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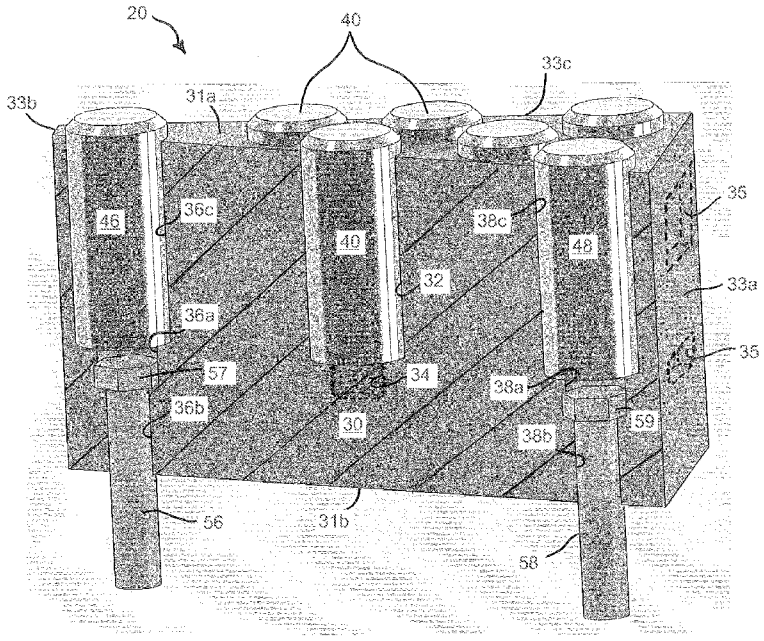

FIG. 5

(57) Abstract: A roller press is disclosed. The roller press comprises a roller [1] having a substrate body [10], a roller edge [16] formed by the intersection of a roller end [14] and an outer surface [12]. A plurality of surface wear components [20] are provided to the roller [1], Each surface wear component [20] comprises a body [30] having a lower contact surface [31 B] configured to contact the substrate body [10], an upper surface [31A] configured to support an autogenous layer, a first wear insert aperture [36C] configured to receive a first wear insert [46], a second through bore [36B] extending from said first wear insert aperture [36C].

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MODULAR PROTECTION FOR GRINDING ROLLS

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CROSS-REFERENCE OF RELATED APPLICATIONS

This application is an international application which claims the benefit of U.S. Provisional Patent Application No. 61/837,580 filed on 20 June 2013.

BACKGROUND OF THE INVENTION

This invention relates to crushing, grinding, and comminution equipment, and more particularly to high pressure grinding roller (HPGR) systems used, for instance, in the mining, cement, coal, aggregate, grain, and minerals processing industries.

Conventional grinding rollers may experience high rates of wear while in use. During such wear, wear inserts (e.g., studs) and edge protection elements may break off. Furthermore, portions of the roller surface, roller sleeve, and/or substrate substrate may fail. Tramp material or hard ore may cause outer portions of a roller to "chunk" (i.e., chip away). After a period of use a roller usually must be repaired, remanufactured, or replaced. Typically, fill weld is used to replace voids in the damaged roller, and then the fill is machined or ground down to match surrounding areas.

Recent attempts have been made to prevent premature roller surface wear in grinding rollers and to improve function and reduce problems associated with wear. Examples of historical roller designs which incorporate the application of various wear-resistant materials to surfaces of a roller may be seen in Patent/Application Publication Nos. WO03011465,

WO08132137, WO10121304, WO11020764, EP0872280, EP0897751, EP0399058, EP2239058, DE4235298, DE4235499, DE4312207, DE4400797, DE19515568, DE19606671, DE19709263, DE202010005879, TW356740, RU2207907, JP2008272712, US2008142272, US2008191074, US2008265073, US2009047543, US2009218429, US2010151268, US3635637, US5000392, US5054702, US5199657, US5203513, US5253816, US5269477, US5312056, US5704561, US5902685, and US6523767. However, many of these designs are susceptible to various forms of "washout", where roller sleeve substrate material begins to erode due to the migration of abrasive particles forming the autogenous layer. Additionally, some of these designs which incorporate formed or otherwise inlaid wear patterns formed into the roller substrate or sleeve itself, are susceptible to wearing down and loss of effectiveness. Furthermore, inserts, studs, and modular pieces which are welded to a roller substrate may crack or fail catastrophically in use, wherein replacement weld studs may need to be cut to size to match surrounding worn studs. Additionally, many of these prior designs do not provide an easy way to quickly and simply remove and replace only localized worn sections of a roller in-situ in a short amount of time. Furthermore, prior devices are not especially configured to be replaced without necessarily removing a substantial number of other roller components, such as clamping devices or special edge protection units. For example, some prior devices utilize tongue and groove features which would prevent selective replacement of wear devices. Some devices for protection of grinding rolls, such as those described in DE19614999, US3760477, and US5601520 are further not configured to maintain an autogenous layer, which helps reduce roller wear and extends roller life. Yet even other devices require very large or entire sections of sleeves to be replaced at a time, which wastes material, adds expense, requires more time, and subjects refurbishing

operators to dangerous heavy lifting/pinch points. Cranes, jigs, hoists, tethers, hydraulic jacks, and/or lifting apparatus are mandatory in order to lift and position these heavy large sections.

OBJECTS OF THE INVENTION

It is, therefore, an object of the invention to provide a mechanically-robust modular surface wear prevention system which is capable of forming and holding an autogenous layer of grinding material.

It is also an object of the invention to provide surface wear components having adequate support, attachment strength, stability, and resistance to "pull off".

It is yet another object of the invention to provide a means for quickly repairing damaged sections of roller quickly and without the need to remove a substantial number of other components of a roller.

It is another object of the invention to provide a surface wear system for a grinding roller which can be assembled by a small team or individual person without any use of cranes, jigs, hoists, lifts, hydraulic jacks, or other machinery which is commonly used to maintain and refurbish prior grinding rollers.

It is a further object of the invention to provide means for dressing outer surfaces of very large rollers with inexpensive means for wear protection.

These and other objects of the invention will be apparent from the drawings and description herein. Although every object of the invention is believed to be attained by at least one embodiment of the invention, there is not necessarily any one embodiment of the invention that achieves all of the objects of the invention.

SUMMARY OF THE INVENTION

A roller press is disclosed. The roller press comprises a roller having a substrate body and a roller edge formed by the intersection of a roller end and an outer surface. The roller further comprises a plurality of surface wear components provided to the roller. Each surface wear component may comprise a body having a lower contact surface configured to contact the substrate body, an upper surface configured to support an autogenous layer of grinding material, a first wear insert aperture configured to receive a first wear insert, a second through bore extending from said first wear insert aperture and to the lower contact surface, a first fastener extending through the second through bore and into the substrate body of the roller in order to secure the body to the substrate body, and a first wear insert provided within the first wear insert aperture and covering the first fastener. In some embodiments, each surface wear component may comprise a first through bore which is larger than the second through bore and extends between the first wear insert aperture and the second through bore. In some embodiments, the first fastener may comprise a first fastener head, and the first fastener head may be provided within said first through bore. In some embodiments, each surface wear component may further comprise a second wear insert aperture configured to receive a second wear insert, a fourth through bore extending from said second wear insert aperture, a second fastener extending through the fourth through bore and into the substrate body of the roller in order to secure the body to the substrate body, and a second wear insert provided within the second wear insert aperture and covering the second fastener. Each surface wear component of the roller press may further comprise a third through bore which is larger than the fourth through bore which extends between the second wear insert aperture and the fourth through bore. In some embodiments, the second fastener may comprise a second fastener head which is provided within said third through

bore. In some embodiments, removal means engageable with a tool for easily removing the body of the surface wear component from the substrate body may be provided to a surface wear component(s). Supplemental wear insert apertures which are configured to receive supplemental wear inserts may further be provided, wherein supplemental wear inserts may be provided within the supplemental wear insert apertures. In further embodiments, removal means may be provided adjacent to said supplemental wear insert aperture, wherein supplemental wear inserts may cover the removal means. In some embodiments, removal means may comprise a thread or other engagement feature extending from the at least one supplemental wear insert aperture. Surface wear components may comprise a first side, a second side, and a third side, wherein the first, second, and third sides are configured to engage respective first, second, and third sides of adjoining surface wear components which are provided to the roller. Some of the plurality of surface wear components provided to the roller which are adjacent to the roller edge may comprise one or more edge wear components which are brazed or otherwise permanently or temporarily affixed to at least one of the first side, second side, or third side of the body of the wear component.

A method of repairing a roller press is also disclosed. The method comprises the steps of selecting a surface wear component provided to a roller, engaging a first fastener, securing the selected surface wear component to the roller by access through the first wear insert aperture, removing the first fastener from a substrate body provided to the roller, and removing the surface wear component from the roller. Prior to engaging the first fastener, a first wear insert may be removed from a first wear insert aperture in the selected surface wear component. In some embodiments, the method may comprise the step of removing the first fastener from the body of the selected surface wear component. In some embodiments, the method may comprise the steps

of removing a second wear insert from a second wear insert aperture in the selected surface wear component, engaging a second fastener, securing the selected surface wear component to the roller by access through the second wear insert aperture, and removing the second fastener from a substrate body provided to the roller. In some instances, removal means provided to a surface wear component may be engaged with a tool, and a force may be exerted on said tool to assist with removing the surface wear component from the roller. In some embodiments, the method may comprise the step of removing a supplemental wear insert from a supplemental wear insert aperture in order to gain access to said removal means. In some embodiments, the steps of supplying a replacement surface wear component, providing the replacement surface wear component to the roller, inserting the first fastener or a replacement first fastener through the second through bore, re-engaging the first fastener or replacement first fastener with the substrate body of the roller, and securing the body of the replacement surface wear component to the substrate body may take place.

