US 20230301240A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2023/0301240 A1**

Osterchill et al. (43) **Pub. Date: Sep. 28, 2023**

(54) **A DRIVESHAFT AND AN OUTDOOR POWER EQUIPMENT COMPRISING SUCH DRIVESHAFT**

(71) Applicant: **HUSQVARNA AB**, Huskvarna (SE)

(72) Inventors: **Jeff Osterchill**, Davidson, NC (US); **Camden White**, Huntersville, NC (US); **Andrew Curtis**, Charlotte, NC (US)

(21) Appl. No.: **18/020,744**

(22) PCT Filed: **Aug. 17, 2021**

(86) PCT No.: **PCT/SE2021/050797**

§ 371 (c)(1),
(2) Date: **Feb. 10, 2023**

Related U.S. Application Data

(60) Provisional application No. 63/068,556, filed on Aug. 21, 2020.

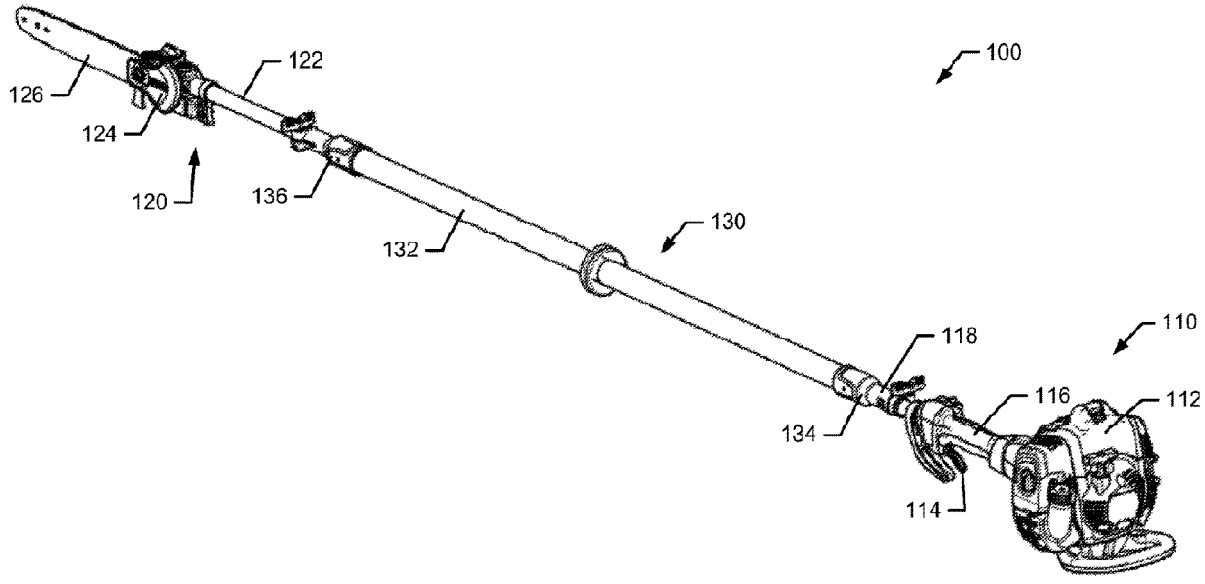
Publication Classification

(51) **Int. Cl.**
A01G 3/08 (2006.01)

(52) **U.S. Cl.**
CPC ***A01G 3/086*** (2013.01)

(57) **ABSTRACT**

A driveshaft (**130**, **330**) for outdoor power equipment (**300**) may include a power head interface assembly (**340**) configured to operably couple the driveshaft (**130**, **330**) to a power head (**110**, **310**) of the outdoor power equipment (**300**), an attachment interface assembly (**342**) configured to operably couple the driveshaft (**130**, **330**) to a cutting attachment (**120**, **320**) of the outdoor power equipment (**300**), an external casing rigidly coupling the power head interface assembly (**340**) to the attachment interface assembly (**342**), and a segmented internal drive assembly (**360**) configured to provide mechanical communication of mechanical power from the power head (**110**, **310**) to the cutting attachment (**120**, **320**). The segmented internal drive assembly (**360**) may include individually electrically insulated segments.



