{OCW} , or not greater than about 0.125 L_{OCW} . Further, WL_{SWS} can be at least about 0.05 L_{OCW} , such as at least about 0.06 L_{OCW} , at least about 0.07 L_{OCW} , at least about 0.08 L_{OCW} , or at least about 0.09 L_{OCW} . WL_{SWS} can be within a range between and including any of the maximum and minimum values of WL_{SWS} described herein.

[0047] For example, WL_{SWS} can be not greater than about 0.2 L_{OCW} and at least about 0.05 L_{OCW} , such as not greater than about 0.2 L_{OCW} and at least about 0.06 L_{OCW} , not greater than about 0.2 L_{OCW} and at least about 0.07 L_{OCW} , not greater than about 0.2 L_{OCW} and at least about 0.08 L_{OCW} , or not greater than about 0.2 L_{OCW} and at least about 0.09 L_{OCW} . In another aspect, WL_{SWS} can be not greater than about 0.175 L_{OCW} and at least about 0.05 L_{OCW} , such as not greater than about 0.175 L_{OCW} and at least about 0.06 L_{OCW} , not greater than about 0.175 L_{OCW} and at least about 0.07 L_{OCW} , not greater than about 0.175 L_{OCW} and at least about 0.08 L_{OCW} , or not greater than about 0.175 L_{OCW} and at least about 0.09 L_{OCW} . Further, WL_{SWS} can be not greater than about 0.15 L_{OCW} and at least about 0.05

L_{OCW} , such as not greater than about $0.15 L_{OCW}$ and at least about $0.06 L_{OCW}$, not greater than about $0.15 L_{OCW}$ and at least about $0.07 L_{OCW}$, not greater than about $0.15 L_{OCW}$ and at least about $0.08 L_{OCW}$, or not greater than about $0.15 L_{OCW}$ and at least about $0.09 L_{OCW}$. Further still, WL_{SWS} can be not greater than about $0.125 L_{OCW}$ and at least about $0.05 L_{OCW}$, such as not greater than about $0.125 L_{OCW}$ and at least about $0.06 L_{OCW}$, not greater than about $0.125 L_{OCW}$ and at least about $0.07 L_{OCW}$, not greater than about $0.125 L_{OCW}$ and at least about $0.08 L_{OCW}$, or not greater than about $0.125 L_{OCW}$ and at least about $0.09 L_{OCW}$.

[0048] As illustrated in FIG. 3, the central segment portion 136 can include a leading radial sidewall 180 that can extend from the outer circumferential wall 142 of the inner segment portion 132 to the inner circumferential wall 160 of the outer segment portion 134. The central segment portion 136 can also include a trailing radial sidewall 182 that can extend from the outer circumferential wall 142 of the inner segment portion 132 to the inner circumferential wall 160 of the outer segment portion 134. In a particular aspect, the leading radial sidewall 180 of the central segment portion 136 can establish an acute angle, α , with respect to the outer circumferential wall 142 of the inner segment portion 132 and an obtuse angle, β , with respect the inner circumferential wall 160 of the outer segment portion 136.

[0049] In a particular aspect, α can be not greater than about 90° , such as not greater than about 75° , not greater than about 70° , not greater than about 65° , or not greater than about 60° . Moreover, α can be at least about 40° , such as at least about 45° , at least about 50° , or at least about 55° . Further, α can be within a range between and including any of the values of α described herein. For example, α can be not greater than about 90° and at least about 40° , such as not greater than about 90° and at least about 45° , not greater than about 90° and at least about 50° , or not greater than about 90° and at least about 55° . Further, α can be not greater than about 75° and at least about 40° , such as not greater than about 75° and at least about 45° , not greater than about 75° and at least about 50° , or not greater than about 75° and at least about 55° . Additionally, α can be not greater than about 70° and at least about 40° , such as not greater than about 70° and at least about 45° , not greater than about 70° and at least about 50° , or not greater than about 70° and at least about 55° . In another aspect, α can be not greater than about 65° and at least about 40° , such as not greater than about 65° and at least about 45° , not greater than about 65° and at least about 50° , or not greater than about 65° and at least about 55° . Still further, α can be not greater than about 60° and at least about 40° , such as not greater than about 60° and at least about 45° , not greater than about 60° and at least about 50° , or not greater than about 60° and at least about 55° .

[0050] In another aspect, β can be greater than about 90° , such as at least about 115° , at least about 120° , at least about 125° , or at least about 130° . Moreover, β can be not greater than about 150° , such as not greater than about 145° , not greater than about 140° , or not greater than about 135° . In another aspect, β can be within a range between and including any of the maximum and minimum values of β described herein. For example, β can be greater than about 90° and not greater than about 150° , such

as greater than about 90° and not greater than about 145° , greater than about 90° and not greater than about 140° , or greater than about 90° and not greater than about 135° . Additionally, β can be at least about 115° and not greater than about 150° , such as at least about 115° and not greater than about 145° , at least about 115° and not greater than about 140° , or at least about 115° and not greater than about 135° . Further, β can be at least about 120° and not greater than about 150° , such as at least about 120° and not greater than about 145° , at least about 120° and not greater than about 140° , or at least about 120° and not greater than about 135° . Further still, β can be at least about 125° and not greater than about 150° , such as at least about 125° and not greater than about 145° , at least about 125° and not greater than about 140° , or at least about 125° and not greater than about 135° . Even further, β can be at least about 130° and not greater than about 150° , such as at least about 130° and not greater than about 145° , at least about 130° and not greater than about 140° , or at least about 130° and not greater than about 135° .

[0051] As best indicated in FIG. 9, each serrated portion 150, 170 can include a plurality of serrations 190. Each serration includes a leading edge 192, a trailing edge 194, and a ramped surface 196 extending there between. In particular, each ramped surface 196 can extend at an angle, γ , into the first grinding face 148 or the second grinding face 168 from the trailing edge 194 to the leading edge 192. In a particular aspect, γ can be at least about 10° , such as at least about 12.5° , or at least about 15° . Further, γ can be not greater than about 30° , such as not greater than about 25° , or not greater than about 20° . In another aspect, γ can be within a range between and including any of the maximum and minimum values described herein.

[0052] For example, γ can be at least about 10° and not greater than about 30° , such as at least about 10° and not greater than about 25° , or at least about 10° and not greater than about 20° . Further, γ can be at least about 12.5° and not greater than about 30° , such as at least about 12.5° and not greater than about 25° , or at least about 12.5° and not greater than about 20° . Still further, γ can be at least about 15° and not greater than about 30° , such as at least about 15° and not greater than about 25° , or at least about 15° and not greater than about 20° .

[0053] In a particular aspect, the abrasive segment 120 can include a thickness, T_{AS} , measured from a rear face to a front face, e.g., the first grinding face 148 or the second grinding face 168. The trailing edge 194 of each serration 190 can extend a distance, D_{TES} , out from the first grinding face 148 or the second grinding face 168 and measured perpendicular to the first grinding face 148 or the second grinding face 168 and D_{TES} can be not greater than about $0.125 T_{AS}$, such as not greater than about $0.1 T_{AS}$, not greater than about $0.075 T_{AS}$, or not greater than about $0.05 T_{AS}$. Moreover, D_{TES} can be at least about $0.0075 T_{AS}$, such as at least about $0.01 T_{AS}$, at least about $0.0125 T_{AS}$, or at least about $0.015 T_{AS}$. In another aspect, D_{TES} can be within a range between and including any of the maximum or minimum values of D_{TES} described herein.

[0054] For example, D_{TES} can be not greater than about $0.125 T_{AS}$ and at least about $0.0075 T_{AS}$, such as not greater than about $0.125 T_{AS}$ and at least about $0.01 T_{AS}$, not greater than about $0.125 T_{AS}$ and at

least about $0.0125 T_{AS}$, or not greater than about $0.125 T_{AS}$ and at least about $0.015 T_{AS}$. Further, D_{TES} can be not greater than about $0.1 T_{AS}$ and at least about $0.0075 T_{AS}$, such as not greater than about $0.1 T_{AS}$ and at least about $0.01 T_{AS}$, not greater than about $0.1 T_{AS}$ and at least about $0.0125 T_{AS}$, or not greater than about $0.1 T_{AS}$ and at least about $0.015 T_{AS}$. Further still, D_{TES} can be not greater than about $0.075 T_{AS}$ and at least about $0.0075 T_{AS}$, such as not greater than about $0.075 T_{AS}$ and at least about $0.01 T_{AS}$, not greater than about $0.075 T_{AS}$ and at least about $0.0125 T_{AS}$, or not greater than about $0.075 T_{AS}$ and at least about $0.015 T_{AS}$. Even further, D_{TES} can be not greater than about $0.05 T_{AS}$ and at least about $0.0075 T_{AS}$, such as not greater than about $0.05 T_{AS}$ and at least about $0.01 T_{AS}$, not greater than about $0.05 T_{AS}$ and at least about $0.0125 T_{AS}$, or not greater than about $0.05 T_{AS}$ and at least about $0.015 T_{AS}$.

