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(54) **Title:** GOLF CLUBS AND GOLF CLUB HEADS IN FAIRWAY WOOD FAMILY HAVING VARIABLE CAMBER AND RELATED METHODS

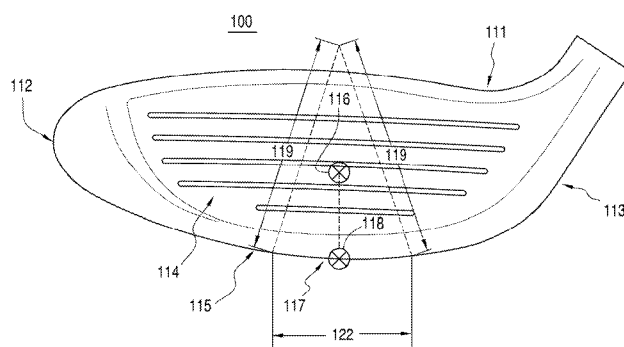


FIG. 1

(57) **Abstract:** A set of golf club heads including two or more fairway wood-type golf clubs heads each having a different loft angle. The two or more fairway wood-type golf club heads can each include a sole, which can include a center point and a camber region having a radius of curvature. The camber region can extend at least approximately 0.5 inch from the center point in each of a toe direction and a heel direction. The loft angles of the two or more fairway wood-type golf club heads can progressively increase across the two or more fairway wood-type golf club heads. The radii of curvature of the two or more fairway wood-type golf club heads can progressively decrease across the two or more fairway wood-type golf club heads. Other embodiments for related sets of golf club heads, golf clubs, and methods are disclosed.



**GOLF CLUBS AND GOLF CLUB HEADS IN FAIRWAY WOOD FAMILY HAVING
VARIABLE CAMBER AND RELATED METHODS
CROSS-REFERENCE TO RELATED APPLICATION**

[0001] This application claims the benefit of U.S. Patent Application No. 14/476,863, filed September 4, 2014, which claims the benefit of U.S. Provisional Application No. 61/900,994, filed November 6, 2013. U.S. Patent Application No. 14/476,863 and U.S. Provisional Application No. 61/900,994 are incorporated herein by reference in their entirety.

TECHNICAL FIELD

[0002] This disclosure relates generally to sports equipment, and relates more particularly to golf club heads and golf clubs, and related methods.

BACKGROUND

[0003] Fairway wood-type golf club heads, which are now almost exclusively made of metal, are in common use today. People often use lower-lofted fairway woods from the tee and good lies on the fairway when they want to hit the ball as far as possible with accuracy and consistency. People often use higher-lofted fairway woods from a variety of lies when they want to hit the ball at discrete distances and to blend into the distance gaps of the lower-lofted irons and hybrids. As such, people generally want the lower-lofted fairway woods to hit the ball as far as possible with accuracy and want the higher-lofted fairway woods to be versatile for a variety of lies.

BRIEF DESCRIPTION OF THE DRAWINGS

[0004] To facilitate further description of the embodiments, the following drawings are provided in which:

[0005] FIG. 1 illustrates a schematic view of a golf club head view from the front, according to an embodiment;

[0006] FIG. 2 illustrates a golf club head set, showing a front elevational view of each golf club head, according to another embodiment;

[0007] FIG. 3 illustrates the golf club head set of FIG. 2, showing a front-side cross-sectional view of each golf club head;

[0008] FIG. 4 illustrates a set of golf clubs, according to another embodiment; and

[0009] FIG. 5 illustrates a flow chart for an method of providing a set of golf clubs, according to another embodiment.

[0010] For simplicity and clarity of illustration, the drawing figures illustrate the general manner of construction, and descriptions and details of well-known features and techniques may be omitted to avoid unnecessarily obscuring the present disclosure. Additionally, elements in the drawing figures are not necessarily drawn to scale. For example, the dimensions of some of the

elements in the figures may be exaggerated relative to other elements to help improve understanding of embodiments of the present disclosure. The same reference numerals in different figures denote the same elements.

[0011] The terms “first,” “second,” “third,” “fourth,” 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.

[0012] The terms “left,” “right,” “front,” “back,” “top,” “bottom,” “over,” “under,” 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 apparatus, methods, and/or articles of manufacture described herein are, for example, capable of operation in other orientations than those illustrated or otherwise described herein.

[0013] The terms “couple,” “coupled,” “couples,” “coupling,” and the like should be broadly understood and refer to connecting two or more elements mechanically and/or otherwise. Two or more mechanical elements may be mechanically coupled together, but not be electrically or otherwise coupled together. Coupling may be for any length of time, e.g., permanent or semi-permanent or only for an instant. “Mechanical coupling” and the like should be broadly understood and include mechanical coupling of all types.

[0014] The absence of the word “removably,” “removable,” and the like near the word “coupled,” and the like does not mean that the coupling, etc. in question is or is not removable.

[0015] As defined herein, two or more elements are “integral” if they are comprised of the same piece of material. As defined herein, two or more elements are “non-integral” if each is comprised of a different piece of material.

[0016] As defined herein, “approximately” can, in some embodiments, mean within plus or minus ten percent of the stated value. In other embodiments, “approximately” can mean within plus or minus five percent of the stated value. In further embodiments, “approximately” can mean within plus or minus three percent of the stated value. In yet other embodiments, “approximately” can mean within plus or minus one percent of the stated value. The apparatus,

methods, and articles of manufacture described herein are not limited in this regard.

DETAILED DESCRIPTION OF EXAMPLES OF EMBODIMENTS

[0017] Various embodiments includes a set of golf club heads. the set of golf club heads can include two or more fairway wood-type golf clubs heads. The two or more fairway wood-type golf club heads can each have a different loft angle. The two or more fairway wood-type golf club heads can each include a sole. The sole can include a center point and a camber region. The camber region can have a radius of curvature. The camber region can extend at least approximately 0.5 inch from the center point in each of a toe direction and a heel direction. The loft angles of the two or more fairway wood-type golf club heads can progressively increase across the two or more fairway wood-type golf club heads. The radii of curvature of the two or more fairway wood-type golf club heads can progressively decrease across the two or more fairway wood-type golf club heads.

[0018] A number of embodiments can include a set of golf clubs. The set of golf clubs can include two or more fairway wood-type golf clubs. The two or more fairway wood-type golf clubs can each include a golf club head having a different loft angle. The golf club head can include a sole. The sole can include a center point and a camber region. The camber region can have a radius of curvature. The camber region can extend at least approximately 0.5 inch from the center point in each of a toe direction and a heel direction. The loft angles of the golf club heads of the two or more fairway wood-type golf clubs can progressively increase across the two or more fairway wood-type golf clubs. The radii of curvature of the golf club heads of the two or more fairway wood-type golf clubs can progressively decrease across the two or more fairway wood-type golf clubs.

[0019] Some embodiments include a method of providing a set of golf clubs. The method can include providing a set of golf club heads. The set of golf club heads can include two or more fairway wood-type golf clubs heads. The two or more fairway wood-type golf clubs heads can each have a different loft angle. The two or more fairway wood-type golf club heads can each include a sole. The sole can include a center point and a camber region. The camber region can have a radius of curvature. The camber region can extend at least approximately 0.5 inch from the center point in each of a toe direction and a heel direction. The method also can include providing a set of shafts. The method further can include assembling each shaft of the set of shafts with each club head of the set of club heads. The loft angles of the two or more fairway wood-type golf club heads can progressively increase across the two or more fairway wood-type golf club heads. The radii of curvature of the two or more fairway wood-type golf club heads can progressively decrease across the two or more fairway wood-type golf club heads.

