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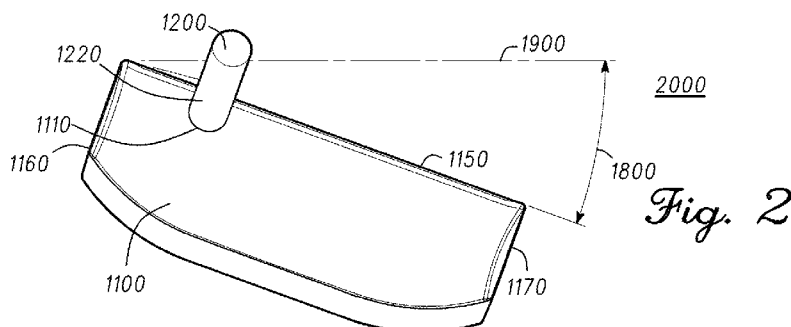
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(54) Title: CUSTOMIZABLE HANG ANGLE GOLF CLUBS, SYSTEMS, AND RELATED METHODS



(57) Abstract: Embodiments of customizable hang angle golf clubs and related mechanisms are presented herein. Other examples, systems, and related methods are also disclosed herein. In some examples, a golf club can comprise a club head and a shaft. The club head can comprise a heel portion, a toe portion, a hosel, a strikeface comprising a strikeface centerpoint, and a club head horizontal plane extending through the strikeface centerpoint. The shaft can be coupled to the hosel and can comprise a shaft lower portion comprising a shaft hosel end, and a shaft upper portion comprising a shaft grip end. An effective shaft axis can extend along a centerline of the shaft upper portion. The shaft can be configurable to accept and retain a shaft bend.

CUSTOMIZABLE HANG ANGLE GOLF CLUBS, SYSTEMS,
AND RELATED METHODS

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CROSS-REFERENCE TO RELATED APPLICATION(S)

10 This is an International Patent Application claiming the benefit of U.S. Patent Application No. 13/648,927, filed on October 10, 2012 at the U.S. Patent & Trademark Office.

TECHNICAL FIELD

15 The present disclosure relates generally to sports equipment, and relates, more particularly, to customizable hang angle golf clubs, systems, and related methods.

BACKGROUND

20 Several sports, like golf, require equipment with features that can be selected or custom-fit to an individual's characteristics or preferences. For example, the recommended club shaft and/or club head may vary based on the individual's characteristics, such as skill, age or height. Once assembled, however, golf clubs normally have fixed, unchangeable characteristics. Accordingly, when determining suitable equipment for the individual, an unnecessarily large number of golf clubs must be available to test different combinations of, for example, club shafts and club heads. Such shortcomings create problems with respect to predicting and maintaining needed quantities of
25 golf club components. Considering the above, further developments with respect to customizable golf clubs, systems, and related methods will ameliorate and/or address such shortcomings of current golf club technology.

BRIEF DESCRIPTION OF THE DRAWINGS

30 The present disclosure may be better understood from a reading of the following detailed description of examples of embodiments, taken in conjunction with the accompanying figures.

FIG. 1 illustrates a top view of a first golf club comprising a first golf club head and a first golf club shaft having a first shaft bend.

35 FIG. 2 illustrates a top view of a second golf club comprising the first golf club head and the first golf club shaft having a second shaft bend.

FIG. 3 illustrates a top view of a third golf club comprising the first golf club head and the first golf club shaft having a third shaft bend.

FIG. 4 illustrates a front view of the first golf club of FIG. 1.

FIG. 5 illustrates a front view of the second golf club of FIG. 2.

5 FIG. 6 illustrates a front view of the third golf club of FIG. 3.

FIG. 7 illustrates a front view of the first golf club of FIGs. 1 and 4.

FIG. 8 illustrates a front view of the second golf club of FIGs. 2 and 5.

FIG. 9 illustrates a front view of the third golf club of FIGs. 3 and 6.

10 FIG. 10 illustrates a flowchart of a method which can be used to provide, form, and/or manufacture a golf club in accordance with the present disclosure.

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
15 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.

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
20 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
25 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.

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
30 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.

The terms “couple,” “coupled,” “couples,” “coupling,” and the like should be broadly understood and refer to connecting two or more elements, mechanically or otherwise. Coupling (whether mechanical or otherwise) may be for any length of time, e.g., permanent or semi-permanent or only for an instant.

- 5 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.

DETAILED DESCRIPTION

10 In some examples, a golf club can comprise a club head and a shaft. The club head can comprise a heel portion, a toe portion, a hosel, a strikeface comprising a strikeface centerpoint, and a club head horizontal plane extending through the strikeface centerpoint. The shaft can be coupled to the hosel and can comprise a shaft lower portion comprising a shaft hosel end, and a shaft upper portion comprising a shaft grip end. An effective shaft axis can extend along a centerline of the shaft upper portion. The shaft can be configurable to accept and retain a shaft bend comprising any
15 one of: (1) a first bend corresponding to a straight stroke swing style, (2) a second bend corresponding to a slight arc swing style, or (3) a third bend corresponding to a strong arc swing style. The shaft bend can be locatable, along a length of the shaft, between the shaft upper portion and the shaft lower portion. The shaft bend can comprises a shaft bend height above the club head horizontal plane. The club head horizontal plane can be at least one of substantially perpendicular
20 to a vertical component of the effective shaft axis, or substantially parallel to a ground plane when the club head is at an address position.

 In the same or other examples, a golf club system can comprise a first club head and a first shaft for a first golf club, and a second club head and a second shaft for a second golf club. The first club head can comprise a first hosel, a first strikeface with a first strikeface centerpoint, a first club head
25 horizontal plane through the first strikeface centerpoint. The first shaft can comprise a first shaft bend located at a first bend height above the first club head horizontal plane. The second club head can comprise a second hosel, a second strikeface with a second strikeface centerpoint, and a second club head horizontal plane through the second strikeface centerpoint. The second shaft can comprise a second shaft bend located at a second bend height above the second club head
30 horizontal plane. The first and second club heads can be substantially equal to each other. The first and second shaft bend heights can be different from each other. The first and second shafts can be substantially equal to each other, other than with respect to the first and second bend heights. The first shaft bend can be configured to impart a first hang angle to the first golf club, the first hang angle comprising a first one of a face-balanced hang angle, a mid-hang angle, or a toe-down hang

angle. The second shaft bend is configured to impart a second hang angle to the second golf club, the second hang angle being different than the first hang angle and comprising a second one of the face-balanced hang angle, the mid-hang angle, or the toe-down hang angle.

In some implementations, a method for providing a golf club can comprise providing a shaft comprising a shaft length and configured to be coupled to a hosel of a club head, and imparting a shaft bend at a target shaft bend height along the shaft length. The target shaft bend height can correspond to a target swing style comprising one of a straight stroke swing style, a slight arc swing style, or a strong arc swing style. The target shaft bend height can be measured at the shaft bend and relative to a club head horizontal plane. The club head horizontal plane can pass through a strikeface centerpoint of the club head and can be at least one of substantially perpendicular to a vertical component of an effective shaft axis defined by the shaft, substantially parallel to a ground plane when the club head is at an address position.

Other examples and embodiments are further disclosed herein. Such examples and embodiments may be found in the figures, in the claims, and/or in the present description.

Turning to the drawings, FIG. 1 illustrates a top view of golf club 1000 comprising golf club head 1100 and golf club shaft 1200 coupled to club head 1100 via hosel 1110 of golf club head 1100. FIG. 2 illustrates a top view of golf club 2000 comprising golf club head 1100 and golf club shaft 1200. FIG. 3 illustrates a top view of golf club 3000 comprising golf club head 1100 and golf club shaft 1200. Although hosel 1110 comprises a cavity or bore internal to club head 1100, there can be other embodiments with hosels that can be at least partially external. In the embodiments of FIGs. 1-3, each of golf clubs 1000, 2000, and 3000 comprises a golf club head 1100 and a golf club shaft 1200. For example, golf club heads 1100 of golf clubs 1000, 2000, and 3000 can be of the same model and/or fabricated substantially the same as each other within club head manufacturing tolerances. Similarly, golf club shafts 1200 of golf clubs 1000, 2000, and 3000 can be of the same model and/or fabricated substantially equal to each other within shaft manufacturing tolerances. Nevertheless, golf clubs 1000, 2000, and 3000 differ structurally from each other with respect to the shaft bend imparted onto their respective golf club shafts 1200. For example, shaft 1200 of golf club head 1000 comprises shaft bend 100, shaft 1200 of golf club head 2000 comprises shaft bend 200, and shaft 1200 of golf club head 3000 comprises shaft bend 300, where shaft bends 100, 200, and 300 are different from each other.