[0055] The leading edge 192 of each serration 190 can extend a distance, D_{LES} , into the first grinding face 148 or the second grinding face 168 and measured perpendicular to the first grinding face 148 or the second grinding face 168, and D_{LES} can be not greater than about $0.125 T_{AS}$, such as not greater than about $0.1 T_{AS}$, not greater than about $0.075 T_{AS}$, or not greater than about $0.05 T_{AS}$. Moreover, D_{LES} can be at least about $0.0075 T_{AS}$, such as at least about $0.01 T_{AS}$, at least about $0.0125 T_{AS}$, or at least about $0.015 T_{AS}$. In another aspect, D_{LES} can be within a range between and including any of the maximum or minimum values of D_{LES} described herein.

[0056] For example, D_{LES} can be not greater than about $0.125 T_{AS}$ and at least about $0.0075 T_{AS}$, such as not greater than about $0.125 T_{AS}$ and at least about $0.01 T_{AS}$, not greater than about $0.125 T_{AS}$ and at least about $0.0125 T_{AS}$, or not greater than about $0.125 T_{AS}$ and at least about $0.015 T_{AS}$. Further, D_{LES} can be not greater than about $0.1 T_{AS}$ and at least about $0.0075 T_{AS}$, such as not greater than about $0.1 T_{AS}$ and at least about $0.01 T_{AS}$, not greater than about $0.1 T_{AS}$ and at least about $0.0125 T_{AS}$, or not greater than about $0.1 T_{AS}$ and at least about $0.015 T_{AS}$. Further still, D_{LES} can be not greater than about $0.075 T_{AS}$ and at least about $0.0075 T_{AS}$, such as not greater than about $0.075 T_{AS}$ and at least about $0.01 T_{AS}$, not greater than about $0.075 T_{AS}$ and at least about $0.0125 T_{AS}$, or not greater than about $0.075 T_{AS}$ and at least about $0.015 T_{AS}$. Even further, D_{LES} can be not greater than about $0.05 T_{AS}$ and at least about $0.0075 T_{AS}$, such as not greater than about $0.05 T_{AS}$ and at least about $0.01 T_{AS}$, not greater than about $0.05 T_{AS}$ and at least about $0.0125 T_{AS}$, or not greater than about $0.05 T_{AS}$ and at least about $0.015 T_{AS}$.

[0057] In another particular aspect, the abrasive segment 120 can include a central axis 200 that can extend through a center 202 of curvature of the abrasive segment and bisect the leading radial sidewall 180 of the central segment portion 136 of the abrasive segment 120. In this aspect, the first serrated portion 150 on the first segment portion 132 can lie entirely behind the central axis 200 with respect to a direction of rotation of the abrasive segment 120. Further, the second serrated portion 170 on the second segment portion 134 can lie entirely ahead of the central axis 200 with respect to a direction of rotation of the abrasive segment 120.

[0058] Further, in a particular aspect, a portion of the inner segment portion 132 can extend ahead of the leading radial sidewall 180 of the central segment portion 136 with respect to the direction of rotation. Moreover, a portion of the outer segment portion 134 can extend behind the trailing radial sidewall 182 of the central segment portion 136 with respect to the direction of rotation.

[0059] In a particular aspect, the mounting body 102 of the abrasive article 100 described herein can be in the form of a cup, a ring, a ring section, a plate, or a disc depending upon the intended application of the abrasive article. The mounting body 102 can be made of a metal or metal alloy. For instance, the mounting body 102 can be made of steel, and particularly, a heat treatable steel alloys, such as 25CrMo4, 75Cr1, C60, or similar steel alloys for a core having a thin cross section or simple construction steel like St 60 or similar for a thick core. The mounting body 102 can have a tensile strength of at least about 600 N/mm². The mounting body 102 can be formed by a variety of metallurgical techniques known in the art.

[0060] In an exemplary embodiment, the abrasive segments 120 can include abrasive particles embedded in a bond matrix. In a particular aspect, the bond matrix can include a metal matrix having a network of interconnected pores. The abrasive particles can include an abrasive material having a Mohs hardness of at least about 7. In particular instances, the abrasive particles can include a superabrasive material, such as diamond or cubic boron nitride. The abrasive particles can have a particle size of not less than about 400 US mesh, such as not less than about 100 US mesh, such as between about 25 and 80 US mesh. Depending on the application, the size can be between about 30 and 60 US mesh.

[0061] The abrasive particles can be present in an amount between about 2 vol% to about 50 vol%. Additionally, the amount of abrasive particles may depend on the application. For example, an abrasive segment for a grinding or polishing tool can include between about 3.75 and about 50 vol% abrasive particles of the total volume of the abrasive segment. Alternatively, an abrasive segment for a cutting-off tool can include between about 2 vol% and about 6.25 vol% abrasive particles of the total volume of the abrasive segment. Further, an abrasive segment for core drilling can include between about 6.25 vol% and about 20 vol% abrasive particles of the total volume of the abrasive segment.

[0062] The metal matrix can include a metal element or metal alloy including a plurality of metal elements. For certain abrasive segments, the metal matrix can include metal elements such as iron, tungsten, cobalt, nickel, chromium, titanium, silver, and a combination thereof. In particular instances, the metal matrix can include a rare earth element such as cerium, lanthanum, neodymium, and a combination thereof.

[0063] In one particular example, the metal matrix can include a wear resistant component. For example, in one embodiment, the metal matrix can include tungsten carbide, and more particularly, may consist essentially of tungsten carbide.

[0064] In certain designs, the metal matrix can include particles of individual components or pre-alloyed particles. The particles can be between about 1.0 microns and about 250 microns.

[0065] In a particular aspect, the abrasive segments 120 can be formed such that an infiltrant is present within the interconnected network of pores within the body of the abrasive segment 120. The infiltrant can partially fill, substantially fill, or even completely fill the volume of the pores extending through the volume of the abrasive segment 120. In accordance with one particular design, the infiltrant can be a metal or metal alloy material. For example, some suitable metal elements can include copper, tin, zinc, and a combination thereof. In another example, the infiltrant can be only copper.

[0066] In particular instances, the infiltrant can be a bronzing material made of a metal alloy, and particular a copper-tin metal alloy, such that it is particularly suited for welding according to embodiments herein. For example, the bronzing material can consist essentially of copper and tin. Certain bronzing materials can incorporate particular contents of tin greater than about 5% by weight, such as greater than about 6% by weight, greater than about 7% by weight, or even greater than about 8% by weight. Further, certain bronzing materials can incorporate particular contents of tin less than about 20% by weight, such as less than about 15% by weight, less than about 12% by weight, or even less than about 10% by weight of the total amount of materials within the composition.

[0067] In accordance with an embodiment, the bronzing material can include an amount of tin within a range between and including about 5% by weight and about 20% by weight, such as between and including about 5% by weight and about 15% by weight, between and including about 5% by weight and about 12% by weight, or between and including about 5% by weight and about 10% by weight.

[0068] In another embodiment, the bronzing material can include an amount of tin within a range between and including about 6% by weight and about 20% by weight, such as between and including about 6% by weight and about 15% by weight, between and including about 6% by weight and about 12% by weight, or between and including about 6% by weight and about 10% by weight.

[0069] Further, in yet another embodiment, the bronzing material can include an amount of tin within a range between and including about 7% by weight and about 20% by weight, such as between and including about 7% by weight and about 15% by weight, between and including about 7% by weight and about 12% by weight, or between and including about 7% by weight and about 10% by weight.

[0070] Still further, in accordance with another embodiment, the bronzing material can include an amount of tin within a range between and including about 8% by weight and about 20% by weight, such as between and including about 8% by weight and about 15% by weight, between and including about 8% by weight and about 12% by weight, or between and including about 8% by weight and about 10% by weight.

[0071] Moreover, certain bronzing materials can be used as infiltrant material, and can have an amount of copper of at least about 50%, at least about 60%, at least about 70%, at least about 80%, at least about 85%, or even at least about 88% by weight of the total amount of materials within the

composition. Some bronzing materials can utilize an amount of copper within a range between about 50% and about 95%, such as between about 85% and about 95%, or even between about 88% and about 93% by weight of the total amount of materials within the composition. The copper amount also can be in a range between any of these minimum and maximum values.

[0072] Additionally, the bronzing material may contain a particularly low content of other elements, such as zinc to facilitate proper formation of the abrasive article according to the forming methods of the embodiments herein. For example, the bronzing material may utilize not greater than about 10%, such as not greater than about 5%, or even not greater than about 2% zinc. In fact, certain bronzing materials can be essentially free of zinc.