[0020] Turning to the drawings, FIG. 1 illustrates a schematic view of a golf club head 100

viewed from the front, according to an embodiment. Golf club head 100 is merely exemplary and embodiments of the golf club head are not limited to the embodiments presented herein. The golf club head can be employed in many different embodiments or examples not specifically depicted or described herein.

[0021] Golf club head 100 can include a suitable fairway wood-type golf club head. In a number of embodiments, golf club head 100 can be composed of a body 111, which can be made of stainless steel, titanium, or one or more other materials having a high shear modulus and/or high strength-to-weight ratio. In various embodiments, body 111 can be hollow. In some embodiments, body 111 has a volume of no more than 350 cubic centimeters. In the same or different embodiments, body 111 can have a volume of no more than 250 cubic centimeters.

[0022] In some embodiments, golf club head 100 can include a toe 112, a heel 113, a face plate 114, and/or a sole 115. In some embodiments, golf club head 100 can include an engineered impact point 116, which can be the ideal point at which the strike a golf ball. In many embodiments, when golf club head 100 is at a nominal lie angle, as shown in FIG. 1, engineered impact point 116 can be located on a vertical line that bisects in equal halves a lowermost groove of face plate 114 of golf club head 100.

[0023] In many embodiments, sole 115 can have a camber, which is a curvature of sole 115. In some embodiments, a camber region 117 can be vertically centered with the engineered impact point on face plate 114. In a number of embodiments, camber region 117 can be vertically centered with the lowermost groove of face plate 114 of golf club head 100. In various embodiments, a center point 118 on sole 115 can be located on a vertical line running through engineered impact point 116 when golf club head 100 is at a nominal lie angle. In some embodiments, center point 118 on sole 115 can be located on a vertical line running through the lowermost groove of face plate 114 of golf club head 100. In various embodiments, center point 118 can be centered on golf club head 100 between toe 112 and heel 113. In many embodiments, center point 118 can bisect camber region 117.

[0024] Camber region 117 can extend partially across sole 115 between toe 112 and heel 113. In many embodiments, camber region 117 can be measured for at least 0.5 inch (in.) / 1.27 centimeters (cm) on each side of center point 118. In various embodiments, camber region 117 can extend at least approximately 0.5 in. / 1.27 cm from center point 118 in a toe direction (e.g., toward toe 112) and at least approximately 0.5 in. / 1.27 cm from center point 118 in a heel direction (e.g., toward heel 113). In a number of embodiments, camber region 117 can have a camber dimension 122 of at least approximately 1.0 in. / 2.54 cm. In many embodiments, camber region 117 can have a camber radius of curvature 119, which can be constant throughout camber region 117. Camber radius of curvature 119 of camber region 117 can be measured, for

example, by using a curvature gauge on sole 115 across camber region 117. As an example, camber radius of curvature 119 can be approximately 1.7 in. / 4.318 cm to approximately 6.5 in. / 16.51 cm.

[0025] In some embodiments, camber region 117 can be located at a leading edge of sole 115, which can be the front-most point of sole 115. In other embodiments, camber region 117 can be located between approximately 0.25 in. / 0.635 cm and approximately 1.0 in. / 2.54 cm backward from the leading edge of sole 115. In many embodiments, camber region 117 can be located at approximately 0.5 in. / 1.27 cm backward from the leading edge of sole 115.

[0026] Turning ahead in the drawings, FIG. 2 illustrates a front elevational view of a golf club head set 200, showing a front elevational view of each golf club head depicted. FIG. 3 illustrates golf club head set 200, showing a cross-sectional view of each golf club head depicted. Golf club head set 200 is merely exemplary, and embodiments of the golf club head set are not limited to the embodiments presented herein. The golf club head set can be employed in many different embodiments or examples not specifically depicted or described herein. Golf club head set 200 can include a golf club head 210, a golf club head 230, and/or a golf club head 250. Golf club head 210, golf club head 230, and/or golf club head 250 can be similar to golf club head 100 (FIG. 1), and various components and/or constructions of golf club head 210, golf club head 230, and/or golf club head 250 can be identical or substantially similar to various components of golf club head 100 (FIG. 1).

[0027] In many embodiments, golf club head 210, golf club head 230, and golf club head 250 can each be a fairway wood-type golf club head. In some embodiments, fairway wood-type golf club heads can have a wood number that can roughly correspond to a loft angle of the face plate. For example, a fairway wood-type golf club head with a loft angle of approximately 15 degrees can be a 3-wood, a fairway wood-type golf club head with a loft angle of approximately 16.5 degrees can be a 4-wood, a fairway wood-type golf club head with a loft angle of approximately 18 degrees can be a 5-wood, and/or a fairway wood-type golf club head with a loft angle of approximately 21 degrees can be a 7-wood. In some embodiments, golf club head set 200 can include other fairway wood-type golf club heads, such as a 2-wood, a 4-wood, a 6-wood, an 8-wood, and/or a 9-wood. In some embodiments, golf club head set 200 can include two or more fairway wood-type golf club heads each having a different loft angle. In many embodiments, golf club head set 200 can have three or more fairway wood-type golf club heads each having a different loft angle.

[0028] In some embodiments, golf club head 210 can be a 3-wood golf club head. In many embodiments, golf club head 210 can have a loft angle of approximately 14.5 degrees. In some embodiments, golf club head 210 can include a face plate 214 and a sole 215. Face plate 214

can be similar to face plate 114 (FIG. 1), and/or sole 215 can be similar to sole 115 (FIG. 1). In a number of embodiments, golf club head 210 can have a camber region 217, which can be centered at center point 218. Camber region 217 can be similar to camber region 117 (FIG. 1), and/or center point 218 can be similar to center point 118 (FIG. 1). In various embodiments, center point 218 can be located on a vertical line below the midpoint of a bottom groove 221 on face plate 214 when golf club head 210 is at a nominal lie angle, as shown in FIG. 2.

[0029] In some embodiments, golf club head 230 can be a 5-wood golf club head. In many embodiments, golf club head 230 can have a loft angle of approximately 18 degrees. In some embodiments, golf club head 230 can include a face plate 234 and a sole 235. Face plate 234 can be similar to face plate 114 (FIG. 1), and/or sole 235 can be similar to sole 115 (FIG. 1). In a number of embodiments, golf club head 230 can have a camber region 237, which can be centered at center point 238. Camber region 237 can be similar to camber region 117 (FIG. 1), and/or center point 238 can be similar to center point 118 (FIG. 1). In various embodiments, center point 238 can be located on a vertical line below the midpoint of a bottom groove 241 on face plate 234 when golf club head 230 is at a nominal lie angle, as shown in FIG. 2.

[0030] In some embodiments, golf club head 250 can be a 7-wood golf club head. In many embodiments, golf club head 250 can have a loft angle of approximately 21 degrees. In some embodiments, golf club head 250 can include a face plate 254 and a sole 255. Face plate 254 can be similar to face plate 114 (FIG. 1), and/or sole 255 can be similar to sole 115 (FIG. 1). In a number of embodiments, golf club head 250 can have a camber region 257, which can be centered at center point 258. Camber region 257 can be similar to camber region 117 (FIG. 1), and/or center point 235 can be similar to center point 118 (FIG. 1). In various embodiments, center point 258 can be located on a vertical line below the midpoint of a bottom groove 261 on face plate 254, when golf club head 250 is at a nominal lie angle, as shown in FIG. 2.

