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(54) **Title**: EDGE PROTECTION WITH INTERNAL THREADED RECEIVING SECUREMENT

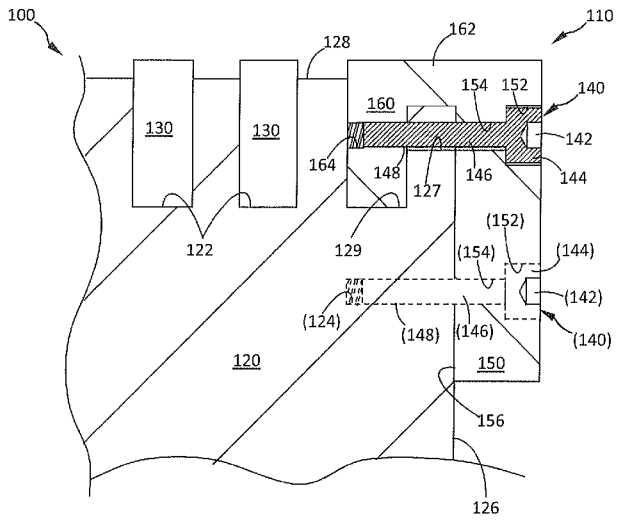


FIG. 3

(57) **Abstract**: A roller press comprises a roller [100] having: a roller edge [110] formed by the intersection of a roller end [126] and an outer surface [128], an edge wear component [150] provided at said roller edge [110], an anchor portion [160], and a bridge portion [162] extending between the edge wear component [150] and the anchor portion [160]. The anchor portion [160] is housed within an anchor mounting pocket [129] located inland of said roller end [126] and spaced from said roller edge [110]. A fastener [140] may extend between the edge wear component [150] and the anchor portion [160] to keep the edge wear component [150] attached to the roller [100]. In some embodiments, the fastener [140] threadedly engages female threads [164] provided within the anchor portion [160]. Also disclosed, is a method of mounting an edge wear component [150] to a roller [100] in a roller press using an anchor portion [160].

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— *with information concerning request for restoration of the right of priority in respect of one or more priority claims (Rules 26bis.3 and 48.2(b)(vii))*

EDGE PROTECTION WITH INTERNAL THREADED RECEIVING SECUREMENT

CROSS-REFERENCE OF RELATED APPLICATIONS

This application is an international application which claims the benefit of U.S. Provisional Patent Application No. 61/720,696 filed on 31 October 2012.

BACKGROUND OF THE INVENTION

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

FIG. 1 shows a conventional edge wear component 950 which is threadedly secured to the edge 910 of a roller sleeve 920 which forms a portion of a roller 900. A series of wear inserts 930 are distributed over an outer surface 928 of the roller sleeve 920 and are disposed within wear insert pockets 922. A fastener 940 having a head 944, a socket 942, and a shaft 946 comprising male threads 948 is inserted into a hole within roller sleeve 920, the hole comprising female threads 924. The head 944 of the fastener fits within a head recess 952 provided within the edge wear component 950 and the shaft 946 extends through a shaft opening 954. An abutment surface 956 of the edge wear component 950 rests against an end 926 of the roller sleeve 920.

In such configurations, the hole having female threads 924 is positioned well below wear insert pockets 922 in order to avoid interferences between the wear inserts 930 and the fastener 940. This lower fastening position makes the edge wear component 950 more susceptible to premature "pull-off" due to larger moment forces, which are created, for instance, when feed

and/or autogenous layer material pushes laterally against upper regions of the edge wear component 950.

Currently, when a roller edge 910 erodes, it is repaired by filling gaps, holes, and worn-away material on the roller sleeve 920 with hardface weld material. Subsequent grinding and machining processes on the roller sleeve 920 may be necessary after hardface welding, in order to bring the roller 900 back to original specifications. Such methods are time-consuming, inefficient, and costly. Moreover, with the aforementioned prior art designs, if female threads 924 in the roller shell 920 become stripped by the fastener 940, the roller sleeve 920 needs to be reworked.

Recent attempts have been made to prevent premature edge wear grinding rollers. For instance, KHD and Polysius have pursued roller designs which incorporate the fastening of removable hard bodies to the roller edges (see U.S. Patent Nos. 7,497,396 and 7,510,135). However, these designs are susceptible to "washout", where roller sleeve substrate material begins to erode due to the migration of abrasive particles forming the autogenous layer.

OBJECTS OF THE INVENTION

It is, therefore, an object of the invention to provide a mechanically-robust edge wear component system.

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

It is yet another object of the invention to provide a means for quickly dealing with stripped or damaged female threads which would otherwise require the reworking of a roller or sleeve portion thereof.

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 roller edge formed by the intersection of a roller end and an outer surface. The roller press further comprises an edge wear component provided adjacent said roller edge, an anchor portion, and a bridge portion which extends between the edge wear component and the anchor portion. An anchor mounting pocket may be provided within the roller, in the outer surface, inland of the roller end, and spaced from the roller edge. The anchor mounting pocket receives the anchor portion. The anchor mounting pocket may be generally isolated from the roller end, and may be entirely surrounded at its radially-outermost portions by only portions of the outer surface of the roller.

A fastener, which secures the edge wear component to the roller, may threadedly engage female threads provided within the anchor portion. Alternatively, a fastener may threadedly engage female threads within the roller itself, such as female threads within a roller sleeve or tire body of the roller. The fastener may extend through a portion of the edge wear component to secure the edge wear component to the roller. The anchor portion may be a separate piece from the edge wear component, and may comprise, for instance, a wear insert such as a stud. The bridge portion may be monolithic and unitary with the edge wear component, and in some instances, the anchor portion may be monolithic and unitary with both the edge wear component

and bridge portion. The bridge portion may comprise an aperture that receives an anchor portion in the form of a separate wear insert, for example, a stud. The anchor portion may be of a similar dimension and/or size as the edge wear component, or the anchor portion may be reduced in size or dissimilar when compared to the edge wear component.

The anchor portion and/or the edge wear component may comprise one or more inserts. The inserts may comprise an opening for receiving a fastener shank, a recess for receiving a fastener head, or female threads for engagement with male threads of a fastener. The inserts may be received in complimentary receiving portions within the anchor portion and/or edge wear component.

Inserts may be attached to the anchor portion and/or the edge wear component via brazing, welding, soldering, sintering, hot isostatic pressing powdered metallurgy, hot forging, warm compacting, powder forging, metal injection molding, high temperature processes, interference fit pressing, gluing, or other conventional means for mechanical bonding. In some embodiments, one or more inserts may be formed to the anchor portion. The inserts may comprise softer, more formable/machinable materials than the edge wear component, bridge portion, and/or anchor portion. The edge wear component may be configured to accept a plurality of fasteners, and the plurality of fasteners may threadedly engage female threads in the anchor portion or in another portion of the roller, such as a roller sleeve or tire body of the roller. The anchor portion may cylindrically-shaped or polygonal – such as box-shaped. An undersurface of the bridge portion may be configured to rest against an outer surface of the roller. In some instances, the bridge portion may extend from the edge wear component, and past the anchor, forming a lip. Surfaces of the bridge portion may comprise a rounded fillet, a chamfer, a radius, and/or combinations thereof. The anchor mounting pocket may comprise a

circumferentially-spaced blind recess, or a continuous annular circumferential groove which extends around the roller. Any one or more of the edge wear component, anchor portion, and/or bridge portion may be welded, adhered, or otherwise permanently joined to the roller. For example, a weld space may be intentionally formed between the anchor portion and the anchor mounting pocket, or otherwise adjacent to the anchor portion and the mounting pocket, which is suitable for filling with weld material after the edge wear component is assembled to the roller.

A method of mounting an edge wear component to a roller is also disclosed. The method comprises the steps of: providing a roller as described above; providing an edge wear component adjacent said roller edge, the edge wear component having an anchor portion connected thereto via a bridge portion extending between the edge wear component and the anchor portion; positioning the edge wear component adjacent the roller edge; positioning the anchor portion within the anchor mounting pocket; and, fixing the edge wear component to the roller. In some embodiments, the step of fixing the edge wear component to the roller may comprise extending a fastener through the edge wear component, through a clearance hole, and threadedly engaging the fastener with female threads in the anchor portion. In other examples, the step of fixing may comprise providing or forming a weld space between the anchor portion and the anchor mounting pocket or otherwise adjacent to the anchor portion and the mounting pocket, which is suitable for filling with weld material after the edge wear component is assembled to the roller. The edge wear component may be configured to accept a plurality of fasteners, and any number of the fasteners may be configured to threadedly engage female threads in a portion of the roller other than the anchor portion. In some instances, the anchor portion may be cylindrical, and the anchor mounting pocket may comprise one of a series of circumferentially-spaced blind drilled recesses. In other instances, the anchor portion may be block-shaped, and the anchor mounting

pocket may comprise a continuous annular circumferential groove which extends around the roller. In some embodiments, the bridge portion may comprise an aperture configured to receive an anchor portion in the form of a wear insert (e.g., a stud). The step of positioning the anchor portion within the anchor mounting pocket may comprise inserting a wear insert through the aperture in the bridge portion, and into an anchor mounting pocket which is sized like a wear insert pocket. In some embodiments, the aperture may be used to form the aforementioned weld space.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a diametrical cross-sectional view of an edge section of a grinding roller according to the prior art;