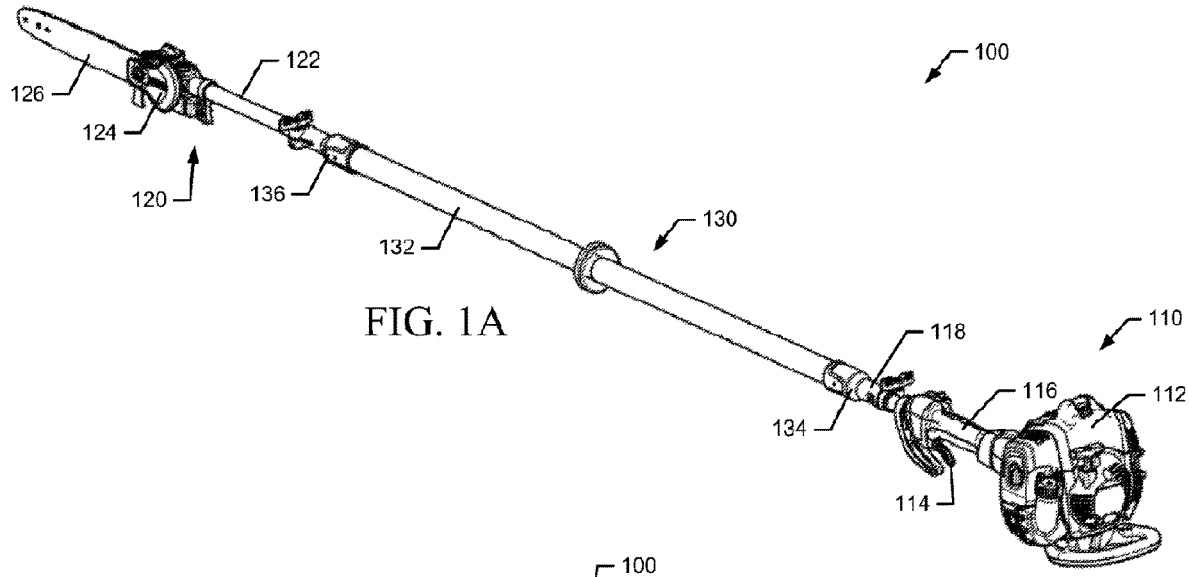

100
122
126
124
120
136
130
132
118
110
116
112
134
114

FIG. 1A

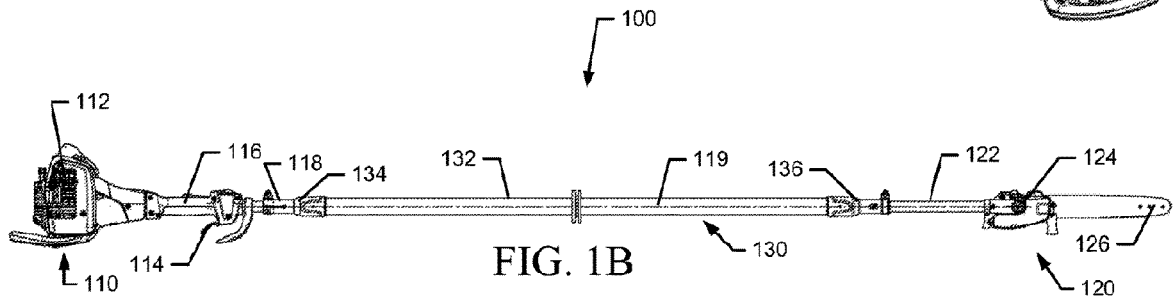
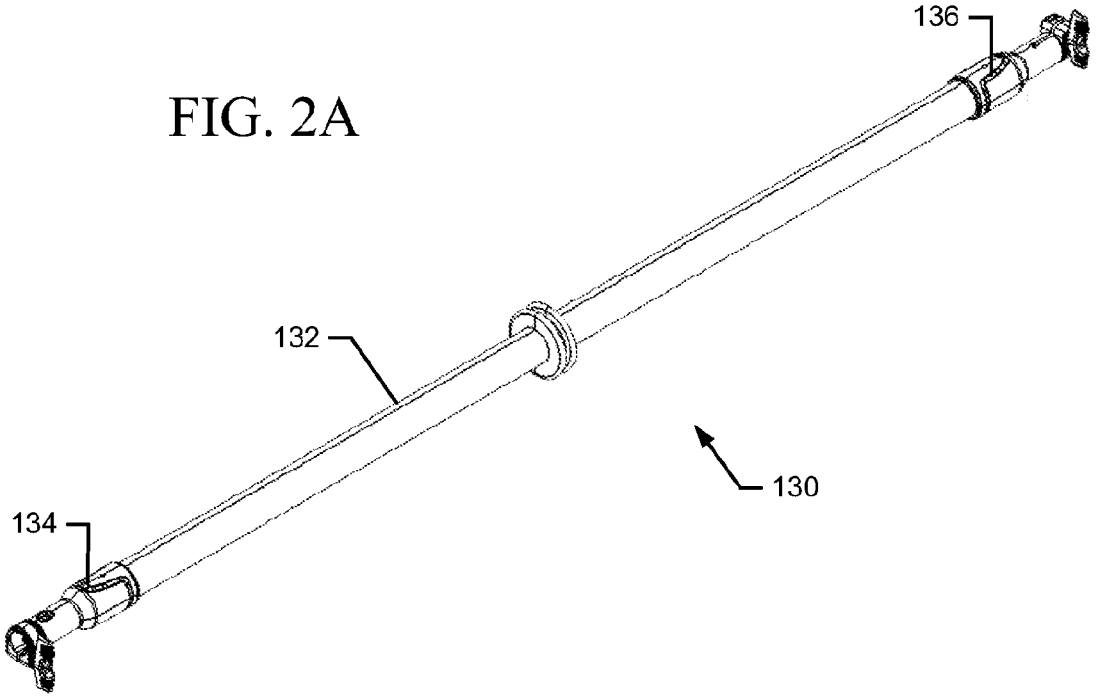

100
112
116
118
134
132
119
136
122
124
126
130
114
110
120

FIG. 1B

FIG. 2A



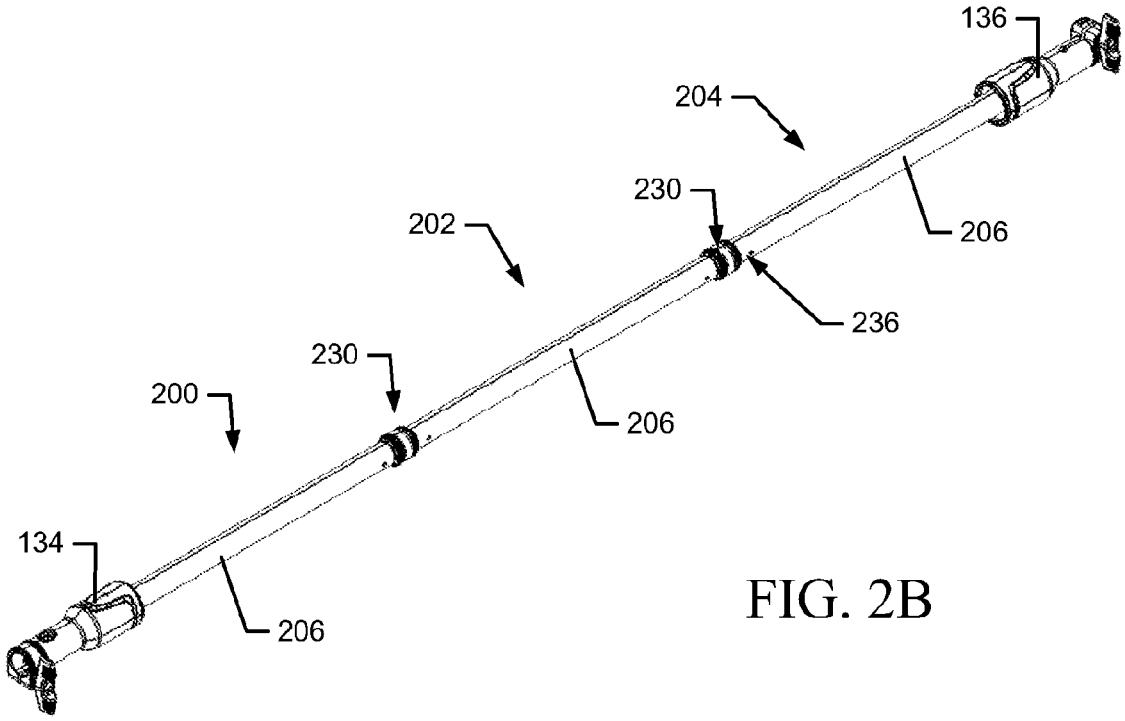


FIG. 2B

FIG. 2C

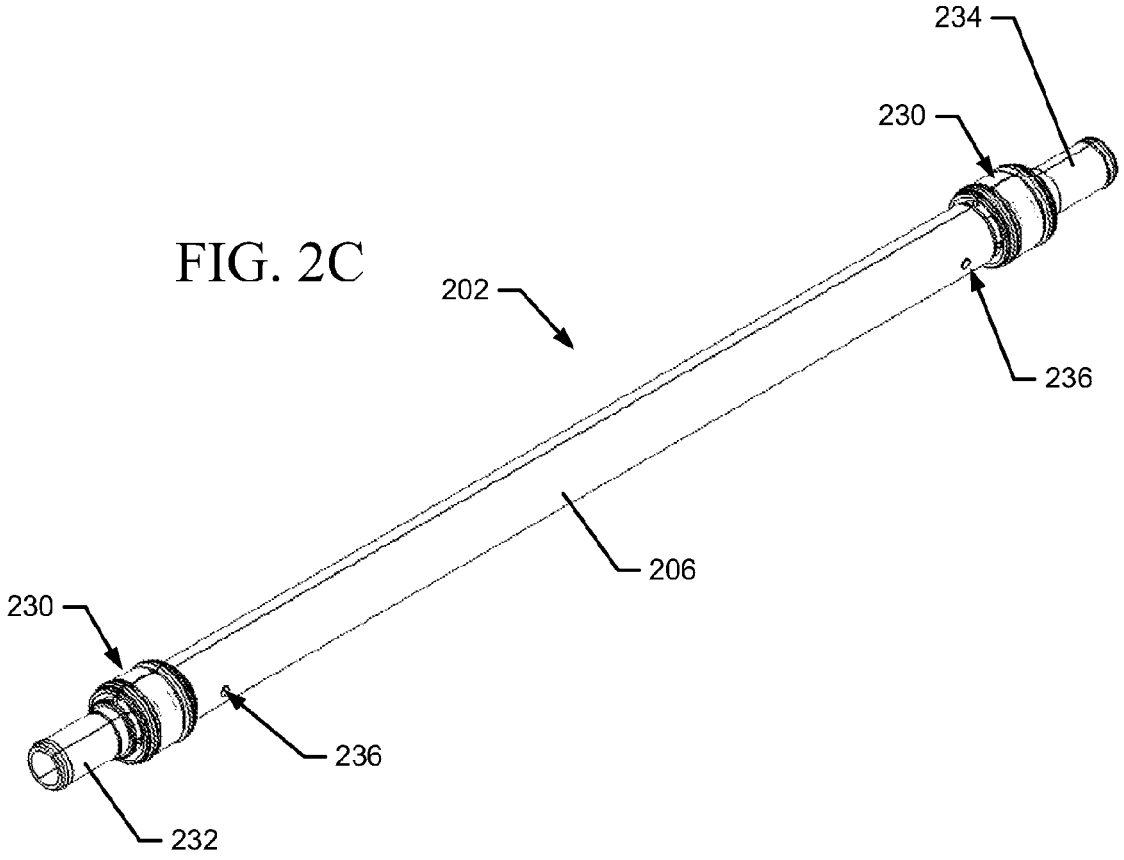
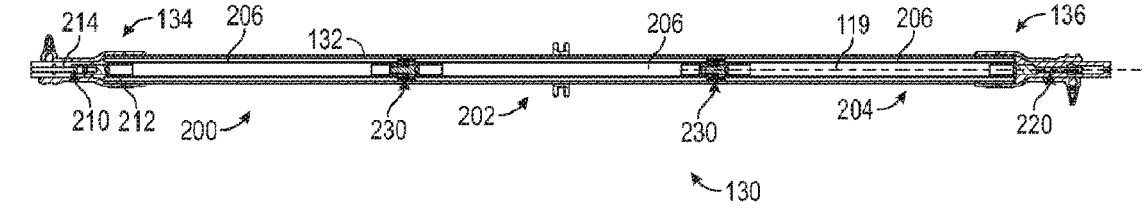