A surface wear component configured to be provided to a roller is also disclosed. The surface wear component may comprise a body having a lower contact surface configured to contact a substrate body, an upper surface configured to support an autogenous layer of grinding material, a first wear insert aperture configured to receive a first wear insert, a second through bore extending from said first wear insert aperture and to the lower contact surface, a first fastener configured to extend through the second through bore and configured to extend into and fasten to a substrate body of the roller in order to secure the body to the substrate body, a first wear insert configured to be provided within the first wear insert aperture and cover the first fastener, a second wear insert aperture configured to receive a second wear insert, a fourth through bore extending from said second wear insert aperture, a second fastener configured to

extend through the fourth through bore and configured to extend into and fasten to a substrate body of the roller in order to secure the body to the substrate body, and a second wear insert configured to be provided within the second wear insert aperture and cover the second fastener. In some embodiments, at least one supplemental wear insert aperture configured to receive a supplemental wear insert may be provided to the surface wear component. A supplemental wear insert may be provided within the supplemental wear insert aperture. Removal means may further be provided, which is engageable with a tool for easy removal of the body of the surface wear component from a substrate body of a roller. In some embodiments, the removal means may be provided adjacent to said supplemental wear insert aperture, wherein the supplemental wear insert may cover the removal means.

In preferred embodiments, surface wear components [20] are configured with a size, shape, and/or weight which obviates the need for cranes or similar equipment conventionally used to assist with moving the surface wear component [20] and permits a small team of (e.g., one or two) maintenance personnel to alone man-handle individual surface wear components [20]. In some preferred embodiments, each surface wear component [20] is further configured with a size, shape, and/or weight which permits a small team of (e.g., one or two) maintenance personnel to alone transport, install, and remove surface wear components [20] unassisted by cranes or similar equipment typically used to perform routine roller [1] maintenance.

BRIEF DESCRIPTION OF THE DRAWINGS

To complement the description which is being made, and for the purpose of aiding to better understand the features of the invention, a set of drawings illustrating preferred filtration media and methods of making such filtration media is attached to the present specification as an

integral part thereof, in which the following has been depicted with an illustrative and non-limiting character. It should be understood that like reference numbers used in the drawings may identify like components.

FIG. 1 is an isometric view of a portion of a roller and arrangement of surface wear components according to some embodiments;

FIG. 2 is an isometric view of a portion of a roller and arrangement of surface wear components according to some embodiments;

FIG. 3 is an isometric view of a portion of a roller and arrangement of surface wear components according to some embodiments;

FIG. 4 is an isometric view of a portion of a roller and arrangement of surface wear components according to some embodiments;

FIG. 5 is a partial cross-sectional view along a surface wear component shown in FIG. 1; and,

FIGS. 6-10 are cross-sectional schematic views of alternative surface wear components according to various embodiments of the invention.

In the following, the invention will be described in more detail with reference to drawings in conjunction with exemplary embodiments.

DETAILED DESCRIPTION OF THE INVENTION

FIGS. 1-4 show various embodiments of a roller 1, 100, 200, 300 which may be used within a grinding roll press or equivalent HPGR device. Turning now to FIG. 1, a roller 1 comprises a substrate body 10. The substrate body 10 may be integral to and/or monolithic with the roller shaft (not shown), or it may comprise a separate sleeve piece which is formed to or otherwise

attached to the shaft of the roller 1. The substrate body 10 comprises a generally cylindrical outer surface 12 and two opposing ends 14. A roller edge 16 is defined at each intersection between the two ends 14 and the outer surface 12. A plurality of rectangular prismatic surface wear components 20 may be distributed about the substrate body 10 in an "alternating brick" arrangement around the outer surface 12 to form a completed roller 1 having surface wear protection. It should be noted that some surface wear components 20 are intentionally not shown in the figures for clarity. Surface wear components 20 provided near the roller edge may be integrally-provided with one or more edge wear components 90. The edge wear components 90 are preferably permanently brazed to a side of a wear component 20, but the one or more edge wear components 90 may alternatively be bolted or otherwise attached to a side of a surface wear component 20 (e.g., using adhesive means and one or more interlocking surface features provided between an edge wear component 90 and a surface wear component 20). As shown, some of the rectangular prismatic surface wear components 20 may be of different size and/or shape. For instance, as shown, some of the surface wear components 20 may comprise cubes, rather than elongated rectangles in order to accommodate the "alternating brick" arrangement adjacent the roller edges 16.

As better shown in FIG. 5, surface wear components 20 disclosed herein may comprise a body 30 having an upper surface 31A configured to support an autogenous layer of grinding material between a number of supplemental wear inserts 40, a lower contact surface 31B configured to abut a substrate body 10, a first side 33A, a second side 33B, a third side 33C, and a fourth side (not shown due to cutaway view). A first through bore 36A and a second through bore 36B may be provided in the body 30 coaxially with a first wear insert aperture 36C. Together, the first wear insert aperture 36C, first through bore 36A, and second through bore 36B may extend through the body 30 from the upper surface 31A to the lower contact surface

31B. As shown, the first wear insert aperture 36C may be larger in diameter than the first 36A and/or second 36B through bores, and may be configured to receive a first wear insert 46. The first wear insert 46 is preferably similar in size, shape, and material as supplemental wear inserts 40; however, it is envisaged that the first wear insert 46 may alternatively be of a different size, shape, and/or material than supplemental wear inserts 40.

A first fastener 56 may be disposed within the second through bore 36B which is configured to engage the substrate body 10 of the roller 1. In the particular embodiment shown, the first fastener 56 comprises a threaded bolt having a first fastener head 57 which is received in a first through bore 36A. The first fastener head 57 may comprise a torque engagement surface such as a blind square recess, hexagonal recess, hexalobular recess, or other form of recess (e.g., square, pentagon, slot, cruciform-type), or the first fastener head 57 may comprise an outer profile which exhibits the ability to transfer a torque (e.g., hexagonal head). In instances where a central recess is provided, the first through bore 36A may be sized and shaped to closely approach or abut an outer surface of the first fastener head 57, since little room would be needed for a driver-type tool. In instances where an outer torque surface is provided to an outer profile of the first fastener head 57, a clearance between the first through bore 36A and the first fastener head 57 may be greater to allow room for a socket-type tool to engage said outer profile. In some preferred embodiments, the first through bore 36A may be larger in diameter than the second through bore 36B. This creates a shelf portion between the first through bore 36A and the second through bore 36B which can support said first fastener head 57 and help provide a clamping force with the substrate body 10. A portion of the first fastener 56 which is opposite the first fastener head 57 may comprise male or female threads which are designed to be received by complimentary female or male threads (not shown), respectively, which are provided within

the substrate body 10. Accordingly, the body 30 of a surface wear component 20 may be readily secured to the roller 1 in a removable manner.

A third through bore 38A and a fourth through bore 38B may be provided in the body 30 coaxially with a second wear insert aperture 38C. Together, the second wear insert aperture 38C, third through bore 38A, and fourth through bore 38B may extend through the body 30 from the upper surface 31A to the lower contact surface 31B. As shown, the second wear insert aperture 38C may be larger in diameter than the third 38A and/or fourth 38B through bores, and may be configured to receive a second wear insert 48. The second wear insert 48 is preferably similar in size, shape, and material as supplemental wear inserts 40 and first wear insert 46; however, it is envisaged that the second wear insert 48 may alternatively be of a different size, shape, and/or material than supplemental wear inserts 40 and/or the first wear insert 46.

A second fastener 58 may be disposed within the fourth through bore 38B which is configured to engage the substrate body 10 of the roller 1. In the particular embodiment shown, the second fastener 58 comprises a threaded bolt having a second fastener head 59 which is received in the third through bore 38A. The first fastener head 57 may comprise a torque engagement surface such as a blind square recess, hexagonal recess, hexalobular recess, or other form of recess (e.g., triangular, square, pentagon, slot, cruciform-type), or the second fastener head 59 may comprise an outer profile which exhibits the ability to transfer a torque (e.g., hexagonal head). In instances where a central recess is provided, the third through bore 38A may be sized and shaped to closely approach or abut an outer surface of the second fastener head 59, since little room is needed for a driver-type tool. In instances where an outer torque surface is provided to an outer profile of the second fastener head 59, clearance between the third through bore 38A and the second fastener head 59 may be greater to allow room for a socket-

type tool to engage said outer profile. In preferred embodiments, the third through bore 38A is slightly larger in diameter than the fourth through bore 38B. This creates a shelf portion between the third through bore 38A and the fourth through bore 38B which can support said second fastener head 59 and help provide a clamping force with substrate body 10. A portion of the second fastener 58 which is opposite the second fastener head 59 may comprise male or female threads which are designed to be received by complimentary female or male threads (not shown), respectively, which are provided to the substrate body 10. Accordingly, the body 30 of a surface wear component 20 may be readily secured to the roller 1 in a removable manner.

