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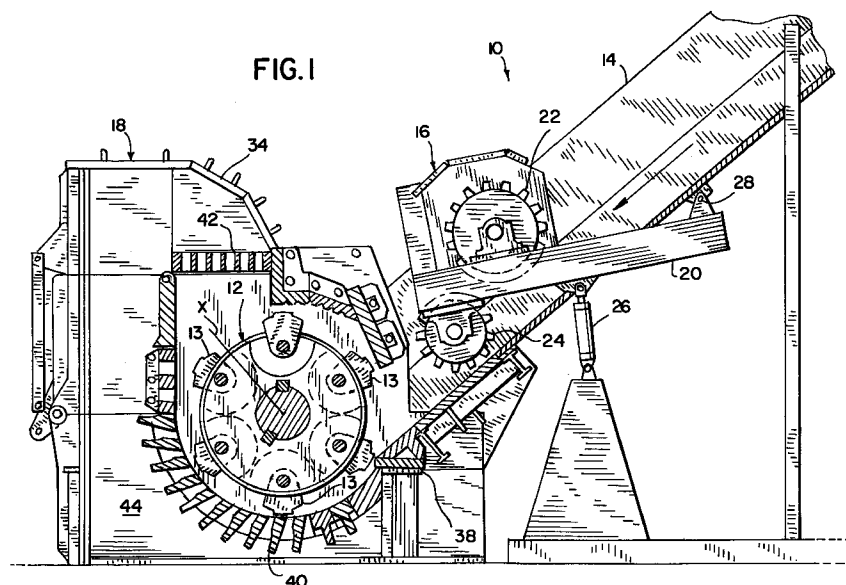
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(54) Rotor for shredders and hammermills

(57) A rotor for shredders and hammermills includes a rotor body having an outer cylindrical surface extending along an axis, a plurality of axially spaced concavities defined on the outer cylindrical surface and a hammer supported within each concavity. The outer cylindrical surface has a convex surface radially extending at least ninety degrees about the axis. Each concav-

ity is radially offset from an adjacent concavity. The outer cylindrical surface is preferably protected by a liner system comprising a plurality of individual wear caps mating end-to-end and side-by-side about the outer convex surface of the rotor, each wear cap being reversible and interchangeable.



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Description

FIELD OF THE INVENTION

The present invention relates to rotors for shredders and hammermills. In particular, the present invention relates to a rotor having a generally gapless imperforate outer surface and providing full cutting action across an axis of the rotor.

BACKGROUND OF THE INVENTION

Hammermills and shredders are generally used for crushing, shredding or breaking scrap metal and other materials such as automobile bodies into small fragments or pieces for recovery and reuse. Hammermills and shredders typically include a housing, a rotor hammer assembly rotatably supported within the housing, and a drive assembly for rotating the rotor hammer assembly past grate bars of the housing to fragment and shred material therebetween. Rotor hammer assemblies conventionally comprise either a disk style rotor or a spider style rotor.

Disk style rotors generally consist of a rotor drive shaft centered along an axis, a plurality of circular plates fixedly secured to the drive shaft along the axis, a plurality of hammer support rods extending parallel to the axis through each plate, and a plurality of hammers rotatably supported about the hammer support rods between consecutive plates. To reduce wear of the plates which support the hammer support rods and hammers, each plate is typically provided with a cap or liner made of wear resistant material and is positioned about the entire circumferential perimeter of the plate. As a result, disk style rotors are extremely durable and wear-resistant. However, because disk style rotors require a plate between each consecutive hammer for supporting the hammers, disk style rotors inherently include gaps along the axis of the rotor where material remains uncut by the hammers. As a result of these gaps in the cutting action of the disk style rotor, the feeding of material into the hammermill or shredder is more difficult and shredding efficiency is reduced.

Spider style rotors typically consist of a rotor drive shaft, a plurality of multi-armed spiders fixedly secured on the drive shaft, a plurality of hammer support rods extending through the arms of the multi-armed spiders, and a plurality of hammers rotatably supported about the hammer support rods. Each hammer is positioned and supported by radially aligned arms of every first and third consecutive multi-armed spider between the arms of an intermediate second spider. As a result, spider style rotors include at least one hammer along the entire axis of the rotor to provide full cutting action. Consequently, material feed and shredding efficiency is improved. Although spider style rotors achieve full cutting action along the rotor axis, spider style rotors inherently include a multitude of openings between the

hammers and between the hammer rows. These openings subject the spider style rotor to wear and material clogging.

SUMMARY OF THE INVENTION

A rotor for shredders and hammermills includes a rotor body having an outer cylindrical surface extending along an axis, a plurality of axially spaced concavities defined on the outer cylindrical surface and a hammer supported within each concavity. The outer cylindrical surface has a convex portion radially extending at least ninety degrees about the axis. Each concavity is radially offset from an adjacent concavity.

The invention is more specifically directed to a rotor that includes a plurality of segments supported end-to-end along the axis. Each segment includes a body configured for rotation about the axis. The body has an outer periphery or peripheral surface concentric with the axis. The outer periphery includes a convex portion extending at least ninety degrees about the axis and at least one concave portion sized for at least partially receiving the hammer. Preferably, the convex portion extends approximately three hundred degrees about the axis while the concave portion extends approximately sixty degrees about the axis. The convex portion preferably includes at least one wear cap partially extending about the axis to define the convex portion.

According to one preferred aspect of the present invention, each of the plurality of segments includes two or less concavities. The plurality of segments are arranged in a rotational pattern so as to statically and dynamically balance the rotor. Preferably, for each first concavity spaced from an axial center line of the rotor body by a first distance on a first side of the center line, the rotor body contains a second concavity radially aligned with the first concavity and spaced from the axial center line by the first distance on a second side of the axial center line. For each first plurality of concavities in radial alignment about the axis, the rotor body includes a second plurality of concavities of equal number radially spaced from the first plurality of concavities by approximately one hundred eighty degrees about the axis.

In one preferred embodiment, the rotor body includes a first concavity along the axial center line, a second concavity along the axial center line spaced one hundred eighty degrees from the first concavity and six consecutive axial spaced concavities outwardly extending from each side off the axial center line. Each outer consecutive concavity is radially incremented by approximately sixty degrees.

The invention is also directed to a rotor liner system for protecting the outer convex surface of the rotor from wear. The liner system includes a plurality of individual wear caps mating end-to-end and side-by-side about the outer convex surface of the rotor. Each wear cap is preferably reversible and interchangeable.

DETAILED DESCRIPTION OF THE DRAWINGS

Fig. 1 is a sectional view of a hammermill including a rotor of the present invention.

Fig. 2 is a partially exploded schematic perspective view of the rotor.

Fig. 3 is an exploded perspective view of intermediate segments of rotor 12.

Fig. 3A is a schematic diagram illustrating an angular pattern for the intermediate segments.

Fig. 3B is a schematic diagram illustrating an alternative angular pattern for the intermediate segments.

Fig. 4 is a sectional view of the assembled rotor of Fig. 2 taken along lines 4--4.

Fig. 5 is a cross sectional view of the rotor of Fig. 4 taken along lines 5--5.