[0031] FIG. 3 shows cross-sectional views of golf club head 210, golf club head 230, and golf club head 250 of golf club head set 200, in which the cross-sectional cut is at a point approximately 0.5 in. / 1.27 cm back from the leading edge of each of the golf club heads (e.g., golf club head 210, golf club head 230, and golf club head 250). In some embodiments, camber region 217 of golf club head 210 can be centered at the cross-sectional cut around center point 218 and can extend for approximately 0.5 in. / 1.27 cm on each side of center point 218 in a toe direction toward a toe 312 and in a heel direction toward a heel 313. In several embodiments, camber region 217 can have a camber dimension 322 of at least approximately 1.0 in. / 2.54 cm.

[0032] In a number of embodiments, camber region 237 of golf club head 230 can be centered at the cross-sectional cut around center point 238 and can extend for approximately 0.5 in. / 1.27 cm on each side of center point 238 in a toe direction toward a toe 332 and in a heel direction

toward a heel 333. In various embodiments, camber region 237 can have a camber dimension 342 of at least approximately 1.0 in. / 2.54 cm.

[0033] In many embodiments, camber region 257 of golf club head 250 can be centered at the cross-sectional cut around center point 258 and can extend for approximately 0.5 in. / 1.27 cm on each side of center point 258 in a toe direction toward a toe 352 and in a heel direction toward a heel 353. In various embodiments, camber region 257 can have a camber dimension 362 of at least approximately 1.0 in. / 2.54 cm.

[0034] In some embodiments, camber region 217 can have a camber radius of curvature 319 of between approximately 3.2 in. / 8.128 cm and approximately 6.2 in. / 15.748 cm. In certain embodiments, camber region 217 can have camber radius of curvature 319 of approximately 4.7 in. / 11.938 cm. In various embodiments, camber region 237 can have a camber radius of curvature 339 of between approximately 2.5 in. / 6.35 cm and approximately 5.5 in. / 13.97 cm. In certain embodiments, camber region 237 can have camber radius of curvature 339 of approximately 4.0 in. / 10.16 cm. In many embodiments, camber region 257 can have a camber radius of curvature 359 of between approximately 2.0 in. / 5.08 cm and approximately 5.0 in. / 12.7 cm. In certain embodiments, camber region 237 can have camber radius of curvature 359 of approximately 3.5 in. / 8.89 cm. In many embodiments, the camber radius of curvature (e.g., camber radius of curvature 319, camber radius of curvature 339, camber radius of curvature 359) at the camber region (e.g., camber region 217, camber region 237, camber region 257) of any golf club head (e.g. golf club head 210, golf club head 230, golf club head 250) in golf club head set 200 can be less than approximately 6.5 in. / 16.51 cm.

[0035] In many embodiments, the golf clubs heads (e.g. golf club head 210, golf club head 230, golf club head 250) of golf club head set 200 can have an inverse relationship between the camber radius of curvature (e.g., camber radius of curvature 319, camber radius of curvature 339, camber radius of curvature 359) and the loft angle. In a number of embodiments, as the loft angle increases among the golf club heads (e.g. golf club head 210, golf club head 230, golf club head 250), the camber radius of curvature (e.g., camber radius of curvature 319, camber radius of curvature 339, camber radius of curvature 359) can decrease, which can result in greater curvature for the golf club heads having a greater loft angle and less curvature for the golf club heads having a lower loft angle.

[0036] In a number of embodiments, golf club head 210 can have a lower loft angle than golf club head 230, and golf club head 230 can have a lower loft angle than golf club head 250. Meanwhile, camber radius of curvature 319 of golf club head 210 can be larger than camber radius of curvature 339 of golf club head 230. Similarly, camber radius of curvature 339 of golf club head 230 can be larger than camber radius of curvature 359 of golf club head 250.

[0037] In some embodiments, for any second golf club head having a progressively next higher loft angle than any first golf club head in a set of golf club heads (e.g., golf club head set 200), the camber radius of curvature of the second golf club head can be at least approximately 0.125 in. / 0.3175 cm less than the camber radius of curvature of the first golf club head. For example, camber radius of curvature 339 of golf club head 230 can be at least approximately 0.125 in. / 0.3175 cm less than camber radius of curvature 319 of golf club head 210, and camber radius of curvature 359 of golf club head 250 can be at least approximately 0.125 in. / 0.3175 cm less than camber radius of curvature 339 of golf club head 230.

[0038] Turning ahead in the figures, FIG. 4 illustrates a set of golf clubs 400. Set of golf clubs 400 is merely exemplary, and embodiments of the set of golf clubs are not limited to the embodiments presented herein. The set of golf clubs can be employed in many different embodiments or examples not specifically depicted or described herein. In some embodiments, set of golf clubs 400 can include a golf club 410, a golf club 430, and/or a golf club head 450, which can each be a different one of a fairway wood-type golf club.

[0039] In many embodiments, golf club 410 can include a golf club head 412, a shaft 411, and a grip 414. Golf club head 412 can be similar or identical to golf club head 100 (FIG. 1) and/or golf club head 210 (FIGs. 2-3), and various components and/or constructions of golf club head 412 can be similar or identical to various components of golf club head 100 (FIG. 1) and/or golf club head 210 (FIGs. 2-3). Golf club head 410 can be a fairway wood-type golf club head. For example, golf club 410 can be a 3-wood golf club having a loft angle of approximately 14.5 degrees. Golf club head 412 can have a camber region, which can be similar or identical to camber region 117 (FIG. 1) and/or camber region 217 (FIGs. 2-3). The camber region of golf club head 412 can have a camber radius of curvature, which can be similar to camber radius of curvature 119 (FIG. 1) and/or camber radius of curvature 319 (FIG. 3).

[0040] In a number of embodiments, golf club 430 can include a golf club head 432, a shaft 431, and a grip 434. Golf club head 432 can be similar or identical to golf club head 100 (FIG. 1) and/or golf club head 230 (FIGs. 2-3), and various components and/or constructions of golf club head 432 can be similar or identical to various components of golf club head 100 (FIG. 1) and/or golf club head 230 (FIGs. 2-3). Golf club head 430 can be a fairway wood-type golf club head. For example, golf club 430 can be a 5-wood golf club having a loft angle of approximately 18 degrees. Golf club head 432 can have a camber region, which can be similar or identical to camber region 117 (FIG. 1) and/or camber region 237 (FIGs. 2-3). The camber region of golf club head 432 can have a camber radius of curvature, which can be similar to camber radius of curvature 119 (FIG. 1) and/or camber radius of curvature 339 (FIG. 3).

[0041] In various embodiments, golf club 450 can include a golf club head 452, a shaft 451, and

a grip 454. Golf club head 452 can be similar or identical to golf club head 100 (FIG. 1) and/or golf club head 250 (FIGs. 2-3), and various components and/or constructions of golf club head 452 can be similar or identical to various components of golf club head 100 (FIG. 1) and/or golf club head 250 (FIGs. 2-3). Golf club head 450 can be a fairway wood-type golf club head. For example, golf club 450 can be a 7-wood golf club having a loft angle of approximately 21 degrees. Golf club head 452 can have a camber region, which can be similar or identical to camber region 117 (FIG. 1) and/or camber region 257 (FIGs. 2-3). The camber region of golf club head 452 can have a camber radius of curvature, which can be similar to camber radius of curvature 119 (FIG. 1) and/or camber radius of curvature 359 (FIG. 3).

[0042] In some embodiments, set of golf clubs 400 can include other fairway wood-type golf clubs, such as a 2-wood, a 4-wood, a 6-wood, an 8-wood, and/or a 9-wood. In some embodiments, set of golf clubs 400 can include two or more fairway wood-type golf clubs each having a different loft angle. In many embodiments, set of golf clubs 400 can have three or more fairway wood-type golf club heads each having a different loft angle. In many embodiments, the loft angles of the golf clubs (e.g., golf club 410, golf club 430, golf club 450) of set of golf clubs 400 can progressively increase across set of golf clubs 400 as the camber radii of curvature of the golf club heads (e.g., golf club head 412, golf club head 432, golf club head 452) of the golf clubs (e.g., golf club 410, golf club 430, golf club 450) of set of golf clubs 400 progressively decrease across set of golf clubs 400.

