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(19) **United States**(12) **Patent Application Publication**
Kultala(10) **Pub. No.: US 2022/0226705 A1**(43) **Pub. Date: Jul. 21, 2022**(54) **TAPERED GRIP FOR SENSORS**(52) **U.S. Cl.**(71) Applicant: **KARSTEN MANUFACTURING CORPORATION**, Phoenix, AZ (US)CPC *A63B 53/14* (2013.01); *A63B 60/46* (2015.10); *A63B 60/16* (2015.10)(72) Inventor: **David S. Kultala**, Phoenix, AZ (US)

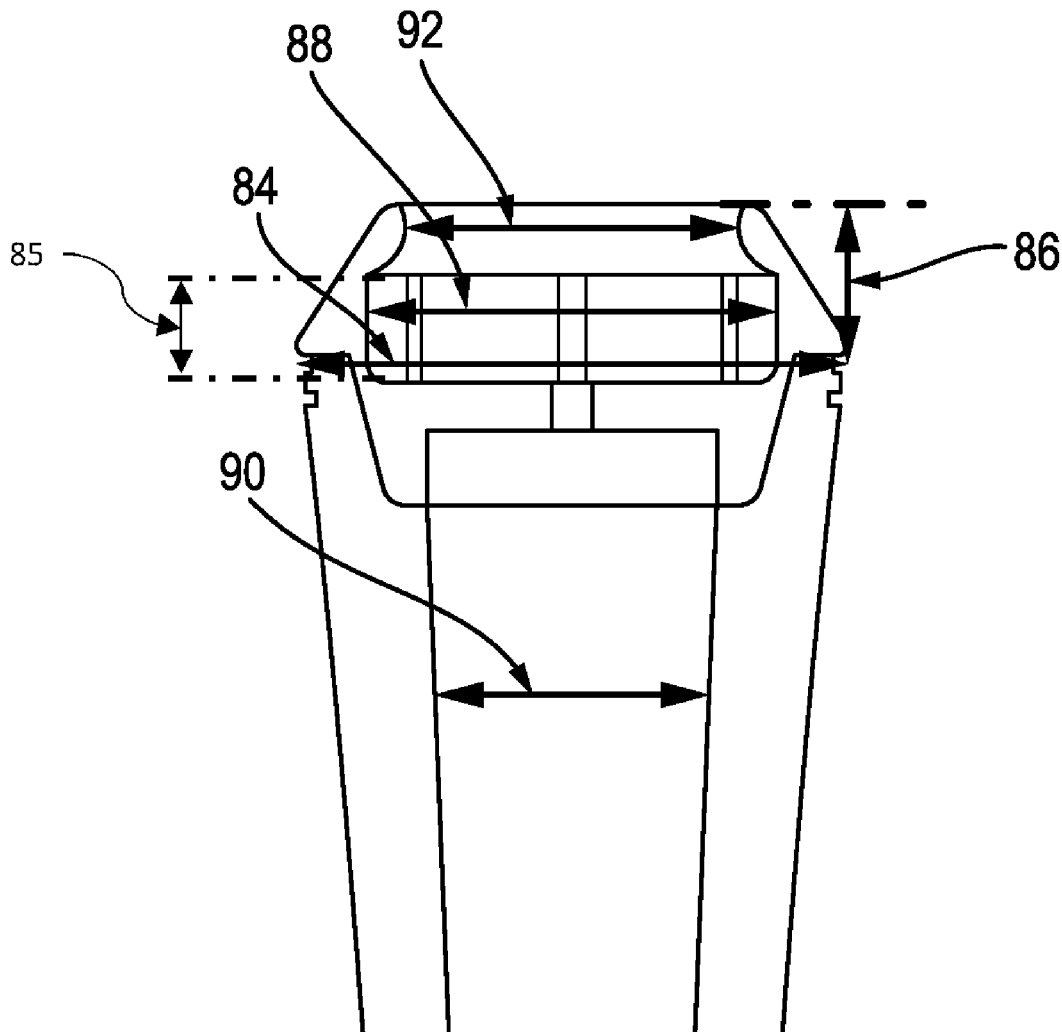
(57)

ABSTRACT(21) Appl. No.: **17/578,042**(22) Filed: **Jan. 18, 2022****Related U.S. Application Data**

(60) Provisional application No. 63/138,729, filed on Jan. 18, 2021.

Publication Classification(51) **Int. Cl.***A63B 53/14* (2006.01)*A63B 60/16* (2006.01)*A63B 60/46* (2006.01)

Embodiments of a golf club grip configured to house a sensor are described herein. The golf club grip comprises a grip body and an end cap configured to house a sensor. The grip body defines a gripping surface where the golfer is encouraged to grip the body at a point that does not interact with the endcap. The end cap is integrally formed or otherwise secured to the grip body. The end cap comprises an upper portion having a first cavity that receives the sensor. The upper portion is tapered to define a non-gripping surface that guides a golfer's grip toward the gripping surface without interacting or having the endcap interfere with this grip thereby providing a more stable and repeatable grip and/or swing. The end cap further comprises a lower portion configured to couple with the grip body.

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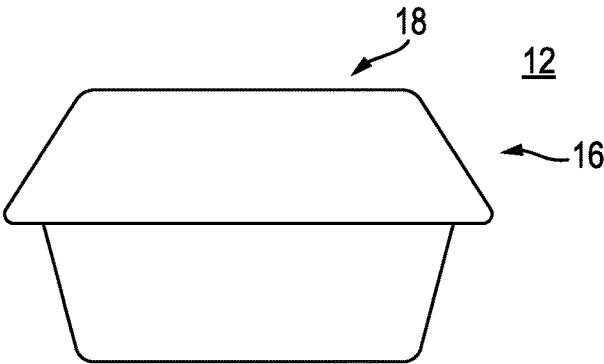