FIG. 3A


214
134
206
132
206
119
206
136
210
212
200
230
202
230
204
220
130

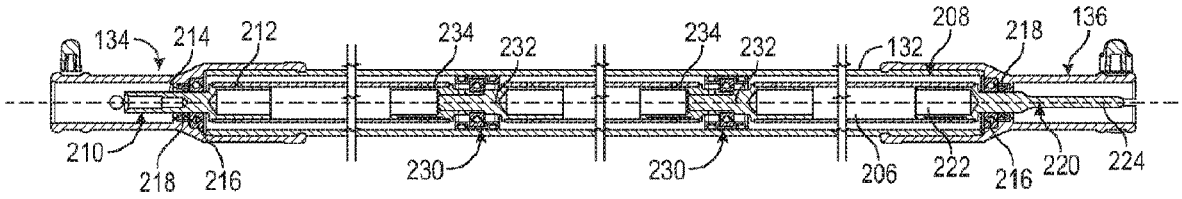
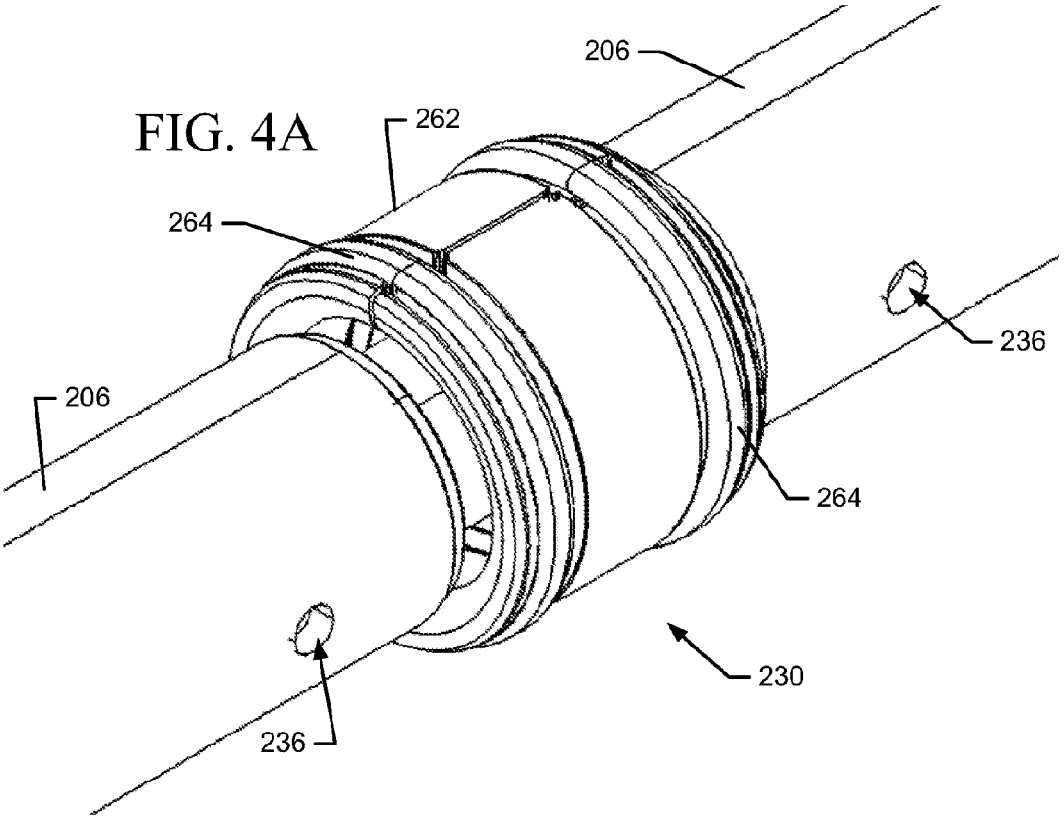

134
214
212
234
232
234
232
132
208
218
136
210
218
216
230
230
206
222
216
220
224

FIG. 3B

FIG. 4A


206
262
264
236
206
264
230
236

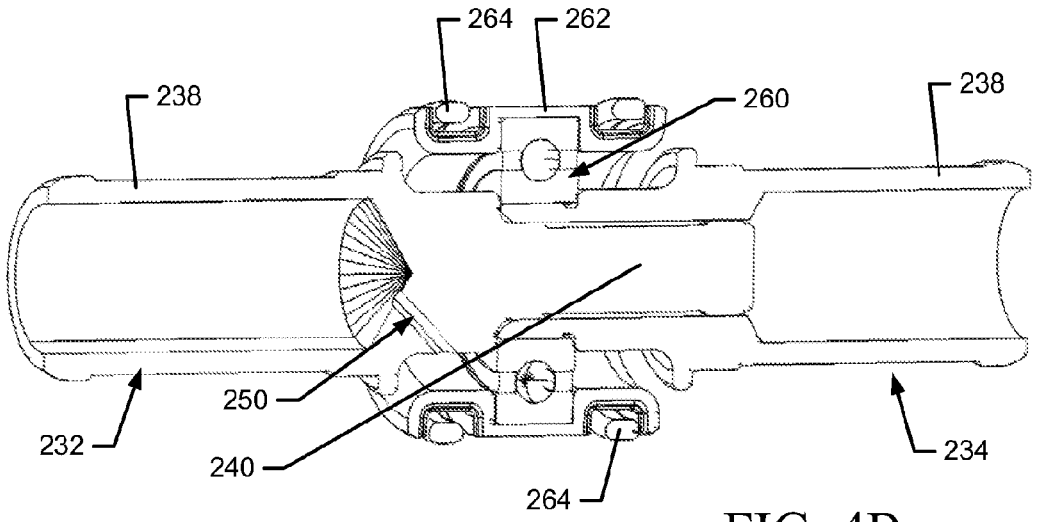
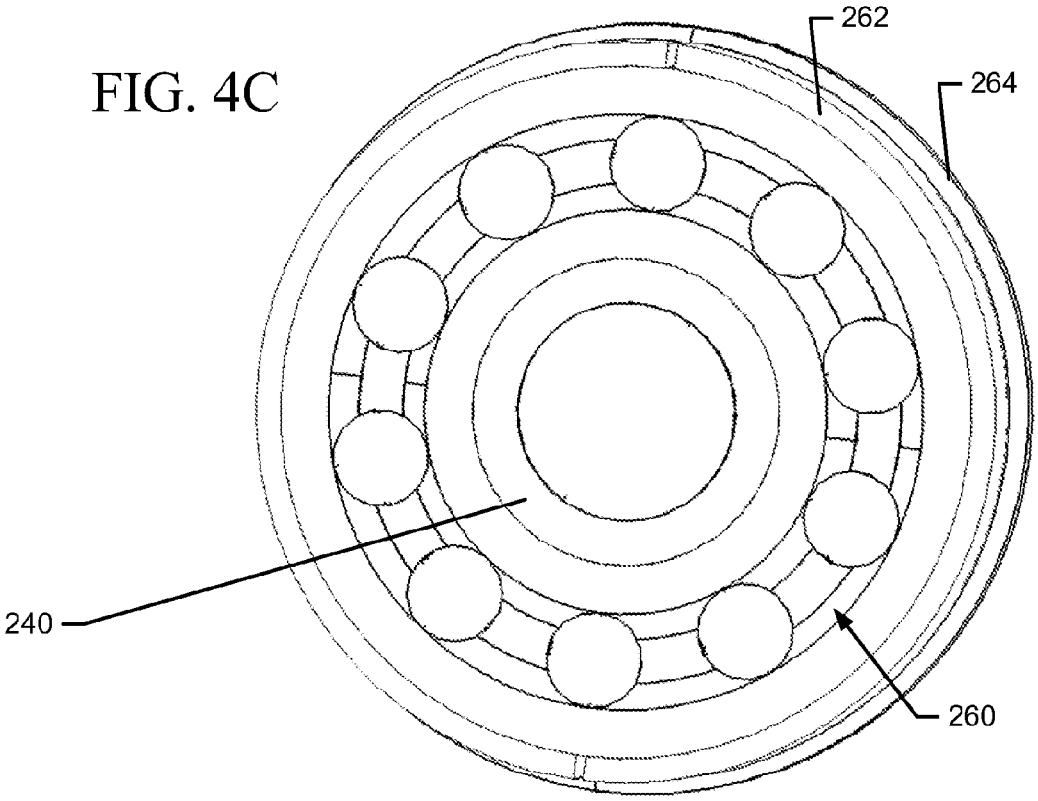