According to some embodiments, supplemental wear inserts 40 may be distributed about the body 30 and disposed within supplemental wear insert apertures 32 arranged in a predetermined pattern about the upper surface 31A of the body 30. The supplemental wear insert apertures 32 may be through bores, but are preferably blind apertures having a bottom. In any one or more of the supplemental wear insert apertures 32, removal means 34 may optionally be provided. Removal means 34 may comprise any divot, connector, thread, protuberance, or recess which is configured to be engaged with a tool to help break friction between the lower contact surface 31B and the outer surface 12 of the roller 1, and/or break friction between the sides 33A, 33B, 33C of a surface wear component 20 and surrounding sides 33A, 33B, 33C of surrounding surface wear components 20. For example, as shown, removal means 34 may comprise a female thread disposed adjacent a bottom portion of a supplemental wear insert aperture 32. To replace a broken wear component 20, a respective supplemental wear insert 40 may be removed from its supplemental wear insert aperture 32. A tool, such as a slap-hammer having a male threaded portion may be passed through the supplemental wear insert aperture 32 and engages the removal means. In the instance shown in FIG. 5, male threads of a slap-hammer

tool would engage the female threads forming the removal means 34. Once the slap-hammer tool is fully engaged with the removal means 34, the slap-hammer may be actuated to jerk the body 30 of the surface wear component 20 away from the substrate body 10, thereby facilitating removal of the surface wear component 20 from roller 1. Subsequent installation of a replacement surface wear component 20 may also be facilitated and accomplished in a reverse order, wherein a slap-hammer tool (not shown) may be engaged with the removal means 34, the body 30 of the surface wear component 20 may be positioned relative to the outer surface 12 of the roller, respective with surrounding surface wear components 20, and a force may be applied to the body 30 via the tool to seat the lower contact surface 31B of the replacement surface wear component 20 on the outer surface 12 of the substrate body 10 of the roller 1.

In preferred embodiments, surface wear components 20 are configured with a size, shape, and/or weight which obviates the need for cranes, jigs, lifts, hoists, hydraulic jacks, or similar equipment conventionally used to assist with moving/refurbishing/repairing modular HPGR surfaces and further permits a small team of (e.g., one, two, three, or four) maintenance personnel to alone man-handle individual surface wear components 20. In some preferred embodiments, each surface wear component 20 is further configured with a size, shape, and/or weight which permits a small team of (e.g., one, two, three, or four) maintenance personnel to alone transport, install, and/or remove surface wear components 20 unassisted by cranes, jigs, lifts, hoists, hydraulic jacks, or similar equipment typically used to perform routine roller maintenance on prior devices. In most preferred embodiments, a size, shape, and/or weight of each surface wear component 20 is configured to permit two or less people (e.g., a single individual) to lift, carry, position, place, push, pull, install, uninstall, and/or transport at least one surface wear component 20. In most preferred embodiments, a size, shape, and/or weight of

each surface wear component 20 is configured to permit a single person to lift, carry, position, place, push, pull, install, uninstall, and/or transport a single surface wear component 20 with one or two hands, without the aid of a tool engaged with removal means 34. In other highly preferred embodiments, a size, shape, and/or weight of each surface wear component 20 is configured to permit a single person to lift, carry, position, place, push, pull, and/or transport, two surface wear components 20 by engaging carrying tools with removal means 34, wherein the single person may handle or manipulate a single one of the two surface wear components 20 with each hand.

The size and shape of surface wear components 20 disclosed herein may be configured with ergonomic features for better handling by personnel. For example, one or more recessed fingerholds and/or handholds 35 may be built into one or more surfaces or sides 33A, 33B, 33C of each surface wear component 20, and tools used to engage removal means 34 may comprise large padded T-shaped handles, D-shaped handles, or eye bolts (for use with a carabineer and carry harness/sling) for easy manipulation of surface wear components 20. In some instances, the weight of each surface wear component may be equal to or less than the recommended weight limit (RWL) determined by the National Institute for Occupational Safety and Health (NIOSH) lifting equation, which defines a maximum acceptable load that nearly all healthy employees could lift over the course of an 8 hour shift without increasing the risk of musculoskeletal disorders (MSD) to the lower back. The NIOSH lifting equation is defined in more detail in the publication "Applications Manual For the Revised NIOSH Lifting Equation" by Thomas R. Waters, Ph.D., Vern Putz-Anderson, Ph.D., Arun Garg, Ph.D. Centers for Disease Control & Prevention, Published on 01 January 1994.

In some instances, the weight of each surface wear component 20 may be equal to or less than an acceptable lifting index (LI) which is calculated according to NIOSH, wherein the LI is a relative estimate of the level of physical stress and MSD risk associated with the manual lifting, carrying, positioning, placing, pushing, pulling, installation, uninstallation, and/or transportation of one or more surface wear components 20. For example, in some embodiments, surface wear components 20 may be configured to generate a NIOSH lifting index less than approximately 1.0, wherein,

(1) **NIOSH Lifting Equation:** RWL = LC (51) x HM x VM x DM x AM x FM x CM

Wherein:

LC= Load constant of 51 pounds

H = Horizontal location of the object relative to the body

V = Vertical location of the object relative to the floor

D = Distance the object is moved vertically

A = Asymmetry angle or twisting requirement

F = Frequency and duration of lifting activity

C = Coupling or quality of the workers grip on the object

M = Task variable expressed as coefficient/multiplier

(2) **NIOSH Lifting Index (LI):** LI = Weight ÷ RWL

Wherein LI is a function of:

Average weight of the objects lifted

Maximum weight of the objects lifted

In some embodiments, the Frequency-Independent Recommended Weight Limit (FIRWL) and the Frequency-Independent Lifting Index (FILI) as determined by NIOSH calculators and methodology may be less than an appropriate predetermined amount. For example, in some embodiments, a surface wear component 20 may be configured so as to yield an FILI which is less than about 1.0 when a single surface wear component 20 according to the invention is lifted by a single average-build maintenance worker. In another example, surface wear components 20 may be configured so as to yield an FILI which is less than about 1.0 when more than one surface wear component 20 according to the invention is lifted by single maintenance person.

In some embodiments, surface wear components 20 may be configured to be less than a FIRWL of approximately 20 lbs to about 80 lbs. In further embodiments, surface wear components 20 may be configured to be less than a FIRWL of approximately 40 lbs to about 60 lbs. In yet even further embodiments, surface wear components 20 may be configured to be less than a FIRWL of approximately 51 lbs (e.g., approximately 50 lbs or less). FIRWL may be calculated by using a frequency multiplier (FI) of 1.0 along with the other task variable multipliers in order to effectively remove frequency as a variable, reflecting a weight limit for a single repetition of that task and allows equal comparison to other single repetition tasks. The Frequency-Independent Lifting Index (FILI) may be calculated by dividing the weight lifted by the FIRWL. The FILI can help identify problems with infrequent lifting tasks if it exceeds the value of 1.0.

In further embodiments, surface wear components 20 may be sized and configured to weigh approximately the same or less than the recommended maximum lifting weight of 50 lbs. for men, or approximately 25 lbs. or less for women (as outlined by the Bureau of Labor Standards of the U.S. Department of Labor published "Bulletin No. 11--A Guide to the Prevention of Weight Lifting Injuries" and subsequently adopted as the established recommendation by the National Safety Council). In yet further embodiments, surface wear components 20 may be configured to comply with, meet, or exceed guidelines established in the International Labour Organisation (ILO) convention C127(a), ILO C155, European Directive 89/391/EEC, European Directive 90/269/EEC, (HSE) Manual Handling Operations Regulations 1992, and/or combinations thereof, without limitation. In some preferred embodiments, surface wear components 20 may be equal or less than approximately 25 kilograms.

Turning now to FIG. 2, a roller 100 comprises a substrate body 110. The substrate body 110 may be integral to the roller shaft (not shown), or a separate sleeve which is formed to the shaft of the roller 100. The substrate body 110 comprises a generally cylindrical outer surface 112 and two opposing ends 114. A roller edge 116 is defined at each intersection between the two ends 114 and the outer surface 112. A plurality of hexagonal prismatic surface wear components 120 may be distributed about the substrate body 110 in an "alternating brick" arrangement around the outer surface 112 to form a completed roller 100 having surface wear protection. It should be noted that some surface wear components 120 are not shown in the figures for clarity. Surface wear components 120 provided near the roller edge may be integrally-provided with one or more edge wear components 190. The edge wear components 190 are preferably permanently brazed to a side of a wear component 120, but an edge wear component may alternatively be bolted to a side of a wear component 120. As shown, some of the hexagonal prismatic surface wear components 120

may be of different size or shape. For instance, as shown, some of the surface wear components 120 may comprise "half-sections" of hexagonal prisms, rather than whole hexagonal prisms in order to accommodate the "alternating brick" arrangement. As shown, these "half-sections" may omit more than half of the total number of wear inserts found on a full hexagonal prismatic surface wear component 120.

Turning now to FIG. 3, a roller 200 comprises a substrate body 210. The substrate body 210 may be integral to the roller shaft (not shown), or a separate sleeve which is formed to the shaft of the roller 200. The substrate body 210 comprises a generally cylindrical outer surface 212 and two opposing ends 214. A roller edge 216 is defined at each intersection between the two ends 214 and the outer surface 212. A plurality of four-sided prismatic surface wear components 220 may be distributed about the substrate body 210 in an "alternating brick" arrangement around the outer surface 212 to form a completed roller 200 having surface wear protection. The four-sided prismatic surface wear components 220 may have a diamond, rhombus, or parallelogram shape as shown. It should be noted that some surface wear components 220 are not shown in the figures for clarity. Surface wear components 220 provided near the roller edge may be integrally-provided with one or more edge wear components 290. The edge wear components 290 are preferably permanently brazed to a side of a wear component 220, but an edge wear component may alternatively be bolted to a side of a wear component 220. As shown, some of the four-sided prismatic surface wear components 220 may be of different size or shape. For instance, as shown, some of the surface wear components 220 may comprise "half-sections" of four-sided prisms, rather than whole four-sided prisms in order to accommodate the "alternating brick" arrangement. As shown, these "half-sections" may omit more than half of the total number of wear inserts found on a full four-sided prismatic surface wear component 220.