FIG. 1

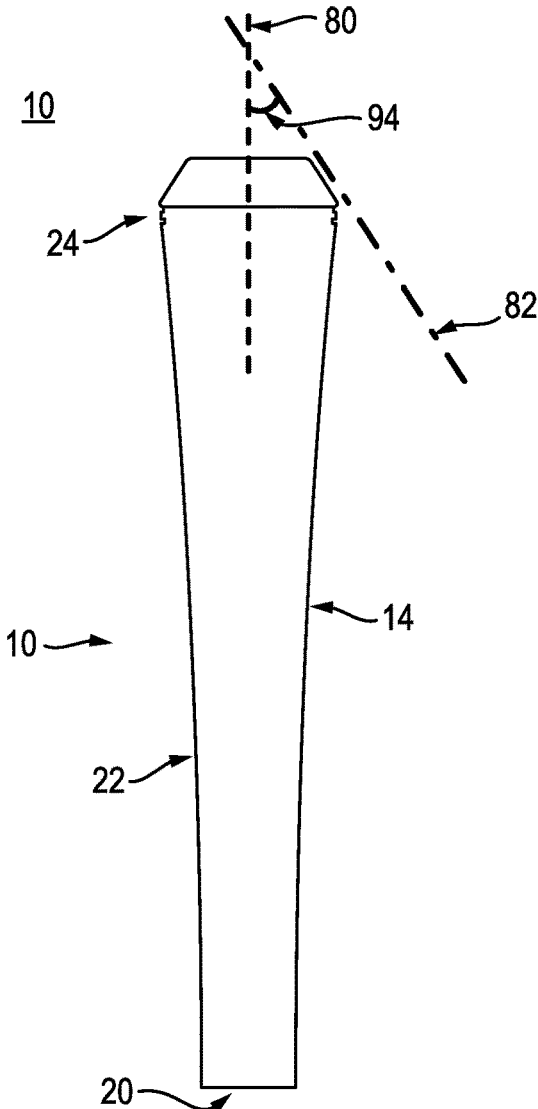


FIG. 2

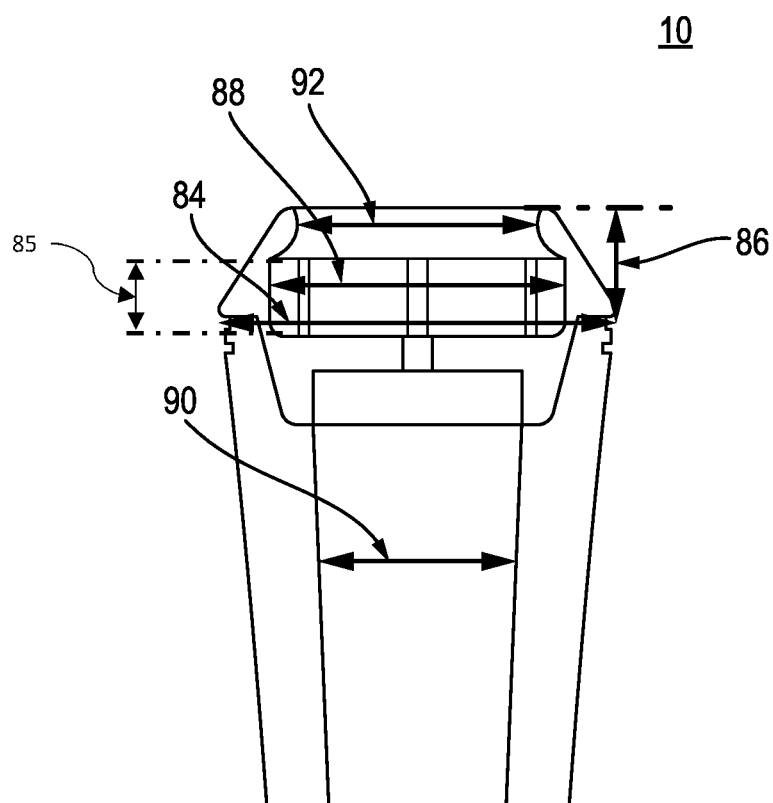


FIG. 3

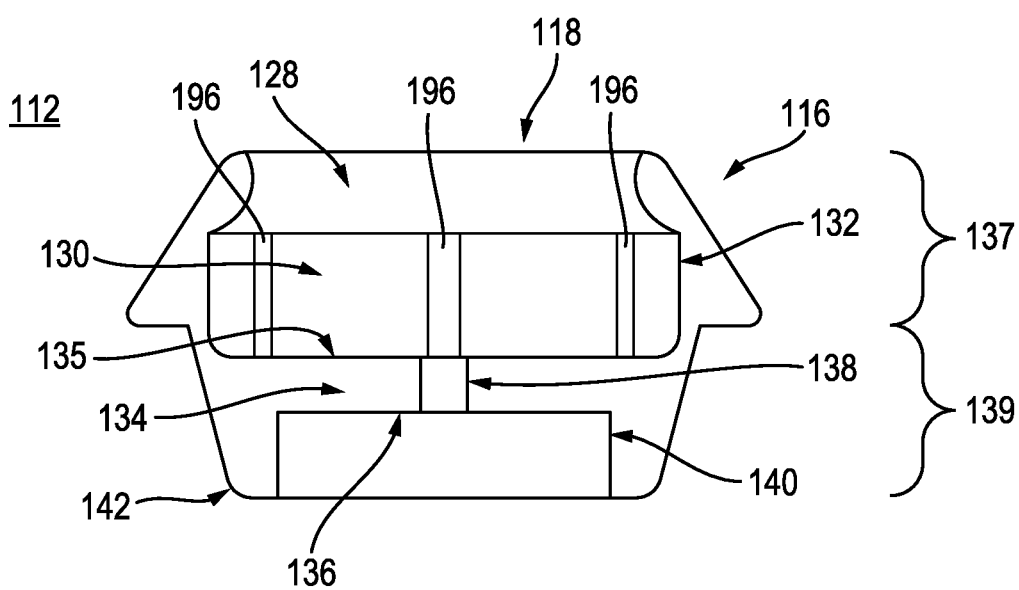


FIG. 4

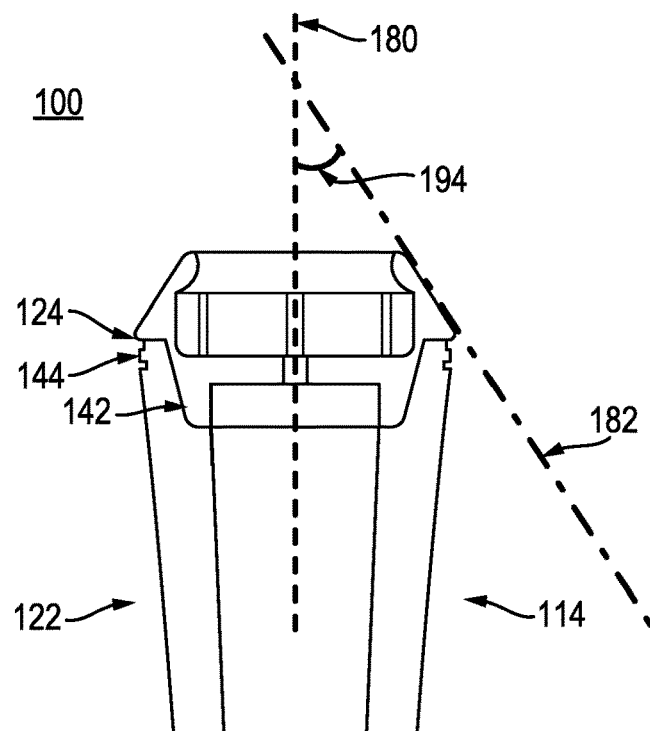


FIG. 5

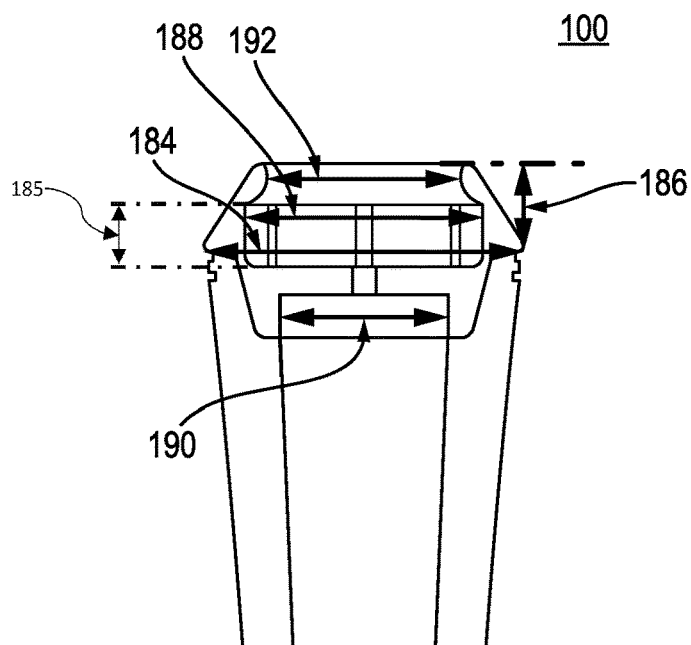


FIG. 6

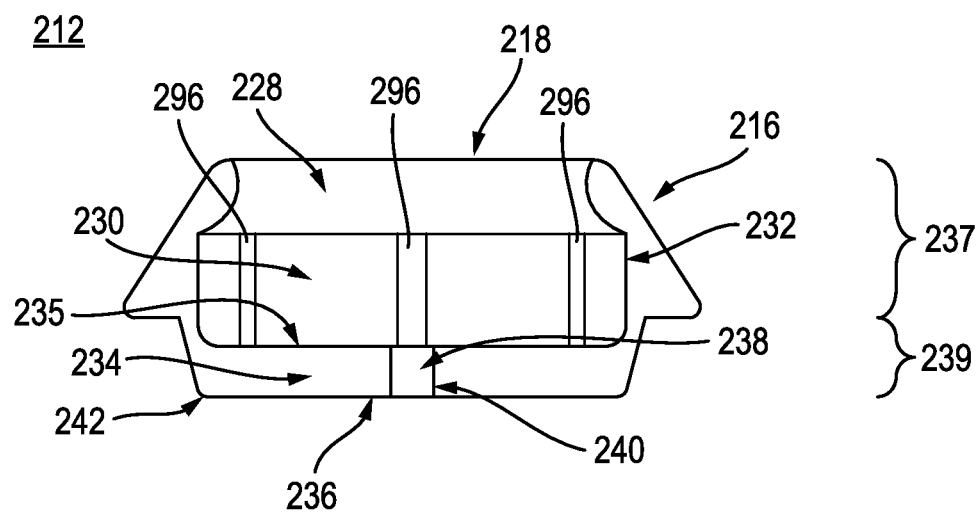


FIG. 7

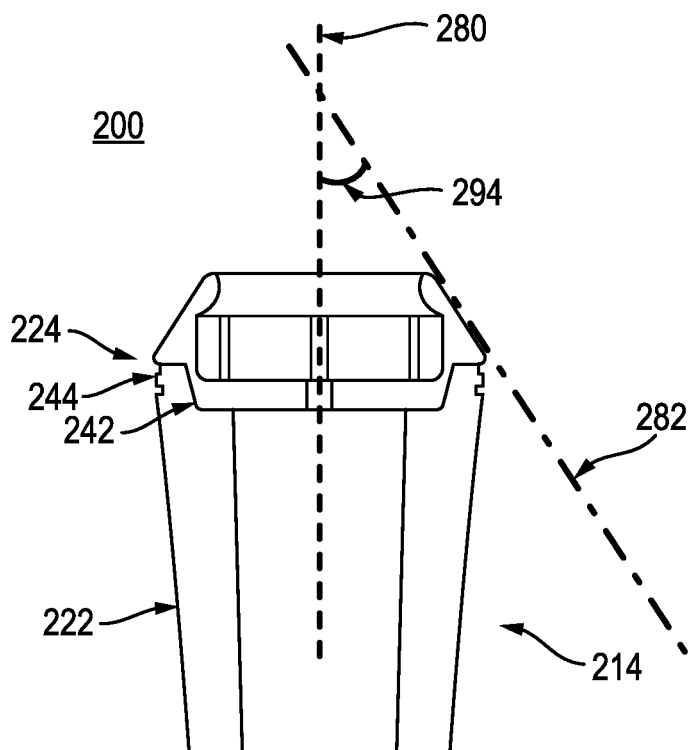


FIG. 8

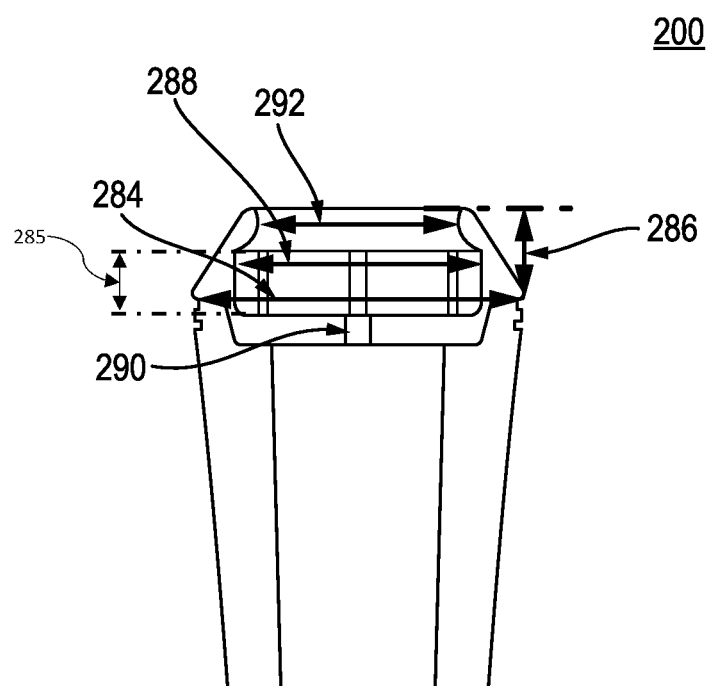


FIG. 9

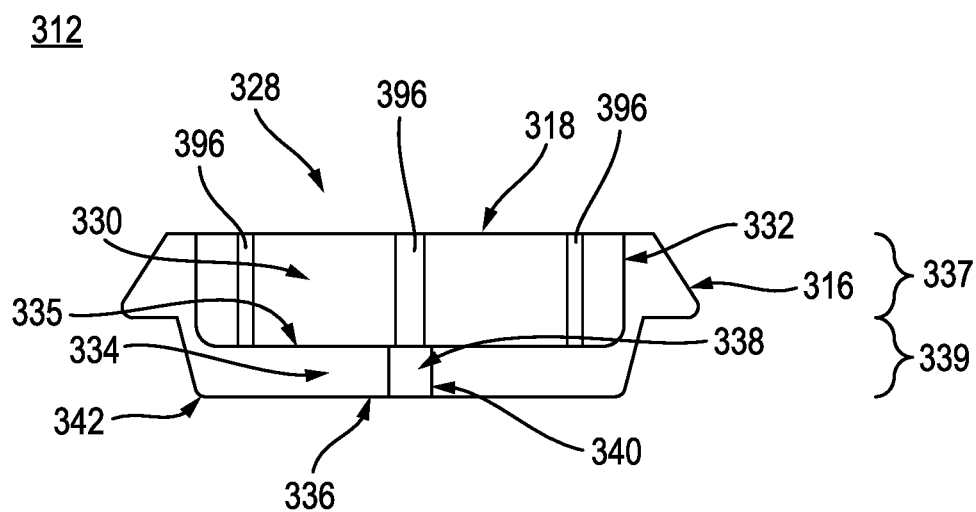


FIG. 10

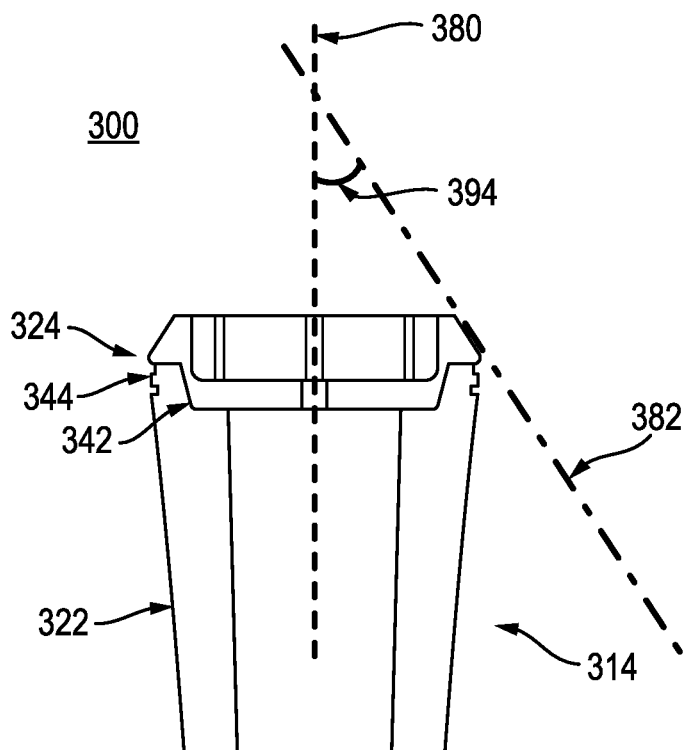


FIG. 11

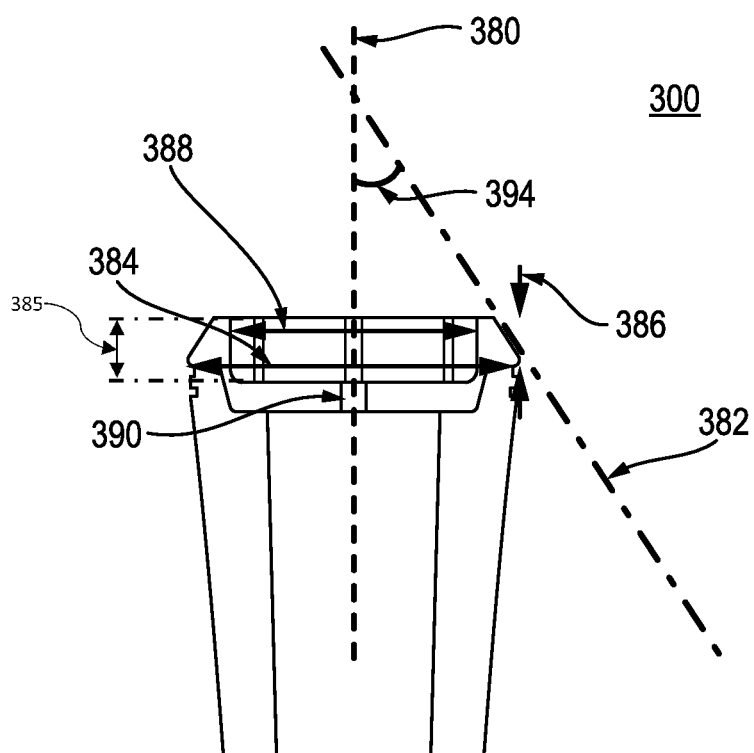


FIG. 12

TAPERED GRIP FOR SENSORS

CROSS REFERENCE PRIORITIES

[0001] This claims the benefit of U.S. Provisional Application No. 63/138,729, filed Jan. 18, 2021, the contents of which are fully incorporated herein by reference.

TECHNICAL FIELD

[0002] This disclosure relates generally to golf clubs and relates more particularly to golf club grips having embedded end caps to have sensors for such measurements as swing speeds and distance of shots.

BACKGROUND

[0003] Golf clubs can be equipped with a sensor that records a golfer's shots and can pair with a smartphone app where the shot data can be viewed. Several methods have been developed to secure the sensor to a golf club. Some sensors can be secured directly to the grip. For example, sensors can be screwed into the butt end of a grip. Other sensors can be embedded within the grip and require a separate component of the grip, such as an end cap, to house the sensor. In most grips, the shaft is a rigid body that extends through the grip body and terminates within the end cap. In most embodiments, an end cap is an unsupported extension of the grip because the shaft does not extend through the end cap. Since the end cap is unsupported, the grip feels unstable to golfers who prefer to hold the grip near the end. This instability can be distracting to a golfer during a swing and can provide inaccurate feedback from shots. Overall, the execution of shots or gripping of the club feel unstable to the average golfer.

[0004] Most grips taper such that the largest diameter is at the butt end, and the smallest diameter is near the tip end. Since the grip forms one smooth continuous shape, the golfer will naturally grip the club near the butt end where the sensor sits. The current end cap geometry does not prevent golfers from gripping near the sensor. Therefore, there is a need in the art for a grip that prevents a golfer from gripping near the end and guides the golfer to a stable grip region even when the grip comprises an end cap.

BRIEF DESCRIPTION OF THE DRAWINGS

[0005] To facilitate further description of the embodiments, the following drawings are provided in which:

[0006] FIG. 1 illustrates a perspective view of a tapered end cap.

[0007] FIG. 2 illustrates a perspective view of a grip with a tapered end cap.