FIGs. 1-3 show golf clubs 1000, 2000, and 3000, respectively, in equilibrium relative to horizontal axis 1900. As a result of the differences between shaft bends 100, 200, and 300, each of golf clubs 1000, 2000, and 3000 exhibits different hang angles relative to horizontal axis 1900. In some examples, to measure the hang angle of a golf club, the golf club can be set to equilibrium

such that its shaft is balanced along a horizontal plane, and such that its shaft can freely rotate about its shaft longitudinal axis as the center of gravity of the golf club's club head aligns relative to gravity. The hang angle can then be measured between the horizontal plane and the strike face of the golf club. Thus, golf club 1000 in FIG. 1 comprises hang angle 1800 between its strikeface 1150 and horizontal axis 1900, where hang angle 1800 comprises a face balanced hang angle resulting from shaft bend 100. Golf club 2000 in FIG. 2 comprises hang angle 2800 between its strikeface 1150 and horizontal axis 1900, where hang angle 2800 comprises a mid-hang hang angle resulting from shaft bend 200. Golf club 3000 in FIG. 3 comprises hang angle 3800 between its strikeface 1150 and horizontal axis 900, where hang angle 3800 comprises a toe-down hang angle resulting from shaft bend 300.

In some examples, club head 1100 can comprise a blade-type putter head, such that toe-down hang angle 3800 (FIG. 3) can be defined to be greater than approximately 48 degrees, mid-hang hang angle 2800 (FIG. 2) can be defined to be approximately 16 degrees to approximately 48 degrees, and/or face-balanced hang angle 1800 (FIG. 1) can be defined to be less than approximately 16 degrees.

There can be other examples, however, where club head 1100 comprises another style of club head. For instance, club head 1100 could instead comprise a mallet-type putter head, such that toe-down hang angle 3800 (FIG. 3) can be defined to be greater than approximately 23 degrees, mid-hang hang angle 2800 (FIG. 2) can be defined to be approximately 7 degrees to approximately 23 degrees, and/or face-balanced hang angle 1800 (FIG. 1) can be defined to be less than approximately 7 degrees.

Blade-type putter heads and mallet-type putter heads have different hang angle ranges because they have different locations for their respective centers of gravity. For example, the center of gravity for mallet-type putter heads lies further back from the strikeface than the center of gravity for blade-type putter heads. By increasing distance of the center of gravity from the strikeface, the range of achievable hang angles decreases, and smaller hang angle changes have greater effect on club head rotation or delivery.

The embodiments of FIGs. 1-3 can be selected to correspond to specific golf swing styles in some implementations. When fitting an individual for a golf club, one or more golf swings of the individual can be measured to determine, for example, the swing rotation of the strike face of the club head about the golf club shaft. Such swing rotation or other measured swing characteristics can be used to establish a measured swing style of the individual, which can be classified as a straight stroke swing style, a slight arc swing style, and/or a strong arc swing style, in some implementations. In some examples, the straight stroke swing style can comprise a swing rotation

of approximately zero degrees to approximately 3.5 degrees, the slight arc swing style can comprise a swing rotation of approximately 3.5 degrees to approximately 7.5 degrees, and/or the strong arc swing style comprises a swing rotation greater than approximately 7.5 degrees.

Based on such analysis, a golf club can be chosen or adjusted for the individual by selecting or
5 adjusting the corresponding shaft bend of the golf club. For example, shaft bend 100 of golf club 1000 can be configured to impart to golf club 1000 swing characteristics, such as face-balanced hang angle 1800, suitable for or corresponding to a straight stroke swing style for the individual being fitted. Similarly, shaft bend 200 of golf club 2000 can be configured to impart to golf club 2000 swing characteristics, such as mid-hang hang angle 2800, suitable for or corresponding to a
10 slight arc swing style for the individual being fitted. In addition, shaft bend 300 of golf club 1000 can be configured to impart to golf club 3000 swing characteristics, such as face-balanced hang angle 3800, suitable for or corresponding to a strong arc swing style for the individual being fitted.

In the present embodiments of FIGs. 1-3, shafts 1200 are configurable to accept and retain their corresponding shaft bends 100, 200, or 300 upon deformation or bending. For example, shafts 1200
15 may start off being substantially equal to each other, upon manufacture, lacking any of shaft bends 100, 200, or 300, and then may be modified by deformation or bending to achieve the desired shaft bend 100, 200, or 300. In the same or other examples, such deformation or bending can be applied to the shafts at the fitting locale where the individual is fitted, or at an adjustment location upon receipt of an order for a specific shaft bend after the individual's swing style is measured or
20 otherwise known. Shafts 1200 may be deformed or bent to achieve the desired shaft bend 100, 200, or 300, whether prior to or after being coupled to club head 1100. The ability to rely on a common golf club head and a common shaft modifiable to achieve golf clubs fitting different performance or swing style requirements can facilitate or simplify manufacturing and/or inventory management for both manufacturers and retailers. There can also be examples where shafts 1200 may be
25 manufactured by the factory to comprise shaft bends 100, 200, or 300, if desired.

FIG. 4 illustrates a front view of golf club 1000 with shaft bend 100 positioned to divide shaft 1200 into shaft upper portion 1210 and shaft lower portion 1220, where shaft upper portion 1210 comprises a shaft grip end of shaft 1200, and shaft lower portion 1220 comprises a shaft hosel end of shaft 1200. Shaft upper portion 1210 comprises shaft axis 4211 extending through a longitudinal
30 centerline thereof, where shaft axis 4211 can be geometrically subdivided into corresponding horizontal and vertical components, such as vertical component 42111. FIG. 5 illustrates a front view of golf club 2000 with shaft bend 200 positioned to divide shaft 1200 located between shaft upper portion 2210 (having a shaft grip end) and shaft lower portion 2220 (having a shaft hosel end). FIG. 6 illustrates a front view of golf club 3000 with shaft bend 300 positioned to divide shaft

1200 between shaft upper portion 3210 (having a shaft grip end) and shaft lower portion 3220 (having a shaft hosel end).

As seen in FIGs. 4-6, club head 1100 comprises club head horizontal plane 4900 extending across heel portion 1160 and toe portion 1170 of club head 1100, and passing through strikeface centerpoint 4150 of strikeface 1150. In some examples, horizontal plane 4900 can be substantially parallel to ground plane 4500 when golf club 1000 is at a golf address position, such as seen in FIGs. 4-6. In the same or other examples, horizontal plane 4900 can be substantially perpendicular to vertical component 42111 of shaft axis 4211, where vertical component 42111 can be substantially perpendicular a top end of hosel 1110, substantially perpendicular to a top end of strikeface 1150, and/or substantially perpendicular to ground plane 4500 when golf club 1000 is at the address position in some implementations.

In some examples, strikeface centerpoint 4150 can be located at a geometric centerpoint of strikeface 1150, a geometric centerpoint of a strikeplate of strikeface 1150, and/or at a geometric centerpoint of the front end of club head 1100. In the same or other examples, strikeface centerpoint 4150 can be located in accordance with the definition of a golf governing body such as the United States Golf Association (USGA). For example, strikeface centerpoint 4150 can be determined in accordance with Section 6.1 of the USGA's Procedure for Measuring the Flexibility of a Golf Clubhead (USGA-TPX3004, Rev. 1.0.0, May 1, 2008) (available at <http://www.usga.org/equipment/testing/protocols/Procedure-For-Measuring-The-Flexibility-Of-A-Golf-Club-Head/>).

As seen in FIGs. 4-6, shaft bend 100 defines shaft bend angle 401 for golf club 1000 (FIG. 4), shaft bend 200 defines shaft bend angle 501 for golf club 2000 (FIG. 5), and shaft bend 300 defines shaft bend angle 601 for golf club 3000 (FIG. 6), where shaft bend angles 401 (FIG. 4), 501 (FIG. 5) and 601 (FIG. 6) are substantially equal to each other in golf clubs 1000 (FIGs. 1, 4) 2000 (FIGs. 2,5) and 3000 (FIGs. 3, 6). In some examples, shaft bend angles 401, 501, and/or 601 can be approximately 146 degrees to approximately 174 degrees.