Turning now to FIG. 4, a roller 300 comprises a substrate body 310. The substrate body 310 may be integral to the roller shaft (not shown), or a separate sleeve which is formed to the shaft of the roller 300. The substrate body 310 comprises a generally cylindrical outer surface 312 and two opposing ends 314. A roller edge 316 is defined at each intersection between the two ends 314 and the outer surface 312. A plurality of interlocking prismatic surface wear components 320 may be distributed about the substrate body 310 in an "alternating brick" arrangement around the outer surface 312 to form a completed roller 300 having surface wear protection. The interlocking prismatic surface wear components 320 may comprise chevron shapes as shown, but may also comprise other interlocking shapes having less or more than six sides, for example - three, four, five, seven, or eight sides, without limitation. It should be noted that some surface wear components 320 are not shown in the figures for clarity. Surface wear components 320 provided near the roller edge may be integrally-provided with one or more edge wear components 390. The edge wear components 390 are preferably permanently brazed to a side of a wear component 320, but an edge wear component may alternatively be bolted to a side of a wear component 320. As shown, some of the interlocking prismatic surface wear components 320 may be of different size or shape.

Turning now to FIGS. 6-10, a number of different connection features for surface wear components 420, 520, 620, 720, 820 are shown. FIG. 6 shows a surface wear component 420 having a first wear insert 446, a second wear insert 448, and a supplemental wear insert 440 disposed within a body 430. A bottom portion of the body 430 comprises a male-female connection or interface with a substrate body 410 of a roller. The male-female connection may comprise a first portion 417 and a second portion 416. In the instance shown, the first portion 417 is provided to the body 430 of the surface wear component 420 and may comprise at least one of a

first fastener 456 and a second fastener 458. First 456 and second 458 fasteners may be connected (e.g., peripherally) to form an annular boss, for example, a square ring protrusion which extends around a perimeter of the bottom portion of body 430. First 456 and second 458 fasteners may be independent and distinct bosses or bifurcations of body 430. First 456 and second 458 fasteners may comprise first 457 and second 459 interlocking features, respectively, such as a Morse taper or 1-3 degree tapered lead-in as shown. The second portion 416 of the male-female connection may comprise, for example, a boss or other protrusion extending from an outer surface 412 of the substrate body 410. The boss may be formed by machining, casting, or as a result of cross-hatching, scoring, or channeling the outer surface 412 of the substrate body 410.

FIG. 7 shows a surface wear component 520 having a first wear insert 546, a second wear insert 548, and a supplemental wear insert 540 disposed within a body 530. A bottom portion of the body 530 comprises a male-female connection or interface with a roller substrate body 510. In the instance shown, at least one of a first fastener 556 and a second fastener 558 may be provided to the surface wear component 520. First 556 and second 558 fasteners may be connected to form an annular boss or lip, for example, a circular ring protrusion which extends around an inner cavity 570 in the body 530. First 556 and second 558 fasteners may also be independent and distinct elements, such as bosses or bifurcations extending from body 530 and may comprise one or more engagement features such as lips or tangs which engage a post 516 extending from the substrate body 510 of a roller. The post 516 extending from the substrate body 510 may be provided within a receiving portion 513 within the substrate body 510. The receiving portion 513 may comprise a press-fit with said post 516, a gluing surface for said post 516, a weld surface for said post 516, a portion of a threaded surface, or the like. As in the embodiment shown, upper exposed portions of the post 516 may comprise one or more engagement features 559 such as portions of an annular

channel or groove which complimentarily mate with one or more engagement features 557 provided on the first 556 and second 558 fasteners. To install the surface wear component 520, the body 530 is pressed towards the outer surface 512 of the substrate body 510 until it rests against outer surface 512 and engagement features between the surface wear component and the substrate body 510 engage each other.

FIG. 8 shows a surface wear component 620 similar to that shown in FIG. 7 having a first wear insert 646, a second wear insert 648, and a supplemental wear insert 640 disposed within a body 630. A bottom portion of the body 630 comprises a male-female connection or interface with a roller substrate body 610. As shown, at least one of a first fastener 656 and a second fastener 658 may be provided. First 656 and second 658 fasteners may be connected to form an annular boss, for example, a circular ring protrusion which extends around an inner cavity 670 in the body 630. First 656 and second 658 fasteners may be independent and distinct bosses or bifurcations extending from body 630, and may comprise one or more engagement features such as lips or tangs which operatively engage a clip 690. An open end 692 of the clip 690 may be introduced to and operatively engaged with a post 616 extending from the substrate body 610 of a roller. The post 616 may be provided within a receiving portion 613 provided to the substrate body 610. The receiving portion 613 may be, for instance, configured to provide a press-fit, and adhesive bond, a weld connection, a threaded anchoring connection of the post 616, or the like. As in the embodiment shown, the post 616 may comprise one or more engagement features such as one or more ribs or projections which complimentarily mate with engagement features provided on the clip 690 and/or first 656 or second 658 fasteners. To install the surface wear component 620, the body 630 may be pressed against a closed end 694 of the clip 690 such that first 656 and second 658 fasteners engage a middle portion 696 of the clip 690. While not shown, the clip 690 may be

retained within cavity 670 without the use of said first 656 or second 658 fasteners. One or more interlocking features 695 such as a finger or barb may be provided on the clip 690 to better secure the clip 690 to the body 630 of the surface wear component 620. One or more first interlocking features 611 such as one or more projections, barbs, annular lips, grooves, recesses, detents, snap fits, clip portions, or surface textures may be provided to the post 616 to more positively receive portions of clip 690.

FIG. 9 shows a surface wear component 720 having a first wear insert 746, a second wear insert 748, and a supplemental wear insert 740 disposed within a body 730. A bottom portion of the body 730 comprises a male-female connection or interface with a roller substrate body 710. In the instance shown, at least one of a first 756 and second 758 fastener may be provided. First 756 and/or second 758 fasteners may be provided in the form of a solid or annular boss, for example, a tapered protrusion which extends from the body 730 and projects into a complimentarily-shaped receiving portion 713 in an outer surface 712 of the substrate body 710. First 756 and second 758 fasteners may be independent and distinct bosses extending from body 730, or they may be integrally-formed with body 730 and comprise one or more engagement features such as lips or tangs (not shown) which operatively engage complimentary engagement features in receiving portion 713. In some embodiments, the receiving portion 713 may include a press-fit, a taper-fit, a glued connection, or the like. In some embodiments more than two fasteners 756, 758 may be employed. To install the surface wear component 720, the body 730 may be pressed against the substrate body 710 until outer portions of first 756 and/or second 758 fastener(s) engage with respective receiving portion(s) 713. In some instances, body 730 may come into full or partial contact with the outer surface 712. Alternatively, in some instances, body 730 may be spaced slightly from outer surface 712 when a fastener(s) is fully engaged with the receiving portion(s)

713. While not shown, the body 730 may be retained within receiving portions 713 via one or more engagement features provided on any one of said first 756and second 758 fasteners.

FIG. 10 shows a surface wear component 820 having a first wear insert 846, a second wear insert 848, and a supplemental wear insert 840 disposed within a body 830. A bottom portion of the body 830 comprises a male-female connection or interface with a roller substrate body 810. In the instance shown, a male-female connection may comprise a first fastener comprising a post 816 extending from body 830. The post 816 may be provided within a through bore which also accepts a wear insert (e.g., supplemental wear insert 840 as shown). Post 816 may comprise one or more first interlocking features such as a projection, barb, annular lip, groove, recess, detent, snap fit, clip portion, or surface in order to more positively receive complimentary engagement features and/or portions of a clip 890 disposed between the substrate body 10 and body 830 of surface wear component 820 (e.g., a middle portion 896 of a clip 890). A distal end portion of post 816 and/or portions of clip 890 may extend into a receiving portion 813 in the outer surface 812 of the substrate body 810. The receiving portion 813 may comprise, for instance, a press-fit, a friction fit, or an adhesive layer. An open end 892 of the clip 890 may be introduced to the post 816 and operatively engaged with the post 816. To install the surface wear component 820, the body 830 is pressed towards an outer surface 812 of the substrate body 810. A closed end 894 of the clip 890 may be installed within the receiving portion 813 prior to pressing the body 830 towards the substrate body 810, or the open end 892 may be installed over the post 816 prior to pressing the body 830 towards the substrate body 810. The one or more first interlocking features may engage a narrow (shown) or bulbous (not shown) middle portion 896 of the clip 890. One or more second interlocking features 895 (e.g., such as a finger or barb) may be provided on the clip 890 to secure the

clip 890 to the body 830 of the surface wear component 820. Body 830 may rest against outer surface 812 of the substrate body 810.

A contractor or other entity may provide a grinding roller or operate a grinding roller apparatus in whole, or in part, as shown and described. For instance, the contractor may receive a bid request for a project related to designing or operating a grinding roller apparatus, or the contractor may offer to design such a modular wear protection system or a process for a client. The contractor may then provide, for example, any one or more of the devices or features thereof shown and/or described in the embodiments discussed above. The contractor may provide such devices by selling those devices or by offering to sell those devices. The contractor may provide various embodiments that are sized, shaped, and/or otherwise configured to meet the design criteria of a particular client or customer. The contractor may subcontract the fabrication, delivery, sale, or installation of a component of the devices disclosed, or of other devices used to provide said devices. The contractor may also survey a site and design or designate one or more storage areas for storing the material used to manufacture the devices, or for storing the devices and/or components thereof. The contractor may also maintain, modify, or upgrade the provided devices. The contractor may provide such maintenance or modifications by subcontracting such services or by directly providing those services or components needed for said maintenance or modifications, and in some cases, the contractor may modify a preexisting grinding roller apparatus, or parts thereof with a "retrofit kit" to arrive at a modified grinding roller apparatus comprising one or more method steps, devices, components, or features of the systems and processes discussed herein.