[0008] FIG. 3 illustrates a perspective cross-sectional view of grip with a tapered end cap.

[0009] FIG. 4 illustrates a perspective cross-sectional view of an embodiment of an end cap.

[0010] FIG. 5 illustrates a perspective cross-sectional view of grip with the end cap of FIG. 4.

[0011] FIG. 6 illustrates the dimensions of a perspective cross-sectional view of grip with the end cap of FIG. 4.

[0012] FIG. 7 illustrates a perspective cross-sectional view of an embodiment of an end cap.

[0013] FIG. 8 illustrates a perspective cross-sectional view of grip with the end cap of FIG. 7.

[0014] FIG. 9 illustrates the dimensions of a perspective cross-sectional view of grip with the end cap of FIG. 7.

[0015] FIG. 10 illustrates a perspective cross-sectional view of an embodiment of an end cap.

[0016] FIG. 11 illustrates a perspective cross-sectional view of grip with the end cap of FIG. 10.

[0017] FIG. 12 illustrates the dimensions of a perspective cross-sectional view of grip with the end cap of FIG. 10.

DEFINITIONS

[0018] The invention described herein is a grip having a grip body and an end cap that houses a sensor. The end cap described herein is designed to address these instability issues that extend from the grip. For example, the end cap is tapered to define a non-gripping surface. The non-gripping surface creates a gap between the golfer's hands and the butt end of the grip to create a surface that is uncomfortable for a golfer to hold. The non-gripping surface guides a golfer's grip toward the grip body, where the golfer is encouraged to grip. The grip body provides a more structured contact point between the golfers' hands and the golf club grip. In some embodiments, the end cap includes flanges to further address instability issues. The flanges can comprise a corresponding geometry to a set of receiving arms located on the grip body. The flanges can be received within the receiving arms to secure the end cap to the grip. The end cap described herein addresses instability issues to provide a more stable and repeatable grip and/or swing.

[0019] "Flanges" as used herein describes the lower tapered region of the endcap.

[0020] "Longitudinal axis" as used herein is an axis defined by the shaft. The longitudinal axis runs from a geometric center of the bottom end of the shaft to a geometric center of the top end of the shaft.

[0021] "Tangent plane" as used herein is a plane defined by the end cap. The tangent plane is bound by an outer surface of the upper portion that extends from the maximum outer diameter to the grip butt end.

[0022] "Taper" as used herein is a reduction of thickness toward one end.