FIG. 2 is an end plan view of an edge section of a grinding roller shown in FIG. 1;

FIG. 3 is a diametrical cross-sectional view of an edge section of a grinding roller according to some embodiments;

FIG. 4 is an end plan view of an edge section of the grinding roller shown in FIG. 3;

FIG. 5 is a diametrical cross-sectional view of an edge section of a grinding roller according to other embodiments;

FIG. 6 is an end plan view of an edge section of the grinding roller shown in FIG. 5;

FIG. 7 is an isometric view of a grinding roller according to yet other embodiments;

FIG. 8 is a cross-sectional view of the grinding roller shown in Fig. 7;

FIG. 9 is a cross-sectional view of a grinding roller having an edge wear component with a separate anchor portion;

FIG. 10 is a cross-sectional view of a grinding roller according to further embodiments;

FIG. 11 is an isometric view of an edge wear component according to yet other embodiments;

FIG. 12 is an isometric view of an edge wear component according to still other embodiments;

FIGS. 13-16 illustratively show the construction of an edge wear component according to some manufacturing embodiments;

FIG. 17 shows an embodiment where a wear insert serves as an anchor portion, and a bridge portion is configured with an aperture or other geometry which receives the wear insert; and,

FIG. 18 shows an alternative embodiment where a wear insert serves as an anchor portion, and a bridge portion is configured to be positioned generally flush with an outer surface of the roller.

DETAILED DESCRIPTION OF THE INVENTION

FIGS. 3 and 4 show a roller 100 according to some embodiments. The roller 100 comprises a roller sleeve 120 having a roller end 126 and a roller edge 110. An edge wear component 150 is threadedly secured to the edge of the roller sleeve 120. Wear inserts 130 are distributed over a cylindrical outer surface 128 of the roller sleeve 120 and are disposed within wear insert pockets 122. A fastener 140 having a head 144, a drive socket 142, and a shaft 146 comprising male threads 148 may be inserted through the edge wear component 150 until the male threads 148 engage female threads 164 provided within an anchor portion 160 of the edge wear component 150. The anchor portion 160 is disposed within an anchor mounting pocket 129, and is

connected to the edge wear component 150 via a bridge portion 162. In the embodiment shown, the edge wear component 150, bridge portion 162, and anchor portion 160 form a generally U-shaped element, wherein the anchor portion 160 serves to "hook" the edge wear component 150 to the edge 110 of the roller 100. A clearance hole 127 is provided in the roller sleeve 120 which extends between the roller end 126 and the anchor mounting pocket 129, in order to make way for the shaft 146 of the fastener 140 that extends between the edge wear component 150 and the anchor portion 160.

The head 144 of each fastener 140 may fit within a head recess 152 provided on the edge wear component 150 and the shaft 146 of each fastener 140 may extend through a shaft opening 154. An abutment surface 156 of the edge wear component 150 may rest against an end 126 of the roller sleeve 120. In some embodiments, fasteners 140 may engage female threads 124 which are disposed within the roller 100 itself, for example, within the roller sleeve 120 or tire body of the roller 100. The female threads 124 may be used alone or in combination with female threads 164 provided in the anchor portion.

FIGS. 5 and 6 show a roller 200 according to other embodiments. The roller 200 comprises a roller sleeve 220 having a roller end 226 and a roller edge 210. An edge wear component 250 is threadedly secured to the edge of the roller sleeve 220. Wear inserts 230 are distributed over a cylindrical outer surface 228 of the roller sleeve 220 and are disposed within wear insert pockets 222. A fastener 240 having a head 244, a drive socket 242, and a shaft 246 comprising male threads 248 may be inserted through the edge wear component 250 until the male threads 248 engage female threads 264 provided within an anchor portion 260. In some embodiments, the anchor portion 260 may be shaped like other wear inserts 230. The anchor portion 260 is configured to be positioned within a anchor mounting pocket 229 in the roller sleeve

220. In the embodiment shown, the anchor portion forms an elongated spine which rests in an anchor mounting pocket 229 defined by a circumferentially-extending channel or groove formed in the cylindrical outer surface 228. The anchor portion 260 is disposed within an anchor mounting pocket 229, and is connected to the edge wear component 250 via an upper bridge portion 262. In the embodiment shown, the edge wear component 250, bridge portion 262, and anchor portion 260 form a generally U-shaped element, wherein the anchor portion 260 serves to "hook" the edge wear component 250 to the roller edge 210. A clearance hole 227 is provided in the roller sleeve 220 and extends between the roller end 226 and the anchor mounting pocket 229, in order to make way for the shaft 246 of the fastener 240 that extends between the edge wear component 250 and the anchor portion 260.

The head 244 of each fastener 240 may fit within a head recess 252 provided to the edge wear component 250 and the shaft 246 of each fastener may extend through a shaft opening 254. An abutment surface 256 of the edge wear component 250 may rest against the end 226 of the roller sleeve 220. Supplemental fasteners 240 may be fixed to female threads 224 provided within the substrate of the roller sleeve 220 as shown. In the particular embodiment shown, fasteners 240 are aligned radially along edge wear component 250 in relation to the roller 200, whereas the embodiment shown in FIGS. 3 & 4 show fasteners 140 which are staggered and not aligned radially in relation to the roller 100. While not expressly shown in the drawings, embodiments employing combinations of radially-aligned fasteners 240 and staggered fasteners 140 are also envisaged. Other means for securing such as welding and brazing may also be advantageously utilized.

FIGS. 7 and 8 show a roller 300 according to yet other embodiments. The roller 300 comprises a roller sleeve 320 having a roller end 326 and a roller edge 310. An edge wear component 350 is threadedly secured to the edge of the roller sleeve 320. Multiple edge wear

components 350 may be provided to make up the roller edge 310 as shown. Wear inserts 330 are distributed over a cylindrical outer surface 328 of the roller sleeve 320 and are disposed within wear insert pockets 322. A fastener 340 comprising male threads 348 is inserted through the edge wear component 350 until the male threads 348 of the fastener engage female threads 364 provided within an anchor portion 360. The anchor portion 360 is configured to be positioned within an anchor mounting pocket 329 in the roller sleeve 320. The anchor mounting pocket 329 may comprise one of many individual recesses which are spaced from each other along the outer surface 328, or the anchor mounting pocket 329 may comprise a continuous annular groove or channel which surrounds roller sleeve 320 as shown in FIG. 6. An abutment surface 356 of the edge wear component 350 rests against the end 326 of the roller sleeve 320. As shown, a bridge portion 362 connects the anchor portion 360 to the edge wear component 350. The bridge portion 362 may extend past the anchor portion 360 as shown to form a lip 365. A chamfer 363 may be provided to an upper portion of the lip 365 and/or bridge portion 362, in order to accommodate high side loads experienced near roller edges 310.

FIG. 9 shows a roller 400 according to yet other embodiments, wherein the anchor portion is provided separately. The roller 400 comprises a roller sleeve 420 having a roller end 426 and a roller edge 410. An edge wear component 450 is threadedly secured to the edge 410 of the roller sleeve 420. Wear inserts 430 are distributed over a cylindrical outer surface 428 of the roller sleeve 420 and are disposed within wear insert pockets 422. A fastener 440 comprising male threads 448 may be inserted through the edge wear component 450 until the male threads 448 of the fastener engage female threads 464 provided within a separate anchor portion 460. In this way, the bridge portion 462 connects the edge wear component 450 to the anchor portion 460 in a limited capacity (e.g., physical contact). The anchor portion 460 is configured to be separately positioned within an

anchor mounting pocket 429 in the roller sleeve 420, prior to installation of the edge wear component 450. The anchor mounting pocket 429 may comprise individual blind recesses which are spaced from each other along the outer surface 428, or the anchor mounting pocket 429 may comprise a continuous annular groove or channel which surrounds roller sleeve 420 as shown in FIG. 6. In preferred embodiments, anchor mounting pockets 429 are located inland of the roller end 426, and are completely surrounded by portions of the outer surface 428 of the roller 400.

An abutment surface 456 of the edge wear component 450 rests against the end 426 of the roller sleeve 420. Unlike the other embodiments of FIGS. 3-8, FIG. 9 shows an embodiment where a bridge portion 462 serves to "cover" or "protect" the pre-inserted anchor portion 460. The bridge portion 462 may extend axially along the outer surface 428 and past the anchor portion 460 as shown, thereby forming a lip 465. A chamfer 463 may be provided to an upper portion of the lip 465 and/or bridge portion 462, in order to accommodate high side loads experienced near roller edges 410. In such an embodiment where the anchor portion is separate from the edge wear component, the edge wear component 450 may comprise a single unitary ring member. While this is not shown, the unitary ring member may be placed on the roller 400 after a plurality of in-situ anchor portions 460 are disposed within the anchor mounting pockets 429.