[0073] The abrasive segment 120 may be manufactured, such that abrasive particles can be combined with a metal matrix to form a mixture. The metal matrix can include a blend of particles of the components of the metal matrix or can be pre-alloyed particles of the metal matrix. In an embodiment, the metal matrix can conform to the formula $(WC)_w W_x Fe_y Cr_z X_{(1-w-x-y-z)}$, wherein not greater than about 0.8, not greater than about 0.7, not greater than about 0.8, not greater than about 0.05, $w+x+y+z$ not greater than about 1, and X can include other metals such as cobalt and nickel. In another embodiment, the metal matrix can conform to the formula $(WC)_w W_x Fe_y Cr_z Ag_v X_{(1-w-x-y-z)}$, wherein not greater than about 0.5, not greater than about 0.4, not greater than about 1.0, not greater than about 0.05, not greater than about 0.1, $v+w+x+y+z$ not greater than about 1, and X can include other metals such as cobalt and nickel.

[0074] The mixture of metal matrix and abrasive particles can be formed into an abrasive preform by a pressing operation, particularly a cold pressing operation, to form a porous abrasive segment. The cold pressing can be carried out at a pressure within a range between and including about 50 kN/cm² (500 MPa) to about 250 kN/cm² (2500 MPa). The resulting porous abrasive segment can have a network of interconnected pores. In an example, the porous abrasive segment can have a porosity between about 25 vol% and 50 vol%.

[0075] The resulting porous abrasive segment 120 can then be subject to an infiltration process, wherein the infiltrant material is disposed within the body of the abrasive segment, and particularly, disposed within the interconnected network of pores within the body of the abrasive segment. The infiltrant may be drawn into the pores of the cold pressed abrasive segment via capillary action. After the infiltration process, the resulting densified abrasive segment can be not less than about 96% dense. The amount of infiltrant that infiltrates the abrasive segment can be between about 20 wt% and 45 wt% of the densified abrasive segment.

[0076] The abrasive segment 120 can include a backing region, disposed between the abrasive segment and the base, i.e., the mounting body 102, which facilitates the joining of the abrasive segment and the mounting body 102. According to one embodiment, the backing region can be a

distinct region from the abrasive segment 120 and the mounting body 102. Still, the backing region can be initially formed as part of the abrasive segment 120, and particularly may be a distinct region of the abrasive segment 120 along a bottom surface of the abrasive segment 120 that has particular characteristics facilitating the joining of the abrasive segment 120 and the mounting body 102. For example, according to one embodiment, the backing region can have a lesser percentage (vol%) of abrasive particles as compared to the amount of abrasive particles within the abrasive segment 120. In fact, in certain instances, the backing region can be essentially free of abrasive particles. This may be particularly suitable for forming methods utilizing a beam of energy (e.g., a laser) used to weld the abrasive segment 120 to the mounting body 102.

[0077] At least a portion of the backing region can include a bonding composition. The bonding composition can include a metal or metal alloy. Some suitable metal materials can include transition metal elements, including for example, titanium, silver, manganese, phosphorus, aluminum, magnesium, chromium, iron, lead, copper, tin, and a combination thereof.

[0078] In particular instances, the bonding composition can be similar to the infiltrant, such that the bonding composition and the infiltrant are different from each other by not greater than a single elemental species. In even more particular instances, the bonding composition can be the same as the infiltrant. According to embodiments herein, the bonding composition can be related to the infiltrant composition in having a certain degree of commonality of elemental species. Quantitatively, an elemental weight percent difference between the bonding composition and the infiltrant composition does not exceed 20 weight percent. Elemental weight percent difference is defined as the absolute value of the difference in weight content of each element contained in the bonding composition relative to the infiltrant composition. Other embodiments have closer compositional relationships between the bonding composition and the composition of the infiltrant. The elemental weight percent difference between the bonding composition and the infiltrant composition may, for example, not exceed 15 weight percent, 10 weight percent, 5 weight percent, or may not exceed 2 weight percent. An elemental weight percent difference of about zero represents the same composition making up the backing region and the infiltrant. The foregoing elemental values may be measured by any suitable analytical means, including microprobe elemental analysis, and ignores alloying that might take place along areas in which the infiltrant contacts the metal matrix.

[0079] The backing region can include at least about 90 wt% infiltrant, such as at least about 95 wt% infiltrant, such as at least about 98 wt% infiltrant. The infiltrant can be continuous throughout the backing region and the densified abrasive segment. In certain instances, the backing region can be formed primarily of the infiltrant material, and in more particular instances, can consist essentially of the infiltrant material. Still, in other embodiments, the backing region can be an infiltrated region, like the abrasive segment. Accordingly, the backing region can include a network of interconnected pores formed between a matrix metal, and wherein the infiltrant material substantially fills the interconnected pores. The backing region can contain similar amounts of matrix metal and infiltrant.

Notably, the backing region may be essentially free of abrasive particles. In such embodiments wherein the backing region includes interconnected pores substantially filled with the infiltrant, the infiltrant material can act as a bronzing material in forming a joint (e.g., a welded joint) between the base and the abrasive segment.

[0080] In one embodiment, the backing region can be formed of the bronzing material described herein. In fact, certain backing regions can consist essentially of a copper-tin bronzing material having about 88% copper and 12% tin or 90% copper and 10% tin.

[0081] In a particular aspect, a method of making the abrasive article 100 can include stamping, cutting, molding, infiltrating, and a combination thereof. The method can include affixing the abrasive segments 120 to the mounting body 102. Affixing the abrasive segments 120 to the mounting body 102 (or other intermediate component) can include welding the abrasive segments 120 to the mounting body 102. In particular, the welding process can include impinging a beam of energy at the base of each abrasive segment 120. More particularly, in the instance of a abrasive segment 120 having a backing region, welding can include impinging a beam of energy at the backing region between the abrasive segment 120 and the mounting body 102. In particular instances, the beam of energy can be a laser, such that each abrasive segment 120 is attached to the mounting body 102 via a laser welded bond joint. The laser may be a Roffin laser source commonly available from Dr. Fritsch, GmbH. It will be appreciated that all description of methods of bonding the abrasive segment to the mounting body will be the same for bonding or coupling of the abrasive segments to any intervening components described herein, including for example, a dampening member.

[0082] In one aspect, each abrasive segment 120 can be formed by pressing a green segment in a mold and curing the green segment. The pressing can include hot pressing or cold pressing. In another aspect, forming each abrasive segment 120 can include sintering a green segment, e.g., using an electro-discharge sintering process. In yet another aspect, forming each abrasive segment 120 can include the infiltration method described herein.

[0083] In another aspect, each abrasive segment 120 can be include a single layer metal bond ("SLMB") segment having a core and a single layer of abrasive electro-plated, or otherwise deposited, on a cutting, or grinding surface of the core.

[0084] , wherein at least a portion of the dampening member is configured to be in direct contact with a portion of the mounting body, wherein at least a portion of the dampening member is configured to be in direct contact with an annular rim portion of the mounting body.

[0085] As illustrated in the embodiments provided in FIG. 9 and FIG. 10, the abrasive article may include a dampening member that can be coupled to the mounting body 102 and the abrasive segment 120. According to one embodiment, the dampening member 1030 can have a generally an annular shape, which can be defined by a first major surface 1033, a second major surface 1034 spaced apart from the first major surface 1033, and interior annular surface 1032 extending between the first major surface 1033 and the second major surface 1034. The interior annular surface 1032 can define a

central opening 1038 extending through the dampening member 1030. The dampening member 1030 may further including an outer peripheral surface 1031 separating the first major surface 1033 and the second major surface 1034.

[0086] In certain instances, the dampening member 1030 can include a material different than a material of the mounting body 102, and more particularly, may include a material having a hardness less than a hardness of the mounting body 102. The dampening member 1030 may facilitate absorbing vibrations and shocks during use (such as grinding), which can facilitate improved use conditions for a user and improved results on the workpiece. In one embodiment, the dampening member 1030 can include a material selected from the group consisting of inorganic materials, organic materials, natural materials, synthetic materials, and a combination thereof. More particularly, the dampening member 1030 may include a material selected from the group consisting of a metal, a metal alloy, a polymer, a resin, an elastomer, a thermoplastic, a thermoset, an adhesive, and a combination thereof. In one instance, the dampening member 1030 can include copper, and may consist essentially of copper. In another embodiment, the dampening member 1030 include rubber, and can consist essentially of rubber. In still another design, the dampening member 1030 can be an adhesive material, which may be in the form of a layer (continuous or interrupted), which can be disposed between at least one Z-shaped abrasive segment 120 and the mounting body 102. According to one particular embodiment, the dampening member 1030 can be permanently adhered to the mounting body 102.

[0087] In one aspect, the dampening member 1030 can have an elastic modulus less than an elastic modulus of the mounting body 102. For example, in certain instances, the dampening member 1030 can have an elastic modulus of less than about 200 GPa, such as less than about 180 GPa, less than about 150 GPa, less than about 120 GPa, less than about 100 GPa, less than about 80 GPa, less than about 50 GPa, less than about 30 GPa, or even less than about 10 GPa. Still, the dampening member 1030 can have an elastic modulus of at least about 0.01 MPa.