[0023] For simplicity and clarity of illustration, the drawings illustrate the general manner of construction, and descriptions and details of well-known features and techniques may be omitted to avoid unnecessarily obscuring the invention. Additionally, elements in the drawing are not necessarily drawn to scale. For example, the dimensions of some of the elements in the drawings may be exaggerated relative to other elements to help improve understanding of embodiments of the present invention. The same reference numerals in different drawings denote the same elements.

[0024] The terms "first," "second," and the like in the description and in the claims, if any, are used for distinguishing between similar elements and not necessarily for describing a particular sequential or chronological order. It is to be understood that the terms so used are interchangeable under appropriate circumstances such that the embodiments described herein are, for example, capable of operation in sequences other than those illustrated or otherwise described herein. Furthermore, the terms "include," and "have," and any variations thereof, are intended to cover a non-exclusive inclusion, such that a process, method, system, article, device, or apparatus that comprises a list of elements is not necessarily limited to those elements but may include other elements not expressly listed or inherent to such process, method, system, article, device, or apparatus.

[0025] The terms “top,” “over,” “upper,” “lower,” “inner,” “outer,” “maximum,” “taper,” “chamfer,” and the like in the description and in the claims, if any, are used for descriptive purposes and not necessarily for describing permanent relative positions. It is to be understood that the terms so used are interchangeable under appropriate circumstances such that the embodiments of the invention described herein are, for example, capable of operation in other orientations than those illustrated or otherwise described herein.

[0026] The terms “couple,” “coupled,” “couples,” “coupling,” and the like should be broadly understood and refer to connecting two or more elements or signals, electrically, mechanically and/or otherwise.

DESCRIPTION

[0027] The invention described herein is an embodiment of a grip comprising a grip body and a tapered end cap. The grip body defines a gripping surface, which is the lower portion of the grip where the golfer can grip without interfering with the end cap. The tapered end cap is located near the end of the grip body and houses a sensor. In some embodiments, the sensor is press-fit into a cavity and held into place by the end cap. In some embodiments, the sensor is secured within the cavity with an epoxy material. The end cap is designed to improve stability within the grip. The end cap is tapered to define a non-gripping surface, which prevents the golfer from gripping near the unsupported end cap. Further, the end cap comprises flanges that couple with receiving arms on the grip body to form a secure connection. The non-gripping surface and flange connection form a sturdy grip that prevents the golfer from holding the grip near the end cap.