264
262
238
260
238
250
232
240
234
264

FIG. 4B

FIG. 4C



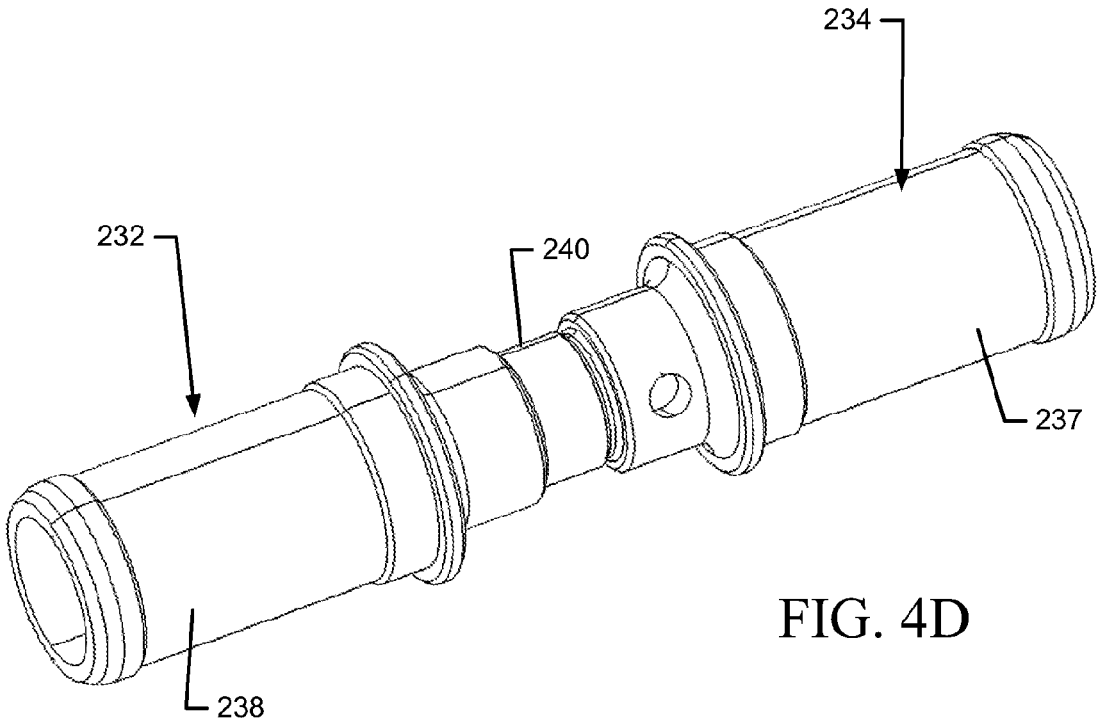
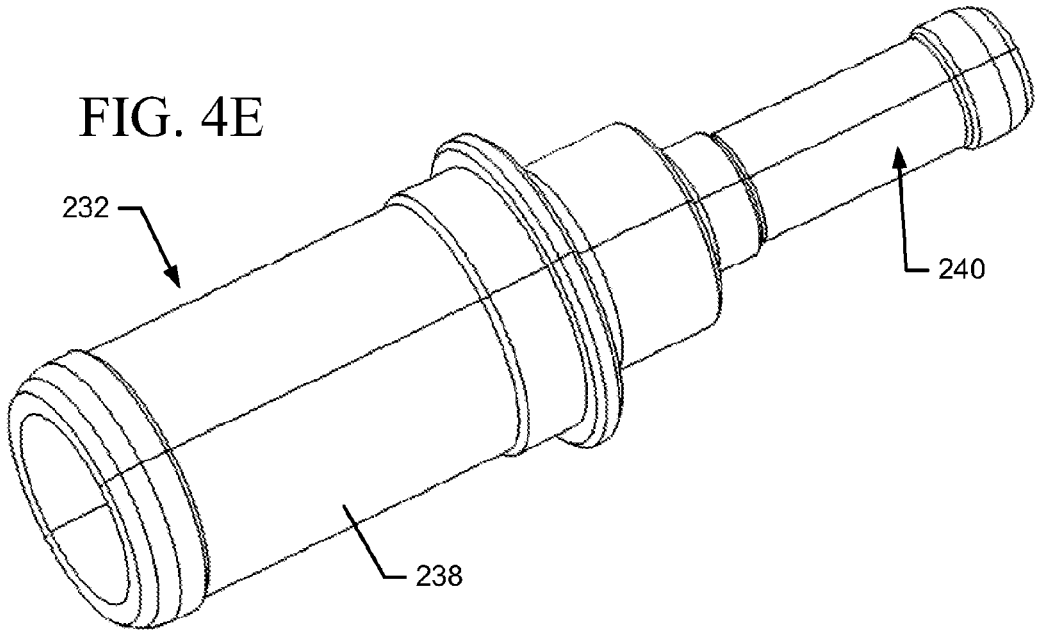