[0088] The dampening member 1030 can have a particular shape to facilitate use. For example, the dampening member 1030 can have an aspect ratio (D/t) of at least about 1.5, wherein D is a diameter of the body of the dampening member 1030 measured as a greatest distance between points on an outer peripheral surface 1031 and extending through a center point. The " t " can represent the thickness of the body of the dampening member 1030 measured as a distance between the first major surface 1033 and the second major surface 1034, and more particularly, can be the smallest distance between the first major surface 1033 and second major surface 1034 at the outer peripheral surface 1031 or interior annular surface 1032. In certain instances, the aspect ratio (D/t) of the dampening member can be at least about 2, such as at least about 3, or even at least about 4.

[0089] In at least one embodiment, the dampening member 1030 can have a recess 1035. The recess 1035 can be in a portion of the first major surface 1033 of the dampening member 1030. Moreover, in certain designs, the dampening member 1030 can have a recess 1035 in the first major surface

1033, which is configured to engage and center the mounting body 102 relative to the dampening member. More particularly, the annular rim portion 116 of the mounting body 102 can be configured to engage a portion of the recess 1035.

[0090] As shown in FIG. 10, and more particularly in the cross-sectional view of a portion of the dampening member of FIG. 12, the dampening member 1030 may also include a lip 1036 extending axially from an outer peripheral surface 1031 of the dampening member 1030 and defining at least a portion of the recess 1035 at the first major surface 1033 of the dampening member 1030. The lip 1036 can have an inner axial lip surface 1037, such that at least a portion of the mounting body 102 is configured to engage a portion of the inner axial lip surface 1037 when the abrasive article is assembled. More particularly, a portion of an outer peripheral surface 1031 of an annular rim portion 116 of the mounting body 102 can be configured to engage a portion of the inner axial lip surface 1037.

[0091] In particular instances, as shown in FIG. 12, the recess 1035 can have a depth (d_r) of at least about $0.03(t_{dm})$, wherein t_{dm} represents a thickness of the dampening member 1030 defined as a distance along an interior annular surface 1032 extending between the first major surface 1033 and the second major surface 1034. In other instances, the depth of the recess 1035 can be at least about $0.05(t_{dm})$, at least about $0.08(t_{dm})$, at least about $0.1(t_{dm})$, at least about $0.15(t_{dm})$, or even at least about $0.2(t_{dm})$. Yet, in another embodiment, the recess 1035 can have a depth of not greater than about $0.9(t_{dm})$, such as not greater than about $0.5(t_{dm})$. It will be appreciated that the depth of the recess 1035 can be within a range between any of the maximum and minimum values noted above.

[0092] The dampening member 1030 can have an annular channel 1040 extending through at least a portion a second major surface 1034 of the dampening member 1030. According to one embodiment, the annular channel 1040 can have an interior annular surface 1041, an outer annular surface 1042, and a bottom surface 1043 extending between the interior annular surface 1041 and the outer annular surface 1042. For at least one design, the annular channel 1040 can extend axially into a portion of the body of the dampening member 1030 from the second major surface 1034. For example, the annular channel 1040 can have a depth (d_{ac}) defined by a length of the interior annular surface 1041 or the outer annular surface 1042, and more particularly, a distance between the bottom surface 1043 and the second major surface 1034. According to one particular embodiment, the depth (d_{ac}) of the annular channel 1040 can be less than a thickness (t_{dm}) of the dampening member 1030.

[0093] For certain designs of the embodiments herein, the annular channel 1040 can have an average width (w_{ac}) less than an average width (w_{dm}) of the dampening member 1030. The average width (w_{ac}) of the annular channel 1040 can be a distance between the interior annular surface 1041 and the outer annular surface 1042, and the average width (w_{dm}) of the dampening member 1030 can be a distance between the interior annular surface 1032 and the outer peripheral surface 1031.

[0094] The second major surface 1034 of the dampening member 1030 can have an inner annular portion 1045 and an outer annular portion 1046 separated by the annular channel 1040. In one

embodiment, at least a portion of the inner annular portion 1045 can be configured to engage at least a portion of the curved inner segment portion 132 of one or more Z-shaped abrasive segments, and at least a portion of the outer annular portion 1046 can be configured to engage at least a portion of the curved outer segment portion 136 of one or more Z-shaped abrasive segments 120. Moreover, the central segment portion 136 of the Z-shaped abrasive segment 120 can span and be spaced apart from the annular channel 1040 in the second major surface 1034 of the dampening member 1030. For certain embodiments, the width (w_{iap}) of the inner annular portion 1045 can be different than a width (w_{oap}) of the outer annular portion 1046. The width of the inner annular portion 1045 can be a measure of a radial distance between an interior annular surface 1032 of the dampening member 1030 and the interior annular surface 1041 of the annular channel 1040. The width (w_{oap}) of the outer annular portion 1046 can be a measure of a radial distance between the outer annular surface 1042 of the annular channel 1040 and an outer peripheral surface 1031 of the dampening member 1030.

[0095] According to another embodiment, the dampening member 1030 can also include at least one (e.g., a first) borehole 1050, which can be configured to engage a portion of a fastener 1060. The borehole 1050 can extend through the entire thickness of the dampening member 1030 from a first major surface 1033 to a second major surface 1034. In certain instances, the borehole 1050 can have a first opening having a first diameter 1051 at the first major surface 1033 and a second opening 1052 having a second diameter different than the first diameter at the second major surface 1034 of the dampening member 1030. The use of a borehole 1050 with different diameters at the first major surface 1033 and second major surface 1034 may facilitate securing the mounting body 102 and dampening member 1030 to each other using particular fasteners described herein. The dampening member 1030 can have a plurality of boreholes, and more particularly, the plurality of boreholes can be substantially, evenly distributed with respect to each other throughout a circumferential distance around the dampening member.

[0096] The abrasive article, such as the article illustrated in FIGs. 10-11 may further include a fastener 1060. FIG. 14 includes a perspective view illustration of fastener 1060 engaged with a portion of the mounting body 102 according to an embodiment. The fastener 1060 can be configured to couple the mounting body 102 and the dampening member 1030 to each other. More particularly, in certain instances, the fastener 1060 can be configured to engage a fastener opening 1068 in the mounting body 102. The fastener 1060 can have a head 1061 and a stud 1062 extending from the head 1061. In one embodiment, the stud 1062 can have a substantially smooth surface, such that it may be unthreaded. Moreover, in one design, the stud 1062 can have at least one groove 1063 proximate to a distal end 1064 of the stud 1062. The groove 1063 can extend circumferentially around the stud 1062. The groove 1063 can be configured to engage a clamping member 1080 after extending through the mounting body 102 and the dampening member 1030 to contain the fastener 1060 in the borehole 1050 and removably couple the dampening member 1030 to the mounting body 102. The stud 1062 can be configured to extend axially through a thickness of an annular rim portion

116 and a borehole 1050 of the dampening member 1030. Removable coupling of the mounting body 102 and the dampening member 1030 can facilitate maintenance of the components, which can include replacement of the dampening member 1030 without destruction or disposal of the mounting body 102.

[0097] It will be appreciated that the abrasive article can include a plurality of fasteners, wherein each fastener 1060 of the plurality of fasteners is configured to engage and couple the mounting body 102 and the dampening member 1030.

[0098] The abrasive articles of the embodiments herein can further include at least one sealing member 1070, which can be configured to engage at least one fastener 1060. In one particular non-limiting design, the fastener 1060 can extend between the mounting body 102 and the dampening member 1030, and the sealing member 1070 can be configured to engage a surface of the dampening member 1030. The sealing member 1070 can further engage at least a portion of the annular rim portion 116 of the mounting body 102. According to one embodiment, the sealing member 1070 can be configured to engage a first major surface 1033 of the dampening member 1030. The sealing member 1070 may also be configured to engage a recess 1035 of the dampening member 1030. As illustrated in one particular embodiment, the sealing member 1070 may be an annular member configured to engage and wrap around a portion of a stud 1062 of a fastener 1060.

[0099] In the foregoing, reference to specific embodiments and the connections of certain components is illustrative. It will be appreciated that reference to components as being coupled or connected is intended to disclose either direct connection between said components or indirect connection through one or more intervening components as will be appreciated to carry out the methods as discussed herein. As such, the above-disclosed subject matter is to be considered illustrative, and not restrictive, and the appended claims are intended to cover all such modifications, enhancements, and other embodiments, which fall within the true scope of the present invention. Thus, to the maximum extent allowed by law, the scope of the present invention is to be determined by the broadest permissible interpretation of the following claims and their equivalents, and shall not be restricted or limited by the foregoing detailed description.

[00100] The Abstract of the Disclosure is provided to comply with Patent Law and is submitted with the understanding that it will not be used to interpret or limit the scope or meaning of the claims. In addition, in the foregoing Detailed Description of the Drawings, various features may be grouped together or described in a single embodiment for the purpose of streamlining the disclosure. This disclosure is not to be interpreted as reflecting an intention that the claimed embodiments require more features than are expressly recited in each claim. Rather, as the following claims reflect, inventive subject matter may be directed to less than all features of any of the disclosed embodiments. Thus, the following claims are incorporated into the Detailed Description of the Drawings, with each claim standing on its own as defining separately claimed subject matter.