Fig. 6 is a cross sectional view of the rotor of Fig. 4 taken along lines 6--6.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Fig. 1 is a sectional view of hammermill 10 including rotor 12. Rotor 12 is a generally cylindrical body having an axial length and being configured for rotation about a generally concentric axis. Rotor 12 is rotatably supported about the axis in a conventionally known manner and is rotatably driven by a conventional rotary actuator or drive mechanism. Rotor 12 generally includes hammers 13 which extend about axis X and along the axial length of rotor 12. Preferably, hammers 13 are each rotatably supported by rotor 12 about individual axes encircling rotor axis X. As a result, hammers 13 swing radially outward into engagement with the material being shredded. Hammers 13 forcefully engage material within hammermill 10 to crush and shred the material for recovery and reuse.

Hammermill 10 feeds automobile bodies and other scrap material to rotor 12 for shredding and conveys the shredded fragments produced by rotor 12 for recovery and reuse. In the preferred embodiment illustrated, hammermill 10 generally includes feed ramp 14, feed roller assembly 16, and housing 18. Feed ramp 14 is a generally elongate chute or slide upon which automobile bodies and scrap are fed to rotor 12 by feed roller assembly 16.

Feed roller assembly 16 generally includes support 20, upper feed roller 22, lower feed roller 24 and actuator 26. Support 20 is an elongate structure configured for rotatably supporting upper feed roller 22 and lower feed roller 24 in engagement with automobile bodies and other material being fed into hammermill 10. In the preferred embodiment illustrated, support 20 is pivotally coupled to feed ramp 14 by pivot 28. Actuator 26 is coupled to support 20 so as to selectively pivot support 20, upper feed roller 22 and lower feed roller 24 about pivot 28 to adjust the spacing between feed rollers 22 and 24 and feed ramp 14 depending upon the size of

the material being fed into hammermill 10.

Upper feed roller 22 and lower feed roller 24 are preferably rotatably driven by a drive mechanism (not shown) above feed ramp 14 so as to engage and feed material into housing 18 for being shredded by rotor 12. In addition to feeding material into housing 18, feed rollers 22 and 24 crush the material prior to the material being fed to rotor 12.

Housing 18 rotatably supports, encloses and cooperates with rotor 12 to shred material fed to rotor 12. Housing 18 generally includes hood 34, cutter bar 38, lower grate 40 and upper grate 42. Hood 34 surrounds and encloses cutter bar 38, lower grate 40 and upper grate 42. Hood 34 includes a plurality of walls which define an interior chamber 44 extending about lower grate 40 and upper grate 42. Chamber 44 receives the smaller shredded material which passes through lower grate 40 and upper grate 42.

Cutter bar 38 is a generally elongate anvil extending along an entire axial length of rotor 12. Cutter bar 38 is supported at a lower end of feed ramp 14 below feed rollers 22 and 24 and adjacent to rotor 12. As feed rollers 22 and 24 feed large scrap material between rotor 12 and cutter bar 38, hammers 13 of rotor 12 cooperate with cutter bar 38 to shred the material. As rotor 12 continues to rotate, rotor 12 carries the shredded material in a clockwise direction across lower grate 40 and upper grate 42.

Lower grate 40 and upper grate 42 each comprise a generally elongate rigid framework of bars arranged so as to screen material being shredded by rotor 12. Lower grate 40 and upper grate 42 extend along the entire axial length of rotor 12 and are supported so as to cooperate with hammers 13 to further shred and reduce the size of the material being shredded by rotor 12. Once the material has been sufficiently shredded by rotor 12, the material passes through openings within lower grate 40 and upper grate 42 into chamber 44.

Although not illustrated, hammermill 10 additionally includes a conventional conveying mechanism for removing and carrying away shredded material from chamber 44 for further processing. As conventionally known, hammermill 10 may also be provided with a suction hood or other separating mechanisms for separating and removing light weight particles such as plastics, dirt and foam from the shredded material.

Figs. 2 and 3 schematically illustrate rotor 12 and hammers 13 in greater detail. As best shown by Fig. 2, rotor 12 generally includes intermediate segments 50a-50m, end segments 52, drive shaft 54 and hammer support rods 56. Intermediate segments 50a-50m form the substantially imperforate body of rotor 12 for supporting hammers 13 while hammers 13 shred material. In the preferred embodiment illustrated, intermediate segments 50a-50m comprise generally cylindrical plates configured for being supported end-to-end along rotor axis X to provide rotor 12 with its generally imperforate body. Each intermediate segment 50a-50m includes a

concentric bore 60, eccentric bores 62 and a concavity 64. Concentric bore 60 coaxially extends through each intermediate segment 50a-50m and receives drive shaft 54. Eccentric bores 62 extend through intermediate segments 50a-50m circumjacent to drive shaft 54 proximate the outer perimeter of each intermediate segment 50a-50m. Eccentric bores 62 of intermediate segments 50a-50m are aligned with one another and are also aligned with eccentric bores 68 of end segments 52.

Concavities 64 are cut-outs inwardly extending from an outer periphery of each segment 50a-50m towards the center of each segment 50a-50m. As a result, each intermediate segment 50a-50m has a scalloped shape. Each concavity 64 is sized for at least partially receiving one of hammers 13. In the preferred embodiment illustrated, each concavity 64 is radially offset from adjacent concavity 64 of adjacent segments 50a-50m. Concavities 64 receive hammers 13 and enable rotor 12 to provide full cutting action along rotor axis X while minimizing or eliminating openings along rotor axis X to minimize wear and material clogging.

End segments 52 (only one of which is shown in Fig. 2) are generally cylindrical plates having an outer diameter substantially equal to the outer diameters of intermediate segments 50a-50m. End segments 52 each define concentric bore 66 and eccentric bores 68. Concentric bore 66 concentrically extends through end segment 52 and is sized for receiving drive shaft 54. Eccentric bores 68 extend through end segment 52 at locations circumjacent concentric bore 66. Eccentric bores 68 are preferably equidistantly spaced about concentric bore 60 and drive shaft 54 proximate the outer perimeter of end segment 52. Eccentric bores 68 receive hammer support rods 56 to carry hammer support rods 56 about drive shaft 54 during rotation of drive shaft 54.

Drive shaft 54 is an elongate rigid shaft extending through and supporting end segments 52 and intermediate segments 50a-50m of rotor 12. Drive shaft 54 extends through concentric bore 66 of end segment 52 along rotor axis X. Drive shaft 54 is rotatably driven by a drive mechanism (not shown) to rotate rotor 12 about rotor axis X.

Hammer support rods 56 are elongate shafts or pins extending through intermediate segments 50a-50m and hammers 13. Each hammer support rod 56 includes an end received within an eccentric bore 68 of one of end segments 52. Hammer support rods 56 couple intermediate segments 50a-50m to end segments 52. In addition, hammer support rods 56 rotatably support hammers 13 about the axis of each hammer support rod 56 along rotor axis X.

Upon assembly of rotor 12, end segments 52, drive shaft 54 and hammer support rods 56 support and maintain intermediate segments 50a-50m and hammers 13 together to form an elongate compact and solid rotor body 69 for supporting hammers 13 along rotor axis X. Along rotor axis X, rotor body 69 contains two or

less concavities 64 in any one plane extending perpendicular to rotor axis X. In the preferred embodiment illustrated, rotor body 69 contains a single concavity 64 in any one plane extending perpendicular to rotor axis X except for the plane perpendicularly extending along the center line of rotor body 69. As a result, the rotor body 69, thus formed, minimizes the number of openings along its outer surface to reduce wear, material clogging and impact damage.