FIG. 4D

FIG. 4E



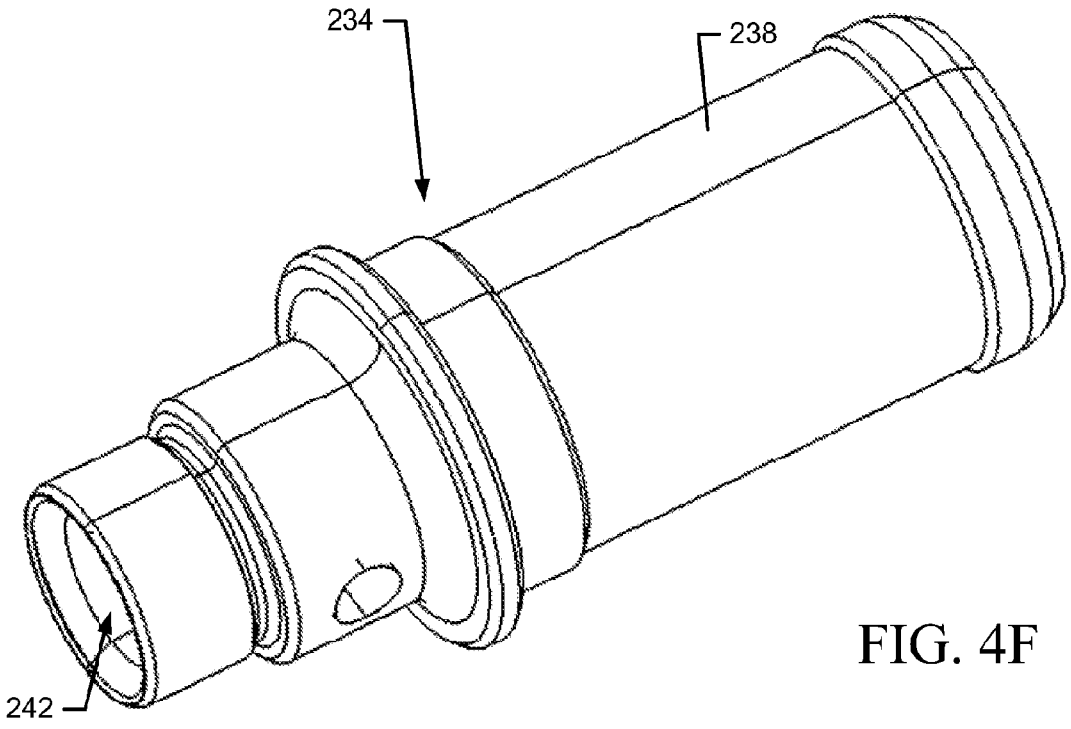


FIG. 4F

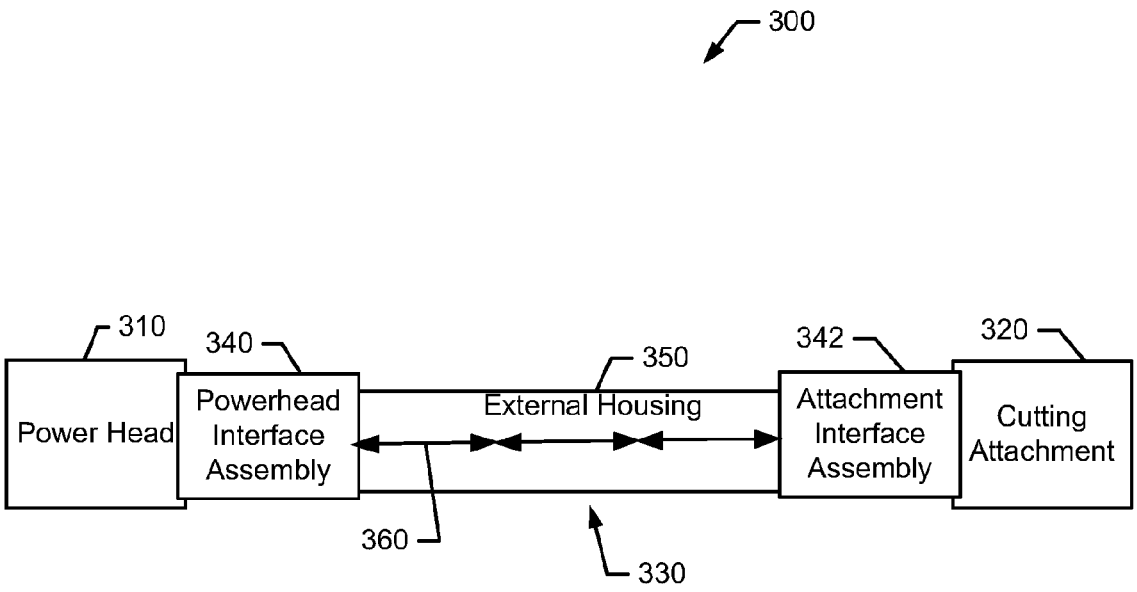

300
310
340
350
342
320
Power Head
Powerhead Interface Assembly
External Housing
Attachment Interface Assembly
Cutting Attachment
360
330

FIG. 5

A DRIVESHAFT AND AN OUTDOOR POWER EQUIPMENT COMPRISING SUCH DRIVESHAFT

TECHNICAL FIELD

[0001] Example embodiments generally relate to power equipment and, more particularly, relate to a pole saw with a non-conductive driveshaft.

BACKGROUND

[0002] Property maintenance tasks are commonly performed using various tools and/or machines that are configured for the performance of corresponding specific tasks. Some of those tools, like chainsaws, are designed to be effective at felling trees or at cutting felled trees. However, sometimes operators may need or wish to cut individual branches at heights above the operator's head, or even outside the reach of the operator. Accordingly, pole saws have been developed to facilitate cutting in such situations. The pole saws may either be manually operated or powered.

[0003] In some cases, pole saws may be used in the vicinity of high voltage wires. Since a typical powered pole saw has a conductive mechanical connection between the powerhead and the cutting attachment, there could be a risk of shock if the operator accidentally contacts the high voltage wires. Thus, a manually operated pole saw would typically be used in such situations, and the manually operated pole saw would have a dielectric (e.g., insulated) construction.

BRIEF SUMMARY OF SOME EXAMPLES

[0004] Some example embodiments may provide a powered pole saw with a dielectric construction. Thus, example embodiments may enable powered pole saw operation with confidence in safety in more use contexts.

[0005] In an example embodiment, a driveshaft for outdoor power equipment may be provided. The driveshaft may include a power head interface assembly configured to operably couple the outdoor power equipment, an external casing rigidly coupling the power head interface driveshaft to a power head of the outdoor power equipment, an attachment interface assembly configured to operably couple the driveshaft to a cutting attachment of the assembly to the attachment interface assembly, and a segmented internal drive assembly configured to provide mechanical communication of mechanical power from the power head to the cutting attachment. The segmented internal drive assembly may include individually electrically insulated segments.

[0006] In another example embodiment, an outdoor power equipment device may be provided. The device may include a power head, cutting attachment and driveshaft. The driveshaft may include a power head interface assembly configured to operably couple the driveshaft to a power head, an attachment interface assembly configured to operably couple the driveshaft to a cutting attachment, an external casing rigidly coupling the power head interface assembly to the attachment interface assembly, and a segmented internal drive assembly configured to provide mechanical communication of mechanical power from the power head to the cutting attachment. The segmented internal drive assembly may include individually electrically insulated segments.

[0007] Some example embodiments may improve the user experience, safety, and/or productivity during use of outdoor powered equipment.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING(S)

[0008] Having thus described some example embodiments in general terms, reference will now be made to the accompanying drawings, which are not necessarily drawn to scale, and wherein:

[0009] FIG. **1**, which is defined by FIGS. **1**A and **1**B, illustrates a perspective view and side view, respectively, of a pole saw in accordance with an example embodiment;

[0010] FIG. **2**, which is defined by FIGS. **2**A, **2**B and **2**C, illustrates a perspective view of a driveshaft in isolation, various segments thereof, and a single segment in isolation, respectively, in accordance with an example embodiment;

[0011] FIG. **3**, which is defined by FIGS. **3**A and **3**B, illustrates cross section views of the driveshaft in accordance with an example embodiment;

[0012] FIG. **4**, which is defined by FIGS. **4**A, **4**B, **4**C, **4**D, **4**E and **4**F, illustrates various components of the driveshaft in accordance with an example embodiment; and

[0013] FIG. **5** is a block diagram of a device having a driveshaft in accordance with an example embodiment.

DETAILED DESCRIPTION

[0014] Some example embodiments now will be described more fully hereinafter with reference to the accompanying drawings, in which some, but not all example embodiments are shown. Indeed, the examples described and pictured herein should not be construed as being limiting as to the scope, applicability or configuration of the present disclosure. Rather, these example embodiments are provided so that this disclosure will satisfy applicable legal requirements. Like reference numerals refer to like elements throughout. Furthermore, as used herein, the term "or" is to be interpreted as a logical operator that results in true whenever one or more of its operands are true. As used herein, operable coupling should be understood to relate to direct or indirect connection that, in either case, enables functional interconnection or interaction of components that are operably coupled to each other.