[0028] A golf club described herein comprises a club head, a shaft, and a grip. The shaft comprises a rigid body having a top end and a bottom end. Referring to FIGS. 1 and 2, the grip 10 comprises a butt end 18 and a tip end 20 opposite the butt end 18. The grip 10 further comprises a grip body 22 and an end cap 12 near the butt end 18. The grip body 22 comprises a first end 24 near the grip butt end 18, and a second end 26 near the grip tip end 20. The grip body 22 defines the gripping surface 14 between the first end 24 and the second end 26. In one embodiment referring to FIG. 5, the grip body 122 further comprises receiving arms 144 that extend from the first end 124 towards the grip butt end 118. The receiving arms 144 form the outer circumference of a connection between the grip body 122 and the end cap 112. The grip body 22 and the end cap 12 are integrally formed, or otherwise secured together to form the grip 10.

[0029] Referring to FIG. 2, the grip body 22 defines the gripping surface 14, or an area that provides the golfer feedback from each shot. The grip body 22 further comprises an outer surface made up of both the gripping surface 14 and the non-gripping surface 16 that extends from the tip end 20 to the butt end 18. The grip body 22 further defines a cross-sectional area, defined within a boundary of the outer surface, and measured in a plane orthogonal to the longitudinal axis 80. The grip body 22 tapers such that the grip body 22 can be largest at the first end 24, or the end cap 12 referring to FIG. 3, maximum outer diameter 84, and the cross-sectional area decreases toward the second end 26. As a result of the taper of the non-gripping surface 16, the golfer will naturally grip lower on the grip body 22 preventing the golfer from gripping any unstable portion of the grip 10. Since the grip 10 is flexible, the dimensions of the grip 10

can vary slightly when the grip is mounted onto a shaft. The size of the shaft can also affect the mounted the grip 10 dimensions. The grip 10 cross-sectional area, and length can be measured when the grip 10 is mounted on the shaft.

[0030] The grip 10 defines a length, measured along the longitudinal axis 86 from the butt end 18 to the tip end 20. The grip length is between 9.5 inches and 11.5 inches. In some embodiments, the grip length is 9.5 inches, 9.75 inches, 10 inches, 10.25 inches, 10.5 inches, 10.75 inches, 11 inches, 11.25 inches, or 11.5 inches. The end cap 12 increases the length of the grip 10, making the grip 10 longer than a grip without a sensor. In one embodiment, the end cap 12 extends the grip length 0.25 inches. Different embodiments of the end cap 12 comprise different geometries and components.

[0031] Referring to FIG. 5, the end cap 112 is formed near the grip body first end 124. Referring to FIG. 4, the end cap 112 comprises an upper portion 137, a lower portion 139, and a floor wall 134. The upper portion 137 is near the grip butt end 118, and the lower portion 139 is proximate to the grip body 122. The floor wall 134 comprises an upper surface 135 and a lower surface 136, wherein the upper surface 135 is proximate the upper portion 137, and the lower surface 136 is proximate the lower portion 139. The floor wall 134 defines a boundary between the upper portion 137 and the lower portion 139. The upper portion 137 houses the sensor, and the lower portion 139 houses the top end of the shaft.

[0032] The upper portion 137 comprises the upper surface 135, and a first circumferential wall 132, as illustrated in FIG. 4. The upper surface 135 is recessed into the upper portion 137 via the first circumferential wall 132 to form a first cavity 130 that harbors a sensor.

[0033] Referring to FIG. 6, the first cavity 130 defines a diameter 188, measured in a plane orthogonal to the longitudinal axis 180. The first cavity diameter 188 is between 0.60 inch and 1.00 inch. In some embodiments, the first cavity diameter 188 is 0.60 inch, 0.65 inch, 0.70 inch, 0.75 inch, 0.80 inch, 0.85 inch, 0.90 inch, 0.95 inch or 1.00 inch. The dimensions of the first cavity 130 are selected to accommodate the sensor.

[0034] Referring again to FIG. 6, the first cavity 130 further defines a height 185 measured along the longitudinal axis 180. The first cavity height 185 is between 0.3 inch and 0.4 inch. In some embodiments, the first cavity height 185 is approximately 0.3 inch, approximately 0.31 inch, approximately 0.32 inch, approximately 0.33 inch, approximately 0.34 inch, approximately 0.35 inch, approximately 0.36 inch, approximately 0.37 inch, approximately 0.38 inch, approximately 0.39 inch, or approximately 0.4 inch. In one exemplary embodiment, the first cavity height 185 is 0.365 inch to accommodate a specific sensor. The dimensions of the first cavity 130 are selected to accommodate the sensor.

[0035] The upper portion 137 further comprises a lip 128 at the perimeter of the first cavity 130, as illustrated in FIG. 4. The lip 128 defines a lip diameter 192 that can be smaller than the first cavity diameter 188. The sensor can be press-fit into the first cavity 130, secured by the first circumferential wall 132, and pinched within the first cavity 130 by the lip 128. In some embodiments, the sensor is further secured within the first cavity 130 with an epoxy material. The epoxy material requires a design to aid in securing of the sensor.

[0036] Referring to FIG. 4, in some embodiments, the upper portion 137 further defines a plurality of depressions

196 that radiate outwardly from a center of the upper surface 135 and up the first cavity wall 132. The plurality of depressions 196 allow epoxy to flow around the sensor to increase the bonding surface area between the sensor and the upper surface 135. Further, the plurality of depressions 196 can alleviate pressure that builds up during installation from air and grip adhesive. The upper portion 137 serves to house the sensor, while the lower portion 139 receives the shaft.

[0037] Referring to FIG. 4, the upper portion 137 further defines a non-gripping surface 116 that prevents the golfer from gripping on the end cap 112. The non-gripping surface 116 is a tapered region of the end cap 112 that interrupts the grip outer surface and prompts the golfer to grip within the gripping region. The non-gripping surface 116 can be tapered, rounded, chamfered, or reshaped in any suitable manner. The non-gripping surface 116 further secures the sensor within the first cavity by pinching it into place.

[0038] Referring to FIG. 5, the non-gripping surface 116 defines a taper angle 194. The tangent plane 182 intersects the longitudinal axis 180 at a point beyond the grip butt end 118. The taper angle 194, is measured between the longitudinal axis 180 and the tangent plane 182. The taper angle 194 is between 15 degrees and 80 degrees. In some embodiments, the taper angle 194 is between 15 degrees to 20 degrees, 20 degrees to 25 degrees, 25 degrees to 30 degrees, 30 degrees to 35 degrees, or 35 degrees to 40 degrees. In alternate embodiments, the taper angle 194 is between 10 degrees to 40 degrees. The taper angle 194 is between 40 degrees to 50 degrees. In some embodiments the taper angle 194 is approximately 40 degrees, approximately 41 degrees, approximately 42 degrees, approximately 43 degrees, approximately 44 degrees, approximately 45 degrees, approximately 46 degrees, approximately 47 degrees, approximately 48 degrees, approximately 49 degrees, or approximately 50 degrees. In some embodiments, the taper angle 94 is between 65-80 degrees. In some embodiments, the taper angle 194 is between 65 degrees and 70 degrees, between 70 degrees and 75 degrees, or between 75 degrees and 80 degrees. In one exemplary embodiment, the taper angle 194 is 30 degrees. The upper portion 137 defines the non-gripping surface 116, while the lower portion 139 secures the end cap 112 to the grip body 122.

[0039] Referring again to FIG. 4, the lower portion 139 comprises the lower surface 136, and a second circumferential wall 140. The lower surface 136 is recessed into the lower portion 139 via the second circumferential 140 wall to form a second cavity 138. The shaft extends through the grip body 122 into the second cavity 138. The second cavity diameter 190 can be consistent throughout to form a tight connection with the shaft. The second cavity 138 and the second circumferential wall 140 provide structural rigidity between the shaft and then end cap. This structural rigidity prevents the end cap from moving, thus providing the golfer with a more stable grip 100. The connection between the end cap 112 and the grip body 122 provides another aspect of structural rigidity to the grip 100.

[0040] The first cavity 130 and the second cavity 138 are formed along the longitudinal axis 180. The first cavity 130 is exposed near the grip butt end 118 such that the sensor is visible when viewing the grip butt end 118 in a plane orthogonal to the longitudinal axis 180. The second cavity 138 is below the first cavity 130 and receives the shaft. To accommodate the sensor, the diameter of the first cavity 130 is greater than the diameter of the second cavity 138. In

some embodiments, the first cavity 130 is within the upper portion 137. In other embodiments, the first cavity 130 is within the upper portion 137 and a section of the lower portion 139. The upper and lower portions 137, 139 are generally separated near a middle of the end cap 112.