FIG. 10 shows a roller 500 according to yet other embodiments, wherein a bridge portion 562 and lip 565 are provided with a radius 561 or fillet 563, in contrast to a chamfer 363, 463 as described above. The roller 500 comprises a roller sleeve 520 having a roller end 526 and a roller edge 510. An edge wear component 550 is threadedly secured to edge areas of the roller sleeve 520. Wear inserts 530 are distributed over a cylindrical outer surface 528 of the roller sleeve 520 and are disposed within wear insert pockets 522. A fastener 540 comprising male threads 548 may be inserted through the edge wear component 550 until the male threads 548 of the fastener engage

female threads 564 provided within a separate anchor portion 560. The anchor portion 560 is configured to be positioned within an anchor mounting pocket 529 in the roller sleeve 520. The anchor mounting pocket 529 may comprise individual recesses which are circumferentially spaced from each other along the outer surface 528, or the anchor mounting pocket 529 may comprise a continuous annular groove or channel which surrounds roller sleeve 520 as shown in FIG. 6.

An abutment surface 556 of the edge wear component 550 rests against the end 526 of the roller sleeve 520. The bridge portion 562 may extend past the anchor portion 560 as shown, thereby forming a lip 565. A fillet 563 or radius 561 may be provided to an upper portion of the lip 565 and/or bridge portion 562, in order to accommodate high side loads experienced near roller edges 510.

FIGS. 11-16 show various edge wear components 650, 750, 850 according to further embodiments. The edge wear components 650, 750, 850 each comprise one or more inserts 670, 680, 770, 870 which may be mechanically attached thereto. The inserts may be provided to portions of the edge wear component 650, 750, 850, portions of the anchor portion 660, 760, 860, or portions of the bridge portion 662, 762, 862.

FIG. 11 is an example of an edge wear component 750 comprising an anchor portion 760 which is designed to "hook into" an anchor mounting pocket until the abutment surface 756 of the edge wear component 750 is positioned against the roller end. Bridge portion 762 provides support between the edge wear component 750 and the anchor portion 760, as well as provides additional wear protection to the outer surface and edge areas of a roller. The edge wear component comprises a shaft opening 754 configured to accept a threaded fastener (not shown), and a head recess 752 configured to accept the head of a threaded fastener (not shown). In order to facilitate the manufacturing of a shaft opening 754 and/or head recess 752, especially when wear component

750 is formed of a very hard material (e.g., cemented tungsten carbide), such features may be provided to a separate insert 770 which is made of softer, more formable, ductile, weldable, and/or machinable material. The insert 770 may be subsequently welded, soldered, brazed, or otherwise joined to the edge wear component 750 and/or portions of a roller.

FIG. 12 is an example of an edge wear component 850 comprising an anchor portion 860 which is smaller than the edge wear component 850 and designed to "hook into" an anchor mounting pocket which is inland of the roller end circumferentially spaced from other anchor mounting pockets. The edge wear component comprises an abutment surface 856 which, in use, rests against with the roller end. Bridge portion 862 provides support between the edge wear component 850 and the anchor portion 860, as well as provides additional wear protection to the outer surface and edge areas of a roller. The edge wear component 850 comprises one or more shaft openings 854 configured to accept one or more threaded fasteners (not shown). In order to facilitate the manufacturing of the shaft openings 854 in a very hard edge wear component 850, such features may be provided to a separate insert 870 which is made of a softer, more formable, ductile, weldable, and/or machinable material. The insert 870 may be welded to a bottom portion of the edge wear component 850 as shown. Outer portions of the edge wear component 850 may be chamfered by a tangential angle 811 in order to more closely follow the outer profile of a cylindrical roller. Moreover, sidewalls of the edge wear component 850 which neighbor other sidewalls of other edge wear components may also be angled by a number of degrees in order to more closely follow the outer profile of a cylindrical roller. Such circumferential angles 813 may be greater or less, depending on the diameter of the roller. In some embodiments, an optional second insert 880 having female threads 864 may be provided to the anchor portion 860. In use, a

fastener (not shown) may extend through a shaft opening 854 in the edge wear component 850, and threadedly engage the female threads 864.

FIGS. 13-16 show an embodiment where an anchor portion 660 is generally similar in size and/or configuration as an edge wear component 650. A blank (FIG. 13) may be pressed utilizing powdered metallurgy processes known in the art. One or more receiving portions 669 may be formed into the anchor portion 660, and one or more receiving portions 657 may be formed into the edge wear component 650. A first insert 670 having a shaft opening 654 and head recess 652 may be provided within receiving portion 657, and joined to the edge wear component 650. A second insert 680 having female threads 664 may be provided within receiving portion 669, and joined to the anchor portion 660. While not shown in FIGS. 13-16, a bridge portion 662 connecting the anchor portion 660 and the edge wear component 650 may comprise a chamfer, radius, or fillet, as previously discussed herein. In use, the assembly is positioned at a roller edge and the anchor portion 660 is placed in an anchor mounting pocket as an abutment surface 656 of the edge wear component 650 contacts a roller end. The assembly is pushed into the roller until an undersurface of bridge 662 rests against an outer surface of the roller. The dotted lines shown in FIG. 13 represent examples of optional receiving portions (657), (659) which would inherently capture inserts 670, 680, and therefore, might not require mechanical joining of the inserts 670, 680. The optional receiving portions (657), (659) may be used in addition to, or as an alternative to the receiving portions 657, 659 shown.

FIG. 17 shows an embodiment wherein the anchor portion 1060 may be comprised of a wear insert 1030 or weld fill. A bridge portion 1062 having an aperture 1061 therein extends from edge wear component 1050. In use, the abutment surface 1056 of the edge wear component 1050 may be placed against the end 1026 of a roller 1000 or roller sleeve 1020 and positioned such that

an undersurface of bridge portion 1062 rests against an outer surface 1028 of the roller 1000. Aperture 1061 may be aligned with anchor mounting pocket 1029. FIG. 18 shows an embodiment wherein the anchor portion 1160 may be comprised of a wear insert 1130 or weld fill. A bridge portion 1162 having an aperture 1161 therein extends from edge wear component 1150. In use, the abutment surface 1156 of the edge wear component 1150 may be placed against the end 1126 of a roller 1100 or roller sleeve 1120 and positioned such that an upper surface of bridge portion 1162 is generally flush with an outer surface 1128 of the roller 1100 thereby creating a smooth transition between the roller 1100 or roller sleeve 1120, and the edge wear component 1150. Aperture 1161 may be aligned with anchor mounting pocket 1129. In some embodiments, anchor portion 1160 may comprise cemented tungsten carbide,

Edge wear components disclosed herein may be recessed so as to be flush with or sit proud with respect to other portions of the roller. For example, as shown in FIG. 3, the undersurface of the bridge 162 may be sunken deeper than portions of the outer surface 128 of the roller 100. Alternatively, as shown in FIG. 5, the undersurface of the bridge 262 may be flush with the outer surface 228 of the roller 200. Moreover, as shown, outer portions of the bridge 162, 262 may be configured to not extend radially past the highest outer point of each wear insert 130, 230. Washers (not shown) may be provided within the head recess 452 under the head 444 and surrounding shaft 446. One or more weld channels in the form of holes, grooves, or oversized clearances between components may be formed in or around the anchor portions, bridge portions, or edge wear components disclosed herein. Moreover, while not shown, edge wear components may be formed by fusing, bonding, coating, cladding, or otherwise mechanically fastening a harder lining material to a softer body substrate material. Fusion of a hard liner material to the softer body substrate material may be accomplished using explosion welding, soldering, friction welding, graded

powdered metallurgy, total or selective heat treatments, adhesives, or other conventional means. Anticipated embodiments include those where hard tiles (e.g., cemented tungsten carbide) are bonded to a softer substrate (vanadium steel).

A contractor or other entity may provide a grinding roller, or operate a grinding roll 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 roll apparatus, or the contractor may offer to design such a 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 stacking 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 roll apparatus, or parts thereof with a "retrofit kit" to arrive at a modified grinding roll 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 non-limiting embodiments, edge wear components may comprise vanadium steel, a tungsten carbide, heat-treated mild steel, cermets, alloys or composites thereof, or other material having resistance to heavy wear and impact. Materials for the various elements disclosed may be hard materials having a higher hardness achieved through a heat treatment process, an alloying process using one or more elements, or a combination thereof. In some embodiments, materials may also be cemented carbides, which are composites of a discontinuous hard metal carbide phase dispersed in a continuous relatively soft binder phase. The dispersed phase may typically comprise grains of a carbide having one or more of the transition metals selected from the group consisting of titanium, vanadium, chromium, zirconium, hafnium, molybdenum, niobium, tantalum, and tungsten. The binder phase may typically comprise at least one of cobalt, a cobalt alloy, nickel, a nickel alloy, iron, and an iron alloy. Alloying elements such as, for example, chromium, molybdenum, ruthenium, boron, tungsten, tantalum, titanium, and/or niobium may be added to the binder to enhance certain properties of the composite. In other non-limiting embodiments, a bridge portion may comprise a series of "steps" rather than a chamfer, radius, or fillet.