Although rotor 12 is illustrated as including six hammer support rods 56 supporting hammers 13 radially offset from one another by approximately sixty degrees, rotor 12 may alternatively include a variety of alternative configurations and arrangements. For example, rotor 12 may alternatively include eight hammer support rods 56 for supporting hammers 13 that are radially offset ninety degrees from one another about rotor axis X. Various other rotational patterns are also contemplated for providing full cutting action along rotor axis X while minimizing or eliminating openings or unfilled gaps about and along rotor axis X.

Although intermediate segments 50a-50m are illustrated as being supported adjacent to one another by end segments 52, drive shaft 54 and hammer support rods 56, intermediate segments 50a-50m may alternatively be supported or joined to one another by any one of a variety of alternative assembly arrangements. Moreover, in lieu of rotor body 69 being formed from a plurality of intermediate segments 50a-50m mounted adjacent to one another, rotor body 69 may alternatively be formed as a single unitary body configured for rotation about rotor axis X and provided with concavities 64 for partially housing hammers 13.

Fig. 3 is an exploded perspective view schematically illustrating intermediate segments 50a-50m and hammers 13 in greater detail. As best shown by Fig. 3, each intermediate segment 50a-50m has an outer perimeter 70 extending in a plane perpendicular to rotor axis X. Each outer perimeter 70 includes at least one convex portion 72 and at least one concave portion 74. Convex portions 72 and concave portions 74 of each individual segment 50a-50m extend in a single plane perpendicular to rotor axis X. When combined, the convex portions 72 and concave portions 74 of an individual segment 50a-50m extend three hundred sixty degrees about rotor axis X to form outer perimeter 70.

Convex portions 72 extend about and define the generally solid mounting structure of each intermediate segment 50a-56m. In particular, convex portions 72 extend circumjacent to eccentric bores 62 for supporting hammer rods 56 (shown in Fig. 2). The degree to which convex portions 72 extend about rotor axis X of each intermediate segment 50a-50m is preferably maximized to reduce the size and number of openings about rotor axis X where material clogging and wear occur. In particular, each convex portion 72 preferably extends radially about rotor axis X by at least about ninety degrees. Convex portions 72 of each segment 50a-50m

preferably extend a combined total of at least one hundred eighty degrees about rotor axis X. For example, if a particular segment 50a-50m includes a single concavity 64, the single convex portion 72 would extend at least one hundred eighty degrees about rotor axis X to provide the particular segment with at least a semi-cylindrical configuration. In the preferred embodiment illustrated, convex portions 72 of segments 50a-50f and segments 50h-50m extend three hundred degrees about rotor axis X. Convex portions 72 of segments 50g each extend one hundred twenty degrees about rotor axis X and encircle rotor axis X by a combined total of two hundred forty degrees.

Concave portions 74 extend inwardly from convex portions 72 towards concentric bore 60 and rotor axis X. Each concave portion 74 extends inwardly from convex portions 72 a sufficient distance such that the concavity 64 formed by concave portion 74 is sufficiently sized for receiving a hammer 13. In the preferred embodiment illustrated, concave portion 74 is a generally arcuate shaped contour formed along perimeter 70 of each segment 50a-50m. Alternatively, concave portion 74 may have a variety of other inwardly extending contours such as semi-hexagonal, semi-octagonal, rectangular, triangular, and the like. Furthermore, concave portions 74 may alternatively comprise a linearly contoured cut-out so as to provide each segment with a substantially semi-circular cross section.

As further shown by Fig. 3, segments 50a-50f and 50h-50m are substantially identical to one another in that each includes a single concavity 64. In contrast, segment 50g includes a pair of opposite concavities radially spaced approximately one hundred eighty degrees. Segment 50g is centered between segments 50a-50f and 50h-50m. Preferably, segment 50g is centered along an axial center line of rotor 12. In the preferred embodiment illustrated, concavities 64 of segments 50a-50m are preferably rotated about rotor axis X in increments of approximately sixty degrees relative to a preceding segment. As a result, each concavity 64 of each segment 50a-50m is sandwiched between and adjacent to convex portions 72 of adjacent segments when stacked end-to-end to form rotor 12. For example, concavity 64 of segment 50b is located between and adjacent to convex portions 72 of both segments 50a and 50c. As a result, each segment 50a-50m along rotor axis X includes at least one hammer 13 to provide full cutting action along rotor axis X. At the same time, however, the number of inwardly projecting openings or unfilled gaps about and along rotor axis X is reduced to reduce material clogging and wear.

Figs. 3A and 3B illustrate patterns for arranging intermediate segments 50a-50m so as to provide full cutting action along the entire rotor axis X while statically and dynamically balancing rotor 12 to reduce vibration and other undesirable forces. In particular, each vertical column represents a single intermediate segment 50a-50m. Each horizontal row represents sixty

degrees about rotor axis X. Each capital letter represents a concavity 64 defined by a particular segment 50a-50m and angularly positioned about rotor axis X.

Fig. 3A graphically illustrates the arrangement of intermediate containers 50 presented in Fig. 3. As best shown by Fig. 3A, segments 50a, 50g and 50m each include concavities A in angular alignment with one another and equidistantly spaced from the axial center line of rotor 12. In particular, the concavities of segments 50a and 50m are equidistantly spaced from the center most segment 50g and the axial center line of rotor 12. Segments 50f and 50h include concavities B in angular alignment with one another and equidistantly spaced from the center line of rotor 12. Segments 50e and 50i, 50d and 50j, 50c and 50k, and 50b and 50l similarly include concavities C, D, E, and F, respectively, in angular alignment with one another and equidistantly spaced from the center line of rotor 12. To balance rotor 12, segment 50g additionally includes a second concavity D angularly spaced one hundred eighty degrees from concavity A. As illustrated by Fig. 3A, for each concavity spaced from the axial center line of rotor 12 by a first distance on a first side of the center line, rotor 12 includes a second concavity radially aligned with the first concavity and spaced from the axial center line by the same distance on a second side of the axial center line. Furthermore, for each plurality of concavities in radial alignment about the axis, rotor 12 includes a second plurality of concavities of equal number radially spaced from the first plurality of concavities by approximately one hundred eighty degrees about the axis.