Shaft bends 100 (FIG. 4), 200 (FIG. 5), and 300 (FIG. 6) differ from each other, however, with respect to their respective heights relative to club head horizontal plane 4900. For example, golf club 1000 can comprise shaft bend 100 located at shaft bend height 4100 above club head horizontal plane 4900 (FIG. 4), where shaft bend height 4100 can be greater than approximately 95 mm above club head horizontal plane 4900 in some implementations. Golf club 2000 can comprise shaft bend 200 located at shaft bend height 5200 above club head horizontal plane 4900 (FIG. 5), where shaft bend height 5200 can be approximately 70 mm to approximately 100 mm above club head horizontal plane 4900 in some implementations. Golf club 3000 can comprise shaft bend 300

located at shaft bend height 6300 above club head horizontal plane 4900 (FIG. 6), where shaft bend height 6300 can be less than approximately 85 mm above club head horizontal plane 4900 in some implementations. Shaft bend height 4100 (FIG. 4) is greater than shaft bend height 5200 (FIG. 5), and shaft bend height 5200 is greater than shaft bend height 6300 (FIG. 6). In some examples, shaft bend height 4100 (FIG. 4) may be referred to as a high bend height; shaft bend height 5200 (FIG. 5) may be referred to as a medium bend height; and shaft bend height 6300 (FIG. 6) may be referred to as a low bend height. In the present examples, shaft bend height 4100 (FIG. 4), shaft bend height 5200 (FIG. 5), and shaft bend height 6300 (FIG. 6) is measured with respect to the shaft bend closest to the shaft grip end of the shaft, regardless of any further bend(s) towards the hosel end of the shaft. In the same or other examples, golf club shaft 1200 for each of golf club 1000 (FIGs. 1, 4), golf club 2000 (FIGs. 2, 3), and/or golf club 3000 (FIGs. 3, 6) can comply with Section 2a of Appendix II of the USGA Rules of Golf (available at <http://www.usga.org/uploadedFiles/USGAHome/rules/CompleteROGbook.pdf>), which requires that "The shaft must be straight from the top of the grip to a point not more than 5 inches (127 mm) above the sole, measured from the point where the shaft ceases to be straight along the axis of the bent part of the shaft and the neck and/or socket."

In the same or other examples, the high bend height of shaft bend height 4100 for shaft bend 100 can be configured to impart face-balanced hang angle 1800 (FIG. 1) to golf club 1000, such as in situations where the measured swing style of the individual is the straight stroke swing style. Similarly, the medium bend height of shaft bend height 5200 for shaft bend 200 can be configured to impart mid-hang angle 2800 (FIG. 2) to golf club 2000, such as in situations where the measured swing style of the individual is the slight arc swing style. In addition, the low bend height of shaft bend height 6300 for shaft bend 300 can be configured to impart toe-down hang angle 3800 (FIG. 3) to golf club 3000, such as in situations where the measured swing style of the individual is the strong arc swing style.

As can be seen in FIG. 4, shaft upper portion 1210 of golf club 1000 comprises shaft axis 4211 extending through a longitudinal centerline of shaft upper portion 1210, and continues straight past shaft bend 100 to intersect club head horizontal plane 4900 at intersection distance 4215 away from strikeface centerpoint 4150 of strikeface 1150. Similarly, as can be seen in FIG. 5, shaft upper portion 2210 of golf club 2000 comprises shaft axis 5211 extending through a longitudinal centerline of shaft upper portion 2210, and continues straight past shaft bend 200 to intersect club head horizontal plane 4900 at intersection distance 5215 away from strikeface centerpoint 4150 of strikeface 1150. In addition, as can be seen in FIG. 6, shaft upper portion 3210 of golf club 3000 comprises shaft axis 6211 extending through a longitudinal centerline of shaft upper portion 3210,

and continues straight past shaft bend 300 to intersect club head horizontal plane 4900 at intersection distance 6215 away from strikeface centerpoint 4150 of strikeface 1150. In some examples, shaft axes 4211 (FIG. 4), 5211 (FIG. 5), and 6211 (FIG. 6) may be respectively referred to as the “effective” shaft axes of golf clubs 1000, 2000, and 3000, because such golf clubs may substantially perform as if their respective shafts are, in effect, attached to the top of the club head 1100 proximate to respective intersection distances 4215 (FIG. 4), 5215 (FIG. 5), or 6215 (FIG. 6) from strikeface centerpoint 4150, rather than attached to the location of hosel 1110.

In the present examples, intersection distance 6215 in golf club 3000 (FIG. 6) is greater than intersection distance 5215 in golf club 2000 (FIG. 2), and intersection distance 5215 in golf club 2000 (FIG. 2) is greater than intersection distance 4215 in golf club 1000 (FIG. 1), where such differences between intersection distances 4215, 5215, and 6215 are respectively dictated by shaft bend heights 4100, 5200, and 6300 of shaft bends 100 (FIG. 4), 200 (FIG. 5), and 300 (FIG. 6). Intersection distance 4215 (FIG. 4) can be less than approximately 1.8 mm in some implementations. Intersection distance 5215 (FIG. 5) can be approximately 1.8 mm to approximately 16.5 mm in some implementations. Intersection distance 6215 (FIG. 6) can be greater than approximately 16.5 mm in some implementations.

Considering the above, the shaft bend height can be used to adjust the intersection distance of the effective shaft axes relative to the strikeface centerpoint of the club head, such as to achieve a desired hang angle range and/or to suit a desired swing style. For example, intersection distance 5215 (FIG. 5) places shaft axis 5211, relative to strikeface centerpoint 4150, at a location suitable for imparting a mid-hang hang angle (such as hang angle 2800 (FIG. 2)) onto golf club 2000, and/or suitable for configuring golf club 2000 for a slight arc swing style. In contrast, intersection distance 4215 (FIG. 4) places shaft axis 4211 relatively closer to strikeface centerpoint 4150, and is thus suitable for imparting a face-balanced hang angle (such as hang angle 1800 (FIG. 1)) onto golf club 1000, and/or suitable for configuring golf club 1000 for a straight stroke swing style. For its part, intersection distance 6215 (FIG. 6) places shaft axis 6211 relatively farther away from strikeface centerpoint 4150, and is thus suitable for imparting a toe-down hang angle (such as hang angle 3800 (FIG. 3)) onto golf club 3000, and/or suitable for configuring golf club 3000 for a strong arc swing style.

In some implementations, the shaft bend height can be used to set or adjust the shaft intersection distance, relative to the strikeface centerpoint, to establish desired intersection ratios of the shaft intersection distances relative to a club head length of the club head. In such implementations, the club head length can be measured between opposite heel and toe ends of the

club head. For instance, as seen in FIGs. 4-6, club head 1100 comprises club head length 4140 between opposite heel and toe ends thereof.

Thus, with respect to the embodiment of FIG. 4, golf club 1000 comprises an intersection ratio of intersection distance 4215 over club head length 4140, where such intersection ratio can be of less than approximately 0.05 in some examples, where such intersection ratio can establish a face-balanced hang angle (such as hang angle 1800 (FIG. 1)) onto golf club 1000, and/or where such intersection ratio can configure golf club 1000 for a straight stroke swing style. With respect to the embodiment of FIG. 5, golf club 2000 comprises an intersection ratio of intersection distance 5215 over club head length 4140, where such intersection ratio can be between approximately 0.05 to approximately 0.155 in some examples, where such intersection ratio can establish a mid-hang hang angle (such as hang angle 2800 (FIG. 2)) onto golf club 2000, and/or where such intersection ratio can configure golf club 2000 for a slight arc swing style. With respect to the embodiment of FIG. 6, golf club 3000 comprises an intersection ratio of intersection distance 6215 over club head length 4140, where such intersection ratio can be greater than approximately 0.155 in some examples, where such intersection ratio can establish a toe-down hang angle (such as hang angle 3800 (FIG. 3)) onto golf club 3000, and/or where such intersection ratio can configure golf club 3000 for a strong arc swing style.

FIG. 7 illustrates a heelside view of golf club 1000, with shaft bend height 4100 of shaft bend 100 positioning shaft axis 4211 at offset distance 7216 relative to strikeface 1150. FIG. 8 illustrates a heelside view of golf club 2000, with shaft bend height 5200 of shaft bend 200 positioning shaft axis 5211 at offset distance 8216 relative to strikeface 1150. FIG. 9 illustrates a heelside view of golf club 3000, with shaft bend height 6300 of shaft bend 300 positioning shaft axis 6211 at offset distance 9216 relative to strikeface 1150.