Components of the invention may also be manufactured in a unique manner. For example, instead of incorporating separate inserts 607, 680, a two-piece die may be used to form an edge wear component assembly. One side of the two-piece die may comprise a thread pattern which is configured to form female threads in the anchor portion. Alternatively, a smooth bore opening may be formed in the anchor portion and/or edge wear component. The forming of the

smooth bore opening may be performed *after* the pressing or warm compaction of metal powder by drilling in the green state, or *during* compaction or pressing of the powdered metal using a slider pin in the die. The smooth bore opening may be carefully threaded while still in the green state, prior to sintering.

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

100, 200, 300, 400, 500, 900, 1000, 1100	Roller
110, 210, 310, 410, 510, 910, 1010, 1110	Edge
120, 220, 320, 420, 520, 920, 1020, 1120	Roller sleeve/tire body
122, 222, 322, 422, 522, 922, 1022, 1122	Wear insert pocket
124, 224, 924, 1024, 1124	Female threads
126, 226, 326, 426, 526, 926, 1026, 1126	End
127, 227	Clearance hole
128, 228, 328, 428, 528, 928, 1028, 1128	Outer surface
129, 229, 329, 429, 529, 1029, 1129	Anchor mounting pocket
130, 230, 330, 430, 530, 930, 1030, 1130	Wear insert
140, 240, 340, 440, 540, 940, 1040, 1140	Fastener
142, 242, 942, 1042, 1142	Socket
144, 244, 944, 1044, 1144	Head
146, 246, 946, 1046, 1146	Shaft
148, 248, 348, 448, 548, 948, 1048, 1148	Male threads
150, 250, 350, 450, 550, 650, 750, 850, 950, 1050, 1150	Edge wear component
152, 252, 652, 752, 952, 1052, 1152	Head recess
154, 254, 654, 754, 854, 954, 1054, 1154	Shaft opening
156, 256, 356, 456, 556, 656, 756, 856, 956, 1056, 1156	Abutment surface
160, 260, 360, 460, 560, 660, 760, 860, 1060, 1160	Anchor portion
162, 262, 362, 462, 562, 662, 762, 862, 1062, 1162	Bridge portion
363, 463	Chamfer
561	Radius
563	Fillet
164, 264, 364, 464, 564, 664, 864	Female threads
365, 465, 565, 1065, 1165	Lip
657	First receiving portion
669	Second receiving portion
670, 770, 870	First insert
680, 880	Second insert
811	Tangential angle
813	Circumferential angle
1061, 1161	Aperture

WHAT IS CLAIMED IS:

1. A roller press comprising:

a roller [100] having a roller edge [110] formed by the intersection of a roller end [126] and an outer surface [128];

an edge wear component [150] provided adjacent to said roller edge [110], the edge wear component further comprising an anchor portion [160] connected to the edge wear component [150] via a bridge portion [162] which extends between the edge wear component [150] and the anchor portion [160]; and,

an anchor mounting pocket [129] located inland of said roller end [126] and being spaced from said roller edge [110] and provided within the roller [100], the anchor mounting pocket [129] being configured to receive the anchor portion [160], the anchor mounting pocket being generally isolated from the roller end [126] and surrounded at its radially-outermost portion of the roller [100] by said outer surface [128].

2. The roller press according to claim 1, wherein a fastener [140] threadedly engages female threads [164] within the anchor portion [160] and the fastener [140] extends through a portion of the edge wear component [150] to secure the edge wear component [150] to the roller [100].

3. The roller press according to claim 1, wherein a fastener [140] threadedly engages female threads [124] within a roller sleeve [120] or tire body of the roller [100] and the fastener

[140] extends through a portion of the edge wear component [150] to secure the edge wear component [150] to the roller [100].

4. The roller press according to claim 2, wherein the anchor portion [460] is a separate piece from the edge wear component [450].

5. The roller press according to claim 4, wherein the bridge portion [462] is monolithic and unitary with the edge wear component [450].

6. The roller press according to claim 1, wherein the anchor portion [160] is monolithic and unitary with the edge wear component [150] and bridge portion [162].

7. The roller press according to claim 1, wherein the anchor portion [660] is of similar dimension and size as the edge wear component [650].

8. The roller press according to claim 1, wherein at least one of the anchor portion [660] and the edge wear component [650] comprise at least one insert [670, 680].

9. The roller press according to claim 8, wherein the at least one insert [670, 680] comprises a recess or opening [652, 654, 664].

10. The roller press according to claim 8, wherein the at least one insert [670, 680] is placed within a complimentary receiving portion [657, 669] on the anchor portion [660] and/or on the edge wear component [650].

11. The roller press according to claim 8, wherein the at least one insert [670, 680] is attached to the anchor portion [660] and/or the edge wear component [650] via a brazing, welding, soldering, sintering, hot isostatic pressing powdered metallurgy, hot forging, warm compacting, powder forging, metal injection molding, high temperature process, interference fit pressing, gluing, or other means for mechanical bonding.

12. The roller press according to claim 8, wherein the at least one insert [670, 680] is formed to the anchor portion [660].

13. The roller press according to claim 8, wherein the at least one insert [670, 680] is formed of a softer, more formable material than the edge wear component [650], bridge portion [662], and/or anchor portion [660]

14. The roller press according to claim 1, wherein the edge wear component [150] accepts a plurality of fasteners [140], wherein at least one of said plurality of fasteners [140] threadedly engages female threads [164] in the anchor portion [160], and at least one of said plurality of fasteners [140] threadedly engages female threads [124] in another portion of the roller [100].

15. The roller according to claim 13, wherein said another portion of the roller [100] is a roller sleeve [120] or tire body.

16. The roller according to claim 1, wherein said anchor portion [160] is cylindrically-shaped.

17. The roller according to claim 1, wherein said anchor portion [260, 360, 460, 560, 760, 860] comprises a polyhedron shape.

18. The roller according to claim 1, wherein an undersurface of said bridge portion [262, 362, 462, 562] rests against the outer surface [228, 328, 428, 528] of the roller [200, 300, 400, 500].

19. The roller according to claim 1, wherein said bridge portion [362, 462, 562] extends from the edge wear component [350, 450, 550], and past the anchor [360, 460, 560], forming a lip [365, 465, 565].

20. The roller according to claim 1, wherein a portion of the bridge portion [362, 462, 562] comprises a rounded fillet [563], a chamfer [363,463], or a radius [561].

21. The roller according to claim 1, wherein said mounting insert pocket [129] comprises a circumferentially-spaced blind recess or a continuous annular circumferential groove which extends around the roller [100].

22. The roller press according to claim 1, wherein any one or more of the edge wear component [150], anchor portion [160], and bridge portion [162] are welded, adhered, or otherwise permanently joined to the roller [100].

23. The roller press according to claim 1, wherein the bridge portion [1062] comprises an aperture [1061] that receives an anchor portion in the form of a wear insert [1030] or weld fill material.

24. A method of mounting an edge wear component [150] to a roller [100] in a roller press comprising:

providing a roller [100] having a roller edge [110] formed by the intersection of a roller end [126] and an outer surface [128], an anchor mounting pocket [129] located inland of said roller end [126] and spaced from said roller edge [110], the anchor mounting pocket [129] being configured to receive an anchor portion [160], the anchor mounting pocket [129] being generally isolated from the roller end [126] and surrounded at its radially-outermost portion of the roller [100] by said outer surface [128];

providing an edge wear component [150] adjacent to said roller edge [110], the edge wear component further [150] comprising an anchor portion [160] connected to the edge wear component [150] via a bridge portion [162] which extends between the edge wear component [150] and the anchor portion [160];

positioning said edge wear component [150] adjacent said roller edge [110];

positioning said anchor portion [160] within said anchor mounting pocket [129]; and,

fixing the edge wear component [150] to the roller [100].

25. The method according to claim 24, wherein the step of fixing comprises extending a fastener [140] through a clearance hole [127] and through the edge wear component

[150] and threadedly engaging the fastener [140] to female threads [164] in the anchor portion [160].

26. The method according to claim 24, wherein the edge wear component [150] is configured to accept a plurality of fasteners [140], and wherein at least one of said plurality of fasteners [140] is configured to threadedly engage female threads [124] in a portion of the roller [100].

27. The method according to claim 24, wherein said anchor portion [260, 360, 460, 560, 660, 760, 860] is block-shaped.

28. The method according to claim 24, wherein said mounting insert pocket [129] comprises a circumferentially-spaced blind recess or a continuous annular circumferential groove which extends around the roller [100].

29. The method according to claim 24, wherein the bridge portion [1062] comprises an aperture [1061] that receives an anchor portion [1060] in the form of a wear insert [1030] or weld fill, and the step of positioning said anchor portion [1060] within the anchor mounting pocket [129] comprises one of:

    a. inserting the anchor portion [1060] through the aperture [1061] in the bridge portion [1062], and into the anchor mounting pocket [1029], and
    b. filling the anchor mounting pocket [1029] and the aperture [1061] with weld fill material.