[0043] In some embodiments, each shaft (e.g., shaft 411, shaft 431, shaft 451) of the golf clubs (e.g., golf club 410, golf club 430, golf club 450) of set of golf clubs 400 can have a shaft length. In many embodiments, shaft lengths of the shafts (e.g., shaft 411, shaft 431, shaft 451) of set of golf clubs 400 can progressively decrease across set of golf clubs 400. For example, the shaft length of shaft 431 of golf club 430 can be shorter than the shaft length of shaft 411 of golf club 410. Similarly, the shaft length of shaft 451 of golf club 450 can be shorter than the shaft length of shaft 431 of golf club 430.

[0044] In some embodiments, for any second golf club having a progressively next higher loft angle than any first golf club in a set of golf club (e.g., set of golf clubs 400), the camber radius of curvature of the second golf club can be at least approximately 0.125 in. / 0.3175 cm less than the camber radius of curvature of the first golf club. For example, the camber radius of curvature of golf club 430 can be at least approximately 0.125 in. / 0.3175 cm less than the camber radius of curvature of golf club 410, and the camber radius of curvature of golf club 450 can be at least approximately 0.125 in. / 0.3175 cm less than the camber radius of curvature of golf club 430. In many embodiments, the camber radius of curvature of any golf club (e.g. golf club 410, golf club 430, golf club 450) in set of golf clubs 400 can be less than approximately

6.5 in. / 16.51 cm.

[0045] As described, in many embodiments fairway woods with lower loft angles can have a larger camber radius of curvature, and fairway woods with higher loft angles can have a smaller camber radius of curvature. Fairway woods with lower loft angles, such as a 3-wood, are often used for longer-distance shots, such as shots from the tee or longer shots with good lies from the fairway. Many golfers want to hit such shots as far as possible, and/or hit such shots with greater accuracy and consistency than typically had with a driver. Increasing the camber radius of curvature on fairway woods with lower loft angles can advantageously lower the center of gravity of the golf club head and/or can increase the size of the face plate, as an increased camber radius of curvature results in a flatter sole region and less relief at the heel and toe regions. Increasing the camber radius of curvature can beneficially promote greater surface area on the low toe and/or low heel portions of the face plate. Increasing the surface area of the face plate can advantageously result in an increased shot distance upon striking the ball with a lower-lofted fairway wood, as the greater surface area can result in a greater bounce. Lowering the center of gravity of the golf club head can beneficially reduce the gear effect on the ball upon striking the ball, which can advantageously result in an increased shot distance upon striking the ball with a lower-lofted fairway wood, as a ball hit by a fairway wood generally already has more than enough gear effect.

[0046] In many embodiments, fairway woods with higher loft angles can have a smaller camber radius of curvature. Fairway woods with higher loft angles, such as a 5-wood and/or a 7-wood, are often used for shots of discrete distances and/or for shots from a variety of lies. Such shots generally require a versatile club, such as one that can more easily go through rough and/or handle well at various lie angles. Decreasing the camber radius of curvature on fairway woods with higher loft angles can create a more rounded sole region, which can advantageously have greater toe and/or heel relief. A more rounded sole region can beneficially pass more easily through rough and/or can beneficially handle various lie angles.

[0047] Although versatility can still be important in lower-lofted fairway woods, some versatility can be sacrificed to increase face size and/or lower the center of gravity in the lower-lofted fairway woods to maximize shot distance with the lower-lofted fairway woods.

[0048] Returning to the drawings, FIG. 5 illustrates a flow chart for a method 500 of providing a set of golf clubs in accordance with the present disclosure. Method 500 is merely exemplary and is not limited to the embodiments presented herein. Method 500 can be employed in many different embodiments or examples not specifically depicted or described herein. In some embodiments, the procedures, the processes, and/or the activities of method 500 can be performed in the order presented. In other embodiments, the procedures, the processes, and/or

the activities of method 500 can be performed in any suitable order. In still other embodiments, one or more of the procedures, the processes, and/or the activities of method 500 can be combined or skipped.

[0049] Referring to FIG. 5, method 500 can include a block 510 of providing a set of golf club heads. In many embodiments, the set of golf club heads can be similar or identical to golf club head set 200 (FIGs. 2-3). In some embodiments, the set of golf club heads of method 500 can include two or more fairway wood-type golf club heads. In the same or other embodiments, the set of golf club heads of method 500 can include three or more fairway wood-type golf club heads. For example, the fairway wood-type golf club heads can be identical or similar to golf club head 210 (FIGs. 2-3), golf club head 230 (FIGs. 2-3), and/or golf club head 250 (FIGs. 2-3), and/or also can be identical or similar to golf club head 412 (FIG. 4), golf club head 432 (FIG. 4), and/or golf club head 452 (FIG. 4). The fairway wood-type golf club heads of method 500 can each be provided via casting, forging, milling, machining, molding, and/or other processes, where the portions of the fairway wood-type golf club heads can be a single piece or can include several pieces coupled together such as via welding, brazing, and/or adhesives.

[0050] In many embodiments, the fairway wood-type golf club heads can each have a different loft angle. In several embodiments, the fairway wood-type golf club heads can each include a sole. The sole can be similar or identical to sole 115 (FIG. 1), sole 215 (FIGs. 2-3), sole 235 (FIGs. 2-3), and/or sole 255 (FIGs. 2-3). In some embodiments, the sole can include a center point. The center point can be similar or identical to center point 118 (FIG. 1), center point 218 (FIGs. 2-3), center point 238 (FIGs. 2-3), and/or center point 258 (FIGs. 2-3). In various embodiments, the center point of the sole can be located on a vertical line extending through an engineered impact point of the fairway wood-type golf club head when the fairway wood-type golf club head is positioned at a nominal lie angle. The engineered impact point can be similar or identical to engineered impact point 116 (FIG. 1).

[0051] In many embodiments, the sole can include a camber region. The camber region can be similar or identical to camber region 117 (FIG. 1), camber region 217 (FIGs. 2-3), camber region 237 (FIGs. 2-3), and/or camber region 257 (FIGs. 2-3). In some embodiments, the camber region of the sole can be located at approximately 0.5 in. / 1.27 cm behind a leading edge of the sole. In many embodiments, the camber region can have a radius of curvature. The radius of curvature can be similar or identical to camber radius of curvature 119 (FIG. 1), camber radius of curvature 319 (FIG. 3), camber radius of curvature 339 (FIG. 3), and/or camber radius of curvature 359 (FIG. 3). In some embodiments, the radius of curvature for each of the two or more fairway wood-type golf club heads can be less than approximately 6.5 in. / 16.51 cm. In many embodiments, the camber region can extend at least approximately 0.5 in. / 1.27

cm from the center point in each of a toe direction and a heel direction. For example, the toe direction can be in a direction from the center point toward a toe of the fairway wood-type golf club head. The toe can be similar or identical to toe 112 (FIG. 1), toe 312 (FIG. 3), toe 332 (FIG. 3), and/or toe 352 (FIG. 3). The heel direction can be in a direction from the center point toward a heel of the fairway wood-type golf club head. The heel can be similar or identical to heel 113 (FIG. 1), heel 313 (FIG. 3), heel 333 (FIG. 3), and/or heel 353 (FIG. 3).