Fig. 3B graphically illustrates an alternative rotational pattern of intermediate segments 50a-50m for statically and dynamically balancing rotor 12. As shown by Fig. 3B, segment 50g includes concavities A and D extending along the axial center line of rotor 12 and radially spaced one hundred eighty degrees apart from one another. Segments 50f and 50h include a first pair of concavities B spaced from the axial center line of rotor 12 by a first distance and radially offset from concavity A of segment 50 by approximately sixty degrees. Segments 50e and 50i include a second pair of concavities D spaced from the axial center line of rotor 12 by a second distance greater than the first distance and radially offset from concavity A of segment 50 by approximately one hundred eighty degrees. Segments 50d and 50j include a third pair of concavities F spaced from the axial center line of rotor 12 by a third distance greater than the second distance and radially offset from concavity A of segment 50g by approximately three hundred degrees. Segments 50c and 50k include a fourth pair of concavities C spaced from the axial center line of rotor 12 by a fourth distance greater than the third distance and radially offset from concavity A of segment 50 by approximately one hundred twenty degrees. Segments 50b and 50l define a fifth pair of concavities E spaced from the axial center line of rotor 12 by a fifth distance greater than the fourth distance and radially

offset from the first concavity A of segment 50g by approximately two hundred forty degrees. Lastly, segments 50a and 50m include a sixth pair of concavities A spaced from the axial center line of rotor 12 by a sixth distance greater than the fifth distance and in radial alignment with concavity A of segment 50g. Although Figs. 3A and 3B illustrate two such angular patterns for intermediate segments 50a-50m, various other angular patterns for intermediate segments 50a-50m are contemplated depending upon the exact configuration and number of intermediate segments 50.

Figs. 4-6 illustrate rotor 12 in greater detail. In particular, Fig. 4 is a sectional view of assembled rotor 12 taken along lines 4--4 of Fig. 2. Fig. 5 is a cross sectional view of rotor 12 taken along lines 5--5 of Fig. 4. Similarly, Fig. 6 is a cross sectional view of rotor 12 taken along lines 6--6 of Fig. 4. As best shown by Fig. 4, drive shaft 54 extends through opposite sides of hood 34 and includes exterior threaded ends 80 for threadably receiving nuts 82. Nuts 82 thread about ends 80 of drive shaft 54 to axially secure intermediate segments 50a-50m and end segments 52 against one another and along drive shaft 54. Intermediate segments 50a-50m and end segments 52 are keyed to drive shaft 54 to radially secure intermediate segments 50a-50m and end segments 52 about drive shaft 54. As illustrated by Figs. 4-6, intermediate segments 50g-50m and end segments 52 are further optionally interconnected by tie rods 83 extending through eccentric bores 84 and secured by nuts 85 for added strength.

As best shown by Figs. 4-6, each intermediate segment 50a-50m preferably includes a disk or hammer support 86 and at least one exterior wear liner or cap 88. Hammer support 86 is a generally circular disk configured for being fixedly secured about drive shaft 54 in an end-to-end relationship with adjacent supports 86. In the preferred embodiment illustrated, support 86 includes generally flat, planar front and rear faces which butt against faces of adjacent supports 86. Alternatively, supports 86 may be provided with other mating configurations such as corresponding male and female facial surfaces. As shown by Figs. 5 and 6, each support 86 defines at least one concavity 64. Each support 86 further defines concentric bore 60 and eccentric bores 62 through which drive shaft 54 and hammer support rods 56 are inserted.

Wear caps 88 are generally wear-resistant leet members configured for extending about and covering an outer portion of hammer supports 86. As best shown by Figs. 5 and 6, each segment 50a-50m preferably includes 5 wear caps 88 extending about hammer support 86 to define convex portion 72. Each wear cap 88 arcuately extends about rotor axis X by approximately sixty degrees. Alternatively, each wear cap 88 may arcuately extend about rotor axis X by greater than or less than sixty degrees thereby decreasing and increasing, respectively, the number of wear caps 88 necessary to line or cover the entire convex portion 72 of each

intermediate segment 50a-50m. Wear caps 88 protect hammer supports 86 from wear while rotor 12 shreds material.

In the preferred embodiment illustrated, hammer supports 86 and wear caps 88 are specifically configured to form a mechanical interlock to securely support wear caps 88 relative to hammer supports 86. As best shown by Figs. 4-6, hammer supports 86 preferably define inwardly extending grooves 90 configured and sized for partially receiving wear caps 88 to form a mechanical interlock. Wear caps 88 are generally elongate arcuate T-shaped members including an inwardly extending tongue portion 94 and an arcuately extending liner portion 96. Tongue 94 extends generally perpendicular to liner portion 96 into groove 90. Tongue 94 defines a bore 98 extending through tongue 94. Bore 98 is sized and located for receiving hammer support rod 56. As a result, upon assembly of rotor 12, hammer support rods 56 project through bores 98 of wear caps 88 to reliably secure wear caps 88 to hammer supports 86. Alternatively, wear caps 88 may be secured to hammer supports 86 by a variety of other alternative mounting arrangements.

Liner portions 96 of wear caps 88 extend generally perpendicular to tongues 94 and are sized for extending over the outer peripheral surfaces of hammer supports 86 to protect hammer supports 86 from wear. As shown by Figs. 5 and 6, liner portions 96 of wear caps 88 mate end-to-end about the outer peripheral surfaces of hammer supports 86. As shown by Fig. 4, liner portions 96 of wear caps 88 also mate side-by-side along rotor axis X and about the outer peripheral surfaces of hammer supports 86. As a result, wear caps 88 fully cover and protect the outer convex surface of rotor 12 from wear in both circumferential and axial directions. Because wear caps 88 mate end-to-end and side-by-side about the outer convex surface of rotor 12 they provide rotor 12 with a constant outer radius. This constant outer radius minimizes abrasive wear and impact damage by eliminating corners or irregularities which would otherwise take direct hits from large bales or pieces of scrap. The constant outer radius also provides a smooth surface which prevents the accumulation or wedging of scrap. Because liner portions 96 of wear caps 88 mate side-by-side along rotor axis X, wear caps 88 eliminate gaps to prevent scrap from impacting on hammer supports 86 and from wedging between adjacent wear caps 88.

In addition to better protecting hammer supports 86 of rotor 12, the rotor liner system formed by wear caps 88 is simple and economical to produce, assemble and maintain. As illustrated by Figs. 4-6, each wear cap 88 is interchangeable with other wear caps 88 and fits every position along and about rotor axis X of rotor 12. Because the rotor liner system formed by wear caps 88 requires only a single wear cap design, the rotor liner system has reduced pattern, tooling and manufacturing costs. Assemblage and maintenance are also simplified due to the single capped design. As further shown by

Figs. 4-6, due to each wear cap's generally symmetrical design, each wear cap is reversible. Wear caps 88 positioned adjacent hammer pockets, such as concavity 64, generally wear at a higher rate along the hammer pockets. Because wear caps 88 are generally reversible, however, the useful life of each wear cap 88 positioned adjacent a hammer pocket may be increased by reversing the wear cap 88 to position the lesser worn edge of the wear cap 88 adjacent the hammer pocket.

In the preferred embodiment illustrated, hammer supports 86 are formed from mild or alloy steel. Wear caps 88 are preferably formed from cast manganese steel. As can be appreciated, hammer supports 86 and wear caps 88 may alternatively be formed from a variety of different materials having various hardnesses depending upon the particular materials being shredded and the anticipated wear of the caps 88. Moreover, wear caps 88 may be omitted in favor of each intermediate segment 50a-50m being formed as a single unitary body made of a single or several composite materials.

In conclusion, rotor 12 more effectively shreds material in hammermills and shredders. In contrast to conventional disk style rotors, rotor 12 provides full cutting action along the axis of rotor 12 to improve material feeding and shredding efficiency. As compared to conventional spider style rotors, rotor 12 provides full cutting action along the axis of the rotor with fewer or smaller gaps or openings about and along rotor axis X. Because rotor 12 reduces the number or size of gaps along and about rotor axis X, rotor 12 is less susceptible to wear, material clogging and impact damage. In the preferred embodiment illustrated, rotor 12 has a rotor body 69 that is substantially imperforate but for concavities 64 which contain hammers 13. At the same time, rotor 12 provides a rotor that is statically and dynamically balanced.