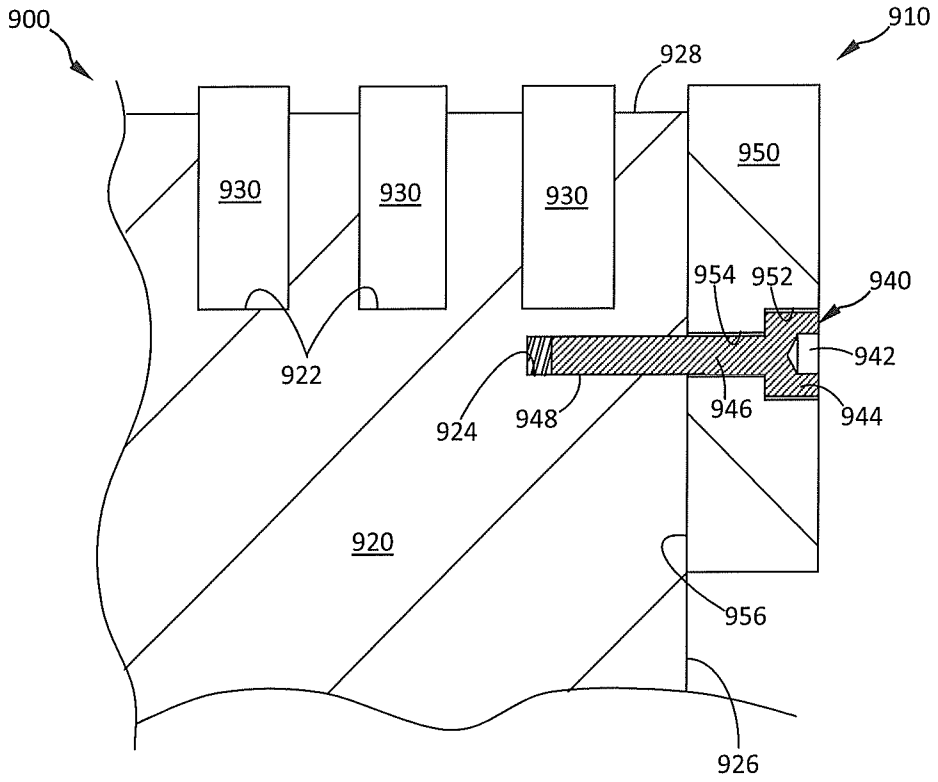


FIG. 1

(PRIOR ART)

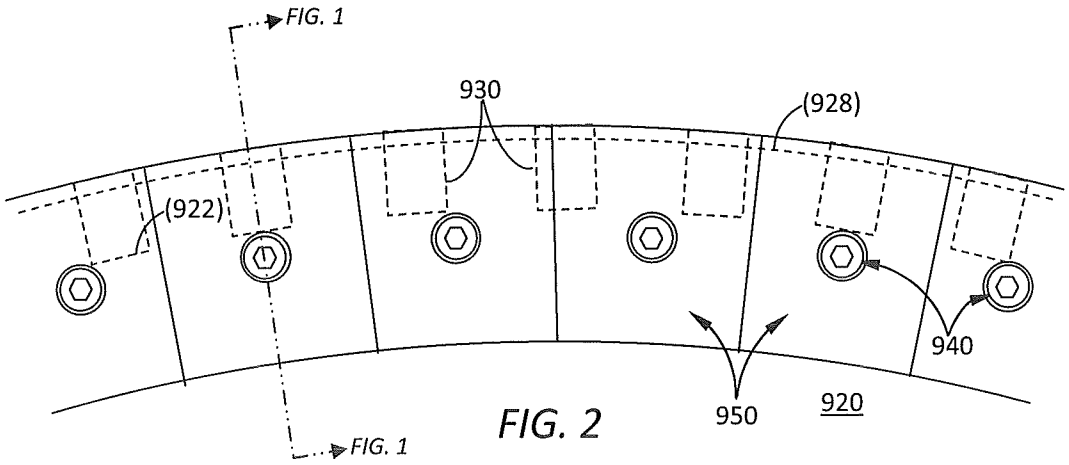


FIG. 2

(PRIOR ART)

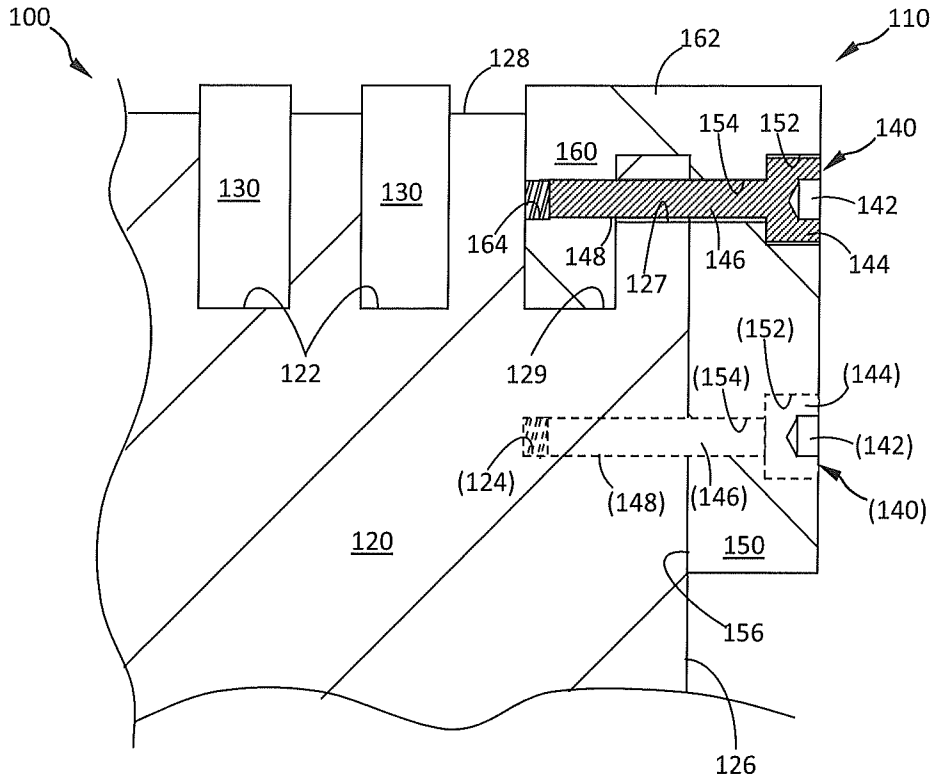

100
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128
162
154
152
140
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142
164
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127
146
144
122
129
(152)
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(144)
(142)
(124)
(148)
(146)
(140)
120
150
156
126