Although the invention has been described in terms of particular embodiments and applications, one of ordinary skill in the art, in light of this teaching, can generate additional embodiments and modifications without departing from the spirit of or exceeding the scope of

the claimed. For example, in some embodiments, while not shown, the surface wear components 20 shown in FIG. 1 may instead comprise bodies which are similar in shape and size and may be aligned in a circumferential direction rather than in the "alternating brick" arrangement shown. In such arrangements, hole patterns provided to the outer surface 12 of substrate body 10 would be generally aligned along circumferences which are spaced along predetermined axial locations of a roller 1. As another example, wear inserts 40, 46, 48 disclosed herein may be provided to surface wear component bodies 30 in any configuration, pattern, or size distribution. For example, outer surface wear components comprising edge wear components 90 may comprise closer stud spacing patterns, a higher number of studs, and/or smaller studs than other surface wear components located more centrally to the roller 1. As yet another example, wear inserts 40, 46, 48 and/or wear insert apertures 32, 36C, 38C may comprise shapes other than cylindrical shapes. For instance, wear inserts 40, 46, 48 and/or wear insert apertures 32, 36C, 38C may comprise regular or irregular prismatic polygonal shapes (e.g., pentagonal prismatic wear inserts or tapered octagonal prismatic wear inserts provided within round or tapered wear insert apertures). Moreover, while each of the surface wear components 20, 120, 220, 320 shown appear to be of similar shape and size, the shapes, sizes, and/or configurations of surface wear components 20, 120, 220, 320 may vary within the same roller 1, 100, 200, 300.

Even more alternatively, first 46 and or second 48 wear inserts may be integrally-formed with respective first 56 or second 58 fasteners. In such instances, the first 46 and/or second 48 wear insert may comprise means for torque engagement/transmission which would otherwise normally be applied to the first 56 or second 58 fastener. In such embodiments, upper portions of wear inserts 40, 46, 48 may comprise outer flats such as those found on a hexagonal outer circumferential profile, or may comprise inner torque-transmitting recesses such as a triangular,

square, pentagonal, hexagonal, or hexalobular recess extending therethrough. Consequently, fastening features of the first 56 and/or second 58 fasteners (e.g., male or female threads) may be built into lower portions of wear inserts 46, 48. In such embodiments, the step of separately removing a first 46 or second 48 wear insert to gain access to a first 56 or second 58 fastener for removal of a surface wear component 20 may be obviated. An operator, in such embodiments, would only need to remove the wear insert-fastener combination in a single step to facilitate removal of a body from a substrate body.

In further embodiments, first 46 and second 48 wear inserts may be omitted entirely, wherein the first 36C and second 38C wear insert apertures and/or the first 36A and third 38A through bores are configured to fill with grinding material and form a portion of the autogenous layer. In yet further embodiments, while not shown, three-sided or "triangular" surface wear components may be provided. Wear inserts 40, 46, 48 discussed herein may be swaged, glued, force-fitted, knurled, welded, pressed, or explosion bonded to a body 30 without limitation. Furthermore, supplemental wear inserts 40 may comprise additional features which serve to protect removal means 34. For example, in some non-limiting embodiments, a supplemental wear insert 40 which covers removal means 34 may further comprise a lower protrusion having a male thread or smooth surface plug which closely matches an inner diameter thread of the removal means 34. The lower protrusion or plug, when coupled to or positioned adjacent to the removal means, would reduce the chance of grinding material working its way to portions of the removal means 34 and causing wear to the removal means 34.

In some instances, fasteners may comprise alternative fastening means other than the bolt-type fasteners 56, 58 which are shown in the drawings. For example, while it may not be shown, one or more of the following may be used in conjunction with or as a replacement to

shown fasteners 56, 58: a clip and complimentary retaining recess in the outer surface 12 of the substrate body 10, a clevis pin and complimentary receiving aperture in the outer surface 12 of the substrate body 10, a quick-release pit-pin and complimentary receiving aperture in the outer surface 12 of the substrate body 10, a headed or headless press-fitted smooth or knurled pin and a complimentary slightly-undersized receiving aperture in the outer surface 12 of the substrate body 10, an anchor bolt of the wedge or expansion-type and a complimentary hole in the outer surface 12 of the substrate body 10, or one or more dovetail features provided to the lower surface 31b of the body 30 which fit into one or more undercut grooves provided within the outer surface 12 of the substrate body.

Accordingly, it is to be understood that the drawings and descriptions herein are proffered by way of example to facilitate comprehension of the invention and should not be construed to limit the scope thereof.

REFERENCE NUMERAL IDENTIFIERS

1, 100, 200, 300	Roller
10, 110, 210, 310	Substrate body
410, 510, 610, 710, 810	
12, 112, 212, 312	Outer surface
412, 512, 612, 712, 812	
14, 114, 214, 314	End
16, 116, 216, 316	Edge
20, 120, 220, 320,	Surface wear component
420, 520, 620,720, 820	
90, 190, 290, 390	Edge wear component
30, 430, 530, 630, 730, 830	Body
31A	Upper surface
31B	Lower contact surface
32	Supplemental wear insert aperture
33A	First side
33B	Second side
33C	Third side
34	Removal means
35	Fingerhold/handhold
36A	First through bore
36B	Second through bore
36C	First wear insert aperture
38A	Third through bore
38B	Fourth through bore
38C	Second wear insert aperture
40, 440, 540, 640, 740, 840	Supplemental wear insert
46, 446, 546, 646, 746, 846	First wear insert
48, 448, 548, 648, 748, 848	Second wear insert
56, 456, 556, 656, 756	First fastener
57	First fastener head
58, 458, 558, 658, 758	Second fastener
59	Second fastener head
416	Second portion of male-female connection
417	First portion of male-female connection
457	First interlocking feature (e.g., taper)
459	Second interlocking feature (e.g., taper)
513, 613, 713, 813	Receiving portion
516, 616, 816	Post
557	First interlocking feature (e.g., lip/tang)
559	Second interlocking feature (e.g., lip/tang)
570, 670	Cavity
611	First interlocking feature (e.g., finger)
690, 890	Clip
692, 892	Open end
694, 894	Closed end
695, 895	Second interlocking feature (e.g., finger)
696, 896	Middle portion

CLAIMS

WHAT IS CLAIMED IS:

1. A roller press comprising:

a roller [1] having a substrate body [10] and a roller edge [16] formed by the intersection of a roller end [14] and an outer surface [12];

a plurality of surface wear components [20] provided to the roller [1], each surface wear component [20] having:

a body [30] having a lower contact surface [31B] configured to contact the substrate body [10];

an upper surface [31A] configured to support an autogenous layer of grinding material;

a first wear insert aperture [36C] configured to receive a first wear insert [46];

a second through bore [36B] extending from said first wear insert aperture [36C] and to the lower contact surface [31B];

a first fastener [56] extending through the second through bore [36B] and into the substrate body [10] of the roller [1] in order to secure the body [30] to the substrate body [10]; and,

a first wear insert [46] provided within the first wear insert aperture [36C] and covering the first fastener [56].

2. The roller press according to claim 1, wherein each surface wear component [20] further comprises a first through bore [36A] which is larger than the second through bore [36B] extending between the first wear insert aperture [36C] and the second through bore [36B].

3. The roller press according to claim 2, wherein the first fastener [56] comprises a first fastener head [57], and the first fastener head [57] is provided within said first through bore [36A].

4. The roller press according to claim 2, wherein each surface wear component [20] further comprises:

a second wear insert aperture [38C] configured to receive a second wear insert [48];

a fourth through bore [38B] extending from said second wear insert aperture [38C];

a second fastener [58] extending through the fourth through bore [38B] and into the substrate body [10] of the roller [1] in order to secure the body [30] to the substrate body [10]; and,

a second wear insert [48] provided within the second wear insert aperture [38C] and covering the second fastener [58].

5. The roller press according to claim 4, wherein each surface wear component [20] further comprises a third through bore [38A] which is larger than the fourth through bore [38B] extending between the second wear insert aperture [38C] and the fourth through bore [38B].

6. The roller press according to claim 5, wherein the second fastener [58] comprises a second fastener head [59], and the second fastener head [59] is provided within said third through bore [38A].

7. The roller press according to claim 1, wherein each surface wear component [20] further comprises removal means [34] engageable with a tool for easily removing the body [30] of the surface wear component [20] from the substrate body [10].

8. The roller press according to claim 1, wherein each surface wear component [20] further comprises a supplemental wear insert aperture [32] configured to receive a supplemental wear insert [40], and a supplemental wear insert [40] provided within the supplemental wear insert aperture [32].

9. The roller press according to claim 8, wherein each surface wear component [20] further comprises removal means [34] engageable with a tool for easily removing the body [30] of the surface wear component [20] from the substrate body [10].

10. The roller press according to claim 9, wherein said removal means [34] is provided adjacent to said supplemental wear insert aperture [32], wherein the supplemental wear insert [40] covers the removal means [34].

11. The roller press according to claim 9, wherein said removal means [34] comprises a thread or other engagement feature extending from the at least one supplemental wear insert aperture [32]

12. The roller press according to claim 1, wherein each surface wear component [20] further comprises a first side [33A], a second side [33B], and a third side [33C]; wherein the first [33A], second [33B], and third [33C] sides are configured to engage respective first [33A], second [33B], and third [33C] sides of adjoining surface wear components [20].

13. The roller press according to claim 12, wherein some of the plurality of surface wear components [20] provided to the roller [1] adjacent the roller edge [16] comprise an edge wear component [90] which is brazed to at least one of the first side [33A], second side [33B], or third side [33C] of its body [30].