[0041] The lower portion 139 of the end cap 112, further comprises one or more flanges 142 near the grip body first end 126, as illustrated in FIG. 4. The one or more flanges 142 comprise a geometry that corresponds to the geometry of the receiving arms 144 of the grip 100. The corresponding geometries allow the flanges 142 of the end cap 112, to couple with or be received by the receiving arms 144, of the grip 100 to form a tight connection between the end cap 112 and the grip body 122. The receiving arms 144 form the outer circumference of the grip body 122 and the end cap 112 connection. The flanges 142 anchor the end cap 112 to the grip body 122. Further, the flanges 142 circumscribe the second cavity 138. The grip 100 comprises both the end cap 112 and the grip body 122. The connection made between the end cap 112 and the grip body via the flanges 142 of the end cap 112 and the receiving arms 144 of the grip body 122. This connection solidifies the grip 100 and the end cap 112 biases the golfer to grip slightly lower on the grip 100 as to ensure a stable point of contact with the grip 100.

[0042] Referring to FIG. 6, the end cap 112 defines a maximum outer diameter 184. In some embodiments, the maximum outer diameter 184 is located near the floor wall 134 and further defines the boundary between the upper portion and the lower portion. The maximum outer diameter 184 is offset 186 at a vertical distance of between 0.20 inch to 0.80 inch from the grip butt end 118. In some embodiments, the offset 186 is approximately 0.20 inch, 0.25 inch, 0.30 inch, 0.35 inch, 0.40 inch, 0.45 inch, 0.50 inch, 0.55 inch, 0.60 inch, 0.65 inch, 0.70 inch, 0.75 inch, or 0.80 inch. From the maximum outer diameter 184, the grip 100 tapers to a smaller outer diameter towards the grip tip end 120. The taper of the end cap 112 creates a bias for the golfer to grip slightly lower on the grip 100 as to ensure a stable point of contact with the grip 100.

[0043] The hardness of the end cap 12 material is measured using the Shore A Hardness Scale and is between 50 to 100. In some embodiments, the Shore A hardness is between 50 to 60, 60 to 70, 70 to 80, 80 to 90, or 90 to 100. The end cap 12 is formed from a material that is harder than that of the grip body 22. In one embodiment, the Shore A hardness is 78. The Shore A hardness of the end cap 12 helps protect the sensor and grip butt end 18 since golfers tend to put the grip butt end 18 on various surfaces that could be damaging to the grip butt end 18.

[0044] The grip body 22 is formed from a material with a hardness that is measured using the Shore A Hardness Scale. The grip body 22 has a Shore A hardness between 30 to 60. In some embodiments, the Shore A hardness is between 30 to 40, 40 to 50, or 50 to 60. In one embodiment, the Shore A hardness is 55. The end cap 12 has a higher Shore A hardness than the grip body 22 to compensate for rigidity that is lost near the portion of the end cap 12 that is not supported by the shaft. Additionally, the harder end cap 12 prevents the shaft from penetrating the end cap 12 during installation when the shaft is inserted into the grip body 22.

[0045] FIGS. 7-9 illustrate an alternative embodiment of a grip 200 comprising an end cap 212. The grip 200 is similar to the grip 100 and is described using similar reference numbers. For example, the grip 200 comprises a grip body

222 similar to the grip body 122 of the grip 100. Further, the end cap 212 is similar to the end cap 112 and is also described using similar reference numbers. For example, the end cap 212 comprises a non-gripping surface 216 similar to the non-gripping surface 116 of the end cap 112. The end cap 212 is similar to the end cap 112, however, the end cap 212 does not include flanges. Referring to FIG. 9, the end cap 212 comprises dimensions similar to the dimensions of the end cap 112.

[0046] Referring to FIG. 7, the end cap 212 comprises an upper portion 237, a lower portion 239, and a floor wall 234. The floor wall 234 defines a boundary between the upper portion 237 and the lower portion 239. The upper portion 237 houses the sensor, and the lower portion 239 abuts the top end of the shaft. Referring to FIG. 8, the lower portion 239 is received within the grip 200. The end cap 212 differs from the end cap 112 in that the end cap 212 does not include flanges that correspond to receiving arms of the grip 200. Instead, the lower portion 239 is flat and does not define a second cavity that receives the shaft. The end cap 212 does not interfere with the shaft, which allows the grip 200 to be easily installed to the shaft.

[0047] FIGS. 10-12 illustrate an alternative embodiment of a grip 300 comprising an end cap 312. The grip 300 is similar to the grip 100 and is described using similar reference numbers. For example, the grip 300 comprises a grip body 322 similar to the grip body 122 of the grip 100. Further, the end cap 312 is similar to the end cap 112 and is also described using similar reference numbers. For example, the end cap 312 comprises a non-gripping surface 316 similar to the non-gripping surface 116 of the end cap 112.

[0048] Referring to FIG. 10, the end cap 312 comprises an upper portion 337, a lower portion 339, and a floor wall 334. The floor wall 334 defines a boundary between the upper portion 337 and the lower portion 339. The upper portion 337 houses the sensor, and the lower portion 339 abuts the top end of the shaft. Referring to FIG. 11, the lower portion 339 is received within the grip 300, similar to the end cap 212 shown in FIG. 8. The end cap 312 differs from the end cap 112 in that the end cap 312 does not include flanges that correspond to receiving arms of the grip 300. Instead, the lower portion 339 is flat and does not define a second cavity that receives the shaft. Similar to the end cap 212, the end cap 312 does not interfere with the shaft, which allows the grip 300 to be easily installed to the shaft.

[0049] The end cap 312 differs from the end caps 112 and 212 in that the end cap lacks a lip near the first cavity 330. Referring to FIGS. 4 and 7, the end caps 112 and 212 both comprise a lip 128, 228 that pinches the sensor into the first cavity 130, 230. The end cap 312, however, lacks the lip and instead, secures the sensor through other forms of coupling. For example, the sensor can be secured within the cavity 330 via a screw or an adhesive. The removal of the lip from the end cap 312 allows the sensor to be placed within the cavity 330 without the use of a tool. Referring to FIG. 12, the first cavity 330 comprises a constant diameter.

Method

[0050] The method of manufacturing the golf club grip described herein can comprise (1) forming an end cap, (2) forming a grip body, (3) securing the end cap to the grip body (4) inserting a shaft into the grip body and/or a second cavity, (5) securing a sensor within a first cavity. In step 1, the end cap comprises an upper portion and a lower portion. The upper portion includes a first cavity configured to house a sensor. The first cavity further comprises depressions designed for adhesive to flow around the sensor. The lower

portion comprises flanges configured to couple with the grip body. The lower portion further comprises a second cavity configured to receive a shaft. In step 2, the grip body comprises a gripping surface and receiving arms. Wherein the gripping surface has a taper. The receiving arms are designed to complement the flanges of the end cap and provide a form of coupling between the two components. In steps 1 and 2, the end cap and grip body can both be molded. In step 3, the end cap and the grip body can be secured via the one or more flanges and the one or more receiving arms. In step 4 the shaft is inserted into the grip body and in some embodiments is also inserted into the second cavity. In step 5, the sensor can be secured within the first cavity with an adhesive, such as epoxy, or through a mechanical means, such as press-fitting. The depressions allow the adhesive to flow around the sensor increasing the surface area for adhesion.

EXAMPLES

I. Example 1: Player Test

[0051] A player test was conducted to compare the feel of two golf clubs having different grips. The golf clubs were similar but for the difference in the grip end cap constructions. The results compared the effect of the different end caps on player satisfaction and performance.

[0052] The first golf club comprised a grip (hereafter referred to as the “control grip”) having a traditional, non-tapered end cap. The second golf club comprised a grip (hereafter referred to as the “exemplary grip”) similar to the grip shown in FIG. 2. The exemplary grip comprised a tapered end cap that defined a non-gripping surface. The grips were similar but for the difference in the end cap geometries. The player test was conducted to compare the feel of the tapered end cap of the exemplary grip versus the non-tapered end cap of the control grip.