[0052] In many embodiments, the loft angles of the two or more fairway wood-type golf club heads can progressively increase across the two or more fairway wood-type golf club heads, and the radii of curvature of the two or more fairway wood-type golf club heads can progressively decrease across the two or more fairway wood-type golf club heads. In some embodiments, the loft angle of a first fairway wood-type golf club head of the two or more fairway wood-type golf club heads is less than a loft angle of a second fairway wood-type golf club head of the two or more fairway wood-type golf club heads, and the radius of curvature of the second fairway wood-type golf club head is at least approximately 0.125 inch less than the radius of curvature of the first fairway wood-type golf club head. In a number of embodiments, the loft angle of a third fairway wood-type golf club head of the two or more fairway wood-type golf club heads is greater than a loft angle of the second fairway wood-type golf club head, and the radius of curvature of the third fairway wood-type golf club head is at least approximately 0.125 inch less than the radius of curvature of the second fairway wood-type golf club head.

[0053] Method 500 also can include a block 520 of providing a set of shafts. The set of shafts of method 500 can be similar or identical to two or more of shaft 411 (FIG. 4), shaft 431 (FIG. 4), and shaft 451 (FIG. 4). Each of the shafts of the set of shafts of method 500 can be provided via casting, forging, milling, machining, molding, and/or other processes.

[0054] Method 500 also can include a block 530 of assembling each shaft of the set of shafts with each club head of the set of club heads. Each of the golf club heads of the set of set of golf club heads of method 500 and each of the shafts of the set of shafts of method 500 can be assembled through welding, brazing, adhesives, and/or other processes.

[0055] Although the golf clubs and golf club heads with variable camber have been described with reference to specific embodiments, it will be understood by those skilled in the art that various changes may be made without departing from the spirit or scope of the present disclosure. For example, to one of ordinary skill in the art, it will be readily apparent that blocks 510, 520, and/or 530 of FIG. 5 may be comprised of many different procedures, processes, and activities and be performed in many different orders, that various elements of FIGs. 1-5 may be modified, and that the foregoing discussion of certain of these embodiments does not necessarily represent a complete description of all possible embodiments.

[0056] As the rules to golf may change from time to time (e.g., new regulations may be adopted or old rules may be eliminated or modified by golf standard organizations and/or governing bodies such as the United States Golf Association (USGA), the Royal and Ancient Golf Club of St. Andrews (R&A), etc.), golf equipment related to the apparatus, methods, and articles of manufacture described herein may be conforming or non-conforming to the rules of golf at any particular time. Accordingly, golf equipment related to the apparatus, methods, and articles of manufacture described herein may be advertised, offered for sale, and/or sold as conforming or non-conforming golf equipment. The apparatus, methods, and articles of manufacture described herein are not limited in this regard.

[0057] While the above examples may be described in connection with a fairway wood-type golf club head, the apparatus, methods, and articles of manufacture described herein may be applicable to other types of golf clubs such as a driver wood-type golf club, an iron-type golf club, a wedge-type golf club, or a putter-type golf club. Alternatively, the apparatus, methods, and articles of manufacture described herein may be applicable other type of sports equipment such as a hockey stick, a tennis racket, a fishing pole, a ski pole, etc.

[0058] Additional examples of such changes have been given in the foregoing description. Other permutations of the different embodiments having one or more of the features of the various figures are likewise contemplated. Accordingly, the disclosure of embodiments is intended to be illustrative and is not intended to be limiting. It is intended that the scope of the present disclosure shall be limited only to the extent required by the appended claims.

[0059] The golf club heads with variable camber discussed herein may be implemented in a variety of embodiments, and the foregoing discussion of certain of these embodiments does not necessarily represent a complete description of all possible embodiments. Rather, the detailed description of the drawings, and the drawings themselves, disclose at least one preferred embodiment, and may disclose alternative embodiments.

[0060] All elements claimed in any particular claim are essential to the embodiment claimed in that particular claim. Consequently, replacement of one or more claimed elements constitutes reconstruction and not repair. Additionally, benefits, other advantages, and solutions to problems have been described with regard to specific embodiments. The benefits, advantages, solutions to problems, and any element or elements that may cause any benefit, advantage, or solution to occur or become more pronounced, however, are not to be construed as critical, required, or essential features or elements of any or all of the claims, unless such benefits, advantages, solutions, or elements are expressly stated in such claim.

[0061] Moreover, embodiments and limitations disclosed herein are not dedicated to the public under the doctrine of dedication if the embodiments and/or limitations: (1) are not expressly

claimed in the claims; and (2) are or are potentially equivalents of express elements and/or limitations in the claims under the doctrine of equivalents.

CLAIMS

What is claimed is:

1. A set of golf club heads comprising:

two or more fairway wood-type golf clubs heads, each comprising:

a different loft angle; and

a sole comprising a center point and a camber region, the camber region comprising a radius of curvature and extending at least approximately 0.5 inch from the center point in each of a toe direction and a heel direction,

wherein:

the loft angles of the two or more fairway wood-type golf club heads progressively increase across the two or more fairway wood-type golf club heads; and

the radii of curvature of the two or more fairway wood-type golf club heads progressively decrease across the two or more fairway wood-type golf club heads.

2. The set of golf club heads of claim 1 further comprising three or more fairway wood-type golf club heads, each having a different loft angle, wherein:

the three or more fairway wood-type golf club heads comprise the two or more fairway wood-type golf club heads;

the loft angles of the three or more fairway wood-type golf club heads progressively increase across the three or more fairway wood-type golf club heads; and

the radii of curvature of the three or more fairway wood-type golf club heads progressively decrease across the three or more fairway wood-type golf club heads.

3. The set of golf club heads of any one of claims 1 or 2, wherein, for each of the two or more fairway wood-type golf club heads, the camber region of the sole is located at approximately 0.5 inch behind a leading edge of the sole.

4. The set of golf club heads of any one of claims 1, 2, or 3, wherein, for each of the two or more fairway wood-type golf club heads, the center point of the sole is located on a vertical line extending through an engineered impact point of the fairway wood-type golf club head when the fairway wood-type golf club head is positioned at a nominal lie angle.

5. The set of golf club heads of any one of claims 1, 2, 3, or 4, wherein:
 - the loft angle of a first fairway wood-type golf club head of the two or more fairway wood-type golf club heads is less than a loft angle of a second fairway wood-type golf club head of the two or more fairway wood-type golf club heads; and
 - the radius of curvature of the second fairway wood-type golf club head is at least approximately 0.125 inch less than the radius of curvature of the first fairway wood-type golf club head.
6. The set of golf club heads of claim 5, wherein:
 - the loft angle of a third fairway wood-type golf club head of the two or more fairway wood-type golf club heads is greater than a loft angle of the second fairway wood-type golf club head; and
 - the radius of curvature of the third fairway wood-type golf club head is at least approximately 0.125 inch less than the radius of curvature of the second fairway wood-type golf club head.
7. The set of golf club heads of any one of claims 1, 2, 3, 4, 5, or 6, wherein, for each of the two or more fairway wood-type golf club heads, the radius of curvature is less than approximately 6.5 inches.
8. The set of golf club heads of any one of claims 1, 2, 3, 4, 5, 6, or 7, wherein each of the two or more fairway wood-type golf club heads comprises a body having a volume of no more than approximately 350 cubic centimeters.
9. A set of golf clubs comprising:
 - two or more fairway wood-type golf clubs each comprising:
 - a golf club head comprising:
 - a different loft angle; and
 - a sole comprising a center point and a camber region, the camber region comprising a radius of curvature and extending at least approximately 0.5 inch from the center point in each of a toe direction and a heel direction,
 - wherein:

the loft angles of the golf club heads of the two or more fairway wood-type golf clubs progressively increase across the two or more fairway wood-type golf clubs; and

the radii of curvature of the golf club heads of the two or more fairway wood-type golf clubs progressively decrease across the two or more fairway wood-type golf clubs.