14. A method of repairing a roller press having a roller [1] formed of a substrate body [10] and a roller edge [16] formed by the intersection of a roller end [14] and an outer surface [12]; and a plurality of surface wear components [20] provided to the roller [1], each surface wear component [20] having: a body [30] having a lower contact surface [31B] configured to contact the substrate body [10]; an upper surface [31A] configured to support an autogenous layer of grinding material; a first wear insert aperture [36C] configured to receive a first wear insert [46]; a second through bore [36B] extending from said first wear insert aperture [36C] and to the lower contact surface [31B]; a first fastener [56] extending through the second through bore [36B] and into the substrate body [10] of the roller [1] in order to secure the body [30] to the

substrate body [10]; and, a first wear insert [46] provided within the first wear insert aperture [36C] and covering the first fastener [56]; the method comprising the steps of:

selecting a surface wear component [20] provided to the roller [1];

engaging a first fastener [56] securing the selected surface wear component [20] to the roller [1] by access through the first wear insert aperture [36C];

removing the first fastener [56] from a substrate body [10] provided to the roller [1]; and,

removing the surface wear component [20] from the roller [1].

15. The method according to claim 14, further comprising the step of removing the first fastener [56] from the body [30] of the selected surface wear component [20].

16. The method according to claim 14, further comprising the steps of:

removing a second wear insert [48] from a second wear insert aperture [38C] in the selected surface wear component [20];

engaging a second fastener [58] securing the selected surface wear component [20] to the roller [1] by access through the second wear insert aperture [38C]; and,

removing the second fastener [58] from a substrate body [10] provided to the roller [1].

17. The method according to claim 14, further comprising the steps of:

engaging a removal means [34] with a tool; and,

exerting a force on said tool to assist with the step of removing the surface wear component [20] from the roller [1].

18. The method according to claim 17, further comprising the step of:

removing a supplemental wear insert [40] from a supplemental wear insert aperture [32] in order to gain access to said removal means [34].

19. The method according to claim 14, further comprising the steps of:

supplying a replacement surface wear component [20];

providing the replacement surface wear component [20] to the roller [1];

inserting the first fastener [56] or a replacement first fastener [56] through the second through bore [36B];

engaging the first fastener [56] with the substrate body [10] of the roller [1]; and,

securing the body [30] of the replacement surface wear component [20] to the substrate body [10].

20. The method according to claim 14, further comprising the step of:

removing a first wear insert [46] from a first wear insert aperture [36C] in the selected surface wear component [20];

wherein the step of removing a first wear insert [46] from a first wear insert aperture [36C] in the selected surface wear component [20] is performed prior to the step of engaging or removing the first fastener [56] securing the selected surface wear component [20].

21. A surface wear component [20] configured to be provided to a roller [1], the surface wear component [20] comprising:

a body [30] having a lower contact surface [31B] configured to contact a substrate body [10];

an upper surface [31A] configured to support an autogenous layer of grinding material;

a first wear insert aperture [36C] configured to receive a first wear insert [46];

a second through bore [36B] extending from said first wear insert aperture [36C] and to the lower contact surface [31B];

a first fastener [56] configured to extend through the second through bore [36B] and configured to extend into and fasten to a substrate body [10] of the roller [1] in order to secure the body [30] to the substrate body [10];

a first wear insert [46] configured to be provided within the first wear insert aperture [36C] and cover the first fastener [56];

a second wear insert aperture [38C] configured to receive a second wear insert [48];

a fourth through bore [38B] extending from said second wear insert aperture [38C];

a second fastener [58] configured to extend through the fourth through bore [38B] and configured to extend into and fasten to a substrate body [10] of the roller [1] in order to secure the body [30] to the substrate body [10]; and,

a second wear insert [48] configured to be provided within the second wear insert aperture [38C] and cover the second fastener [58].

22. The surface wear component [20] according to claim 21, further comprising at least one supplemental wear insert aperture [32] configured to receive a supplemental wear insert [40], and a supplemental wear insert [40] provided within the supplemental wear insert aperture [32].

23. The surface wear component [20] according to claim 22, further comprising removal means [34] engageable with a tool for easily removing the body [30] of the surface wear component [20] from a substrate body [10] of a roller [1].

24. The surface wear component [20] according to claim 23, wherein said removal means [34] is provided adjacent to said supplemental wear insert aperture [32], wherein the supplemental wear insert [40] covers the removal means [34].

25. A surface wear component [420] configured to be provided to a roller, the surface wear component [420] comprising:

a body [430] having a lower contact surface configured to contact an outer surface [412] of a substrate body [410];

an upper surface configured to support an autogenous layer of grinding material;

a wear insert aperture configured to receive a wear insert [440];

a first portion [456] of a male-female connection configured to engage a second portion [416] of a male-female connection provided to the substrate body [410] and configured to fasten to said a substrate body [410] in order to secure the body [430] to the substrate body [410]; and,

a wear insert [440] configured to be provided within the wear insert aperture.