WHAT IS CLAIMED IS:

1. An abrasive article comprising:
a mounting body;
a dampening member coupled to the mounting body; and
a Z-shaped abrasive segment coupled to the mounting body.
2. An abrasive article comprising:
a mounting body comprising a cup-shape contour;
a dampening member coupled to the mounting body; and
a Z-shaped abrasive segment coupled to the mounting body.
3. An abrasive article comprising:
a mounting body;
a dampening member coupled to the mounting body;
a sealing member disposed between the mounting body and the dampening member; and
a Z-shaped abrasive segment coupled to the mounting.
4. The abrasive article of any one of the preceding claims, wherein the mounting body comprises a cup-shaped body including an annular rim portion, wherein the mounting body comprises an annular rim portion including an outer peripheral surface, an inner peripheral surface, and an annular rim surface extending between the outer peripheral surface and an inner peripheral surface, wherein the dampening member is configured to be coupled to at least a portion of the annular rim surface.
5. The abrasive article of any one of the preceding claims, wherein the mounting body comprises an intermediate portion extending from an annular rim portion, wherein the intermediate portion comprises a intermediate portion surface extending in a plane different than a plane defined by an annular rim surface of the annular rim portion, wherein the intermediate portion surface is tapered relative to the annular rim portion, wherein the intermediate portion defines an arcuate surface, wherein the intermediate portion defines a bowl-shape, wherein the intermediate portion comprises at least one opening.
6. The abrasive article of any one of the preceding claims, wherein the mounting body comprises an arbor portion coupled to an intermediate portion of the mounting body, wherein the arbor portion comprises a central opening.
7. The abrasive article of any one of the preceding claims, wherein the mounting body comprises an inorganic material, wherein the mounting body comprises a metal, wherein the mounting body comprise iron, wherein the mounting body comprises steel.
8. The abrasive article of any one of the preceding claims, wherein at least a portion of the dampening member is configured to be in direct contact with a portion of the mounting body, wherein at least a portion of the dampening member is configured to be in direct contact with an annular rim portion of the mounting body.

9. The abrasive article of any one of the preceding claims, wherein the dampening member has an annular shape comprising a first major surface, a second major surface spaced apart from the first major surface, an interior annular surface extending between the first major surface and the second major surface, wherein the interior annular surface defines a central opening extending through the dampening member, and an outer peripheral surface separating the first major surface and the second major surface.

10. The abrasive article of any one of the preceding claims, wherein the dampening member comprises a material different than a material of the mounting body, wherein the dampening member comprises a material having a hardness less than a hardness of the mounting body, wherein the dampening member comprises a material selected from the group consisting of inorganic materials, organic materials, natural materials, synthetic materials, and a combination thereof, wherein the dampening member comprises a material selected from the group consisting of a metal, a metal alloy, a polymer, a resin, an elastomer, a thermoplastic, a thermoset, an adhesive, and a combination thereof, wherein the dampening member comprises copper, wherein the dampening member comprises rubber, wherein the dampening member is an adhesive layer disposed between the Z-shaped abrasive segment and the mounting body, wherein the dampening member is permanently adhered to the mounting body.

11. The abrasive article of any one of the preceding claims, wherein the dampening member has an elastic modulus less than an elastic modulus of the mounting body, wherein the dampening member comprises an elastic modulus of less than about 200 GPa, less than about 180 GPa, less than about 150 GPa, less than about 120 GPa, less than about 100 GPa, less than about 80 GPa, less than about 50 GPa, less than about 30 GPa, less than about 10 GPa.

12. The abrasive article of any one of the preceding claims, wherein the dampening member comprises an aspect ratio (D/t) of at least about 1.5, wherein D is a diameter measured as a greatest distance between points on an outer peripheral surface extending through a center point, and t represents a thickness measured as a distance between a first major surface and a second major surface, wherein the aspect ratio is at least about 2, at least about 3, at least about 4.

13. The abrasive article of any one of the preceding claims, wherein the dampening member comprises a recess, wherein a first major surface of the dampening member comprises a recess, wherein the dampening member comprises a recess configured to engage and center the mounting body, wherein an annular rim portion of the mounting body is configured to engage a portion of the recess, wherein the dampening member further comprises a lip extending axially from an outer peripheral surface of the dampening member and defining the recess at the first major surface of the dampening member, wherein the lip comprises an inner axial lip surface, wherein at least a portion of the mounting body is configured to engage a portion of the inner axial lip surface, wherein a portion of an outer peripheral surface of an annular rim portion of the mounting body is configured to engage a portion of the inner axial lip surface.

14. The abrasive article of any one of the preceding claims, wherein the dampening member comprises a recess, wherein a first major surface of the dampening member comprises a recess, wherein the recess comprises a depth of at least about $0.03(t)$, wherein t represents a thickness of the dampening member defined as a distance along an interior annular surface extending between the first major surface and the second major surface, at least about $0.05(t)$, at least about $0.08(t)$, at least about $0.1(t)$, at least about $0.15(t)$, at least about $0.2(t)$, and not greater than about $0.9(t)$, not greater than about $0.5(t)$.

15. The abrasive article of any one of the preceding claims, wherein the dampening member further comprises an annular channel extending through at least a portion of a second major surface of the dampening member, wherein the annular channel comprises an interior annular surface, an outer annular surface, and a bottom surface extending between the interior annular surface and the outer annular surface, wherein the annular channel extends axially into a portion of the body of the dampening member from the second major surface, wherein the annular channel has a depth defined by a length of one of the interior annular surface and the outer annular surface that is less than a thickness of the dampening member measured as a length of one of an interior annular surface and an outer peripheral surface.

16. The abrasive article of claim 15, wherein the annular channel has an average width less than an average width of the dampening member, wherein the average width of the annular channel is a distance between the interior annular surface and the outer annular surface, and the average width of the dampening member is a distance between the interior annular surface and the outer peripheral surface.

17. The abrasive article of any one of the preceding claims, wherein the second major surface further comprises an inner annular portion and an outer annular portion separated by the annular channel, wherein at least a portion of the inner annular portion is configured to engage at least a portion of a first arm of the Z-shaped abrasive segment, and at least a portion of the outer annular portion is configured to engage at least a second arm of the Z-shaped segment, wherein the width of the inner annular portion is different than a width of the outer annular portion, wherein the width of the inner annular portion is a measure of a radial distance between an inner annular surface of the dampening member and the interior annular surface of the annular channel, and wherein the width of the outer annular portion is a measure of a radial distance between the outer annular surface of the annular channel and an outer peripheral surface of the dampening member.

18. The abrasive article of any one of the preceding claims, wherein the dampening member further comprises a first borehole, wherein the borehole is configured to engage a portion of a fastener, wherein the borehole extends through the entire thickness of the dampening member from a first major surface to a second major surface, wherein the borehole has a first opening having a first diameter at the first major surface and a second opening having a second diameter different than the first diameter at the second major surface, wherein the second diameter is greater than the first

diameter, wherein the dampening member comprises a plurality of boreholes, wherein the plurality of boreholes are substantially evenly distributed with respect to each other throughout a circumferential distance around the dampening member.

19. The abrasive article of any one of the preceding claims, further comprising at least one fastener configured to couple the mounting body and the dampening member, wherein the fastener comprises a head and a stud extending from the head, wherein the stud comprises a substantially smooth surface, wherein the stud is unthreaded, wherein the stud comprises at least one groove proximate to a distal end of the stud and extending circumferentially around the stud, wherein the groove is configured to engage a clamping member, wherein the stud is configured to extend axially through a thickness of an annular rim portion and a borehole of the dampening member.

20. The abrasive article of claim 19, further comprising a plurality of fasteners, wherein each fastener of the plurality is configured to engage and couple the mounting body and the dampening member.

21. The abrasive article of any one of the preceding claims, further comprising at least one sealing member configured to engage at least one fastener, wherein the fastener extends between the mounting body and the dampening member, wherein the sealing member is configured to engage a surface of the dampening member, wherein the sealing member is configured to engage a first major surface of the dampening member, wherein the sealing member is configured to engage a recess of the dampening member, wherein the sealing member is an annular member configured to engage a portion of a stud of a fastener.

22. The abrasive article of any one of the preceding claims, wherein the Z-shaped abrasive segment comprises a body including an inner segment portion comprising an inner circumferential wall, an outer circumferential wall, a leading radial sidewall extending between the inner circumferential wall and the outer circumferential wall, and a trailing radial sidewall extending between the inner circumferential wall and the outer circumferential wall opposite the leading radial sidewall.