10. The set of golf clubs of claim 9, wherein:

each of the two or more fairway wood-type golf clubs comprise a shaft having a shaft length; and

the shaft lengths of the shafts of the two or more fairway wood-type golf clubs progressively decrease across the two or more fairway wood-type golf clubs.

11. The set of golf clubs of any one of claims 9 or 10, further comprising three or more fairway wood-type golf clubs each having a different loft angle, wherein:

the three or more fairway wood-type golf club heads comprise the two or more fairway wood-type golf club heads;

the loft angles of the golf club heads of the three or more fairway wood-type golf clubs progressively increase across the three or more fairway wood-type golf clubs; and

the radii of curvature of the golf club heads of the three or more fairway wood-type golf clubs progressively decrease across the three or more fairway wood-type golf clubs.

12. The set of golf clubs of claim 11, wherein the three or more fairway wood-type golf clubs comprise a 3-wood-type golf club, a 5-wood-type golf club, and a 7-wood-type golf club.

13. The set of golf clubs of any one of claims 9, 10, 11, or 12, wherein, for each of the two or more fairway wood-type golf clubs, the camber region of the sole is located at approximately 0.5 inch behind a leading edge of the sole.

14. The set of golf clubs of any one of claims 9, 10, 11, 12, or 13, wherein, for each of the two or more fairway wood-type golf clubs, the center point of the sole is located on a vertical line extending through an engineered impact point of the golf club head of the fairway wood-type golf club when the golf club head is positioned at a nominal lie angle.

15. The set of golf clubs of any one of claims 9, 10, 11, 12, 13, or 14, wherein:

the loft angle of a first fairway wood-type golf club of the two or more fairway wood-type golf clubs is less than a loft angle of a second fairway wood-type golf club of the two or more fairway wood-type golf clubs; and
the radius of curvature of the second fairway wood-type golf club is at least approximately 0.125 inch less than the radius of curvature of the first fairway wood-type golf club.

16. The set of golf clubs of claim 15, wherein:

the loft angle of a third fairway wood-type golf club of the two or more fairway wood-type golf clubs is greater than a loft angle of the second fairway wood-type golf club;
and
the radius of curvature of the third fairway wood-type golf club is at least approximately 0.125 inch less than the radius of curvature of the second fairway wood-type golf club.

17. The set of golf clubs of any one of claims 9, 10, 11, 12, 13, 14, 15, or 16, wherein, for each of the two or more fairway wood-type golf clubs, the radius of curvature is less than approximately 6.5 inches.

18. The set of golf clubs of claim 9, 10, 11, 12, 13, 14, 15, 16, or 17, wherein the golf club head of each of the two or more fairway wood-type golf clubs comprises a body having a volume of no more than approximately 350 cubic centimeters.

19. A method of providing a set of golf clubs comprising:

providing a set of golf club heads, the set of golf club heads comprising two or more fairway wood-type golf clubs heads, each comprising:
a different loft angle; and
a sole comprising a center point and a camber region, the camber region comprising a radius of curvature and extending at least approximately 0.5 inch from the center point in each of a toe direction and a heel direction,
providing a set of shafts; and
assembling each shaft of the set of shafts with each club head of the set of club heads,
wherein:
the loft angles of the two or more fairway wood-type golf club heads progressively increase across the two or more fairway wood-type golf club heads; and

the radii of curvature of the two or more fairway wood-type golf club heads progressively decrease across the two or more fairway wood-type golf club heads.

20. The method of claim 19, wherein the set of golf club heads comprise three or more fairway wood-type golf clubs, each having a different loft angle, wherein:

the three or more fairway wood-type golf club heads comprise the two or more fairway wood-type golf club heads;

the loft angles of the three or more fairway wood-type golf club heads progressively increase across the three or more fairway wood-type golf club heads; and

the radii of curvature of the three or more fairway wood-type golf club heads progressively decrease across the three or more fairway wood-type golf club heads.

21. The method of any one of claims 19 or 20, wherein, for each of the two or more fairway wood-type golf club heads, the camber region of the sole is located at approximately 0.5 inch behind a leading edge of the sole.

22. The method of any one of claims 19, 20, or 21, wherein:

the loft angle of a first fairway wood-type golf club head of the two or more fairway wood-type golf club heads is less than a loft angle of a second fairway wood-type golf club head of the two or more fairway wood-type golf club heads; and

the radius of curvature of the second fairway wood-type golf club head is at least approximately 0.125 inch less than the radius of curvature of the first fairway wood-type golf club head.

23. The method of claims 22, wherein:

the loft angle of a third fairway wood-type golf club head of the two or more fairway wood-type golf club heads is greater than a loft angle of the second fairway wood-type golf club head; and

the radius of curvature of the third fairway wood-type golf club head is at least approximately 0.125 inch less than the radius of curvature of the second fairway wood-type golf club head.

24. The method of any one of claims 19, 20, 21, 22, or 23, wherein, for each of the two or more fairway wood-type golf club heads, the radius of curvature is less than approximately 6.5 inches.

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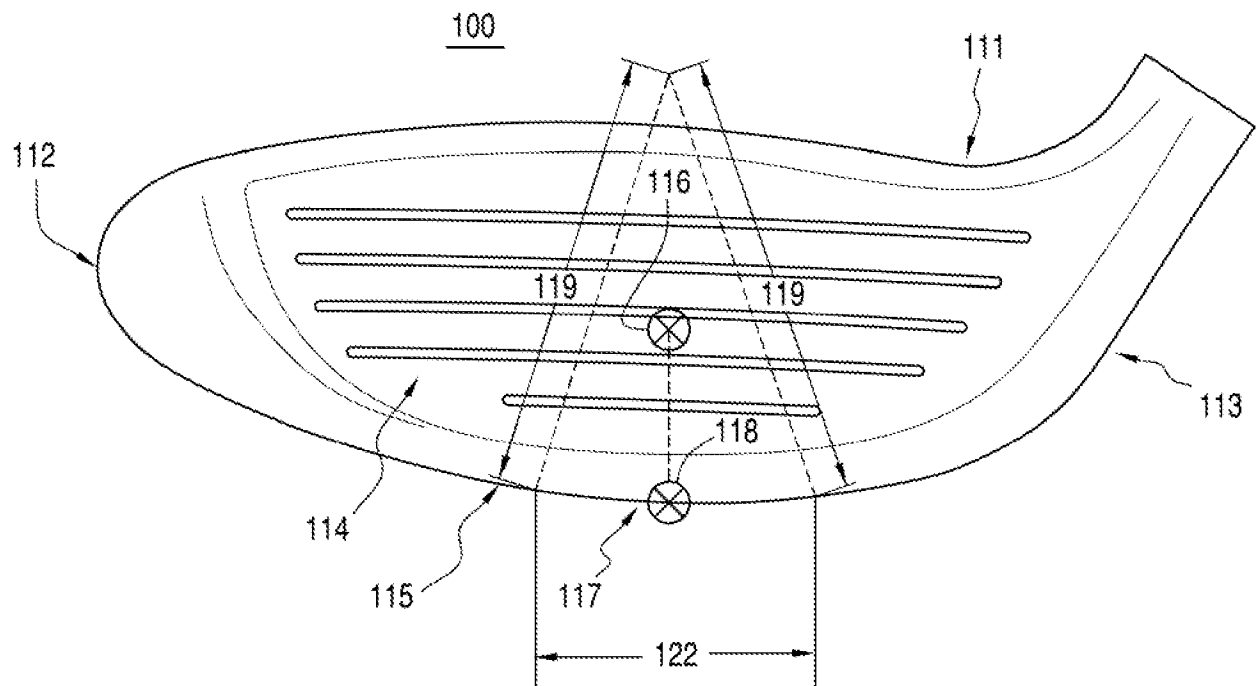