As can be seen in FIGs. 7-9, the different shaft bend heights of shaft bends 100, 200, and 300 impart different offset distances 7216, 8216, and 9216 for club heads 1000, 2000, and 3000, respectively. For the present examples of FIGs. 7-9, the taller the shaft bend height, the greater the offset distance between the effective shaft axis and the strikeface. Thus, different offsets can be achieved using the same golf club head and the same golf club shaft by imparting the appropriate the shaft bend height. For instance, offset distance 9216 between shaft axis 6211 and strikeface 1150 in golf club 3000 (FIG. 9) can be selected, via shaft bend height 6300 of shaft bend 300, to establish a toe-down hang angle (such as hang angle 3800 (FIG. 3)) onto golf club 3000, and/or to configure golf club 3000 for a strong arc swing style. Similarly, offset distance 8216 between shaft axis 5211 and strikeface 1150 in golf club 2000 (FIG. 8) can be selected, via shaft bend height 5200 of shaft bend 200, to be greater than offset distance 9216 and/or to establish a mid-hang hang angle

(such as hang angle 2800 (FIG. 2)) onto golf club 2000, and/or to configure golf club 2000 for a slight arc swing style. In addition, offset distance 7216 between shaft axis 4211 and strikeface 1150 in golf club 1000 (FIG. 7) can be selected, via shaft bend height 4100 of shaft bend 100, to be greater than offset distance 8216 and/or to establish a face-balanced hang angle (such as hang angle 1800 (FIG. 1)) onto golf club 1000, and/or to configure golf club 1000 for a straight stroke swing style. The offset distances 7216, 8216, and 9216 can be defined relative to a positive offset direction that is perpendicular to strikeface centerpoint 4150 and points forward of golf club head 1100.

In the present examples of FIGs. 1-9, the angles of the shaft lower portions relative to club head horizontal plane 4900 are set by hosel 1110 and are substantially the same for each of golf club heads 1000 (FIGs. 1, 4, 7), 2000 (FIGs. 2, 5, 8), and 3000 (FIGs. 3, 6, 9). In some implementations, shaft lower portions 1220 (FIGs. 1, 4, 7), 2220 (FIGs. 2, 5, 8), and 3220 (FIGs. 3, 6, 9) can comprise shaft-to-strikeface angle 7222 (FIG. 7) of approximately 70 degrees to approximately 100 degrees, and shaft-to-heel angle 4221 (FIG. 4) of approximately 105 degrees to approximately 75 degrees. In the same or other examples, shaft-to-strikeface angle 7222 can be approximately 82 degrees, and shaft-to-heel angle 4221 (FIG. 4) can be approximately 88 degrees. Although shaft-to-strikeface angle 7222 (FIG. 7) and shaft-to-heel angle 4221 (FIG. 4) are illustrated in the figures as acute angles relative to club head horizontal plane 4900, there may be embodiments where one or both of shaft-to-strikeface angle 7222 and shaft-to-heel angle 4221 are not acute angles.

FIG. 10 illustrates a flowchart of a method 10000, which can be used to provide, form, and/or manufacture a golf club in accordance with the present disclosure. In some examples, the golf club of method 10000 can be similar to any one of golf club 1000 (FIGs. 1, 4, 7), golf club 2000 (FIGs. 2, 5, 8) or golf club 3000 (FIGs. 3, 6, 9).

Method 10000 comprises block 10100 for providing a shaft configured to accept a shaft bend and to be coupled to a hosel of a golf club head of the golf club. In some examples, the golf club head can be similar to golf club head 1100 (FIGs. 1-9), and the shaft can be similar to shaft 1200 (FIGs. 1-9) of golf club 1000 (FIGs. 1, 4, 7), golf club 2000 (FIGs. 2, 5, 8), or golf club 3000 (FIGs. 3, 6, 9). In the same or other examples, the shaft can be coupled to the golf club head via a hosel similar to hosel 1110 (FIGs. 1-9), whether such hosel is fully internal or at least partially external the golf club head. Likewise, in the same or other examples, depending on the type of implementation being sought, the shaft bend can be similar to any one of shaft bend 100 (FIGs. 1, 4, 7), shaft bend 200 (FIGs. 2, 5, 8), or shaft bend 300 (FIGs. 3, 6, 9).

Method 10000 also comprises block 10200 for imparting the shaft bend at a target shaft bend height along the shaft length of the shaft. In some examples, the target shaft bend height may be

similar to one of shaft bend height 4100 (FIGs. 4, 7), shaft bend height 5200 (FIGs. 5, 8), or shaft bend height 6300 (FIGs. 3, 6, 9).

In some examples, block 10200 of method 10000 comprises sub-block 10210 for configuring the golf club, via the shaft bend, for a target swing style comprising one of a straight stroke swing style, a slight arc swing style, or a strong arc swing style. For instance, the shaft bend may be defined within a range of shaft bend heights, and/or within a range of shaft bend angles, configured to establish one or more swing characteristics for the golf club to complement a measured swing style of an individual being fitted, whether the measured swing style comprises the straight stroke swing style, the slight arc swing style, or the strong arc swing style described above with respect to FIGs. 1-9. There can be examples where the target swing characteristics of the golf club can be defined by setting the shaft bend height, while relying on the same shaft bend angle for all shaft bend height options. In one example, the shaft bend may configure the golf club for the straight stroke swing style when its shaft bend height is similar to the high shaft bend height described above with respect to shaft bend height 4100 (FIGs. 4, 7). In another example, the shaft bend may configure the golf club for the slight arc swing style when its shaft bend height is similar to the medium shaft bend height described above with respect to shaft bend height 5200 (FIGs. 5, 8). In another example, the shaft bend may configure the golf club for the strong arc swing style when its shaft bend height is similar to the low shaft bend height described above with respect to shaft bend height 6300 (FIGs. 6, 9).

In the same or other examples, block 10200 of method 10000 also can comprise sub-block 10220 for configuring the shaft, via the shaft bend, to impart a target hang angle for the golf club. In some implementations, the target hang angle may be similar to hang angle 1800 (FIG. 1), hang angle 2800 (FIG. 2), or hang angle 3800 (FIG. 3). In the same or other implementations, the target hang angle can comprise one of a face-balanced hang angle, a mid-hang hang angle, or a toe-down hang angle as described above with respect to golf club 1000 (FIGs. 1, 4, 7), golf club 2000 (FIGs. 2, 5, 8) or golf club 3000 (FIGs. 3, 6, 9).

Imparting the shaft bend onto the shaft in block 10200 can also be accomplished by establishing a desired intersection distance between a strikeface centerpoint of a strikeface of the golf club head and an intersection point where an effective shaft axis of the shaft intersects a club head horizontal plane. In some examples, the strikeface centerpoint can be similar to strikeface centerpoint 4150 of strikeface 1150 (FIGs. 4-9), the effective shaft axis can be similar to shaft axis 4211 (FIGs. 4, 7), shaft axis 5211 (FIGs. 5, 8), or shaft axis 6211 (FIGs. 6, 9). The intersection distance can be similar to intersection distance 4215 (FIG. 4), 5215 (FIG. 5), or 6215 (FIG. 6). For example, if the target swing style of block 10200 comprises the straight stroke swing style, the shaft bend can be

imparted such that the effective shaft axis intersects the club head horizontal plane at an intersection distance similar to intersection distance 4215 (FIG. 4). As another example, if the target swing style of block 10200 comprises the slight arc swing style, the shaft bend can be imparted such that the effective shaft axis intersects the club head horizontal plane at an intersection distance similar to intersection distance 5215 (FIG. 5). As yet another example, if the target swing style of block 10200 comprises the strong arc swing style, the shaft bend can be imparted such that the effective shaft axis intersects the club head horizontal plane at an intersection distance similar to intersection distance 6215 (FIG. 6).

After block 10200, method 10000 can further comprise block 10300 for coupling the shaft to the hosel of the golf club head. As an example, the result of the coupling can be similar to what is shown in FIGs. 1-9.

In some examples, one or more of the different blocks of method 10000 can be combined into a single block or performed simultaneously, and/or the sequence of such blocks can be changed. For example, in some implementations, sub-blocks 10210 and 10220 may be combined if desired. In the same or other implementations, block 10300 can precede block 10200. There also can be examples where some of the blocks of method 10000 can be subdivided into several sub-blocks. As an example, block 10200 may further comprise a sub-block for configuring the golf club, via the shaft bend, to comprise an intersection distance similar to one of intersection distances 4215 (FIG. 4), 5215 (FIG. 5), or 6215 (FIG. 6) based on the target swing style and/or the target hang angle. As another example, block 10200 may further comprise a sub-block for configuring the golf club, via the shaft bend, to comprise an intersection ratio as described above with respect to the examples of FIGs. 4-6 and based on the target swing style or the target hang angle. As an example, block 10200 may further comprise a sub-block for configuring the golf club, via the shaft bend, to comprise an offset distance similar to one of offset distances 7216 (FIG. 7), 8216 (FIG. 8), or 9216 (FIG. 9) based on the target swing style or the target hang angle.

There can also be examples where method 10000 can comprise further or different blocks. As an example, method 10000 may comprise another block for measuring a swing style of an individual being fitted, and/or for imparting the shaft bend of block 10200 based on the swing style of the individual being fitted. In addition, there may be examples where method 10000 can comprise only part of the steps described above. For instance, block 10300 may be optional in some implementations. Other variations can be implemented for method 10000 without departing from the scope of the present disclosure.