FIG. 3

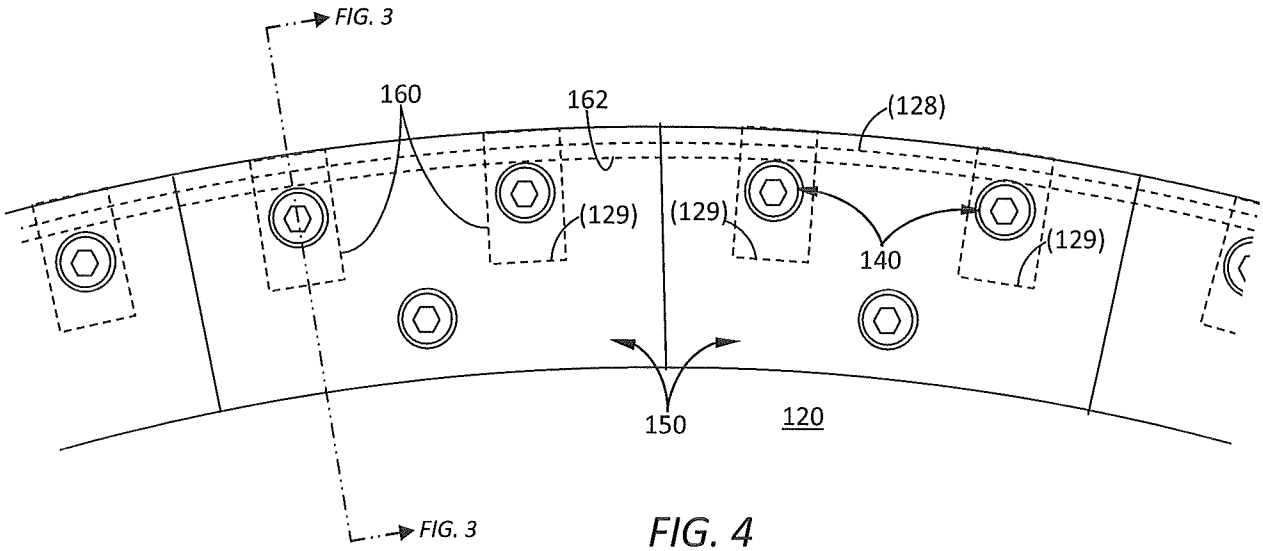

FIG. 3
160
162
(128)
(129)
(129)
140
(129)
150
120
FIG. 3

FIG. 4

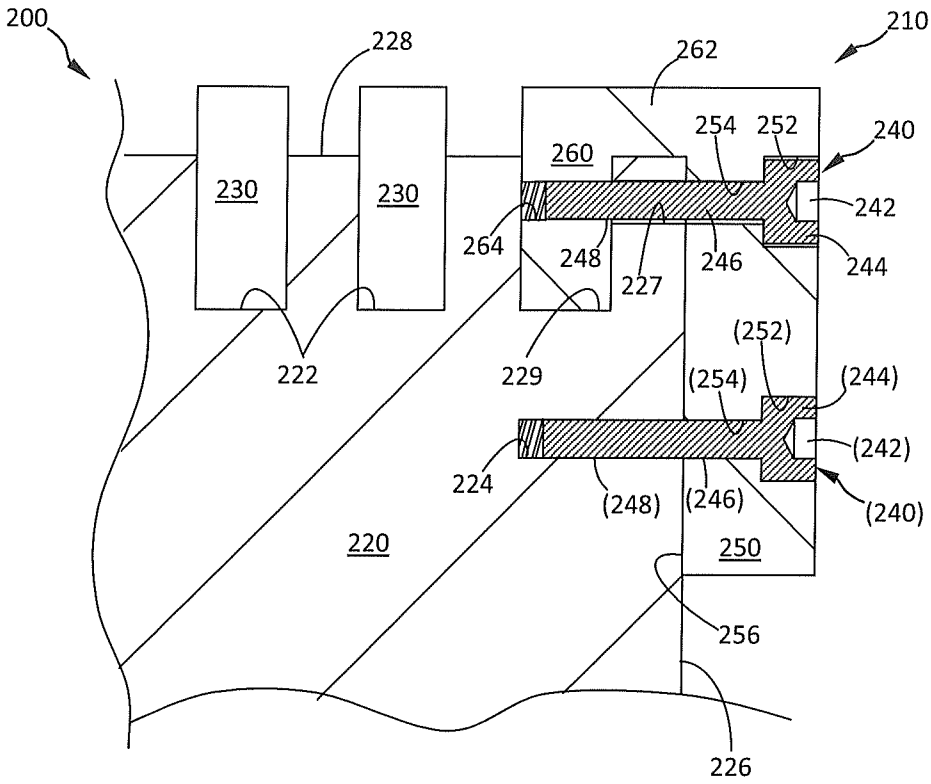

200
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262
210
254
252
240
260
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230
242
264
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227
246
244
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(252)
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(244)
224
(242)
(248)
(246)
(240)
220
250
256
226