FIG. 1

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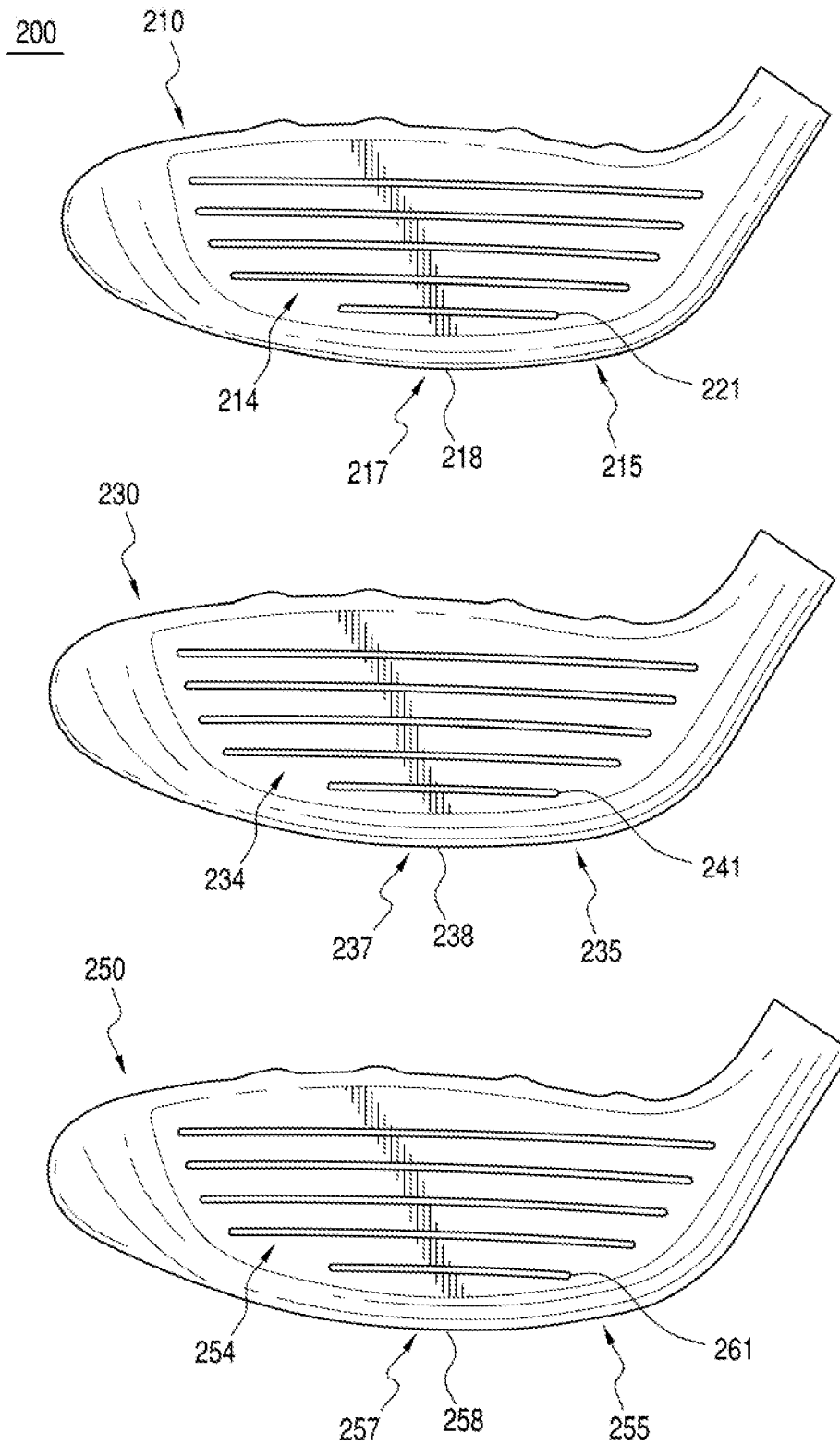