[0015] Some example embodiments may provide a powered pole saw that electrically isolates the power head from the cutting attachment via a dielectric driveshaft. In some example embodiments, not only may the driveshaft be dielectric, and therefore electrically insulated, but the driveshaft may further be made of segments that have bearing and/or bushing support between each respective segment. Furthermore, in some cases, the segments may be vented to allow the release of trapped gasses or pressure that may build up therein.

[0016] FIG. **1**, which is defined by FIGS. **1**A and **1**B, illustrates an example embodiment being applied where the outdoor power equipment (e.g., pole saw **100**) includes a power head **110** that is operably coupled (e.g., permanently or removably) to a cutting attachment **120** via a dielectric or insulated driveshaft **130**. Although the power head **110** could take many different forms, the power head **110** of FIG. **1** includes a power source **112** (e.g., a battery powered, electric motor or a gasoline/petrol engine) that is operable responsive to actuation of a trigger **114** while the operators

grasps handle **116**. The power head **110** of this example may be operably coupled directly to the driveshaft **130** via a coupler **118**. Although not shown, a spline portion (e.g., having a female fitting) may extend along a longitudinal axis **119** of the pole saw **100** into the coupler **118** in order to mate with a corresponding spline portion (e.g., having a male fitting) of the driveshaft **130**. However, it should be appreciated that other joining methods/structures are also possible other than a spline. For example, male/female fittings with any shape (hex, square, etc.) could alternatively be employed among other options. Responsive to actuation of the trigger **114**, the power source **112** may turn the spline portion, which turning may then be translated to the driveshaft **130** (via the spline portion of the driveshaft **130**).

[0017] The driveshaft **130** may then communicate the drive power provided from the power head **110** to the cutting attachment **120**. In this regard, for example, the cutting attachment **120** may include a coupling shaft **122**. The coupling shaft **122** may include a spline portion (e.g., having a male fitting) that could couple the coupling shaft **122** to the driveshaft **130** as described in greater detail below. The spline portion of the coupling shaft **122** may turn and thereby power through saw body **124** to turn a cutting chain about guide bar **126**. The saw body **124** may include an oil reservoir for enabling the guide bar, sprocket and/or other components of the saw body **124** to be lubricated.

[0018] The driveshaft **130** may include an external housing **132** that may extend between a first coupler **134** and a second coupler **136**. The first coupler **134** and the second coupler **136** may each include the corresponding spline portions mentioned above (see elements **210** and **220** in FIG. **3**A), and may be configured to mate with the coupler **118** of the power head **110** and the coupling shaft **122** of the cutting attachment **120**, respectively. The first and second couplers **134** and **136** may be configured for tool-less attachment to the coupler **118** of the power head **110** and the coupling shaft **122** of the cutting attachment **120**, respectively. Thus, for example, a wing knob or other threaded fastener, which can be operated by hand only, and without any need for tools, may be provided at one or both of the first and second couplers **134** and **136**. However, in some cases, a tool may be employed to operate the first and second couplers **134** and **136**.

[0019] A perspective view of the driveshaft **130** is shown in isolation in FIG. **2**A. Meanwhile, in FIG. **2**B, the external housing **132** is removed in order to expose internal components of the driveshaft **130**. In this regard, FIG. **2**B shows multiple segments (e.g., a first segment **200**, a second segment **202** and a third segment **204**) that may be used to form the internal rotary shaft of the driveshaft **130**, via which rotary power is actually transferred between the power head **110** and the cutting attachment **120**. However, more or fewer than three segments (of equal or unequal lengths) may be used in alternative embodiments. FIG. **2**C shows one segment (i.e., the second segment **202**) in isolation along with portions of segment couplers that are used to operably couple the first segment **200** to the second segment **202**, and the second segment **202** to the third segment **204**, respectively. Each of the first, second and third segments **200**, **202** and **204** may include a segment shaft body **206**. Each of the segment shaft bodies **206** may be a substantially hollow, cylindrical tube that is made of non-conductive material (e.g., fiberglass). However, shapes other than cylindrical tubes may alternatively be employed. Notably, an air gap **208** (see FIG. **3**B) may exist outside of each of the segment shaft bodies **206** between the segment shaft body **206** and the external housing **132**. The air gap **208** may enable the first, second and third segments **200**, **202** and **204** to freely turn within the external housing **132** without any contact therebetween.

[0020] FIG. **3**, which is defined by FIGS. **3**A and **3**B, illustrate cross section views of the driveshaft **130** taken along a plane passing through the longitudinal axis **119** of FIG. **1**. FIG. **3**A shows a full cross section view of the driveshaft **130**. Meanwhile, in FIG. **3**B, some portions are removed in order to enable a closer view of the internal components of the driveshaft **130**. FIG. **4**, which is defined by FIGS. **4**A, **4**B, **4**C, **4**D, **4**E and **4**F, shows various additional views of the internal components of the driveshaft **130**.

[0021] Referring now primarily to FIGS. **2**-**4**, it can be appreciated that the external housing **132** of the driveshaft **130** may be a continuous hollow, cylindrical tube that extends between the first and second couplers **134** and **136**. That said, non-continuous tubes may be used in alternative embodiments. In an example embodiment, the external housing **132** may be made of fiberglass or another non-conductive material. Furthermore, the external housing **132** is fixed to each of the first and second couplers **134** and **136** (and therefore does not rotate). The first and second couplers **134** and **136** may each have cylindrical and hollow receiver portions inside which respective opposing ends of the external housing **132** may be disposed (and fixed). In some cases, the opposing ends of the external housing **132** may be fixed to the receiver portions of the first and second couplers **134** and **136**, respectively, with fasteners. However, friction fittings, adhesives or other fixing means may be used in alternative embodiments.

[0022] As shown in FIG. **3**, the first coupler **134** may house a female spline member **210** of the first segment **200**. Meanwhile, the second coupler **136** may include a male spline member **220** of the third segment **204**. However, it should be appreciated that the male/female arrangements could be reversed dependent upon the structures of the power head **110** and the cutting attachment **120**. The male and female spline members **210** and **220** may each be made of metallic materials or other such strong materials.

[0023] The female spline member **210** may include a cup portion **212** and a shaft portion **214**. The female fitting may be disposed at the distal end of the shaft portion **214**. The cup portion **212** may be a substantially hollow, cylindrical portion that has an external diameter that is slightly smaller than an internal diameter of the segment shaft body **206**. The segment shaft body **206** and the cup portion **212** may then be affixed to each other via friction fitting, adhesive, and/or one or more fasteners. In some cases, a combination of a press fit and epoxy may be used to fix the segment shaft body **206** and the cup portion **212** together.

[0024] In an example embodiment, the shaft portion **214** may have a smaller diameter than the cup portion **212**. The transition between the shaft portion **212** and the cup portion **214** may therefore also be a location at which the female spline member **210** interfaces with the first coupler **134**. In this regard, for example, the first coupler **134** may also transition in diameter proximate to the interface with the female spline member **210**, and the first coupler **134** may include a bearing assembly **216** and a shaft seal **218** (e.g., a

swiping shaft seal) that rotatably support the female spline member **210** within the first coupler **134**.

[0025] The male spline member **220** may similarly include a cup portion **222** and a shaft portion **224**. The male fitting may be disposed at the distal end of the shaft portion **224**. The cup portion **222** may be a substantially hollow, cylindrical portion that has an external diameter that is slightly smaller than an internal diameter of the segment shaft body **206**. The segment shaft body **206** and the cup portion **222** may then be affixed to each other via friction fitting, adhesive, and/or one or more fasteners (e.g., a combination of a press fit and epoxy).