Although the customizable hang angle golf clubs, systems, and related methods herein have been described with reference to specific embodiments, various changes may be made without

departing from the spirit or scope of the present disclosure. As an example, golf club shaft 1200 can be provided with a telescoping mechanism to permit the shaft bend of the golf club to be adjustable between shaft bend height 4100 (FIGs. 4, 7), shaft bend height 5200 (FIGs. 5, 8), or shaft bend height 6300 (FIGs. 6, 9). In addition, although some implementations of shaft bends 100 (FIGs. 1, 4, 7), 200 (FIGs. 2, 5, 8), or 300 (FIGs. 3, 6, 9) have been described above as comprising the same shaft bend angle, there can be embodiments where the shaft bend angles of shaft bends 100, 200, and 300 may differ from one another.

Additional examples of such changes and others 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 specification, claims, and drawings herein are intended to be illustrative of the scope of the disclosure and is not intended to be limiting. It is intended that the scope of this application shall be limited only to the extent required by the appended claims.

The customizable hang angle golf clubs, systems, and related methods 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.

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 claims.

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.

While the above examples may be described in connection with a putter-type golf club, the apparatus, methods, and articles of manufacture described herein may be applicable to other types of golf club such as a driver-type golf club, a fairway wood-type golf club, a hybrid-type golf club, an iron-type golf club, or a wedge-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.

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

1. A golf club comprising:

a club head comprising:

a heel portion; a toe portion; a hosel;

a strikeface comprising a strikeface centerpoint; and

a club head horizontal plane extending through the strikeface centerpoint;

a shaft coupled to the hosel and comprising:

a shaft lower portion comprising a shaft hosel end; and

a shaft upper portion comprising a shaft grip end;

and

an effective shaft axis extending along a centerline of the shaft upper portion;

wherein:

the shaft is configurable to accept and retain a shaft bend comprising any one of:

a first bend corresponding to a straight stroke swing style;

a second bend corresponding to a slight arc swing style; or

a third bend corresponding to a strong arc swing style;

the shaft bend is locatable, along a length of the shaft, between the shaft upper portion and the shaft lower portion;

the shaft bend comprises a shaft bend height above the club head horizontal plane; and

the club head horizontal plane is at least one of:

substantially perpendicular to a vertical component of the effective shaft axis; or

substantially parallel to a ground plane when the club head is at an address position.

2. The golf club of claim 1, wherein:

the straight stroke swing style comprises a straight stroke swing rotation of approximately zero degrees to approximately 3.5 degrees;

the slight arc swing style comprises a slight arc swing rotation of approximately 3.5 degrees to approximately 7.5 degrees;

the strong arc swing style comprises a strong arc swing rotation greater than approximately 7.5 degrees; and

the vertical component of the effective shaft axis is substantially perpendicular to at least one of:

a top end of the hosel of the club head;

a top end of the strike face; or

the ground plane when the club head is at the address position.

3. The golf club of any one of claims 1-2, wherein:

the shaft bend corresponds to a measured swing style of an individual, the measured swing style being correlated, based on one or more measured golf swings of the individual, to one of the straight stroke swing style, the slight arc swing style, or the strong arc swing style; and the golf club is a putter.

4. The golf club of any one of claims 1-3, wherein:

the shaft is configurable to accept the shaft bend such that:

for the straight stroke swing style, the shaft bend height of the first bend comprises a high bend height;

for the slight arc swing style, the shaft bend height of the second bend comprises a medium bend height;

for the strong arc swing style, the shaft bend height of the third bend comprises a low bend height;

the high bend height is greater than the medium bend height; and the medium bend height is greater than the low bend height.

5. The golf club of claim 4, wherein:

when the shaft comprises the first bend at the high bend height:

the golf club comprises a face-balanced hang angle;

when the shaft comprises the second bend at the medium bend height:

the golf club comprises a mid-hang angle; and

when the shaft comprises the third bend at the low bend height:

the golf club comprises a toe-down hang angle.

6. The golf club of any one of claims 1-4, wherein:

when the shaft bend corresponds to the straight stroke swing style:

the golf club comprises a face-balanced hang angle;

when the shaft bend corresponds to the slight arc swing style:

the golf club comprises a mid-hang angle; and

when the shaft bend corresponds to the strong arc swing style:

the golf club comprises a toe-down hang angle.

7. The golf club of claim 6, wherein:

when the club head comprises a blade-type putter head:

the face-balanced hang angle is less than approximately 16 degrees;

the mid-hang hang angle is approximately 16 degrees to approximately 48 degrees; and

5 the toe-down hang angle is greater than approximately 48 degrees;

and

when the club head comprises a mallet-type putter head:

the face-balanced hang angle is less than approximately 7 degrees;

the mid-hang hang angle is approximately 7 degrees to approximately 23 degrees; and

10 the toe-down hang angle is greater than approximately 23 degrees.

8. The golf club of any one of claims 1-7, wherein:

if the shaft is configured for the straight stroke swing style:

15 the shaft bend height is greater than approximately 95 mm above the club head horizontal plane;

if the shaft is configured for the slight arc swing style:

the shaft bend height is approximately 70 mm to approximately 100 mm above the club head horizontal plane;

and

20 if the shaft is configured for the strong arc swing style:

the shaft bend height is less than approximately 85 mm above the club head horizontal plane.

9. The golf club of any one of claims 1-8, wherein:

if the shaft is configured for the straight stroke swing style:

25 the effective shaft axis intersects the club head horizontal plane at a first intersection distance from the strikeface centerpoint;

if the shaft is configured for the slight arc swing style:

the effective shaft axis intersects the club head horizontal plane at a second intersection distance from the strikeface centerpoint, the second distance being greater than the first distance;

30 and

if the shaft is configured for the strong arc swing style:

the effective shaft axis intersects the club head horizontal plane at a third intersection distance from the strikeface centerpoint, the third distance being greater than the second distance.

35

10. The golf club of claim 9, wherein:

the first intersection distance is less than approximately 1.8 mm;

the second intersection distance is approximately 1.8 mm to approximately 16.5 mm; and

the third intersection distance is greater than approximately 16.5 mm.

5

11. The golf club of any one of claims 9-10, wherein:

the club head comprises:

a club head length between opposite ends of the heel and toe portions;

when the shaft is configured for the straight stroke swing style:

10 a first intersection ratio, between the first intersection distance and the club head length,
is less than approximately 0.05;

when the shaft is configured for the slight arc swing style:

a second intersection ratio, between the second intersection distance and the club head
length, is between approximately 0.05 to approximately 0.155;

15 and

when the shaft is configured for the strong arc swing style:

a third intersection ratio, between the third intersection distance and the club head length,
is greater than approximately 0.155.

20 12. The golf club of any one of claims 1-11, wherein:

the shaft bend defines a shaft bend angle between the shaft upper portion and the shaft lower
portion; and

the shaft bend angle is the same regardless of whether the shaft bend comprises the first bend for
the straight stroke swing style, the second bend for the slight arc swing style, or the third bend
25 for the strong arc swing style.

13. The golf club of claim 12, wherein:

the shaft bend angle is approximately 146 degrees to approximately 174 degrees.

30 14. The golf club of any one of claims 1-13, wherein:

the hosel is configured to position the shaft lower portion in at least one of:

a shaft-to-strikeface angle, between the shaft lower portion and the club head horizontal
plane at the strikeface, and non-perpendicular to the club head horizontal plane; or

a shaft-to-heel angle, between the shaft lower portion and the club head horizontal plane at
35 the heel portion, and non-perpendicular to the club head horizontal plane.

15. The golf club of claim 14, wherein the shaft-to-striкеface angle is acute.

16. The golf club of claim 14, wherein:

- 5 the shaft-to-striкеface angle is approximately 70 degrees to approximately 100 degrees; and
 the shaft-to-heel angle is approximately 105 degrees to approximately 75 degrees.

17. The golf club of any one of claims 1-16, wherein:

 if the shaft comprises the first bend:

- 10 the effective shaft axis is offset from the strikeface by a first offset distance;

 if the shaft comprises the second bend:

 the effective shaft axis is offset from the strikeface by a second offset distance;

 if the shaft comprises the third bend:

 the effective shaft axis is offset from the strikeface by a third offset distance;

- 15 the first offset distance is greater than the second offset distance;

 the second offset distance is greater than the third offset distance; and

 the first, second and third offset distances are measured relative to a positive offset direction that
 is perpendicular to the strikeface at the strikeface centerpoint and points forward of the golf club.