FIG. 2

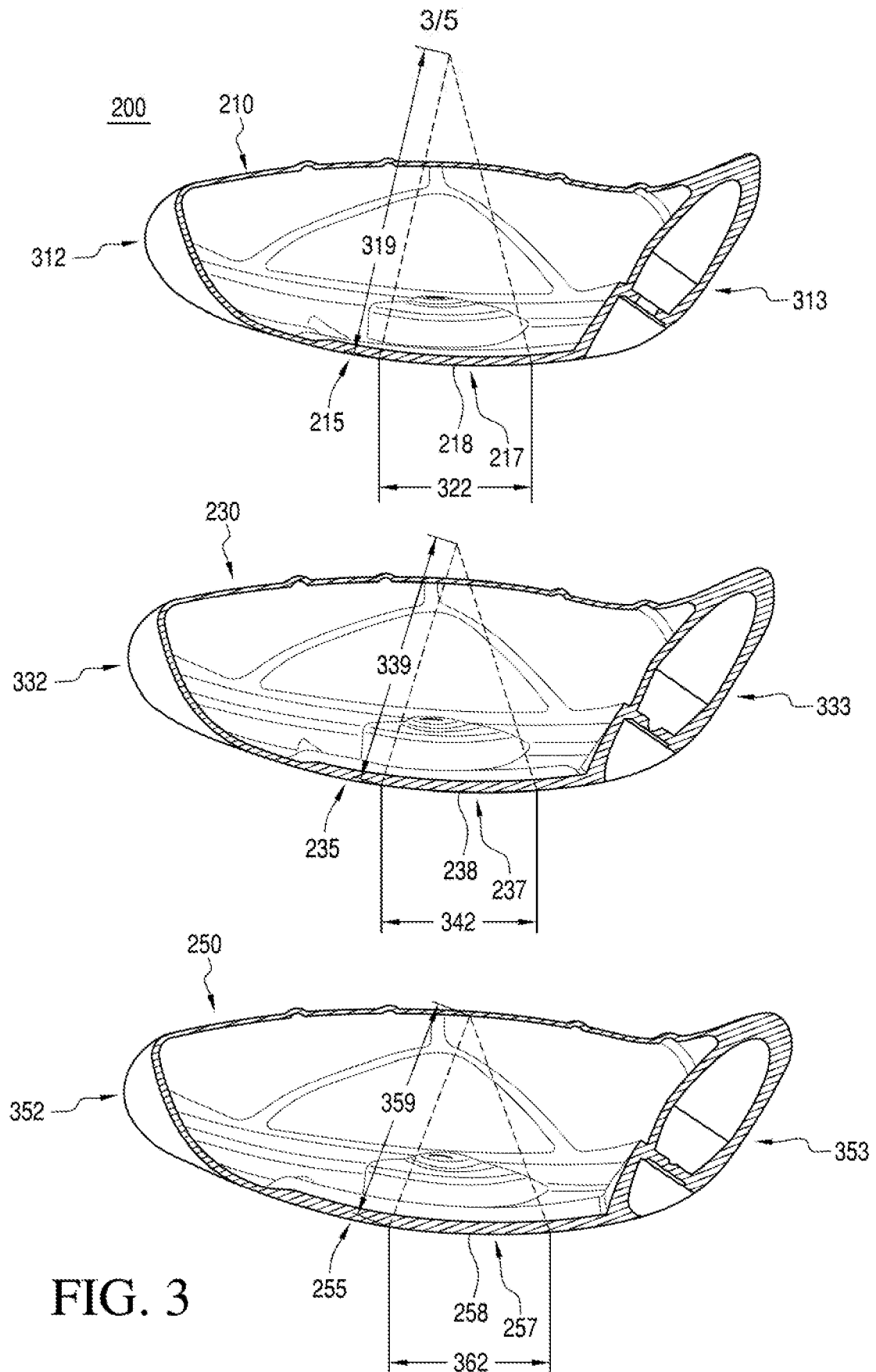
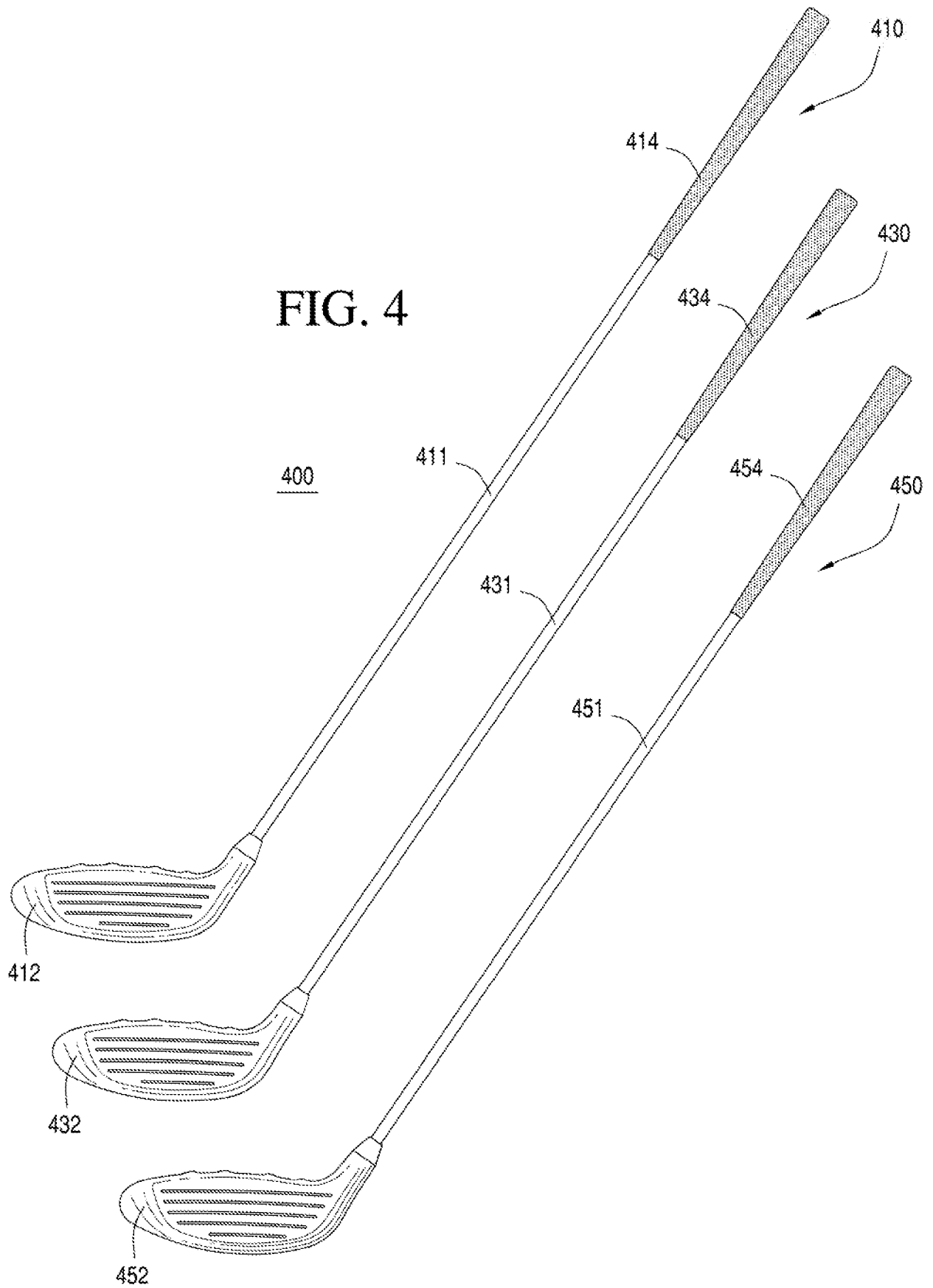


FIG. 3

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FIG. 4



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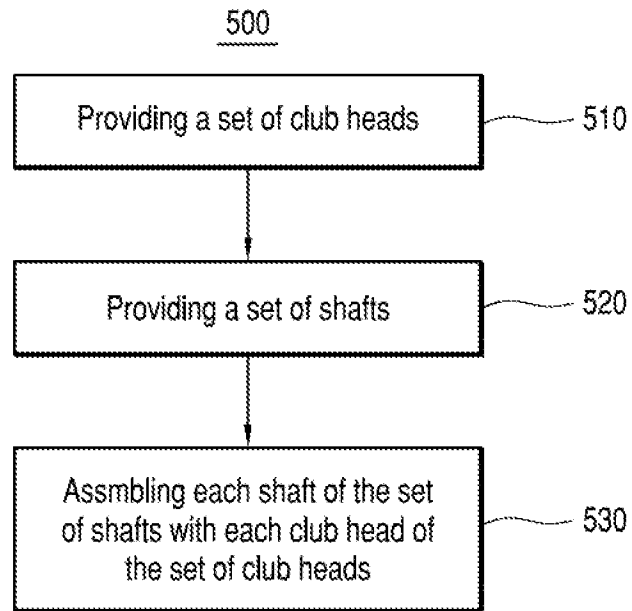


FIG. 5

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2014/064354**A. CLASSIFICATION OF SUBJECT MATTER****A63B 53/04(2006.01)i, A63B 53/02(2006.01)i**

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

A63B 53/04; A63B 53/00; A63B 53/02

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean utility models and applications for utility models

Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKOMPASS(KIPO internal) & Keywords: fairway wood type golf club, loft angle, sole

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2011-0118051 A1 (THOMAS) 19 May 2011 See abstract; paragraphs [0037], [0048]-[0049]; claims 1, 37.	1-3, 9-12, 19-21
A	US 2009-0181789 A1 (REED et al.) 16 July 2009 See abstract; figure 3; claim 1.	1-3, 9-12, 19-21
A	US 5193811 A (OKUMOTO et al.) 16 March 1993 See claims 1-8.	1-3, 9-12, 19-21
A	US 7854666 B2 (HORACEK et al.) 21 December 2010 See claims 1-12.	1-3, 9-12, 19-21
A	US 2004-0009830 A1 (NISHIO) 15 January 2004 See figures 1-2; claims 1-2.	1-3, 9-12, 19-21



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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

"&" document member of the same patent family

Date of the actual completion of the international search

09 February 2015 (09.02.2015)

Date of mailing of the international search report

09 February 2015 (09.02.2015)

Name and mailing address of the ISA/KR

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INTERNATIONAL SEARCH REPORTInternational application No.
PCT/US2014/064354**Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)**

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☒ Claims Nos.: 6,16,23
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
Claims 6, 16 and 23 are unclear since they refer to multiple dependent claims which do not comply with PCT Rule 6.4(a).
3. ☒ Claims Nos.: 4-5,7-8,13-15,17-18,22,24
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of any additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2014/064354

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