Although the present invention has been described with reference to preferred embodiments, workers skilled in the art will recognize that changes may be made in form and detail without departing from the spirit and scope of the invention.

Claims

1. A rotor for shredders and hammermills, the rotor comprising:

a rotor body having an outer cylindrical surface extending along an axis, wherein the outer peripheral surface has a convex portion radially extending at least about ninety degrees about the axis;
a plurality of axially spaced concavities defined on the outer cylindrical surface, each concavity being radially offset from an adjacent concavity; and
a hammer supported within each concavity.

2. The rotor of claim 1 wherein the rotor body contains two or less concavities in any one plane extending perpendicular to the axis along the axis.

3. The rotor of claim 1 wherein the hammer support body includes:

a plurality of segments supported end-to-end along the axis.

4. The rotor of claim 3 including:

a hammer support rod extending parallel to the axis across each concavity, wherein the hammer support rod supports the hammer at least partially within each concavity.

5. The rotor of claim 3 wherein the segment includes:

at least one wear cap defining at least a portion of the convex portion.

6. The rotor of claim 5 wherein said at least one wear cap defines the entire convex outer portion.

7. The rotor of claim 1 wherein the convex portion extends at least about one hundred twenty degrees about the axis.

8. The rotor of claim 1 wherein the convex portion extends approximately three hundred degrees about the axis.

9. The rotor of claim 1 wherein the plurality of axially spaced concavities and the hammer within each concavity are statically and dynamically balanced.

10. The rotor of claim 9 wherein for each first concavity spaced from an axial center line of the rotor body by a first distance on a first side of the center line, the rotor body includes a second concavity radially aligned with the first concavity and spaced from the axial center line by the first distance on a second side of the axial centerline; and

wherein for each first plurality of concavities in radial alignment about the axis, the rotor body includes a second plurality of concavities of equal number radially spaced from the first plurality of concavities by approximately one hundred eighty degrees about the axis.

11. The rotor of claim 10 wherein the rotor body includes a first concavity along the axial center line;

a second concavity along the axial center line and spaced one hundred eighty degrees from the first concavity; and
six consecutive axially spaced concavities out-

wardly extending from each side of the axial center line, each outer consecutive concavity radially incremented by sixty degrees.

12. The rotor of claim 10 wherein the plurality of concavities includes:

a first concavity extending along the axial center line of the rotor body;

a second concavity along the axial center line of the rotor body and radially spaced one hundred eighty degrees relative to the first concavity;

a first pair of concavities, each concavity of the first pair being spaced from the axial center line by a first distance and being radially offset from the first concavity by approximately sixty degrees;

a second pair of concavities, the second pair of concavities being spaced from the axial center line by a second distance greater than the first distance and being radially offset from the first concavity by approximately one hundred eighty degrees;

a third pair of concavities, each concavity of the third pair being spaced from the axial center line by a third distance greater than the second distance and being radially offset from the first concavity by three hundred degrees;

a fourth pair of concavities, each concavity of the fourth pair spaced from the axial center line by a fourth distance greater than the third distance and being radially offset from the first concavity by approximately one hundred twenty degrees;

a fifth pair of concavities, each concavity of the fifth pair spaced from the axial center line by a fifth distance greater than the fourth distance and being radially offset from the first concavity by approximately two hundred forty degrees;

a sixth pair of concavities, each concavity of the sixth pair spaced from the axial center line by a sixth distance greater than the fifth distance and being in radially alignment with the first concavity.

13. A segment for use in shredder and hammermill rotor assemblies, the segment comprising:

a body configured for rotation about an axis, the body having an outer periphery, the outer periphery including:

a first convex portion extending greater than ninety degrees about the axis; and
a concave portion sized for at least partially receiving a hammer of a rotor assembly.

14. The segment of claim 13 including:

a second convex portion extending about the axis, wherein the first convex portion and the second convex portion, combined, extend at least one hundred eighty degrees about the axis.

15. The segment of claim 13 wherein the first convex portion extends at least one hundred eighty degrees about the axis.

16. The segment of claim 14 wherein the first convex portion extends approximately three hundred degrees about the axis and wherein the concave portion extends sixty degrees about the axis.

17. The segment of claim 13, including:

at least one wear cap partially extending about the axis to define the first convex portion.

18. The segment of claim 13 wherein the segment includes:

a disk; and
at least one wear cap coupled to the disk, wherein said at least one wear cap extends at least one hundred eighty degrees about the axis.

19. A hammermill rotor assembly comprising:

a rotor drive shaft centered along an axis;
a plurality of parallel plates secured to the drive shaft, each plate defining two or less concavities, wherein concavities of adjacent plates are radially offset from one another;
a hammer support rod extending parallel to the axis across each concavity; and
a hammer supported by the hammer support rod within each concavity.

20. The rotor assembly of claim 19 wherein each parallel plate includes:

a disk; and
a wear cap supported by the disk.

21. The rotor assembly of claim 19 wherein each parallel plate has an outer peripheral surface with at least one convex portion extending at least ninety degrees about the axis.

22. The rotor assembly of claim 19 wherein each plate defines a convex portion extending at least one hundred eighty degrees about the axis.

23. The rotor assembly of claim 22 wherein the convex portion extends approximately three hundred degrees about the axis.

24. A rotor liner system for protecting an outer convex surface of a hammermill rotor from wear, the liner system comprising:

a plurality of individual wear caps mating end-to-end and side-by-side about the outer convex surface of the rotor, each wear cap being reversible and interchangeable.