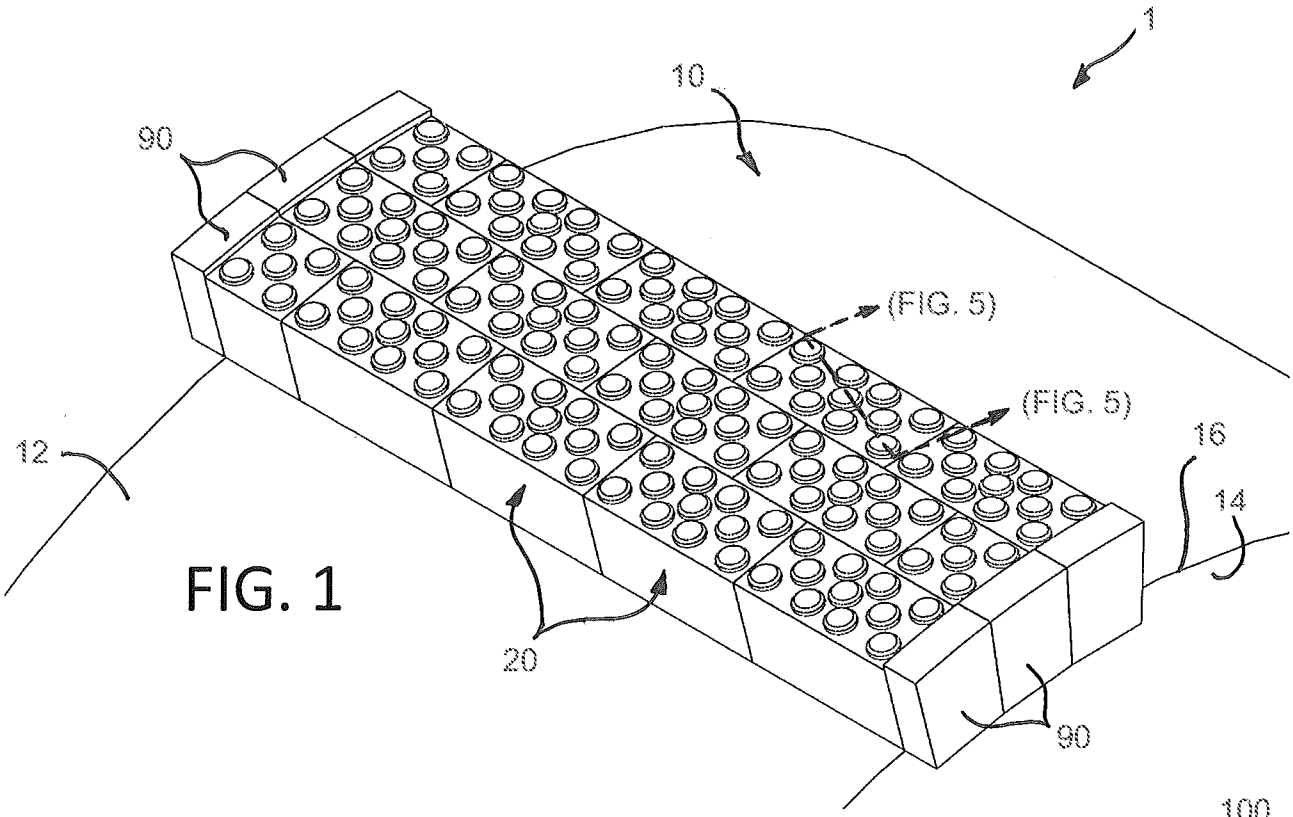


FIG. 1

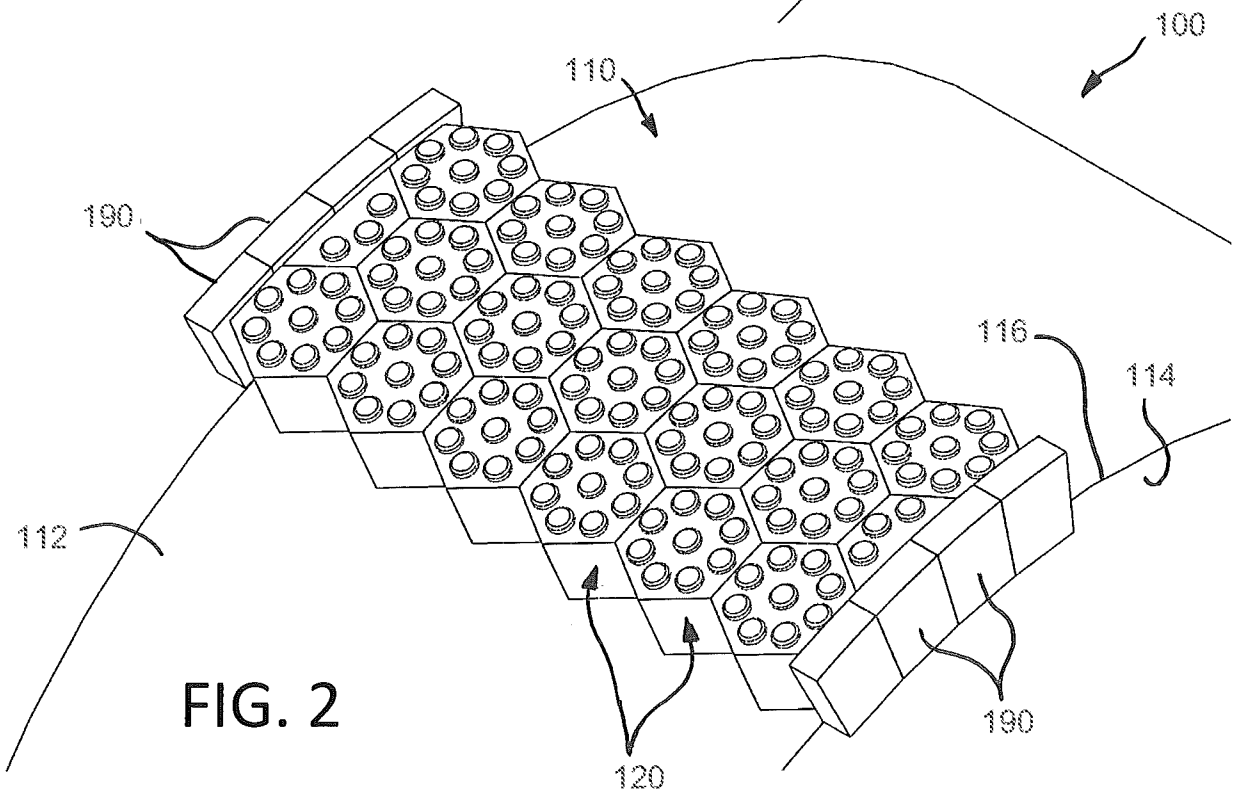


FIG. 2

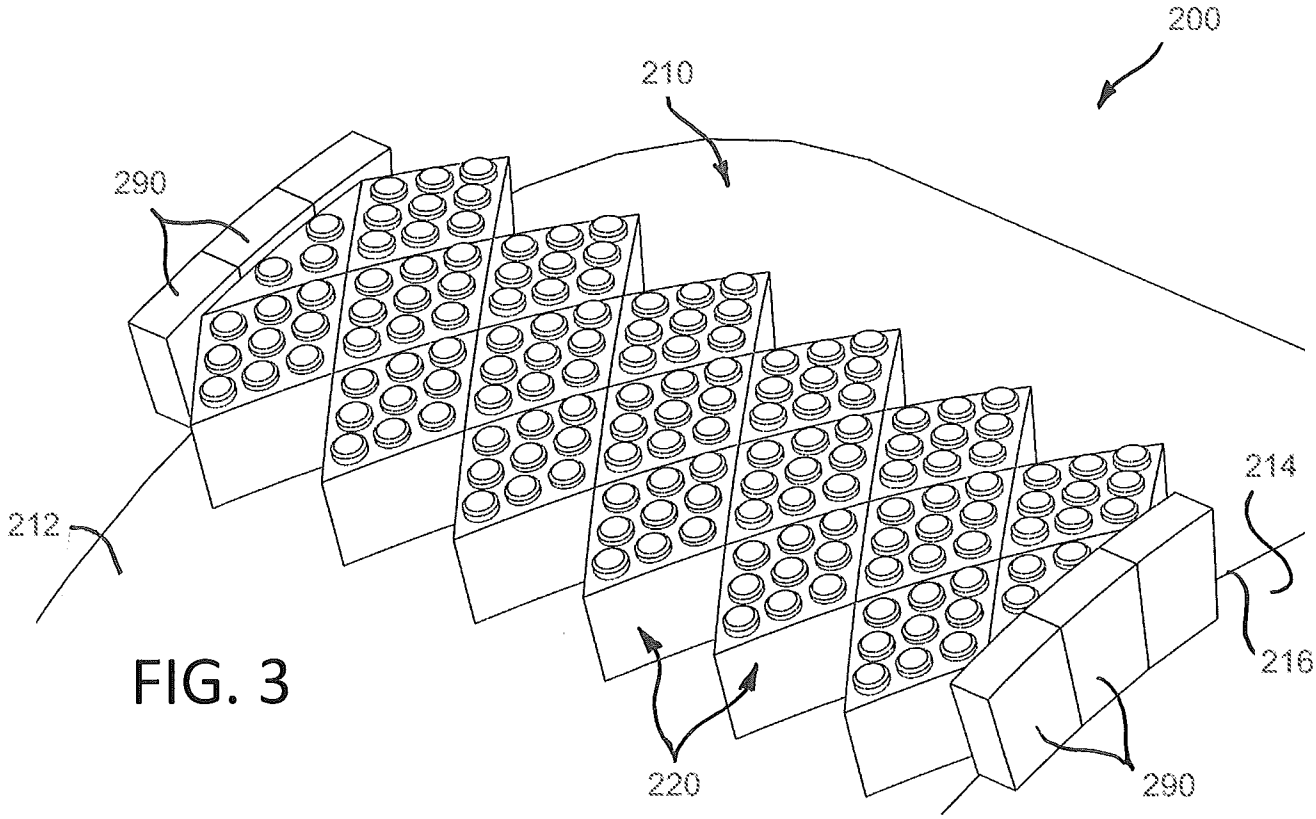


FIG. 3

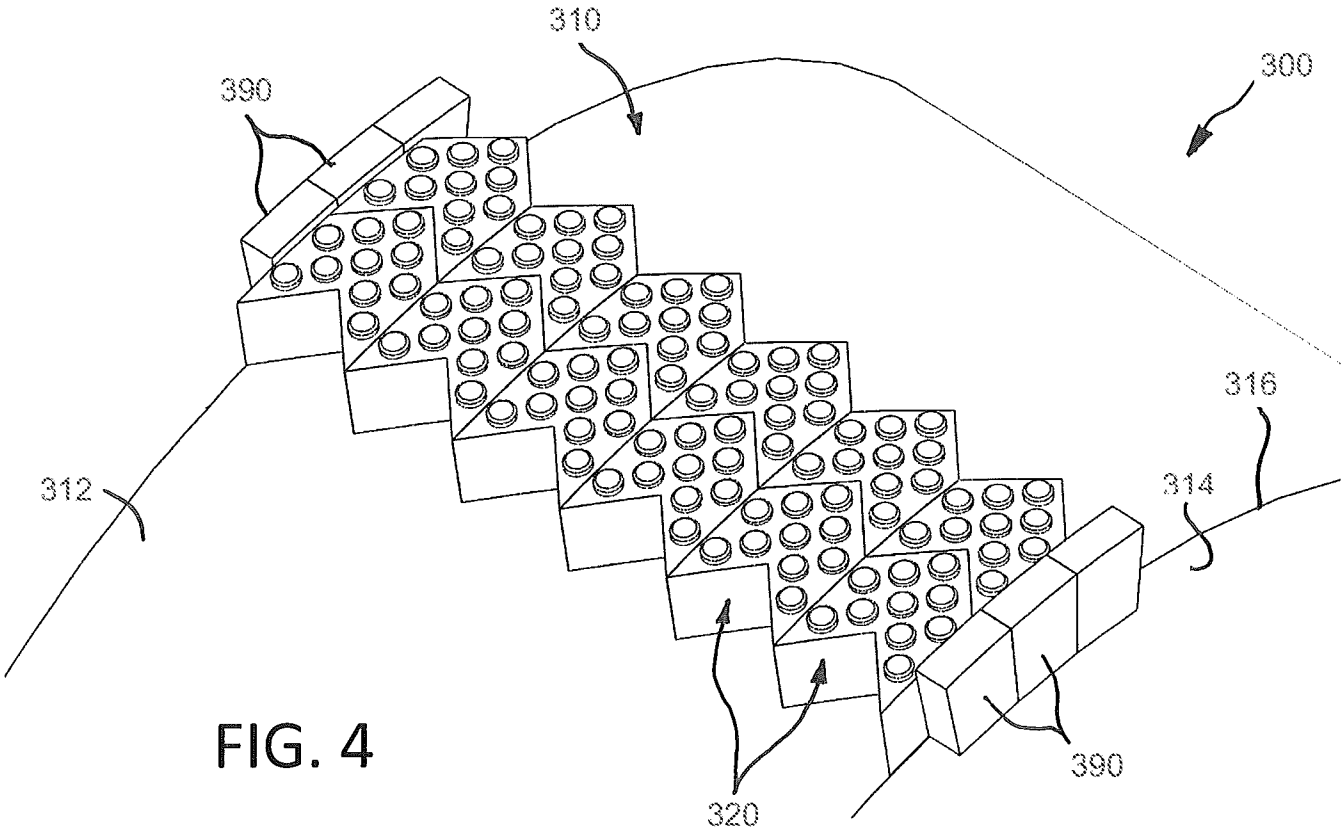
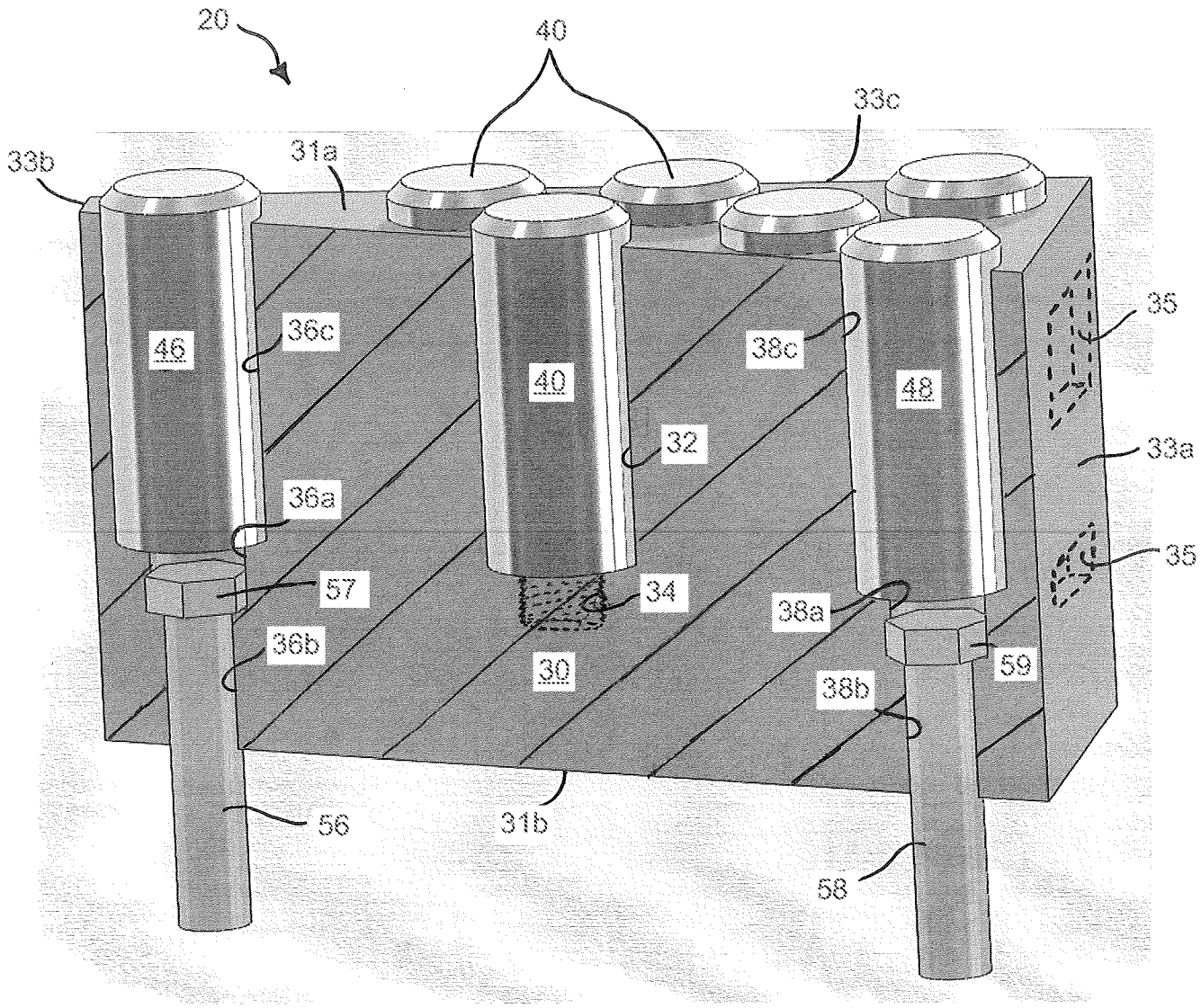