FIG. 5

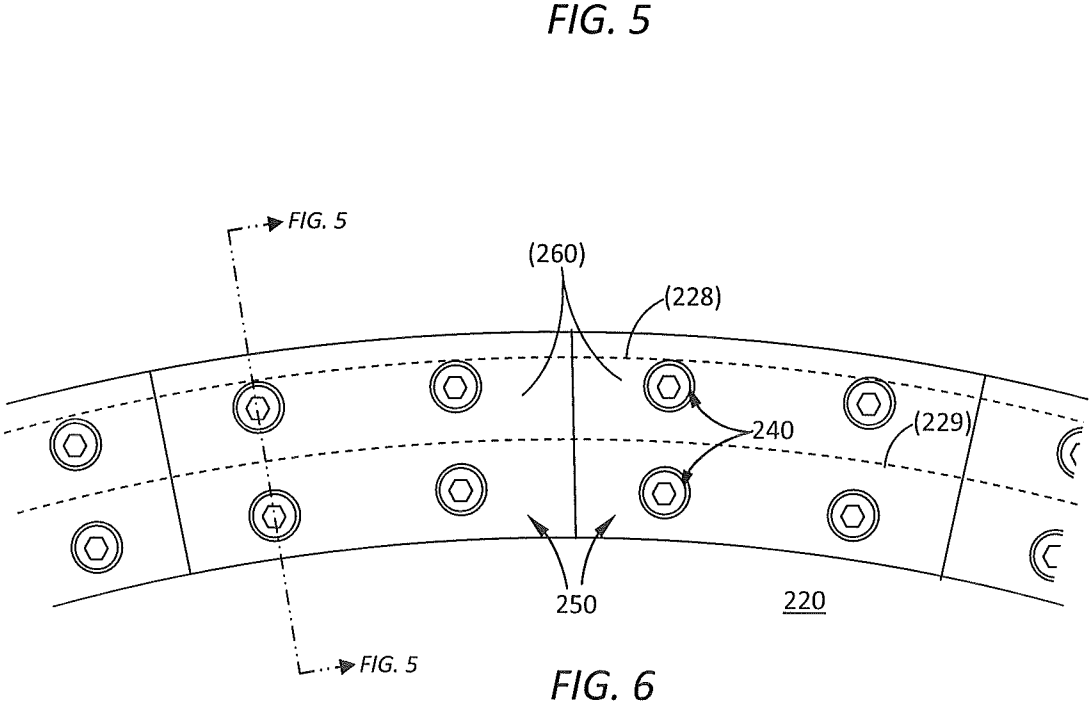

FIG. 5
(260)
(228)
240
(229)
250
220
FIG. 5

FIG. 6

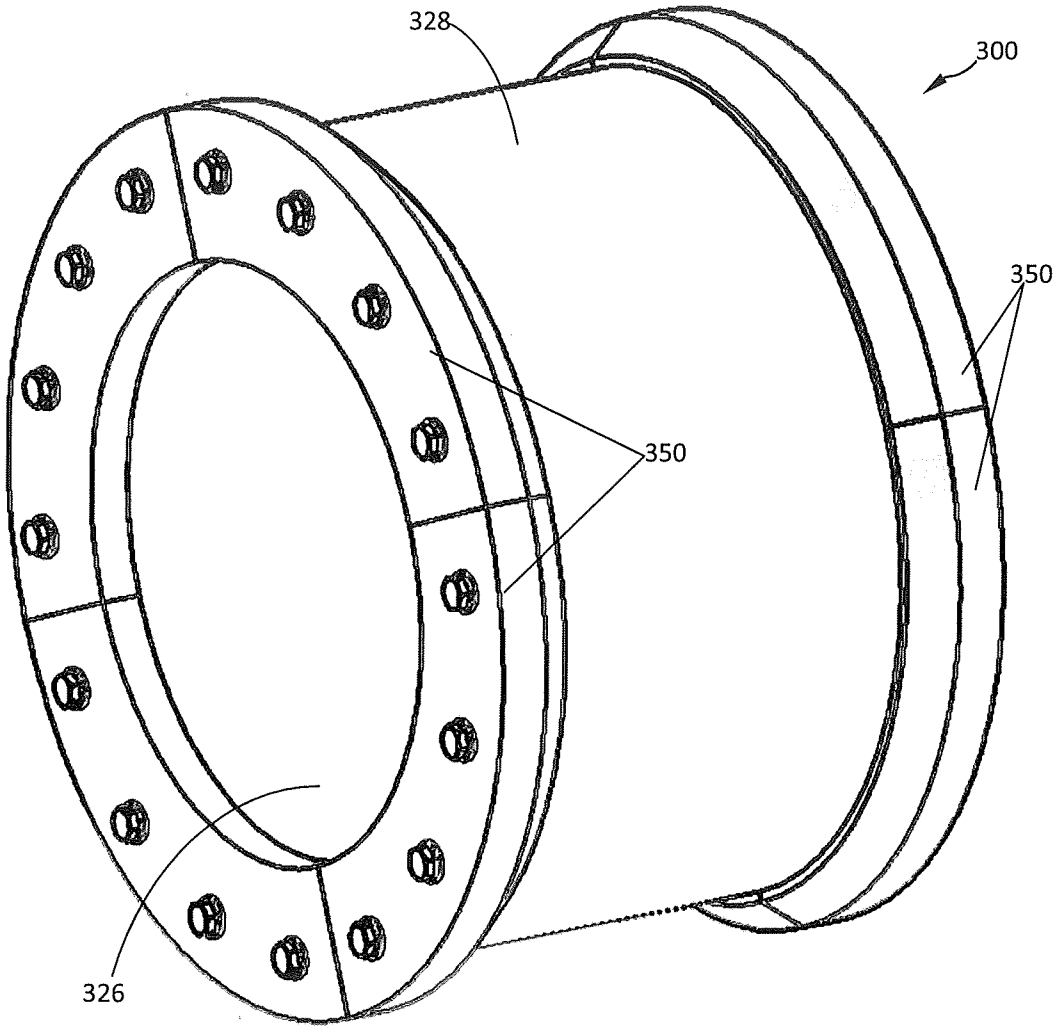


FIG. 7

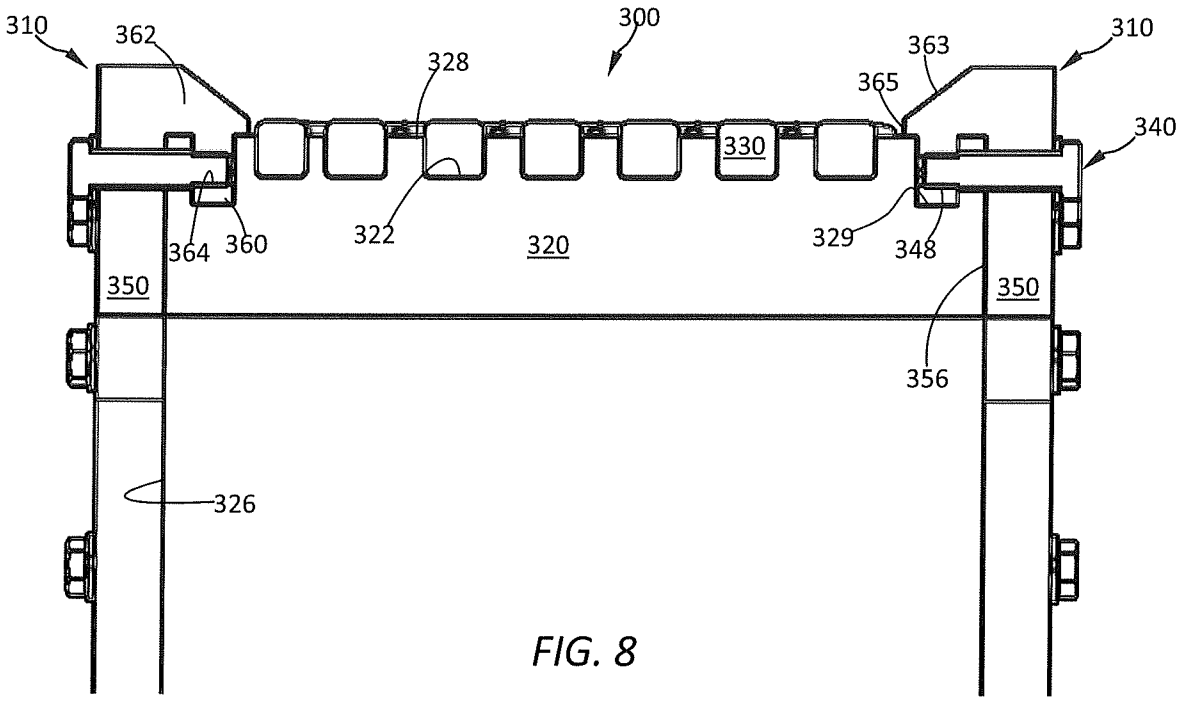

310
362
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326

FIG. 8

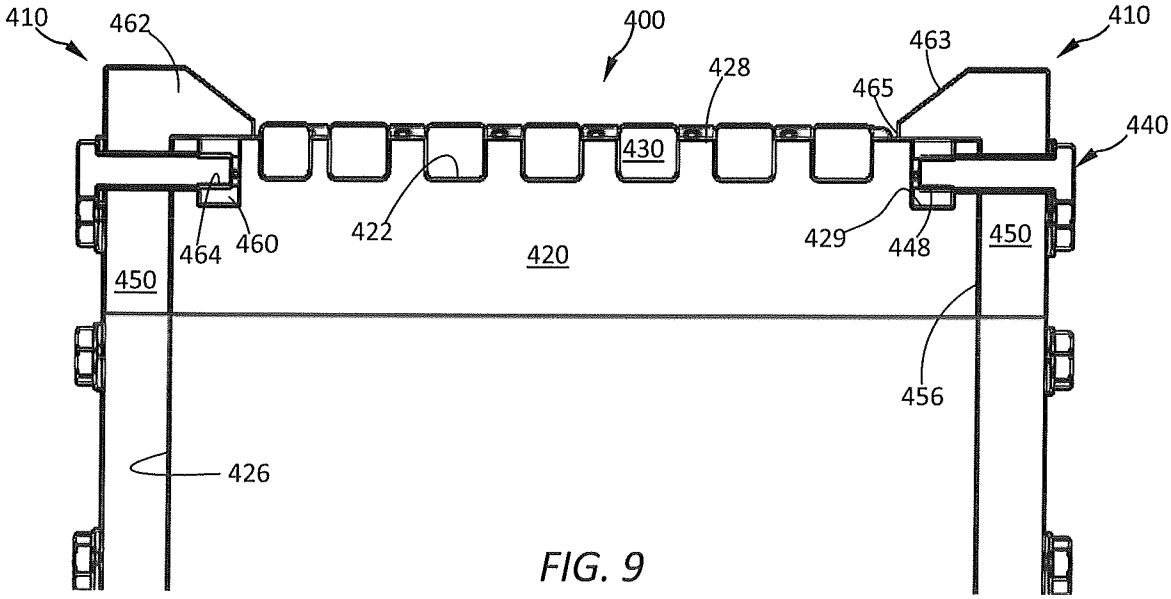

410
462
400
428
463
410
465
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422
420
429
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464
460
450
450
456
426