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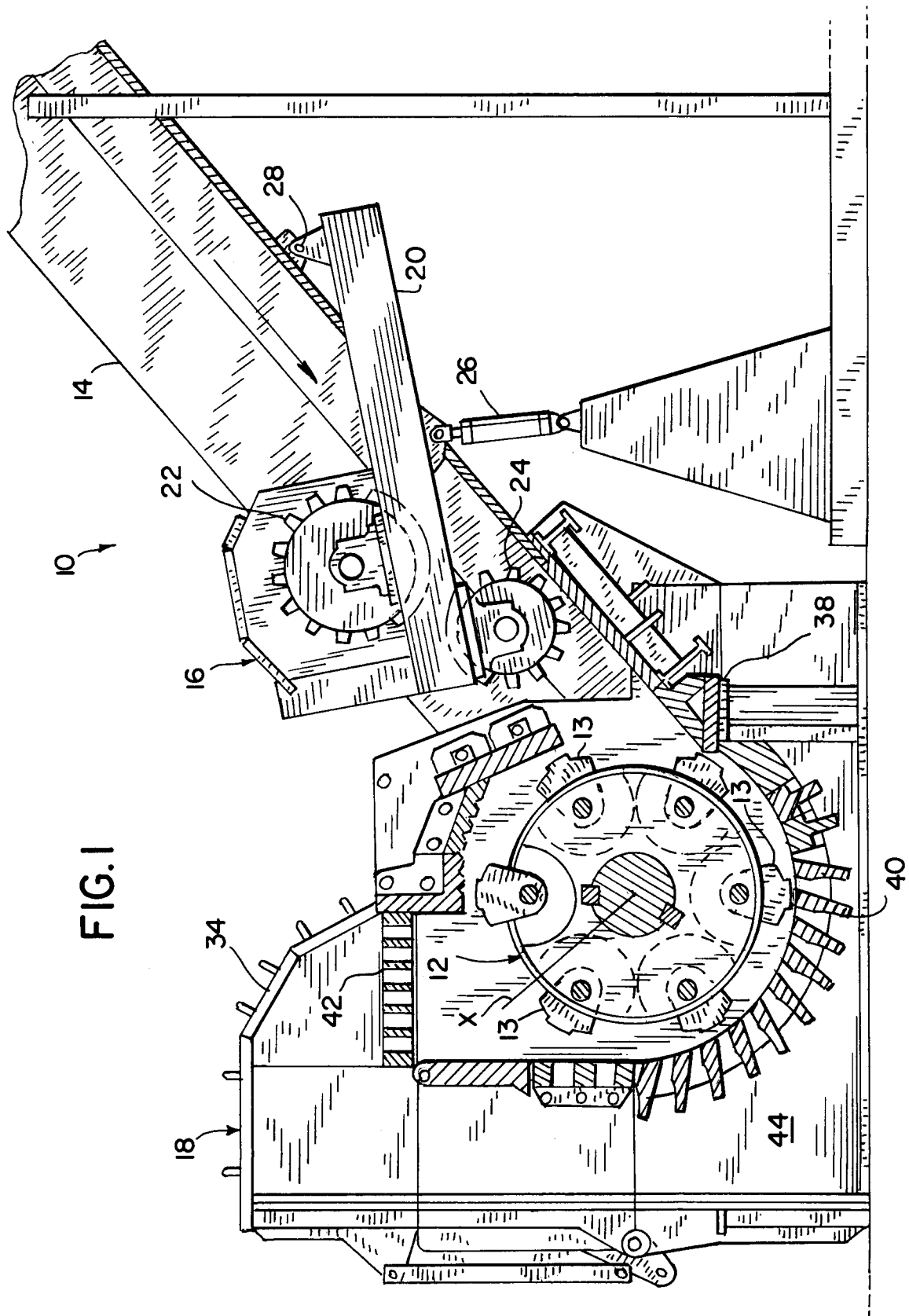