[0026] In an example embodiment, the shaft portion **224** may have a smaller diameter than the cup portion **222**. The transition between the shaft portion **222** and the cup portion **224** may therefore also be a location at which the male spline member **220** interfaces with the second coupler **136**. In this regard, for example, the second coupler **136** may also transition in diameter proximate to the interface with the male spline member **220**, and the second coupler **136** may include a bearing assembly **226** and a shaft seal **228** (e.g., a swiping shaft seal) that rotatably support the male spline member **220** within the second coupler **136**.

[0027] The segment shaft body **206** of the first segment **200** and the segment shaft body **206** of the third segment **204** may extend toward each other to engage respective segment couplers **230** that operably couple the first and third segments **200** and **204** to the opposing respective ends of the second segment **202**. FIG. **2**C illustrates the second segment **202** and the segment couplers **230** on each opposing end thereof. Portions of the segment couplers **230** are shown in greater detail in FIG. **4**.

[0028] In an example embodiment, each of the segment couplers **230** may include a first body engagement portion **232** and a second body engagement portion **234**. The first and second body engagement portions **232** and **234** may be structured substantially similarly to the cup portions **212** and **222** described above (e.g., they may each be made of metallic materials). Moreover, each of the first and second body engagement portions **232** and **234** may be operably coupled to ends of respective instances of the segment shaft body **206** in a similar manner to how the cup portions **212** and **222** are connected to the segment shaft body **206** as described above. For example, orifices **236** formed in the segment shaft body **206** may enable epoxy to be inserted between the first and second body engagement portions **232** and **234** and corresponding portions of the segment shaft body **206**. More specifically, the first and second body engagement portions **232** and **234** may each include a cup portion **238** similar to the cup portions **212** and **222** described above.

[0029] As shown in FIGS. **4**E and **4**F, the first body engagement portion **232** may include a shaft **240**, which may extend into a corresponding receiver **242** of the second body engagement portion **234**. In some cases, the shaft **240** and receiver **242** may each have a hex, star or other unique corresponding shape configuration to enable the shaft **240** to socket into the receiver **242**. However, other coupling strategies may alternatively be employed. For example, any combination or friction fitting, adhesives, fasteners, etc., may be employed to affix the first body engagement portion **232** to the second body engagement portion **234**. In an example embodiment, the cup portions **238** of the first and second body engagement portions **232** and **234** may be disposed opposite either the shaft **240** or the receiver **242**, respectively.

[0030] In some examples, one or both of the first and second body engagement portions **232** and **234** may include a vent **250** (see FIG. **4**B). The vent **250** may extend from inside the first and second body engagement portions **232** and **234** to a portion outside thereof. As such, the area inside each of the first, second and third segments **200**, **202** and **204** may be vented to the air gap **208**. By venting the inside to the outside of the first, second and third segments **200**, **202** and **204**, any trapped pressure or gasses that may otherwise build up in any or each of the segments may be released.

[0031] The segment couplers **230** may also include a bearing assembly **260**, which may be supported between respective ones of the first, second and third segments **200**, **202** and **204** by a carrier assembly **262**. The carrier assembly **262** of some examples may be a plastic or other non-conductive structure comprised of two case halves, which may be held together by one or more rubber o-rings **264**. In this example, the carrier assembly **262** has an external diameter that is slightly smaller than an internal diameter of the external housing **132**. Thus, particularly when the o-rings **264** are in place, the o-rings **264** and the carrier assembly **262** may both engage the inside of the external housing **132** to rotatably support the first and second body engagement portions **232** and **234**, and divide the air gap **208** into respective parts that correspond to the first, second and third segments **200**, **202** and **204**.

[0032] The carrier assembly **262** may be structured to retain the bearing assembly **260** in a fixed location, and the bearing assembly **260** may further interface with one or both of the first and second body engagement portions **232** and **234** to rotatably support the first and second body engagement portions **232** and **234**. As shown in FIGS. **4**B and **4**C, which are cross sections along the axis **219** and perpendicular to the axis **219**, respectively, the bearing assembly **260** may include ball bearings disposed between inner and outer rings. Accordingly, the first and second body engagement portions **232** and **234** may rotate with the inner ring while the outer ring may remain fixed with the carrier assembly **262** and the external housing **132**.

[0033] As can be appreciated from the descriptions above, the power head **110** is operably coupled to one of the female spline member **210** or the male spline member **220**, and the cutting attachment **120** is operably coupled to the other of the male spline member **220** or the female spline member **210**. Meanwhile, the driveshaft **130** is structured so that the entirety of the external housing **132** is both fixed and non-conductive (e.g., dielectric), while the first, second and third segments **200**, **202** and **204** are operably coupled to the female spline member **210** or the male spline member **220** to rotate therewith inside the external housing **132**. In this regard, for example, the segment shaft body **206** of each of the first, second and third segments **200**, **202** and **204** is rigidly and fixedly coupled to respective ones of the female spline member **210**, the male spline member **220**, and the segment couplers **230** to create a continuous shaft that rotates responsive to power application from the power head **110**.

[0034] In accordance with this example, the power head **110** rotates the female spline member **210**, which in turn rotates the segment shaft body **206** of the first segment **200**, which is rigidly coupled thereto. The segment shaft body

206 of the first segment **200** is rigidly coupled to the segment coupler **230** disposed between the first and second segments **200** and **202** and thereby rotates the segment shaft body **206** of the second segment **202**, which is rigidly coupled to the segment coupler **230**. The segment shaft body **206** of the second segment **202** is then rigidly coupled to the segment coupler **230** disposed between the second and third segments **202** and thereby rotates the segment shaft body **206** of the third segment **204**, which is rigidly coupled to the segment coupler **230**. The segment shaft body **206** of the third segment **204** is then also rigidly coupled to the male spline member **220**, which is operably coupled to the cutting attachment **120**.

[0035] Although the female spline member **210**, the male spline member **220**, and the segment couplers **230** may each include metallic materials, none of these components contact each other. Moreover, the only components connecting the female spline member **210**, the male spline member **220**, and the segment couplers **230** (i.e., primarily the segment shaft body **206** of each respective segment) are non-metallic and therefore dielectric or insulating. Thus, while the driveshaft **130** includes a continuous mechanical connection from the power head **110** to the cutting attachment **120**, any potential path for electrical connection between the power head **110** and the cutting attachment **120** is substantially insulated. Example embodiments therefore provide a rugged and fully functional driveshaft **130** that operably couples rotating power efficiently, while also providing full electrical isolation between the power head **110** and the cutting attachment **120**. Any inadvertent contact of the cutting attachment **120** with electrical wires or some other power source could then not be transmitted through the driveshaft **130** to the operator.

[0036] As noted above, the specific structures described in reference to FIGS. **1-4** are all examples of one embodiment. However, other example embodiments may employ other specific structures. As such, FIG. **5** is provided to illustrate a block diagram of a piece of outdoor power equipment **300** that may be configured in accordance with example embodiments of the present invention. In this regard, the outdoor power equipment **300** driveshaft for outdoor power equipment may include a power head **310** and a cutting attachment **320** that are operably coupled together via a driveshaft **330** (e.g., a dielectric or insulated driveshaft). The driveshaft **330** may include a power head interface assembly **340** configured to operably couple the driveshaft **330** to the power head **310**. The driveshaft **330** may also include an attachment interface assembly **342** configured to operably couple the driveshaft **330** to the cutting attachment **320**. The driveshaft **330** may also include an external housing **350** rigidly coupling the power head **310** to the cutting attachment **320** (e.g., via a fixed portion of the power head interface assembly **340** and the attachment interface assembly **342**). The driveshaft **330** may also include a segmented internal drive assembly **360** configured to provide mechanical communication of rotary power from the power head **310** to the cutting attachment **320** (e.g., via a movable portion of the power head interface assembly **340** and the attachment interface assembly **342**). The segmented internal drive assembly **360** includes individually electrically insulated segments.