23. The abrasive article of claim 22, wherein the Z-shaped abrasive segment comprises a body including an outer segment portion spaced a radial distance, d , from the inner segment portion, the outer segment portion comprising an inner circumferential wall, an outer circumferential wall, a leading radial sidewall extending between the inner circumferential wall and the outer circumferential wall, and a trailing radial sidewall extending between the outer circumferential wall and the inner circumferential wall opposite the leading radial sidewall.

24. The abrasive article of claim 22, wherein the Z-shaped abrasive segment comprises a body including a central segment portion connected to the inner segment portion and the outer segment portion, the central segment portion including a leading radial sidewall and a trailing radial sidewall, wherein the leading radial sidewall of the central segment portion establishes an acute angle,

α , with respect to the outer circumferential wall of the inner segment portion and an obtuse angle, β , with respect the inner circumferential wall of the outer segment portion.

25. The abrasive article of claim 22, wherein the Z-shaped abrasive segment comprises a body including an inner segment portion comprising a first grinding face and a first serrated portion extending at least partially over the first grinding face, an outer segment portion spaced a radial distance, d , from the inner segment portion, the outer segment portion comprising a second grinding face and a second serrated portion extending at least partially over the second grinding face, and a central segment portion connected to the inner segment portion and the outer segment portion.

26. The abrasive article of claim 25, wherein each serrated portion includes a plurality of serrations and each serration includes a leading edge, a trailing edge, and a ramped surface that extends at an angle, γ , into the first grinding face or the second grinding face from the trailing edge to the leading edge.

27. The abrasive article of claim 26, wherein γ is at least about 10° , at least about 12.5° , at least about 15° , and not greater than about 30° , not greater than about 25° , and not greater than about 20° .

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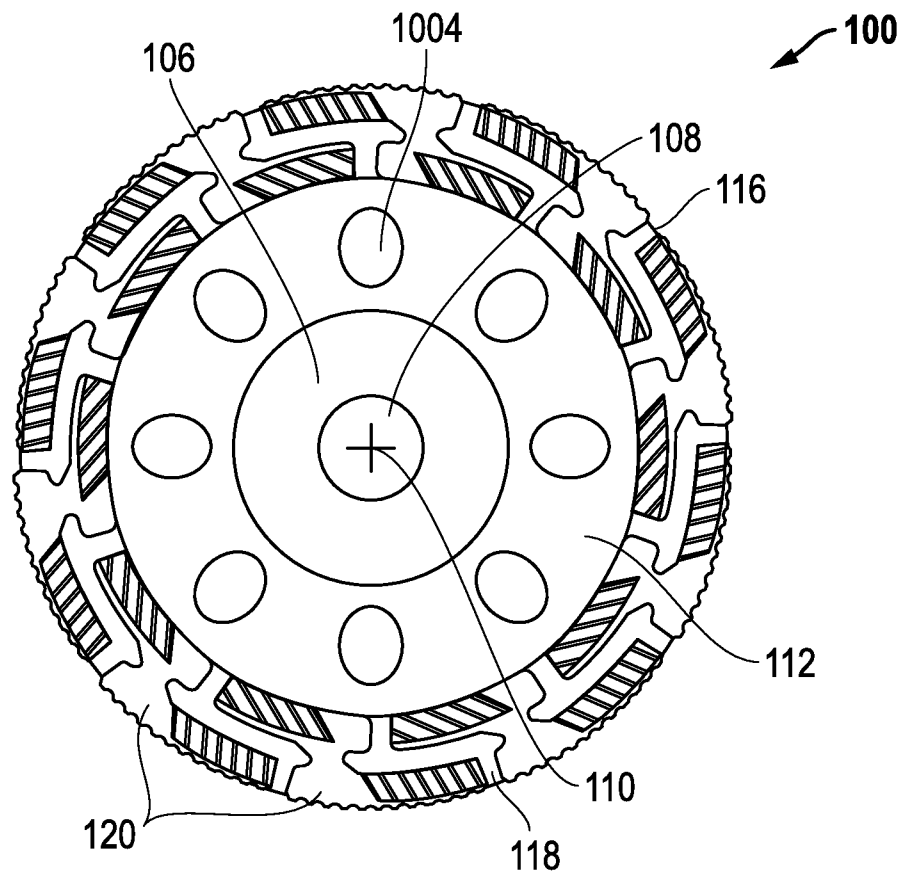
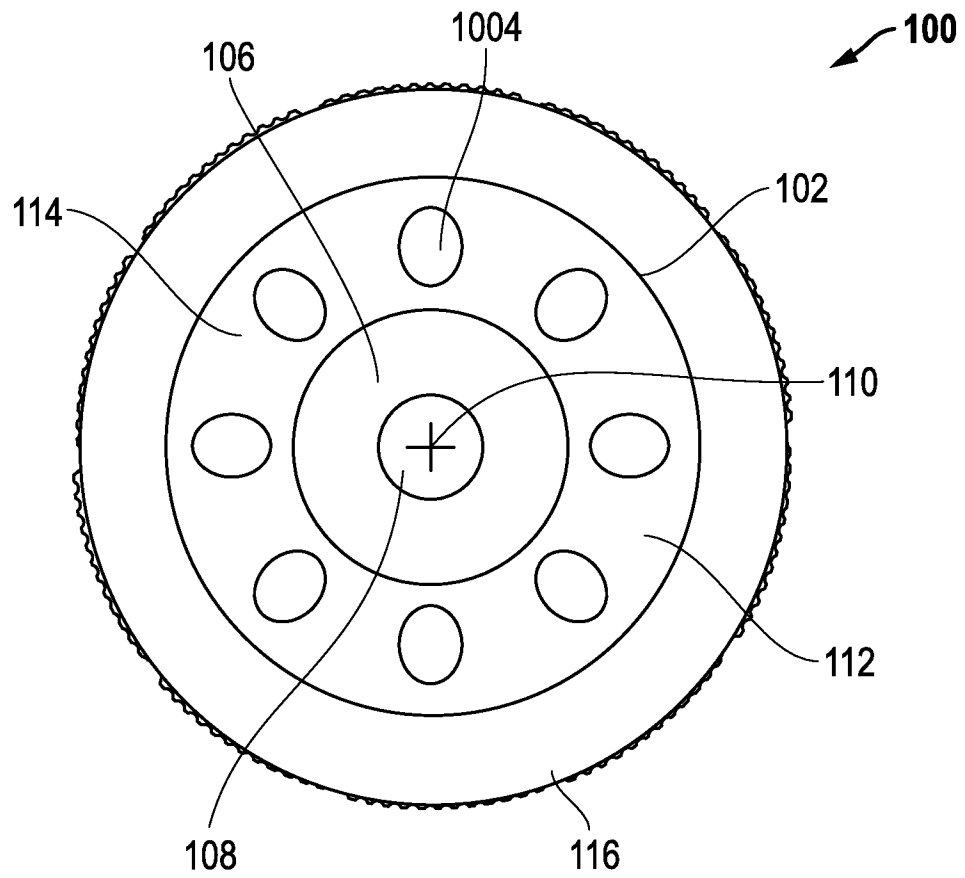


FIG. 1

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*FIG. 2*

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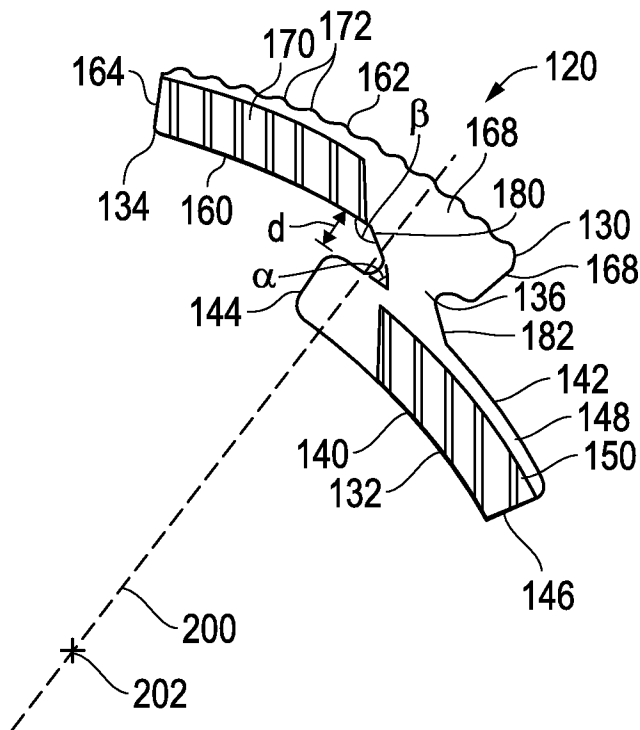