FIG. 4

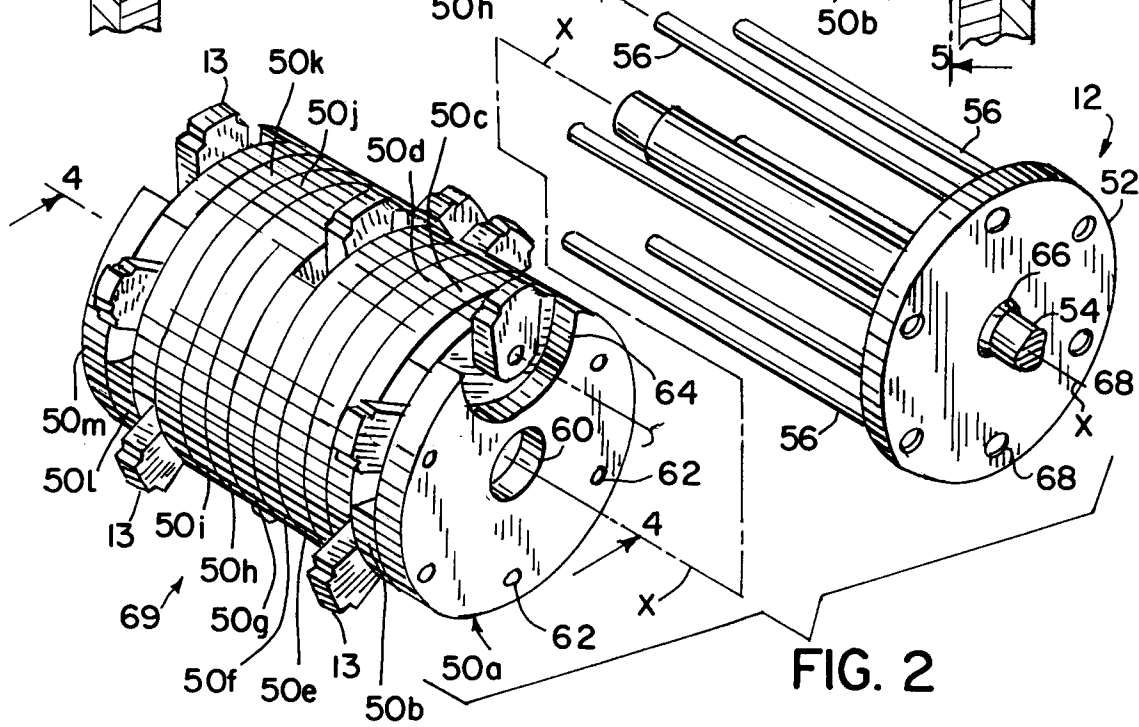
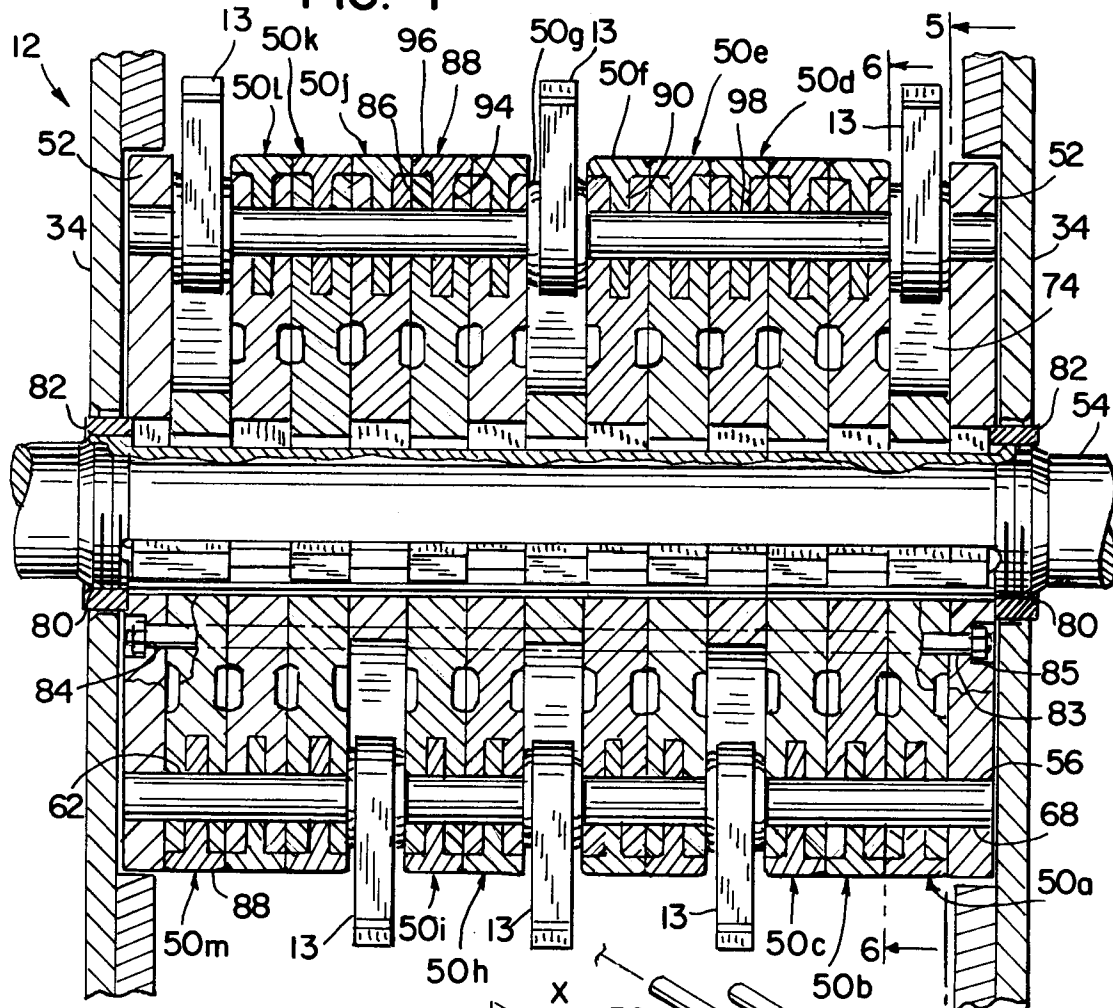
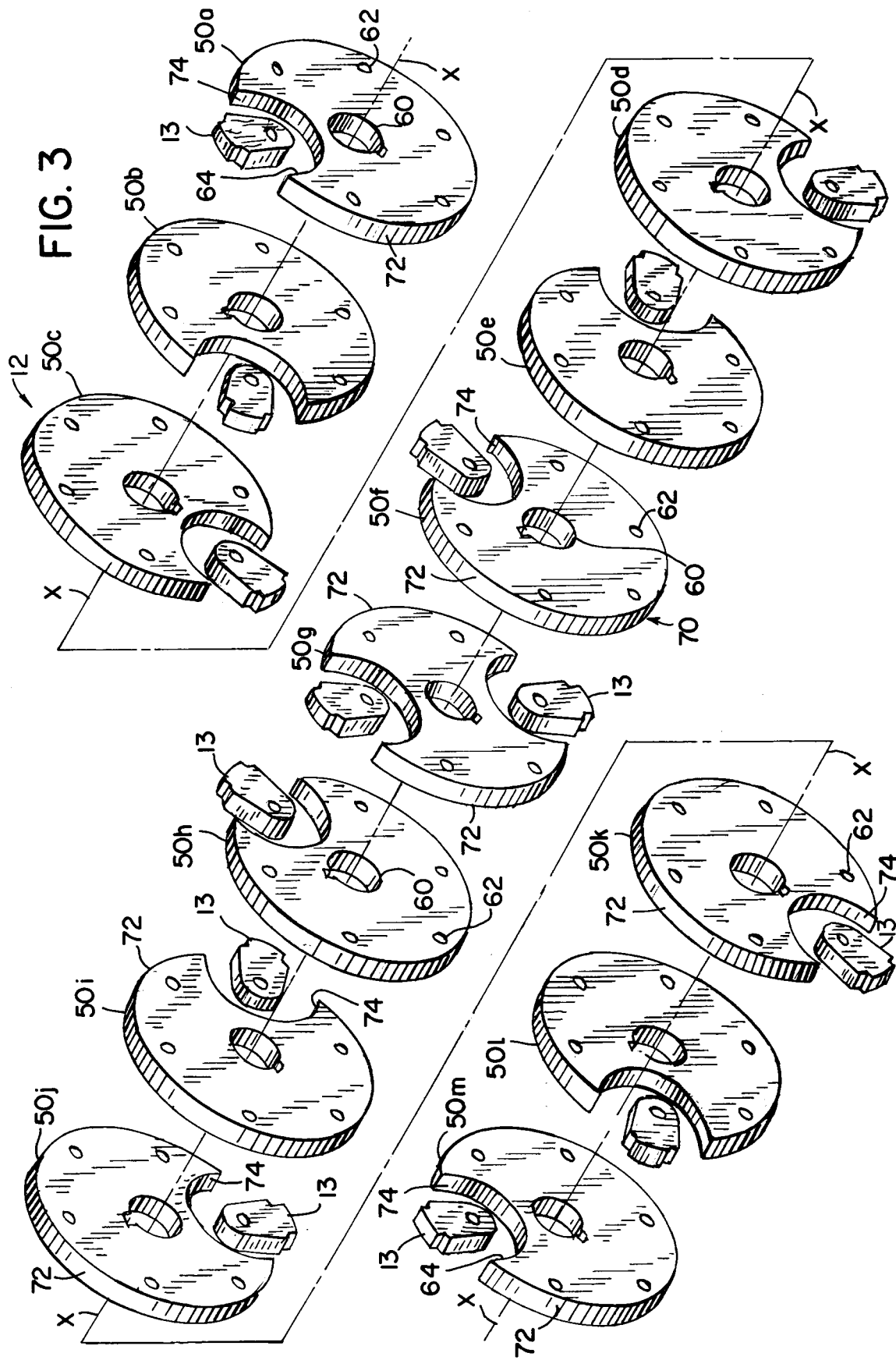


FIG. 2



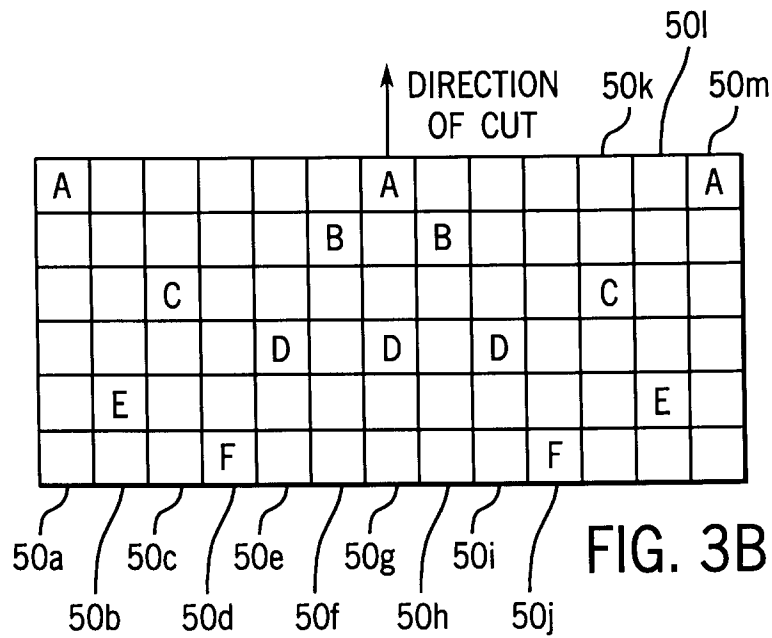
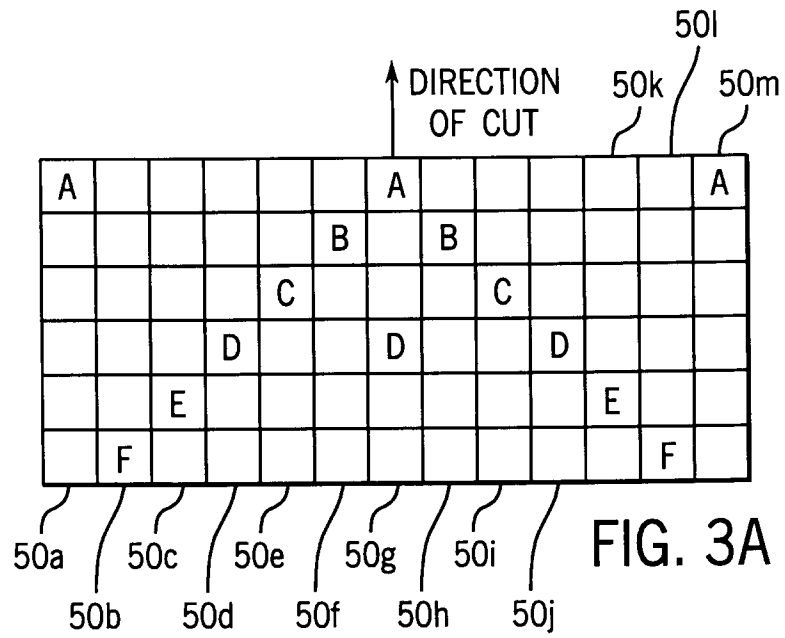