20

18. A golf club system comprising:

 a first club head for a first golf club, the first club head comprising:

 a first hosel;

 a first strikeface with a first strikeface centerpoint; and

- 25 a first club head horizontal plane through the first strikeface centerpoint;

 a first shaft for the first golf club, the first shaft comprising:

 a first shaft bend located at a first bend height above the first club head horizontal plane;

 a second club head for a second golf club, the second club head comprising:

 a second hosel;

- 30 a second strikeface with a second strikeface centerpoint; and

 a second club head horizontal plane through the second strikeface centerpoint;

 and

 a second shaft for the second golf club, the second shaft comprising:

 a second shaft bend located at a second bend height above the second club head

- 35 horizontal plane;

wherein:

the first and second club heads are substantially equal to each other;

the first and second shaft bend heights are different from each other;

the first and second shafts are substantially equal to each other, other than with respect to
5 the first and second bend heights;

the first shaft bend is configured to impart a first hang angle to the first golf club, the first
hang angle comprising a first one of:

a face-balanced hang angle;

a mid-hang angle; or

10 a toe-down hang angle;

the second shaft bend is configured to impart a second hang angle to the second golf club, the
second hang angle being different than the first hang angle and comprising a second one of:

the face-balanced hang angle;

the mid-hang angle; or

15 the toe-down hang angle.

19. The golf club system of claim 18, wherein:

the first hang angle corresponds to a first one of:

a straight stroke swing style;

20 a slight arc swing style; or

a strong arc swing style;

the second hang angle corresponds to a second one of:

the straight stroke swing style;

the slight arc swing style; or

25 the strong arc swing style;

the first shaft bend comprises a first shaft bend angle;

the second shaft bend comprises a second shaft bend angle; and

the first and second shaft bend angles are equal to each other.

30

20. The golf club system of any one of claims 18-19, further comprising:

a third club head for a third golf club, the third club head comprising:

a third hosel;

a third strikeface with a third strikeface centerpoint; and

35 a third club head horizontal plane through the third strikeface centerpoint;

and

a third shaft for the third golf club, the third shaft comprising:

a third shaft bend located at a third bend height above the third club head horizontal plane;

wherein:

the first, second, and third club heads are substantially equal to each other;

5 the first, second, and third shaft bend heights are different from each other;

the first, second, and third shafts are substantially equal to each other, other than with respect to the first, second, and third bend heights;

the third shaft bend is configured to impart a third hang angle to the third golf club, the third hang angle being different than the first and second hang angles and comprising a

10 third one of:

the face-balanced hang angle;

the mid-hang angle; or

the toe-down hang angle.

15

21. A method for providing a golf club, the method comprising:

providing a shaft comprising a shaft length and configured to be coupled to a hosel of a club head; and

imparting a shaft bend at a target shaft bend height along the shaft length;

20

wherein:

the target shaft bend height corresponds to a target swing style comprising one of:

a straight stroke swing style;

a slight arc swing style; or

a strong arc swing style;

25

the target shaft bend height is measured at the shaft bend and relative to a club head horizontal plane,

the club head horizontal plane passing through a strikeface centerpoint of the club head and being at least one of:

substantially perpendicular to a vertical component of an effective shaft axis

30

defined by the shaft; or

substantially parallel to a ground plane when the club head is at an address position.

22. The method of claim 21, further comprising:

35

coupling the shaft to the hosel of the club head prior to imparting the shaft bend.

23. The method of any one of claims 21-22, further comprising:

determining the target swing style for an individual based on one or more measured golf swings of the individual and prior to imparting the shaft bend onto the shaft for the individual.

5

24. The method of any one of claims 21-23, wherein:

for the strong arc swing style, the target shaft bend height comprises a low shaft bend height;

for the slight arc swing style, the target shaft bend height comprises a medium shaft bend height greater than the low shaft bend height; and

10 for the straight stroke swing style, the target shaft bend height comprises a high shaft bend height greater than the medium shaft bend height.

25. The method of claim 24, wherein:

imparting the shaft bend comprises:

15 configuring the golf club for a face-balanced hang angle if the target shaft bend height comprises the high shaft bend height;

configuring the golf club for a mid-hang angle if the target shaft bend height comprises the medium shaft bend height; and

20 configuring the golf club for a toe-down hang angle if the target shaft bend height comprises the low shaft bend height.

26. The method of claim 25, wherein:

when the club head comprises a mallet-type putter head:

the face-balanced hang angle is less than approximately 16 degrees;

25 the mid-hang hang angle is approximately 16 degrees to approximately 48 degrees; and

the toe-down hang angle is greater than approximately 48 degrees;

and

when the club head comprises a blade-type putter head:

the face-balanced hang angle is less than approximately 7 degrees;

30 the mid-hang hang angle is approximately 7 degrees to approximately 23 degrees; and

the toe-down hang angle is greater than approximately 23 degrees.

27. The method of any one of claims 24-26, wherein:

the shaft bend defines a shaft bend angle; and

35 the shaft bend angle is the same regardless of whether the shaft bend height comprises the low shaft bend height, the medium shaft bend height, or the high shaft bend height;

the shaft bend angle is approximately 146 degrees to approximately 174 degrees;
the straight stroke swing style comprises a swing rotation of approximately zero degrees to
approximately 3.5 degrees;
the slight arc swing style comprises a swing rotation of approximately 3.5 degrees to
5 approximately 7.5 degrees;
the strong arc swing style comprises a swing rotation of above approximately 7.5 degrees;
the high shaft bend height is greater than approximately 95 mm above the club head
horizontal plane;
the medium shaft bend height is approximately 70 mm to approximately 100 mm above the
10 club head horizontal plane; and
the low shaft bend height is less than approximately 85 mm above the club head horizontal
plane.

15 28. The method of any one of claims 21-27, wherein:

imparting the shaft bend comprises:

imparting the shaft bend between:

a shaft lower portion comprising a shaft hosel end; and

a shaft upper portion comprising a shaft grip end, the effective shaft axis extending
20 along a centerline of the shaft upper portion;

and

imparting the shaft bend such that, when the shaft is coupled to the hosel:

if the target swing style comprises the straight stroke swing style:

the effective shaft axis intersects the club head horizontal plane at a first
25 intersection distance from the strikeface centerpoint;

if the target swing style comprises the slight arc swing style:

the effective shaft axis intersects the club head horizontal plane at a second
intersection distance from the strikeface centerpoint,

the second distance being greater than the first distance;

30 and

if the target swing style comprises the strong arc swing style:

the effective shaft axis intersects the club head horizontal plane at a third distance
from the strikeface centerpoint,

the third distance being greater than the second distance.

29. The method of claim 28, wherein:

if the target swing style comprises the straight stroke swing style:

the first intersection distance from the strikeface centerpoint is less than approximately 1.8 mm;

5 if the target swing style comprises the slight arc swing style:

the second intersection distance from the strikeface centerpoint is approximately 1.8 mm to approximately 16.5 mm;

and

if the target swing style comprises the strong arc swing style:

10 the third intersection distance from the strikeface centerpoint is greater than approximately 16.5 mm.

30. The method of any one of claims 28-29, wherein:

if the target swing style comprises the straight stroke swing style:

15 a first intersection ratio, between the first intersection distance and a club head length extended between heel and toe ends of the club head, is less than approximately 0.05.

if the target swing style comprises the slight arc swing style:

a second intersection ratio, between the second intersection distance and the club head length, is between approximately 0.05 to approximately 0.155;

20 and

if the target swing style comprises the strong arc swing style:

a third intersection ratio, between the third intersection distance and the club head length, is greater than approximately 0.155.