FIG. 3

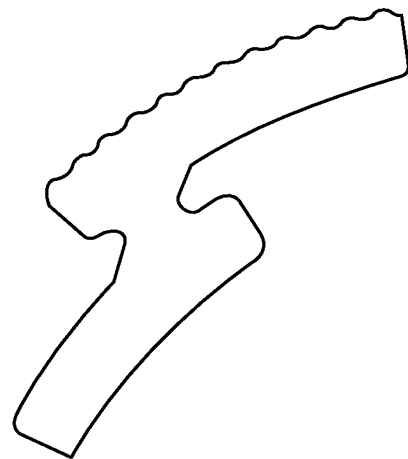


FIG. 4



FIG. 5



FIG. 6



FIG. 7



FIG. 8

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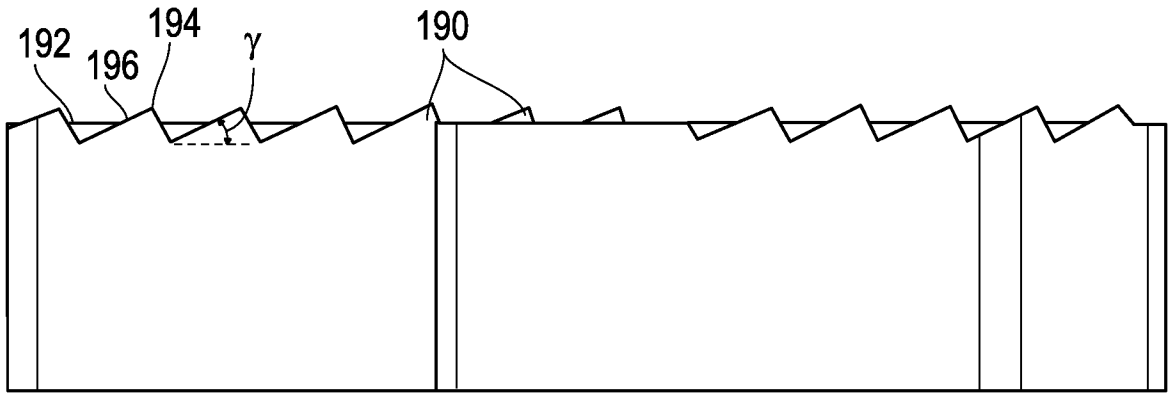


FIG. 9

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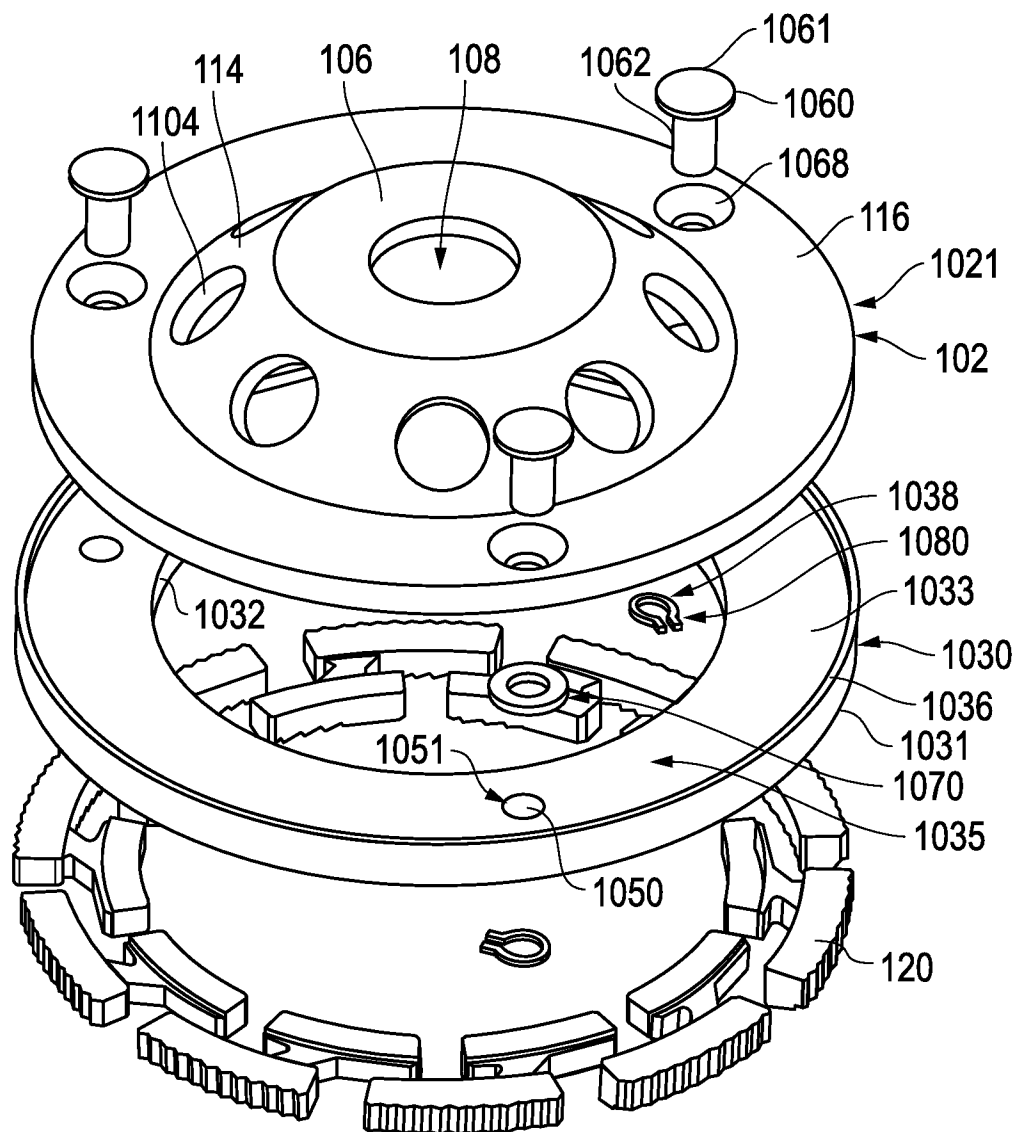


FIG. 10

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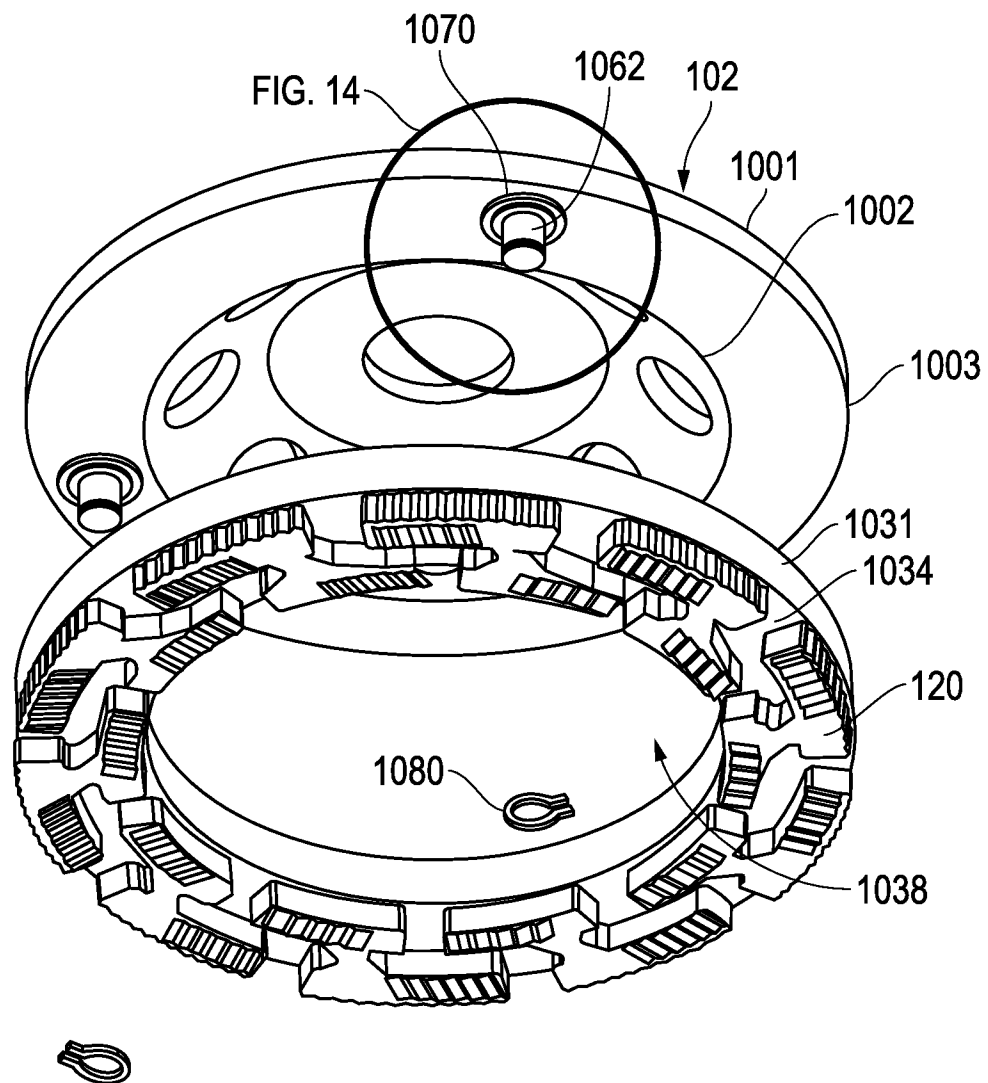