[0037] Accordingly, in one example embodiment, a driveshaft for outdoor power equipment may be provided. The driveshaft may include a power head interface assembly configured to operably couple the driveshaft to a power head of the outdoor power equipment, an attachment interface assembly configured to operably couple the driveshaft to a cutting attachment of the outdoor power equipment, an external casing rigidly coupling the power head interface assembly to the attachment interface assembly, and a segmented internal drive assembly configured to provide mechanical communication of mechanical power from the power head to the cutting attachment. The segmented internal drive assembly may include individually electrically insulated segments.

[0038] In some cases, modifications or amplifications may further be employed as optional alterations or augmentations to the description above. These alterations or augmentations may be performed exclusive of one another or in any combination with each other. In some cases, such modifications or amplifications may include each of the individually insulated segments including a segment shaft body made of non-metallic, insulating material and a segment coupler configured to couple a first segment shaft body of one segment to a second segment shaft body of an adjacent segment. In an example embodiment, the segment shaft body and the external housing may each be made of fiberglass, and the segment coupler may include metallic materials. In some examples, the segment coupler may include a bearing assembly and a carrier assembly. The carrier assembly may support the bearing assembly proximate to the segment coupler. In an example embodiment, the carrier assembly may include a non-conductive material and one or more o-rings to affix the carrier assembly inside the external housing. In some examples, the segment coupler may be vented from an internal portion of the segmented internal drive assembly to an external portion of the segmented internal drive assembly. In an example embodiment, an air gap may be disposed between the external housing and the segment shaft body of each of the individually electrically insulated segments. In some examples, the segmented internal drive assembly may include a first insulated segment, a second insulated segment and a third insulated segment. The first insulated segment may include the first segment shaft body, the second insulated segment may include the second segment shaft body, and the third insulated segment may include a third segment shaft body. The segment coupler may couple the first segment shaft body to the second segment shaft body, and a second segment coupler may couple the second segment shaft body to the third segment shaft body. The first, second and third segment shaft bodies may turn with each other independent of the external housing. In an example embodiment, the attachment interface assembly and the power head interface assembly may each include a bearing assembly and a shaft seal. In some examples, the attachment interface assembly and the power head interface assembly may each be configured for attachment to the cutting attachment and the power head, respectively, without tools. In an example embodiment, the cutting attachment may be one of a plurality of different interchangeable cutting attachments.

[0039] Many modifications and other embodiments of the inventions set forth herein will come to mind to one skilled in the art to which these inventions pertain having the benefit of the teachings presented in the foregoing descriptions and the associated drawings. Therefore, it is to be understood that the inventions are not to be limited to the specific embodiments disclosed and that modifications and other

embodiments are intended to be included within the scope of the appended claims. Moreover, although the foregoing descriptions and the associated drawings describe exemplary embodiments in the context of certain exemplary combinations of elements and/or functions, it should be appreciated that different combinations of elements and/or functions may be provided by alternative embodiments without departing from the scope of the appended claims. In this regard, for example, different combinations of elements and/or functions than those explicitly described above are also contemplated as may be set forth in some of the appended claims. In cases where advantages, benefits or solutions to problems are described herein, it should be appreciated that such advantages, benefits and/or solutions may be applicable to some example embodiments, but not necessarily all example embodiments. Thus, any advantages, benefits or solutions described herein should not be thought of as being critical, required or essential to all embodiments or to that which is claimed herein. Although specific terms are employed herein, they are used in a generic and descriptive sense only and not for purposes of limitation.

1. A driveshaft for outdoor power equipment, the driveshaft comprising:

a power head interface assembly configured to operably couple the driveshaft to a power head of the outdoor power equipment;

an attachment interface assembly configured to operably couple the driveshaft to a cutting attachment of the outdoor power equipment

an external housing rigidly coupling the power head to the cutting attachment, the external housing being made of an insulating material; and

a segmented internal drive assembly configured to provide mechanical communication of rotary power from the power head to the cutting attachment,

wherein the segmented internal drive assembly comprises individually electrically insulated segments.

2. The driveshaft of claim **1**, wherein each of the individually insulated segments comprises a segment shaft body made of non-metallic, insulating material and a segment coupler configured to couple a first segment shaft body of one segment to a second segment shaft body of an adjacent segment.

3. The driveshaft of claim **2**, wherein the segment shaft body and the external housing are each made of fiberglass, and

wherein the segment coupler includes metallic materials.

4. The driveshaft of claim **2**, wherein the segment coupler comprises a bearing assembly and a carrier assembly, the carrier assembly supporting the bearing assembly proximate to the segment coupler.

5. The driveshaft of claim **4**, wherein the carrier assembly comprises a non-conductive material and one or more elastomeric components to affix the carrier assembly inside the external housing.

6. The driveshaft of **2**, wherein the segment coupler is vented from an internal portion of the segmented internal drive assembly to an external portion of the segmented internal drive assembly.

7. The driveshaft of claim **2**, wherein an air gap is disposed between the external housing and the segment shaft body of each of the individually electrically insulated segments.

8. The driveshaft of claim **2**, wherein the segmented internal drive assembly comprises a first insulated segment, a second insulated segment and a third insulated segment,

wherein the first insulated segment comprises the first segment shaft body, the second insulated segment comprises the second segment shaft body, and the third insulated segment comprises a third segment shaft body,

wherein the segment coupler couples the first segment shaft body to the second segment shaft body, and a second segment coupler couples the second segment shaft body to the third segment shaft body, and

wherein the first, second and third segment shaft bodies turn with each other independent of the external housing.

9. The driveshaft of claim **1**, wherein the attachment interface assembly and the power head interface assembly each include a bearing assembly and a shaft seal.

10. The driveshaft of claim **1**, wherein the attachment interface assembly and the power head interface assembly are each configured for attachment to the cutting attachment and the power head, respectively, without tools.

11. An outdoor power equipment device comprising:

a power head;

a cutting attachment; and

a driveshaft operably coupling the power head to the cutting attachment, the driveshaft comprising:

a power head interface assembly configured to operably couple the driveshaft to the power head;

an attachment interface assembly configured to operably couple the driveshaft to the cutting attachment;

an external housing rigidly coupling the power head to the cutting attachment, the external housing being made of an insulating material; and

a segmented internal drive assembly configured to provide mechanical communication of rotary power from the power head to the cutting attachment,

wherein the segmented internal drive assembly comprises individually electrically insulated segments.

12. The device of claim **11**, wherein each of the individually insulated segments comprises a segment shaft body made of non-metallic, insulating material and a segment coupler configured to couple a first segment shaft body of one segment to a second segment shaft body of an adjacent segment.

13. The device of claim **12**, wherein the segment shaft body (and the external housing are each made of fiberglass, and

wherein the segment coupler includes metallic materials.

14. The device of claim **12**, wherein the segment coupler comprises a bearing assembly and a carrier assembly, the carrier assembly supporting the bearing assembly proximate to the segment coupler.

15. The device of claim **12**, wherein the segment coupler is vented from an internal portion of the segmented internal drive assembly to an external portion of the segmented internal drive assembly.

16. The device of claim **12**, wherein an air gap is disposed between the external housing and the segment shaft body of each of the individually electrically insulated segments.

17. The device of claim **12**, wherein the segmented internal drive assembly comprises a first insulated segment, a second insulated segment and a third insulated segment,

wherein the first insulated segment comprises the first segment shaft body, the second insulated segment comprises the second segment shaft body, and the third insulated segment comprises a third segment shaft body,

wherein the segment coupler couples the first segment shaft body to the second segment shaft body, and a second segment coupler couples the second segment shaft body to the third segment shaft body, and

wherein the first, second and third segment shaft bodies turn with each other independent of the external housing.

18. The device of claim **11**, wherein the attachment interface assembly and the power head interface assembly each include a bearing assembly and a shaft seal.

19. The device of claim **11**, wherein the attachment interface assembly and the power head interface assembly are each configured for attachment to the cutting attachment and the power head, respectively, without tools.

20. The device of claim **11**, wherein the cutting attachment is one of a plurality of different interchangeable cutting attachments.

* * * * *