25

1/4

1000

Fig. 1

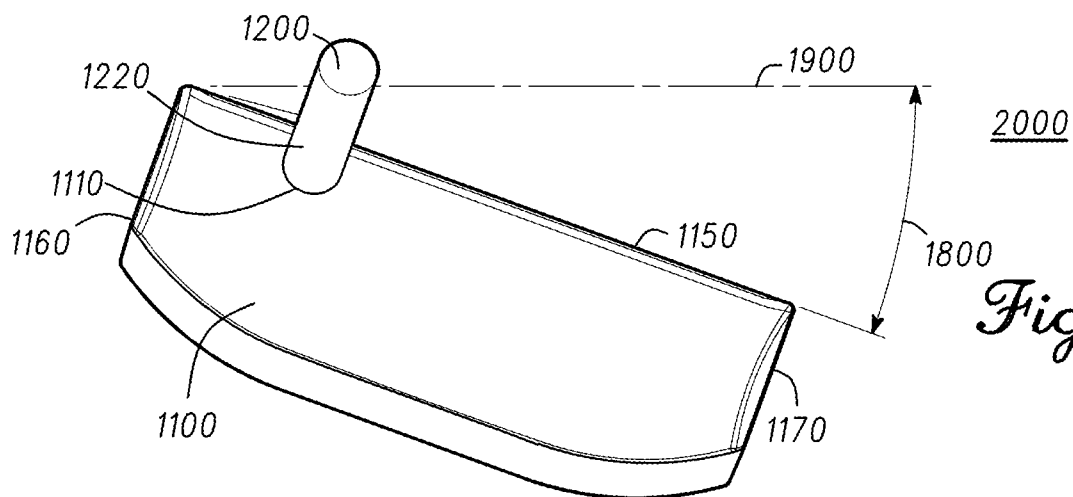
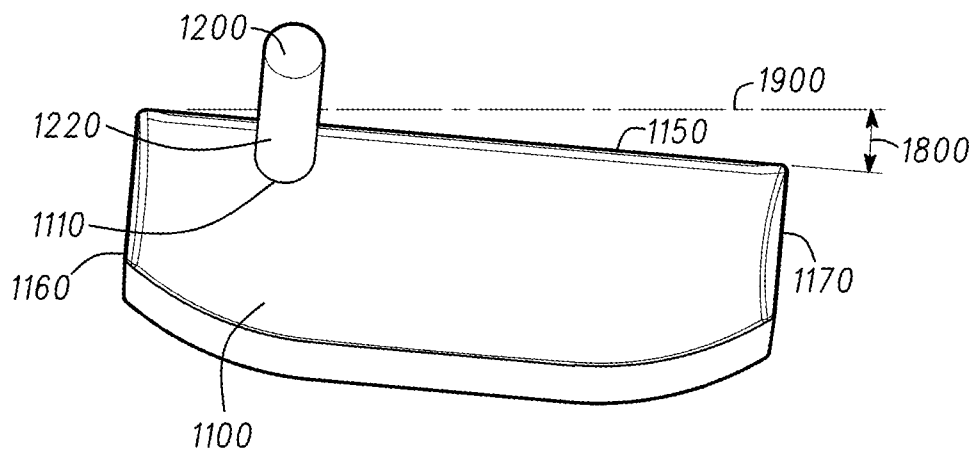


Fig. 2

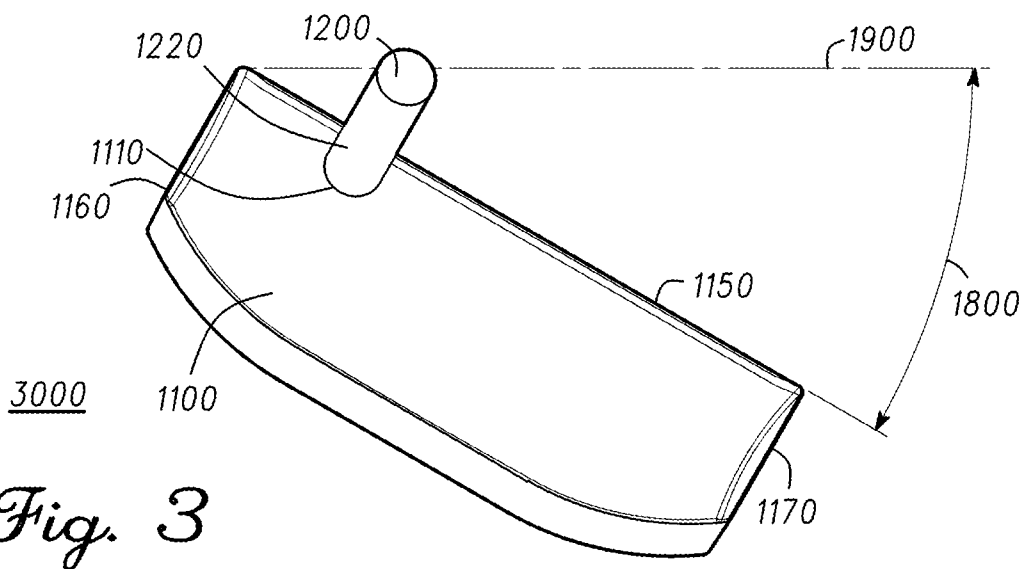


Fig. 3

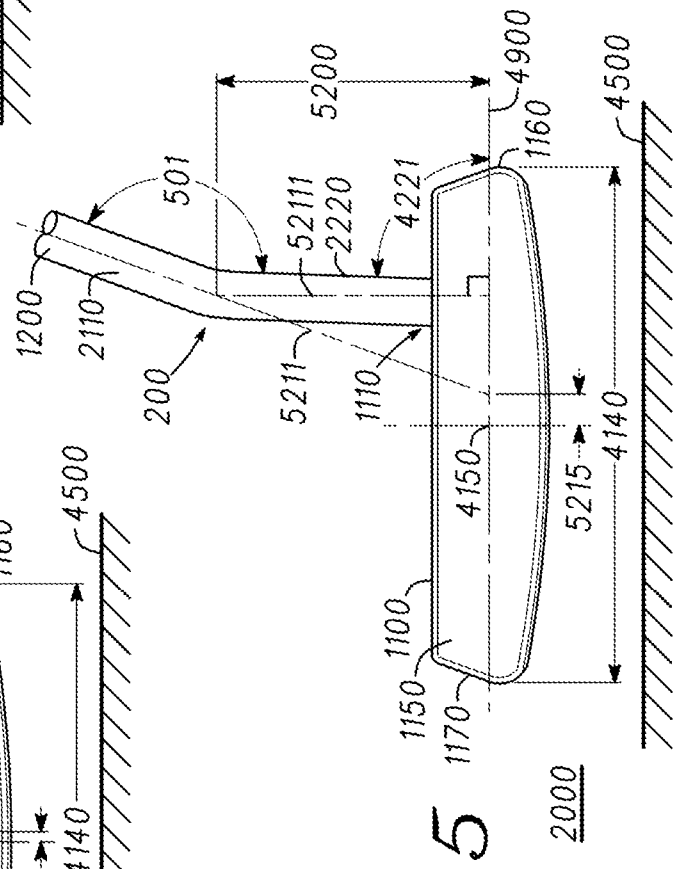
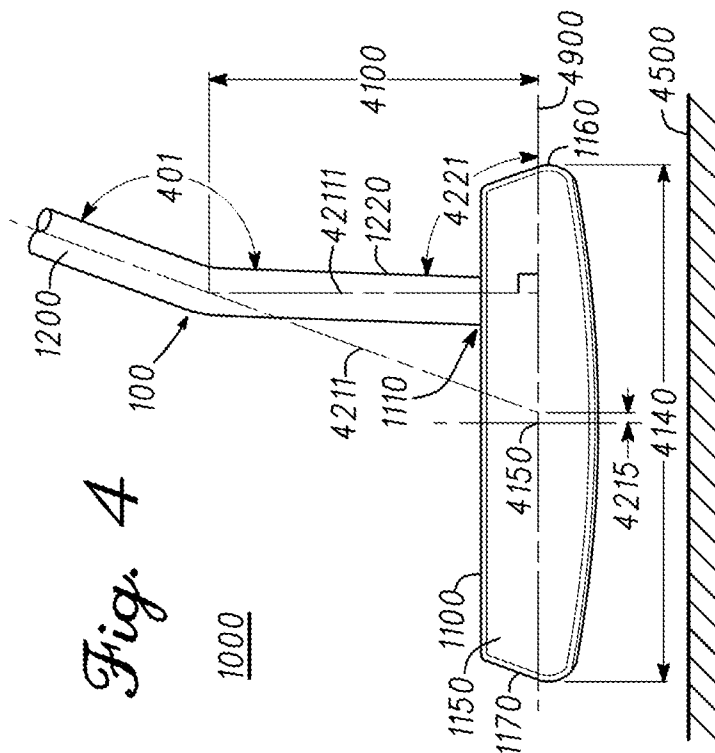
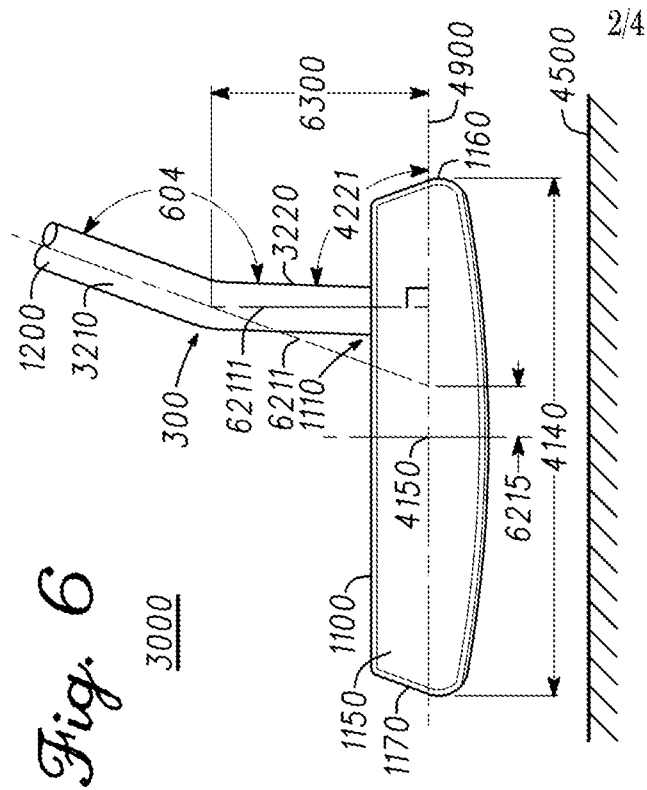