FIG. 11

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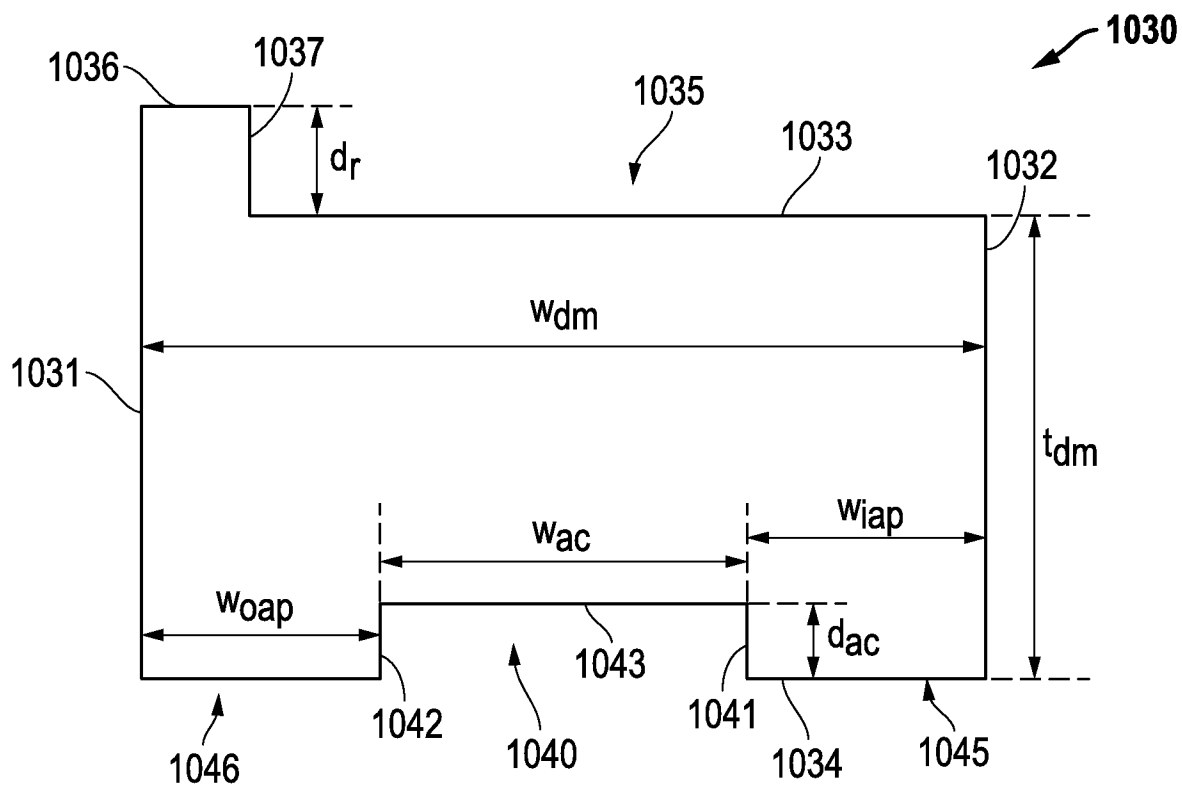


FIG. 12

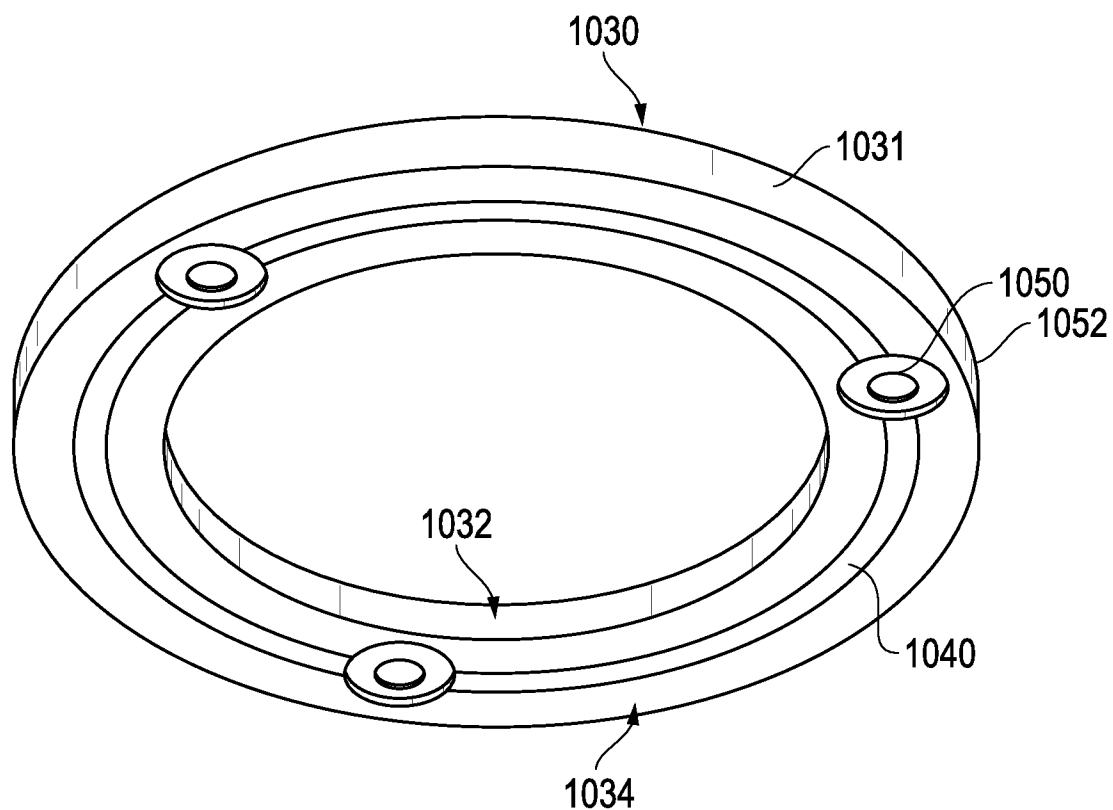


FIG. 13

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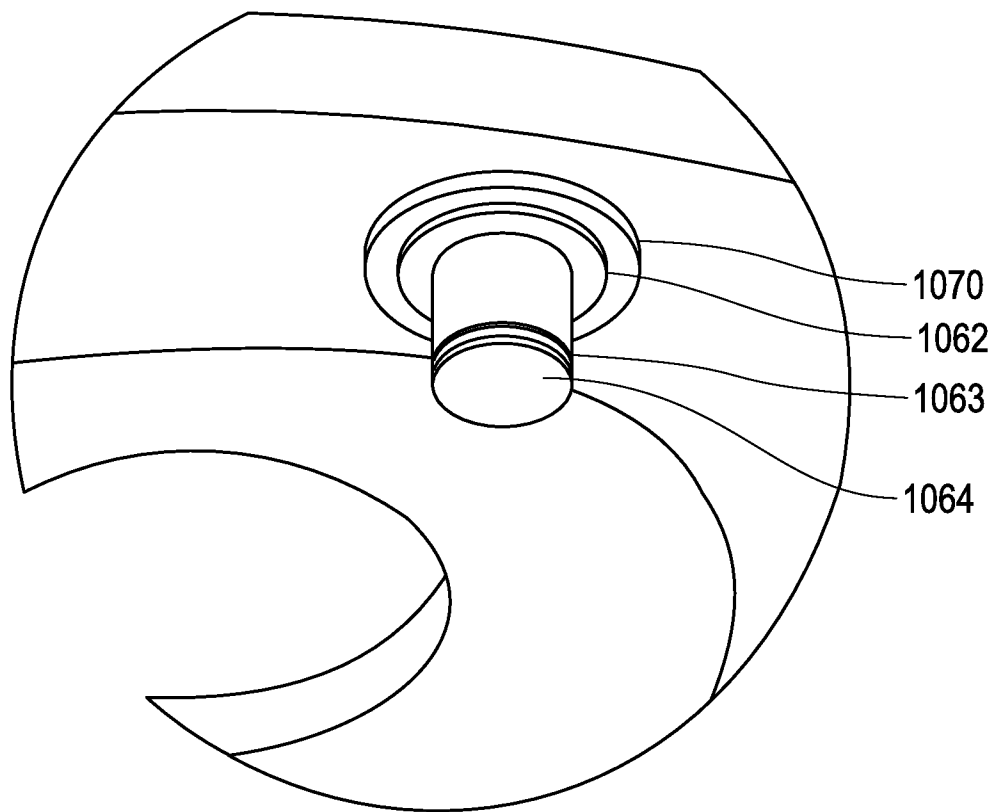


FIG. 14