FIG. 5

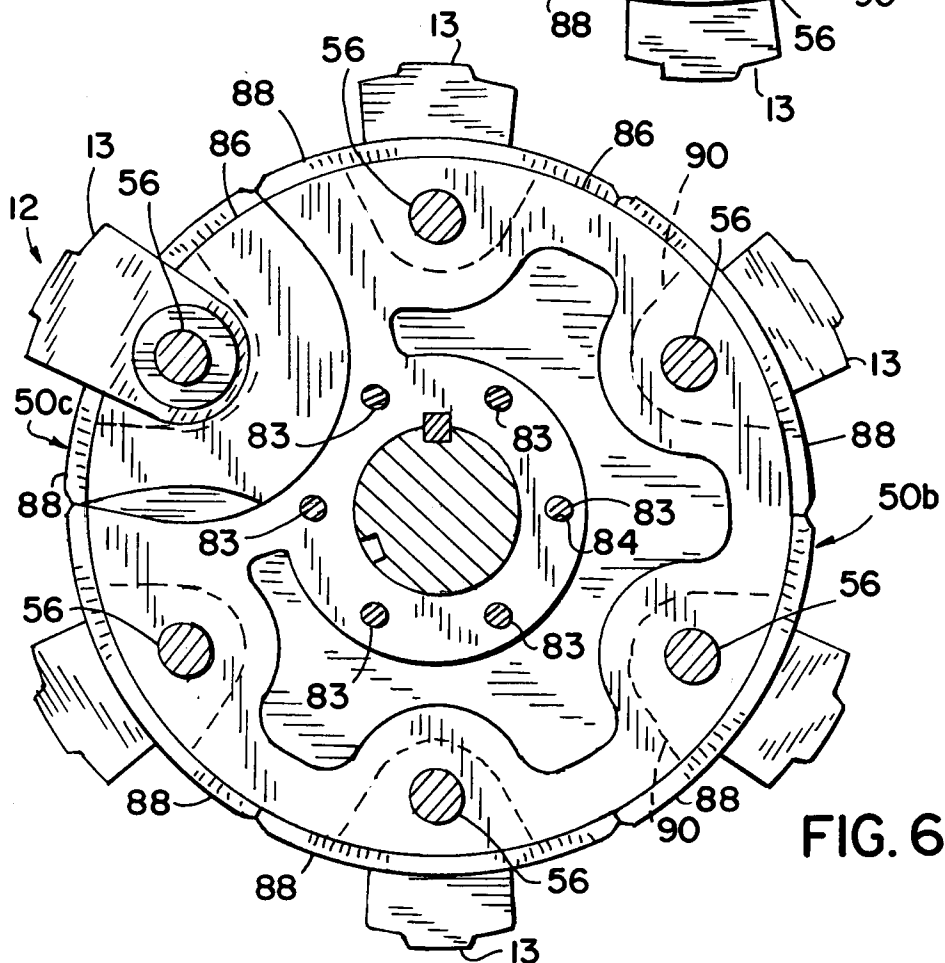
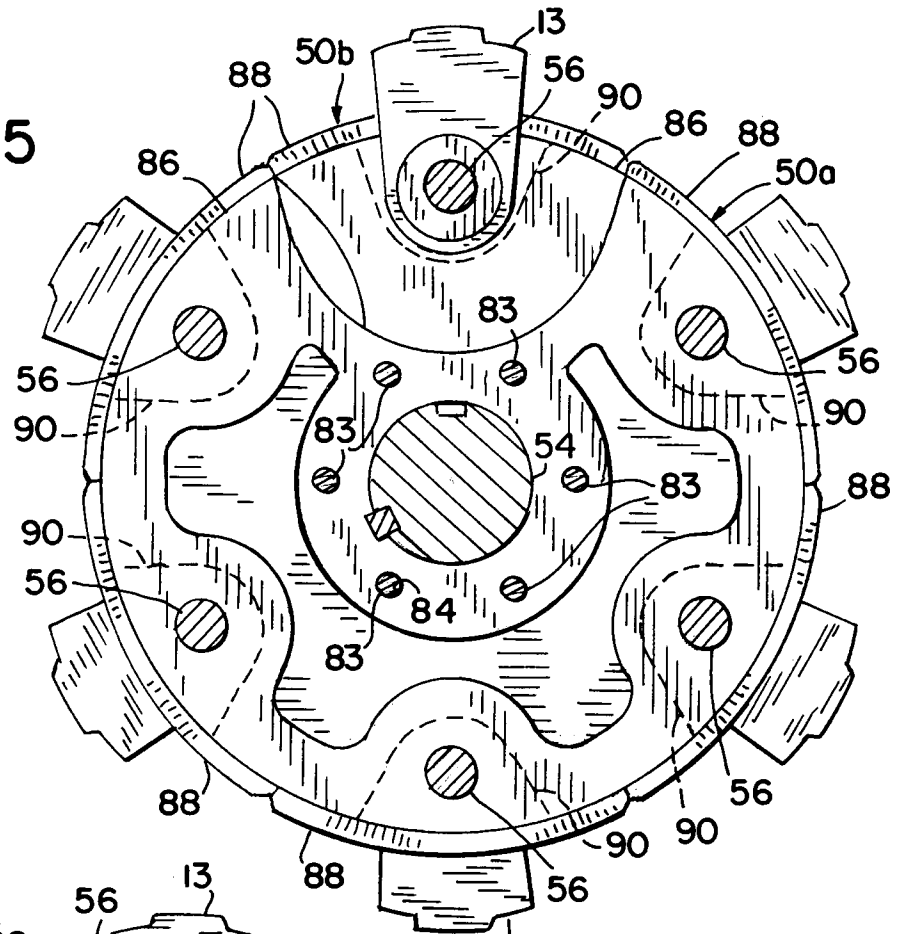


FIG. 6