FIG. 4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36c
38c
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48
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33a
36a
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57
34
38a
36b
30
59
38b
56
31b
58

FIG. 5

FIG. 6

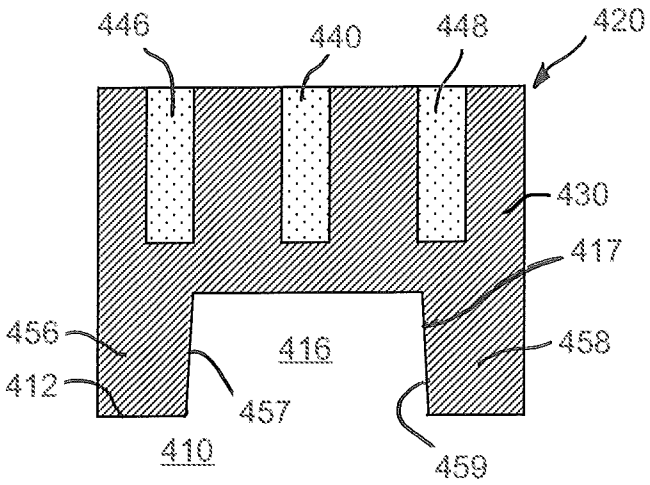

FIG. 7

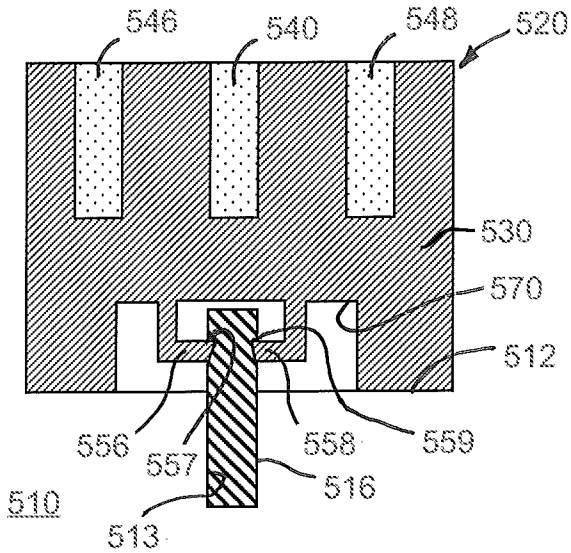

FIG. 8

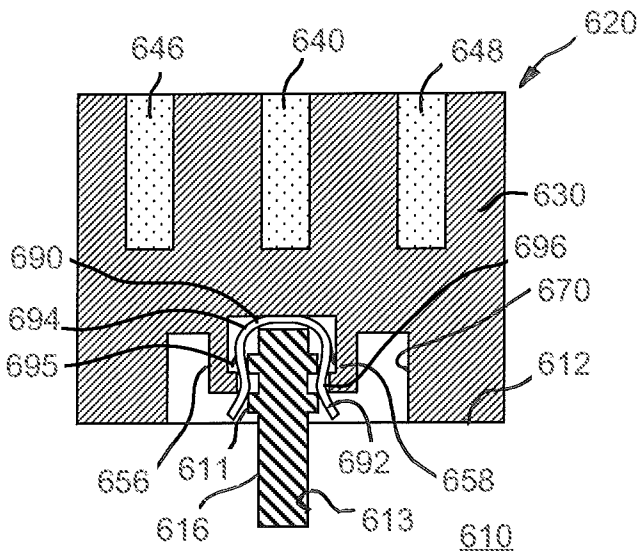

FIG. 9

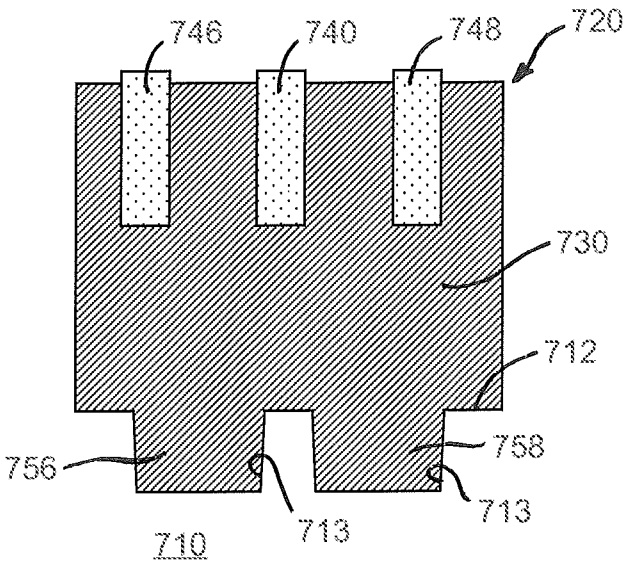
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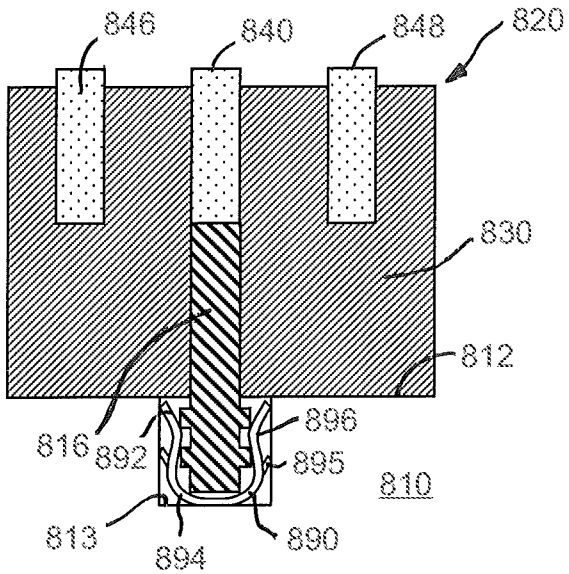
FIG. 10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890

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2013/062070

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - B02C 4/30 (2014.01)
USPC - 241/294
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC(8) - B02C 4/00, 4/02, 4/28, 4/30; B30B 3/00, 11/18 (2014.01)
USPC - 241/291, 293, 294, 300

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
CPC - B02C 4/02, 4/30, 4/305 (2013.01)

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
Orbit, Google Patents, Google Scholar, Google, YouTube

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 2012/092427 A1 (SHARMAN) 05 July 2012 (05.07.2012) entire document	25
Y	US 6,523,767 B1 (RAMESOHL) 25 February 2003 (25.02.2003) entire document	25
A	US 2012/0312907 A1 (GRONVALL et al) 13 December 2012 (13.12.2012) entire document	1-25
A	US 2012/0119004 A1 (TADA et al) 17 May 2012 (17.05.2012) entire document	1-25
A	US 4,807,820 A (GUNDLACH) 28 February 1989 (28.02.1989) entire document	1-25

☐ Further documents are listed in the continuation of Box C. ☐

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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
08 February 2014	05 MAR 2014
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-3201	Authorized officer: Blaine R. Copenheaver PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

Form PCT/ISA/210 (second sheet) (July 2009)