FIG. 9

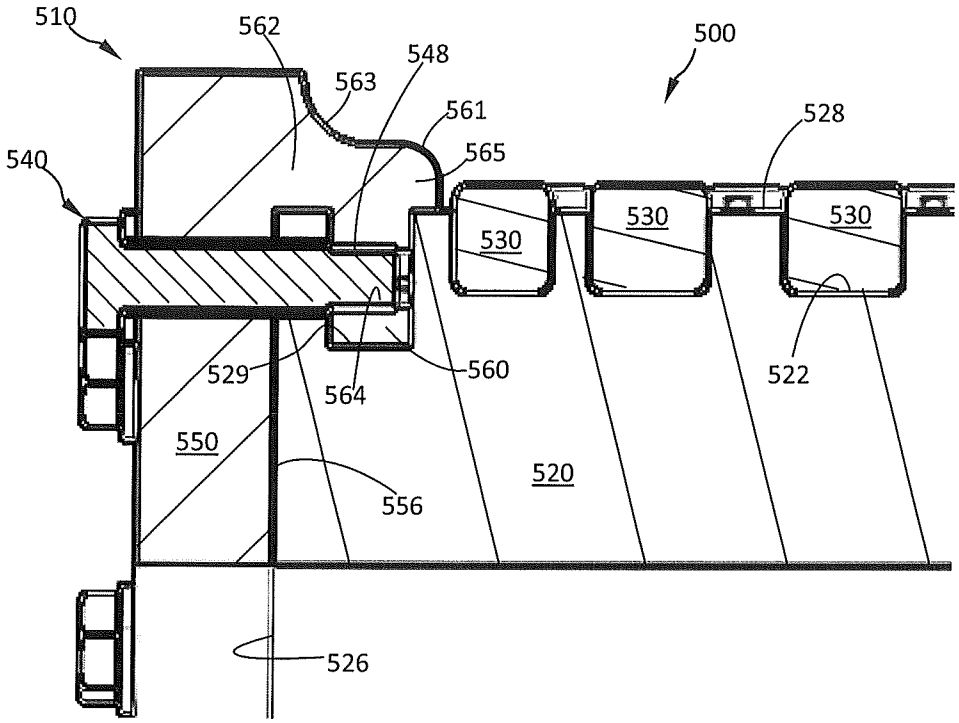


FIG. 10

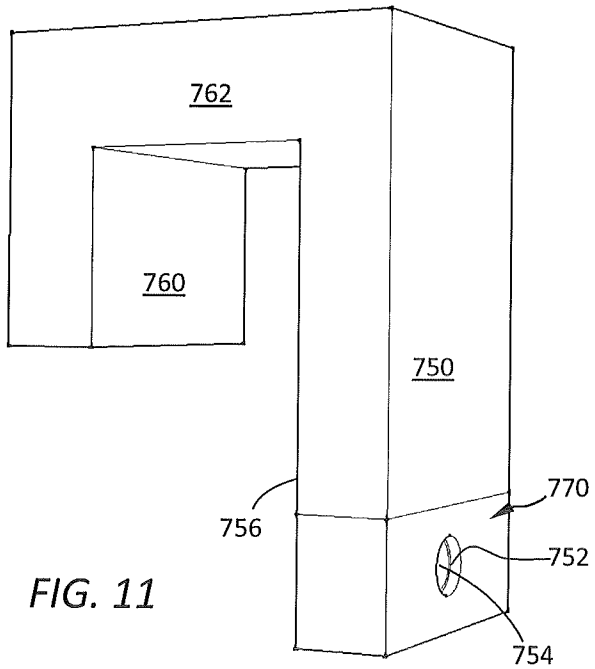


FIG. 11

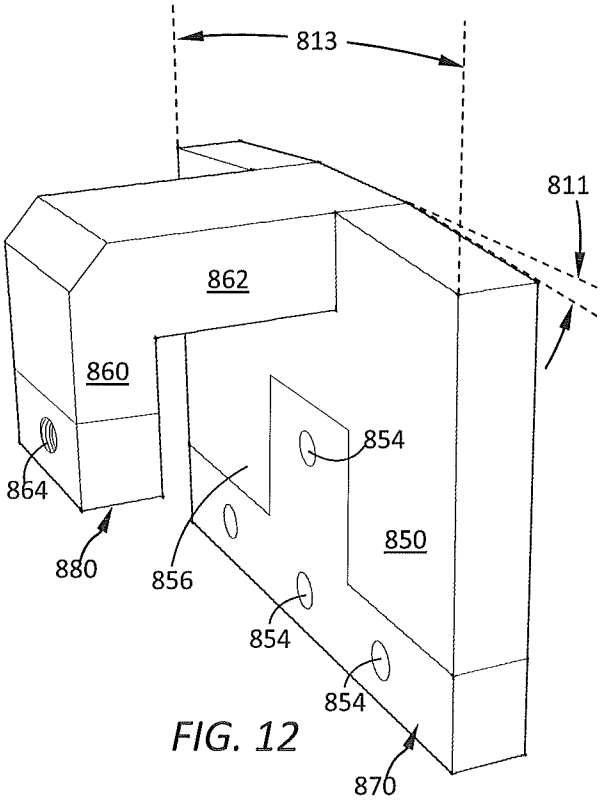


FIG. 12

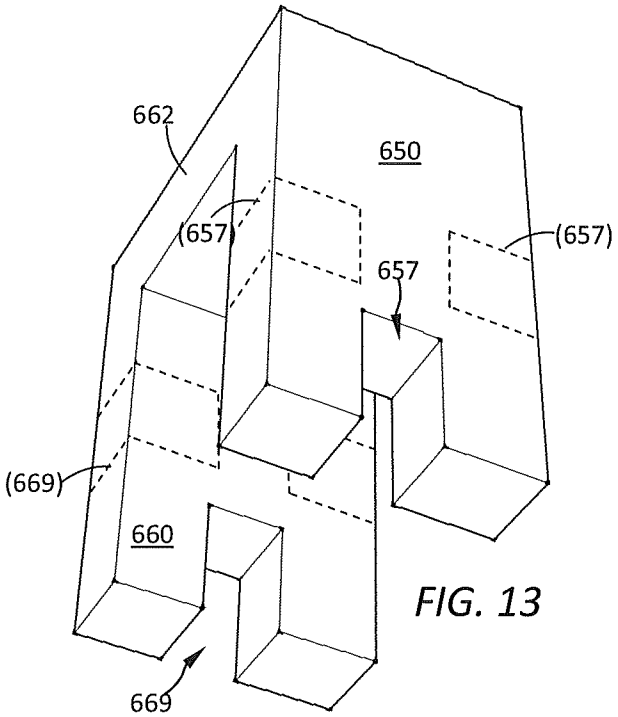


FIG. 13

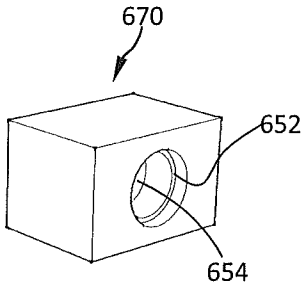


FIG. 14

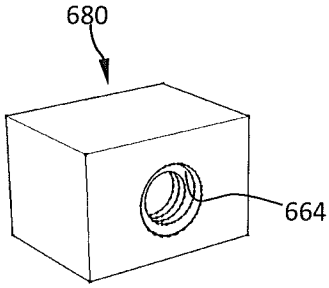


FIG. 15

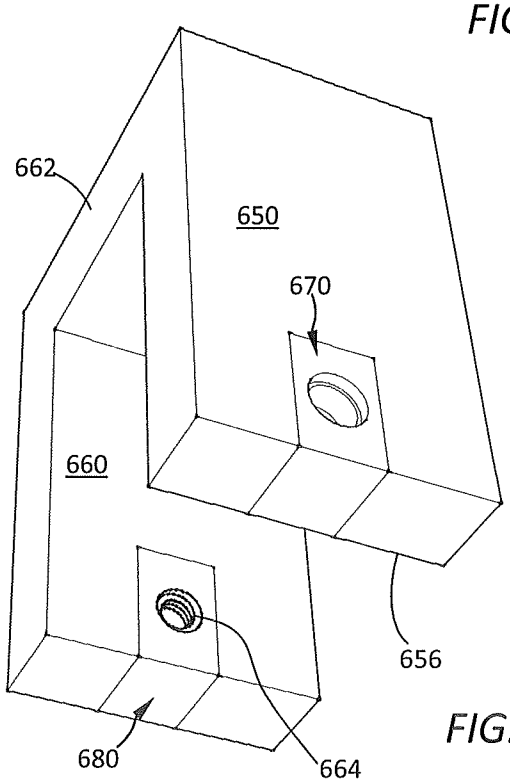


FIG. 16

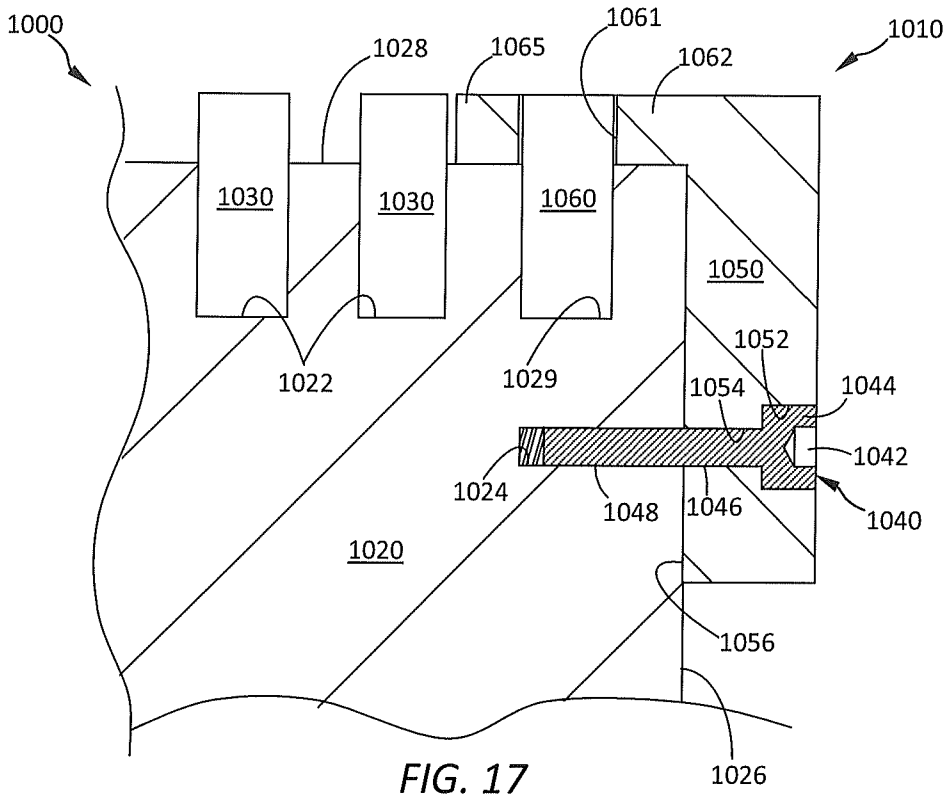

1000
1028
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FIG. 17

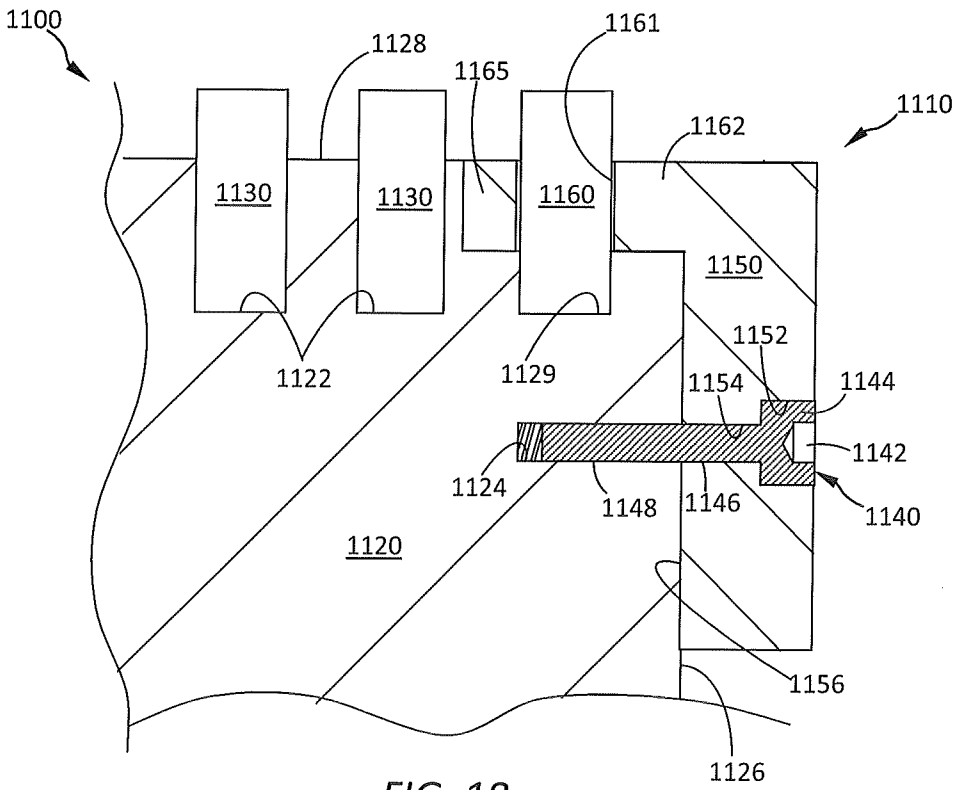

1100
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FIG. 18