Fig. 7

1000

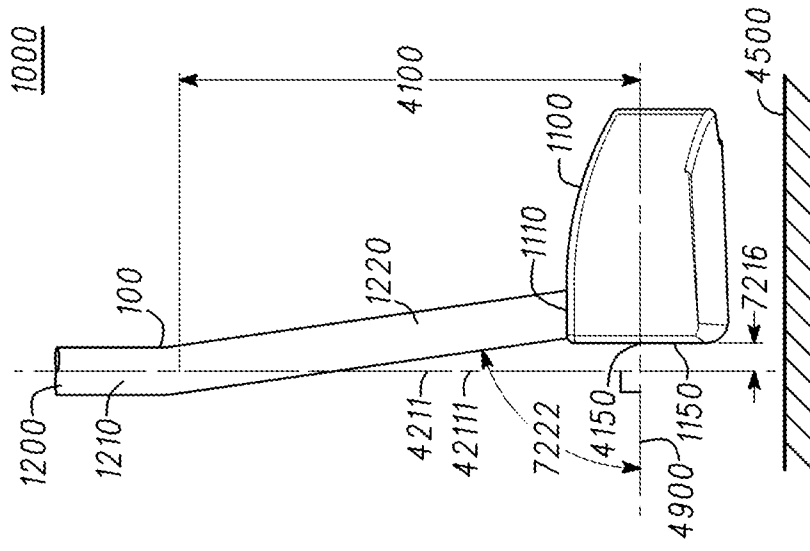


Fig. 8

2000

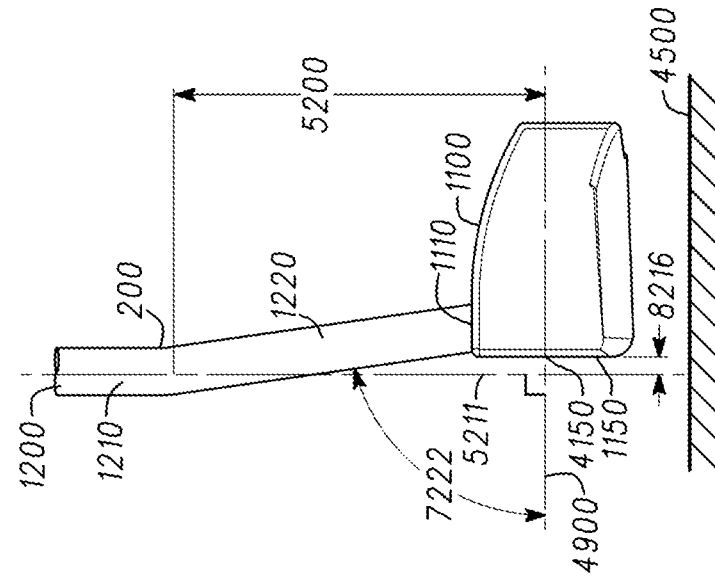
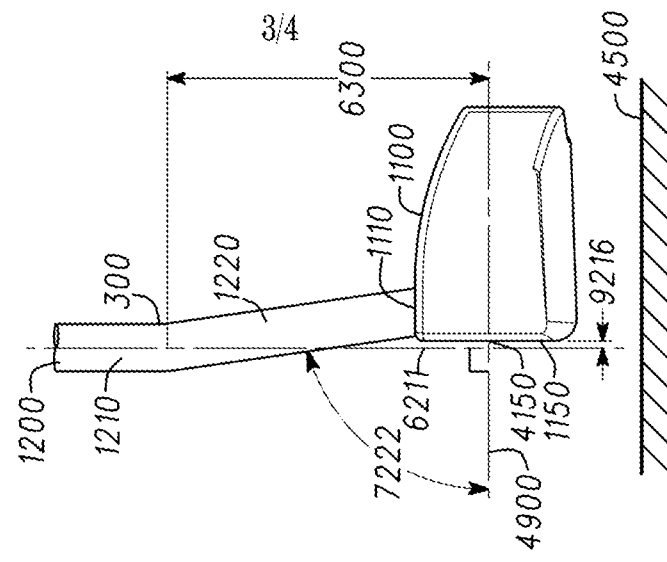
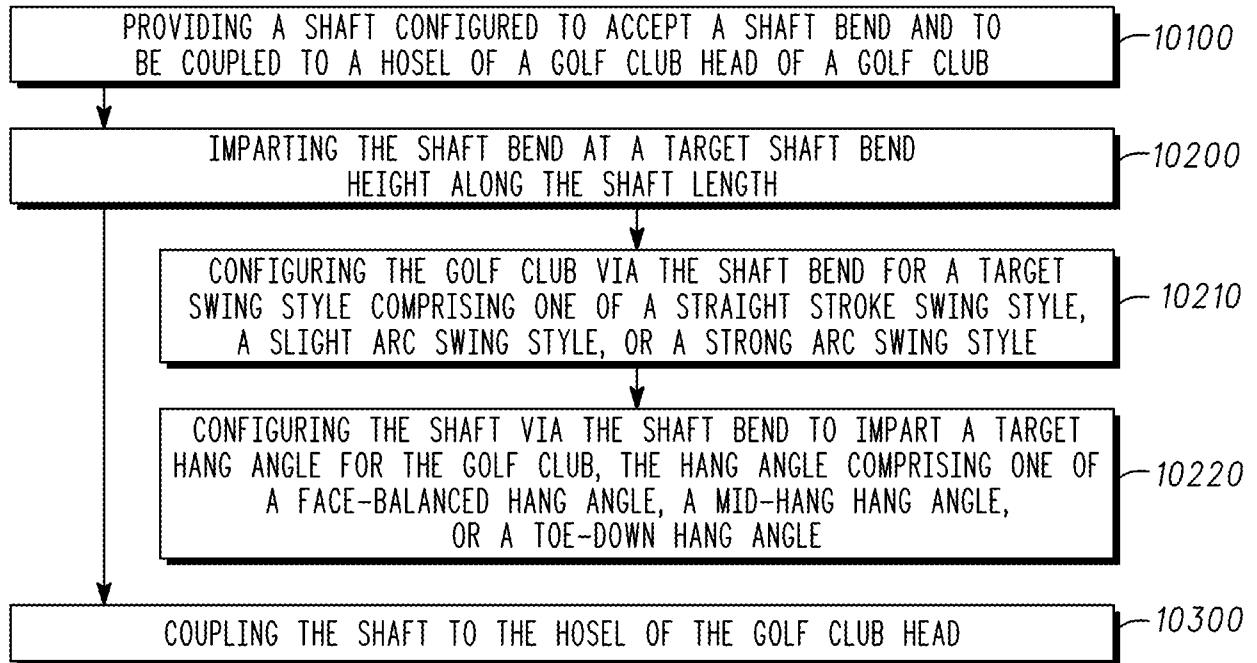


Fig. 9

3000



4/4

10000*Fig. 10*

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US2013/063898

A. CLASSIFICATION OF SUBJECT MATTER IPC(8) - A63B 53/04 (2014.01) USPC - 473/313 According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) IPC(8) - A63B 53/00, 53/04, 53/08 (2014.01) USPC - 473/305, 313, 314 Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched CPC - A63B 53/007, 53/02, 53/0487 (2013.01) Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) Orbit, Google Patents, Google		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2003/0228926 A1 (WANG) 11 December 2003 (11.12.2003) entire document	1, 2, 3, 21-23
A	US 7,201,668 B1 (PAMIAS) 10 April 2007 (10.04.2007) entire document	1, 2, 3, 18-23
A	US 6,270,425 B1 (DYER) 07 August 2001 (07.08.2001) entire document	1, 2, 3, 18-23
A	US 7,976,400 B1 (POTTORFF) 12 July 2011 (12.07.2011) entire document	1, 2, 3, 18-23
☐ Further documents are listed in the continuation of Box C. ☐		
* 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 14 February 2014		Date of mailing of the international search report 11 MAR 2014
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-3201		Authorized officer: Blaine R. Copenheaver PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US2013/063898

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.:
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:
3. ☒ Claims Nos.: 4-17 and 24-30
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 additional fees, this Authority did not invite payment of 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.