[0053] The player test involved fifteen players who participated in a survey that compared their experiences with the exemplary grip and the control aid devoid of a tapered end cap. The players tested each club head under similar conditions, where the golf club heads included similar shaft lengths and similar loft angles. Further, the player test was conducted on a typical surface.

[0054] After testing, the participants rated the grip performance and satisfaction based several parameters including their comfort and overall performance with the different grips. The grips were given a rating of between 1 to 5 for each of these parameters. A rating of 1 represented the lowest level of satisfaction, and a rating of 5 represented the highest level of satisfaction. The ratings in each category were averaged over the 15 participants.

TABLE 1

	Control Grip	Exemplary Grip
Grip Stability	3.59	4.06
Grip Contour	3.53	3.82
Hand Positioning	3.50	3.81
Overall Satisfaction	3.21	3.71

[0055] The results of the player test are illustrated in Table 1 above. First, the players were asked, “How satisfied are you with the stability of the grip end in your hands during your swing?” The exemplary grip scored higher at a 4.06 than the control grip, which scored a 3.59. Of the surveyed players, 86% indicated they were “very satisfied,” or “sat-

isfied” with how secure the exemplary grip felt. One player commented that his hands tended to slip off the wobbly control grip. Next, the players were asked, “How satisfied are you with the contour of the grip?” The exemplary grip again scored higher at a 3.82 than the control grip which scored a 3.53. Of the surveyed players, 73% indicated they were “very satisfied,” or “satisfied” by the natural feel of the contour. The players observed that the chamfer was very noticeable and helped naturally guide their hands to the gripping region. The players were then asked, “How satisfied are you with the ability to position your hands on the grip in the same position that you typically would on a grip without a measurement technology?” The exemplary grip again scored higher at a 3.81 than the control grip, scoring a 3.50. Of the surveyed players, 71% indicated they were “very satisfied,” or “satisfied” with how similar their grip felt to their normal grip when using the exemplary grip. When the players were asked to rate their overall satisfaction, the exemplary grip scored higher at a 3.71 than the control grip, only scoring a 3.21. Some players observed that the control grip felt heavier and longer than the exemplary grip. The survey concluded that most of the players had a better experience using the exemplary grip.

[0056] The tapered end cap provides advantages that are an improvement over the art. Removing material from the end cap upper portion (i.e. forming a chamfer or taper in the end cap) encourages the golfer to grip near the stable portion of the grip body. Additionally, the sensor is protected since the golfer is not leveraging against the flexible sensor housing. Based on the survey that was conducted, the tapered end cap can improve stability for players who grip near the end of a grip.

CLAUSES

[0057] Clause 1. A golf club comprising a club head, a shaft, and a grip; wherein the grip comprises: a butt end, a tip end, a grip body, and an end cap; wherein the grip body comprises a first end, a second end, and one or more receiving arms; wherein the first end is opposite the second end, the first end is proximate to the butt end, and the second end is proximate to the tip end; wherein the receiving arms are formed near the first end; wherein the end cap comprises an upper portion, a lower portion, a floor wall, and an outer diameter; wherein the floor wall comprises an upper surface, proximate to the upper portion, and a lower surface, proximate to the lower portion; wherein the floor wall defines a boundary between the upper portion and the lower portion; wherein the upper portion comprises a first circumferential wall, the upper surface, a non-gripping surface, and a lip; wherein the upper surface is recessed into the upper portion via the first circumferential wall to form a first cavity that harbors a sensor; wherein the lower portion comprises a second circumferential wall, the lower surface, and one or more flanges, wherein the lower surface is recessed into the lower portion via the second circumferential wall to form a second cavity; wherein the one or more flanges are received within the one or more receiving arms to form a connection between the end cap and the grip body.

[0058] Clause 2. The golf club of clause 1, wherein the one or more receiving arms and the one or more flanges have complimentary geometries that form a tight connection to secure the end cap to the grip body.

[0059] Clause 3. The golf club of clause 1, wherein the one or more receiving arms can be 1 receiving arm, 2 receiving arms, 3 receiving arms, 4 receiving arms, or any suitable number of receiving arms.

[0060] Clause 4. The golf club of clause 1, wherein the one or more flanges can be 1 flange, 2 flanges, 3 flanges, 4 flanges, or any suitable number of flanges.

[0061] Clause 5. The golf club of clause 1, wherein a maximum outer diameter of the end cap further defines the boundary between the upper portion and the lower portion.

[0062] Clause 6. The golf club of clause 1, wherein a surface between the first end and the second end defines a gripping surface, and a non-gripping surface is defined by the end cap.

[0063] Clause 7. The golf club of clause 1, wherein the receiving arms form an outer circumference of the connection between the end cap and the grip body.

[0064] Clause 8. The golf club of clause 1, wherein the sensor is secured with an adhesive, or through a mechanical means, such as press-fitting.

[0065] Clause 9. The golf club of clause 1, wherein the grip body and the end cap are formed integrally, secured together with an adhesive, or otherwise connected to form the grip.

[0066] Clause 10. The golf club of clause 1, wherein: the first cavity comprises a first cavity diameter; and the lip is above the first cavity, and the lip comprises a lip diameter smaller than the first cavity diameter to secure the sensor in place.

[0067] Clause 11. The golf club of clause 1, wherein the upper surface comprises a plurality of depressions to allow an adhesive to flow around the sensor.

[0068] Clause 12. The golf club of clause 11, wherein the depressions radiate outward from a center of the upper surface.

[0069] Clause 13. The golf club of clause 1, wherein the non-gripping surface can be tapered, rounded, chamfered, or otherwise reshaped.

[0070] Clause 14. The golf club of clause 1, wherein the grip has a longitudinal axis through a geometric center of the grip; wherein the non-gripping surface defines a tangent plane and a taper angle that is measured between the longitudinal axis and the tangent plane, and the taper angle is between 15 degrees and 80 degrees.

[0071] Clause 15. The golf club of clause 1, wherein the end cap has a greater Shore A hardness than the grip body.

[0072] Clause 16. The golf club of clause 1, wherein the grip has a longitudinal axis through a geometric center of the grip; wherein the first cavity defines a cavity height measured along the longitudinal axis, and wherein the cavity height is between 0.3 inches and 0.4 inches.

[0073] Clause 17. The golf club of clause 1, wherein the sensor is harbored within the upper portion of the end cap.

[0074] Clause 18. The golf club of clause 1, wherein the end cap further defines a maximum outer diameter, wherein the maximum outer diameter is offset from the butt end of the grip by distance between 0.2 inch to 0.8 inch, and the non-gripping surface has a taper from the maximum outer diameter to a smaller outer diameter toward the butt end.

[0075] Clause 19. A method of manufacturing a grip comprising: forming an end cap, the end cap comprising an upper portion having a plurality of depressions, and a lower portion comprising one or more flanges; forming a grip body, the grip body comprising a first end, a second end, and

one or more receiving arms, proximate to the first end; coupling the one or more flanges with the one or more receiving arms to form a secure connection between the end cap and the grip body; inserting a shaft into the grip body and the lower portion of the end cap; securing a sensor within the upper portion; and wherein the sensor is secured with an adhesive, or through a mechanical means, such as press-fitting.

[0076] Clause 20. The method of manufacturing of the grip of clause 19, wherein the sensor securing step further comprises allowing the adhesive to flow around the sensor via the plurality of depressions.

[0077] Clause 21. A golf club grip comprising: a butt end, a tip end, a grip body, and an end cap; wherein the grip body comprises a first end, a second end, and one or more receiving arms; wherein the first end is opposite the second end, the first end is proximate to the butt end, and the second end is proximate to the tip end; wherein the receiving arms are formed near the first end; wherein the end cap comprises an upper portion, a lower portion, a floor wall, and an outer diameter; wherein the floor wall comprises an upper surface, proximate to the upper portion, and a lower surface, proximate to the lower portion; wherein the floor wall defines a boundary between the upper portion and the lower portion; wherein the upper portion comprises a first circumferential wall, the upper surface, a non-gripping surface, and a lip; wherein the upper surface is recessed into the upper portion via the first circumferential wall to form a first cavity that harbors a sensor; wherein the lower portion comprises a second circumferential wall, the lower surface, and one or more flanges, wherein the lower surface is recessed into the lower portion via the second circumferential wall to form a second cavity; wherein the one or more flanges are received within the one or more receiving arms to form a connection between the end cap and the grip body.

[0078] Clause 22. The golf club grip of clause 21, wherein the one or more receiving arms and the one or more flanges have complimentary geometries that form a tight connection to secure the end cap to the grip body.

[0079] Clause 23. The golf club grip of clause 21, wherein the one or more receiving arms can be 1 receiving arm, 2 receiving arms, 3 receiving arms, 4 receiving arms, or any suitable number of receiving arms.

[0080] Clause 24. The golf club grip of clause 21, wherein the one or more flanges can be 1 flange, 2 flanges, 3 flanges, 4 flanges, or any suitable number of flanges.

[0081] Clause 25. The golf club grip of clause 21, wherein a maximum outer diameter of the end cap further defines the boundary between the upper portion and the lower portion.

[0082] Clause 26. The golf club grip of clause 21, wherein a surface between the first end and the second end defines a gripping surface, and a non-gripping surface is defined by the end cap.

[0083] Clause 27. The golf club grip of clause 21, wherein the receiving arms form an outer circumference of the connection between the end cap and the grip body.

[0084] Clause 28. The golf club grip of clause 21, wherein the sensor is secured with an adhesive, or through a mechanical means, such as press-fitting.

[0085] Clause 29. The golf club grip of clause 21, wherein the grip body and the end cap are formed integrally, secured together with an adhesive, or otherwise connected to form the grip.

[0086] Clause 30. The golf club grip of clause 21, wherein: the first cavity comprises a first cavity diameter; and the lip is above the first cavity, and the lip comprises a lip diameter smaller than the first cavity diameter to secure the sensor in place.

[0087] Clause 31. The golf club grip of clause 21, wherein the upper surface comprises a plurality of depressions to allow an adhesive to flow around the sensor.

[0088] Clause 32. The golf club grip of clause 21, wherein the depressions radiate outward from a center of the upper surface.

[0089] Clause 33. The golf club grip of clause 21, wherein the non-gripping surface can be tapered, rounded, chamfered, or otherwise reshaped.

[0090] Clause 34. The golf club grip of clause 21, wherein the grip has a longitudinal axis through a geometric center of the grip; wherein the non-gripping surface defines a tangent plane and a taper angle that is measured between the longitudinal axis and the tangent plane, and the taper angle is between 15 degrees and 80 degrees.

[0091] Clause 35. The golf club grip of clause 21, wherein the end cap has a greater Shore A hardness than the grip body.

[0092] Clause 36. The golf club grip of clause 21, wherein the grip has a longitudinal axis through a geometric center of the grip; wherein the first cavity defines a cavity height measured along the longitudinal axis, and wherein the cavity height is between 0.3 inches and 0.4 inches.

[0093] Clause 37. The golf club grip of clause 21, wherein the sensor is harbored within the upper portion of the end cap.

[0094] Clause 38. The golf club grip of clause 21, wherein the end cap further defines a maximum outer diameter, wherein the maximum outer diameter is offset from the butt end of the grip by distance between 0.2 inch to 0.8 inch, and the non-gripping surface has a taper from the maximum outer diameter to a smaller outer diameter toward the butt end.

1. A golf club grip comprising:

a butt end, a tip end, a grip body, and an end cap;

wherein the grip body comprises a first end, a second end, and one or more receiving arms;

wherein the first end is opposite the second end, the first end is proximate to the butt end, and the second end is proximate to the tip end;

wherein the receiving arms are formed near the first end;

wherein the end cap comprises an upper portion, a lower portion, a floor wall, and an outer diameter;

wherein the floor wall comprises an upper surface, proximate to the upper portion, and a lower surface, proximate to the lower portion;

wherein the floor wall defines a boundary between the upper portion and the lower portion;

wherein the upper portion comprises a first circumferential wall, the upper surface, a non-gripping surface, and a lip;

wherein the upper surface is recessed into the upper portion via the first circumferential wall to form a first cavity that harbors a sensor;

wherein the lower portion comprises a second circumferential wall, the lower surface, and one or more flanges,

wherein the lower surface is recessed into the lower portion via the second circumferential wall to form a second cavity;

wherein the one or more flanges are received within the one or more receiving arms to form a connection between the end cap and the grip body.

2. The golf club grip of claim 1, wherein the one or more receiving arms and the one or more flanges have complementary geometries that form a tight connection to secure the end cap to the grip body.

3. The golf club grip of claim 1, wherein the one or more receiving arms can be 1 receiving arm, 2 receiving arms, 3 receiving arms, 4 receiving arms, or any suitable number of receiving arms.

4. The golf club grip of claim 1, wherein the one or more flanges can be 1 flange, 2 flanges, 3 flanges, 4 flanges, or any suitable number of flanges.

5. The golf club grip of claim 1, wherein a maximum outer diameter of the end cap further defines the boundary between the upper portion and the lower portion.

6. The golf club grip of claim 1, wherein a surface between the first end and the second end defines a gripping surface, and a non-gripping surface is defined by the end cap.

7. The golf club grip of claim 1, wherein the receiving arms form an outer circumference of the connection between the end cap and the grip body.

8. The golf club grip of claim 1, wherein the sensor is secured with an adhesive, or through a mechanical means, such as press-fitting.

9. The golf club grip of claim 1, wherein the grip body and the end cap are formed integrally, secured together with an adhesive, or otherwise connected to form the golf club grip.

10. The golf club grip of claim 1, wherein:

the first cavity comprises a first cavity diameter; and
the lip is above the first cavity, and the lip comprises a lip diameter smaller than the first cavity diameter to secure the sensor in place.

11. The golf club grip of claim 1, wherein the upper surface comprises a plurality of depressions to allow an adhesive to flow around the sensor.

12. The golf club grip of claim 11, wherein the depressions radiate outward from a center of the upper surface.

13. The golf club grip of claim 1, wherein the non-gripping surface can be tapered, rounded, chamfered, or otherwise reshaped.

14. The golf club grip of claim 1, wherein the golf club grip has a longitudinal axis through a geometric center of the golf club grip; wherein the non-gripping surface defines a tangent plane and a taper angle that is measured between the longitudinal axis and the tangent plane, and the taper angle is between 15 degrees and 80 degrees.

15. The golf club grip of claim 1, wherein the end cap has a greater Shore A hardness than the grip body.

16. The golf club grip of claim 1, wherein the golf club grip has a longitudinal axis through a geometric center of the golf club grip; wherein the first cavity defines a cavity height measured along the longitudinal axis, and wherein the cavity height is between 0.3 inches and 0.4 inches.

17. The golf club grip of claim 1, wherein the sensor is harbored within the upper portion of the end cap.

18. The golf club grip of claim 1, wherein the end cap further defines a maximum outer diameter, wherein the maximum outer diameter is offset from the butt end of the golf club grip by distance between 0.2 inch to 0.8 inch, and the non-gripping surface has a taper from the maximum outer diameter to a smaller outer diameter toward the butt end.

19. A method of manufacturing a golf club grip comprising:

forming an end cap, the end cap comprising an upper portion having a plurality of depressions, and a lower portion comprising one or more flanges;

forming a grip body, the grip body comprising a first end, a second end, and one or more receiving arms, proximate to the first end;

coupling the one or more flanges with the one or more receiving arms to form a secure connection between the end cap and the grip body;

inserting a shaft into the grip body and the lower portion of the end cap;

securing a sensor within the upper portion; and
wherein the sensor is secured with an adhesive, or through a mechanical means, such as press-fitting.

20. The method of manufacturing of the golf club grip of claim 19, wherein the sensor securing step further comprises allowing the adhesive to flow around the sensor via the plurality of depressions.

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